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Development Strategies for the Mediterranean Coastal Landscape: Adaptive Decision-Making Processes for Implementing the Circular Economy in the Redevelopment of the Reggio Calabria Waterfront

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Abstract: This document explores a circular approach to the redevelopment of the city–port system of Reggio Calabria, an area characterized by complex challenges involving economic, social, and environmental needs. By developing a multidimensional decision-making process, three development scenarios were identified to support a sustainable transition. The methodology integrates both quantitative and qualitative assessments, actively involving the local community and stakeholders. The proposed methodology operationalizes the principles of the circular economy by aligning sustainable regeneration scenarios with local needs and environmental constraints. The integrated assessment ensures the applicability of circular models for the resilient redevelopment of the waterfront. The results demonstrate how this model can be applied to other Mediterranean port cities to promote sustainable and resilient regeneration.

Keywords: port city; circular economy; urban regeneration; stakeholder analysis; multicriteria analysis

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1. Introduction

In recent years, port cities have taken on a central role in the transition towards sustainable development models. Port areas are not only strategic infrastructures for trade and tourism but also critical convergence points between urbanization, economic demands, and environmental challenges [1–4]. This aspect is further reinforced by the work of Hein [5], which highlights how port cities serve as key nodes within global networks, shaping the economic and territorial dynamics of their surrounding regions.

In particular, many European port cities, especially in the Mediterranean, face complex challenges related to resource scarcity, pollution, and the functional segregation between the port and the city [5,6]. The port waterfront represents a contested space where urban and port-related needs overlap, requiring innovative design and management solutions [7].

Consequently, the redevelopment of these spaces requires innovative approaches that integrate economic, social, and environmental considerations to promote urban resilience [4]. In this context, the concept of the Circular Economy (CE) has emerged as a paradigm capable of (i) preserving and enhancing natural capital by managing finite stocks and balancing the flow of renewable resources, (ii) optimizing resource yields by maintaining their utility at the highest level across all stages of technical and biological cycles, and (iii) promoting system effectiveness by identifying and eliminating negative

externalities [8]. The translation of these objectives into urban planning and design processes, as in the case of city–port systems, can effectively address sustainability needs, offering opportunities for urban regeneration [9–11]. The literature highlights how port cities, due to their hybrid and dynamic nature, can serve as ideal laboratories for applying the principles of the CE [12–14].

Applying CE principles to port cities not only reduces the environmental impact of port activities but also fosters new economic growth models and enhances urban quality of life [15–17]. This approach has also been promoted by research projects and initiatives such as 'Circular Cities', which provide practical insights into how to integrate the CE into urban and port regeneration strategies [18,19].

However, regeneration strategies based on these principles must be tailored to the specific characteristics of port areas, which requires a multidimensional assessment and an adaptive, inclusive decision-making process [20]. Some studies propose the adoption of operational tools that enable the translation of the circular economy model into concrete actions, through stakeholder involvement and the integration of environmental, social, and economic dimensions [21,22].

Furthermore, the active involvement of stakeholders—from public administrations to the local community—has proven crucial in developing shared and balanced solutions [23,24]. In this regard, the adoption of circular governance approaches (Jonker & Montenegro Navarro, 2018) can facilitate the transition to more transparent, inclusive, and sustainable management models, promoting cooperation between public and private actors [25].

The study in question is positioned within this debate, proposing a model for the regeneration of the city–port system of Reggio Calabria, a Mediterranean port city that faces a significant disconnection between the port and the urban fabric. Using a combination of methodological approaches, such as the multicriteria PROMETHEE method (Preference Ranking Organization METHod for Enrichment Evaluation) and the CATWOE method (Customers, Actors, Transformation process, Worldview, Owner, Environmental constraints) for stakeholder involvement, this work explores three alternative scenarios for the redevelopment of the Reggio Calabria waterfront, integrating circular economy principles with local peculiarities [26–28]. The importance of adopting integrated approaches for waterfront regeneration has also been highlighted in a recent study [29], which proposed a multidimensional decision-making process for the transformation of port landscapes.

The recent scientific literature provides valuable contributions on various urban regeneration models applied to port contexts, yet it highlights a certain fragmentation between approaches that focus solely on economic development and those primarily oriented towards social and ecological sustainability [30,31]. For example, while some studies emphasize the importance of enhancing port infrastructure to boost economic competitiveness [32,33], others focus on social inclusion and the preservation of cultural heritage as key elements for urban resilience [5,30].

This fragmentation reflects a divergence of views between those who prioritize development focused on economic growth and those who see sustainable and inclusive strategies as a more balanced and resilient path. In this work, we propose to overcome this dichotomy through a hybrid scenario that reconciles economic, environmental, and social needs. The aim of this study is therefore to propose and test an integrated, multistakeholder decision-making process to support the transformation of the Reggio Calabria waterfront according to a circular model. This innovative approach can contribute to making the city more resilient and enhancing the quality of life, while simultaneously creating a replicable reference for other Mediterranean port cities that is transferable to similar contexts.

The main objectives were to analyze the challenges and potential for the regeneration of the Reggio Calabria city–port system, develop an inclusive decision-making process that incorporates circular economy principles, and propose a regeneration scenario that could be replicated in other Mediterranean urban contexts. The results of the study further demonstrate how a circular model can effectively and balanced address sustainability, resilience, and economic growth needs, providing a methodological framework that can be expanded and adapted in future research.

In conclusion, it is important to highlight that this study was structured within an action-research project developed as part of the research activities of the interdisciplinary research laboratory 'LandEM Edoardo Mollica' of the University of 'Mediterranea' of Reggio Calabria. This project involved students from the course on 'Real Estate Appraisal and Economic Evaluation of Plans and Projects' of the Department of Architecture at the University of 'Mediterranea' of Reggio Calabria, who actively participated in the laboratory activities. This collaborative approach enriched the research process, fostering a deeper understanding of urban regeneration challenges and the application of circular economy principles in real-world contexts.

2. The Case Study: The Multidimensional Decision-Making Process for the Redevelopment of the Reggio Calabria City–Port Waterfront System

The redevelopment of the Reggio Calabria city–port waterfront represents a strategic element in the socio-economic revitalization of the city, as it serves as one of the main connection points between the urban fabric and the Mediterranean coastal environment [34]. The port of Reggio Calabria is a category 2, class 2 port located within Special Economic Zone (ZES) no. 4 of the Strategic Development Plan of the Calabria Region (PSS) and is part of the Trans-European Transport Network (TEN-T). It covers a water surface of 236,000 square meters, with depths ranging from 4 to 13 m and operational quays extending for 1848 m, behind which 75,400 square meters of yards have been developed [35]. Located along the eastern shore of the Strait of Messina, it spans an area of significant scenic and environmental value, exposed to hydrogeological risks and coastal erosion, while also facing challenges related to infrastructure degradation and the lack of an integrated vision for sustainable development. With its historical roots dating back to the Greek era, the port has played a crucial role in trade and mobility across the Mediterranean, but today it requires targeted interventions to restore its centrality within the urban and regional context. This reconnection is essential to revive its economic attractiveness, starting primarily from the enhancement of natural capital, including the landscape, environmental assets, and their ecosystem services, in order to promote a multidimensional regeneration model that considers the socio-economic, environmental, cultural, and technological needs of the city [27,36].

The study area is located along the eastern shore of the Strait of Messina. The waterfront of the Reggio Calabria city–port system extends over an area that includes the city's seafront, the commercial port, and surrounding areas characterized by a predominance of residential buildings and underutilized spaces. The Falcomatà seafront, often described as one of the most beautiful in Italy, provides a privileged setting for the relationship between the city and the sea, offering extraordinary potential for regeneration projects. However, the presence of outdated infrastructure and disused industrial areas poses a barrier to fully leveraging the city–port system. These areas, once the hub of productive activities, are now empty spaces awaiting new purposes, capable of hosting functions that integrate the paradigms of sustainability, resilience, and circularity.

The metropolitan area of Reggio Calabria is characterized by a moderate population density, but significant unemployment rates negatively affect the social fabric [37]. Accord-

ing to recent data [38], the general unemployment rate stands at around 30%, while the youth unemployment rate exceeds 50%, indicating the need for targeted interventions to stimulate the local economy. This situation is further exacerbated by the migration of young people to other regions or abroad in search of job opportunities. The crisis in industrial and port activities has also led to the abandonment of numerous structures along the coastline, contributing to a sense of urban decay and marginalization. In this context, intervention in the city–port system plays a central role in reversing these trends and creating an attractive and inclusive urban environment.

Among the ongoing projects for the redevelopment of the city–port system, interventions focused on the regeneration of the waterfront and improving the connection between the port and the city center stand out. The plan includes the creation of new publicly accessible spaces, such as green areas and pedestrian paths, aimed at enhancing accessibility and quality of life for both residents and visitors, as well as improving ecological, environmental, and climate-related aspects. Another key element is the implementation of sustainable infrastructure, such as renewable energy systems and technologies for water resource management, in line with the objectives of the blue economy [39]. The project also includes the transformation of disused areas into multifunctional hubs dedicated to cultural, social, and entrepreneurial activities, aiming to stimulate an economic rebirth based on the diversification of activities and innovation.

In each of the regeneration scenarios proposed for the Reggio Calabria waterfront, the principles of the CE have been central in guiding design and operational decisions. The use of recycled and sustainable materials has been prioritized in the design of public spaces and infrastructures, ensuring not only a reduction in their environmental impact but also the extension of the life cycle of resources. The promotion of sustainable mobility is another key element, with the introduction of pedestrian and cycle paths, as well as public transport systems powered by renewable energy, which aim to reduce CO_2 emissions and improve the quality of urban life. In addition, resource efficiency has been addressed through the implementation of water and waste management systems designed to maximize reuse and minimize waste. These interventions demonstrate a clear alignment with the principles of the CE, helping to create a more resilient, sustainable, and adaptable urban environment.

An emblematic example is the plan for the redevelopment of the northern pier, which envisages the creation of a center for cultural and tourism activities, including exhibition spaces, areas for outdoor events, and a museum dedicated to the city's maritime and port history. The redevelopment of the urban mobility system represents another strategic pillar of the project, with the design of an integrated transport system linking the port to the urban center and major regional arteries, promoting easy and sustainable access.

The case study of the waterfront in the Reggio Calabria city–port system highlights the importance of an integrated and regenerative approach to address contemporary urban challenges. The complexity of territorial, social, and economic dynamics requires a strategy based on cooperation between public and private stakeholders capable of combining the protection and enhancement of cultural and environmental heritage, social inclusivity, technological innovation, and sustainable development. Ongoing projects demonstrate how it is possible to transform existing challenges into opportunities for regeneration, reconnecting the city to the sea and enhancing cultural and environmental heritage. If successfully implemented, this process could serve as a replicable model for other coastal cities in the Mediterranean, helping to strengthen the role of city–ports as engines of sustainable, resilient, and circular development.

3. Materials and Methods

3.1. Structure of the Decision-Making Process

The main objective of this study was to develop a methodological framework for analyzing and designing sustainable and circular transformation strategies for the city–port system of Reggio Calabria (Figure 1). This integrated approach aims to support an adaptive decision-making process capable of addressing the complexity of the dynamics between the city and its waterfront and to guide the selection of development scenarios based on a balance between economic, social, and environmental needs. Particular attention is given to the synergy between port logistics and urban functions, as well as to the enhancement of identity-rich places and the expectations of local communities. The proposed methodological framework, which combines qualitative and quantitative methods, aims to provide a useful tool for defining urban regeneration strategies that promote resilience and sustainability in the city–port system of Reggio Calabria [40] according to the principles of CE.

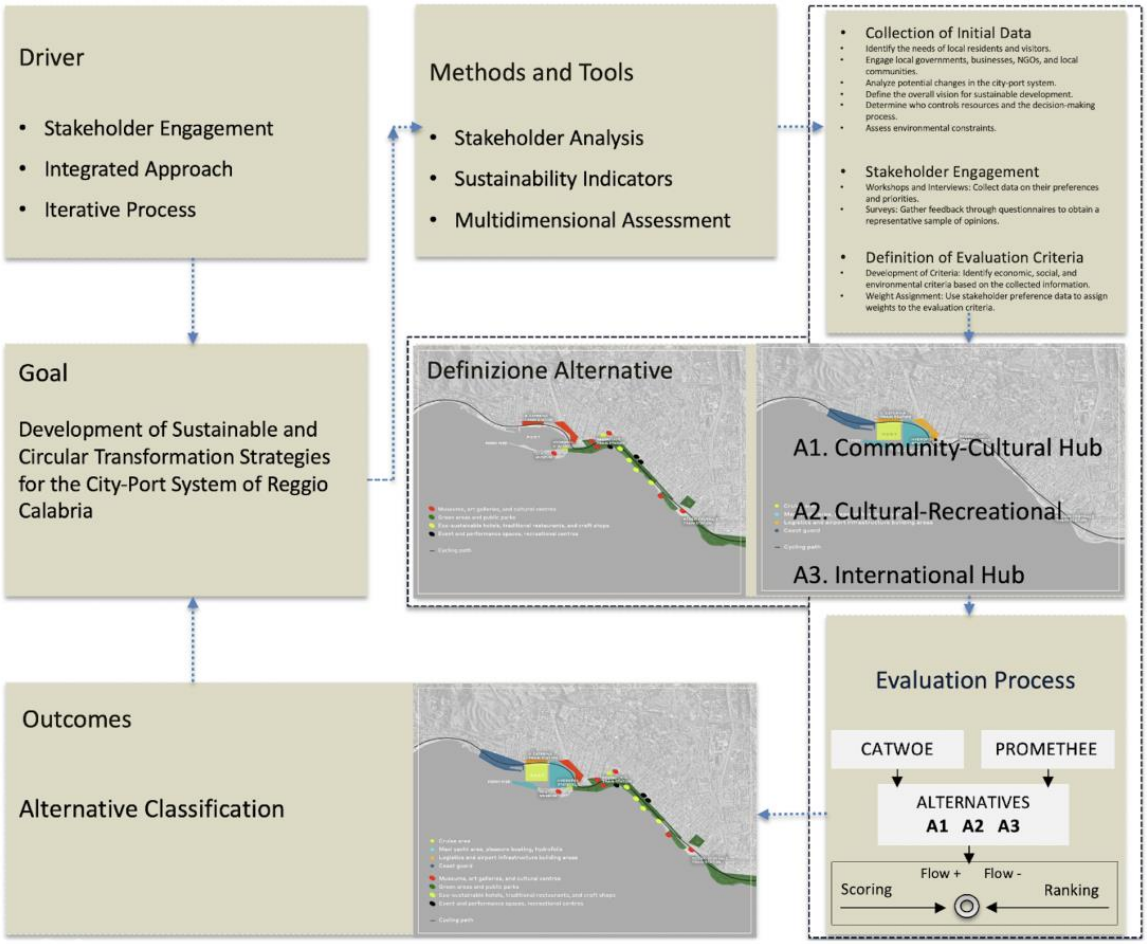

Figure 1. Methodological framework.

CATWOE (Customers, Actors, Transformation process, Worldview, Owner, Environmental constraints): This is a method that helps identify local needs and priorities. Adapted to the context of the port of Reggio Calabria, the method was used to gather input from the community and local stakeholders, enabling a deep understanding of the benefits and limitations of potential urban transformations [15]. CATWOE has been particularly effective in identifying Circular Economy (CE) opportunities, such as the optimization of resource use. These insights informed the criteria used in PROMETHEE, ensuring alignment with the CE objectives. Preferences from various stakeholder groups were systematically collected

through workshops, surveys, and direct interviews, contributing to the definition of the weighting system within the PROMETHEE evaluation framework.

PROMETHEE (Preference Ranking Organization METHod for Enrichment Evaluation) is a multicriteria method employed to assess and compare alternative development scenarios. This method utilizes a weighting system that reflects the preferences and needs of the stakeholders involved, thereby translating these perspectives into measurable criteria that balance economic, social, and environmental impacts. Specific weights were assigned to the preferences of each stakeholder group based on the relative importance of their concerns, determined through a structured elicitation process. Although developed in the 1980s, PROMETHEE remains a widely adopted methodology, supported by a large and extensive body of recent studies that highlight its relevance and applicability in contemporary research [41]. In this study, PROMETHEE was employed as the primary multicriteria decision-making (MCDM) tool to evaluate alternative urban regeneration scenarios for the Reggio Calabria city–port system and as an adaptation to the specific complexities of city–port dynamics. The study integrated a multidimensional analysis, addressing the economic, social, and environmental dimensions of sustainability, thereby contributing to the Circular Economy (CE) principles. This allowed for a balanced consideration of the needs and impacts of various stakeholders, including the local community and port logistics, ensuring that sustainability indicators are not only defined but actively used to guide decision-making.

The methodology's innovative strength lies in its combination of PROMETHEE with the CATWOE framework, which facilitates the integration of stakeholder perspectives and the incorporation of local community preferences. This participatory approach strengthens the robustness of the decision-making process, ensuring that the final selection of alternatives is not only technically valid but also socially acceptable. While the PROMETHEE method itself is not new, its application to the unique challenges faced by Mediterranean port cities, particularly the Reggio Calabria case, introduces a new level of specificity in evaluating circular, adaptable, and resilient urban regeneration strategies.

In addition to the technical aspects of PROMETHEE, the study also addresses the growing body of research on participatory planning and stakeholder engagement in coastal and urban regeneration. By leveraging recent advancements in multicriteria decision-making, this study contributes to the field by demonstrating how established methodologies can be effectively adapted to current urban and sustainability challenges, offering insights into the application of PROMETHEE in increasingly complex decision-making contexts.

The widespread use of PROMETHEE stems from its intuitive approach, which makes the derivation of results more transparent compared to methods often referred to as 'black-box'. Its simplicity and ability to provide transparent results make it an ideal choice for various decision-making contexts.

PROMETHEE enables the classification of alternatives based on the aggregated judgments of all stakeholders, facilitating the selection of the most optimal compromise solution among the proposed options [42]. This approach ensures that the final rankings of the alternatives are not only technically valid but also socially acceptable, as they incorporate a diverse range of stakeholder values and priorities. Comparing the evaluation outcomes and analyzing the scores of the different options promotes the selection of balanced solutions aimed at reducing conflicts between divergent objectives.

The proposed methodology addresses the challenges arising from the complexity of the scenarios and variables at play, facilitating a comparative analysis that allows for balancing the divergent priorities of stakeholders. This integrated approach, combining CATWOE and PROMETHEE, provides a robust framework for exploring opportunities and challenges, enabling the management of conflicts between differing interests through

a negotiation process aimed at ensuring balanced solutions between environmental sustainability, social inclusion, and economic viability. The integration of PROMETHEE and CATWOE enables navigation through the challenges typical of complex decision-making processes, promoting the sharing of divergences and the validation of solutions. The iterative nature of the decision-making process allows for continuous feedback from stakeholders, ensuring that their evolving preferences are reflected in the final decision. Thanks to this cyclical and interactive approach, innovative strategies for the city–port system have been developed, taking into account the diverse needs and perspectives of stakeholders. The final alternative selected aims to promote circular, adaptable, and resilient development capable of responding to the ongoing economic, environmental, and social transformations of the context.

Recent studies have demonstrated the relevance of combining qualitative methods like CATWOE with multicriteria decision-making models such as PROMETHEE in urban regeneration. For instance, applications of CATWOE in urban planning highlight its strength in structuring stakeholder perspectives and aligning them with broader Sustainable Development Goals [43–45]. Similarly, the PROMETHEE method has been widely used in evaluating urban infrastructure projects, showcasing its robustness in handling complex, multistakeholder decisions [46,47]. These advancements underline the adaptability and relevance of these methods in navigating urban challenges, particularly in Mediterranean port cities where economic, social, and environmental needs intersect.

3.2. Definition of Scenarios

The active involvement of stakeholders played a crucial role in defining regeneration alternatives capable of meeting the city's development expectations [48]. Through thematic round tables and workshops, an inclusive and participatory decision-making process was facilitated. The participants included representatives from the municipality, port authorities, residents, local associations, and academics, whose collaboration allowed for the identification of three possible visions for the future of the port, along with corresponding actions and compatible functions.

1. International Hub

This scenario (Figure 2) focuses on the expansion of port infrastructure to increase commercial and industrial capacities, with an emphasis on economic competitiveness. However, it partially sacrifices cultural and social development in the urban area, highlighting a lower level of social integration.

Actions:

Expansion of Port Infrastructure:

- Construction of new container docks and cargo ship terminals.
- Development of storage facilities and automated warehouses.
- Creation of high-capacity logistics areas for the rapid transit of goods.

Enhancing Intermodal Connectivity:

- Improvement of railway connections to the port, including the creation of cargo stations and adjacent railway terminals.
- Development of a dedicated road transport network for heavy traffic, with direct access to the port.

Sustainability and Technological Innovation:

- Implementation of 'smart port' technologies to optimize the management of maritime and land traffic.
- Introduction of renewable energy solutions, such as the use of solar panels to power docks and loading/unloading areas.

Reorganization of Industrial Areas:

- Creation of industrial zones and warehouses within the port perimeter to attract investments in logistics and international trade sectors.

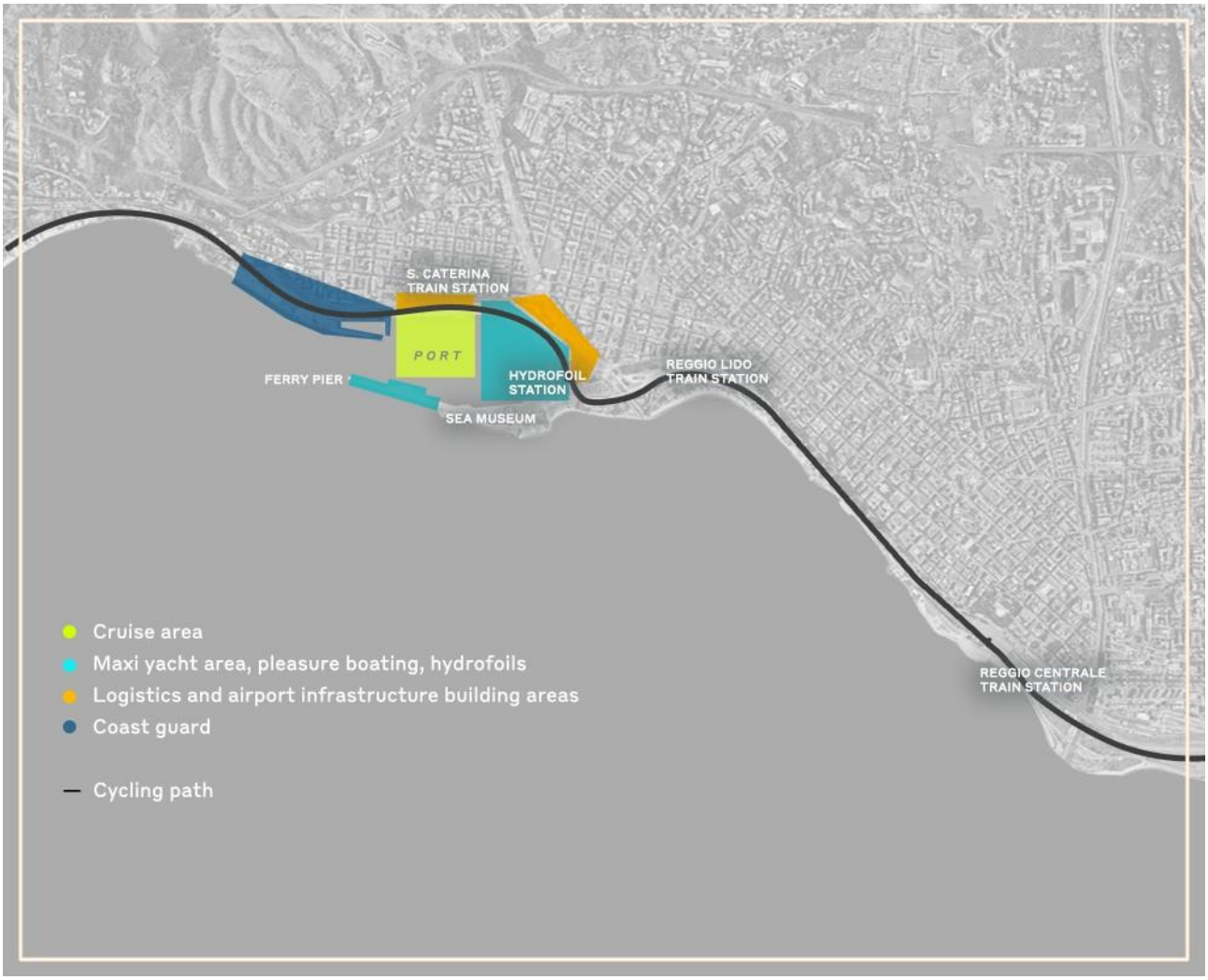

Figure 2. International Hub scenario.

Compatible Functions:

Expansion of Port Infrastructure:

- Construction of new container docks and cargo ship terminals.
- Development of storage facilities and automated warehouses.
- Creation of high-capacity logistics areas for the rapid transit of goods.

Enhancing Intermodal Connectivity:

- Improvement of railway connections to the port, including the creation of cargo stations and adjacent railway terminals.
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Reorganization of Industrial Areas:

- Creation of industrial zones and warehouses within the port perimeter to attract investments in logistics and international trade sectors.

Existing Projects:

- Port Development Plan: This includes the enhancement and expansion of port infrastructure. The creation of new port basins and the upgrading of maritime terminals are part of this context.

2. Cultural–Recreational Hub

In this scenario (Figure 3), the needs of the local community and the enhancement of cultural heritage are prioritized. Port activities are reduced to foster sustainable tourism and recreational development, improving quality of life and promoting social inclusion.

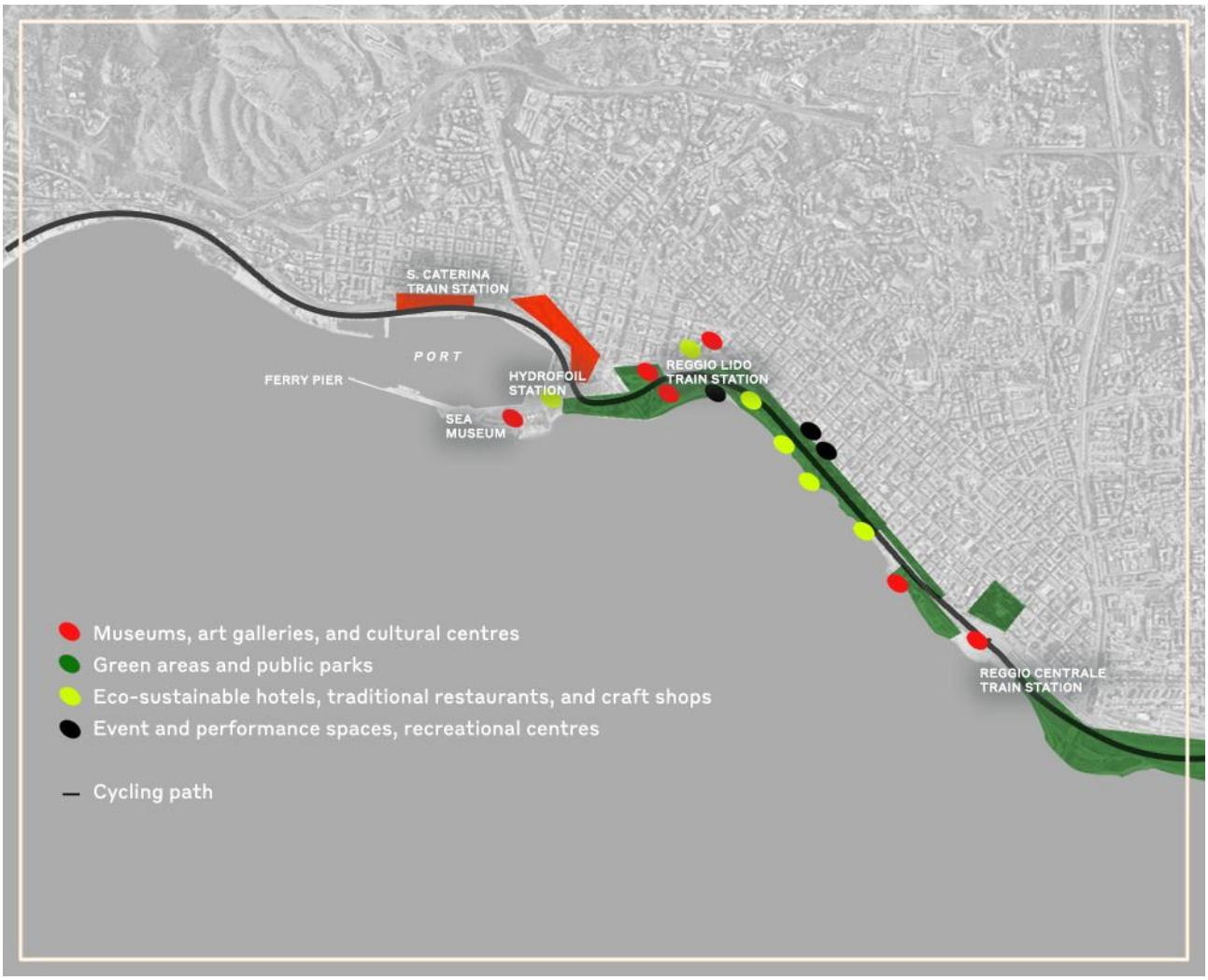

Figure 3. Cultural–Recreational Hub scenario.

Actions:

Recovery and Enhancement of Historical and Cultural Heritage:

- Creation of thematic museums (e.g., dedicated to Magna Graecia and the history of the port).
- Development of an exhibition center for local artists and temporary exhibitions.
- Creation of a cultural route along the waterfront, connecting museums, galleries, and historic points of interest.

Public and Recreational Spaces:

- Creation of a public park along the seafront with relaxation areas, playgrounds, and spaces for outdoor events.
- Development of a pedestrian/cycle path connecting the city center to the port, facilitating access to the coastline.

Sustainable Tourism:

- Implementation of eco-friendly tourism solutions, such as eco-sustainable accommodation, pedestrian- and bike-friendly paths, and green transport systems (electric vehicles, bicycles, and shuttles).

Compatible Functions:

- Cultural: Museums, art galleries, theaters, event halls, and cultural centers.
- Recreational: Outdoor sports areas, playgrounds, and relaxation and socialization zones.
- Touristic: Hotels, restaurants, and shops related to cultural and recreational tourism.

Existing Projects:

- National Museum of Magna Graecia: An existing structure to be further enhanced by connecting the museum with other cultural and recreational areas.
- Urban Regeneration Projects: Initiatives aimed at renewing the waterfront area to make it more attractive to tourists, with a strong emphasis on enhancing underutilized historical and cultural heritage.

3. Community–Cultural Hub

This scenario (Figure 4) proposes a balanced approach, integrating port development with cultural and social enrichment. The port area would be transformed into a sustainable space, with multifunctional public spaces, greater access to the coastline, and new economic opportunities for the local community.

Actions:

Sustainable and Multifunctional Port Development:

- Construction of shared public spaces within the port area, integrating commerce and culture.
- Design of a port terminal with spaces for events, markets, and cultural exhibitions.

Public Spaces and Accessibility:

- Creation of multifunctional squares for social events, markets, and community gatherings.
- Design of a coastal promenade with pedestrian and cycle paths, improving access to the coastline.

Promotion of Local Culture and Social Inclusion:

- Development of spaces for local culture, such as community centers, art schools, and places for local traditions.
- Creation of spaces for educational activities and workshops for all ages, including programs for youth and the elderly.
- Strengthening areas dedicated to small local commercial and craft activities, such as artisan shops, markets, and stores selling local products.

Sustainable Accessibility and Green Mobility:

- Implementation of a shared electric transportation system, with electric shuttles for tourists and residents.
- Promotion of soft mobility options, such as bicycles and electric scooters.

Spaces for Socialization and Social Inclusion:

- Construction of social gathering centers, community event halls, and coworking spaces.
- Creation of areas dedicated to initiatives for the inclusion of vulnerable groups.

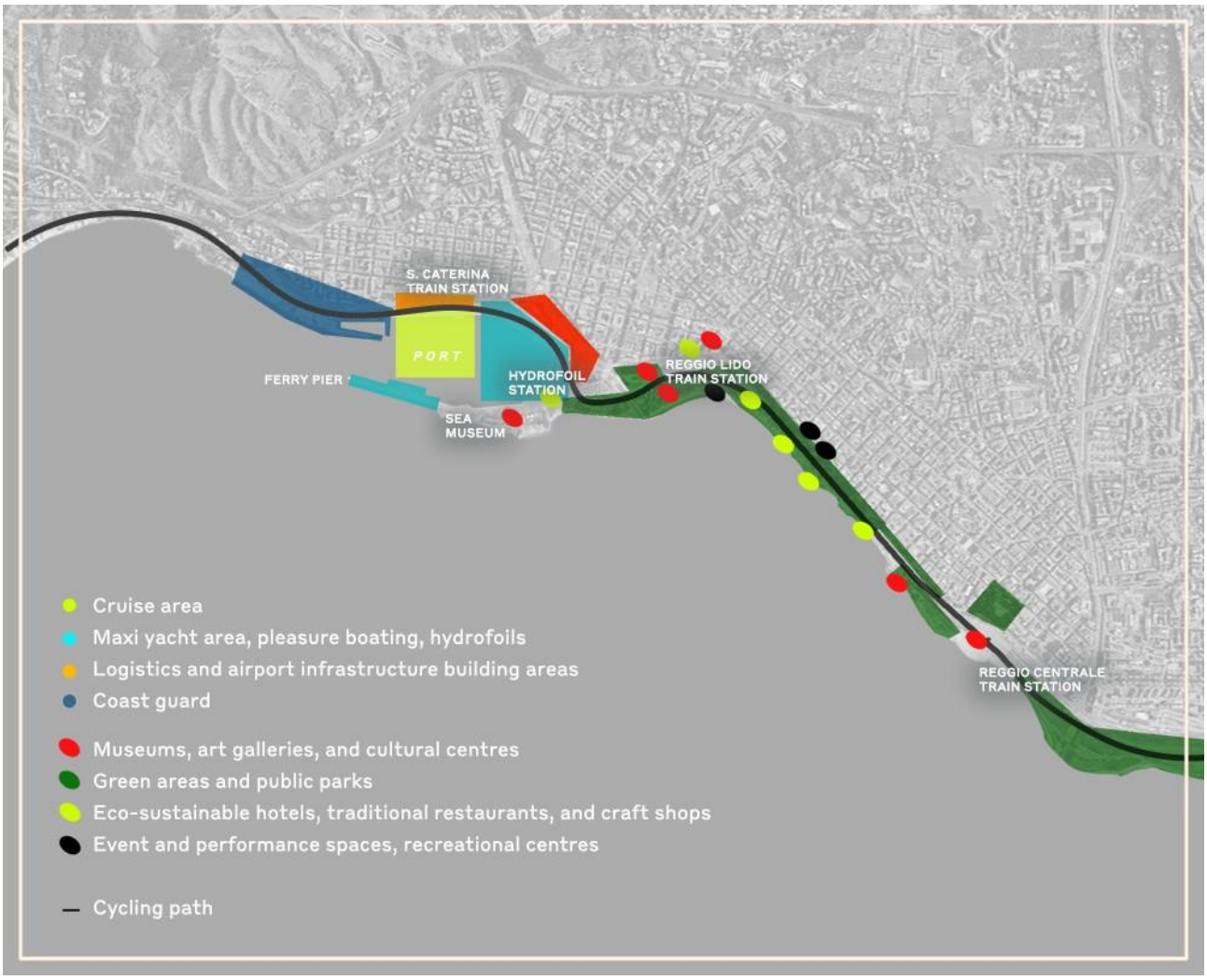

Figure 4. Community–Cultural Hub scenario.

Compatible Functions:

- Cultural and Social: Community centers, art schools, and museums for cultural activities; event halls; social gathering places; and coworking spaces.
- Functional Reuse: Existing structures in the eastern area (e.g., the Fish Market, etc.) and various buildings near the Port Authority to host local events and markets.
- Economic: Small commercial and craft activities linked to local culture, markets, and traditional restaurants.
- Educational: Classrooms and spaces for training courses, creative workshops, educational programs for all ages, and areas dedicated to initiatives for vulnerable-group inclusion.

Existing Projects:

- Waterfront Masterplan: Creating a stronger connection between the port and the city, with the development of green spaces and public areas.

3.3. Multicriteria Evaluation

To identify the most satisfactory scenario, the three models were subjected to an outranking multicriteria analysis using the PROMETHEE method. This method allowed for the assignment of different weights to various criteria based on the importance attributed by the stakeholder groups. Since the issue involved multiple stakeholders with divergent interests, the preferences of each group—from environmental organizations to local businesses, government agencies, and community members—were carefully considered. The evaluation considered indicators such as environmental impact, job creation, social cohesion, and quality of life [20]. The integration of stakeholder preferences enabled a comprehensive analysis aimed at minimizing conflicts and highlighting potential synergies. Through the PROMETHEE method, these preferences were synthesized, allowing for the identification of balanced solutions that best align with the diverse needs and expectations of the local community and institutions. The data collected were analyzed using the Visual PROMETHEE version 1.4.0 software [49], which facilitated the identification of compromise options that best meet the expectations of the community and local institutions [23].

The final model, reflecting a flexible vision for the future, was designed to adapt to the continuous changes in the economic, environmental, and social conditions of the urban–port system. Taking into account the complexity of the issues, needs, and sometimes conflicting perspectives, the evaluation process helped shape a territorial development plan that prioritizes sustainable and circular urban growth

4. Results

The research results highlight the effectiveness of the methodological framework in identifying, analyzing, and classifying the proposed urban regeneration scenarios for the waterfront of Reggio Calabria according to criteria that balance economic, social, and environmental aspects. The main results of the analysis, conducted with the aid of the tools used, are presented below.

4.1. Results of the CATWOE Model

The CATWOE model was used to identify and evaluate stakeholder perspectives regarding the urban regeneration of the Reggio Calabria waterfront. The analysis process involved a wide range of stakeholders, including local authorities, residents, and representatives from the tourism and environmental sectors, aiming to achieve a holistic and shared understanding of needs and expectations.

Stakeholder engagement was conducted in three main phases: initially through individual interviews and focus groups to gather preliminary information, then through participatory workshops to discuss development alternatives, and finally with feedback sessions to validate the final proposals. In each phase, stakeholders were invited to share their opinions and preferences, contributing to the development of a shared understanding of priorities and challenges. Approximately 70% of the invited stakeholders actively participated in the process, ensuring balanced and inclusive representation.

The information gathered from the CATWOE analysis played a central role in defining the evaluation criteria used in the PROMETHEE method. These criteria reflect the priorities expressed by the stakeholders, ensuring that the assessment of alternatives effectively addresses their concerns and the outlined objectives. The analysis process focused on economic, social, and environmental trends; the main interests of stakeholders; and the physical configuration of the city–port.

To address and manage the conflicts arising among stakeholders, continuous dialogue was promoted, facilitating a deep understanding of the diverse needs and fostering a collective learning process that supported the precise definition of scenarios and evaluation

criteria [50,51]. This participatory approach ensured that stakeholder perspectives were integrated at every stage of the decision-making process, enabling the definition of development scenarios that reflected collective needs and the establishment of robust evaluation criteria based on CE sustainability principles for assessing alternatives [52,53]. The overall approach facilitated the integration of stakeholder expectations and constraints, creating a shared vision for the regeneration of the city–port and its relationship with the waterfront, balancing the economic, social, and environmental dimensions of development [52–54].

Below are the key findings according to the six dimensions of the CATWOE model. The insights gathered during stakeholder engagement were essential for exploring the six dimensions of the CATWOE model, providing a solid foundation for the in-depth analysis of perspectives and priorities.

- Customers:

The local community, including residents and tourists, was identified as the primary beneficiary of the regeneration interventions. Interviews and focus groups revealed that residents desire accessible public spaces, green areas, and cultural activities to enhance quality of life and create social opportunities. Tourists, on the other hand, are interested in accommodation facilities and activities that highlight the city's cultural uniqueness.

- Actors:

The actors involved included local administrations, environmental non-governmental organizations (NGOs), local businesses, and citizen representatives. Each actor contributed specific perspectives and expertise, promoting solutions that balance economic development and environmental protection. NGOs particularly emphasized minimizing ecological impacts, while local businesses highlighted the importance of attracting new tourist flows.

- Transformation Process:

The proposed transformation process involves regenerating the port area to create a 'Community–Cultural Hub' that offers cultural and social services while supporting environmentally sustainable activities. This process addresses the community's need for shared and accessible spaces that reflect local identity and promote social cohesion.

- Worldview:

Urban regeneration is perceived as an opportunity to revitalize the waterfront without compromising environmental integrity. Stakeholders share a vision of the waterfront as a symbol of sustainability and urban resilience, capable of promoting sustainable cultural tourism and fostering community pride.

- Owners:

Public entities and the municipal administration hold decision-making control over the regeneration project. The support of authorities was crucial in setting priorities, as they are responsible for ensuring that interventions comply with local regulations and yield positive impacts for the community.

- Environmental Constraints:

Environmental constraints include the protection of coastal areas, biodiversity preservation, and pollution reduction. Stakeholders recognized the importance of adopting sustainable practices to minimize the ecological impact of regeneration, such as using eco-friendly materials and promoting public transportation and cycling.

4.2. Results of the PROMETHEE Method

The multicriteria PROMETHEE method was applied to rank the regeneration alternatives based on economic, social, and environmental criteria [26], aligning with the priorities identified through the CATWOE model.

To ensure alignment between the qualitative insights from the CATWOE model and the quantitative results from PROMETHEE, an iterative validation process was conducted. This process involved engaging stakeholders to review discrepancies, refine the selection of criteria, and adjust their weights where necessary. The integration of stakeholders' preferences was a key aspect of this process, ensuring that the model reflected the diverse priorities of different groups. By fostering coherence between qualitative priorities and quantitative evaluations, the approach ensured that decisions were not only technically robust but also socially acceptable. This adaptive framework balanced competing priorities, delivering a final evaluation that is both comprehensive and inclusive, while reinforcing the sustainability and resilience of the chosen scenario.

The evaluation process was divided into the following analytical phases:

4.2.1. Definition of Evaluation Criteria

To assess the three proposed scenarios for the Reggio Calabria port, a cluster of sustainability criteria and indicators was defined in collaboration with stakeholders (Table 1). Each criterion is described with its unit of measurement, minimum and maximum thresholds, and its connection to relevant Sustainable Development Goals (SDGs). The contribution of various stakeholder groups was essential in defining the criteria, ensuring that they were aligned with both local needs and broader sustainability objectives.

Table 1. Criteria and sustainability indicators.

Criterion	Description	U.M.	Min.	Max.	SDGs
Local Economic Impact	Evaluates the increase in local GDP generated by the project	% GDP increase	0%	10%	8
Job Creation	Number of new jobs created directly and indirectly by the project	No. of jobs	0	500	8
Accessibility and Sustainable Mobility	Measures the percentage of trips to the area conducted using sustainable transportation modes (walking, cycling, public transport)	% of trips	0%	100%	11
Reduction in CO_2 Emissions	Quantifies the reduction in CO_2 emissions achieved through the implementation of the project	Ton CO_2/year	0	1000	13
Enhancement of Cultural Heritage	Number of cultural sites restored or newly created as part of the project	No. of sites	0	10	11
Social Inclusion	Percentage of local population involved in cultural and recreational activities promoted by the project	% of population	0%	100%	10
Efficient Land Use	Percentage of the local population engaged in cultural and recreational activities promoted by the project	% of revitalized area	0%	100%	15
Financial Sustainability	Ratio of anticipated economic benefits to the project's investment costs	Benefit–Cost Ratio (B/C)	0	3	9
Technological Innovation	Number of innovative technologies implemented in the project (e.g., smart grids and renewable energy)	No. of technologies	0	5	9
Community Participation	Number of local stakeholders involved in the decision-making and implementation process of the project	No. of stakeholders	0	50	16

These criteria and indicators provide a foundation for evaluating the effectiveness and sustainability of the three proposed scenarios, aligning with the United Nations' Sustainable Development Goals (SDGs).

The evaluation criteria were defined based on the priorities that emerged from the CATWOE process, ensuring that stakeholder expectations were effectively integrated into the decision-making process. In particular, the needs for environmental sustainability and social inclusion, highlighted through CATWOE, were considered in the weighting of the PROMETHEE criteria. These criteria were then used to guide the selection of the preferred scenario, with a particular focus on the consistency between the qualitative and quantitative dimensions of the results.

4.2.2. Evaluation of Alternatives

The evaluation focused on three alternative scenarios defined in the first phase of the decision-making process using the CATWOE method.

Each scenario was analyzed based on the established criteria, and scores were assigned based on the expected performance for each criterion (Table 2).

- Community–Cultural Hub: This scenario received high scores for environmental sustainability and social inclusion, as the project includes green spaces, cultural activities, and low-impact environmental infrastructure. The Community–Cultural Hub stands out due to its balanced approach, which integrates Sustainable Development Goals across economic, social, and environmental factors.
- Cultural–Recreational Hub: This scenario showed good economic potential but received lower scores for environmental sustainability due to the possible expansion of tourism infrastructure. While it presents significant opportunities for economic growth and job creation, its impact on sustainability is relatively lower.
- International Hub: This scenario received the lowest scores for social inclusion and environmental sustainability, despite its strong economic potential, due to the expected increase in traffic and emissions. The International Hub is focused primarily on economic expansion, but its negative social and environmental impacts were seen as significant drawbacks.

Table 2. Alternative performances based on evaluation criteria.

Criteria	Community–Cultural Hub	Cultural–Recreational Hub	International Hub
Local Economic Impact (%)	8	7	9
Job Creation (no. of jobs)	200	150	500
Accessibility and Sustainable Mobility (%)	90	80	70
Reduction in CO_2 Emissions (Ton CO_2/year)	600	450	200
Enhancement of Cultural Heritage (no. of sites)	5	3	1
Social Inclusion (%)	80	60	40
Efficient Land Use (%)	75	65	55
Financial Sustainability (B/C Ratio)	2.5	2.0	1.5
Technological Innovation (no. of technologies)	4	2	3
Community Participation (no. of stakeholders)	40	30	15

4.2.3. Calculation of Preferences and Final Ranking

In the context of complex decisions, where conflicting values exist among different stakeholder groups and the decision-making problem involves multiple criteria, the chosen multicriteria method that best fits this situation is the Preference Ranking Organization Method for Enriched Evaluation (PROMETHEE). This method allows for comparing alternatives through a pairwise dominance process, determining both individual and global preferences for each alternative based on the defined criteria. In this specific case, the criteria used correspond to the sustainability indicators (Table 1), which were adopted as proxies to measure the social, economic, and environmental aspects of the alternatives according to CE principles. The application of the PROMETHEE method enabled the quantification of the superiority of each alternative over the others, taking into account the preferences expressed by the main stakeholder groups involved.

Through the PROMETHEE open-source software, version 1.4.0 application, the overall preference for each alternative was calculated.

The PROMETHEE methodology assigns preference values to each alternative relative to others for each criterion. The Positive Flow (F+) represents the advantages of an alternative over others, while the Negative Flow (F−) captures its disadvantages. The Net Fow (F+—F−) indicates the overall preference for each alternative in comparison to others. These flows are then aggregated to produce a final ranking.

Table 3 presents the weights assigned to each criterion by each stakeholder group involved in the evaluation process, while Table 4 presents the Net Flow (F+—F−) for each alternative for each criterion, according to the normalized and weighted scores assigned to the criteria by each of the stakeholders. The Net Flows provide a clearer understanding of the overall performance of each alternative, summarizing the balance of advantages and disadvantages across all criteria.

Table 3. Criteria weights.

Criteria	Local Administrations	Citizen Representatives	Local Businesses	Environmental Non-Governmental Organizations (NGOs)
Local Economic Impact	0.10	0.10	0.25	0.05
Job Creation	0.10	0.10	0.25	0.05
Accessibility and Sustainable Mobility	0.15	0.15	0.10	0.10
Reduction in CO_2 Emissions	0.20	0.05	0.05	0.20
Enhancement of Cultural Heritage	0.10	0.15	0.05	0.10
Social Inclusion	0.05	0.20	0.05	0.05
Efficient Land Use	0.15	0.10	0.05	0.15
Financial Sustainability	0.10	0.05	0.10	0.10
Technological Innovation	0.05	0.05	0.05	0.10
Community Participation	0.10	0.05	0.05	0.10

Table 4. Net flows of criteria for each alternative and Final Net Flows.

Criteria	Community–Cultural Hub (Net Flow)	Cultural–Recreational Hub (Net Flow)	International Hub (Net Flow)
Local Economic Impact	0	0.01	−0.01
Job Creation	0	0.01	−0.07
Accessibility and Sustainable Mobility	0.015	−0.015	0.015
Reduction in CO_2 Emissions	0.03	−0.12	0
Enhancement of Cultural Heritage	0.02	−0.02	0
Social Inclusion	0	−0.01	0
Efficient Land Use	0.015	0.015	−0.015
Financial Sustainability	−0.004	0.017	−0.017
Technological Innovation	0.01	−0.02	0.01
Community Participation	0.02	0.01	−0.01
Final Net Flows			
Alternatives	Positive Flow (F+)	Negative Flow (F−)	Net Flow (F+—F−)
Community–Cultural Hub	0.50	−0.50	0
Cultural–Recreational Hub	−0.05	−0.25	0.20
International Hub	−0.10	−0.05	−0.05

Interpretation of Results

Community–Cultural Hub: This alternative exhibits a neutral Net Flow of 0, indicating a balanced evaluation where the positive and Negative Flows cancel each other out. The Community–Cultural Hub performs strongly across multiple criteria, particularly in the areas of social inclusion and reduction in CO_2 emissions, making it a well-rounded option. The Community–Cultural Hub is especially favored by local administrations and the local community, reflecting its alignment with local priorities and social needs.

Cultural–Recreational Hub: With a positive Net Flow of 0.20, this alternative performs the best in terms of economic potential (e.g., job creation and local economic impact), making it an appealing option from a business perspective. However, its performance on environmental and social criteria is weaker compared to the Community–Cultural Hub, which might present challenges in meeting long-term sustainability goals.

International Hub: This alternative shows a negative Net Flow of −0.05, indicating that it is the least favorable option overall. While it has potential for attracting international investments, it underperforms on social inclusion and CO_2 emissions reduction, which are critical criteria for long-term sustainability.

The 'Community–Cultural Hub' scenario therefore emerged as the preferred option due to its balance between environmental sustainability, social inclusion, and economic potential.

The final ranking, based on the aggregated scores, is as follows:

1. Community–Cultural Hub;
2. Cultural–Recreational Hub;
3. International Hub.

This ranking indicates that the Community–Cultural Hub is the most balanced option, with good results along multiple dimensions of environmental sustainability, social inclusion, and economic development. Although the Cultural–Recreational Hub shows strong economic potential, its environmental and social performance need further improvement. The International Hub, while promising for international investments, falls short in key areas related to sustainability and local priorities.

The approach ensures that the final selection aligns with the stakeholder priorities and provides a basis for further negotiation and validation where conflicts exist. This methodology could be easily adapted to other Mediterranean port cities by adjusting the criteria to reflect local needs while maintaining the underlying principles of sustainability and stakeholder involvement.

4.2.4. Sensitivity Analysis

A sensitivity analysis was conducted to test the robustness of the results against variations in the criteria weights, following the One-at-a-Time (OAT) approach [55].

In particular, the following variables were analyzed:

- Variation in criteria weights: Different scenarios were tested by varying the weights assigned to key criteria (e.g., environmental sustainability, job creation, and economic sustainability) to understand how these changes impact the overall evaluation of each alternative.
- Stakeholder-related weights: The weights associated with the involved stakeholders were modified to simulate different perspectives or priorities of the groups, particularly those with the most influence, such as local governments and the economic sector.

The results of the sensitivity analysis confirmed the robustness of the final ranking of alternatives, with the following key outcomes:

The Community–Cultural Hub scenario maintained its position as the top choice across all scenarios, even when the weights related to environmental and social criteria were modified. This suggests that this alternative is solid and well-balanced in terms of sustainability.

The Cultural–Recreational Hub scenario showed some variability, with its net score fluctuating between second and third place depending on the weighting of economic criteria. However, it never surpassed the Community–Cultural Hub.

The International Hub scenario, while consistently ranked third, demonstrated some sensitivity to economic weights. However, its environmental and social performance continued to consistently penalize it.

In conclusion, the sensitivity analysis confirmed that the Community–Cultural Hub represents the most robust and stable solution compared to the other scenarios, with strong consistency in stakeholder preferences, regardless of variations in weights. The Cultural–Recreational Hub also showed some flexibility in the rankings, while the International Hub was consistently disadvantaged in overall evaluations.

These results affirm the strength of the preferred scenario and the importance of a multidimensional evaluation that considers various aspects for a more comprehensive and sustainable decision-making process.

5. Discussion

The discussion of the results of the waterfront urban regeneration in Reggio Calabria, obtained through the application of the CATWOE model and the PROMETHEE method, highlights several crucial considerations for the sustainable and inclusive development of coastal urban spaces [56].

The CATWOE analysis provided an in-depth understanding of stakeholder perspectives, revealing how the waterfront represents not only a physical space but also a symbol of local identity and a catalyst for social cohesion and economic development. Stakeholders, including residents, local administrations, and NGOs, expressed a clear preference for solutions that integrate environmental sustainability and social inclusion. The priority given to the creation of accessible and shared spaces, as seen in the 'Community–Cultural Hub' scenario, emphasizes the importance of a participatory approach that addresses the community's needs while strengthening the sense of belonging of citizens to these places.

This approach reflects a growing trend in sustainable urban regeneration which prioritizes stakeholder involvement to ensure that projects are both strategically relevant and accepted by the community. However, it is important to note that the CATWOE model has limitations in quantitatively measuring outcomes and predicting potential conflicts of interest among the involved actors. The combination of CATWOE with PROMETHEE, therefore, allowed for compensating for these shortcomings by integrating qualitative preferences with a quantitative evaluation of the alternatives.

The results obtained through PROMETHEE highlight that the 'Community–Cultural Hub' option represents an optimal balance between environmental sustainability, social inclusion, and economic value. The results highlight how the Community–Cultural Hub reflects the principles of the CE through multifunctional regenerative solutions. The transformation of abandoned areas into public spaces and the promotion of sustainable mobility embody the circular paradigm, reducing environmental impacts and fostering social inclusion. This approach can serve as a replicable model for other Mediterranean port cities, emphasizing the need for adaptive strategies to implement CE in complex urban contexts.

In an application context such as Mediterranean port cities, the proposed model offers a holistic view of sustainability and resilience, addressing the specific challenges of these areas. The dual-method approach allows for balancing environmental, social, and economic needs. However, in case of discrepancies between the qualitative results of CATWOE and the quantitative results of PROMETHEE, it is essential to adopt a mediation process with local stakeholders. This process ensures that the final solutions are feasible and have community support, increasing the likelihood of success in implementation. The model could be easily adapted to other port cities, taking local specificities into account, but always following the same logic of reconciling qualitative and quantitative approaches.

This outcome aligns with the preferences expressed by the stakeholders and demonstrates the effectiveness of the PROMETHEE method in providing structured decision support. In fact, the PROMETHEE methodology enabled the quantification of preferences and the ranking of alternatives based on well-defined criteria, providing a clear hierarchy of regeneration options.

An interesting element emerging from the PROMETHEE results is the robustness of the chosen solution, highlighted by the sensitivity analysis. Even with significant changes in the weights of the criteria (for example, an increase in the economic relevance), the 'Community–Cultural Hub' remained at the top of the rankings, confirming its potential as a balanced option. However, it is important to underline that the multicriteria approach has certain limitations, including the subjectivity in defining the weights and the need for careful calibration of the criteria to avoid distortions in the results.

One of the main limitations of the study concerns data availability and the complexity in measuring the long-term benefits of each alternative. Urban regeneration is a complex and dynamic process, and some impacts may only manifest after several years [23,29]. Furthermore, while the CATWOE method is effective in identifying stakeholder perspectives, it does not allow for a quantitative evaluation of the economic and environmental impact of

urban regeneration choices, making it necessary to integrate it with other evaluation methods, such as the complex Analytic Network Process of the BOCR type [57], Cost–Benefit Analysis (CBA), Willingness to Pay (WTP) or Willingness to Accept Compensation (WTA) estimations, integrated risk assessment from bio-physical–economic evaluation of ecosystem services [58], and Social Impact Assessment [59,60].

Another limitation is the need to consider the variability in stakeholder preferences over time. The community's needs and priorities may evolve, especially in response to socio-economic and environmental changes. Therefore, it is essential to continuously monitor developments and adjust regeneration strategies to ensure that they remain aligned with the expectations of the local population. In this regard, some tools from Stakeholder Analysis can be considered complementary to the CATWOE method to address the identified limitations more effectively. For example, the Interest/Power Matrix can be applied in multiple stages of the process to assist in tracking increases or decreases in stakeholder interest levels. When combined with Social Network Analysis, it helps identify the most significant real relationships, as well as those that may be synergetic or conflictual, promoting a focused mediation by the decision-maker to prevent stagnation in the entire process [61].

This study paves the way for several future research directions. First, it would be useful to conduct a study to monitor the impact of the regeneration project over time, assessing the long-term benefits in terms of sustainability and social cohesion [62]. Furthermore, it would be interesting to explore the integration of predictive models that could estimate the socio-economic impact of the considered alternatives, broadening the analysis framework beyond the current stakeholder preferences.

Another potential research avenue could be the application of more interactive and digitalized participation models, such as active participation platforms, which allow for continuous community engagement and a more flexible adaptation of regeneration policies. The use of participatory GeoDesign platforms that integrate geographic information systems (GISs) and future scenario simulations [63,64] could further enrich the planning and evaluation process, providing a more interactive and interoperable vision of regeneration options.

Some studies have validated the robustness of both PROMETHEE in evaluating multidimensional alternatives [46,47] and the adaptability of CATWOE in capturing the different needs of stakeholders in urban environments [43–46]. These parallels strengthen the applicability of the integrated approach proposed in this study and its potential to be replicated in other Mediterranean port cities.

6. Conclusions

This study analyzed the potential for urban regeneration of the Reggio Calabria waterfront [65,66] using an integrated approach based on the CATWOE and PROMETHEE models to support public and private stakeholders in making informed and sustainable decisions.

The combination of these two methods allowed for the consideration of both the qualitative priorities expressed by stakeholders and a structured quantitative evaluation of the design alternatives, providing a comprehensive framework to support urban planning in a city–port system that is not easy to regenerate. This approach has allowed for the identification of the most suitable solutions, balancing the complex economic, social, and environmental needs. The hybrid methodology has demonstrated how the integration of qualitative and quantitative assessments can lead to more informed and sustainable choices.

The results highlighted how the Community–Cultural Hub option represents the optimal solution to balance environmental sustainability, social inclusion, and economic value.

This project not only addresses the needs of the community but is also resilient to variations in the weights of the criteria, making it a strategic long-term choice. This choice not only aligns with sustainability objectives but also offers greater adaptability to future variations in evaluation criteria, making it a versatile and resilient solution. Furthermore, the analysis emphasized the importance of a participatory approach in urban regeneration, where the involvement of stakeholders and citizens plays a crucial role in the success of development initiatives. The active involvement of citizens, through workshops and thematic meetings, allowed for the gathering of valuable insights, improving the effectiveness of the strategies adopted and reinforcing the community's sense of belonging.

However, the study has some limitations, including the need for data to assess long-term impacts and the challenge of considering the evolving dynamics of community priorities. To overcome these limitations, future research will focus on building predictive models and impact assessment models based on the collection of user perceptual data through neural devices for continuous monitoring of the effects of urban regeneration [67]. Furthermore, future research could explore the use of emerging technologies for environmental monitoring and urban resource management, contributing to the development of even more innovative and sustainable regeneration models.

This study has highlighted how the integration of CE principles in the regeneration of the Reggio Calabria waterfront has the potential to transform complex challenges into opportunities for sustainable development. The proposed approach not only promotes efficient resource management and reduces environmental impacts but also supports social cohesion and local economic growth. Through the adoption of participatory methods and integrated assessment, the model presented offers a roadmap for port cities seeking to balance urban development needs with environmental sustainability and social resilience [68,69]. The adoption of a circular approach not only promotes sustainability but also strengthens the long-term resilience of the Reggio Calabria city–port system, providing a replicable model for other Mediterranean port cities looking for pathways to sustainable urban regeneration.

In conclusion, the adopted approach offers a methodological framework that can be replicated and transferred to other city–port contexts requiring urban regeneration actions, contributing to guiding policies and urban solutions that are more sustainable and inclusive. The regeneration project of the Reggio Calabria waterfront represents a significant step towards the enhancement of public spaces that promote social well-being, sustainability, and economic development, while simultaneously strengthening local identity and the community's sense of belonging.

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