GREEN LOGISTICS IN PORTCASTELLO

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1. INTRODUCTION

For a few decades now, both society and businesses have become aware of environmental problems such as strong carbon emissions, global warming and product shortages.

For this reason, companies are taking steps to try to reduce environmental damage.

Many companies are committed changing some of their activities to reduce their impact on the environment. One of the activities that most affects this fact is the logistics of companies.

From this problem, the concept of Green Logistics has emerged that it was to define in this work. But before you know that it is Green Logistics, you must consider other concepts such as Sustainable Supply Chain Management, Green Supply Chain Management, Reverse Logistic and Closed-Loop Supply Chain. To be able to differentiate the main concept from others.

Knowing the definition of Green Logistics this work will focus on a sector, the Port, mainly in PortCastello.

In this sector, the concept of green port has emerged due to the need to reduce energy levels, the development of ecological protection and healthy living in the vicinity of the terminals and to be able to create an environment that improves environmental, economic and social efficiency.

Therefore, this work is intended to check If the PortCastello is implementing measures to become a green port. Since among its main objectives is the promotion of sustainability and corporate social responsibility policies whose aim is to strengthen the role of the port as an agent for the development of the social and business fabric, thus favoring port-city integration. And to be able to provide new measures to benefit from the application of Green Logistics.

Regarding the election of green logistics at the PortCastello, it comes from my personal interest to find out if the adequate measurements are really taking place to decrease contamination, if they are not, this could be a big problem for the general society and the PortCastello port which is a big export and import of goods and could affect it seriously.

For the realization of this academic paper I have been able to help myself from the next subjects related to the degree, Spanish economy and universal economy, the reason for this, is because I have had to analyze different graphics that are related with the economic content. The subject of operations managements which is very related to logistic process at enterprises; English for business, because this academic paper has been made in this language, and lastly the used of APA standards which are applied to this work.

Finally, the structure of this work is divided in three theoretical parts, in the first one it will be explained the different meanings of logistics, in the second one an analysis of the global maritime sector and the Spanish, in this there will also be included green practices of different ports related with the theory and the characteristic of the PortCastello, and the third and last part will link together the green theory with the PortCastello.

2. GREEN LOGISTICS DEFINITION

Before defining the concept of Green Logistics, it is necessary to consider other concepts to come to understand it. Therefore, to able be to differentiate. The concepts are Sustainable Supply Chain Management, Green Supply Chain Management, Reverse Logistic and Closed-Loop Supply Chain Management.

Firstly, the definition of the concept of Business Sustainability according to some actors cited below.

Table 1: Definition Sustainability Business

References	Concepts	Definitions
IISD 1992	Business sustainability	For the business enterprise, sustainable development means adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining, and enhancing the human and natural resources that will be needed in the future.
Dyllick and Hockerts 2002	Corporate sustainability	Corporate sustainability can accordingly be defined as meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc), without compromising its ability to meet the needs of future stakeholders as well.
Hassini 2012	Business sustainability	We define business sustainability as the ability to conduct business with a long-term goal of maintaining the well-being of the economy, environment, and society.

Source: (Ahi and Searcy 2013)

Of the above definitions is concluded that Business Sustainability is the ability of companies to carry out their business activities with the long-term objective, maintaining well-being , both environmental, economic and social and also taking into account stakeholders, customer, etc.

Currently issues related to sustainability have increased his importance and it has in account the social, economic, and environmental field.

In the sustainability, firms have found a new way for be competitive. For it some firms are implementing new forms sustainable inside and beside of organization because it gets a better position in the different fields.

For this reason, organizations are giving more importance to the life cycle of products in the supply chains process. There are different studies which talk about four sustainability of supply chains. These are sustainable supply chain management, green supply chains, reverse logistic and closed-loop supply chains (Batista,2008).

In the next point, it will be explained the four sustainable supply chain.

2.1. Sustainable supply chain management (SSCM)

The first of the four (SSCM) is the supply chain management, below it can be seen different definitions in the table 2.

Table 2:Definition Sustainable Supply Chain Management

Reference	Definition
Seuring and Muller 2008	"The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements"
Carter and Rogers 2008	"The strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains."
Seuring 2008	"The integration of sustainable development and supply chain management [in which] by merging these two concepts, environmental and social aspects along the supply chain have to be taken into account, thereby avoiding related problems, but also looking at more sustainable products and processes."
Pagell and Wu 2009	"The specific managerial actions that are taken to make the supply chain more sustainable with an end goal of creating a truly sustainable chain."
Ciliberti 2008	"The management of supply chains where all the three dimensions of sustainability, namely the economic, environmental, and social ones, are taken into account."

Source: (Ahi and Searcy 2013)

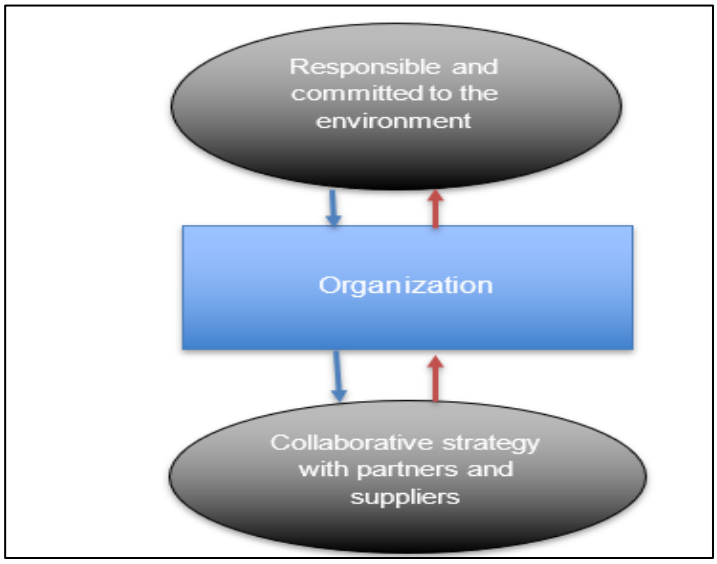
The supply chain includes different functional areas as supply chain management-related activities such as provisioning area (inventory control, sourcing, procurement), fabrication area warehousing, distribution area (inbound and outbound transportation, and supply management). Furthermore, other parts of this process are Production planning, forecasting, scheduling, and customer service order processing (Kumar 2016). All these areas must be managed taking into account the different dimensions of business sustainability (Economic, Social and Environmental). In order to meet the needs and improve the performance of stakeholders and organizations in the short and long term. As can be concluded in the definitions in Table 2.

However, for good Sustainable supply chain management to occur both companies and supply chain, and the entire entity must develop appropriate resources to implement appropriate practices.

For this reason, companies are carrying out a strategy of collaboration, through to design and managing a network of interdependent relationship. The suppliers are very important in this strategy because his participation improve the performance of supply chain.
The performance of companies depends on efficiency and effective with which it coordinates with the direct partners and the coordination of them with their own partners through the interaction of resources achieving a competitive advantage each of them.

In addition, both companies and suppliers need to gain confidence in each other so that the interaction of resources can work. to do this, companies need to be transparent with their partners, providing the necessary information. Easier now thanks to the technologies. Also, it is important that firms and suppliers have the same vision and long-term goals.

Figure 1:Sustainable Supply Chain Management



Sources: Own Elaboration

2.2. Green Supply Chain Management GSCM

The SSCM is the extended definition of Green Supply Chain Management. The big difference is that Green Supply Chain Management (GrSCM) is focuses only on environmental issues (Ahi and Searcy 2013). Then, the table 3 shows different definitions.

Table 3: Definition Green Supply Chain Management

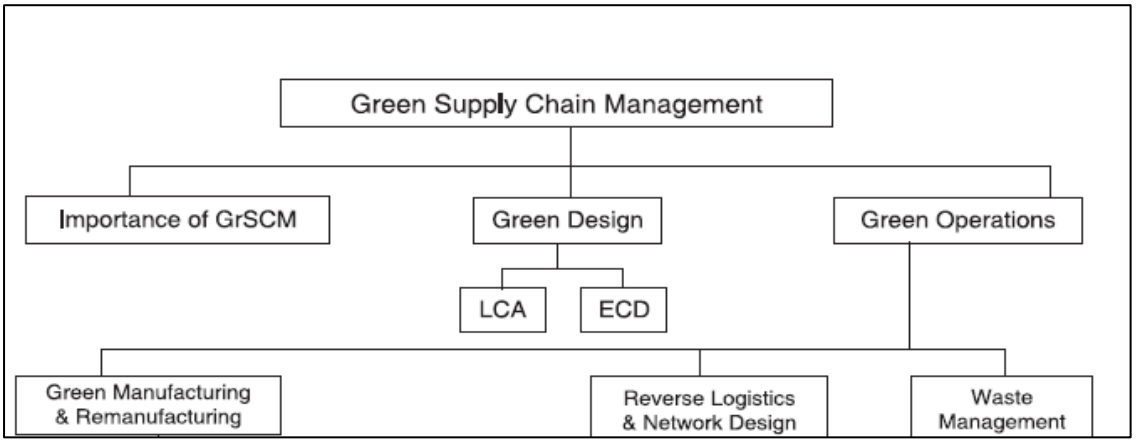
Reference	Definition
Srivastava 2007	Integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life.
Handfield 1997	Is the use of environmental management principles applied to the entire set of activities across the whole customer order cycle, which include design, procurement, manufacturing, assembly, packaging, logistics, and distribution.
Zhu 2005	An important new archetype for enterprises to achieve profit and market share objectives by lowering their environmental risks and impacts while raising their ecological efficiency.
Sheu 2005	Combination of both the product manufacturing supply chain and used-product reverse logistics chain.
Hervani 2005	Green Purchasing + Green Manufacturing/Materials Management + Green Distribution/Marketing + Reverse Logistics

Source: (Ahi and Searcy 2013)

It can be concluded that GrSCM is to include environmental thinking in the supply chain and to put into practice in the product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life (Srivastava 2007).
Furthermore, GrSCM relates such as proactive practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.)

As has been said before companies are increasingly attaching importance to the environment. For to make it work companies must drastically change their processes, redesign their products, etc and thus achieve a green chain of supplies.
The Green Supply Chain Management is divided on three categories that is based on the problems in the context Supply Chain design. It is showed in the image.

Figure 2: Categories Green Supply Chain Management



Sources:(Srivastava 2007)

As to importance of GrSCM, three approaches arise. The reactive where companies are committed to using the minimum resources with environmental management, start labelling products that are recyclable to lower the environmental impact of production.
In the approach proactive, they begin to give importance to new environmental laws, and companies initiate the recycling of products and the design of environmental products.
In the value-seeking approach, are focus on implementing environmental activities such as green activities and ISO application-based strategies in their businesses.

Another category is Green Design or ecodesign, this term emerged in the 1980s with the name of green design and has been renamed ecodesign or sustainable design. Ecodesign is a concept that integrates multidisciplinary and environmental aspects into the design of a product whose main objective is to create sustainable solutions that meet the needs and desires of the client (Salgado, Bravo, and Camarena, 2016).
It is a design philosophy that does not only focus on objects but includes the physical part (such as the materials used) and services to meet needs considering the pillars of sustainable development (economic, social, and environmental).

The Green Design is giving priority to environmentally conscious design (ECD) and life-cycle assessment/analysis (LCA) of products. This is a process for assessing the environmental, occupational health and resource-related consequences of a product, through all phases of its life from extracting and processing raw materials, production,

transportation and distribution, use, remanufacturing, recycling and final disposal (Srivastava 2007).

Finally, Green operations category, some of challenge are integrating remanufacturing with internal operations, understanding the effects of competition among remanufacturers, integrating product design, product take-back and supply chain incentives.

As for Green manufacturing and remanufacturing, is defined as recycling-integrated manufacturing. And it relates with Reverse Logistic concept, so product recovery refers to the broad set of activities designed to reclaim value from a product at the end of its useful life. One of the disadvantages is that repairing used products does not have the same quality as a new product. That is why many authors believe that reverse logistics and supply chain processes are more complex than traditional methods.
Other methods can be the disassembly, is the process of separating the components of a product. And components that are suitable and function can be reused in another product or process.

On the other hand, waste management is a model a solid waste management system that includes collection, transportation, incineration, composting, recycling, and disposal.

2.3. Reverse Logistic

The Reverse Logistic, is important area for Green Supply chain Management, it will be commented below. In the table 4 shows four definitions of Reverse Logistic from different authors.

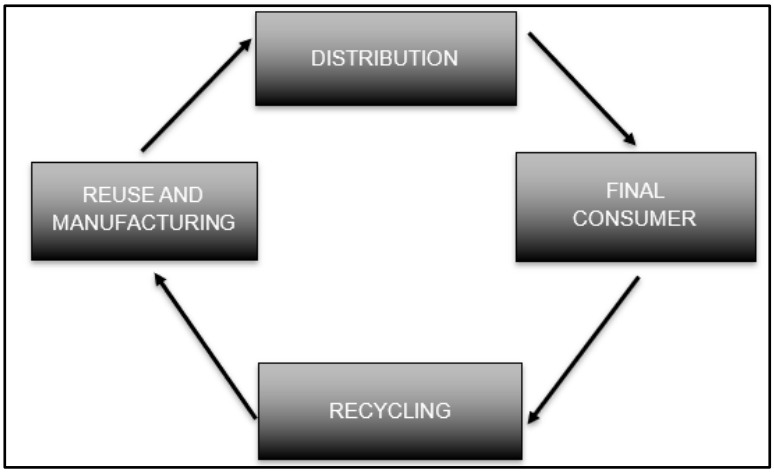
Table 4: Definitions Reverse Logistic

Reference	Definition
Sarkis, Helms, and Hervani 2010	"the process of planning, implementing and controlling backward flows of raw materials, in process inventory, packaging and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal"
Pacheco 2018 Geisendorf and Pietrulla 2018 Rubio, Chamorro, and Miranda 2008	"RL has been defined as: 'The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or of proper disposal"
Carter and EllraM 1998	"Reverse logistic is a process whereby companies can become more environmentally efficient through recycling, reusing, and reducing the amount of materials used. Viewed narrowly, it can be thought of as the reverse distribution of materials among channel members. A more holistic view of reverse logistic includes the reduction of materials in the forward system in such a way that fewer materials flows back reuse of materials is possible, and recycling is facilitated"
Fleischmann 1997	"Reverse logistics is a process which encompasses the logistics activities all the way from used products no longer required by the user to products again, usable in a market".

Source: Own Elaboration based on different authors

In recent years, Reverse Logistic (RL) has gained more weight within companies. Especially the companies that have a high social responsibility. Companies have realized that using this method involves saving space, fuel and landfill costs as well as improving the environment. It can conclude that RL is a process of planning, implementing and controlling materials flows from the time of manufacture to recycling and it is reused with a new function within the process. It illustrates in the figure 3.

Figure 3: Reverse Logistic Process



Source: Own Elaboration

Reverse logistics is responsible for the recovery, recycling of both packaging, crating and hazardous waste. And in addition to the process of returning excess inventory. It also facilitates the construction of channels for selective collection of industrial waste, construction, electronic or electrical equipment, vehicles and tyres that are not in operation.

The implementation of the RL can improve the company's image in the face of society. In addition, the efficient management of returns.

On other hand, partners and customers of the company must collaborate, returning used end products. And, the company must also consider its ability to design more recyclable packaging.

But it is not easy to implement this model as we find some barriers. As the four environmental forces, the customers, suppliers, competitors, and government agencies, (Carter and Ellram 1998). Many of the customers or producers are unaware of this type of logistics and the benefit of the waste and are not aware of its environmental impact.

And so also many companies are not prepared for this change because the structures of the company are not suitable for a reverse flow of materials and products.

2.4. Closed-loop supply chains.

Reverse Logistic term is widened in the concept Closed-Loop Supply Chain that then it will be discuss. In the table 5 can see the different definitions of this concept.

Table 5:Definition Closed-loop supply chain

Reference	Definition
GGuide, Jayaraman, and Linton 2003	"Closed loop supply chain (CLSC) are supply chain networks that include the returns processes and the manufacturer has the intent of capturing additional value and further integrating all supply chain activities"
Geisendorf and Pietrulla 2018	"CLSC's consist of both a forward and reverse supply chain where a mix of reuse options" is employed by the producer depending on "the most profitable alternative".

Sources: Own Elaboration based on different authors.

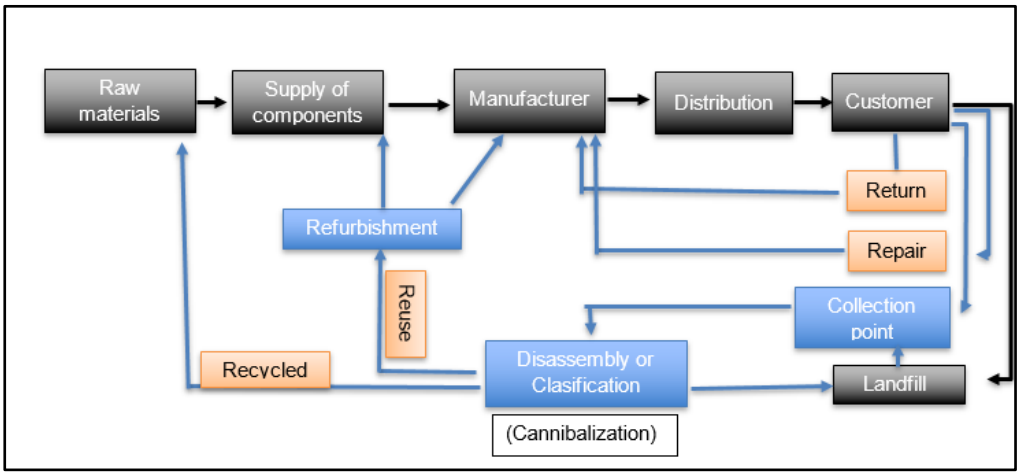
The CLSC is a mix of concepts (industrial ecology, reverse logistic, and the measurement from life cycle assessments). It is a strategic propose that it create economic and environment value. Further, it includes four categories of products, reuse, end-of-life, end-of-use and returns like reverse logistic (Geisendorf and Pietrulla 2018). For the closed-loop supply chains or closed supply chains (CLSCs), is important of circularity.

The Closed-Loop Supply Chain process consists of the following. Firstly, as in any supply chain, the raw material becomes part of the supply of components and then used for the manufacture of the product. The next step is distribution to the customer. In a traditional supply chain, at the end of the life of the products, it would be transferred to the landfill. But as in the figure 4 show, in Closed-Loop Supply Chain, the product can be returned or want to be repaired, and it is the customer who returns it to the manufacturing channel (Souza 2013).

On the other hand, when the product reaches the end of its life there are two options. The first option would be to move him to the landfill. And the second would be to take him to a collection point where he would become disarmed and then sorted

(Cannibalization). Three types of parts can emerge which no longer have any utility that would go directly to the landfill. Other parts are refurbished or reused in supply components for use already in products manufacturing. And third parts are recycled and part of the raw materials to create the components of the suppliers (Reverse Logistic).

Figure 4: Closed-Loop Supply Chain Process



Source: Own Elaboration

2.5. Green Logistics

The objective of the academic research was to be able to define Green Logistics and differentiate it from the other concepts. In the table 6 shows different definitions of the term.

Table 6: Definition of Green Logistics

References	Definition
Rodriguez, Slack & Comtois, 2001	Green logistics is based on the administrative policies of supply chain production and how to achieve sustainable monetary development considering the related administration, proper management, and the transfer of resources between companies and market sectors in order to reduce costs.
Lee & Klassen 2008	Green logistics represents all activities that provide information for the purposes of consumer goods production about all specifications wished by the consumer and needed for their conversion and strive to increase market demand.
Bin & Chaoyuan 2005	Green logistics is a measurement of business activity through the integration of elements of supply chain management, which contribute the added value of environmental performance.
McKinnon 2010	Green logistics can also be defined in terms of the integration among private, operational, strategic, local and global elements, in terms of government intervention as representative of the general government sector, in terms of pressure on the private sector to contribute to the construction of the financial economic sector and to solve public sector problems and support it, and in terms of the integration of different sectors with one another, which also means observing the operational processes of the other sectors and adapting them to the elements and principles of the particular environmental strategy. Over the long term, all of these contribute to building the economy; here is where a third perspective comes in, a view that looks beyond the local context to the larger global framework.
Seuring and Muller 2008	they define green logistics as "the management of the flow of knowledge, materials and funds between institutions, which aim to grow with an emphasis on social and environmental sustainability, paying attention to the demands of all stakeholders. Ecological logistics is a concept that unifies strategies for the development of environmentally sensitive products and methods for manufacturing and service."

Source:(Alshubiri 2017)

According to the definitions of the different authors it can be concluded that Green Logistics is development of strategies for product manufacturing and design. With the proper management of the flows of information, materials and resources between stakeholders and institutions to achieve social and environmental sustainability.

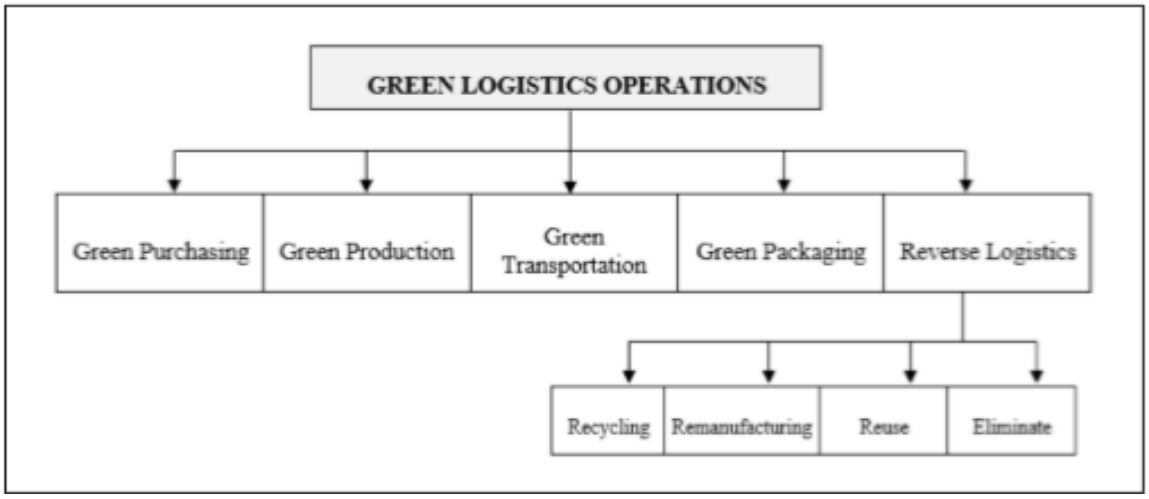
There is a great concern about environmental impact on the part of society, due to the strong carbon emissions, global warming and product shortages, so companies are changing to be more sustainable. For this, companies are opting for a green logistics and thus design cleaner manufacturing processes and manage environmental risks.

Now companies include it within their strategies. In fact, the environmental impacts of logistics practices are now included in the World Bank's "Logistics Performance Index" (LPI).

As far as environmental problems can say that climate change is the most important also directly affects the economy. The sector logistic contributes to 13.1% of carbon emissions, so the concept of green logistics becomes stronger to be sustainable.
Initially, organizations sought to reduce carbon emissions (from alternative resources, packaging disposal, reverse supply chain, and distribution channel reorganization (Rad and Gülmez 2017)

Instead, it now looks for with green logistics, improve a company's business performance along with its environmental image, providing the most efficient use of resources, allow recycling and improve market share.
Institutions also take as measures to reduce impact. Establishing emissions agreements and taxes on emitted carbon.
The different processes that are going to be affected by the Green Logistics are those exposed in the figure 5.

Figure 5: The classification Green Logistics Operations



Source: (Rad and Gülmez 2017)

As for Green purchasing it is based on the action of buying goods and services and having a negative environmental effect. Buyers look to whether the product is made from materials that do not affect human health and the environment and in factors such as quantity, type of energy and resources used or as has been manufacturing processes (cleaning), means of distribution and whether the resource used is refurbished (Rad and Gülmez 2017)

On the other hand, Green production, which according to the United Nations Environment Programme, is defined as “the implementation of preventive environmental management strategies in an integrated way in the production process, the elimination of risks to human health and environmental values and the improvement of efficiency" (Rad and Gülmez 2017)

The third process is the distribution of the green transportation, this is responsible for the movements of the materials of the value chain from the beginning to the end.
Unfortunately, the transport sector is the means that causes the most pollution to the environment, especially the fuel, the frequency of travel, the frequency of customers, the weight, the material and the forms are also characteristics that affect. All this gets worse when we talk about globalization since the distribution distances are longer. Studies in 2015 identify road transport expelling a greater source of greenhouse gases, with an 85% share. Air emissions have increased, and railway emissions are very low (Rad and Gülmez 2017)

The fourth process is green or environmental packaging, which is defined as “the packaging method, which values human and animal health, as well as the environment throughout the life cycle, using reusable materials or recycled natural plant material.”
Packaging affects both performance and efficiency within the supply chain. The size, shapes of the packaging and the use of materials that do not adversely affect the environment should be given importance in environmental packaging. This reduces the use of materials, the use of space in warehouses and it only use the strictly necessary transport. A different option is to use containers that can be reused and pallets or boxes instead of disposable containers. (Rad and Gülmez 2017).

And, the Reverse Logistics that has been mentioned above, and is very important within the green logistics.

Launching green logistics in a company is a topic of discussion for companies. Since many believe they cost more than a benefit. And it really it is because it is an investment, the change of the organizational structure, training and purchase of materials that do not affect the environment. But in turn this change reduces storage, inventory, transportation, and energy costs. It also helps to improve the image of the company.

Finally, the table below differentiates the commented concepts according to the dimensions, functions, objectives, and activities they perform.

Table 7: Functions objectives and activities of the different terms

	Dimensions	Functions	Objectives	Activities
Sustainable Supply chain Management	Social, Economic and Environmental.	Manage the different functional areas. In order to meet the needs and improve the performance of stakeholders and organizations in the short and long term	The organization must be responsible and committed to the environmental The increase the performance of supply chains thanks to the strategic of collaboration.	Provisioning area. Distribution area. Production. Planning. Forecasting. Scheduling.
Green Supply Chain Management	Environmental	To include environmental thinking in the supply chain and to put into practice.	Use the minimum resources. To design environmental products. Assess environmental consequences. Products recovery. Disassembly and classification parts of products. Waste management.	Green Design. Green operations. Green manufacturing. Waste management.
Reverse Logistic	Economic and Environmental	Plan, implement and control material flows.	It facilitates the construction of channels for selective collection. Improving the company's image. Improve efficient supply chain performance management.	Collection point Recycled To design new products with recycled products.
Closed-Loop Supply Chain	Economic and Environmental	Plan, implement, control and manage material flows. it is important circularity.	Reducing waste. Product lifecycle assessment.	Reverse Logistic. Disassembly and classification. Waste or out-of-use products. Refurbished. Recycled. Collection point.
Green Logistics	Social and Environmental	Development of strategies for product manufacturing and design. With the proper management of the flows of information, materials and resources between stakeholders and institutions.	Reduce CO_2 emissions. Reduce waste. Effectively use resources.	Green purchasing. Green production. Green transport. Green or environmental packaging. Reverse Logistics.

Source: Own Elaboration

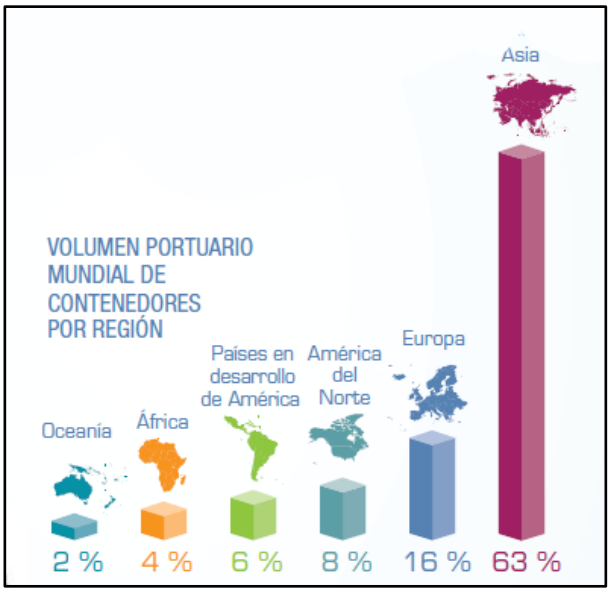
3. GREENING PORTS

The concept Green Port arises from the need to reduce energy levels, the development of ecological protection and a healthy life in the vicinity of the terminals and to be able to create an environment that improves environmental, economic and social efficiency. According with Maura and Andrade "the concept of green port is a port characterized by a favourable environment, ecological protection and reasonable utilization of resources, low energy consumption and low levels of pollution. It must generate a Green Value to bear social responsibility. In addition, the green port implementation must be straight linked with the port management; otherwise, the success cannot be achieved"

Next, the characteristics of the port sector will be described, followed by the characteristics that make it green and several examples of the green practices carried out by the different ports.

Maritime activities in the port have around 3% impact on global emissions. It is an important quantity. In the figure 6 can observe global port volume of containers. The continent with more volume is Asia with a 63% global volume that stands out above the other continents.

Figure 6: Global port volume of containers



Source:(Naciones Unidas 2018)

Some of the ports more important in the world are showing in the figure 7. It can observe that cargo traffic has increased a 5% among 2016 to 2017.

Figure 7:The first ports the world of cargo traffic.

(En millones de toneladas y variación porcentual anual)

Posición	Puerto	Tráfico de carga		Variación porcentual
2017		2016	2017	2017-2016
1	Ningbo-Zhoushan	918	1 007	9,7
2	Shanghái	700	706	0,8
3	Singapur	593	626	5,5
4	Suzhou	574	608	5,9
5	Guangzhou	522	566	8,5
6	Tangshan	516	565	9,6
7	Qingdao	501	508	1,4
8	Port Hedland	485	505	4,3
9	Tianjin	549	503	-8,4
10	Rotterdam	461	467	1,3
11	Dalian	429	451	5,2
12	Busan	362	401	10,5
13	Yingkou	347	363	4,4
14	Rizhao	351	360	2,7
15	South Louisiana	295	308	4,4
16	Gwangyang	283	292	3,1
17	Yantai	265	286	7,6
18	Hong Kong RAE	257	282	9,7
19	Zhanjiang	255	282	10,3
20	Huanghua	245	270	10,0
	Total	8 907	9 354	5,0

Source: (Naciones Unidas 2018)

In addition, the ports more important are in Asian continent by their volume but the European Ports are more responsible with environmental. According to ESPO (The European Sea Ports Organization) there are more certified green ports in Europe than in other continents. In the figure 12 can see the port with certificate Ecoport.

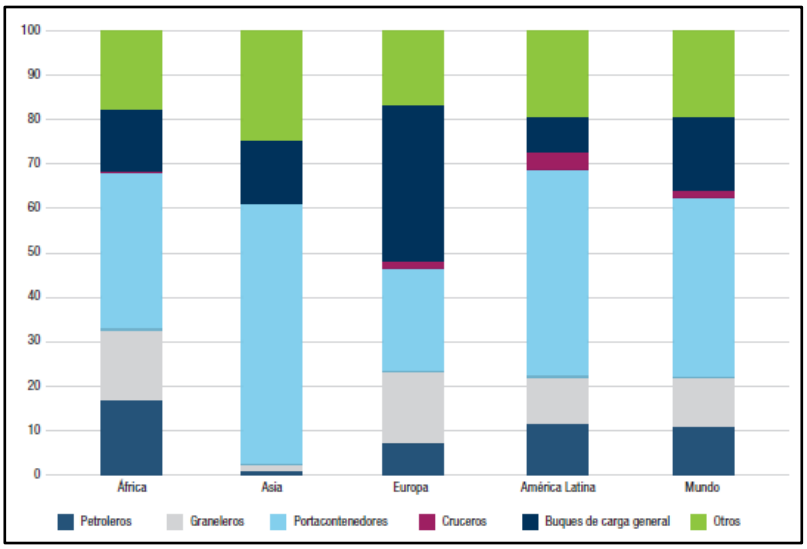
Figure 8: Ecoports

Source: (EcoPort 2020)

On the other hand, the different activities carried out on Port, there are much cargo handling equipment and traffic. As for example, vehicles, trains, ship, that generate many pollutions, such as air pollution, which implies the emission of carbon dioxide (CO2), methane (CH4), sulfuric oxides (SOX), nitrogen oxides (NOX) and particulate. Other is acoustic pollution, dredging, water contamination and the constant risk of releasing accidentally hazardous material. Also, a negative aspect is that these particles affect the health of port workers. Another problem is the consumption of energy using handling equipment such as rubber-tired gantry (RTG) cranes, reach stackers, yard tractors, wheel loaders and forklifts. In addition, these equipment runs on diesel an expensive and polluting product (Moura and Andrade 2018).

Such thing can be observed in the figure 9, the types of boats that are most used across different continents are containers vessel (portacontenedores), that can be an environmental problem, because it generates air and noise pollution. Since the average waiting time of these vessel containers is 15 hours according to figure 11.

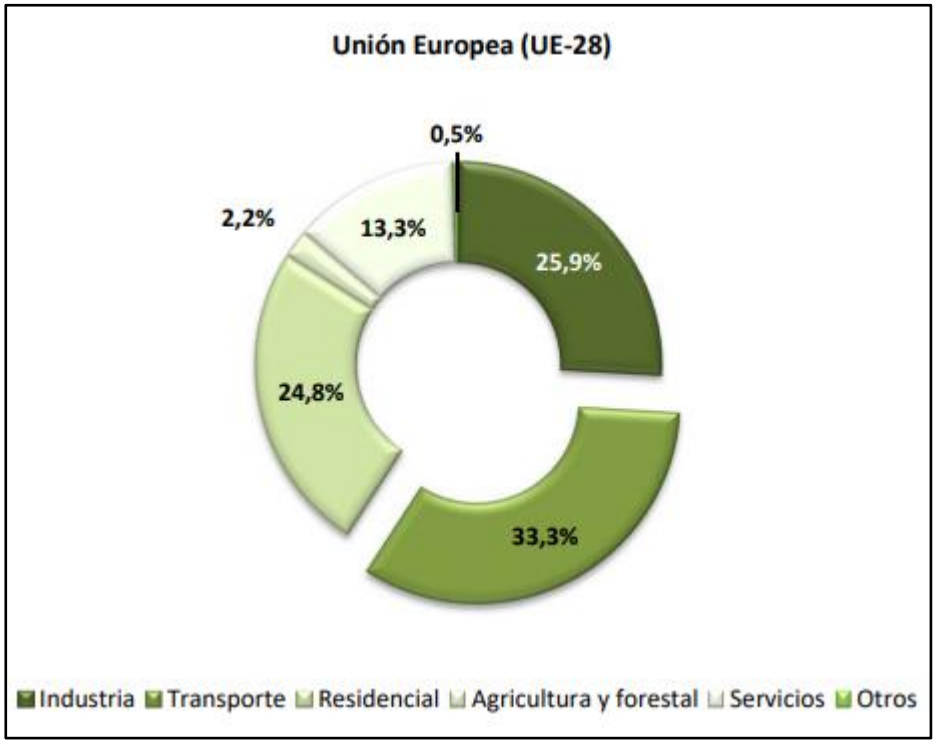
Figure 9: Average arrivals by boat types, 2010-2017 (in percentages)



Source: (Naciones Unidas 2018)

Other boats type is 15% of ships with general loads, in other words, these loads are transported by land to the respective customers. And this type of vehicle emits a lot of gases besides running on fuel and high energy consumption. In figure 10 it can be seen that the transport sector is the one that consumes the most energy in Europe by 33.3%. And this means that it is the sector that consumes the most gasoline

Figure 10: Energy consumption in the transport sector and others (2014)



Sources: (Indicadores OTLE, 2014)

It is cause of this growth that the OMI (Organization Maritime International) has taken action. And it has reached agreements with the different countries. These agreements aim to reduce ship emissions. One of the measures is that shipbuilding by 2025 will have to be 30% more energy efficient than 2014 ships. In addition, this 2020 is expected to implement the reduction in the use of fuel sulphur consumed by ship around the world. This would reduce greenhouse gases using and alternative fuel clearer (Omi,2015)
But this measure is difficult to implement because most sectors depend on oil, especially the transport sector.

For this reason, some ports are trying new methods more sustainable. And like this manage to improve economics and environmental aspects.
In addition, the port will be more competitive due to reduced emissions and distribution cost. Mainly, ports look for save in time and costs (Moura and Andrade 2018).
But before implementing a green port, there are a few aspects to consider:
- Evaluate all ongoing operations, environmental practices, and energy data.
- Decentralization of responsibilities and empowerment of employees, to achieve environmental performance.
- And to keep management informed and supportive of the changes.
If the port wants to become green it must consider, the factors table below.

Table 8: Factors to establish a green port.

Environmental Quality	Environmental Construction	Resource Management
- CO2 - water quality - land use - environmental management	- Expansion of the plantation - green building - Comprehensive e-service - wireless network port	- Selection of materials - waste management - water resources - use of energy and transport

Source: Own Elaboration (Moura and Andrade 2018)

In the table 8 we can see that there are three key factors to establish a green port and the practices to achieve it.

The first factor is environmental quality, which refers to practices related to reducing CO2 emissions, water care, efficient land use and maintaining proper management.

The second factor is environmental construction, which takes into account efficient land use, green and sustainable construction and the use of electronic media.

And finally, the resource management factor that is based on waste management, the selection of green materials for different processes. Also important is the use of hybrid resources such as vehicles or cranes. And looking for new energy alternatives (Moura and Andrade 2018).

The main practices that are being attempted in the different ports of the world are the reduction of waste, the conservation of resources, the count of the carbon footprint of all the routes that dare ships, use less the trucks of use small vessels between primary and secondary ports.

Other non-operational practices are to have an energy and environmental and water management system, this can improve the planning of the strategies.

In addition, the training of workers since collaboration would continue to reduce the proposed consumption (Moura and Andrade 2018).

Then, in figure 11 it should be noted that the ports that consider environmental expenses and revenue in their balance are very few. This balanced scorecard is the information of 48 ports among the years 2010-2017.

Figure 11: Port balanced scorecard indicators

Categorías		Indicadores	Número de valores	Media (2010-2017)
Finanzas	1	EBITDA/ingresos (margen de explotación)	126	39,30%
	2	Tasa del buque/ingresos	135	15,90%
	3	Tasa de la mercancía/ingresos	120	34,20%
	4	Arrendamientos/ingresos	117	10,10%
	5	Costos laborales/ingresos	106	24,80%
	6	Tarifas y asimilados/ingresos	114	18,10%
Recursos humanos	7	Toneladas/empleado	134	54 854
	8	Ingresos/empleado	128	$235 471
	9	EBITDA/empleado	107	$119 711
	10	Costos laborales/empleado	89	$42 515
	11	Costos de capacitación/sueldos	101	1,30%
Género	12	Tasa de participación femenina, global	54	15,70%
	12,1	Tasa de participación femenina, administración	53	30,90%
	12,2	Tasa de participación femenina, operaciones	39	12,30%
	12,3	Tasa de participación femenina, manipulación de la carga	29	5,30%
	12,4	Tasa de participación femenina, otros empleados	8	32,00%
	12,5	Tasa de participación femenina, administración y operaciones	119	19,60%
Operación de buques	13	Tiempo medio de espera	129	15 horas
	14	Tonelaje bruto medio por buque	165	17 114
	15,1	Llegadas de petroleros, promedio	28	10,80%
	15,2	Llegadas de graneleros, promedio	28	11,20%
	15,3	Llegadas de portacontenedores, promedio	28	40,30%
	15,4	Llegadas de cruceros, promedio	29	1,80%
	15,5	Llegadas de buques de carga general, promedio	28	16,50%
	15,6	Llegadas de otros buques, promedio	27	19,10%
Operaciones de carga	16	Tonelaje medio por arribo (total)	156	6 993
	17	Toneladas por hora, granel seco o sólido	91	402
	18	Cajas por hora, contenedores	120	29
	19	Tiempo de permanencia de TEU en puerto (días)	73	6 días
	20	Toneladas por hora, granel líquido	46	299
	21	Toneladas por hectárea (total)	130	131 553
	22	Toneladas por metro de atraque (total)	143	4 257
	23	Total de pasajeros en transbordadores	18	811 744
	24	Total de pasajeros en cruceros	20	89 929
Medio ambiente	25	Inversión en proyectos medioambientales/CAPEX total	10	0,90%
	26	Gastos medioambientales/ingresos	17	0,30%

Source: (Naciones Unidas 2018)

Note: The number of values the product of the number of ports that have data on the variable by the number of years

Each port is different, and it is not easy for them to apply new measures. Before applying them, it is necessary to consider a level of environmental knowledge and check whether the infrastructures are adequate. These changes are also a big investment. But this change means being more appealing to investors, customers, or partners and to society at large.

Some of the green practices of the most important ports in the world will now be discussed in the table 9

Table 9:Green Logistics Practices in different countries

Green logistics / Greening ports	Environment quality	Environment construction	Resources Management
Green Purchasing		Busan port provides more facilities when it comes to allocate in the port those companies that are highly technological	
Green Production	Potato starch is used in Hamburg port as a substitute for petroleum to elaborate chemicals.	Busan port provides more facilities when it comes to allocate in the port those companies that are highly technological In the Valencian port the realization of customs documents is only made by internet, there are no physical documents	The companies located in the Rotterdam port reuse their wastes that are the result of their productive process. The por of Valencia has set the aim to produce his energy through wind power.
Green Transportation	Busan port has chosen the use of the railway to move it containers between the different terminals of the port. At the Rotterdam port, truck congestions are minimals due to intermodality. Another practice is the unload of oil that is supervised by port authorities and different organizations as well in order to avoid spills at sea. In the A Coruña port, roundabouts have been built to avoid congestions inside the port. And a wheel washer has been installed for trucks that leave the port	Rotterdam port uses cranes of high technology. At the Hamburg port automatic cranes are used without a crane driver. In the Valencian port are different routes for entrance and exit.	The port of Busan has chosen to use the railway to move containers between different port terminals, and the great capacity of the cranes to move containers to the trucks. The Rotterdam port has intermodal connections for the transport of goods.
Green Packaging			The port of Busan, manages and classifies the packaging of the goods before the transfer.
Reverse Logistic			The port of Busan has a large container area exclusively for waste. In the Rotterdam port is mandatory to take out all the ship wastes and their subsequent reception in the waste facilities In the port of Valencia and A Coruña there is waste management based on the Marpol agreement.

Source: Own Elaboration based on (Trillo and Panam 2017, Hamburg Port Authority 2015, Puerto del Estado 2015, Autoridad Portaria de Valencia 2017)

In the table number 9, it can be seen the green practices that follow different ports according to the parts of the green logistics that are related with the factors that need to be taken into account in order to become green.

In the first place, we have the Busan port which is in the eleventh place at the ranking of the ports with the most cargo traffic in the world. One of their practices is the use of a railroad for the transfer of contains inside the port, this is a green transportation practice because this kind of transport is less contaminant than trucks, besides it is more effective and efficient due to the great capacity of the containers that can transport in only a trip. Time and energy are saved and from this it comes it relationship with resources management. Secondly, this port manages and classify the packaging of all the goods, by doing this it controls that none of the goods can be spilled in the floor or at sea by accident when it's being transported. This is a green practice packaging because it avoids any accidents that could contaminate and by this reason it is associated with management resources.

In third place, an important measurement is the one that integrates the port with companies that are highly technological and environmentally friendly. It is a measurement of green production and purchasing because companies are the ones who compose the port and they produce and buy goods that do not affect significantly the environment and by this reason this is related to environment construction because this companies are part of the port. And lastly, the port of Busan has installed big containers where waste is received

Busan port have restructured the port to gain public access space in front of water. It is a change to improve the social environment and can be considered a practice related to Green Port Term (Trillo and Panam 2017).

The next port is the Rotterdam port, one of their practices is the intermodal connections due to the use of different transportations methods such as pipes to transport petroleum, diesel or any other chemical, transportation by road using trucks, the fluvial network of channels and the railroad transportation. (Trillo and Panam 2017). Those are practices of green transportations because thanks to this there are no congestions of trucks which is the most contaminant transport and due to this it is also related to the management resources because there is a less consumption of energy and environment quality due to the low emission. Another green practice transportation is the use of high technology cranes which are controlled from a central station, with this congestions are avoid inside the port, which eliminate death times and improves efficiency of the used energy by this

reason is that environment construction is related due to the efficient use of the ground when it comes to store the containers.
Another mandatory regulation for all the ships is to unload all the waste of the ship and receive then in the correct waste station. This a practice of reverse logistic because there is a waste management, and also it is related with the management resources factor. The companies of the port of Rotterdam recycle those wastes that can be reused and the integrate them in their productive process, this is a practice of green production because this companies include in their productions process those recycled products. And due to this it is related to the management resources factor.

Another example is the port of Hamburg, which carry on practices such as the use of potato starch as a substitute of petroleum to produce chemicals products. This change would reduce the use of 60 tons of crude oil (Petroleum). It is a green production practice because it already uses green products to the production of new products, and this reduce the pollution that is provoked by petroleum and from this comes it relations to the environment quality. Another measure is the maintenance of the railroads to avoid annoying noises. It is a green transportation practice because it is an improvement in the railroad, it is also related to the environment quality factor because it focuses in the reduction of acoustic pollution. Another practice is the use of vehicles and cranes without drivers, it is controlled by an informatic system (Hamburg Port Authority 2015). This is also a green practice transportation because the main function of that is to move the goods to the corresponding place, this makes that the load and unload of the goods faster and without dead times. A benefit is the efficient distribution of the goods that entails the efficient use of the port ground this is related to the environment construction factor.

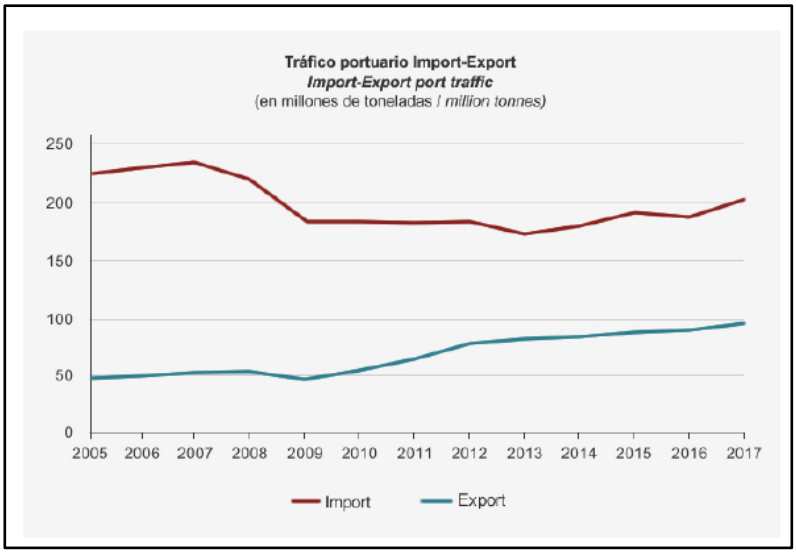
The port of the A coruña authority has opted for practices such as the construction of roundabouts inside the ports (Puerto del Estado 2015) to control the intense traffic of trucks and reduce the atmospheric pollution that this entails. It is a green transportation practice because it tries to improve the crowds that are created when transporting containers and the reduction of the atmospherics pollution, from there it comes the relation to the environment quality factor. Besides, this port also follows the indications proposed by the marpol agreement and provide different facilities for each type of waste. It is a Reverse Logistic practice because it manages and controls the waste that are generated and because of this it also can be related to the management resource factor.

Lastly, the valencian port stands out because of his practices such as the realization of all the customs documents via online, by doing this, they reduce the use of paper in the administration. It is a green production practice because this activity reduce significantly the use of paper and it also relates with the environment construction factor because this factor includes the electronic process that help the environment. Also, each port has various access and exits points to avoid agglomerations of trucks and has railroads, with this the emission of particles is reduced. It is a green transportation practice that also relates with the environment construction factor because it tries to do an efficient use of the ground, and likewise reduce the atmospheric pollution in the transportation of materials. And because of the A Coruña port also complies with the marpol agreement. An objective that his port has is the construction of an Eolic plant that provides energy to all the port. This will be a green production practice because it will provide energy that will be renewable, which is a more respectful kind of energy to the environment and it will also relate to the management resources (Autoridad Portaria de Valencia 2017).

3.1. Ports in Spain

Currently Spain is one of the countries that most exports and imports goods, 61% and 75% respectively through the ports. And as you can see in the figure the pace of exports and imports is increasing.

Figure 12: Import port traffic



Source: (Puertos de Estado 2017)

The port traffic and the economic activity are affected by the world economy since it is transited in international areas, the main routes are the East-West, East route or "round the world" that circumvents the planet through the straits of Malacca, Suez, Gibraltar, etc. In addition, it is the country with the most commercial and international sea routes thanks to its strategic postponements.

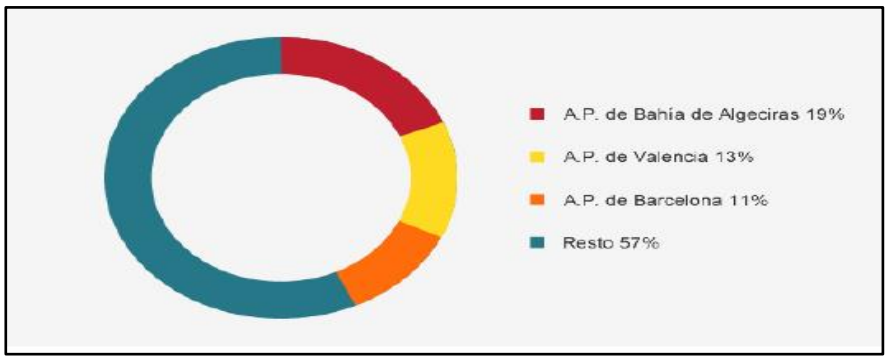
In Spain, the port sector consists of 28 Port Authorities. These take care of 45 ports. The State Ports carry out their port planning and management taking into account the economic viability of its activity and the contribution to the organization of efficient logistics, responsibility for society and the environment, as well as its commitment to transparency (Molina, González, and Soler 2017).

Figure 13:Ports of the State-Owned Port System

Source: *(Puertos de Estado 2017)*

Below you can see in the figure 15, total traffic distribution by port authorities (%), as Bahia de Algeciras, Valencia and Barcelona that have had the greatest movement of goods in 2017, totalling 236.6 million tonnes between these three, which accounts for 43% of total traffic.

Figure 14: Total traffic distribution by Port Authorities (%)



Source: (Puertos de Estado 2017)

Add also that all the Spanish communities have exceeded one million tons of goods movements. The following figure 16 shows how traffic has increased by 7% from 2016 to 2017. Due to the increase of the main traffic of the different types of goods in Spain, as liquid bulk, solid bulk, general cargo, fish captures, supplies, local traffic.

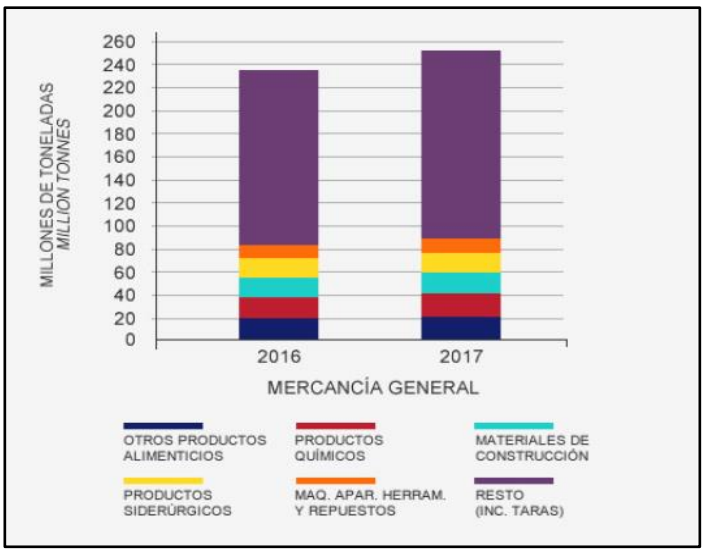
Figure 15: Traffic variation (2016-2017)

	Millones de toneladas *Million tonnes*		Variación *Variation*
	2016	2017	%
Graneles líquidos / *Liquid bulk*	167,6	178,2	6,4
Graneles sólidos / *Solid bulk*	92,0	101,4	10,3
Mercancía general / *General cargo*	236,0	252,5	7,0
Pesca capturada / *Fish captures*	0,2	0,2	4,4
Avituallamiento / *Supplies*	10,3	10,1	-2,0
Tráfico interior / *Local traffic*	3,3	2,7	-18,5
TOTAL	509,5	545,2	7,0

Source: *(Puertos del Estado 2017)*

It is also worth noting the increased traffic of other products such as foodstuffs, chemicals, construction materials, steel products, machinery, equipment, tools and spare parts, paper and pulp and vegetables and legumes, accounting for 46% of total port traffic.

Figure 16: Main general cargo goods



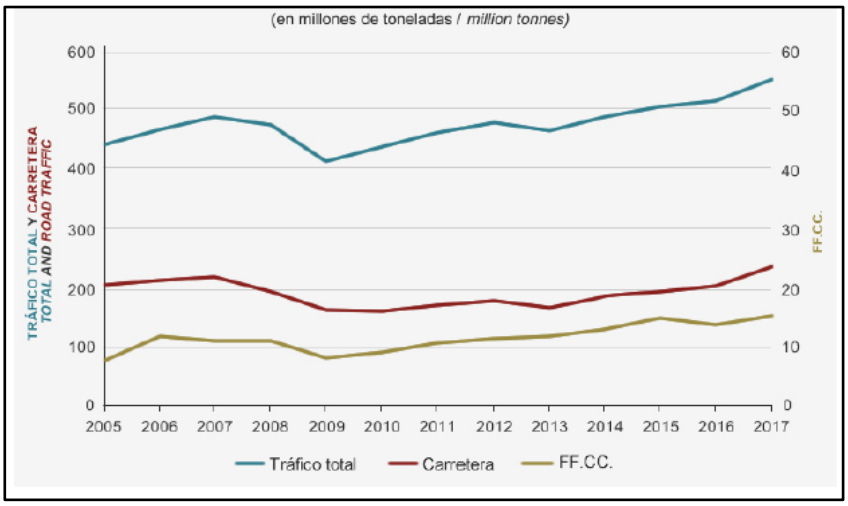
Source: (Puertos del Estado 2017)

The general cargo goods are mainly transported in containers, approximately 72%. The transporting of containers which it has dedicates to import-export has increased 3.5% and 7.6% containers in transit through of railway or road traffic.

The railway moved 15.5 million tons of goods, this type of transport is growing, has many benefits such as the amount of goods that can be transported in one trip, is less polluting than other transport and more economical. But it needs a specific infrastructure that coordinates the different connections between countries correctly. For this reason, road

transport continues to predominate (It moves 200millions tons approximately) according with figure 18.

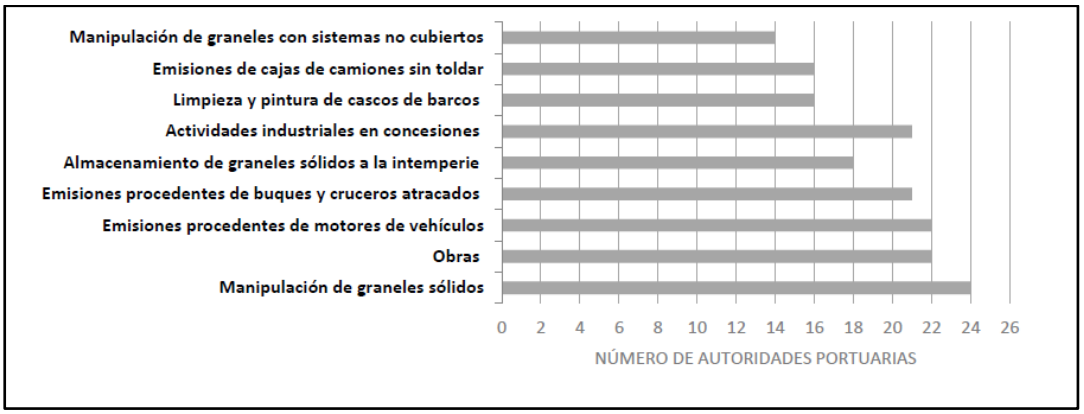
Figure 17: Land traffic entering or leaving the port



Source: (Puertos del Estado,2017)

The polluting aspects of some of these activities are shown in the following figure , among the sources of atmospheric emissions considered most relevant by the port authorities are the handling of solid bulks, works and vehicle traffic in the port, emissions from ships and industrial facilities present in the port are also considered relevant sources by more than 75% of the port authorities.

Figure 18: Main hotspots of emissions into the atmosphere

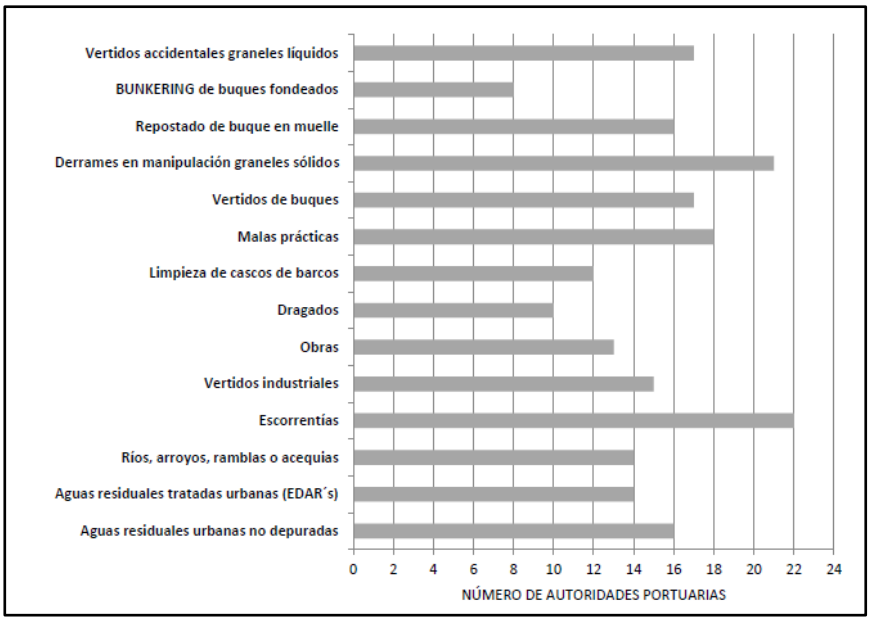


Source: (Puerto del Estado 2015)

Other aspects are those that affect water such as those set out below, 78% of port authorities consider rainwater runoff or irrigation (unchannelled or untreated) to be the main source of emissions to water. Spills during loading or unloading of solid bulks and

bad practices during cleaning and maintenance of docks and equipment are also considered relevant.

Figure 19:Main spill pockets to the port water mass.



Source: (Puertos del Estado,2015)

There are many pollution aspects to ports for this reason, the European Union's port policies are intended to be more sustainable in economic, social, and environmental terms (Chirino, Hernández and Lesdema 2014). For this reason, Spain is adapting to ensure competitive productivity. In 2008 it was created, the state corporate social responsibility board that defines the RS as: "a set of commitments voluntary in the economic, social and environmental fields for both businesses and public organizations and institutions (Chirino, Hernández and Lesdema 2014).

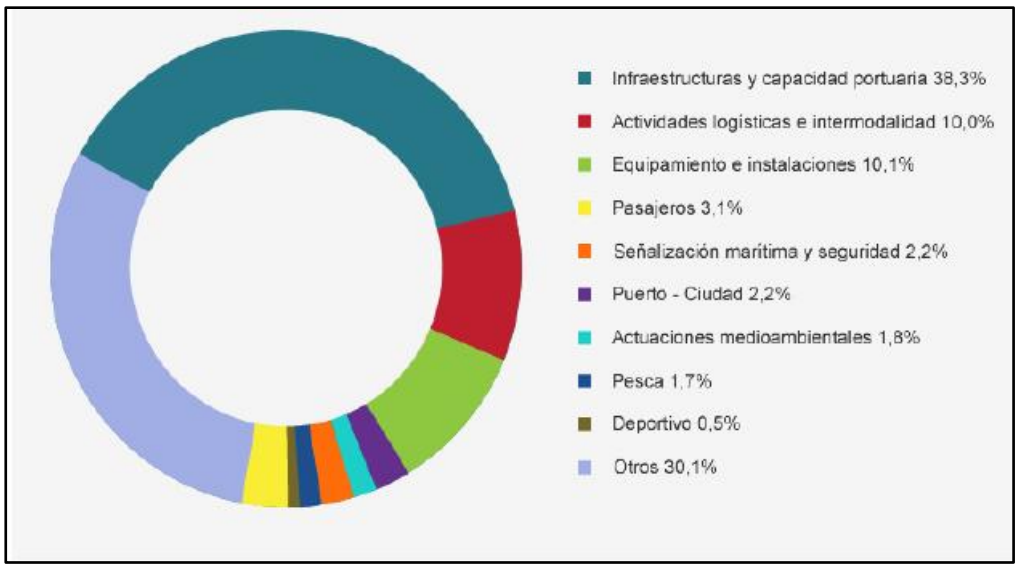
In addition, Spain's government passes the Ports Act 33/20105 highlighting the new role it is up to the ports and the shipping to achieve sustainability economic, social, and environmentally friendly as part of the European freight transport system.
From this law all Spanish ports must carry out a sustainability report. This will be approved by Ports of the State, after a hearing with the Authorities Port. With thus, allow to spread among the stakeholders the most relevant aspects of the Business Plan designed according to a scheme overall sustainability performance.

The State Port has implemented the following strategies to reduce the impact of transport *(Puertos de Estado 2017)*

- Impulse to the development of Motorways of the Sea.
- Promotion of rail transport to and from ports.
- Improvement of the mobility of heavy vehicles in the port environment.
- Promotion of alternative energies in transport.
- Improving energy efficiency and promoting the use of renewable energies.
- Control of diffuse emissions in the handling of solid and liquid bulks.
- Improving the traceability and degree of recovery of waste.
- To valorise construction waste in port landfills.
- Optimising the response to marine pollution emergencies.
- Contribute to improving the quality of water and sediments in ports.
- Contribute to preventing the dumping of waste from ships at sea.
- Optimize water management and use in ports.

Below in the figure 21 you can see what has been invested in the ports of Spain in 2017. Mainly in infrastructure and increase the capacity of the port by 38.3%. As for the investment in the environment we can include the investment in new equipment more efficient and less polluting (10.1%), 2.2% in converting the port into part of the city, another 2.2% in maritime signalling and maintaining security, and finally 1.8% in environmental actions.

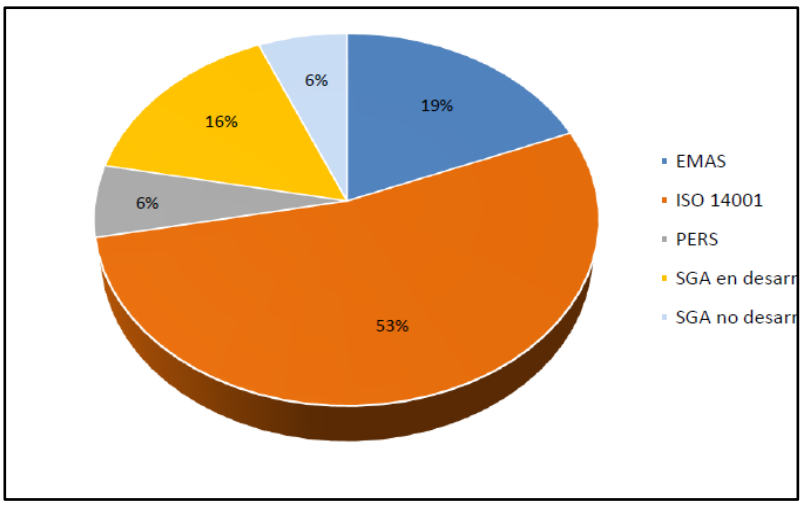
Figure 20: Investment of Spain Ports



Source:(Puertos del Estado 2017)

The commitment to environmental improvement of the port system has been strengthened, in 2010 only 9 port authorities had implemented management systems (allowing to objectify and systematize the environmental policies developed) whereas in 2015 there were 6 port authorities that were registered in the EMAS environmental register, 17 had ISO 14001 certificates and 2 were in the implementation phase of this management system, 2 were certified under the PERS (Port Environmental Review System) standard. Only 2 port authorities do not have an environmental management system nor are they in the process of implementing one.

Figure 21: Degree of implementation of environmental management systems (SGA)



Source: *(Puertos de Estado 2015)*

3.2. PortCastello

In 1865 there was talk of creating a port in Grao de Castellón, 39 politicians and businessmen from Castellón wrote a claim to Queen Isabel II asking for a port in this city to export artistic ceramics, agricultural products and promote the development of industry and trade. And that is where it all began.
In the 90's the wall that separated the city from the port was destroyed, as they wanted to make El Grao a recreational area for the citizens and now it is the main tourist attraction of Castellón. Already at this time they began to think about the environment and environmental quality.

Nowadays, PortCastelló is located at Muelle Serrano Lloberes, s/n 12100 Grao Castellón (Spain). PortCastelló is the logistics platform of the Mediterranean. The figures place him on the podium of the growth of the Spanish port system. It is in the ninth place of the 46 Spanish ports of general interest and is consolidated in the fourth position in solid bulk.

Figure 22: Location of the PortCastello

Source: Portcastello web

Mission:
The Mission of PortCastello is to promote the integral provision of logistics services that generate value for our customers, also promoting the integration of the port in the city and being an engine of development of the social and business fabric of its environment.
Vision:
The vision is to be a highly competitive port based on innovation and to be a reference in the Mediterranean for its proactive attitude and sustainability.

Values:

And values are the feeling of belonging, closeness in human treatment, customer satisfaction, safety and sustainability and commitment to society.

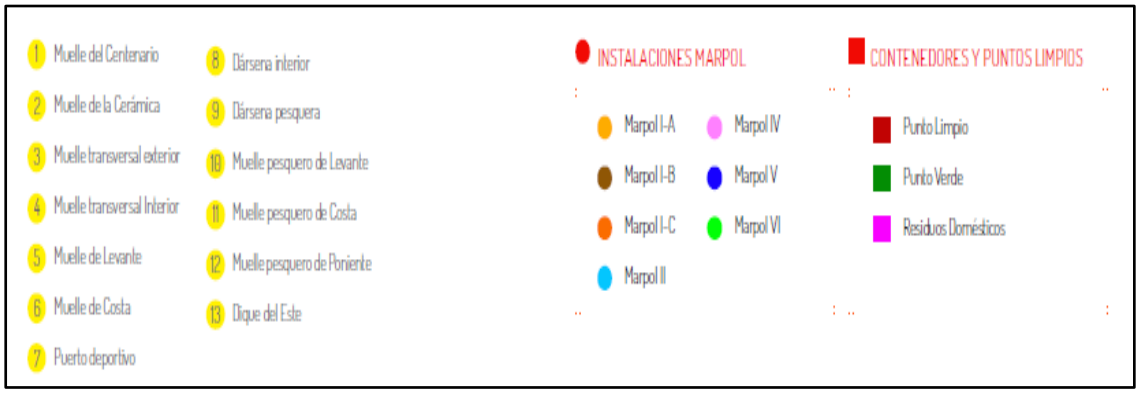
As you can see, both in the vision and in the values of the port, sustainability is given an import.

The parts of Port

PortCastello is composed of 13 parts that are named in the following figure and you can see its location in the figure 25. In addition, the facilities Marpol where the waste generated by the ships or cargo residues is received. And also the green points to recycle those residues that can be reused, the clean points where the residues that cannot be reused and domestic residues go, that is to say, those that do not come from activities of the port. In total the surface of the port is 2.700.000M2.

Regarding the meaning of MARPOL (Marine Pollution) is the name of the international agreement to prevent the ships pollution and regulates the discharge of substances that ships made to the ocean, it was signed in 1973.

Figure 23: Parts of Port



Source: (Portcastello 2018)

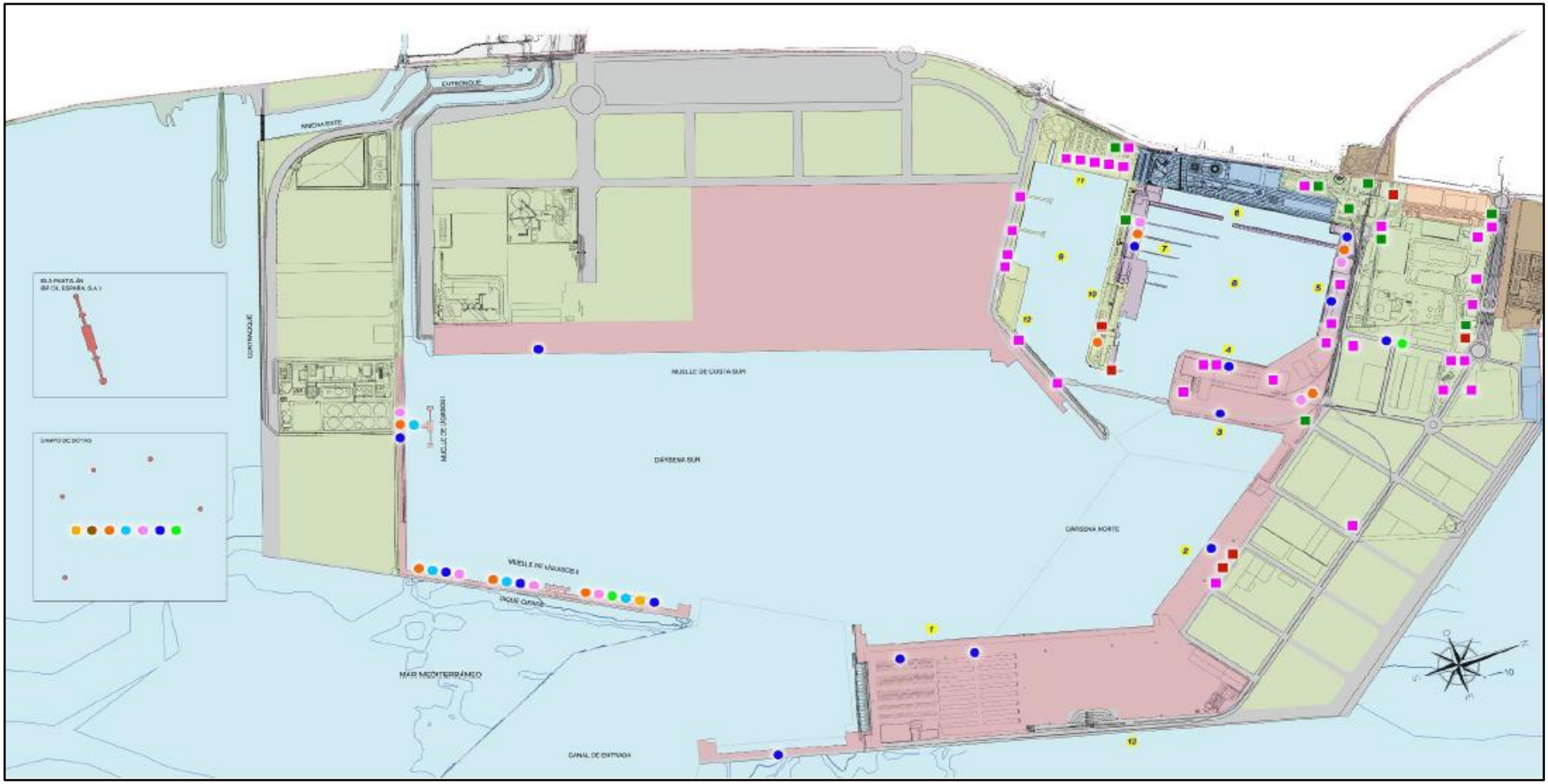
In the table 10 it can be observed the different Marpol facilities and the waste that is generated for each.

Table 10: Facilities MARPOL

Marpol facilities	Waste generated	Examples
Marpol I	**Type A:** Those receiving ship-generated waste or oil cargo residues crude oil and ballast water contaminated with crude oil. **Type B**: Those receiving ship-generated waste or oil cargo residues and ballast water contaminated with petroleum products other than crude oil. **Type C:** Those receiving ship-generated waste from the bilges of the engine room or the fuel and oil purification equipment of the ship's engines and whose density are less than or equal to one.	Bilge oils. /Crude oil cargo residues. /Diesel oil Kerosene/MOGAS NAFTA/Fuel Oil VGO
Marpol II	Those that receive cargo residues of noxious liquid substances from ships.	Sulfuric acid. /Phosphoric acid. /Contaminated vegetable acids. /FAME/Cyclohexane/MTBE/ETBE
Marpol IV	The ones that receive dirty water from the ships.	Dirty water (bathrooms and kitchens)
Marpol V	The ones that receive solid waste from the ships.	Paper/cardboard. /Plastics. /Metals. /Glass. /household waste. /Contaminated rags. /Contaminated plastic containers. /Contaminated metal packaging. /Batteries and cells. /Contaminated plastics and metals.
Marpol VI	Prevention of air pollution from ships	Substances that deplete the ozone and equipment containing such substances. /Bottom ash and slag containing hazardous substances.

Source: Own Elaboration

Figure 24: PortCastello



Source: (Portcastello 2018)

As for the traffic of goods in the PortCastello, it has managed to increase by 18% more than in 2017, approximately 21000000 million tons of goods loaded and unloaded all over the world. In figure 26 you can see these countries and the amount of movement of goods in each of them.

Figure 25: Total goods by country of origin and destination.

PAÍS	EMBARCADAS	DESEMBARCADAS	TOTAL
ALBANIA	1.144	49.874	51.018
ALEMANIA	10.184	10.964	21.148
ANGOLA	390.801	523	391.324
ANTIGUA Y BARBUDA	1		1
ARABIA SAUDI	156.976	19.176	176.153
ARGELIA	229.304	836.663	1.065.967
ARGENTINA	32.794		32.794
AUSTRALIA	42.550		42.550
BAHRAIN		92.183	92.183
BARBADOS			
BÉLGICA	12.799		12.799
BENIN	5.289	5.520	10.808
BRASIL	1.293.542	49.793	1.343.335
BULGARIA	31.642	46.350	77.992

PAÍS	EMBARCADAS	DESEMBARCADAS	TOTAL
CABO VERDE		505	505
CAMERUN	9	6.019	6.027
CANADA	54.385	91.893	146.277
CHILE	59.502		59.502
CHINA	186		186
CHIPRE	3.588	69.408	72.997
COSTA MARFIL	92.648	40.329	132.976
CROACIA	1.811	1.375	3.186
DESCONOCIDO	24	9.600	9.624
DINAMARCA		7.544	7.544
DJIBOUTI	4.635	1.614	6.249
E.E.U.U.	163.441	97.357	260.797
EGIPTO	133.246	290.018	423.264
ESPAÑA	373.343	2.095.377	2.468.720

PAÍS	EMBARCADAS	DESEMBARCADAS	TOTAL
ESTONIA	15.531		15.531
FINLANDIA	15.114		15.114
FRANCIA	102.425	432.833	535.258
GABON	4	4.082	4.087
GAMBIA		2.389	2.389
GEORGIA		54.249	54.249
GHANA	9.570	106.829	116.399
GIBRALTAR		193.847	193.847
GRAN BAHAMAS	30	36.976	37.008
GRECIA	10.162	209.978	220.140
GUINEA-CONAK	65.786	5.268	71.054
HOLANDA	457.468	227.070	684.538
HONDURAS	20.504		20.504
INDIA	10.210	108	10.318
INDONESIA	320.867		320.867
IRAN	22.348	17.380	39.729
IRAQ		907	907
IRLANDA	23.475	60.993	84.468
IS. MARSHALL	38	4	41
ISRAEL	95.299	233.246	328.546
ITALIA	636.808	293.385	930.192
JORDANIA	8.823	92.872	101.695
KENIA	101	15.610	15.710
KUWAIT		837	837
LETONIA	31.819		31.819
LÍBANO	10.537	150.166	160.704
LIBERIA	3	916	919
LIBIA	214.237	162.399	376.636
MALASIA	111.260		111.260
MALTA	35.648	160.589	196.238
MARRUECOS	111.151	410.956	522.107
MAURITANIA		37.753	37.753
MOLDAVIA		1.319	1.319

PAÍS	EMBARCADAS	DESEMBARCADAS	TOTAL
MONTENEGRO		1.473	1.473
MOZAMBIQUE	6.050	4.012	10.062
NAMIBIA	20		20
NIGERIA	742.018	165.071	907.089
NORUEGA	71.915		71.915
OMAN	129	181	309
PAKISTAN	28	275	303
PANAMA	60		60
POLONIA	285		285
PORTUGAL	387.954	24.847	412.800
REINO UNIDO	184.743	48.307	233.050
RUMANIA	190.526	177.853	368.379
RUSIA	1.226.288	42.318	1.268.526
STOME Y PRINCIPE		63	63
SENEGAL	11.978	69.954	81.933
SIERRA LEONA		1.286	1.286
SINGAPUR			
SIRIA	7.972	20.739	28.712
SOMALIA		4	4
SUDAFRICA	17.211	22.429	39.640
SUDAN	115	7	122
TAIWAN	1.913		1.913
TANZANIA		5.403	5.403
THAILANDIA	8.705		8.705
TOGO	128	2.624	2.752
TRINIDAD-TOB	9.199		9.199
TUNEZ	75.469	83.768	159.237
TURQUIA	3.637.450	97.165	3.734.615
U.E. ARABES	10.329	1.012	11.341
UCRANIA	1.476.827	54.099	1.530.927
URUGUAY	3.042		3.042
VENEZUELA		36.589	36.589
ZIMBABWE		204	204
TOTAL	13.493.509	7.684.250	21.307.759

Source: (Portcastello 2018)

Of this total 10,393,834 tons were of liquid bulk, the PortCastello is in 7th place in the ranking of the 28 Port Authorities. In addition,7,425,415 tons correspond to solid bulk which is in 4th place in the ranking. As for general goods, 3,288,509 tons are moved, and it is in 9th position. And finally, 229,093 TEUS (measurement of the weight of containers) moves in containers, ranking 7th among the port authorities.

On the other hand, the means most used by the PortCastello to move the goods are the roads with movements of 10,623,768 tons and through underwater pipes the large liquids such as diesel, biodiesel and others, a quantity of 10,393,834 tons.

Figure 26:Means of transport used for the entry or exit of the port service area

/ TRANSPORT	CARGADAS EN BARCO	DESCARGADAS DE BARCO	TOTAL
Ferrocarril			
Carretera	4.082.672	6.541.096	10.623.768
Tubería	3.489.054	6.904.780	10.393.834
Otros medios			
Sin transporte terrestre ST	42.504	47.653	90.157
Total de mercancia según transporte	**7.614.230**	**13.493.529**	**21.107.759**
Pesca, avituallamientos y tráfico interior o local	24.455	5.415	29.871
TOTAL	**7.638.686**	**13.498.944**	**21.137.629**

Source: (Portcastello 2018)

The PortCastello is main objective is to become more competitive in the sector, thus benefiting all its stakeholders. To this end, it has set itself more specific objectives to achieve this.

- Optimization of processes and services, whose objective is to promote the competitiveness of the port by means of the continuous improvement of the processes of the Port Community, guaranteeing the optimal level in the relation price, time, and quality.
- Development of intermodally to promote competitiveness, integrating all means of transport into the logistics chain of the port.
- Put in value of the assets. This line aims to promote the use of infrastructure and available land as a hub for the development of the port and a driving force for society in general
- Balance and diversification of traffic, to favour a balanced increase in the volume of traffic through the port, seeking to maintain competitiveness over time and promoting the development of added value in services.
- Promotion of sustainability and corporate social responsibility policies whose aim is to strengthen the role of the port as an agent for the development of the social and business fabric, thus favouring port-city integration.

This academic research is mainly focused on the last objective, it will be checked if green logistics measures are being taken.

As for the legislation, the port authority of the Port follows quality and sustainability policies with which it wants to become a reference in the Mediterranean due to its proactive attitude and sustainability. In order to achieve the objectives, a management system based on the following principles has been established (PortCastello 2018):

- To achieve the full satisfaction of our customers and users by providing logistics services that generate value.
- Integrate continuous improvement actions in all our processes and services, through the periodic review of quality and sustainability objectives to contribute to the proper functioning of our Quality and Environmental Management Systems.
- Promote awareness of climate change among Port Authority of the PortCastello employees and our stakeholders through energy efficiency, rational consumption of resources and reduction of waste and emissions.
- Respect and comply with the applicable regulations, as well as any other commitment acquired.
- To promote the integration of the port in the city, being the motor for the development of the social and business fabric of the surroundings.
- The involvement and awareness of all employees, together with the total support of the Company's Management Team, is essential to achieve the established objectives.

The port authority has committed itself to these principles and is improving it is management systems.
In addition, it must comply with the following regulations set out in Table 11.

Table 11: Regulation in port

Water Pollution Prevention Laws	Waste Laws
• Ley 22/1988, de 28 de julio, de Costas. • Real Decreto Legislativo 1/2001, de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas. • Reglamento de Dominio Público Hidráulico (RDPH). • Real Decreto 907/2007, de 6 de julio, por el que se aprueba el Reglamento de la Planificación Hidrológica. • VERTIDOS A DOMINO PÚBLICO: Real Decreto 817/2015, de 11 de septiembre, por el que se establecen los criterios de seguimiento y evaluación del estado de las aguas superficiales y las normas de calidad ambiental. • VERTIDOS DE TIERRA A MAR: Real Decreto 258/1989, de 10 de marzo, por el que se establece la normativa general sobre vertidos de sustancias peligrosas desde tierra al mar. • VERTIDOS A COLECTOR: Ley 2/1992, de 26 de marzo, del Gobierno Valenciano, de saneamiento de aguas residuales de la Comunidad Valenciana. • Ordenanza Reguladora de vertidos líquidos residuales. Castellón de la Plana. BOP nº 9 de 21 de enero de 1995.	• Convenio MARPOL 73/78, Convenio Internacional para prevenir la contaminación ocasionada por los buques, de 1973, modificado por su Protocolo de 1978. • Real Decreto 1381/2002, de 20 de diciembre, sobre instalaciones portuarias de recepción de desechos generados por los buques y residuos de carga. • Real Decreto Legislativo 2/2011, de 5 de septiembre, por el que se aprueba el texto refundido de la Ley de Puertos del Estado y la Marina Mercante.
Law on Acoustic Pollution	**Pollution Prevention Laws**
• Ley 7/2002, de 3 de diciembre, de la Generalitat Valenciana, de Protección contra la Contaminación Acústica. • Ley 37/2003, de 17 de noviembre, del Ruido. • Decreto 266/2004, de 3 de diciembre, del Consell de la Generalitat, por el que se establecen normas de prevención y corrección de la contaminación acústica en relación con actividades, instalaciones, edificaciones, obras y servicios. • Ordenanza Municipal de protección contra la contaminación acústica. Castellón de la Plana. BOP nº 146 de 7 de diciembre de 2010.	• Ley 22/2011, de 28 de julio, de residuos y suelos contaminados. • Ley 10/2000, de 12 de diciembre, de Residuos de la Comunidad Valenciana. • Real Decreto 1/2016, de diciembre, por el que se aprueba el texto refundido de la Ley de prevención y control integrado de la contaminación.

Source: Own Elaboration (PortCastello 2018)

4. METHODOLOGY

The methodology is to use information of term Green Logistics to check whether the theory is carried out at the seaports. Mainly in the PortCastello.
The theory information obtained has been collected from review literature of database as ProQuest (ABI/INFORM global) it is one of the most comprehensive business databases on the market, including in-depth coverage from thousands of publications, most of them in full text.

And secondly, the information obtained about the green ports and their practices has been acquired on the the official institution State Port where you can find updated statistics of all ports, as well as the sustainability reports of each port.
And in addition to the website of Ecoports and other institutions such as the International Maritime Organization. Some information has also been found in the Proquest database.
As far as, the information about PortCastello has been obtained from official website of this port.

Finally, it will be concluded if activities related to green logistics are carried out and possible new measures will be contributed to achieve the being a green port.

5. GREEN LOGISTICS IN THE PORTCASTELLO.

In recent years, the PortCastello has invested time and money in promoting environmental sustainability and approximately 1,500,000 million euros in social costs (PortCastello 2018).

The main logistics processes that have the most negative effect on the port are related to activities such as the storage of goods that involve the consumption of fuel, water, energy and raw and auxiliary materials, and this involves negative aspects such as the emission of polluting particles (CO, NOx, CO2, SO2) into the environment, odours, soil pollution and the generation of urban and hazardous waste.
Other important activities are the loading and unloading of goods from the ship to the quay, which involves the consumption of energy, fuel, and consumption of auxiliary materials, and this causes a negative effect by the emission of particles, noise, water pollution of the dock (Dársena) , soil pollution and the generation of urban and hazardous waste (Indaport 2012)
Also, the transport of goods is among the most important activities of the ports, and these movements of goods involve the consumption of water, energy, fuel, and raw and auxiliary materials. And like the previous activity, its negative effects are the emission of particles, noise, soil pollution and the generation of urban and hazardous waste (Indaport 2012)

That is why the port has chosen for different practices that are related with the green logistics in order to become a green port and by doing this improve the negative aspects that are provoked by the activities that are being carried by the logistics. In the 12 table, such practices are exposed.

Table 12: Practice green logistics at PortCastelló

Green logistics / Greening ports	Environment Quality	Environment Construction	Resources Management
Green Purchasing			
Green Production		Masol Company: Produce Biodiesel	Energy efficiency
Green Transportation	Control of particle emission. Cleaning all trucks wheels.	Wind break screens that absorb particles. Anti-pollution barriers.	Use of conveyer belts. Cleaning of zones.
Green Packaging			
Reverse logistics		MARPOL Facilities	Waste identification

Source: Own Elaboration based on (PortCastello 2018)

By seeing the table, it can be seen that different practices are being carried by the port. Firstly, the green production practices, in this case, the companies that have operations inside the port like MASOL which is the one that has the productions of biodiesels using certain vegetables oils, so that is why it is considered a green practice. The port has authorized the installation of this company inside the port and because of this it could be considered an environmental construction practice.

Moreover, an energy efficiency project has been developed to the public lighting of the port. It helps to save 45% of its energy. The main objectives are the reduction of energy consumption costs, improve areas with deficit of energy or over energy consumption and establish an average illuminance in order to maintain the objective of peer-to-peer control of the public lighting network. For now, it only has been applied to a part of the port, this practice has into account the management resources factor because it manage the energetic waste, in this case the light, is a green production practice because this management affect directly in the lighting of the production process of the different companies that work in the port.

Secondly, green transportation practices are being applied having into account the quality environment factor, like the measurements to control the emission of particles with the installation of three quality of air control stations. The Air quality network of the PortCastello is the organization that is responsible for monitoring the emissions levels of PM10 and PM 2.5 particles. In the annex you will find Air Quality Assessment reports of the PortCastello.

Also, the port attempts to control the agglomeration of trucks that circulates within its limits by creating new roads of circulation, this measure assumes environmental benefits by reducing the emissions to the atmosphere of 1000 tons of CO2 per year. In addition, the port police control the speed levels of the trucks, they must no exceed 30km/h, since a higher speed emits a higher emission of particles. Another measure is the installation of a system to wash the wheels of the trucks at the port exists, this prevents the dragging of particles and other products out of the port. It is mandatory for all trucks.

Regarding the environment construction factor, the port has installed dust trapping screens to protect the Grao of Castellón from this kind of particles during the handling of solid bulk cargo in the port area. It is composed of five screens of 12 meters high and its efficiency has been proven by studies of the ceramic technology institute (ITC)

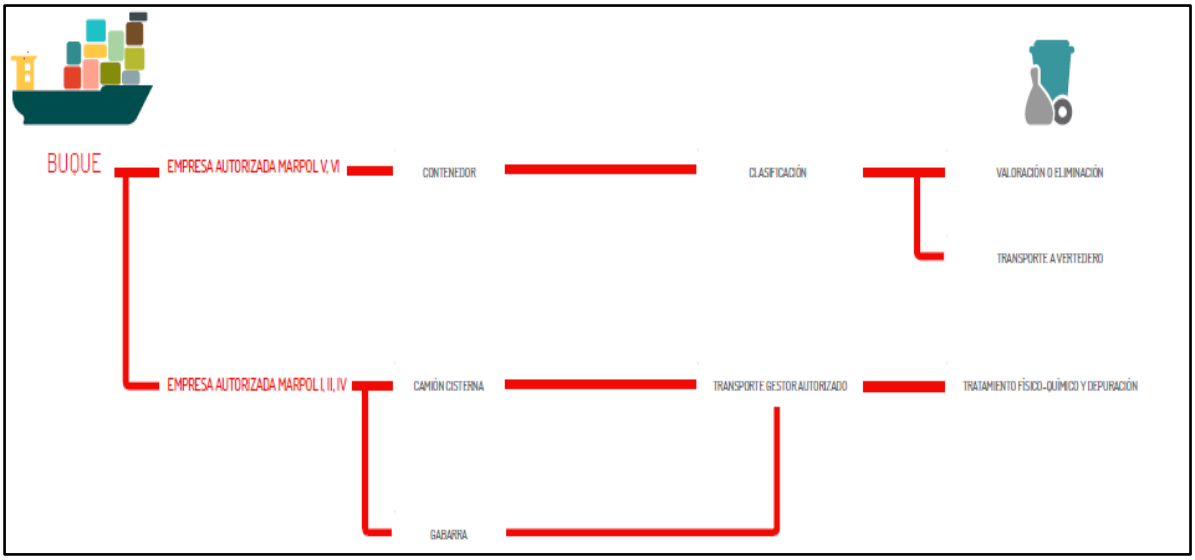
Additionally, another practice is the incorporation of anti-pollution barriers, there are 3 barriers that serve to contain the possible discharged of contaminant liquid in the water such as spills of crude or refined oil. The first barrier is composed of 3 sections and has 150 meters long, the second one is installed in Iberdrola channel and has 75 meters long and the third and final barrier, is designed for use in open waters at the entrance of the port, it measures 400 meters long and weight 2500 kilograms. Besides, the final barriers are unique in Europe because it has the property of being inflatable this means that it automatically extends itself once it comes in contact with the water, and it unfolds completely in 10 minutes. In addition, it is equipped with a fresh water supply so that it can be cleaned while it's being deployed so the risk of accidents is reduced in the automatically unfolding process thanks to a hydraulic system.

On the other hand, the practices that are related with the green transportation has into account the management resources factor, because at the time of loading and unloading the containers it do it is across the conveyors belts and by doing this, avoiding the possible spills of wastes in the ground of the ports. Also, after this process the zone is cleaned.

And finally, the reverse logistic practices are related to the environment construction and resources management factors, because zones of the port have been enabled to the

pickup and treatment of the wastes. The so-called MARPOL facilities are divided in different zones por each type of waste. The process is like this, First, there is an authorization from the responsible inspector in order to be able to transfer the waste generated from the ships according to the type of waste to be transferred to one Marpol area or another, and they are assigned a code to be aware of the life cycle of that product. In the following image you can see the process.

Figure 27: Waste Management



Source: (PortCastellon,2018)

In addition, the PortCastello reviews voluntarily renews every 2 years the certificate of environmental management system PERS (Port Environmental Review System) from ESPO. The certificate is found in the annex.

6. PROPOSALS OF GREEN LOGISTICS PRACTICES IN PORTCASTELLO

Next, it Will be exposed in the table 13 the different practices that the PortCastello could carry on to improve the term of green logistics.

Table 13: Proposals of Green Logistics practices in PortCastello

Green Logistics / Greening Port	Environment Quality	Environment Construction	Resources Management
Green Purchasing	Purchase of office supplies with a minimum environmental impact.	Give easy entry installation to companies that are committed to the environment	
Green Production		Use of electronic customs documents	
Green Transportation	Use of railroads.		Use of biodiesels for different vehicles or any other alternative fuel.
Green Packaging			Packaging management to avoid spills

Sources: Own Elaboration

Regarding the practices that are related with Green Purchasing, it can not be seen any related activities. These practices are more commons in enterprises that are dedicated to the production of a product or the buy and sell. Which is not the case of the port. But it could be taken into account when purchasing materials related to port documentation, trying to get materials with the minimum environmental impact. Another measure is to facilitate entry and installation at the port to external companies that are highly committed with the environment like the port of Busan

Regarding the theme of green production, practices are minimal since the port, as has been said, it is not a production company. As a proposal a practice could be the use of electronic custom documents without the need of physical documents, and there would not be a waste of paper, like the port of Valencia already does.

Regarding the practices of Green Transportation, there are several since it is the main activity of the port. As a proposal to improve taking advantage of the railway infrastructures located in the port, it would be important to use these, because they will save time , it is a less polluting medium and the number of transport containers is greater. Another possible practice would be to take advantage of the biodiesel provided by the Masol Company for the combustion of the machines, cars and trucks. And the ships to opt for alternative less polluted fuels.

On the other hand, there is no evidence that practices related to green packaging are been carried out because it is an activity made by import and export companies. But the port could take over the packaging management by checking that there are no breaks that cause spills that may contaminate the port soil, as well as the port of Busan.

Lastly, the reverse logistics practices are adequate enough and similar to the international maritime ports.

7. CONCLUSIONS AND FUTURE DIRECTIONS

In conclusion, the strong preoccupation of the port sector due to the environmental impact caused by the activities that they do, have unleashed a series of measurement to reduce this impact. The benefits are, reduction of damage to the environment, having a proper port management in order to reduce negative accidents that could endanger the environment. Moreover, the risk that could cause health problems to workers will be limited and they working conditions will be improved, it will avoid any harm to all the citizens, damage to properties, and the infrastructure and machinery used would be reduced.

Regarding the PortCastello and according to the definitions of green ports that are expressed in this academic research, PortCastello can be considered green as it has been implementing strategies in order to become a sustainable and environmentally friendly port in both, the short and in the long term.
In addition, there is a reasonable management of resources by the port authority that is being carried by the workers of the port, but mainly, it has been thanks to the integration of the port with the city that has been made possible to generate a green value assuming a great social responsibility.

Regarding the relationship of the PortCastello with the green logistics, it can be seen that the port has adopt several logistic activities that are helping the port to be more sustainable, since it adopts green practices of production, transportation and reverse logistics, which help to reduce the emissions that are generated by the different activities, save energy in the land use management, and to manage the wasted that are generated and if it possible, to reuse them.

For now, the president of PortCastello has confirmed that he is strengthening the future of the port with and investment of 80 million euros that will be used to innovate in infrastructure and environmental protection. The greatest challenge are the rail connections that move 60% of the goods destined for Europe, and 40% for the entrances and exits of the port. Another plan is to be revolutionary with the management of solid bulk. With the measures that has been taken so far, emissions to the atmosphere have been reduced by 20%, and it is expected that with the new proposals this percentage will grow (Mundo, 2019)

Moreover, a great option would be to have into account the objectives, the introductions of practices that are related with the buying and green packaging, this would bring great benefits like the reduction of the carbon fingerprint, less ground pollution, besides of promoting the port image.

There are some strategies that has to be taking into account that the state of the port (2018) has proposed to reduce the impact of the transport, which is the main activity of the ports.

PorCastello wants to continue strengthening the green logistics activities in order to achieve a balance between the economic, energy and environmental efficiency.

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9. ANEXO

Air Quality Assessment Reports

https://www.portcastello.com/wp-content/uploads/2019/02/evaluaci%c3%93n_calidad_aire_red_apcs_2018.pdf

Good Practices Guide:

https://www.portcastello.com/wp - content/uploads/2018/07/port_castello%cc%81_guia_medioambiental_2018_pliegos_baja.pdf

Pers Certification:

https://www.portcastello.com/wp-content/uploads/2019/09/certificado_2018-2020.pdf