

Port Sustainability Practices:  
A Case Study of Port of Rotterdam and Port of Los Angeles

Bachelor Thesis

06/11/2017

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# 1. Introduction

Ports are crucial facilitators of global trade bringing economic growth and development for their regions and countries. They are nodes in worldwide supply chains providing not only a sea-land connection but various value-added services too. According to (Cetin & Cerit, 2010) ports have evolved into a logistics and industrial sectors with national and worldwide significance. They need to find balance between valuable land, labor and technology while being multifunctional business centers providing employment to their host cities and countries (Sakar & Cetin 2012). As port operations became standardized the competition between ports shifted towards the ability to offer tailored services with individual approach depending on the requirements of the clients (Carbone & De Martino, 2003). Ports compete being part of global supply chains and their effectiveness, flexibility and responsiveness within the frames of these chains is what determines their market position (Hall, 2009; Cheon & Deakin, 2010). With the increase of global trade the pressure on ports reached a larger scale which had a negative effect on their performance. Accommodating ultra large container carriers led to congestions at and around the ports, underutilization of capital and negative externalities such as air and noise pollution. Except the environmental issues that ports face Dooms et al. (2004) argue that they have to ensure stable financial performance satisfying their stockholders. Port industry has a significant impact on economic growth including revenue, value-added and employment (both direct and indirect) noted by Notteboom, (2008). Seaports are responsible for the attractiveness and the livability of the residential area in the port vicinity meaning that a social perspective is needed when actions are taken (Hall, 2007).

Various legislative regulations, pressure from stakeholders and severe competition have put ports in a position to implement strategies that would guarantee a vital growth in market share while ensuring ecological quality and social responsibility. The pursuing of strong financial performance must be well-balanced with social issues and environmental quality (UNCTAD, 2014) Sustainability was recognized as the best strategic framework that should lead a company in its development. Such strategy incorporates the economic, environmental and social impact of the company and tries to achieve win-win solutions leading to higher satisfaction of all parties (Sakar, 2012). In the port industry this concept can be viewed as the desire to improve the economic condition of the area and the country, to contribute to a livable residential area and to decrease the negative environmental impact that port operations have (Rodrigue & Notteboom, 2009).

Adams & Quinonez (2009) explain that sustainable development improves port competitive position. The benefits resulting from sustainability practices such as reduced operating costs, process improvements, enhanced brand image and better supply chain coordination have been identified by Kim & Chiang, (2014) and Hall, (2007).

One of the largest seaports worldwide incorporate sustainability under different forms in their strategies. Trying to improve their competitive positions they satisfy the

stakeholders and improve the environmental quality (Shanghai Port Authority, 2015; Maritime and Port Authority Singapore 2014; Port of Antwerp 2015). Nowadays a trend in the port industry towards such strategy implementation for both developed and developing countries can be observed. It shows how the industry is pursuing a new phase of operations where the main focus is put on finding balance between financial performance, economic prosperity and environmental quality. The discussion in this section leads to the following research question:

### **What sustainability practices do Port of Rotterdam and Port of Los Angeles implement?**

In this paper the sustainability practices of Port of Rotterdam (PoR) and Port of Los Angeles (PoLA) will be assessed using a dynamic strategy framework presented by Kim & Chiang (2014). These ports are chosen because they both claim to be one of the most sustainable ports in the world, they are net importers of containerized cargo from Asia and have leading market positions in their respective competitive regions based on TEUs handled.

From scientific point of view this paper will contribute to the field of port sustainability strategies, providing examples with two of the largest ports in the world. The investigation of their practices will add to the literature on this topic which is scarce and may have positive impact on other ports since sustainability as a strategy is still in a growing phase, especially in the developing countries (Lam et al. 2014).

From social point of view the research paper will contribute to the understanding of the general public regarding the practices and the different projects that ports implement. This understanding may be beneficial not only for educational purposes but also it can positively influence the decisions made involving social groups. Furthermore awareness of the port practices aimed at social well-being improvement may favorably shape the socially-responsible image of the port.

The paper is organized as follows. Section 2 includes the literature review discussing port sustainability research from different perspectives and a sub-conclusion based on the findings. Section 3 presents the theoretical framework adopted to analyze the ports concluding with the data and methodology used for the analysis. Section 4 is the main section where the analysis of the strategies will be presented from the perspective of the theoretical framework. Chapter 5, titled Analysis discussion is a pre-conclusion section which discusses the main findings in the analysis and connects them with the literature review. This section is followed by a critical assessment of the sustainability practices and tries to look from more critical perspective to these strategies. The paper concludes with section 5 including discussion of the findings, limitations of the paper and the suggestions for further research.

## 2. Literature review

Ports, being part of global supply chains must develop and compete while considering different viewpoints when implementing a strategy (Tongzon, Chang & Lee, 2009). In the paper authors present global supply chains in which parties from all over the world such as senders, shippers and forwarders have to closely work with each other in order to achieve efficiency in the value delivery to customers. Coordination and coherent strategies among the supply chains are crucial for their competitiveness (Rodrigue & Notteboom, 2009). The port's ability to serve as a synchronization node in international supply chains is a crucial differentiation factor (Notteboom & Rodrigue, 2000).

The only way for ports to stay competitive is to be active and adaptive to the changing market conditions by implement various adequate strategies. Before implementation these strategies should be discussed with multiple parties called stakeholders each one with different views and objectives (Dooms et al. 2004; Sakar & Cetin, 2012). The stakeholders can be grouped into two categories:

- Internal:
  - *The parties inside the port authorities` organizational boundaries.*
- External:
  - *The private sector: the investors at the port area such as terminal operators, all kinds of value-added, logistics and maritime-related services;*
  - *The public stakeholders such as NGOs, government departments and commissions related to different public goods;*
  - *Representatives of social organizations and residential groups.*

Recently there has been increase in the pressure from the stakeholders on seaports to improve economic performance and societal impact while creating less negative externalities. This can be considered as a desire for sustainable port operations (Sakar & Cetin, 2012). The awareness of final consumers regarding the undesired practices of different industries and companies led them to put pressure on the producers to become more engaged in issues regarding the nature and the economic impact they have. Hennessey et al. (2003) explain that the supply chain performance very much depends on all supply chain parties` performance, especially the one of the ports. From this point of view an implementation of a sustainability strategy by a given supply chain would not be effective if the port(s) in this chain do not implement such strategy as well. Legislative

regulations are the other driving force for the utilization of sustainable strategies (Dinwoodie et al. 2012). Such strategies present a win-win situation leading to improved economic conditions and favorable environmental outcomes (Kim & Chiang, 2014). The term sustainability has been defined by the World Commission on Environment and Development (WCED, 1987) as:

*“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.*

Three building blocks of sustainability can be distinguished, namely: environmental, ecological and social sustainability (Glavic and Lukman, 2007). Jeon and Amekudzi (2005) describe port sustainability as:

*“Business strategies and activities that meet the current and future needs of the port and its stakeholders while protecting and sustaining human and natural resources”.*

Utilizing such strategy ports may not only satisfy the needs of their stakeholders but also significantly improve the port performance in terms of asset utilization and resources allocation (Robinson 2002). Adopting practices of active and advanced environmental and social responsibility is recognized as the most viable option for ports by Neef (2012).

Academic research on sustainable port practices and strategies has been conducted by numerous authors some of which are Carbone & De Martino (2003); Hall (2007); Hassini et al. (2012). They have mainly focused on the environmental impact of ports leaving the social aspect (employment and living environment) and the economic aspect (value-added, taxes, duties, impact on imports and exports) under researched (Acciaro, 2014). Being environmentally-friendly, reducing GHG emissions and noise pollution are only some of the crucial points of sustainable strategy (Hassini et al. 2012).

The increased pressure on ports from different parties has played an important role in the process of port development (Shiau and Chung 2015). This has led seaports to include the triple bottom line in their strategies balancing all parties` interests that would be affected by port`s choices. (Seuring and Müller 2008). The triple bottom line (figure 1) is the main concept describing what sustainability includes. The framework is systemized by UNCTAD 2009 in the following way.

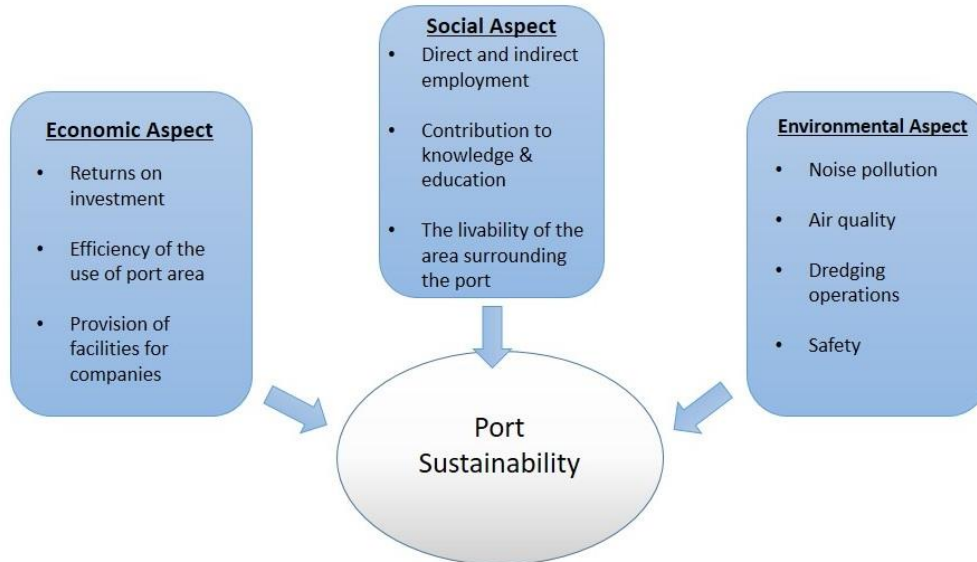


Figure 1. Sustainability diagram

Source: [www.unctad.org](http://www.unctad.org)

- The *economic* perspective concerns returns on investment, value-added for the national GDP and the strategic value translated into trade enhancement

As already discussed ports create value-added and contribute to the national GDP. Except the logistics and industrial clusters that typically find their locations at a seaport it is of crucial importance to discuss innovation that takes place at a port. Wong & Ho (2005) argue that innovation is the factor that brings economic growth in the long-run. Innovation is crucial for economic development (Youtie, 2008). The location of companies presenting new innovative methods, technologies and products will lead to improved region's productivity and future economic development (de Langen et al. 2012). This is very much related to the port industry, argued by Nijdam and van der Horst (2017) who indicate that PA can influence the economic condition of the port region and to a large extent this of the whole country. Attracting innovative companies at the port area may create valuable synergies which will spill over multiple sectors and eventually benefit all port stakeholders.

- The *social* aspect relates to direct and indirect contribution to employment; education and knowledge investments and enhancement; improvements in the livability of the surrounding areas.

The relationship between the port and its city has undergone various stages explained by Hoyle (2000) in his 'Port development model'. The author argues that the port-city relationship has weakened due to numerous factors such as scale of operations and legislative reforms. Although this process is evident in almost all port cities the dependence of a port on its city for land allocation is still very strong. On the one hand ports need more space to expand, to build more extensive infrastructure and larger superstructure in order to better meet the needs of their clients. On the other hand the growth in population requires more land for residential areas and recreational purposes. This is why a communication between the two parties is very important in order to arrive at a satisfying consensus. The employment and the contribution to the livability of an area are another factor that port strategy should take into account. The port demand for skilled labor makes programs and investments in local training, education and knowledge viable. This may also improve the port's image and social relations, further enhancing port-city cooperation.

- The *environmental* management includes air and noise pollution; dredging disposal, water contamination and wildlife protection.

During the last decade a significant amount of the public debate has been focused on the environmental issues, the negative impact that large industrial complexes have on the global warming and the possible actions that can tackle these serious problems. Ports are one of the most heavily affected industries by such 'eco-movements' as they are large contributors to air, water and noise pollution. This indicates that for a port it is of crucial importance to work on its transformation towards the 'green' direction of operations. Such practices may lead to improved social image and can very well act as a differentiation factor, enhance the port competitive situation turning out to be a win-win strategy.

Shiau and Chuang (2015) have researched this topic and they have systemized several indicators of port sustainability, which can be useful when comparing ports' achievements in this field. Peris-Mora et al. (2005) developed a system of sustainability indices by surveying industry specialists in order to collect more information based on real practices.

The researchers Gul and Cimen (2012) claim that only if a sustainability practice is



implemented in coordination with the port` stakeholders it will be effective. A close cooperation with multiple parties such as society, the private sector and the governmental departments will have significant positive impact on the results of such strategy. A sustainable supply chain requires the inclusion of multiple actors and based on mutual trust they should exchange information, know-how and cooperate with each other so that to achieve the collective goal. Lu et al. (2016) explain that employee training and active staff participation in sustainability practices formation is favorably associated with the effectiveness of the strategy. The authors conclude that sustainable port strategy is positively associated with port competitive positions while generating employment, value-added, offering a livable social area and environmental quality. Ports which implement such practices tend to improve their competitive positions as they become more attractive to shipping lines, which also face the stakeholders` pressure to become `green` (Suslian et al. 2016).

Summarizing the literature review it can be concluded that sustainability strategies regarding the economic and social impact of ports are less researched although multiple authors share the opinion that these two fields are becoming more important in recent years. The theoretical approach to this topic is more commonly found which supports the scientific importance of this case study. The triple bottom line lacks the ability to capture various practices that are also sustainability-related which has led to the development of multiple criteria for performance assessment. Most of the authors discuss that the effective sustainability strategies are only possible if ports work closely with other supply chain parties, local communities and terminal operators. Coordination and cooperation are crucial as the sustainability approach is not done in isolation but rather depends on all stakeholders` awareness and participation. Starting from internally implementing the strategy, ports should integrate various parties in the decision-making process and actively communicate their goals and views.

### **3. Theoretical Framework**

Kim and Chiang (2014) also support the statement that ports can improve their competitiveness by introducing sustainability practices. The authors explain that port authorities put significantly more emphasis on the sustainability in the last couple of years. Such strategy is pursued mainly because it is believed to be related with efficiency and competitiveness. In the paper it is discussed that the triple bottom line approach is not sufficient enough to encounter all practices that ports do in order to assess their sustainability performance. This is why the framework presented by these authors is most suitable for assessment of the strategies of Port of Rotterdam and Port

of Los Angeles. It allows for a thorough examination of the seaports and presents a framework which takes into account broader perspective including important aspects which may otherwise be left unobserved.

Resulting from an extensive empirical research the authors have structured the following graph presenting sustainability practices in port operations:

Structure of sustainability practices in port operations

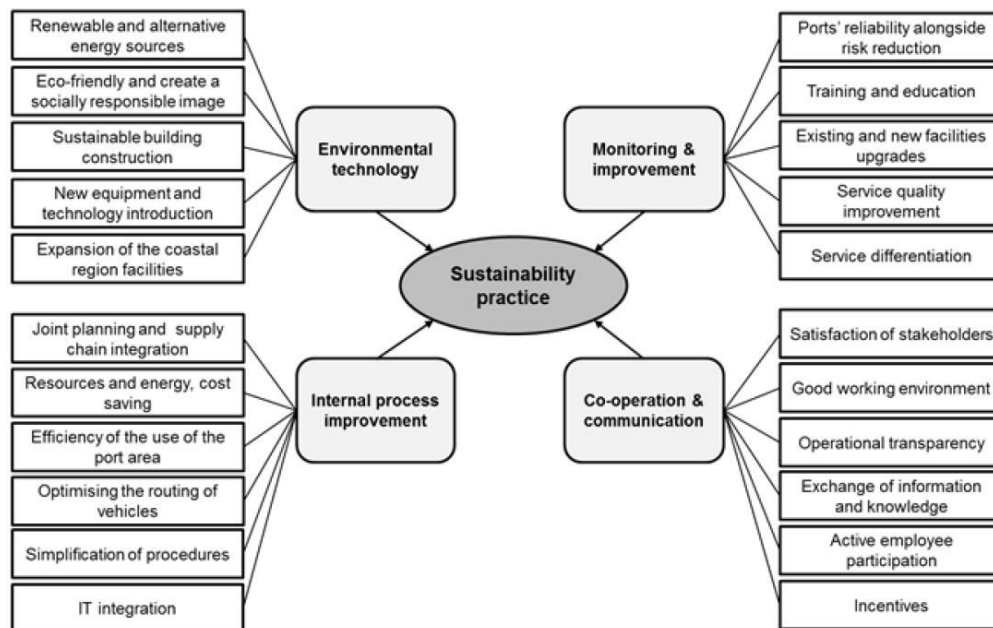


Figure 2. Port sustainability practices

Source: Kim & Chiang, 2014

The four quadrants are explained in the following way.

*Environmental technology:*

These practices include equipment and methods introduction that decrease energy consumption. Green port practices leading to cost and resource efficiency are considered as innovations. As already discussed innovation is closely related with efficient resources utilization and economic prosperity. Port facilities constructed in accordance with specific sustainable regulations lead to lower costs for maintenance and produce less negative externalities. The use of renewable and alternative energy sources is very much pursued especially in the light of the Paris climate agreement, signed in 2015 (United Nations, 2015) for transition from fossil fuels towards renewable energy.

#### *Continual monitoring and improvement:*

Port sustainability requires adequate operation improvements by all parties related to port activities. Seaports must be adaptive to the turbulent business environment in order to successfully achieve positive results and communicate them with their stakeholders. From an operational perspective potential service quality improvement and service differentiation would lead to comparative advantage while better satisfying the needs of the customers. Continual training and education of all internal stakeholders including employees, tenants and managers together with cooperation with R&D and innovation departments helps promoting and better implementing the port sustainability strategy through improved awareness, knowledge exchange, skills and motivation.

#### *Operational efficiency through internal process improvement:*

Internal process improvements allow for greater efficiencies in port operations which lead to win-win outcome in terms of performance incorporating economic and environmental aspects. Such practices include: utilizing of automation systems, efficient use of the port area, optimizing the routing of vehicles (modal shift) and less port congestion. From the integration of IT systems numerous procedures can be simplified (joint planning, electronic data exchange and supply chain integration).

#### *Cooperation and communication:*

In order to respond to pressure from all sorts of external stakeholders in the face of: competitors, customers, shareholders, regulators, governments and community groups, ports should effectively coordinate and cooperate with each of the abovementioned parties. Active and open communication not only carries out the model of sustainable seaports through better understanding of mutual benefits but also promotes continual improvement in port practices. Stakeholders` satisfaction, operational transparency, exchange of information and knowledge and active employee participation are another way to achieve sustainable port operations.

## Data and Methodology

In order to analyze the practices of the ports data for both the private as well as the public sector will be used. It has been retrieved from multiple sources such as the websites of the ports and the companies which can be considered as reliable sources as they are the official platform via which they communicate with the general public. Throughput, sustainability and strategy reports of the two ports are the base of this research. Furthermore data from the website of the World Bank and the maritime database has been used to construct the market shares of the ports. Newspapers, research papers and information from the websites of the companies working together with the ports on a specific project have been used in order to present a thorough explanation on every sustainability practice.

Having gathered all the relevant data and information, it has been grouped and analyzed according to the four sub-sections in the framework discussed. Some of the practices that are not in the main focus of the ports have been omitted in order to put emphasis only on the most relevant actions taken, making the research clear and understandable.

## **4. Analysis**

### **Port of Rotterdam**

Port of Rotterdam is situated in Rotterdam, The Netherlands (map in the Appendix). The port authority managing the seaport is called the Port of Rotterdam with shareholders the municipality of Rotterdam for 70 percent and the Dutch State Government for 30 percent. The PoR fits in the model of a landlord port where the PA manages the port infrastructure and leases the port land to the private sector. Furthermore it aims for sustainable development, management and operation of the port and maintains a safe and smooth handling of all vessels that call at the port. The Port Authority generates its revenue from port dues and land rents. Rotterdam has favorable geographical location as it has direct access to the North Sea and the mouth of the Rhine river. This combination presents very good competitive advantage for the seaport. PoR has a draft of 25 meter allowing it to accommodate even the largest ships built. Because of its location it is first and last port of call in Europe for many international shipping companies which makes the port attractive choice for both receivers and senders of cargo. Rotterdam is located in the center of the economic activity in Europe - 'the Blue Banana' (see Appendix). The key location is coupled with outstanding accessibility - the market reach of the port is 500 mln customers in less than 24 hours by water, air, road and rail which makes the port a preferable choice regarding numerous types of cargo trade for both shippers and forwarders.

Port of Rotterdam in 2015 created employment for about 90 000 people in the country. The added value of the port for 2015 was 21 bln euro which is 3.1% of the Dutch GDP. The container throughput and its annual growth are presented in figure 3.

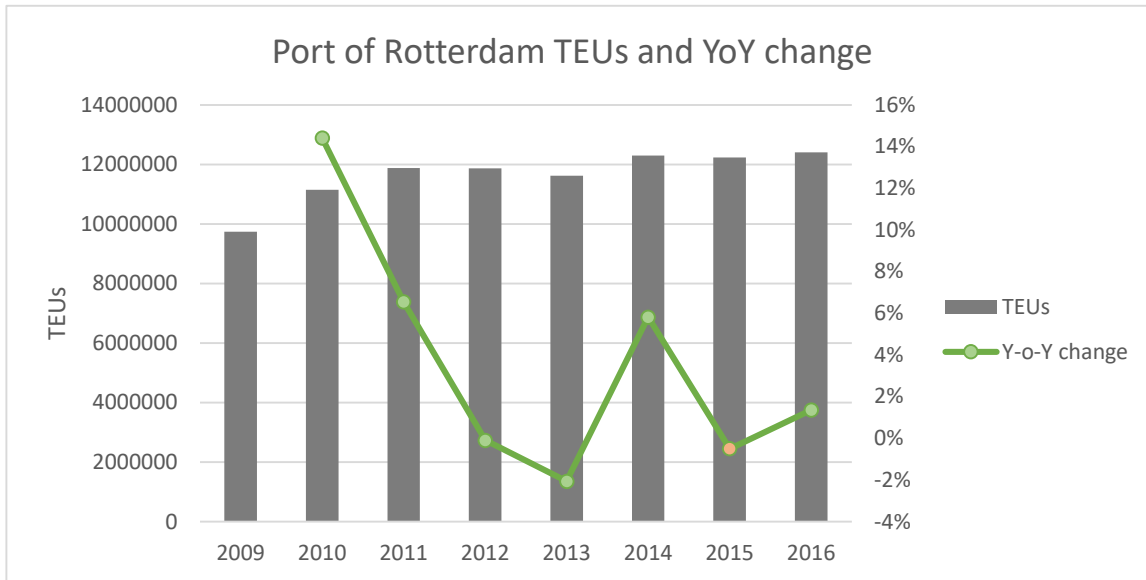


Figure 3. PoR TEU throughput and respective yearly growth

From the perspective of contestable hinterland Port of Rotterdam can be considered to be in a competition with the ports in the Hamburg – Le Havre range. The market shares based on container throughput in mln tons for year 2015 in the HLH range can be seen in figure 4.

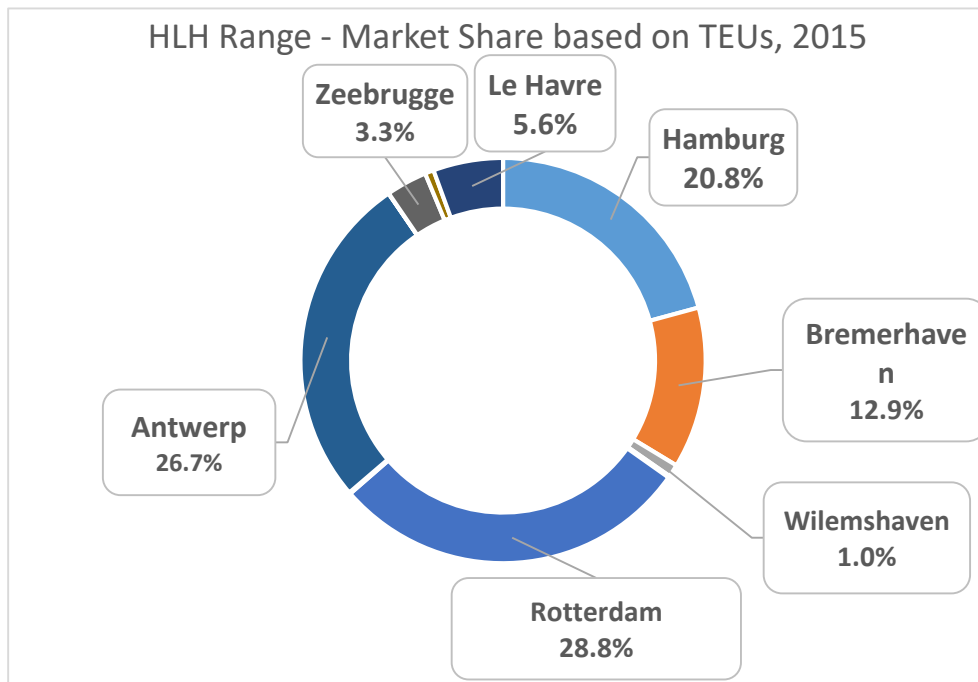


Figure 4. Ports' market shares in the Hamburg-Le Havre range, based on TEU throughput

The port authority has an objective to become world's most modern and efficient port. Although the PA does not have the ability to directly control tenants' activities it may use multiple 'instruments', such as lease contract clauses or incentives, in order to influence the development of the port towards a more sustainable direction. Two main strategies have been set by the Port Authority in order to become one of the most sustainable ports, namely: energy transition and innovation. To a large extent the port depends on fossil fuels for industry activities and logistics. The Paris agreement on climate change is one of the most recent legislative changes that motivate the port to reduce the emissions of CO2. The ambitions of the port is to become a world hub for bio-based fuels, with leading positions in R&D and innovation in this field. The port authority recognizes the sharing of information and knowledge to be among the forces to boost the growth of global trade in the coming decades. Digitization of the supply chains can improve the coordination between the parties, contribute to timeliness resulting in efficient operations in the whole supply chains.

The practices of Port of Rotterdam fitted in the framework of Kim & Chiang (2014) are systemized in figure 5.

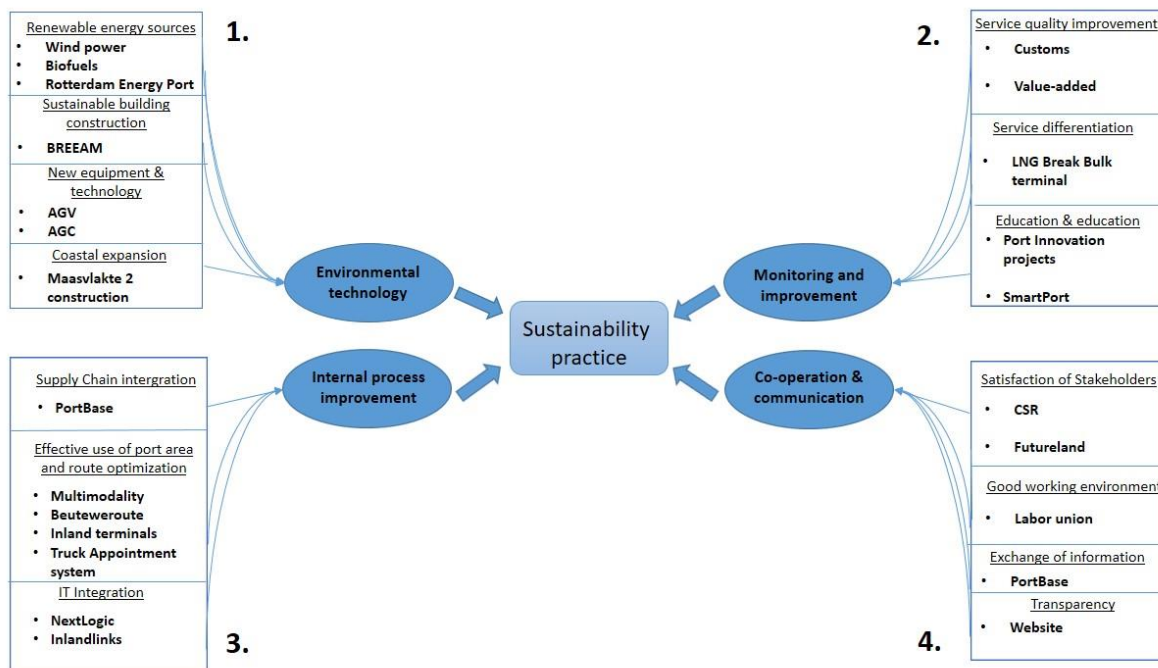


Figure 5. Port of Rotterdam sustainability practices

## 1. Environmental Technology

### **Windpower:**

In 2009 the PoR together with public and private parties have signed a 'Wind Energy Agreement' which makes the port area location for green energy production. This agreement allowed the installment of wind turbines in the port areas with expected doubling of the capacity by 2020. Except this project, another wind park also positioned at the port supplies 18,000 households in the Rotterdam municipality with green energy. The PA expects a growth in the amount of wind energy produced in the port and actively works to enhance it because this will contribute to the achievement of its ambition to become the sustainable power plant of Northwestern Europe.

### **Biofuels:**

The greening process laid in the Paris agreement together with the push from multiple stakeholders for green energy shape the future of bio-based products. The production of such energy became cost competitive compared to fossil alternatives because of economies of scale experienced (Wilco van der Lans, 2015). Rotterdam is actively working to become a global hub of the bio-based industry. Given that bio-based products are expected to take over the current fossil fuel market PoR has a strategic advantage over its competitors. It already has the alliances with industrial companies and suppliers of feedstocks for bio-based production. The existing petrochemical industry at the port area offers labor and input. These companies' products and side products can be used as an input in the bio-industry – the so-called "industrial ecosystem". Opportunities for sharing of work experience and knowledge between current and future workers is present and can be benefitted from. Furthermore the proximity of the port to three of the world's leading universities in this field can enhance the development of the industry.

A pioneer in this field in the company "GoodFuels", situated in Rotterdam. It tries to enhance the development of this industry and cooperates with international experts in order to become a leader in this market niche.

### **Rotterdam Energy Port:**

The intensity of work at PoR creates significant amount of air pollution which drives for a sustainable energy transition and reduction in the current levels of CO<sub>2</sub>. The port wants to reduce the CO<sub>2</sub> emissions with 50 percent by 2025 which will be achieved by transition to sustainable energy resources and utilization of modern methods for capturing and storing such pollutants. Rotterdam PA proves to be innovative in the latter process as it successfully stores and transports CO<sub>2</sub> in order to heat households, greenhouses and companies in the area of Rotterdam. An appropriate pipeline network eases this process and allows 200 000 tons of CO<sub>2</sub> per annum to be used in a productive direction rather than emitted in the air.

### **Sustainable Building Construction (BREEAM NL):**

Port of Rotterdam has put significant attention to the sustainability of the buildings,

especially these at the newest part of the port – Maasvlakte 2. The possession of a BREEAM NL certificate, which indicates the sustainability performance of new buildings according to pre-set criteria, is obligatory. This certificate takes into account a large number of parameters set by a governmental commission ensuring that the effect a building has on the environment obeys the criteria.

**AGV & AGC:**

The Automated Guided Vehicles (AGVs) and the automated gantry cranes (AGC) allow for optimization of cargo handling at container terminals. They use batteries to operate which makes them harmless for the environment. Furthermore the computers that navigate them do not allow for an accident to happen - one of the strongest advantages of this type of equipment. The terminal operators at the newest part of the port are fully electric, equipped with the top notch types of such automated vehicles. One of the container terminals at the port has launched the world`s first remotely controlled gantry cranes. Automated vehicles which transport containers between the quay and the container stacks are also used by several terminal operators. These vehicles are powered by wind-generated electricity, they are quieter due to the lack of engine and achieve 50% reduction in energy consumption compared to their predecessors. Such investments from the private sector significantly influence the image of PoR and rank it among the leaders in innovative cargo handling methods.

**Maasvlakte 2 construction:**

Because of the need for expansion and the lack of space the PoR has decided to construct artificial land in the North Sea, called Maasvlakte 2. This project was finalized at 2013 after 5 years of work during which 1000 acres of port land was retrieved from the water. All companies involved in the construction have been obliged to work according to a preset sustainable rules. The dredging process and the design of the Maasvlakte 2 have been specifically tailored so that the least negative impact on both society and wild life is left. During the planning process the PA has closely worked with multiple social representatives, municipality and governmental organizations so that every party has had the opportunity to present their views, promote their interests this way improving the project.

## 2. Monitoring & Improvement

**Customs:**

Given that PoR is the leader in container throughout in the HLH rage necessitates for efficient and professional Customs services. The Dutch Customs manages to perform its responsibilities in an efficient and adequate manner, leaving all supply chain parties satisfied. In this sphere not only security is crucial (given that Rotterdam is an external boarder of Europe) but also timeliness and tailored to different customers services are



significant for the competitiveness of the port itself. Innovation in inspection methods and security allow the Customs to improve their work and positively influence the punctuality of cargo movement.

**Value-added:**

The port is home of of the largest transportation and value-added services cluster in Europe. Due to the favorable location and the synergies that can be captured at the port area numerous companies specialized in the field of production, storage and transportation can be found there. The petrochemical industry has played a major role in the development of the port and its market positions. Companies from all over the world engage in transaction with this cluster bringing benefits for the whole Dutch economy. The presence of such strong clusters at the port create synergies and localized economies which are very difficult to replicate elsewhere – one of foundations of the port`s competitive advantage.

**LNG Break Bulk Terminal:**

On the Maasvlakte 2 area of the port is located the “Gate Terminal”. It is specialized in loading, unloading and storing of liquefied natural gas (LNG) arriving from the Middle East, Australia, Asia and other locations in the world. The Gate terminal also serves as a distribution point. From there the LNG can be re-loaded onto smaller vessels for short sea shipping. It can also be transported in gaseous form as the port has access to the gas pipeline network of Europe. The presence of such facilities is an important differentiation factor for the port as the demand of LNG is expected to rise in the near future. With such unique break bulk facility for loading smaller vessels the port already has competitive advantage over the other ports in the HLH and may very well benefit from this fact as the following trends show:

The German manufacturing company “Volkswagen” plans to charter two LNG-powered vessels from 2019 for vehicle shipment between Europe and North America.

Thirteen cruise ships that will be delivered before 2026 will be powered by LNG.

Furthermore the energy giant “Shell” has ordered inland barge fleet that will run on liquefied natural gas. Apart from the maritime industry LNG finds its usage in the road transport as “Scania” shows. Currently the company is developing truck engine powered by LNG, expected to reduce the PM and CO2 emissions by 80%.

**Innovation projects:**

As stated in the strategy of the Port of Rotterdam Authority, innovation is a crucial factor on which they want to put significant emphasis. Attracting start-up businesses that specialize in different fields is expected to positively affect the performance of the port. The project called “Port Innovation Lab” is aimed at gathering together professionals, students, scientists and researchers and provide them the opportunity to closely work with each other. Close cooperation with innovative start-ups may result in ground-breaking innovations that would not only improve the performance of the port and its competitive positions but more importantly they can positively change our daily lives.

This is why the port heavily stimulates and contributes to the growth of this 'innovative start-ups cluster' at the port area.

Another program called "PortXL" realized with the cooperation of multinational companies like "EY", "Boskalis" and "E.ON" takes place at the port area. Multiple companies work closely with Erasmus University Rotterdam and Cambridge Innovation Centre and combine efforts in order to provide start-ups with knowledge, expertise and resources, in a three-months program, so that they can kick-off their businesses and mutually help each other.

#### **SmartPort:**

The PA of Rotterdam together with several Dutch universities are part of a project that aims to solve maritime technical issues. The project is called "SmartPort" and it contributes to the abovementioned initiatives focused on the development of the port as an innovation cluster. For example SmartPort focuses on the 3D printing in the marine sector. In 2016 it successfully managed to 3D print a metal ship propeller which was unique in the world. The program shows very large potential to develop in the port industry innovation field as it can enjoy the close cooperation with world-leading professionals.

### **3. Internal Process Improvement**

#### **PortBase:**

As it is discussed in the port introduction the PoR recognizes the importance of smooth and seamless information sharing among all port-located companies. This is why the PortBase, which is an online platform for data exchange, was introduced. The PA of Rotterdam joined forces with the port authority of Amsterdam and in 2009 this non-profit platform was introduced. Its purpose is to make the logistics chains in both Dutch ports more attractive as they share know-how and crucial information not only between, but also within each other. Since PortBase was developed a significant ease in the exchange of information among terminal operators, logistics companies and service providers at the ports has been observed helping every party to optimize its own processes and satisfy customers better.

#### **Multimodality**

Multimodality is one way to alleviate the pressure at the port. It leads to lower CO2 emissions, punctual and reliable services as well as differentiation from the competitors.

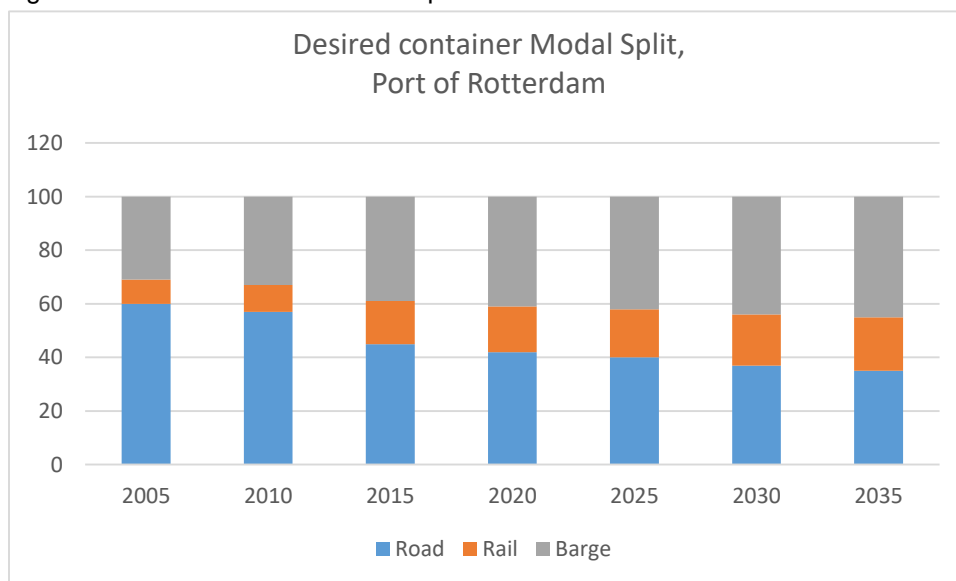
Utilization of barges offers flexibility, it is not dependent on possible congestions and is more energy efficient (see Appendix). It can generate economies of scale allowing cheaper transportation of the cargo. PoR is at a favorable geographical location for multimodal transportation. Inland vessels can transport cargo via the rivers Maas and Rhine which gives them direct access to some of the major economic centers in France, Belgium, Austria and Germany. Inland shipping is reliable, safe and sustainable with emissions almost 80% less compared to road transport and energy consumption 8 times less per ton kilometer compared to road.

Rail cargo movement is another option for multimodal transportation. It also provides

the opportunity for economies of scale, punctuality, better planning, and reliable services all these with very low emissions. More than 250 weekly intermodal rail cargo services to and from locations all over Europe depart or arrive at the port of Rotterdam. The Betuweroute is a dedicated freight railway line that connects the PoR directly to the German railway network. Currently this route is being extended with the so-called ‘third track’ in Germany enabling the rail transportation to continue growing in the future. The so-called “PortShuttle” is a rail shuttle that carries containers to and from the various deep-sea terminals at the port. This rail connection eases the work of the TOs, decreases the congestion levels on the road network and via better planning and organization leads to more efficient utilization of resources.

Port of Rotterdam as a part of its sustainability strategy wants to achieve a modal split in the coming years as shown in figure 6. Although the pre-set goals fail to be met upon the time of writing (road transport has share larger than 40%) if the port manages to meet the desired modal split it will contribute to the decrease in emissions related to cargo transportation and alleviation of port congestion.

Figure 6. Port of Rotterdam modal split desire



Another solution for smooth cargo handling are the ‘inland terminals’ or ‘extended gates’. The difference between the two is based on the activities that take place at the location but in both cases they alleviate the pressure at the seaport and extend its reach offering better planning and organization in the whole supply chain. Located in the hinterland they are closer to the customers (both senders and receivers) and serve as cargo consolidation or deconsolidation points. Locating inland, the terminals can benefit lower land charges, less congestion and better planning possibilities which improves the efficiency of the deep-sea terminals and the port as a whole. At locations nearby the inland terminals supplementary activities such as storage, container repairs, labeling and repackaging of different types of cargo take place.

### Truck Appointment systems

Some of the container terminals at the port use a so-called “Truck appointment system” which requires any truck that visits given port to have announced in advance its visit. The purpose of this system is to make the work at the terminals more predictable. This way lower congestion levels, improved timeliness and less accidents are achieved which is beneficial for the whole supply chain. Better organization allows the terminal operator to know at any moment how many trucks are expected to arrive or leave. This way they can predict the workload and prepare accordingly so that the equipment is used in the most efficient manner.

The need for reliable exchange of information among the port users and the parties involved in the supply chains has led to the development of several platforms for information sharing. PoR puts a lot of attention in the supply chain integration which is why it is either an initiator or a partner the following projects.

#### **Nextlogic and Inlandlinks**

Nextlogic and Inlandlinks are online platforms aimed at supply chain information sharing. Nextlogic is oriented towards the barge operators and offers punctual data regarding all deep-sea as well as inland terminals, their turnaround times, possible disruptions and delays as well as quay and equipment availability. This way the platform contributes to the smooth, effective and accident-free movement of cargo via water. Inlandlinks is more internationally-oriented platform offering all kinds of information regarding cargo movement to and from the port of Rotterdam. Data such as terminals` equipment and punctuality, reliability, productivity, depth, capacity, sustainability index as well as empty depots, alternative transport modes with their specific characteristics can be found on this website. Using Inlandlinks parties from all over the world can easily plan their own supply chain and choose exactly which ports and modes of transportation to use so that their cargo reaches its final destination. The customization of the supply chain that this information allows may significantly contribute to the port competitiveness, offering its customers the flexibility that they expect.

## **4. Cooperation & Communication**

#### **Corporate Social Responsibility**

CSR is the framework within which PoR operates meaning that they balance the port development with economic growth and efforts to improve the living environment around the port area.

The shareholders (Rotterdam Municipality and The Dutch National Government) can experience good financial results and stable ROI with turnover for 2016 of 675.4 mln euro and profit of 222mln euro. The port creates employment and added-value that benefits the economic growth of The Netherlands.

#### **Futureland:**

The Information Centre FutureLand allows visitors to discover the port industry, its

operations and development throughout the years. This place has both informational and recreational purposes where together with the astonishing view of container terminals and some of the largest ships built it is possible to see some of the numerous animals and plants that habitat the port area.

**Good working environment:**

The PoR pays significant attention to its employees and the impact it has on the employment in the region and in the whole country. It is of primary importance to create a nice working environment where all employees feel motivated and are able to fulfill their tasks in the most efficient way.

A well-organized and predictable work environment is preferable for both the employees of the port as well as the shipping companies which may easily choose another port to call if some disruptions due to port labor protest take place. This is why the PA works closely with the port labor union and prevents such situations. A recent survey shows that for 2016 the percentage of enthusiastic and engaged employees increased from 33% to 39.5% with respect to 2015. This indicates improvements in the working environment and labor engagement in the decision making processes.

**Operational Transparency:**

The port is very transparent in all of its actions providing different kind of information, statistics and documents related to its performance and activities both off- and online. All activities that the PA undertakes are thoroughly discussed with all stakeholders that may be possibly influenced by these parties.

**Port of Los Angeles**

The Port of Los Angeles is located in the San Pedro Bay, south of downtown Los Angeles, USA (see Appendix). The Port of Los Angeles and the Port of Long Beach (located side-by-side) are two distinct entities and together they form the fifth-busiest port facility in the world. The port of LA is a landlord port meaning that it is the owner of the port infrastructure and the ground which it leases to the private sector. Port of Los Angeles is an important contributor to the USA economy, bringing roughly \$260 billion annually and provides directly and indirectly employment to 3.6 million people. The largest portion of the throughput of the port is generated by containerized cargo. The TEU throughput figures together with the annual percentage growth can be observed in figure 7.

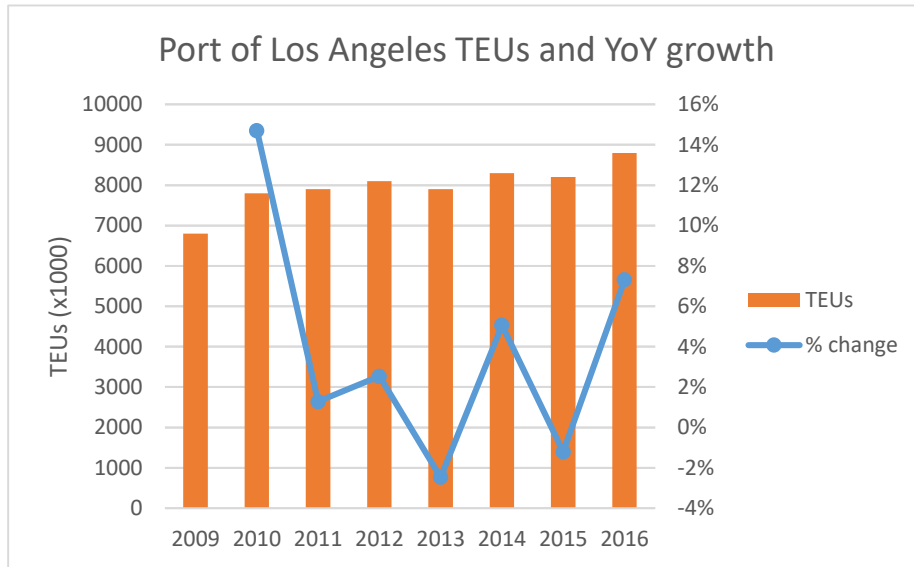


Figure 7. PoLA TEU throughput and respective yearly growth

Rodrigue & Notteboom (2010) show that the concentration of economic activity in the USA is at the two coastal region (East and West). Because of the Panama Canal container carriers larger than 13000 TEUs, Panamax vessels arriving from Asia, cannot pass the canal and go to the east coast of North America. Because of these limitations the East Coast ports are mainly serviced by ships carrying the Asian cargo that come from Europe's hub terminals. On the other hand the West coast is directly reached by the shipping companies and the San Pedro Bay is the preferable point due to the presence of adequate infrastructure and physical characteristics such as 16 meters draft, enough to accommodate container carriers with up to 18 000 TEUs capacity. As the other ports on the West Coast serve to a large extend the same hinterland as PoLA they can be considered as competitors of the port. The market share based on TEUs handled during year 2015 can be seen in figure 8.

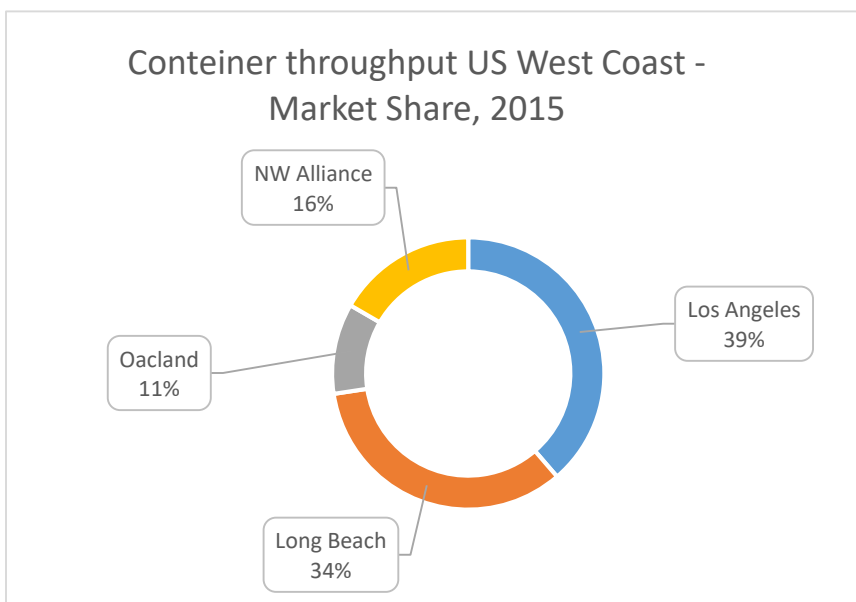


Figure 8. West coast of USA ports' market shares, based on TEU throughput

The strategy that the port of Los Angeles pursues has outlined two important goals. The first one concerns the decrease of the CO2 emissions which can be done by utilization of electric equipment and lower congestion levels. The second goal relates to the increased competition on the west coast and the need for significant infrastructure improvements both at the port and in the direction of the hinterland. Apart from these targets the port is currently increasing supply chain efficiencies, by continuously exploring new technologies and creative ideas that support business competitiveness, environmental sustainability, security, and efficiency.

The practices that Port of Los Angeles fitted in the framework of Kim & Chiang (2014) are systemized in figure 9.

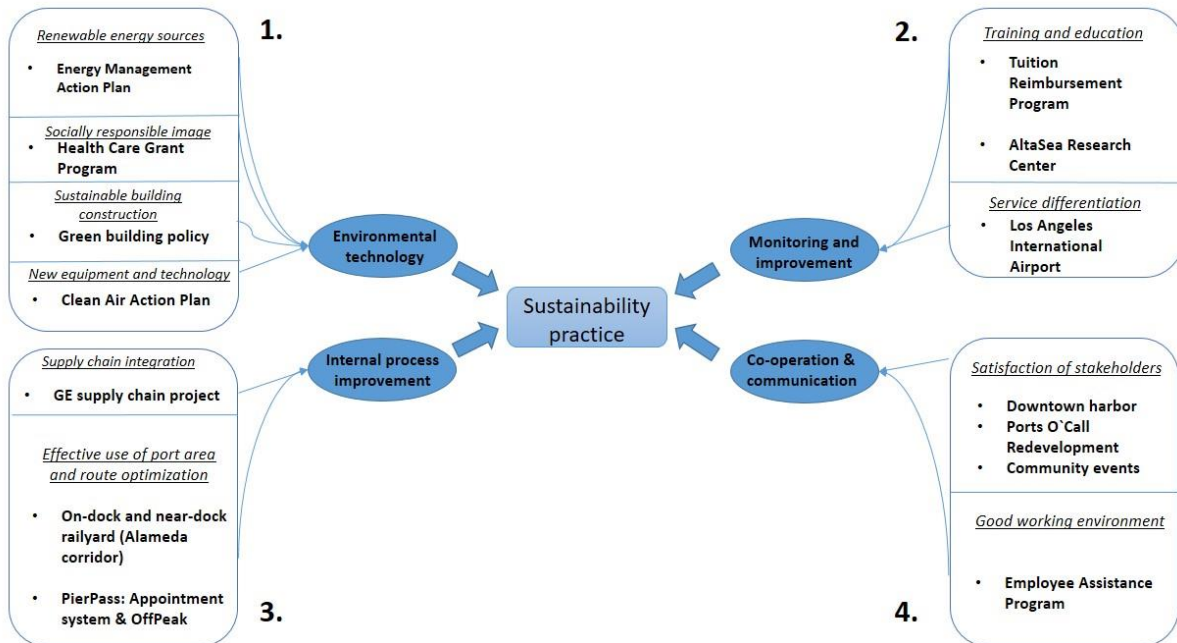


Figure 9. Port of Los Angeles sustainability practices

## 1. Environmental Technology

### Energy Management Action Plan

In 2013, the Port Authority announced the Energy Management Action Plan which aims to improve the energy efficiency of all port located companies via different incentive programs. This plan targets alternative energy sources development at the port which will lead to more sustainable and independent operations. One of the possible way to achieve it is the installment of solar panels. The PA together with the Los Angeles municipality offer financial support for the private sector to install such panels and it can be observed that already multiple companies invested in solar systems. Another option

for environmentally-friendly operations is to use the so-called fuel cell system which uses natural gas and generates electricity with nearly 0 pollutants.

### **Health Care Grant Program**

The PA pays a lot of attention to the residents near the port. Via this Health care program the PoLA organizes on an annual basis 'open' respiratory clinics located at several places in the close to the port areas of Los Angeles. These temporary on-street clinics give free asthma education classes, exercise programs and provided the opportunity for the residents to measure different body factors. As the PA recognizes its negative impact on the local air it not only works to improve the current condition but also invests in preventive measures and education about respiratory problems.

### **Green Building Policy**

This policy, using multiple criteria set by authorized organizations, measures to what extent a given facility is sustainable. Given that the port of LA pursues green operations it well incorporates in its strategy the requirements of sustainable building construction. In 2012, the Port received its first certification under the LEED™ rating system for the Port Police building. Since then numerous other building at the port have received such certificate which indicates the sustainable orientation of the port development.

### **The Clean Air Action Plan (CAAP)**

The PoLA and PoLB cooperated and set this plan which aims to reduce the air and noise pollution related to port activities. The plan identifies air quality goals and the respective actions to achieve them. The main goal that the action plan pursues is the reduction of emissions from ships, trucks, locomotives and cargo-handling equipment. The strategy was implemented in 2005 with favorable results of CO<sub>2</sub> and PM reduction exceeding 80%.

#### **Ships**

Different financial incentives are offered from the PA for 'modern-engine' vessels calling the port, which emit 80% less CO<sub>2</sub> compared to the regular engines. Furthermore vessels that are equipped with electrical engines must plug into the electrical grid of the port once they arrive. This eliminates almost all emissions and still allows the vessel to perform its activities and support efficient cargo loading and discharging.

#### **Trucks**

The Action plan has set a requirement which all trucks must obey. A year of production and type and volume of emission criteria are used in order to differentiate which trucks are eligible to access the port area. These measures led to a 'modernization' of the truck fleet that serves the port at a daily basis and led to substantial emission reductions in



CO2, NOx, Sox an PMs.

### **Trains**

As rail locomotives are one of the major pollution source the port of LA had tailored a project for the company managing rail transportation of cargo from the port called 'Anacostia'. Because investments in this industry are large and most of the times impossible for the private sector the PA entered into a public-private partnership making the long-term investment in ultra-low emission locomotives feasible option. With this upgrade to its fleet, Anacostia not only decreased its negative environmental impact but also managed to realize operational improvements.

## **2. Monitoring and Improvement**

### **Tuition Reimbursement Program**

The Tuition Reimbursement Program supports ongoing training and education for port employees in order to increase their job proficiency, prepare them for promotional opportunities and improve the overall level of service quality provided to the port's clients. Moreover with such project the PA is able to improve its relations with the port workforce, better understand their viewpoint and develop its strategy using the insight the labor provides.

### **AltaSea Research Center**

One of the old port areas on the waterfront in San Pedro has been turned into a marine research and innovation center. The Altasea project is home of different labs, offices, classrooms and lecture halls aimed at providing education and information for tourists and students from the region. In cooperation with 11 major universities in California and several private companies the PA strives to develop the AltaSea into a hub of research & development in the marine industry with international significance. The research center is expected to contribute to the regional employment, economic growth and last but not least to the favorable brand image of the port of LA.

### **Los Angeles International Airport**

The Los Angeles airport is the major international cargo airport of USA with its largest cargo share generated from the Asia-Pacific trade. Port of Los Angeles and the Airport of Los Angeles work together to enhance cargo movement and share information for both efficiency and security reasons. Serving as consolidation/deconsolidation points PoLA cooperates with the airport offering specialized services for its customers.

### **3. Internal Process Improvement**

#### **Joint planning SC Integration**

Port of Los Angeles and General Electric Transportation have implemented their pilot program aiming to digitize maritime data. The program is designed to offer a timely access to supply chain information in order to better coordinate importers, truckers, shipping lines and terminal operators. This project allows the stakeholders to experience benefits that lead to optimizing of the whole supply chains they are part of. Knowledge used in advance allows better planning and more efficient assets utilization. Stronger positions of the private sector contribute to the better performance of the whole port.

#### **Rail & Intermodal Yards**

As the scale of the ships calling at the port has been increasing throughout the years sensible congestions and unwanted bottlenecks started disrupting the smooth port operations. The PA in cooperation with several private parties worked in a direction to alleviate this pressure on the infrastructure. Several of the measures are discussed in the following paragraphs.

#### **On-Dock Intermodal Service**

Several terminal operators located at the port of LA make use of dedicated on-dock rail yards. The railway infrastructure that the TOs use helps them work with less disruptions due to road congestions. They can plan in advance the arrival and departure of the train compositions, allocate their equipment and labor more efficiently and at the same time reduce the pollution of their operations. Eight kilometers away from the port area is located the “Near-dock” rail yard. Its most important purpose is to bundle cargo for different destinations in the country coming from the different TOs via the on dock railways and to send it to the transcontinental rail network via the Alameda corridor, reaching all states in the country.

#### **PierPass**

This non-for-profit company tackles port-related issues such as road congestion, poor air quality and security.

The terminals at the port of LA introduced an appointment system for the trucks because the random-access system used so far proved to be inefficient leading to many delays, underutilization of scarce resources and at the worst case accidents. With the PierPass

a better coordination between the TOs and the trucking companies will lead to a win-win strategy in which both parties will organize their work in an efficient manner.

Furthermore a program to reduce severe road congestion on and around the port of LA was established. The incentive-based system encourages trucking companies to pick up or deliver containers during the off-peak hours and charges higher fees the ones that visit the port during the two peak windows in the day. This project turned out to be very successful as it decreased the trucks arriving at peak hours with 50% only for two years after its implementation.

#### **4. Cooperation and communication**

##### **Downtown Harbor**

The waterfront where the old port was located is now turned into livable recreational park with many picnic spots, walking alleys and beautiful gardens all this decorated in a maritime style. There are palm trees illuminated and numerous information boards combine the recreational purposes with education. The area also shows the history and the maritime roots of the city hosting maritime museums with valuable artefacts from 19<sup>th</sup> and 20<sup>th</sup> centuries. With this project the port authority shows its care for the local residents and aims to create a strong relationship with its community.

##### **Ports O'Call Redevelopment**

Ports O'Call Village is a waterfront property located nearby the downtown Los Angeles. In 2013, the Port started revitalization procedure of the area with the purpose to construct restaurants, retail space and a boutique hotel with conference center. The redevelopment plans also include open space that would be used for both business events related to the maritime industry as well as concert area where the local residents can celebrate different holidays.

##### **Community Events**

Port of Los Angeles is hosting a wide range of free of charge events such as car shows, music festivals and live performances. One of the most interesting ones have been the show of the famous acrobatic troupe Cirque du Soleil and the annually held 'Tall Ships Parade' which attracts people from all over the world with its unique ship tours, real sword fights and sail training demonstrations.

##### **Employee Assistance program**

One of the purposes of this program is to promote healthy lifestyle among the port employees. It stimulates the employees and educates them how to live a balanced life and exercise more by providing free health screenings and guest lectures given by

professionals in the field. The other aspect of the program is oriented towards the provision of appropriate help either with legal, mental or health care to its employees. This way the port companies show respect to their staff and create a stimulating work environment.

## **5. Analysis discussion**

From the Analysis section several main sustainability aspects on which each port focuses and tries to develop can be identified. Although the implementation of trends like technological development and computerization in port-related activities is common topic for both ports' strategies they also differ in some aspects. The boundaries of geographical location, the supply chains, the economic environment and the legislation within which the ports operate very much influence the direction of development and strategy they pursue.

The port of Los Angeles is more focused on the monitoring of environmental performance indexes as well as the infrastructure and superstructure improvements. This is evident by the multiple projects they have undertaken in the recent years in order to relief the port congestion and mitigate the negative externalities the port creates mostly concerned with CO<sub>2</sub>. In their latest strategy report the PoLA Authority emphasizes that the Clean Air Action Plan, aimed at improvement of the port area environment has been a successful practice that will be continued in the future. Furthermore they strive to become more environmentally-friendly by working closely with their stakeholders and introducing new incentive-based programs for green operations. Except the focus on the environmental part of sustainability, the port also recognizes its threats in this turbulent business environment. Although the port of LA is the largest in terms of throughput, a severe competition emerges on the west coast of North America which may question the port's market share in the near future. From this point of view the Los Angeles Port Authority has become part of different public-private initiatives aimed at infrastructure improvements and construction where needed. Via these investments the port aims to improve its competitive positions namely through the provision of more appropriate and punctual services as their clients expect. Among the most important tasks for the PA are dredging, stricter safety measures, optimization of the customs activities and attracting future clients (container shipping lines, terminal operators and warehousing companies). The port mainly focuses on the environmental part of sustainability as well as its internal processes improvements. The future development of the port, as the PA states, relies on the growth of containerized cargo and the followed demand for storage and distribution, improving the economic as well as the social aspect of the triple bottom line. As stated in the literature review such 'green'

practices as the Clean Air Action Plan may very well coincide with the needs of the port stakeholders for transition towards environmentally-friendly supply chains. From this point of view the port of LA can satisfy its clients as well as its citizens achieving a desirable outcome for both parties. On the other hand, the port stays passive to a certain extent with its expectations to grow heavily dependent on the containerized cargo throughput. The ports have three functions as explained by De Langen (2007). Except the transportation and logistics hub the ports are or can be industrial complexes. If a PA, the author elaborates, manage to attract such industries at the port area it will create synergies beneficial for many different parties and will improve the performance of the port itself. The lack of port-related industry clusters at the port area is evident as a report of the PA of LA shows that the American ports, the port of LA as the largest specifically, fall behind other international seaports in establishing a well-functioning port-related industries at the port area. Possible changes in the containerized cargo trade make the port vulnerable and questions the contributions to the society and the economy that the port will be able to make.

The assessment of the practices of Port of Rotterdam show that it, as well as the PoLA utilizes quite successfully the development of the technologies in the port-related business. The introduction of electric and more efficient equipment in terminals is left at the hands of the private sector while the PA is trying to connect with crucial partners and create strategic ties. For the PoR it is of extreme importance to provide a SC coordination and to implement data-sharing platforms in order to ensure a smooth communication between both local and international stakeholders. Although the port enjoys strong petrochemical and value-added clusters it identifies that the future of these industries is questionable. Taking into account all legislative as well as social trends towards energy independence and 'greening' the PA does not fully rely only on these clusters for its future growth. It proves to be active in the process of attracting new companies, most of them focused on innovation, bio-based production and storage, alternative energy sources and 3D printing. Offering location of such highly-innovative companies the port tries to ensure its sustainable development in the future as not only improving its environmental impact but also focusing and investing more in growing industries that are expected to bring economic benefits in the future. This way it creates the so-called 'advantage of the incumbent' as being the first to start clustering such companies will most probably result in beneficial non-replicable competitive advantage. With its focus on the port development from more strategic rather than technical point of view the port aims to innovate and provide flexible services to all its stakeholders. As Van den Bosh, et al (2011) explain, the innovation-driven economies have the higher competitive index. By attracting such companies the PA of Rotterdam may improve its strategic position in this business, bring growth in the Dutch GDP and last but not least enhance the knowledge and education of its citizens. According to the literature the ports must be adaptive, flexible and better prepared to respond to the rapid changes in global trends. The focus on improvements today must

be well-balanced with innovation and possible transition towards new services and operations within a relevant time horizon if the ports want to become more competitive and sustainable.

## **6. Critical assessment of the analysis section**

Seaport sustainability may be presented as very attractive and valuable framework for development but it must be noticed that it also has negative sides. Ports put emphasis on and promote their strong and better-than-average performance areas in order to attract clients, advertise their services and impress the stockholders. Usually they do not point out the weak and even negative sides brought about by their operations which is why a closer look is required when assessing such policies.

Transition to electrically-powered equipment may be environmentally-friendly but is the production of electricity itself a clean process? Is the money of the stockholders invested in the most efficient way, financing crucial projects which would have permanent positive effect on the economy and the port itself or the main factor considered is the return on investment? Is the attention that ports pay to the society enough and to what extent educational port-trips can be compared to cleaner air and noise reduction?

The purpose of this paper is not to extensively discuss all sides of the sustainability practices such as how ports may use them as a marketing tool or as an instrument in order to achieve specific goals. It is of significant importance to discuss them and to provide reasons for further research.

Ports which use alternative energy sources and innovative equipment try to establish their positions in the future of this business and to strengthen their market shares. As discussed sustainable practices are being implemented by developed nations as well as the financially strong companies. If only the large horizontally-integrated TOs with worldwide presence can allow sustainable operations the smaller TOs are prevented from entering the business to a large extent. This will deteriorate the competitive positions of the whole port. Higher service prices would drive clients away and eventually this can negatively affect the whole economy.

Transition to new energy sources may require significant investments in infrastructure and facilities which may not be accepted by the society or the companies located at the port. If for example given port-located company heavily uses fossil fuels or is part of an industrial ecosystem related to fossil fuels a possible energy transition standards may hamper its operations and eventually it may relocate from the port area.

The innovation projects that are discussed may not be executed because the ports are rigorous to contribute to the society and its knowledge and education but rather they can use it as an instrument. Such innovation projects may bring favorable publicity and positive social opinion for the port. With such solicitous image the port authorities may achieve their goals easier when negotiating with different stakeholders.

The optimization of vehicle routing or the modal split require shifting work from one type of transportation to another. This may to a large extent disrupt the competitiveness in this sector and lead to negative consequences as growth in transportation prices or inability of the terminals to efficiently handle cargo.

Integration between different parties usually means more efficient and smooth operations but on the other hand this requires better planning and coordination with all relevant companies. Sharing information may not be desired by all companies as some of them are competitors and confidentiality is crucial. The support of such IT systems is very expensive, they are susceptible to hacking attacks and leakage of large amounts of information is likely as the data are being stored at one centralized place. This means that cooperation is valuable but a significant obstacles which must be overcome are also present.

The problem with transparency and exchange of information is present not only because of the competitors unwilling to share information but also because of linguistic, cultural and ethical issues which hamper the free flow of information among all SC parties.

These ports are given the ability to satisfy specific stakeholder groups on which the achievement of a given port goal depends. For example a port is interested to present itself as a sustainable one which contributes to the wellbeing and livability of the nearby areas and communities. Organizing attractive events and port-trips for citizens is a sound way to show their respect, attention and care for the local community. When new infrastructure projects have to be discussed with local communities the ports will be in a position more likely to receive affirmative answer, having done something favorable for the local residents.

Sustainability is determined by government-set rules, standards and criteria and measures taken and evaluated by the port itself. This means that the governments can only influence the standards and the evaluations they set. Their actions should ensure that the intrinsic motivation of a port to improve the triple bottom line is the main if not the only reason to implement sustainability development framework. Changing the sustainability policies is required in order to ensure that ports do not use some of the practices discussed as instruments trying to achieve their goals. Further research on this topic would provide more critical viewpoint which would be favorable for both

stakeholders and governments.

## 7. Conclusion

Both ports have set sustainable development to be their leading framework for port operations. They have recognized the balance that should be achieved between economic growth, social wellbeing and environmental impact and have undertaken numerous practices to achieve it.

The Port of Rotterdam puts a lot of emphasis on energy transition from fossil towards bio-based fuels. Its automated terminals are a cornerstone in the process of sustainability development. In the near future the need for bio-based products may develop to a point being more efficient substitute of fossil fuels. Given this happen the port may enjoy significant competitive advantage bringing benefits for all its stakeholders. The other crucial energy source that they provide is LNG. If this technology becomes widely-used and the port acts on time attracting substantial amount of customers then it will not only ensure sufficient amount of revenue but it will contribute to less air pollution, less noise and better living environment. The geographical location of the port allows it to use all types of multimodal transport which is beneficial for multiple parties along the supply chain. The goals of modal split though have not been met which creates the necessity the port authority to apply different approach towards this issue. The digitization of information via different online platforms that the port has developed is crucial for the smooth working process and information exchange between the supply chain parties. This way a safe and time-efficient operations are achieved. The significant emphasis of the port towards innovation and R&D shows the engagement of the port with not only the present but with the future too, ensuring enough specialist and innovators that will keep the competitive edge of the port.

The Port of Los Angeles has the main strategy become green decreasing the emissions of CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub> and PM and it has implemented policies in order to monitor and reduce them. The truck appointment system shows how significant reduction in the air pollution can be achieved with moderate investment. The port has implemented supply chain integration projects and although being at developing stage they promise to significantly contribute to the efficiency and information exchange between the SC parties. Being able to utilize the rail services at place the terminal operators become more efficient and serve customers from the whole continent in a time and cost-efficient manner. The close work of the port with local universities and high schools establishes relations which will benefit the port in the future easily attracting well-educated and motivated personnel. The port puts significant attention to its stakeholders and mostly the social groups living nearby the port. Numerous leisure and recreation areas have been created in order to improve the wellbeing of the society.



The ports have understood the importance of port sustainability and have implemented strategies to enhance it. Not only the push from different stakeholders but also internal desire to be sustainable turns out to shape the pattern in which modern ports develop. As can be observed most of the largest ports in the world have in one way or another implemented sustainability strategies. This predicts that in the future such emphasis on society, economy and environment will be seen more often. As facilitators of global trade ports try to operate in a way that ensures reduction in costs and positive impact on the whole supply chain.

In this paper I examined Port of Rotterdam and Port of Los Angeles. Not every single strategy was included but I tried to present the most significant ones. One of the limitations of the study is the fact that significant amount of the information used has been retrieved from the official ports' websites. This prevents the ability to observe the aspects in which the ports do not perform well or do not put emphasis at all as they emphasize only the aspects in which they perform considerable well. Another limitation of the study is the objectivity of the analysis since I have decided exactly which practices to include and which not. In order to improve this aspect of the research more sources of information may be utilized and thoroughly examined.

Sustainability is gaining importance in the recent years and literature on this topic can be very useful as a guideline for ports that are now in the process of developing their strategies in the field. In order to measure the sustainability performance in a numerical way questionnaires/ interviews with the staff from both ports can be conducted. Based on criteria available in the papers more thorough and exact performance can be presented which will reveal which practices are more efficient. Another research may investigate several supply chains in which ports operate and see to what extent sustainability practices are present in the different parties along these supply chains. Using panel data it can be concluded to what extent the ports' sustainability attention throughout time translates to its partners and clients.

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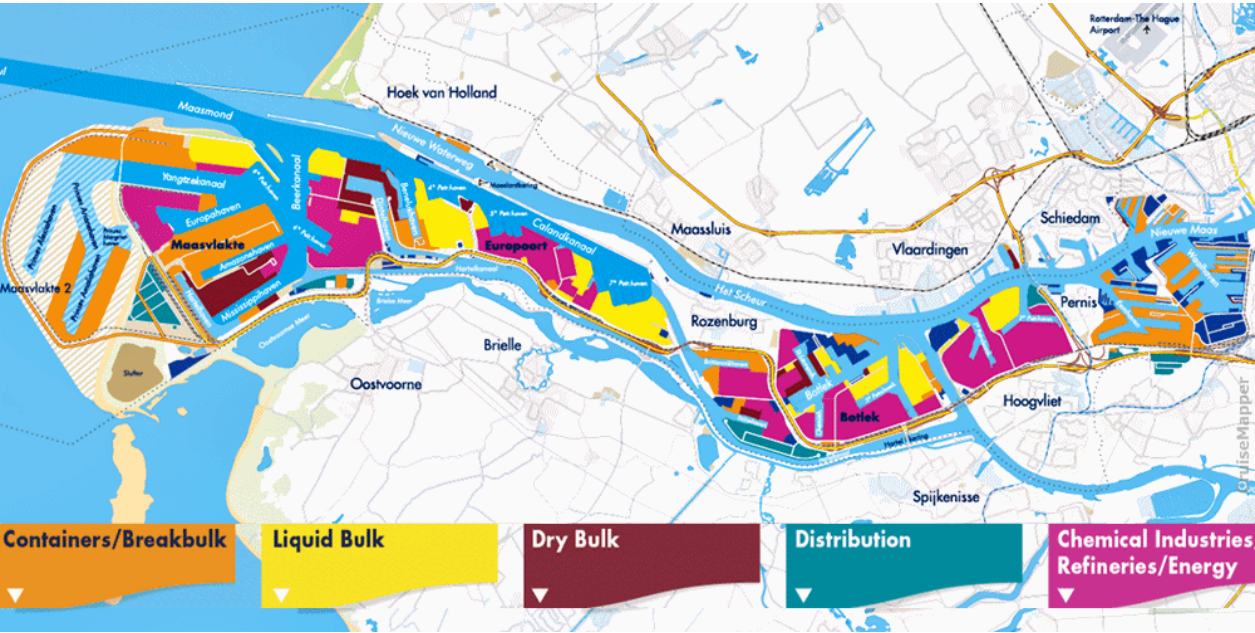
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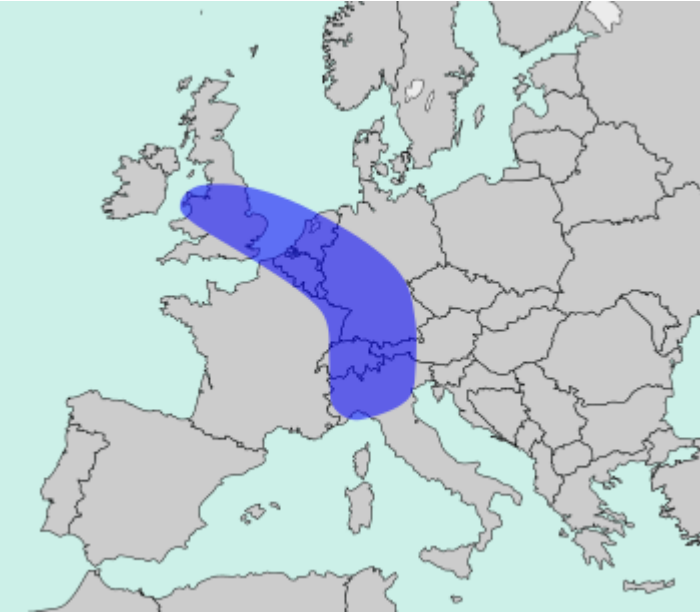
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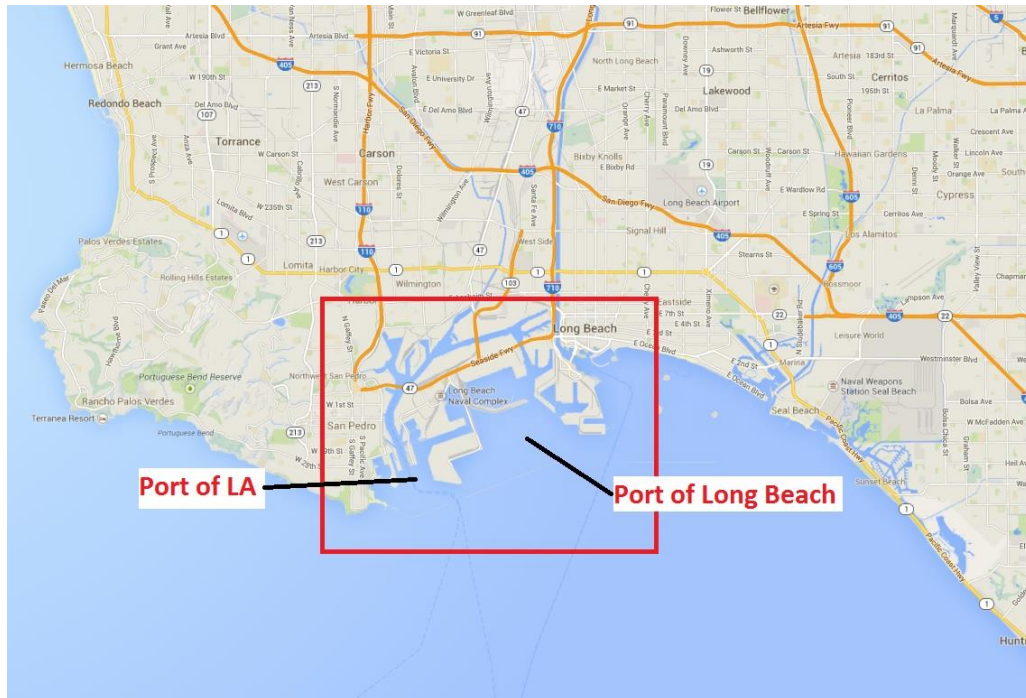
Appendix:



The Port of Rotterdam Map  
(Source: [www.portofrotterdam.com](http://www.portofrotterdam.com))



The Blue Banana of economic activity in Europe  
(Source: [www.wikipedia.org/wiki/Blue\\_Banana](http://www.wikipedia.org/wiki/Blue_Banana))



Port of Los Angeles Map  
(Source: [www.portoflosangeles.org](http://www.portoflosangeles.org))