Rotterdam's sustainability strategy: a case study on municipal policies*

Recibido: 27 de marzo de 2020 • Aprobado: 23 de mayo de 2020
https://doi.org/10.22395/seec.v23n54a11

Dominik Różewicz**

ABSTRACT

Rotterdam houses the largest port in Europe. It is a crucial element of the city's economy, but also a major CO_2 emissions generator. Rotterdam's municipality developed a strategy to responsibly reconcile various interests. The present article aims to show the sustainability strategy adopted in Rotterdam and its primary elements through qualitative research; municipality's documents were analyzed and the connections between them were stated. This leads to the conclusion that Rotterdam has developed a comprehensive and coherent strategy for sustainable development. The strategy is divided in four elements: energy transition, circularity, climate resilience and a healthy living environment. All elements were developed in response to the city's existing problems.

PALABRAS CLAVE

Sustainability; energy transition; circularity; climate resilience.

JEL CLASSIFICATION

Q01, Q42, Q57

CONTENT

* This article is a brief summary of the main aspects of Rotterdam's sustainable development strategy, a city that aspires to be the precursor of modern urban management. The article is the result of an extensive bibliographic review.

** B.A. in American Studies, University of Warsaw, Warsaw, Poland. Postgraduate Student of Spatial Planning, University of Warsaw, Poland. Email: d.rozewicz@student.uw.edu.pl. Orcid: https://orcid.org/0000-0001-5076-0882

ESTRATEGIA DE SOSTENIBILIDAD DE ROTTERDAM: UN ESTUDIO DE CASO EN POLÍTICAS MUNICIPALES

ABSTRACT

Rotterdam aloja el puerto más grande en Europa. Es un elemento crucial para la economía de la ciudad, pero también un gran emisor de CO2. Las autoridades administrativas de Rotterdam han desarrollado una estrategia para reconciliar responsablemente diversos intereses. Este artículo tiene como objetivo mostrar la estrategia de sostenibilidad adoptada en Rotterdam y sus principales elementos a través de investigación cualitativa. La municipalidad de Rotterdam desarrolló una estrategia para reconciliar responsabelmente distintos intereses; la documentación de las autoridades municipales fueron analizadas y las conexiones entre estas fueron establecidas. Lo anterior lleva a concluir que las autoridades de Rotterdam han desarrollado una estrategia comprensible y coherente con un desarrollo sostenible. Esta estrategia está dividida en cuatro elementos: transición energética, circularidad, resiliencia climática y un entorno vivo saludable. Todos los elementos fueron desarrollados como respuestas a los problemas de la ciudad.

PALABRAS CLAVE

Sostenibilidad; transición energética; circularidad; resiliencia climática.

CLASIFICACIÓN JEL

Q01, Q42, Q57

CONTENIDO

Introducción; 1. Transición Energética; 2. Circularidad; 3. Resiliencia climática; 4. Entorno vivo saludable; Conclusión; Referencias

ESTRATÉGIA DE SUSTENTABILIDADE DE ROTERDÃ: UM ESTUDO DE CASO SOBRE AS POLÍTICAS MUNICIPAIS

RESUMO

Roterdã conta com o maior porto da Europa, que é um elemento crucial para a economia da cidade, mas também é um grande gerador de emissões de CO2. A prefeitura da cidade de Roterdã desenvolveu uma estratégia para reconciliar vários interesses responsavelmente. O presente artigo busca mostrar a estratégia de sustentabilidade adotada em Roterdã e seus elementos fundamentais por meio da pesquisa qualitativa; para isso, os documentos da prefeitura foram analisados e as conexões entre eles foram estabelecidas. Isso nos leva à conclusão de que essa cidade desenvolveu uma estratégia coerente e abrangente para o desenvolvimento sustentável. A estratégia está dividida em quatro elementos: transição de energia, circularidade, resiliência climática e ambiente de vida saudável. Todos os elementos foram desenvolvidos em resposta aos problemas existentes na região.

PALAVRAS-CHAVE

Sustentabilidade; transição de energia; circularidade; resiliência climática.

CLASSIFICAÇÃO JEL

Q01, Q42, Q57

CONTEÚDO

Introdução; 1. Transição de energia; 2. Circularidade; 3. Resiliência climática; 4. Ambiente de vida saudável; Conclusão; Referências.

INTRODUCTION

In Rotterdam, sustainable development and responsible approaches towards climate change are crucial because of two correlational reasons. On the one hand, it is a low lying delta city with an expanded water system, so it is exceptionally exposed to rising sea levels. On the other hand, the Port of Rotterdam –the largest in Europe (Eurostat, 2020)– is a major producer of CO_2 emissions (Port of Rotterdam [PR], 2019). These contradictory factors make Rotterdam's case particularly interesting. They have evoked the question of how to reconcile such conflicting interests and maintain the dynamic development of the city.

The search for proper solutions has driven local authorities to create a strategy aiming to make the city sustainable. Most of municipality documents concerning sustainability were passed in 2019, in some cases replacing or updating previous ones. In the moment, Rotterdam has an extensive but coherent and up-to-date strategy. The sustainable development process is supervised by councilor of a dedicated municipality unit responsible for sustainability, air quality and energy transition.

The departure point of the municipality strategies analysis is the city's Sustainability Compass (R*otterdams* D*uurzaamheidskompas*) (Municipality of Rotterdam [MR], 2019e). It is a tool first created in 1997 to enable common understanding of sustainability. Directions of a regular compass are renamed following well-known first letters: nature, economy, society and wellbeing (Compass Education, 2017). The tool allows to easily comprehend major aspects of sustainability. In Rotterdam, the directions of the Sustainable Compass are energy transition, circularity, climate resilience and healthy living environment (MR, 2019e). Through isolating given factors from the broad understanding of sustainable development, Rotterdam puts clear emphasis on the importance of these elements.

The main focus of this paper is to demonstrate sustainability strategy adopted by Rotterdam's municipality and its presence in the city planning documents: strategies, agreements and initial outlines. Each element of the policy –energy transition, circularity, climate resilience and healthy living environment– is described and complemented with tables summarizing the targets of the sector, as well as relevant documents. Subsequently, selected documents are discussed in more detail. The paper gives a view on main aspects of Rotterdam's complex sustainability strategy.

1. ENERGY TRANSITION

Energy transition is the most elaborated aspect of the sustainability strategy and it is directly based on various documents, as well as divided into further elements:

infrastructure, clean energy sources, port, mobility and construction. It is a major challenge for the municipality and a crucial process on a national level. Due to the harborside activities, Rotterdam is responsible for one-fifth of CO_2 emissions in the Netherlands (Verheij, 2019), while being home for less than 4 % of its population (CBS, 2020; MR, 2020). In this situation, transition to clean energy is a priority for the municipality.

City of Rotterdam aims to fulfill postulates of the Paris Agreement and limit the temperature rise to a maximum of 2 °C, compared to the pre-industrial era (UN, 2015). The municipality is also obliged to meet the targets provided in the national Climate Agreement of 2019 (K*limaatakkoord*) (CN, 2019). These include lowering CO_2 emissions to the half of 1990 emissions by 2030. In order to make it possible, annual city CO_2 emissions are supposed to be in a downward trend by 2022. The National Climate Agreement also requires disconnection of 1.5 million apartments from the natural gas network by 2030 and intends that all buildings will be heated sustainably by 2050, so the country is completely independent from natural gas. The municipality itself aims to become climate neutral by 2050 (MR, 2019c) (table 1).

Table 1. Energy transition targets in Rotterdam

National and international targets	*City targets*
Paris Agreement 2015	
- Maximum 2 °C temperature rise compared to the pre-industrial era.	- In 2030, national CO_2 emissions will be 49 % lower than in 1990
Climate Agreement 2019	
- In 2030, national CO_2 emissions will be 49 % lower than in 1990.	- Climate neutrality by 2050
- Disconnection of 1.5 million apartments from the gas network by 2030.	- Annual city CO_2 emissions in a downward trend by 2022
- All buildings heated sustainably by 2050.	

Source: Rotterdams Duurzaamheidskompas (2019).

The basis of all of the municipality's activities in the field of energy transition is Rotterdam's Climate Agreement, adopted in autumn 2019. The set of documents is the result of cooperation between the municipality and over a hundred companies and social organizations. Under the leadership of independent chairmen, participants of five climate boards –Port & Industry, Built Environment, Mobility, Clean Energy and Consumption– have developed 49 so-called climate deals which provide an impulse for the low-carbon economy (MR, 2019c). The Agreement aims to reduce CO_2 emissions by half by 2030, compared to 2017, so under 15 mt CO_2/yr (MR, 2019e). The document contains proposals for large wind farms off the Rotterdam

coast, the construction of a hydrogen network and the large-scale insulation of Rotterdam homes.

Within the scope of clean energy, the following documents have been adopted: Energy Infrastructure Plan, Solar and Wind Energy Acceleration Outlines, and Clean Energy Strategy. The last-mentioned indicates which sources of clean energy are available and demanded in the city. It consists of sources qualification, indication of their potential in 2050, 2030 and now, as well as a prognosis of the demand. In other words, the document provides insight into the possibilities for generating clean energy in Rotterdam, including the associated potential. (MR, 2019f).

Clean Energy Strategy serves as a background for another document –Rotterdam Power System Strategy (*Rotterdamse Energiesysteemvisie*)– which is going to be completed in 2021. Knowing the possibilities of using clean energy sources in advance allows to prepare a strategy that meets the challenges of sustainability better. What is more, maintaining a proper order of adopting documents works for the consistency of strategic planning (table 2).

Table 2. Documents directly concerning energy transition

<table>
<tr><th colspan="2">Clean energy</th><th>Port</th><th>Mobility</th><th>Construction</th></tr>
<tr><td colspan="2">Rotterdam Climate Agreement (Rotterdams Klimaatakkoord)
Regional Energy Strategy Rotterdam – The Hague (Regional Energiestrategie)</td><td rowspan="2">Rotterdam Climate Agreement (Rotterdams Klimaatakkoord)

Port Strategy (Havenvisie)</td><td rowspan="2">Rotterdam Climate Agreement (Rotterdams Klimaatakkoord)

Zero Emissions Strategy (Aanpak Nul Emissie Mobiliteit)

Mobility Strategy (Rotterdamse Mobiliteits Aanpak)</td><td rowspan="2">Rotterdam Climate Agreement (Rotterdams Klimaatakkoord)

Heat Transition Strategy – to be formulated by 2021 (Warmtetransitie visie)

Map of Heating Profitability (Watkaart)</td></tr>
<tr><td>Infrastructure</td><td>Clean energy sources</td></tr>
<tr><td>Energy Infrastructure Plan (Energie Infrastructuur Plan)</td><td>Clean Energy Strategy (Schone Energie Strategie)
Solar Energy Acceleration Outline (Startnota versnelling Zonne-energie)
Wind Energy Acceleration Outline (Startnota er the title versnelling Wind-energie)
Biomass Strategy (Visie Biomassa)</td><td></td><td></td><td></td></tr>
</table>

Source: Rotterdams Duurzaamheidskompas (MR, 2019e).

2. CIRCULARITY

The Netherlands is a major waste generator. In 2016, the country generated 520 kg of municipal waste per person, nearly 40 kg more than the EU average (EP, 2018). A sustainable economy requires a well-developed waste management, which means both reduction and effective processing of remaining waste. To achieve that, Rotterdam aspires to become circular. The basis for a circular economy consists of preventing and reducing the use of primary raw materials; extending the life of products; reusing products and parts; recycling materials into raw materials (Murray, 2017). It is contrary to the current linear economy where products simply devaluate and materials they are made of are wasted (Murray, Skene & Haynes, 2017). Rotterdam aims to become fully circular by 2050 (MR, 2019d) (table 3).

Table 3. Targets of circularity in Rotterdam

National targets	*City targets*
National Waste Management Plan 2017	- Limited use of primary raw materials in 2030
- Fully circular economy by 2050.	- Creation of 3,500- 7,000 jobs directly contributing to the circular economy by 2030
	- No-waste society by 2050

Source: Rotterdams Duurzaamheidskompas (MR, 2019e).

Municipal documents directly concerning circularity:

- **Rotterdam Circularity Programme 2019-2023** (Programma Rotterdam Circulair)
- **Raw Materials Management Outline 2019-2023** (Grondstoffennota)
- **Rotterdam Climate Agreement** (Rotterdams Klimaatakkoord)

The basis of all of the municipality's activities in the field of circularity is Rotterdam's Circularity Programme 2019-2023. Main points of focus includes increasing circular awareness among residents and increasing activity in the circular economy and employment. The program emphasizes on aspirations in sectors of construction, green streams, consumer goods and health care. Goals aimed to be achieved by 2023 include:

- realization of 40 new circular initiatives in the city;
- household waste separation percentage increased to 45 %, compared to 32.2 % in 2018;
- increase in circular behavior of the population of Rotterdam from 20 % in 2018 to 30 % in 2023.

Construction plays the most important role in the document. This sector includes the development, design and management of areas, buildings, infrastructure and public spaces. It is a crucial element of the strategy, as it is responsible for generating 66 % of waste in the Netherlands (OECD, 2020) and the sector is expected to continue to grow in Rotterdam (MR, 2019d). Its importance rests on the belief that a lot can be achieved in a relatively short time due to the low efficiency of construction today. Rotterdam's Municipality aims to extend the lifetime of existing buildings and dismantle as many materials as possible for efficient reuse. It is to be achieved through strategic issuing of permits and mostly through promotion of circular construction. Just like circular economy in general, it translates in reducing the use of primary raw materials, reusing and recycling materials (Murray et al., 2017).

Separating and collecting raw materials in densely populated cities is a major challenge due to the lack of physical space for various bins. In 2018, 129 kilograms of raw materials were collected separately per person in Rotterdam (MR, 2019b). That same year, another 296 kilograms of residual materials were burned per person (MR, 2019b). Raw Materials Management Outline (G*rondstoffennota*) postulates that households in the city will no longer produce residual waste by 2050. The first step is to reduce it to 249 kilograms per person in 2020. About 40 % of the household residual material consists of organic waste which is difficult to limit. The municipality successively provides residents with proper containers, so organic waste can be reused. The best way to reduce the amount of residual materials is to prevent their usage (Bortoleto, 2015). Among other things, the document requires educational actions aiming to create awareness among residents.

3. CLIMATE RESILIENCE

Rotterdam is a low laying city with an extensive water system, situated in the estuary of the Rhine, Meuse and Scheldt rivers. It is linked directly with the North See, only around 30 kilometers down the broad waterway. Like many parts of the Netherlands, Rotterdam is significantly threatened by backflow and flooding. To prevent that, the Delta Works programme (D*eltawerken*) initiated in the 1950s. It is a series of construction projects aiming to protect the Rhine delta through a system of dams, dykes, etc. (Schaminee et al., 2019). Rotterdam had been the weak spot of the system until the 1997 completion of the Maeslant barrier which cuts off the waterway automatically in the event of danger (Deltawerken Online, 2004). As the sea level rises, solutions created several dozen years ago might not be sufficient. It's not just a question of how to protect, but how to protect and function normally in matters of economy and social life. Greater susceptibility to floods will result in more frequent closing of barriers (including the Maeslant), thus hindering the operation of the port.

Other climate change problems facing Rotterdam include increase in rainfall, longer periods of drought and longer heat waves (MR, 2013). In order to absorb heavy rainfall, long-term drought and heat interventions are required in public and private areas. At the same time, flexibility is needed to adjust the approach based on new insights. All of that is intended to make Rotterdam a climate-resilient city.

The strategy in this field focuses mainly on the challenges, needs and measures at neighborhood level. Many solutions not only have functional value (water storage) and financial value (less damage due to flooding), but also social value (MR, 2019a). For example, water squares and green roofs are places where people meet, and children can play. They contribute to the quality of life and recreational opportunities in the city. Only 40 % of Rotterdam area is public land. Since creating a resilient city requires physical solutions in urban space, cooperation with private entities and residents is essential (MR, 2019a).

The municipality has adopted the Rotterdam Adaptation Strategy to set the framework for the city to become resilient. The document indicates expected effects of the climate change and proposes available solutions (MR, 2013). It is based on four principles:

1. Solid system: preservation and reinforcement

   Protection of the flood protection system, its maintenance and strengthening. Using knowledge of the system's weak spots to improve it. Preventing failure of vital facilities.

2. Adaptation: utilization of urban space

   Restoring city's "sponge function" –retaining rainwater– through water squares, infiltration zones along infrastructure and increase in green areas.

3. Collaboration and interdependence

   Cooperation between various branches of regional and national administration. Cooperation between the municipality, private entities and residents. Alignment of various municipal companies.

4. Added value for living environment, society, economy and ecology

   Creating opportunities for strengthening the economy of the city and port, improving the quality of life in neighborhoods, increasing biodiversity and involving residents in social life.

Rotterdam Adaptation Strategy aims to protect the city and its residence from negative effects of climate change. Residents are expected to be aware of the

consequences of climate change and of the action options they have. The municipality wants them to take their responsibility and contribute to the city efforts (MR, 2013). The document also emphasizes on the port's safety and accessibility, as it is a crucial part of the city's economy. What is more, Rotterdam wants to gain profit from becoming climate-resilient, both economically and marketing-wise (table 4 and 5). It is to be achieved through new economic impulses and creating the image of a progressive, leading city (MR, 2013). Actions taken as a part of climate adaptation contribute to a comfortable and attractive city.

Table 4. Targets of climate resilience in Rotterdam

International targets	*City targets*
	- Rotterdam will be 100 % climate-adaptive by 2025.
Paris Agreement 2015 - Strengthening resilience to climate change and reducing vulnerability.	- The percentage of buildings that do not have an increased risk of flooding in heavy rain increases from 88 % to 90 % by 2025. - 22 hectares of green spaces more in 2020 compared to 2018.

Source: Rotterdams Duurzaamheidskompas (MR, 2019e).

Table 5. Documents directly concerning climate resilience

Climate resilience	
Adaptation	*Greening and ecology*
Rotterdam Adaptation Strategy (*Rotterdamse Adaptatiestrategie*)	**Rotterdam Greening Action Plan** (*Actieplan Rotterdam gaat voor groen*)
Rotterdam WeatherWise Urgency Document (*Rotterdams WeerWoord Urgentiedocument*)	

Source: Rotterdams Duurzaamheidskompas (MR, 2019e).

4. HEALTHY LIVING ENVIRONMENT

Number of residents and households in Rotterdam is expected to grow at least until 2,035 (MR, 2018b). Intensification of space usage might bring negative effects, including health, safety and comfort issues for residents. One of the examples is housing being increasingly realized at locations close to highways and railways, which is associated to noise. Another challenge is transforming industrial areas into

new forms of use, due to possible soil contamination. Also clean air is essential for a livable and healthy city. As mentioned before, Rotterdam and its port are major CO_2 emissions generators.

Rotterdam's municipality believes that eliminating the above-mentioned problems and creating a healthy living environment is a crucial element of the sustainability strategy (MR, 2019e). It is reflected in already adopted Clean Air Course Plan and documents which are intended to be released in 2020: Noise Action Plan, Soil Course Plan and Environmental Safety Course Plan. This part of the sustainability strategy is centered mostly around residents and their needs but requires action in various fields.

The Noise Action Plan is an interesting document, as it demonstrates the importance of living comfort in the city strategy. Excessive noise exposure can lead to health problems in both the living and working environment (MR, 2018a). The municipality wants to limit the impact of noise on health through a number of initiatives. Rotterdam expects to construct a total of 22.7 hectares of silent asphalt by 2024 and connect the process with the road maintenance program. It is a crucial element of the strategy, as road traffic is responsible for 93 % of noise in the city. Decreasing the noise levels of road traffic is also relatively easy to achieve by local authorities, since over 90 % of all roads in the city are municipal (MR, 2018a).

In land development plans, the municipality is increasingly confronted with conflicting spatial claims, as well as competing wishes and interests between business and housing, construction and greenery, or transport and livability. This requires choices, in which creating the healthy living environment has priority (MR, 2019e). Such policy stimulates the realization of high-quality public and private spaces (table 6).

Table 6. Targets of healthy living environment in Rotterdam

National and international targets	*City targets*
- To meet the EU air quality standards by 2020. - To meet WHO recommended exposure limits concerning air quality by 2030.	- To meet the EU air quality standards by 2020. - There will be no streets exceeding EU standards for NO_2 by 2020. - 22 hectares of green spaces more in 2020 compared to 2018.

Source: Rotterdams Duurzaamheidskompas (MR, 2019e).

Municipal documents directly concerning healthy living environment:

- **Clean Air Course Plan** (*Schone Lucht Koersnota*)
- **Noise Action Plan** (*Actieplan Geluid*)
- **Soil Course Plan** (*Koersnota Bodem*)
- **Environmental Safety Course Plan** (*Koersnota Omgevingsveiligheid*)
- **Rotterdam Mobility Approach** (*Rotterdamse MobliteitsAanpak*)

5. CONCLUSION

Rotterdam is heavily exposed to the negative consequences of climate change. At the same time, its economy is profoundly dependent on the work of the largest port in Europe, whose activities generate significant CO_2 emissions. To reconcile these two opposing factors, the municipality of Rotterdam has developed an extensive strategy for sustainable development. The city intends to use its complicated situation to create an innovative model combining ecological, economic and social benefits, and thus also image-related. The municipality of Rotterdam divides its sustainability strategy into four elements: energy transition, circularity, climate resilience and healthy living environment.

As of 2020, the sustainability strategy consists of twenty-one documents developed by the municipality. They operate in correlation with regional, national and international strategies. The process of creating documents that make up the strategy is noteworthy, it is continuous rather than closed. This can be seen in the naming, where in addition to strategies, there are also outlines and approaches. The latter are usually acts initiating work on more detailed documents. Grading the policy-making process in a given field allows for both greater coherence and needed alterations of the general strategy.

The municipality's efforts to showcase individual elements of the strategy are worth mentioning. The documents are characterized by high accessibility, understandable language, and attractive graphic design. They all build up a vision of a healthy, safe and economically innovative city fueled by clean energy. As such prospect is an ambition of many cities, Rotterdam's municipality stands out in terms of social participation, actively encouraging its citizens to contribute to the process of becoming sustainable. Many of them contain elements designed directly for residents, educational or inspiring action. Making residents conscious and active is part of the strategy itself. For this reason, accessible communication of its elements increases its coherence.

REFERENCES

Bortoleto, Ana Paula. (2015). Waste Prevention Policy and Behaviour - New Approaches to Reducing Waste Generation and its Environmental Impacts. London: Routledge Taylor & Francis, 202p.

CBS -Central Statistics Bureau- (2020). Over 17.4 Million Inhabitants.

CN -Cabinet of the Netherlands- (2019). Climate Agreement. The Netherlands: CN. 237p.

Compass Education (2017). A Guide to AtKisson Accelerator and Systems Thinking Tools and Methods. Chiang Mai, Thailand: Compass Education, 13p.

Deltawerken Online (2004). Maeslant Barrier.

EP -European Parliament- (2018). Zarządzanie Odpadami w UE.

Eurostat (2020). Maritime ports freight and passenger statistics.

MR -Municipality of Rotterdam- (2013). Rotterdamse Adaptatiestrategie. The Netherlands: MR. 137p.

MR -Municipality of Rotterdam- (2018a). Actieplan Geluid. The Netherlands: MR. 21p.

MR -Municipality of Rotterdam- (2018b). Bevolkingsprognose Rotterdam 2018-2035. The Netherlands: MR. 11p.

MR -Municipality of Rotterdam- (2019a). Actieplan Rotterdam gaat voor groen. The Netherlands: MR. 9p.

MR -Municipality of Rotterdam- (2019b). Grondstoffennota. The Netherlands: MR. 24p.

MR -Municipality of Rotterdam- (2019c). Klimaatakkord. The Netherlands: MR. 43p.

MR -Municipality of Rotterdam- (2019d). Rotterdam Circularity Programme 2019-2023. The Netherlands: MR. 24p.

MR -Municipality of Rotterdam- (2019e). Rotterdams Duurzaamheidskompas. The Netherlands: MR. 46p.

MR -Municipality of Rotterdam- (2019f). Schone Energie Strategie. The Netherlands: MR. 32p.

MR -Municipality of Rotterdam- (2020). Bevolkingsmonitor Rotterdam Januari 2020. The Netherlands: MR. 4p.

Murray, Alan; Skene, Keith and Haynes, Kathryn. (2017). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. In: J Bus Ethics, n°. 140, p. 369-380. DOI: 10.1007/s10551-015-2693-2

OECD -Organization for Economic Co-operation and Development- (2020). Generation of Waste by Sector.

PR -Port of Rotterdam- (2019). Decarbonising the Port and Industrial Complex Rotterdam. The Netherlands: PR. 4p.

Schaminée, Joop; Janssen, John; Kwak, R., Litjens, G.J.J.M., Mulder, J.P.M., Roels, B., Smith, S.R., Walles, Brenda; van Winden, A., Winter, H.V. and Ysebaert, T. (2019). Biodiversiteit in de Zuidwestelijke Delta. In: Wageningen Environmental Research, n°. 2942, p. 1-330. DOI: 10.18174/475540

UN -United Nations- (2015). The Paris Agreement. United Nations Framework Convention on Climate Change, 25p. https://unfccc.int/process-and-meetings/the-paris-agreement/the--paris-agreement

Verheij, Koldo (2019). C02-Uitstoot Rotterdam. Trend 2010-2018. DCMR Milieudienst Rijnmond, 16p.