



Title: Manual on Sustainable Finance

Deliverable 7.5: Development of a Manual on Sustainable Finance

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Date: 31 March 2025



This project has received funding from the European Union's Horizon H2020 innovation action programme under grant agreement 101037424.

Deliverable Number and Name	D7.5: Development of a Manual on Sustainable Finance
Work Package	WP7 – Financial issues and financing instruments/ Business models
Dissemination Level	Public
Author(s)	Phoebe Koundouri, Conrad Felix Michel Landis, Lydia Papadaki, Mary Psilou, Audrey Alamy (AUEB); Dimitris Spyrou, Pavlos Filippidis (PPA); Marina Arroyo Bovea, Noemí Monterde Higuero, David Calduch Verduch (FV); Olympia Nysiforou (CUT); Giannis Adamos, Chrysi Laspidou (UTH); Ralf Ludwig (VKU), Gunnar Braun (LMU), Dijana Likar (IECE), Maria Papadopoulou (NECCA), Noelia Cruz Pérez (ULL), Nicolaos Theodossiou (AUTH), Martin Drews (DTU), Albert Chen (UNEXE), Marco Dettori (ARGIS)
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Date Due	31 March 2025
Date Submitted	31 March 2025
File Name	ARSINOE_D7.5_fv
Status	Public
Reviewed by (if applicable)	Ebun Akinsete & Eleni Toli (ATHENA)
Suggested citation	Koundouri et al (2025). Manual on Sustainable Finance. ARSINOE Deliverable 7.5, H2020 grant no. 101037424

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This document has been prepared in the framework of the European project ARSINOE. This project has received funding from the European Union's Horizon 2020 innovation action programme under grant agreement no. 101037424.

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LIST OF ABBREVIATIONS

AUEB	Athens University of Economics and Business
ESG	Environmental, Social and Governance
KPIs	Key Performance Indicators
SDGs	Sustainable Development Goals
CS	Case Study
TEEB	The Economics of Ecosystems and Biodiversity
ES	Ecosystem Services
TEV	Total Economic Value
SFR	Sustainable Finance Registry
GEP	Gross Ecosystem Product

EXECUTIVE SUMMARY

This deliverable is linked to ARSINOE Task 7.5. It is the fifth of five deliverables in Work Package 7 (WP7), which aims to develop a Manual on Sustainable Finance.

The main objectives are:

- To provide useful information and tools to assist stakeholders in assessing the state of play concerning sustainable finance (Task 7.1).
- To provide stakeholders with information and tools to assist with the identification of barriers to climate finance and develop financing pathways towards their resilience (Task 7.2).
- To provide tools and knowledge to conduct SCBA (Social Cost Benefit Analysis), which is crucial in the design of financial and fiscal instruments to support their transition.
- To develop a hybrid model to quantify and measure performance at the CS level. This model integrates the Sustainable Development Goals (SDGs) into the sustainability reporting and performance model, which is based on Environmental, Social, and Governance (ESG) criteria (Task 7.4).
- Ultimately, the above culminates in a "Manual for Sustainable Finance," which will combine the results of all previous tasks of WP7 into tailored portfolios of financing solutions for each ARSINOE case study.

D7.5 is submitted as a report, but it bundles three applications designed in Microsoft Office Excel 365:

1. The SMR (Sustainable Finance Registry) tool
2. The SMReadiness (Sustainable Finance Readiness tool
3. The HFRM Tool (Hybrid Financial Reporting Model)

The tools are offered free of access¹.

¹Tools can be downloaded here: <https://tinyurl.com/4annw9bp>

1.0 INTRODUCTION

1.1 Scope of the Deliverable

The current Deliverable will integrate and build upon the frameworks developed in Deliverables 7.1 to 7.4, resulting in a suite of tools that implement the concepts demonstrated in the case studies. The Manual of Sustainable Finance is an integrated framework and tool development for climate change adaptation finance. It represents the culmination of previous efforts by combining the frameworks and methodologies developed across Deliverables 7.1, 7.2, 7.3, and 7.4. Building on the foundational work, the current output integrates three core elements:

Adaptation of Finance Registry

Drawing from Deliverable 7.1, the tool incorporates a comprehensive registry of financing sources, financial instruments, and barriers to accessing or leveraging adaptation finance. It guides users to assess their current state-of-play and identify their main barriers in accessing finance to support their transition towards resilience. Drawing from Deliverable 7.2, the tool also provides guidance on adaptation finance pathways, that is solutions on the short-, medium- and long-term horizon to overcome the identified barriers to unlock financing of solutions. Together, these elements establish a robust structure for understanding how various public, private, and blended financial resources can be mobilized in the development of a financial plan to support the portfolio of interventions in project's case studies.

Design of Financial Instruments

Based on the work presented in Deliverable 7.3, the current manual provides users with innovative methods—such as choice experiments and virtual reality assessments—to design financial instruments with varied maturities and risk profiles. This approach ensures that the financing solutions are closely aligned with the specific time horizons and risk tolerances of the adaptation projects highlighted in the case studies.

Hybrid Reporting and Performance Measurement

The hybrid reporting model developed in Deliverable 7.4 is integrated into the tool to monitor both financial and sustainability performance. By combining Environmental, Social, and Governance (ESG) criteria with key financial metrics and Sustainable Development Goals (SDGs), the tool offers a transparent and dynamic way to track progress for the implementation of the CS vision. This model is applied directly to the case studies, providing measurable results that illustrate how the conceptual frameworks are operationalized in practice.

The Deliverable not only synthesizes these methodologies into a coherent framework but also transforms them into operational tools. The tool serves as a decision support system where the outputs—ranging from tailored portfolios of financing solutions to performance metrics—reflect the real-world application of the case study concepts. In doing so, it offers stakeholders a clear, actionable pathway to implement and monitor climate adaptation strategies effectively. These integrated tools become a central asset in guiding stakeholders through the complex landscape of climate adaptation finance. It bridges the gap between conceptual frameworks and practical implementation, ensuring that the lessons learned from the case studies are reflected in tangible, measurable outcomes.

1.2 Overview

This deliverable is structured as follows:

- Section 2 describes the Climate Finance Registry tool and showcases its implementation in the project's case studies.

- Section 3 discusses the methodological frameworks for the development of financial instruments linked to the ecosystem services valuation and the Choice experiment designed for the Case Study of Athens.
- Section 4 describes the implementation of the Hybrid Financial Reporting Model and its use in the Case Study of Mediterranean Ports.

A list of references is provided, followed by an Annex.

2. Adaptation Finance Registry

Deliverable 7.1 provided the results of our desk research to identify and develop the frameworks to classify the financing sources and financial instruments. Moreover, extensive desk research identified different types of barriers in accessing and leveraging finance and financing pathways were outlined. As described in D7.2, a series of workshops was performed to identify the state of play of ARSINOE CSs in relation to their capacity for adaptation finance and the design of financing pathways to support the implementation of their vision (WP2, WP6).



Figure 1 Adaptation Finance Registry (AFR)

Sustainable Finance Registry (SFR, Figure 1) consists of a detailed catalogue for the underlying Financial Sources and Financial instruments with a synthesis of a set of important factors to be considered upon designing of financing pathways.

2.1 Financial Instruments

Financial instruments are defined as the specific tools or vehicles used to manage, allocate, or raise capital from the financing sources described in the previous session. They define the terms, structure, and nature of financial transactions, specifying how the financing is deployed, managed, and repaid.

SFR includes an extensive list of financial instruments (Figure 2).

Financial instruments / Mechanisms	Subcategory / Instruments	Description	Access / Leverage	Issuer	Financing Horizon	Available To
Standard Finance	Public-Private Partnerships (PPPs)	Joint public-private infrastructure funding	Access & Leverage	Public & Private Entities	Long term	Both
Carbon pricing mechanisms	EU ETS	European emissions trading scheme in carbon market	Leverage	Government	Medium-term	Public
Debt	Green bonds, syndicated	Capital to be contributed with terms	Access	Banks and Financial Institutions	Long term	Both
Equity	Venture capital	Investment for high-risk, early-stage projects	Access	Private investors, investment banks	Medium-term	Private
Equity	Private equity	Private funding for growth companies	Access	Private investors, funds	Medium-term	Private
Equity	Green equity	Equity of a company with at least 20% of its revenues and investments must derive from activities considered green	Access	Public Authorities	Medium-term	Public
Face/Share Changes	Property-related fees	Charges tied to infrastructure usage	Leverage	Public Authorities	Long term	Public
Face/Share Changes	Business Improvement Districts	Charges for area regeneration	Leverage	Local Authorities	Medium-term	Both
Face/Share Changes	Greenwater Fees	Fees based on impermeable area	Leverage	Municipalities	Medium-term	Both
Face/Share Changes	Development Impact Fees	Developer contribution to new infrastructure	Leverage	Municipalities, Planning Agencies	Long term	Private

Figure 2 SFR – Financial Instruments

The Table of financial instruments is structured around several key analytical dimensions to provide a clear understanding of each mechanism's role, accessibility, and financial implications. The first column, “Financial Instruments/Mechanisms”, categorizes the broad type of funding or policy approach, such as equity, debt, grants, or taxation. The “Subcategory/Instruments” column specifies the tool within each mechanism, like green bonds or venture capital. The “Description” column summarizes the instrument's purpose and application. “Access/Leverage” distinguishes whether the instrument primarily improves access to finance or also leverages additional capital. The “Issuer” identifies the typical entity responsible for offering or implementing the instrument, such as governments, financial institutions, or both. “Financing Horizon” refers to the expected timeframe over which the instrument supports projects—short, medium, or long term—based on the structure and lifecycle of the financing involved. The “Available To” column indicates whether the instrument targets public bodies, private actors, or both. “Level of Risk” classifies the financial or institutional exposure associated with each mechanism, helping stakeholders anticipate and manage uncertainties. The “Common Eligibility Criteria” column outlines typical requirements to access funding or support, such as alignment with policy goals or financial viability. Finally, the “Risk Justification” column provides a rationale for the assigned risk level, based on financial structure, repayment expectations, and market exposure. This holistic structure ensures that the table not only lists instruments but also contextualizes their relevance and application across public and private investment landscapes.

Carbon pricing mechanisms, particularly through the European Union Emissions Trading System (EU ETS), represent a tool used by governments to create financial incentives for reducing greenhouse gas emissions. Under this system, companies are allocated or purchase emission allowances that they can trade, thereby establishing a market for carbon emissions. This instrument is classified under leverage because it uses regulatory structures to catalyze behavioral and investment changes. The issuer is the government, as it regulates and administers the system. The financing horizon for this tool is medium-term because while financial commitments occur annually, the behavioral and investment shifts that result often extend over several years. The mechanism is primarily available to public bodies, especially those involved in regulatory oversight, and large private emitters. The level of risk is medium, justified by the moderate exposure of participants to market fluctuations in carbon prices and the necessity of compliance, balanced by the fact that it does not involve upfront capital outlays.

Pollution permits, such as peat taxes or emissions allowances, follow the “polluter pays” principle and are designed to incentivize reductions in environmentally harmful emissions. This instrument is categorized as leverage due to its role in shifting costs onto polluters, thereby driving environmental compliance and investment in cleaner technologies. Issued by governments, pollution permits are medium-term instruments; they are typically revisited in fiscal or policy cycles. They are primarily targeted at public authorities and regulated private sector entities. The associated financial risk is low, as

this is a policy-based instrument with predictable compliance costs rather than speculative returns. This classification is justified by the fact that there is limited market exposure and a structured regulatory framework. Eligibility criteria commonly include compliance with environmental regulations and sector-specific emission benchmarks.

Green bonds are debt instruments specifically earmarked for financing projects with environmental benefits, such as renewable energy or biodiversity conservation. These instruments fall under the category of access, enabling both public and private entities to tap into sustainable finance. Green bonds are typically issued by banks and financial institutions, and they have a long-term financing horizon due to the multi-year nature of infrastructure and conservation projects. Risk is classified as medium because while bonds are generally secure, their success depends on project execution and market interest rates. Eligibility criteria typically include a detailed use-of-proceeds framework, environmental impact assessments, and adherence to international green bond standards.

Debt-for-nature swaps involve the restructuring of a country's debt in exchange for commitments to finance conservation efforts. Typically involving sovereign and multilateral actors, these instruments provide access to concessional finance for environmental objectives. They are issued by governments or negotiated through international financial institutions. With a long-term financing horizon, these instruments support systemic environmental benefits and debt sustainability. Access is primarily public, though non-governmental partners often implement conservation components. Risk is considered medium due to reliance on international negotiations, macroeconomic stability, and geopolitical factors. Eligibility depends on debt levels, conservation strategy, and the willingness of creditors to restructure. The medium risk classification is justified by the complex, multi-party nature of these instruments and their dependence on diplomatic processes and development policy alignment.

REDD+ refers to mechanisms for reducing emissions from deforestation and forest degradation, especially in developing countries. It is designed to provide access to results-based finance in exchange for proven reductions in emissions from forest loss. Implemented by national governments and supported by international organizations, REDD+ projects generally follow a medium-term financing horizon. These instruments target public actors, though community-level and private partnerships are often involved in implementation. The risk level is medium due to performance-based disbursement and the technical complexity of measuring avoided emissions. Eligibility includes the establishment of forest reference levels, monitoring systems, and national strategies. The justification for medium risk lies in the conditional nature of funding and the challenges of institutional capacity and long-term sustainability.

Grants are non-repayable transfers issued by public institutions such as governments, the EU, or international organizations. They offer access to capital for targeted public interest objectives such as climate adaptation, innovation, or inclusion. The medium-term financing horizon reflects typical project lifecycles ranging from one to five years. Grants are primarily directed toward public actors but may include civil society or private partners in collaborative projects. Their risk level is low because they do not require repayment and are managed through formalized administrative channels. Eligibility typically depends on alignment with strategic priorities, organizational capacity, and compliance with application processes. The low-risk assessment is justified by the grantor's assumption of financial risk and the secure disbursement structure.

Loans, Bonds, and Crowdfunding represent traditional debt financing, where capital is made available under terms requiring repayment. They offer access to funds for a wide range of projects and are primarily issued by banks and financial institutions. The financing horizon is long-term, suitable for capital-intensive infrastructure or business expansion. These instruments are accessible to both public and private entities. Risk is classified as medium due to the exposure to borrower creditworthiness, interest rate variability, and macroeconomic conditions. Eligibility is contingent on financial viability,

collateral, and compliance with credit assessments. The risk classification is justified by standard banking practices and repayment obligations, balanced by underwriting standards and regulatory protections.

Payments for ecosystem services (PES) are results-based financing instruments that compensate landowners or communities for maintaining ecosystem functions. Issued by governments, international donors, or NGOs, PES provides access to finance in return for measurable environmental services. With a medium-term financing horizon, PES schemes typically align with annual or seasonal ecological monitoring cycles. They are accessible to both public and private stakeholders involved in land stewardship. Risk is low to medium due to dependency on verification mechanisms and ecosystem variability. Eligibility is based on service baselines, clear land rights, and performance metrics. The risk justification derives from payment conditionality and the uncertainties of environmental service delivery under dynamic ecological conditions.

Pay-for-taxes programs offer tax benefits linked to environmental performance, such as energy efficiency or pollution control. These schemes are implemented by public authorities and provide access to fiscal incentives. Their financing horizon is short to medium term, matching the tax year or program cycle. They are available to both public and private actors. Risk is low, as these instruments do not require disbursement and are anchored in predictable tax policy. Eligibility criteria include demonstrated environmental performance and compliance with audit requirements. The low-risk classification is supported by the passive nature of the incentive and the clear statutory environment in which it operates.

Venture capital provides equity investment to early-stage, high-growth companies, often in the clean-tech or green innovation sectors. It provides private-sector access to risk-tolerant funding and is issued by venture firms or investment funds. The financing horizon is medium to long term, reflecting the scaling time required for start-ups. Venture capital is available to private entities. Risk is high due to the uncertain return on investment, early-stage fragility, and competitive market dynamics. Eligibility typically depends on innovation potential, business model scalability, and investor fit. The high-risk assessment is justified by the volatility of start-up ventures and the absence of guaranteed returns.

Private equity functions similarly to venture capital but targets more mature businesses seeking expansion or restructuring. It serves as an access instrument and is issued by private investors, funds, or financial intermediaries. The financing horizon is long-term due to the scale of investment and the time needed to realize returns. These instruments are available exclusively to private sector actors. The level of risk is high, particularly due to illiquidity, exit uncertainties, and the dependence on management performance. Eligibility criteria typically include the company's financial performance, governance structure, and growth potential. The justification for high risk lies in the capital intensity and potential volatility of outcomes in private markets.

Public-Private Partnerships (PPPs) combine public and private capital to finance infrastructure, services, or technology deployment. They function as both access and leverage instruments, as public funds attract private investment while enabling project implementation. Issued through government contracts or concession agreements, PPPs have a long-term financing horizon, reflecting the duration of infrastructure and service contracts. These instruments are available to both public agencies and private investors or developers. Risk is medium, due to complex procurement processes, long negotiation periods, and shared liability. Eligibility typically involves strong governance, financial modeling, and risk allocation frameworks. The risk classification is justified by extensive coordination and legal exposure inherent in multi-stakeholder arrangements.

Property and Land Taxes is a fiscal tool used by local authorities to generate revenue based on land or property values. It operates as a leverage mechanism, enabling reinvestment into infrastructure and sustainable development. Issued by municipal governments, its financing horizon is medium-term, aligned with planning and budgeting cycles. These taxes affect private landowners and generate public

income. The risk is low, as tax administration is well-established, and revenue is predictable. Eligibility is automatic, based on land registry and classification. Risk is low due to the stable institutional nature of municipal finance systems.

Betterment Charges are imposed on private property owners who benefit from nearby public investments. They are leverage tools issued by local governments to recover the value uplift from infrastructure improvements. The financing horizon is medium-term, following planning and construction phases. Available to municipalities and applied to private beneficiaries, the risk is medium. Eligibility criteria include spatial proximity to the investment and evidence of value appreciation. Risk is justified by valuation complexities and potential resistance from affected property owners.

Tax Increment Financing (TIF) is used by local governments to fund public investments by capturing the increase in future property tax revenues. It is a leverage instrument with a long-term financing horizon, reflecting the time needed for property value increases and tax collection. TIF is public in application but relies on private sector-led development. Risk is medium due to the speculative nature of future revenue streams. Eligibility involves district designation, development feasibility, and fiscal analysis. The risk justification lies in the reliance on economic trends and the potential gap between projected and realized revenues.

Land value taxation applies levies on the unimproved value of land to encourage efficient land use. Issued by local governments, it is a leverage mechanism with a long-term financing horizon. These instruments apply primarily to private property owners. The risk level is low, as valuation mechanisms are standardized, and administrative systems are mature. Eligibility depends on land registration and valuation assessments. Risk is low due to the inherent stability and transparency of land-based fiscal policies.

Joint development is a cost-sharing model between public and private partners, often seen in transit-oriented or sustainable urban development. It acts as a leverage instrument with a long-term horizon, mirroring project development timelines. Available to both sectors, its risk level is medium due to potential mismatches in priorities and negotiation difficulties. Eligibility includes land contribution, development capacity, and zoning compliance. Risk is justified by potential delays, misalignment of interests, and market dependencies.

Air Rights refer to the transfer or sale of air rights allows vertical expansion of development above a property or zone. This is a leverage issued by governments or landowners, with a long-term financing horizon. It is available primarily to private developers. Risk is medium due to zoning restrictions, legal complexities, and demand variability. Eligibility depends on urban planning regulations and development rights. Risk is justified by market and regulatory uncertainty, particularly in dense urban contexts.

Land readjustment involves pooling and reconfiguring land parcels to improve urban layout and infrastructure efficiency. Issued by public authorities, it operates as a leverage instrument with a medium-term horizon. It is accessible to landowners within the designated redevelopment area. Risk is medium, stemming from coordination challenges and potential land valuation disputes. Eligibility includes property ownership and stakeholder consensus. The risk classification is justified by the need for voluntary participation and the potential for legal contention.

Urban co-development integrates public infrastructure or sustainability features into private development projects. This is a leverage mechanism issued by local governments, with a long-term financing horizon. It applies to both public entities and private developers. Risk is medium due to implementation complexity and cost-sharing arrangements. Eligibility criteria include inclusion in urban development plans and regulatory compliance. Risk is justified by dependencies on multi-party coordination and delivery capacity.

General taxation measures can incentivize or penalize environmental or economic behavior. Issued by public authorities, they function as leverage instruments with a medium-term horizon. These apply to both private and public sectors depending on scope. Risk is low due to the stability and predictability of fiscal policy instruments. Eligibility is based on tax jurisdiction and legal registration. The low-risk classification is justified by the legal clarity and broad application of tax codes.

Insurance products mitigate financial losses associated with environmental risks or disasters. Issued by insurers, they are both access and leverage instruments with a long-term horizon, covering operational and capital risk exposure. These products are available to both public and private clients. Risk is medium, as the insurer manages exposure through underwriting and diversification. Eligibility criteria include asset valuation, actuarial risk profiles, and coverage terms. Risk is justified by the financial strength of the issuer and the clarity of contractual terms.

Guarantees are instruments that mitigate risk and improve creditworthiness, often issued by development banks or public agencies. They act as leverage mechanisms with a long-term financing horizon. Available to both public and private actors, they carry medium risk, contingent upon default events. Eligibility includes financial due diligence, project alignment, and policy relevance. The medium-risk designation reflects the contingent nature of the obligation, and the government or institutional backstop typically involved.

Derivatives like carbon futures and options hedge against price and risk volatility. Issued by financial institutions, they are leverage tools with a short- to medium-term horizon. These are available to financially sophisticated private actors. The risk level is high due to market complexity and sensitivity to external shocks. Eligibility includes access to trading platforms, margin capacity, and regulatory compliance. High risk is justified by leverage effects, liquidity constraints, and exposure to market movements.

Property-related fees refer to land or infrastructure use fund ongoing services and maintenance. Issued by public authorities, these instruments act as leverage tools with a medium-term horizon. They apply to both public and private users. Risk is low due to administrative consistency and predictability of collection. Eligibility is based on property characteristics and service consumption. Risk is low as these fees are mandated and formula driven.

The manual also provides an analysis of the results of the ARSINOE workshops in relation to the capacity of CS to use the underlying categories of financial instruments presented in D7.2 (Figure 5).

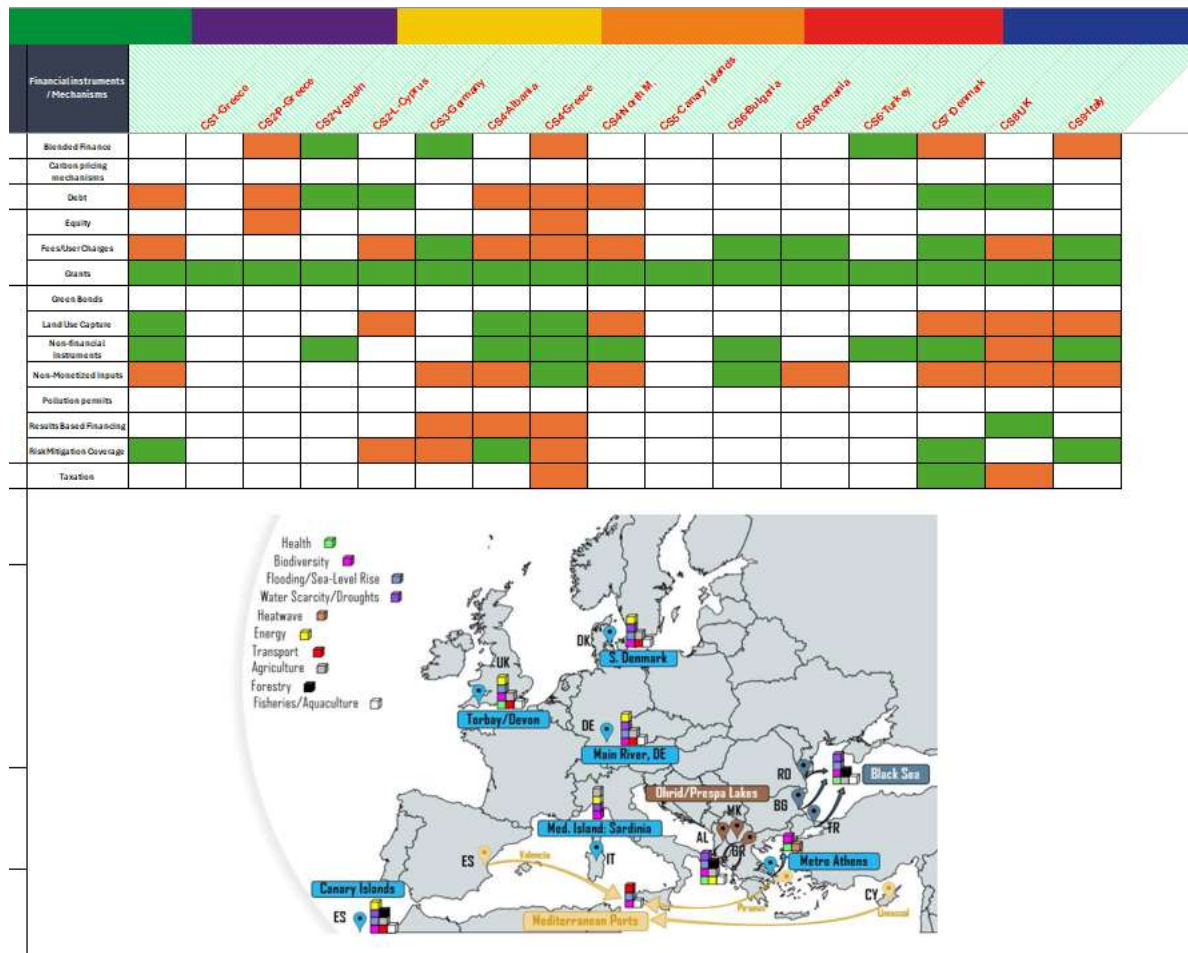


Figure 3 SFR ARSINOE CS – Financial Instruments

2.2 Financing Sources

Financing sources are defined as the origins or entities from which funds are generated to finance an adaptation action plan or an adaptation intervention. These sources can be public, private or Voluntary, including any combination among them. The sources may refer to institutions, stakeholders, or mechanisms responsible for mobilizing the funds.

SFR classifies sources under the Public, Private or Voluntary. Public sources include government bodies at national, regional, and local levels, as well as supranational institutions and development finance entities that mobilize public funds to support infrastructure, social programs, and sustainable development (Figure 4).

Category	Name	Subcategory	Description	Focus	Instruments	Justification
Public	European Institutions	EC	Includes supranational public such as the European Commission and development banks providing financing across EU and neighbouring countries.	Global	Bank Loans, Guarantees, Blended Finance	European institutions (EC, EIB) and EIB provide grants, loans, and blended instruments to support EU policy and global development goals.
Public		EIB				
Public		European Bank for Reconstruction and Development				
Public	National-level Government Entities	Ministries	Government ministries, central banks, and state-owned enterprises responsible for fiscal and monetary policies and national development strategy.	Regional	Subsidies, Grants, Investments, Sovereign Bonds, Tax Incentives	Government-owned banks and public investments in private sectors and transport infrastructure.
Public		Central Banks				
Public		Government Agencies				
Public		National Development Bank				
Public		Publicly owned utilities				
Public		Regulators				
Public		Sovereign Wealth Funds				
Public		National Enterprises (SOEs)				
Public		Regional government				
Public		Regional agencies				
Public	Regional and International Government Entities	Regional government	Local and regional authorities including municipalities and regional agencies responsible for implementing policies at local levels.	Local	Participations, Local Loans, PPPs	Local entities often rely on municipal bonds and grants to finance public infrastructure and transport community projects.
Public		Regional agencies				

Figure 4 SFR – Financing Sources

Private sources consist of profit-driven actors such as businesses, banks, investors, and individuals who finance projects through market-based mechanisms and investment strategies. On the other hand, voluntary sector sources encompass foundations, charities, NGOs, and philanthropies that channel non-profit, mission-driven funding into social, environmental, and humanitarian causes.

For all documented process, manual provides a comprehensive description, the “Focus” which indicates whether the source operates at a primarily local or global level, reflecting its capacity to allocate resources across different regions and highlighting the scale and reach of its influence. Moreover, it maps the most associated financial tools or mechanisms that the source uses to provide funding, illustrating the strategic ways in which capital is deployed. Finally, a short justification is provided, elaborating the link between sources and instruments, drawing on the entity’s mandate, institutional structure, historical behaviour, and operational logic to clarify how and why certain financial tools are most applicable.

Public Sources

European Institutions represent supranational bodies such as the European Commission (EC) and the European Investment Bank (EIB), as well as other entities like the European Bank for Reconstruction and Development and the Council of Europe Development Bank. These institutions play a critical role in financing regional cohesion, infrastructure development, climate action, and sustainable growth across Europe and neighbouring countries. They are empowered to provide grants, loans, guarantees, and blended finance instruments that combine public and private capital to maximize developmental impact. Their global focus allows them to direct resources where needed most, especially in cross-border projects aligned with EU-wide or international development objectives. The justification for associating these institutions with such instruments lies in their institutional mandates and financial capacity, which are designed to fill gaps in traditional capital markets and stimulate broader economic transformation.

National-level Government Entities encompass ministries, central banks, government agencies, national development banks, publicly owned utilities, regulators, sovereign wealth funds, and state-owned enterprises (SOEs). These entities manage national budgets, fiscal and monetary policy, and strategic investments. They typically engage through subsidies, public investments, sovereign bonds, and tax incentives to achieve macroeconomic stability and drive national development goals. Their ability to mobilize resources at scale, enact regulatory change, and fund long-term infrastructure or social programs justifies their use of these instruments. Furthermore, many of these entities manage sovereign borrowing and investment strategies that allow for broad economic and sectoral interventions.

Regional and Subnational Government Entities include local municipalities, regional governments, and regional agencies. These bodies are closest to the community level and often hold direct responsibility for delivering public services, implementing infrastructure projects, and managing local development plans. Their financing mechanisms include municipal bonds, local taxation, and public-private partnerships (PPPs), which allow them to leverage limited public funds with private investment. These instruments align with the entities' local focus and their need for flexibility and responsiveness to community needs. Given their mandate and scale of operation, subnational governments are key enablers of climate resilience and inclusive urban development.

Development Finance Institutions (DFIs) are specialized institutions mandated to support development in low- and middle-income countries. They typically provide concessional loans, equity investments, and guarantees to reduce investment risks and catalyses private sector participation in high-impact sectors such as energy, agriculture, health, and infrastructure. DFIs operate globally and are often co-funded by multiple governments or international agencies, which positions them uniquely to take on investments that traditional commercial actors deem too risky. Their financial instruments are justified by their developmental mandate and risk-sharing function, which is crucial in fragile or underdeveloped markets.

International Climate or Development Funds are dedicated pools of finance established by multilateral or bilateral entities to address global challenges, notably climate change and sustainable development. These funds disburse climate grants, offer results-based finance, and provide technical assistance to developing countries. Their global orientation allows them to operate in diverse contexts, often in partnership with local institutions. Their use of results-based instruments and technical assistance is justified by their mission to build capacity and deliver measurable environmental or developmental outcomes while aligning with international frameworks such as the Paris Agreement or the SDGs.

Private Sources

Businesses span a wide range of entities, from micro, small, and medium-sized enterprises (MSMEs) to large multinationals and social enterprises. These actors generate and reinvest profits, raise capital through corporate bonds, and finance operations internally or through equity. In some cases, businesses also contribute through business improvement districts and adaptation-focused ventures that align with sustainability goals. Their financial operations are largely local in scope but can scale globally depending on their size. The justification for the instruments linked to businesses lies in their self-financing capabilities, need for external capital, and growing role in impact-driven innovation.

Banks serve as the financial backbone of the private sector. Whether retail, corporate, or investment banks, they provide credit lines, loans, and project finance. These services are fundamental for business growth, infrastructure development, and personal finance. Banks have both local and global operations, with the flexibility to support projects of varying scales. Their role as intermediaries between savers and borrowers justifies their use of these instruments. Moreover, their regulatory oversight ensures that they can leverage capital efficiently while managing systemic risk.

Asset Owners and Institutional Investors include pension funds, insurers, reinsurers, asset managers, and impact investment groups. They manage large pools of capital and have long-term investment horizons, making them well-suited for funding infrastructure, climate action, and innovation. Instruments such as equity, green bonds, REITs, and infrastructure funds align with their investment strategies and risk-return profiles. These actors have a global focus due to the international nature of capital markets. Their justification for using these instruments stems from their fiduciary duty to generate returns while increasingly integrating ESG considerations into their portfolios.

Private Investors, such as venture capitalists, project developers, and angel investors, inject capital into high-risk, high-reward opportunities. They typically use equity instruments like venture capital and project equity to support early-stage companies or innovation in sectors like clean technology, digital

infrastructure, and healthcare. Their global footprint allows them to chase returns across markets. The justification lies in their risk appetite and agility to fund transformative ideas that traditional investors might overlook.

Lotteries, although less conventional, generate funds that are often redirected into public or social programs. These sources are typically localized in scope, but their proceeds can support a variety of causes, including environmental conservation and community development. The instrument linked here—lottery proceeds or contributions—is justified by its nature as a pooled funding source supported by voluntary participation.

Associations and Professional Bodies represent networks or unions of professionals or industries that occasionally provide funding, training, or support to aligned causes. Their instruments are more indirect, often in the form of grants, member contributions, or programmatic funding. Their focus is usually local or sector-specific, and their ability to finance depends on their membership structure and resource base.

Academic and Research Institutions, including universities and think tanks, contribute to financing through research grants, internal endowments, or third-party funding. They are instrumental in producing data, policy insights, and technical expertise that underpin broader financing strategies. Their scope can be both local and global depending on their partnerships and research agendas. Their instruments are justified by their mission to generate knowledge and build human capital.

Community Entities encompass a wide range of local organizations such as community development companies, land trusts, and financial institutions. These entities promote financial inclusion and community ownership through instruments like community shares, impact investments, and crowdfunding. Their operations are local by design, grounded in trust and close-knit social structures. The justification for their instruments lies in their role in democratizing finance and addressing the unique needs of underserved communities.

Households are direct contributors to the economy through payments for services, property ownership, and utility bills. Although not traditionally seen as investors, their aggregate financial flows are significant and form the basis for public finance and service delivery. Their financing role is local and linked to consumption or tax-based instruments, which justifies the inclusion of user fees and service-related payments.

Finally, individuals, include retail investors, savers, visitors, and high-net-worth individuals. They channel capital through personal savings, retail investment products, and philanthropy. Depending on their means and motivations, individuals can fund both local initiatives and global causes. Their instruments are justified by their financial autonomy and the growing accessibility of digital investment platforms that broaden participation.

Voluntary Sector

Foundations are private or family-owned philanthropic entities that support charitable, educational, and social initiatives. They typically provide grants and may engage in program-related investments that align with their mission. Foundations can have a global reach, supporting causes across borders. Their instruments are justified by their endowments and commitment to long-term social impact.

Charities and Trusts are nonprofit organizations that manage funds for specific public benefit goals. Their funding often comes from donations, bequests, or endowment income, and they disburse these funds via grants or direct implementation of programs. Their scope is generally local, though international charities do exist. The use of grants and endowment spending as instruments is justified by their legal structure and philanthropic purpose.

NGOs, or non-governmental organizations, operate independently from the state and often serve critical roles in humanitarian aid, environmental protection, and social justice. Their financing is derived from donor grants, member contributions, and increasingly, crowdfunding. NGOs typically have a global focus, working in multiple regions or in partnership with local actors. Their instruments are justified by their advocacy mission and their ability to mobilize grassroots support and implement community-level interventions.

Philanthropies refer to a broad spectrum of organizations dedicated to advancing social good through voluntary financial contributions. These include both structured foundations and more informal giving platforms. Philanthropies support initiatives through strategic grants and long-term commitments. Their global reach and ability to catalyse innovation justify their inclusion as significant financial actors in sustainable development.

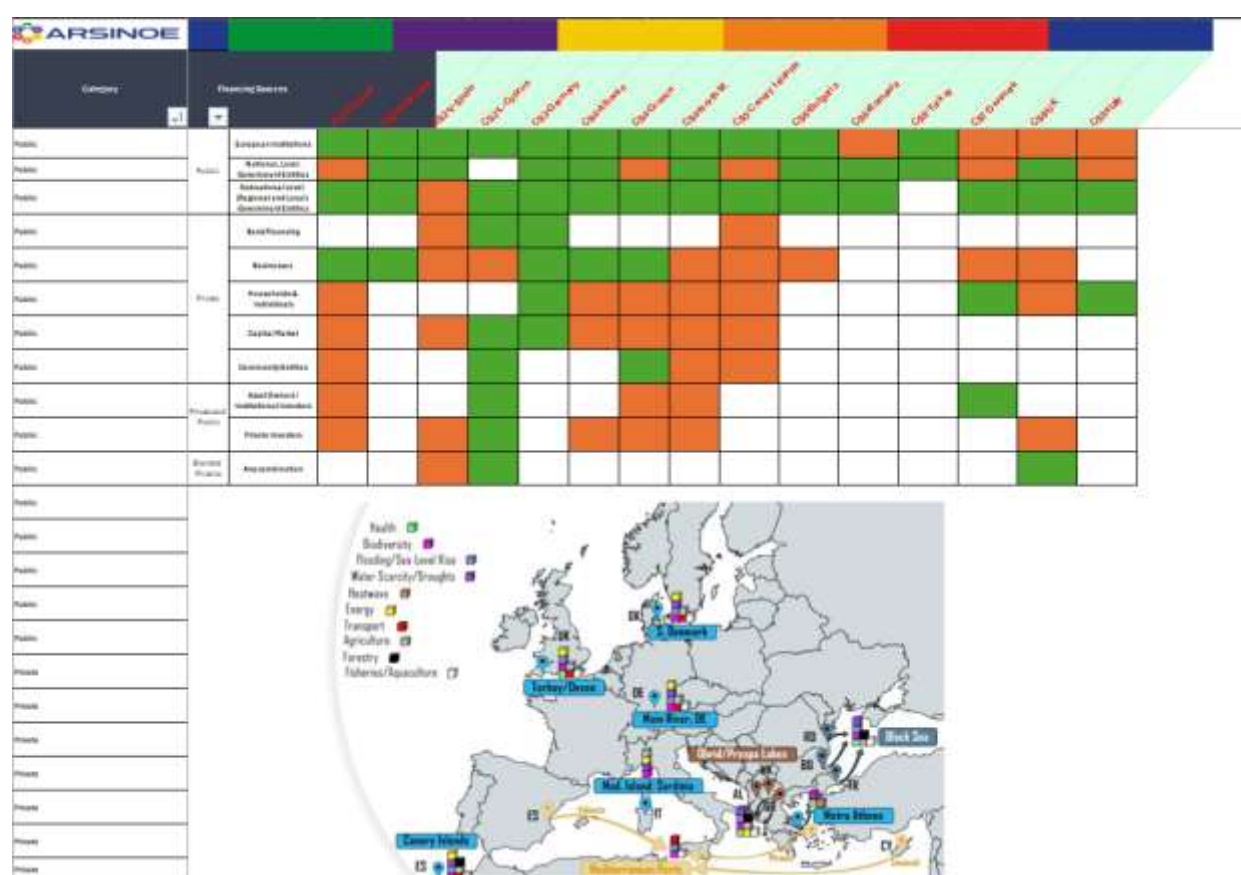


Figure 5 SFR – ARSINOE DS – Financing Sources

The manual also provides the analysis of the results of the ARSINOE workshops in relation to the capacity of CS to use the underlying categories of financial instruments, presented in D7.2 (Figure 4).

2.3 Barriers and Financing Pathways

In D7.1 we provided an extended classification for the different type of Barriers, consisting of major obstacles to adaptation finance. The scope of analysis focused on underscoring the effect of each barrier on:

- (i) attracting financial resources for regional adaptation plans and
- (ii) leveraging financial resources for maximum efficiency of adaptation strategies

The Barriers were classified to four broad categories:

- (i) economic and market barriers.
- (ii) socio-cultural and behavioural barriers.
- (iii) knowledge and awareness barriers.
- (iv) technological barriers and
- (v) political and institutional barriers.

Regarding the latter category, this report underlines regional and national attributes, which may not constitute barriers per se but nonetheless shape regional capacity for adaptation.

In D7.2, Financing pathways were defined as solutions in overcoming barriers faced to access and leverage adaptation finance.

SFR provides a list of all barriers, the identifying solutions with detailed references supporting the identification of the pathways (Figure 6).

ARSINOE			
Type	Barriers	Solutions	References
Economic	1.1 Strengthen climate vulnerability assessment to identify the needs	1.1 Strengthen climate vulnerability assessment to identify the needs	1. Guilford, 2005a,b. The concept of structural economic vulnerability and its related Development Countries and other regions 2. Lenton, 2019. Development of a Climate Change Vulnerability Assessment Using a Risk Based Vulnerability Assessment (Risk-Based Vulnerability Assessment)
	1.2 Develop climate proofed financial instruments related to adaptation	1.2 Develop climate proofed financial instruments related to adaptation	3. Thomas, E. Financing and Impact of Climate Change: Assessing Vulnerability to Climate Change 4. World Bank report 2020. Impact of climate change on the world's economies: A global assessment published in 2020 on the basis of the assessment of the impact of climate change on the world's economies (www.worldbank.org/en/impact/2020/01/01/2020-01-01-2020-01-01)
	1.3 Provide information of type of adaptation measures and political of financial solutions	1.3 Provide information of type of adaptation measures and political of financial solutions	5. African Adaptation Acceleration Programme - Africa's response to the climate change 6. United Nations Development Programme, 2021. Partnership with the Private Sector (Engagement in Development Cooperation), chapter 50 7. JOINT DECLARATION BY THE PRIME MINISTERS OF THE REPUBLIC OF RWANDA AND THE GOVERNMENT OF THE BURUNDI ON THE STRATEGIC PARTNERSHIP between the two countries to strengthen their collaboration in the fields of trade and investment 8. Rwanda's Financial and Political Cooperation with the World Bank 9. Rwanda's Financial and Political Cooperation with the World Bank 10. Rwanda's Financial and Political Cooperation with the World Bank

Figure 6 SFR – ARSINOE DS – Barriers and Pathways

The tool also includes the results from all the workshops conducted in ARSINOE and reported on D7.2.

ARSINOE		Public Sector Government	Public Sector Regional Authorities	Public Sector Local Authorities	Private Sector	Academia	Non-Governmental Organizations (NGO)	Local Citizens Individuals
	Key Stakeholders in Financing Solutions							
	CS1 Athens Metropolitan Area							
	CS3 Aled Pold-France							
	CS2 Maa Port-Venise							
	CS2 Maa Port-Limassol							
	CS3 Rhein River Germany							
	CS4 Orin Pardo Lakes Albania							
	CS4 Orin Pardo Lakes Greece							
	CS4 Orin Pardo Lakes North Macedonia							
	CS5 Canary Islands							

Figure 7 SFR – Barriers / Workshops

In the next step we performed desk research to identify best practices in using Financing Sources and Leveraging Financial instruments for the implementation of the pathways. SFR contains a catalog of best practices, providing all references, spanning most of the EU countries over the last 20 years. The table is structured to document and analyze adaptation or climate-related finance initiatives by identifying the geographical area where the project is implemented. "Source" refers to the origin of the financial support, such as a fund, development bank, or donor agency. The "Organization leading / receiving financing" column details which institution is responsible for implementing the project or is the recipient of the funds. "Year of the project" indicates the timeframe or starting year of the initiative. "Access / Leverage" describes the extent to which the project has unlocked additional funding or enhanced access to financial resources, especially for vulnerable or underfunded actors. "Financial Instruments" outlines the specific mechanisms used to channel funding, such as grants, loans, bonds, or blended finance. The "Impact" column assesses the outcomes or measurable benefits of the intervention, including social, environmental, or economic results. "Summary" provides a brief narrative of the project, capturing its context, goals, and implementation approach. Finally, "Solutions" presents key actions, policy changes, or innovations introduced through the project that address identified climate finance challenges or barriers.

Based on the above desk research, we do the exercise of matching solutions with actions and financial instruments considering the horizon of implementation. The mapping is included in the registry and identifies the most suitable instruments to support the implementation of solutions both in the short-term horizon and the long term. Figure 8 provides a screenshot of this section of the manual (Solutions vs Instruments and Pathways).

Pathways towards accessing finance

1. Strengthen climate vulnerability assessments to identify and prioritize adaptation needs

Strengthening climate vulnerability assessments is a foundational step toward developing targeted adaptation strategies. In the short term, grants are the most suitable financial instrument to support this solution. Grants can be rapidly deployed to support data collection, research, stakeholder engagement, and development of methodologies for assessing vulnerabilities across regions and sectors. These funds are provided by national governments, international organizations, or development agencies with the objective of creating an enabling environment for long-term climate action. In the long term, Insurance and Risk Transfer Instruments become particularly relevant. Once vulnerabilities are well understood and adaptation strategies are formulated, risk-transfer mechanisms such as climate risk insurance or catastrophe bonds can be tailored to cover specific hazards. This ensures that communities and local governments are better protected from future climate-induced losses.

2. Develop a diverse portfolio of financial instruments for adaptation

This solution reflects the growing recognition that no single financial mechanism can meet the diverse needs of climate adaptation. In the short term, blended finance emerges as the most effective tool. It enables the strategic use of development finance and philanthropic funds to mobilize additional private capital. This approach reduces investment risk and makes climate adaptation projects more attractive to investors who would otherwise be hesitant due to low or uncertain returns. Over the long term, carbon pricing mechanisms serve as a sustainable financing source. Instruments such as emissions trading systems or carbon taxes can generate significant revenue that can be reinvested into climate adaptation efforts. These revenues are stable, scalable, and create direct incentives for reducing greenhouse gas emissions.

3. Foster collaborations between governments, development banks, and the private sector

Fostering multi-stakeholder collaboration is essential for unlocking the full potential of adaptation financing. Initially, grants are well-suited for catalyzing these partnerships. They can be used to finance workshops, coordination platforms, and feasibility studies that align the interests and priorities of diverse actors. This upfront support lowers the cost and risk of entering into partnerships, particularly in contexts where trust and shared vision may still be developing. In the long run, equity-based financing becomes more appropriate. Equity investments can support the scaling up of successful pilot initiatives and ensure that all parties, including the private sector, maintain a long-term interest in the success of adaptation projects. Equity instruments also foster co-ownership and accountability among stakeholders, leading to more sustainable project governance and outcomes.

4. Capacity building initiatives for local actors

Capacity building is critical to ensuring that local stakeholders can effectively plan, finance, and implement adaptation measures. Grants are the most appropriate short-term instrument as they can be directed toward training programs, knowledge transfer, institutional strengthening, and hiring technical staff. These investments lay the groundwork for future engagement in larger, more complex projects. In the long term, public-private partnerships (PPPs) are well-positioned to sustain capacity building. Through PPPs, private entities can provide ongoing training, maintenance, and technical support in exchange for incentives or shared project revenue. PPPs ensure continuity and innovation in capacity development.

5. Technical assistance for developing project pipelines and bankable proposals

Developing a pipeline of bankable projects is a prerequisite for scaling up adaptation finance. In the short term, technical assistance facilities are ideal. These facilities offer targeted support for feasibility studies, cost-benefit analyses, environmental impact assessments, and project structuring. They are often managed by multilateral development banks or bilateral aid agencies and serve to bridge the gap between project ideas and investment readiness. In the long term, debt instruments such as concessional loans or green bonds become critical. Once projects are bankable, they require large-scale financing for implementation. Debt provides this financing while also instilling financial discipline and accountability.

6. Inadequate capabilities of local actors to quantify adaptation needs and co-develop project proposals

When local actors lack the capacity to assess adaptation needs or contribute meaningfully to project development, targeted short-term financial support is essential. Grants are again the most suitable instrument at this stage, particularly when administered through capacity-building programs or small-scale development funds. These funds empower local actors with knowledge, tools, and networks. Over the longer term, equity financing can be a powerful tool to incentivize and reward capable local actors who become project implementers or co-investors. Equity also promotes financial inclusion and can build a pipeline of local champions who are directly invested in the success of climate adaptation interventions.

7. Establish mechanisms to measure effectiveness and track adaptation finance flows

Monitoring and tracking systems require upfront investment in data infrastructure and governance processes. As such, grants are the preferred short-term tool to initiate these efforts. These can support the creation of metrics, dashboards, and reporting protocols that align with international standards. For long-term sustainability, debt instruments or results-based financing may be suitable. These instruments encourage continuous monitoring and ensure that finance is linked to measurable results. This incentivizes efficiency and fosters trust among funders and stakeholders by demonstrating accountability.

8. Create enabling conditions through supportive regulations and policies

The creation of enabling environments is often a government-led process that benefits from short-term grant financing. Grants can fund policy reviews, stakeholder consultations, and legal analyses that help align national strategies with global adaptation goals. In the long run, carbon pricing mechanisms offer a self-sustaining financial source to reinforce policy measures.

9. Mobilize private sector investment in adaptation

To engage the private sector, short-term instruments like blended finance are ideal. They help de-risk private investment and improve the bankability of projects. Blended finance structures attract commercial capital by leveraging concessional public funds. In the long term, equity instruments offer the private sector an opportunity to maintain a vested interest in adaptation projects. Equity facilitates long-term engagement, allowing private entities to share financial returns while contributing to societal resilience.

10. Promote local ownership and stakeholder engagement

Local ownership is best initiated through short-term grants. These can support participatory processes, awareness campaigns, and community-based planning, all of which are vital for gaining public support and legitimacy. In the longer term, Public-private partnerships can help sustain stakeholder engagement by embedding participation into service delivery models and ensuring that local actors have both voice and stake in project governance.

11. Integrate adaptation into national budgets and development planning

Integration of adaptation into national frameworks requires political commitment and institutional coordination, which can be supported in the short term through targeted grants. These can fund integration workshops, planning tools, and cross-sectoral coordination mechanisms.

Over time, debt instruments like budget support loans or adaptation-linked bonds can provide the resources needed for large-scale programmatic implementation. These instruments link financial flows directly to policy commitments and institutional performance, ensuring coherence and sustainability.

12. Leverage international climate finance

To access international finance effectively, countries and institutions must build application and project preparation capacity. In the short term, technical assistance and grants are key. These instruments support proposal development, fiduciary assessments, and alignment with fund criteria. For the long term, blended finance can serve as an intermediary vehicle to pool international and domestic resources while reducing risk. By leveraging global climate finance, local actors can scale impact and catalyze systemic change in adaptation finance ecosystems.

13. Strengthening monitoring and evaluation frameworks

Short-term support through grants and technical assistance is essential to establish baseline data systems and evaluation metrics. These instruments facilitate capacity-building, stakeholder consultation, and development of context-specific indicators. In the long term, results-based finance can incentivize accountability and long-term engagement in monitoring and evaluation activities, with disbursements tied to verified progress.

14. Improve knowledge sharing and dissemination of best practices

Knowledge networks and learning hubs can be supported in the short term through grants and development bank funding for platforms, publications, and training. These ensure cross-sectoral and regional knowledge exchange. Over the long term, equity and public-private partnerships can help sustain innovation hubs and knowledge ecosystems by engaging academic institutions, local governments, and the private sector as co-investors.

15. Develop local adaptation champions and leadership programs

Leadership development is initially driven by grants and philanthropic financing, which fund education, training, and mentoring schemes. Technical assistance may also be required to tailor such programs to local contexts. In the long run, equity investments can provide long-term support to local leaders in scaling adaptation enterprises or launching community-focused organizations that contribute to resilience.

16. Encourage innovation in adaptation technologies

Innovation often requires upfront de-risking to bring new technologies to market. In the short term, challenge funds and innovation grants are highly effective. These encourage early-stage experimentation and pilot testing in local contexts. For the long term, venture capital and equity funding support the commercialization and scaling of successful innovations. These instruments align with private sector incentives and ensure long-term sustainability.

17. Promote risk-informed planning and decision-making

Planning tools and risk assessments require targeted early support. In the short term, grants and technical assistance can fund modeling, data development, and training in scenario planning. In the long term, risk pooling mechanisms or parametric insurance schemes can provide financial resilience to unexpected climate events, reinforcing the integration of risk into planning frameworks.

18. Ensure social inclusion in adaptation efforts

Socially inclusive adaptation demands early investment in engagement, targeting, and equity assessments. Grants and gender-focused budgeting instruments are effective in the short term for building inclusive project pipelines. Over the long term, social impact bonds can be a useful instrument to link finance to equity outcomes, ensuring that marginalized communities benefit from adaptation investments.

19. Build climate-resilient infrastructure

Infrastructure development requires a combination of upfront support and long-term capital. In the short term, project preparation facilities and guarantees can support feasibility studies, permitting, and stakeholder engagement. In the long term, green bonds and infrastructure debt financing are key to mobilizing the scale of investment needed, with repayment linked to infrastructure performance or revenues.

20. Strengthen early warning systems and disaster preparedness

Early warning systems rely on foundational investments in data and communications. Grants and concessional loans are appropriate in the short term to build core infrastructure. In the long term, insurance-linked securities, such as catastrophe bonds, can provide ongoing financing tied to risk levels, ensuring rapid post-disaster response.

21. Support ecosystem-based adaptation solutions

Nature-based solutions are often underfunded due to limited revenue generation. In the short term, environmental trust funds and grants are essential to initiate conservation and restoration efforts.

In the long term, payment for ecosystem services (PES) schemes can provide ongoing financing by linking beneficiaries of ecosystem services (e.g., water utilities) to providers (e.g., forest communities).

22. Support from multilateral development banks and international financial institutions

Engagement with multilateral development banks (MDBs) and international financial institutions (IFIs) is critical for scaling adaptation finance in developing and climate-vulnerable countries. In the short term, technical assistance and concessional finance are effective instruments. MDBs can support the structuring of adaptation strategies through in-kind support and advisory services, while concessional finance allows early project execution without the pressure of commercial rates. In the long term, co-financing frameworks such as blended finance or syndicated loans enable MDBs to crowd in private capital, ensuring project viability at larger scales and across extended horizons.

23. Streamlining application procedures and adjusting eligibility criteria

Complex and opaque application procedures are a barrier to accessing adaptation finance. In the short term, technical assistance and dedicated grant windows can be used to simplify application processes, including guidance documents, mentoring, and helpdesks tailored to vulnerable regions and organizations. Long-term improvements require structural changes in climate finance architecture, which can be supported by results-based financing mechanisms. These align access to funding with performance outcomes, incentivizing institutions to maintain simpler, more transparent systems while improving absorptive capacity.

24. Providing technical support to firms and regions

Businesses and local regions often lack the in-house expertise to engage in adaptation planning. In the short term, innovation grants and capacity-building programs are critical to equip firms and regions with the knowledge and tools required for risk assessments and climate-proofing investments. Over the long term, equity investment platforms focused on regional resilience or green venture capital can support

adaptation-aligned enterprises, ensuring that technical support transitions into sustained commercial strategies.

25. Initiating capacity development programs for local public authorities

Public authorities are frontline actors in adaptation planning, but often under-resourced. Short-term grants and institutional strengthening programs (possibly via development agencies) can help initiate tailored training and systems design.

For long-term sustainability, PPPs are suitable for embedding adaptive capacity within the functions of local government, particularly when delivering public goods or critical services that require private expertise and continuity.

26. Implement standardized methodologies for assessment

A lack of consistency in adaptation project assessment weakens evaluation and comparability. In the short term, technical assistance from multilateral institutions and support from climate finance readiness programs can ensure the deployment of common frameworks. Grants can fund the piloting and co-creation of such methodologies in partnership with local stakeholders. In the long term, institutionalized tools embedded in national planning—supported by debt-financed reform programs or conditional budget support—can maintain standardized assessment practices.

27. Use long-term climate impact projections and sector-specific data

Forward-looking data is essential to planning climate-resilient investment. In the short term, research grants and technical cooperation programs can develop the data infrastructure and modeling capacity required. This includes developing regional datasets, climate models, and impact studies. In the long term, public-private investment funds or data cooperatives supported by equity investments can ensure continuous updating and use of these datasets across sectors, linking data provision to service value.

28. Establish frameworks for continuous monitoring of adaptation progress

Effective adaptation requires monitoring systems that track implementation over time. Short-term investments through grants and results-based pilot programs can support the early design and rollout of monitoring frameworks. Long-term impact can be sustained via climate performance bonds or other linked financing tools that reward measurable progress and improve transparency and accountability in adaptation finance.

29. Increase accessibility to information on funding sources

Awareness of funding opportunities remains limited among local actors and vulnerable groups. In the short term, digital platforms funded by grants and innovation challenges can centralize and disseminate real-time information on available finance. In the long term, integration into public financial management systems—through IT infrastructure upgrades supported by budget support or long-term debt—can institutionalize transparent information flows and improve budgeting for adaptation across all levels of government.

Pathways towards leveraging finance

30. Lack of a bankable investment project, planning and mobilizing diverse stakeholders at the regional and national level

A frequent challenge in scaling adaptation finance is the absence of coordinated planning and development of bankable projects. In the short term, Grants (EU, Technical Assistance) are instrumental in fostering stakeholder engagement and building the foundational capacities needed to prepare viable adaptation projects. These grants support the creation of multi-stakeholder platforms where public institutions, private investors, and civil society organizations collaboratively identify and prioritize

adaptation investments. Technical Assistance further enhances institutional ability to navigate regulatory requirements, assess project feasibility, and design interventions that meet investor standards. In the long term, Blended Finance (Public Private Partnerships (PPPs)) mechanisms mobilize large-scale capital, combining public or concessional funds with private investment, thus reducing risk for commercial actors and ensuring broader participation. Coordinated stakeholder platforms and blended finance structures align adaptation projects with national goals and secure necessary resources for implementation.

31. Financial resources allocated to targets other than adaptation

Many countries struggle with the misalignment of public budgets and climate priorities, resulting in underfunding of adaptation. Short-term targeted Grants (EU, Technical Assistance) and Debt (Loans, bonds) as policy-based budget support can redirect financial flows toward adaptation. Grants enable rapid assessments of spending patterns and development of budgeting frameworks prioritizing resilience. Long-term Adaptation-linked Bonds categorized under Green Bonds (Green Bonds) effectively earmark proceeds specifically for climate-resilient infrastructure or services, creating accountability mechanisms and encouraging sustained investment in adaptation.

32. Low presence of innovative firms and innovation systems to apply complex adaptation (transformational) solutions

Limited firm capacity to deploy transformative adaptation technologies is a technological barrier with financial implications. Short-term Grants (EU, Technical Assistance) and Non-financial Instruments (Subsidies) stimulate early investment in climate-resilient technologies, reducing research costs and incentivizing private-sector engagement in high-risk innovation. Long-term Equity (Venture capital) investment channels support firms in scaling adaptation technologies, fostering partnerships with governments and civil society to integrate solutions into existing systems, and facilitating knowledge transfer from innovation leaders to vulnerable regions.

33. Poor dissemination due to lack of infrastructure to facilitate synergies

Dissemination of adaptation knowledge and technologies often fails due to insufficient collaboration infrastructure. Short-term Grants (EU, Technical Assistance) and Non-Monetized Inputs (Facilitation, Knowledge sharing) build platforms, databases, and communication channels, funding regional knowledge centers and online tools facilitating access to resources.

Long-term sustainability is ensured through Blended Finance (Public Private Partnerships (PPPs)), maintaining and expanding systems with shared responsibilities for data management, capacity development, and continuous innovation.

34. Poor estimation of budget allocations required and inability to shape public-private solutions

When governments struggle to forecast adaptation costs and attract private sector investment, adaptation funding falls short. Short-term Grants (EU, Technical Assistance) for technical assistance and Risk Mitigation Coverage (Guarantees) address planning accuracy and investment risk. Blended Finance (Public Private Partnerships (PPPs)) serve as long-term mechanisms sharing investment and operational risks, embedding adaptation priorities into joint investment frameworks to unlock private capital for infrastructure and service delivery.

35. Allocation of scarce financial resources to other projects

Competing policy priorities often divert financial resources away from adaptation. Short-term advocacy Grants (EU, Technical Assistance) and Non-financial Instruments (Information) monitoring tools influence policy agendas and ensure transparency in resource allocation.

Results Based Financing (Payments for Ecosystem Services, Pay for Taxes) ties funding to adaptation outcomes, rewarding performance and maintaining political attention on adaptation goals, creating awareness and accountability.

36. No identification of actors (private & research sector) to efficiently design, implement and monitor an adaptation project

The success of adaptation projects depends on capable actors' involvement. Short-term Grants (EU, Technical Assistance) for capacity-building and Non-financial Instruments (Information) stakeholder mapping initiatives identify and empower relevant actors. Long-term Non-Monetized Inputs (Knowledge sharing) platforms provide structured environments for ongoing collaboration, institutionalizing adaptive learning and project co-design.

37. Poor identification of actors to engage, inadequate design of bankable adaptation projects

Poor project preparation hinders access to finance. Solutions can be short-term Grants (EU, Technical Assistance) for technical assistance and feasibility studies that enhance project quality, aligning goals with funding criteria and developing investor-appealing financial models. Long-term Debt (Loans, bonds, crowdfunding) in the form of sovereign climate bonds finance adaptation projects, signaling commitment to sustainable development and aligning public finance with climate goals to attract investors.

38. Mismanagement of Funds

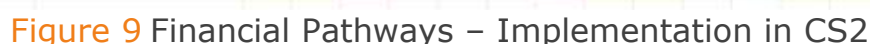
Mismanagement of climate finance deters investment. Short-term Grants (EU, Technical Assistance) for governance technical assistance and audits build robust financial oversight systems, ensuring transparent and effective fund management. Long-term Non-financial Instruments (Regulations, Information), such as transparency-linked instruments, encourage continuous improvement in fund management, promote financier trust and efficient, equitable resource utilization.

2.4 Implementation in ARSINOE Case studies

Figures 8 and 9 show the identified portfolios of solutions, i.e. pathways for all ARSINOE case studies.

CS1-Athens Metropolitan Area	CS2-Med Port-Praxos	CS2-Med Port-Vaencia	CS2-Med Port-Limassol	CS3-Main River Germany	CS4-ChindPraxos Lakes-Albanya	CS4-ChindPraxos Lakes-Greece	CS4-ChindPraxos Lakes-Mali	CS5-Canary Islands	CS6-Black Sea-Bulgaria	CS6-Black Sea-Greece	CS6-Black Sea-Turkey	CS7-Southern Denmark	CS8-Texel and Devon County	CS9-Sardinia
	S3	S1,S2	S1,S2,S3	S2,S3	S2,S3	S2,S3	S1,S3	S3	S3	S3	S3	S3	S1,S2,S3	
	S4		S4	S6	S6	S6	S4,S5	S5	S5	S5	S5	S6	S4,S5	
			S7				S7,S8,S9	S7,S9	S7,S9	S7,S9	S7,S9			
	S11	S11	S10,S11	S11,S12	S11,S12	S11,S12	S11,S12	S10,S12	S10,S12	S10,S12	S10,S12	S12	S11,S12	
			S14	S15	S15	S15	S13,S14,S25	S14,S15	S14,S15	S14,S15	S14,S15	S14	S13,S14,S15	S13,S14,S15
	S16		S16,S26	S18	S18	S18	S16,S17					S18	S16,S17	S16,S26
	S19,S21	S19	S19	S21	S21	S21	S20	S19	S19	S19	S19	S21	S19	S19
S22,S24	S24,S27		S24					S23	S23	S23	S23	S24	S22,S23,S24	S22,S23,S24

Figure 8 ARSINOE CS – Financing Pathways 1



To support its transition toward a greener and more climate-resilient future, the Athens municipality has adopted a mix of strategic financing solutions that address core barriers in accessing and leveraging finance. Two critical enablers are S22 – Establish Integrated Investment Platforms and S24 – Capacity Building and Technical Assistance Programs. In the short term, these rely on grants and technical assistance to create a foundation of well-prepared, bundled investment projects that align with climate and biodiversity goals. In the long term, S22 facilitates access to debt instruments, while S24 promotes public-private partnerships (PPPs), enhancing the attractiveness of projects to a wider investor base and supporting scaling-up beyond initial pilot efforts.

To reinforce these foundational measures, Athens leverages a set of solutions aimed at strengthening governance and enabling investment-readiness. Solutions S30 to S35 and S38 focus on fiscal autonomy, improved coordination across municipalities, performance monitoring, and innovative financial risk management. For instance, these include grants and technical assistance in the short term to support institutional reforms and project preparation, and long-term mechanisms such as equity investments, blended finance, PPPs, and insurance/risk transfer instruments. These instruments help de-risk investments, especially crucial in a city exposed to extreme heat and flash floods, while also attracting private capital through shared risk and returns.

Together, this financing architecture offers a robust roadmap for implementing green infrastructure and biodiversity enhancement in Athens. The strategy begins with catalytic public funding (grants, TA) to overcome technical and capacity barriers and evolves toward structurally integrated, long-term investment solutions (debt, equity, PPPs, insurance). This dynamic and phased approach not only aligns with the municipality's climate adaptation objectives but also builds institutional resilience, improves investor confidence, and lays the groundwork for replicating successful interventions across the metropolitan area. In doing so, it transforms climate-related risks into investment opportunities that support both environmental and social co-benefits for Athens' residents.

Piraeus

To secure the resilience of Piraeus Port—Greece’s largest maritime gateway and a strategic node for short-sea shipping—financing efforts begin with reinforcing institutional collaboration and local capabilities. Solution S3, which promotes collaborations between governments, development banks,

and private actors, is essential to mobilize the right mix of funding and expertise. Its reliance on grants and guarantees in the short term supports joint feasibility studies, technical dialogues, and risk-sharing frameworks for climate-proofing port infrastructure. This creates a trust-based, shared investment environment. In the long term, equity investments will be needed to scale innovative infrastructure projects, including resilient logistics hubs and climate-smart port operations.

To enhance implementation readiness, Solutions S4 and S11 focus on local capacity building and the use of long-term climate impact projections. These are vital to designing adaptation pathways that address erosion, flooding, and infrastructure strain due to sea-level rise and intensifying storms. Both solutions are grounded in short-term instruments such as grants and technical assistance, which fund skills development, training programs for port authorities, and procurement of climate risk tools. In the long term, public-private partnerships (under S4) and debt financing mechanisms (under S11) will help deploy capital-intensive upgrades like elevated docking platforms, early-warning systems, and nature-based breakwater solutions that blend ecosystem protection with port functionality.

Resilience planning must be data-driven and spatially precise. Solutions S16 and S19 therefore guide the deployment of advanced climate risk models and the mainstreaming of adaptation strategies into national development planning. These enable the port authority and coastal municipalities to assess cascading risks from extreme weather, shifting sea currents, and potential supply chain interruptions. Grants and technical assistance fund initial modeling, vulnerability assessments, and scenario simulations. In the longer horizon, debt instruments provide continuity for integrating adaptive capacity into land-use zoning, dredging regimes, and insurance-backed maintenance programs—ensuring climate resilience is embedded into the long-term operating model of Piraeus Port.

The success of climate resilience strategies at Piraeus Port hinges on inclusive governance frameworks and empowered stakeholder engagement. Solution S21, which promotes the empowerment of local actors in decision-making, recognizes that effective adaptation must be locally tailored and socially accepted. Short-term grants and technical assistance are crucial to supporting participatory processes, policy roundtables, and stakeholder training sessions that give port communities a voice in planning. Over the long term, this inclusion can be institutionalized through debt-financed local initiatives and participatory budgeting mechanisms that allow communities to co-invest in protective infrastructure and early-response systems.

Parallel to community empowerment, Solution S24 addresses the structural bottlenecks in project development by focusing on technical assistance and capacity building. Many port authorities lack financial engineering or legal expertise to structure complex adaptation projects. Here, grants and technical assistance serve as catalytic tools to deploy project preparation facilities and advisory services. As the project pipeline matures, public-private partnerships (PPP) become a viable long-term instrument, especially for hybrid infrastructure models combining grey and green solutions—like sea walls reinforced with blue carbon ecosystems (seagrasses, salt marshes) to simultaneously tackle erosion and biodiversity loss.

A strategic enabler for aligning these efforts is Solution S27, which focuses on promoting data standards and digital platforms for monitoring and reporting adaptation progress. In Piraeus, this means building interoperable systems that track real-time sea conditions, port disruptions, and ecosystem health—critical for both operational safety and climate transparency. These platforms can be developed through grants and technical assistance, while in the long term, blended finance models and digital public infrastructure investments—backed by multilateral development banks—can sustain the operational costs and facilitate innovation partnerships with private tech providers and startups.

A pivotal step for Piraeus Port is aligning local and regional financial systems with climate resilience goals. Solution S31, which encourages the strengthening of fiscal autonomy and the integration of climate

criteria in budgetary planning, is critical in this regard. Through short-term instruments like grants and technical assistance, local governments and port authorities can improve their budgetary frameworks, integrate climate risk screening, and develop resilience-oriented investment plans. In the long term, this opens access to blended finance instruments that combine concessional public finance with commercial capital, enabling larger-scale investments in adaptive infrastructure such as resilient cargo terminals and electrified port logistics.

Looking ahead, the interplay between resilience planning and financial innovation will define the sustainability of adaptation pathways. The portfolio of solutions adopted by Piraeus enables layered financing: technical assistance helps design project concepts, guarantees and equity de-risk innovation pilots, and PPP and debt mechanisms mobilize long-term capital. These financing channels are crucial for implementing nature-based solutions like coastal vegetation buffers or sediment traps, which provide both engineering protection and ecosystem services. In addition, fiscal instruments—like climate bonds or resilience-linked loans—could be integrated into the port authority’s capital strategy as they align environmental KPIs with financial terms.

Finally, by embedding climate adaptation into its core governance, Piraeus Port can become a flagship for resilient maritime infrastructure across the Mediterranean. The strategic blend of short-term grants, guarantees, and technical support, paired with long-term equity, debt, and PPPs, forms a resilient financing architecture. It empowers the port not just to survive the growing climate pressure but to thrive as a blue economy hub that leads in sustainable port management, community-inclusive adaptation, and carbon-conscious logistics. This comprehensive financing approach ensures that Piraeus remains not only a critical node for maritime trade but also a model of climate-smart development on Europe’s southern coastline.

Valencia

The Port of Valencia, one of the Mediterranean’s busiest and most strategically positioned logistics hubs, is increasingly exposed to climate-induced stressors—rising sea levels, intense storm events, and heatwaves—that threaten not only port infrastructure but also regional economic continuity. To address these risks, Valencia’s resilience strategy initiates with Solution S11, focused on integrating long-term climate impact projections into infrastructure and operations planning. In the short term, this involves mobilizing grants and technical assistance to finance climate modelling, vulnerability assessments, and scenario analysis tailored to port logistics and maritime access. These insights are foundational in shaping adaptation roadmaps and ensuring alignment with the port’s long-term development goals. Over the longer term, debt instruments—such as sustainability-linked loans or infrastructure bonds—will be essential for financing hard adaptation measures like storm surge barriers, elevated terminal zones, and flood-resilient storage systems.

Equally crucial is Solution S19, which promotes the mainstreaming of climate adaptation into national and regional development frameworks. The Port of Valencia’s adaptation agenda cannot be realized in isolation—it must be tightly interwoven with broader land-use, transportation, and coastal development plans. In this context, grants and technical assistance are leveraged to build institutional linkages and harmonize port climate action with national strategies such as Spain’s National Climate Change Adaptation Plan. By doing so, the port enhances access to public co-financing and alignment with EU green transition policies. As adaptation efforts progress, long-term debt financing, supported by multilateral development institutions or green bond frameworks, will become key in rolling out scalable interventions such as climate-resilient logistics parks and climate-proofed intermodal transport links.

To support the full integration of climate adaptation within the port’s financial and governance systems, Solution S31 calls for the strengthening of fiscal autonomy and the incorporation of climate metrics into budgeting processes. Valencia’s port authority can use short-term instruments like grants and technical

assistance to establish internal climate budgeting units, integrate risk-adjusted planning tools, and set climate-linked investment targets. Over the long term, this enables the port to pursue blended finance instruments, combining public and concessional capital with commercial finance, while applying ESG screening criteria and climate KPIs across portfolios. Solution S35 further accelerates this transformation by facilitating the valuation of ecosystem services—such as the protective role of coastal dunes and wetlands—which allows the port to make the economic case for nature-based adaptation. These efforts can be jumpstarted via grants and carried forward through public-private partnerships and innovative equity mechanisms, unlocking funding for projects like dune restoration and sediment management that serve both protective and ecological goals.

Together, these solutions form a coherent and investable transition pathway. Valencia’s approach blends climate foresight, institutional integration, and fiscal innovation to build a resilient, adaptive port system. The use of short-term instruments enables foundational planning, knowledge transfer, and alignment with stakeholders, while long-term financing tools such as debt, PPPs, and equity provide scalability and financial sustainability. As climate risks escalate, the Port of Valencia is positioning itself not just to endure these changes—but to lead as a Mediterranean blueprint for climate-smart port development, combining hard infrastructure upgrades with soft system reforms and nature-based interventions.

Limassol

As Cyprus’ primary commercial port, the Port of Limassol is exposed to climate stressors such as sea-level rise, coastal erosion, and intensifying storms—all posing threats to port operations, maritime transport, and coastal livelihoods. Addressing these requires a forward-looking, climate-risk-informed strategy. Solution S1, which supports climate vulnerability assessments and risk screening, sets the foundation for long-term resilience. In the short term, this is financed through grants and technical assistance to fund localized climate diagnostics and risk mapping—informing infrastructure upgrades and emergency preparedness systems. In the long term, tools like insurance and risk transfer mechanisms are essential to secure port assets and reduce the financial volatility from acute climate events, thus enhancing investor confidence.

To build on this, Solution S2 calls for the development of a diverse portfolio of financial instruments tailored to different risk profiles and project types. In Limassol’s case, this includes adaptation for port infrastructure, coastal protection, and blue carbon interventions such as salt marsh restoration. Grants and blended finance play a catalytic role in early-stage development, bundling technical design with initial capital mobilization. Over time, the port can access carbon pricing mechanisms or nature performance bonds, which offer results-based funding for verified ecosystem-based adaptation (EbA) outcomes. This solution promotes financial innovation and ensures alignment with EU Blue Economy and Green Deal goals.

Supporting this transition is a core group of governance-focused solutions. Solutions S30 through S35 collectively aim to institutionalize climate adaptation in port governance and budgetary systems. For instance, S30 and S31 work to improve the fiscal autonomy of the port and mainstream climate considerations into its financial planning processes. In the short term, this includes deploying grants and technical assistance to revise budgeting procedures and align them with climate KPIs. As fiscal maturity grows, long-term blended finance and equity investments can support adaptation-aligned capital investment strategies—such as electrification of port operations and floating infrastructure.

2.4.3 CS3 Main River, Germany

To address the complex climate and land-use dynamics of the Main River Basin, the financing strategy for Case Study 3 is anchored in a comprehensive and diversified set of solutions designed to overcome both institutional and technical barriers. Foundational steps include S1 (strengthening climate vulnerability assessments), S2 (diversifying financial instruments), and S3 (fostering multilevel collaborations). These

rely on short-term instruments such as grants, technical assistance, guarantees, and blended finance to build capacity, bridge institutional silos, and develop robust, data-informed planning frameworks. Over the long term, the use of insurance and risk transfer mechanisms, carbon pricing instruments, and equity investments is essential to de-risk investments and attract sustained private sector participation in water-energy-land (WEL) nexus resilience.

Complementary enablers such as S4 (local capacity building), S7 (streamlining procedures), and S10/S11 (data accessibility and decision-making tools) ensure project implementation is grounded in local realities while scaling innovations like high-frequency environmental monitoring and integrated hydroclimatic modelling. These are supported by grants and technical assistance in the short term and evolve toward long-term financing through public-private partnerships and debt instruments. With regional water and land use governance being highly fragmented, solutions such as S14 and S16 (governance and stakeholder coordination) and S19 (monitoring frameworks) play a critical role in aligning policies and incentives. Their financing mix encourages cooperation among municipalities, agricultural stakeholders, and the energy sector, which is vital for balancing trade-offs in a basin characterized by both floods and droughts.

The later-stage transition enablers—S24, S26, S31, S32, S35, S36, and S37—focus on institutional reform, fiscal innovation, and ecosystem services integration. These solutions expand the region's adaptive capacity by combining short-term measures like technical assistance and grants with long-term instruments such as blended finance, equity, and insurance/risk-sharing schemes. These tools are pivotal in funding multi-benefit projects (e.g., adaptive agriculture, low-carbon energy, and ecological restoration) underpinned by ecosystem service valuation and strong climate foresight. The strategic use of diverse instruments enhances the resilience of civil infrastructure, agricultural productivity, and water security—ensuring that the Main River Basin can meet the climate ambitions while protecting ecological integrity and sustaining economic vitality in a diverse and heavily contested landscape.

To scale adaptation and foster policy coherence, Solution S32 focuses on enhancing inter-municipal and regional cooperation, which is particularly crucial in the Cypriot context where coastal dynamics and port dependencies extend beyond municipal boundaries. In the short term, grants and technical assistance can be used to set up shared governance platforms, integrate data systems across administrative levels, and establish joint planning mechanisms for coastal resilience. In the long term, these efforts support the design of public-private partnerships and multi-level investment vehicles, enabling regional authorities and the private sector to co-finance infrastructure that benefits the broader coastal economy—such as stormwater retention systems or dual-use transport corridors.

Simultaneously, Solution S33 facilitates the use of financial intermediaries and aggregators to pool projects and reduces transaction costs, especially for smaller-scale, nature-based solutions that may not be individually attractive to institutional investors. In the short term, this involves grants and capacity support to establish frameworks for project aggregation and shared financial services for port-related climate action. Eventually, this unlocks access to blended finance facilities and innovation funds—allowing bundled projects in coastal protection, renewable energy, or blue carbon to be financed through a portfolio approach that balances risk and returns while achieving adaptation co-benefits.

Next, Solution S34 plays a strategic role in enhancing transparency and accountability by promoting monitoring, reporting, and verification (MRV) systems for resilience projects. For Limassol, such systems enable the port to document climate risks, track adaptation investments, and provide credible metrics to investors and regulators. With short-term support via grants and technical assistance, these MRV systems can be digitized and aligned with EU taxonomy and ESG standards. Over time, they also attract equity investment and performance-based financing, especially when tied to climate-linked securities or environmental outcome contracts. This increases the visibility and bankability of nature-based and hybrid infrastructure solutions.

Finally, Solution S35 brings a powerful valuation lens to the forefront by focusing on the economic valuation of ecosystem services—especially relevant for Limassol, where coastal ecosystems such as dunes, wetlands, and seagrasses play a pivotal role in shoreline stabilization and flood mitigation. Short-term grants and assistance can fund ecological assessments, stakeholder co-valuation processes, and the creation of asset registries for natural infrastructure. These efforts lay the groundwork for market-based mechanisms and nature-positive investment strategies. In the long term, valuation outcomes can underpin public-private partnerships, attract green bond issuances, and support insurance products that assign value to ecosystem-based risk reduction.

Together, the full set of solutions and instruments creates a cohesive transition architecture for the Port of Limassol. The blend of technical assessments, institutional upgrades, fiscal reforms, and ecosystem valuation ensures that resilience financing is not just reactive but strategic, scalable, and inclusive. By deploying short-term grants, technical assistance, and capacity-building tools, the port can structure a strong pipeline of adaptation investments. These will then be financed and scaled through long-term debt, equity, PPPs, blended finance, and emerging nature markets.

As Limassol positions itself at the intersection of maritime logistics, climate resilience, and blue growth, this comprehensive approach ensures that the port evolves into a regional exemplar for sustainable coastal infrastructure. Through its tailored financing strategy, it not only reduces climate risk but also contributes to the economic and ecological revitalization of Cyprus' southern coastline—turning adaptation challenges into blue economy opportunities.

2.4.4 CS4 Ohrid Prespa Lakes

The transboundary water systems of the Ohrid and Prespa Lakes, straddling Greece, North Macedonia and Albania, face mounting pressure from climate change. These pressures threaten not only aquatic and terrestrial biodiversity but also the water-dependent economic activities of the region—agriculture, energy production, and tourism—as well as human health and community resilience.

The assessment would be unique as all countries identified common financing pathways. To address these multifaceted challenges, the case study implements a suite of interconnected solutions that combine institutional reform, financial innovation, and ecological restoration. Solution S2, promoting a diverse portfolio of financial instruments, sets the foundation by enabling flexible financing models for water governance, ecosystem protection, and cross-sectoral adaptation. Grants and blended finance serve as short-term enablers for piloting nature-based solutions, adaptive agriculture, and integrated hydropower-water-ecosystem management. Over the long term, carbon pricing mechanisms can reward ecosystem conservation efforts such as peatland or wetland restoration with measurable climate benefits.

To support collaborative, cross-border resilience planning, Solution S3 emphasizes the importance of multi-level cooperation among governments, MDBs, and the private sector, while Solution S6 activates MDB engagement for technical and institutional capacity building. These efforts are essential in a region where the hydrological system—and the risks tied to its mismanagement—are shared. Early-stage funding through grants, guarantees, and technical assistance supports the development of joint hydrological models, early warning systems, and stakeholder roadmaps. These platforms can later attract equity and debt instruments for long-term financing of shared infrastructure—such as transboundary wetland reserves, sustainable tourism facilities, or adaptive energy systems linked to hydropower operations on the Drin River.

Resilience-building is rooted in foresight and information systems. Solutions S11 and S12 integrate long-term climate impact projections and real-time monitoring into institutional planning, helping align water allocation, agricultural planning, and energy production with future climate conditions. In the short term, grants and concessional loans fund digital monitoring infrastructure, stakeholder training, and regional

early warning systems. The long-term financial sustainability of these systems is ensured through results-based financing, especially when linked to verified water quality, biodiversity, or energy output performance indicators.

Ecological resilience and social inclusion are tackled together through Solutions S15, S18, and S21. These advance ecosystem-based infrastructure design, integration of national adaptation strategies, and community empowerment in water governance. Short-term technical assistance and grant funding support the design of ecological corridors, wetland rehabilitation, and stakeholder engagement processes. Over time, debt instruments and PPPs can fund co-managed irrigation upgrades, ecological farming systems, and community-operated nature-based tourism assets that deliver both climate resilience and economic opportunity. These measures are designed to preserve rare habitats and sustain clean water access, while also mitigating land use conflict between agriculture, hydropower, and environmental protection.

The enabling environment is further reinforced by Solutions S30 to S33, which improve fiscal autonomy, inter-municipal coordination, and financial intermediation across borders. In the short term, grants and technical assistance support institutional audits, budget reform, and joint planning bodies to ensure transparent, climate-aligned spending. As these institutions mature, they become eligible for blended finance and equity instruments that can fund water-saving innovations, decentralized water treatment infrastructure, and shared ecosystem service valuation frameworks. Solution S33, with its emphasis on aggregators and intermediaries, allows fragmented and smaller-scale climate solutions—such as reforestation or riparian buffer restoration—to be bundled into larger investment vehicles.

Finally, Solutions S36 and S37 consolidate the region's transformation by creating mechanisms for transparent tracking of climate finance and aligning sectoral financing frameworks with resilience goals. These solutions build the institutional trust and investor visibility needed to attract international climate funds, facilitate cooperation with EU mechanisms, and ensure that water-related adaptation interventions are integrated across hydropower, agriculture, tourism, and conservation sectors. The combination of short-term monitoring grants and long-term risk-transfer instruments, blended finance, and public-private structures creates a resilient financial ecosystem capable of sustaining water governance in the face of growing uncertainty.

Together, this cohesive financing framework positions the Ohrid–Prespa region as a model of transboundary water resilience. It blends technical foresight, social participation, institutional strengthening, and financial innovation into a replicable blueprint for climate-smart water management. With this architecture in place, the region not only protects its unique biodiversity and cultural heritage, but also lays the foundation for equitable, low-carbon, and sustainable development across borders.

2.4.5 CS5 Canary Islands

The Canary Islands, a volcanic archipelago with fragile ecosystems and complex energy-water-agriculture interdependencies, are undergoing an ecological transition aimed at ensuring long-term sustainability and resilience. To support this transformation, a blend of institutional, technical, and financial strategies has been designed to address the region's aquifer vulnerability, agricultural water demand, and carbon-intensive energy dependence. The narrative begins with Solutions S1 and S3, which build the foundations for climate-informed planning and investment coordination. Grants, technical assistance, and guarantees support early-stage climate risk assessments, foster partnerships among governments and development actors, and develop robust investment frameworks. In the long term, risk transfer instruments and equity investments provide stability and scalability for water reuse systems, nature-based agriculture buffers, and carbon-smart infrastructure.

Resilience must be deeply rooted in local capacities and project readiness. Solutions S4 and S5 enhance technical skills and project development pipelines. These are especially relevant for agricultural

cooperatives, desalination facilities, and decentralized renewable energy providers seeking access to climate finance. In the short term, grants and technical assistance are essential to design feasibility studies, business models, and climate-proof project proposals. Once matured, public-private partnerships (PPPs) serve as long-term vehicles to finance efficient irrigation technologies, low-emission agro-processing units, and off-grid solar for water pumping and treatment. In parallel, Solutions S7 to S9 work to streamline bureaucratic and regulatory hurdles. By simplifying access to climate funds and embedding local knowledge in planning processes, the Canary Islands can speed up investment timelines. These efforts start with technical assistance and policy support, later evolving into debt-financed interventions tailored to sector-specific infrastructure upgrades.

Strategic planning tools also shape the long-term success of this transition. Solutions S11 and S12 integrate long-term climate impact projections and adaptive monitoring frameworks into the archipelago's water-energy-agriculture nexus. These tools enable public and private stakeholders to understand hydrological risks, aquifer stress points, and the impact of shifting climate baselines on food production. Short-term grants and concessional loans help develop real-time digital dashboards, water accounting systems, and forecasting models. In the long term, these investments can be scaled through results-based financing, rewarding outcomes like increased crop water-use efficiency, reduced carbon intensity in agricultural exports, and higher aquifer recharge rates.

To enable systemic change, Solutions S13, S14, and S25 introduce institutional reforms and cross-sectoral integration. By embedding ecosystem services into economic planning and climate indicators into regional budgeting, the Canary Islands can align their Smart Specialization Strategy (RIS3) with broader EU climate and sustainability objectives. Early support through grants and capacity building facilitates institutional alignment and multi-stakeholder governance platforms. Over time, this paves the way for innovative insurance products, equity models, and green budgeting frameworks that make sustainability financially viable for both public agencies and private actors. Likewise, Solutions S16 and S17 focus on climate risk modelling and data interoperability, vital for connecting the agricultural sector's carbon and water footprint to island-wide energy and water policy reforms.

Lastly, Solutions S30, S31, S34, and S38 ensure that the ecological transition is fiscally embedded, transparent, and attractive to long-term financiers. These solutions work in tandem to enhance fiscal autonomy, align local budgets with climate goals, and build robust monitoring, reporting, and verification (MRV) systems that comply with international ESG standards. Through short-term grants and technical support, local governments and water agencies can develop climate-linked investment plans and adaptive performance frameworks. As financial credibility strengthens, the Canary Islands can access blended finance, insurance, and public-private structures to fund clean energy, circular agriculture, and smart water networks. These mechanisms allow the region to move beyond pilot interventions and scale sustainable impact in line with their RIS3 goals, Europe's Green Deal, and long-term climate resilience.

In summary, the Canary Islands' financing approach leverages a rich suite of ARSINOE solutions to align technical readiness, institutional innovation, and financial instruments. The transition strategy balances immediate capacity needs with scalable investment frameworks, using a blend of grants, PPPs, equity, debt, and results-based tools. This enables the islands not only to adapt to climate threats but to emerge as a regional leader in integrated, cross-sectoral sustainability for insular environments.

2.4.6 CS6 Black Sea

Like CS4, all four countries participating in this transboundary CS have defined common pathways, the analysis would be unique, with references to each region.

The Black Sea region, from its upstream land uses to its coastal marine ecosystems, represents one of the most intricate and vulnerable ecological corridors in Europe. Faced with the dual threats of climate change and anthropogenic degradation, the region demands an integrated watershed-to-sea strategy.

Case Study 6 of the ARSINOE project implements such an approach, focusing on the headwaters, transition zones, and coastal wetlands like the Danube Delta and Ropotamo Ramsar site. At the heart of this strategy is Solution S3, which facilitates collaborations between national governments, development banks, and local authorities, supported by grants and guarantees to build regional partnerships and launch pilot projects. Over time, these partnerships can scale through equity instruments, particularly to finance marine restoration, nutrient pollution reduction, and biodiversity corridors.

To accelerate implementation, Solutions S5, S7, and S9 provide the technical backbone of the strategy—enhancing project development capabilities, streamlining access to funding, and enabling local capacity building. These foundational steps are supported in the short term through grants and technical assistance, which help design resilient infrastructure for wetland management, plastic litter mitigation, and climate-smart agriculture along the riverine zones. In the long term, public-private partnerships and debt instruments offer financial sustainability for infrastructure such as floodplain reconnection systems, low-impact aquaculture, and green embankments. Local authorities and NGOs, empowered through these solutions, will be better equipped to lead community-driven actions and co-develop solutions with national stakeholders.

Scientific integrity and monitoring capacity are critical to success, particularly across diverse sub-ecosystems. Solutions S10 and S12 drive the use of standardized climate risk assessment methodologies and continuous monitoring frameworks. Through short-term technical assistance, the Black Sea case enables the implementation of low-cost sensors, satellite-linked platforms, and predictive modelling for flood and pollution events. Long-term, these systems are sustained through debt instruments and results-based financing, linking funding to measurable reductions in nutrient load, improved fish habitat conditions, and enhanced ecosystem services. These outcomes form the basis of transparent reporting and policy feedback loops, ensuring alignment with the EU Blue Growth Strategy and the Strategic R&I Agenda (SRIA) for the region.

Water governance and biodiversity protection in the Black Sea cannot be effective without strong institutional and societal anchoring. Solutions S14, S15, and S19 promote ecosystem-based management, multi-level governance, and mainstreaming of climate adaptation into sectoral planning. These are particularly relevant for the Danube delta and other high-biodiversity areas, where agriculture, tourism, and conservation intersect. Early funding through grants and technical assistance facilitates ecosystem service valuation, stakeholder dialogue, and integration into regional policy. Over time, debt and innovative PPPs will support the restoration of estuarine wetlands, nutrient-trapping buffer zones, and sustainable land use mosaics—delivering resilience and economic benefit to local populations and biodiversity alike.

Finally, the enabling financial architecture is reinforced through Solutions S23, S31, S33, S35, and S38. These work together to develop climate-aligned financial flows, enhance fiscal autonomy, leverage financial intermediaries, and improve transparency in tracking investments and outcomes. Grants and blended finance support early adoption of financial tracking systems and ecosystem valuation models, while long-term investments are structured through insurance/risk-sharing instruments, equity, and public-private vehicles. These solutions also create opportunities for mobilizing private capital into blue carbon and coastal adaptation projects, supported by robust monitoring and impact reporting platforms. Together, these financing solutions allow the Black Sea region to navigate the complexity of integrated watershed and marine system management under climate uncertainty.

In summary, the Black Sea case study weaves together upstream, midstream, and coastal resilience through a smart blend of grants, PPPs, equity, debt, and performance-based instruments. It enhances cooperation, empowers local stakeholders, supports biodiversity, and creates an investment-ready environment for nature-based and hybrid infrastructure solutions. This positions the Black Sea as a model

for climate-smart watershed-to-coast governance, aligned with the EU Green Deal, regional SRIA, and long-term ecological and economic resilience objectives.

2.4.7 CS7 Southern Denmark

Southern Denmark is at the frontline of Europe's climate vulnerability, facing multi-hazard flood risks exacerbated by sea-level rise, storms, extreme rainfall, and coastal runoff. The region's low-lying coastal areas, critical infrastructure, and iconic ecosystems such as the Wadden Sea require a strategic, integrated financing framework that supports both immediate adaptation and long-term systemic transformation. Anchoring this strategy is Solution S3, which promotes collaboration between government bodies, MDBs, and private actors. This collaboration is seeded through grants and guarantees that support joint coastal risk assessments and investment forums involving municipalities, ports (e.g., Esbjerg), and energy developers. Over the long term, equity instruments can mobilize private capital into nature-based flood protection, hybrid seawall-ecological buffers, and green urban infrastructure for climate-smart urban planning.

Building technical and institutional capacity is essential to move from risk recognition to action. Solution S6, which facilitates support from multilateral development banks (MDBs), ensures access to climate finance and project design support. This is particularly critical in sectors like water management, agriculture, and energy infrastructure, where projects must be engineered for climate variability and cross-sector benefits. Short-term funding through grants and technical assistance prepares pre-feasibility studies, while MDB-backed debt instruments provide long-term, concessional loans for major infrastructure upgrades, including coastal protection schemes, smart drainage systems, and flood-resilient transport corridors.

Monitoring and evaluation frameworks must accompany this investment surge to ensure transparency and performance. Solution S12 introduces adaptive monitoring systems and MRV frameworks that tie financing to measurable flood risk reduction and resilience gains. These systems can initially be implemented through grants and concessional loans and later scaled via results-based financing instruments—rewarding municipalities or private partners for verified reductions in flood risk, enhanced biodiversity in buffer zones, or improved resilience metrics in agriculture and housing. These outcomes help demonstrate climate finance effectiveness, aligning local adaptation with EU performance-based budget initiatives.

Governance remains a cornerstone of this integrated approach. Solutions S14 and S18 simplify application procedures for climate finance and promote international knowledge exchange. These two interventions enable local governments and sectoral actors, especially in agriculture and energy — to reduce transaction costs and build on tested methodologies across Nordic and EU contexts. Short-term support through grants and technical assistance allows municipalities and regional bodies to access larger-scale funding, while long-term debt instruments scale region-wide initiatives, such as renewable-powered floodwater pumping or flood-tolerant crop systems. International collaboration also opens pathways for replicating success stories across North Sea regions.

Community participation and inclusion are addressed through Solution S21, which focuses on empowering local actors and stakeholders in flood and land-use governance. Through participatory planning and co-financing frameworks, residents, farmers, and coastal businesses become co-creators of adaptation strategies. This is initially funded by grants and TA, and gradually shifts to community-backed investment models, such as resilience bonds or local green funds supported by municipal debt or PPPs. This deepens both political legitimacy and social resilience.

To institutionalize resilience and scale cross-sector action, Solutions S24, S30, S34, S35, and S36 deliver the financial system architecture. These solutions work in tandem to enhance fiscal autonomy, track climate finance flows, integrate ecosystem service valuation, and align public budgets with climate

adaptation. Initial grants and technical assistance support fiscal innovation, performance-based budgeting, and MRV adoption. Over time, these tools attract insurance schemes, blended finance, and equity investments into large-scale adaptation corridors, nature restoration, and smart agriculture innovations—particularly within the rural-urban nexus prioritized by the region.

Together, this multi-layered financial approach ensures that Southern Denmark is equipped not only to withstand climate risks, but also to transform them into investment opportunities. Through a strategic combination of short-term capacity support and long-term financial instruments, the region can lead the way in coastal resilience, nature-based flood management, and cross-sector green innovation, anchored in inclusive governance, robust metrics, and future-proof capital flows.

2.4.8 CS8 Torbay and Devon County

Torbay, located on the coast of South Devon, faces significant challenges from recurrent and intensifying flooding, originating from both inland and coastal sources. Rising sea levels, compounded by more frequent storm events, pose threats to the area's infrastructure, water supply, public health, and ecological integrity. The ARSINOE case study provides a comprehensive suite of financing solutions aimed at building long-term resilience through proactive planning, ecosystem-based approaches, and inclusive governance. The foundation lies in Solutions S1, S2, and S3, which promote climate vulnerability assessments, diverse financial instruments, and multi-actor collaboration. These are catalyzed by short-term grants, guarantees, and blended finance, helping the local council, utilities, and communities co-design interventions ranging from permeable pavements to flood-retention landscapes. In the long term, financing shifts to risk transfer mechanisms, equity, and carbon pricing, supporting innovative flood management schemes and blue-green infrastructure.

To implement these strategies, capacity building is essential. Solutions S4 and S5 target technical readiness and pipeline development, equipping stakeholders across water utilities, emergency services, and civil society with the tools and support to translate resilience plans into financeable projects. Technical assistance and grants support training and project design in the short term, while public-private partnerships (PPPs) emerge as suitable instruments for larger interventions like tide gate retrofitting, sewer network upgrades, and energy-resilient pumping stations. This is complemented by Solutions S11 and S12, which bring in long-term climate impact modelling and adaptive monitoring systems. Through concessional loans and results-based finance, the case enables ongoing evaluation of interventions against key indicators like reduced hospitalizations from waterborne diseases or improved uptime of critical transport routes during floods.

The ecosystem and community dimensions are deeply embedded in financial architecture. Solutions S13, S14, and S15 focus on ecosystem services integration, application streamlining, and cross-sector coordination, particularly relevant to Torbay's biodiverse coastal margins and low-lying urban neighborhoods. These interventions enable multi-functional green infrastructure—flood basins that double as parks, or coastal wetlands that absorb wave energy while supporting biodiversity. Short-term grants fund ecosystem valuations and integrated development plans, while long-term debt and PPPs ensure implementation and maintenance. Similarly, Solutions S16 and S17 contribute with risk modelling and data-sharing platforms, ensuring that local actors—from households to health providers—have access to flood forecasts and resilience indicators, building trust and community-wide awareness.

Governance and funding coordination are strengthened by Solutions S19, S22, S23, S24, S31, and S35, which collectively improve policy mainstreaming, investment platform creation, climate finance tracking, fiscal autonomy, and ecosystem service valuation. These create an enabling environment for sustained finance mobilization, institutional accountability, and climate-aligned budgeting at the local level. Grants and technical support are deployed early to establish digital MRV platforms, climate-risk budgeting models, and regional resilience compacts. As these structures mature, blended finance, equity, and

insurance products support the deployment of nature-based flood defenses, retrofitting of critical infrastructure, and catchment-scale stormwater management initiatives.

Altogether, Torbay's financing strategy is built on an integrated, adaptive, and inclusive foundation—aligning short-term support with long-term system transformation. It reflects the complexity of climate impacts in low-lying coastal urban systems and provides a replicable model for other UK and EU municipalities facing similar threats. By coordinating public, private, and civic capital and blending it through a wide spectrum of instruments, the case equips Torbay to not only respond to floods—but to lead in sustainable urban adaptation under a changing climate.

2.4.9 CS9 Sardinia

Southern Sardinia is emblematic of Mediterranean agricultural vulnerability under climate change—characterized by increasing temperatures, erratic rainfall, and land degradation. These pressures severely threaten staple crops like durum wheat, as well as the viability of local food chains, water resources, and rural livelihoods. The ARSINOE case study addresses this challenge through a robust Water-Food-Energy Nexus (WFEN) approach, combining climate-resilient agriculture, renewable energy integration, and nature-based solutions under a sustainable finance framework. Solutions S13 to S15 set the stage by improving access to finance, simplifying application processes, and enabling cross-level governance collaboration. These are supported by grants, technical assistance, and guarantees, which help municipalities, farming cooperatives, and agro-industry actors prepare bankable projects and unlock national and EU climate funds. Long-term instruments such as debt and equity back the implementation of renewable-powered irrigation infrastructure, smart reservoirs, and sustainable food processing technologies.

Central to the region's resilience is the use of predictive climate intelligence and adaptive planning tools. Solution S16 deploys advanced climate risk models, while S26 enables the integration of ecosystem services into investment planning—key to maintaining soil fertility and water availability for crop production. These tools, developed through short-term grants and technical assistance, allow for seasonal risk mapping and hydrological modelling at the catchment level. Over time, long-term debt and results-based financing mechanisms support adaptive land and water management practices like conservation agriculture, micro-irrigation, and water-energy efficient storage systems. These solutions are particularly important for aligning local agricultural practices with broader EU goals for food security, carbon soil sequestration, and circular bioeconomy.

To embed these innovations within governance and fiscal frameworks, the case activates Solutions S19, S22, S23, and S24. These focus on mainstreaming climate adaptation, building investment platforms, and establishing robust MRV systems and budget alignment tools. Initially, this requires short-term grants and TA to train local administrations, improve coordination between agricultural and environmental agencies, and implement digital climate-finance tracking systems. Once institutional capacity is in place, blended finance, equity mechanisms, and insurance can be leveraged to fund cooperative agricultural hubs, regenerative farming pilots, and carbon-sequestering landscape restoration. This approach ensures that adaptation interventions generate measurable environmental, social, and economic outcomes that meet the standards of investors and policy frameworks like the EU Green Deal and the CAP 2023–2027.

Scaling the transition is supported by Solutions S31, S33, S34, S35, and S38, which build fiscal autonomy, aggregate smaller investments into bankable portfolios, and strengthen transparency and valuation of ecosystem services. These are crucial to unlock private sector participation, especially in water infrastructure, off-grid renewable systems, and nature-positive agroforestry. In the short term, grants support the formation of cooperatives, digital MRV platforms, and climate-aligned investment strategies. As these structures evolve, long-term public-private partnerships, insurance schemes, and performance-linked instruments will support Sardinia's shift to autonomous, climate-resilient food and energy systems.

These instruments are particularly well-suited for scaling circular economy innovations—such as organic fertilizers derived from animal by-products—which both address waste and enhance soil biodiversity.

In conclusion, Sardinia's transition from vulnerability to resilience is made possible through a finely tuned blend of institutional strengthening, ecosystem integration, and smart financing. ARSINOE's solutions provide the tools to structure this transition, beginning with technical support and climate intelligence, and evolving toward impact-aligned investment vehicles. This positions Sardinia not only to secure its agricultural and ecological future—but also to serve as a scalable model for Mediterranean regions facing similar climate-induced pressures on food, water, and energy systems.

3.0 Tool to assess readiness and design financing pathways

This manual for sustainable finance aims to provide a comprehensive view of the mechanisms that are available to access and / or leverage finance depending on the context and the need for financing to finance environmentally friendly projects in a timely manner.

Prior to the use of financial instruments, this manual provides to the users some insight on the main stages paving the financial pathway to identify which instruments can be the best fits depending on where an organisation stands in terms of sustainability. This manual aims to provide recommendations to the users to direct its efforts towards the most efficient financial solutions, nevertheless the user of the financial manual should take it as recommendations only, and management decisions as well as investment decisions cannot be taken only based on this manual.

This manual for sustainable finance aims to support the design of financial pathways in understanding the best mix of mechanisms and instruments to address barriers and achieve sustainability by the mid-21st century.

It is prepared in the context of the ARSINOE project and does not aim to be a global sustainable finance manual but to deliver a comprehensive manual based on the results of the use cases and practices in Europe. Nevertheless, the manual provides a comprehensive mapping of financial practices within Europe supporting the user of the manual to better understand the scope of possibilities and provide key insight of the use of the financial instruments.

This tool will also provide support to stakeholders in their way for financing their Adaptation²:

An assessment form to support the decision makers in developing their financing solutions, as described in the manual. Moreover, we offer an assessment so that the other stakeholders can test it outside of ARSINOE context and maximize project's impact. Moreover, we include A simulation to understand their readiness to change as well as a set of recommendations to accelerate their transition and support in defining their financial pathway to support the long-term implementation of their vision. The simulation is based on the actual exercises we performed through ARSINOE.

To enhance the generated reports, we will structure it around four activities which are crucial towards its long term for the implementation

- **Design and Development:** engagement of all parties within the organisation to design and define the action plan on a short, mid and long term to achieve sustainability. Including, and not limited to, committees, local community engagement, research on innovative solutions etc.

² The tools are available here:

- **Structural Investments:** major investments needed to reach environmental neutrality, including machinery, innovative production capacity, installation of new energy systems, etc.
- **Human Capital Expenses:** recurring costs on a multi annual plan to skills and upskills workers and open up to local communities and engage stakeholders in leading actions locally.
- **Management & Monitoring Investment & Expenses:** long term and recurring expenses aiming to create an efficient monitoring system of results and a reward-based organisation towards sustainable decisions, as well as information system and data structure.



Figure 10 Assessment Framework

It is important to highlight that the status of the organisation such as financial stability, market positioning, maturity of service and product as well as regulatory framework can influence each of these stages towards sustainability.

- **The key success factors towards the most efficient financial pathway**

The desk research as well as the use cases conducted in the context of ARSINOE project have highlighted the following key success factors to engage in a financial pathway towards sustainability:

- The importance of policy makers and think tanks, policies can accelerate your change.
- International alignment and collaborations, ensuring to learn and improve faster.
- National policies and regulations, the support of the national government can ease the access to a broader range of instruments, such as guarantees, taxation etc.
- Openness towards research and new processes and materials/products, thinking differently to create a sustainable business model and improve business processes.
- Internal stakeholders to support the transition towards sustainability, relying on your internal human capacity (advisor in sustainability, team in charge of sustainability, etc.).

The transition toward sustainability in any organization or territory begins with a deeply participatory and strategic phase known as design and development. This stage entails the active engagement of all relevant parties—internal departments, governance bodies, and external stakeholders—to co-create a clear and actionable plan that outlines how sustainability goals will be achieved in the short, medium,

and long term. It involves establishing dedicated sustainability committees, consulting with local communities, and initiating research on innovative solutions and best practices. This process is not limited to technical planning; it fosters institutional ownership and ensures that environmental, social, and economic goals are aligned with the region's or organization's identity and future vision. By fostering early and broad-based engagement, the organization builds a credible foundation for sustainability that is robust, inclusive, and well-calibrated to the real challenges and opportunities it faces.

With a roadmap in place, the next step involves structural investments—these are capital-intensive actions needed to transform the physical and technical systems that underpin unsustainable practices. This includes the installation of renewable energy systems, the modernization of machinery to reduce emissions and increase efficiency, and the creation of infrastructure that supports circular economy practices such as water reuse or low-input agriculture. These investments often require significant upfront funding but deliver long-term environmental and operational benefits. They represent the tangible shifts—such as new production facilities, off-grid solar irrigation systems, or decentralized energy networks—that make sustainability goals physically and functionally possible. They often attract blended financing through public subsidies, green bonds, or private equity aligned with climate goals.

Equally important is the investment in human capital, which involves recurring, multi-annual costs related to the development and empowerment of the people driving and sustaining the transition. This includes training and upskilling workers, building local knowledge ecosystems, and engaging communities in active roles throughout the transformation process. It ensures that sustainability is not just a technical fix, but a socially embedded practice that enables inclusive development. Human capital investments also help overcome resistance to change, create green jobs, and foster a culture of innovation. By linking people to purpose and empowering stakeholders at every level—from farmers and technicians to educators and civil society leaders—this component ensures that the benefits of the transition are widely shared, and that the transformation becomes durable over time.

Finally, no sustainability transition can succeed without a strong system of management and monitoring. This includes the design of digital infrastructure and processes to track environmental and social performance, verify outcomes, and adapt based on evidence. These systems also enable reward-based structures within organizations, incentivizing decisions that align with sustainability targets. Long-term and recurring costs are involved in building and maintaining information systems, analytics capabilities, data governance protocols, and reporting mechanisms that meet the expectations of funders, regulators, and citizens. By embedding transparency and accountability, this layer ensures that progress is measurable and credible. It also supports continuous learning and adaptive management, reinforcing a culture where sustainability is not an endpoint, but an evolving commitment rooted in both operational excellence and ethical responsibility.

This model has been developed by AUEB team in the context of the ARSINOE. It aims to help users measure their readiness towards Climate Adaptation and provide you key recommendations to be implemented towards a successful financing pathway (Figure 11).

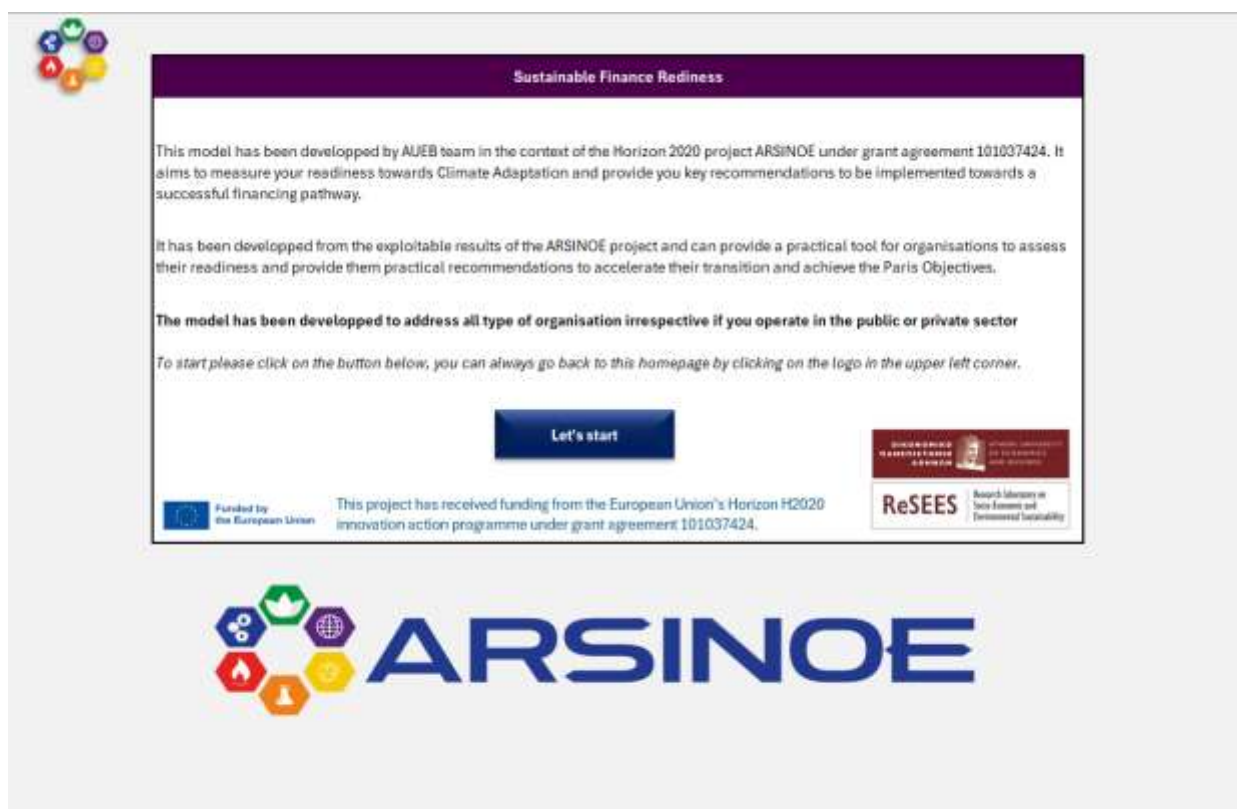


Figure 11 SF_Readiness Tool

Documentation is also embedded on the application, providing further details in relation to the scores used in assessment (Figure 12).



Figure 12 SF_Readiness Tool – Documentation

The tools assist user in performing a self-assessment following the frameworks we develop in the Manual, Figures 13-16) present screenshot of the tool, where the inputs to the assessment are completed to mirror the values provided by Fundacion Valencia port in the relevant assessment through ARSINOE CS2s.

The Ecosystem for Adaptation Finance

In this first part, please fill in all the tables indicating your level of exposure. Make sure all data are filled in, before proceeding.

Hazards	Select the hazards you are exposed to
Heatwaves/ Extreme Heat	high
Droughts (water scarcity & wildfires)	low or not applicable
Floods, heavy precipitation and Storms	medium
Landslides, Snow and Avalanches	low or not applicable
Sea level rise/ coastal erosion/ coastal flooding	medium
Biodiversity and quality loss	low or not applicable
Land Use	low or not applicable
Ecosystem Services	low or not applicable
Economic/financing	medium

Stakeholders importance	Select the most relevant Stakeholders
Public Sector/ Government	high
Public Sector/ Regional Authorities	high
Public Sector/ Local Authorities	medium
Private Sector	medium
Academia	low or not applicable
Non Governmental Organizations (NGO)	low or not applicable
Local Community/ Individuals	low or not applicable

Based on your vision, by when do you expect to achieved resilience ?

2030

Next

Figure 13 SF_Readiness Tool Exercise – Screenshot 1



Back

The Barriers

Barriers to access finance	Select the barriers you are facing
Poor identification of type of adaptation needs and portfolio of financial solutions	medium
Inadequate capabilities of local actors to quantify and attract finance	low or not applicable
Regions and Firms do not meet the criteria for Finance	low or not applicable
Poor evaluation of adaptation finance needs	high
No identification of funding opportunities and procedures, EU projects, complex mechanisms	low or not applicable
Inadequate estimation of financing needs for adaptation and financial opportunities	low or not applicable
Adaptation Needs not high in Priorities	high
Lack of mechanism to identify and assess investment plans	low or not applicable

Barriers to leverage finance	Select the barriers you are facing
Lack of a bankable investment project, planning and mobilizing diverse stakeholders at the regional and national level	low or not applicable
Financial resources allocated to targets other than adaptation, conflicts with other more pressing development issues	high
Low presence of innovative firms and innovation systems to apply complex adaptation (transformational) solutions	low or not applicable
Poor dissemination due to lack of infrastructure to facilitate synergies	low or not applicable
Poor estimation of budget allocations required and inability to shape public-private solutions	medium
Allocation of scarce financial resources to other projects, time frame and conflicted scales	medium
No identification of actors (private & research sector) to efficiently design, implement and monitor an adaptation project	low or not applicable
Poor identification of actors to engage, inadequate design of bankable adaptation projects	low or not applicable
Mismanagement of Funds, lack of willingness to act and pay	low or not applicable

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Figure 14 SF_Readiness Tool Exercise – Screenshot 2



The Opportunities

Financing Sources	Availability of the below sources
European Institutions	high
National Level Public Entities	high
Regional and sub-national government entities	low or not applicable
Bank Financing	low or not applicable
Businesses	low or not applicable
Households / Individuals	low or not applicable
Capital Market Financing	low or not applicable
Community Entities	low or not applicable
Asset Owners/ Institutional Investors	low or not applicable
Private Investors	low or not applicable
Any Combination of the Above	low or not applicable

Financial Instruments	Availability of the below instruments
Grants	high
Debt	low or not applicable
Results Based Financing	low or not applicable
Equity	low or not applicable
Blended Finance	low or not applicable
Land Use Capture	low or not applicable
Taxation	low or not applicable
Risk Mitigation Coverage	low or not applicable
Fees/ User Charges	low or not applicable
Non-Financial Instruments	low or not applicable
Non-Monetize Inputs	low or not applicable

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Figure 15 SF_Readiness Tool Exercise – Screenshot 3



Solutions as regards to the challenges identified	Likelihood of the solutions
Strengthen climate vulnerability assessments to identify specific needs	medium
Develop a diverse portfolio of financial instruments tailored to adaptation	high
Foster collaborations between governments, development banks, and private sector actors	medium
Implement standardized methodologies for assessing adaptation finance needs	high
Use long-term climate impact projections and scenario planning to evaluate financing requirements	low or not applicable
Establish frameworks for continuous monitoring, reporting and evaluation of adaptation interventions to ensure their financial efficiency	medium
Mainstream climate adaptation in national development planning and budgeting	medium
Increase advocacy for adaptation as a critical aspect of sustainable development goals (SDGs)	low or not applicable
Engage in dialogues with international funding bodies to prioritize adaptation in climate finance allocations	low or not applicable
Clear regulations against the green washing	low or not applicable
Provide visibility to citizens on the ESG score of products	low or not applicable
Conduct a comprehensive review of current financial allocations and introduce mechanisms that prioritize adaptation needs	medium
Develop policies that ensure a portion of climate finance is ring-fenced for adaptation projects	medium
Ensure long-term financial commitments for climate resilient infrastructure and systems	medium
Improve the accuracy of financial estimates for adaptation projects by applying advanced modeling tools	low or not applicable
Promote public-private partnerships (PPPs) that incentivize private sector investment in adaptation initiatives through risk-sharing mechanisms and	medium
Advocate for the reallocation of financial resources by raising awareness among policymakers and stakeholders about the critical need for adaptation	high
Establish financial tracking mechanisms to ensure that adaptation projects receive the necessary funding	high

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Figure 16 SF_Readiness Tool Exercise – Screenshot 4

After the evaluations, a report with recommendations is printed to help users optimize their pathways (Figures 17, 18).



In ARSINOE D7.3 we made an introduction to natural capital, ecosystem services and models/methods to assign monetary values to externalities, in the context of designing a Choice experiment for CS1 Athens case study.

3.1 Social Cost Benefit Analysis

ARSINOE Deliverable 7.5

equipment; indirect costs like administrative and operational overheads; and non-monetary costs that may include environmental damage or social disruption, which are often harder to quantify.

In parallel, SCBA distinguishes between different types of benefits. These include direct and measurable gains such as increased economic output, indirect benefits like improved public health or reduced travel time, and intangible benefits such as a better quality of life or enhanced ecosystem health. A fundamental principle in this analysis is the use of a discount rate, which adjusts future benefits and costs to their present value, reflecting the concept that money and value today are worth more than the same amounts in the future. Notably, different discount rates may be applied depending on whether the values are market-based (tangible) or relate to non-market outcomes (intangible or ecosystem services).

The analysis is carried out over a defined time horizon, which determines the duration over which projected costs and benefits are considered. At its core, SCBA involves calculating the Net Present Value (NPV) of an intervention—this is derived by subtracting the discounted value of total expected costs from the discounted value of total expected benefits (eq 1). A positive NPV indicates that the intervention is likely to generate a net benefit for society.

$$NPV_0 = NPV_m + NPV_{nm} \text{ (eq1)}$$

The Net Present Value of market-related benefits and costs (NPV_m) is determined by summing, over the defined time horizon, the discounted net profits (revenues minus operating expenses), and then subtracting the initial capital investment (eq2). This calculation applies to a market discount rate, typically based on a short-term interest rate, e.g. 3-month EURIBOR.

$$NPV_m = \sum_{t=1}^{T-1} \frac{Profits_t - Cost_t}{(1 + r_m)^t} - Initial\ Cost_0 \text{ (eq2)}$$

The Net Present Value of non-market benefits and costs (NPV_{nm}) is calculated in a similar manner, using the Total Private Benefits (TPB) as the basis, but applying Time Declining Discount Rates (DDR). This approach reflects the idea that future benefits—particularly those related to long-term challenges like climate change—should be valued more highly over time (eq3). The use of DDRs accounts for intergenerational equity and acknowledges that the importance of benefits accruing to future generations justifies applying lower discount rates to longer time horizons.

$$NPV_{nm} = \sum_{t=0}^T \frac{TPB_t}{(1 + r_s)^t} \text{ (eq3)}$$

The concept of a declining discount rate in social cost-benefit analysis addresses the need to more accurately evaluate long-term projects—particularly those related to climate change adaptation—that impact future generations. Unlike traditional approaches that apply a constant discount rate, which can heavily downplay the value of future benefits and costs, the declining discount rate method gradually lowers the rate over time. This ensures that outcomes affecting future generations, and the long-term sustainability of ecosystems are given greater weight in present-day decision-making. This approach reflects ethical and intergenerational considerations by emphasizing a fairer valuation of future well-being and environmental integrity. It responds to concerns that constant high discount rates undervalue climate resilience, natural capital, and other long-horizon benefits. In this analysis, three alternative discount rate scenarios are used: the rates proposed by Florio et al. (2013), Tajani et al. (2023), and a moderate rate representing the average of the two. Each scenario applies a declining discount rate methodology as outlined by Koundouri et al. (2008), ensuring consistency with best practices in sustainable economic evaluation.

In case of externalities, TSB_t is not observed and needs to be estimated. Typically,

$$TSB_t = \widehat{WTP_t} N_t (eq4)$$

where N denotes the number of individuals and WTP , the individual's marginal willingness to pay for an incremental improvement for specific attributes of the underlying nonmarket goods. In ARSINOE we use Choice experiments to estimate WTP .

Based on Lancaster's (1966) theory of value, which emphasizes the characteristics of goods, a choice experiment assumes that any product or service can be represented as a set of attributes, each with specific levels. The associated utility function generally follows the structure:

$$U_{i,j} = V_{i,j}(X_{i,j}) + \varepsilon_{i,j} \quad (eq5)$$

Where, $V_{i,j}(X_{i,j}) = f(X_{i,j})$ is the deterministic component, function of a vector of k attributes for the j th alternative: $X_{i,j}$

Usually, $f(X_{i,j})$ is assumed linear, so $f(X_{i,j}) = \beta X_{i,j}$, where β a vector of k parameters.

$\varepsilon_{i,j}$ stochastic element, which represents unobservable influences on individual choice.

The probability that an individual prefers option $g \in J$, to any alternative option $h \in J$, can be expressed as the probability that the utility associated with option g exceeds that associated with all other options

$$Pr[(U_{i,g} > U_{i,h}) \forall g \neq h] = Pr[(V_{i,g} - V_{i,h}) > (\varepsilon_{i,h} - \varepsilon_{i,g})] \quad (eq6)$$

$\varepsilon_{i,j}$ is independently and identically distributed with an extreme-value (Weibull) distribution:

$$Pr(\varepsilon_{i,j} \leq t) = \exp(-\exp(-t)) \quad (eq7)$$

The above distribution of the error term implies that the probability of any particular alternative g being chosen as the most preferred can be expressed in terms of the logistic distribution (multinomial logit model)

$$Pr[(U_{i,g} > U_{i,h} \forall g \neq h)] = \frac{\exp(V_{i,g})}{\sum_{j=1}^J \exp(V_{i,g})} \quad (eq8)$$

Multinomial Logit Model can be estimated by maximum likelihood procedures, with the respective log-likelihood function:

$$\log L = \sum_{i=1}^N \sum_{j=1}^J y_{i,j} \log \left[\frac{\exp(V_{i,g})}{\sum_{j=1}^J \exp(V_{i,g})} \right] \quad (eq9)$$

Where $y_{i,j} = 1$ if individual, i , chooses option j , and zero otherwise. The marginal benefit (Marginal Willingness to pay) for the k th attribute:

$$MWTP_k = -\frac{b_k}{b_c} \quad (eq10)$$

Where b_k and b_c the maximum likelihood estimates of (eq9).

In ARSINOE, and specifically through the work in Task 6.4, we are employing Choice experiments to estimate equations 9 and 10. Then equation 4 can be estimated and the Total Private Benefit could be estimated, and it can be linked with various instruments and interventions.

3.2 Financial Instruments linked to ecosystem services and externalities

From the exhaustive list of financial instruments included in our framework and SFR, several can be linked to externalities and valuation.

Public financing instruments play a foundational role in supporting the valuation and preservation of ecosystem services. Grants and **subsidies** are often the initial source of funding for ecosystem-related initiatives, especially during early-stage conservation, restoration, or the implementation of nature-based solutions. These funds typically support ecological assessments, stakeholder consultations, and pilot projects. Subsidies may also be directed toward landowners or farmers who manage ecosystems that deliver public goods such as biodiversity conservation or carbon sequestration. **Results-based** aid further advances this approach by providing payments only when ecosystem-related outcomes—such as improvements in water quality or reforestation—are achieved and verified. Social cost-benefit analysis (SCBA) helps define these outcomes and structure appropriate performance metrics or sets the relevant prices directly. In parallel, **green budgeting** and public investment programs allow governments to integrate ecosystem valuation into their fiscal planning and infrastructure development strategies.

Market-based instruments also rely heavily on ecosystem valuation to function effectively. **Payments for ecosystem services (PES)** schemes offer conditional incentives to those who maintain or enhance the functioning of ecosystems, such as through water conservation, pollination, or carbon capture. The valuation of ecosystem services is central to determining appropriate payment levels and tracking environmental performance. Similarly, **environmental taxes and fees** are designed to internalize externalities by imposing costs on activities that damage ecosystems, such as carbon emissions or water overuse. These fees are informed by studies that estimate the true social cost of environmental degradation. **Tradable permits** and quotas, such as carbon credits or biodiversity offset certificates, also depend on ecosystem valuation to establish baselines and ensure market integrity. These instruments incentivize sustainable practices by assigning economic value to ecosystem conservation and restoration.

Blended finance instruments create synergies between public and private capital to scale up ecosystem-based investments. **Public-private partnerships (PPPs)** are often employed to co-finance green infrastructure, such as wetlands that serve both flood protection and biodiversity functions. SCBA plays a crucial role in quantifying the societal benefits that justify public contributions to such partnerships. **Guarantees and risk-sharing mechanisms** offered by development banks or public agencies help attract private investment by covering initial losses or credit risk, with valuation enhancing confidence in projected ecosystem returns. **Concessional loans and green credit** lines—offered at below-market rates—also benefit from SCBA, which supports the economic case for long-term investments in interventions like watershed restoration or agroforestry that yield non-market benefits.

Investment and capital market instruments are increasingly aligned with ecosystem services, particularly through green financial products. **Green bonds** and **climate bonds** are used to fund projects with environmental benefits, including nature-based solutions, which is one of the key topics in CS1 Athens. Ecosystem valuation supports the selection of eligible projects and the reporting of measurable impact metrics. **Sustainability-linked bonds and loans** tie financial conditions to environmental performance indicators, such as improved water quality or habitat restoration, which are derived from SCBA frameworks. **Natural capital investment funds** channel capital into projects that conserve or enhance ecosystem services, such as regenerative agriculture or rewilding initiatives. The financial structure of these funds is supported by SCBA, which helps quantify co-benefits to biodiversity, climate resilience, and livelihoods. Impact investors and ESG-focused portfolios also use SCBA to evaluate and report on the environmental and social dimensions of their investments.

Insurance and risk transfer instruments represent another important category. Resilience bonds and catastrophe bonds link climate risk reduction to ecosystem restoration efforts, such as mangrove planting

to reduce coastal storm surge impacts. Valuation provides the evidence needed to price these instruments and measure avoided losses. Insurance-backed restoration models allow insurers to co-finance ecosystem interventions that reduce their exposure to risk. SCBA helps insurers understand and quantify the return on investment from natural infrastructure. **Parametric insurance products** offer payouts based on predefined environmental indicators, such as rainfall or soil moisture levels. The design of these indices and their link to societal outcomes relies on robust valuation of ecosystem services.

Finally, **philanthropic funding, voluntary markets**, and emerging innovative instruments are increasingly influenced by ecosystem valuation. **Biodiversity offsetting** and **habitat banking schemes** allow developers to fund conservation in exchange for residual impacts elsewhere, with valuation ensuring ecological equivalence. In voluntary carbon markets, nature-based projects generate credits for carbon sequestration and other co-benefits, which are priced and certified based on SCBA methodologies. **Social impact bonds (SIBs)** and **environmental impact bonds (EIBs)** enable private investment in ecosystem restoration, with returns linked to performance-based outcomes. Digital innovations, such as tokenized natural capital or blockchain-based tracking systems, also rely on robust valuation frameworks to represent ecosystem assets and flows transparently. SCBA thus serves as the analytical foundation for a growing array of financial instruments that recognize, invest in, and protect the value ecosystems provide to society.

In ARSINOE Task 6.4, we will demonstrate the design of a series of financial instruments to support the financing pathways of the Athens case study. This will be based on the Choice Experiment developed in Task 7.3, as well as the theoretical foundations and frameworks established in Task 7.5.

4.0 Hybrid Financial Reporting Model

ARSINOE D7.4, developed a Hybrid Financial Reporting Model to holistically evaluate ESG and SDG performance in companies.

In D7.5 we describe the implementation of the model for ARSINOE CS2, as well as its specifications for targets and Key performance Indicators KPIs. The model is also included in the suite of tools bundled in the manual (Figure 19).

4.1 Key performance Indicators



Figure 19 Manual for Sustainable Finance – Hybrid Financial Reporting Model (HFRM)

The final version of the HFRM for ports contains a total number of 75 KPIs, classified under four Pillars: Environment (13), Social (12), Governance (44) and Financial (6). Table 1 reports the Material issues identified under each pillar as well as the number of KPIs included in each material issue.

Table 1 HFRM – Material Issues and KPIs

Pillars	Material Issues	# KPIs
Environmental	Biodiversity	2
	Climate Change and Environment	4
	Energy, Emissions and Energy Efficient Buildings	2
	Water Management	1
	Environment - Ports Specific	2
	Waste, Material and Hazardous Material Management	2
Financial	Accounting	6
Social	Community Support & Social Contribution	1
	Diversity, Equality & Inclusion	1
	Employees, Training and Development	7
	Social - Ports Specific	2
	Suppliers & Outsourcing	1
Governance	External Reporting, Regulatory Compliance and Communication	8
	External Stakeholder Engagement	8
	Governance - Ports Specific	10
	Highest Governance Body and Committees	8
	Information systems and cybersecurity	3
	Policies	5
	Remuneration	2

In relation to the format of the total 75 KPIs, 31 are numerical, 43 binary and one is categorical. Appendix Table 1 presents all KPIs used in the analysis.

4.2 Targets

HFRM allows users to input their own targets for all KPIs, except in the case of binary indicators, where the lower and upper bounds are automatically set to [0, 1]. To define the KPI targets, we applied a Policy Target approach. Specifically, for all 31 numerical KPIs, the optimal value or target was established based either on existing binding policies or on commonly accepted practices reflected in non-binding policy guidelines (e.g., setting the number of accidents to zero, even if not mandated by an active regulation).

The Key Performance Indicators (KPIs) for port operations and sustainability in the ARSINOE project are grounded in internationally recognized policy targets, institutional best practices, and economic performance benchmarks. The first KPI addresses carbon emissions, setting a target of a 20% reduction by 2025 relative to 2015 levels, or alternatively, maintaining emissions below 0.04 tCO₂e per cargo unit. This aligns with the goals of the European Green Deal and the IMO GHG Strategy. Similarly, the percentage of energy consumed from renewable sources is targeted to reach at least 50% by 2030, in line with the EU Renewable Energy Directive and broader decarbonization objectives. Waste reduction is also a major focus. Non-hazardous waste generation is to be reduced by 30% and hazardous waste by 50% by 2025, reflecting the EU Waste Framework Directive and related legislation designed to promote circular economic principles and minimize public health risks.

Financial and operational targets include allocating at least 3% of the annual budget to environmental protection, with reference to the best practices among European port authorities. Turnover is expected to grow annually by at least 5%, and the EBIT margin should reach a minimum of 15%, which are both indicators of sustainable financial performance based on sources such as the OECD Maritime Outlook and Drewry research. Additionally, ports are encouraged to increase revenue per cargo unit by 10% and reduce expenses per cargo unit by the same margin by 2025, promoting operational efficiency and cost competitiveness. Net profit per cargo unit is expected to achieve a 10% margin, while return on equity (ROE) should be maintained at 12%, supporting long-term financial sustainability. These financial benchmarks are justified through international port and economic analysis provided by institutions such as UNCTAD, PIANC, and the World Bank.

Infrastructure-related KPIs focus on terminal capacity and vessel handling. By 2030, terminals should support a draught of at least 16 meters and berth lengths of 400 meters, accommodating larger vessels. Vessel size targets include an average gross tonnage of 50,000 GT by 2030. Cargo throughput targets span different modalities: a minimum 5% year-on-year increase in TEU (container) volume, 3% annual growth in both solid and liquid bulk, and a 4% increase in intermodal transport units. These targets reflect competitiveness, cargo diversification, and improved connectivity as recommended by international bodies like IMO, World Bank, and the European Commission on Intermodal Transport. The number of ferry passengers and cruise ship passengers is also targeted to grow by 5% annually, which supports maritime tourism and regional development according to data from Eurostat and CLIA.

Land use efficiency is measured through tons handled per hectare, with a target of 50,000 tons per hectare by 2025. Regular ESG reporting is essential, with a communication frequency of at least every three months to improve accountability and stakeholder engagement. Gender and social inclusion are emphasized, with a target of at least 40% female representation in governance bodies by 2030 and a 50–50 parity between permanent and temporary contracts. The temporary employment rate should be capped at 10% to foster stable employment conditions. These indicators align with frameworks such as SDG 5 and are based on recommendations from the ILO and the European Commission’s Gender Balance guidelines.

Employment and labor force metrics include generating a 3% annual increase in direct jobs and a 2% increase in indirect employment, supporting broader economic development. Training is another priority, with a requirement of at least 20 hours of annual training per employee to ensure a skilled, adaptive workforce. Labor productivity is expected to improve by 10% from the baseline by 2025. Lastly, safety at work is critical, with the number of workplace accidents capped at one per million hours worked. These human capital and safety indicators are aligned with ILO and World Bank standards, including the ILO OSH Convention, reflecting the importance of workforce development, equity, and occupational health in resilient port ecosystems. Appendix Table 2 presents all KPIs, targets and sources, together with links.

4.3 Inputs

Users can provide three types of input: update current data, set targets (optional), and define baseline data (optional). Providing current data is mandatory, while the model will internally manage targets and baseline values if they are not specified. By default, model uses 2020 for baseline values.

4.4 Results

HFRM provides a comprehensive assessment of ESG performance and progress in relation to the Sustainable Development Goals (Figure 20).



Figure 20 HFRM Dashboard – ARSINOE CS2 Valencia Port

The overall ESG score is 77.96, which places the project in the third-highest ranking tier, indicating a solid performance with significant potential for improvement in specific areas. Among the ESG pillars, environmental performance is the weakest, with a score of 53.51. Key environmental material issues such as biodiversity, waste and hazardous material management, and diversity, equality and inclusion received scores of zero. While climate change and environment, as well as energy and emissions, scored moderately at 75 and 65.19 respectively, the overall environmental profile remains underdeveloped. Interestingly, the category "Environment – Ports Specific" achieved a perfect score of 100, reflecting a strong focus on environmental practices directly linked to port operations, but also highlighting the need to expand environmental efforts beyond these operational boundaries.

The financial pillar, with a score of 67.95, shows a competent but not outstanding performance. Categories such as accounting and policy received positive evaluations, while areas like remuneration, scoring only 50, and other compliance-related dimensions suggest inconsistency in financial governance. The social pillar is stronger, with a score of 77.41. High scores in employee training and development, community support, and port-specific social performance show an investment in human capital and local engagement. However, a score of zero in diversity, equality, and inclusion is a significant gap, indicating that inclusivity in hiring, promotion, and governance structures is not yet integrated. Remuneration and supplier outsourcing also scored modestly, suggesting that social sustainability within extended networks needs attention.

Governance stands out as the strongest ESG dimension, scoring 86.71. Governance-specific material issues such as oversight by top committees, information systems and cybersecurity, and external stakeholder engagement received top scores or were close to perfect. This reflects maturity in institutional capacity, transparency, and resilience. Regulatory compliance and ESG communication were also particularly strong, underlining a high level of strategic alignment and reporting standards. In the material issues breakdown, multiple categories scored 100, particularly in port-specific and governance-related topics. These include community support, highest governance bodies, and cybersecurity. However, the existence of several zero scores—especially in biodiversity and hazardous waste—creates stark contrasts in performance and highlights areas requiring urgent policy development.

The alignment with the Sustainable Development Goals (SDGs) demonstrates mixed results. High-scoring SDGs include Goal 5 on gender equality, Goal 7 on clean energy, Goal 8 on economic growth, and Goal 9 on infrastructure and innovation, all of which are supported by strong social and operational data. Training and education align with Goal 4 and are reflected in a score of 62.5. Medium-level scores are seen in Goals 10, 11, and 12, linked to inequality, sustainable cities, and responsible consumption. These reflect partial progress but also the impact of underperformance in areas such as waste management and inclusivity. Lower-scoring SDGs include Goal 13 on climate action, which scores just 25.33, indicating

a significant gap in broader climate mitigation efforts. Similarly, Goals 16 and 17, which relate to institutional integrity and partnerships, are underperforming, reflecting a lack of engagement in global cooperation and inter-institutional collaboration. While Goals 14 and 15, relating to life below water and life on land, show scores above 70, this may largely reflect port-centric environmental activities rather than comprehensive biodiversity protection, which remains unaddressed as shown by the zero-biodiversity score.

In conclusion, Valencia Port demonstrates clear strengths in governance, stakeholder engagement, and port-specific environmental and social practices. However, it also shows major weaknesses in broader environmental strategy, social inclusion, and intergenerational climate commitments. Biodiversity, hazardous waste, and diversity remain critical blind spots, which are mirrored in lower SDG scores for climate action, institutional cooperation, and long-term sustainability. Future actions should focus on enhancing environmental stewardship beyond operational compliance, embedding diversity and equality frameworks, and fostering external partnerships to strengthen alignment with the full spectrum of the SDGs. The results underscore that while there is solid infrastructure and governance capacity in place, the transformation toward inclusive, holistic, and climate-resilient sustainability remains an ongoing process.

The ESG and SDG results of the CS2 case demonstrate a strong foundation in governance and port-specific social and environmental management, with high marks in oversight, stakeholder engagement, and sector-relevant sustainability. However, critical weaknesses exist in biodiversity, waste management, and diversity, equality, and inclusion, which limit environmental and social progress. These shortcomings are mirrored in low performance across several SDGs, especially those linked to long-term climate action and equity. Going forward, strategic attention should focus on integrating biodiversity action plans, establishing inclusive employment frameworks, and scaling environmental management beyond operational compliance. Strengthening collaboration and partnership-based strategies will also be essential to enhance SDG 17 and build holistic resilience envisioned by the ARSINOE framework.

5.0 Conclusions and Next Steps

The ARSINOE Manual on Sustainable Finance emphasizes the central role that tailored financial instruments, and integrated frameworks play in achieving climate adaptation goals. The project has successfully translated conceptual frameworks into operational tools, facilitating the design of financing pathways grounded in case study-specific contexts. These tools—such as the Sustainable Finance Registry (SFR), the Sustainable Finance Readiness Tool (SFReadiness), and the Hybrid Financial Reporting Model (HFRM)—are now available to stakeholders as part of a structured approach to align policy goals, stakeholder engagement, and financing strategies. The manual highlights that the ARSINOE approach has moved beyond theory, equipping regional actors with the capacity to co-develop sustainable finance solutions that reflect local priorities, risks, and investment profiles.

Next steps include the implementation and iterative refinement of these tools through continuous engagement with local stakeholders. This entails institutionalizing the models developed under the ARSINOE framework into public sector planning, particularly integrating the Hybrid Financial Reporting Model into local governance mechanisms to monitor ESG and SDG-related outcomes. The financial instruments identified and their associated pathways—such as grants, debt, blended finance, and risk transfer mechanisms—must now be translated into actionable investment plans through capacity building, technical assistance, and inclusive financing mechanisms. The manual also suggests prioritizing investment-readiness efforts, especially through structured project preparation facilities, which will support the scaling of nature-based solutions, green infrastructure, and climate-resilient public services.

In the next step, WP6 Task 6.4 will bundle together the financing pathways developed through WP7, policy pathways through WP2 and Innovation pathways from WP5 and 6, into Innovation packages, supplemented with the design of financial instruments for Athens.



References

Florio, Massimo and Sirtori, Emanuela, The Social Cost of Capital: Recent Estimates for the EU Countries (2013). Available at SSRN: <https://ssrn.com/abstract=2723379> or <http://dx.doi.org/10.2139/ssrn.2723379>

Koundouri, P., Gollier, C. & Pantelidis, T. (2008). Declining discount rates: Economic justifications and implications for long-run policy. *Economic Policy*, 23(56), 758-795

Lancaster, K.J. (1966) A New Approach to Consumer Theory, *Journal of Political Economy*, 74, 132-157.

Tajani, F., Anelli, D., Di Liddo, F. and Morano, P. (2023), "An innovative methodology for the assessment of the social discount rate: an application to the European states for ensuring the goals of equitable growth", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/SASBE-12-2022-0274>



Appendix

Table 2 HFRM – Key Performance Indicators (KPIs)

Material Issues	KPI
Biodiversity	Existence of Invasive Species from Ballast Water
Biodiversity	Biodiversity Action Plan
Climate Change and Environment	Annual Resources Allocated to Environmental Protection to Turnover
Climate Change and Environment	Adapting to Climate Change
Climate Change and Environment	Decarbonization programme in place
Climate Change and Environment	Compliance with environmental national and international regulation
Energy, Emissions and Energy Efficient Buildings	Carbon Footprint: Total greenhouse gas emissions with respect to cargo handled (T CO ₂ Eq)
Energy, Emissions and Energy Efficient Buildings	Percentage of energy consumption from renewable sources
Water Management	Annual Water Consumption (m ³)
Environment - Ports Specific	Port resilience in disasters
Environment - Ports Specific	Implementation of the Environmental Management System
Waste, Material and Hazardous Material Management	Port non Hazardous Waste Generated (other than MARPOL, T)
Waste, Material and Hazardous Material Management	Port Hazardous Waste Generated (other than MARPOL, T)
Accounting	Turnover
Accounting	EBIT Margin
Accounting	Revenue per Cargo Unit
Accounting	Expenses per Cargo Unit
Accounting	Net Profit for the Fiscal Year per Cargo Unit
Accounting	ROE
Community Support & Social Contribution	Volunteering plan in place
Diversity, Equality & Inclusion	Gender Parity by Type of Contract (Female)
Employees, Training and Development	Temporary Employment Rate
Employees, Training and Development	Volume of Direct Jobs Generated
Employees, Training and Development	Training of Human Capital (Per Employee)
Employees, Training and Development	Productivity per Employee
Employees, Training and Development	Annual Frequency of Accidents (Per Mil Hour Worked)

Material Issues	KPI
Employees, Training and Development	Employee wellbeing programme
Employees, Training and Development	Exclusion of child and compulsory labor
Social - Ports Specific	Measures to reduce or eliminate illegal activity at the ports
Social - Ports Specific	Facilities for people with special needs
Suppliers & Outsourcing	Volume of Indirect Jobs Generated
External Reporting, Regulatory Compliance and Communication	Frequency of progress communication regarding ESG and KPIs (months)
External Reporting, Regulatory Compliance and Communication	The port authority publishes annual accounts
External Reporting, Regulatory Compliance and Communication	Audits of annual accounts are carried out by an external auditor
External Reporting, Regulatory Compliance and Communication	Port fees are publicly available
External Reporting, Regulatory Compliance and Communication	Port traffic data is published on a regular monthly/quarterly basis
External Reporting, Regulatory Compliance and Communication	Public complaints, adverse media coverage or NGO campaigns on ESG issues in the last five years
External Reporting, Regulatory Compliance and Communication	Non-financial information disclosure
External Reporting, Regulatory Compliance and Communication	Grievance mechanisms for external stakeholders
External Stakeholder Engagement	The port authority leads sectoral partnerships involving other managing bodies
External Stakeholder Engagement	The port authority participates in joint projects with other port bodies
External Stakeholder Engagement	The port authority runs joint projects with other managing bodies
External Stakeholder Engagement	The port authority participates in sectoral partnerships with other managing bodies
External Stakeholder Engagement	There is a Port Centre open to inhabitants who wish to find out how it works and what projects are carried out
External Stakeholder Engagement	The port authority promotes cultural/leisure activities for citizens
External Stakeholder Engagement	The port authority provides port spaces for public use

Material Issues	KPI
External Stakeholder Engagement	The port authority carries out activities to foster relations with neighbouring populations
Governance - Ports Specific	Maximum Terminal Draught (m)
Governance - Ports Specific	Maximum Berthing Length (m)
Governance - Ports Specific	Average gross tonnage (GT)
Governance - Ports Specific	Total Cargo Handled (TEU)
Governance - Ports Specific	Total Cargo Handled (SLD BLK)
Governance - Ports Specific	Total Cargo Handled (LQD BLK)
Governance - Ports Specific	Total Cargo Handled (ITU)
Governance - Ports Specific	Total Number of Ferry Passengers
Governance - Ports Specific	Total Number of Cruise Ship Passengers
Governance - Ports Specific	Tons per Hectare
Highest Governance Body and Committees	Women within the organisation's governance bodies (%)
Highest Governance Body and Committees	The port authority has its own legal status
Highest Governance Body and Committees	The port authority can outsource the provision of port services to third parties
Highest Governance Body and Committees	The port authority is a public entity
Highest Governance Body and Committees	The port authority participates in sectoral partnerships with other managing bodies
Highest Governance Body and Committees	The port authority contributes to or oversees the resolution of maritime access operational/service bottlenecks as well as administrative bottlenecks
Highest Governance Body and Committees	Staff or officer for ESG topics daily management
Highest Governance Body and Committees	Processes in place for the highest governance body to ensure conflicts of interest are avoided and managed
Information systems and cybersecurity	The port authority manages an Information and Communication Technology (ICT) system for the benefit of the port community
Information systems and cybersecurity	Existence of a Security System in the Supply Chain
Information systems and cybersecurity	Existence of an Information Security Management System

Material Issues	KPI
Policies	The port authority develops its own Master Plan
Policies	The port authority has a Business Continuity Plan
Policies	ESG criteria in the suppliers' code
Policies	Anti-corruption / Anti-bribery policy
Policies	Codes or policies addressing harassment, discrimination, intimidation and workplace violence
Remuneration	ESG performance in the HGB and senior executives remuneration policy
Remuneration	Remuneration policy disclosure

Table 3 HFRM – Goals

KPI	Policy-Based Target	Justification	Source	Source Link
1. Carbon Footprint: Total greenhouse gas emissions (T CO₂ Eq per cargo unit)	20% reduction by 2025 relative to a 2015 baseline <i>or</i> ≤ 0.04 tCO ₂ e per cargo unit	Aligns with EU Green Deal and IMO GHG Strategy to reduce maritime emissions.	European Commission & IMO	European Green Deal IMO GHG
2. Percentage of energy consumption from renewable sources	≥ 50% renewable energy consumption by 2030	Reflects ambitions under the EU Renewable Energy Directive and global decarbonization goals.	European Commission	EU Renewable Energy
3. Port non Hazardous Waste Generated (other than MARPOL)	Reduce non-hazardous waste by 30% by 2025 (or ≤ 0.5 kg per cargo unit)	In line with the EU Waste Framework Directive and Circular Economy Action Plan aiming to minimize waste.	European Commission Waste Framework Directive	EU Waste Framework Directive
4. Port Hazardous Waste Generated (other than MARPOL)	Reduce hazardous waste by 50% by 2025 relative to a 2015 baseline	Reflects stricter hazardous waste management to mitigate environmental and public health risks.	EU Waste Legislation	EU Waste Legislation
5. Annual Resources Allocated to Environmental Protection	Allocate at least 3% of the annual operating budget to environmental measures	Ensures a dedicated funding stream for sustainability improvements in line with best practices among European ports.	European Port Authorities Best Practices	NAPA Group
6. Turnover	Achieve a minimum annual turnover growth rate of ≥ 5%	Indicates sustainable financial performance and competitiveness in port operations.	OECD Maritime Outlook	OECD Maritime
7. EBIT	Target an EBIT margin of ≥ 15%	Reflects robust operational efficiency and profitability.	Drewry Maritime Research	Drewry
8. Revenue per Cargo Unit	Increase revenue per cargo unit by ≥ 10% from baseline by 2025	Encourages value-added services and improved operational efficiency.	World Bank	World Bank – Transport
9. Expenses per Cargo Unit	Reduce expenses per cargo unit by 10% from baseline by 2025	Enhances cost efficiency and competitive positioning.	OECD Port Economic Studies	OECD Transport

KPI	Policy-Based Target	Justification	Source	Source Link
10. Net Profit for the Fiscal Year per Cargo Unit	Achieve a net profit margin of $\geq 10\%$	Supports reinvestment in port infrastructure and sustainable operations.	UNCTAD	UNCTAD Transport
11. ROE	Maintain a Return on Equity (ROE) of $\geq 12\%$	Indicates effective use of shareholder capital.	PIANC	PIANC
12. Maximum Terminal Draught (m)	Ensure a terminal draught of ≥ 16 m by 2030	Allows accommodation of larger, modern vessels (e.g., Panamax vessels).	International Maritime Organization (IMO)	IMO Ship Design
13. Maximum Berthing Length (m)	Provide a berthing length of ≥ 400 m by 2030	Enables handling of larger container ships and modern cruise vessels.	World Bank	World Bank – Ports
14. Average Gross Tonnage (GT)	Target an average vessel size of $\geq 50,000$ GT by 2030	Reflects the capacity to attract larger, more efficient vessels.	Clarksons Research	Clarksons
15. Total Cargo Handled (TEU)	Achieve $\geq 5\%$ year-on-year (yoy) growth in TEU throughput	Measures competitiveness and capacity expansion in container handling.	Drewry Container Terminal Reviews	Drewry
16. Total Cargo Handled (SLD BLK)	Achieve $\geq 3\%$ yoy growth in solid bulk throughput	Encourages diversification of cargo types.	OECD Port Commodity Outlook	OECD Transport
17. Total Cargo Handled (LQD BLK)	Achieve $\geq 3\%$ yoy growth in liquid bulk throughput	Ensures stable handling capacity for liquid cargo (e.g., oil, chemicals).	IEA	IEA
18. Total Cargo Handled (ITU)	Achieve $\geq 4\%$ yoy growth in intermodal transport units	Promotes multimodal connectivity and efficient logistics chains.	European Commission on Intermodal Transport	EU Intermodal
19. Total Number of Ferry Passengers	Achieve $\geq 5\%$ yoy growth	Supports growth in maritime passenger transport and regional tourism.	Eurostat	Eurostat – Maritime Transport
20. Total Number of Cruise Ship Passengers	Achieve $\geq 5\%$ yoy growth	Stimulates tourism and related economic development.	Cruise Lines International Association (CLIA)	CLIA

KPI	Policy-Based Target	Justification	Source	Source Link
21. Tons per Hectare	Achieve ≥ 50,000 tons/ha by 2025	Enhances land-use efficiency and port productivity.	World Bank	World Bank – Ports
22. Frequency of progress communication regarding ESG and KPIs (months)	Communicate progress at least every 3 months	Enhances transparency, accountability, and stakeholder engagement.	Global Reporting Initiative (GRI)	GRI
23. Women within the organisation’s governance bodies (%)	Ensure ≥ 40% female representation in governance by 2030	Supports gender diversity and is aligned with Sustainable Development Goal 5 (gender equality).	European Commission – Gender Balance	EU Gender Balance
24. Gender Parity by Type of Contract	Achieve full parity (50–50) in permanent vs. temporary contracts	Promotes equitable employment conditions across genders.	International Labour Organization (ILO)	ILO Standards
25. Temporary Employment Rate	Limit temporary employment to ≤ 10% of the total workforce	Fosters stable employment relationships and long-term skill development.	OECD Employment Outlook	OECD Employment
26. Volume of Direct Jobs Generated	Achieve ≥ 3% yoy increase in direct port-related employment	Supports local job creation and economic development.	UNCTAD	UNCTAD Transport
27. Volume of Indirect Jobs Generated	Achieve ≥ 2% yoy increase in indirect employment	Boosts broader regional economic activity and supply chain growth.	World Bank Regional Assessments	World Bank – Transport
28. Training of Human Capital (Total)	Provide ≥ 20 hours of training per employee per year	Builds a skilled workforce in line with international labor standards.	International Labour Organization (ILO)	ILO
29. Productivity per Employee	Improve productivity per employee by ≥ 10% from baseline by 2025	Encourages operational efficiency and competitiveness.	ILO & World Bank	ILO Statistics World Bank – Competitiveness
30. Annual Frequency of Accidents (Per Mil Hour Worked)	Limit to ≤ 1.0 accidents per million hours worked	Enhances occupational safety in accordance with international health and safety standards.	ILO Occupational Safety and Health (OSH) Convention	ILO OSH

Systems Innovation Approach (SIA) addresses the growing complexity, interdependencies and interconnectedness of modern societies and economies, focusing on the functions of the cross-sectoral system as a whole and on the variety of actors. The Climate Innovation Window (CIW) is the EU reference innovations marketplace for climate adaptation technologies. ARSINOE shapes the pathways to resilience by bringing together SIA and CIW, to build an ecosystem for climate change adaptation solutions. Within the ARSINOE ecosystem, pathways to solutions are co-created and co-designed by stakeholders, who can then select either existing CIW technologies, or technologies by new providers (or a combination) to form an innovation package. This package may be designed for implementation to a specific region, but its building blocks are transferable and re-usable; they can be re-adapted and updated. In this way, the user (region) gets an innovation package consisting of validated technologies (expanding the market for CIW); new technologies implemented in the specific local innovation package get the opportunity to be validated and become CIW members, while the society (citizens, stakeholders) benefits as a whole. ARSINOE applies a three-tier, approach: (a) using SIA it integrates multi-faceted technological, digital, business, governance and environmental aspects with social innovation for the development of adaptation pathways to climate change for specific regions; (b) it links with CIW to form innovation packages by matching innovators with end-users/regions; (c) it fosters the ecosystem sustainability and growth with cross-fertilization and replication across regions and scales, at European level and beyond, using specific business models, exploitation and outreach actions. The ARSINOE approach is show-cased in nine widely varied demonstrators, as a proof-of-concept with regards to its applicability, replicability, potential and efficacy.



This project has received funding from the European Union's Horizon H2020 innovation action programme under grant agreement 101037424.