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Market study on the water, port and sustainable urban infrastructure sector in Cartagena: Dutch business opportunities for climate-smart solutions

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HOLLAND HOUSE COLOMBIA
CÁMARA DE COMERCIO COLOMBO-HOLANDESA

Reino de los Países Bajos

MARKET STUDY ON THE WATER, PORT AND SUSTAINABLE URBAN INFRASTRUCTURE SECTOR IN CARTAGENA: DUTCH BUSINESS OPPORTUNITIES FOR CLIMATE-SMART SOLUTIONS

June 2023

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Executive Summary

This executive summary provides an overview of a study conducted to explore opportunities for Dutch companies in the sectors of Water, Ports, and Sustainable Urban Development in the city of Cartagena. The study employed a methodology that involved desk research, interviews with local stakeholders, and an analysis of the current state of these sectors in Cartagena. The main objective was to identify the city's primary needs and highlight potential opportunities for Dutch companies. Additionally, the study aimed to establish criteria for evaluating these opportunities and ultimately identify feasible prospects that align with the existing supply of expertise and knowledge of Dutch companies.

The present study utilized a twofold approach. First, determine the state of play of these three sectors in Cartagena, and second, it explores potential market opportunities for Dutch businesses in the field of water, port, and sustainable urban development. Through these methods, this study delivers valuable insights into the existing conditions and requirements within the sectors. A matrix of evaluation criteria was developed to assess the potential opportunities identified.

Based on the research and analysis, the study identified eight opportunities that present the most promising potential for Dutch companies to contribute their expertise and experience in Cartagena. These opportunities include: Water supply and treatment in designated areas; Sustainable infrastructure and technologies for the Canal del Dique project; Climate-smart innovations for SPRC/Contecar; Climate adaptation solutions for the Cluster of Petrochemical Port Terminals; Urban waterborne public transport systems; Sustainable urban infrastructure solutions in Chambacú and Bazurto; Caribbean Innovation and Technology Center and Smart city initiatives.

The study concludes that the opportunities mentioned above match well with the capabilities and knowledge offered by Dutch companies. By addressing in these sectors, Dutch businesses can make a substantial contribution to the development and improvement of Water, Ports, and Sustainable Urban Development in Cartagena. Each of these opportunities represents a tangible chance for Dutch companies to address the identified needs in the city and establish a presence in the local market.

Finally, this study shares a proposed ‘Route to Success’, where the focus aims to identify the optimal approach for presenting the Dutch offer and effectively connecting it with the needs outlined in the opportunities chapter. It is recommended that Dutch companies take advantage of their strengths, such as advanced technology, sustainability expertise, and innovative solutions, to create value propositions tailored to the specific needs of Cartagena. Additionally, fostering partnerships and collaborations with local stakeholders and government bodies will increase the chances of successful entry and long-term growth in the market.

Picture: Pexels

1. Introduction

Cartagena is a city located on the Caribbean coast of Colombia with a population of approximately 1 million people. The economy of the city is primarily driven by tourism, which makes the industry account for a significant portion of the city's GDP. Other important economic sectors include commerce, construction and manufacturing. During the last few years, Cartagena has made progress in terms of reducing poverty and improving access to basic services. Despite its challenges, Cartagena remains a vibrant and dynamic city, with a rich cultural heritage and a unique blend of Caribbean and Latin American influences.

Due to the impact of the ever-increasing carbon emissions, climate change, pollution and sea levels, the challenge to bring human activity into harmony with the aquatic ecosystems has never before been more significant. Urgent global and collective action will be needed in order to be able to leave a well-preserved legacy for current and future generations. As a densely populated low-lying country, the Netherlands has learned to deal with the forces of the oceans for centuries which enabled them to build what is today known as the world's best protected delta. The Netherlands is proud of its excellent maritime knowledge centers and highly skilled workforce, dedicated to creating long-term solutions and products that meet the highest quality and safety standards. The country has learned to find long-term solutions by combining spatial planning with people, planet and profit. This is why their knowledge could be perfectly matched with the urgent need to develop projects for climate adaptation challenges in Cartagena.

Cartagena, a city through which a significant share of the international trade in Colombia takes place, is considered one of the most important and modern ports on the Caribbean coast. Despite this, the city and surrounding areas are suffering and will continue to suffer from problems caused by climate change, such as storms, floods, erosion and rising sea levels. On the social level it faces problems such as the lack of security, road infrastructure and basic sanitation. In fact, 46% of the basic indicators investigated by *Cartagena Como Vamos* deteriorated in 2020 due to the coronavirus pandemic, while other indicators were a direct consequence of district instability of the last decade and the lack of a political class that sees beyond its personal interests.

The Netherlands could play an important role in tackling these problems in a successful and comprehensive way. Dutch entities can take part in plans that are already underway and other future developments in which they also can be of great value regarding technological and knowledge support. In this study, we will map out current and upcoming projects and illustrate in detail where the Dutch private sector can be useful. Therefore, the aim of the study is to present the business opportunities in the private and public sectors of Cartagena for projects directly related to the water, port and sustainable urban infrastructure sector that in turn can be matched with

Dutch companies, organizations, institutions or consultants. This study focusses mainly on the private sector and the identification of possible B2B deals as well as B2G deals.

Picture: Pixabay

2. Methodology

This study was carried out by using a qualitative methodological approach and the use of selected data collection methods such as literature review and semi-structured interviews. Furthermore, the study was subdivided into three phases. Firstly, the phase of understanding and defining the environment in which this study is developed in order to identify the particular needs of Cartagena. During the desk research the most important documents and information were collected from various recognized sources, such as local and national authorities, and were analyzed through documentary analysis. Documents such as government reports, national and local development plans and journal articles were fundamental in this phase. The main result of the desk research was an overview of developments and trends regarding climate change consequences on the water, port and sustainable urban infrastructure in Cartagena, and the corresponding possibly interested entities in the Netherlands.

On the other hand, the field research included qualitative interviews with a variety of actors from the public and private sectors, from which different perspectives were obtained. Through the use of field research, the gaps in the information collected during the desk research were filled and clarified, and a network of key actors in the sector was constructed and consolidated. The field work was fundamental for the identification of the level of progress of the opportunities, the actors involved and the creation of a possible roadmap for the short and medium term, as this collected information is not accessible for the public. The key elements taken into account in this phase were: description of the sectors for water, ports and sustainable urban infrastructure, readiness of government and its policies and plans for the city, stakeholder analysis, current concrete pilots or projects, initiatives/programs led by the public or private sector and a competitor analysis.

Secondly, after all the information was gathered, the challenges and possibilities in the market for water, port and sustainable urban infrastructure in Cartagena were analyzed and the possible shortages and inefficiencies identified. Observations and data were structured and all the information found in Phase 1 were compared and interpreted to identify opportunities for Dutch Businesses, according to the analysis per business opportunity described above. This phase allowed the description of the main issues and all relevant information and answers to the research questions. Thirdly, after a final analysis of the desk and field research, a set of identified business opportunities will be presented in this document, named ‘Opportunities’, as well as the final conclusions and further recommendations. These recommendations form the basis for the eventual proposed roadmap that will offer Dutch Businesses the right focal point and guidelines. Additionally, a list of contacts and relevant actors per opportunity was established in order to guide the roadmap with local actors involved directly in each identified opportunity.

Finally, the results of this study will be presented during a webinar promoted in collaboration with *EKN Bogotá*. Our connections within the sector, our social media reach and extensive event

organization experience will ensure that relevant companies will be aware of the event and that a significant part of the Dutch sector will be present.

Picture: Pexels

CARTAGENA DE INDIAS

Officially: Distrito Turístico y Cultural de Cartagena de Indias

General information

Capital of the department of Bolívar. Cartagena is located in the north of the department of Bolívar on the shores of the Caribbean Sea.

Population: 1.013.38924
Area: 609.1 km2 of which 76 km2 are urban land, 547 km of rural land. The population located in the urban area is **95.6%** while in the rural area it is **4.4%.**

Cartagena de Indias has a solid multifaceted economy thanks to its diversified productive structure in sectors such as:

- Industry Petrochemical, Chemical and Plastic
- Tourism
- Logistics for international maritime trade

Historic center, called "Ciudad Amurallada", was declared a National Heritage of Colombia in 1959 and by Unesco as a World Heritage Site in 1984.

Strategic location on the Caribbean Sea in North South America and in the center of the American continent.

Places to visit

- San Felipe Castle
- The Palace of the Inquisition
- The Clock Tower
- The walls
- The colonial streets
- Natural beauties

Mamonal Industrial Park
One of the most important industrial zones in Colombia

8.04% of the country's GDP.

Tourism became a potential factor in the city thanks to its natural attractions and its rich history, manifested in the variety of architectural styles.

Cartagena is one of the cities in Colombia with the highest incidence of poverty and political corruption. According to the National Planning Department, Cartagena is the second city in Colombia with the highest monetary poverty, only behind Quibdó in Chocó.

3. Current State in Water, Ports and Urban Sustainable Development sectors in Cartagena

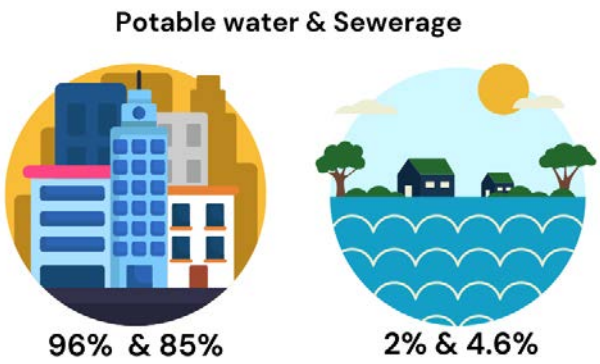
3.1 Water systems: supply, treatment and protection

36% of the world's population lives in water-stressed areas. Colombia counts on vast water resources, being among the top ten water-rich countries in the world. However, water availability has been declining over the last decades causing water stress in several regions and cities. The National Government has made a commitment to overcome these barriers through the implementation of different strategies aimed at improving the coverage, quality and treatment of water at the national level, while protecting the aquatic ecosystems and water bodies.

However, despite the efforts and improvements made in the past years, the reality is that the actual coverage of drinking water and sewerage services in Cartagena is unknown. Indeed, for this first matter and according to *Aguas de Cartagena,* the aqueduct coverage for 2021 was 93% and sewerage 86%. However, these do not include the rural area and neighborhoods in permanent high-risk areas where there is evidence of notable inequity in access to the resource and sanitation systems, accompanied by a notably inadequate rainwater system that afflicts all citizens. And, more related to a second matter of protection of the water bodies of the city, it cannot be denied that although Cartagena, due to natural conditions, presents characteristics and conditions of protected water bodies that exceptionally promote development activities (port traffic, tourism, fishing and recreation), there is evidence of inefficient management of the disposal and dumping of waste that have constituted a source of contamination within these bodies.

Related to the first event, the inequality of access to drinking water between urban and rural Cartagena needs the immediate attention of the District Administration. While 93% of the Cartagena residents in the urban area do have access to potable water and 86% to sewerage, in the rural area only 4.6% have access to potable water and only 2% of the people to sewerage. Although the lack of water service in rural areas is being counteracted in some cases by public pools or tank cars for more than 20,000 homes, these forms of water supply are not the most effective. Neither do these methods always guarantee water quality and continuity of service, because, in cases such as those of the 4

communities of Tierrabomba, the water that reaches them by tanks or boats contaminates quickly due to poor sanitation conditions.



Inequities are also seen in the costs. While a stratum 3 dwelling in the urban area of Cartagena, with direct access to the city's aqueduct, pays about 80 thousand pesos per month, in communities such as Caño del Oro in Tierrabomba, stratum 1 and 2 dwellings pay up to 120 thousand pesos per month for poor quality water that is delivered to their homes in tanks and buckets. According to the World Economic Forum, poverty and difficulties in accessing potable water are often two sides of the same coin. In Cartagena, the areas that do not have coverage of these services are located in the neighborhoods with the highest incidence of poverty in the city.

For example, the service is extremely poor in the townships of the insular zone and some areas in the rural zone, which implies the need to develop and promote tools aimed at making the management of public service providers in the country more efficient.

At the local level, Cartagena has set out central topics for the management and improvement of public services and in particular of the water resources in the city. To meet this goal, the Program for Saving and Efficient Use of Public Services, "Water and Basic Sanitation for All", has been established with the aim of improving public services based on technological modernization, saving and rational consumption. It also requires companies to base their processes on the analysis of life cycles and eco-efficiency, reducing the collective environmental liability, as well as making the necessary investments in order to increase the coverage, quality and continuity of the provision of water and sewage services. All of this with a special emphasis on the most disadvantaged population in order to improve their quality of life and the inclusion in the economy.

Chart 1: Prioritized Zones in Cartagena

PRIORITIZED ZONES

GOAL 2020 / 2023	ENTITY IN CHARGE
Bring to 80% the percentage of coverage of the population with access to aqueduct services in a safe way in the communities of: Arroyo de la Canoas, Arroyo Grande, Vereda el Zapatero, community of la Sevillana, located in rural land.	GENERAL SECRETARY, PUBLIC SERVICES ADVISORY OFFICE, AGUAS DE CARTAGENA
Bring to 80% the percentage of the population with access to safe water services in the communities of Bayunca, Manzanillo del Mar, Tierra Baja and Puerto Rey located in rural areas.	
Bring to 50% the percentage of the population with access to safe water services in the communities of Tierra Bomba, San Bernardo Archipelago, Fuerte Island and Baru Island, located on island soil.	
To increase to 100% the percentage of the population with access to safe water services in the communities of Puerta de Hierro and Membrillal, located in urban areas.	
To increase to 80% the percentage of the population with access to safe water supply services in the township of Pasacaballos, located in rural areas.	
Bring to 50% the percentage of the population with access to safe sewerage services in the towns of Bayunca, Pontezuela, Arroyo Grande and Las Canoas, Arroyo de Piedra, Vereda el Zapatero, La Sevillana, Manzanillo del Mar, Tierra Baja and Puerto Rey.	
Bring to 50% the percentage of the population with access to safe sewage services in the four towns of Tierra Bomba, Baru Island, Fuerte Island and San Bernardo Archipelago.	
To increase to 50% the percentage of the population with access to safe sewage services in the communities of Jorge Eliecer Gaitán, Meza Valdez, Madre Herlinda, La Esmeralda and Membrillal, in rural areas.	
Bring to 90% the percentage of the population with access to safe sewage services in the neighborhoods of Villa Rosa, Arroz Barato, Policarpa and Puerta de Hierro and 19 other neighborhoods in the district of Cartagena.	
Increase by 50%, the adequate disposal of domestic wastewater generated in the insular and rural areas.	

Source: Development Plan, Alcaldía de Cartagena, (2020/2023)

Another issue with a high impact on the city's water management is related to stormwater control. It is important to remember that Cartagena has multiple connections between wetlands, lagoons, rivers, rainwater channels and the Caribbean Sea, which makes it a hydrologically complex environment. This, in addition to the rainy season and the blows that always put the capital of Bolivar in public calamity with floods and emergencies in 70% of the city.

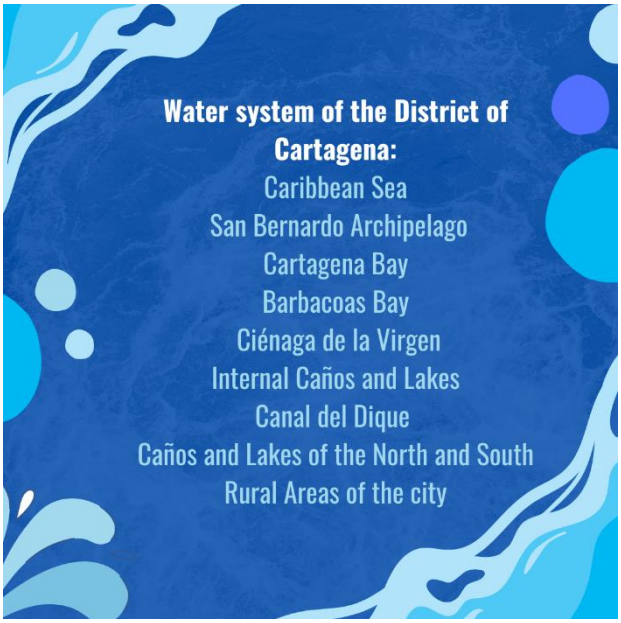
For this reason, the Pluvial Drainage Master Plan is currently under development and will be realized throughout the district's territory, including land that has been classified within the urban perimeter, urban expansion and rural land belonging to the areas of the Northern Zone, la Cienaga Virgen, Cartagena Bay, Caribbean Sea and Barbacoa Bay - Canal del Dique. This program has the purpose of seeking an adequate Pluvial Drainage System to minimize, improve and avoid the harmful effects of rainfall in the basins that make up the territory of the rural and urban areas of the District of Cartagena (Mayor's Office of Cartagena, 2018).

It is planned to technically prioritize 26 canals that are to be intervened in the following phases:

1. Study and Design (Diagnostic Phase - Conceptual Design Phase)
2. Detail Engineering Stage
3. Contracting Stage
4. Construction Stage

It is not the first time in Cartagena that an attempt has been made to materialize such a plan. Local parties have been working on different Storm Drainage Plans for more than a decade. The progress however has been minimal. Even though this plan is attractive due to the amount of new infrastructure that can be applied throughout the city, many stakeholders in the country believe that the current Drainage Plan is not executable because the proposal is outdated. Since Colombia changed, several regulations and guidelines adjustments are needed, as well as an evident issue of financing. Regarding this topic, there is also an additional proposal from the Secretariat of Infrastructure, in which the 'Water as Leverage' program would focus on the model for city drainage.

The second component included in the water management section of this study is related to the protection of water bodies, which, as mentioned before, is essential for the integral development of the city, but that due the deficient management of the disposal and dumping of waste constitutes a source of contamination in the bodies of water and peripheral ecosystems of the city. Currently, economic activities, linked to urban development or not, are causing an overload of chemical, physical, organic and microbiological pollutants that prevent the development of other productive activities and introduce risk factors for the health of the inhabitants.



Due to the effect of pollution, natural systems such as bays, coastal lagoons and highly productive estuaries have been affected in their biological capacities for raising and producing various resources. For their part, monocultures generate soil degradation and demand a large number of agrochemicals that pollute the environment. Furthermore, the lack of knowledge of the carrying capacity of ecosystems has not allowed the establishment of standards and controls that avoid exceeding or exploiting the environmental offer beyond the real levels of impact tolerance.

At the local level and within the program "Let´s save our water resource together", the district seeks to positively influence the implementation of protection, conservation and sustainable development actions in the city's water bodies, to contribute to the improvement of its quality, and allow the enjoyment and sustainable use of the resource.

In this sense, investments for the recovery and environmental sustainability of bodies of water and their areas of influence must attract and be combined with other investments from complementary sectors and from physical and social infrastructure, capable of promoting processes of improvement and urban development and/or rural. Given that water bodies constitute environmental determinants, the realization of strategic actions in these will require the greatest management efforts of the entities and actors involved in its environmental development. Among the planned activities that the city initially hopes to develop are:

- Intervene 4 bodies of water with the goal to optimize their physical, hydraulic and environmental conditions in rural and urban zones
- Develop 4 Water roundabouts associated with a drainage system, delimited and bounded
- Rehabilitate 2 Elements of the "La Bocana System" (Development Plan, Alcaldía de Cartagena, 2022-2023)

3.2 Port sector

The importance of Cartagena for the country regarding the port sector explains the need to prepare against the impacts of climate change in its various terminals and ports along its maritime and fluvial routes. According to the *Ministry of Environment and Sustainable Development* (2017), there are important consequences in terms of the impact of climate change in the region due to the increasing maritime and river traffic. This is reflected by the decreasing rainfall in the Páramo areas, rising maximum temperature, growing number of hydrometeorological events, rise of sea level, among others. It was found that more than 80% of the main port areas have a medium to high vulnerability to climate change. It is important to take this into consideration as more than 93% of foreign trade cargo is moved through these areas.

It is necessary to identify the main problems caused by the increase in maritime traffic, together with climate change, and the impact this would have on one of the main ports in the region: the port of Cartagena. Identification of possible opportunities for solutions that allow a sustainable and efficient operation of the port of Cartagena and other comparable places in the region is thus essential.

Cartagena accounts for 27% of the tons mobilized in the country. According to the type of cargo, it mobilizes mainly containerized cargo (59.4%), liquid bulk - mainly hydrocarbon (22.9%) and solid bulk other than coal (17.7%). On the other hand, the number of ship arrivals is a determining factor in identifying the importance of port areas. In that sense, the port of Cartagena stands out significantly by having the highest percentage of participation in the country with 36.2% during 2021, despite the negative percentage variation of 1.2% with respect to 2020.

The port infrastructure capacity in Cartagena is divided into 30 terminal and dock concessions granted by the *National Infrastructure Agency* (ANI for its Spanish acronym) along its coastal area. Among the main port concessions are the following: *Sociedad Portuaria Regional de Cartagena (SPRC), Terminal de Contenedores de Cartagena (CONTECAR), Compañía de Puertos Asociados, Sociedad Portuaria Puerto de Mamonal, Refinería de Cartagena (REFICAR)*.

According to the *Ministry of Environment and Sustainable Development* (2017), due to its ecosystems, climate and location, this infrastructure is facing a series of threats such as:

- Coastal erosion: moderate-high in Tierrabomba and Punta Canoas. In general, erosion values are -0.37 m/year, reaching -6.40 m/year in some areas.
- Sea level rise: increases of 2-5 mm/year can be expected, reaching 0.8 - 1m by 2100. Gradual loss of large areas of land and flooding.
- Flooding: alteration of natural drainage, deforestation and colonization of hillsides and hills that aggravated the problem of mass removal and soil erosion. Moderate to high exposure level in 20% of the port area.>
- Tsunamis: the threat of tsunamis is related to volcanic activity in the Martinique and St. Thomas Islands, although the probability of occurrence is 0.1.
- Sedimentation: due to climate variability, there is a constant need for dredging in Cartagena. A very striking example of this occurred in 2014, when dredging needs amounted to $25 Million USD.

Figure 2: Projected Sea Level - 2040

Source: Ministry of Environment and Sustainable Development, (2017)

Following this, a medium level of vulnerability to climate change is observed, derived mainly from:

Chart 2: Climate Change Vulnerabilities for 2040 - Ports of Cartagena

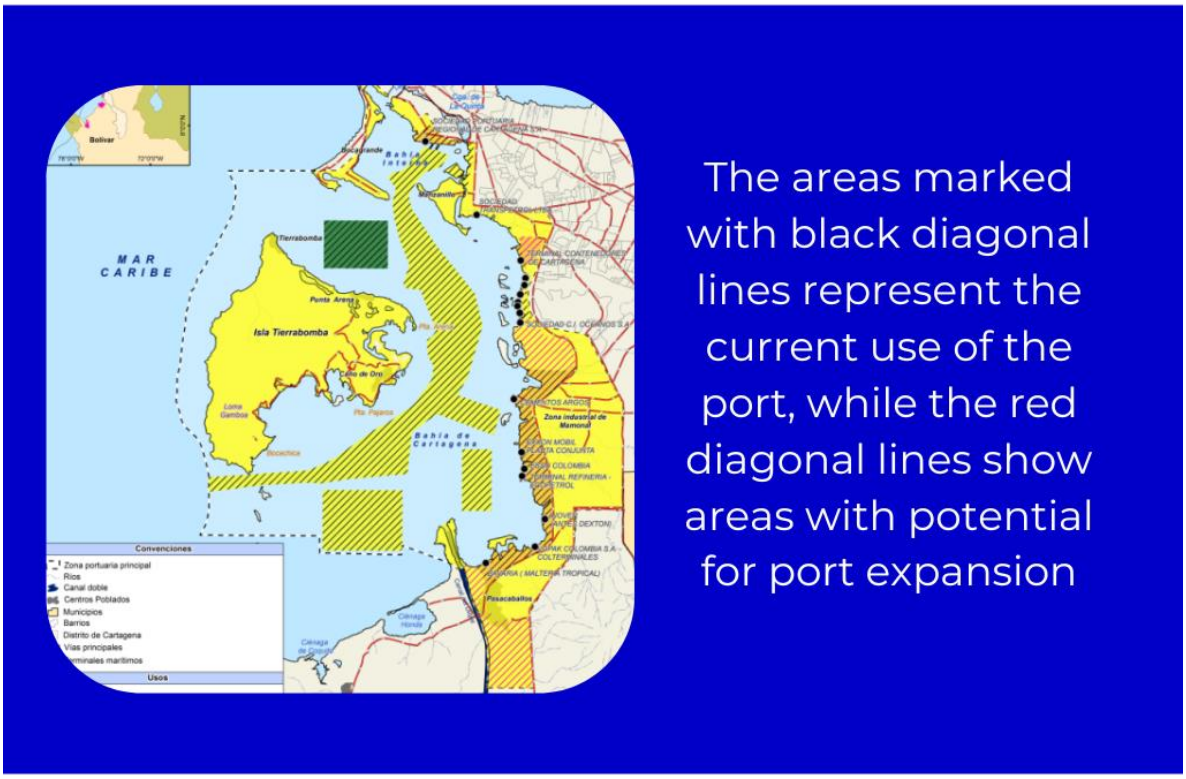
Erosive Processes	Affectation of 18.9% of the coastline of the port area
Flooding	25% of the terminals affected
Sea Level Rise	Affectation of: • 68% of terminals • 44.6% of the port use area • 20.5% of the expansion area • 50% of access roads • 30% of cargo volume Investment exposed to threats: US$9650 million. (Estimate made in view of the increase in the projected level to 2040).

Source: Ministerio de Ambiente y Desarrollo Sostenible, (2017)

Due to the vulnerability of certain areas of the region regarding floods and accumulation of sedimentation caused by poor maintenance of its waterways and maritime routes, in addition to the tragic experience of the great flood that occurred in 2010, the government began to take measures to prevent similar events. The main action in this matter is known as the Canal del Dique Megaproject, an initiative that involves the restoration, maintenance and control of 115.5km of waterway between the municipality of Calamar and the bay of Cartagena, as well as to the construction of two systems of locks and gates.

The following image shows the vulnerability of the Cartagena port area to climate change in 2040, where the green area represents low vulnerability, the yellow area represents medium vulnerability and, finally, the orange area, high vulnerability.

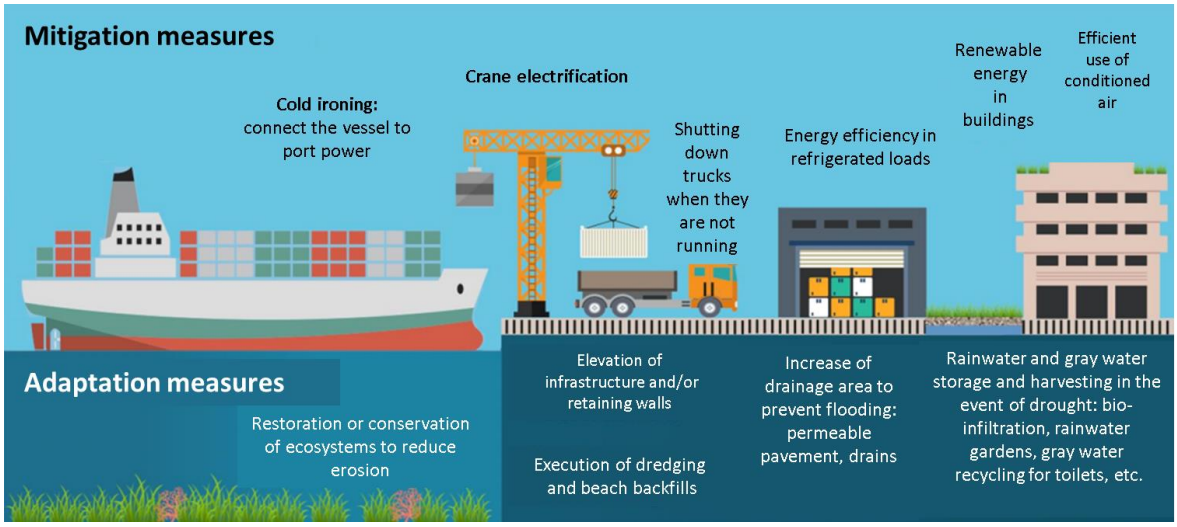
Figure 3: Expansion Potential of Cartagena Ports



Source: Ministry of Environment and Sustainable Development, (2017)

Regarding port public policies, the entities in charge of drafting, executing and enforcing them in the different concessions of the coastal area of Cartagena are: *General Maritime Directorate (DIMAR), the Ministry of Environment and Sustainable Development, the National Infrastructure Agency (ANI)*. In 2017, the *Ministry of Environment and Sustainable Development* published a climate change management plan for the maritime ports of Colombia since 80% (including erosive processes, flooding and sea level rise) of the main port areas are at risk. This plan proposes adaptation and mitigation measures for each port considering their specific conditions.

Figure 4: Climate Change Mitigation and Adaptation Measures



Source: Ministry of Environment and Sustainable Development, (2017)

The plan establishes some important actions for adaptation to climate change in the Port of Cartagena. For example:

- Sea-level rise, floods, erosion: barriers to protect the coastal ecosystem management and the planning the use of dredged material.
- Increased rainfall and temperature: integration of climate change variables into procedures or operating plans, reforestation of mangrove coastal lagoons and riparian forest, and revegetation of areas surrounding the terminal.
- Sedimentation: planning of dredging activities.
- Floods and droughts: rainwater harvesting, handling and storage of rainwater, water consumption reduction technologies.

In terms of greenhouse gas mitigation, the following actions are proposed:

- CO_2 capture: protection or restoration of ecosystems with CO2 sequestration functions.
- Renewable energy: take advantage of the wind season for alternative energy generation and its supply, and the installation of photovoltaic panels to power small infrastructure units.
- Energy efficiency: adequacy of port facilities to optimize energy and water consumption, and the promotion of ship-to-shore cold ironing technologies.

The Port Sector in Cartagena is already facing climate adaptation needs due to the impacts of climate change, including sea-level rise, increased frequency and intensity of extreme weather events, and changes in precipitation patterns. These impacts are putting pressure on the city's port infrastructure.

To address these challenges, promoting renewable energy connections in Cartagena should be an important matter of discussion for the national and local institutions. Specifically, green hydrogen and offshore wind energy have been identified as potential solutions in order to decarbonize the port development processes. Green hydrogen is produced using renewable electricity and can be used as a fuel for transportation and industry, while wind energy can provide clean electricity to port activities.

3.3 Sustainable Urban Development sector

Urban development in Cartagena is of great importance for the residents of the city and for the right management of its natural resources, but also because of its tourist vocation. The city accounts for nearly 70% of the GDP of the department of Bolívar (Instituto de Estudios Urbanos, 2020). The sector of tourism is of great influence to the GDP of the city, the region and the country, as it is an economic engine that mobilizes foreign exchange and generates the most employment in the city. For example, accommodation and food services account for 10% of the city's employees (Semana, 2023), that is around 48.100 people. Even though the COVID-19 pandemic had a great impact on the sector, there has been a major economic recovery in the last two years. During the first 9 months of 2022, the city received more than 2.7 million travelers, 28% more than pre-pandemic figures (Semana, 2022).

According to *Invest In Cartagena*, the city's investment promotion agency, there are several reasons why people should invest in Cartagena. For example, 11 international hotel chains can be found, it was ranked 9th in the Americas in the ICCA Ranking (international events and conventions) and 57th worldwide, because it holds a wide range of rooms and convention centers with adequate technological infrastructure and quality services, there are tax incentives for tourism investments and 90% of the cruise ship visitors to Colombia arrive in Cartagena (Invest in Cartagena).

Cartagena already relies upon sustainable urban infrastructure projects such as the *Serena del Mar* project. Novus Civitas, a management firm for sustainable, avant-garde and world-class urban projects, is in charge of this project described as “the most important urban development project in Colombia and the Caribbean Region” (Novus Civitas). *Serena del Mar* is expected to be a national and international benchmark for sustainable development. Inside this “dream city” there are several integrated components such as a hospital, several residential projects, educational institutions, beach resorts, lodges, boutiques, business hotels, commercial areas, business sector with offices, recreation areas including trails, waterways, parks and golf courses, among others.

This project is a showcase of what can be done in the city in order to improve urban planning with a sustainable approach. There are several forgotten sectors and neighborhoods with a high potential of economic, social and territorial exploitation, for example, Bazurto or Chambacú. In the city, there are some areas that have been classified as zones with urban renewal treatment. The implementation of

partial urban renewal plans on these parts of the city could result in a “transformation that favors public space and the urban image of the city” (El Universal, 2020). The idea of these plans is to make changes in terms of land use, urban development and offer better public services and infrastructure.

In spite of the modern urban development projects in the city, there are problems in terms of urban infrastructure in Cartagena that need to be solved. For instance, according to *Invemar* in "Third Communication of Climate Change", one of the coastal areas that would be most affected by floods as a result of the rise in sea level in the country would be Cartagena and its historic center.

As a result of the lack of urban planning, some high-risk coastal areas have been occupied by human settlements. Invasions by housing informal construction in bodies of water and low-tide areas have invaded the space of the coastal lagoon and thus reduced its capacity to store water and impact on water quality, biodiversity losses and overall sustainability. The lack of adaptation of these homes to the effects of climate change makes them highly vulnerable to phenomena such as floods and landslides, a situation that is especially aggravated in the rainy season. However, this does not only happen in coastal areas where informal settlements are located. In November 2022, the historic center of Cartagena made headlines as a result of the floods that occurred due to the overflow of the bay into the city. Landmarks such as the Pegasos Pier and the surroundings of the Convention Center were affected. This situation has been happening already for a few years as a result of different climatic phenomena.

An example of projects that are currently being developed by the Mayor’s Office on this field is the seafront at the Ciénaga de La Virgen. According to the *Environmental Observatory of Cartagena de Indias*, this coastal lagoon is one of the priority watersheds for sustainable planning and management in the city (Observatorio Ambiental de Cartagena de Indias, 2015). The coastal lagoon is currently facing problems such as high levels of deforestation, contamination, irregular settlements and improper wastewater discharges. Within the current Development Plan of Cartagena, it is proposed to work on a territorial planning program and social, environmental and urban recovery of the coastal lagoon in which issues of resettlement and urban renewal are contemplated. This would imply an "urban reorganization of the edge of the coastal lagoon, as well as urban improvement works (paving of streets, sidewalks) in the surroundings of the Perimetral road” (Alcaldía de Cartagena, 2020).

On the other hand, in terms of mobility, the city also faces some challenges. One of the goals of the current Development Plan of Cartagena is to finish the Master Plan of Sustainable and Safe Mobility that is in charge of the *Public Space and Mobility Management Office*. This project will generate a roadmap for the strategic planning of mobility in the city, mainly taking into account the promotion of alternative means of transport, such as the use of bicycles, public transport with low or zero emissions and waterborne public transport.

Additionally, the Caribbean Regional Train is being contemplated and it seeks to connect the departments of Bolívar, Magdalena and Atlántico in order to boost the competitiveness of the region and the optimization of travel times through a mixed freight and passenger rail project. It is expected to be a 100% electric system, thus reducing pollution levels.

The creation of infrastructure for the energy transition in Cartagena is also underway. The city is part of the Network of Thermal Districts of the Ministry of Environment and Sustainable Development. These districts are "a sustainable air conditioning infrastructure that, through outsourced service networks, supply heat or cold to public, commercial or residential buildings" (Ministerio de Ambiente y Desarrollo Sostenible, 2022). This project in Cartagena is led by Convex Efficiency and designed by its technical partner EON-Eficiencia Estratégica. With this "energy savings of at least 10% are projected for connected users, including the Intercontinental and Almirante hotels, and the NAO Shopping Center" (Ministerio de Ambiente y Desarrollo Sostenible, 2022).

The private sector has also been working on thermal districts. For example, *Celsia* has made progress regarding this topic and is a leader in the private sector "not only because of the number and size of the projects, but also because they combine residential, commercial and even hospital sectors" (La República, 2021), as mentioned before on the *Serena del Mar* project. On the other hand, the *Chamber of Commerce of Cartagena* has supported this project as a sustainable urban development solution.

As a result, there are diverse opportunities for development and investment in Cartagena in the area of sustainable urban infrastructure, especially in the fields of mobility, urban renovation and energy transition. During different occasions, the local administration has searched for public-private partnerships in order to carry out these types of projects. According to *Invest In Cartagena*:

> Cartagena was selected among 481 cities on the continent as the city with the Best Strategy for Attracting Investment in the Americas in the 2017-2018 American Cities of the Future ranking, published by FDI Magazine of the Financial Times. (Invest In Cartagena)

In terms of public policy, the Development Plan of the City "Let's Save Cartagena Together 2020-2023" (Alcaldía de Cartagena, 2020) is organized into pillars, and each pillar contains strategic lines of action. Throughout the plan, issues regarding urban infrastructure are mentioned and strategies are explained. The first strategy is mentioned on the "Resilient Cartagena" pillar, on the "Saving Our Natural Heritage Together" strategic line of action to be precise. Within this strategy, the Environmental Management and Climate Change Adaptation Program for Environmental Sustainability anticipates where the environmental variable will be included in the Land Use Plan in order to promote the reduction of vehicular pollution, especially through the use of alternative means of transportation such as waterborne public transport. It is also expected to mention the best working methods in terms of use and urban planning. This includes actions such as thermal districts and the reduction of fossil fuels.

Cartagena's current Comprehensive Climate Change Management Plan (Plan Integral de Gestión del Cambio Climático) includes climate change as a variable in environmental land use planning. In addition, it is expected that the revision process, through which 2001´s Land Use Plan is currently passing, will result in the inclusion of the climate variable as one of its bases. This is in order to plan new neighborhoods under the principles of climate adaptation with an integral vision of the city's physical and natural infrastructure.

Under the same pillar, there is another strategic line of action called “Public Space, Mobility and Resilient Transportation”. It is noted that the initiatives associated with mass transportation will receive special attention for the formulation of the first phase of waterborne and multimodal transportation. In this line, there are several programs, such as plans and measures for the design of alternative means of mobility which are contemplated and a Sustainable Mobility Program in the District of Cartagena that will focus on sustainable mobility to stimulate the use of alternative modes of transportation.

The next strategic line of action is about “Urban Development”. There are programs about topics such as building, adapting, improving, rehabilitating and/or maintaining urban and rural roads with complementary urban planning works (avenues, green areas, bike paths). An example is the Integral Program for lakes, lagoons and coastal lagoons of Cartagena de Indias, which discusses the recovery of the bodies of water mainly related to the environmental cleanup and their navigability, infrastructure and complementary works, such as bridges, bike paths, public space, urban equipment and the socioeconomic use of urban facilities and public space. The Bazurto market is considered the first stage.

Another strategic line is “Land Management Instruments”. The shoreline of bodies of water has real estate and landscape potential that has not been exploited due to environmental deterioration and land use conflicts. For this reason, they have been classified as urban renewal treatment areas. The public and private sector need to engage in projects in agreement with the social and economic needs of these areas. Regarding this need for action, the Land Management and Social, Environmental and Urban Recovery Program of the Ciénaga de la Virgen is considered.

3.4 Criteria Matrix: Defining opportunities on the nexus between needs and Dutch strengths

Based on the previously presented information, thirteen main opportunities can be identified. In the following matrix, these opportunities will be evaluated through a series of key criteria that accurately determine and prioritize various factors when considering viable opportunities for Dutch companies operating and offering solutions in the water, ports, and sustainable urban development sectors.
By determining the key criteria such as the stage of development of the project or business, financial feasibility, sustainability and environmental compliance, public sector dependency and relevance of the Dutch experience and knowledge, this matrix aims to provide a comprehensive framework for identifying and analyzing the most relevant opportunities within the sectors mentioned before.

Through this assessment process, Dutch companies can effectively address the dynamic landscape, take advantage of promising prospects and play a decisive role in shaping a sustainable future for Cartagena.

Chart 3. Criteria Matrix: Defining opportunities on the nexus between needs and Dutch strengths

Criteria	Water			Ports			Sustainable Urban Development						
	[01]	[02]	[03]	[04]	[05]	[06]	[07]	[08]	[09]	[010]	[011]	[012]	[013]
Stage of development of the project or business	1	3	4	2	3	2	2	2	3	3	4	1	2
Size of the project	4	2	3	5	4	5	4	4	4	2	3	4	4
[01]: Drainage master plan [02]: Ciénaga La Virgen seafront	[03]: Water: supply and treatment in set areas [04]: Sustainable Infrastructure and Technologies in the Canal del Dique Project			[05]: Climate-smart innovations for SPRC/Contecar [06]: Climate-adaptation for Cluster of Petrochemical Port Terminals			[07]: Urban waterborne public transport systems [08]: Sustainable urban infrastructure solutions in Chambacú and Bazurto		[09]: Caribbean Innovation and Technology Center [010]: Cycle Infrastructure Development Plan		[011]: Public Illumination Modernization Plan [012]: Regional Caribbean Train [013]: Smart Cities		
From 1to 5: **1. (Very low), 2. (Moderately low), 3. Intermediate, 4. (Medium-High), 5. (Very High)**													

Criteria	Water			Ports			Sustainable Urban Development						
	[01]	[02]	[03]	[04]	[05]	[06]	[07]	[08]	[09]	[010]	[011]	[012]	[013]
Willingness to enter into partnerships with foreign companies	X	X	Y	Y	Y	Y	Y	Y	Y	M	X	Y	Y
Previous existence of Dutch experience	M	M	X	Y	Y	Y	Y	Y	Y	Y	Y	X	X
Relevance of the Dutch experience/knowledge	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	Y
Public sector intervention	Y	M	Y	M	M	M	Y	M	Y	Y	Y	Y	Y
Sustainability and Environmental Compliance	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	Y
Complementary to the Water as Leverage approach	Y	Y	Y	Y	M	M	Y	M	M	X	M	M	M
Financial and economic viability of the project	X	X	Y	Y	Y	M	M	M	Y	X	X	M	M
[01]: Drainage master plan [02]: Ciénaga La Virgen seafront	[03]: Water: supply and treatment in set areas [04]: Sustainable Infrastructure and Technologies in the Canal del Dique Project			[05]: Climate-smart innovations for SPRC/Contecar [06]: Climate-adaptation for Cluster of Petrochemical Port Terminals			[07]: Urban waterborne public transport systems [08]: Sustainable urban infrastructure solutions in Chambacú and Bazurto		[09]: Caribbean Innovation and Technology Center [010]: Cycle Infrastructure Development Plan		[011]: Public Illumination Modernization Plan [012]: Regional Caribbean Train [013]: Smart Cities		
Y= Relevant/Available **X= Not Relevant/Available** **M=Medium/Moderate**													

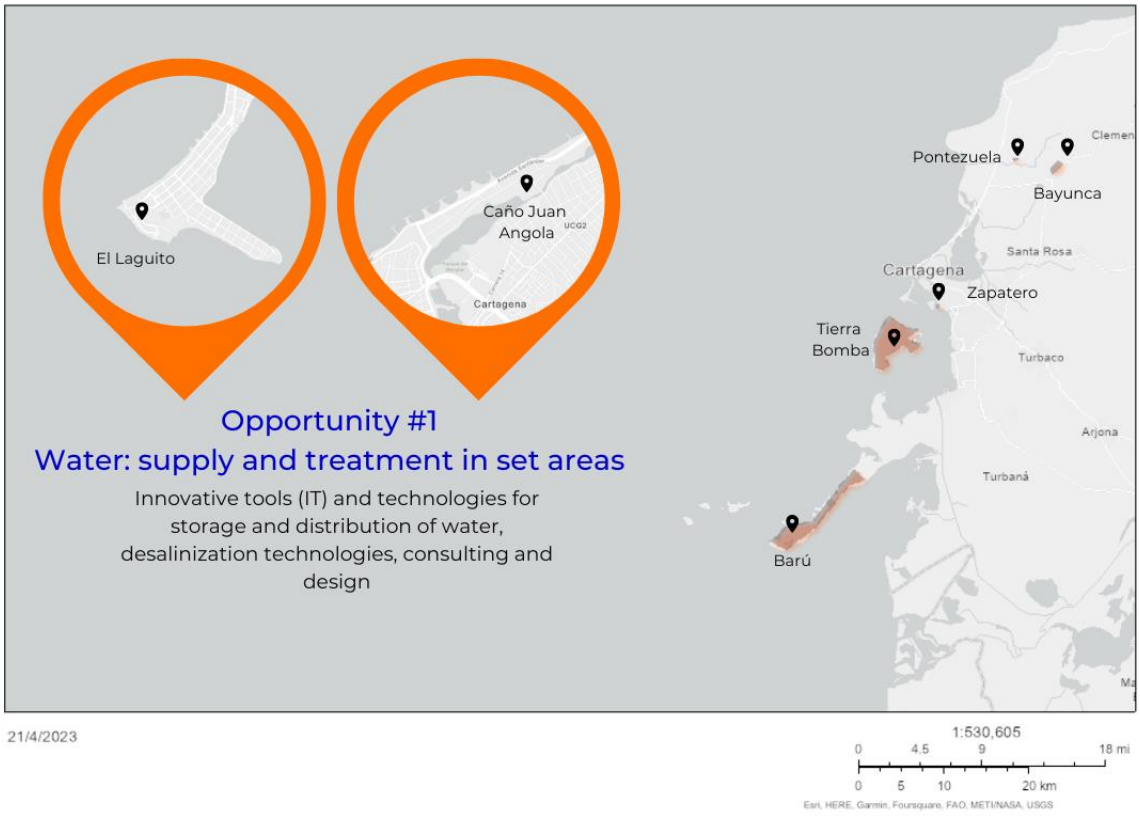
Upon analysis of the scores and 'concreteness' of each opportunity, **eight opportunities** remain and will be further detailed in the next chapte

Picture: Terminal de Contecar - Crédito: Héctor Rico S. - Grupo Puerto de Cartagena

4. Opportunities

Opportunity 1: Water: supply, treatment and protection in determined areas

When talking about the access to water and its treatment, a first set of opportunities can be identified. The reality is that the real coverage of the drinking water and sewerage service in rural areas and in neighborhoods in high-risk areas is unknown. The population without aqueduct and sewerage coverage in Cartagena is mainly concentrated in rural areas, where it is estimated that around 25,898 people do not have access to drinking water and 45,040 to sewerage. This added to serious deficiencies in the management of rainwater that cause chaos and calamities in the city, as well as a possible loss of bodies of water in the city.



One of the most important comprehensive projects that are going to be developed in the rural areas of the city is related to the update of the definition and implementation of the provision scheme of water and sewerage services in the communities of *Tierra Bomba*, *San Bernardo Archipelago*, *Isla Fuerte and Isla Barú*, *Vereda el Zapatero*, *Bayunca* and *Pontezuela*.

- Tierra Bomba: studies and designs present

- Archipiélago de San Bernardo: no studies or designs
- Isla Fuerte: no studies or designs
- Isla Baru: no studies or designs

Regarding these first 4 locations, there are some previous studies, technical reports, plans, budget and technical specifications, as well as work groups that have taken place for technical assistance by the *Ministry of Housing, City and Territory (Ministerio de Vivienda)* with the participation of *Aguas de Cartagena* and the *General Secretariat.*

The Technical Operational Plan is being adjusted through temporary solution proposals presented by the community and plaintiffs and organized visits to the territory, which are being monitored by the Committee and the *Public Ministry*. In cooperation with *Ministerio de Vivienda*, consultations have taken place that updated the status of the project for the ultimate solution and request for technical assistance.

As for Vereda el Zapatero, the review process of technical documents for the approval and feasibility of the sanitation project by the *Planning Secretariat* - Project Bank is in progress. This project will make 85 homes in the Zapatero community benefit and includes:

- Sanitary solutions for Vereda Zapatero de la Boquilla District in Cartagena: in order to meet the proposed goals, the project already holds previous studies and is in pre-contractual procedures.
- Extensions of sewerage networks: in order to meet the proposed goals, this project is undergoing diagnostic studies of the networks already built. The project has an extension of 3,600 meters, of which 478 meters have been inspected so far. Preliminary studies are being prepared to start the contracting process for the construction of sanitation infrastructure in the Zapatero village.

Additionally, regarding the zones of Bayunca and Pontezuela, the *National Land Agency* announced that the land where the construction of the Wastewater Pumping Station (Ebar) of the sewage system of these two districts will be soon awarded to the District of Cartagena.

It consists of the construction of a Pumping and Residual Water Station (EBAR) in each district. This means a huge step in the construction of the sewage system for both districts, because after the National Land Agency approved the studies of the property in Pontezuela, the Ebar will be built here if everything is in order.

On the other hand, from the interviews that have been conducted we were able to identify certain more general opportunities for the local Public Aqueduct and Sewerage Company *ACUACAR - Aguas de Cartagena* in the following areas.
In the next 5 years they will open a second water treatment plant, since the current plant is expected to reach its peak. This will imply an investment of $35 million dollars which will generate 52 thousand cubic meters a day. As a result, ACUACAR will have to open a tender for the purchase of

equipment for the construction. This includes the procurement for the area of operations, such as pumping equipment, valves, dynamic pressure control valve technologies, pressure valves, elements installed in the network that are constantly changing, as well as innovative filtration technologies (because of sulphate scarcity).

Furthermore, the long-term network expansion will be prioritized, consisting of a) Line 1400 to move drinking water to the north of the city. Solutions are needed to make use of and then connect to the water treatment system. b) Action plan in urbanized Cartagena where before only houses were to be found and now also multi-story buildings. The flows and the collection of water are multiplied. It is necessary to renew the networks and make the wastewater pumping systems more robust.

The second set of opportunities is related to the recovery of bodies of water in different areas of the city, such as El Laguito, Caño Juan Angola, and those located between the Chambacú Lagoon and the Cabrero Lagoon.

The Planning Secretariat of Cartagena and EPA (Environmental Public Authority) are working on contracting the environmental impact studies of the proposed works designed to solve the sedimentation problems that are constantly present in the body of water of *El Laguito*. Once these studies are available, the environmental license can be processed before the ANLA (National Authority for Environmental Licensing), which will allow the contracting and execution of the works. (Alcaldía de Cartagena, 2023)

During the inspection operations in the area, several critical points have been revealed, for which reason it was determined to expedite the administrative measures in this regard in order to avoid further damage to the ecosystems of these bodies of water, especially the indiscriminate felling of mangrove coastal lagoons.

However, what has been done so far in some of these areas are educational work and work-groups with the surrounding communities. As in the case of the Juan Angola canal, the area that has made the greatest progress, where social cartography workshops have been held with neighboring communities in order to identify the current environmental situation of the body of water in question, to then be able to execute 10 actions in which various entities of the city are expected to intervene. The district is expected to continue working on obtaining the resources in conjunction with the entities involved, such as EPA Colombia, Corvivienda, Secretary of Planning and Secretary of Infrastructure.

Furthermore, it is clear that the District must look for alternatives that allow solving the problem of invasions and fillings of the body of water. For this, progress has also been made in the characterization of the invasions present there and in the existing fillings throughout the years. Corvivienda and the EPA hope to plan solutions to recover, protect and conserve these bodies of water and the consequent recovery of mangrove areas and their fauna, improvement of the channel and its hydraulic capacity. (EPA Cartagena, 2022).

Needs that offer the best fit with the Dutch offering:

The challenge for a city like Cartagena is to find cost-effective, sustainable and simple solutions for municipal and industrial water that have a small footprint and meet the strictest purification requirements. That is why the Netherlands can offer a unique portfolio of smart game-changing solutions in sustainable water use.

Opportunities for Dutch expertise

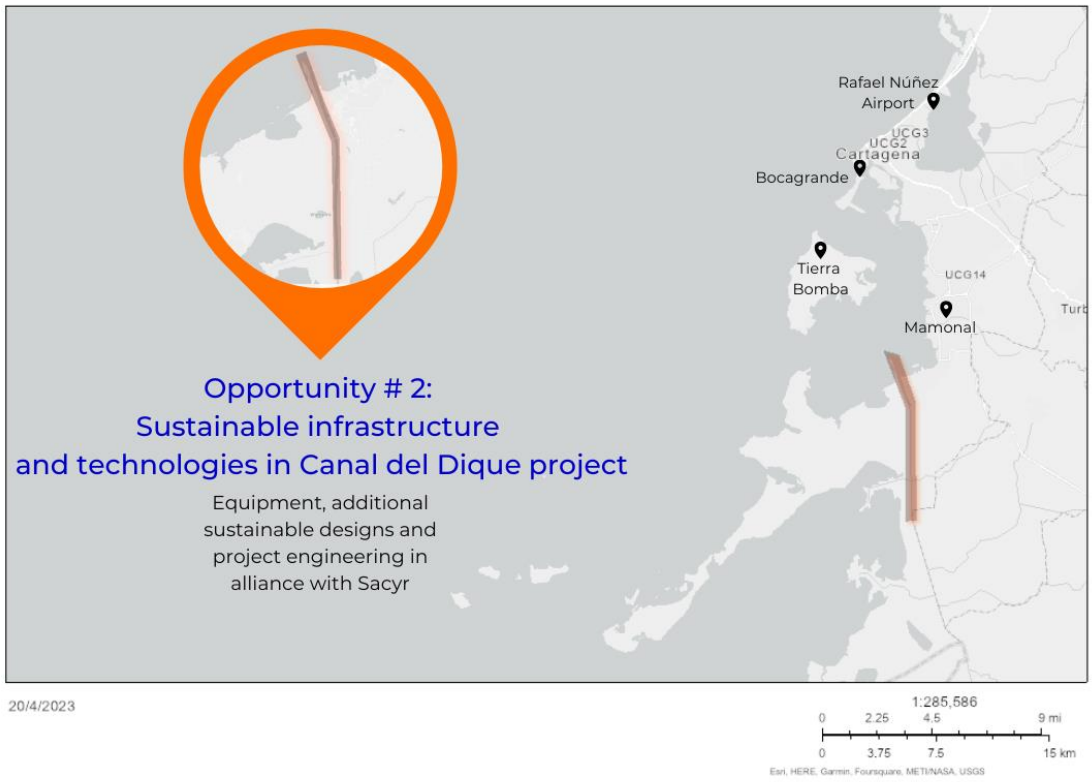
- Innovative tools (IT) and technologies for storage and distribution of water: access and visualization of updated information on the availability, demand and use of water. For this, platforms that have the capacity to display information in real time (meteorological, hydrological, groundwater, water quality, satellite monitoring, among others), forecasts, drought indicators and maps.
- (Desalinization) technologies for providing drinking water: cost-effective and innovative purification and sanitation technologies that use unique components such as aerobic granular biomass, or engineered filtration processes based on ceramic membranes or UV applications and advanced filtration methods that provide excellent water quality through compact and easy to operate installations, at low energy consumption.
- Consulting and design for water plant companies: allies in solving challenges such as those that are evident in Cartagena through consultancy, engineering and architecture studies covering the entire chain, from policy formulation and design to contracting and

construction supervision. As well as design and architectural expertise to realize the projects aligned with the historical-cultural landscapes of the city, while using ecological architectural designs that contribute to air purification, lower ambient temperatures, heat regulation and biodiversity.

- Innovative equipment and tools for water management operations: wide range of equipment, tools and materials customized to the needs of each project. Examples are real-time meters and equipment. This also considers other tools and items to make self-cleaning networks, effective and innovative water pipe systems, valves, hydrants, items for inspection, dewatering and sewage pumps, groundwater loggers and producers of performance products for water treatment, such as coagulants and flocculants.
- Solutions to restore aquatic ecosystems without chemicals or other harmful pollutants that prevent access to new natural water sources that have been affected and contaminated by natural or industrial effects, as well as to keep the water treatment plants free of different contaminants such as algae or debris. If not treated at the source, these contaminants are likely to end up in treatment plants, clogging filters and pipes, which raises concerns about water quality and safety, can cause service interruptions during treatment, or even operational shut-downs. That is why by using existing filtration monitoring technologies it is possible to achieve more efficient water treatment projects and more conserved water bodies in the city.
- Innovations to accelerate solving challenges of coastal maintenance and cleaner waters, as well as technologies to monitor waste streams and prevent them from finding their way into waterways leading to the water bodies. Accompanied by filter systems that allow the control of contamination of water bodies by removing color, micropollutants and other contaminations with significant energy and chemical savings.

Opportunity 2: Sustainable infrastructure and technologies for the Canal del Dique project

The magnitude of a project like this requires a large number of intervening actors for the realization of the different actions included. These stakeholders need to provide technology and equipment, as well as support in the redesign and restructuring of the infrastructure related to the proper functioning and disaster prevention of the waterway.



Canal del Dique is a mega-project whose execution was awarded to the Spanish firm *Sacyr* on December 7, 2022. This project has an investment close to $600 million USD and seeks to counteract the risk of floods in communities neighboring this river corridor in the event of climate phenomena, as well as to recover degraded ecosystems that would benefit 19 municipalities.

The project concerns a waterway of approximately 115.5 km between the municipality of Calamar and the bay of Cartagena. The concession will have a 15-year term for the execution and maintenance of the operations, which will permit active control of the canal.

According to the *National Infrastructure Agency - ANI* (2022), the project is based on ten specific objectives:

- Active regulation of inflows to the Canal del Dique system.
- Control of sediment transit between the canal and the bays of Cartagena and Barbacoas.
- Control of floods and control of water levels in the canal.
- Control of saline intrusion.
- Climate change adaptation scenarios.
- Improvement of the marsh canal connections.
- Restoration of the Corales del Rosario and San Bernardo National Natural Park ecosystems.
- Restoration of marshes, canals and the Dique Canal.

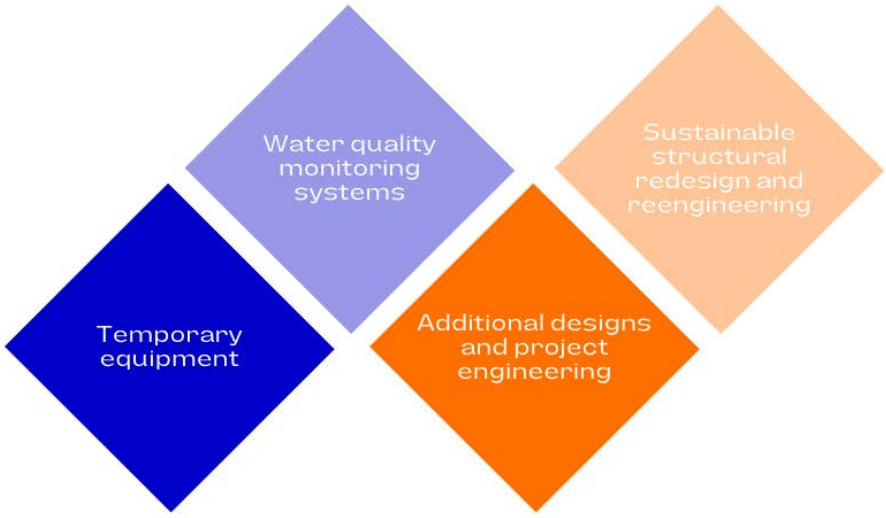
- Securing the canal's water resources for drinking water, irrigation, livestock, fishing, and other services.
- Improvement of the canal's navigability.

Source: El País (2022). Canal del Dique

The works to be concluded include a system of locks and gates to prevent the uncontrolled entry of large amounts of sediment and flow into the system, maintenance dredging, bank protection, implementation of SCADA systems, dikes, pumping stations, and works for coastal lagoon connections, among others.

During an interview with the awarded firm, *Sacyr*, they expressed their interest in partnerships with Dutch Businesses aimed at consulting and design improvement, as well as new designs and structure planning. Currently, the project is in its initial stage, but this year - 2023 - the preconstruction stage with a duration of 18 months will be started.

Opportunities for Dutch expertise



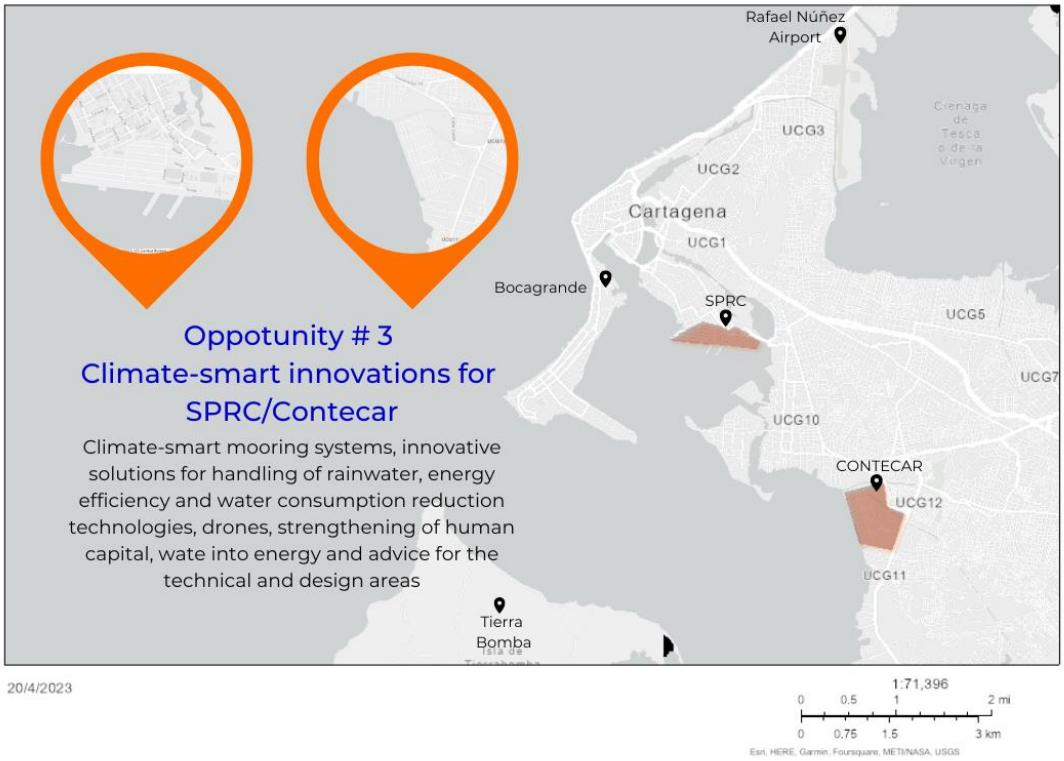
- (temporary) Equipment: Sheet piles, combined walls, anchorage products, excavators (standard and LRE), material handlers, wheel loaders, moto graders, containerized workshops, customized conveyor belts, stationary light sets, among others.
- Water quality monitoring systems that allow control at different points along the waterway, in addition to allowing the transmission and processing of information in real time.
- Additional designs and project engineering: Hand in hand with the application of Nature Driven Design principles to ensure sustainability, in line with programs such as "*Room for the River*" that as a concept aims to have interventions in the landscape that restore the capacity of rivers to act as "natural water sponges". This brings reduction of flood risks by increasing the depth of rivers, controlling floods and river inflows and in general being able to better face climate changes.

To ensure this, the engineering must also encompass scoping studies, environmental impact assessments, designs and engineering, accompanied by a guidance in the area of procurement and supervision of works that are necessary for the proper development of the macroproject for the canal, such as:

- Hydraulic, groundwater and morphological modelling needed to solve some of the main issues such as navigation in the main canal.
- Ecological and landscaping analysis, so that the environmental impact is as low as possible on the marine ecosystems and that even nature can be an ally in the project, since the Netherlands has shown that natural systems can be better solutions for different coastlines and river areas around the world.
- Dedicated designs for better inflows and navigability with solutions that can take away several bottlenecks that hold up the river flow causing local high-water levels. Instead of raising the levees to meet future higher peak discharges, the rivers can be given more room to flow.
- Long-term oriented interventions to limit ground water extraction, bringing back rivers into the floodplain and using "Building with Nature" measures. While in the more urban areas with less mangrove cover, other hybrid (green-gray) mitigation strategies may apply, integrated into a broader coastal management approach.
- Technologies that help to improve the efficiency of freshwater use in areas subject to salinization, including the retention and storage of rainwater, a better separation of fresh and saltwater, and the increase of surface water levels to suppress salt water seepage.
- Sustainable structural redesign and reengineering: taking into account the need for adaptation in infrastructure that the impact of environmental change generates in ports, as well as the constant updates of governmental requirements for the approval of expansion and the proper functioning of terminals, the Dutch expertise in this area offers an opportunity for companies with knowledge in asset management, civil engineering, geotechnical advice, environmental management, ROV underwater inspection, as well as hydraulic engineering and water safety.

Opportunity 3: Climate-smart innovations for SPRC/Contecar

The two main ports of Cartagena are in constant search of technologies and maritime equipment that allow them to remain at the forefront. Reaffirming their concern for the care of the environment and risk prevention in the face of the impact of climate change, both are looking for eco-friendly and sustainable infrastructure designs, as well as the exchange of experiences that can be enriching in the field.



Sociedad Portuaria Regional de Cartagena (SPRC) is the city's main port. It has operated at the Manga maritime terminal since 1993, the year of its concession, which was granted for 40 years with the commitment of making significant investments and executing a Master Development Plan. On the other hand, *Contecar* is located in one of the main industrial zones of Colombia, being an ideal spot for container handling and other international trade services.

Being part of the same group, and being categorized as one of the region's leading ports (2023: 1st Latin American and 5th worldwide port in efficiency according to World Bank and Standard & Poors), its technological development has gone hand in hand with its operational growth. Both ports benefit from large infrastructure, which allows them, together with the technological equipment for the handling of goods, ships, and containers, to be the ideal port regarding the connectivity and competitiveness required nowadays.

Chart 4: SPRC and CONTECAR Infrastructure and Equipment

Concession	Infrastructure	Equipment
Sociedad Portuaria Regional de Cartagena (SPRC)	Warehouses (2) - 9076m2 Sheds (2) - 1616m2 Yard - 242094 m2 Berths (9) - Capacity (42.855m2) Length of berth - 1808m Depth - Between 6.8 to 15.5m	Gantry Cranes (6) Mobile Cranes (2) RTGs (32) Tractor-trucks (81) Reefer Intakes (1140) Scales (7)
Terminal de Contenedores de Cartagena	Warehouses (6) - 28265m2 Shed IMO (1) - 432m2 Yard - 62303m2 Berths (3) - Capacity (173500m2) Lenght of berth - 1000m Depth - 17m	Gantry Cranes (13) RTGs (60) Tractor-trucks (120) Reefer Intakes (2400)

Source: SuperTransporte, (2022)

Both ports have recently been implementing technology and programs in favour of port security, energy efficiency, coastal erosion management, flood risk prevention, adaptation and port structural planning in the face of climate change.

As part of this implementation, the following projects can be highlighted:

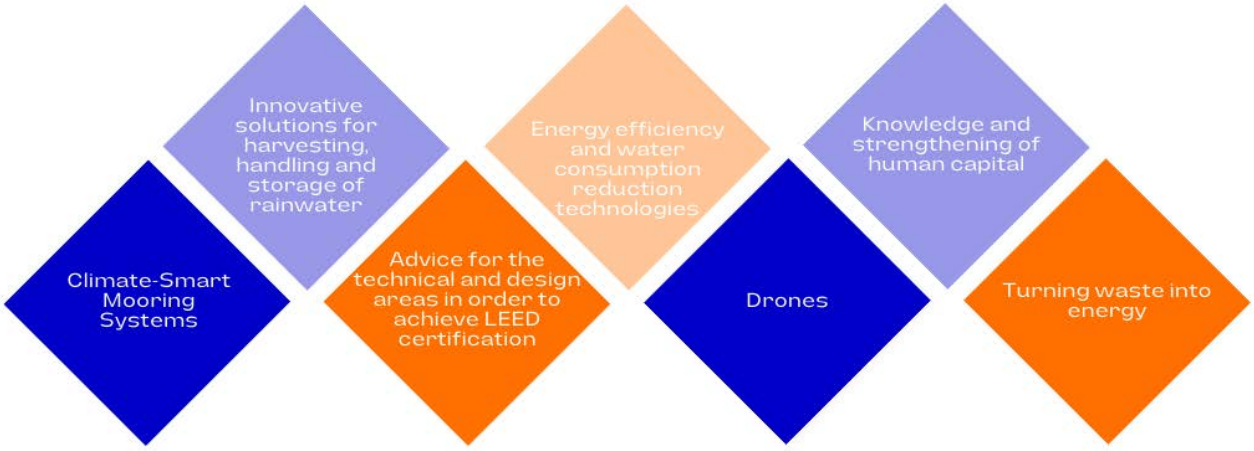
- Electrification of RTG yard cranes and mobile cranes, which switched from fossil fuel consumption to electric power. With this change the Group achieved an annual decrease of 113 tons of CO2 per unit and 381 tons of CO2 per unit, respectively.
- Use of high-efficiency electric motors.
- Replacement of lighting technology to LED in storage yards, gantry cranes, RTGs and buildings.
- Implementation of automatic controls for air-conditioning systems.
- Installation of a reactive power compensation system for power control.
- Commissioning of the solar roof for the new Contecar International Logistics Distribution Center (CDLI). 6,000 Solar modules were installed by Celsia which will supply 10% of the

port's annual energy needs, a renewable energy source that will reduce CO2 emissions by 1,101 tons per year.

- Coastal protection project, in charge of Consorcio Proplaya.
- The port currently is equipped with infrastructure adapted to the effects of climate change. It has platforms and piers with an elevation of 2 meters with the aim of withstanding the sea level rises. Additionally, it has expanded the storm water collection system and new drainage systems have been built to deal with floods and heavy rainfall.
- Management and dredging plan for the channel and permanent depth monitoring was implemented in order to deal with sedimentation. During this work, more than 8,700 species of fauna and flora were relocated and saved.
- It has water reclamation systems with rainwater harvesting, naturally lit and ventilated warehouses and more than 10 acres with green areas inside the terminals.

It is important that SPRC and Contecar remain at the forefront of technological innovations in port equipment, especially in the light of the short-, medium- and long-term impact that climate change will have on this sector. This is why they are always on the lookout for the latest innovations in technology and solutions.

Opportunities for Dutch expertise



- Climate-smart mooring systems: Mooring systems that are more environmentally friendly, cost efficient and have been tested under extreme weather conditions, including significant temperature changes, tidal differences, etc. In order to be able to collect information in real time and efficiently in the midst of water bodies affected by the impacts of climate change, it is necessary to implement more advanced mooring systems. It is important that the information or data collected is transmitted in real time, so that the risk is reduced to a minimum, ruling out the need for storage or power supply for future data transfer.

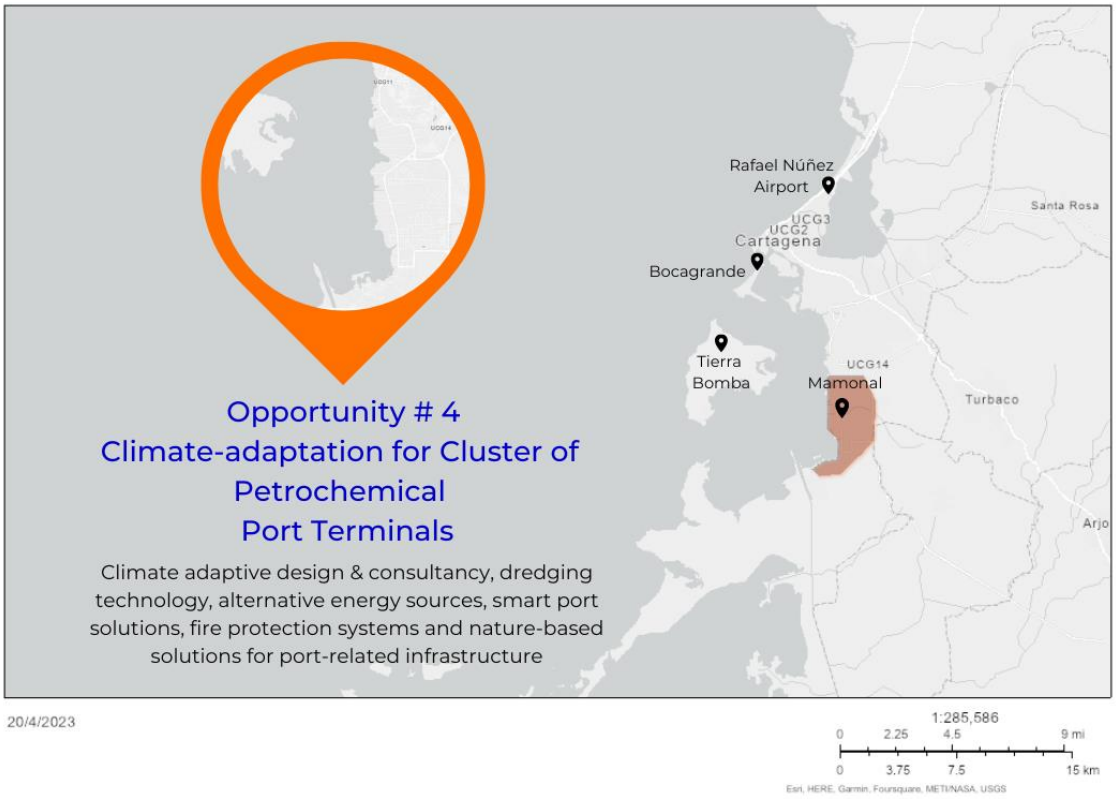
Another necessary feature is the ease of transport and deployment of the mooring devices, emphasizing lightness and small size. Energy autonomy is an important point to take into account, implying intelligent mooring systems that use 100% green energy would be the preferable solution. Similarly, it is paramount to be able to customize the devices according to the use to be given, as well as the information to be collected, since it varies according to each port and/or type of study to be performed.

- Innovative solutions for harvesting, handling and storage of rainwater: Tailor-made water storage and harvesting tanks, with automatic flood prevention systems during rainy periods. As well as easy to use and large capacity water purifiers, powered by eco-friendly energy. The objective is to be able to use rainwater for alternative uses such as plumbing and, depending on capacity, fire hydrants. Preferably it would allow the use of this water for cleaning and irrigation activities, minimizing the use of fresh water for this purpose.
- Advice for the technical and design areas of SPRC/Contecar in order to achieve LEED certification (Leadership in Energy and Environmental Design) for future port expansion plans: in order to achieve the necessary building and design requirements for port expansion projects such as Site Sustainability; Energy consumption and greenhouse gas emissions; Materials and natural resources, among others, there is a great opportunity for Dutch companies that could provide consulting services for future projects such as new warehouses for coffee storage in Contecar, as well as the expansion of the port dock by 33 meters, the construction of the entire administrative area, warehouses and additional yards.
- Energy efficiency and water consumption reduction technologies: Customized energy efficiency solutions on an industrial scale that can offer different energy sources such as large-scale solar energy collection and storage, modular, battery-powered or photovoltaic energy systems. As for the reduction of water consumption, opportunities exist for consultancy services as well as technologies for storage and distribution of water in the ports with clear visualization and updated information on the availability, demand and use of water.
- Drones: Recently, the use of drones for port security and surveillance has begun to be included, due to the large dimensions of their land and spaces, as well as the difficulty of access in some areas. In order to accomplish this task, it is important that the drones have the following characteristics: long distance flight capabilities, fully autonomous, with payload capacity, capable of flying in difficult weather conditions (rain and strong winds).
- Knowledge and strengthening of human capital: While the main solutions that ports can choose to address the potential threats posed by climate change are related to high-tech engineering and water management infrastructure, it is fundamental to integrate and transfer Dutch experience and knowledge to the institutions and people that are part of the port community in the city of Cartagena. Climate change can be seen as an opportunity for Dutch organizations and training centers to offer educational and Train-the-Trainer programs. These programs would have to focus primarily on climate change adaptation, climate change mitigation, port resilience and sustainable decarbonization processes.

- Turning waste into energy: If the waste from the ships that constantly enter and leave the port of Cartagena would be used to generate energy, it could be an opportunity to offer a solution that would contribute not only to the decarbonization of the port but also to the possibility of implementing a sustainable system for the management of waste from ships.
- Adaptation to new energy sources: Wind and offshore wind energy projects have started to gain relevance according to the national energy transition policy promoted by the central government. It is a great opportunity for Dutch companies involved in wind energy projects to advise and share the technical and local experience to port related organizations in Cartagena in terms of pre-feasibility studies and adaptation of infrastructure.

Opportunity 4: Climate-adaptation for Cluster of Petrochemical Port Terminals

The need for new designs adapted to the prevention of climate change impacts, as well as the transition to eco-friendly technologies is essential for the petrochemical ports in the Mamonal area. As a consequence, new tools and cutting-edge systems, as well as consultancy and sustainable development proposals are demanded by the terminals.



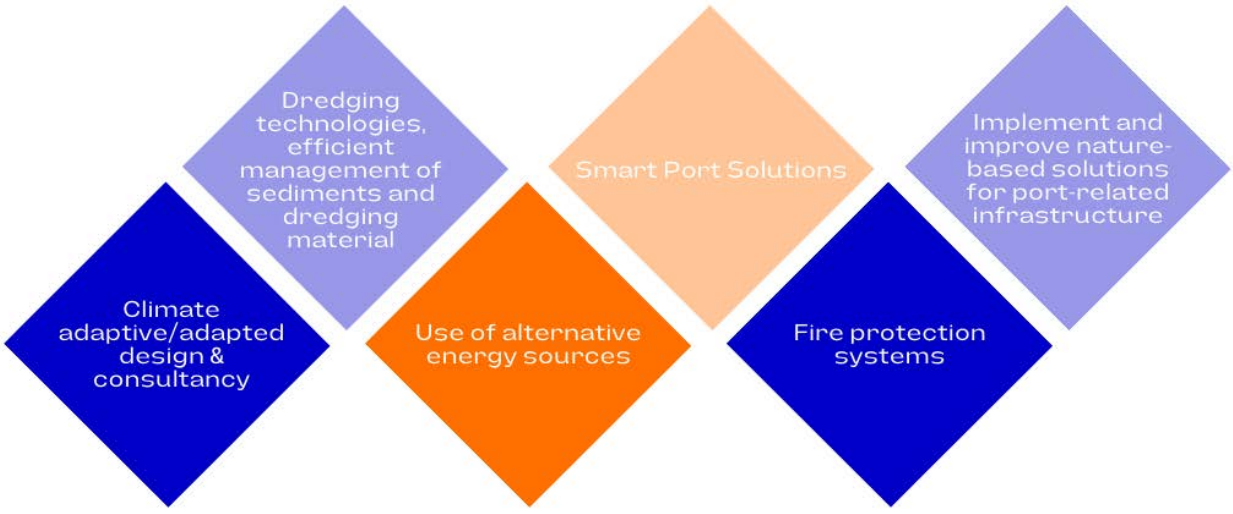
Throughout the industrial zone of Mamonal there are a series of private concession port terminals of different sizes and needs. These include ports of great importance such as *Reficar, Ecopetrol, Transpetrol, Sociedad Portuaria Olefinas y Derivados, Oiltanking Colombia*.

According to an interview with the *National Infrastructure Agency (ANI)*, these ports are in need of a series of redesigns according to the reorganizations that are carried out from time to time, during which the concession contracts are reviewed and adapted to environmental and technical requirements in order to avoid negative externalities resulting from their operations, as well as catastrophes caused by structural vulnerabilities to climate change of the terminals.

These new designs would need to have a greater eco-friendly component due to the new environmental policies of the current government, where, for example, own energy production is encouraged and, in the short/medium term, will be required in each terminal. In addition, it is important that they take into account the water bodies located in the area, in order to prevent affecting the water quality and the impact on the environment. It is imperative to consider the design of infrastructure that allows for the treatment of wastewater and pollutant discharges.

It is paramount to note that, due to the flammability of the products that pass by these port terminals, it is necessary to be aware of the latest technology in fire protection systems, as well as adequate fire prevention.

Opportunities for Dutch expertise



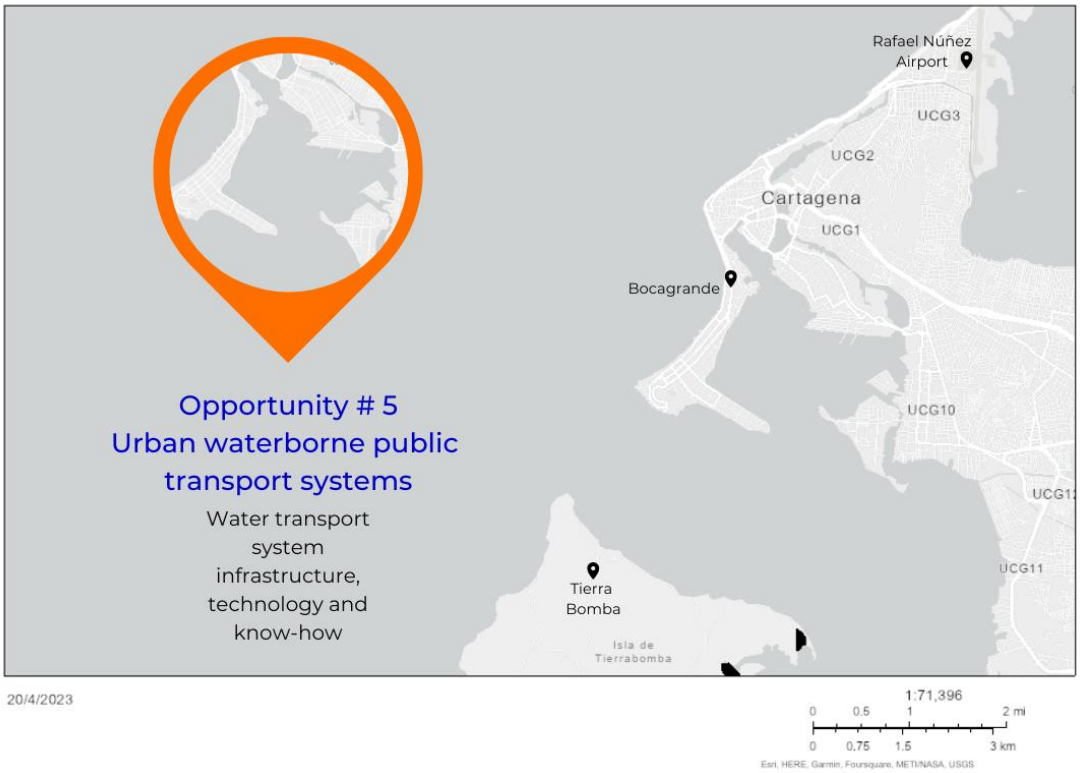
- Climate adaptive/adapted design & consultancy: With the identified risks, a series of infrastructural adaptations in this port area are elemental in order to reduce the consequences of these phenomena, such as relocation, redesign and construction of protection systems such as dikes, seawalls, elevation and strengthening of infrastructure, the redesign of evacuation routes and operational plans, installation of barriers, identification of alternative routes, design of hydraulic structures such as drainage channels,

strengthening of foundations, raising of the pier and its levels and construction of temporary flood retention basins, among others.

- Dredging technologies, efficient management of sediments and the handling of dredging material in ports. For example, methods to reduce nitrogen-based emissions of dredging operations, improvement on the efficiency of dredge pumps and large-scale sediment transport, and morphological modelling as a sediment management tool.
- Use of alternative energy sources: Energy efficiency and water consumption reduction technologies: Customized energy efficiency solutions on an industrial scale that can offer different energy sources such as large-scale solar energy collection and storage, modular, battery-powered or photovoltaic energy systems.
- Smart Port solutions: The majority of these ports face environmental concerns, due to a wide range of air and water pollution, as well as other negative environmental externalities generated by port activities. That is why we consider it fundamental to try to incorporate a transition to “smart ports”, which rely on the use of new technologies and digitalization, to rationalize, reorganize and streamline port activities, as it has proven to address both economic efficiency and environmental performance.
- Fire protection systems: Smoke detectors, anti-corrosion extinguishing systems that withstand extreme weather conditions. Aerosol fire suppression systems. Monitors with electrical, hydraulic and manual control and nozzles with large flow of straight stream or fog pattern or the right type of extinguishing foam with varying capabilities. As long as distress signals for emergency situations, hoses, branch pipes and fire extinguishers of the highest quality.
- Implement and improve nature-based solutions for port-related infrastructure: Considering the areas with high potential for port expansion projects in Cartagena, it would be necessary to rethink the design and implementation of such proposals to include innovative solutions that could reduce the effects of climate change. Thus, this is an interesting opportunity for Dutch companies that can develop port infrastructure projects reusing local coastal materials such as sediments and salt marshes. This would contribute to a more sustainable port expansion, while at the same time developing a nature that contributes to water quality, ecology, coastal defenses, and coastal attractiveness.

Opportunity 5: Urban waterborne public transport systems

As a result of the accelerated process of urbanization that the city has undergone in the past years, its mobility has been severely affected. Some roads in the city have deteriorated or cannot support the high vehicular flow. However, the city has some great potential that has not been explored yet: the bodies of water surrounding and within the city.



In terms of mobility, the creation of a water public transport system has been considered as a solution to some of these problems. Some benefits of the formalization of water transport would be the reduction of time and expenses for users and the decongestion of public transport systems within the city. This system could be integrated into the existing one, *Transcaribe*, which is a pioneer in having all the buses of its system operating on natural gas. According to *Dimar,* this system should cover all bodies of water, including the Bay, Ciénaga de la Virgen, and canals.

The project for the creation of a water public transport system was presented to the private sector in 2014, but it was subsequently withdrawn. However, in 2015 *Dimar* signed a resolution (Resolution 0576 of 2015) to revive the project. Additionally, in the Resolution 0576 of September 2015 the conditions, procedures and safety measures for this transport were established. As a result, the City Hall signed an agreement with *Financiera de Desarrollo Nacional* in order to carry out the prefeasibility study of a public water transport system in Cartagena (La FM, 2016). This agreement lasted four years.

> FDN will carry out an analysis of socio-economic, budgetary and institutional benefit, and will work on the integral structuring of the project, also on the identification of the sources of financing, as well as on the appropriate legal mechanisms to advance it. (Revista Zetta, 2016)

According to the studies carried out by the *Financiera de Desarrollo Nacional*, the development of sustainable goals is necessary in order for this project to be appealing for foreign investment. In 2019, the results of the study were presented to *FINDETER,* with the aim of gaining their support for project

development. Also, meetings with *Transcaribe, Cotecmar* and *Dimar* took place concerning this process.
On the other hand, the private sector of the city has shown its interest in the project. *AECOM*, an American multinational infrastructure consulting firm, has been working closely with the Mayor's Office and the *Chamber of Commerce of Cartagena.* In an interview, this company told us that they are already working on estimations to determine the routes. They believe in the potential of the bodies of water as a good and viable transportation solution. Although they still do not dispose of a final study (types of boats, established routes), they are already looking at some factors such as the need to consider the use of environmental-friendly waterbuses.

The current Development Plan of Cartagena is in line with the previous National Development Plan, especially in its chapter "Pact for the Caribbean Region". One of its initiatives was a multimodal water transport project in order to foster sustainable environmental management of the water sources in the region. Furthermore, according to the city's development plan "the initiatives associated with mass transport will have a special attention to the formulation of the first phase of water and multimodal transport" (Alcaldía de Cartagena, 2020).

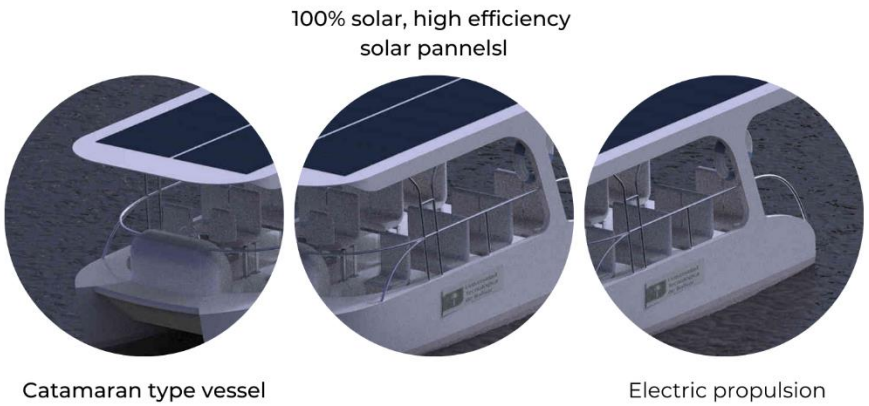
Academic institutions have also shown interest in the development of this system. For example, the Faculty of Engineering of the *Technological University of Bolívar* developed the model of an aquabus with the help of navy, electrical, mechanical, systems and computer engineering programs. For this project, they will need adequate infrastructure and an aquabus, which could create opportunities for the Dutch expertise in this field. The university is now working on a solar-powered prototype for 12 people, and the design for an aquabus of 20 people already exists. In March 2023, the university presented the "AquaBus-e", the first completely emission-free vessel for the aquatic transportation of passengers in the inner bay of Cartagena.

> It is a catamaran type vessel, with a capacity for 12 passengers, electric propulsion, 100% solar and free of CO2 emissions that incorporates photovoltaic recharge systems on the deck and is based on the routes and environmental and maritime conditions for sheltered waters in Cartagena, which allows increasing the range of this in the daylight hours, while reducing its operating costs, since it does not use fossil fuels. In addition, the vessel will have a state-of-the-art communications system, high-efficiency solar panels, safe space for wheelchairs, hydrodynamic design of lines and shapes in shallow water operations, as well as electric propulsion with better efficiency than conventional systems and an innovative steering system, as well as submersible lithium batteries with integrated protection and echo sounder for basic bathymetry functions. (Invest in Cartagena, 2023)

According to the interview with the *Secretary of Infrastructure*, a Dutch-backed program could generate confidence at the time of the formulation as private investment will be very important in this project. It was emphasized during the interview that Cartagena has the potential to become a fluvial city, such as Amsterdam. This makes the trademark and experience of the Netherlands of great relevance.

Although the design for different alternatives have already been carried out, the city nor the country have the necessary knowledge and expertise for the development of this type of infrastructure. The Mayor's Office will be looking for companies that are interested in infrastructure planning and execution, but that also are able to execute the operation. After all, they are looking for a well-structured project with financing. Luis Villadiego, the Secretary of Infrastructure, believes that the best way to implement this type of initiative is through a public-private partnership. Opportunities regarding the supply of waterbuses, proper infrastructure and expertise on management of the system are identified.

Figure 5: Sustainable Catamaran



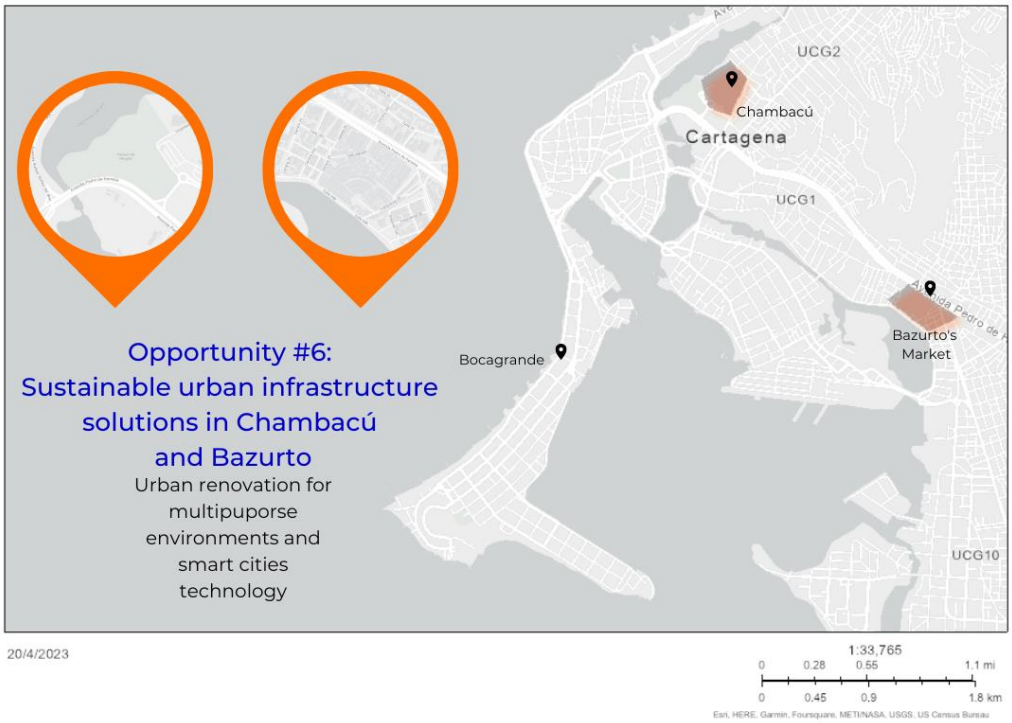
Furthermore, the *Office of Risk Management and Prevention* has identified a particular need that concerns the lack of an emergency response boat. Considering that the city has been severely affected by floods in recent years, the availability of this type of vessel is essential to ensure a rapid and effective response to disasters. Being able to use the water bodies within the city could improve the work of this Office.

In conclusion, the particular needs identified on this opportunity and those that Dutch expertise could solve are:

- Knowledge of commercial routing/exploitation for water transport systems or for bodies of water in general.
- Construction and supply of waterbuses, taxis and similar.
- Technology and knowledge in terms of ship comfort needs, hull technologies, naval engineering, technical training on how these vessels can be maintained, propulsion modes.
- Service delivery training.
- Passenger water terminals and how to manage and operate them. Experience in how to make the system sustainable.
- Emergency response boats.

Opportunity 6: Sustainable urban infrastructure solutions in Chambacú and Bazurto

Cartagena's tourist vocation has prompted the city to think about urban development regarding tourism. Modern residential units, international hotels and resorts, shopping malls and business centers are among the most renowned projects in the city. For this reason, large international firms have set their sights on the city in order to develop world scale architectural projects. This opportunity identifies the possibilities in terms of sustainable urban infrastructure: Chambacú and Bazurto's market as the main urban renovation projects in the city.



Chambacú is considered a strategic area in Cartagena due to its proximity to the historic center (less than 100 meters), the Fort of San Felipe de Barajas and the bodies of water. In the past century, it used to be a neighborhood with precarious housing and no public services. 50 years ago, the neighborhood was evicted and people were relocated (Museo Histórico de Cartagena de Indias).

At the end of the 90's, a project called "Proyecto Chambacú de Indias" envisioned the construction of 27,2 acres that included recreational parks, water parks and spaces for cultural exchange. However, the project did not make it. In 2002, another project called "Centro Internacional Gran Velero" was proposed. This time the plan was to build a center for business development that included a convention center, shopping center, business center, ophthalmological and cosmetic surgery center, service center, cultural center and a hotel.

In 2010, Carlos Mattos presented a plan called "Multicentro Chambacú" (El Tiempo, 2010) with an extension of 54,500 m2 and an investment of $114 million dollars. It had two stages: the first one included a shopping center of approximately 35,000 m2 and a hotel. It also included "the assembly of a bridge that will facilitate access to the complex and, incidentally, will be a contribution to the urban development and mobility of the city" (Portafolio, 2010). At the time, international supermarket and department store chains were interested in the project. This year, *AECOM* proposed a plan for the renovation of Chambacú. The plan was presented to different investment funds and to the European Union Cooperation.

It has been pointed out that due to Chambacú's proximity to the historic center, it makes it an easily accessible site that is currently a vacant lot that is being wasted. Within the plans for this zone, a

convention center is considered. For this, it is necessary to achieve a connection between the entities at the district level. *AECOM* was able to reach an agreement on where these strategic projects could be located. What should be done now is looking at the studies and the true potential of the area in order to identify if it is more efficient to have housing, commerce, offices or recreational projects. Additionally, this area has mangrove potential. This urban renovation could prove that Cartagena is not only its historic center, but that it can also attract other types of events, since there is always a limit in terms of hotels and events whenever a convention is organized in the city. This would become a modern business and events center, and would allow the city to dream of becoming an even better positioned business tourism destination.

According to our interview with the *Chamber of Commerce of Cartagena*, they initially propose an urban renewal with *Dakia U Ventures* and *AECOM*. Furthermore, the Spanish Development Finance Company, *Cofides,* also has been approached. The idea is that this project has as its heart a convention center to achieve a mixed urban development. On one side of the sidewalk there would be different recreational activities, businesses, bars, among others, and across the street there would be offices, residential and mixed-use centers. Investing in Chambacú would generate more impact than other areas where it would be easier to implement. For the Chamber, the project has a great potential to attract investment funds and for this reason it is necessary to guarantee a good planning of the area so that there is an important real estate development that attracts such investment funds. An important financial instrument for this type of initiatives is financing through land value capture.

Figure 6: Potential Spaces for Chambacú

Currently, steps are being taken so that the initiative can be developed and alliances with important international partners are being sought and created. The general approach is to ensure that, within the framework of planning, the project is attractive to investors, thus reducing the risk of financing

problems. This time, the Chamber is also looking at the city as a whole, connecting the renovation of the city's mobility and its transportation issues. The renovation of Chambacú is beneficial and is in line with the decongestion of the mobility in the city and could also promote the ambitious dream of water transportation for the people of Cartagena.

On the other hand, the renewal of Bazurto, Cartagena's main food market, is another urban reorganization plan that is awaiting the city. The idea is to move the market to another place in order to turn it into a large central wholesale supply center along with a public network of markets. The current area where the market is located could be used for interactive parks, an interchange point for the multimodal urban transport system, among other residential and commercial activities (Caracol Radio, 2022).

Figure 7: Proposal for the Urban Renovation of Bazurto

Source: El Universal, Caracol Radio and Pontificia Universidad Javeriana. Bazurto Market

There is a plan to architecturally restore the building and to enhance the market's restaurant sector (El Universal, 2021). Some sectors of the local administration believe that “the market building should be rebuilt, it is a national engineering prize, which is why its preservation as an artisan, gastronomic and cultural center is its best destination” (Bolivarense, 2023). The market square will be the central axis of the new design, highlighting its heritage, architectural and community value. The surroundings of the building also have great potential for turning them into parking lots or business centers. Since 2010, the *Administrative Court of Bolívar* requested the relocation of the market, but different administrative problems have delayed the plan. This court decision makes the local administration want to take action on this matter. The Chamber mentions that the renovation of the market is easy,

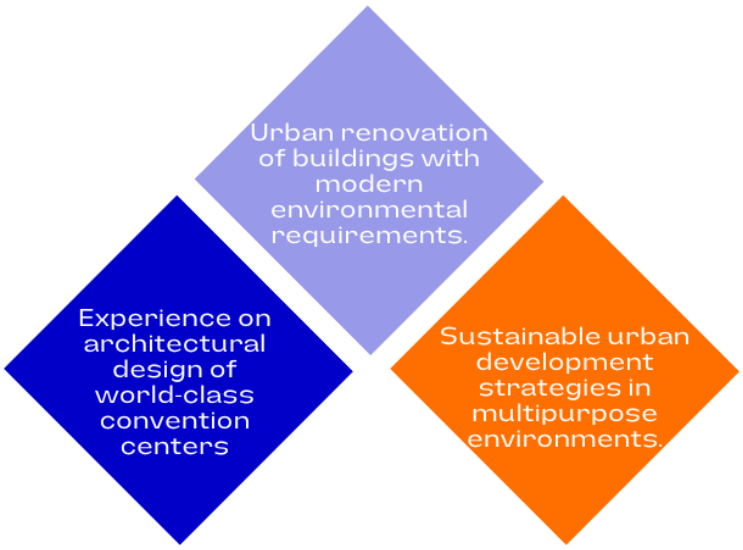
but that its transfer is difficult, since the market system of the city is a private property and it does not depend on the district.

However, the renovation of the area can only be done until the market is relocated. According to our interview with the *Chamber of Commerce of Cartagena*, it will also be important to give life to the bodies of water that are now contaminated because wastewater is being discharged into the Las Quintas coastal lagoon near Bazurto and because of poor waste management. The level of contamination is very serious, to such an extent that the market has been called the heart of contamination in Cartagena.

The *Environmental Public Establishment of Cartagena* (EPA), with the support of the *Environmental Guard, Environmental Police* and the Administration of the Bazurto Market carry out control and surveillance operations on illegal discharges made by some commercial establishments into the Las Quintas coastal lagoon as they are exacerbating the environmental problem in the area. However, structural changes need to be done in order to recover the coastal lagoon. In 2022, the re-cleaning works on this coastal lagoon planned to remove 76.000 cubic meters of residual material from its interior. This work was awarded through a public bidding process to the *CO323-Las Quintas* consortium, for a value of more than $1.5 million dollars. For this reason, urban renovation should also environmentally recover these ecosystems.

Recuperating Bazurto is a priority as the lack of control on the area and the various invasions give rise to contamination, poor waste disposal, insecurity, vehicular congestion and illegal activities. In January 2023, a round table called “Let's Save the Bazurto Market Together” was organized, where the main objective is to generate an entire intervention phase in favor of a sustainable and competitive development as a palliative measure to reduce the impact of the area. Additionally, in February of this year, *FINDETER* and the Mayor’s Office agreed to initiate the structuring process for the pre-feasibility of the relocation of the Bazurto Market (El Universal, 2023). The Public Markets Advisory Office has stated that a Certificate of Budget Availability for around $460.000 dollars has already been issued for the study for the relocation of the Bazurto market in 2023.

Opportunities for Dutch expertise

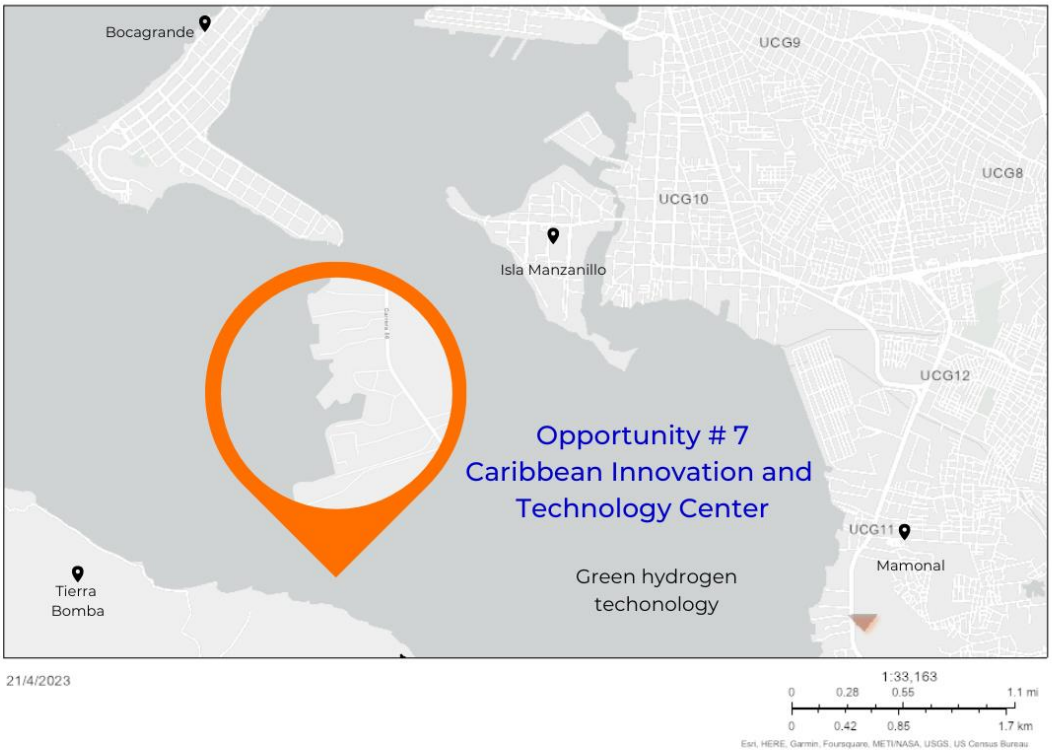


In conclusion, the particular needs identified on this opportunity and that Dutch expertise could solve are:

- Firms with experience on architectural design on world-class convention centers, modern business centers and multipurpose environments, providing solutions to urban issues.
- Urban renovation of buildings with modern environmental requirements.
- Sustainable urban development strategies in multipurpose environments.

Opportunity 7: Caribbean Innovation and Technology Center

Energy transition has been a priority in the last decades. Creating greener economies is a major task for governments all around the world and new technologies on this matter are essential to ensure an effective transition. Cartagena is betting on green hydrogen as an alternative and clean source of energy to replace the use of fossil fuels by local industries. However, the technology that currently exists in the city is limited and in its initial stages. At present, the city is not able to meet the local demand for green hydrogen despite the great potential the city has for its production. Several needs in terms of infrastructure and knowledge have been identified.



The Caribbean Innovation and Technology Center (El Universal, 2022) was recently launched in the city. The Center works on hydrogen economy, energy transition and petrochemistry in order to generate development opportunities. This center, the first of its kind in Latin America, counts with the participation of *Ecopetrol, ANDI, Chamber of Commerce of Cartagena, iNNPulsa Colombia, ISA, Esenttia, Tenaris, Biz Nation* and some universities and organizations (Caracol Radio, 2022). The purpose of this project is to turn Cartagena into a green hydrogen and offshore wind energy corridor. The investment for this center exceeds $1.8 million dollars (Semana, 2023).

According to the Center, upon project initiation there are already multiple opportunities in terms of green hydrogen technology. The private sector could be part of this Center in two ways: firstly, by paying a linkage fee or secondly, by participating as an external partner by proposing a new project. Currently, they have identified challenges associated to different aspects of hydrogen production, storage and transport. Particularly, they have identified the need of electrolyzer brand representatives in the region as they want to be able to produce their own electrolyzers in the future. Some of these challenges can be found on the “Retos Econova” website. These challenges have been launched by Ecopetrol in order to find innovative solutions. Three of these challenges address green hydrogen with regard to how to transport it, strengthen its production supply chain and create a market for this energy product. The rest of the challenges focus on recycling single-use plastic in Cartagena, reducing emissions from shipping in the Caribbean, finding new ways to reuse industrial wastewater and transforming garbage into a clean energy resource.

The *Chamber of Commerce of Cartagena* believes that Cartagena has great potential, particularly in the production of green hydrogen. However, it is necessary to achieve that the different physical infrastructures begin to work as an ecosystem that interacts to produce, store, transport and consume hydrogen and its derivatives. This in order to have hydrogen as the main energy vector in the local industry and to make its export a reality. Cartagena meets the right conditions to turn Colombia into a leader in green hydrogen production, so much that Cartagena could become the epicenter for hydrogen production in Colombia. Currently, the city has two pilot projects to produce green hydrogen with electrolyzers in operation. The Chamber proposes an integration of the Caribbean region so that the hydrogen industry is developed, taking advantage of the specific potential of each territory and that it focuses on the demand of the energy sector, in which the industrial zone of Mamonal plays a crucial role.

Ecopetrol, the largest hydrogen producer in Colombia, is executing an ambitious plan for the production of green, blue and white hydrogen with an average annual investment close to $140 million dollars by 2040. This plan consists of 3 stages (Ecopetrol, 2022):

1. Between 2022 and 2030, focused on the expansion of hydrogen of its own operations with industrial-scale projects and the start of applications in sustainable mobility with cars and buses.
2. From 2030 to 2040, seek to capture and materialize significant results in the decarbonization of operations, expand in maritime and aviation mobility with hydrogen and new commercial opportunities in the European and Asian markets.
3. From 2040 onwards, focus on the massification of hydrogen use and portfolio expansion.

Additionally, the President of Colombia, Gustavo Petro, has recently commanded the company to prioritize its investments in green hydrogen development (La República, 2023). According to the President, the country has the fourth cheapest green hydrogen in the world. Partnering with the leading companies in the sector will be essential for the production and export of green hydrogen in a competitive way.

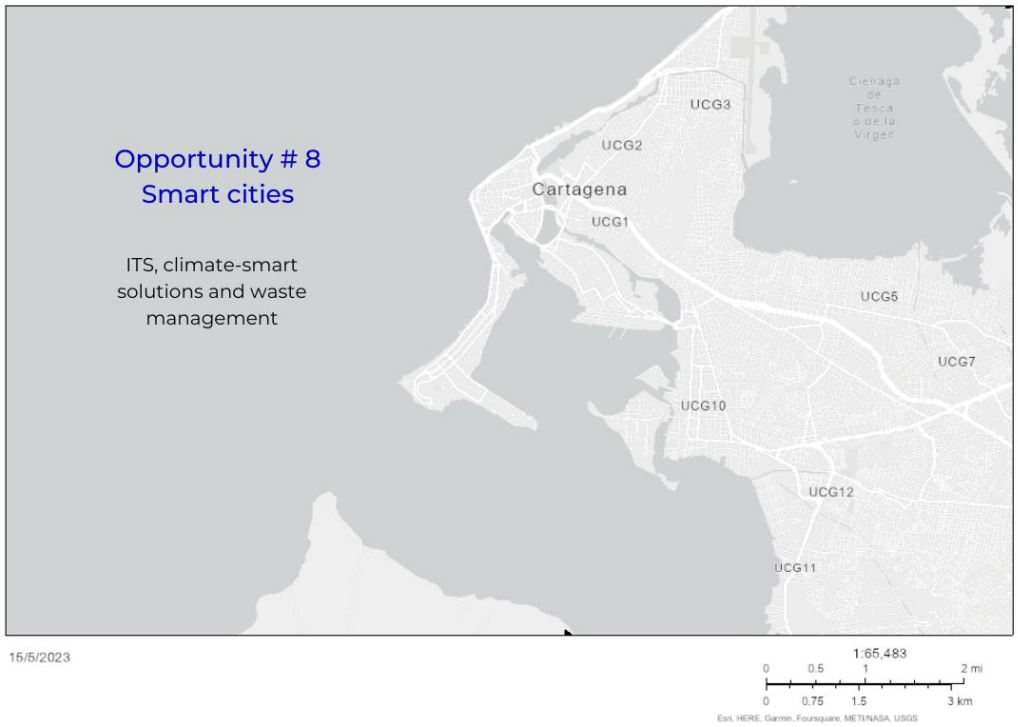
The plans and projects in terms of green hydrogen and offshore wind energy are relatively new and in their early stages of development. Dutch involvement from the start would offer a competitive edge. For instance, Port of Rotterdam has made progress in its contacts with the Colombian national government (signing a Memorandum of Understanding) and a training on green hydrogen was recently provided by STC Next with support of the Embassy of the Netherlands in Colombia.

In conclusion, the particular needs identified on this opportunity and that Dutch expertise could solve are:

- Further development and connection with offtakers, technology and knowledge providers.
- Knowledge on decarbonization of natural gas and refinery gasses for hydrogen as fuel/feedstock.
- Hydrogen infrastructure for transport, distribution and storage.
- Knowledge on creating regional networks on hydrogen.
- Hydrogen storage linked with offshore wind energy production.
- Use of hydrogen as an industrial feedstock.
- Knowledge on powering commercial vehicles with hydrogen fuel cells.
- Experience on exporting hydrogen

Opportunity 8: Smart Cities

Adapting cities to the challenges of the modern world has put a lot of pressure on local governments. Innovative solutions to reduce and to adapt to the risks of climate change have been prioritized in order to reduce cities' vulnerability. As a result, mixing the use of technology and innovation with environmental approaches seems to be a major commitment to achieve more inclusive, greener and more advanced cities. The local administration has started to think on how to make Cartagena a smart city. However, not much has been done in this field and several opportunities can be identified.



Firstly, the *Administrative Department of Transit and Transportation of Cartagena* developed a plan for the renovation of the city's traffic light network. Intelligent pedestrian traffic lights are being envisaged and a vehicular traffic lights renewal is considered. The current system is an adaptive system that adapts to the traffic volumes, but works with outdated technology. Until 2019 the network was concessioned and that is why until today the Department is working on the adjustment of this infrastructure. The Administrative Department is the one in charge of contracting the works and they predict that the project will take place in the next 4-5 years.

Besides, they have a plan with the *Security Agency* for the implementation of photo detection cameras to reduce accident rates. The project has already been approved but is lacking the process of implementation and execution. In our interview, the Department expressed their interest in the Dutch offer on this type of technology and the possibility to unify the camera and traffic light network projects.

Secondly, the implementation of innovative solutions for risks regarding climate change. For example, in 2017 a group of expert engineers and researchers from the *Technological University of Bolivar* and the *University of TU Delft* in the Netherlands and the international consultancy *Royal HaskoningDHV* developed a study to propose solutions to the flooding problem in Cartagena. Mauro Maza Chamorro, doctor in Marine Science and director of the project, mentioned the importance of working on the issues such as watershed and rainwater management. The study proposes small-scale solutions at the neighborhood level, using water retention systems with green roofs, tanks or rain gardens to alleviate the flooding phenomena.

The *Colombian Chamber of Construction (Camacol)* was selected by the *International Finance Corporation*, part of the *World Bank Group* as its local partner to implement the Excellence in Design for Greater Efficiencies (EDGE) strategy. This strategy requires that the buildings comply with water, energy and energy saving parameters. Another important standard for green buildings is the Leadership in Energy and Environmental Design (LEED) certification. These certifications work for several types of buildings: residential use, education, offices, hotels, hospitals and resorts. The implementation of water retention systems could be a great opportunity for construction companies that are looking to obtain these certifications and the benefits it brings. However, this type of strategies has not been widely explored in the city and it could be a partial solution implemented by both private and public sectors.

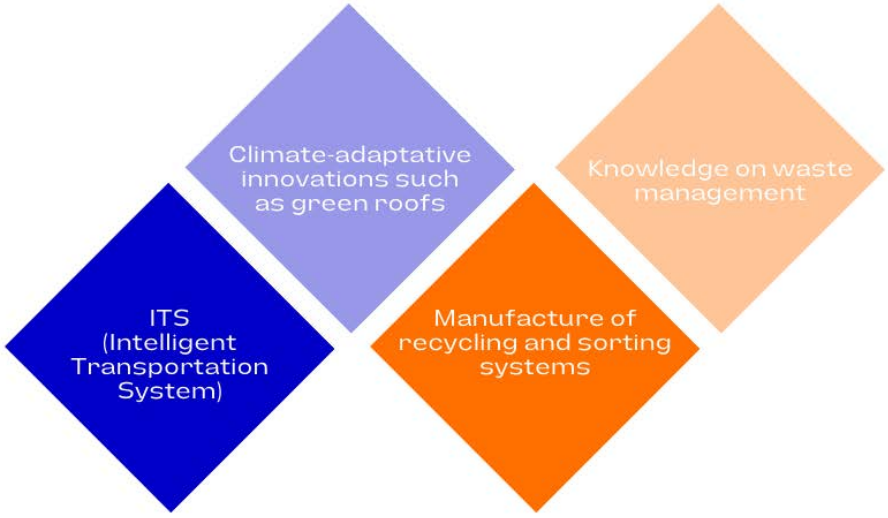
Another important solution that needs to be implemented in Cartagena concerns waste disposal and recycling. The city faces several problems as satellite or illegal dumps constantly increase. They are a major source of pollution because most of the waste is not ordinary. More than 5,000 tons of irregularly disposed waste and debris are generated monthly in Cartagena. In addition, water bodies are also affected by poor waste management, a problem that is aggravated during rainy seasons. Cartagena has a garbage collection and garbage transportation service, but not an integral use of plastics, metals, paper, and even organics for the local production of fertilizers. Additionally, the city does not have a comprehensive public recycling policy and waste management operators are not obliged to re-use solid waste.

Aware of the problem of the lack of waste management in the city, there are national NGOs, such as the *Fundación Bahía y Ecosistemas de Colombia*, who together with international NGOs such as *Plastic Oceans*, seek to implement initiatives with objectives such as: plastic waste reduction, circular economy waste management practices, increase sustainable and dignified jobs, and increase community education on plastic and circular waste management.

Furthermore, the city has several associations of recyclers such as *Cartagena Recycling Corporation E.S.P CORECA*, *Recycling Corporation Reciclar CORECICLAREC* and *Gremial Association of Cartagena's Recyclers- A-Reciclar.* Their work results in tons of usable material recovered and its incorporation into the city's recycling value chains. As a result, the private sector has established alliances with these associations in order to create collection centers. For example, *Esenttia* created the *Cartagena Amigable Collection Center* where they concentrate or gather potentially usable materials such as different types of plastics, cardboard, glass, scrap, and paper, among others, so that they can be separated, compacted and marketed. This project aims to improve the lives of recyclers in the city while promoting a circular economy.

On the other hand, in February of this year, the local government delivered more than $440.000 dollars as an incentive to companies for the use and treatment of solid waste in the Tourist and Cultural District of Cartagena. This demonstrates the commitment the city has for improving the way in which waste is being managed. Colombia currently recycles only 17% of the 12 million tons of solid waste per year. Knowledge and technology on this field could represent a great opportunity for the Dutch offer.

Opportunities for Dutch expertise



In conclusion, the particular needs identified on this opportunity and that Dutch expertise could solve are:

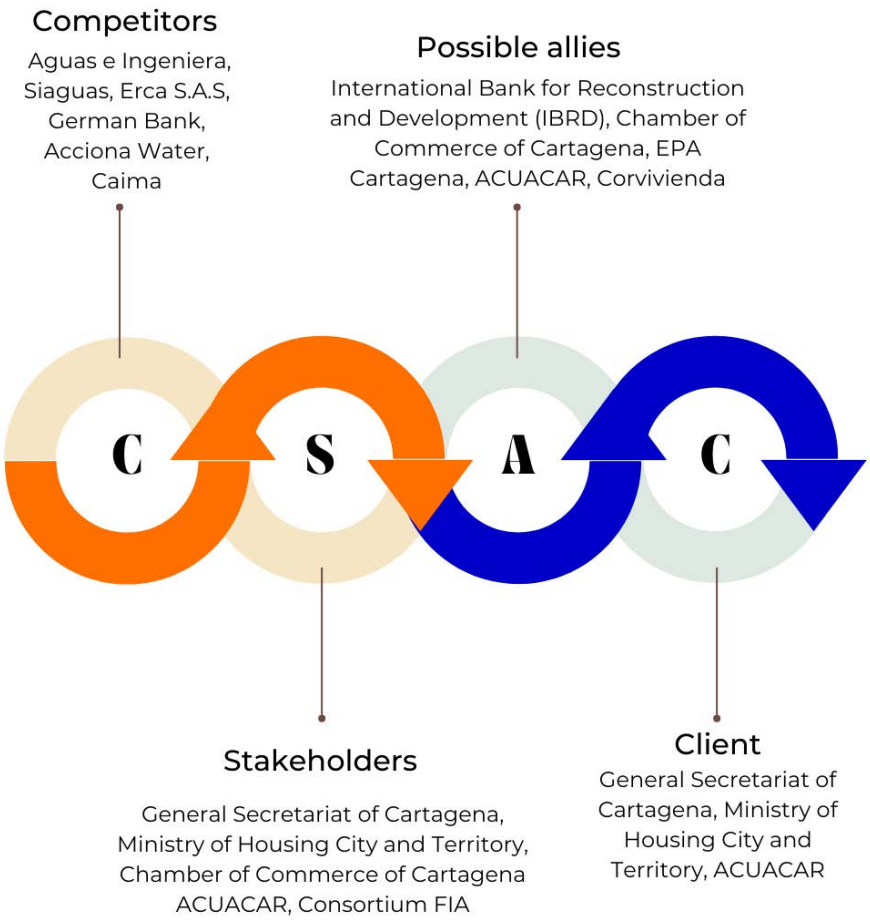
- ITS (Intelligent Transportation System) such as smart traffic lights, photodetection cameras.
- Companies that work with innovations such as green roofs and living walls, climate-adaptive rooftops.
- Recycling technology for waste recovery, smart recycling solutions and waste management.
- Supply of recycling and sorting systems.
- Knowledge on reduction of waste impact.

Picture: @Adolfomuro

5. Route to success: How to proceed

In this chapter, that discusses the routes to success, we seek to identify the ideal procedure to introduce the Dutch offer and connect relevant companies with the needs presented in the previous chapter. These processes vary depending on the actors involved in each project. Unlike public entities, private entities have independent administrations that allow them to negotiate much more directly with foreign partners, without the imperative need for a tender. The following is a description of each opportunity.

Opportunity 1: Water: supply, treatment and protection in determined areas



Certain key actors that are part of the network have been identified and are crucial to understanding how Dutch companies and entities could be part of certain projects for this sector. As for stakeholders, we can find at the national level the Ministry of Housing, Water and Sanitation

(*Minvivienda*) as the actor in charge of promoting sustainable development through the formulation and adoption of policies, programs, projects and regulations for the access of the population to drinking water and basic sanitation, as well as the coordination, execution and implementation of plans and projects at the national level. Likewise, at the national level we find *FINDETER*, which, supported by *Minvivienda*, is a key organization for the structuring and execution of infrastructure projects that promote the supply of water and sanitation, since it is in charge of coordinating the national resources for the sector, as well as the financial evaluation of the projects.

At the district level, we find actors such as the *Alcaldía de Cartagena* and its *General Secretariat*, which, apart from designing the city plans, are also in charge of evaluating, approving, and coordinating the execution of the projects together with the advice of local allies, such as environmental entities and the *Chamber of Commerce of Cartagena*. Furthermore, at the local level we find another key actor called *Aguas de Cartagena, ACUACAR*, which is the private entity in charge of guaranteeing public Aqueduct and Sewerage services in the city.

Once the main stakeholders have been identified, it is possible to find 2 routes to access the projects presented in this study and additional ones that can be developed with national or private resources:

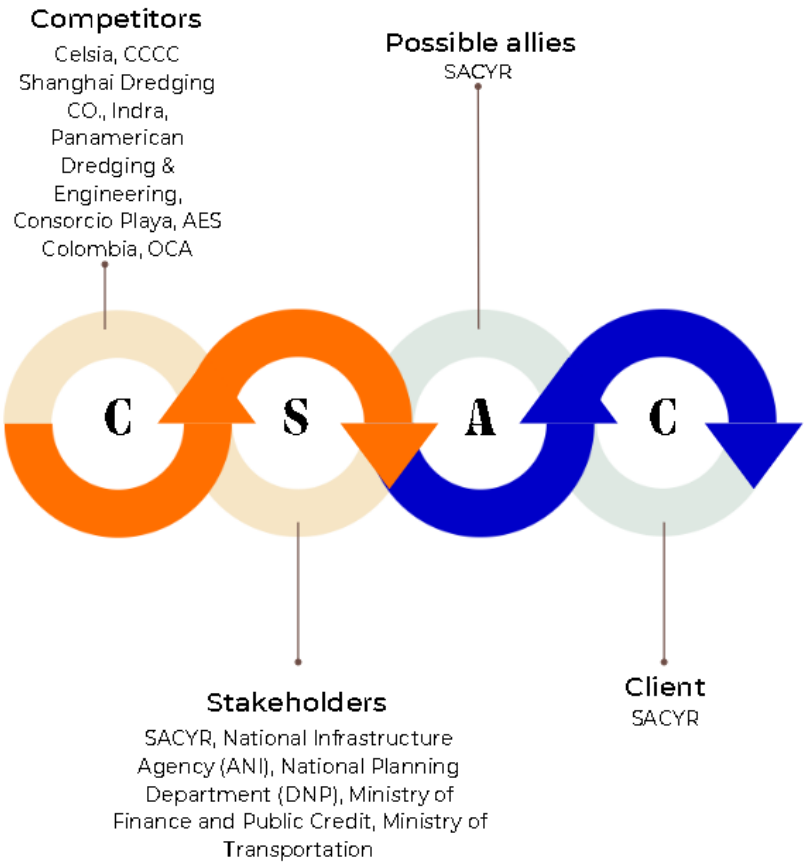
The first route is for those projects whose financing is realized with national resources. In this case, it is possible on the one hand, to find the open calls on the FINDETER page https://www.findeter.gov.co/. Holland House Colombia recommends locating a local ally and presenting the proposal together.

However, it is also possible to participate in projects with national resources through the *Alcaldia de Cartagena*. In this case, it will be necessary to present to the General Secretariat of Infrastructure the proposal, solution or added value that the Dutch company or entity can offer for one of the projects. Subsequently, the district will present the project at the national level and will be assessed by entities such as *Minvivienda*, which will evaluate the viability and compliance with the national guidelines; *FINDETER*, which will evaluate the financial viability; local water and sanitation entities such as *EPA*; and the *Chamber of Commerce of Cartagena* who also may support the process. Finally, once the project is approved, the financing administration will be in charge of entities such as *Consortium FIA*.

The second route is to access projects that can be executed with local resources, which can be from the district of the city of Cartagena or directly from *ACUCAR*. In the first case, it will be necessary to contact the General Secretariat, and present the added value or solution for the selected project. Subsequently, the Secretariat will evaluate and possibly approve the project in alliance with local entities. Eventually, the project will be executed with local resources. In order to work with *ACUACAR*, it is necessary to get in contact with the entity and present the intention, proposal and solution.

Finally, in terms of competition, it is important to consider national companies that have experience in the execution of projects with national resources, as well as the international companies and entities that have already been leaders or allies in the development of projects in the city, through providing consulting, engineering and financing services.

Opportunity 2: Sustainable infrastructure and technologies for the Canal del Dique project



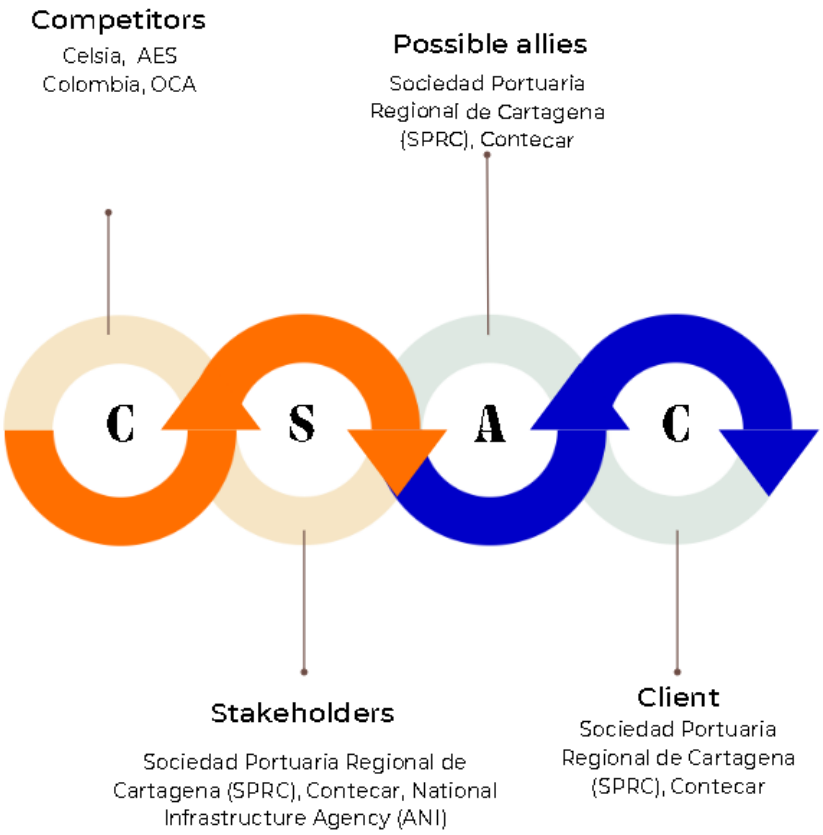
During its proposal and initial phases, the Canal del Dique Mega Project involved a series of entities such as the *National Planning Department, Ministry of Finance and Public Credit, Ministry of Transportation*, among others, which were in charge of both planning (budget, timeline, etc.) and social tasks (in dialogue with the surrounding communities and prior consultation).

In the end, the project was awarded to the Spanish firm *SACYR*, which obtained the concession for the execution, maintenance and revision of the project for the following 15 years. During the different operations necessary for the execution of the project, *SACYR* has the opportunity to outsource work to local and foreign companies.

During the interview we had with them, they pointed out their special interest in Dutch companies for redesign, optimization and improvement. They also mentioned that the initial structure and reference design was done by a Colombian-Dutch consortium, which allowed them to have more confidence in this particular business network.

In order to be part of this project as a supplier, it is necessary to get in contact with the Country Director of *SACYR*, as well as his operational team, since they are the decision makers on this matter. They indicated that, ideally, they would be open to receiving proposals in the initial months of the project, between May and November 2023.

Opportunity 3: Climate-smart innovations for SPRC/Contecar

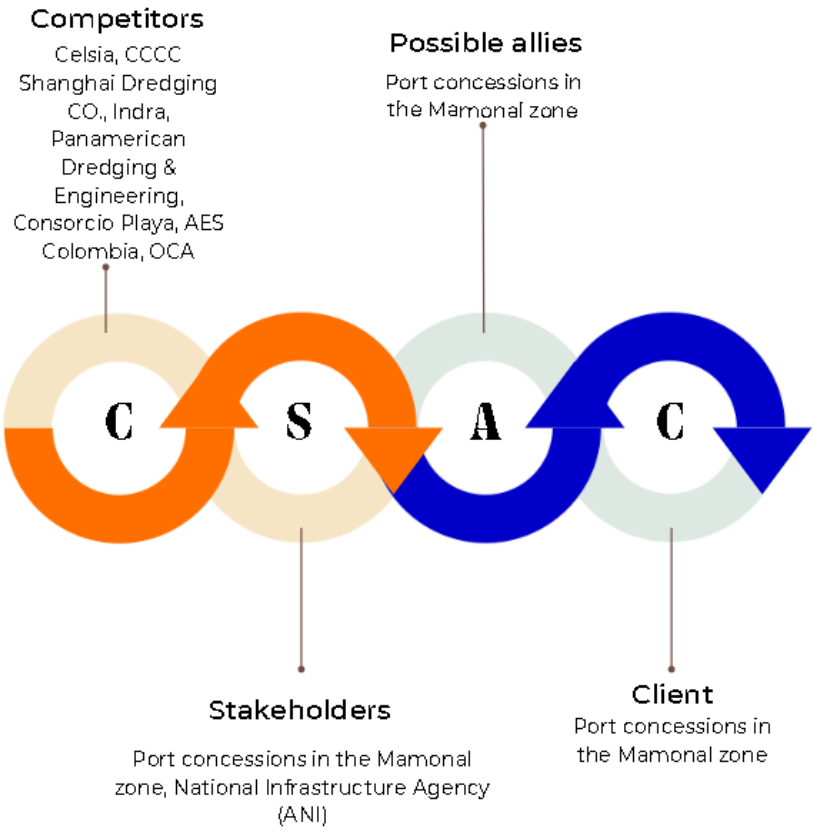


For the implementation of renewable and efficient energy technology, rainwater management, mooring systems, drones, among others, the only way is direct contact with *Contecar* and *SPRC´*s management, since they are the decision makers regarding these matters. Due to their interest in staying at the forefront, these terminals are open to receive non-call proposals of new technologies for their ports.

The *National Infrastructure Agency* is in charge of approving modifications in the infrastructure of the concessions. However, these changes must be proposed by the concessionaire itself, so there is no interference from other institutions for the acquisition of different kinds of equipment.

It is important to highlight that local companies such as *Celsia* or *AES* have implemented renewable energy projects in the ports of Cartagena, such as the implementation of 6,000 solar panels at the *SPRC.* Thus, the national and international competition is strong.

Opportunity 4: Climate-adaptation for Cluster of Petrochemical Port Terminals



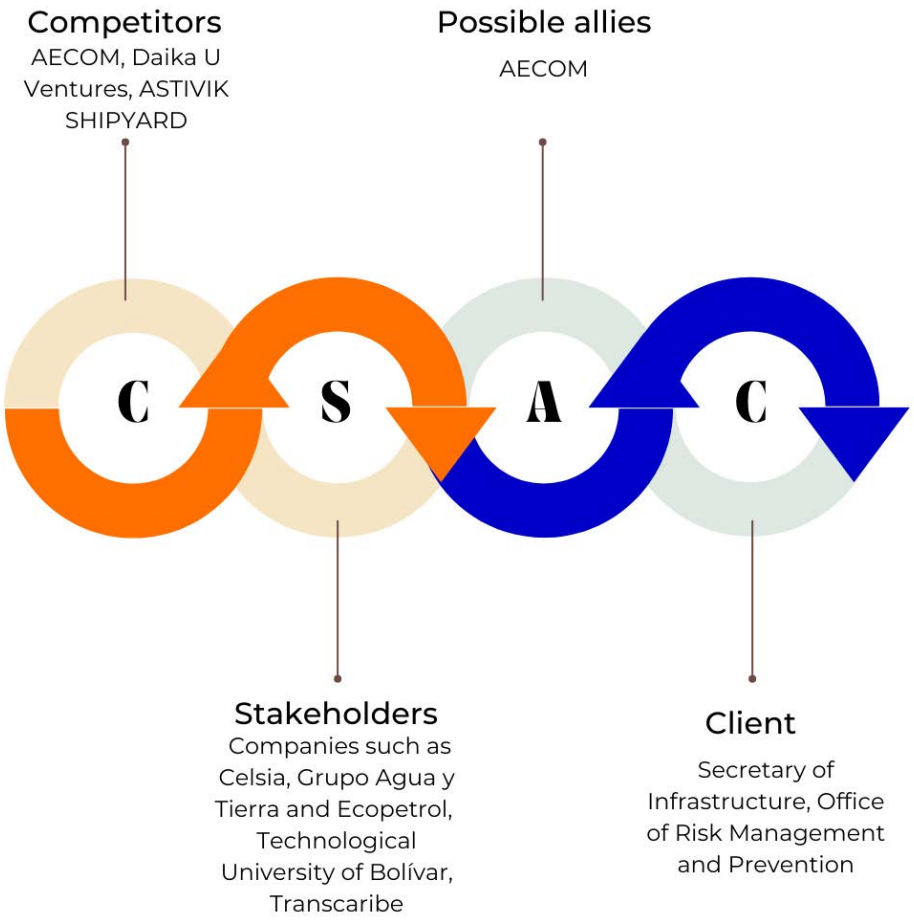
The outsourcing of adaptation and redesign of infrastructure of the different port concessions are under the decision of the concessionaires themselves, in this case, the *port concessions of the Mamonal area*. They are autonomous in the implementation of different kinds of technological improvement.

However, it is important to highlight that the *National Infrastructure Agency* is in charge of the approval of structural modifications proposed by the concessionaires, in accordance with climate change infrastructure plans.

We consider it important to review Colombia's new port implementation policies, which will focus more on stricter environmental requirements as well as measures to address climate change.

With respect to competition, there exists a record of several firms, both domestic and foreign, that have been working throughout the country on various dredging projects, adaptation to renewable energy in ports, use of alternative energies, etc.

Opportunity 5: Urban waterborne public transport systems



For the water transport system project, several actors have been identified. On the one hand, some relevant local actors are especially involved in the investigative process of creating a prototype for the bus. Companies such as *Celsia, Grupo Agua y Tierra* and *Ecopetrol* have joined the project of the *Technological University of Bolívar* and launched their tests at the end of 2022 that "will allow a technological validation and the operation of the system, which will determine the technical tariff" (El Universal, 2022). This prototype was assembled with the help of *ASTIVIK SHIPYARD*, the most

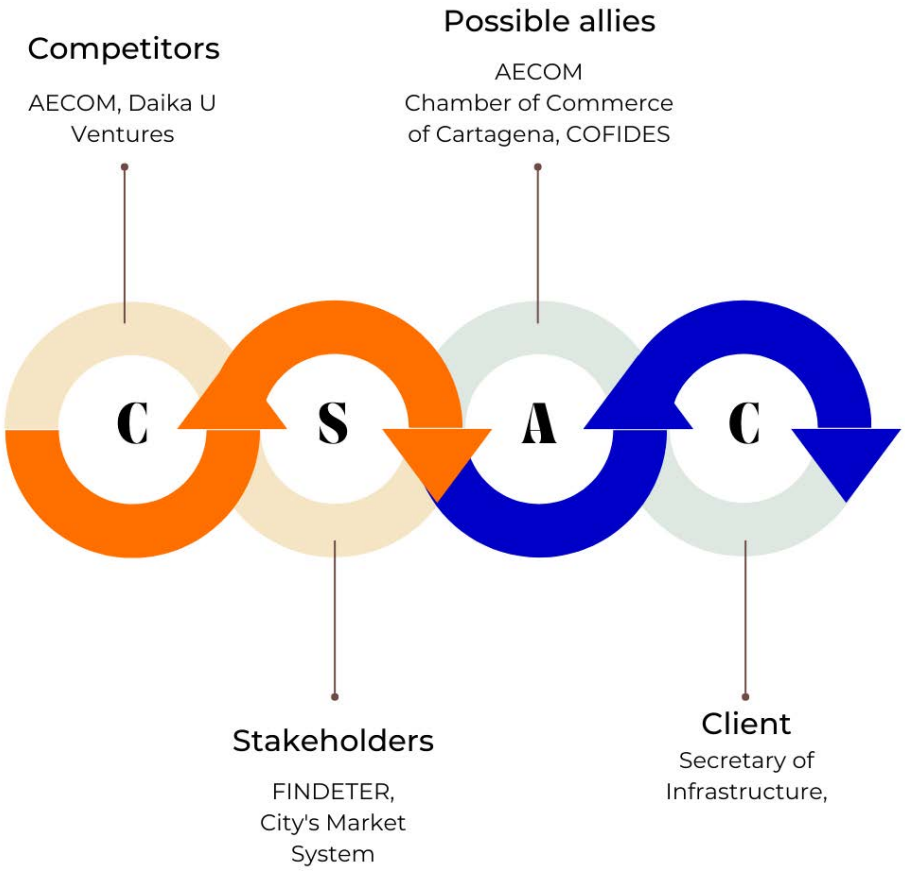
important private shipyard in Colombia. Thus, they could be considered competitors for the supply of aquabuses.

On the other hand, some actors have been interested in the design and implementation. *Dakia U Ventures* signed a MoU with the Mayor's Office that could possibly result in a collaboration for this project. *AECOM*, one of its allies, has also been working with the local authorities and the *Chamber of Commerce of Cartagena* on an estimation of the possible routes. However, water transport systems are not their area of expertise. As a result, a possible alliance with them could be an opportunity as they have already reached out to several local actors, since they do not have experience with aquabuses, and infrastructure and maintenance of a water transport system in general.

Nevertheless, this could also provide an opportunity to submit a proposal to the Secretary of Infrastructure that examines the whole system, since they are looking for companies that are interested in infrastructure planning and execution of the operation itself. We consider that, having in mind the Dutch expertise on this field and its integral knowledge on water bodies navigation, submitting a proposal could be the best opportunity for this project. Furthermore, the local administration and the private sector interviewed, underlined the Dutch leading position in this field. In short, a proposal would be highly recommended. This project counts with support at the national level as it is part of the Nation Plan for Multimodal Transport, so it could lead for example to other projects on water transport systems in other cities of the country.

Regarding the emergency response boats, we consider that a proposal should be made to the *Office of Risk Management and Prevention* as they are the main client.

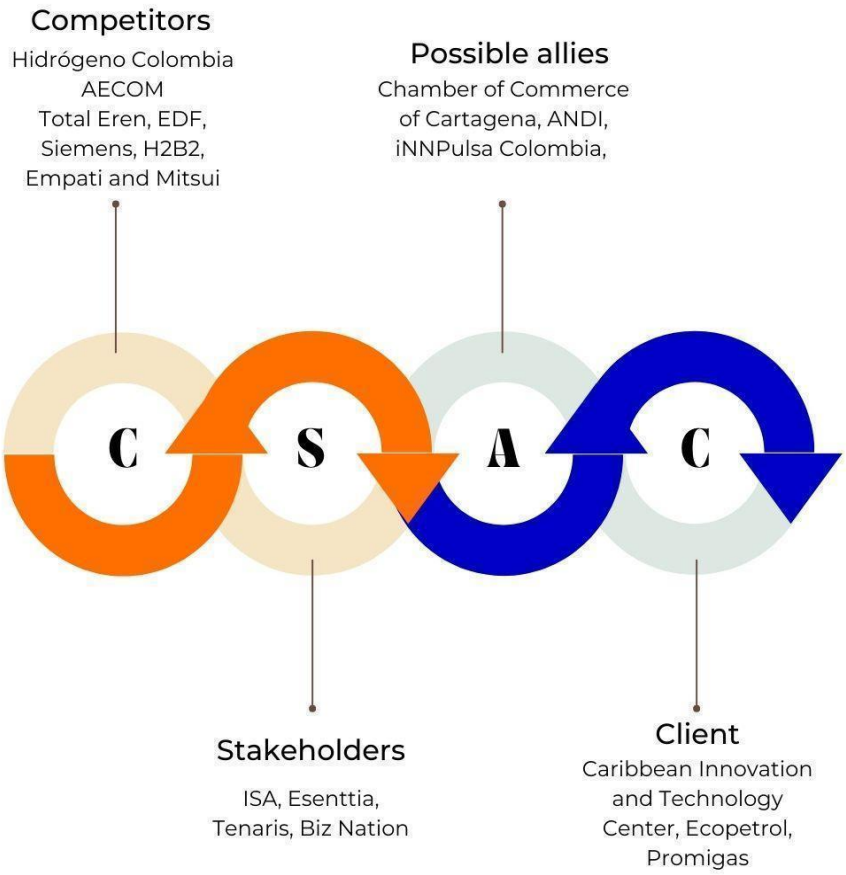
Opportunity 6: Sustainable urban infrastructure solutions in Chambacú and Bazurto



The principal actors identified regarding urban renovation are *Dakia U Ventures* and *AECOM*. Firstly, *Dakia U Ventures*' MoU in collaboration with the Mayor's Office was created in order to work on both urban renovation projects. Secondly, *AECOM* has been working closely with the *Chamber of Commerce of Cartagena* and has already worked on some designs and on the establishment of international alliances with actors such as *COFIDES*. The best way-to-market for this project is to get in contact with *AECOM* to explore the collaboration opportunities and alliances as they have already taken several steps.

However, plans regarding the renovation of Bazurto's market have not yet been developed. The renovation of the building has to wait until the market is relocated. Both opportunities on the design of the new market network and the renovation of the current building create opportunities that have not been explored yet. We believe that searching for an alliance with *AECOM* could be the best route as they are locally engaged with the public and private sectors involved this project. The pre-feasibility studies that are currently being carried out by *FINDETER* could be a great route for discovering what can and needs to be done in this area.

Opportunity 7: Caribbean Innovation and Technology Center



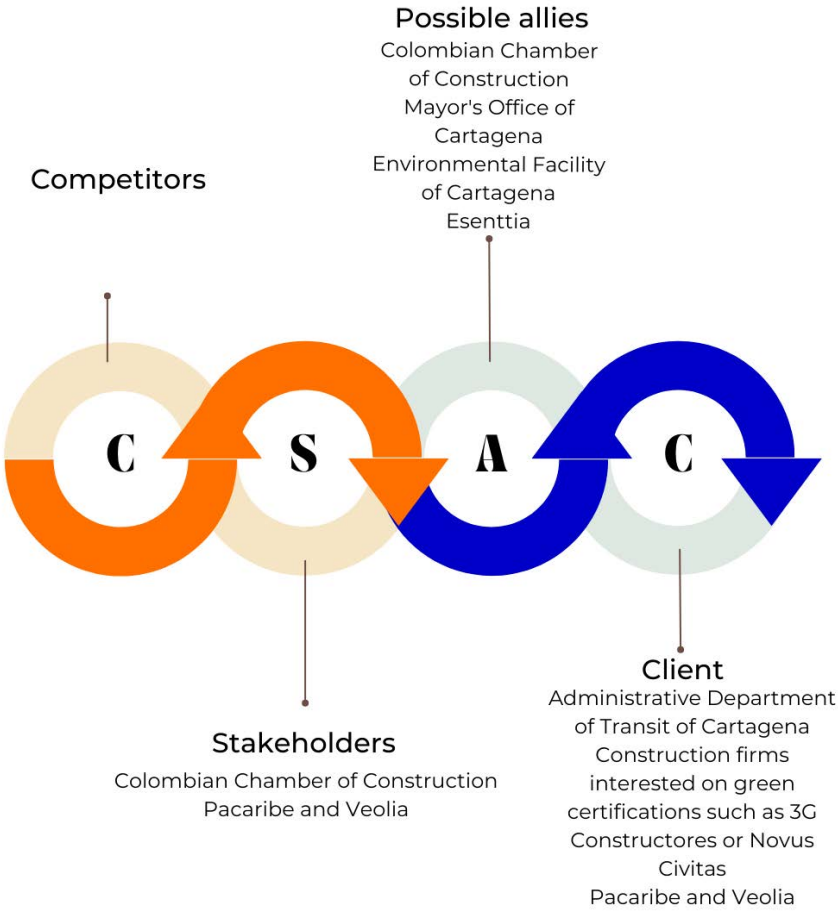
The recent launch of the Caribbean Innovation and Technology Center opens a great door full of opportunities for experience and knowledge on green hydrogen and offshore wind energy. The companies *Ecopetrol* and *Promigas* have been working in particular on pilots for the production of green hydrogen. *Ecopetrol* already invested in an electrolyzer and has a very ambitious plan for the next two decades. This plan considers technologies that already exist in the Netherlands, so this could represent an opportunity having *Ecopetrol* as a main client. *Promigas* is also turning its efforts into green hydrogen production and, thus, could also be a potential client. The plan is to create a whole network of green hydrogen in the Caribbean region, so the scope of the opportunity goes beyond Cartagena. If work wants to be done directly with the Caribbean Innovation and Technology Center as it groups different companies and allies (such as *Esenttia* and *ISA*), getting in contact with the *Chamber of Commerce of Cartagena* could be the best way to proceed. Associations like *ANDI* (National Business' Association of Colombia) and institutions such as *INNpulsa* could also be great allies to get in contact with and other companies interested in this type of technology.

Ecopetrol has claimed that its main allies are *Total Eren* and *EDF*, from France; *Siemens*, from Germany; *H2B2*, from Spain; *Empati*, from the United Kingdom and *Mitsui*, from Japan. This is why

these are considered competitors. Furthermore, the main sector organization named *Hidrógeno Colombia* (Colombian Hydrogen Association) has partner companies such as *Air Liquide*, *TW Solar*, *Messer*, *KPMG*, *BlueFoat*, *PRF*, etc. In this competitive landscape, knowledge, experience and innovation will play an essential role in finding opportunities.

Furthermore, green hydrogen is one of the priorities for the Petro administration. Using it as a decarbonization strategy is going to be the main purpose at the national level. Developing a hydrogen port is on the lookout of the Government but the necessary infrastructure, knowledge and experience still need to be developed. For this reason, approaching the Ministry of Environment and Sustainable Development and the Ministry of Mines and Energy could be the best route for the Dutch companies that wish to carry out a nation-wide project or strategy.

Opportunity 8: Smart Cities



With regard to smart cities, the *Administrative Department of Transit and Transportation of Cartagena* is the main client for ITS. The projects have not been launched yet, but they are already

being considered. Presenting a proposal of Dutch technology is the best option to proceed, as the Department is the entity in charge of contracting this kind of service.

Other innovative technologies such as green roofs and living walls could be presented both to the private and public sectors. The housing sector has grown considerably during the past years in the city and it could be a potential client if this technology is presented as a smart solution for the flooding issue. Construction firms such as *3G Constructores and Novus Civitas* have engaged on several projects with a sustainability approach in Cartagena. Furthermore, the public sector could be a pioneer in implementing this type of technology in public spaces and buildings in order to stimulate its use.

In terms of waste management, the companies in charge of this service in the city are *Pacaribe* and *Veolia.* Both technologies on waste management and on recycling should be presented to these companies as an opportunity to improve their performance in the city and to increase the percentage of waste that can be reused. Also, these technologies can be presented to the *Public Environmental Facility of Cartagena*, EPA, as it is the environmental authority in the urban perimeter of the district and it is the organization in charge of promoting and implementing programs and policies related to the environment and renewable natural resources. Linkages with the private sector can be sought with companies such as *Esenttia* as they have tried to improve the collection of recyclable materials, but would have to invest in the technology for its transformation. *Ecopetrol* has also shown interest in acquiring technology for solid waste management and to give a new life to single-use plastics.

Picture: Pexels

6. A Comprehensive Plan of Action

The conclusion that can be drawn from the findings in this report is that doing business in water, port and sustainable urban development projects in Cartagena is not just a matching, *"plug-and-play"* process between a Dutch company and stakeholders in Cartagena. Instead, the process from "contact to contract" is the result of a complex and multidisciplinary process that involves breaking several barriers (both from the Dutch side and the Colombian side) along the way.

Considering the presented opportunities, this section aims to provide an action plan of concrete actions involving both public and private Dutch stakeholders. From desk research, as well as the interviews with different Dutch entities, the following steps for the Dutch actors have been identified and grouped to target the main challenges identified:

- **[A1] Promotion of dialogues between Dutch and Colombian stakeholders**

Enhancing active and continuous engagement between Dutch players and local public/private stakeholders in Cartagena has been identified as an essential action. These dialogues, which could be done online, should promote the exchange of information and experiences in both directions.

It means that not only should products, services or expertise be showcased by Dutch companies to the Cartagena stakeholders. Also, experiences, best practices and challenges in the water, port and sustainable urban development sectors in Cartagena could be provided by stakeholders, from a technical, economic, institutional or cultural barrier. Such bidirectional approach could enhance:

  - A better alignment between problem and solution, since Dutch companies can better understand the contextual unique issues in the Cartagena region.
  - A better understanding of the local culture, leading to higher trust between parties.
  - Increase the understanding of the solutions by the Cartagena stakeholders, and therefore get a more realistic perception of risks.

- **[A2] Advice on the establishment of local offices or local agents**

Given the economic barriers (i.e., tax national/local framework) as well as the *"local first"* approach in Colombia, it is recommended for Dutch companies to establish either contact with local agents or assess the feasibility of opening local offices (should the Dutch entity be interested).

In this sense, Dutch companies could find assistance through (1) local embassies which provide contacts with local agents; and (2) look for advice on the entire (administrative and financial) process for establishing local stations with Dutch entities, including contextualized challenges in that particular opportunity. Among others, major benefits could be:

- Better understanding of the local culture, leading to higher trust between parties.
- Better price competitiveness via reduced import taxes or adjusted labor costs.
- Ease contracting processes for the Dutch companies in Colombia (RUP, SECOP, etc.).

- **[A3] Informal Networking**

While it is true that the previous two points can enhance contact with stakeholders from the water, port and sustainable urban development sectors in Cartagena, establishing a more personal relationship in Colombia, while being a time-consuming process, can help build trust, lower cultural barriers and therefore open room for business opportunities.

The team involved in the present study highly advises participating Dutch companies to strengthen ties with local stakeholders on a personal basis. This can be done either (1) on an individual basis by the Dutch companies, or (2) through joint company missions promoted by both the Dutch government and the Embassy of The Netherlands in Colombia.

- **[A4] Promote knowledge building in Colombia**

Given the identified knowledge gap between the Netherlands and the Cartagena region in terms of port adaptation, resilience and digitalization, it is important for the latter to enhance knowledge building in its port communities. As already mentioned, the role of research and knowledge infrastructure can be on the basic elements supporting innovation, and therefore technological development. In this sense, the port clusters in Cartagena should enhance continuous innovation, promotion of start-up accelerators, investment in research, and (re) training of the human capital as a well-encompassing approach to embrace and implement digital solutions.

Perhaps one of the most notorious (long term) benefits could be the increased knowledge independence. That is, they could have strengthened human and technical capital to come up with their own solutions or services which fit their unique circumstances in the future.

It is important to remark that the knowledge building process, from initial, multi-stakeholder discussion rounds until implementing and starting to yield results, can take several years. An interesting selling point for the Dutch stakeholders could be their involvement in this multidisciplinary and multi-stakeholder process. Knowledge building on port adaptation and development could be tailored to either, or a combination of the following, focus areas:

- Research institutes: universities and other knowledge institutes.
- Vocational training: training on the water, port and sustainable urban development sectors.
- Innovation Centers and missions: start-up incubators and accelerators tailored to the water, port and sustainable urban development sectors.

- **[A5] Influential missions for key stakeholders to the Netherlands.**

Considering that face-to-face activities have resumed after the world sanitary crisis caused by Covid-19, the involvement of Cartagena's key stakeholders in technical and influential missions to the Netherlands related to water, ports and urban sustainable development can have several important outcomes when looking to materialize business opportunities. Here is an explanation of why such missions would be significant:

- Knowledge and Expertise Exchange: by engaging in technical and influential missions with Dutch counterparts, Cartagena's stakeholders can gain valuable insights, knowledge, and best practices. This exchange can help them understand innovative approaches, advanced technologies, and successful strategies that have been implemented in the Netherlands.
- Collaboration and Partnerships: by organizing missions to the Netherlands, creating opportunities for Cartagena's key stakeholders to establish collaborations and partnerships with Dutch organizations, government agencies, research institutions, and businesses. These initiatives can promote deals, share resources, and collaborate on research and development projects.
- Global approach for Cartagena: participating in missions to the Netherlands can demonstrate the 'global approach' of Cartagena's key stakeholders and the city itself. It demonstrates their willingness to learn from global leaders in the field and their proactive approach towards sustainable development.

- **[A6] Invite Dutch speakers to the main sector congresses in Colombia**

Inviting Dutch speakers and experts to main sector congresses in Colombia, would contribute to possible business opportunities for Dutch companies in several ways. It would increase visibility and awareness of Dutch expertise and solutions in the Colombian market. Local businesses and government representatives attending the congresses would become familiar with the Dutch capabilities and may consider working with Dutch companies for current and coming projects.

The events serve as a gateway to understand the local market dynamics, regulations, and opportunities within the water, ports and urban sustainable development sectors in Cartagena. In this way, Dutch companies can get insights into the specific needs and challenges of the Colombian market. They can establish networking with key decision-makers, local businesses, and government representatives, enabling them to explore potential collaborations and contracts.

- **[A7] Organize sector trade missions for Dutch companies to Colombia**

Organizing sector trade missions for Dutch companies to Colombia in the water, ports and urban sustainable development sectors would be important since it facilitates market access, knowledge transfer, partnerships, sustainable development, and stronger commercial ties between the two countries. These missions create a win-win situation, allowing Dutch companies to expand their business horizons and contribute to Colombia's development while benefiting from Colombia's growing market and collaborative opportunities.

The following table summarizes the described actions, including the identified opportunities that could potentially be targeted, as well as the expected involvement of (public and private) Dutch stakeholders.

Chart 4. Barriers to be targeted by each action item.

Action item	Barrier to target				Dutch involvement[1]	
	Technical	Economic	Institutional & Legal	Cultural	Public[2]	Private[3]
[A1] Promotion of dialogues between Dutch and Colombian stakeholders	✓			✓	High	High
[A2] Advice on the establishment of local offices or local agents		✓	✓	✓	High	High
[A3] Informal Networking				✓	Medium	High
[A4] Promote knowledge building in Colombia/Cartagena	✓	✓	✓	✓	High	High
[A5] Influential missions for key stakeholders to the Netherlands.	✓			✓	High	High
[A6] Invite speakers to the main sector congresses in Colombia	✓	✓	✓		High	High
[A7] Organize sector trade missions for Dutch companies to Colombia	✓	✓		✓	High	High

[1]Involvement in terms of time.

[2]Public Dutch stakeholders may refer to any Dutch governmental organization.

[3]Private Dutch stakeholders mainly refers to companies which could potentially start or increase business in Cartagena (Colombia).

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Annex 1: List of contacts for business opportunities

Annex 2: List of interviewed entities

Annex 3: Organization chart of the Mayor's Office of Cartagena

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Prinses Beatrixlaan 2
PO Box 93144 | 2509 AC The Hague
T +31 (0) 88 042 42 42
Contact
www.rvo.nl

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