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THESEUS

Hub4Circularity

A First of a kind Hub for circularity demonstrator for Attica and peripheral regions

Grant Agreement No 101178059

D2.10 Regional/interregional pathways v1

Work Package: 02 Development of the Theseus framework

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Publishable summary

This document in the first version of the deliverable series D2.10-D2.12 Regional/interregional pathways of Theseus H4C project, and it describes the work planned and performed in the framework of Task 2.4 “Regional and interregional pathways for symbiotic flows linked to EU and local regional plans”.

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Abbreviations

Abbreviations	Full name
AI	Artificial Intelligence
CE	Circular Economy
DoA	Description of Action
EC	European Commission
eSC	Extended Steering Committee
EU	European Union
GA	Grant Agreement
H4C	Hub 4 Circularity
IS	Industrial Symbiosis
I-US	Industrial Urban Symbiosis
PM	Project Management
PO	Project Officer
SC	Steering Committee
WP	Work Package

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1 Introduction

This document is the Deliverable D2.10 of Horizon Europe Theseus Project, resulting from Task 2.4 “Regional and interregional pathways for symbiotic flows linked to EU and local regional plans”. This Task will develop regional and interregional pathways for symbiotic flows aligned with EU and local plans, based on Circular Economy Roadmaps.

This document is the first version of deliverable series D2.10-D2.12 and will be updated several times during the project and all the chapters will be further elaborated.

1.1 Purpose of the deliverable

This document in the first version of the deliverable series D2.10-D2.12 Regional/interregional pathways. Theseus H4C project, and it describes the work planned and performed in the framework of Task 2.4 “Regional and interregional pathways for symbiotic flows linked to EU and local regional plans”. Next enhanced versions will be developed in later stages forming the next deliverable versions.

Based on Regional Science and Circular economy roadmaps (CERMs) approaches, it will develop pathways and action plans to integrate the activities of Theseus H4C in Attica and other regions to EU, National, Regional or Municipal Plans (e.g. PEP Attica, RIS3, SUMPs etc). The path towards regional sustainable development will be ensured by measuring the impact of project activities to regions in environmental, social and economic level, how this impact affects their resilience, and their position related to nearby regions, national and EU average level, using classic but also innovative ML enabled methods. Strategic blueprints including actions, initiatives, timelines with a focus on resource optimization and business value creation will be created. KPIs will be identified measuring sustainability and resilience (including economic & social aspects) linked and calculated by circularity aspects and KPIs defined in T2.3, T2.5, T2.6 ,WP10. Outputs: D2.4

Summarizing, this report will deal with the in-depth analysis of the strategic frameworks from participating regions, alongside their corresponding national and European strategies. The steps include the following:

- Starting the analysis of local strategic and related plans, mainly Attica but also national.
- Develop a common framework of sustainability measurement using adjusted indicators based and mapped on SDGs.
- Potential synergies with work performed already in municipalities within Attica.

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2 Framework Analysis

The transition to a circular and symbiotic regional economy is intrinsically linked to the strategic policy environment in which such transitions unfold. Understanding and leveraging this policy landscape is essential for aligning project activities with existing regulatory priorities, financing instruments, and planning mechanisms. As part of Task 2.4, this section offers a comprehensive analysis of the key strategic frameworks that shape circular economy efforts at the local (Attica), national (Greece), and European levels. The purpose is twofold: first, to map and synthesize the main regional and interregional strategies that define the enabling context for the THESEUS H4C project; and second, to identify areas of alignment, synergy, and potential policy integration that can enhance the relevance, scalability, and policy impact of project outputs.

The analysis is structured in three parts. Section 2.1 examines key local strategies and planning instruments within the Region of Attica, including its Regional Operational Programme (official Greek title: ΠΕΠ Αττικής), resilience and climate initiatives, sustainable mobility plans, and other sectoral or institutional programs. This is followed by Section 2.2, which surveys Greece's national-level strategies relevant to circular economy transitions, such as the National Circular Economy Strategy and Action Plan, the National Recovery and Resilience Plan (Greece 2.0), and sectoral frameworks in energy, environment, and innovation (e.g., RIS3). Section 2.3 addresses the broader European policy context, including the EU Circular Economy Action Plan, the European Green Deal, the Cities Mission, NextGenerationEU, and dedicated platforms such as the Circular Cities and Regions Initiative (CCRI) and NetZeroCities.

Each subsection not only provides an overview of the respective framework's scope and priorities but also assesses its relevance to the THESEUS H4C project, with particular attention to shared goals in circularity, industrial symbiosis, data-driven sustainability monitoring, and interregional cooperation. This integrated understanding of strategic frameworks will support the development of viable pathways for embedding THESEUS activities into EU, national, and regional planning structures, as required by the objectives of Work Package 2. It also lays the groundwork for identifying policy leverage points and operational synergies that can enhance the effectiveness and legacy of the project's circular economy interventions.

2.1 Local Strategies and Relevant Plans

The effective implementation of circular economy transitions requires strong alignment with local and regional planning frameworks. In the context of the THESEUS H4C project, particular attention is given to the Region of Attica (official Greek title: Περιφέρεια Αττικής), which serves as one of the core territorial pilots for the development of symbiotic flows and circular resource integration. As the most populous and economically significant region in Greece, Attica possesses a diverse and complex urban-industrial landscape that is central to national environmental and innovation policies. This section provides a structured review of the key strategic documents and initiatives developed at the regional and metropolitan level, focusing on their relevance to circular economy objectives, sustainability transitions, and data-driven planning.

The analysis includes formal development and investment strategies such as the Attica Regional Operational Programme, resilience and climate adaptation frameworks, sustainable mobility strategies (official Greek title: Σχέδια Βιώσιμης Αστικής Κινητικότητας), and locally coordinated observatories or initiatives. Where applicable, links to national frameworks and EU directives are acknowledged to clarify multi-level governance interdependencies. In each subsection, we assess the degree of integration of circularity principles, the presence of monitoring or KPI structures, and the extent to which these frameworks can support or benefit from the methodologies and digital tools developed within THESEUS H4C. This approach ensures not only coherence with existing planning structures but also the identification of leverage points for strategic alignment, replication, and upscaling within the Attica region and beyond.

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2.1.1 Attica Regional Operational Programme 2021-2027 (ΠΕΠ Αττικής 2021-2027)

The Attica Regional Operational Programme 2021-2027 (official Greek title: Περιφερειακό Επιχειρησιακό Πρόγραμμα Αττικής 2021-2027, ΠΕΠ Αττικής) is the official regional cohesion programme for Attica under Greece's Partnership Agreement for the 2021-2027 programming period. It is co-financed by the European Regional Development Fund (ERDF) and the European Social Fund Plus (ESF+), with a total budget of approximately €1.617 billion (Region of Attica, n.d.-a; European Commission, n.d.-a).
According to the official programme documentation, the strategic priorities of the Attica ROP are structured along the following axes:

1. A Smarter Europe through innovation, digitalisation, and economic transformation (Priority 1)
    a. Includes support for research and innovation capacities, digital connectivity, and digitisation of public services (Region of Attica, n.d.-a, p. 10).

2. A Greener Europe through clean energy, circular economy, and climate adaptation (Priority 2)
    a. Focus areas include energy efficiency, renewable energy integration, sustainable water and waste management, and urban climate adaptation (Region of Attica, n.d.-a, pp. 10-11).

3. A More Connected Europe by improving mobility and regional accessibility (Priority 3)
    a. Investments in public transport, sustainable urban mobility, and logistics infrastructure are foreseen (Region of Attica, n.d.-a, p. 11).

4. A More Social and Inclusive Europe (Priority 4)
    a. Includes actions for access to employment, social services, education and training (Region of Attica, n.d.-a, p. 12).

5. Europe Closer to Citizens through Integrated Territorial Development (Priority 5)
    a. Supported by tools such as Integrated Territorial Investments (official Greek title: Ολοκληρωμένες Χωρικές Επενδύσεις, ΟΧΕ) and Sustainable Urban Development strategies (official Greek title: Στρατηγικές Βιώσιμης Αστικής Ανάπτυξης, ΣΒΑΑ) in selected urban centres including Athens and Piraeus (Region of Attica, n.d.-a, p. 13).

The programme also includes horizontal priorities such as technical assistance and capacity building (Region of Attica, n.d.-a, p. 13).

A published call for proposals confirms that at least €3 million in regional funds are available for projects focusing on circular economy, green innovation, and industrial symbiosis under Priority 2 (Region of Attica, n.d.-b). These initiatives fall under the category of enhancing environmental sustainability and are aimed at small and medium-sized enterprises (SMEs) and public bodies operating in the Attica region.

The governing body responsible for implementing the programme is the Managing Authority of the Region of Attica, which oversees project selection, monitoring, and reporting processes in line with national and EU guidelines.

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Alignment with THESEUS H4C

Several priority axes and eligible actions under the Attica Regional Operational Programme 2021-2027 are directly relevant to the thematic scope of the THESEUS H4C project. In particular, Priority 2 (A Greener Europe) supports the transition to a circular economy through investments in waste prevention, reuse and valorization systems, energy recovery, and environmentally sustainable industrial activities, all of which correspond to the symbiotic flow models, industrial co-location pilots, and resource valorization initiatives of THESEUS. Additionally, funding for green SMEs and regional circular clusters aligns with the project's focus on inter-actor collaboration and circular business models.

Priority 5 (Europe Closer to Citizens) provides a framework for spatially targeted actions through Integrated Territorial Investments (ΟΧΕ) and Sustainable Urban Development strategies (ΣΒΑΑ), which offer possible entry points for the integration of THESEUS digital platforms and replication tools at sub-regional level. These tools can support local decision-making on symbiotic flows and infrastructure sitting, in alignment with the ROP's territorial cohesion goals.

Finally, the presence of digital transformation measures under Priority 1 (A Smarter Europe) enables potential synergies with THESEUS H4C's data-driven governance instruments, including monitoring platforms and decision-support tools for circular resource management.

This thematic and operational convergence between the Attica ROP and the core activities of THESEUS H4C suggests a strong basis for alignment, co-financing opportunities, and integration of project results into regional development mechanisms.

2.1.2 Athens Climate Action Plan (Municipality of Athens, June 2022)

The Athens Climate Action Plan, approved by the Athens City Council in June 2022, aims to align municipal efforts with the Paris Agreement target of limiting global warming to 1.5 °C (City of Athens, 2022; "Climate Action Plan Approved by Athens City Council," 2022). The plan sets quantified targets, detailed action areas, and monitoring provisions based on international climate frameworks (City of Athens, 2022; Spyridon Kagkas, 2022).

Key Targets & Framework

- 61% reduction in greenhouse gas emissions by 2030 compared to 2018 levels, supporting the city's long-term goal to reach climate neutrality by 2050 (City of Athens, 2022).
- Ensure 70% of residents have access to green spaces within a 15-minute walk.
- Achieve 30% of urban surface covered by green or permeable infrastructure (City of Athens, 2022).

Main Action Areas

1. Energy upgrade and RES integration e.g., LED street lighting replacement and RES deployment in public buildings (Kagkas, 2022).
2. Sustainable and smart mobility e.g., Electrification of bus fleet and metro expansion (Kagkas, 2022).
3. Green and blue infrastructure e.g., Pocket parks, green corridors, and renovation of public fountains (City of Athens, 2022).
4. Ecosystem and biodiversity restoration e.g., Nature-based solutions and preservation of urban green "lungs" like Lycabettus Hill (Kagkas, 2022).
5. Climate risk prevention and response e.g., Appointment of a Chief Heat Officer and developing heatwave protocols (#CoolAthens) (Kagkas, 2022).
6. Circular urban living e.g., Inclusion of circular economy, sustainable water use, and waste management in the urban transition (City of Athens, 2022).

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7. Green-digital integration e.g., Digitization of municipal services (e.g., payment, parking) and digital engagement via the Novoville app (Kagkas, 2022).

Monitoring and Governance

- Implementation is under the Strategic Planning and Resilience Office, supported by the Chief Resilience Officer (Kagkas, 2022).
- Data collection systems track environmental, economic, health, and social indicators to evaluate intervention efficacy (City of Athens, 2022).

Alignment with THESEUS H4C

The Athens Climate Action Plan (2022) incorporates a dedicated action area (6) titled "Circular urban living," which includes sustainable waste and water management practices. This aligns directly with THESEUS H4C's pilot activities in industrial-urban symbiosis, waste valorisation, and circular resource flows. Moreover:

- The plan's quantified targets for green space accessibility and infrastructure greening support the environmental context in which THESEUS symbiosis pilots will operate.
- Municipal investment in smart mobility and green infrastructure provides opportunities for integration of THESEUS data and decision-support tools into local planning frameworks.
- The mandate for digital governance (e.g., municipal digitization and the Novoville platform) aligns with THESEUS H4C's focus on AI-enabled monitoring and stakeholder engagement through digital twins.

This confirms a clear thematic alignment between the Climate Action Plan's objectives and the scope of THESEUS H4C, suggesting feasible channels for coordination and support.

2.1.3 Mission Label - Climate-Neutral and Smart Cities (Athens)

Athens was officially selected as one of the 100+ European cities designated under the EU Mission: Climate-Neutral and Smart Cities by 2030, a key component of the Horizon Europe programme (2021-2027). On 5 May 2025, the European Commission awarded the EU Mission Label to Athens, recognizing its Climate City Contract and progress toward climate neutrality (European Commission, 2025; ArgoPhilía, 2025).
Key verified details include:

- Athens is among the cities included in the EU Mission, which targets 100 climate-neutral urban areas by 2030 through cross-sectoral strategies in energy, mobility, waste, and urban planning (European Commission, 2025b.; NetZeroCities, 2025).
- The EU Mission Label, received on 5 May 2025 in Vilnius, signals that Athens has developed a cohesive Climate City Contract and met eligibility criteria reviewed by the Commission alongside JRC and EIB experts (European Commission, 2025a; ArgoPhilía, 2025).

Alignment with THESEUS H4C

The Climate City Contract framework requires integrated, data-led action plans across sectors, including energy, buildings, mobility, and waste management, aligned with the goals of circular city development. This provides a direct synergetic link with THESEUS H4C's digital symbiosis platforms, circular resource flow modeling, and urban pilot deployment, all of which contribute to the monitoring and operational components of Athens's climate strategy. The official designation of Athens as a Mission City presents a structured pathway for embedding THESEUS technical outputs into ongoing municipal climate and circularity investments.

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2.1.4 Sustainable Urban Mobility Plans (SUMPs) (Σχέδια Βιώσιμης Αστικής Κινητικότητας)

The Sustainable Urban Mobility Plan (SUMP) (official Greek title: Σχέδιο Βιώσιμης Αστικής Κινητικότητας, ΣΒΑΚ) is a strategic planning instrument required under Greek national law (Law 4784/2021) and supported by the European Commission through the Urban Mobility Framework (European Commission, 2021b). In the Region of Attica, SUMPs have been developed or are under development by major municipalities including Athens, Piraeus, Kifisia, and others (Hellenic Ministry of Transport and Infrastructure, 2023).

SUMPs aim to promote sustainable and inclusive transport systems, reduce greenhouse gas emissions, improve air quality, and ensure accessibility for all users. They are based on an integrated planning approach, addressing public transport, pedestrian and cycling infrastructure, traffic reduction, digital mobility services, and logistics.

Core Characteristics of SUMPs in Attica:

- Developed following EU SUMP Guidelines (2nd edition, 2019) and Greek National SUMP Specifications (YA 595/2022).
- Require stakeholder participation, impact monitoring, and alignment with local land-use plans.
- Athens' SUMP prioritizes electric public transport, expansion of pedestrian zones, and improved intermodality (Municipality of Athens, 2023).
- Piraeus' SUMP incorporates maritime mobility, last-mile freight logistics, and smart transport systems (Municipality of Piraeus, 2023).

As of 2024, more than 25 municipalities in the Region of Attica have initiated SUMP development, with funding drawn from the national Recovery and Resilience Plan (NRRP) and the Attica ROP 2021-2027 (Hellenic Ministry of Environment and Energy, 2023).

Alignment with THESEUS H4C

SUMPs provide a critical planning and policy framework that supports the integration of circular mobility strategies promoted by THESEUS H4C. These include:

- Industrial symbiosis logistics involving secondary materials transport, optimized routes, and co-location scenarios.
- Digital platforms and mobility data flows that align with municipal-level decision-making under SUMPs.
- Resource planning at mobility hubs, such as waste heat use at depots or multimodal facilities.

The regional and municipal SUMPs within Attica offer an operational interface for embedding THESEUS data tools and pilots into sustainable transport governance, supporting not only environmental but also economic and digital objectives of the project.

2.1.5 Climate Change Observatory of the Attica Region

The Climate Change Observatory of the Attica Region (official Greek title: Παρατηρητήριο Κλιματικής Αλλαγής της Περιφέρειας Αττικής) was formally established in 2022 through a collaboration between the Region of Attica, the Academy of Athens, and the National Observatory of Athens (NOA). It aims to monitor

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and assess climate change impacts within the region by collecting, processing, and interpreting long-term environmental and climatic data (Region of Attica, 2022a; National Observatory of Athens, 2022).

The Observatory is part of the regional implementation of the National Climate Law 4936/2022, which mandates the creation of monitoring mechanisms to track adaptation progress at the regional and local levels (Hellenic Republic, 2022).

Objectives and Functions:

- Establishment of long-term meteorological and environmental data series across multiple points in the Attica region, including temperature, precipitation, air quality, and soil conditions (Region of Attica, 2022b).
- Support for climate risk assessment and adaptation planning, including urban heat risk and hydrological stress zones.
- Coordination with municipal and academic actors to develop early warning and response systems for extreme weather events.

As of 2024, the Observatory contributes to several publicly funded projects focused on nature-based solutions, environmental monitoring, and urban climate resilience. Its datasets are designed to be accessible by public authorities and research institutions for scientific and planning purposes.

Alignment with THESEUS H4C

The Attica Region's Climate Change Observatory offers an important environmental data infrastructure that is directly relevant to WP5 (Monitoring) and WP6 (Digital Integration) of the THESEUS H4C project. Specifically:

- The Observatory's longitudinal climate data can serve as baseline inputs for THESEUS environmental KPIs and AI-based impact assessment tools.
- Its cross-sectoral design and collaboration with academic institutions mirrors the multi-actor model of THESEUS, supporting integration of climate parameters into regional symbiotic flow modeling.
- Additionally, the Observatory can complement THESEUS activities related to risk mapping, infrastructure siting, and early warning systems where environmental thresholds are relevant to circular or industrial operations.

2.1.6 Other Local Initiatives and Instruments

In addition to formal regional and municipal strategies, the Region of Attica participates in or is affected by a number of complementary local-level instruments and networks that support environmental sustainability, circularity, and innovation in governance. These instruments either reinforce or help implement the goals of broader regional and EU strategic frameworks.

1. Sustainable City Network

The Sustainable City Network (official Greek title: Δίκτυο Πόλεων «Βιώσιμη Πόλη») is a Greek inter-municipal platform founded in 2016, aiming to help local authorities design and implement sustainability and circular economy initiatives (Sustainable City Network, n.d.). It operates as a technical support and knowledge exchange mechanism, providing access to project design services, EU funding opportunities, and guidance on circular transition planning.

Attica municipalities such as Agios Dimitrios, Palaio Faliro, and Kaisariani are active participants. The network contributes to the dissemination of good practices on urban circularity, energy transition, waste

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minimization, and mobility integration, offering a relevant channel for bottom-up adoption of THESEUS H4C tools.

2. National Green Public Procurement Action Plan

Adopted in 2021, the National Green Public Procurement (GPP) Action Plan (official Greek title: Εθνικό Σχέδιο Δράσης για τις Πράσινες Δημόσιες Συμβάσεις) outlines criteria and targets for the environmentally responsible procurement of goods and services by public entities at all levels, including regions and municipalities (Ministry of Environment and Energy, 2021). The plan includes requirements for energy efficiency, circular design, waste reduction, and sustainable construction materials.

Local authorities in Attica are progressively integrating GPP criteria into their procurement processes, particularly in building retrofits, IT procurement, and waste collection services. These procurement mandates have the potential to create demand for circular products and resource-efficient services, directly supporting symbiotic solutions explored by THESEUS.

3. Local Climate Networks and Smart City Initiatives

Beyond formal strategies, several Attica municipalities engage in pilot initiatives linked to EU-funded smart city programs, including INTERREG, HORIZON, and URBACT. Notable among these are:

- Cool Athens (#CoolAthens), a municipal initiative targeting urban heat mitigation through real-time monitoring and heatwave response protocols (City of Athens, 2023).
- Digital Twins pilot under ICCS/NTUA in Athens and Kifisia, supporting digital infrastructure modeling and scenario testing (ICCS, 2024b).
- Local initiatives for biowaste valorisation and community composting, e.g., in municipalities like Nea Smyrni and Ilion.

These smaller-scale instruments often serve as demonstration cases or capacity-building mechanisms that feed into regional planning structures or support the deployment of innovative models like THESEUS.

Alignment with THESEUS H4C

Each of the above local-level initiatives creates supportive policy and operational conditions for the implementation and scaling of THESEUS H4C technologies and pilots. Specifically:

- The Sustainable City Network offers a channel for multi-municipality dissemination and horizontal uptake of THESEUS-developed circular economy tools.
- The National GPP Action Plan directly supports market creation for resource-efficient products and services, potentially including solutions emerging from THESEUS pilots.
- Local data infrastructure initiatives and digital twins projects provide testing environments for THESEUS platforms focused on resource flow monitoring, AI-supported planning, and user-centered scenario tools.

These instruments collectively reinforce the regional policy ecosystem into which THESEUS H4C can be embedded, especially in terms of institutional capacity, governance experimentation, and data-driven planning.

2.1.7 Regulatory Plan of Athens-Attica

The Regulatory Plan of Athens-Attica (official Greek title: Ρυθμιστικό Σχέδιο Αθήνας-Αττικής, ΡΣΑΑ Ν. 4277/2014) is the current legally binding spatial planning framework governing the region of Attica. Enacted by Law 4277/2014, this plan outlines the spatial and policy objectives for the entire Attica region,

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including the island of Makronissos, until its revision , scheduled by 2025 , and was originally intended to guide planning up to 2029 (Hellenic Republic, 2014; OpenGov, n.d.).

Scope and Content

- Defines policy orientations, priorities, measures, and programmes for the spatial, urban, and environmental organisation of Attica , grounded in sustainable development principles (Hellenic Republic, 2014, art. 1).
- Applies to all administrative units of Attica and Makronissos (Hellenic Republic, 2014, art. 1-2).
- Includes guidance for:
    - Socio-economic land restructuring
    - Spatial organisation of activities
    - Environmental and natural resource protection
    - Infrastructure networks (transport, utilities, social)
    - Urban land use and zoning
    - Identification of special-interest zones and metropolitan-scale interventions
    - Coordination of spatial planning studies and metropolitan development (Hellenic Republic, 2014, art. 1, paras. 3-4).

Infrastructure & Urban Renewal Directives

- Provides the legal framework for metro extensions, prioritising enhanced coverage of Attica's urban mass transit system (Athens Metro Extensions, 2009).
- Designates pilot territories for Elliniko redevelopment and regeneration projects at Piraeus and former military or industrial sites (Greek Herald, 2025; Insider, 2025).

Revision and Update Process

- A new revision has been commissioned under the Ministry of Environment, Energy and Climate, with the process starting in 2025, funded by the Green Fund with a tender budget of €1 million (Insider, 2025; Greek Herald, 2025).
- The revision seeks to integrate post-crisis spatial trends, environmental resilience, and new macro-infrastructure components (Insider, 2025).

Alignment with THESEUS H4C

The Regulatory Plan's metropolitan-scale land-use and infrastructure provisions can shape the territorial framework necessary for THESEUS H4C symbiotic flow models. Specifically:

- Metro network expansion delineates mobility corridors that can align with symbiotic industrial clusters and urban nodes.
- Designation of metropolitan intervention zones supports the siting of pilot symbiotic facilities, such as waste valorisation or energy exchange centres.
- Ongoing revision allows for the potential incorporation of THESEUS H4C outcomes, such as resource flow modelling and circular cluster identification, into regional spatial planning.

2.1.8 Regional Climate Adaptation Plan for Attica

The Regional Climate Adaptation Plan of Attica (RePACC) was formally approved by Regional Council Decision 255/2020 (ΦΕΚ Β' 5458/2020). It identifies climate vulnerabilities, adaptation measures, and priority zones within the Attica region (Region of Attica, 2020).

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Scope and Content

- Establishes a climate risk analysis, focusing on heatwaves, drought, flooding, coastal changes, and wildfire threats (Region of Attica, 2020, pp. 15-22).
- Prioritises specific types of interventions such as ecosystem restoration, urban green infrastructure, sustainable water management, and flood protection works (Region of Attica, 2020, pp. 35-39).
- Identifies 12 high-risk sub-regional zones, including metropolitan and peri-urban areas in Athens, East Attica, and the Athens Riviera (Region of Attica, 2020, pp. 23-24).
- Assigns implementation protocols and timelines (2020-2030) for each adaptation measure (Region of Attica, 2020, pp. 40-45).

Governance and Monitoring

- Managed by the Region of Attica's Environment & Spatial Planning Department, working with academic and local technical partners (Region of Attica, 2020, p. 5).
- Includes a biennial evaluation cycle and reporting obligations to the Hellenic Ministry of Environment & Energy, in line with Article 8 of the EU Adaptation Strategy (EU Commission, 2021a; Region of Attica, 2020, p. 47).

Alignment with THESEUS H4C

RePACC's focus on urban green infrastructure, sustainable water systems, and ecosystem restoration intersects directly with THESEUS H4C pilot activities, particularly in WP6 and WP7 concerning water symbiosis and resource valorisation. The plan's delineation of 12 priority zones, including densely populated peri-urban districts, maps closely to potential pilot intervention sites in Theseus. Furthermore, the formal monitoring timelines and reporting cycles provide an existing framework within which THESEUS's impact indicators and ML-enabled assessments could be co-integrated, strengthening regional tracking of resilience outcomes.

2.1.9 Regional Waste Management Plan of Attica

The Regional Waste Management Plan of Attica (official Greek title: Περιφερειακό Σχέδιο Διαχείρισης Αποβλήτων Αττικής, ΠΕΣΔΑ Αττικής) was officially adopted under Regional Council Decision 103/2019 (ΦΕΚ Β' 3812/2019). The Plan outlines priority strategies, waste flow management methods, and infrastructure priorities for the region (Region of Attica, 2019).

Scope and Key Measures

- Covers all municipalities within Attica, defining waste collection, treatment, recycling, and disposal pathways (Region of Attica, 2019, pp. 12-14).
- Establishes regional targets for separate collection in accordance with EU Circular Economy Package:
  - 55% recycling of municipal waste by 2025
  - 60% by 2030 (Region of Attica, 2019, p. 21).
- Prescribes a hierarchal approach: prevention → reuse → recycling → recovery → disposal (Region of Attica, 2019, p. 15).
- Identifies seven major infrastructure zones for material treatment and recovery facilities, including mechanical-biological and recycling units (Region of Attica, 2019, pp. 30-32).
- Emphasizes municipal and inter-municipal cooperation for decentralized waste operations and facility management (Region of Attica, 2019, pp. 22-24).

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Governance

- Implementation and monitoring managed by the Region's Waste Management Office under the Environment Department.
- Includes biennial progress reviews, coordination with national waste targets, and environmental reporting under EU waste legislation (Region of Attica, 2019, pp. 40-41).

Alignment with THESEUS H4C

The Plan's statutory targets for separate collection (55% by 2025; 60% by 2030) align with THESEUS's ambitions in sustainable waste management and circular material flows in WPs 6 and 7. The designated infrastructure zones may provide spatial opportunities for THESEUS co-location or pilot interventions, such as recovery clusters or shared resource platforms. Additionally, the Plan's hierarchical framework, from waste prevention to recovery, reinforces the systematic approach to circular transition used in THESEUS, and the monitoring cycles align with the project's planned KPIs and impact evaluations.

2.1.10 Smart City and Digital Innovation Strategies in Attica

While Attica does not have a region-wide Smart Specialisation Strategy independently branded as "smart city policy," several of its municipalities, regional authorities, and academic institutions implement targeted digital innovation programs relevant to smart city development and digital transformation.

Regional and National Frameworks

Attica's Regional Smart Specialisation Strategy (RIS3), developed under the National Strategic Reference Framework (NSRF) 2014-2020 and updated for 2021-2027 under the EU Cohesion Policy, identifies digital transformation, data technologies, and circular economy innovation as key thematic priorities (GSRI, 2021). These priorities guide ERDF-supported investments in research infrastructures, startups, and data systems across sectors including energy, waste, and mobility.

Local Smart City Initiatives

1. **City of Athens - Digital Strategy**:
   Athens operates a multi-pillar digital transformation strategy (Municipality of Athens, 2023c), including:
   a. Open data platform (https://data.gov.gr/)
   b. City operations center for real-time data
   c. #CoolAthens climate resilience platform
   d. Use of sensors and predictive analytics in mobility and energy management
2. **Municipality of Kifisia - ICCS Smart City Pilot**:
   As part of ICCS-led Horizon projects (e.g., STARDUST, syn.ikia) (ICCS, 2024a), Kifisia has piloted:
   a. Building automation systems
   b. Energy data dashboards
   c. IoT-enabled urban monitoring (ICCS, 2024b)
3. **Athens Digital Lab**:
   Public-private innovation incubator supporting pilot deployment of smart services in mobility, waste, and energy (Athens Digital Lab, 2023).
4. **Digital Twins Pilot for Greater Athens**:
   Implemented in cooperation with the National Technical University of Athens (NTUA), focusing on 3D infrastructure modeling, scenario testing, and integrated urban planning tools (NTUA, 2024).

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Digital Infrastructure and AI Capacity

The Region of Attica is also a major beneficiary of digital investments under the National Recovery and Resilience Plan (Greece 2.0), including:

- Regional data centers
- Public sector AI integration
- Smart grid systems (Ministry of Digital Governance, 2022)

Alignment with THESEUS H4C

The smart city and digital infrastructure landscape in Attica offers fertile ground for integration and scaling of THESEUS H4C digital tools, particularly those related to resource monitoring, AI-based flow modelling, and circular logistics platforms. Pilot territories like Athens and Kifisia, already hosting smart city infrastructure, present high-readiness zones for THESEUS deployment. Moreover, the digital priority axes of RIS3 Attica and national RRF programs provide a policy and funding alignment framework for supporting THESEUS deliverables with long-term institutional adoption potential.

2.1.11 Regional Innovation and Entrepreneurship Support Initiatives in Attica

Attica's ecosystem for innovation and entrepreneurship is shaped by a combination of regional development strategies, national funding mechanisms, and EU cohesion policy instruments. Although not governed by a single regional innovation agency, multiple support frameworks foster startups, SMEs, and research-industry partnerships with strong relevance to circular economy and industrial symbiosis themes.

RIS3 - Regional Smart Specialisation Strategy

As part of the EU-mandated RIS3 framework, Attica's smart specialisation priorities include:

- Circular economy technologies and eco-innovation
- Digital transition in manufacturing
- Blue economy and marine-based innovation
- Sustainable construction and building retrofits (GSRI, 2021; Region of Attica, 2023)

RIS3 Attica provides the basis for ERDF support to research-performing SMEs**,** innovation clusters, and digital transition projects aligned with regional sustainability goals.

Key Support Mechanisms and Programs

1. **EPANEK - Operational Programme for Competitiveness, Entrepreneurship and Innovation** (official Greek title: ΕΠΑνΕΚ)
    a. Offers co-financing and grants for SMEs and research projects, including "Green Transition" calls for circular economy pilots (EPANEK, 2022)
2. **Elevate Greece**
    a. National registry and support platform for startups, offering tax incentives, funding programs, and matchmaking (Elevate Greece, 2024). Over 180 startups are headquartered in Attica.
3. **National Recovery and Resilience Plan (NRRP - Greece 2.0)**
    a. Invests over €1.3 billion in green entrepreneurship, energy efficiency upgrades, and digital innovation (Ministry of Finance, 2023)
4. **Municipal and Regional Incubators**

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a. Notably: “Innovathens” in Technopolis (City of Athens), Athens Center for Entrepreneurship and Innovation (ACEin, AUEB), and Orange Grove (Dutch Embassy-led initiative)

5. **Cluster Initiatives**
   a. Examples include “GreenTech Cluster” (renewable energy, smart grids), and “Circular Economy Cluster” led by SEV and CSR Hellas.

Alignment with THESEUS H4C

The regional innovation ecosystem offers multiple integration points for THESEUS H4C pilot and replication activities, particularly in supporting:

- Technology providers, circular SMEs, and data startups involved in symbiotic flow valorization
- Co-financing of pilot initiatives through EPANEK, NRRP, or RIS3-backed instruments
- Replication pathways via cluster networks and innovation hubs in Attica

Moreover, THESEUS H4C can leverage existing knowledge-sharing platforms and startup registries (e.g., Elevate Greece) for dissemination and uptake of project results.

2.1.12 Sustainable Urban Mobility Plans (SUMPs) in Attica

Sustainable Urban Mobility Plans (SUMPs) are strategic mobility frameworks developed by municipalities to ensure safe, accessible, and low-emission transport systems. In Greece, SUMPs are mandated by the Ministry of Environment and Energy (ΥΠΕΝ) and co-financed through national and European structural funds. In the Attica region, multiple municipalities have completed or are in the final stages of preparing SUMPs, which are essential for shaping sustainable infrastructure investments and improving environmental and social outcomes.

Status of SUMP Implementation in Attica

As of 2025, several key municipalities in Attica have formally adopted or are finalizing SUMPs, including:

- **Municipality of Athens** - Completed and approved, with implementation under way since 2021.
- **Municipality of Piraeus** - Adopted in 2020, emphasizing port-city interface, pedestrianization, and multimodal transport hubs.
- **Municipalities of Peristeri, Kifisia, Maroussi, Chalandri, and Ilion** - SUMPs submitted and under evaluation or implementation phase (Ministry of Environment and Energy, 2023).

These SUMPs generally include:

- Reduction of private car use
- Integration of soft mobility modes (walking, cycling)
- Enhancement of public transport efficiency
- Deployment of smart mobility systems
- Climate adaptation elements (heat island mitigation, resilient infrastructure)

The Municipality of Athens SUMP, for example, incorporates specific actions on:

- Bicycle lane expansion (over 30 km planned)
- Public transport priority corridors (Municipality of Athens, 2023a, 2023b)
- Creation of 15-minute neighbourhoods
- Parking and logistics re-regulation in the historic center (Municipality of Athens, 2023)

Legal and Planning Framework

The institutional framework is set under Law 4784/2021, which mandates that SUMPs:

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- Are integrated with spatial planning tools
- Must include monitoring indicators and KPIs
- Require public consultation and approval by ΥΠΕΝ (Government Gazette B' 63/2021)

Alignment with THESEUS H4C

SUMPs form a vital entry point for deploying data-driven decision support tools developed under THESEUS H4C. The project's capabilities in resource flow mapping, AI-driven scenario testing, and environmental performance tracking can enhance mobility-related decision-making in urban centers. In addition, the spatially targeted nature of SUMPs, focused on urban form, emissions, and land-use interactions, makes them highly compatible with THESEUS's territorial symbiosis modelling and urban-scale circularity pilots. These links are especially promising in municipalities such as Athens and Piraeus, where digital readiness and mobility pressure are high.

2.1.13 Climate and Environmental Monitoring Platforms in Attica

In recent years, a growing number of climate and environmental monitoring platforms have been established in the Attica region to support urban resilience, disaster preparedness, and sustainability reporting. These platforms are developed either by public authorities, research institutions, or in the context of EU-funded projects and are increasingly integrated into local and regional planning processes.

Key Platforms and Initiatives

1. **Attica Region Environmental Monitoring Dashboard**
   Developed as part of the implementation of the Attica Regional Adaptation Plan (RePACC), this internal dashboard is used by the Environment Directorate to track climate hazards, emissions, and environmental quality indicators in urban and peri-urban areas (Region of Attica, 2022). It includes heatwave risk mapping, air pollution indices, and green space monitoring based on satellite data.
2. **NOA Meteo Service** - National Observatory of Athens
   The National Observatory of Athens provides real-time and historical weather and environmental data, including:
   a. Urban heat island mapping
   b. Early warning systems for forest fires and floods
   c. Pollen and air quality forecasts
   (NOA, 2023)
3. **ClimAttica Platform (EU LIFE-IP AdaptInGR)**
   The LIFE-IP AdaptInGR project piloted a localized decision support platform for climate risk assessment in Attica, allowing municipalities to:
   a. Upload spatial climate data
   b. Run adaptation scenario analyses
   c. Assess vulnerability metrics per urban sector (LIFE AdaptInGR, 2022)
4. **HELIOS and Copernicus Downscaling Initiatives**
   The HELIOS portal (hosted by the Ministry of Climate Crisis and Civil Protection) offers high-resolution climate projections and downscaled data for the Athens basin and surrounding areas, aligned with EU's Copernicus Climate Services (HELIOS, 2024).

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Alignment with THESEUS H4C

These platforms provide essential environmental datasets and interfaces for integrating THESEUS H4C's digital and AI-based components. Their real-time capabilities and spatial granularity can enhance:

- Symbiotic flow monitoring and optimization models
- Scenario planning modules using real urban-environmental data
- Pilot site selection based on vulnerability assessments or emissions hotspots

Moreover, the data interoperability potential of NOA and Copernicus-linked systems allows for seamless integration with THESEUS's circular economy KPIs and regional sustainability dashboards.

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2.2 National Strategies and Relevant Plans

Greece's national policy landscape provides a comprehensive foundation for promoting circular economy principles, industrial symbiosis, and sustainable regional development. These frameworks are shaped both by EU cohesion policy and domestic legislative commitments, with implementation pathways defined across multiple operational programmes, strategic action plans, and thematic roadmaps. Many of these national strategies intersect with the objectives of THESEUS H4C, providing key alignment opportunities for its regional and interregional activities, particularly in the areas of waste valorization, resource efficiency, digital transformation, and territorial resilience.

National strategies relevant to Attica and THESEUS fall into five primary categories:

1. Operational programmes under the Partnership Agreement for the Development Framework 2021–2027 (PA/ESPA).
2. Dedicated strategies for circular economy and waste management.

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3. Energy and climate frameworks such as the NECP and the National Adaptation Strategy.
4. Innovation and smart specialization strategies (e.g., RIS3 and RRF-linked initiatives).
5. Cross-sectoral plans on public procurement, infrastructure, and environmental compliance.

Each of the following subsections will provide a verified summary of the relevant national plan, followed by a paragraph assessing its potential connection and complementarity with the goals and pilot activities of THESEUS H4C.

2.2.1 Operational Programme "Competitiveness"

The Operational Programme "Competitiveness" 2021–2027 (official Greek title: Επιχειρησιακό Πρόγραμμα Ανταγωνιστικότητα, ΕΠΑνΕΚ) is Greece's core national funding instrument under the European Regional Development Fund (ERDF) and the Cohesion Fund, supporting businesses, innovation, and green transition. Approved by the European Commission in July 2022, it is aligned with Policy Objectives 1 (Smarter Europe) and 2 (Greener Europe) under the EU Cohesion Policy (EC, 2022).

Strategic Priorities

The programme supports over €3.9 billion in funding and is structured around five key priorities:

- Green Transition: Supporting resource-efficient production, clean energy, circular economy, and sustainable infrastructure
- Digital Transformation: Promoting digital uptake by SMEs, smart production, and e-services
- Entrepreneurship & Innovation: Including R&D incentives, technology parks, and industrial clusters
- Skills for Smart Specialisation
- Business Support in Less Developed Regions

Specific measures include:

- Support for industrial symbiosis pilots
- Circular economy incentives in manufacturing
- Investments in waste processing and water efficiency technologies
- Capacity building for regional circular economy initiatives (Ministry of Development & Investments, 2023)

Governance

The "Competitiveness" Program is managed by the Special Secretariat for ERDF and Cohesion Fund Programmes of the Ministry of National Economy and Finance. Calls are published on the national funding portal (https://ependyseis.gr) and are open to enterprises, municipalities, and research institutions.

Alignment with THESEUS H4C

The "Competitiveness" Program provides direct funding alignment potential for THESEUS H4C pilot implementations, particularly for:

- Circular and symbiotic infrastructure development
- SME and startup engagement in resource flow valorisation
- R&D collaboration in environmental technologies
- Regional digital twins and AI-based planning tools

The programme's explicit focus on sustainable entrepreneurship and regional circularity creates opportunities for THESEUS to upscale successful pilot interventions in Attica and extend them to other regions through dedicated calls and cluster integration.

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2.2.2 National Strategy for Circular Economy

The National Strategy for Circular Economy (NSCE, official Greek title: Εθνική Στρατηγική για την Κυκλική Οικονομία) is Greece's central policy framework for transitioning from a linear to a circular economic model. First adopted in 2018 and updated in 2021 to reflect the ambitions of the EU Circular Economy Action Plan and the European Green Deal, the strategy outlines horizontal and sectoral actions for reducing resource use, increasing reuse and recycling, and promoting innovation in circular systems (Hellenic Ministry of Environment & Energy, 2021).

Strategic Axes

The updated NSCE focuses on four key axes:

1. Sustainable production and consumption
2. Waste prevention and high-value reuse
3. Circular economy innovation and digital tools
4. Cross-sectoral cooperation and green finance

It includes specific policy goals for:

- Industrial symbiosis clusters and resource exchange platforms
- Eco-design in manufacturing and product lifecycle extension
- Circular procurement practices
- Sector-specific roadmaps (e.g., construction, plastics, agri-food)

The NSCE also incorporates sustainability indicators in alignment with the Monitoring Framework for the Circular Economy (EU COM 2018/29), aiming to integrate these into national statistics by 2025.

Legislative Integration

The strategy is embedded in the legal framework through Law 4819/2021, which regulates waste management and defines circular economy obligations for regional and local authorities (Government Gazette, 2021). It also mandates the integration of circular economy targets into public investment projects and procurement schemes.

Alignment with THESEUS H4C

The NSCE offers a direct policy foundation and compliance framework for THESEUS H4C. Many of its action areas and particularly those related to industrial symbiosis, urban resource valorisation, and cross-sector coordination, are mirrored in THESEUS's territorial approach. In addition, the national strategy's requirement for digital monitoring tools and indicator frameworks opens clear pathways for incorporating THESEUS's machine-learning and KPI systems into national-level reporting. The development of sectoral circular roadmaps under the NSCE also presents opportunities for THESEUS to contribute case-based evidence and pilot results that can shape future iterations of the national strategy.

2.2.3 National Action Plan for Circular Economy

The National Action Plan for Circular Economy (NAPCE, official Greek title: Εθνικό Σχέδιο Δράσης για την Κυκλική Οικονομία) operationalizes the priorities set by the National Strategy for Circular Economy, providing concrete measures, timelines, and responsible bodies for implementation across key economic

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sectors. The current NAPCE, covering the period 2021-2025, was adopted in alignment with Greece's obligations under EU environmental policy and national legislation (Ministry of Environment & Energy, 2021b).

Key Objectives and Measures

The NAPCE sets out 71 concrete actions grouped under six strategic areas:

1. Institutional framework and governance
2. Waste prevention and management
3. Sustainable production and consumption
4. Innovation and digital tools
5. Education and awareness
6. Monitoring and evaluation

Indicative actions include:

- Establishment of a national digital platform for monitoring circular flows
- Integration of circular economy criteria in public procurement procedures
- Development of circular product labels
- Support for pilot projects in industrial symbiosis and resource recovery
- Mandatory reuse targets for municipalities and infrastructure upgrades

The plan also contains horizontal provisions for the activation of local and regional authorities, requiring regional operational plans (ΠΕΣΔΑ) to align with NAPCE goals.

Monitoring and Evaluation. Implementation is overseen by a Coordination Committee on Circular Economy, supported by the Circular Economy Observatory, which is tasked with KPI development and integration with Eurostat and EEA indicators (Ministry of Environment & Energy, 2021c).

Alignment with THESEUS H4C

NAPCE provides an implementation-level framework that is fully compatible with the operational goals of THESEUS H4C. Its emphasis on pilot testing, digital platforms, and industrial symbiosis schemes aligns with THESEUS's work packages and methodological focus. Specifically, THESEUS pilots can serve as **demonstrator cases** for actions outlined in the NAPCE, contributing practical validation to national planning. Moreover, THESEUS's KPI framework developed in Tasks 2.3–2.6, can directly support the performance tracking tools envisaged under the Circular Economy Observatory, facilitating policy-level feedback loops from regional experimentation to national scaling.

2.2.4 National Energy and Climate Plan

The National Energy and Climate Plan (NECP, official Greek title: Εθνικό Σχέδιο για την Ενέργεια και το Κλίμα – ΕΣΕΚ) of Greece is the country's principal strategic framework for achieving climate neutrality, energy transition, and emission reduction targets through 2030, aligned with the European Green Deal, the EU Climate Law, and the Fit for 55 legislative package. Greece's revised NECP was submitted to the European Commission in October 2023, updating the original 2019 plan in line with increased EU climate ambition (Ministry of Environment & Energy, 2023).

Core Targets (2030)

The updated NECP sets binding and indicative targets including:

- Reduction of greenhouse gas emissions by at least 55% (from 1990 levels)
- Renewables share in gross final energy consumption: 80% for electricity, 42% overall

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- Improvement of energy efficiency by 38–40%
- Electrification and grid modernization, including energy storage capacity of 5.6 GW
- Reduction of final energy consumption by 10.7 Mtoe

The NECP is structured across six pillars:

1. Decarbonisation
2. Renewables
3. Energy efficiency
4. Energy security
5. Internal energy market
6. Research, innovation, and competitiveness

It also includes measures supporting the circular economy, particularly:

- Waste-to-energy deployment where consistent with the waste hierarchy
- Recovery of biogenic waste streams and sludge
- Integration of resource efficiency in industrial energy use

Governance and Implementation

The plan is coordinated by the Ministry of Environment and Energy and includes:

- A monitoring mechanism under the Integrated Climate and Energy Governance Regulation (EU 2018/1999)
- Stakeholder consultations, regional impact assessments, and a National Observatory for Energy and Climate

Alignment with THESEUS H4C

NECP provides a robust policy interface for energy-related symbiotic flows targeted by THESEUS H4C, particularly in:

- Urban-industrial waste-to-energy integration
- Circular recovery of heat, biowaste, and sludge
- Digital optimization of energy and material flows

In addition, the plan's emphasis on regional planning, innovation, and data governance allows for THESEUS outputs to be used in localized scenario modelling and the tracking of low-carbon circular transitions at the regional level (e.g., in Attica).These opportunities are especially strong in sectors like construction, manufacturing, and bio-based industries, which intersect with both NECP targets and THESEUS pilot interventions.

2.2.5 National Recovery and Resilience Plan

The National Recovery and Resilience Plan (NRRP, official Greek title: Εθνικό Σχέδιο Ανάκαμψης και Ανθεκτικότητας - Ελλάδα 2.0), titled *Greece 2.0*, is Greece's comprehensive response to the economic and social impact of the COVID-19 crisis, funded through the EU Recovery and Resilience Facility (RRF). Approved by the European Commission in July 2021, the plan mobilizes more than €30.5 billion, comprising €17.8 billion in grants and €12.7 billion in loans, structured across four pillars: green transition, digital transformation, employment and skills, and private investment support (European Commission, 2021a; Greek Government, 2021).

Strategic Objectives

The NRRP includes 106 reform and investment actions structured across four main axes:

1. Green Transition - over €6 billion for:

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   a. Energy efficiency upgrades in public and private buildings
   b. Sustainable urban mobility and transport electrification
   c. Circular economy initiatives (notably in water and waste sectors)
   d. Reforestation and biodiversity restoration
2. Digital Transformation - €2.1 billion for:
   a. Public digital infrastructure
   b. SME digitisation
   c. Artificial intelligence and data governance tools
3. Employment, Skills and Social Cohesion
4. Private Investment and Transformation of the Economy

Specific circular economy measures include:

- Reform 1.6: National framework for circular economy transition
- Investment 1.5: Industrial symbiosis and green transformation support for SMEs
- Investment 1.7: Waste management infrastructure and green procurement incentives
- Development of circular water reuse schemes

Monitoring and Disbursement

Greece's NRRP is governed by the National Coordination Authority (Ministry of Finance) and monitored by the European Commission's RRF scoreboard and performance indicators. All funded actions must comply with the Do No Significant Harm (DNSH) principle and national environmental legislation.

Alignment with THESEUS H4C

Greece 2.0 presents one of **the most strategically aligned frameworks** for THESEUS H4C, offering:

- Direct co-financing potential for Theseus-related pilot actions, especially those under green transition and circular economy pillars
- Policy alignment and validation pathways through its reform structure and monitoring mechanisms
- Synergies with THESEUS's aims in digitalization, industrial symbiosis, and cross-sectoral urban–industrial integration

In particular, THESEUS's outcomes can contribute to upscaling of Investment 1.5 and 1.7 actions, offering evidence for circular innovation replication and KPI validation at national scale.

2.2.6 National RIS3 Framework and Smart Specialization Priorities

Greece's National Smart Specialization Strategy (RIS3, official Greek title: Εθνική Στρατηγική Έξυπνης Εξειδίκευσης - RIS3) defines the country's thematic and technological investment priorities to support innovation, regional development, and economic transformation. It is a core element of the European Cohesion Policy and a prerequisite for receiving support from the European Regional Development Fund (ERDF) for research and innovation-related investments (European Commission, 2021b). The current strategy is part of the Partnership Agreement 2021-2027 (ESPA 2021-2027) and complements the regional RIS3 strategies developed by each Region, including Attica (General Secretariat for Research & Innovation, 2021).

Strategic Objectives

The updated national RIS3 framework identifies seven thematic priority areas:

1. Agri-food
2. Sustainable energy
3. Circular economy and industrial symbiosis
4. Health and pharmaceuticals

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5. Tourism and culture
6. ICT and digital transformation
7. Transport and logistics

Key cross-cutting objectives include:

- Integration of research infrastructures with regional innovation ecosystems
- Creation of public-private partnerships and innovation clusters
- Support for pilot demonstration units in emerging technologies
- Increased participation of SMEs in R&D-led transitions

The circular economy priority explicitly promotes:

- Valorisation of secondary raw materials
- Development of technology platforms for industrial symbiosis
- Digital tools for monitoring and simulating circular material flows

RIS3 governance follows a multi-level model coordinated nationally by **the General Secretariat for Research and Innovation (GSRI)** and regionally by local RIS3 managing bodies.

Alignment with THESEUS H4C

The national RIS3 framework provides a highly relevant strategic context for THESEUS H4C. Its emphasis on circular economy innovation, territorial R&I integration, and pilot demonstration projects supports the design and diffusion of THESEUS activities across Attica and other regions. Furthermore, THESEUS's methodological and digital tools can support RIS3 implementation by:

- Providing territorial flow data for investment prioritization
- Demonstrating cross-sector collaboration models that align with smart specialization
- Offering KPIs that contribute to the monitoring and evaluation of RIS3 impact

This compatibility opens pathways for THESEUS to actively contribute to smart specialisation platforms at both national and regional levels, including potential inclusion in European S3 Partnerships and Interregional Innovation Investments (I3).

2.2.7 Additional Sector-Specific National Plans

Beyond the broader strategic frameworks, Greece has adopted a series of sector-specific national plans that shape how resources are managed, environmental impacts are controlled, and territorial development is coordinated. These include dedicated action plans for waste, water, and land use, each of which provides additional regulatory and strategic context for circular economy initiatives such as THESEUS H4C.

A. National Waste Management Plan

The National Waste Management Plan 2020–2030 (NWMP, official Greek title: Εθνικό Σχέδιο Διαχείρισης Αποβλήτων - ΕΣΔΑ2020-2030) defines the targets, infrastructure needs, and governance structure for municipal, industrial, hazardous, and special waste streams. Key targets include:

- Reduction of landfilling to 10% of total municipal waste by 2030
- Separate collection of organics, paper, plastic, glass, and metals
- Promotion of waste-to-energy only where residual and non-recyclable
- Support for regional waste management plans (ΠΕΣΔΑ) with local recovery hubs (Ministry of Environment & Energy, 2020)

B. National Water Management Plan

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Water resource management in Greece is structured around 14 River Basin Management Plans (RBMPs), revised periodically in accordance with the EU Water Framework Directive (2000/60/EC). The Attica river basin district (EL06) covers key catchments such as Kifissos and Ilissos. Priorities include:

- Reduction of water stress and groundwater overextraction
- Urban water reuse and circular water systems
- Prevention of industrial and urban water pollution (Special Secretariat for Water, 2023)

C. National Spatial Strategy and Urban Planning Reforms

Greece's updated spatial planning framework is anchored in Law 4759/2020, which mandates new Local Urban Plans (official Greek title: Τοπικά Πολεοδομικά Σχέδια) and Special Urban Plans ((Ministry of Environment & Energy, 2021a) with integrated sustainability requirements. Relevant instruments include:

- Territorial planning of industrial zones and waste recovery facilities
- Spatial integration of circular infrastructure into local plans
- Land-use restrictions and environmental carrying capacity considerations (Ministry of Environment & Energy, 2021)

Alignment with THESEUS H4C

These sectoral plans form the technical and regulatory foundation for several Theseus components. Specifically:

- The NWMP provides the baseline for evaluating waste flow optimizations and designing symbiotic recovery infrastructures.
- The RBMPs are essential for assessing water reuse potential, hydrological limits, and closed-loop solutions.
- The national spatial and land-use planning framework supports territorial alignment of THESEUS pilot interventions and resource hubs.

Together, they establish the enabling environment for the project's implementation in Attica and provide critical references for the territorial dimension of circularity addressed in WP2 and WP6.

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2.3 EU Strategic Frameworks

The European Union has developed a comprehensive ecosystem of strategic frameworks aimed at guiding the continent's transition to a climate-neutral, resource-efficient, and socially inclusive future. These policies reflect the EU's commitment to the United Nations Sustainable Development Goals (SDGs), the European Green Deal, and broader ambitions for digital transformation and economic resilience. In this context, circular economy principles are embedded across multiple regulatory, financial, and innovation-driven instruments at the EU level, shaping the trajectory of regional and interregional development.

This section provides a structured analysis of the most relevant EU strategies, action plans, and mission-oriented initiatives that frame and support circular economy transitions in European regions. It begins with core legislative and policy frameworks such as the EU Circular Economy Action Plan and the European Green Deal, followed by key recovery and investment mechanisms including NextGenerationEU. The section also examines EU Missions (such as the Mission on Climate-Neutral and Smart Cities), specialized platforms like NetZeroCities and the Circular Cities and Regions Initiative (CCRI), and complementary programs such as the New European Bauhaus (NEB), the Urban Agenda for the EU, and the ESPON territorial evidence base.

For each policy framework or initiative, the analysis highlights strategic priorities, governance mechanisms, funding pathways, and implementation tools. Each entry concludes with a brief alignment analysis showing how the framework connects with the scope and activities of the THESEUS H4C project. This linkage ensures that the regional pathways and actions developed under Task 2.4 are not only consistent with EU-level direction but also capable of leveraging pan-European resources, methodologies, and replicability channels.

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2.3.1 EU Circular Economy Action Plan

The EU Circular Economy Action Plan (CEAP), adopted in March 2020, is a flagship initiative of the European Green Deal and the EU's core strategy for achieving a climate-neutral, resource-efficient, and competitive economy by 2050. CEAP builds on the 2015 plan and introduces a more systemic approach to circularity, focusing on the entire life cycle of products, from design to end-of-life, while supporting the decoupling of economic growth from resource use (European Commission, 2020b).

Strategic Focus Areas

CEAP proposes measures across multiple product value chains, with key priorities including:

- Sustainable product policy framework, with eco-design standards and durability rules
- Empowerment of consumers through access to product environmental data
- Circularity in priority sectors: electronics, batteries, construction, packaging, plastics, textiles, and food
- Waste reduction and secondary raw materials markets
- Cross-border value chain cooperation, enabling interregional and industrial symbiosis models

A strong emphasis is placed on integrating circular economy principles into EU industrial policy, green public procurement, and sustainable finance initiatives. The CEAP includes legal proposals and policy measures under the European Climate Law (European Commission, 2020b), the Sustainable Products Regulation, and the Waste Framework Directive revision.

Monitoring and Implementation

Implementation is coordinated through the EU Circular Economy Monitoring Framework, managed by Eurostat, and through dedicated platforms such as the European Circular Economy Stakeholder Platform (ECESP). Progress is tracked via indicators in four dimensions: production/consumption, waste management, secondary raw materials, and competitiveness and innovation (European Commission, 2023b).

Alignment with THESEUS H4C

CEAP offers direct strategic alignment with THESEUS H4C's goals and methodologies. The project's focus on territorial symbiotic flows, digital circularity metrics, and industrial-urban integration corresponds to CEAP priorities for:

- Circular infrastructure deployment at the regional level
- Creation of digitally supported circular value chains
- Interregional cooperation in resource recovery and valorization

Moreover, THESEUS's planned KPI system and machine-learning integration in circular planning contribute to the data-driven monitoring paradigm promoted by CEAP. Results from Attica and other pilot regions can provide replicable models and evidence-based pathways in support of EU-wide circular targets.

2.3.2 European Green Deal

The European Green Deal, presented in December 2019, is the EU's overarching strategy to transform its economy for a sustainable future. It sets the blueprint for making Europe the first climate-neutral continent by 2050, decoupling growth from resource use and ensuring no person or place is left behind. The Green Deal integrates climate, energy, industry, transport, agriculture, and environment policies into a cohesive policy agenda, aligned with the UN Sustainable Development Goals (SDGs) and the Paris Agreement (European Commission, 2019).

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Key Policy Pillars

The European Green Deal defines several strategic areas relevant to regional circular economy initiatives:

- Climate neutrality legislation through the European Climate Law (European Commission, 2020b) and Fit for 55 package
- Sustainable industry transformation under the EU Industrial Strategy
- Sustainable and smart mobility via enhanced Sustainable Urban Mobility Plans (SUMPs)
- "Farm to Fork" strategy for sustainable food systems
- Zero Pollution Action Plan and Biodiversity Strategy
- Expansion of the Just Transition Mechanism for vulnerable regions
- Introduction of a taxonomy for sustainable activities and integration of environmental, social, and governance (ESG) metrics in public and private finance

The European Green Deal is financed through the European Green Deal Investment Plan (EGDIP) and aligned with cohesion funds, Horizon Europe, InvestEU, and the Recovery and Resilience Facility.

Governance and Progress

Progress is monitored through the European Semester, supported by the Recovery and Resilience Scoreboard, environmental performance reviews, and country-specific recommendations. The Deal also fosters multi-level governance, requiring action from national, regional, and local authorities.

Alignment with THESEUS H4C

The European Green Deal provides the macro-policy foundation for the THESEUS H4C initiative. The project contributes to multiple pillars:

- Industrial and territorial decarbonisation through circular infrastructure and symbiotic flows
- Innovation-led sustainability through data integration, urban-industrial cooperation, and KPI-based monitoring
- Climate resilience in regional planning, as demonstrated by the Attica pilots

Moreover, THESEUS supports implementation of regional-level measures under Green Deal instruments such as the Climate Pact, New European Bauhaus, and the Mission for Climate-Neutral and Smart Cities. As a Horizon-funded initiative, THESEUS also acts as a demonstrator of innovation-based transitions, consistent with the Deal's long-term vision.

2.3.3 Next Generation EU and Recovery Instruments

NextGenerationEU (NGEU) is the European Union's recovery instrument designed to repair the economic and social damage caused by the COVID-19 pandemic and accelerate the transition to a green and digital economy. With a total envelope of €806.9 billion, NGEU includes both grants and loans delivered primarily through the Recovery and Resilience Facility (RRF), the central component of the EU recovery plan (European Commission, 2020a).

Structure and Allocation

The RRF accounts for €723.8 billion of the NGEU total, while the remaining funds are distributed among other instruments such as:

- REACT-EU - bridging cohesion policy funding with COVID-19 response
- Horizon Europe – funding R&I to support green and digital transitions

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- InvestEU - de-risking private investment
- Rural Development Programs (EAFRD)
- Just Transition Fund (JTF) - supporting carbon-dependent regions

Member States were required to submit national recovery and resilience plans (NRRPs) aligned with EU objectives, particularly:

- Green transition: minimum 37% of expenditure
- Digital transformation: minimum 20% of expenditure
- Compliance with the Do No Significant Harm (DNSH) principle

In Greece, NGEU funding is operationalized through the "Greece 2.0" NRRP, covered earlier in Section 2.2.5.

Governance and Monitoring

Implementation is governed by the Regulation (EU) 2021/241 (European Commission, 2020d) and monitored via the Recovery and Resilience Scoreboard, annual country reporting, and performance audits by the European Court of Auditors.

Alignment with THESEUS H4C

NGEU instruments directly complement THESEUS H4C both in funding logic and operational objectives. As a Horizon Europe project, THESEUS exemplifies NGEU principles in:

- Supporting cross-sector innovation
- Delivering local pilots that enable the green and digital transition
- Building regional resilience through data-driven, circular economy models

Theseus pilot actions can be mapped against RRF performance indicators, and its territorial interventions in Attica and other regions serve as proof-of-concept projects that could inform future RRF-funded or InvestEU-scaled programs. In this respect, THESEUS contributes to the EU's transformative recovery pathway and can act as a knowledge base for just, sustainable reconstruction.

2.3.4 EU Mission on Climate-Neutral and Smart Cities

The EU Mission on Climate-Neutral and Smart Cities (NetZeroCities) is one of five Horizon Europe missions introduced to deliver targeted solutions to major societal challenges. Its goal is to support at least 100 European cities in becoming climate-neutral by 2030, acting as experimentation and innovation hubs for all other cities by 2050 (European Commission, 2021a).

The Mission is implemented through the NetZeroCities platform, which coordinates technical assistance, systemic innovation, and monitoring support for participating cities. In April 2022, 21 Greek cities were selected for the Mission, including Athens, which is of direct relevance to the THESEUS H4C activities in the Attica Region.

Strategic Components

Key elements of the Cities Mission include:

- Development of Climate City Contracts (CCCs) with integrated mitigation and adaptation targets
- Establishment of Mission Platform Services for digital tools, stakeholder engagement, and financing models
- Emphasis on governance innovation, participatory planning, and just transitions
- Systemic focus on urban energy systems, mobility, circularity, and built environment

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The Mission aligns with broader EU strategies such as the European Green Deal, the Renovation Wave, the EU Urban Agenda, and the New European Bauhaus.

Monitoring and Funding

Mission Cities gain access to:

- Horizon Europe Mission Work Programme funding
- Technical and financial support from the NetZeroCities consortium
- Monitoring frameworks for emissions reduction and resilience co-benefits

Alignment with THESEUS H4C

The Cities Mission and NetZeroCities platform provide a strong operational bridge to THESEUS H4C. Both initiatives:

- Address urban-regional circularity and resilience
- Prioritize cross-sectoral, stakeholder-driven innovation
- Require data-driven monitoring and KPI development

Athens' participation in the Cities Mission opens direct avenues for synergy with THESEUS pilots, especially through integration with local Climate Contracts and circular planning initiatives. Furthermore, THESEUS methodologies, and particularly those on circularity metrics, machine learning-enabled flow mapping, and interregional learning, can support replication efforts in other Mission cities across Europe.

2.3.5 Circular Cities and Regions Initiative and Hubs for Circularity

The Circular Cities and Regions Initiative (CCRI) is a key EU program launched under the EU Circular Economy Action Plan (2020) to accelerate the circular transition at the local and regional level. It supports cities, regions, and territorial clusters in developing and scaling systemic circular economy solutions through a collaborative knowledge and capacity-building platform. The CCRI works in close alignment with Horizon Europe, LIFE Programme, and cohesion policy instruments (European Commission, 2022a).

Components and Participants

The CCRI ecosystem includes:

- CCRI Pilots (cities/regions implementing circular solutions)
- CCRI Fellows (early-stage participants receiving technical assistance)
- CCRI Associated Partners (networks, knowledge providers, and financing institutions)
- Hubs for Circularity (H4C): place-based innovation ecosystems connecting industry, academia, and public authorities to implement circular economy models

The Hubs for Circularity are at the core of CCRI's territorial deployment. They:

- Foster industrial symbiosis and urban–industrial partnerships
- Support digital platforms for resource flow tracking
- Implement KPIs for material, water, and energy circularity (European Commission, 2023a).
- Facilitate replication and cross-border learning among regions

Alignment with THESEUS H4C

THESEUS H4C is itself part of the Hubs for Circularity community and embodies CCRI principles in both structure and ambition. Thus, it:

- Builds circularity demonstration pilots in Attica and other regions
- Supports KPI development, mirroring CCRI and EU monitoring standards
- Facilitates interregional knowledge exchange, a core component of the CCRI replication pathway

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Additionally, THESEUS aligns with the CCRI by integrating multi-level governance models, promoting digital tools for symbiotic flow planning, and contributing to the shared repository of best practices and indicators. The mutual reinforcement between THESEUS and the CCRI positions the project as a flagship territorial demonstrator of the EU's circular economy policy.

2.3.2 Other Relevant EU Programs and Networks

In addition to the core strategic frameworks, the European Union supports a range of complementary programs and knowledge platforms that enable local and regional authorities to develop place-based sustainability, resilience, and circularity strategies. These programs contribute directly or indirectly to the operationalization of circular economy objectives and offer tools, data, and funding mechanisms relevant to THESEUS H4C.

A. Urban Agenda for the EU

The Urban Agenda fosters **multi-**level governance and better integration of urban policy in EU funding and regulation. Its Partnership on Circular Economy, co-led by Oslo and The Hague, delivered action plans on:

- Sustainable product design and reuse
- Urban circular procurement
- Governance models for city-scale circular transitions (European Commission, 2022b)

The Urban Agenda also promotes policy coherence among municipal, regional, and national actors, which is crucial for projects like THESEUS that depend on vertical alignment.

B. New European Bauhaus (NEB)

The NEB is an EU cultural and sustainability initiative linking the Green Deal to built environment aesthetics, inclusion, and community values. It supports local projects that embody beauty, sustainability, and togetherness through small-scale funding, idea competitions, and thematic labs. NEB Labs address:

- Circular construction and reuse of materials
- Regenerative urban spaces
- Citizen engagement in design of public infrastructure (European Commission, 2021c)

C. ESPON Programme

ESPON provides territorial data, indicators, and policy tools to support evidence-based regional development strategies. It:

- Maps circular economy territorial potential
- Offers indicators for regional resilience and cross-border flows
- Supports territorial impact assessments of EU policies (ESPON, 2023)

Alignment with THESEUS H4C

Each of these programs contributes to the enabling environment in which THESEUS operates:

- Urban Agenda complements THESEUS by offering governance models and co-creation mechanisms for urban circular transitions
- NEB aligns with THESEUS's emphasis on citizen engagement, inclusive design, and place-based value creation

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- ESPON offers methodological synergies in territorial analysis, benchmarking, and interregional comparisons, directly supporting WP2 and WP6 of THESEUS

THESEUS can also act as a data provider and use case for these platforms, contributing to European knowledge exchange on regional circular economy innovation.

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3 Framework Alignment

Step 2: Alignment Framework

Based on the documentation of Local, National and EU strategies and plans, their relation to Theseus is being analyzed in the following table. In this section we will present the alignment of the strategic plans with Theseus. The template table will be filled in the 2nd version of this deliverable.

Table 1 Relation of Framework with Theseus Template table

Initiative	EU/National Plan	Regional/Municipal Plan	Theseus H4C Activity

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4 Sustainable Development Goals (SDGs)

This section will develop a common framework of sustainability measurement using adjusted indicators based and mapped on SDGs. This analysis will be described in the 2nd version of this deliverable.

4.1 SDGs in a nutshell

To be analyzed in the 2nd version of this deliverable.

4.2 SDGs related to I-US and H4Cs and Localized SDGs

The analysis to be made in this section will focus within the framework of Urban-Industrial Symbiosis and the Circular Economy and on selected Sustainable Development Goals (SDGs) and/or customized indicators directly related to them. An indicative and preliminary connection refers to the below SDGs:

- SDG 9 (Industry & Innovation)
- SDG 11 (Sustainable Cities)
- SDG 12 (Responsible Consumption & Production)
- SDG 13 (Climate Action)
- SDG 17 (Partnerships)

4.2.1 Theseus Regional Indicators

In this section, specific indicators should be defined to quantitatively capture performance. The indicators must reflect key parameters of industrial symbiosis and the circular economy, ensuring measurable tracking of progress and impact in these areas.

4.2.2 Indicators applied and calculated within Theseus Case

This section will present the identified indicators, calculated for Theseus case.

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5 The Mapping of Theseus

Mapping of Theseus initiative and actions in the context of global (SDGs), European (EU framework), national (Greek programs funded by EU and national agencies), and regional or local actions (applied on select Greek regions, with focus on Attica). Highlight of the bridging role and targeted impact of Theseus as part of the overall European circular, green, and sustainable economy ecosystem, especially regarding the integration in the Attica region. The following conceptual map illustrates the role and position of Theseus in the relevant ecosystem.

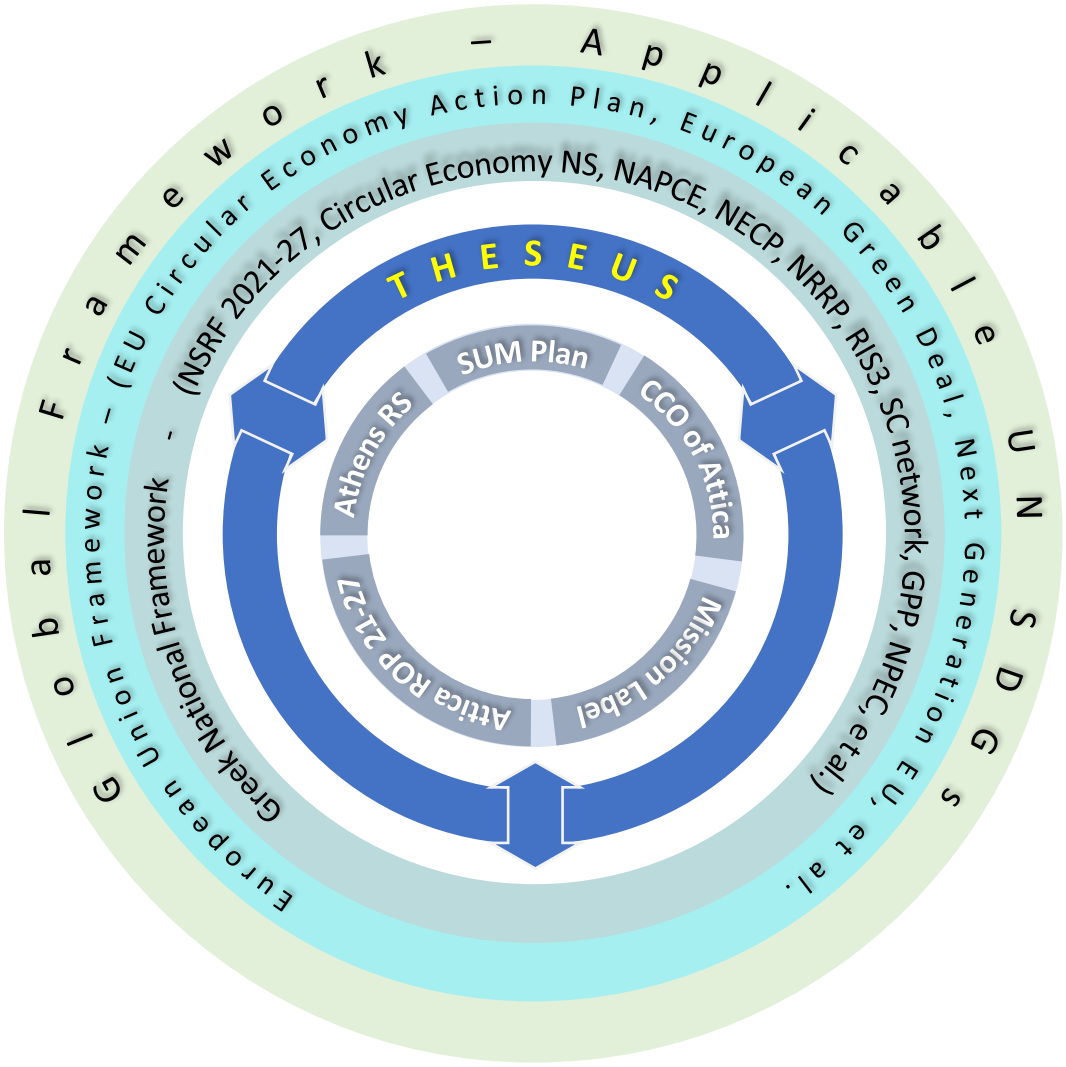


Figure 1 Theseus Positioning Conceptual Map

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6 Conclusions

Conclusions & Next Steps will be updated in next versions.

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References

All references to be merged here.

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Annexes

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