Rotterdam Harbour Development

Long-term sustainable development is actually good for economy and environment

Robbert Misdorp

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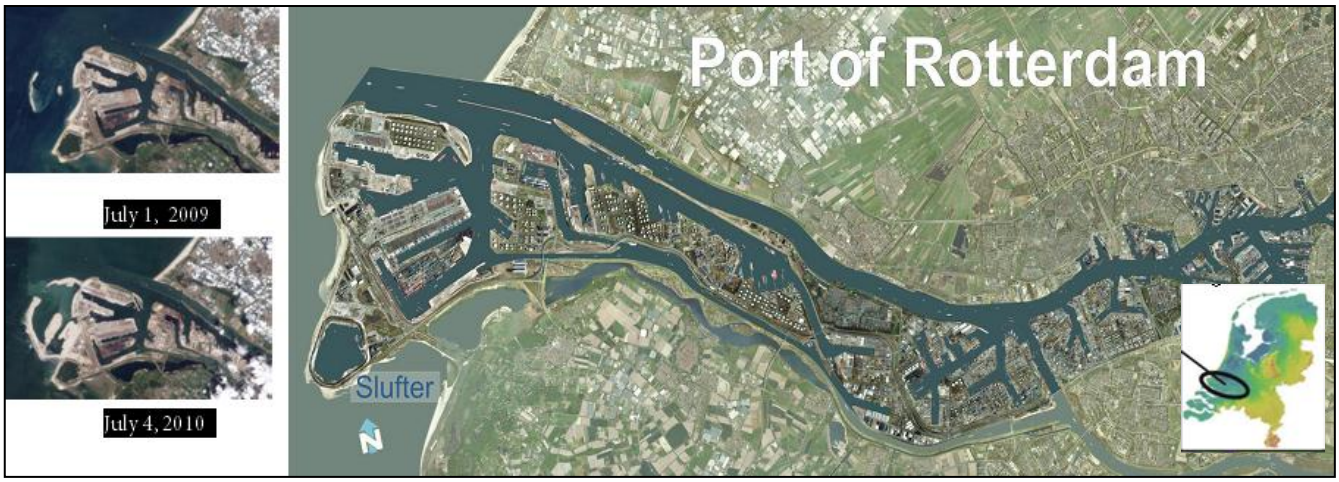
Summary

It became clear in the 1980s that the growth of Rotterdam Harbour could not continue without creating serious environmental problems. These in turn were having an adverse impact on the local population and economic growth. By bringing all the local stakeholders together and with a shared financial risk it has been possible to realise economic growth and environmental protection. Central to this was the development of an integrated and co-operative programme defined by regional spatial planning within a national legal framework. Mitigation of climate change is one of the future challenges currently being addressed.

Box 1: The Port of Rotterdam : its geographic setting



The geographic setting: *The Port of Rotterdam within the Greater Rotterdam Area (GRA) is a part of the delta formed by the rivers Rhine, Meuse, Scheldt and the North Sea. The Nieuwe Waterweg, the main navigation channel without sluices, connects Rotterdam with the North Sea. Even the biggest ocean-going vessels, have unrestricted access all year round with 24 hour maritime services providing rapid turnaround. (photo: Port of Rotterdam)*

The Rotterdam harbour extension:

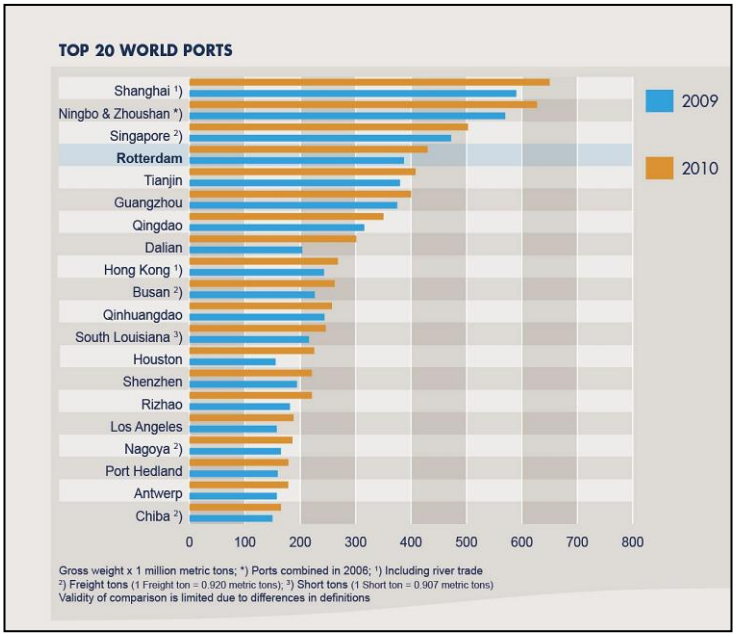
2000 ha land reclamation, the "Maasvlakte – 2" in progress : July 2009 and 2010. (photos: NASA)

Box 2: The Port of Rotterdam: its economic position

The European market is accessible via Rotterdam by many forms of transport. Goods arriving through the port in the morning can be delivered in Germany, Belgium, France or Great Britain the following day.

Improved connections include a new freight train line – the Betuwe line – linking Rotterdam with Germany and an inter-European, high-speed rail passenger transport links Amsterdam, The Hague, Rotterdam, Brussels, Paris and London.

Rotterdam the largest harbour of Europe grows more steadily than the rapidly expanding Asian seaports.



In 2010 Rotterdam, with 430 million metric tons of throughput of goods, was the fourth largest harbour of the world behind Shanghai, Ningbo & Zhoushan and Singapore.

The strong economic development in Asia is reflected by the quickly increasing numbers of large Asian harbours during the last decade. Rotterdam was in 2010, the only non-Asian harbour of the ten largest harbours of the world, seven were Chinese.

(source: Port of Rotterdam Statistics:)

1. Dilemmas for further development – around 1990

During the 1980s it became clear that further unhindered exploitation of Holland's densely populated coastal zone (more than 700 inhabitants/km^2) was unsustainable.

Environmental problems for example had a serious effect on the economics of Rotterdam Harbour and its surroundings, which were intensively used for industrial activities. People working and living there also suffered from air, noise and water pollution and lacked areas for recreation.

Further economic growth would imply even more pollution. At the same time, it became clear that Rotterdam harbour needed more space to expand and to secure future employment.

These complex, interwoven issues demanded integrated, holistic and sustainable management.

In 1988 the Netherlands Ministry of Housing, Spatial Planning and Environment introduced the innovative Spatial Planning and Environment programme (ROM) for ten specific Dutch areas with serious spatial and environmental problems. ROM-programmes use integrated spatial planning, sustainable development of resources and sound environmental policies, in order to reach a balanced exploitation of resources, bringing economy and ecology into harmony.

This ROM Program was preceding the principles of co-developing economy and environment laid down during the UNCED 1992 World Summit. Years later and experience gained, it was taken as leading example by EU/Eurocities – PEGASUS= Planning, Environment, Governance and Sustainability (see PEGASUS 2004).

For the Rijnmond (= Greater Rotterdam Area = GRA = Rotterdam and surroundings) with 1.2 million inhabitants, the challenges of the ROM programme for the near future were clear:

1) To combat pollution of air, water, soil/sediments, and

2) To use space in an efficient way preventing loss of land by coastal erosion and to find space for further expansion and

3) To increase efficiency in mobility reducing transport and traffic congestion.

These became the three principle pillars for sustainable development of the harbour.

In the long term it was necessary to take into account the effects of climate change. Accelerated sea level rise, more storms, greater fluctuations in river discharges, increased risks of flooding and erosion and salt-water intrusion will effect the functioning of the Rotterdam harbour.

2. Coastal Cooperation in practice 1993 – 2010

The ROM-Rijnmond program for the Greater Rotterdam Area began in 1993 with signing of the ROM-Rijnmond Covenant by all relevant parties:

- Four Dutch Ministers,
- The Governor of the South–Holland Province,
- The Rotterdam Port Authorities,
- The Chairman of the Chamber of Commerce Rotterdam,
- The Mayors of all 17 towns of the Rijnmond - greater Rotterdam area,
- The City Council of Rotterdam,
- The representatives of all the 600 Rotterdam Port companies (Deltalinqs) and
- Water and transport related NGOs.

The ROM-Rijnmond programme's main goal is: To enlarge Rotterdam Harbour's productivity in a sustainable way.
The ROM-Rijnmond partners translated this into objectives based on the three principles of sustainable harbour development. They also recognised that improving the quality of life is a major stimulus for economic development. This recognition was shared by all stakeholders.
An Executive Council of the ROM-Rijnmond programme included high-level stakeholder representation, chaired by Rotterdam's Alderman for Harbour Affairs and supported by a technical staff bureau. This council provided the framework for decision making and project implementation.
The partners raised about 7 billion Euro implementing 28 projects over 17 years: 1993-2010.
The partners carry out the projects in a decentralised manner but under the common umbrella.

3. Value of an integrated approach

Most of the environmental and economic goals have been achieved. Some projects, like the seaward extension of the Maasvlakte-2 are under construction (2008 – 2013). Improvements to institutional arrangements, the economy and environment of the Greater Rotterdam Area have been substantial.

Box3: Factors contributed to success:

1. ***The Ministry of Housing, Spatial Planning and the Environment*** took the initiative and coordinated the planning process. It provided a vision for the future innovative functioning of the harbour: "Combining the environment with long term development and profitability" !
2. ***All parties***, including representatives of the 600 harbour companies, signed the 1993 Covenant and stuck to their financial promises, enabling the construction of the necessary infrastructure for expanding the harbour: creating work, increasing the inhabitants' well-being and improving the environment.
3. ***The Executive Council and the Technical Staff Bureau***, facilitated the planning and the execution of the long term, ROM-Rijnmond Covenant Programme.

4. ***The Port of Rotterdam Authority*** (a turnover of € 500 million and a staff of 1,200 employees) as the manager, operator and developer of Rotterdam's harbour and industrial area with commercial, nautical and infrastructure-related responsibilities played an important role during the implementation of the Programme.

5. ***Participation***: many inhabitants of the Rijnmond area work directly in or indirectly for the harbour authority. They used the out-door recreation facilities and helped report urgent pollution incidents. This interaction between the inhabitants and the programme partners, was vital in planning and executing this integrated and complex programme This interaction is facilitated by websites and newsletters and the dissemination of reports.

3.1. Economic success

Many of the socio-economic and environmental objectives, laid down in the 1993 Covenant were reached in 2008. The construction of the Maasvlakte-2 harbour extension started in 2008, the first phase will be completed in 2013, together with the creation of 750 ha recreation and nature area elsewhere in the GRA.
In total, about 7 billion Euro has been invested in the Rijnmond area and these investments can be divided into:

- 'hard' investments directed at improving the functioning of the port itself and its
- 'soft' investments aimed at improving the environment and the quality of life of its inhabitants..

The positive effects of these 'hard' investments can be deducted from the throughput of goods, based on harbour statistics (www.portofrotterdam.nl), see Figure 1. Analyses of these throughputs shows that two periods can be distinguished:

- Between 1975 and 1996, a linear trend can be observed with an annual, averaged growth rate of slightly more than 1 million metric ton goods per year, while
- Between 1996 and 2010 the annual, averaged growth rate of the throughput goods is strongly increased to almost 11 million metric tons goods/year. According to the Year Report 2010 of the Port of Rotterdam, the direct added value of the Rotterdam Harbour area is growing and reached a value of 15.5 billion € with a throughput of 421 million ton of goods in 2008. The direct added value of the Rotterdam Harbour area per ton throughput of goods almost doubled in the period 1996 – 2008.

It is tempting to conclude that the acceleration of increase in the throughput of goods, starting three years after signing the Covenant (1993), is related to implementation of the integrated programme. The accumulated **extra** transhipment of goods in the period 1996 – 2010 on top of the 1975 – 1996 throughput rate (Figure 1) amounts to 800 million metric tons, contributing to a direct added value of about 25 billion €. This **extra** added value of the Rotterdam Harbour area represents a good economic return if related to the total investment ('hard' and 'soft') of 7 billion Euro made between 1993 – 2010.

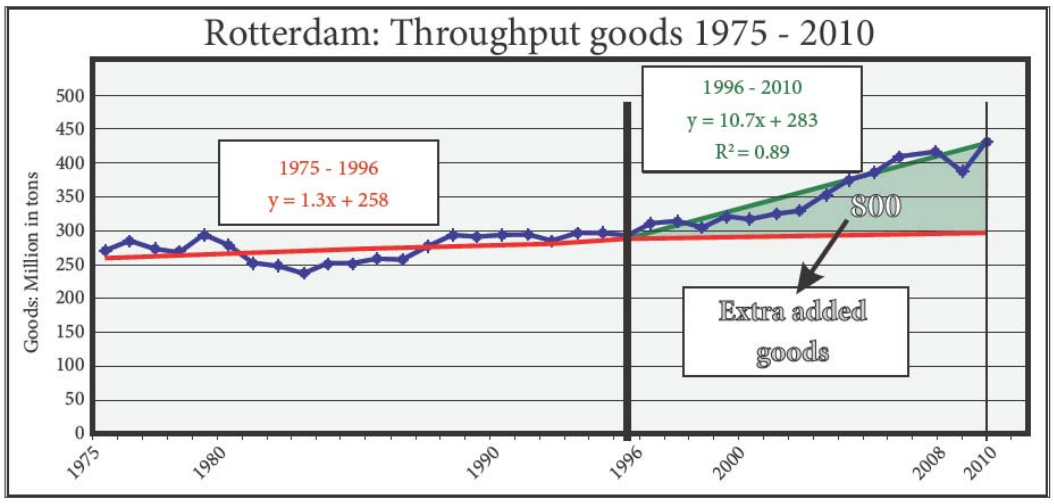


Figure 1: ***Rotterdam: Throughput*** *of total goods (mass-wet, mass-dry, packed goods) during the period 1975 - 1996 – 2010. (Source: R.Misdorp based on Port of Rotterdam Statistics)*

3.2. Environmental achievements

The DCMR - Environmental Protection Agency of Rijnmond area, is amongst other things monitoring the quality of the air and the level of noise, see the annual reports on the DCMR website.

Improved Air Quality:

Monitoring general air quality in Rijnmond area shows how it has improved over the last two decades, thanks to reductions in industrial emissions. The policy of reducing traffic emissions is also showing results, with lower levels of hydrocarbons, fine dust and nitrogen oxides.

Concentrations of most substances monitored, are under the EU Target Values.

However, Nitrogen Oxides (NO_x) and particulate matter (MP10) exceeded the targets at some measuring stations, during a number hours and days in 2006. The year average NO_2 concentrations for Rijnmond is decreasing, reaching values just under the EU Target Value of 40 µgr NO_2/m^3 air (Figure 3).

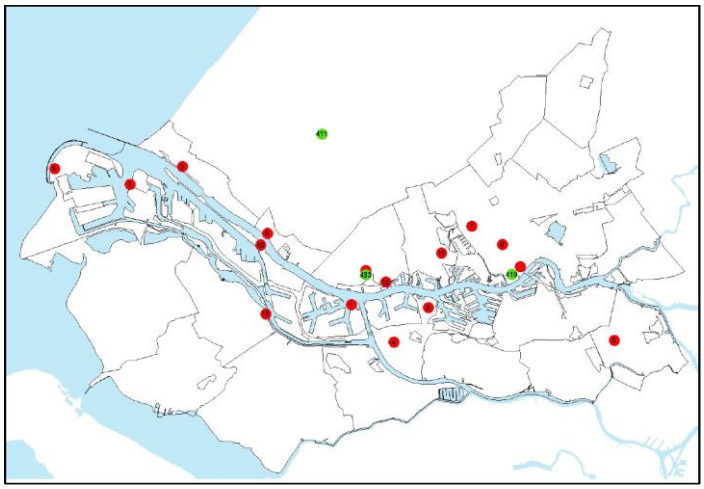


Figure 2: ***Air monitoring stations*** *– red dots. (source: DCMR)*

Far better results have been achieved for lead, cadmium and sulphur dioxide. Most of these substances met their targets before 2002. The year average concentration of cadmium (Cd) for the Rijnmond reached the EU Target value of 5 ngr Cd/m^3 air already in 1990 and now fluctuates around 0.4 ngr/m^3 air (Figure 4) .

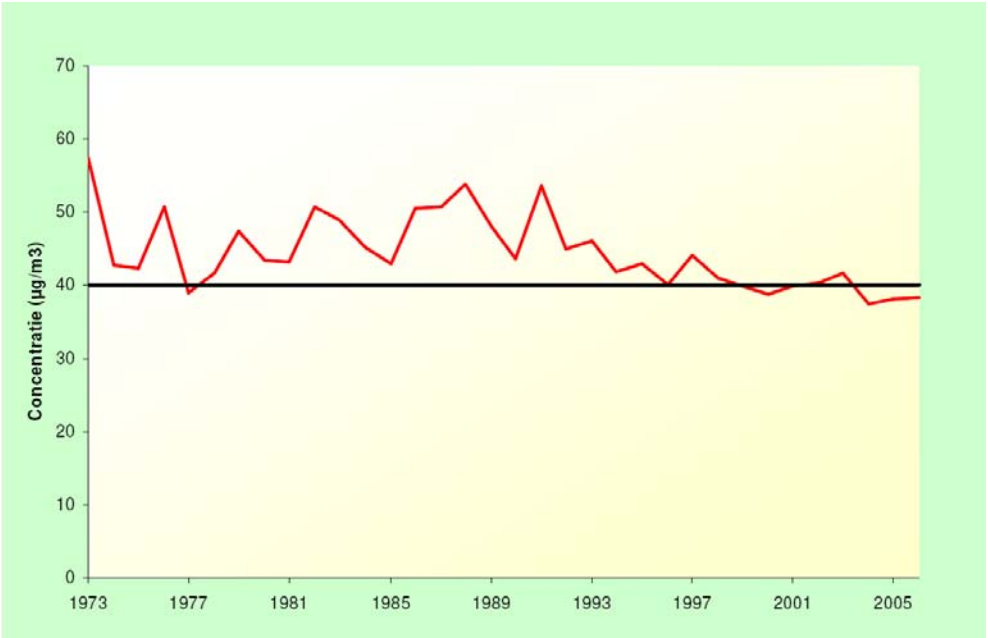


Figure 3: ***Year average NO_2*** *concentration (µg/m^3 = microgram/m^3) in the air of GRA 1973 – 2006 ; EU Target Value : 40 µg NO_2/m^3.. (source: DCMR)*

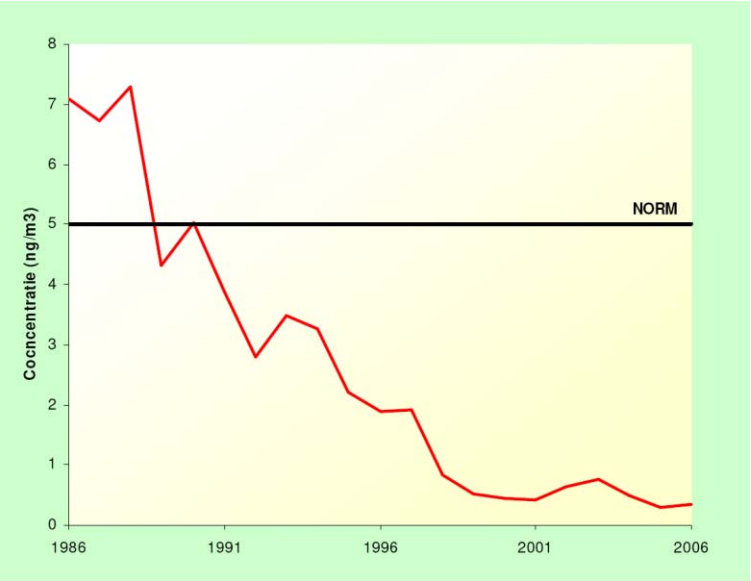


Figure 4: ***Year averaged Cd*** *concentration (ng/m³= nanogram/m³) in the air of GRA 1986-2006; EU Target value: 5 ng Cd/m³. (source: DCMR)*

Noise mapping

In 2007, more than 22,000 complaints were sent to the Complaints Department of the DMCR (the Environmental Division of Rijnmond). About 70% of the complaints were about noise, about a quarter dealt with smell, while the rest concerned nuisance by fine dust, smog and black soot.
Most noise complaints were related to the airport and airplanes, less than half from road traffic, railways, industry, and – in city centers – cafes.
To combat noise pollution in the Rijnmond area, efforts were undertaken to map noise levels related to sources (traffic, rail, industry and air) and time of day. These noise maps covered most of Rijnmond, are modeled and based on extensive measurements using seven noise classes starting with < 50 dB (green) to > 75 dB (blue; Figure 5). These maps enable inhabitants to estimate the noise level at their front doors and help politicians to give priority to mitigation measures.
On 1 January 2007 the Noise Abatement Act came into force, urging the municipalities to submit action plans and noise level maps to the Netherlands Government. Ten Rijnmond municipalities did so, by June 2007.

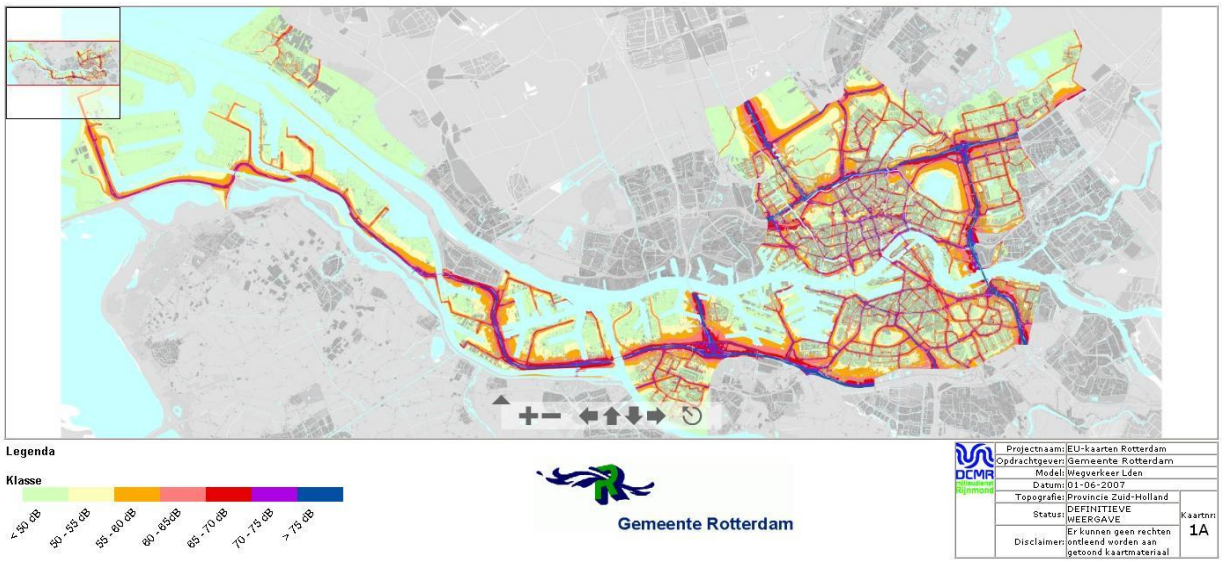


Figure 5: ***Map of the noise distribution*** *produced by traffic during daytime on 1st June 2007, see website: www.si2.nl/eu-kaarten/rdam/index.htm. . (source: DCMR)*

3.3 Win–win solutions

Coastal sand nourishment using dredged material: a cost effective measure against coastal erosion

Coastal erosion in the Rijnmond area occurs mainly north of the 5 km long, northern breakwater of the Nieuwe Waterweg, the main navigation channel. This erosion is compensated by near-shore and beach nourishments using sand dredged from the nearby 'Nieuwe Waterweg ' .

This coastal nourishment is a profitable, integrated win-win activity: the dredged sand is used for land reclamation and combating coastal erosion. It takes cooperation between the national, provincial and local authorities, dredging companies and local interest groups to plan such a successful operation. There were the challenges to integrating dredging activities and use of the new land in a sustainable and balanced way.

This new triangle land measures, about 2 km^2 and is located westwards - seawards - from the original N-S running dune ridge near Hoek van Holland (see yellow line , Figure 6). It not only acts as an extra coastal protection zone, but also serves a recreation and nature protection area. The so far limited settlements are connected to existing (road) infrastructure.

Figure 6: ***Triangular land reclamation*** *- Hoek van Holland (about 180 ha) with jetty and navigation channel, de Nieuwe Waterweg in front, sand nourishment used clean, marine dredged material from the navigation channels; yellow lines mark the original coastline before nourishment. (photo: www.kustfoto.nl - 1993 ; source map: Topografische Dienst Kadaster, Emmen, 2009)*

Such projects help provide addition land for densely populated Holland. Moreover, such solutions can be helpful in combating the impacts of climate change. The approach: working with rather than against nature, increases coastal resilience (see Waterman in CCC III-3-3-1).

Harbour extension coupled with creating green areas and a marine reserve

The Rotterdam Mainport development Project (PMR) was launched at the end of the 1990s. Project Main Port Development Rotterdam is a collaboration between a number of authorities (see PMR website). The PMR dual objective is: land reclamation and simultaneously improving environmental quality. This large project has three main components with delegated responsibility to three partners:

1. Land reclamation for the new Maasvlakte-2 harbour by the Port of Rotterdam;
2. Creating of 750 ha recreation and nature areas by the Province of South Holland and a 25,000 ha sea bed protection area (marine reserve) by the National Government;
3. Series of small scale projects (BRG) to improving on noise pollution and creating city and river parks, bicycle and walking paths and upgrading 200 ha old harbour quays, by the City of Rotterdam.

A three layered approach was used during the planning, design and implementation of the Maasvlakte - 2 harbour extension:
1) Feasibility phase addressed the need for and the viability of an extension and the choice of best location. The Cost Benefit Analysis focussed on the direct and indirect effects of the construction of the Maasvlakte - 2 (= in 'orange-colour', see Figure 7) extension, including the societal values associated with more green space and the 25,000 ha sea bed protection area compensating the ecological values lost by the reclamation. This all is arranged in the Regional Development Plans (PKBs, including Key Physical Decisions) enacted by the national government. The PKBs deal with permits for extraction, exemption from flora and fauna laws, permits under nature protection and adjustments to existing local spatial plans, all detailed in EIAs.
2) The Environmental Impact Assessment (EIA) for Maasvlakte -2 is the most elaborated (6000 pages), ever made in the Netherlands. It contains two EIAs, one for the construction, including sand extraction and one for the future sustainable use of the created harbour.
3) The third level deals with permits for construction and testing whether these comply with the overall permit.

The construction of the, started in September 2008. Costs are estimated at about three billion Euro. The first container ships will be welcomed in 2013. It will provide 1000 hectares of industrial sites and quays. The new land will emerge after the construction of hard (rubble or concrete blocks) and soft (beach and dunes) sea defences are created in the North Sea. The total Maasvlakte – 2 area will encompass about 2000 hectares, including sea defences, railways, roads and port basins (see NASA images above).
The nature compensation measures include a 25,000 ha sea bed protection area and the enlargement of a dune area by about 100 ha providing extra resting areas for protected bird species and will be carried out in accordance with Dutch and European legislation, such as the EU Birds and Habitats Directive.
This all will have positive effects on nature and human inhabitants of the Greater Rotterdam Area.

Figure 7: ***Maasvlakte-2, 2008 - 2013*** *: 2000 ha seaward harbour extension in orange. (source: Rotterdam Port authority)*

Optimising dredging: improving sediment quality and decreasing the quantity
The southern North Sea is a marginal, shallow sea. Many of the estuaries and tidal deltas are sediment sinks. Consequently the shipping lanes towards Rotterdam need constant dredging. Every year about 20 million m^3 (partially contaminated) sediments from the rivers and the sea are dredged in order to keep the navigation channels open. Optimising dredging is economic and environmentally attractive and means optimising

- Dredging techniques,

- Monitor environmental quality,
- Classification of dredged material according to the degree of pollution,
- Confining the most polluted material into man-made basins (such as the 40 m deep Slufter basin).

Figure 8: ***the Slufter basin.***
(photo: //beeldbank,.rws.nl, Rijkswaterstaat)

Since 1990 the amount of polluted material has been reduced substantially by applying these techniques and as the result of international ministerial river basin consultations (see CCC I-2-4).
Minimising dredging costs was achieved by improving depth surveying through the suspended fine-grained, bottom sediment layer, resulted in more exact estimates of real water depth (CZM-Centre, 1995).This reduced the routine dredging quantities by about 25%, with an annual cost reduction of more than 10 million Euro without compromising the safety of navigation.

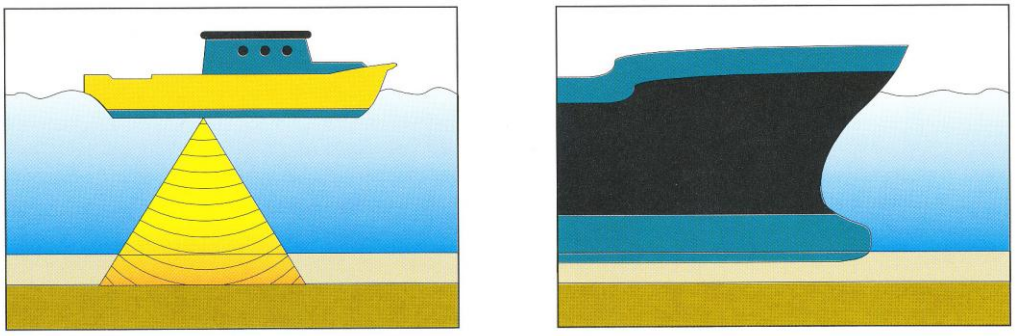


Figure 9: ***Navigation channels*** *demand continuously dredging; optimising depth survey technologies minimises annual quantities of dredged material. (source: CZM-C 1995)*

Recycling contaminated dredged sediments
Immobilising the contaminants in sediments by recycling and making vitrified bricks and gravel, which can be used in the construction industry is one initiative that could decrease the burden of polluted sediments in the coastal and marine environment (see website: *Reused).*
Estimates of the quantity of polluted sediments in European rivers amount to some hundreds of million m^3, so there is scope for growth in recycling dredged material. Experiments with polluted sediments show that immobilisation is technically and economically feasible as building materials such as gravel, sand and clay become more and more costly. Removing contaminated dredged materials in this way, could mean a significant decrease in environmental pollution and its impact on human health.
In the absence of an integrated and comprehensive cost benefit analysis, immobilisation is not common practise and funding for large-scale application is still lacking.

Figure 10: ***Vitrified bricks*** *for construction and gravel for road fillings, made from immobilised polluted dredged material. (source: Reused)*

Residual waste utilisation

Residual heat produced in industrial installations can be transported via pipelines to heat homes and offices rather than being released into the air. Together with cooling water and greenhouse gases their use can: i) Save energy, ii) Improve air quality by decreasing harmful emissions of carbon dioxide and nitrogen oxide, iii) Decrease the impact of warm water to the surrounding water masses, iv) Stimulate more efficient use of resources, all with economic benefits.

Some examples of utilization of residual industrial heat are:

- Producing electricity: The AVR (the Waste Recycling Rotterdam company) recycles 400,000 ton waste and produces annually about 125,000 MWh electric energy. This saves fuel and reduces CO_2 and NO_x emissions. (Ref: Report of Executive Board of the Port of Rotterdam, 2006);
- Heating houses: In 2006, in the community Hoogvliet (GRA) about 5000 household equivalents were connected. Several plans aim at further development of heating houses, offices, glasshouse in GRA using residual heat.

Box 4: From planning to implementation: 1993 – 2010 Rijnmond Covenant program

The integrated spirit during the planning phase was based on the 1993 ROM-Rijnmond Covenant and led in the beginning by the Ministry of Housing, Spatial Planning and Environment. The needed institutional arrangements were undertaken.
The programme was stepwise transferred into verifiable and sustainable projects.
The projects were decentralised implemented by the Covenant partners.
In order to keep the ultimate aim of sustainable harbour development high during the implementation, the central government enacted Regional Development Plans (PKB) safeguarding the sustainable development.

It is good to realise that it may sound all simple, the execution is however a comprehensive and painstaking step by step process encompassing all the elements and stages of an ICZM cycle. Continuous awareness of the added economic and environmental values of this complex process strengthens the mind to sustain…… encountering the many pitfalls.

4. Future perspectives

Rotterdam Harbour Development Programme 2010 - 2020

The port's future depends not only on its market position. The quality of life and the environment are just as important. The Port of Rotterdam Authority will continue to improve the quality of life in the area while developing the port and the industrial complex and encourage the use of renewable energy sources.

Some landmarks for the future:

- In December 2006 Rotterdam specified its future energy programme. Moreover, the city joined the Large Cities Climate Leadership Group, chaired by the City of London and signed up to the Clinton Climate Initiative.
- In 2007, Holland's former Prime Minister, Ruud Lubbers, together with local authorities and Deltalinqs (representing the 600 harbour companies) drew up a strategy to reduce the greenhouse gas - CO_2 - emissions by 50% in 2025, compared to the 1990 level.

Figure 11: ***'Quality Map' of the Rotterdam Harbour 2020;*** *see: www.havenplan2020.nl/*

Common mitigating measures include large-scale use of biomass, using wind and solar energy, increasing residual heat utilization reducing use of raw materials, exploring more intelligent use of coal & gas-fired power plants and looking at underground storage and reuse of CO_2.
The municipality of Rotterdam produced a Port Vision 2020 ('Havenplan').
The Vision includes a 'Quality Chart' of the Rotterdam Harbour 2020 ("Kwaliteitskaart, Figure 11) with more than 25 categories of spatial planning units. It shows concentrations of related harbour works, planned recreation and nature areas and sites for wind energy parks.

5. Conclusions

The description of the development of the Rotterdam Harbour and the Rijnmond area clearly show the benefits of integrated planning and management directed to sustainable use of areas and resources.
The main messages from the long-term development of the Rotterdam Harbour are:

- *Strong cooperation between the stakeholders pays off* both in economic and in environmental sense.
- *Integrated planning can secure sustainable development* by defining a clear goal, creating robust institutional arrangements and ensuring active participation of all partners.
- *A long-term vision helps forge cooperative work and identify opportunities for future environmentally sustainable development***.**

Regional Development Plans (PKBs), provide the national, legal base and serve as a frame for the correct execution of the projects according to the long term plans made for the harbour development.
The long term planning and subsequent implementation of measures to improve the functioning of the harbour area in economic and environmental sense, has all the characteristics of an Integrated Coastal Zone Management (ICZM) cycle even though it is not locally recognised as such.

*The Greater Rotterdam Area development is an example of sustainable development in practise, based on integrated planning and coastal cooperation. Successful economic development goes hand in hand with environmental improvements***.**

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