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Integrated maritime policy in the Port of Rotterdam

by

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Acknowledgements

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Abstract

Every year, we observe extreme weather phenomena and changes in our climate. The wasteful use of energy and resources and the increasing transportation of products around the world affect the environment and in order to minimize the harm, further action must be taken. The European Commission, working towards the protection of the environment, has published several strategies examining the factors responsible for this situation and providing several solutions. In the thesis, these strategies are analyzed. The strategies concern mainly the air pollution and the protection of the environment but examine also the sustainable use of the marine environment, the protection of the fauna and flora and the importance of safety in the European seas. One of these papers, which pays special attention to the marine environment, is the Integrated Maritime Policy or else called, the Blue Paper. The paper recognizes the importance of using the seas and the oceans in a sustainable manner and promotes the cooperation between the European Countries. In the dissertation, the effects of the Integrated Maritime Policy to the Port of Rotterdam are examined.

In the thesis, a brief history, important figures of the Port of Rotterdam and information on the Maasvlakte 2 project are provided at first. Additionally, the efforts of the Port Authority to create a port that is not only successful but also accessible and sustainable are analyzed. The current situation in the European Union and the Netherlands, as far as the air pollution is concerned, is examined and measures and actions taken by the European Countries in order to achieve a decrease in the emissions of greenhouse gases are also provided. Moreover, measures taken by the City of Rotterdam and the Port Authority to decrease the air pollution are examined.

In the last part of the thesis, the effects of the Integrated Maritime Policy to the Port of Rotterdam are analyzed. These effects are mainly projects, in a testing phase or projects already used in other ports, which can lead to a decrease of the greenhouse gases' emissions and can be useful tools to the Port Authority to handle effectively the increasing amount of cargo paying also attention to the environment. The conclusion of the thesis is that the Policy has overall a positive effect to the Port of Rotterdam. On the other hand, there are still difficulties which must be considered and problems to be resolved.

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Chapter 1: Introduction

1.1 Introduction

Over the past years, we have witnessed many changes in the world and probably, the most important one is the climate change. Due to the greenhouse effect an increase in the temperature occurs, leading to the melting of the ice and causing a rise of the sea level. Europe, with a coastline of 70,000 km that goes along four seas (the Mediterranean, the Baltic, the North and the Black Sea) and two oceans (the Arctic and the Atlantic), is highly linked with the sea and is affected by this climate change. Its financial situation is depended on the sea as tourism, shipping, shipbuilding, fisheries and ports bring high revenues, making Europe an important player in the world economy. In order to become more competitive, the European Countries should not only take advantage of the sea and its benefits but also protect it. The changes in the climate and the deterioration of the maritime space brought forward the importance of the environmental protection and the necessity of a sustainable marine environment.

Shipping is an important sector for the European economy. The European countries are benefited by the rapid increase of international trade through the ports and shipping in general. On the other hand, this increase in trade has caused an increase in the use of transportation modes leading to the ruin of the environment. Although the shipping sector is accused to harm the environment by causing air pollution and CO_2 emissions, shipping is more energy efficient than other modes of transport, like truck. The European Commission in an attempt to lower the congestion in the European roads and achieve a modal shift towards other transportation modes introduced an Integrated Maritime Policy (Blue Paper) to promote the idea of secure and safe shipping.

In 2007, the European Commission adopted the Blue Paper concerning the countries of the European Union. In this paper, the importance of the sea and its protection is underlined. The sea does not only regulate our climate but provides the citizens with food, resources and energy. With the development of technology, people had the ability to extract value from the sea but did not consider the consequences of their actions. The Commission realized the urgency of the matter and through this Blue Paper provided the necessary framework to protect our environment and more specifically our maritime space.

The European Commission, through the Integrated Maritime Policy, will pursue several actions and projects. The goal of the Commission is to reduce the CO_2 emissions and the pollution caused by shipping, to create a network of clusters and also a roadmap that will help achieve a spatial planning by all member states. Moreover, the Commission wants to create a barrierless transport space for the European countries, eliminate actions such as pirate fishing and promote the cooperation between the coastguards of the member states in order to achieve a maritime surveillance network. This network is necessary for Europe so that the challenges concerning navigation safety, law enforcement, marine pollution and security in general, are met.

The Maritime Spatial Planning is a key element of the Integrated Maritime Policy. Through this Planning, common principles for the European countries concerning the sustainability of the environment will be achieved. Moreover, the cooperation between stakeholders and the public authorities will be increased, and they will work together in order to coordinate their actions and optimize the use of the maritime space. In that way, both the marine environment and the economic development will be benefited. The Maritime Spatial Planning will improve the decision making process and its goal is to achieve a sustainable use of the marine resources and create a balance between the different sectoral interests.

In our everyday life, we can all observe the deterioration of the environment. Climate changes, extreme weather events, the rise in the temperature and the sea levels are just a few examples. It is important to take action now and start protecting the environment. The European Union's policies will provide the necessary framework and will promote the cooperation between countries. By that, the idea of a sustainable maritime environment is clearer than ever before and can be applied in practice.

1.2 Aim of the work and relevance of the topic

The aim of the thesis is to examine and analyze the effects of the Blue Paper, published by the European Commission, to the Port of Rotterdam and whether it will actually help the Port to become more sustainable.

The most important element of the Blue Paper is that it manages the impact of human activities on the marine environment and promotes the efficient use of the maritime space. Research and technology can be applied in order not only to achieve economic growth but also the sustainable use and the protection of the marine environment. Thus, the Blue Paper can increase the sustainable use of the seas and the oceans. Furthermore, it promotes the idea of a common European market. In that way, problems that occurred in the transportation of the goods from one European port to another, due to bureaucracy, documentation and several time-consuming procedures will occur less frequently. The Maritime Spatial Planning, which is a key instrument of the Blue Paper, helps public authorities and stakeholders to coordinate their actions and work towards common goals and principles. By achieving common principles in the European Union, the decision making process is simplified. The permit and licensing procedures will speed up and port authorities will benefit. The European Commission is trying also to increase the cooperation between the coastguards of the European Countries, so that the seas are secured more efficiently and the cases of terrorism, smuggling and trafficking are reduced.

The Netherlands is a country with great history in the shipping sector and also a country which is directly linked to the sea. Moreover, as a great part of the country is located below the sea level, the protection of the environment is essential. Working towards that direction, the City of Rotterdam, in cooperation with the Port of Rotterdam, has established the Rotterdam Climate Initiative. The main goal of the initiative is the reduction of the air emissions and more specifically the reduction of the Carbon Dioxide emissions. The Port of Rotterdam has become over the years, the biggest seaport in Europe dealing with a great flow of products every day. On the other hand, it is also responsible for the greatest amount of these emissions due

to the exhaust fumes by the vessels. Currently, the port is expanding and the new port area of the Maasvlakte 2 is being built in order to deal with the increased volume of products. The Port Authority is facing the challenge of having not only an efficient and productive port but also a sustainable and an accessible one. Thus, based on the decisions of the Rotterdam Climate Initiative and on the new regulations applied by the European Union, the Port Authority is looking for ways to comply with the Blue Paper and achieve the sustainable use of the environment.

The sustainable development of the Port of Rotterdam is of great economic and social importance not only to the Netherlands but also to the European Union. The Port works as a link in the trade between Asia and Europe and employs many people. Therefore, the decisions of the European Commission affect directly the Port of Rotterdam.

Based on the afore-mentioned arguments, the topic of this thesis is of great relevance to the shipping sector. The port authorities, realizing the impact that shipping has to the environment, are trying with their decisions and actions to protect it. The environmental groups are also playing an important role in this process. With the cooperation of companies and port authorities, a sustainable environment is no more an unreachable dream but it is actually possible to happen.

1.3 Research methodologies and data sources

The research methodology which was used in this dissertation is the open literature and desk research methodology. Based on this methodology, the necessary framework was set, the thesis structure was constructed and the problem, the research question, hypothesis and the objectives of the thesis were defined. In general, this methodology was important to have a clear view of how the dissertation will proceed.

The data sources which were used in this thesis are the following:

1. Internal and external reports
2. Articles and attendance in conferences
3. Secondary data

The majority of the data was obtained by reports and documents. First of all, it was important to study the European Commission's reports concerning the Integrated Maritime Policy, the Maritime Spatial Planning, the protection of the environment and the sustainability of ports. Secondly, it was necessary to study the internal reports of the Port of Rotterdam and the reports about the different projects that are carried out and aim in increasing the sustainability of the port.

The attendance in the Ports and the Environment conference and the TOC Europe was quite helpful as the author had the opportunity to hear about the latest news in the industry with regard to sustainability and to the protection of the environment and also talk with people who have long work experience. Additionally, magazines such as the Green Port magazine have articles about the changes and the decisions in the shipping sector concerning the environment.

Lastly, secondary data were obtained in order to reach the conclusions concerning the topic of this dissertation. These data were mainly obtained by Eurostat which has a database available to the public, with data for Europe and also for the Netherlands. Some data were also obtained from the Organisation for Economic Co-operation and Development (OECD). Moreover, national databases like the ones of the Ministry of Housing, Spatial Planning and the Environment and the Ministry of Transport, Public Works and Water Management were helpful in the data selection process. Lastly, the author obtained data from the Rotterdam Climate Initiative concerning the emissions of greenhouse gases in the Rijnmond area and the decisions and projects of the City of Rotterdam.

1.4 Research questions

The research questions that were asked in this dissertation were the following:

- Does the European Commission's Blue Paper affect the Port of Rotterdam?
- Does the Blue Paper affect the Port of Rotterdam in a positive or in a negative way?

Based on the acquired data, the author expects to reach the conclusion that the Blue Paper affects the Port of Rotterdam. Moreover, even though there are positive and negative aspects of this paper, overall the effect to the Port of Rotterdam is a positive one. This is expected as the Paper promotes the idea of the sustainable use and the protection of the maritime environment. Additionally, the Port of Rotterdam can cooperate with other European Ports, based on the framework provided by the Paper, towards common goals. In that way, actions can be taken in a faster way as through this cooperation, the Port of Rotterdam can save time in the decision making process and increase not only its efficiency but also its sustainability.

1.5 Thesis structure

The structure of the thesis is represented in Figure 1.1.

Chapter 1: Introduction

In this chapter the aim of the work and the relevance of the topic are analyzed. Additionally, the research methodology, question and hypothesis of the thesis are considered.

Chapter 2: The European Commission's strategies

In the second chapter, the strategies published by the European Commission are analyzed. These strategies are the ones concerning the shipping sector and the protection of the marine environment. The strategies analyzed here are the Sustainable Development Strategy, the White, Green and Blue Papers and the Maritime Spatial Planning.

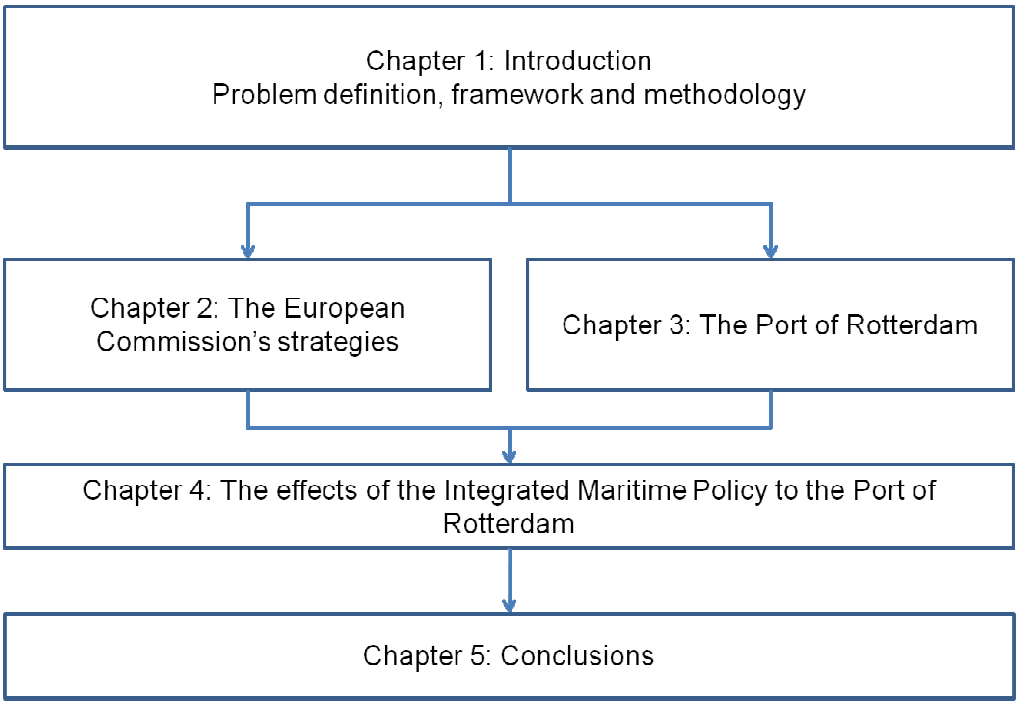

Figure 1.1: Thesis structure *Source: Elaborated by the author*

Chapter 3: The Port of Rotterdam

In the third chapter, the history of the Port of Rotterdam and the changes that have occurred over the years are analyzed. Moreover, the actions that were taken by the Port Authority to achieve a sustainable and accessible port are explained. The construction of the Maasvlakte 2 area is analyzed as this project is considered the most sustainable one nowadays. This project is analyzed extensively in the thesis because it affects the maritime environment of the area and the construction of such a mega-project is a remarkable event not only for the Netherlands but also for Europe and the world.

Chapter 4: The effects of the Integrated Maritime Policy to the Port of Rotterdam

In this chapter, an analysis of the air pollution caused by the shipping sector occurs. Moreover, the air emissions of the different transportation modes of the European Union and the Netherlands are examined. In regard to the air pollution, the actions taken by the City and the Port of Rotterdam to protect the environment are also analyzed. Lastly, the effects of the Integrated Maritime Policy to the Port of Rotterdam are examined, current projects which aim in reducing the emissions of greenhouse gases are analyzed and further actions are discussed.

Chapter 5: Conclusions

In the final chapter, a summary of the thesis' findings is provided.

In Figure 1.2 the relationship between the objectives and the structure of the thesis can be observed.

Relationship between Thesis Objectives and Report Structure					
Thesis objectives	**Ch. 1**	**Ch. 2**	**Ch. 3**	**Ch. 4**	**Ch. 5**
To analyze the actions of the Port of Rotterdam which will increase the sustainability and the accessibility of the port.	o		●		
To examine how the Maasvlakte 2 project can increase the sustainability of the port area.			●		
To examine how the strategies published by the European Commission can lead to the protection of the marine environment		●		o	o
To analyze the Integrated Maritime Policy and examine the goals of the European Commission as far as the sustainable use of the seas is concerned.		●		●	o
To analyze the greenhouse gases' emissions of the EU and the Netherlands				●	
To examine the positive effects of the Integrated Maritime Policy to the Port of Rotterdam	o			●	o
To examine the negative effects of the Integrated Maritime Policy to the Port of Rotterdam	o			●	o

●= strong relationship; ○= weaker relationship

Figure 1.2: Relationship between thesis objectives and report structure

Source: Elaborated by the author

1.6 Difficulties and possible improvements

The amount of time which was available in order to complete the research for this dissertation was limited and for that reason, part of the thesis is based in data and publications which already exist. Additionally, the data which were used in the thesis were mainly until 2007 and therefore, for the years 2008, 2009 and for the next decade, the data which were obtained were based on forecasting models. The author has done all possible, with the use of web resources and of periodical articles, to update the data and the material used in the dissertation.

Another difficulty that occurred during the process was the language barrier. The Dutch government has published studies concerning the deterioration of the environment and the actions taken by the regional authorities to protect it. Unfortunately, most of these studies are written in Dutch and the author was not able to use them.

As far as the effects of the Integrated Maritime Policy are concerned, the main objective of the thesis, limited studies exist. This mainly occurs due to the fact that this policy was published in 2007. These studies were made by the European Commission in order to examine, in a theoretical level, how this policy can affect the European Union in general. In regard to the environmental protection and the measures that the Port Authorities can take towards that direction, the only study that has been made and can be compared to what is examined in this thesis is a study by the Port of Göthenburg.

The trade between countries and the use of the environment and its resources are increased significantly. In order to protect the environment, use it in the most sustainable way and minimize the pollution caused by the shipping sector, further actions need to be taken. Both in regional and in national level, the countries must cooperate to resolve the existing problems and take drastic measures. Thus, the national governments, together with the Port Authorities, should use research to come up with technologies that can be applied in ports, so that the harm caused by actions, like loading and unloading cargo, to the environment is reduced effectively.

Chapter 2: The European Commission's Strategies

2.1 Introduction

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[1]

The European Commission has proposed over the years several strategies concerning the socially, ecologically and economically sustainable development of the European Countries. These strategies provide an important framework for the countries to increase their sustainability but in no means should the national organizations depend only on them. On the contrary, the national organizations must create policies based on the strategies but also adjust them to the needs and problems of each country.

In this chapter, the main strategies are analyzed in chronological order from the oldest to the most recent one. These strategies are the Sustainable Development Strategy, the White, Green and Blue Papers and the Maritime Spatial Planning.

2.2 The Sustainable Development Strategy

The first, important step towards a better world was the Sustainable Development Strategy in 2001. The major point of this strategy was that in the long run, social cohesion, environmental protection and economic growth should go hand in hand. In that way, not only economic growth will be achieved but also a healthier environment will be delivered to the next generations.

The strategy focuses on several problems that are posed as severe threats. These problems are the following[2]:

- Greenhouse emissions
- Food safety
- Threats to the public health due to chemicals
- Poverty
- Ageing of population
- The decrease of bio-diversity
- Transport congestion

Most of these unsustainable trends are known for a long time. The European Commission suggests in the strategy that in order to address these problems in an efficient way, urgent action, new approaches to policymaking, political leadership, global responsibility and participation by all parties and at all levels are required. Additionally, the European Commission has divided the strategy in three parts. The

[1] World Commission on Environment and Development (the "Brundtland Commission", 1987, at: http://europa.eu/eur-lex/en/com/cnc/2001/com2001_0264en01.pdf)

[2] European Commission, The Sustainable Development Strategy

first part is a set of cross-cutting recommendations and proposals that aim in making the policy more effective and the sustainable development achievable. The second part is a set of specific measures and objectives which deal with the biggest threats and challenges in Europe. The final part consists of steps which will implement the Sustainable Development Strategy and also review its overall progress.

In order to achieve sustainable development, policy coherence must be improved. All policies and sectors should have as their central objective the sustainable development. The result of the policies must be judged by their level of contribution to the sustainable development but to achieve this, the policy makers must have better information so that they can deal with uncertainty and risk.

There are many ways to make sustainable development happen. First of all, markets can be reformed to get right prices and influence the behavior of businesses and individuals. Services and products will be developed, fulfilling the economic and social needs and easing the pressure off the environment. Secondly, investments in technology and science lead to innovation and new technologies. These new technologies can reduce pollution by using fewer natural resources. Thirdly, open policy processes are an important aspect of the sustainable development as they promote the cooperation between conflicting parties and also the involvement of the business and the citizens in the policy making process. The involvement of the citizens improves policy and decisions can be taken in a more transparent way. Lastly, the European Union should not only consider the current Member States but also the future ones. Moreover, as Europe is part of the world, the decisions of the Union on sustainability affect the rest of the world. Therefore, the Union should cooperate with other countries and with international institutions in an effective way.

With respect to the environmental protection, the Sustainable Development Strategy suggests that the European Union should reduce the greenhouse emissions in order to meet the Kyoto commitment and also increase the use of alternative fuels such as biofuels. Conclusively, concerning the land use management and the improvement of the transport system, the Union aims to shift from road to more environmental friendly transport modes like short sea shipping and rail.

2.3 The White Paper

The European Commission issued the White Paper in 2001 providing guidelines with regard to transport. Over the years, the demand for products and transport has increased dramatically leading to the importance of policies. These policies are necessary in order to respond to this increasing demand but also to create a transport system which is on the one hand modern and on the other hand economically, environmentally and socially sustainable.

The first White Paper was published in 1992. This was only the start as some of the objectives were fulfilled but due to the technological development, different objectives and needs came up. Therefore, the importance of new, revised papers was identifiable.

The White Paper of 2001 was published as a response to the problems of congestion, environmental damage and the unequal growth of the different

transportation modes. The increase of the transportation by road may show that this mode has adapted in a better way to the needs of a modern transport system but on the other hand leads to other problems like congestion. Congestion is a serious threat to Europe as can be the reason for a loss of its economic competitiveness. Based on the paper, the problems in the organization of the European transport system are partly attributed to the fact that users do not consider all the costs they generate like accidents, infrastructure, congestion and environmental destruction.

As more and more companies relocate in order to reduce their production and labor costs, delays due to congestion lead to financial losses. Thus, a developed transport system is important for the European economy. The White Paper suggests as a solution a more selective public funding, which will promote the construction of major projects which are fundamental for the improvement of the Union's territorial cohesion and for the removal of bottlenecks. Moreover, an efficient transport system is essential as it will allow taking advantage of the globalised trade and the internal market. Additionally, a shift in the balance between the transportation modes will not only decrease congestion and remove several bottlenecks but will also promote the environmental protection as road transport is responsible for the 84% of CO_2 emissions attributed to the transport sector. [3]

Transport is an important part of the White Paper. The European Commission's main goal is to revitalize the railways in order to shift the balance from road to rail. By revitalizing the railway sector, the Commission aims to increase the competition between the railway companies. The opening-up of the market will encourage the companies to restructure and also take account of safety, work conditions and social aspects.

Another key instrument of the Paper is that it promotes the transport of the goods by inland waterways and short sea shipping. These modes are currently underused but can be a solution to the problems of road congestion and of the railways' lack of infrastructure. The ports, through the inland waterways, can connect in an efficient way and increase their profits as they will save time and money by bypassing the bottlenecks and the problems occurring due to congestion.

In order to achieve efficient and clean transport, certain measures need to be taken. First of all, the use of the infrastructure should be charged based on the category of the infrastructure, the weight and size of the vehicles, the distance, the time of the day and all other factors that damage the environment, the infrastructure or affect in any manner the congestion. Second, technology can be used to achieve safer and cleaner transport as intelligent systems can be used to manage efficiently the infrastructure, locate the transferred cargo immediately and deal with any problems that may occur in the transportation process. Lastly, the Commission can regulate the transport within the European boarders but to create an efficient and sustainable system, the Commission should take under consideration the international regulations. Thus, the Commission should cooperate with international organizations, like the International Maritime Organization, so that Europe's interests are safeguarded at a global level.

The European Commission, with this White Paper, pays great attention to the environment. Its purpose is to create a balance between the several transportation modes in order to make a shift to more environmental friendly ones and also to

[3] European Commission White Paper, 2001

increase the safety in shipping so that the risk of accidents leading to pollution is minimized.

2.4 The Green Paper

Europe is surrounded by sea and is highly connected to it. Although many European citizens live close or beside the sea, they are not quite familiar with its importance and with its participation in their everyday life. Moreover, they cannot always see that the oceans play a key role in the modulation of the climate. The European Commission, in the Green Paper, focuses on the protection of the sea through Maritime Policies. The aim of the Commission is to have the European Countries treat the seas holistically and not only enjoy the benefits the oceans provide them, but also respect them and protect them.

Through the Green Paper, the Commission wants to increase the European citizens' awareness of the importance of the seas and the oceans in every step of our lives. The Commission aims to create the right balance with this Paper, between the environmental, economic and social aspects of the sustainable development. Moreover, as oceans are part of the world, it is necessary to have cooperation between the different nations for the protection of the seas but also each nation has to create each own, specific rules based on its problems and needs. Additionally, the coordination between the different levels of the government is necessary so that the policies and the action plans represent the decisions of the sectors involved.

The maritime sector is of significant importance to Europe. Shipping is not only used for the international trade, but through tourism and shipbuilding, brings high profits to the countries of the European Union and employs approximately 350000 people in ports and in related services.[4] Additionally, the ports and the maritime transport are key parts of the logistic and supply chains as they connect the European Union with the world market. For this reason, the European countries are constantly trying to find new ways to increase their competitiveness in order to maintain their position in the market.

In the Green Paper, the necessity for the protection of the environment and the seas is once again recognized. Thus, the European Commission suggests that technology and knowledge should be used in order not only to collect marine data but also to find alternative solutions that will help in the sustainable development of the environment, such as biofuels. Moreover, the Commission seeks to promote the idea of clusters that will increase the development and the well being of the maritime sector. This can be achieved due to the joint innovation and research and also due to the knowledge which will be shared between the participants.

Lastly, an important aspect of the Paper is the development on safety. As incidents like trafficking, terrorist activities and smuggling happen more and more frequently over the years, it is necessary to develop systems that will provide real time information on the vessels. By using tracking systems, the public authorities will be able to monitor economic, human and other activities, provide information to vessels in navigation and minimize the risk for illegal activities.

[4] European Commission, The Green Paper

2.5 The Integrated Maritime Policy – Blue Paper

In the Blue Paper, the European Commission recognizes the importance of the seas to life. The coasts and the maritime environment of Europe are key elements of prosperity and well being because they do not only provide the citizens with resources, food and energy but also regulate the climate and are ideal for the Europeans' vacations. Additionally, they are used as trade routes and increase the economic and competitive position of Europe to the world market. Technology can be used on one hand to extract more value from the oceans but on the other hand, to increase their sustainability. In order to protect the maritime environment and respond to the different challenges, the European Commission has announced the Blue Paper. This Integrated Maritime Policy is based on the recognition that the afore-mentioned matters are related and linked and that all parties participating in the decision making process should cooperate and coordinate their actions towards their common goal, the environmental protection.

The Blue Paper's aim is to change the policy and decision making process with the interaction of the different, involved parties and also to create a work program which will contain projects such as a barrierless marine transport space, a network of clusters and a network between the Member States for maritime surveillance. Maritime surveillance is highly important to Europe in order to ensure that the sea is used safely and also that the maritime boarders are secured. For this reason and to deal with cases of marine pollution, accidents, safe navigation and overall security, the Commission wants to promote the cooperation of the coastguards of all Member States and to create an integrated network of e-navigation and vessel tracking systems which will be helpful to the various public agencies.

This Integrated Maritime Policy focuses in five main areas. These areas are the following:[5]

- The maximization of the sustainable use of seas and oceans
- The use of innovation and knowledge in the maritime policy
- The achievement of a high quality life in the coastal regions
- The promotion of the European leadership in the International Maritime Affairs
- The raise of the visibility of a maritime Europe

Shipping is an important sector for Europe and its economy. In order to achieve a growth in the sector but also use the oceans in a sustainable manner, several steps need to be taken. Although the transport of goods by ships is a solution to the road congestion problem, problems like low public investments and time consuming, complex procedures that vessels face when travelling from one European port to another, are major issues that do not allow the shipping sector to develop in the most efficient and possible way. The European Commission envisages a barrierless marine transport space where ports cooperate to make the travelling between them easier.

Technology, knowledge and innovation are key elements for the maritime policy. As marine research is quite expensive, inefficiencies are not afforded. Thus, it is essential to achieve the cooperation of the policy makers, the scientists and the

[5] European Commission, The Blue Paper, an Integrated Maritime Policy

industry in order to avoid duplication and to achieve the prediction of the climate change's effects not only on the marine environment but also on the maritime activities.

Taking into account the opinions of the participating parties, such as the stakeholders, the parliaments and governments of the Member States and the European Commission, an environmentally sustainable future is feasible.

2.6 The Maritime Spatial Planning

The European Commission adopted on 2007 an Integrated Maritime Policy or the so-called Blue Paper, which contained an Action Plan. The Maritime Spatial Planning is an important element for the Integrated Maritime Policy because it promotes on the one hand the cooperation of stakeholders and public authorities and on the other, the coordination of their actions, in order to develop common principles among the European Union aiming to a better use of the marine environment.

The Maritime Spatial Planning improves the decision making process as it provides a framework towards the cooperation of competing sectors in order to manage the impact of their activities to the marine environment. The purpose of the Spatial Planning together with the Sustainable Development Strategy is the balance of the different sectors' interests and the achievement of the marine resources' sustainable use.

A planning framework, like the Spatial Planning, provides certainty and promotes the investment in the maritime sector. These investments will lead to the development of ports and will provide the financial incentives for research and innovation. Additionally, common principles among the Member States will ease procedures such as licensing and permit. In that way, the countries can achieve a better cooperation across borders and develop common processes towards a sustainable maritime environment.

The Maritime Spatial Planning measures the activities in coastal waters and therefore, its scope differs based on the regional conditions. For that reason, the European Commission decided to use the Planning depending on the type and area of each marine activity, use detailed and specific objectives to manage the activities in the sea area and achieve transparency for all the procedures and documents which are related to the Planning. The Maritime Spatial Planning will increase the participation of the stakeholders and the coordination and cooperation of the European Countries.

The framework developed in the Maritime Spatial Planning will increase the dialogue between the Member States, helping them understand their different needs and problems and work united towards a sustainable use of the marine environment.

Chapter 3: The Port of Rotterdam

3.1 The history of the Port of Rotterdam

The Port of Rotterdam has been expanding towards the sea for the last seven centuries. In the second half of the 13th century, the city of Rotterdam was not yet founded and Rotterdam had the form of a fishing village where the river Rotte flowed in the river Maas. From 1600 to 1620, the construction of the first harbors occurred and until 1900, the Port of Rotterdam served Europe as a bulk and cargo port. During the period 1920-1940, a refinery and two petroleum distribution and storage facilities were constructed and the port lived its first great era.

During the Second World War, the port and the city of Rotterdam went through major destruction. This fact led to the reconstruction of the port during the 1950s and also the construction of the Botlek terminal. Until 1962, Rotterdam had become the largest port in the world, but in the mid 1960s, due to the increasing volume of cargo arriving in the port and due to the construction of larger ships, the port had to expand further and increase its depth. For that reason, during the late 1960s and 1970s, several dredging projects occurred to achieve an increase in the depth of the access channel. The port had now the possibility to accommodate larger containerships. Another result of this process was the creation of Europe Combined Terminal (ECT); a company specialized in the transshipment process of containers. The port had become the primary port for Europe in handling containers and bulk cargo and had the opportunity to develop further.

From 1960 to 1970, the Europoort terminal was constructed and the port had reached its landside constraints. On the other hand, the cargo flow was still increasing and the port realized the urgency and the importance of more container space. The government gave then permission for the construction of the Maasvlakte terminal. The terminal was built with a new process, as it was constructed in the ocean with infill on top of an already existing sandbank. With the Maasvlakte project, the port expanded and accommodated not only a new terminal for containers but also an iron ore and coal transshipment company and an oil terminal.[6]

The Port of Rotterdam has to deal every year with an increasing volume of cargo. Indicatively, in 2006, in the Port of Rotterdam, the container transshipment amounted to 9.7 million TEU[7]. This container throughput, together with the distribution facilities, the railway and the inland waterway network, led the Port of Rotterdam to become not only the dominant port in Europe but also one of the most important ones in the world. The Port Authority realized then that in the future, the port would face again problems with its space. For that reason, a further expansion of the port was necessary. In 2008, the construction of the Maasvlakte 2 project started. This project is not only important to the port but also to the Dutch economy as nowadays 60,000 people are employed directly in the port.[8]

[6] "Transformation of Rotterdam Docklands" by Edward Hupkes, Port of Rotterdam, 2003

[7] Port of Rotterdam

[8] Port of Rotterdam, Maasvlakte 2 project

Today, the Port area including the industrial complexes, cover approximately 10,500 hectares running for 40 kilometers from the city center to the North Sea. Figure 3.1 shows the expansion of the port over the years.

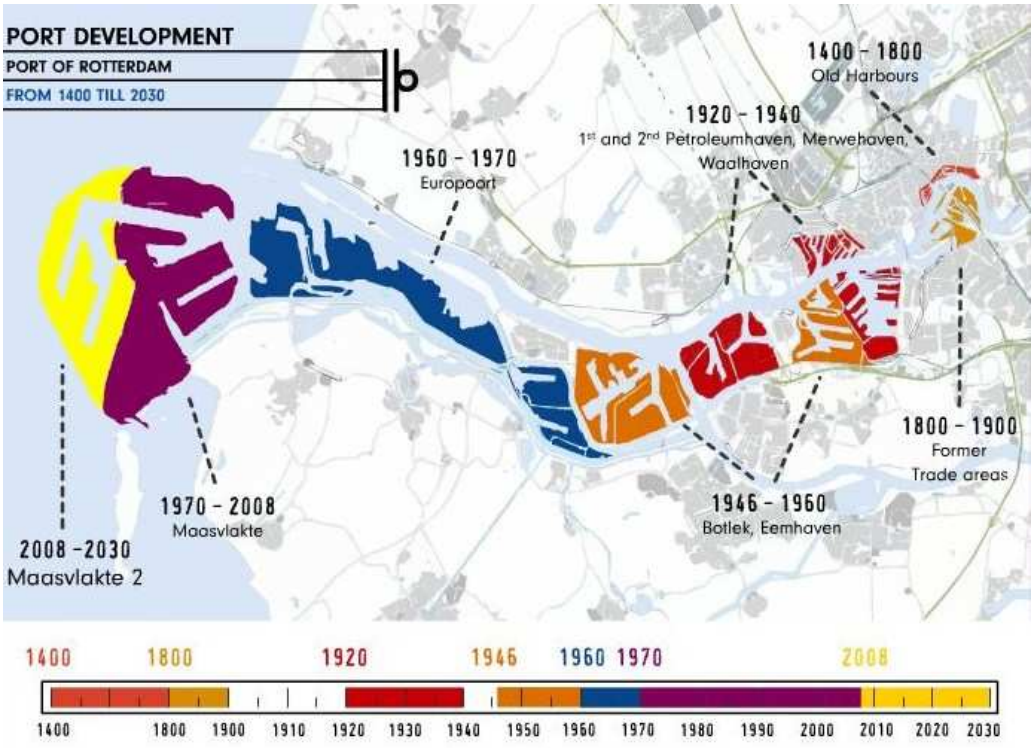

Figure 3.1: The expansion of the Port of Rotterdam over the years

Source: Port of Rotterdam

3.2 Key figures of the Port of Rotterdam

The Port of Rotterdam has become over the past decades the largest European port not only for containers but also for liquid and dry bulk goods. Rotterdam is the major port in the Hamburg-Le Havre range and is listed also as the fourth port worldwide after Shanghai, Zhoushan and Singapore. As can be seen in Figure 3.2 the Port of Rotterdam is mainly handling cargo from and to Europe but the trade with the Asian countries is also significant accounting for 17.9% of the total incoming and outgoing amount of cargo handled in 2007.[9] Over the next years, due to the construction of the new port area, the amount of cargo traded from and to Asia is expected to increase. As the shipping companies are taking advantage of economies of scale and are using larger vessels, the Port of Rotterdam can provide the necessary depth to accommodate these vessels. Additionally, the port provides access to the European market, a market very important to the Chinese companies which want to expand their businesses.

[9] Port of Rotterdam – Port statistics 2008

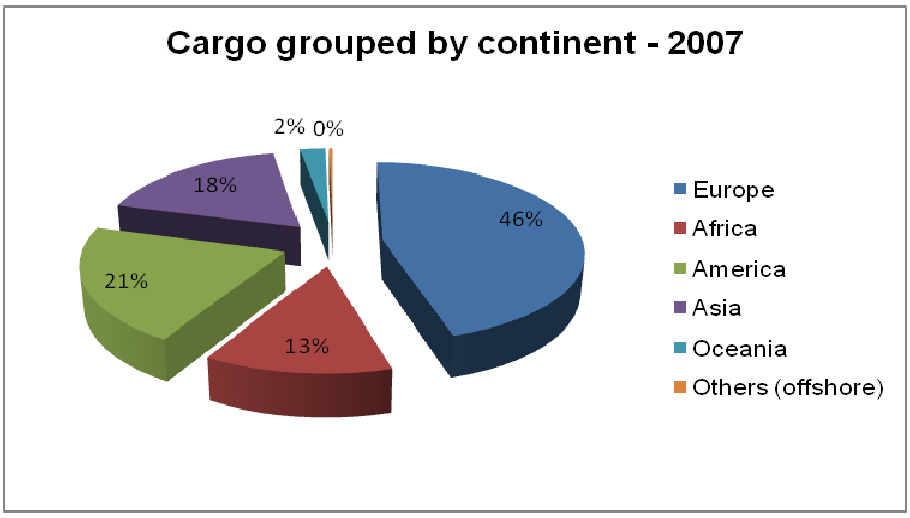

Figure 3.2: Incoming and outgoing cargo grouped by continent – 2007

Source: Port of Rotterdam

The Port handles year over year, an increasing amount of containers, containers which are then transported to the hinterland with different transportation modes. As it can be observed in Figure 3.3, containers are transported to the hinterland mainly by road and less by rail and barge. In order to decrease the air emissions and especially the emissions of Carbon Dioxide, the Port Authority aims in increasing the transportation of goods by rail and inland shipping, transportation modes which are more environmental friendly. In Figure 3.4, a decrease in the amount of containers transported by trucks and also an increase in the transportation of the containers by rail and barge can be observed in year 2008. This change represents the attempt of the Port Authority to protect the environment and minimize the effects of the port activities to the Rotterdam-Rijnmond area.

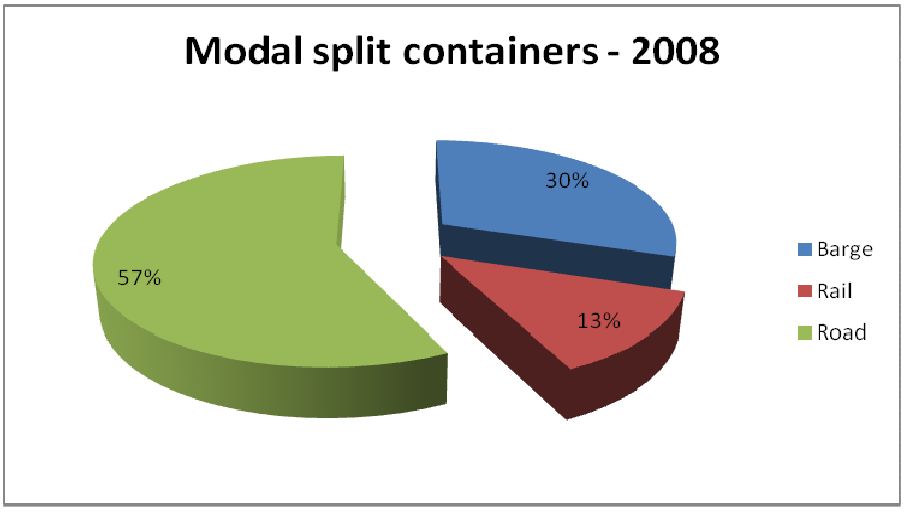

Figure 3.3: Modal split containers in 2008

Source: Port of Rotterdam

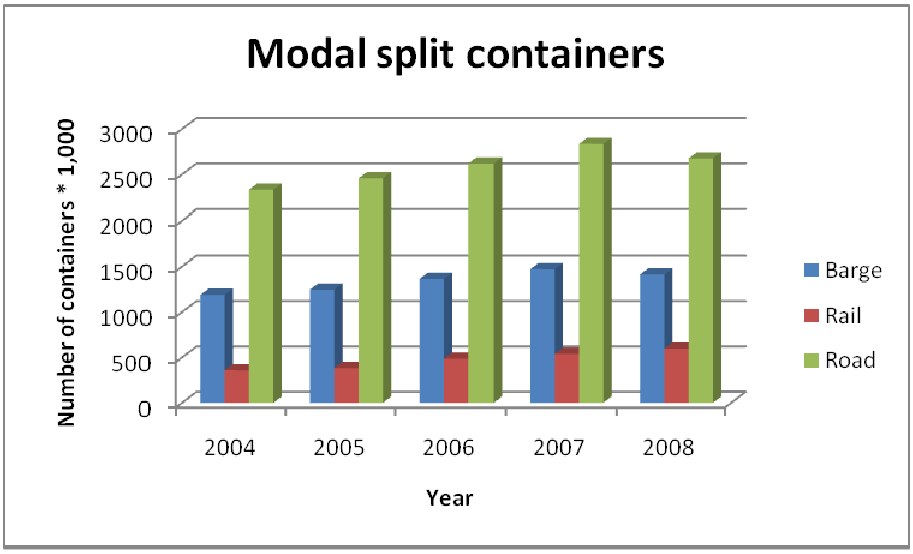

Figure 3.4: Modal split containers

Source: Port of Rotterdam

The Port of Rotterdam is of great importance for the Rijnmond area. It accommodates different companies which specialize in transshipment, storage, auxiliary services and industrial processing and provides access to the hinterland and to other European countries via road, rail, inland shipping, pipelines and short sea/feeder. Additionally a significant number of people are employed in the port, a number that increases annually and will increase even further after the construction of the Maasvlakte 2 area. As can be seen in Figure 3.5 the number of employees working in the port is increased every year. These people are working either in the transport industry or the business industry. The transport industry contains the handling and storage companies, the companies which provide services for transport and also the companies which specialize in the different transportation modes. The business industry contains wholesale companies, companies providing private and public services and also companies which specialize in food, chemicals, metals and petroleum. Figure 3.6 represents the percentage of people working in those two industries and as can be seen, the transport industry employs the majority of people, a percentage equal to 62%.

The Port of Rotterdam, due to its ideal geographical position, has become the greatest European port. The port increases the economic and social welfare of the area as it provides employment and attracts companies which will operate their businesses in the port area. The Port Authority, in cooperation with the Dutch government, is constantly seeking ways to expand the port area and develop further paying also special attention to the environment. The goal of the Port Authority is to have not only a port that is successful but also a sustainable port which uses renewable energy sources and new technologies in order to minimize the harm of the environment.

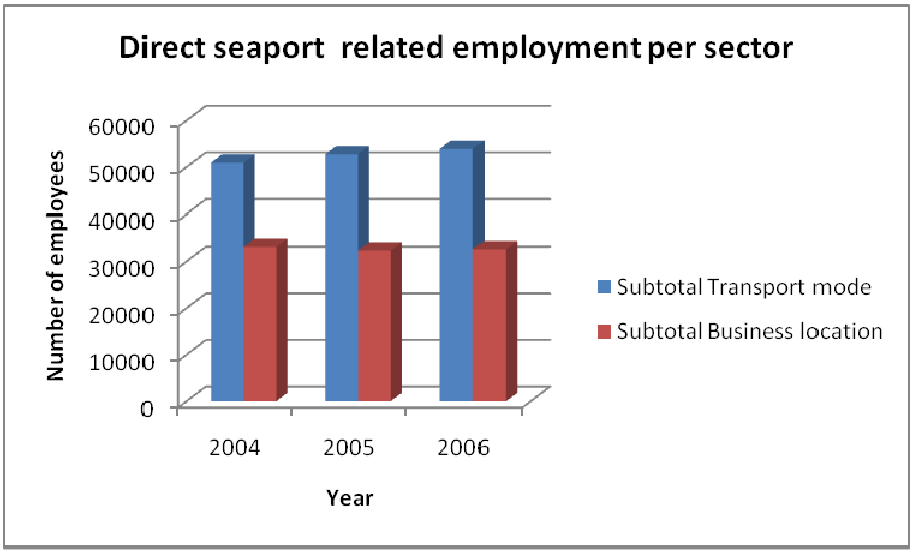

Figure 3.5: Direct seaport related employment per sector

Source: Port of Rotterdam

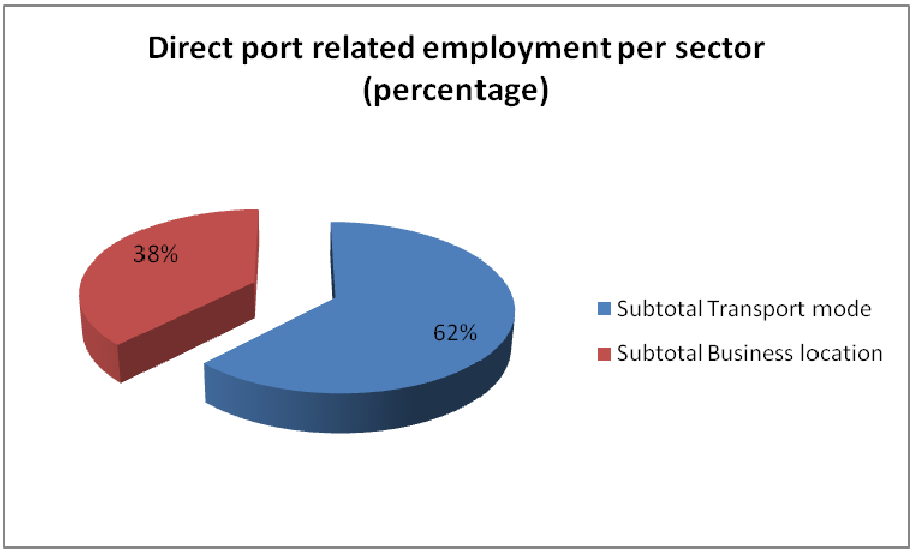

Figure 3.6: Direct port related employment per sector (percentage)

Source: Port of Rotterdam

3.3 A sustainable and accessible port

The sea route which is most heavily navigated is that of the North Sea. As Rotterdam is directly linked to this route, located also centrally in Europe and having major rivers like Maas, the Rhine and Schelde follow into the sea, the natural location of the Port of Rotterdam is ideal. Additionally, the intermodal connections of

the Port are excellent leading to the handling of approximately 400 million cargo, 133,000 inland navigation vessels and 34,000 sea-going vessels.[10]

Over the years, the companies are using bigger ships in order to take advantage of the economies of scale. The problem with this decision is that not all ports have the necessary depth to accommodate these types of ships. The Port of Rotterdam can accommodate larger ships as it has the necessary depth. In order to accommodate ore carriers, mammoth tankers and container vessels, the Eurogeul has been dug in the North Sea, with length equal to 57 kilometers and depth equal to 23 meters. Moreover, the Maasvlakte 2 project will have depth equal to 20 meters, depth unavailable in most European ports, allowing the larger container vessels of the future to berth in the Port of Rotterdam.

The infrastructure of the Port of Rotterdam can be observed in Figure 3.7. The Calandkannal has been dug and the largest ships with deep draught can use it in order to access the Europoort and the Maasvlakte area. The Nieuwe Waterweg provides access to the inland port areas. The river, the fairway and the port basins are dredged periodically so that the proper depth is kept.

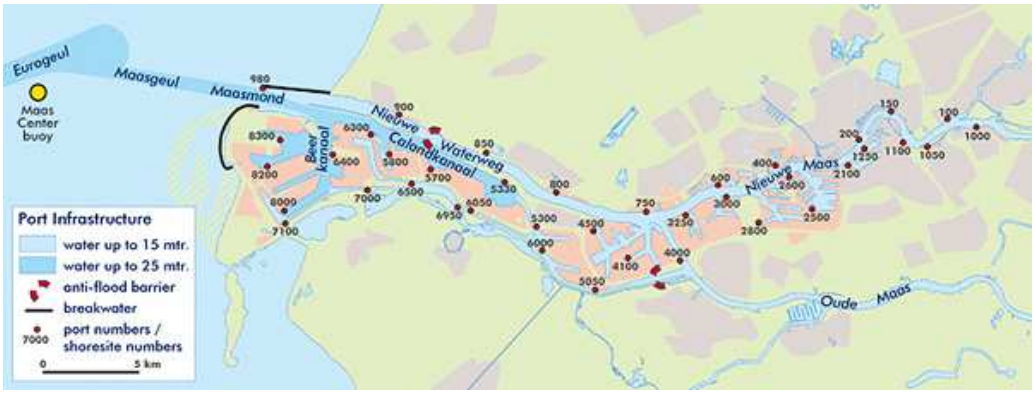

Figure 3.7: The infrastructure of the Port of Rotterdam

Source: Port of Rotterdam

The Port provides several options to the companies for transportation of the goods based on the costs and the required throughput. These choices include rail, inland shipping, pipeline transport and road. The Port Authority does not want to have only an accessible port but also a sustainable port. For this reason, the goal of the Authority is to make a modal shift and transport more goods by rail and inland shipping and less by road.

Since 2007, the Port has a railway line running for 160 kilometers called the Betuweroute. This line is exclusive for freight transport and links directly Rotterdam and Germany. The Betuweroute together with the rail terminals which will be built on the Maasvlakte 2 will increase the number of cargo transported by rail but through the strict control and management and also with the European safety system called the European Railway Traffic Management System (ERTMS), the transportation will be fast but at the same time secure and safe.

[10] Port of Rotterdam Internet site

The pipelines which expand to over 1500 kilometers and can be used for the transportation of chemicals and oil to the hinterland but also to Antwerp, Amsterdam and Germany, are a valuable and important alternative to the transportation of liquid goods. Additionally, inland shipping is an advantage of the Port of Rotterdam. As Rotterdam is connected to the rivers Maas and Rhine, these rivers can be used to transport large volumes of products in a way which is cost-effective. Indicatively, the ECT's Delta Barge Feeder Terminal creates extra capacity which is equal to a million TEU annually.[11] Moreover, inland shipping can be used in the future more extensively for the transportation of goods in order to reduce the road congestion. This can be achieved as there are daily services of inland vessels leaving and arriving to Rotterdam and also as the number of short sea shipping terminal is increased with new terminals being built in Euromax and APMT. Another future goal of the Port Authority is to introduce a concept named transferium. Based on this concept, the containers will be transported after their arrival to the terminal, to a location outside the port area by a short sea vessel. In that way, the road congestion around the port will be reduced as fewer trucks will be arriving and leaving the port.

The Port of Rotterdam does not aim only in becoming an accessible port but also a sustainable one. For this reason, the Port Authority has set several goals for the next 11 years based on the vision of the Port for 2020. First of all, space, energy and raw materials should be used sustainably and efficiently in the future, in order to achieve a sustainable Port. Additionally, companies that operate in the port area should cooperate and use common services. New forms of industry that are also sustainable should be applied and in the handling, production and storage process environmentally friendly energy carriers should be used. Finally, the existing space should be used intensively and research and technology can be an important element not only to create new sustainable techniques that will be used in the production process but also to achieve industrial ecology.

3.4 The Maasvlakte 2 project

The most sustainable on the one hand and the most controversial project on the other hand is the Maasvlakte 2 project. The construction of the Maasvlakte 2 started last year, after many controversies with the environmental parties in order not only to expand the existing port area but also to respect and protect the environment and the habitats of fauna and flora. The new area will be built on reclaimed land in the North Sea, to the west of the existing port. It will cover approximately 1000 hectares that will be used for industrial sites and another 1000 hectares used for infrastructure like railways, port basins, fairways, roads and sea defenses.

The construction of the Maasvlakte 2 area is not only an important project to the Netherlands, but also an exceptional one due to its complexity and to its size. In order to construct the whole area, approximately 400 million m^3 of sand must be removed from the coastal regions. This will have an impact to the environment, the fauna and flora and the bird and fish species of the area. The national government and the Port Authority are trying to minimize this impact and an extensive environmental study has already been made. Additionally, the environmental parties

[11] Port of Rotterdam

of the Netherlands are watching closely the construction in order to ensure that certain species will be protected and no further damage will be made.

The Maasvlakte 2 project is of great importance for the Netherlands and for the Rotterdam – Rijnmond area in particular. After the new area is fully constructed, the Port of Rotterdam will be able to accommodate the larger vessels of the future. Additionally, part of the new area will become a chemical terminal giving the possibility to the Port Authority to attract more clients. The Port of Rotterdam will be able to strengthen its current position as the major European port and also due to this project the spatial quality of the Rijnmond region will be improved.

The goal of the Port Authority, in order to ensure the sustainability of the project, is not only to have companies that will operate in the new port area but also choose the companies which will set up their business there based on environmental criteria and not just on the financial returns. The Port Authority will take under consideration the amount of noise and air pollution caused by the prospective companies. In that way, it will attempt to find future clients who will operate in a sustainable way. For example, the companies should use more hinterland transport by inland shipping and rail and less by road. The Port Authority wants to follow the European regulations concerning the environmental issues and also its responsibility for the environment under which it operates the last years. Additionally, the Maasvlakte 2 project will be constructed in different stages. The construction started with the first port and some industrial sites, parts of the project which the Port Authority has already clients for them. This first part is expected to be ready for the companies to use in the period 2012 – 2014. By constructing the new area in stages, the Port ensures that there will be no unproductive constructed parts of the project. Finally, the Port Authority wants to minimize the impact of the new project on the environment and for that reason a sea bed protection area will be created and a line of dunes will be used as sea defense. The Port Authority wants to provide rest areas for these bird species that are named protected and also protect the sea bed which is harmed by the dredging activities and by the entrance and exit of the ships in the port.

The Maasvlakte 2 project aims also at the creation of clusters which are oriented mainly to the chemical and the container activities of the first Maasvlakte project. The Maasvlakte 2 project will not only be a successful expansion of the existing port area but also a sustainable one. For this reason, some of the goals of the Port Authority concerning the new port area are, safe and environmentally friendly transport mainly by rail and inland shipping, sustainable buildings, responsible management of the water, use of space which is efficient and intensive, industrial ecology, efficient policies aiming to energy and finally having the right companies in the right places.

Figure 3.8 shows the Maasvlakte 2 area when it will be fully constructed. Figure 3.9 shows which companies will be located in the new port area. Moreover, the railroad tracks that make the Maasvlakte 2 area accessible and represent the goal of the Port Authority to increase the transportation of goods by rail can be observed. Finally, a number of wind turbines can be observed which represent the effort of the port to use sustainable energy.

Figure 3.8: The Maasvlakte 2 project *Source: Port of Rotterdam*

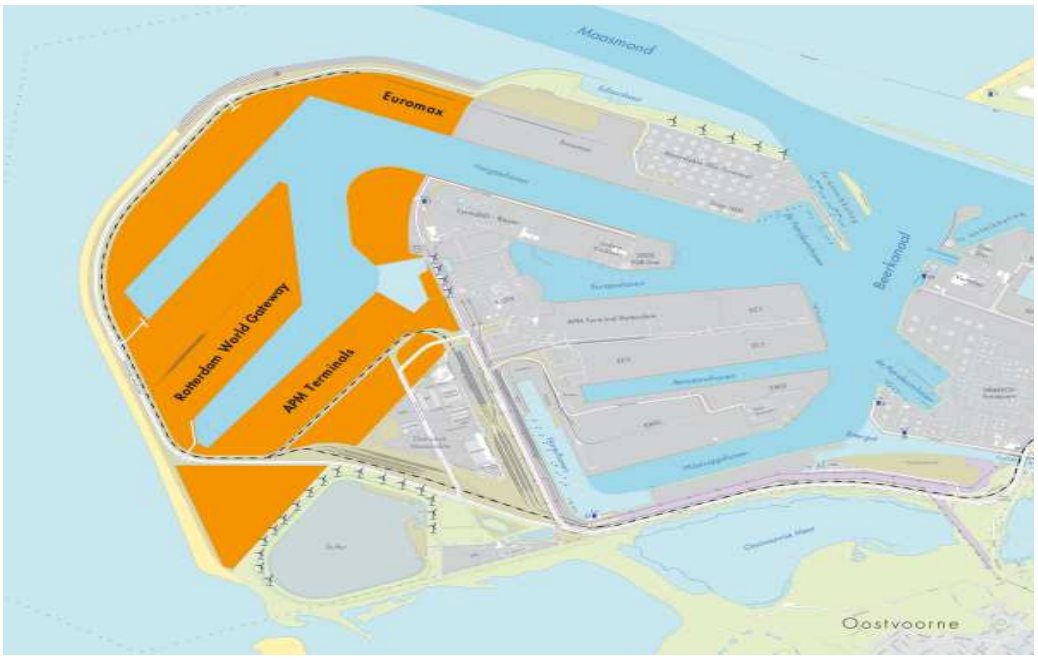

Figure 3.9: The existing port area and the Maasvlakte 2 area
Source: Port of Rotterdam

Over the past years, the Dutch government has been working on various projects to increase the sustainability of the country and also to protect the environment. Since the announcement of the construction of the Maasvlakte 2 area, environmental parties of the country have been protesting for the deterioration of the marine environment due to reclamation. These parties have filed several appeals and have

delayed the beginning of the construction. On February 2009, the Port of Rotterdam has reached an agreement with Milieudefensie (Friends of the Earth Netherlands) and has committed to the performance and to certain environmental goals. Both parties are having studies carried out in order to find ways to reduce the emissions of Nitrogen Oxides (NO_x), Carbon Dioxide (CO_2), Sulphur Dioxide (SO_2) and fine dust by 10 percent from 2020. These emissions will be originated by the activities performed in the existing Maasvlakte and the Maasvlakte 2 area. Moreover, the involving parties have agreed to carry out a study which will examine certain measures and how these measures can lead to the reduction of the air emissions. Such measures are the use of shore-side electricity systems for the vessels which are berthed in port, measure which will lead the vessels to turn their engines off during the time spent in port, reducing not only the exhaust fumes but also the noise which is caused by the engines. Other measures are the establishment of port dues which will provide the ship-owners with the incentive of investing in environmental measures and also the creation of an environmental zone to accommodate cleaner trucks.

The Port of Rotterdam launched in 2005 an open assessment procedure in order to decide which companies will operate in the new container terminal. This procedure consisted of three different phases, the prequalification phase where candidates were selected, the qualification phase and finally the negotiation phase. During the prequalification stage, the Port Authority selected the candidates based on a volume criterion. The candidates, in order to qualify to the next phase, must have transported and/or transshipped over 2 million TEU during the previous year. Also, the intentions and ambitions of the candidates, for the use of the new port area, based on standard methodology were provided to the Port Authority and were also part of the decision made. Fourteen stevedoring and shipping companies were interested and applied for the new port area. The Port Authority gave them the opportunity to form consortia and make better joint offers.

During the second phase, the companies which had been qualified, had to submit to the Authority their business plan. The Authority assessed the business plans based on assessment criteria, strategic assumptions and constraints. The assessment criteria were divided into four categories, the terminal concept accounted for 15%, the sustainability concept accounted for 20%, the strategic and marketing concept accounted for 25% and finally the financial concept which account for 40%. From these criteria, it can be observed that the Port Authority is not only interested in the financial returns of the companies but wants to ensure that the companies will operate in a sustainable way. More specifically, the Authority requested from the companies to estimate the amount of cargo which will be transported to the hinterland through rail and inland waterways and less by road and the emissions of air, noise and light pollution. The candidates had to estimate the amount of containers which will be handled, both incoming and outgoing. Based on these estimations a system of bonuses and penalties will be established. In that way, if the companies handle fewer containers than they estimated, they will have to pay a penalty in order to cover the port dues that are lost. On the other hand, if the companies handle more containers than they estimated, they will get a bonus in the form of a discount. Moreover, the companies should operate in a sustainable manner. This means, that they will transport fewer containers through road and more via rail and inland shipping and also that they will pay attention to the noise, light and air emissions in order to comply with the new regulations of the European

Commission and the goals of the Port Authority. The Port Authority aims in achieving the following modal split in the new port area by 2035; use of road by 35%, use of inland shipping by 45% and use of rail by 20%. In 2005, the modal split was as followed, road: 47%, inland shipping: 40% and rail 13%.

Through the whole assessment process, the consortium which was chosen based on the criteria and on the business plan, was the consortium consisting of the following five companies, the stevedore company DP World and the shipping companies of CMA CGM and the New World Alliance which consists of the MOL, APL and Hyundai companies. Currently, the first part of the new port area is constructed and it is estimated to be ready in 2012 – 2014. Then, these five companies will set their business there in the first container terminal which covers an area equal to 156 hectares.

The Port Authority wants to ensure that the Maasvlakte 2 project will be profitable and that no part of the new area will be unexploited and thus the project will bring fewer profits than the expected ones. For that reason, the area will be constructed in parts and phases and the construction of each part will begin as soon as the Port Authority finds companies which fulfill the requirements to set their businesses there. Additionally, the Port of Rotterdam has assigned to an organization to make a business case study, an economic mathematical simulation model. This organization is the Maasvlakte 2 Project Organization and based on construction methods, the development and the demand of the market and on other factors, is entering data to this model. In that way, it can calculate whether the project will bring the desired profits according to the investments that were made. If the model shows that the desired profit could not be reached, the Port Authority together with the constructing companies can change the project and bring profits. This can be achieved based on the fact that the new area is not constructed all at once but in parts.

The Port Authority has assigned the design of the area to the Project Organisation for the Expansion of the Maasvlakte (PUMA), a joint venture between Van Oord and Boskalis, Dutch marine and dredging contractors. The organization is responsible for the design, the construction and the maintenance of the first container terminal. The design phase lasted two years as the PUMA organization was examining different design innovations that could be applied to the construction of the sea defenses. Additionally, the organization is responsible for the reclamation of the land and for the construction of the roads, the quays, the cycle paths and the railways in this part of the area. The new port area will have a main and a secondary road, a two-track railway line, space which will be used for pipelines and a cycle path. The Port Authority, by assigning the first phase to the PUMA organization can be certain that the reclamation of the land will be finished on time and on a predetermined fixed price. In that way, the Authority will not be confronted with sudden changes which will jeopardize the whole project.

The Project Organization for the Expansion of the Maasvlakte has started the construction of the new port area from the land reclamation. The goal is to create at first an island which will have the shape of a banana and will be located approximately 3 km from the current coastline. Six dredging vessels, called the Trailing Suction Hopper Dredgers, will be deployed in order to transport approximately 200 million m^3 of sand from the extraction site to the new island.

Additionally, the port will be deepened so that the required berth is achieved to accommodate larger vessels. It is estimated that from the internal extraction, approximately 30 million m^3 sand will be obtained, sand which will be used later in the project. In order to protect the new port area, the existing port and the City of Rotterdam from cases of flooding, a seawall will be constructed by 20,000 concrete blocks. After the construction of the seawall, sand will be sprayed in the area between the seawall and the existing port area.

The Port Authority in cooperation with the Municipality of Rotterdam has decided that the port should not only be a sustainable and accessible port but also an attractive one. For that reason, it has been decided that while the Maasvlakte 2 area is constructed, the surrounding area will be recreated. As the Maasvlakte 2 is an expansion to the existing one, the construction of the new area will lead to the partly disappearance of the Slufter Beach, a place popular to the citizens of Rotterdam. The soft sea defense which will be constructed to protect the port area from the North Sea will create a new stretch of beach, a place where the citizens can spend their time and enjoy the sand and the sea. On the other hand, it should be noted, that an area around the port cannot be accessible to people for safety reasons. Thus, it is important for the Port Authority to plan carefully the recreation of the surroundings so that no accidents will occur.

The Maasvlakte 2 project is a mega-project and for that reason, its construction is a challenge. When the project is finished, the Port of Rotterdam will be able to handle the increasing volume of cargo, attract more clients and companies and become an industrial hub of Europe. On the other hand, special attention will be given to the protection of the environment and the achievement of the goals set by the European Commission and the Port Authority concerning the air emissions. Moreover, the financial prosperity and the social welfare of the area will increase, and more people will be employed in the port area. The construction of the Maasvlakte 2 is not only important to the Netherlands but also to the European Union.

3.5 Conclusion

The Port of Rotterdam is one of the world's top ports. With a throughput equal to 185 million tons of goods in the first half of 2009[12], in the middle of the existing financial crisis, and with continual efforts to increase the amount of goods going through the port, the Port Authority is not only concerned about the profits but also is interested in creating a better port; a port which is better in terms of accessibility, safety and sustainability.

The Port of Rotterdam is not only expanding but is also taking a turn for the better. The construction of the Betuweroute, the widening of the A15 motorway and the construction of the Maasvlakte 2 project are only a few examples of what the Port is trying to achieve. The Port Authority is first of all interested in increasing the accessibility of the Port. The Betuweroute will promote the transportation of goods by rail and will increase the amount of cargo ingoing and outgoing from the Port of Rotterdam mainly to Germany. The widening of the A15 and the attempt of the Port

[12] Port of Rotterdam Internet site

Authority to achieve a timetable for trucks in order to arrive out of the rush hours will decrease the congestion of the roads leading to the port. Finally, the rivers Maas and Rhine can be utilized further as inland motorways, so that the transportation of goods by barges will be increased as short sea shipping is an environmentally friendly, reliable and cheap transportation mode.

The Port of Rotterdam aims also in increasing its sustainability. This attempt is represented by the construction of the Maasvlakte 2 project. The environmental study that was made beforehand, the protection of the fauna and flora and the construction of a sea bed show exactly how important is for the Port Authority to protect the environment. Additionally, the Port Authority wants to achieve a safe and secure port. This is essential, because cases such as smuggling, terrorist activities and trafficking have increased over the past years and also more hazardous products are transported.

The Port of Rotterdam, the achievements of the Port Authority, the construction of the new port area on reclaimed land in the North Sea and the increased throughput of transported products every year, are only some of the accomplishments of the Port. The Port of Rotterdam is an outstanding example of a successful port that started from a fishing village and as a small port in the 13th century and has achieved not only to become the top European port but also one of the most important globally. Furthermore, the Port of Rotterdam is nowadays a key link of the trade between Europe and Asia as it has the necessary depth of approximately 23 meters and can accommodate the larger container ships and the mammoth tankers. The Port of Rotterdam is financially significant for Europe but especially for the Netherlands as it employs directly and indirectly a lot of people and helps in the development of the city of Rotterdam and of the wider area.

Chapter 4: The effects of the Integrated Maritime Policy to the Port of Rotterdam

4.1 Introduction

The climate change and the deterioration of the environment are topics that concern all countries. The changes that occur in the environment are mainly attributed to the greenhouse gases that are emitted by the various transportation modes. In order to minimize the harm of the environment, the European countries have decided to cooperate and take several actions. The Integrated Maritime Policy is one of these actions, representing the importance of the oceans and the need of their sustainable use.

The purpose of this chapter is to examine the effects of the Integrated Maritime Policy to the Port of Rotterdam. Nowadays, the main goal of the Port Authority and the City of Rotterdam is to reduce the emissions of Carbon Dioxide. For this reason, the author examines at first the air pollution that is caused by the vessels and by the port activities in general. Then the author focuses on a study held by the International Maritime Organization about air pollution and ways to reduce the emissions of greenhouse gases. Afterwards, the current situation in the European Union and specifically in the Netherlands, as far as the air emissions are concerned, is examined. This analysis examines the emissions caused by the different transportation modes. The last part of this chapter examines the actions that the Port of Rotterdam has taken so far about the air pollution and the protection of the environment and what actions can the Port Authority take in the future based on the Integrated Maritime Policy.

4.2 Air pollution caused by shipping

The major air emissions caused by the shipping sector are the Carbon Dioxide (CO_2), Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Particulate Material (PM). The primary source of air emissions is the vessels' exhaust fumes. In terms of the potential of global warming and of the quantity emitted, the Carbon Dioxide is the most important greenhouse gas with the other air emissions being less important. Based on a study of the International Maritime Organization (IMO), in 2007, 1,046 million tons of Carbon Dioxide were emitted by the shipping sector, amount equal to 3.3% of the global emissions. Additionally, based on several scenarios, with the absence of the necessary policies, the emissions caused by the vessels may increase by 150% to 250% by 2050, compared to the reported emissions of 2007, due to the continuous growth of trade and shipping.[13] Therefore, the Integrated Maritime Policy is a necessary and essential step towards the reduction of the greenhouse gas emissions.

In the European Union, shipping is considered the largest transportation mode with maritime shipping the most important part of the sector and inland navigation being a smaller but promising part in regards of the protection of the environment. Compared to other transportation modes, sea vessels are quite efficient as far as the fuel that is used is concerned. On the other hand, the fuel that is used in vessels

[13] Second IMO Greenhouse Gas study, 2009

contains high content of sulphur and due to the lack of standards concerning engine emissions, the air emissions are high and in several cases, when the vessels are in harbors or close to shore, they lead to air quality issues. In order to understand the effects of shipping to the environment, it is important to consider the emissions of greenhouse gases. In 2005, 16.5 million tons of Sulphur Dioxide were emitted globally by the vessels, 21% of which is attributed to the European Union's fleet. Additionally, shipping is held responsible for 24.3 million tons of Nitrogen Oxide and for 1.2 million tons of Volatile Organic Compound globally emitted.[14]

The air emissions from vessels do not only harm the environment but cause also damage to the human health. The smokestack emissions from the vessels are blamed for the death of 60,000 people annually around the world, 27,000 of these deaths occurre in Europe, leading to a cost for the society equal to 200 billion euro every year.[15]

There are many ways to reduce the air emissions and minimize the deterioration of the environment. In order to achieve that, the different national organizations should cooperate towards common goals. Conclusively, it is important and necessary for organizations like the International Maritime Organization to provide certain goals and deadlines and give motive to the shipping companies and the port authorities to take action towards a better environment.

4.3 International Maritime Organization's study

On April 2009, the International Maritime Organization published a study on the prevention of the air pollution caused by ships. This study is an update on the study on greenhouse gases published by the International Maritime Organization on 2000. The scope of this study is to publish the current and the future air emissions caused by international shipping, the possible reduction of the air emissions through technology, research and policy and the impact on the environment and the world climate due to the emissions.

In the study, several scenarios that can lead to the reduction of the CO_2 emissions are assessed. These scenarios are divided in two categories, design which deals with the new built ships and operation which deals with new and older ships. In the first category, the International Maritime Organisation examines the impact of changes in the design of the ships in the air emissions. Such changes are different propulsion and power systems, changes in the hull and the superstructure of the vessels, the use of low carbon fuels and of renewable energy. In the second category, changes in the operation of the ships, like optimizing the voyage or managing the energy that is used, can lead to the reduction of the CO_2 emissions. These changes can reduce the emissions even by 50% if, for example, the speed that the vessel operates is reduced.[16]

An important part of the effort towards the protection of the environment was the United Nations Framework Convention on Climate Change (UNFCCC), signed in 1992. The various parties that signed this convention (192 parties in March 2009), have obligated to gather data on emissions and share them with the other parties,

[14] Harbours, Air Quality and Climate change conference, 2008
[15] "Air pollution from ships", http://www.airclim.org/factsheets/shipping08.pdf
[16] "Prevention of air pollution by ships", International Maritime Organization

cooperate in order to achieve a change in the climate and also launch national strategies towards the reduction of air emissions. Another well known and also of significant importance protocol for the protection of the environment, is the Kyoto Protocol which was adopted in 1997.

The parties that signed the United Nations' Convention were not committed to reduce and stabilize their emissions but on the other hand, the parties that signed the Kyoto Protocol have agreed to reach the binding targets which were set by the Protocol, on average of 5.2% annually below the 1990 levels, for six greenhouse gases by 2012. In order to achieve this target, the Protocol suggests different mechanisms which will lead to the reduction of the emissions. These mechanisms include the clean development mechanism, the trading of emissions and the mechanism of joint implementation. The clean development mechanism gives the developed countries the opportunity to reduce their emissions by making projects leading to the reduction of the emissions in developing countries. Through these projects, the developed countries have the opportunity to earn reductions for their emissions, reductions which can be later sold to other countries. The joint implementation mechanism is a similar mechanism which gives the opportunity to certain countries to invest in emission reduction projects in other counties (which are specified by the Protocol), instead of reducing the emission in a domestic way. By doing so, the countries can earn emission reduction units and then use these units in their own country to meet the targets that were set by the Protocol. Lastly, it is important to mention that the Kyoto Protocol does not include emissions from the maritime and the aviation sectors.

The study of the International Maritime Organization examines all the greenhouse gases that are connected to the shipping sector and looks at ways that lead to their reduction. The emissions that are caused by the engines built in ships are the Nitrogen Oxides (NO_x). An important regulation in regard to this greenhouse gas is the regulation for the change of the engines. Engines are now divided in two categories. The first category is the Tier 0 which deals with the engines that were built before the 1st January 2000 and are not regulated. The second category is the Tier 1 which includes those engines built after the 1st January 2000 and subject to the regulation on the NO_x emissions. Based on regulation 13 of the MARPOL Annex VI, Tier 0 engines should be replaced with Tier 1 engines and should be checked based on the technical code in order to reduce the NO_x emissions onboard. In the following figure, the reductions in thousand tones of the NO_x emissions due to the 13th regulation can be observed for international and for total shipping. The International Maritime Organization defines international shipping as "*shipping between ports of different countries"* and total shipping as "*international and domestic shipping plus fishing".* As can be seen in Figure 4.1 the NO_x emissions have been reduced significantly due to the 13th regulation.

In the study by the International Maritime Organization regarding the pollution caused by ships, possible solutions to reduce the air emissions are analyzed. Except from the solutions based on regulations that were addressed before, there are also solutions based on the use of technology and the operation of the vessels. The afore-mentioned solutions can be divided into four categories. First of all, the energy that is used in the operation of the vessels can be used more efficiently. In that way, more useful work can be done with the consumption of the same amount of energy. Secondly, renewable energy can be used for the operation of ships. By taking advantage of the wind, wave and solar energy, the air emissions will be

reduced. Thirdly, fuels like natural gas and biofuels create fewer emissions and therefore are friendlier towards the environment. Lastly, the use of technologies such as chemical conversion leads to the reduction of the emissions.

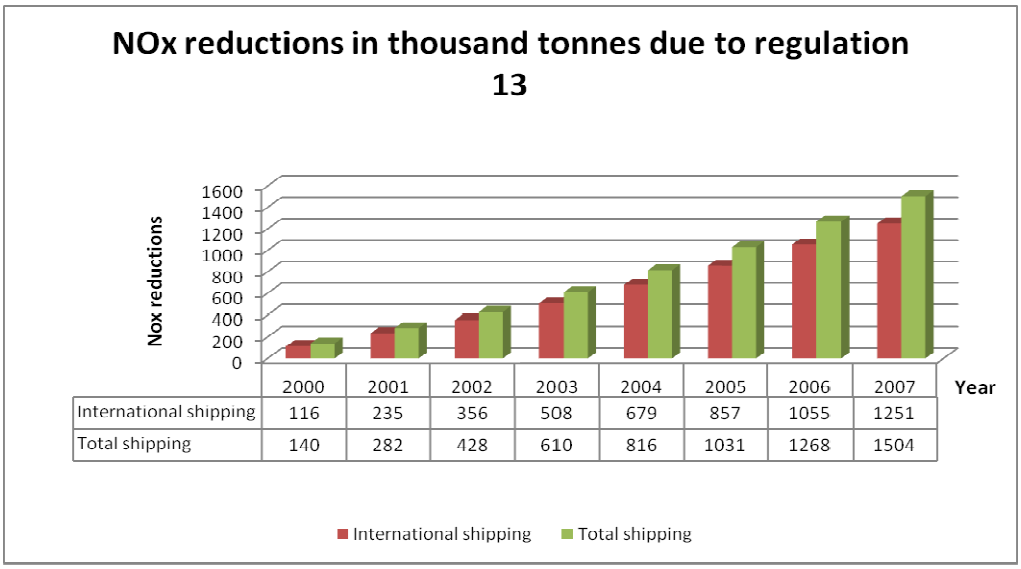

Figure 4.1: NOx reductions

Source: elaborated by the author based on data from the International Maritime Organization

The use of renewable energy sources is considered an alternative for the reduction of emissions and pollution caused by the shipping sector but there are still several problems that need to be addressed with regard to the results of these sources. Traditional and solid wing sails can be used in ships in order to have the wind power as a motive power for the vessels. On the other hand, the efficiency of the wind power depends on the weather conditions which occur in the different routes and regions. Thus, based on a study by the Technical University of Berlin,[17] wind energy can be used in a more effective way in the North Pacific and Atlantic leading to savings on fuels of 5% when the ship travels at 15 knots and on 20% when travelling at 10 knots. Nowadays, the use of wind power especially in large vessels is limited, and saving in fuel is a potential only in medium or long term. The onboard use of solar energy has also several problems. The use of photovoltaic cells, even if they cover the entire deck, cannot meet the power that is needed, for example, in a tanker. Additionally, during the night or in certain areas, solar energy cannot be used and therefore, backup power is necessary and essential. Solar energy, due to high costs and low efficiency is not considered an effective solution towards the reduction of air emissions. Lastly, waves during the motion of ships can be utilized only with the application of external and internal systems that require technical knowledge and are rather complex. This fact together with the low possible emissions' reduction makes this type of energy a not promising one.

[17] "Simulation of the operation of wind-assisted cargo ships"

For the shipping industry, the most important problem concerning the air pollution is the emissions of Carbon Dioxide (CO_2). Effective ways to reduce these emissions are the use of liquefied natural gas (LNG) and biofuels. The biofuels that are used nowadays are the first generation biofuels which are produced by animal fats, sugar and vegetable oil. The majority of these fuels can be used in the diesel engines of the ships. On the other hand, the compatibility of biofuels should be checked beforehand because in certain cases these fuels may cause the engine to shut down, jeopardizing the safety of the vessel. Depending on the type of biofuels, different benefits on the emissions of CO_2 occur. In some cases, it was observed that the use of biofuels did not reduce the CO_2 emissions but on the contrary led to an increase of the NO_x emissions. Currently, biofuels are limitedly used in the shipping sector as they cost more than petroleum fuels and as they are not broadly available. Liquefied Natural Gas has more potentials as an alternative fuel for ships because it brings many benefits. Not only the use of natural gas reduces the CO_2 emissions but due to the fact that it is a clean fuel and contains no sulphur, the SO_x emissions are eliminated and the NO_x emissions can be reduced even by 90% as the peak temperatures during the combustion process are reduced. A significant disadvantage of the use of natural gas is the increase of the methane emissions which lead to the reduction of the net global warming benefit by approximately 10%. In order to take full advantage of the liquefied natural gas, problems like the onboard storage of the gas and the availability of this fuel in the majority of the bunkering ports need to be first solved. If these problems are solved, then in the future, the ship owners will be more willing to buy LNG-propelled ships, as the price of the natural gas is currently lower than that of distillate fuels and the owners can see an increase in the profits by the use of natural gas. Table 4.1 represents the possible reduction of the afore-mentioned changes on the CO_2 emissions.

Table 4.1: Potential reduction of CO_2 emissions from shipping by using known practices and technology

Changes in design - applicable in new ships	**Savings of CO_2 per tonne-mile**	**Combined**	**Combined**
Concept, speed and capability	2-50%*	10-50%*	25-75%*
Hull and superstructure	2-20%		
Power and propulsion systems	5-15%		
Low-carbon fuels	5-15%**		
Renewable energy	1-10%		
Exhaust gas CO_2 reduction	0%		
Changes in operation - applicable in old and new ships			
Fleet management, logistics and incentives	5-50%*	10-50%*	
Voyage optimization	1-10%		
Energy management	1-10%		

* Reductions at this level would require reductions of speed

**CO_2 equivalent based on the use of LNG

Source: International Maritime Organization (2009)

The International Maritime Organization's study analyses the air emissions caused by vessels. The study includes the different greenhouse gases, how shipping and the other transportation modes affect the air pollution, examines the result of possible scenarios or changes in the construction and operation of the ships to the

environment and also how these changes can reduce the air emissions. Moreover, the study provides the current legislations and regulations towards the reduction of the air emissions and in that way is quite important for the ship owners, the shipping companies and the port authorities.

4.4 Air emissions of the European Union

Over the past decade, important changes have occurred in the European Union towards the protection of the environment. The climate change, the increase in the temperature and the increase of the amount of greenhouse gases emitted every year in the environment, made the Countries of the Union realize that action must be taken and that a solution in these problems is urgent. Legislations and regulations like the Kyoto Protocol were signed by a number of participating countries. These countries agreed on reaching certain emissions targets by the year 2012 and reduce their air emissions in order to minimize the harm to the environment.

The emissions of Carbon Dioxide, Carbon Monoxide, Oxides of Nitrogen, Sulphur Dioxide, Particulate Matter and Volatile Organic Compound are analyzed for the different transportation modes. These modes are road, rail, maritime shipping and inland waterways. The following analysis is performed in order to examine how harmful for the environment is each mode, whether there is an increase or decrease in the air emissions over the years and also the predictions for the emitted amounts for the next decade. The data were obtained by the Transport and Environment Database System (TRENDS) and include the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. (Data available in the Appendix)

4.4.1. Air emissions caused by the transportation of goods by Road

The road transportation mode is the most polluting one. For that reason, the national organisations cooperate with the Port Authorities and the companies specializing in supply chain in order to reduce the use of trucks in the transportation of goods.

In 2005 the Kyoto Protocol entered into force obligating the signing countries to take actions towards the reduction of the air emissions. Figure 4.2 represents the emissions caused by road transportation. As can be observed in this figure, after 2005, a decrease of all air emissions has occured. The most significant decreases are the ones of the Carbon Monoxide and the Oxides of Nitrogen.

Figure 4.3 shows the CO_2 emissions caused by the road transportation. Based on the Transport and Environment Database System, the emissions for the next decade can be forecasted. It can be observed, that even after the Kyoto Protocol, the emissions of Carbon Dioxide are forecasted to increase significantly. For this reason, a modal shift is required in order to achieve the reduction in the transportation of goods by road on the one hand and to deal with the problem of road congestion on the other.

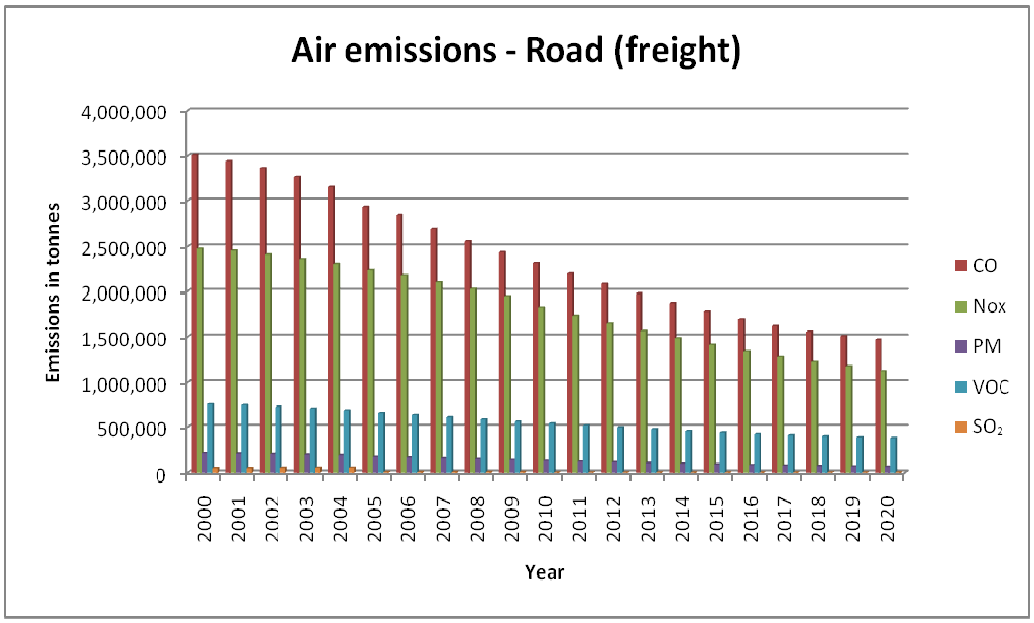

Figure 4.2: air emissions – road (freight) *Source: TRENDS*

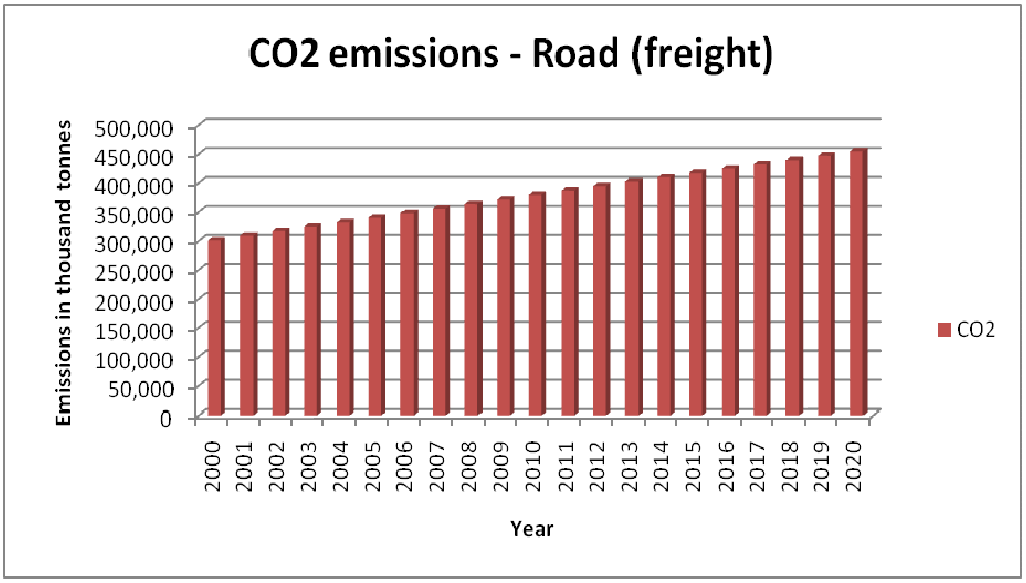

Figure 4.3: CO_2 emissions by road transportation

Source: TRENDS

4.4.2. Air emissions caused by the transportation of goods by Rail

The data obtained by the Transport and Environment Database System provides us with the opportunity of examining the emissions caused by the transportation of

goods by rail. Moreover, it is possible to make a forecast of the emissions for the next decade and also examine whether the European Countries are trying to decrease their emissions and reach the targets set by the Kyoto Protocol.

Figure 4.4 represents the amount of the greenhouse gases that is emitted in the environment due to the transportation of the goods by rail. These greenhouse gases are the Carbon Monoxide (CO), the Sulphur Dioxide (SO_2), the Particulate Matters (PM), the Nitrogen Oxides (NO_x) and the Volatile Organic Compound (VOC). As can be observed in this figure, the emissions of Sulphur Dioxide are forecasted to increase where the emissions of the other gases are forecasted to decrease or remain stable.

Figure 4.5 represents the CO_2 emissions due to the transportation of goods by rail. When this figure is compared to the CO_2 emissions caused by road, it can be observed that rail is a more environmental friendly transportation mode. For this reason, nowadays, most European Countries are trying to use the railway network more extensively. Additionally, currently hybrid locomotives are tested, a future option which can lead to the further reduction of the amounts of Carbon Dioxide emitted.

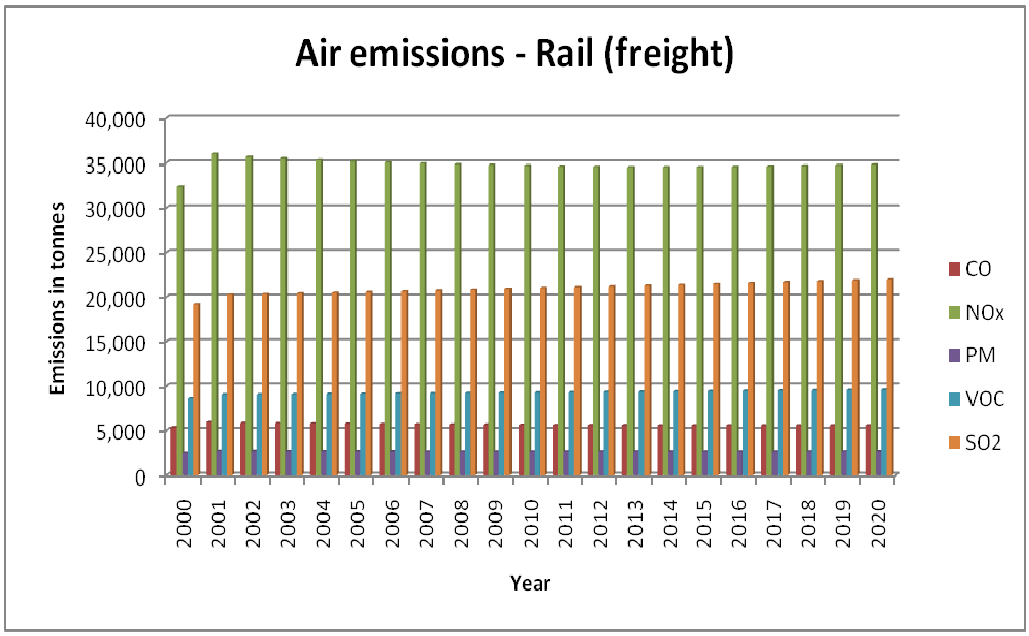

Figure 4.4: Air emissions by rail *Source: TRENDS*

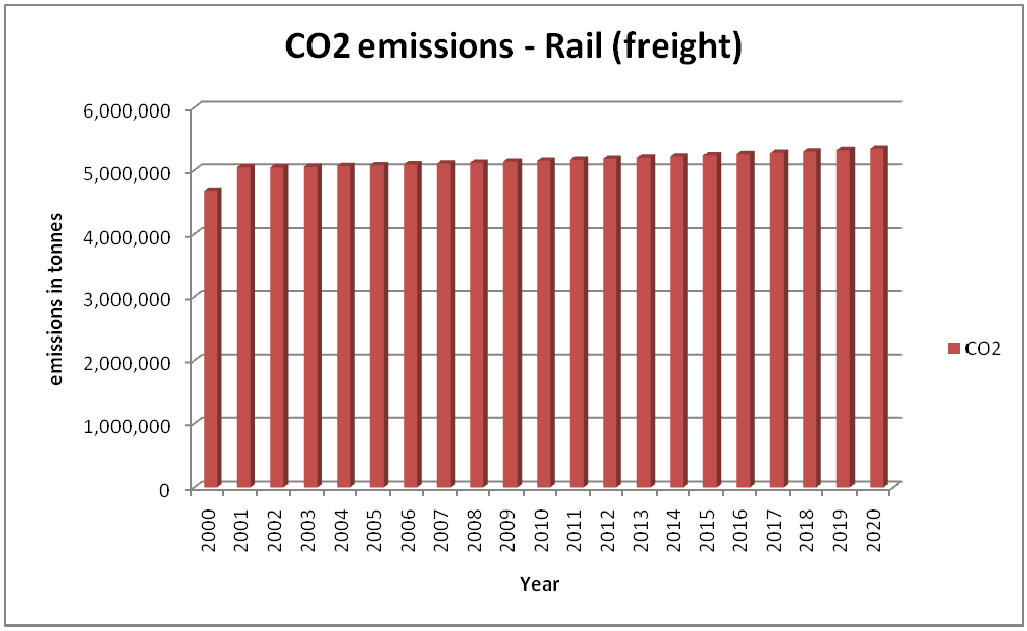

Figure 4.5: CO_2 emissions – Rail (freight) *Source: TRENDS*

4.4.3 Air emissions caused by the transportation of goods by Ships

Over the years, trade, especially between Europe and Asia, has increased significantly. Cases like the discovery of containers, the building of larger ships, which due to economies of scope are more cost-efficient, have led to this increase of trade and to an extensive transportation of goods by ships. In figure 4.6, an increase in the emissions of greenhouse gases can be observed. On the other hand, this observation is based on forecasts which have not taken under consideration the legislations of the European Commission and the International Maritime Organisation for the reduction of the Nitrogen Oxides and the Sulphur Dioxide. These regulations concern the change of the engines built in ships with Tier I engines and also the use of fuels with lower Sulphur Dioxide.

In figure 4.7 the CO_2 emissions caused by the shipping sector can be observed. Over the next decade, the forecasted increase in the emissions is partly explainable as trade and transportation by ships increases every year. On the other hand, actions need to be taken in order to control the increase of the CO_2 emissions and not pollute further the environment. The ship owners need to comply with the new regulations and legislations and the national organizations should cooperate for the protection of the environment.

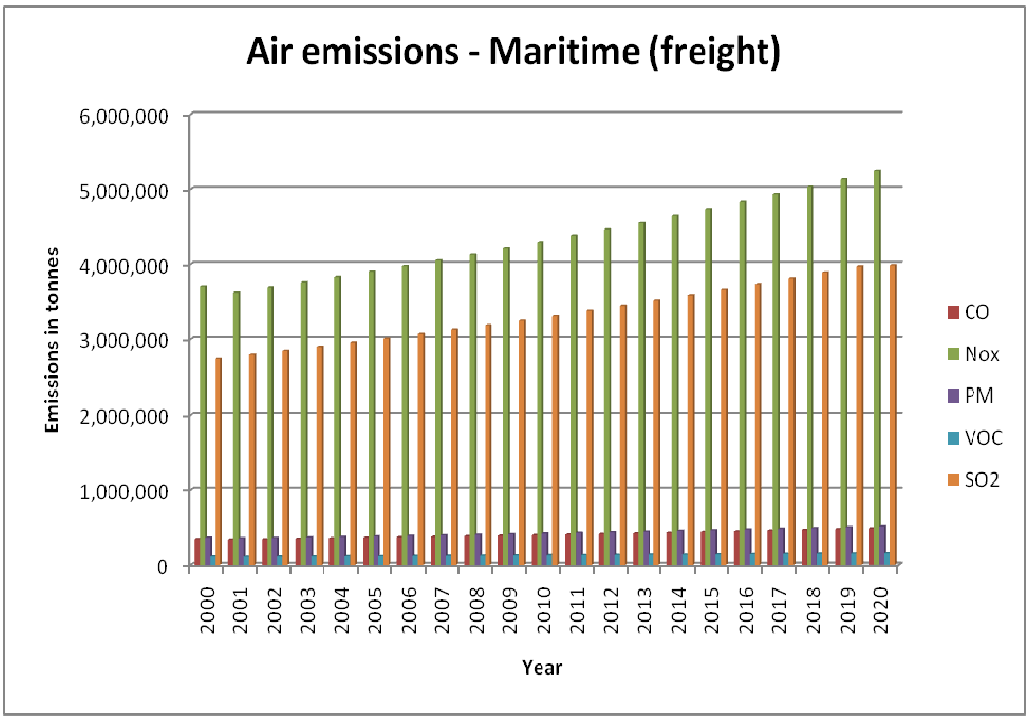

Figure 4.6: Air emissions caused by the transportation of goods by ships

Source: TRENDS

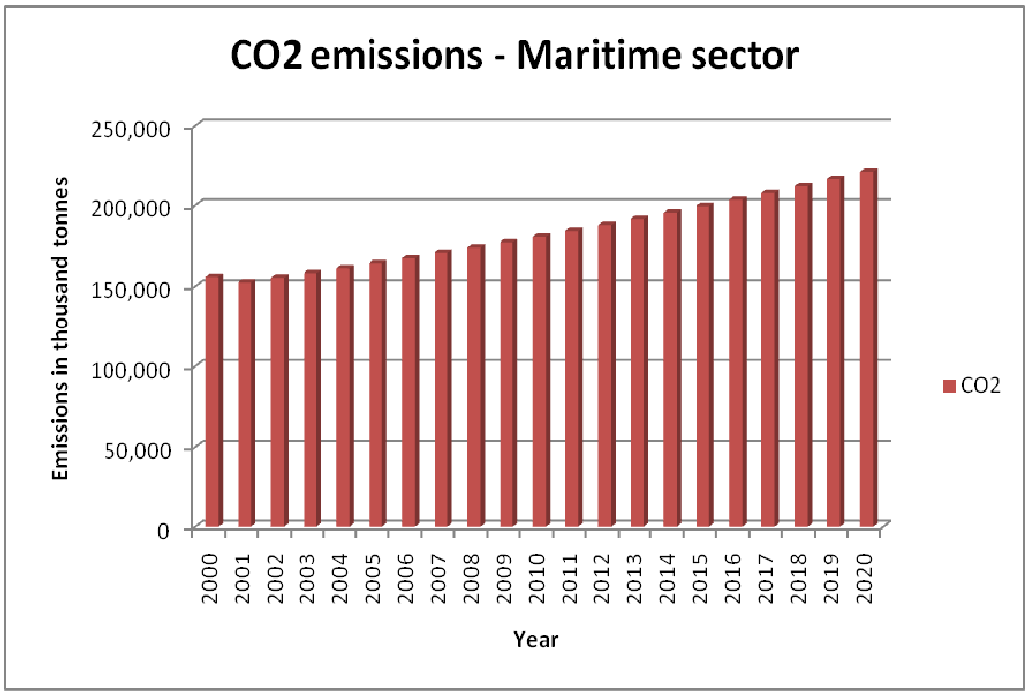

Figure 4.7: CO_2 emissions – Maritime Sector *Source: TRENDS*

4.4.4 Air emissions caused by the transportation of goods through the inland waterways

Nowadays, the utilization of the rivers and the inland waterways in order to transport goods to other ports and cities is an environmental friendly alternative. Moreover, this transportation mode can be used to transfer the goods to the inland and minimize the congestion in ports. The Port of Rotterdam has the advantage of easy access to inland waterways which can be further utilized. The Port Authority aims in using more these waterways and create a transferium where containers will be transported in order to reduce the congestion in the port area, until the Maasvlakte 2 project is fully constructed.

Figure 4.8 represents exactly how the transportation of goods through inland waterways is a more environmental friendly transportation mode. The emissions of Carbon Monoxide, Sulphur Dioxide, Particulate Matters and Volatile Organic Compound are relatively low. The emissions of Nitrogen Oxides are high but still not as high as in the other modes.

Figure 4.9 represents the CO_2 emissions caused by the transportation of goods through the inland waterways. It can be observed that although an increase in the emissions is possible to occur, still the amount of the emissions will be relatively low compared to road or rail.

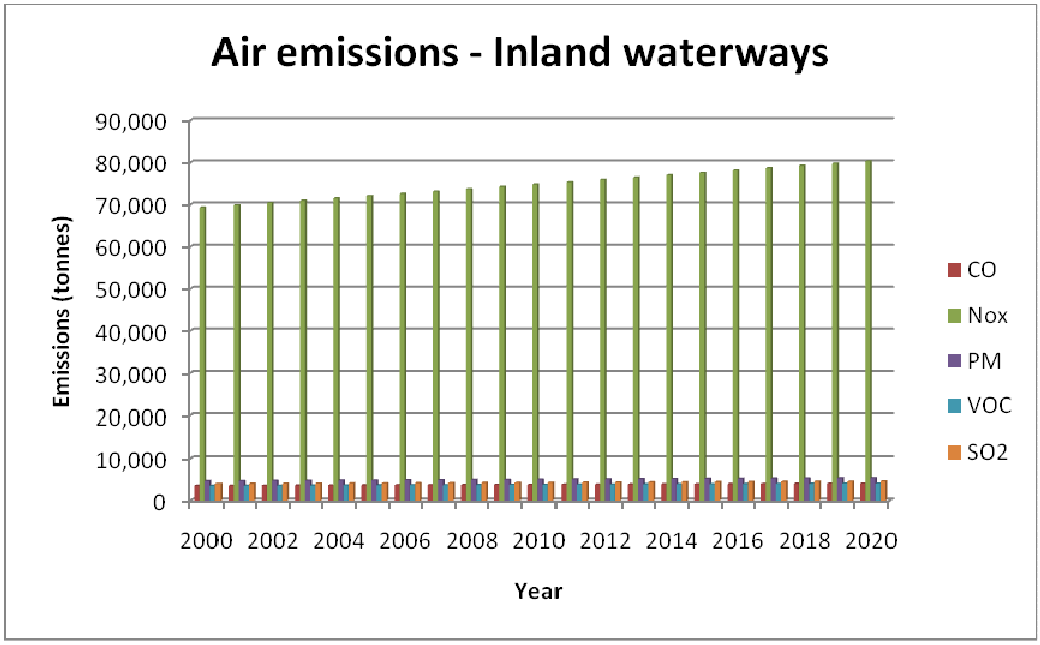

Figure 4.8: Air emissions – inland waterways *Source: TRENDS*

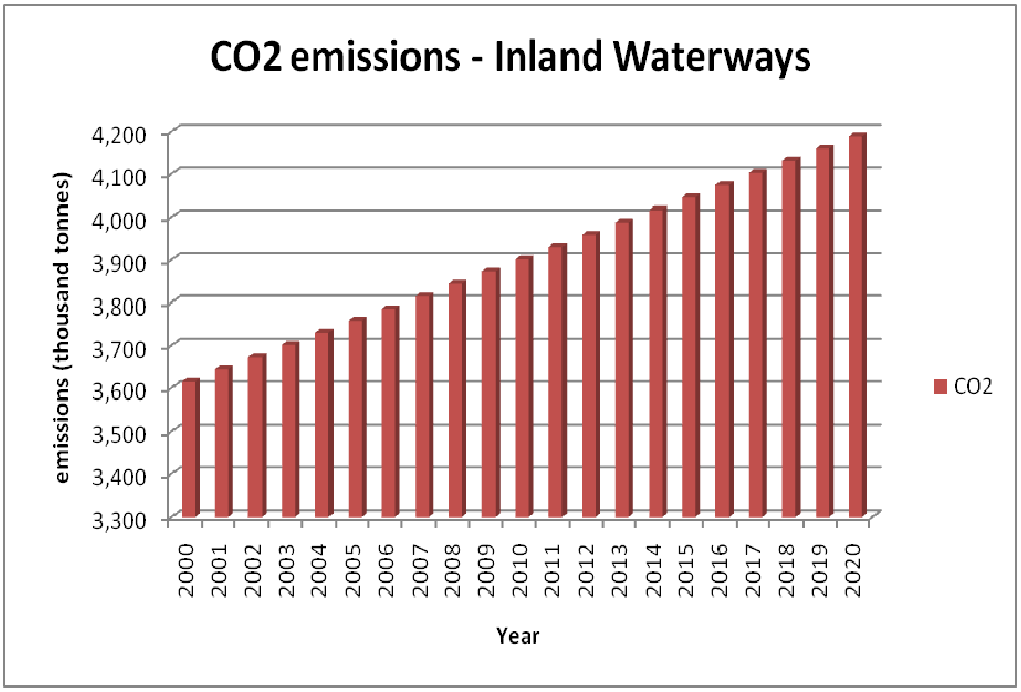

Figure 4.9: CO_2 emissions – inland waterways *Source: TRENDS*

4.4.5 Comparison of CO_2 emissions of all transportation modes

In Figure 4.10 the CO_2 emissions of all transportation modes are compared. It can be observed that in the next decade the emissions, due to the transportation of goods by road, are forecasted to increase significantly. For this reason, the shift to less polluting modes is essential and necessary. The countries of the European Union can develop an advanced railway network that they can use to transport goods faster and in a more secure and efficient way. The Betuweroute between Germany and the Netherlands is an example of how European Countries can cooperate and increase the trade between them by taking advantage of possible inland or railway connections. Additionally, inland waterways can be used more extensively. This transportation mode has many advantages as it is not only environmental friendly but also more secure, cheaper and is not affected by weather conditions.

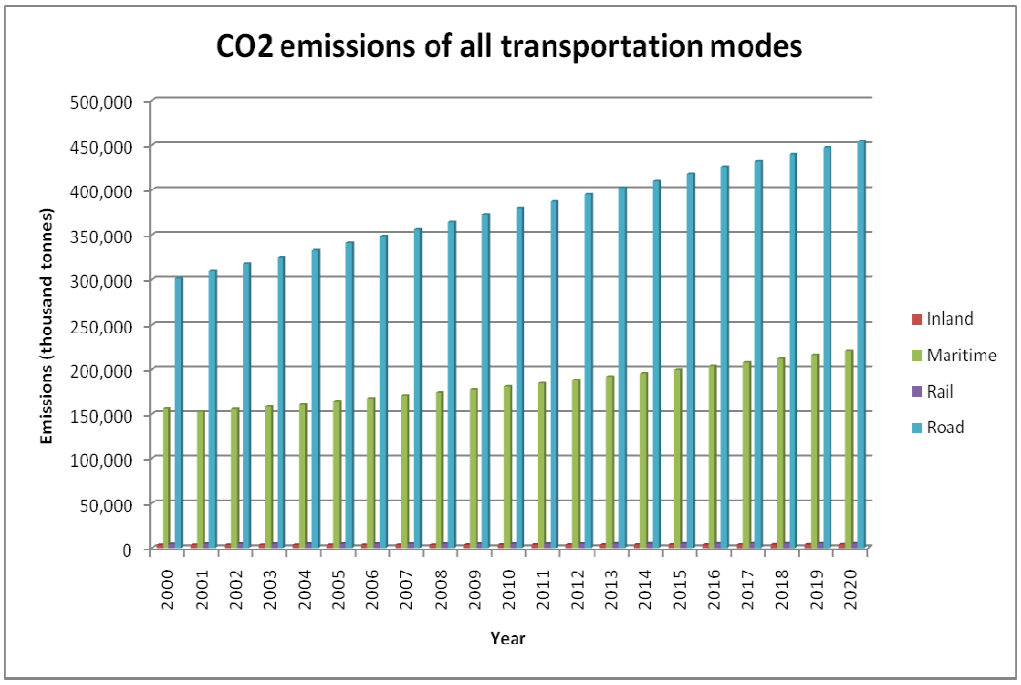

Figure 4.10: CO_2 emissions – comparison of the transportation modes

Source: TRENDS

4.5 Air emissions of the Netherlands

Over the past fifty years, people have witnessed many changes in their way of living. On the one hand, population has increased significantly and prosperity has risen, but on the other hand the need for land and energy in order to satisfy the increasing demands has led to the destruction of biodiversity and the pollution of the environment. For this reason, action must be taken. As part of a global attempt to protect the environment, the European Countries have agreed on reaching several targets to limit the harm towards the environment, the loss of biodiversity and the changes in the climate. These targets concern mainly the emissions of greenhouse gases and even if they are not met in the short term but a progress towards reaching them is to be made then the citizens and the countries will have at least changed their way of thinking and have decided to take action. With the use of technology, the land and the environment can be used more efficiently but even in that way, sustainable development is not possible to occur without further actions and attempts of the national organizations.

Technologic developments led also to an increase in trade and in the number of products transported around the world. Countries have now the opportunity through free trade to specialize, take advantage of economies of scale and increase their profits. Additionally, the removal of barriers and the creation of a single European market promoted trade between the European Countries and the Netherlands witnessed a raise in profits. On the other hand, as an important part of the Netherlands is below sea level and as major projects, like the Maasvlakte 2 project,

are constructed on reclaimed land, the Dutch government pays special attention in the protection of the environment. The changes in the climate, the increase of the temperature and the increase in the sea level are issues that concern the Netherlands. The Dutch government is interested in creating a "climate proof" country which by protecting the environment, will also protect itself by cases of flooding. For this reason, several targets have been set in order to improve air quality and through research and technology, to reach innovative solutions that can be applied in the different transportation modes and can lead to the reduction of the CO_2 emissions.

The Netherlands is a country directly connected to the North Sea. Its position which is close to several European economic centers and also its 18 ports which are distributed over 4 different seaport regions have made the Netherlands over the years an important and necessary part not only of the European economy but also of the trade between Asia and the European Union. For this reason, the Dutch government has decided and is now trying to strengthen the role of its ports in its national economy. Additionally, the ports are responsible for a significant amount of the Gross Domestic Product and are providing employment for a lot of people. Indicatively, in 2005, the seaport regions accounted for 4.2%, based on prices of 2002, of the Gross Domestic Product. On the one hand, ports increase the profits and the economic position of the country but on the other hand, as the west part of the Netherlands is below sea level, attention must be paid for climate changes to minimize the risk of flooding and therefore, the country should not only try to reduce its air emissions but try to protect the environment in general.

Action must be taken not only on a national level but first of all on a citizen level. Human activities, like the burning of gas, lead also to the emission of greenhouse gases. These emissions are responsible for the increase of the earth's temperature and for the changes in the climate which they lead in their turn to social and economic consequences. The Dutch citizens have realized this and have reduced their per capita CO_2 emissions over the years. Figure 4.11 represents this attempt to protect the environment at a personal level.

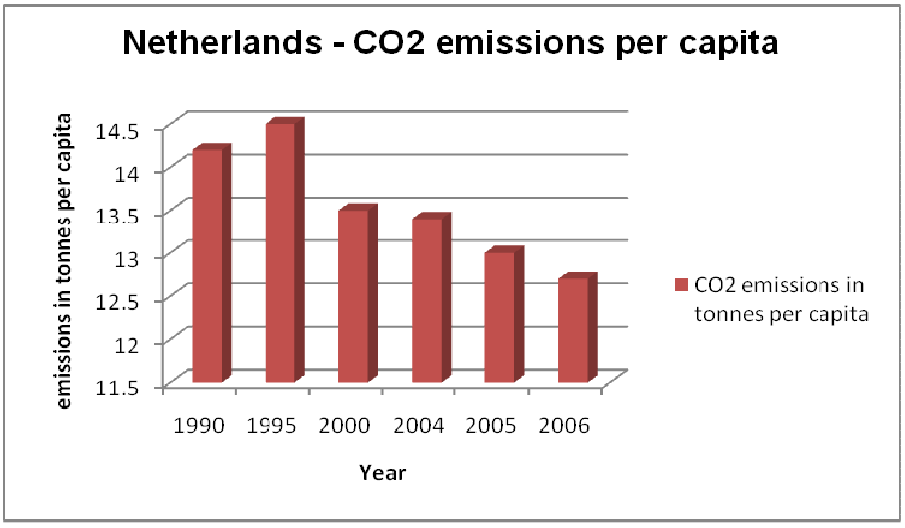

Figure 4.11: Per capita CO_2 emissions in the Netherlands *Source: Eurostat*

The number of Dutch seaports, equal to 18, leads to an increasing amount of cargo imported and exported of them. This amount of cargo is also transported to the inland of the country or to other countries through trucks, rail and barges. The transportation of goods by different transportation modes, and especially by road, leads to an increase in the emissions of greenhouse gases. Figure 4.12 represents these emissions for a time period of eleven years and it can be observed that in 2007 the air emissions declined; a fact that can be explained by the attempts and the regulations of the Dutch government to protect the environment. Moreover, a modal shift between the different transportation modes is one of the goals of the government in order to reduce the CO_2 emissions. This is represented by Figure 4.13 where a reduction in the emissions in the years 2005 and 2006 is observed.

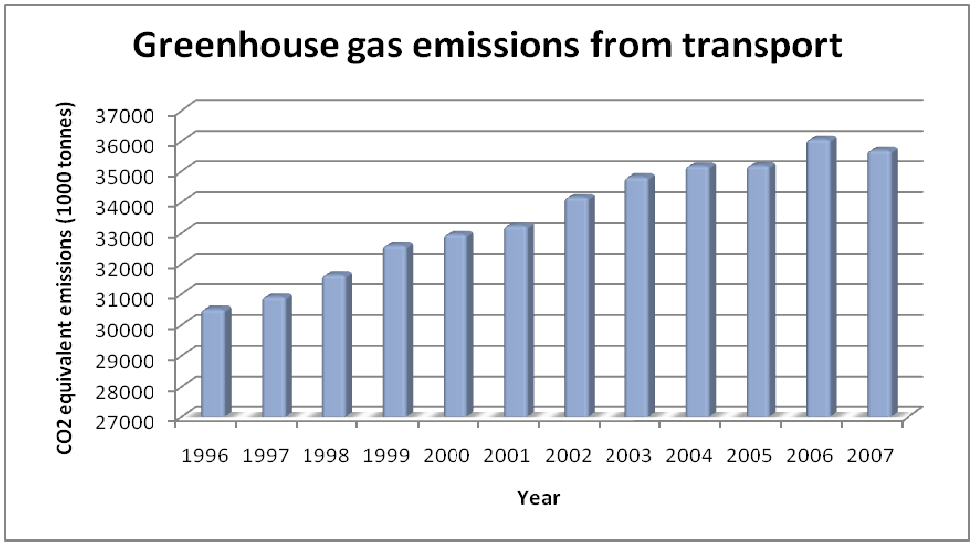

Figure 4.12: Greenhouse gas emissions from transport in the Netherlands
Source: Eurostat

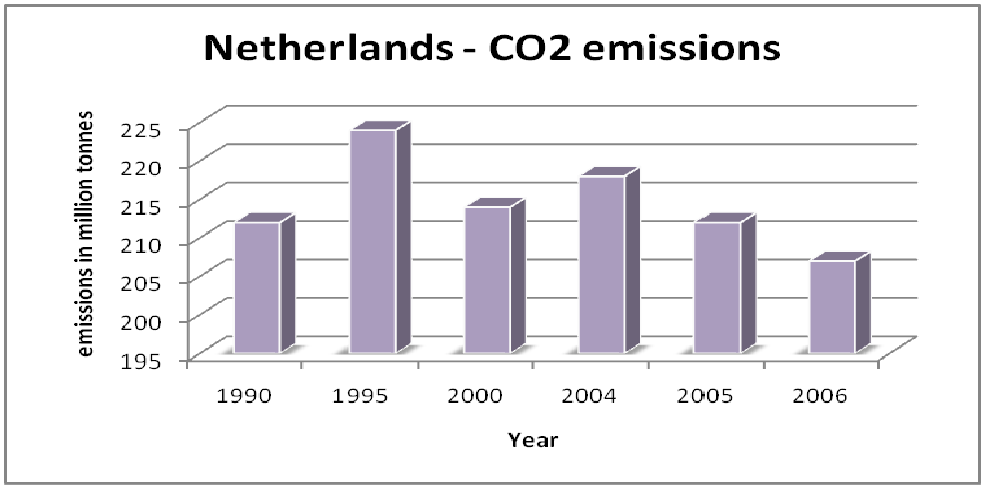

Figure 4.13: CO_2 emissions in the Netherlands *Source: Eurostat*

The Kyoto Protocol which was signed in 1997 and entered into force in 2005 has set targets for the amount of the emissions of the greenhouse gases. These targets are referred to the time period 2008 – 2012 and the European Union has agreed to reduce the emissions by 8% in this period, compared to the reported emissions of the base year which is 1990. Additionally, each participating country has agreed on reaching its own target based on the European Union's burden sharing agreements. For the Netherlands, this target for the emissions of greenhouse gases is equal to 94 million tones when in the year 2006 the emissions were equal to 97.4 million tones. Figure 4.14 represents the emissions of the Netherlands since 1990 which is the base year according to the Kyoto Protocol. The red line represents the target set by the Protocol.

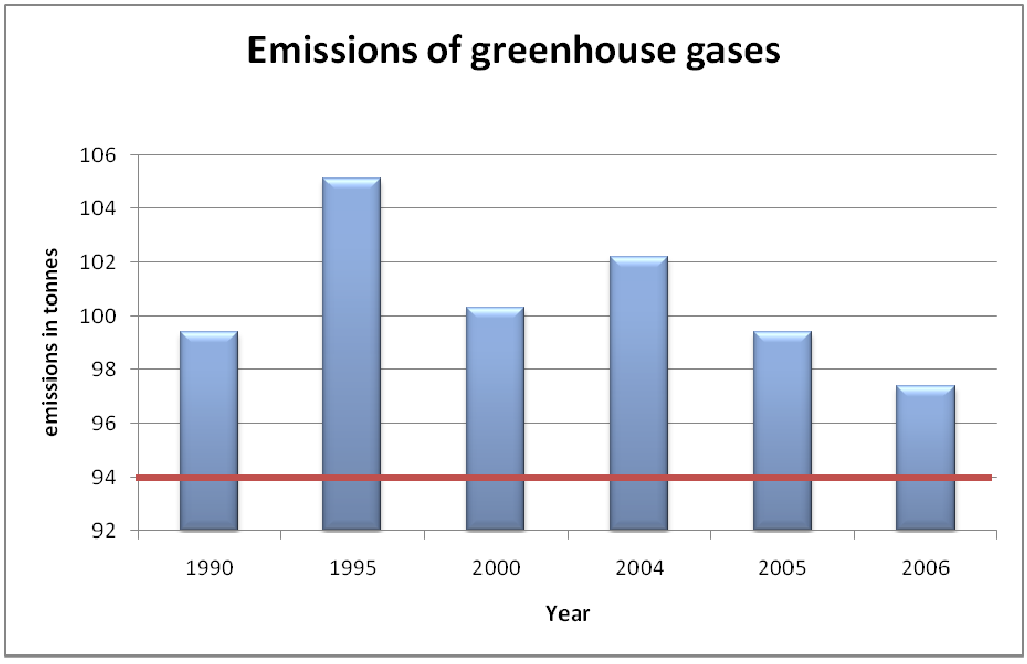

Figure 4.14: Emissions of greenhouse gases in the Netherlands and the target set by the Kyoto Protocol

Source: European Environment Agency / Eurostat

The Netherlands committed, by signing the Kyoto Protocol, to reduce its emissions by 6% compared to the base year under the European Union's burden sharing agreement. In order to examine whether this target can be achieved, the Netherlands examine two different socio-economic scenarios, the "Strong Europe" and the "Global Economy" scenarios. The first one represents the European Union as a political and economically stronger Union. Additionally, the United States are also part of a global attempt towards the protection of the environment and they pursue policies which are based on the mechanisms suggested by the Kyoto Protocol. The second scenario aims in the development of international trade with little political involvement and cooperation. Emphasis is given on the personal responsibility and the initiatives of the citizens and also on the actions of the

corporations in order to increase material welfare and economic growth. It should be marked that under both scenarios, the Netherlands cannot meet the emissions' target of 2010 set by the Protocol. Therefore, it is necessary that the Dutch government will take more efficient measures and focus on the sectors which harm the environment at most.

4.6 Actions and initiatives by the City and the Port of Rotterdam for the protection of the environment

Over the past years, the Netherlands has realized the importance and the necessity of protecting the environment. More specifically, the City of Rotterdam has decided to work towards an environmental friendly city and a sustainable port. For that reason, several measures have been taken in order to control and reduce the emissions of greenhouse gases and minimize the harm of the environment.

The first important and significant initiative is the so called Rotterdam Climate Initiative. In November of 2006, the International Advisory Board of Rotterdam realized the necessity of the reduction of the CO_2 emissions and the economic opportunities and advantages of clean energy. Then, in January of 2007, the Port of Rotterdam, Deltalinqs (the association of entrepreneurs in the Rijnmond port industrial area), the City of Rotterdam and the DCMR Environmental Protection Agency decided to join forces and take specific measures towards the protection of the environment. In May 2007, these participating parties started the Rotterdam Climate Initiative, a unique action and approach in the world and a program that combines on the one hand the environmental protection and on the other hand the economic opportunities that arise from the use of clean energy and renewable energy resources.

The main objectives of the Rotterdam Climate Initiative are to conserve energy, to capture, store and reuse CO_2 and to use sustainable energy. By achieving these goals, Rotterdam will be able to reduce its CO_2 emissions by 50% by 2025 as compared to the level of emissions recorded during the base year (1990), to be a city which is fully climate proof and finally to strengthen the economy of the Rotterdam area. As changes in the climate will continue to occur over the years, the Royal Netherlands Meteorological Institute and the Dutch Delta Committee predicted that a rise in the sea level by maximum 0.85 to 1.20 meters will occur until 2100. If this prediction is proved to be correct, then the Netherlands will face serious problems and the whole country will be jeopardized by cases of flooding. Thus, the reduction of the greenhouse gases which are responsible for the temperature rise is of major significance for the country. Additionally, the protection of the environment brings also results to the economic situation of a country. This happens mainly for two reasons. On the one hand, the shipping companies can save money and increase their profits by switching to more environmental friendly type of fuels. On the other hand, new companies decide to set their business up in the area due to the priority the city assigns in changing the climate and also due to the access that they have to a global market because of the different, international initiators of the Rotterdam Climate Initiative.

Nowadays, the European region emits 20% of the global CO_2 emissions. As part of a worldwide attempt to protect the environment the European Union aims in

reducing these emissions by one fifth. Moreover, the Netherlands has set as a goal to reduce its emissions until 2020 by 30% compared to the emissions of the base year. Rotterdam, as the major European port and an industrial hub for the North-west Europe, is responsible for 14% of the current Dutch CO_2 emissions. With emissions in 1990 and 2005 equal to 24 million tons and 29 million tons respectively, it is estimated that in 2025 Rotterdam will emit, due to its expected economic growth, approximately 46 million tons, if no further action is taken[18]. For that reason, the participating parties of the Rotterdam Climate Initiative have set a maximum limit on the overall CO_2 emissions of the city, equal to 12 million tons in 2025. The CO_2 emissions of Rotterdam over the years and the limit that was set can be observed in Figure 4.15. In order to reach this limit, drastic measures need to be taken by the local authorities, taking also under consideration the growth of the port and the increasing demand over the next years for energy.

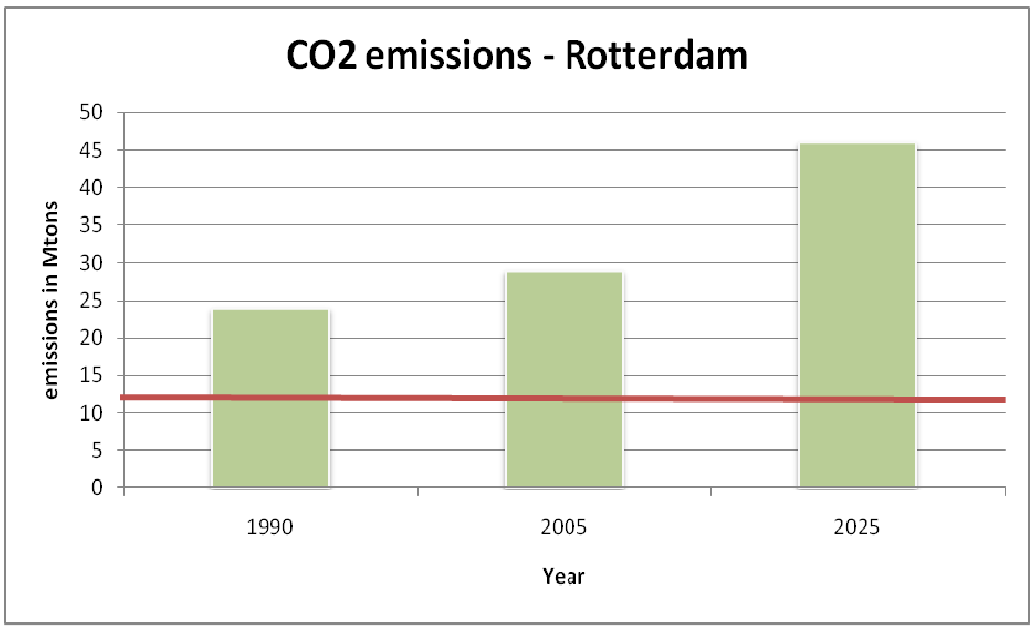

Figure 4.15: CO_2 emissions of Rotterdam

Source: Rotterdam Climate Initiative

The carbon footprint of a city or a region is the amount of greenhouse gases which are emitted in that city during a specific time period. The reported amounts of emissions are divided into three categories based on three scopes. The first scope is the operational control scope and includes the direct emissions of this area's day-to-day operational activities, the second scope includes the emissions from the power stations and the third scope includes the so-called indirect emissions which are related to activities like dredging, emissions data that can be used by the shareholders. The amount of greenhouse gases which were emitted during 2007 by the Port of Rotterdam accounts for 36290 tones CO_2 equivalent. From this amount,

[18] Rotterdam Climate Initiative Internet Site

the direct emissions account for approximately 25%, the energy indirect emissions account for 20% and the other indirect emissions (scope three) account for 55%.[19]

As can be observed in Table 4.2 which represents the CO_2 footprint of Rotterdam, the sector which pollutes the environment at most is the industrial one. On the other hand, the Rotterdam Climate Initiative is not interested in reducing the emissions only of this sector but its goal is to reduce the CO_2 emissions of all sectors without regard to the amount they emit. For that reason, the initiators are trying to find measures to deal with the emissions caused not only by the industries which are located in the area but also by the City and the Port of Rotterdam.

Table 4.2: Rotterdam's CO_2 footprint

Sector	1990	2005	2025
Industry and energy	**20.9**	**25.3**	**42.1**
chemistry	3.9	3.6	3.3
refineries	8.7	10.8	13
power generation	7.8	9.9	24.6
waste incineration	0.2	0.4	0.6
other industries	0.3	0.7	0.6
Traffic and transport	**1.4**	**2**	**2.5**
road traffic	0.9	1.2	1.5
shipping	0.5	0.8	1
Built environment	**1.3**	**1.3**	**1.1**
Total	**23.7**	**28.7**	**45.7**

Source: DCMR Environmental Protection Agency Rijnmond

The second important initiative is the Green Award. This award was first established in 1994, by the cooperation of the Port Authority of Rotterdam with the Dutch Ministry of Transport and Water management. Since 2000, the certification is no longer given by the Port Authority and by the Dutch Ministry, but by a board of experts. This board includes people from the industry. They may be ship owners, scientists or they may work in port and maritime authorities, in the shipbuilding, the environmental or the insurance sector. The operating body is neutral and independent, operates all over the world, keeps expanding and updates the requirements constantly based on the new regulations.

The Green Award was founded at a time when several incidents occurred. Collisions and accidents of vessels were quite often leading to sea pollution and causing damage of the environment. Additionally, the world was facing the first signs of the climate change and the environmental parties were warning about the deterioration of the environment. The Port Authority of Rotterdam realized that action must be

[19] World Ports Climate Conference, Rotterdam, 2008

taken and founded the award in order to improve quality in shipping and also increase the environmental awareness. The award is given to ships which comply with national and international legislations and meet specific requirements concerning not only the technical equipment of the ships but also the environmental behavior of the crew and the management of the vessel.

The green award is not an obligation. The ship owners that decide to have their ships inspected participate voluntarily in order to achieve a good reputation and the advantages of being awarded. The vessels that can be awarded are product tankers, crude oil tankers and bulk carriers which have deadweight of minimum 20,000 tons. The ports that are participating in this initiative and recognize the green award are nowadays 50 in 8 different countries. Each participating port provides different incentives to shipping companies to acquire the award. The main incentive is reduction in the port fees and the tariffs on port use. This reduction may not be significant as it is usually equal to 5 – 10%, but to a shipping company even this reduction increases its profits.

The shipping companies and the port authorities are benefited from the Green Award. The shipping company has not only lower costs due to the lower port dues but can also acquire better charters and lower insurance premiums. Additionally, it promotes a better image as an environmental friendly company and can attract more clients. Moreover, the participating ports are benefited also from the award. First of all, environmental and security risks are reduced and the number of certified and quality ships is increased. Additionally, a positive image of the ports is promoted because by establishing the green award, they pay special attention to pollution and air emissions issues, achieving also a growth in the awareness of these issues. Thus, the ports attract more shipping companies and especially those companies that are interested in becoming more environmental friendly. Lastly, the port can increase its efficiency. This happens because the certified ships spend less time in the port allowing the terminal operators to load and unload more vessels.

The Port of Rotterdam Authority has established several projects in order to become more sustainable and decrease the air emissions in the area. These projects are divided into three categories. The first one focuses on the actions of the Port Authority and measures on the Port of Rotterdam vessels, the second focuses on projects for the port area and the third on projects applied in the supply chain.

The first category contains the calculation of the carbon footprint of the Rotterdam area. Additionally, the Port Authority has assigned TNO to measure the amount of greenhouse gases emitted by the vessels of the Port of Rotterdam. Lastly, the Port Authority has decided to use clean truck diesel fuel on all the vessels of its fleet and to equip its new vessels with post-combustion treatment and sooth filters. As far as the projects of the port area are concerned the Port Authority has decided to use shore-side power for all inland vessels and also study how feasible it is the use of shore-side power for all sea-going vessels. Moreover, the Port Authority focuses on three important projects; to efficiently capture, store and re-use Carbon Dioxide, to monitor and manage effectively the carbon footprint of the Port of Rotterdam and to develop an inland container terminal in order to reduce the congestion in the port area. In the supply chain area, the goals of the Port Authority is to achieve through the lease contracts a modal shift from road to rail and inland shipping and also to replace the engines of barges in order to reduce the emissions.

The City and the Port of Rotterdam, with these initiatives and projects, prove that they are really interested in the protection of the environment and that they are working hard to achieve a better environment for the future generations and to minimize the risks of climate changes. These efforts should be an example for the other European ports in order to reach the limits set by the European Commission and the International Maritime Organization for the emissions of greenhouse gases.

4.7 The effects of the Integrated Maritime Policy

The Integrated Maritime Policy which was published in 2007 by the European Commission draws the attention of the European Countries to the protection of the seas and their significant importance in our everyday lives. The European marine environment is the key element of this paper because on the one hand, is the provider of energy, resources and food and on the other hand is a climate regulator. Moreover, the economical condition of countries like the Netherlands is determined by the seas that surround Europe, because they are used as trade and connection routes with Asia, the upcoming financial power of the world. For these reasons, the marine environment should be protected and the European countries should coordinate their actions and cooperate towards this common goal. The goal of the Integrated Maritime Policy is to manage the European Countries to use the oceans and the seas in a more sustainable way and increase safety and security not only to reduce the collisions between vessels and the pollution caused by them, but also to minimize the cases of terrorism, smuggling and trafficking. With the development of a common European market and of trade between the European Countries without barriers, cases and problems of security are important and should be resolved. Research, technology and innovation can be used efficiently in order to find new ways to make use of the environment without further destroying it and also to overtake current issues in the cases of renewable energy.

4.7.1 The positive effects of the Integrated Maritime Policy to the Port of Rotterdam and future actions

The most important positive effect of the publication of the Integrated Maritime policy is the fact that a framework is now available and based on this policy the Port of Rotterdam can cooperate with other European Ports to protect the environment. Additionally, the shipping companies are trying to comply with the new regulations helping also the Port Authorities to reach a common goal.

The Port of Rotterdam has been working towards the reduction of the greenhouse gases emissions and the increase of the sustainability of the port for several years. With the Integrated Maritime Policy, the Port Authority has now the chance and the ability to cooperate with other ports and minimize the cases of bureaucracy and of delays caused in the transportation of goods due to the different procedures and documents the ports have. Therefore, the transportation of goods by road, rail or inland waterways can now be easier. Moreover, based on the policy, the Port of Rotterdam has the opportunity to promote new strategies and make better use of already existing ones. The positive effects of the Blue Paper are presented here in the form of strategies and actions that the Port of Rotterdam can or will adopt in the next years.

Shore-side electricity – On-shore power supply

A short-side electricity system was first established in 1991 in Pittsburg, California due to a local air permit, but the first terminal which was converted in order to provide services to vessels using this type of systems, was a Ro/Ro terminal in the Port of Gothenburg in 2000.

The ships, during the time they spend in the port, use auxiliary engines to produce the necessary electricity for loading and unloading cargo and for all functions of the vessel. For example, reefer vessels require more electricity in order to control the temperature of the products they transport. During their stay in the port, the ships emit greenhouse gases due to the use of their engines. Therefore, if all vessels during the mooring process shut down their engines and use instead on-shore power supply, the emissions would decrease significantly, as it was observed and recorded in the Port of Gothenburg. In that way, if the Port of Rotterdam adopted these types of systems, it would manage to decrease the emissions reported in the area.

The cargo vessels in order to run all functions in the ship like hot water, heating and engines require a high output of electrical power. As it was measured in the Port of Gothenburg, a Ro/Ro vessel during the average time spent in the port requires 5,000 – 20,000 kWh. Although shore-side electricity, providing low voltage, was previously used, it was not possible to run all functions of the ship as heavy cables were needed. This time-consuming and complex process and also the space that was required on board and on-shore to set such equipment, made these systems undesirable. Nowadays, the shore-side electricity systems are improved and they have become a good alternative for the reduction of the emissions.

Shore-side electricity systems are consisted by the following components. First of all, a national grid and a sub-station are connected with a cable which carries electricity equal to 20-100 kV. This amount of electricity is then transformed in the sub-station to 6-20 kV. Secondly, cables leave from the sub-station, delivering this electricity to the port terminal. There, the electricity needs to be converted to power from the national grid equal to either 50 or 60 Hz, depending on the amount of power the ship runs. On the terminal, it is suggested to have a cable reel tower, supporting a frame, a davit and a cable reel. In that way, the frame and the davit will be used to lower and raise the cables to the vessel, avoiding the handling of the high voltage cables by individuals. Then, the ship should acquire a socket on board in order to connect the cable. On board there will also be a transformer, changing the high voltage electricity to 400 V. This electricity is distributed to the ship and the use of auxiliary engines is no longer needed. The use of high voltage cables is more preferable than the use of low voltage ones, because the high voltage can carry electricity which is 25 times more than the electricity carried by a normal cable. Additionally, high voltage cables are preferred as they are lighter, simple and handy, allowing not only more flexible connections but also these connections have lower maintenance and capital costs compared to the connections of low-voltage cables.

The shore-side electricity system, with its elements, can be observed in Figure 4.16:

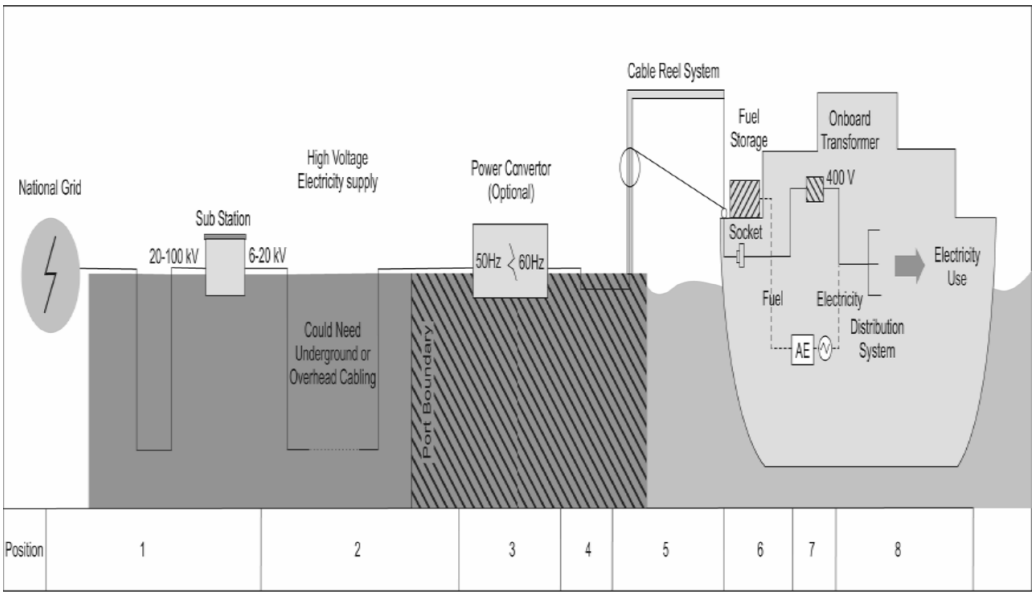

Figure 4.16: Shore-side electricity system *Source: Entec UK*

The use of shore-side electricity systems has advantages and disadvantages. The main advantage is that the emissions of greenhouse gases are reduced. When using these types of systems, the CO_2 emissions, on average, are equal to 330g/kWh. On the other hand, with the use of auxiliary engines during the time spent in port, the emissions are approximately 690-720g/kWh. Therefore, on average a reduction of 50% of the CO_2 emissions is achieved. Moreover, the emissions of Carbon Monoxide with the use of shore-side electricity are estimated in 0.0125g/kWh and with the use of the engines are estimated in 0.9-1.3g/kWh. Thus, the CO emissions can be reduced by approximately 99%.[20] Another advantage is the reduction of noise. When the auxiliary engines are used, exhaust and mechanical noises, noises due to the combustion and also mechanical vibrations occur. With the use of shore-side electricity, the auxiliary engines are no longer used during mooring time and noise and vibrations no longer exist. This is a fact really important to the crew of the ship and to the personnel which works on-board.

On the other hand, there are also disadvantages. First of all, certain types of vessels like refrigerated cargo or dry bulk ships may require more complex electrical connections. Secondly, the costs of supplying a terminal with high-voltage electricity can vary between 10000 and 500000 Euros depending on the distances, the local conditions and to the number of the transformation connections. Generally, as it was observed in the Port of Gothenburg, the external costs are considered high but the technology that is used in these systems can be obtained at a reasonable cost. Additionally, the shore-side electricity systems can be a good alternative to the European Commission's regulation of using fuels with 0.1% sulphur during berth

[20] European Commission: Service Contract on Ship Emissions: Assignment, Abatement and Market-based Instruments, 2005

because it will be cheaper for the ship owners to use electricity instead of low-sulphur fuels. As can be seen in Table 4.3, the percentage reduction of the emissions, during berth time, due to the use of shore-side electricity is significant.

Measure	% emissions reduction per vessel			
	Nox	SO2	PM	VOC
Shore-side electricity compared to the 2.7% sulphur fuels	97%	96%	96%	94%
Shore-side electricity compared to the 0.1% sulphur fuels	97%	0%	89%	94%

Table 4.3: Reductions of emissions due to the use of short-side energy electricity
Source: Entec UK Limited

Currently a pilot project concerning the shore-side power for barges is taking place in the Maashaven area. The duration of this program is two years and is the result of the cooperation between the Port of Rotterdam Authority and the company Eneco energy which will supply all the components to achieve the shore-side electricity supply. The advantages of this pilot program is first of all its ease as the companies can register either via internet or mobile phone and can start or stop the supply of electrical power with a phone call and secondly its cost which is € 0,24 per kilowatt hour for the inland vessels. As can be observed in Figure 4.17, several power units have been installed to supply the vessels with shore-side electricity power.

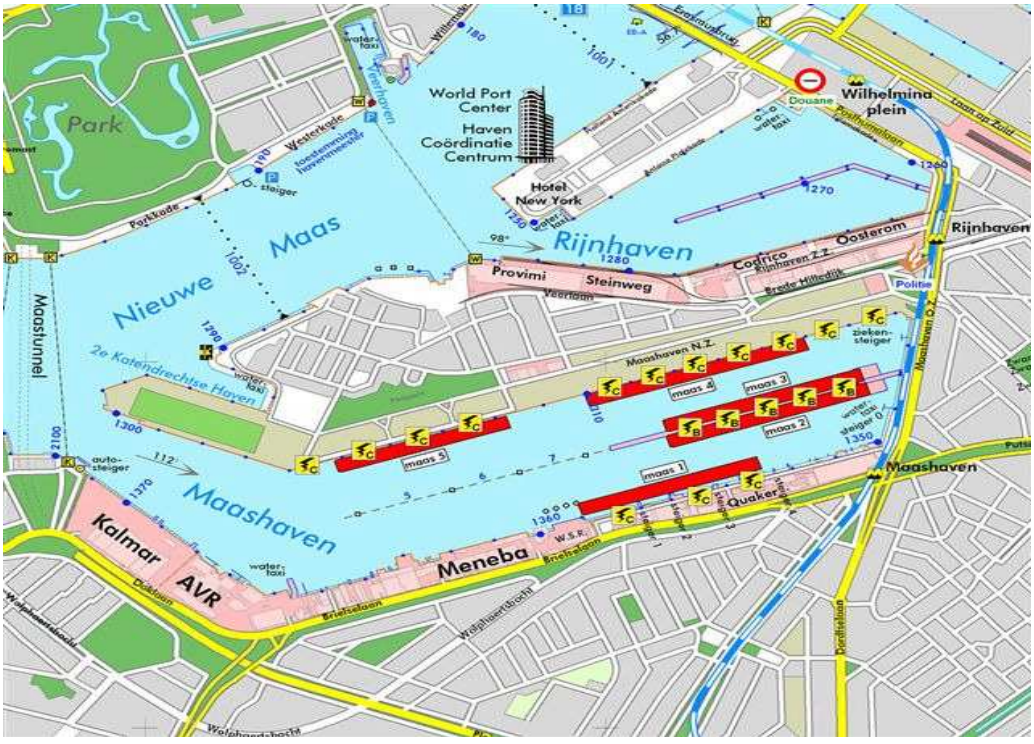

Figure 4.17: Shore-side electricity – Pilot project Maashaven
Source: "Air quality and climate change: involvement of PoR", presentation by Rob Houben in the Harbours, Air Quality and Climate Change Conference

Capture, storage and reuse of CO_2

In 2007, a report was published by the Rotterdam Climate Initiative concerning capturing, storing and reusing Carbon Dioxide. Based on this report, the City of Rotterdam can reach, by applying this method, the target set by the Kyoto Protocol in regard to the reduction of the CO_2 emissions by 50% in 2025 compared to the reported amounts of the base year, 1990. By capturing and storing 20 Mton/year of CO_2, this target can be reached.

The Carbon Capture and Storage program, as is known internationally, examines how emissions of CO_2 can be reduced by capturing and storing Carbon Dioxide underground. This method can be applied in the Rotterdam – Rijnmond area and the analysis made by the DCMR Environmental Protection Agency has shown that Rotterdam has unique opportunities of applying this method, as the costs are lower compared to other locations. Additionally, the Rotterdam Climate Initiative has proposed that until 2015, every year, 5 Mton/year should be stored and from then on and until 2025, this amount should be increased to 20 Mton/year. In that way, emissions can be reduced significantly.

Capturing Carbon Dioxide is a relatively cheap method. In the Rijnmond area, there is a large amount of pure CO_2, coming from several installations producing either biofuels or hydrogen, that can be captured. The process of capturing, drying and compressing this Carbon Dioxide, is estimated to cost approximately €15/ton. As can be seen in Figure 4.18, there are four different ways to capture Carbon Dioxide; through post combustion, pre combustion, oxy-fuel and industrial processes. In all methods, a decrease of Sulphur Dioxide is reported. Moreover, in the oxy-fuel and pre-combustion scenarios the amount of Nitrogen Oxides is reduced and in the oxy-fuel case, the amount of Particulate Matter is also reduced. On the other hand, in the post combustion method there is a significant increase in the emissions of Ammonia (NH_3). The Rotterdam Climate Initiative has set a target of capturing in total 20 Mton of CO_2. This amount will be captured by using the post-combustion technology, a technology now on a demonstration phase. The technology that is used currently is based on using amines, but is not a preferable one as it requires a large amount of energy, leading to higher costs equal to €40/ton.

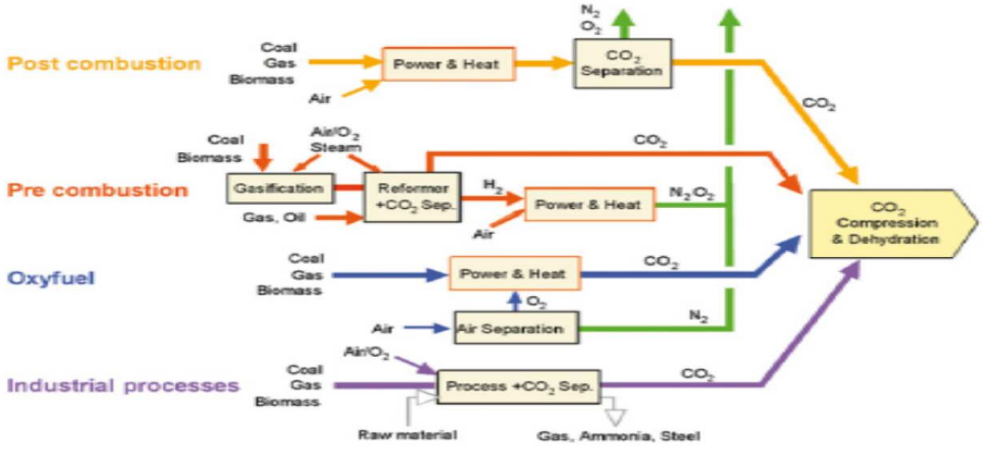

Figure 4.18: Carbon capturing methods *Source: IPCC Special Report, 2005*

For the past 80 years, the main methods of capturing Carbon Dioxide were the cement and steel industrial processes. Nowadays, the post-combustion capture system can be used in conventional power plants. Additionally, the pre-combustion method is of strategic importance as it can deliver not only a mix of hydrogen, electricity and lower carbon containing fuels but also drive the ambition of creating a hydrogen economy. On the other hand, the oxy-fuel combustion, even if is already used in the iron, aluminum, melting and steel industries is still at a research stage as far as carbon capturing is concerned.

The Port Authority of Rotterdam has prepared a case study examining the potentials, advantages and disadvantages of capturing and storing the CO_2 in the port area. This study mainly examines what changes need to be done in the infrastructure and how these changes can be funded. Two scenarios are examined; the basic one which deals with the storage of 1 Mton of Carbon Dioxide per year, and the second one, the maximum scenario, which deals with the storage of 5 Mton annually. These scenarios require approximately €50 million and €270 million investments respectively, estimating that the costs for the transportation of the Carbon Dioxide will be €22 per ton for the basic scenario and €20 per ton for the maximum one. These transportation fees can be reduced to €7.5 – 10 per ton, once a maximum target of throughput which is equal to 18 Mton annually is reached. Another possibility that is currently examined is the transportation of the CO_2 by ships, using the existing network of the Rotterdam area. In this case, the Port of Rotterdam can be developed further as a CO_2 hub, attracting more Carbon Dioxide suppliers. The storage of the CO_2 is, at this point, not considered a problem because there are gas fields in the North Sea which can store a significant amount of the captured Dioxide.

The main revenue generator of this project is the European Emission Trading Scheme. In order to provide profits to the participating companies, a price equal to €39 – 45 per ton is required. On the other hand, the captured Carbon Dioxide can be further used in the Emission Trading System. Based on this system, the underground storage of CO_2 allows companies to reduce costs. Additionally, part of the stored Carbon Dioxide can be sold, through the system, to other countries which cannot reach the targets set by the Kyoto Protocol.

The case of capturing, storing and reusing CO_2 has many advantages for the Port of Rotterdam as it can help increase its profits. Moreover, it helps the Dutch government to meet its CO_2 targets set by the Protocol. On the other hand, more action needs to be taken, especially in funding the project as the costs of the necessary infrastructure are quite high. Therefore, funding either by financial institutions or by the Dutch government and the European Union is essential in order to have the project started.

- **Change in the use of fossil fuels with the use of Liquefied Natural Gas**

The use of fossil fuels like coal and oil has increased significantly over the years. These types of fuels are extensively used in the transportation and more specifically in the shipping sector. The disadvantages of these fuels are, first of all, their limited amount leading to the necessity of finding new types of fuels and secondly, they are responsible for changes in the climate as they increase the emissions of greenhouse gases through their combustion. For that reason, the industry is looking

for ways to reduce the use of these fuels and switch to more environmental friendly ones. Fuels that cause less greenhouse gases emissions are biofuels and Liquefied Natural Gas (LNG). Liquefied Natural Gas accounts nowadays for 15% of the European Union's gas imports and this sector of energy is growing fast. Therefore, switching from fossil fuels to LNG affects directly the Port of Rotterdam as such a switch brings changes in the port infrastructure.

The alternative of LNG has advantages but also disadvantages. The use of liquefied natural gas in the transportation sector is more environmental friendly compared to oil but still pollutes the environment as it contains high amount of methane. Additionally, the volume of LNG is approximately 600 times less than that of the pipeline natural gas and thus the required storage space is fewer. Moreover, due to its liquid condition is easier to be transported especially over long distances and can be stored efficiently.

On the other hand, LNG energy projects are still considered expensive and they are also advanced in terms of the required technology. For example, the construction of the Gate Terminal in the Rijnmond area is estimated to cost Royal Vopak Company 745 million euros. The Port of Rotterdam, in order to follow the trends in the shipping sector, should build new infrastructure to store the Liquefied Natural Gas. In the new area of the port, the Maasvlakte 2 area, 190 out of 1000 hectares will be used for the storage of liquids. Conclusively, there are still many practical difficulties and problems that need to be resolved. The Liquefied Natural Gas may be an alternative of pipelines, but still a great amount of energy is needed to liquefy and store the natural gas.

- **Use of wind energy**

The emissions of greenhouse gases can be reduced with the use of renewable energy sources. The use of wind energy is broadly used nowadays and due to its advantages, it will be used more extensively in the future.

Wind turbines create electricity by making use of the wind. The ones that are used for producing commercial electricity are usually between 100 kilowatts and 5 megawatts. Each kilowatt hour of electricity which is produced by the wind turbines prevents around 1.5 pounds of carbon dioxide from going into the atmosphere, compared to the carbon dioxide that is emitted by the power plants that use coal. In that way, emissions of CO_2 can be reduced.

The Rijnmond area and the Port of Rotterdam are locations where wind energy can be extensively used. In order to start generating electricity, most wind turbines require winds of approximately 16 km/hour. Thus, the strong winds and the flat landscape of Rotterdam are ideal for the construction of wind parks. Another advantage of wind turbines is their long lifespan which is estimated in 20-25 years or to approximately 120,000 working hours. During this lifetime, some moving components may need to be replaced but the cost of maintenance and replacement of these parts is around 1.5 – 2% of the original turbine cost, per year. Moreover, with research and with the development of technology, the noise originated by the turbines has been decreased and many countries regulate the position of wind turbines so that they are not close to residential areas.

The only disadvantage of constructing wind farms is the cost of buying them which varies between 150,000 and 300,000 Euros. On the other hand, this cost should not be considered high as it is an amount which can be easily amortized. The Port of Rotterdam has already decided to construct a wind farm in the Maasvlakte 2 area.

- **Time slots**

Another option that can be used by the Port of Rotterdam is time slots for ships and trucks in order to reduce the air emissions. The vessels, by spending time in the port waiting to be berthed, are making use of their auxiliary engines and the amount of exhaust fumes is increased. Additionally, due to road congestion on the highway A15, the greenhouse gases emitted by the trucks are increased. These cases can be prevented by using a timetable to control the arrivals of trucks and ships. Timetables are a solution which benefits also the ship operators as they will not have to pay demurrages in cases where the ports are busy and delays occur.

A timetable can be used, but in order to succeed certain specifications need to be considered. First of all, the companies which operate the terminals should cooperate not only with the other operators but also with the Port Authority in order to avoid delays. Additionally, extreme weather conditions must be taken under consideration as these conditions can lead to the delay in the arrivals of ships. This problem can be partially resolved based on the Automatic Identification System (AIS) which tracks the vessels within a range of 40 nautical miles. Conclusively, the arrivals' timetable is not a broadly used solution as is difficult to succeed especially in ports with increased traffic like the Port of Rotterdam.

- **Energy saving equipment**

The Port Authority can reduce the air emissions and the amount of energy that is used in the port area by acquiring new energy saving equipment or by modifying the existing one. Hybrid electric vehicles and vehicles which use natural gas or biodiesel, hybrid locomotive and straddle carriers with energy storage system are options that are currently tested and can be future options against the air pollution. The first straddle carrier with an energy storage system is now in service in Hamburg designed to save energy up to 10 percent. This type of straddle carriers emits approximately 350 kg Carbon Dioxide per shift, 200 kg less of the amount emitted by the older, conventional straddle carriers. Moreover, the new type of straddle carrier saves fuel equal to 2 liters per hour, fuel consumption which leads to a 265,000 kg reduction in Carbon Dioxide emissions during its operating life. Additionally, its diesel engine operates more gently reducing the noise and increasing its operating life.

Another option that is currently tested by the Port of Rotterdam Authority is a hybrid shunting locomotive. During its trial period, the locomotive will be pulling trains in a distance equal to 4 kilometers from the Bertschi Terminal to the Botlek rail yard. Alstom Transport, the construction company, expects to achieve a reduction in the emissions of Carbon Dioxide, Nitrogen Oxide and Particulate matters by 50%, fuel savings equal to 40% and reduction in noise by 15 decibels. During the trial period, the construction company will examine how these estimations respond in practice. The advantage of this locomotive, besides the reduction in emissions, is that the

investors can recoup the amount spent in few years. This happens because in regard to the traditional locomotives whose diesel engine runs continually, in the hybrid locomotive, during the long waiting times, the diesel engine is shut down and the drive and auxiliary systems are powered by battery. This leads to major savings in maintenance and fuel costs giving the opportunity to the investor to have profits after a couple of years. On the other hand, the cost of this type of locomotive is still high and equals to 1.5 – 2 million dollars.[21] Possibly, after the trial period, the investors and the Port Authorities will acknowledge the advantages and will find the means to further finance this project.

Conclusion

All the afore-mentioned solutions are projects based on the goals of the Integrated Maritime Policy. Another positive effect of this policy is that through the construction or the application of these projects, employment in the area is increased. More people will be employed in order to construct the Maasvlakte 2 area, or a LNG terminal. Therefore, the social welfare and the economic prosperity of the area is increased but also, special attention is paid to the protection of the environment as all these projects have a common goal, the increased sustainability in the Rotterdam area and the reduction of the greenhouse gases emissions. Additionally, based on the Integrated Maritime Policy and the Maritime Spatial Planning, the Port of Rotterdam has the opportunity to cooperate in a more efficient and effective way with other European Countries. This happens because now all European ports have the same goals and can coordinate their actions. Moreover, the cases of delays that used to occur due to the bureaucratic procedures and the different national documentations are now decreased. Overall, the positive effects of the Blue Paper outbrave the negative ones.

In Table 4.4 a summary of the afore-mentioned effects and actions is provided and the advantages and disadvantages of each action are also presented.

[21] http://www.arb.ca.gov/railyard/ted/comments_ahlt.pdf

Actions	Advantages	Disadvantages
Shore-side electricity systems	Reduction of carbon monoxide, carbon dioxide emissions	Different types of ships like reefers need a more complex electrical connection
	Reduction of noise	High external costs
	Good alternative to the 0.1% sulphur regulation	
	Elements of the system can be obtained at reasonable cost	
Capture and storage of CO2	Low costs for Rotterdam	Higher costs for the companies
	Post-combustion technology is cheaper but still in demonstration phase	Current method using amines costs more and requires a great amount of energy
		Requires high investments
Change of fossil fuels with LNG	LNG friendlier for the environment	Lack of infrastructure
	LNG requires less storage space	LNG expensive
Wind Turbines	Long life duration	Cost
	Use of renewable energy	
	Low maintenance costs	
Time slots	Reductions of port delays	Cooperation is needed
	Reductions of air emissions	Arrivals may vary due to weather conditions
Hybrid Locomotive	Reductions of air emissions by 50%	Cost
	Reduction of noise by 15 decibels	
	Reduction in fuel and maintenance costs	

Table 4.4: Summary table of the positive effects of the Integrated Maritime Policy

Source: Elaborated by the author

4.7.2 The negative effects of the Integrated Maritime Policy to the Port of Rotterdam

The Integrated Maritime Policy does not only affect positively but also negatively the Port of Rotterdam. Through the policy, a framework that was missing from the European Union is now established. The disadvantage is that no penalties are stated in the policy for those European Countries which will not comply with the new regulations and targets. The Dutch Government and the Port of Rotterdam in particular, have been working in the establishment of the goals proposed in the Blue paper for the past years and thus, it will be easier for the Netherlands to reach the required targets compared to the other European Countries.

The other important disadvantage of the policy is that projects that can increase the sustainable use of the oceans and the seas and decrease the air emissions which are responsible for the harm of the environment are quite costly. For that reason, it is necessary that the European Commission, in cooperation with the national governments, will find ways to finance these projects.

In conclusion, the Integrated Maritime Policy was a necessary step towards a better use of the environment and its resources. On the other hand, there are many problems that need to be resolved by the International Maritime Organization and the European Commission in order to deliver to the next generations a world where the environment is protected and special attention is given to the use of the energy resources and to the protection of the marine environment.

Chapter 5: Conclusions

Every year, the amount of products that is traded around the world, is increased significantly. These products are transported by several ways, such as rail, road, vessels and inland waterways. The rivers and the seas are used not only as trade routes but also are part of our everyday life, as they provide us with food, resources, energy, employment through the ports and leisure in the coastal region and the islands. On the other hand, this extensive use of the marine environment has led to its deterioration. Thus, it has become essential to protect our environment and achieve a more sustainable use of it.

In order to promote the environmental protection, the European Commission has published several papers over the past years to provide a framework for the European Countries to develop on the one hand, socially and economically and on the other hand, sustainably by making a better use of the environment and by taking measures to protect it. These papers examine and analyze the current problems the European Union is facing and also suggest ways to resolve them. In general, the goal of the European Countries should be the achievement of economic growth that goes hand by hand with the environmental protection.

The most important of the papers the European Commission has published, is the Integrated Maritime Policy which focuses on the European maritime environment. In this paper, the significance of the seas to our everyday life is recognized and the necessity for environmental protection is highlighted. In order to achieve this, the parties which participate in the decision-making process, both in national and European level, should coordinate their actions and cooperate towards a common goal. The European Commission aims also in creating a network for maritime surveillance between the European Countries and a network of clusters. By achieving cooperation between the coastguards of the Member States and by creating a network for e-navigation and for vessel tracking, the risk of accidents is minimized; the maritime boarders are secured and safety in the seas is increased. In the Integrated Maritime Policy, the European Commission focuses in five goals. These goals include raising the visibility of the maritime Europe, using knowledge and innovation in the maritime policies, maximizing the sustainable use of the oceans and the seas, achieving a high quality life in the coastal regions and promoting the leadership of Europe in the International Maritime Affairs.

The shipping sector is a key element in the European economy. Trade not only increases the profits of the European Countries but also promotes the European Union as an important player in the global economy. Therefore, to achieve the growth of the shipping sector and the sustainable use of the seas, several problems need to be resolved. First of all, the bureaucracy, the complex and time consuming procedures in the transportation of goods from one European port to another, cause problems in the development of the transportation through the inland waterways. Additionally, as the public investments are low and the research in the maritime sector is expensive, it is necessary to achieve the cooperation of the scientists and the policy makers in order to predict the environmental effects of several actions and find solutions to existing problems. Research and technology can be used in order to find ways to increase the sustainable use of the marine environment.

The Port of Rotterdam is the major European port which deals every year with an increasing volume of products, transported with different ways to countries around the world. As a significant part of the Netherlands is below sea level, for the country and especially for the Port of Rotterdam, the protection of the environment is essential. The Port of Rotterdam is continuously seeking ways to become more accessible and sustainable. The construction of the Maasvlakte 2 area which started last year represents exactly that philosophy. On the one hand, the new port area will meet the requirements for growth but on the other hand, the Port Authority has undertaken that the companies which will set up their businesses will respect the environment and will operate in a sustainable way.

The Netherlands, as part of the European Union, has to comply with the regulations published by the European Commission. Therefore, the Port of Rotterdam is affected by the publication of the Integrated Maritime Policy. The effects of this paper are both positive and negative. The major positive effect is that the Paper provides a framework that was missing from the European maritime sector. This framework gives to the Port of Rotterdam the opportunity to cooperate with other European ports in order to achieve the protection of the environment. Additionally, the Port Authority has been looking over the past years, ways to reduce the emissions of Carbon Dioxide and other greenhouse gases that are responsible for the greenhouse effects and the climate changes. Moreover, as the European Commission is aiming in creating a barrierless European market and as the different national governments are cooperating, the transportation of products between the countries has become easier and checking the necessary documents is a procedure less complex and less time-consuming. Furthermore, based on the Integrated Maritime Policy, the Port of Rotterdam can promote new projects and actions, like the shore-side electricity systems, to protect the environment. On the other hand, the new technologies that can be applied are expensive. Thus, it is important that the European Commission will work together with the financial institutions and the national governments in order to find ways to finance the application of these technologies and the research for the finding of new ones. Another disadvantage of the Integrated Maritime Policy is that it does not include any penalties, like paying a fee, for the countries which will not comply with the new regulations.

Conclusively, the Integrated Maritime Policy affects the Port of Rotterdam in a positive way. Even though there are important disadvantages of this Policy, overall, the advantages are more. Of course, there are many problems still to be resolved but it is important that the European Commission has taken the first step towards the protection of the environment. Additionally, based on the Policy further actions can be taken by the countries and by the European Union as a whole. Nowadays, this is more possible and it can be achieved with the cooperation of the involved parties.

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Appendix

The data provided in this appendix were obtained by the TRENDS database.

Year	Mode of transport	Traffic type	pkm/tkm [mio]	vehkm [mio]	Emissions [t]				
					CO_2	CO	NO_x	PM	VOC
1970	Inland	Freight	102,769	158	3,175,417	3,044	60,871	4,058	3,044
1970	Maritime	Freight	7,006,622	711	92,225,071	203,142	2,190,594	214,214	65,828
1970	Rail	Freight	249,362	791	6,251,370	11,222	63,423	4,338	9,905
1970	Road	Freight	891,916	219,848	104,586,018	1,681,854	1,064,313	97,813	340,279
1970	Air	Passenger	200,050	2,364	60,286,793	70,125	199,918		22,098
1970	Maritime	Passenger	37,994	26	1,798,407	3,962	42,713	3,597	1,286
1970	Rail	Passenger	248,158	1,584	10,404,818	15,803	94,469	6,610	18,341
1970	Road	Passenger	1,602,291	915,554	196,700,206	27,178,302	1,580,861	55,658	3,102,650
1971	Inland	Freight	98,113	151	3,031,575	2,906	58,113	3,874	2,906
1971	Maritime	Freight	7,110,435	721	93,620,258	206,216	2,223,733	217,473	66,824
1971	Rail	Freight	229,420	764	5,641,040	9,924	56,314	3,857	8,933
1971	Road	Freight	933,646	230,854	109,660,887	1,760,960	1,115,159	102,620	356,291
1971	Air	Passenger	212,692	2,451	62,259,463	71,556	206,925		22,764
1971	Maritime	Passenger	38,135	27	1,823,605	4,018	43,311	3,653	1,304
1971	Rail	Passenger	238,698	1,598	10,052,957	15,070	90,341	6,307	17,854
1971	Road	Passenger	1,688,489	964,715	208,416,372	28,835,043	1,674,495	59,107	3,258,740
1972	Inland	Freight	96,581	149	2,984,229	2,860	57,206	3,814	2,860
1972	Maritime	Freight	7,305,888	739	96,141,440	211,769	2,283,618	223,389	68,623
1972	Rail	Freight	245,987	763	6,091,581	10,698	60,590	4,160	9,717
1972	Road	Freight	976,242	242,139	114,856,163	1,842,306	1,167,193	107,538	372,654
1972	Air	Passenger	226,231	2,545	64,376,814	73,114	214,412		23,465
1972	Maritime	Passenger	39,222	27	1,853,623	4,084	44,024	3,721	1,325
1972	Rail	Passenger	253,099	1,628	10,724,458	15,656	94,111	6,639	19,186
1972	Road	Passenger	1,822,291	1,017,194	223,541,437	30,763,152	1,830,648	62,766	3,660,480
1973	Inland	Freight	103,407	159	3,195,135	3,062	61,249	4,083	3,062
1973	Maritime	Freight	7,675,976	771	100,632,589	221,661	2,390,296	233,956	71,828
1973	Rail	Freight	251,542	784	6,232,474	11,032	62,424	4,279	9,914
1973	Road	Freight	1,019,584	253,617	120,138,012	1,924,389	1,220,055	112,535	389,217
1973	Air	Passenger	240,736	2,648	66,644,363	74,799	222,400		24,203
1973	Maritime	Passenger	40,606	27	1,887,267	4,158	44,824	3,795	1,349
1973	Rail	Passenger	256,207	1,649	10,930,423	15,680	94,477	6,695	19,680
1973	Road	Passenger	1,963,615	1,074,758	239,710,029	32,832,882	1,995,695	66,675	3,875,580
1974	Inland	Freight	107,417	165	3,319,061	3,181	63,624	4,242	3,181
1974	Maritime	Freight	7,765,873	781	101,855,945	224,356	2,419,354	236,818	72,702
1974	Rail	Freight	263,103	776	6,323,114	11,003	62,386	4,296	10,135
1974	Road	Freight	1,062,896	265,137	125,430,249	2,006,840	1,272,980	117,541	405,788
1974	Air	Passenger	256,282	2,758	69,068,134	76,613	230,911		24,978
1974	Maritime	Passenger	41,311	28	1,917,921	4,226	45,552	3,863	1,371
1974	Rail	Passenger	271,787	1,668	11,452,992	16,224	97,724	6,953	20,745
1974	Road	Passenger	2,095,057	1,129,108	255,026,054	34,778,119	2,153,784	70,349	4,078,556
1975	Inland	Freight	96,621	149	2,985,470	2,861	57,229	3,815	2,861
1975	Maritime	Freight	7,493,992	758	98,668,677	217,336	2,343,647	229,278	70,427
1975	Rail	Freight	235,654	744	5,860,315	10,759	60,604	4,122	9,160
1975	Road	Freight	1,105,681	276,642	130,693,141	2,089,592	1,325,525	122,526	422,288
1975	Air	Passenger	272,948	2,876	71,654,662	78,557	239,968		25,791
1975	Maritime	Passenger	42,119	28	1,950,461	4,297	46,324	3,931	1,395
1975	Rail	Passenger	272,833	1,671	10,840,334	14,946	90,804	6,486	19,761
1975	Road	Passenger	2,217,369	1,180,596	269,373,739	36,598,188	2,301,484	73,801	4,270,048
1976	Inland	Freight	97,307	150	3,006,657	2,882	57,636	3,842	2,882
1976	Maritime	Freight	7,793,179	787	102,587,625	225,968	2,436,734	238,472	73,224
1976	Rail	Freight	249,139	749	6,178,661	11,105	62,738	4,289	9,759
1976	Road	Freight	1,149,292	288,384	136,061,529	2,173,979	1,379,109	127,616	439,100
1976	Air	Passenger	290,822	3,004	74,411,021	80,634	249,597		26,642
1976	Maritime	Passenger	42,852	28	1,985,960	4,375	47,168	4,001	1,420
1976	Rail	Passenger	272,225	1,674	10,822,429	14,859	90,374	6,456	19,708
1976	Road	Passenger	2,322,938	1,230,525	283,048,055	38,329,687	2,442,212	77,117	4,453,534
1977	Inland	Freight	100,933	155	3,118,687	2,989	59,783	3,986	2,989

1977	Maritime	Freight	7,843,266	796	103,683,109	228,381	2,462,754	240,940	74,006	1,863,272
1977	Rail	Freight	242,057	741	6,010,896	10,719	60,644	4,152	9,520	20,147
1977	Road	Freight	1,194,515	300,552	141,629,079	2,261,511	1,434,690	132,894	456,529	232,973
1977	Air	Passenger	309,996	3,141	77,344,833	82,845	259,824		27,536	24,554
1977	Maritime	Passenger	43,580	29	2,020,614	4,452	47,991	4,072	1,445	31,762
1977	Rail	Passenger	275,463	1,689	10,987,756	15,034	91,621	6,551	20,024	46,160
1977	Road	Passenger	2,427,392	1,279,736	296,272,658	39,993,444	2,578,447	80,393	4,629,570	289,058
1978	Inland	Freight	105,951	163	3,273,759	3,138	62,756	4,184	3,138	3,556
1978	Maritime	Freight	7,968,668	818	106,024,131	233,538	2,518,357	246,126	75,678	1,903,491
1978	Rail	Freight	240,739	744	5,910,153	10,128	57,567	3,981	9,553	20,285
1978	Road	Freight	1,241,224	313,118	147,378,787	2,351,613	1,492,087	138,353	474,497	244,339
1978	Air	Passenger	330,571	3,287	80,464,287	85,193	270,679		28,473	25,544
1978	Maritime	Passenger	44,170	29	2,053,292	4,524	48,767	4,137	1,468	32,264
1978	Rail	Passenger	278,770	1,711	11,386,555	15,922	96,578	6,875	20,594	47,412
1978	Road	Passenger	2,521,305	1,328,445	307,915,186	40,501,810	2,697,716	83,636	4,785,660	327,519
1979	Inland	Freight	104,905	161	3,241,430	3,107	62,136	4,142	3,107	3,521
1979	Maritime	Freight	8,683,437	889	115,471,906	254,348	2,742,768	268,132	82,422	2,073,647
1979	Rail	Freight	246,355	761	5,888,941	9,911	56,504	3,920	9,579	20,439
1979	Road	Freight	1,289,255	326,032	153,288,474	2,444,170	1,551,075	143,964	492,989	252,764
1979	Air	Passenger	352,654	3,445	83,778,164	87,680	282,192		29,453	26,596
1979	Maritime	Passenger	46,903	30	2,196,728	4,840	52,174	4,469	1,571	34,836
1979	Rail	Passenger	272,291	1,735	10,930,435	15,094	92,114	6,555	19,768	46,165
1979	Road	Passenger	2,616,642	1,376,293	319,087,828	40,933,515	2,811,789	86,813	4,935,556	352,016
1980	Inland	Freight	105,618	162	3,263,461	3,128	62,558	4,171	3,128	3,545
1980	Maritime	Freight	8,488,271	869	113,160,041	249,256	2,687,856	262,858	80,771	2,032,815
1980	Rail	Freight	247,450	760	5,957,071	9,766	55,819	3,907	9,840	20,982
1980	Road	Freight	1,339,046	339,339	159,390,388	2,538,873	1,612,019	149,765	512,048	274,799
1980	Air	Passenger	376,362	3,614	87,295,850	90,309	294,396		30,480	27,713
1980	Maritime	Passenger	48,958	32	2,278,162	5,019	54,108	4,624	1,629	36,048
1980	Rail	Passenger	289,263	1,772	11,856,832	15,768	96,533	6,965	21,871	50,353
1980	Road	Passenger	2,702,597	1,423,930	329,989,061	41,332,333	2,922,606	89,981	5,081,545	314,073
1981	Inland	Freight	100,780	155	3,113,973	2,985	59,693	3,980	2,985	3,383
1981	Maritime	Freight	8,073,951	829	107,645,665	237,109	2,556,874	250,006	76,835	1,933,447
1981	Rail	Freight	240,390	730	5,742,890	9,241	52,890	3,715	9,561	20,204
1981	Road	Freight	1,390,108	353,045	165,667,619	2,636,634	1,674,694	155,743	531,625	307,427
1981	Air	Passenger	401,820	3,795	91,027,366	93,084	307,326		31,554	28,898
1981	Maritime	Passenger	49,596	32	2,240,643	4,937	53,217	4,532	1,602	35,340
1981	Rail	Passenger	287,942	1,781	11,862,410	15,567	95,476	6,911	21,994	50,457
1981	Road	Passenger	2,796,269	1,470,429	340,483,148	41,775,692	3,058,053	93,121	5,220,966	286,967
1982	Inland	Freight	98,486	152	3,043,103	2,917	58,334	3,889	2,917	3,306
1982	Maritime	Freight	7,905,584	814	105,894,055	233,251	2,515,269	246,057	75,584	1,902,855
1982	Rail	Freight	221,144	700	5,307,805	8,269	47,568	3,362	8,907	18,972
1982	Road	Freight	1,440,134	366,439	171,803,660	2,731,641	1,735,952	161,583	550,692	319,304
1982	Air	Passenger	429,164	3,989	94,983,386	96,005	321,019		32,676	30,153
1982	Maritime	Passenger	50,301	31	2,142,132	4,720	50,877	4,317	1,532	33,667
1982	Rail	Passenger	274,357	1,755	11,457,727	14,765	90,785	6,591	21,243	48,749
1982	Road	Passenger	2,880,301	1,513,297	350,029,297	42,157,360	3,183,350	96,032	5,346,906	249,960
1983	Inland	Freight	98,141	151	3,032,425	2,906	58,130	3,875	2,906	3,294
1983	Maritime	Freight	7,727,599	792	102,702,291	226,220	2,439,456	238,589	73,306	1,845,123
1983	Rail	Freight	220,311	691	5,312,642	8,252	47,541	3,360	8,914	19,102
1983	Road	Freight	1,489,701	379,860	177,926,053	2,827,406	1,796,976	167,422	569,802	298,518
1983	Air	Passenger	458,540	4,197	99,175,267	99,077	335,515		33,849	31,484
1983	Maritime	Passenger	50,865	30	2,114,310	4,658	50,216	4,252	1,512	33,169
1983	Rail	Passenger	278,766	1,784	11,743,237	15,291	94,050	6,810	21,705	50,276
1983	Road	Passenger	2,954,872	1,553,989	359,006,761	42,517,655	3,301,173	98,820	5,465,610	249,295
1984	Inland	Freight	102,395	158	3,163,863	3,032	60,649	4,043	3,032	3,437
1984	Maritime	Freight	8,073,341	826	107,781,453	237,408	2,560,101	250,603	76,931	1,937,938
1984	Rail	Freight	226,607	700	5,328,785	7,527	44,082	3,186	9,209	20,217
1984	Road	Freight	1,539,682	393,311	184,080,355	2,923,965	1,858,403	173,284	589,020	299,468
1984	Air	Passenger	490,106	4,419	103,615,073	102,303	350,855		35,073	32,894
1984	Maritime	Passenger	52,216	32	2,314,684	5,100	54,975	4,720	1,655	36,786
1984	Rail	Passenger	288,018	1,786	11,992,538	15,396	95,194	6,895	22,041	51,917
1984	Road	Passenger	3,029,836	1,593,246	367,618,483	42,879,426	3,412,457	101,504	5,580,264	362,994
1985	Inland	Freight	97,021	149	2,997,833	2,873	57,466	3,831	2,873	3,256
1985	Maritime	Freight	8,160,939	838	109,374,085	240,916	2,597,931	254,280	78,068	1,966,387
1985	Rail	Freight	231,733	710	5,486,074	7,557	44,421	3,236	9,612	21,050
1985	Road	Freight	1,591,400	407,173	190,433,317	3,023,385	1,921,851	179,338	608,851	328,556
1985	Air	Passenger	524,033	4,657	108,315,603	105,684	367,082		36,351	34,386
1985	Maritime	Passenger	53,642	32	2,306,502	5,082	54,781	4,673	1,649	36,435
1985	Rail	Passenger	280,890	1,782	11,823,181	14,927	92,556	6,742	21,926	51,504
1985	Road	Passenger	3,103,427	1,633,393	373,255,797	41,614,195	3,510,319	104,226	5,620,815	369,609
1986	Inland	Freight	102,374	157	3,163,225	3,032	60,637	4,042	3,032	3,436
1986	Maritime	Freight	8,325,536	853	111,153,798	244,836	2,640,203	258,330	79,338	1,997,741
1986	Rail	Freight	219,245	690	5,151,676	6,938	40,906	3,005	9,134	19,998
1986	Road	Freight	1,644,605	421,361	196,950,784	3,124,699	1,986,990	185,556	629,170	332,500
1986	Air	Passenger	560,505	4,912	113,290,422	109,225	384,244		37,684	35,965
1986	Maritime	Passenger	53,441	32	2,208,779	4,866	52,459	4,429	1,579	34,555
1986	Rail	Passenger	276,114	1,783	11,707,993	14,464	90,082	6,606	21,957	51,445
1986	Road	Passenger	3,161,806	1,672,926	378,824,135	40,306,730	3,586,270	106,983	5,643,319	281,046
1987	Inland	Freight	98,840	152	3,054,025	2,927	58,544	3,903	2,927	3,317
1987	Maritime	Freight	8,469,309	871	113,600,942	250,226	2,698,330	264,089	81,085	2,042,247
1987	Rail	Freight	222,653	681	5,318,412	7,672	44,684	3,220	9,200	19,841
1987	Road	Freight	1,698,663	435,729	203,559,569	3,227,054	2,053,069	191,860	649,737	304,757
1987	Air	Passenger	599,719	5,185	118,553,889	112,927	402,390		39,074	37,636
1987	Maritime	Passenger	54,547	33	2,259,457	4,978	53,663	4,536	1,616	35,386
1987	Rail	Passenger	277,611	1,807	11,902,267	13,509	86,446	6,470	23,073	55,148
1987	Road	Passenger	3,219,121	1,713,769	385,143,021	38,963,862	3,643,176	109,704	5,648,253	338,522

1988	Inland	Freight	104,106	160	3,216,745	3,083	61,663	4,111	3,083	3,494
1988	Maritime	Freight	8,944,092	931	121,490,608	267,605	2,885,730	282,358	86,717	2,183,559
1988	Rail	Freight	224,726	682	5,361,054	7,664	44,709	3,231	9,306	20,138
1988	Road	Freight	1,755,173	450,668	210,445,030	3,332,302	2,121,934	198,440	671,110	318,347
1988	Air	Passenger	641,892	5,476	124,121,193	116,793	421,571		40,522	39,404
1988	Maritime	Passenger	57,332	35	2,544,170	5,605	60,426	5,205	1,819	40,559
1988	Rail	Passenger	280,449	1,844	12,032,129	13,280	85,564	6,434	23,523	55,959
1988	Road	Passenger	3,275,173	1,753,414	391,440,417	37,741,573	3,680,680	112,540	5,644,336	333,027
1989	Inland	Freight	104,627	161	3,232,853	3,099	61,972	4,131	3,099	3,512
1989	Maritime	Freight	9,129,152	949	123,923,656	272,964	2,943,521	288,000	88,453	2,227,192
1989	Rail	Freight	225,439	683	5,355,065	7,403	43,423	3,164	9,399	20,405
1989	Road	Freight	1,814,131	466,175	217,605,671	3,440,913	2,193,587	205,286	693,295	278,867
1989	Air	Passenger	687,254	5,789	130,008,379	120,826	441,843		42,030	41,273
1989	Maritime	Passenger	59,426	36	2,603,546	5,736	61,836	5,320	1,861	41,453
1989	Rail	Passenger	279,875	1,870	12,029,849	13,218	85,323	6,428	23,558	56,221
1989	Road	Passenger	3,339,603	1,798,970	398,873,001	36,692,999	3,710,089	115,490	5,641,225	348,822
1990	Inland	Freight	106,217	163	3,281,972	3,146	62,913	4,194	3,146	3,565
1990	Maritime	Freight	9,205,208	949	124,333,876	273,867	2,953,266	289,091	88,746	2,235,572
1990	Rail	Freight	226,293	675	5,427,094	7,644	44,704	3,243	9,472	20,518
1990	Road	Freight	1,875,424	482,137	225,005,642	3,552,509	2,267,742	212,350	716,171	247,007
1990	Air	Passenger	736,057	6,123	136,232,387	125,027	463,263		43,601	43,248
1990	Maritime	Passenger	61,563	36	2,654,143	5,847	63,038	5,424	1,897	42,269
1990	Rail	Passenger	275,897	1,899	11,628,241	12,956	82,599	6,188	22,432	52,403
1990	Road	Passenger	3,393,196	1,842,487	405,892,595	35,680,480	3,704,781	118,481	5,606,550	232,314
1991	Inland	Freight	106,729	164	3,297,795	3,161	63,217	4,214	3,161	3,582
1991	Maritime	Freight	9,436,408	978	127,803,837	281,511	3,035,687	297,059	91,223	2,297,235
1991	Rail	Freight	211,137	678	4,771,787	5,907	35,426	2,650	8,610	19,202
1991	Road	Freight	1,938,167	498,348	232,545,365	3,665,667	2,343,398	219,534	739,406	231,729
1991	Air	Passenger	788,572	6,481	142,811,090	129,398	485,892		45,236	45,337
1991	Maritime	Passenger	64,178	37	2,814,482	6,201	66,846	5,804	2,012	45,201
1991	Rail	Passenger	299,290	1,947	12,530,555	13,611	87,299	6,598	24,396	57,147
1991	Road	Passenger	3,473,049	1,891,717	413,991,098	34,747,210	3,679,998	121,456	5,555,663	239,134
1992	Inland	Freight	106,843	164	3,301,326	3,164	63,284	4,219	3,164	3,586
1992	Maritime	Freight	9,353,171	982	128,293,308	282,589	3,047,312	298,055	91,573	2,304,997
1992	Rail	Freight	207,254	665	4,681,918	6,152	36,535	2,685	8,263	18,408
1992	Road	Freight	2,002,532	514,927	240,266,067	3,781,058	2,420,912	226,896	763,124	241,155
1992	Air	Passenger	845,090	6,863	149,763,322	133,940	509,793		46,938	47,544
1992	Maritime	Passenger	64,872	39	2,879,971	6,345	68,402	5,911	2,059	46,051
1992	Rail	Passenger	272,419	1,987	11,871,752	12,638	81,408	6,139	22,990	53,737
1992	Road	Passenger	3,550,391	1,937,958	421,728,730	33,888,740	3,649,744	124,428	5,501,929	240,410
1993	Inland	Freight	104,578	161	3,231,336	3,097	61,943	4,130	3,097	3,510
1993	Maritime	Freight	9,377,294	983	128,085,264	282,131	3,042,371	297,633	91,424	2,301,708
1993	Rail	Freight	201,051	671	4,664,813	6,100	36,072	2,665	8,321	18,066
1993	Road	Freight	2,068,045	531,772	248,115,704	3,897,412	2,499,689	234,383	787,139	257,116
1993	Air	Passenger	905,930	7,273	157,108,916	138,653	535,035		48,708	49,876
1993	Maritime	Passenger	65,004	39	2,864,587	6,311	68,036	5,890	2,048	45,880
1993	Rail	Passenger	282,550	2,160	12,232,067	12,483	80,496	6,194	24,293	55,058
1993	Road	Passenger	3,598,593	1,984,864	429,321,411	32,356,225	3,450,009	119,423	5,205,432	295,390
1994	Inland	Freight	113,408	174	3,504,146	3,359	67,172	4,478	3,359	3,806
1994	Maritime	Freight	9,734,946	1,026	133,591,645	294,260	3,173,162	310,389	95,354	2,400,369
1994	Rail	Freight	213,906	673	4,931,776	6,339	37,641	2,793	8,840	19,335
1994	Road	Freight	2,131,126	548,108	255,709,646	3,990,413	2,530,588	238,145	802,404	256,638
1994	Air	Passenger	971,432	7,712	164,868,748	143,537	561,688		50,549	52,339
1994	Maritime	Passenger	64,929	39	2,899,830	6,389	68,873	5,947	2,073	46,329
1994	Rail	Passenger	288,084	2,159	13,075,651	13,731	88,087	6,746	25,940	58,907
1994	Road	Passenger	3,670,436	2,036,210	437,958,721	30,953,615	3,263,288	113,865	4,915,511	277,521
1995	Inland	Freight	113,829	175	3,517,179	3,371	67,422	4,495	3,371	3,821
1995	Maritime	Freight	9,912,830	1,049	135,906,663	299,359	3,228,147	315,459	97,008	2,439,712
1995	Rail	Freight	210,114	654	4,834,194	5,960	35,724	2,681	8,750	19,475
1995	Road	Freight	2,193,815	564,400	263,195,772	3,950,103	2,539,533	238,512	799,459	256,396
1995	Air	Passenger	1,041,967	8,182	173,064,767	148,591	589,826		52,442	54,941
1995	Maritime	Passenger	64,264	38	2,759,542	6,080	65,541	5,627	1,973	43,854
1995	Rail	Passenger	283,306	2,165	12,941,277	13,447	86,724	6,652	25,775	58,861
1995	Road	Passenger	3,730,769	2,078,589	444,957,122	29,758,691	3,102,212	108,319	4,637,778	216,867
1996	Inland	Freight	111,708	172	3,451,636	3,308	66,166	4,411	3,308	3,749
1996	Maritime	Freight	10,128,762	1,078	140,050,879	308,488	3,326,585	325,235	99,965	2,515,249
1996	Rail	Freight	205,920	644	4,666,367	5,833	34,920	2,611	8,411	18,840
1996	Road	Freight	2,256,279	580,641	270,657,539	3,899,556	2,545,630	238,772	795,743	64,043
1996	Air	Passenger	1,157,309	8,555	169,639,633	138,373	543,806		50,761	53,854
1996	Maritime	Passenger	67,132	40	2,854,856	6,290	67,805	5,822	2,041	45,376
1996	Rail	Passenger	291,522	2,208	12,908,361	13,385	86,508	6,664	25,688	59,635
1996	Road	Passenger	3,798,728	2,119,061	451,743,430	27,972,047	2,863,836	103,191	4,291,357	81,898
1997	Inland	Freight	119,461	184	3,691,186	3,538	70,758	4,717	3,538	4,010
1997	Maritime	Freight	10,616,271	1,122	146,193,838	322,018	3,472,498	339,664	104,349	2,626,771
1997	Rail	Freight	211,954	627	4,817,732	5,936	35,702	2,673	8,689	19,626
1997	Road	Freight	2,318,711	596,870	278,111,948	3,830,480	2,530,766	235,553	787,753	66,351
1997	Air	Passenger	1,227,924	9,145	179,685,128	143,899	575,026		52,837	57,043
1997	Maritime	Passenger	70,136	40	2,911,910	6,415	69,160	5,957	2,082	46,418
1997	Rail	Passenger	290,787	2,226	12,958,874	13,428	86,730	6,676	25,835	59,581
1997	Road	Passenger	3,861,454	2,157,843	458,264,068	26,445,648	2,683,316	98,194	3,946,817	80,872
1998	Inland	Freight	122,579	189	3,787,530	3,630	72,604	4,840	3,630	4,114
1998	Maritime	Freight	10,796,543	1,143	149,046,073	328,301	3,540,246	346,290	106,385	2,678,007
1998	Rail	Freight	212,782	626	4,807,797	5,943	35,715	2,678	8,683	19,636
1998	Road	Freight	2,383,316	613,570	285,803,555	3,761,203	2,514,951	232,160	779,530	67,366
1998	Air	Passenger	1,358,698	9,896	196,401,108	156,644	626,054		58,251	62,350
1998	Maritime	Passenger	70,399	41	3,111,425	6,855	73,899	6,441	2,224	50,153
1998	Rail	Passenger	297,136	2,279	13,709,218	13,358	87,056	6,850	27,881	63,317
1998	Road	Passenger	3,927,926	2,197,710	465,248,896	25,193,059	2,523,369	93,562	3,627,823	82,938
1999	Inland	Freight	117,611	181	3,634,030	3,483	69,662	4,644	3,483	3,948
1999	Maritime	Freight	10,959,273	1,162	151,608,806	333,946	3,601,118	352,242	108,215	2,724,038
1999	Rail	Freight	220,379	635	5,036,022	6,244	37,337	2,804	9,155	20,226
1999	Road	Freight	2,448,168	630,340	293,519,620	3,696,429	2,497,702	228,512	770,632	68,132
1999	Air	Passenger	1,452,615	10,695	208,452,425	162,304	663,225		60,177	66,175
1999	Maritime	Passenger	72,155	43	3,186,296	7,020	75,677	6,560	2,278	51,098
1999	Rail	Passenger	303,787	2,340	13,602,971	13,663	88,458	6,906	27,580	62,509
1999	Road	Passenger	3,995,681	2,236,806	472,202,477	24,106,974	2,371,954	89,231	3,333,544	74,585

2000	Inland	Freight	116,998	180	3,615,076	3,465	69,299	4,620	3,465	3,927
2000	Maritime	Freight	11,232,234	1,194	155,782,310	343,139	3,700,250	361,928	111,194	2,798,949
2000	Rail	Freight	204,899	620	4,677,017	5,331	32,388	2,477	8,615	19,199
2000	Road	Freight	2,513,512	647,219	301,284,634	3,511,037	2,476,155	219,621	755,926	52,598
2000	Air	Passenger	1,521,492	11,430	215,405,148	166,159	686,393		61,970	68,383
2000	Maritime	Passenger	73,234	43	3,187,930	7,023	75,716	6,565	2,279	51,133
2000	Rail	Passenger	307,821	2,235	13,450,490	13,143	86,523	6,751	27,236	63,538
2000	Road	Passenger	4,062,151	2,275,179	479,157,684	22,253,306	2,192,985	82,423	3,005,225	68,062
2001	Inland	Freight	117,924	181	3,643,706	3,492	69,847	4,656	3,492	3,958
2001	Maritime	Freight	11,010,305	1,168	152,434,227	335,764	3,620,724	354,183	108,804	2,739,041
2001	Rail	Freight	220,238	684	5,046,451	5,944	35,998	2,698	9,056	20,265
2001	Road	Freight	2,578,761	664,086	309,036,396	3,443,843	2,455,131	215,550	745,858	52,487
2001	Air	Passenger	1,416,697	11,326	195,631,543	152,957	618,806		56,873	62,105
2001	Maritime	Passenger	75,044	44	3,250,802	7,162	77,209	6,699	2,324	52,177
2001	Rail	Passenger	325,852	2,350	14,747,504	14,937	97,810	7,577	29,677	70,065
2001	Road	Passenger	4,125,830	2,311,858	485,910,556	21,303,727	2,035,062	78,207	2,741,926	61,426
2002	Inland	Freight	118,856	183	3,672,491	3,520	70,399	4,693	3,520	3,989
2002	Maritime	Freight	11,200,203	1,190	155,268,821	342,008	3,688,053	360,778	110,827	2,790,041
2002	Rail	Freight	220,905	686	5,044,265	5,866	35,621	2,676	9,067	20,324
2002	Road	Freight	2,644,556	681,069	316,839,480	3,365,184	2,410,069	209,961	728,481	55,920
2002	Air	Passenger	1,499,484	11,010	201,544,525	154,673	666,470		57,089	63,982
2002	Maritime	Passenger	76,496	44	3,308,055	7,288	78,569	6,822	2,365	53,132
2002	Rail	Passenger	329,961	2,387	14,972,775	15,074	98,910	7,679	30,200	71,449
2002	Road	Passenger	4,189,083	2,348,306	492,705,735	20,399,730	1,877,108	74,203	2,498,458	60,044
2003	Inland	Freight	119,787	184	3,701,275	3,548	70,951	4,730	3,548	4,021
2003	Maritime	Freight	11,395,001	1,212	158,175,373	348,410	3,757,092	367,541	112,901	2,842,333
2003	Rail	Freight	221,870	688	5,055,300	5,829	35,458	2,668	9,092	20,405
2003	Road	Freight	2,710,881	698,162	324,692,668	3,262,961	2,358,122	203,658	708,456	56,669
2003	Air	Passenger	1,577,433	11,508	209,990,783	157,084	685,808		58,243	66,664
2003	Maritime	Passenger	77,962	45	3,365,661	7,415	79,937	6,946	2,406	54,091
2003	Rail	Passenger	334,094	2,424	15,196,850	15,204	99,979	7,780	30,724	72,835
2003	Road	Passenger	4,251,268	2,384,166	499,498,442	19,685,294	1,737,963	70,535	2,279,650	66,675
2004	Inland	Freight	120,719	186	3,730,060	3,575	71,503	4,767	3,575	4,052
2004	Maritime	Freight	11,594,834	1,234	161,155,847	354,975	3,827,886	374,475	115,029	2,895,955
2004	Rail	Freight	222,831	691	5,066,812	5,793	35,306	2,660	9,118	20,487
2004	Road	Freight	2,777,720	715,363	332,593,236	3,158,416	2,303,771	197,072	687,930	56,648
2004	Air	Passenger	1,660,892	12,042	216,318,461	159,782	707,104		59,524	68,673
2004	Maritime	Passenger	79,442	46	3,423,605	7,543	81,314	7,070	2,447	55,055
2004	Rail	Passenger	338,257	2,461	15,418,967	15,326	101,004	7,877	31,247	74,219
2004	Road	Passenger	4,312,608	2,419,584	506,292,342	19,042,377	1,609,233	67,245	2,084,983	68,066
2005	Inland	Freight	121,651	187	3,758,844	3,603	72,055	4,804	3,603	4,083
2005	Maritime	Freight	11,799,840	1,257	164,212,270	361,707	3,900,485	381,586	117,210	2,950,941
2005	Rail	Freight	223,797	693	5,079,073	5,761	35,168	2,652	9,144	20,570
2005	Road	Freight	2,845,059	732,665	340,538,347	2,930,838	2,233,402	177,734	657,569	8,749
2005	Air	Passenger	1,733,673	12,497	221,021,906	161,265	723,898		60,366	70,166
2005	Maritime	Passenger	80,936	46	3,481,858	7,671	82,697	7,194	2,489	56,022
2005	Rail	Passenger	342,446	2,499	15,639,210	15,440	101,985	7,973	31,771	75,604
2005	Road	Passenger	4,373,183	2,454,614	513,084,528	17,311,164	1,442,223	57,693	1,837,471	12,452
2006	Inland	Freight	122,532	189	3,786,084	3,629	72,577	4,838	3,629	4,113
2006	Maritime	Freight	12,010,164	1,281	167,346,729	368,611	3,974,936	388,878	119,448	3,007,330
2006	Rail	Freight	224,757	696	5,091,839	5,730	35,041	2,646	9,171	20,654
2006	Road	Freight	2,910,861	749,605	348,299,741	2,836,383	2,177,575	171,234	637,654	8,838
2006	Air	Passenger	1,810,718	12,978	226,033,024	162,902	742,253		61,293	71,757
2006	Maritime	Passenger	82,246	47	3,519,831	7,755	83,599	7,269	2,516	56,606
2006	Rail	Passenger	346,676	2,536	15,857,707	15,543	102,918	8,065	32,296	76,991
2006	Road	Passenger	4,429,606	2,487,154	519,419,564	16,161,170	1,324,586	55,005	1,669,216	12,736
2007	Inland	Freight	123,464	190	3,814,869	3,656	73,128	4,875	3,656	4,144
2007	Maritime	Freight	12,225,953	1,306	170,561,377	375,692	4,051,293	396,356	121,742	3,065,161
2007	Rail	Freight	225,721	698	5,105,399	5,702	34,932	2,640	9,199	20,739
2007	Road	Freight	2,977,047	766,618	356,086,172	2,696,210	2,101,550	161,992	611,961	9,062
2007	Air	Passenger	1,892,334	13,488	231,400,219	164,761	762,498		62,329	73,460
2007	Maritime	Passenger	83,186	47	3,512,845	7,739	83,433	7,235	2,511	56,354
2007	Rail	Passenger	350,943	2,573	16,073,561	15,636	103,793	8,154	32,821	78,377
2007	Road	Passenger	4,485,683	2,519,559	525,777,668	15,027,095	1,209,993	52,427	1,519,803	13,121
2008	Inland	Freight	124,395	191	3,843,653	3,684	73,680	4,912	3,684	4,175
2008	Maritime	Freight	12,447,359	1,331	173,858,434	382,954	4,129,607	404,026	124,095	3,124,472
2008	Rail	Freight	226,685	701	5,119,603	5,677	34,834	2,635	9,226	20,826
2008	Road	Freight	3,043,602	783,702	363,901,930	2,562,027	2,026,489	152,809	587,300	9,391
2008	Air	Passenger	1,980,382	14,041	237,359,497	166,981	785,573		63,522	75,352
2008	Maritime	Passenger	84,208	48	3,512,557	7,739	83,426	7,218	2,511	56,226
2008	Rail	Passenger	355,250	2,611	16,287,059	15,716	104,608	8,240	33,346	79,764
2008	Road	Passenger	4,541,605	2,551,953	532,177,430	14,018,946	1,111,454	50,146	1,389,752	13,259
2009	Inland	Freight	125,327	193	3,872,438	3,712	74,232	4,949	3,712	4,206
2009	Maritime	Freight	12,674,539	1,356	177,240,188	390,403	4,209,933	411,893	126,509	3,185,306
2009	Rail	Freight	227,646	703	5,134,467	5,655	34,751	2,631	9,255	20,913
2009	Road	Freight	3,110,508	800,850	371,747,493	2,436,904	1,952,970	143,731	563,662	9,574
2009	Air	Passenger	2,072,975	14,623	243,734,371	169,447	811,314		64,820	77,376
2009	Maritime	Passenger	85,316	48	3,519,396	7,754	83,588	7,217	2,516	56,230
2009	Rail	Passenger	359,599	2,648	16,767,546	15,829	106,117	8,411	34,578	82,892
2009	Road	Passenger	4,597,560	2,584,464	538,642,462	13,117,430	1,024,262	48,157	1,277,755	12,799
2010	Inland	Freight	126,258	194	3,901,223	3,739	74,784	4,986	3,739	4,238
2010	Maritime	Freight	12,907,655	1,383	180,709,001	398,044	4,292,327	419,962	128,985	3,247,704
2010	Rail	Freight	228,610	706	5,150,154	5,635	34,685	2,628	9,284	21,003
2010	Road	Freight	3,177,751	818,059	379,625,362	2,314,955	1,823,975	134,793	540,778	2,985
2010	Air	Passenger	2,131,144	14,932	244,300,104	166,955	811,825		64,588	77,556
2010	Maritime	Passenger	86,697	49	3,554,646	7,831	84,426	7,285	2,541	56,761
2010	Rail	Passenger	363,992	2,686	16,983,731	15,887	106,839	8,491	35,114	84,329
2010	Road	Passenger	4,653,505	2,617,056	545,152,313	12,307,975	948,186	46,433	1,181,433	7,975

2011	Inland	Freight	127,190	196	3,930,007	3,767	75,336	5,022	3,767	4,269
2011	Maritime	Freight	13,146,875	1,410	184,267,308	405,882	4,376,846	428,240	131,525	3,311,710
2011	Rail	Freight	229,572	708	5,166,369	5,618	34,629	2,626	9,314	21,094
2011	Road	Freight	3,242,503	834,561	387,191,887	2,196,991	1,735,298	126,022	518,402	3,182
2011	Air	Passenger	2,210,962	15,401	247,806,439	166,790	825,292		65,147	78,669
2011	Maritime	Passenger	89,602	50	3,768,132	8,302	89,496	7,782	2,694	60,600
2011	Rail	Passenger	368,424	2,724	17,197,922	15,935	107,509	8,569	35,650	85,768
2011	Road	Passenger	4,703,949	2,646,663	551,093,408	11,554,342	877,179	44,914	1,097,973	9,199
2012	Inland	Freight	128,122	197	3,958,792	3,794	75,887	5,059	3,794	4,300
2012	Maritime	Freight	13,392,369	1,437	187,917,623	413,922	4,463,551	436,731	134,130	3,377,369
2012	Rail	Freight	230,537	710	5,183,538	5,604	34,594	2,625	9,344	21,186
2012	Road	Freight	3,307,446	851,084	394,778,517	2,083,891	1,648,279	117,490	496,821	3,384
2012	Air	Passenger	2,291,614	15,870	251,055,533	166,309	837,939		65,649	79,700
2012	Maritime	Passenger	89,323	50	3,614,017	7,962	85,836	7,393	2,584	57,604
2012	Rail	Passenger	372,879	2,762	17,409,331	15,973	108,126	8,643	36,186	87,204
2012	Road	Passenger	4,753,584	2,675,842	556,972,658	10,871,208	814,929	43,614	1,025,818	7,476
2013	Inland	Freight	129,053	199	3,987,577	3,822	76,439	5,096	3,822	4,332
2013	Maritime	Freight	13,644,317	1,466	191,662,538	422,171	4,552,503	445,441	136,803	3,444,729
2013	Rail	Freight	231,498	713	5,201,286	5,593	34,571	2,625	9,375	21,279
2013	Road	Freight	3,372,563	867,625	402,385,304	1,975,931	1,564,002	109,277	476,310	3,210
2013	Air	Passenger	2,373,099	16,339	254,047,710	165,514	849,767		66,095	80,650
2013	Maritime	Passenger	90,874	51	3,666,168	8,077	87,074	7,500	2,621	58,441
2013	Rail	Passenger	377,368	2,800	17,619,479	16,003	108,705	8,715	36,722	88,642
2013	Road	Passenger	4,802,117	2,704,403	562,748,007	10,261,513	761,292	42,512	963,701	6,968
2014	Inland	Freight	129,985	200	4,016,361	3,850	76,991	5,133	3,850	4,363
2014	Maritime	Freight	13,902,902	1,495	195,504,730	430,634	4,643,765	454,378	139,546	3,513,836
2014	Rail	Freight	232,463	715	5,219,844	5,585	34,564	2,625	9,407	21,374
2014	Road	Freight	3,437,840	884,178	410,012,125	1,874,358	1,483,502	101,470	457,140	3,218
2014	Air	Passenger	2,455,420	16,808	256,783,296	164,406	860,776		66,484	81,519
2014	Maritime	Passenger	94,298	52	3,929,390	8,657	93,326	8,116	2,809	63,202
2014	Rail	Passenger	381,876	2,838	17,828,577	16,028	109,260	8,785	37,259	90,082
2014	Road	Passenger	4,849,644	2,732,389	568,420,947	9,728,854	715,960	41,589	910,092	5,967
2015	Inland	Freight	130,916	201	4,045,146	3,877	77,543	5,170	3,877	4,394
2015	Maritime	Freight	14,168,313	1,525	199,446,964	439,318	4,737,404	463,547	142,360	3,584,740
2015	Rail	Freight	233,425	718	5,238,998	5,579	34,570	2,627	9,439	21,471
2015	Road	Freight	3,503,262	900,741	417,659,036	1,780,149	1,408,076	94,174	439,621	3,444
2015	Air	Passenger	2,538,574	17,277	260,760,815	162,989	870,969		66,819	82,781
2015	Maritime	Passenger	95,643	53	3,951,064	8,705	93,841	8,150	2,824	63,472
2015	Rail	Passenger	386,391	2,877	18,036,615	16,050	109,794	8,855	37,795	91,521
2015	Road	Passenger	4,896,021	2,759,712	573,968,609	9,269,982	678,314	40,827	863,885	7,306
2016	Inland	Freight	131,848	203	4,073,930	3,905	78,095	5,206	3,905	4,425
2016	Maritime	Freight	14,440,745	1,556	203,492,092	448,228	4,833,487	472,955	145,247	3,657,493
2016	Rail	Freight	234,386	720	5,258,669	5,575	34,587	2,629	9,471	21,569
2016	Road	Freight	3,566,723	916,682	425,052,568	1,696,031	1,338,184	87,445	423,810	3,022
2016	Air	Passenger	2,622,562	17,746	264,559,572	161,224	880,346		67,074	83,987
2016	Maritime	Passenger	97,103	54	3,986,381	8,782	94,680	8,216	2,850	63,992
2016	Rail	Passenger	390,912	2,915	18,244,311	16,071	110,325	8,924	38,330	92,960
2016	Road	Passenger	4,937,577	2,784,457	579,030,761	8,879,709	647,068	40,179	823,633	9,547
2017	Inland	Freight	132,779	204	4,102,715	3,932	78,646	5,243	3,932	4,457
2017	Maritime	Freight	14,720,401	1,587	207,643,061	457,371	4,932,084	482,609	148,210	3,732,148
2017	Rail	Freight	235,352	723	5,279,297	5,575	34,623	2,632	9,505	21,668
2017	Road	Freight	3,630,220	932,600	432,454,322	1,620,928	1,275,040	81,402	410,061	3,820
2017	Air	Passenger	2,707,383	18,215	268,179,978	159,112	888,907		67,248	85,137
2017	Maritime	Passenger	100,122	55	4,196,462	9,245	99,670	8,704	3,000	67,761
2017	Rail	Passenger	395,433	2,954	18,451,455	16,089	110,846	8,993	38,865	94,399
2017	Road	Passenger	4,977,956	2,808,524	583,954,634	8,552,272	621,674	39,662	788,660	10,731
2018	Inland	Freight	133,711	206	4,131,500	3,960	79,198	5,280	3,960	4,488
2018	Maritime	Freight	15,007,488	1,620	211,902,915	466,754	5,033,267	492,516	151,250	3,808,758
2018	Rail	Freight	236,312	725	5,300,304	5,577	34,669	2,636	9,538	21,769
2018	Road	Freight	3,693,739	948,494	439,862,227	1,557,735	1,219,068	76,087	398,375	3,578
2018	Air	Passenger	2,793,039	18,684	271,622,445	156,653	896,655		67,342	86,229
2018	Maritime	Passenger	100,915	55	4,147,659	9,138	98,511	8,567	2,965	66,716
2018	Rail	Passenger	399,952	2,992	18,658,629	16,109	111,374	9,061	39,399	95,839
2018	Road	Passenger	5,017,349	2,832,019	588,760,144	8,281,907	601,415	39,264	758,210	7,260
2019	Inland	Freight	134,643	207	4,160,284	3,987	79,750	5,317	3,987	4,519
2019	Maritime	Freight	15,302,223	1,653	216,274,798	476,384	5,137,111	502,683	154,371	3,887,381
2019	Rail	Freight	237,274	728	5,321,945	5,581	34,728	2,641	9,572	21,871
2019	Road	Freight	3,757,267	964,359	447,273,703	1,506,768	1,170,445	71,515	388,687	4,446
2019	Air	Passenger	2,879,527	19,153	274,887,385	153,848	903,589		67,356	87,266
2019	Maritime	Passenger	102,563	56	4,192,591	9,237	99,578	8,656	2,997	67,412
2019	Rail	Passenger	404,469	3,031	18,865,539	16,129	111,900	9,130	39,932	97,278
2019	Road	Passenger	5,056,018	2,855,087	593,476,668	8,065,387	585,689	38,974	731,797	6,534
2020	Inland	Freight	135,574	209	4,189,069	4,015	80,302	5,353	4,015	4,550
2020	Maritime	Freight	15,604,827	1,687	220,761,960	486,268	5,243,693	513,118	157,573	3,968,074
2020	Rail	Freight	238,238	730	5,344,216	5,587	34,798	2,646	9,607	21,975
2020	Road	Freight	3,820,792	980,192	454,685,947	1,466,661	1,128,785	67,646	380,798	3,700
2020	Air	Passenger	2,903,763	19,171	273,268,904	149,252	895,854		67,003	86,752
2020	Maritime	Passenger	103,800	57	4,186,165	9,223	99,425	8,622	2,992	67,154
2020	Rail	Passenger	408,988	3,070	19,072,339	16,150	112,431	9,199	40,464	98,717
2020	Road	Passenger	5,094,084	2,877,800	598,118,550	7,896,405	573,814	38,778	708,923	8,929