Ref. Ares(2025)8227700 - 30/09/2025

TOURAL

Multidimensional model of tourism verticals driving the sustainable balanced growth among rural & remote grids and urban clusters of rural regions, fostering macro-regional cooperation

101132489, HORIZON-CL2-2023-HERITAGE-01

Deliverable D3.2:

Multi-Objective Optimisation Methods for UCCST Model Design

Deliverable Version:	D3.2, v.1
Document Identifier:	TOURAL Optimisation Methods for UCCST Models - Sustainability & Barriers
Preparation Date:	September 30, 2025
Document Status:	Final
Author(s):	Alexios Papaioannou (CERTH), Zdravko Popov (BHF), Ipek Hokkaci (BSEC)
Dissemination Level:	PU - Public

Funded by the European Union

HORIZON-CL2-2023-HERITAGE-01-05

Deliverable SUMMARY SHEET

Deliverable Details	
Type of Document:	Deliverable
Document Reference #:	D3.2
Title:	Multi-Objective Optimisation Methods for UCCST Model Design
Version Number:	1
Preparation Date:	September 30, 2025
Delivery Date:	September 30, 2025
Author(s):	Alexios Papaioannou (CERTH), Zdravko Popov (BHF), Ipek Hokkaci (BSEC)
Contributor(s)	Evdoxia Eirini Lithoxoidou (CERTH), Eleni Tsompanidou (CERTH)
Document Identifier:	TOURAL Optimisation Methods for UCCST Models - Sustainability & Barriers
Document Status:	Final
Dissemination Level:	PU - Public

Project Details	
Project Acronym:	TOURAL
Project Title:	Multidimensional model of tourism verticals driving the sustainable balanced growth among rural & remote grids and urban clusters of rural regions, fostering macro-regional cooperation
Project Number:	101132489
Call Identifier:	HORIZON-CL2-2023-HERITAGE-01
Call Theme:	**HORIZON-CL2-2023-HERITAGE-01-05**
Project Coordinator:	Centre for Research and Technology Hellas (CERTH)
Participating Partners:	CERTH – Centre for Research and Technology Hellas – Greece MoN – NESEBAR MUNICIPALITY – Bulgaria BHF – FONDATSIYA BALKANSKO NASLEDSTVO – Bulgaria BRTA – BURGASKA REGIONALNA TURISTICHESKA ASOTSIATSIA – Bulgaria GALDD – ASOCIATIA GAL DELTA DUNARII – Romania KIN – CIVIL ORGANIZATION KINBURN – Ukraine NECU – NATIONAL ECOLOGICAL CENTRE OF UKRAINE – Ukraine BSEC – ORGANIZATION OF THE BLACK SEA ECONOMIC COOPERATION – Türkiye ICBSS – INTERNATIONAL CENTER FOR BLACK SEA STUDIES – Greece

	MoA – DIMOS ALONNISOU – Greece MoS – DIMOS SKOPELOU – Greece ZDRN – AGENCIJA ZA RAZVOJ ZADARSKE ZUPANIJE ZADRA NOVA – Croatia ITACA – IL TERRITORIO AL CENTRO DELLATTENZIONE - ASSOCIAZIONE PER LO SVILUPPO LOCALE – Italy PoT – PROVINCIA DI TERAMO – Italy ABR – REGIONE ABRUZZO – Italy ATL – ATLANTIS SYMVOULEFTIKI ANONYMI ETAIREIA ATLANTIS CONSULTING SA – Greece AMU – UNIVERSITE D'AIX MARSEILLE – France CPMR – CONFERENCE DES REGIONS PERIPHERIQUES MARITIMES D EUROPE – France Ruraltour – FEDERATION EUROPEENNE DE TOURISME RURAL – France IHU – DIETHNES PANEPISTIMIO ELLADOS – Greece
Contract Start Date:	January 1, 2024
Duration:	36 Months

Deliverable D3.2: Short Description

T3.2 will design multi-objective models to optimise the UCCST model developed in T3.1, following the co-design processes defined in T2.3. The optimisation will take into account: (a) value propositions for each targeted niche, maximising the unique assets and strengths of TOURAL regions; (b) blended propositions across niches; (c) effectiveness gains of corroborated tourism offerings through joint service provision; and (d) benefits from potential stakeholder collaborations at inter-, intra-, and macro-regional levels. This work is linked to deliverable D3.2.

Building on these results, T3.3 will complement the UCCST model with a sustainability assessment of the TOURAL regions across all four dimensions (environmental, social, cultural, and economic). It will also analyse barriers to implementation—such as limited niche penetration in global markets, shortages of qualified professionals, or seasonality in human resources—and propose mitigation measures (e.g. diversified packages with incentives, training programmes, synergies and joint planning, targeted marketing, digital service blueprints, and innovative business models). Using the methods established in T2.3, consortium partners will then co-design and adapt the UCCST model with local stakeholders, individualising tourism offerings and services to reflect each region's distinct assets and comparative advantages. This task also contributes to deliverable D3.2.

Deliverable D3.2: Revision History

Version:	Date:	Status:	Comments
0.1	07/07/2025	Draft	ToC preparation
0.3	8/09/2025	Draft	Multi-objective models (related to T3.2 added) by CERTH
0.5	10/09/2025	Draft	T3.3 – "Sustainability/Barriers Assessment in TOURAL Sites & UCCST Model Individualisation Thru Co-Design" content merged into deliverable by BHF, Introduction, Executive Summary and Overall Conclusions developed by BSEC
0.7	25/09/2025	Draft	Reviewed by TOURAL partners
1.0	30/09/2025	Final	Final version prepared by BSEC

Copyright notices

© 2025 TOURAL Consortium Partners. All rights reserved. TOURAL is a Horizon Europe Project supported by the European Commission under contract #101132489. For more information on the project, its partners, and contributors please see http://www.toural-project.eu/. You are permitted to copy and distribute verbatim copies of this document, containing this copyright notice, but modifying this document is not allowed. All contents are reserved by default and may not be disclosed to third parties without the written consent of the TOURAL partners, except as mandated by the European Commission contract, for reviewing and dissemination purposes. All trademarks and other rights on third party products mentioned in this document are acknowledged and owned by the respective holders. The information contained in this document represents the views of TOURAL members as of the date they are published. The TOURAL consortium does not guarantee that any information contained herein is error-free, or up to date, nor makes warranties, express, implied, or statutory, by publishing this document.

Table of Contents

1 Introduction 1
2 Task 3.2 - Multi-Objective Optimisation Methods for UCCST Model Design 2
2.1 Relation to other tasks 2
2.2 Multi-Objective Optimisation Method Overview 2
2.2.1 Optimization Objective Function 3
2.2.2 Enabler Scores and Importance Weights 4
2.2.3 Optimisation Algorithms 7
2.2.4 Interpretations of the output 9
2.3 Optimization Process and Results 11
2.3.1 Implementation Details 11
2.3.2 Regional Case Studies 11
2.4 Task 3.2 Conclusions 30
3 Task 3.3 - Sustainability/Barriers Assessment in TOURAL Sites & UCCST Model Individualisation Thru Co-Design 32
3.1 Sustainability assessment of TOURAL UCCST regions 32
3.1.1 Methodology and background 32
3.1.2 Environmental sustainability 34
3.1.3 Social sustainability 37
3.1.4 Cultural sustainability 40
3.1.5 Economic sustainability 42
3.1.6 Sustainability Assessment Conclusion 44
3.2 Analysis of implementation barriers 45
3.2.1 Barriers/challenges identified so far in the project 45
3.2.2 Analysis of the barriers to the UCCST model framework implementation 46
3.3 Mitigation prescriptions 48
3.3.1 Prescriptions/solutions described so far in the project 48
3.3.2 Analysis of currently rated mitigation prescriptions 49
3.4 Task 3.3 Conclusions 51
4 Overall Conclusions 53
5 Appendix 54
5.1 Appendix A – Pilot Sites Comparative Analysis 54
5.2 Appendix B – Questionnaire - T3.3 54
6 References 59

List of Figures

Figure 1 Overview of the Multi-Objective Optimisation Process 2
Figure 2 Assessment of the 4 levels of sustainability, distributed by TOURAL UCCST regions, based on the questionnaires data. 45
Figure 3 Barrier's importance assessment, distributed by region, and by type of barrier. 48
Figure 4 Assessment of 10 mitigation prescriptions, made by TOURAL partners. 51

List of Tables

Table 1: Description of the Enablers **4**
Table 2: Example of a prompt for the LLM **6**
Table 3 Comparison of different methods **9**
Table 4 Enabler Scores and Importance Weights in a Hypothetical Region **10**
Table 5: Quantitative and qualitative input data for the LLM-based Scoring method (North Sporades) **11**
Table 6: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (North Sporades) **13**
Table 7: Results of the different optimisation methods (North Sporades) **13**
Table 8: Output of the LLM-based Interpretation method (North Sporades) **14**
Table 9: Quantitative and qualitative input data for the LLM-based Scoring method (Nessebar) **15**
Table 10: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Nessebar) **16**
Table 11: Results of the different optimisation methods (Nessebar) **17**
Table 12: Output of the LLM-based Interpretation method (Nessebar) **17**
Table 13: Quantitative and qualitative input data for the LLM-based Scoring method (Danube Delta, Tulcea) **18**
Table 14: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Danube Delta, Tulcea) **19**
Table 15: Results of the different optimisation methods (Danube Delta, Tulcea) **20**
Table 16: Output of the LLM-based Interpretation method (Danube Delta) **20**
Table 17: Quantitative and qualitative input data for the LLM-based Scoring method (Teramo Province) **21**
Table 18: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Teramo Province) **22**
Table 19: Results of the different optimisation methods (Teramo Province) **23**
Table 20: Output of the LLM-based Interpretation method (Teramo Province) **23**
Table 21: Quantitative and qualitative input data for the LLM-based Scoring method (Kutsurub) **24**
Table 22: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Kutsurub) **25**
Table 23: Results of the different optimisation methods (Kutsurub) **26**
Table 24: Output of the LLM-based Interpretation method (Kutsurub) **26**
Table 25: Quantitative and qualitative input data for the LLM-based Scoring method (Šimuni) **27**
Table 26: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Šimuni) **28**
Table 27: Results of the different optimisation methods (Šimuni) **29**
Table 28: Output of the LLM-based Interpretation method (Šimuni) **30**
Table 29: Regions Sustainability **45**
Table 30: Barriers Assessment **48**
Table 31: Mitigation Prescriptions **50**
Table 32: Pilot Sites Comparative Analysis **54**

Executive Summary

This deliverable (D3.2) builds on the multidimensional Underwater, Cultural, Creative, Science and Silver Tourism (UCCST) model introduced in D3.1 and advances its application by developing and applying multi-objective optimisation methods (Task 3.2) and conducting a sustainability and barriers assessment combined with co-design processes (Task 3.3). The overarching aim is to design feasible, scalable, and sustainable UCCST models that maximise regional potential, balance local constraints, and support macro-regional cooperation across the pilot sites.

Task 3.2 introduces a robust multi-objective optimisation methodology to guide strategic decision-making in tourism development. The framework integrates sectoral potentials, enabler conditions, and stakeholder insights into a Tourism Success (TS) function, optimised through advanced algorithms. Regional case studies demonstrate the adaptability of the methodology, providing tailored strategies for each pilot site. The optimisation results reveal differentiated sectoral priorities and highlighted gaps in enablers such as connectivity, technology, and stakeholder collaboration. These findings allow pilot regions to identify targeted actions that enhance competitiveness and long-term sustainability.

Task 3.3 complements the optimisation with a comprehensive sustainability assessment across environmental, social, cultural, and economic dimensions. It also examines barriers hindering implementation, such as funding constraints, regulatory issues, and limited stakeholder engagement. The task also explores mitigation strategies, ranging from capacity-building initiatives to improved governance frameworks, with prescriptions prioritised based on partner evaluations.

Together, Tasks 3.2 and 3.3 provide an integrated evidence base for advancing UCCST. The optimisation framework offers a forward-looking tool for strategic allocation of resources, while the sustainability and barrier analysis ensures that proposed models are grounded in local realities and resilient to challenges. The combined outcomes underline the importance of coordinated stakeholder collaboration, investment in infrastructure and technology, and supportive policy frameworks at regional, national, and EU levels.

This deliverable demonstrates that UCCST has significant potential to extend tourism seasons, diversify offerings, and generate socio-economic benefits in rural and remote areas while safeguarding cultural and natural assets. It lays the foundation for pilot implementation, contributing directly to TOURAL's mission of promoting sustainable, balanced growth through innovative niche tourism development.

List of Symbols and Abbreviations

Abbreviation	Meaning
CCT	Cultural & Creative Tourism
CH	Cultural Heritage
CST	Cultural Science Tourism
KAC	Knowledge Awareness Centre
MDM	Multidimensional Model
MRC	Macro-Regional Cooperation
RRG	Rural and Remote Grids
SBG	Sustainable Balanced Growth
SLT	Silver Tourism
TV	Tourism Verticals
UCCST	Underwater, Cultural, Creative, Science and Silver Tourism
UCH	Underwater Cultural Heritage
UCNHT	Cultural & Nature Heritage Tourism
UCRR	Urban Clusters of Rural Regions
SLSQP	Sequential Least Squares Programming
COBYLA	Constrained Optimization BY Linear Approximations
UW	Underwater
VR	Virtual Reality
WP	Work Package

1 Introduction

The TOURAL project seeks to develop and implement **Underwater, Cultural, Creative, Science, and Silver Tourism (UCCST)** models that foster macro-regional cooperation and strengthen the competitiveness of Europe's rural and coastal regions.

Following the multidimensional UCCST model established in Deliverable D3.1, this deliverable (D3.2) advances the framework by focusing on two core tasks:

- **Task 3.2: Multi-Objective Optimisation Methods for UCCST Model Design** – dedicated to creating a quantitative, adaptable decision-support framework that allocates resources across tourism niches by accounting for sectoral strengths, regional conditions, and enabler readiness.
- **Task 3.3: Sustainability and Barriers Assessment with Co-Design** – aimed at assessing the sustainability of UCCST models across environmental, social, cultural, and economic dimensions, while identifying barriers to implementation and developing mitigation strategies through participatory processes.

The methodological approach combines advanced optimisation algorithms, LLM-based interpretation of regional data, and structured stakeholder engagement. This ensures that the proposed UCCST models are not only evidence-based but also context-sensitive and inclusive of local priorities.

The results presented in this deliverable provide both **analytical insights**—such as optimal sectoral allocations, sustainability performance, and barrier prioritisation—and **practical guidance** for policy and strategy development. The findings serve as a bridge between theoretical model design and pilot-level implementation, preparing the ground for small-scale trials and long-term adoption in participating regions.

By integrating quantitative optimisation with qualitative sustainability analysis, D3.2 positions UCCST as a transformative approach for diversifying tourism, extending seasons, and creating resilient local economies by establishing replicable practices for other European rural and coastal regions.

2 Task 3.2 - Multi-Objective Optimisation Methods for UCCST Model Design

2.1 Relation to other tasks

The optimisation framework presented on this deliverable relies on the regional profiles and sectoral potential values that were developed in D3.1, where a baseline was set for comparative analysis of pilot sites. Furthermore, D3.2 utilised the knowledge, priorities, and dynamics of development that were acquired through T2.2 and T2.3, which were used in the LLM based scoring method. Additionally, information for the definitions of the four operational enablers (Connectivity & Accessibility, Customer Experience, Stakeholder Collaboration and Technological Application) were collected from D2.5.

2.2 Multi-Objective Optimisation Method Overview

The objective of the optimization model developed in Task 3.2 is to identify the most effective allocation of effort and investment across the four tourism niches, Cultural and Creative Tourism (CCT), Cultural Science Tourism (CST), Silver Tourism (SLT), and Underwater Cultural & Nature Heritage Tourism (UCNHT) within each TOURAL pilot region.

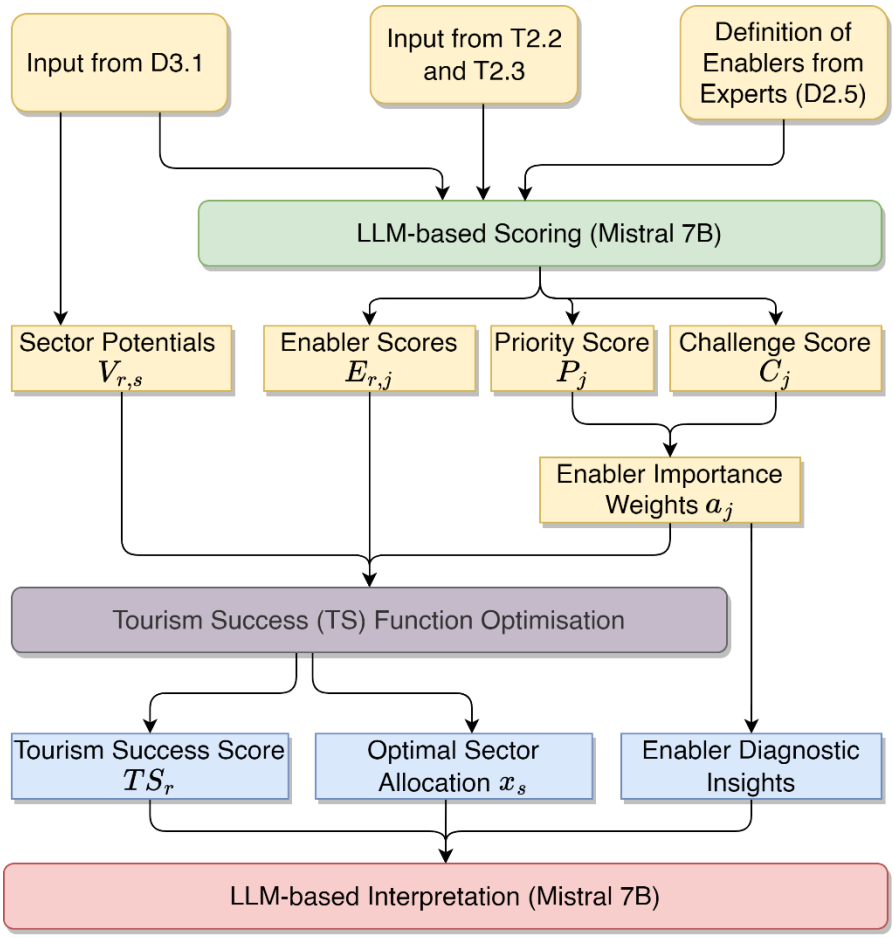

Figure 1 Overview of the Multi-Objective Optimisation Process

Figure 1 illustrates the process pipeline of the multi-objective optimisation framework. Inputs are shown in yellow boxes and include data from D3.1 (regional profiles), T2.2 and T2.3 (stakeholder insights), and expert-defined enabler descriptions derived from D2.5. These data are processed using LLM-based scoring method (green box), specifically a Retrieval-Augmented Generation (RAG) pipeline implemented with Mistral 7B, which produces region-specific enabler scores $E_{r,j}$

and importance weights a_j derived from the priority score P_j and the challenge score C_j. Subsequently, sector potentials $V_{r,s}$ are derived from D3.1. These three components feed into the Tourism Success (TS) function (gray box), which models regional tourism performance by combining strategic potential with contextual readiness. The function is then optimised using different optimisation algorithms (SLSQP, COBYLA, Powell), resulting in an optimal effort allocation across tourism sectors x_s, a TS score and diagnostic insights (blue boxes). The final step includes the interpretation of the results from the optimization function, covering various aspects including the TS score, optimal sector allocation, and diagnostic insights from enablers.

2.2.1 Optimization Objective Function

At the core of the optimisation methodology is a purposely designed objective function that aims to represent the multidimensional nature of TS in different regional contexts. Unlike generic resource allocation models, this function integrates not only sector-specific potential but also the interdependencies between sectors and the operational reality of each region through enabler conditions.

The TS score serves as an indicator that the model aims to maximize. It measures how a particular combination of tourism investment (or strategic effort) can leverage the strengths of the region while addressing its operational weaknesses. Additionally, the model relies on a composite scoring formula that integrates both quantitative (pilot sites comparative analysis values) and qualitative (key challenges, key strengths, development dynamics) data from D3.1 and T2.3, capturing each region's comparative strengths and constraints. It serves as a decision-support tool that informs strategic investment planning at regional level.

The TS score for a given region r is defined as:

$$TS_r = \left(\sum_s V_{r,s} * x_s\right) * \left(\sum_j a_j * E_{r,j}\right)$$

Where:

- $x_s \in [0,1]$: Proportion of total effort or investment allocated to tourism sector s, constrained to $\sum_s x_s = 1$.
- $V_{r,s} \in [0,1]$: Normalized sector potential for sector s in region r, derived from D3.1
- $E_{r,j} \in [0,1]$: Score of operational enabler j in region r
- a_j: Importance weight of enabler j, based on regional priority, challenge, and stakeholder input
- $TS \in [0,1]$: TS score for a region representing the combined effect of sectoral potentials and enabler readiness.

This formulation consists of two multiplicative parts. The weighted sum of sector potentials, reflecting the strategic value of each tourism niche and the enabler multiplier, showing the operational capacity of the region to deliver results:

- The term $\sum_s V_{r,s} * x_s$ represents the aggregate tourism value expected based on regional sector strengths. Sector potentials $V_{r,s}$ are derived from the D3.1, where each tourism niche was scored on a 1-5 scale and then normalized to [0,1] for use in the model.
- The second term $\sum_j a_j * E_{r,j}$ acts as a moderating multiplier. It captures the region's readiness to implement tourism strategies across four critical operational dimensions. E1: Connectivity & Accessibility, E2: Customer Experience & Services, E3: Stakeholder Collaboration, E4: Technological Integration. Each enabler $E_{r,j}$ is scored on a [0,1] scale and weighted by a corresponding importance factor a_j. These weights are region-specific

and are designed to reflect the degree to which each enabler affects overall tourism success in that context (details provided in Section 2.3).

2.2.2 Enabler Scores and Importance Weights

To ensure that the optimisation model includes both the strategic attractiveness of tourism sectors and the practical readiness of each region to implement them, a variable of enabler scores $E_{r,j}$ (2.2.2.1.1) and corresponding importance weights a_j is used. These two components work together as a multiplier that adjusts the TS score per region based on contextual capacity. This section describes how these values are calculated using a semi-automated, explainable AI pipeline, using Retrieval-Augmented Generation (RAG) with a lightweight language model (Mistral 7B).

RAG enabled automation on a large scale while maintaining local relevance, ensuring each region's score reflected its unique challenges and priorities. It also supported explainability by providing brief explanations with each numerical value, improving transparency. Mistral 7B [1] was chosen for its strong performance in instruction-following tasks, its lightweight architecture, and its open-source and locally deployable nature**.** By deploying Mistral via a local Ollama [2] instance, the project ensured full offline operation and compliance with EU data governance regulations, including GDPR.

2.2.2.1.1 Calculation of Enabler Scores $E_{r,j}$

Each enabler score $E_{r,j} \in [0,1]$ captures the readiness level of region r to deliver success in operational dimension j. It reflects current infrastructure, institutional capacity, and implementation maturity for the four enablers (E1, E2, E3, E4). Following is the step-by-step process of the calculation of the $E_{r,j}$:

1. Document Retrieval and Preprocessing: The first step includes the collection and preprocessing of regional context data. From the **D3.1 TOURAL UCCST** models, region-specific sections were extracted describing qualitative information including infrastructure, tourism assets, stakeholder coordination, digital tools, and known challenges. Additionally, input was collected from **Task T2.2** and **T2.3**, which included direct stakeholder quotes, consultation summaries, and prioritisation inputs gathered during co-design workshops and surveys. These inputs were categorised into three aspects, key challenges, key strengths and development dynamics. All inputs were pre-processed to remove formatting inconsistencies, standardize language, and ensure clarity.
2. Definition of Enablers: The second step includes the definition of each enabler. The definition for each enabler was defined by the experts and based on D2.5. These definitions were used across all region prompts to support objective interpretation by the language model. Table 1 presents the description of each enabler.

Table 1: Description of the Enablers

Enabler	Description
E1. Connectivity & Accessibility	**Definition**: *Availability and quality of transport infrastructure and access to tourism sites, including the physical and digital accessibility of remote and rural areas. Focuses on seasonal access, public mobility, and the capacity to support year-round tourism.* **Positive indicators**: *Improved road and maritime infrastructure, year-round ferry or air services, accessible transport for elderly or differently-abled travelers, regional mobility networks connecting tourist points.*

	Negative indicators: *Inadequate or seasonal-only transport, Isolation during off-peak periods, Poor infrastructure connecting cultural/natural sites.*
E2. Customer Experience	**Definition**: *Quality, diversity, and accessibility of hospitality services, wellness and health provision, cultural activities, and tourist offerings that enhance visitor satisfaction. Emphasizes inclusivity (e.g. for Silver Tourism) and local community integration.* **Positive indicators**: *High-quality accommodations and tour services, availability of wellness and health services, engagement with cultural and creative sectors (CCT), services tailored for off-season or niche tourism (e.g., divers, seniors).* **Negative indicators**: *Outdated or limited service range, Lack of services for off-peak tourists, No consideration for heritage or local identity.*
E3. Stakeholder Collaboration	**Definition**: *Level of cooperation among public institutions, private actors, academia, and civil society in co-planning, decision-making, and delivery of tourism development.* **Positive indicators**: *Functional regional tourism partnerships and governance structures, Involvement of local communities and SMEs, Presence of cross-sector and multi-level planning, Integration of LL results into policy instruments.* **Negative indicators**: *Top-down strategies without local buy-in, fragmented governance or no stakeholder participation, poor linkage between levels of decision-making.*
E4. Technological Integration	**Definition**: *Use of digital technologies, ICT tools, and smart systems to promote, manage, and innovate tourism experiences. Includes both operational tools and strategic innovation capabilities, aligned with sustainability and resilience.* **Positive indicators**: *Use of digital platforms (e.g. booking, heritage apps, VR experiences), digital promotion of local assets, tourism data systems or digital infrastructure, innovation initiatives (e.g., virtual Living Labs, remote co-creation tools).* **Negative indicators**: *Low digital presence of destinations or SMEs, absence of data systems or online visibility, manual or paper-based tourism management.*

3. Prompt Construction: For each region, a structured prompt was developed and fed into the LLM. The prompt includes the following elements:
    a. Contextual insights extracted from the D3.1 regional profiles
    b. Stakeholder inputs from T2.2 and T2.3
    c. Fixed definitions of the four enablers based on expert and D2.5
    d. Instructions and constraints requesting structured output, including for each enabler, the priority score (P_j) for each region, the challenge score (C_j) as well as a small justification.

    The priority score P_j shows how important an enabler is to the region's tourism development. A high priority score (1.0) indicates that the enabler is seen as key to success. For example, in island regions, E1 (connectivity) typically receives a high priority value due to its crucial role in enabling access. On the other hand, an enabler might get a lower score (0.0 or 0.5) if it's less important to the region's tourism plans or if it's already stable and not a major concern.

The challenge score C_j measures how weak or underdeveloped an enabler is. A score of 1.0 means there is a serious problem, while 0.0 denotes no visible challenges. This score helps make sure the model doesn't ignore weak enablers, even if they aren't the most talked about by stakeholders. By combining these two values, the resulting reflects both the urgency (based on weakness) and importance (based on role) of the enabler.

An example of a prompt for the LLM is presented in Table 2.

Table 2: Example of a prompt for the LLM

Region *X* **Key Challenges**: *Underdeveloped infrastructure, lack of diverse employment opportunities, limited tourism offerings beyond nautical and summer family vacations, need for sustainable development beyond agriculture…* **Key Strengths**: *Beautiful coastal environment with three bays, strong nautical tourism infrastructure (ACI Marina), peaceful and family-friendly reputation…* **Development Dynamics**: *Plans to diversify economic activities through sustainable tourism and SME entrepreneurship. Focus on enhancing skills, leveraging underwater cultural heritage…* **Enabler Context**: E1 – Connectivity & Accessibility (*Content from* Table 1) E2 – Customer Experience (*Content from* Table 1) E3 – Stakeholder Collaboration (*Content from* Table 1) E4 – Technological Integration (*Content from* Table 1) **Task**: *For each enabler (E1–E4), provide:* *- Priority score (P): Low = 0.0, Medium = 0.5, High = 1.0* *- Challenge score (C): No issue = 0.0, Moderate = 0.5, Critical = 1.0* *- Justification: Max 2 sentences per enabler.* *Return your answer in JSON format.*

4. The final step includes the calculation of the enabler score for the specific region. The Mistral 7B model returned structured JSON-formatted responses containing P_j and C_j as well as justification sentences for each enabler. From this output, the final enabler score was calculated as:

$$E_{r,j} = 1 - C_j$$

This simple transformation ensures that regions with high challenge levels receive lower enabler scores, while regions with low or no challenges achieve high readiness scores. Additionally, the model output might be manually reviewed to ensure consistency and accuracy using the justification sentences.

2.2.2.1.2 Calculation of Enabler Importance Weights α_j

While the enabler score $E_{r,j}$ captures how well a region performs in a particular operational area, the importance weight α_j describes how much that enabler matters for achieving tourism success in that specific regional context. The purpose of this weighting system is to account for regional variability. A weak enabler may have limited influence in some places but be critically important

in others. Therefore, each region has its own set of α_j values for the four enablers (E1–E4), allowing the optimisation model to scale the enabler contribution appropriately.

The α_j it is not a fixed value across all regions. Instead, it is based on the priority score P_j, and the challenge score C_j. The following equation describes the a_j for each enabler j:

$$a_j = \lambda_1 \cdot P_j + \lambda_2 \cdot C_j$$

Where $\lambda_1$and λ_2 are predefined coefficients that balance the contribution of each component. For our case, those values are both set to 0.5, meaning that priority and challenge are treated as equally influential in determining how important an enabler is.

Once the weights are computed for all four enablers, they are normalised so that their sum per region equals 1.

$$\sum_j a_j = 1$$

This step ensures that the final multiplier $\sum_j a_j \cdot E_{r,j}$ remains within a similar scale across regions and allows prioritising without raising the overall TS score.

In the final TS function, the enabler scores $E_{r,j}$ and their corresponding importance weights a_j are combined into a single multiplicative term $\sum_j a_j * E_{r,j}$, which acts as a regional adjustment factor. This term scales the sector-based success component $\sum_s V_{r,s} * x_s$, ensuring that a region's strategic sector allocation is moderated by its operational capacity to deliver tourism outcomes. Regions with high enabler performance in areas that are also strategically critical (i.e., high $E_{r,j}$ and high a_j) will see their TS scores increased, while those with weak enablers will be penalised. This interaction allows the model to capture both the opportunity (sector potential) and the feasibility (enabler readiness) of tourism development strategies in a region.

2.2.3 Optimisation Algorithms

The core objective of the optimisation algorithms is to identify the optimal allocation of effort across four tourism sectors in each TOURAL region. This is set up as a continuous optimization problem with constraints, where the aim is to maximize the TS score. The TS function is nonlinear due to the region-specific enabler multiplier, and it includes both equality and bound constraints on the decision variables. Mainly, the optimization focuses on determining the vector $x = \{x_s\}$, representing the share of effort allocated to each tourism sector s:

$$max_x TS_r = \left(\sum_s V_{r,s} * x_s\right) * \left(\sum_j a_j * E_{r,j}\right)$$

For the previous equation, there are some limitations:

- Equality constraint: $\sum_s x_s = 1$
- Bound constraints for each tourism sector: $0 \leq x_s \leq 1$

Based on the characteristics of the TS function and practical considerations of interpretability, three methods were selected for evaluation: Sequential Least Squares Programming (SLSQP) [3], Constrained Optimization BY Linear Approximations (COBYLA) [3], and Powell's method [3]. Each one has its own benefits and approaches the problem in a different way.

2.2.3.1 *Sequential Least Squares Programming (SLSQP)*

SLSQP is a gradient-based method designed for solving smooth nonlinear optimisation problems with both equality constraints and variable bounds. It is suitable for the TS model optimization

due to its ability to handle the summation constraint ($\sum x_s = 1$) and maintain the bounds $x_s \in [0,1]$ without transformation.

The following equation describes the SLSQP:

$$min_x \ f(x) \ \ subject\ to\text{:}\ c_i(X) = 0, \ \ d_j(x) \geq 0$$

In our case:

- Objective: $f(x) = -TS_r(x)$ since the function from the scipy library minimises by default
- Constraint: $c(x) = \sum x_s - 1 = 0$
- Bounds: $x_s \in [0,1]$

SLSQP uses quasi-Newton updates and local quadratic approximations of the objective, making it computationally efficient and accurate for small-scale problems with smooth gradients. It was used as the primary optimisation method in this task due to its reliability and native support for all required constraint types.

2.2.3.2 *Constrained Optimization BY Linear Approximations (COBYLA)*

COBYLA is a derivative-free optimisation algorithm that solves nonlinear problems using linear approximations of constraints. It is particularly useful when the objective function is not differentiable. COBYLA handles constraints in the form:

$$g_i(x) \geq 0$$

Because COBYLA does not support variable bounds directly, bounds must be re-expressed as inequality constraints:

$$x_s \geq 0,\ 1\text{-}x_s \geq 0$$

The equality constraint on total effort is mentioned:

$$\epsilon \leq \sum x_s \leq 1 + \epsilon$$

with ϵ being a small tolerance, 1e−4.

This makes COBYLA less strict than SLSQP but more flexible, allowing it to be useful when regions have complex policy-driven constraints, binary activation limits, or when gradient information is noisy or non-smooth.

2.2.3.3 *Powell's method*

Powell's method is a derivative-free, direction-set optimization algorithm that performs sequential univariate minimizations along chosen directions in parameter space. Unlike SLSQP or COBYLA, Powell does not handle constraints natively. However, the scipy library allows for soft constraint approximations by applying penalisation strategies or projecting the solution space.

Powell solves problems of the form $min_x f(x)$. To adapt Powell for this model, the effort vector x is post-normalised after optimisation to satisfy the equality constraint. Although this makes the method somewhat approximate, Powell provides an effective test case to explore solution behaviour under relaxed assumptions and can help validate the robustness of solutions produced by the stricter SLSQP formulation.

2.2.3.4 *Comparison of Optimization methods*

To better understand the strengths and limitations of each optimisation algorithm used in this task, Table 3 presents a comparison based on key features relevant to the structure of the TS function.

These features include the need for gradient information, support for constraints and convergence properties.

Table 3 Comparison of different methods

Features	SLSQP	COBYLA	Powell's method
Gradient Requirement	Yes, uses gradients	No, derivative-free	No, derivative-free
Equality Constraints	Fully supported	Not supported directly	Not supported directly
Inequality Constraints	Supported	Supported (linear approximations)	Requires penalty methods
Bound Constraints	Directly supported	Must be reformulated as inequalities	Supported via bounds argument
Convergence Behavior	Fast and accurate with smooth objectives	Slower, less precise but more tolerant to noise	Slower, less precise

These comparisons explain why SLSQP was chosen as the main solver. It fully supports the TS model's constraints and is efficient for its structure. COBYLA adds flexibility for future model changes that might involve non-differentiable constraints or policy logic, while Powell acts as a stress-test method to ensure the optimization works as expected, even with looser assumptions.

2.2.4 Interpretations of the output

This subsection describes how to interpret the outputs produced by the optimisation model described in the Section 2.2.3. It focuses on the optimised allocation of effort across tourism sectors, represented by the decision variables x_s , the influence of regional enablers on the final TS score and the interpretation of the LLM model.

2.2.4.1 *Optimised Effort Allocation (x_s)*

The direct output of the model is the optimal value of the decision variables x_s, where each element represents the proportion of total strategic effort or investment that should be allocated to a given tourism niche: CCT, CST, SLT, or UCNHT.

For each region, the x_s, are constrained between [0,1] and sum to 1 as mentioned above. These values for each niche should be interpreted as relative shares of effort or focus. For example, a results of $x_{CCT} = 0.15$, $x_{CST} = 0.10$, $x_{SLT} = 0.55$, $x_{UCNHT} = 0.20$ would indicate that SLT should receive the majority of the region's tourism development effort, while CST should be de-prioritised.

These outputs allow regional actors to focus their planning and funding on sectors where success is most likely, and where investment will yield the highest return in tourism outcomes, given the region's characteristics.

2.2.4.2 *Role of Enablers in the final outputs*

While the effort allocation x_s is the main decision variable, the final TS score is critically affected by the region's enabler profile. Each enabler score $E_{r,j}$ reflects actual regional performance in that operational domain, such as connectivity or digital infrastructure, while each weight a_j represents the degree to which that enabler influences tourism success in the given regional context.

Although the enablers are fixed inputs and not directly optimized, they are still important for interpreting the results. A region with high sectoral potential and a well-allocated effort mix may still underperform if the enablers it depends on are weak. In this way, enablers serve as scaling levers either increasing or constraining the outcomes of sector-level decisions.

To support the process of the interpretation, the model identifies critical enablers, which are those that are both highly important (high a_j) and underperforming (low $E_{r,j}$). This combination shows that a specific enabler is limiting the region's ability to succeed in tourism, even if the sector has strong potential. Identifying these enablers allows stakeholders to plan targeted actions, like upgrading infrastructure, improving coordination, or adopting new technologies.

For example, consider the previous hypothetical region, and the following table with the enabler scores and importance weights:

Table 4 Enabler Scores and Importance Weights in a Hypothetical Region

Enabler	$E_{r,j}$	a_j
E1	0.40	0.35
E2	0.75	0.20
E3	0.60	0.15
E4	0.30	0.30

The resulting enabler multiplier is:

$$\sum_j a_j \cdot E_{r,j} = (0.35 \cdot 0.40) + (0.20 \cdot 0.75) + (0.15 \cdot 0.60) + (0.30 \cdot 0.30) = 0.47$$

This means the region's final TS score will be reduced by more than half, even though the sectoral allocation is highly targeted. The two critical enablers in this case are E1 (Connectivity) and E4 (Technology), both of which have high importance weights and low readiness scores. These enablers are key to success but are currently weak points in the system.

2.2.4.3 *LLM-Generated Interpretation*

The final step of Figure 1 involves the LLM, which generates an interpretive summary of the quantitative results. This module takes as input the TS score, the optimal sector allocation, and the enabler profile, and produces a structured summary designed to support decision-making and strategic planning.

The LLM-generated interpretation follows a clear and structured format to ensure clarity, and usefulness. Each response consists of three main sections:

- TS score interpretation: The response of the LLM includes a brief explanation of the TS score's value and what it means. This includes qualitative descriptors (e.g., "very strong," "moderate") and places the score in context by comparing it to the theoretical maximum.
- Sectoral Focus Breakdown: The next section analyzes the optimal sector allocation. The LLM presents the sectors in descending order of allocation priority, interprets the implications of each, and connects them to the region's strengths or needs.
- Enabler Diagnosis and Strategic Recommendations: The final section focuses on the enabler profile. It compares readiness scores with importance scores, pointing out mismatches that indicate strategic gaps. The LLM explains which enablers are performing well or poorly and why. This section ends with clear recommendations, such as improving connectivity, enhancing services, or strengthening stakeholder collaboration, based on the enabler analysis.

2.3 Optimization Process and Results

Section 3 gives a detailed explanation of how the optimization methodology from Section 2 was applied in practice for each pilot. The section describes the implementation details of the optimization methodology. Also presents and compares the results generated by different optimisation algorithms (SLSQP, COBYLA, Powell) across all TOURAL pilot regions. For each region, the output includes the calculated TS score, recommended sector allocation, and a structured interpretation of the findings.

2.3.1 Implementation Details

The optimisation model was implemented in Python, using the scipy.optimize.minimize function to solve the constrained non-linear optimisation problem described in Section 2. The TS function was defined using the two primary components: sector potentials ($V_{r,s}$) and the enabler multiplier ($\sum_j a_j * E_{r,j}$). The model was tested using three optimization algorithms SLSQP, COBYLA**,** and Powell to evaluate performance, robustness, and sensitivity to constraints.
The RAG pipeline was implemented using a local instance of Mistral 7B, deployed via Ollama as mentioned in Section 2.2.2, ensuring the model could operate offline, reproducibly, and consistently across runs. For each region, a custom prompt was automatically assembled as mentioned also in Section 2.2.2.1.1, combining contextual narrative from D3.1 (regional assets, infrastructure, challenges), stakeholder inputs from T2.2 and T2.3 and input from the experts and T2.5 for the definitions of the enablers E1–E4.

2.3.2 Regional Case Studies

This subsection presents applications of the UCCST optimisation model in the TOURAL pilot regions. Each case study demonstrates how regional data, stakeholder inputs, and local priorities were transformed into strategic tourism planning outputs. This subsection includes LLM-based enabler scoring, optimisation results using the three optimization algorithms, and interpretations focused on each region's unique context.

2.3.2.1 *North Sporades (Greece)*

The North Sporades region was analysed using the UCCST model to assess its tourism development readiness and strategic focus areas. The region's qualitative profile, as compiled from D3.1 and stakeholder engagements in T2.2 and T2.3, highlighted key challenges including seasonal tourism dependency**,** limited accessibility for elderly visitors**,** and underdeveloped infrastructure and off-season services. On the other hand, its strengths included rich coastal and underwater heritage**,** a strong nautical tourism infrastructure**,** cultural programming**,** and a vision for sustainable, multi-season tourism**.** The inputs for the LLM-based scoring method are presented in Table 5.

Table 5: Quantitative and qualitative input data for the LLM-based Scoring method (North Sporades)

Deliverable	**Text Input**	**Variable influence**
D2.2	**Key Challenges:** Underdeveloped infrastructure, lack of diverse employment opportunities, limited tourism offerings beyond nautical and summer family vacations, need for sustainable development beyond agriculture, and seasonal tourism dependency. **Key Strengths:** Beautiful coastal environment with three bays, strong nautical tourism infrastructure (ACI Marina), peaceful and family-	a_j, P_j, C_j

	friendly reputation, potential for UWCNH tourism, and vision for smart sustainable development. **Development Dynamics:** Plans to diversify economic activities through sustainable tourism and SME entrepreneurship. Focus on enhancing skills, leveraging underwater cultural heritage, and transforming into a multi-destination tourism hub. Strategies aim to address infrastructure gaps, broaden tourism offerings, and reduce seasonality impact.	
D3.1	Pilot sites comparative analysis values (Appendix A – Pilot Sites Comparative Analysis Table 32)	$V_{r,s}$
D3.1	**Key Challenges:** Seasonal reliance, limited accessibility for elderly visitors, and needs for better infrastructure and eco-tourism integration. The lack of year-round programming also limits their Silver and Creative tourism potential. **Key Strengths:** Feature over 15 dive sites, including the Peristera Underwater Museum. They host creative events like music festivals and film screenings for youth, with partnerships such as the University of Piraeus in CST. It has stunning beaches, lush forests, and picturesque villages that make them an ideal destination for nature lovers and adventure seekers alike. The islands' rich history and culture are evident in their traditional architecture, monasteries, and local cuisine, offering a unique blend of experiences for tourists. **Development Dynamics:** It includes enhancing services for all ages, increasing transport options, and promoting sustainable practices to preserve their natural beauty.	a_j, P_j, C_j

Table 6 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values.

- The Priority (P_j) represents how important the enabler is for tourism development in the specific regional context. A value of 1.0 for E1 (Connectivity) indicates that this enabler is critically important to the region due to the reliance on ferry access and seasonal transport limitations. A lower priority value of 0.5 for E2–E4 means these enablers are still important, but less critical for immediate tourism success.
- The Challenge (C_j) presents how much the enabler is currently underperforming. A score of 0.5 for E1 and E2 indicates moderate issues, including limited year-round transport or off-season service quality. A value of 0.0 for E3 and E4 implies no critical challenge was detected in the qualitative data.
- The Enabler score (E_j) is calculated as ($1 - C_j$) and reflects how operationally prepared the region is in each dimension. E1, E2 and E4 have a readiness score of 0.5, meaning connectivity is important but only partially sufficient and needs improvement. On the other hand, a readiness score of 1.0 (E3) means that no major improvements are needed.
- The Importance Weight (a_j) combines priority and challenge scores and is then normalized across all four enablers to sum to 1. In this case, E1 receives the highest weight (0.75), meaning it has both high importance and moderate challenge and is thus

the most influential enabler in determining tourism outcomes in the region. E2–E4, with weights of 0.5 or 0.25, have less impact on the final TS score, either because their challenges are small or because they are less important for regional success.

Table 6: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (North Sporades)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1.0	0.5	0.5	0.75	*Seasonal tourism dependency and limited accessibility for elderly visitors highlight critical infrastructure gaps, but existing nautical infrastructure and development plans show potential for improvement.*
E2	0.5	0.5	0.5	0.5	*While the region offers strong nautical and cultural experiences, limited off-season services and niche tourism (e.g., Silver Tourism) present moderate challenges.*
E3	0.5	0.0	1.0	0.25	*Partnerships with academia and local events suggest collaboration, but fragmented governance and lack of year-round programming indicate area for improvement.*
E4	0.5	0.0	0.5	0.5	*Digital presence and innovation are emerging (e.g., underwater museum, creative events), but no severe weaknesses are evident.*

Table 7 presents the output of the optimisation model for North Sporades across the three different algorithms. The TS score reflects the overall tourism development potential for the region, taking into account both strategic sector potential and operational readiness through enablers. Among the algorithms, SLSQP yielded the highest TS score (0.9441) with a balanced sector allocation, indicating it provided the most effective and realistic strategy under the given constraints. On the other hand, COBYLA produced an extreme, single-sector recommendation (100% in SLT) with a lower TS score, while Powell defaulted to an equal allocation across all sectors, resulting in the lowest score.

Table 7: Results of the different optimisation methods (North Sporades)

Algorithm	TS Score	CCT	CST	SLT	UCNHT
SLSQP	0.9441	0.256	0.231	0.281	0.231
COBYLA	0.5625	0	0	1	0
Powell	0.2016	0.25	0.25	0.25	0.25

The final step of the methodology involves the LLM-generated interpretation, which provides a summary of the model's results to help stakeholders and non-technical users understand the key points. The output includes a TS score of 0.9441, showing a good balance between growth, visitor experience, and sustainability. The sectoral focus summary presents the optimized sector allocation, identifying SLT as the top priority (28.1%), followed by CCT (25.6%), and CST and UCNHT (23.1%). Finally, the LLM explains the enabler readiness and importance scores, highlighting strengths (e.g., E4 (Technology), with high readiness and low importance) and gaps (e.g., E1(Connectivity) with high importance but low readiness). Based on this, it suggests improvements including improving transport links, expanding off-season services, and

strengthening stakeholder coordination to boost tourism potential. Table 8 presents the output of the LLM-based Interpretation method.

Table 8: Output of the LLM-based Interpretation method (North Sporades)

=== LLM-Generated Interpretation (SLSQP) ===

Interpretation of North Sporades Tourism Optimization Results

The **TS Score of 0.9441** indicates that North Sporades has strong tourism competitiveness, sustainability, and readiness, positioning it as a highly attractive destination. This score reflects a balanced approach to tourism development, leveraging the region's unique cultural, natural, and heritage assets while maintaining environmental and social sustainability. The high score suggests that North Sporades is well-positioned to capitalize on emerging tourism trends, though further optimization can enhance its global standing.

The sector allocations highlight a strategic focus on **Silver Tourism (SLT, 28.1%)**, reflecting the region's appeal to older travelers seeking relaxation and wellness. **Cultural and Creative Tourism (CCT, 25.6%)** is prioritized due to its potential to attract niche markets through local arts and crafts. **Cultural Science Tourism (CST, 23.1%)** and **Cultural & Nature Heritage Tourism (UCNHT, 23.1%)** are equally weighted, emphasizing the region's rich history and biodiversity. These allocations suggest a diversified tourism strategy that balances economic growth with cultural preservation.

The enabler analysis reveals **strong stakeholder engagement (E3, E=1.00, α=0.25)**, indicating high collaboration among local actors. However, **connectivity (E1, E=0.50, α=0.75)** and **technology (E4, E=0.50, α=0.50)** are critical gaps, as their importance outweighs readiness. **Services (E2, E=0.50, α=0.50)** are moderately developed but require improvement to support growing visitor demands. Addressing these gaps will enhance tourism resilience and competitiveness.

Strategic recommendations

- **Boost CCT × SLT** by promoting art workshops for seniors to extend stays.
- **Upgrade E1 (connectivity)** with ferry upgrades to improve access for travelers.
- **Enhance E4 (technology)** with digital heritage guides for UCNHT and CCT.
- **Strengthen E2 (services)** by training staff in multilingual hospitality for SLT.
- **Leverage E3 (stakeholders)** to co-create SLT wellness packages with local spas.
- **Market CST × UCNHT** through eco-science tours linking marine biology and heritage sites.

2.3.2.2 *Nessebar (Bulgaria)*

The Nessebar region was analysed using the UCCST model to assess its tourism development readiness and strategic focus areas. The region's qualitative profile, as compiled from D3.1 and stakeholder engagements in T2.2 and T2.3, highlighted key challenges including overcrowding during peak summer months, seasonality that limits year-round employment, lack of high-skilled tourism jobs, and the need for improved sustainable heritage management. On the other hand, its strengths include its designation as a UNESCO World Heritage site, rich underwater archaeological resources, Natura 2000 biodiversity zones, and vibrant cultural programming**.** The inputs for the LLM-based scoring method are presented in Table 9.

Table 9: Quantitative and qualitative input data for the LLM-based Scoring method (Nessebar)

Deliverable	Text Input	Variable influence
D2.2	**Key Challenges:** Overcrowding and pollution from visitors, during the high season / summer months, seasonality limiting year-round employment, lack of high-skilled tourism jobs, limited diverse employment, need to protect local identity, and sustainable heritage management. **Key Strengths:** UNESCO World Heritage site, Natura 2000 biodiversity zones, favorable climate and natural attractions, potential for UWCNH tourism, and commitment to sustainable tourism development. **Development Dynamics:** Balancing coastal tourism expansion with rural development and heritage conservation. Strategy includes diversifying tourism offerings, extending seasons, improving employment quality, and leveraging cultural and environmental assets sustainably.	a_j, P_j, C_j
D3.1	Pilot sites comparative analysis values (Appendix A – Pilot Sites Comparative Analysis Table 32)	$V_{r,s}$
D3.1	**Key Challenges:** Limited funding, trained personnel shortages, and complex underwater heritage regulations. **Key Strengths:** Rich underwater archaeological resources, including a partially accessible submerged ancient city, supporting academic and tourism diving activities like the Underwater Archaeology Field School. The town hosts festivals, art residencies, and exhibitions, with partnerships in Cultural Science Tourism, enhancing its cultural vibrancy and drawing visitors who are interested in history and art. **Development Dynamics:** Increased investment in training programs for specialists and streamlined regulatory frameworks could be implemented. Additionally, public-private partnerships might help secure necessary funding. Silver Tourism, has significant growth potential if targeted appropriately. Developing specific tour packages that meet the needs and interests of older tourists, along with effective marketing strategies, could attract a new demographic to Nessebar. Improving accessibility and providing health and wellness services can also enhance the appeal of Silver Tourism.	a_j, P_j, C_j

- P_j: Connectivity (E1) and Customer Experience (E2) are assessed as highly important, reflecting the region's dependence on transport access, service quality, and visitor

experience. Stakeholder Collaboration (E3) and Technology Integration (E4) are considered less critical, though still relevant for long-term sustainability.

- C_j: All four enablers are moderate challenges (0.5), including limited off-peak transport, underdeveloped niche services, fragmented governance, and insufficient digital promotion. This indicates that while no enabler is critically weak, each requires improvement.
- E_j: The readiness level across all dimensions stands at 0.5, showing that Nessebar is moderately prepared but lacks fully developed capacities. Connectivity and services are functional yet constrained, while collaboration and technology remain underexploited.
- a_j: Connectivity (E1) and Customer Experience (E2) is the most influential enablers, each receiving the highest weighting. Collaboration (E3) and Technology (E4) hold secondary influence but still provide opportunities for improving overall performance.

Table 10 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values.

- P_j: Connectivity (E1) and Customer Experience (E2) are assessed as highly important, reflecting the region's dependence on transport access, service quality, and visitor experience. Stakeholder Collaboration (E3) and Technology Integration (E4) are considered less critical, though still relevant for long-term sustainability.
- C_j: All four enablers are moderate challenges (0.5), including limited off-peak transport, underdeveloped niche services, fragmented governance, and insufficient digital promotion. This indicates that while no enabler is critically weak, each requires improvement.
- E_j: The readiness level across all dimensions stands at 0.5, showing that Nessebar is moderately prepared but lacks fully developed capacities. Connectivity and services are functional yet constrained, while collaboration and technology remain underexploited.
- a_j: Connectivity (E1) and Customer Experience (E2) is the most influential enablers, each receiving the highest weighting. Collaboration (E3) and Technology (E4) hold secondary influence but still provide opportunities for improving overall performance.

Table 10: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Nessebar)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1	0.5	0.5	0.75	*Connectivity is critical due to seasonality and overcrowding, but challenges like limited off-peak transport and infrastructure gaps exist.*
E2	1	0.5	0.5	0.75	*Customer experience is critical for diversifying tourism, but services for niche markets (e.g., Silver Tourism) and off-peak visitors are underdeveloped.*
E3	0.5	0.5	0.5	0.5	*Stakeholder collaboration is relevant but faces moderate challenges due to fragmented governance and limited local involvement in decision-making.*
E4	0.5	0.5	0.5	0.5	*Technology and innovation are relevant for promoting heritage and diving tourism, but digital presence and data systems are underutilized.*

Table 11 presents the results of the optimisation model for Nessebar across the three different algorithms. Among the algorithms, SLSQP produced the highest TS score (1.0) with a balanced

distribution across all four tourism niches. In contrast, COBYLA generated an extreme, uneven allocation (nearly all effort in CCT and SLT) with a lower TS score. Powell defaulted to an equal split across all sectors, which also resulted in a comparatively low score.

Table 11: Results of the different optimisation methods (Nessebar)

Algorithm	TS Score	CCT	CST	SLT	UCNHT
SLSQP	1.0	0.262	0.238	0.262	0.238
COBYLA	0.625	0.626	0	0.374	0
Powell	0.4688	0.25	0.25	0.25	0.25

The final step of the methodology includes the LLM-generated interpretation. The enabler analysis highlights both opportunities and gaps. Connectivity (E1) and Customer Experience (E2) are highly important but only moderately developed, while Stakeholder Collaboration (E3) and Technology (E4) are of secondary importance but also underperforming. This indicates that transport access, service diversification, and quality remain the most critical levers for improvement. Additionally, the interpretation recommends enhancing connectivity, improving visitor services (particularly for off-season and niche markets), strengthening local stakeholder collaboration, and leveraging digital tools to better promote Nessebar's cultural and natural heritage. Table 12 presents the output of the execution of the LLM for the Nessebar region.

Table 12: Output of the LLM-based Interpretation method (Nessebar)

=== LLM-Generated Interpretation (SLSQP) ===

Interpretation of Nessebar Tourism Optimization Results

The **TS (Tourism Sustainability) score of 1.0** indicates that Nessebar is performing **above average** in its ability to balance tourism growth with sustainability. A score of 1 suggests that the region is on the right track, but there is still room for improvement to fully unlock its tourism potential. This score reflects a mix of strengths and challenges across different tourism sectors and supporting factors.

The optimization prioritizes **Cultural and Creative Tourism (26.2%)** and **Silver Tourism (26.2%)**, leveraging Nessebar's UNESCO-listed heritage and aging population appeal. **Cultural Science Tourism (23.8%)** and **Cultural & Nature Heritage Tourism (23.8%)** are also emphasized, capitalizing on educational and eco-tourism potential.

The **enabler profile** reveals that **connectivity and services** (E1 and E2) are **moderately strong** in readiness (50%) but **highly important** (75%), meaning these areas are critical for growth but may need upgrades to fully support tourism. **Stakeholder engagement and technology adoption** (E3 and E4) are **less critical** (50% importance), but their readiness is also only at 50%, suggesting they could be improved to better support tourism development.

Strategic recommendations

- **Upgrade digital platforms (E4) for CCT × CST** to attract tech-savvy heritage and science tourists.

- **Improve transport links (E1) for SLT** to ease access for senior travelers.

- **Expand eco-friendly services (E2) for UCNHT** to align with nature-focused tourism trends.

- **Train local guides (E2) in multilingual storytelling** to enhance CCT experiences.

- **Launch intergenerational programs (E3) for SLT × CCT** to foster community engagement.

- **Promote Nessebar as a UNESCO hub (E3) via global campaigns** to boost CST visibility.

2.3.2.3 *Danube Delta, Tulcea (Romania)*

The qualitative profile, for the Danube Delta, based on D3.1 and stakeholder engagements in T2.2 and T2.3, indicates key challenges such as remoteness, poor infrastructure, limited access to essential services, fragmented governance, and risks from unregulated tourism. At the same time, the region's strengths are significant, including its designation as a UNESCO Biosphere Reserve and Ramsar site, exceptional biodiversity, strong cultural traditions, and growing scientific and community initiatives supporting sustainable tourism. Table 13 presents the inputs for the LLM-based scoring method

Table 13: Quantitative and qualitative input data for the LLM-based Scoring method (Danube Delta, Tulcea)

Deliverable	Text Input	Variable influence
D2.2	**Key Challenges:** Underdeveloped infrastructure, lack of diverse employment opportunities, limited access to essential services, restricted tourism offerings, remoteness, low population density, and unexplored cultural and natural heritage assets. **Key Strengths:** Exceptional environmental heritage (UNESCO Biosphere Reserve & Ramsar site), rich cultural traditions, strong potential for nature-based tourism, access to the Black Sea for coastal tourism, and a clear vision for sustainable development. **Development Dynamics:** Focused on leveraging natural and cultural heritage to boost economic opportunities and quality of life. Overcoming remoteness and service limitations through stakeholder cooperation, new tourism value chains, and sustainable tourism initiatives. Protecting and promoting environmental identity is central to future development.	a_j, P_j, C_j
D3.1	Pilot sites comparative analysis values (Appendix A – Pilot Sites Comparative Analysis Table 32)	$V_{r,s}$
D3.1	**Key Challenges:** Poor infrastructure, accessibility issues, and lack of coordination among stakeholders restrains development. Additionally, unregulated tourism and weak enforcement pose significant environmental threats. **Key Strengths:** Rich biodiversity and pristine wetlands, making it ideal for Nature Heritage Tourism and environmental CST. Its cultural vibrancy from multi-ethnic communities and folklore events enhances tourism. Scientific hubs and community innovation centers boost CST growth. Seasonal festivals and folklore events provide visitors with a glimpse into the rich cultural tapestry of the area. On the scientific front, research institutions and innovation centers in the Danube Delta contribute to sustainable tourism development by promoting conservation	a_j, P_j, C_j

	efforts and educating both locals and tourists about the importance of preserving this unique environment. **Development Dynamics:** Biological richness offers numerous opportunities for ecotourism activities such as bird watching, fishing, and guided nature tours. Immense potential for Nature Heritage Tourism and environmental CST.	

Table 14 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values.

- P_j: Connectivity (E1) and Stakeholder Collaboration (E3) are considered highly important due to the region's remoteness and the need for strong partnerships to safeguard biodiversity. Customer Experience (E2) and Technology (E4) are relevant but of lower strategic importance in the current phase.
- C_j: All four enablers are moderate challenges (0.5), ranging from infrastructure and transport limitations to underdeveloped hospitality services, fragmented governance, and limited digital tools.
- E_j: Each enabler shows a readiness level of 0.5, suggesting that the region is only moderately prepared across all dimensions, with no severe weaknesses but also no strong capacities.
- a_j: Connectivity (E1) and Stakeholder Collaboration (E3) receive the highest weightings (0.75 each), confirming their high influence in tourism results. Customer Experience (E2) and Technology Integration (E4) are less influential (0.5 each), but still relevant to enhancing the visitor offer and long-term competitiveness.

Table 14: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Danube Delta, Tulcea)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1	0.5	0.5	0.75	*Connectivity is critical due to remoteness and seasonal accessibility challenges, but moderate improvements in maritime and road infrastructure exist.*
E2	0.5	0.5	0.5	0.5	*Customer experience is relevant but faces moderate challenges due to limited off-season services and underdeveloped hospitality offerings.*
E3	1	0.5	0.5	0.75	*Stakeholder collaboration is critical for sustainable development, but fragmented governance and weak enforcement pose moderate challenges.*
E4	0.5	0.5	0.5	0.5	*Technology and innovation are relevant, with some digital promotion and research hubs, but overall digital presence and tools are underdeveloped.*

Table 15 presents the results of the optimisation model for the Danube Delta across the three algorithms. Among the algorithms, SLSQP achieved the highest TS score (0.7562) with a balanced allocation across the four niches, making it the most effective and realistic strategy. COBYLA produced an extreme solution concentrated in a single sector, resulting in a much lower TS score, while Powell defaulted to an equal distribution across all sectors, which also underperformed compared to SLSQP.

Table 15: Results of the different optimisation methods (Danube Delta, Tulcea)

Algorithm	TS Score	CCT	CST	SLT	UCNHT
SLSQP	0.7562	0.269	0.219	0.269	0.244
COBYLA	0.4375	0	0	1	0
Powell	0.2734	0.25	0.25	0.25	0.25

Based on the LLM-generated interpretation the enabler profile confirms that Connectivity (E1) and Stakeholder Collaboration (E3) are the most critical levers, with high importance but only moderate readiness, while Customer Experience (E2) and Technology (E4), also need improvement. This means that upgrading transport links, strengthening governance and local partnerships, and progressively enhancing service quality and digital infrastructure will be essential to unlocking the region's full tourism potential. Table 16 presents the output of the execution of the LLM for the Nessebar region.

Table 16: Output of the LLM-based Interpretation method (Danube Delta)

=== LLM-Generated Interpretation (SLSQP) ===

Interpretation of Danube Delta Tourism Optimization Results

The Danube Delta's **TS Score of 0.7562** reflects moderate competitiveness, sustainability, and readiness for tourism growth. While the region shows potential, its score indicates room for improvement in infrastructure, stakeholder collaboration, and digital integration to enhance visitor experiences and long-term viability. The balanced allocation across sectors suggests a diverse tourism ecosystem, but uneven readiness across enablers may limit optimization.

The region prioritizes **Cultural and Creative Tourism (26.9%)** and **Silver Tourism (26.9%)**, leveraging its rich heritage and appeal to older travelers. **Cultural Science Tourism (21.9%)** and **Cultural & Nature Heritage Tourism (24.4%)** also play key roles, highlighting the Delta's unique blend of biodiversity and cultural assets. These sectors align with global trends, but their success depends on addressing gaps in infrastructure and stakeholder engagement.

The **enabler profile** reveals that **connectivity (E1) and stakeholder engagement (E3)** are the most critical factors, with high importance scores (both E=0.50, α=0.75). However, their readiness levels (0.50) indicate that improvements are needed—better transportation links and stronger collaboration among local stakeholders could significantly boost tourism. **Services (E2) and technology (E4)** are less critical but still important, with moderate readiness and importance.

Strategic recommendations

- **Expand CCT × SLT** by offering intergenerational cultural workshops to attract diverse age groups.
- **Upgrade E1 infrastructure** to improve access for Silver Tourism (SLT) visitors.
- **Boost E4 readiness** with digital tools for UCNHT, like virtual heritage tours.
- **Strengthen E3 collaboration** by forming a Delta-wide tourism alliance.
- **Enhance E2 services** with eco-friendly accommodations for CST and UCNHT.
- **Promote CCT × CST** through science-themed art exhibitions to attract niche travelers.

2.3.2.4 *Teramo Province (Italy)*

The qualitative profile for the Teramo Province (Table 17), based on D3.1 and stakeholder engagements in T2.2 and T2.3, presents key challenges including underdeveloped infrastructure in rural areas, weak collaboration among tourism providers, uneven distribution of visitors between coastal and rural zones, and limited skills in tourism-related professions. On the other hand, the region benefits from important strengths, including a rich combination of coastal and mountain landscapes, strong gastronomic traditions, underwater cultural heritage assets, and growing demand for SLT. Development strategies are oriented towards balancing the well-developed coastal sector with emerging rural tourism, improving branding and operator training, digitalising cultural heritage, and fostering stakeholder cooperation to build a more equitable and resilient tourism economy.

Table 17: Quantitative and qualitative input data for the LLM-based Scoring method (Teramo Province)

Deliverable	**Text Input**	**Variable influence**
D2.2	**Key Challenges:** Underdeveloped infrastructure in rural areas, lack of tourism-related skills and knowledge, weak collaboration among tourism providers, uneven distribution of tourism between coastal and rural areas, and limited employment opportunities inland. **Key Strengths:** Rich natural and cultural landscapes, including mountains, coastal regions, and historical towns. Strong gastronomic traditions. Increasing demand for sustainable tourism. Unique underwater cultural heritage assets. Potential for diversification towards new tourist demographics. **Development Dynamics:** The region aims to balance the well-developed coastal tourism sector with the emerging rural tourism market. Strategies focus on improving infrastructure, enhancing tourism-related competencies, fostering collaboration, and creating a more equitable tourism economy. Emphasis is placed on digitalizing cultural heritage, promoting tourism to diverse groups, and strengthening regulatory support for rural tourism development.	a_j, P_j, C_j
D3.1	Pilot sites comparative analysis values (Appendix A – Pilot Sites Comparative Analysis Table 32)	$V_{r,s}$
D3.1	**Key Challenges:** To improve niche tourism sectors, better branding, operator training, and access, particularly in rural areas, are needed. **Key Strengths:** Rich marine biodiversity and opportunities for diving and snorkeling. Meanwhile, the University of Teramo enhances the city's profile by contributing to research and education in various fields. CST is linked with education, scientific tourism, and biodiversity initiatives, drawing scholars and eco-tourists interested in learning about sustainable practices and local ecosystems. Silver Tourism caters to seniors with group	a_j, P_j, C_j

	packages and regional funding, offering tailored experiences that accommodate the needs and preferences of older travelers. **Development Dynamics:** Better branding, operator training, and access, particularly in rural areas, are needed.	

Table 18 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values.

- P_j: Connectivity (E1) and Stakeholder Collaboration (E3) are identified as highly important, as bridging rural coastal gaps and improving governance are essential to the region's tourism success. Customer Experience (E2) and Technology (E4) are relevant but less decisive, though they still contribute to the overall strategy.
- C_j: Connectivity (E1) and Customer Experience (E2) are moderate challenges, linked to rural infrastructure gaps and uneven off-peak offerings. Stakeholder collaboration is also moderately constrained by weak coordination among providers. Technology (E4) is comparatively stronger, with fewer critical barriers.
- E_j: Connectivity (E1), and Stakeholder Collaboration (E3) all register moderate readiness (0.5), indicating partial but insufficient development. On the other hand, Customer Experience (E2) and Technology (E4) show full readiness (1.0), reflecting solid digital progress and fewer operational constraints.
- a_j: Connectivity (E1) and Stakeholder Collaboration (E3) receive the highest weighting (0.75 each), confirming their decisive role in determining outcomes. Customer Experience (E2) and Technology (E4) have a secondary role (0.25), showing it is less critical in the current regional context.

Table 18: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Teramo Province)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1	0.5	0.5	0.75	*Connectivity is critical due to the need to bridge gaps between coastal and rural areas, but challenges like underdeveloped rural infrastructure and seasonal access are moderate.*
E2	0.5	0.5	1	0.25	*Customer experience is relevant, with strengths in gastronomy and Silver Tourism, but services in rural areas and off-peak periods remain moderately limited.*
E3	1	0.5	0.5	0.75	*Stakeholder collaboration is critical for balancing coastal and rural tourism, but weak coordination among providers poses a moderate challenge.*
E4	0.5	0	1	0.25	*Technology and innovation are relevant, with digitalization efforts in cultural heritage, but no severe challenges are noted.*

Table 19 presents the results of the optimisation model for Teramo Province across the three algorithms. The TS score captures both sectoral strengths and operational readiness. Among the algorithms, SLSQP achieved the highest TS score (1.0), with a balanced allocation across all four niches, making it the most effective and realistic option under the given constraints. COBYLA produced an extreme solution with nearly all resources allocated to a single sector, resulting in a

significantly lower TS score. Powell defaulted to an equal distribution, which also underperformed relative to SLSQP. These results confirm that SLSQP provides the most reliable optimisation pathway for Teramo Province.

Table 19: Results of the different optimisation methods (Teramo Province)

Algorithm	TS Score	CCT	CST	SLT	UCNHT
SLSQP	1.0	0.262	0.238	0.238	0.262
COBYLA	0.3125	0.997	0	0	0.003
Powell	0.1563	0.25	0.25	0.25	0.25

The LLM-generated interpretation provides a summary of the model's results to guide decision-makers and local stakeholders. The output includes a TS score of 1.0, indicating above-average potential for sustainable tourism development. The sectoral allocation shows a balanced profile, with CCT (26.2%) and UCNHT (26.2%) as the leading areas, followed closely by SLT (23.8%) and CST (23.8%). This distribution reflects Teramo's strengths in cultural heritage, gastronomy, and diverse landscapes, while also pointing to opportunities in education-driven tourism and Silver Tourism.

The enabler profile highlights Connectivity (E1) and Stakeholder Collaboration (E3) as the most critical gaps, both moderately developed but highly important. Customer Experience (E2) also requires improvement, particularly in rural and off-season contexts. Technology (E4) stands out as a strength, showing full readiness but carrying less influence in the overall outcome. Based on the previous, the recommendations for Teramo Province include enhancing transport links to rural areas, strengthening collaboration among providers, improving service quality and diversity, and strategically leveraging digital tools to promote local assets and attract new demographics.

Table 20: Output of the LLM-based Interpretation method (Teramo Province)

=== LLM-Generated Interpretation (SLSQP) ===

Interpretation of Teramo Tourism Optimization Results

Teramo's **TS Score of 1.0** indicates a balanced tourism ecosystem with excellent competitiveness, sustainability, and readiness. The score suggests that Teramo is performing slightly above the baseline, with room for growth in key areas. The region's tourism potential is well-distributed across sectors, but strategic investments in enablers like connectivity and stakeholder engagement could further enhance its appeal.

The sector allocations reveal a strong focus on **Cultural and Creative Tourism (CCT, 26.2%)** and **Cultural & Nature Heritage Tourism (UCNHT, 26.2%)**, reflecting Teramo's rich artistic and natural assets. **Cultural Science Tourism (CST, 23.8%)** and **Silver Tourism (SLT, 23.8%)** also play significant roles, catering to niche markets like educational travelers and older adults. These sectors align with Teramo's strengths in heritage, innovation, and accessibility, but require targeted marketing to maximize their impact.

Teramo's enabler profile shows **Services (E2) and Technology (E4)** as strong (E=1.00), meaning the region excels in infrastructure and digital readiness. However, **Connectivity (E1) and Stakeholder Engagement (E3)** are critical (E=0.50, α=0.75), indicating urgent needs for improved transport links and collaborative governance. Addressing these gaps will be key to unlocking Teramo's full tourism potential.

Strategic recommendations

- **Boost CCT × UCNHT** by promoting art festivals in natural settings to attract cultural and eco-tourists.

- **Enhance SLT** by improving accessibility in historic sites for older travelers.

- **Strengthen E1 (Connectivity)** by expanding public transport to key attractions.

- **Leverage E4 (Technology)** to create digital guides for CST, blending science and heritage.

- **Foster E3 (Stakeholder Engagement)** by forming public-private partnerships for tourism projects.

- **Market CST × UCNHT** to science travelers, highlighting Teramo's unique heritage-lab hybrids.

2.3.2.5 *Kutsurub (Ukraine)*

The qualitative profile of the Kutsurub, based on D3.1 and stakeholder engagements in T2.2 and T2.3, (Table 21) reveals severe challenges caused by the ongoing conflict, including damaged infrastructure, high poverty levels, lack of tourism services, limited employment opportunities, and accessibility issues. Despite these difficulties, the region retains significant strengths, including its exceptional natural landscapes, the cultural and archaeological importance of Ancient Olbia, and potential for diverse tourism niches including green, rural, gastronomic, and underwater tourism. Development strategies currently focus on heritage valorisation, environmental conservation, long-term recovery planning, and fostering macro-regional collaboration to build resilience in the post-war period.

Table 21: Quantitative and qualitative input data for the LLM-based Scoring method (Kutsurub)

Deliverable	**Text Input**	**Variable influence**
D2.2	**Key Challenges:** Severe damage due to military invasion, high poverty levels, lack of entrepreneurial experience, absence of coordinated tourism development, underdeveloped infrastructure, lack of employment opportunities, limited tourism services, and accessibility issues. **Key Strengths:** Exceptional natural resource potential, historical and cultural heritage (Ancient Olbia), diverse tourism possibilities (green, rural, gastro, underwater), commitment to heritage preservation, and focus on collaboration and learning. **Development Dynamics:** Facing major challenges due to conflict, but recognizing potential in tourism. Strategy includes fostering macro-territorial cohesion, learning from best practices, and systematically developing tourism once stability is restored. Key focus areas: cultural heritage valorisation, environmental conservation, infrastructure improvement, and partnership-building for long-term regional resilience.	a_j, P_j, C_j
D3.1	Pilot sites comparative analysis values (Appendix A – Pilot Sites Comparative Analysis Table 32)	$V_{r,s}$

D3.1	**Key Challenges:** Hostilities hinder safe development, and existing infrastructure has been heavily damaged. The ongoing conflict poses a severe threat to tourism and the preservation of heritage sites. There is a pressing need for post-war recovery planning to restore and rebuild the damaged infrastructure, ensuring that the cultural and archaeological assets can be protected and showcased once again. **Key Strengths:** This area is rich in history and holds significant importance for both local communities and researchers. The region had significant CST (Cultural and Scientific Tourism) potential, with collaborations between research institutions and tourism operators creating unique and informative experiences for visitors. **Development Dynamics:** Improved accessibility is crucial for reviving tourism in the region. Enhanced branding and governance structures are essential to promote Kutsurub as a desirable destination, attract funding, and manage resources effectively.	a_j, P_j, C_j

Table 22 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values.

- P_j: Connectivity (E1) and Customer Experience (E2) emerge as the most critical enablers, given the urgent need to restore infrastructure and basic tourism facilities. Stakeholder Collaboration (E3) and Technology (E4) are recognised as relevant but of lower immediate importance under current circumstances.
- C_j: Severe challenges are noted, especially for Customer Experience (E2) and Technology (E4), both of which face critical gaps (1.0), reflecting the near absence of structured offerings and digital presence. Connectivity (E1) and Collaboration (E3), while still challenged, show moderate issues (0.5), as recovery plans and some coordination structures are in place.
- E_j: Customer Experience (E2) and Technology (E4) register the lowest readiness (0.0), underscoring the lack of operational capacity in these areas. Connectivity (E1) and Collaboration (E3) achieve moderate readiness (0.5), reflecting partial functionality but still far from sufficient for sustainable tourism.
- a_j: Connectivity (E1) and Customer Experience (E2) receive the highest weights (0.75 each), confirming that they are the most decisive factors for tourism development in Kutsurub. Collaboration (E3) and Technology (E4) receive lower weightings (0.5), indicating that while relevant, they are secondary to addressing the fundamental gaps in infrastructure and service provision.

Table 22: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Kutsurub)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1	0.5	0.5	0.75	*Critical due to severe infrastructure damage and accessibility issues caused by conflict. Moderate challenge as post-war recovery plans aim to improve connectivity, but progress depends on stability.*

E2	0.5	1	0	0.75	*Relevant due to potential in cultural and scientific tourism, but severe weakness exists due to limited services, underdeveloped offerings, and lack of infrastructure to support tourism.*
E3	0.5	0.5	0.5	0.5	*Relevant as collaboration is a recognized strength, but moderate challenges persist due to fragmented governance and lack of coordinated development.*
E4	0	1	0	0.5	*Not a priority currently due to conflict and infrastructure damage. Severe weakness in digital presence and innovation, requiring post-war recovery efforts.*

Table 23 presents the output of the optimisation model for Kutsurub across the three algorithms. The TS score reflects the region's capacity to combine sectoral strengths with operational readiness, though it remains constrained by current challenges. Among the algorithms, SLSQP delivered the highest TS score (0.5785) with a moderately balanced allocation across the four niches, showing the most realistic approach under the given conditions. COBYLA produced a more extreme allocation**,** splitting resources unevenly between two sectors, with a lower TS score. Powell defaulted to equal allocation, which also underperformed compared to SLSQP. These results confirm that, despite its limitations, SLSQP provides the most appropriate optimisation strategy for Kutsurub.

Table 23: Results of the different optimisation methods (Kutsurub)

Algorithm	**TS Score**	**CCT**	**CST**	**SLT**	**UCNHT**
SLSQP	0.5785	0.238	0.237	0.263	0.263
COBYLA	0.4688	0	0	0.5	0.5
Powell	0.3906	0.25	0.25	0.25	0.25

The last stage of the methodology is the LLM-generated interpretation. The output includes a TS score of 0.5785, indicating moderate potential but also emphasising that significant barriers remain. The sectoral allocation shows a distribution, with SLT (26.3%) and UCNHT (26.3%) slightly prioritised, followed by CCT (23.8%) and CST (23.7%).

The enabler analysis indicates Connectivity (E1) and Customer Experience (E2) as urgent priorities: both very important but almost not developed, limiting the region's ability to deliver tourism outcomes. Collaboration (E3) is moderately functional but needs further strengthening, while Technology (E4) is at a critical low, requiring major investment to build digital infrastructure and presence. Based on this, the recommendations for Kutsurub include: restoring and upgrading basic infrastructure and services, enhancing stakeholder collaboration structures, rebuilding digital capacity, and refining sectoral strategies to emphasise cultural, heritage, and sustainable nature-based tourism once recovery allows.

Table 24: Output of the LLM-based Interpretation method (Kutsurub)

=== LLM-Generated Interpretation (SLSQP) ===

Interpretation of Kutsurub Tourism Optimization Results

Kutsurub's Tourism Sustainability (TS) Score of **0.5785** indicates moderate competitiveness, sustainability, and readiness for tourism growth. While the region shows potential, gaps in infrastructure, services, and technology hinder its ability to fully capitalize on its tourism assets.

Strengthening key enablers like connectivity and stakeholder engagement could significantly improve its performance.

The optimization prioritizes **Silver Tourism (SLT) and Cultural & Nature Heritage Tourism (UCNHT)** (each at **26.3%**), reflecting Kutsurub's aging population and rich natural/cultural heritage. **Cultural and Creative Tourism (CCT) and Cultural Science Tourism (CST)** (each at **~24%**) are also emphasized, leveraging local traditions and scientific attractions. This balanced approach ensures broad appeal while targeting niche markets.

Kutsurub's enabler profile reveals critical gaps: **Services (E2) and Technology (E4)** are at **0.00 readiness**, despite high importance (α = 0.75 and 0.50, respectively). **Connectivity (E1) and Stakeholder Engagement (E3)** show moderate readiness (E = 0.50) but require further investment to align with their importance (α = 0.75 and 0.50).

Strategic Recommendations

- Upgrade transport links (E1) to boost CCT × UCNHT accessibility.

- Train local guides (E2) to enhance CST × SLT experiences.

- Launch digital platforms (E4) to promote UCNHT × CCT offerings.

- Form tourism cooperatives (E3) to unite SLT × CST stakeholders.

- Develop senior-friendly trails (SLT) with nature-themed workshops (UCNHT).

- Host cultural festivals (CCT) to attract visitors and media (E1).

2.3.2.6 *Šimuni, Island of Pag (Croatia)*

The qualitative profile, based on D3.1 and stakeholder engagements in T2.2 and T2.3, indicates key challenges including seasonal dependency, limited tourism diversification beyond summer and nautical activities, accommodation shortages during peak periods, and funding gaps. At the same time, Šimuni demonstrates important strengths, including its beautiful coastal environment, strong nautical tourism infrastructure, underwater cultural heritage, and creative tourism initiatives in gastronomy, arts, and storytelling. Based on these situations, development strategies are focused on expanding sustainable tourism, improving access, promoting underwater and scientific tourism and cultural tourism, and consolidating local engagement. The inputs for the LLM-based scoring method are presented in Table 25.

Table 25: Quantitative and qualitative input data for the LLM-based Scoring method (Šimuni)

Deliverable	Text Input	Variable influence
D2.2	**Key Challenges:** Depth of shipwrecks limit accessibility, insufficient awareness and funding, critical seasonal accommodation shortages, and strong seasonality affecting CST and Silver Tourism growth.**Key Strengths:** Unique blend of cultural heritage and modern attractions, active community engagement through arts, gastronomy, and storytelling, strong appeal for diverse visitors, and growing interest in Cultural Science Tourism linking recreation with research and education.**Development Dynamics:** Efforts to improve accessibility with innovative diving technologies and training, initiatives to raise awareness through marketing and research partnerships, and strategies to	a_j, P_j, C_j

	expand accommodation via off-season promotion and eco-friendly lodging. Focus on unlocking CST and Silver Tourism potential for sustainable community growth.	
D3.1	Pilot sites comparative analysis values	$V_{r,s}$
D3.1	**Key Challenges:** Broad awareness, funding, and seasonal accommodation issues further hinder expanding CST and Silver Tourism potential. Seasonal accommodation remains a critical issue, as the influx of tourists during peak seasons often exceeds the available lodging capacity. **Key Strengths:** The area combines underwater assets with creative tourism, including arts, gastronomy, and storytelling. Cultural Science Tourism is advanced through site interpretation and scientific collaboration. The local community has embraced creative tourism by organizing art exhibitions, culinary festivals, and storytelling events that highlight the rich history and traditions of the region. These activities have contributed to a growing interest in Cultural Science Tourism (CST), where tourists not only enjoy recreational activities but also engage with scientific research and educational experiences related to the shipwreck and other historical sites. **Development Dynamics:** Improve accessibility to the shipwreck by developing innovative diving technologies and training programs for amateur divers. Additionally, there are initiatives to increase public awareness about the significance of the shipwreck through marketing campaigns, partnerships with educational institutions, and collaborations with international researchers	a_j, P_j, C_j

Table 26: Quantitative results from LLM-based Scoring method using as input qualitative data from D3.1, T2.2 and T2.3 (Šimuni)

Enabler	P_j	C_j	E_j	a_j	Justification
E1	1	0.5	0.5	0.75	*Connectivity is critical due to seasonal tourism dependency and infrastructure gaps, but moderate challenges exist with plans to improve accessibility and regional mobility.*
E2	0.5	0.5	0.5	0.5	*Customer experience is relevant with strong nautical and cultural offerings, but moderate challenges remain in diversifying services and addressing seasonal capacity issues.*
E3	0.5	0	1	0.25	*Stakeholder collaboration is relevant with local community engagement and partnerships, but no severe weaknesses are evident.*
E4	0.5	0.5	0.5	0.5	*Technology and innovation are relevant with digital promotion and smart development plans, but moderate challenges exist in scaling digital tools and data systems.*

Table 26 presents the output of the LLM-based scoring method, converting the qualitative data to quantitative values:

- P_j: Connectivity (E1) is assessed as highly important, given the reliance of the region on accessibility of services and visitors. Customer Experience (E2), Stakeholder Collaboration (E3), and Technology (E4) are considered relevant but but with less strategic relevance.
- C_j: Moderate challenges (0.5) are evident across Connectivity (E1), Customer Experience (E2), and Technology (E4), including limited seasonal accessibility, underdeveloped off-peak opportunities, and digital scaling limitations. One area that shows no critical issues (0.0) is Stakeholder Collaboration (E3) which reflects active engagement with the community and local partnerships.
- E_j: Connectivity (E1), Customer Experience (E2), and Technology (E4) each register a readiness level of 0.5, suggesting partial but insufficient development. Stakeholder Collaboration (E3) has a score of 1.0, revealing it as a regional strength in which governance, and collaboration, are already well developed.
- a_j: Connectivity (E1), receives the highest weighting (0.75), confirming its decisive role in shaping outcomes. Customer Experience (E2), and Technology (E4) hold medium weight (0.5 each), while Stakeholder Collaboration (E3), despite being strong, carries less influence (0.25) in driving overall tourism success.

Table 27: Results of the different optimisation methods (Šimuni)

Algorithm	TS Score	CCT	CST	SLT	UCNHT
SLSQP	0.999	0.256	0.231	0.256	0.256
COBYLA	0.5625	0.911	0	0.089	0
Powell	0.4922	0.25	0.25	0.25	0.25

Table 27 presents the output of the optimisation model for Šimuni across the three algorithms. Among the algorithms, SLSQP achieved the highest TS score (0.9990), producing a balanced allocation across the four niches and confirming it as the most effective strategy under the given constraints. COBYLA generated a skewed allocation, placing nearly all resources into CCT with a lower TS score, while Powell defaulted to equal distribution, which also underperformed compared to SLSQP. These results highlight that SLSQP offers the most realistic and balanced optimisation for Šimuni.

Regarding the LLM-based interpretation the output includes a TS score of 0.9990, indicating strong overall performance and readiness for sustainable tourism development, as well as a sector allocation which show a balanced approach, with CCT (25.6%), SLT (25.6%), and UCNHT (25.6%) equally prioritised, and CST (23.1%) slightly lower.

The enabler analysis highlights Connectivity (E1), Customer Experience (E2), and Technology (E4) as moderate gaps that need improvement, while Stakeholder Collaboration (E3) stands out as a strength, fully ready and supported by active local involvement. This means the region should focus on addressing accessibility, improving service diversification, and upgrading its digital presence to complement its already strong governance and community engagement. Based on the above results the recommendations for Šimuni include investing in transport and mobility infrastructure, enhancing accommodation and service capacity for off-peak seasons, scaling

digital tools for tourism promotion, and leveraging stakeholder collaboration to co-create innovative tourism offers.

Table 28: Output of the LLM-based Interpretation method (Šimuni)

=== LLM-Generated Interpretation (SLSQP) ===
Interpretation of Simuni's Tourism Optimization Results The **TS Score of 0.9990** reflects its strong competitiveness, sustainability, and readiness to optimize tourism development. This score reflects how effectively the region balances its tourism sectors and supporting enablers, showing strong potential for sustainable growth. However, while the score is high, the underlying data reveals areas where targeted improvements could further boost performance. The sector allocations reveal a balanced focus on **Cultural and Creative Tourism (CCT, 25.6%)**, **Cultural Science Tourism (CST, 23.1%)**, **Silver Tourism (SLT, 25.6%)**, and **Cultural & Nature Heritage Tourism (UCNHT, 25.6%)**. The equal emphasis on SLT and UCNHT highlights the region's appeal to older travelers and nature enthusiasts, while CCT and CST underscore its potential for experiential and educational tourism. This diversification minimizes risk and maximizes appeal across diverse visitor segments. The **enabler profile** highlights both strengths and gaps. **Stakeholder engagement (E3)** is a standout strength, fully ready (E=1.00) but relatively low in importance (α=0.25), meaning while collaboration is strong, it may not be the biggest driver of success. **Connectivity (E1), Services (E2), and Technology (E4)** are all at moderate readiness (E=0.50) but vary in importance—connectivity is more critical (α=0.75) than services or technology (α=0.50). This suggests Simuni should prioritize improving infrastructure (like transport and digital access) to support tourism growth, while ensuring service quality and technology keep pace. Simuni's enabler profile shows **strong readiness in stakeholder engagement (E3)**, scoring 1.00, but these is of lower importance (α = 0.25). In contrast, **C**onnectivity (E1), Services (E2) and Technology (E4)**** are critical gaps, with moderate readiness (E = 0.50) but high importance (α = 0.75) for E1 and moderate importance for E2 and E4. Addressing connectivity is essential to unlocking Simuni's full potential, particularly for CCT × SLT and CST × UCNHT synergies. **Strategic recommendations** **- Upgrade transport links (E1)** to improve access for Silver Tourism (SLT) and Cultural Science Tourism (CST). **- Promote CCT × SLT** by developing senior-friendly creative workshops and heritage tours. **- Enhance digital marketing (E4)** to attract Cultural & Nature Heritage Tourism (UCNHT) visitors. **- Strengthen stakeholder collaboration (E3)** to align UCNHT and CST offerings with local conservation goals. **- Expand eco-friendly services (E2)** to support sustainable growth in UCNHT and SLT**.** **- Launch cross-sector festivals** blending CCT, CST, and UCNHT to boost visitor retention.

2.4 Task 3.2 Conclusions

The results obtained across the five pilot regions highlight several important insights regarding the optimisation methodology and its implications for sustainable tourism development.

For all regions, the SLSQP algorithm has the highest TS scores and has the most balanced optional allocation across all sectors. The key for SLSQP was its ability to balance both equality and inequality constraints and effectively exploiting the smooth, differentiable nature of the TS function. In comparison, COBYLA often creates extreme single-sector allocations, which are not practical for regional strategies, even though they are mathematically feasible. Powell's method produced balanced allocations but less optimal strategies due to its inability to handle any constraints. This is consistent with the literature, which suggests that SLSQP is reliable solver for constrained nonlinear optimisation problems, particularly given the nature of the objective function including both continuous decision variables and weighted multipliers.

Kutsurub and the Danube Delta showed lower TS scores than the North Sporades, Nessebar, and Teramo. In Kutsurub, damage to infrastructure caused by the conflict in Ukraine, restrictive accessibility, and suspended services have limited the area's potential to exploit its cultural and natural resources. In the Danube Delta, geographical isolation, limited transport links, and fragmented governance directly reduce the TS score even when sectoral potentials are strong.

A regular pattern across the pilots is that Connectivity & Accessibility (E1) and Stakeholder Collaboration (E3) typically rank highly as important enablers but have moderate to low levels of readiness. Hence, physical and digital infrastructure, along with governance and coordination, are the most common bottlenecks. Technology (E4) can be variable: in some regions (e.g., Teramo, North Sporades) digital readiness is substantially good, whilst in some places (e.g., Kutsurub) it is critically underdeveloped. Customer Experience (E2), typically takes a middle ground, it has strong potential but with seasonal or limited-service diversification.

With high TS scores (e.g., Nessebar, Teramo, Šimuni), the optimisation results show consistent recommendations for balanced allocations across all four niches (CCT, CST, SLT, UCNHT). This indicates high performance regions successfully diversify their tourism approaches and are utilising synergies, reducing risk while simultaneously increasing potential for growth. For low performing contexts (e.g., Kutsurub, Danube Delta) the optimisation still suggests balanced allocations but with a slightly bigger focus on SLT and UCNHT. This suggests that these contexts are relying on natural and cultural heritage niches with relatively lower levels of infrastructure to develop when compared to mass tourism. This shows that while the model can adjust to contextual challenges, weak enablers are limiting projected TS scores regardless of sectoral potential.

Although this current methodology has produced a static optimisation account of TS based on changes in available data, there is potential to advance towards predictive modelling of TS evolution over time. By enabling some form of dynamic variable consideration such as incorporating expected infrastructure investments, anticipated recovery trajectories, or early notifications of policy changes, it may be possible to explore the probable TS score changes envisaged under each of these elements.

3 Task 3.3 - Sustainability/Barriers Assessment in TOURAL Sites & UCCST Model Individualisation Thru Co-Design

The sustainability assessment of TOURAL UCCST regions is an integral part of WP 3 and of the overall structure of the project, providing an opportunity to baseline the possibilities for implementing the UCCST model within the pilot regions and the current resources available at the local level.

3.1 Sustainability assessment of TOURAL UCCST regions

3.1.1 Methodology and background

3.1.1.1 *Background*

Sustainability is a multifaceted concept encompassing environmental protection, social equity, economic viability, and cultural preservation. In the context of the European Union, achieving sustainable development across its diverse regions is a key policy objective, enshrined in initiatives such as the European Clean Industrial Deal and the 2030 Agenda for Sustainable Development.

The 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), adopted by the United Nations (UN) in September 2015, is the world's roadmap for achieving sustainable development in this decade. The European Union (EU) has fully committed itself to delivering on the 2030 Agenda, and the SDGs form an intrinsic part of the period 2024 to 2029. Monitoring and communicating about the progress made towards the 17 SDGs is essential in realizing the 2030 Agenda's vision, both globally and in the EU. [4]

Meanwhile, in the past half decade (2020-2025) the world faced a number of serious challenges (incl. COVID-19), thus Europe and the EU in particular had to deal with the consequences of the ongoing geopolitical tensions in the region, namely the war in Ukraine and the military collisions in the Middle East (such as in Syria, Gaza, etc.).

In 2023 a survey was made by the OECD, SDSN and the European Committee of the Regions on localizing the UN Sustainable Development Goals (SDGs) in a changing landscape, where is stated that a series of significant shocks in recent years, including the COVID-19 pandemic, higher inflation and energy prices, disruptions to global supply chains, and heightened geopolitical tensions, have raised hurdles on the path toward achieving the SDGs. Only 15% of them are considered to be on track for achievement by the 2030 deadline. Progress towards 48% of the SDG targets is currently insufficient, and 37% are either stagnating or regressing, including on key targets such as those related to poverty, hunger and climate action. [5]

More specifically, rises in price levels and energy costs, alongside disruptions in global food markets, have adversely affected SDG targets related to poverty and inequality (SDGs 1 and 10), affordable energy (SDG7) and food security (SDG 2). The survey of over 175 local and regional governments (LRGs) revealed a decline in living standards due to inflationary pressures and the repercussions of recent shocks among 80% of respondents. Over 70% indicated an increase in electricity costs, putting the achievement of SDG 7 at risk, while around half noted the growing importance of combating hunger (SDG 2). [5]

The latest Eurostat SDGs report was released in June 2025, containing statistical research data for all EU members countries, and eight non-EU members from the Continent, exploring the period 2018 - 2023.

The monitoring exercise is based on the EU SDG indicator set. It is structured along the 17 SDGs and covers the social, economic, environmental and institutional dimensions of sustainability as represented by the 2030 Agenda. Progress towards each SDG is measured by six main indicators. These indicators have been selected for their policy relevance from an EU perspective, availability, country coverage, data freshness and quality, reflecting the SDGs' broad objectives

and ambitions. Out of the 102 indicators, 33 are 'multi-purpose', meaning they are used to monitor more than one goal. [4]

3.1.1.2 *Methodology*

The current research employed a mixed methodology combining quantitative and qualitative research techniques to compare and analyse data extract from 2025 Eurostat SDGs report for the 5 year period between 2018 and 2023 (in isolated cases 2017-2022 or 2019-2024), and information from project partners and stakeholders about dynamics in the data collected through the questionnaires for the past year and a half (2024 – 1H 2025), corresponding to chosen SDGs indicators.

There are a number of indicators from 2025 Eurostat SDGs report that were used for apposition and comparison in the current study, as the quantitative data they provide could be correlated with qualitative data on the current evolution of regional sustainability (collected by questionnaires), and analysed in the context of the implementation of the TOURAL UCCST model framework.

An additional part of the methodology entails a thematic analysis of the assessment made by partners and stakeholders involved in the research, using a questionnaire, to identify and assess regions sustainability assessment, coupled with an analysis of implementation barriers and mitigation prescriptions.

The multi-step assessment procedure methodology consisted of five steps:

1. Identification of corresponding indicators: For each of the four sustainability dimensions (environmental, social, economic, and cultural), desk-based research was carried out. Specific indicators were identified based on their availability in the 2025 Eurostat SDGs report, and their relevance to the respective sustainability concept of this research, in the light of UCCST model framework;
2. Forming the Questionnaire: Creating the basis for information collecting and building the correlating questions to the chosen relevant SDGs indicators;
3. Data collection: Data for the selected indicators were extracted from the 2025 Eurostat SDGs report, and questionnaires were sent to the project partners and returned back;
4. Analysis and Synthesis: The collected data were analysed to identify regional patterns, disparities, and trends. Qualitative insights from the questionnaires were converted into numbers for calculations, and results were integrated to provide context and to deepen the understanding of the quantitative findings. The analysis aimed to highlight both progress and persistent challenges within the observed regions, current sustainability situation with respect to the UCCST model implementation. Additionally, this work will be coupled with an analysis of implementation barriers and mitigation prescriptions.
5. Reporting: The findings were presented in a structured report format, set in the TOURAL project documents, with dedicated sections for each sustainability dimension. Key data points were presented, both from the 2025 Eurostat SDGs report, and the questionnaires as well, with data related to their possible impact on the implementation of the UCCST model being reported as conclusions at the end of each section, using an assessment scale "positive-stable-neutral-negative" with the respective short-term outlook.

3.1.1.2.1 Limitations

While this report strives for comparative comprehensiveness, it is subject to certain limitations. The assessment is based mainly on publicly available data and does not involve primary data collection (except for the questionnaires) and in-depth case studies of the specific regions.

The data for the individual countries from the 2025 Eurostat SDGs report are equated and used as such for the respective TOURAL UCCST regions, as far as no other information was found

containing sufficient official and comparable data specifically for the TOURAL UCCST regions to be used as an official and equal basis for quantitative comparisons and analyses.

Furthermore, the availability of regional data varies across indicators and dimensions. Particularly for cultural sustainability, there are no specific indicators included in the 2025 Eurostat SDGs report to be used as a corresponding marker to the TOURAL UCCST regions assessment process, despite the fact that the importance of studying the culture sustainability has been stated in numerous recommendations, e.g. in papers of Brainstorming sessions organized by the European Commission's Voices of Culture (2021), or the EU Work Plan for Culture 2023-2026, so, cultural dimension sustainability assessment in this work is based only on the qualitative data collected from the questionnaires used.

Also, the 2025 Eurostat SDGs report contains no data for Ukraine (the sixth pilot region of TOURAL project), thus all data analysed for this region are taken from the questionnaires of Ukraine partners, and thereby all conclusions drawn in the current work cannot be interpreted as final or valid, given the ongoing war in Ukraine and the unclear present and future status quo of the region.

3.1.2 Environmental sustainability

Looking at the environmental sustainability in the European regions, there emerged four main topics to be discussed here - management of natural resources; usage of renewable energy sources; waste recycling & circular material in use; local initiatives to adapt to climate change.

Starting by the assessment of the management/use of natural resources, and the most important one - water - the 2025 Eurostat SDGs report give an observation and data for the water exploitation index (WEI+) as part of 6th SDG – Clean water and sanitation.

WEI+ provides a measurement of total water consumption as a percentage of the renewable freshwater resources available for a given territory and a given period. It quantifies how much water is abstracted and how much water is returned to the environment by economic sectors before or after its use. The difference between water abstractions and water returns is regarded as ‘water consumption’. In the absence of agreed Europe-wide formal targets, values above 20% are generally considered to be a sign of water scarcity, while values equal to or greater than 40% indicate situations of severe water scarcity, meaning the use of freshwater resources is unsustainable. [4]

For the period 2017-2022 the average WEI+ level for the EU is increasing slightly from 4.5 to 4.9, which can be considered as stable indicator for the whole territory of the EU. However, looking at different TOURAL UCCST regions one can see big differences, e.g. in Romania, where the WEI+ level is above 20%, as compared to Croatia where it is close to 0%. The index for Bulgaria is below 5% while for Greece and Italy it is about 15%. A significant increase in the WEI+ has been reported only in Italy – about 5%. So, the average WEI+ level for EU TOURAL UCCST regions is about 11%, which can be described as stable, even above the EU average level.

The next 2025 Eurostat SDGs report indicator observed here is the material footprint, part of 12th SDG – Responsible consumption and production.

The material footprint, also referred to as raw material consumption (RMC), represents the demand for the extraction of materials (minerals, metal ore, biomass and fossil energy materials) induced by consumption of goods and services within a geographical reference area. Data for material footprint system from material flow accounts, which models the flows of natural resources from the environment into the economy. These include domestic extraction of materials measured in tons of gross material (for example, gross ore or gross harvest) as well as estimated imports and exports of the raw material equivalents of the products traded (domestic and outer extraction required to produce the traded products). [4]

For the period 2018-2023 RMC (as tons per inhabitant per anum) as an average for the EU is about 15, but here again big differences in the TOURAL UCCST regions can be observed. While in Italy and Greece the level is about 10, in Croatia it goes to 15, in Bulgaria – up to 20, and in Romania – close to 30. Huge dynamics in RMC is reported only in Romania – 10 tones increase for the period. The average RMC for the EU TOURAL UCCST regions is about 17, which is slightly above the EU average level, so it can be deemed stable (except for Romania).

The corresponding question from the questionnaire is about dynamics in the development of the natural resources efficient use from 2024 till present day. Transforming qualitative answers to digits (1 standing for "Significant progress", down the scale to 4) the average level of 1.93 for all six TOURAL UCCST regions is stated, Bulgaria having the best level of 1.5, and Croatia being the worst by 2.33. This shows that in the past 18 months a "Moderate progress" (since 1.92 is closest to 2) is reported by most respondents on the issue. Together with the Eurostat data discussed above, the assessment result of the first environmental sustainability issue can be deemed stable (in the middle of the scale) pertaining a positive outlook.

The second issue in the environmental sustainability assessment here is usage of renewable energy sources, and the extracted data from the 2025 Eurostat SDGs report are from 7th SDG – Affordable and clean energy.

Use of renewable energy has grown steadily in the EU, almost doubling from 12.6 % of gross final energy consumption in 2008 to reach 24.6 % in 2023. Reductions in investment costs due to economies of scale and greater competition, more efficient technologies, supply chain improvements and renewable energy support schemes have driven this growth (7). Nevertheless, even faster growth will be needed across the EU to meet the 42.5 % target in 2030. Looking at specific renewable energy sources, the largest share of available renewable energy in 2023 came from solid biofuels (36.7 %), followed by wind energy (15.8 %), hydropower (10.9 %) and solar photovoltaics (8.1%). Wind and solar photovoltaic energy made the biggest contribution to the absolute increase in renewable energy production between 2018 and 2023. [4]

The indicator from 7th SDG used here is "Share of renewable energy in gross final energy consumption" (SRE), and its distribution by country. It shows that for the period 2018-2023 the average level of SRE for the EU has an improvement from 20% to 25%. All the TOURAL UCCST EU regions are relatively close to this level, starting from shortly below 30% for Croatia and ending by 20% in Italy, as the biggest rise here is represented by Greece – from below 20% to almost 30%. This data indicates that the SRE in the TOURAL UCCST EU regions is in a stable position with an upward trend, presenting suitable conditions for UCCST model implementation.

The corresponding question from the questionnaire here is about dynamics in widespread usage of renewable energy sources in the period 2024 – 1H 2025. Transforming again the qualitative answers to numbers in a similar mode as before, the data reveals an average result of 1.97 for the TOURAL UCCST regions, starting by the best level of 1 in Italy (improvement in the last 18 months), and finishing by 3 in Ukraine (which is only logical considering the continuing war in the country). The average data shows significant progress in the past months in line with the same trend for the period 2018-2023, which means continuing progress on the issue. Assessment here can be described as stable with a very positive outlook.

The third issue in the environmental sustainability assessment in the present work is the implementation of waste recycling & circular material in use practices, and the extracted data from the 2025 Eurostat SDGs report are from 11th SDG (Sustainable cities and communities) and 12th SDG (Responsible consumption and production).

From 11th SDG, extracted data is connected to an indicator named "Recycling rate of municipal waste" (RW).

This indicator measures the tonnage recycled or prepared for re-use from municipal waste divided by the total municipal waste generated. Recycling includes material recycling, composting and

anaerobic digestion. Municipal waste primarily consists of waste generated by households but it also includes similar types of waste generated by small businesses, offices and public institutions that are collected by or on behalf of municipalities. [4]

The RW data (% of total municipal waste generated) in the 2025 Eurostat SDGs report shows that the average level in the EU is close to 50%, but there is a big difference among EU members, incl. the TOURAL UCCST regions. Looking at the EU TOURAL pilot sites countries, Italy holds the first place with 50% RW, while Romania is occupying the last position with little above 10%. The other three countries have RW between 20% and 35%. Thus, the RW average level of EU TOURAL pilot sites countries is little below 30%, which is under the average EU level for this indicator, and that can be described as very slow progress, as far as there is a little progress reported in 4 of all the 5 countries anyway.

The next 2025 Eurostat SDGs report indicator observed in this work is "Circular material use rate", part of 12th SDG.

The circular material use rate (CMU) measures the share of material recovered and fed back into the economy in overall material use. The CMU is defined as the ratio of the circular use of materials to the overall material use. The overall material use is measured by summing up the aggregate domestic material consumption (DMC) and the circular use of materials. DMC is defined in economy-wide material flow accounts. The circular use of materials is approximated by the amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad. A higher CMU rate value means more secondary materials are being substituted for primary raw materials, thus reducing the environmental impacts of extracting primary material. [4]

The CMU data (% of material input for domestic use) demonstrates about 12% average level for the EU for the period 2018-2023. There are again big differences among the EU members, incl. the TOURAL UCCST regions, as CMU of Italy is about 20% while the number for Romania is about 1%. The other three countries show improvement of about 5%. So, the average CMU of EU TOURAL pilot sites is little above 7%, which is almost half of the EU average level, and it means that circular material in use practices is not well presented in the most of TOURAL UCCST regions despite of some small improvement reported, that is why the overall assessment of this issue is negative with a mixed outlook.

The data from answers to corresponding question № 3 from the questionnaire shows that in the past 18 months (transforming again the qualitative answers to numbers similar to the above described) the average result is 2.04, as the most positive attitude is reported in Bulgaria (1.72) and the most negative – in Croatia (2.33). The data indicates close to "no progress" situation, which confirms the negative outlook on the issue stated in the 2025 Eurostat SDGs report and tends to a negative assessment.

The fourth issue in the environmental sustainability assessment is about initiatives to adapt to climate change and the data used from the2025 Eurostat SDGs report is from 13th SDG – Climate action.

Although most of the data in the 2025 Eurostat SDGs report is related to the lowering of greenhouse gas (GHG) emissions, the climate-related economic losses observed will be corelated to the availability of initiatives in this direction, reported subsequently in the questionnaires.

2023 marked another negative year with climate-related economic losses amounting to EUR 43.9 billion, most of which (EUR 25.7 billion) was caused by hydrological events such as floods. This marks the third year in a row with economic losses well above the long-term trend. However, recorded losses vary substantially over time: about 61% of total losses have been caused by just 5% of unique extreme events. This variability makes the analysis of historical trends difficult. A closer look at a 30-year moving average shows an almost steady increase in annual climate-related

economic losses, from EUR 12.8 billion in 2009 to EUR 20.1 billion in 2023 (14), corresponding to a 57.7% increase. [4]

Data for Climate-related economic losses (30-year moving average) by country, 2018 and 2023 (EUR per capita, constant prices) shows about 45 points average for EU countries and close to this result for the EU TOURAL pilot sites as average, which means no positive state at this topic.

The data from the questionnaires shows average number of 2.62, (transforming again the qualitative answers in numbers similarly) which makes it obvious that no big efforts are being made in this direction in the TOURAL UCCST regions (at least as a result of any initiatives whatsoever, including political ones). The worst situation is observed in Romania (3.33) meaning that almost no such initiatives are existing. The optimum result is in Bulgaria with an index of 2.06, marking a progress below moderate.

The overall assessment is negative with mixed outlook.

In conclusion, the result of assessing of environmental sustainability of TOURAL UCCST regions can be described as **Stable** (close to "moderate progress"), as far as there are 2 positive and 2 negative assessments of the four discussed issues. The average result from all regions questionnaires data for this first level of sustainability is 2.14, and the above/on the level of "moderate progress" are Bulgaria and Italy, while at the bottom of the scale stand Croatia and Romania by their results of 2.36 and 2.38. So, it could be inferred that TOURAL UCCST regions are sufficiently sustainable regarding the environment and offer enough stable conditions for the implementation of the TOURAL UCCST model.

See the figures in

Table 29.

3.1.3 Social sustainability

In the field of the social sustainability regarding the above-mentioned European regions, four basic topics will be observed in this chapter - quality of living environment (housing, air, traffic, etc.); availability and equitability of healthcare and social services; accessibility of education and training; implementation of programs to support youth citizens and prevent depopulation.

Concerning the first issue (quality of living environment) the 2025 Eurostat SDGs report offers data about two indicators from 11th SDG, relevant to the current study, and the first indicator is named “Severe housing deprivation rate”.

The severe housing deprivation rate is defined as the percentage of the population living in a dwelling_which is overcrowded, while also exhibiting at least one of the following housing deprivations measures: i) a leaking roof, ii) no bath/shower and № indoor toilet, and iii) considered too dark. [4]

The data distribution by country (as % of population) shows that for the period 2018-2023 the average level for EU member states of about 4%, and the average for the TOURAL UCCST regions is above 6%. The best data belongs to Croatia – about 3% and the worst - Romania with about 10% (although Romania reports the biggest improvement for the period – more than 30%). The other three regions have a rate of about 6%. So, as far as the stated rate of this indicator for TOURAL UCCST regions is very close to the EU average, and Eurostat declares an overall improvement in this item, the assessment can be set as stable.

The next 11th SDG indicator used here is "Road traffic deaths" with data for the period 2018-2023.

This indicator measures the number of fatalities caused by road crashes, including drivers and passengers of motorised vehicles and pedal cycles, as well as pedestrians. People dying of road crashes up to 30 days after the crash are counted as fatalities. [4]

The data distributed by country (number per 100 000 people) shows that the EU average level for this indicator is 4.5%, compared to the average level for EU TOURAL regions of about 7%. The most acceptable situation occurs in Italy – a bit above 6% and the worst data is represented for Bulgaria and Romania – above 8%. The short-term prospect set by Eurostat here is negative, and the same can be described for TOURAL UCCST regions.

The questionnaires data for this first issue reveals an average rate of 2.03, as the boundaries are very thin (from 1.61 in Bulgaria to 2.22 in Croatia), which is very close to the assessment of "Moderate progress". Considering also the fact that out of the reviewed SDG indicators, there is one positive and one – negative, the overall assessment on this issue can be set as Stable with a positive perspective.

The second issue observed in this work (availability and equitability of healthcare and social services), the data excerpt from the 2025 Eurostat SDGs report is taken from 3td SDG indicator "Good health and well-being" and from two particular indicators – "Standardized avoidable mortality" and "Self-reported unmet need for medical care".

Avoidable mortality covers both preventable and treatable causes of mortality. Preventable mortality refers to mortality that can mainly be avoided through effective public health and primary prevention interventions (carried out before the onset of diseases/injuries to reduce incidence). Treatable mortality can mainly be avoided through timely and effective health care interventions, including secondary prevention and treatment (after the onset of diseases to reduce case-fatality). The total avoidable mortality rate includes a number of infectious diseases, several types of cancers, endocrine and metabolic diseases, as well as some diseases of the nervous, circulatory, respiratory, digestive and genito-urinary systems, some diseases related to pregnancy, childbirth and the perinatal period, a number of congenital malformations, adverse effects of medical and surgical care, a list of injuries and alcohol and drug-related disorders. [4]

The data for standardized avoidable mortality by country for the period 2017 – 2022, (number per 100 000 persons aged under 75), shows average level for EU of about 250, though there is a big difference between TOURAL UCCST regions data (from 170 in Italy to more than 500 in Romania). The average level for EU TOURAL regions is about 350 which is 40% worse than the EU average, and 3 of 5 regions are above this level. So, this result can be assessed as negative, at least in short-term perspective.

The second indicator observed in this topic (Self-reported unmet need for medical care) shows data for the period 2018-2023.

In the context of SDG monitoring, this indicator measures the share of the population aged 16 and over reporting unmet needs for medical care due to one of the following reasons: 'financial reasons', 'waiting list' and 'too far to travel'. Self-reported unmet needs concern a person's own assessment of whether they needed medical examination or treatment (dental care excluded) but did №t have it or did not seek it. [4]

In the data distributed by country (% of population aged 16 and over) presents an average level for the EU of about 2%. For EU TOURAL regions the average level here is 4 – double than the EU average, and again there is a big difference between TOURAL UCCST regions data (starting by 1 in Croatia to 11 in Greece). Despite the fact that 3 of 5 EU TOURAL regions are under the average line, and the total trend for the period in the EU is upward, the overall picture can be described as unstable.

The data from questionnaires (question № 6) connected to this issue shows an average level for TOURAL UCCST regions of 2.31, moving from 1.72 in Bulgaria to 3 in Ukraine. The data for Ukraine can be expected, but numbers like 2.17 in Greece and 2.33 in Croatia and Romania don't give a positive signal. Combined with the reviewed SDG data above, the overall assessment of this issue is Unstable with mixed perspective.

The third issue from this chapter is about accessibility of education and training, and the data used from the 2025 Eurostat SDGs report is taken from 4th SDG indicator – "Quality education".

The first indicator from 4th SDG observed in this survey is "Early leavers from education and training" containing data from 2019 to2024.

The indicator measures the share of the population aged 18 to 24 with lower secondary education at the most who were not involved in any kind of education or training during the four weeks preceding the survey carried out to monitor it. [4]

Distributed by country (as % of population aged 18 to 24) the figures show the average level in the EU of about 10%, and about 8% average level for the EU TOURAL regions, better than the EU average and showing improvement in all EU TOURAL regions except Romania. Again, there is a big difference between EU TOURAL regions as the data for Croatia is about 2%, but for Romania is 16%. Moreover, the trend for 2002-2024 of this indicators is affirmative and very close to the 2030 objective (0.3% left), so the overall assessment for this indicator is positive with a positive outlook.

The second indicator in this issue is "Tertiary educational attainment" from 4th SDG, containing data from 2019 till 2024.

This indicator measures the share of the population aged 25 to 34 who have successfully completed tertiary studies (for example, at university or a higher technical institution). Tertiary educational attainment refers to ISCED (International Standard Classification of Education) 2011 levels 5–8 for data from 2014 onwards and to ISCED 1997 levels 5–6 for data up to 2013. [4]

The data for tertiary educational attainment by country (as % of population aged 25 to 34) display the average level for the EU of about 44%, as the same average for EU TOURAL regions being above 35%, which is relatively close to the EU average. All EU TOURAL regions except Romania are over 30% level and show an upward trend for the period. What is more, the trend of 2002-2024 period of this indicator is affirmative again and very close to the 2030 objective (0.8% left), so the overall assessment for this indicator again is positive with a positive outlook.

The questionnaires data for this issue reveals an average rate of 2.08, which practically equals "Moderate progress" (using a qualitative assessment). The most positive numbers are reported for Bulgaria – 1.39, and the most negative for Ukraine – 3 (understandable, given the war in the country). The other TOURAL UCCST regions are close to 2, and the common assessment here (reporting development in the last year and a half) ultimately confirm the stated trend in the Eurostat report (even from the year 2002), so the overall assessment for this issue is Positive with a positive outlook.

The fourth topic in the social sustainability assessment is implementation of programs to support youth citizens and prevent depopulation, where there is no totally corresponding data to be found directly in the 2025 Eurostat SDGs report, but some information from 8th SDG ("Decent work and economic growth") can be useful, especially that of the chapter "Young people neither in employment nor in education or training" (NEET), and the data thereof will be used for a kind of parallel for the needs of this survey.

The NEET rate for 15- to 29-year-olds in the EU has been improving since 2013, reaching a record low of 11.0 % in 2024. However, the rate of decline slowed in 2023 and 2024, meaning further efforts seem necessary for the EU to reach its NEET rate target of 9 % by 2030. Since 2009, the NEET rate in rural areas and in towns and suburbs had been higher than in cities. By 2024, it

amounted to 12.3 % in rural areas and 11.4 % in towns and suburbs, compared with 10.0 % in cities. [4]

A considerable proportion of young people aged 15 to 29 in the EU are not employed. For some this is due to the pursuit of education and training. However, others have withdrawn from education and training as well. Those are captured by the statistics on young people who are neither in employment (meaning they are outside of the labour force market or unemployed), nor in education and training (NEET rate). [4]

Disseminated data by country for the period 2019-2024 (as % of population aged 15 to 29) shows an average EU level of about 12%, and the same average level for the EU TOURAL regions, where the five regions are close to the EU average and only Romania reports 19%. Considering the overall affirmative trend in this indicator from 2009, the assessment here can be only positive.

The data from the questionnaires for this issue (question № 8), shows an average level of 2.51, and this result tends to the qualitative equivalent of “no progress”. Half of the regions report a level on/over 3, whereby only Italy is below 2, and Croatia and Bulgaria are between 2 and 3. Moreover, a third to a half of the respondents in Greece, Croatia and Romania report “no such programs available”. So, the result can be described as neutral.

In conclusion, the result of the assessment of social sustainability of TOURAL UCCST regions can be described as **Stable** (close to "moderate progress"), as far as there is a 1 stable, 1 unstable, 1 positive, and 1 neutral assessment in the four discussed issues. The average result from all regions’ questionnaires data for this level of sustainability is 2.23, similar to the above level of "moderate progress" (tending to 1) being Bulgaria and Italy, and at the other end of the scale being Romania and Ukraine with results of 2.52 and 2.75. Thus, it could be inferred that most of TOURAL UCCST regions are sufficiently sustainable regarding the social environment and offer enough stable conditions for TOURAL UCCST model implementation. For Ukraine, certainly, nothing could be done before the war ends, and a lot of work should be done after that in order to reach a stable enough level of social sustainability and to calmly implement UCCST model.

See the figures in

Table 29.

3.1.4 Cultural sustainability

As was indicated in the “Limitations” part of the chapter 5.1 “Methodology and background”, there are not specific indicators for cultural sustainability included in the 2025 Eurostat SDGs report to be used as a corresponding marker to the TOURAL UCCST regions assessment process, despite the fact that the importance of studying the culture sustainability has been stated in numerous recommendations, e.g. in papers of Brainstorming sessions organized by the European Commission's Voices of Culture (2021), or EU Work Plan for Culture 2023-2026, so cultural dimension sustainability assessment in this work is based only on the qualitative data collected from the questionnaires used.

Considering the fact that most of the cultural activities were almost stopped for about 3 years during the time of COVID-19 pandemic (2020-2022), the positive development in this area during the last 2.5 years should define an uptrend and significant progress in the level of cultural sustainability presently.

Four issues will be observed as a part of a cultural sustainability area: a number of measures for preservation and promotion of intangible cultural heritage; a number of measures for maintaining

and integrating the cultural heritage sites into community life; the level of involvement of local cultural actors into local economic development; the level of partnerships between cultural institutions and other sectors.

The first issue discussed in this survey is the dynamics in the level/number of measures for preservation and promotion of intangible cultural heritage (Question № 9), and the average result of assessment from the six TOURAL UCCST regions is 1.86, which is better than "Moderate progress". Significant progress is reported by Italy, followed by Bulgaria, Croatia, Greece and Romania which are over 2 (and over the average). Ukraine has the worst result (3), but this can be expected considering the ongoing war there.

The overall assessment of the first issue is Stable with a positive outlook, as far as the reported data shows better than moderate progress in 4 of the 6 regions.

The second issue discussed as data from the questionnaires (Question № 10) is the dynamics in the level/number of measures for maintaining and integrating the cultural heritage sites into community life. Here the project partners declare average result of 1.94 which is close to the results of the previous issue, and it shows in fact "Moderate progress" in this subject too. Italy and Bulgaria again have the best results of 1.33, followed by Croatia, Greece and Romania (1.56-2.25). It can be marked here that the rates are in a very thin range, close to the average number, so the assessment is homogeneous and consistent. And again, Ukraine has the worst result (3), and explanation again, unfortunately, is notorious.

The overall assessment of the second topic is again Stable with positive outlook, as far as the reported data shows better than moderate progress in the half of the regions, and 4 of 6 regions have rate 2 and better.

The third issue is concerning the dynamics in the level of involvement of local cultural actors (artists and cultural practitioners) into the economic development (question № 11 from questionnaires), and the results show an average level of 1.99 in the project partners assessments, which is a "Moderate progress" (2) again. The best rate pertains to Bulgaria and Croatia (1.72 and 1.78), followed by Italy, Ukraine and Romania (2.00-2.08). Greece is in the last place by a rate of 2.20 in this respect. It can be marked again that the rates are in very close range (1.72-2.20), and near to the average number, so the assessment is homogeneous.

The overall assessment of the third issue is Stable with a neutral outlook, as far as the reported data shows better than moderate progress in 2 regions, moderate progress in 2 regions, and below moderate progress in the last 2 regions, and the average level is practically equal to Moderate progress.

The fourth issue observed the level of partnerships between cultural institutions and other sectors (question № 12 from questionnaires) and the average result declared here from the project partners is again 1.99, which is actually "Moderate progress" (2) again. On the top places stand Italy, Croatia and Bulgaria (1.33-1.78), while the assessment for Greece is the most negative again (2.67).

The overall assessment of the fourth issue is Stable with positive outlook, as far as the reported data shows better than moderate progress in 3 regions, moderate progress in 1 region, and below moderate progress in the other 2 regions, and the average level is practically equal to Moderate progress but distributed differently by regions.

In conclusion, the result of assessment of cultural sustainability of TOURAL UCCST regions can be described definitely as **Stable** (almost equal to the "moderate progress"), as far as there are four assessments "stable" in the four discussed issues. This is the most positively assessed sustainability level so far. Italy is marking the most positive development, and Ukraine is occupying the last place. So, it could be assumed that all of the TOURAL UCCST regions are sufficiently sustainably stable enough for TOURAL UCCST model implementation. As for

Ukraine, unfortunately and obviously, the end of the war should come before the real implementation of the UCCST model begins.

See the figures in Table 29

3.1.5 Economic sustainability

Going to the last level of sustainability assessment of the European regions - economic one - the four main issues to be discussed here are: the stability level of local economy to seasonal & global challenges; the employment opportunities; the accessibility of digital services; the implementation of strategies to promote sustainable tourism.

Assessment of the dynamics in resilient/stability level of local economy to seasonal & global challenges (wars, crises) is the first issue, and the 2025 Eurostat SDGs report offers data from two indicators relevant to the current study, from 8th SDG "Decent work and economic growth" and 9th SDG "Industry, innovation and infrastructure", the first indicator from SDG 8 being "Real GDP per capita".

Gross domestic product (GDP) is a measure of economic activity and is often used as a proxy for changes in a country's material living standards. It refers to the value of total final output of goods and services produced by an economy within a certain time period. Real GDP per capita is calculated as the ratio of real GDP (GDP adjusted for inflation) to the average population of the same year and is based on rounded figures. [4]

In the figure for change in real GDP per capita (compound annual growth rate in %), distributed by country, for the period 2019–2024, the data shows that the average level for the EU is about 0.8%. The EU TOURAL regions average is above 2.5% and Croatia is leading in the EU by almost 4%, followed by Bulgaria, Greece and Romania (2%-3%), while Italy is at the bottom by about 1.5%. The average level of the project partners data is about three times higher than that in the EU and this is indicative by itself, so the assessment here is positive, with a positive outlook.

The second indicator for this issue is from SDG 9 and it is named "Gross domestic expenditure on R&D".

This indicator measures gross domestic expenditure on R&D (GERD) as a percentage of gross domestic product (GDP) — also called R&D intensity. Despite the EU's long-standing 3% target, the EU's R&D intensity has grown only modestly over the past two decades. After prolonged stagnation between 2000 and 2007, the EU's R&D intensity increased slowly, reaching 2.28 % in 2020. It declined again slightly in the following years and stood at 2.24 % in 2023. [4]

The GERD data (as % of GDP), distributed by country, for the period 2018–2023, the numbers reveal the average level for the EU TOURAL regions of a bit over 1.1%, compared to 2.24 average EU level – half as much. Greece and Croatia are leading the project partners data by above 1.5% and are the biggest in increase for the period. Bulgaria and Romania take the last places (0.8%-0.5%). Thus, the data is not very positive for the EU TOURAL regions, but the reported progress in all 5 regions leads to an assessment of neutral with a positive outlook.

The data from the questionnaires for this issue (question № 13), shows an average level of 2.31, and this result is closer to the qualitative equivalents of "Moderate progress". Bulgaria holds the best score here – 1.83, Greece, Italy and Croatia about 2, and Romania and Ukraine are the last (2.75-3). Combining these results with the data from 2025 Eurostat SDGs report (positive and neutral), the overall assessment on this issue could be Stable with a mixed outlook.

The second issue in this chapter is dynamics in the employment opportunities, and again data from 8th and 9th SDGs from 2025 Eurostat SDGs report will be used, as the first indicator from SDG 8 is named "Employment rate".

The employment rate is defined as the percentage of employed persons in relation to the total population. The data investigated presently focuses on the population aged 20 to 64. Employed persons are those who, during a reference week, worked at least one hour for pay or profit or were temporarily absent from such work. [4]

From the data of the employment rate, distributed by sex and by country, for the period 2019 – 2024, it can be observed that the average level for the EU at the end of last year is 75.8% relatively close to the 2030 target of 78%. The level of employment by men is about 5% higher than average, and the level by women is about 5% lower, and such a difference is almost constant from 2009. In the EU TOURAL regions data, the average level is about 72% having no large deviations from the average in the countries data, as Bulgaria and Croatia are above/on average, and Romania, Greece and Italy are on/below the level of 70%, though progress is reported in all 5 pilot regions, so the assessment is stable with a positive outlook.

The second indicator is "R&D personnel" from SDG 9.

This indicator measures the share of R&D personnel in the following institutional sectors: business enterprise, government, higher education and private non-profit. Data is presented in full-time equivalents as a share of the labour force. R&D personnel consist of persons engaged directly in R&D, which refers to the creative and systematic work undertaken to increase the stock of knowledge, including knowledge of humankind, culture and society, and to devise new applications of available knowledge. In addition, R&D personnel also include those providing direct services for R&D activities, such as R&D managers, administrators, technicians and clerical staff. [4]

The data distributed by country (% of population in the labour force) here shows 1.56% average level in the EU, but the average level for the EU TOURAL regions is about 0.9% - almost twice as low. The best situation occurs in Greece – above average, and the worst – in Romania (0.4%), though the improvement is very slow in most of the EU TOURAL regions. This logically leads to assessment neutral with a mixed outlook.

The data from answers to corresponding question № 14 from the questionnaires, shows that for the past 18 months the average result is 2.13 and only Italy and Bulgaria report data above 2. Greece, Croatia and Romania have results from 2 to 2.58, and Ukraine is at the bottom (3) which is explainable, given the war in the country. The data from TOURAL regions is a little different from that of the countries (Eurostat), meaning no big progress has been indicated in the past year, but the average is close to qualitative equivalents "Moderate progress", and considering the overall improvement since 2009, and the selected Eurostat data, the common assessment in this issue is stable with a neutral outlook.

The third issue in economic sustainability is dynamics in the accessibility of digital services and data from 17th SDGs ("Partnerships for the goals") from the 2025 Eurostat SDGs report will be used here, as the indicator from SDG 17 is named "Share of households with high-speed internet connection".

This indicator measures the share of households with a fixed very high-capacity network (VHCN) connection. A VHCN is either an electronic communications network that consists entirely of optical fibre elements, at least up to the distribution point at the serving location; or an electronic communications network capable of delivering, under usual peak-time conditions, similar network performance in terms of available downlink and uplink bandwidth, resilience, error-related parameters, and latency and its variation. [1]

The data distributed by type of area and by country, for the period 2018-2023, reveals that in the "Low-settled areas" (rural areas) VHCN coverage is on 55.7% level at the end of the period, compared with 78.8% totally in the EU. Despite reported improvement (more than 30%) VHCN coverage has only about half of the rural areas in the EU. Looking on by country distribution, the average level at the EU TOURAL regions is about 70%, a bit below the EU average. The best

VHCN coverage declare Romania and Bulgaria (about 90%), and at the bottom is Greece with about 40%. In the 3 of 5 EU TOUTAL regions the data is below the EU average, but only in one – below the EU rural area level. Huge improvement (over 20%) is reported in all TOURAL pilot regions for the period. The assessment here is positive with a neutral outlook.

Correspondingly data from the questionnaires (question № 14) shows average level of 1.89 (the best from all four issues observed, and the second of all four sustainability levels), as close to 1 are Italy, Bulgaria and Romania, and about 2 are Greece and Croatia. Ukraine, understandably, is again on the last place. Combined with the Eurostat data above, the assessment in this issue is Positive with a neutral outlook.

The fourth issue is implementation of strategies to promote sustainable tourism. As far as there is not specific data connected to tourism in the 2025 Eurostat SDGs report, the SDG 17 data about 'Greening' the taxation system will be treated in reference to transition to a climate-neutral economy and promotion of sustainable tourism. The indicator from SDG17 is named "Share of environmental taxes in total tax revenues".

Environmental taxes help to provide the right price signals and incentives to producers, users and consumers to encourage less polluting consumption and to contribute to sustainable growth. They may also provide opportunities to reduce taxes in other areas, for example on labour, and if revenue for adequate social protection is protected, they can offer a win–win option for addressing both environmental and employment issues, as laid out in the EU's Action Plan for Fair and Simple Taxation. Environmental taxes support the transition to a climate-neutral economy. As indicated in the Communication on Business taxation for the 21st century as regards the EU tax mix, behavioural taxes, such as environmental and health taxes, continue to be of growing importance for EU tax policies. [4]

The data (%) distributed by country for the period 2018-2023 shows average level for the EU of 5%, compared to an average level for EU TOUTAL regions of 9% - almost double. The highest levels are in Bulgaria (11%) and the lowest in Italy (6%). The assessment is negative.

The data from the questionnaires (question № 15) connected to this issue presents a clear picture with an average level of 2.03 (equivalent to "Moderate progress"), and assessments are in a short range (from 1.67 to 2.67), so this clearly leads to an overall assessment Stable, with a negative outlook, considering the not so exact connection between Eurostat data and the core of the topic.

In conclusion, the result of assessment of economic sustainability of TOURAL UCCST regions can be described as **Stable** (very close to "moderate progress"), as far as there are 1 positive and 3 stable assessments in the discussed topics. The average result from all regions questionnaires data for the last level of sustainability is 2.09, as the above the level of "moderate progress" are Bulgaria and Italy, and at the other end of the scale stand Romania and Ukraine by results of 2.42 and 2.75. Ultimately, the TOURAL UCCST regions are sufficiently sustainable regarding the economic environment too and can offer enough stable conditions for TOURAL UCCST model implementation.

See the figures in Table 29

3.1.6 Sustainability Assessment Conclusion

As a general conclusion of the chapter of sustainability assessment of TOURAL UCCST regions, the common average rate of sustainability is **STABLE**, as far as we have 4 assessment "stable" at all four levels of sustainability. So, the possibility of UCCST model implementation in the TOURAL pilot regions (except Ukraine, where first the war should end) can be confirmed The most positive is the data for the area of culture level, followed by economic, environmental and social level. Bulgaria is reported as the most sustainable in the environmental level, for the social

one those are Italy and Bulgaria practically sharing the first place (0.05 difference), as for the cultural and economic sustainability Italy and Bulgaria are leading again, followed by Croatia and Greece.

See the figures in Table 29: Regions Sustainability

Table 29: Regions Sustainability

Table 1

		REGIONS SUSTAINABILITY (4 LEVELS)															
		A. Environmental				B. Social				C. Cultural				D. Economic			
	Average by section	2,14				2,23				1,94				2,09			
	Question No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Average result by question	1,93	1,97	2,04	2,62	2,03	2,31	2,08	2,51	1,86	1,94	1,99	1,99	2,31	2,13	1,89	2,03
R	Greece (North Sporades)	1,67	2,00	2,00	2,83	2,17	2,50	2,17	3,17	1,83	2,17	2,33	2,67	2,17	2,00	2,17	1,67
E	Italy (Province of Teramo)	2,00	1,00	2,00	3,00	2,00	2,00	1,67	1,00	1,00	1,33	2,00	1,33	2,00	1,33	1,00	2,00
G	Croatia (Island of Pag/Village Šimuni)	2,33	2,17	2,33	2,50	2,22	2,33	2,00	2,44	1,56	1,56	1,78	1,67	2,11	2,00	2,00	2,22
I	Bulgaria (Nessebar)	1,50	1,72	1,72	2,06	1,61	1,72	1,39	2,11	1,44	1,33	1,72	1,78	1,83	1,89	1,50	1,61
O	Romania (Danube Delta LAG, Tulcea)	2,08	1,92	2,17	3,33	2,17	2,33	2,25	3,33	2,33	2,25	2,08	2,50	2,75	2,58	1,67	2,67
N	Ukraine (Kutsurub rural region)	2,00	3,00	2,00	2,00	2,00	3,00	3,00	3,00	3,00	3,00	2,00	2,00	3,00	3,00	3,00	2,00

		COMMON SUSTAINABILITY			
	Common Average Level	2,10			
	Levels of sustainability by Section	A	B	C	D
	Average result by Section	2,14	2,23	1,94	2,09
	Average result by Region / by section	A	B	C	D
R	Greece (North Sporades)	2,13	2,50	2,25	2,00
E	Italy (Province of Teramo)	2,00	1,67	1,42	1,58
G	Croatia (Island of Pag/Village Šimuni)	2,36	2,25	1,64	2,08
I	Bulgaria (Nessebar)	1,75	1,71	1,57	1,71
O	Romania (Danube Delta LAG, Tulcea)	2,38	2,52	2,29	2,42
N	Ukraine (Kutsurub rural region)	2,25	2,75	2,50	2,75

Data conversion:
Significant progress = 1
Moderate progress = 2
No progress = 3
No such...available = 4

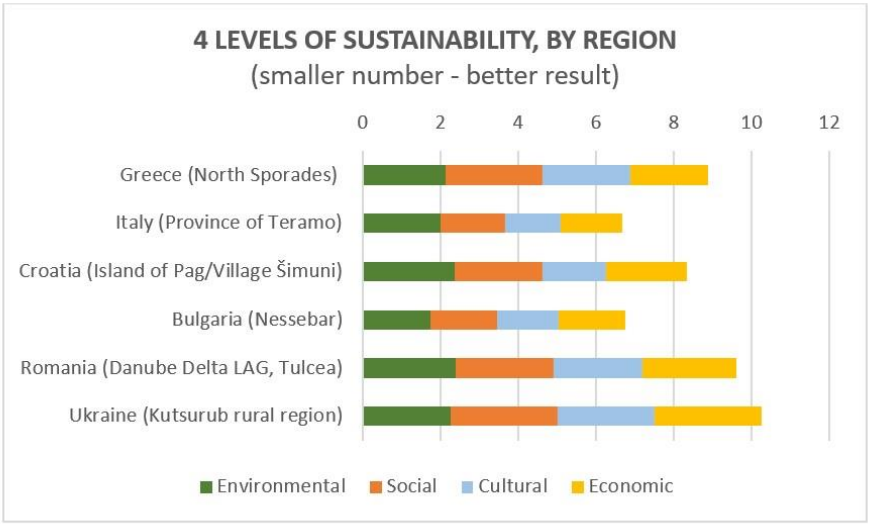

Figure 2 Assessment of the 4 levels of sustainability, distributed by TOURAL UCCST regions, based on the questionnaires data.

3.2 Analysis of implementation barriers

3.2.1 Barriers/challenges identified so far in the project

A lot of work was done by the TOURAL project partners till now, including in the area of identification of barriers to the project model implementation, named in different ways. Below we offer a short-summarized result of this work.

The first identified in the project barriers to the implementation of TOURAL UCCST model (BIM) can be found in Deliverable 2.1 (D2.1) where they were described as "Weaknesses" and namely those are:

Seasonality (uneven temporal and spatial distribution of tourists); Lack of understanding of the potential of UCCST/CCT tourism among tourism stakeholders; Lack of awareness of the need to develop sustainable tourism; Lack of innovation; Resistance of the local population; Depopulation; Labor shortage; Insufficiently experienced and trained employees in the tourism sector; Environmental threats; Security threats; Insufficient and dysfunctional transport and communal infrastructure in tourist destinations; Overbuilding; Inaccessibility of content for people with disabilities and children; Insufficient development of tourist infrastructure facilities; Limited financial resources for marketing; Lack of cooperation between tourism stakeholders.

The next group of BIM was defined and assessed during the conducted Living labs in the six pilot sites. 13 BIM defined as "challenges" were assessed by the stakeholders involved in the conducted Living labs and finally all of the pilot sites received a summarized list with the most important 5 ones confirmed by stakeholders. This fruitful information should be used from the pilot sites partners in the process of individualizing the design of the UCCST model, and co-designing/co-creating their tourism offerings/services. For example – for Bulgaria (Nessebar) pilot region, the one assessed as most important challenge was: Shortage of skilled labour to meet the market needs in the niche tourism sectors; Lack of interest in the potential of niche tourism sectors; Lack of financial support for niche tourism sectors; Lack of a well-organized communication strategy for the region's heritage; Policy gap in addressing market & social needs for the development of niche tourism sectors; Lack of tourist facilities/infrastructure for niche tourism sectors.

In the Deliverable 6.1 (D6.1) it was also identified "market barriers" to the new products/services offering in the next 4 years to the market as a TOURAL exploitable results, such as: Product differentiation; Dependence on 3rd parties for specific product components; Capital requirements; Limit pricing; Access to distribution channels; Government policy & regulations; Impact of pandemic situations.

Detailed data for distributed by regions and TOURAL tourism verticals, can be found in Deliverable 3.1 (D3.1), where the research and evaluation of BIM named "challenges" is made accordingly. For example – for Romania (Danube Delta LAG, Tulcea) region: Access, infrastructure, and environmental risks are displayed as primary for the UCNHT; Seasonality is the most important for CCT; Coordination, information gaps are the biggest barrier to CST; and very limited accessibility is the main challenge to SLT.

All this data, together with assessment of sustainability-barriers-mitigation results from Task 3.3 can be implemented from the pilot sites partners in the process of individualizing the design of the UCCST model, and co-designing/co-creating their tourism offerings/services based on regions' unique assets and own merits, and to continue working on the project in Task 3.4.

3.2.2 Analysis of the barriers to the UCCST model framework implementation

To continue the BIM evaluation and to conclude the barriers assessment area by in-depth research and analyses, in the questionnaire used in this work, additional questions about 5 specific barriers not evaluated till now were offered to the project partners and stakeholders, as well as one open question, to estimate the level of importance of these barriers regarding UCCST model implementation.

The potential barriers included in the first 5 questions are as follows:

1. lack of effective platforms for collaboration between different sectors/actors (e.g. cultural heritage, arts, education, healthcare, accommodation), leading to missed opportunities for tourist offerings - (Q1);
2. unequal distribution of economic benefits between tourist market participants (discouraging local community participation and leading to limited economic opportunities/activities) - (Q2);
3. insufficient data-driven planning and marketing (big data collection and systems about visitor patterns, preferences, local capacities, leading to targeted marketing and specialized trainings) -(Q3);
4. lack of good digital infrastructure supply, (e.g. insufficient access to high-speed internet or digital literacy, leading to ineffective usage of AR/VR, mobile apps, virtual museums) - (Q4);
5. missing/imperfect environmental regulatory frameworks (insufficient monitoring, and lax enforcement of environmental protection laws) - (Q5).

The result of the assessment of the importance of these barriers is exposed in Table 2 below. Using the scale for importance (1 is very low, 5 is very high), the data here shows that in average for all the partners the Q1 and Q2 has a biggest pressure, with an almost equal rate of 4.20-4.21. The next important one is Q3 (insufficient data-driven planning and marketing) with assessment level of 4.13. Below the level of importance 4 are Q4 and Q5 with results 3.85 and 3.91.

For the different TOURAL regions data reveals that for Croatia, Bulgaria and Ukraine the most important barrier identified is Q1 (lack of effective platforms for collaboration between different sectors/actors). It should be noted that data from Ukraine shows that 4 of 5 barriers have maximum importance, which is explainable by the ongoing war in the country.

For Italy the most important barrier is unequal distribution of economic benefits between tourist market participants (Q2) with almost maximum importance, while in Greece and Romania the most important barrier is missing/imperfect environmental regulatory frameworks (Q5). It can be noted that in Romanian assessments all the numbers are high in the scale (between 4 and 5), until in Bulgarian assessments all the answers rates are in the middle of the scale (3 to 4), showing the different overall importance of the assessed barriers. In the Croatia data of the assessment scale are very consistent (3.67-4.22), indicate the importance of the rated barriers, while in Italy and Greece they are in a wide range from 2.83 to 4.67, leading to the very different value of the various barriers (e.g. in Greece Q4 has little importance).

In the open question from the questionnaire participants from Italy and Greece were most active, and most of barriers they added in consequence are already assessed previously, mainly during the Living Labs or in D3.1, as the some of them are: lack of interest/awareness in the potential of niche tourism sectors; Transport and infrastructure problems; the absence of coordinated co-planning between different sectors/stakeholders; low digital maturity, especially with respect to IoT technologies and smart mobility solutions.

See the figures in

Table 30.

Table 30: Barriers Assessment

Table 2

		BARIERS				
	Average by section	4,06				
	Question / Barier No	1	2	3	4	5
	Average result by question	4,20	4,21	4,13	3,85	3,91
R	Greece (North Sporades)	4,17	4,00	3,83	2,83	4,67
E	Italy (Province of Teramo)	4,00	4,67	4,33	4,00	3,00
G	Croatia (Island of Pag/Village Šimuni)	4,22	3,67	4,00	3,89	4,11
I	Bulgaria (Nessebar)	3,72	3,44	3,33	3,11	3,00
O	Romania (Danube Delta LAG, Tulcea)	4,08	4,50	4,25	4,25	4,67
N	Ukraine (Kutsurub rural region)	5,00	5,00	5,00	5,00	4,00

Scale of data:
1 is very low, 5 is very high

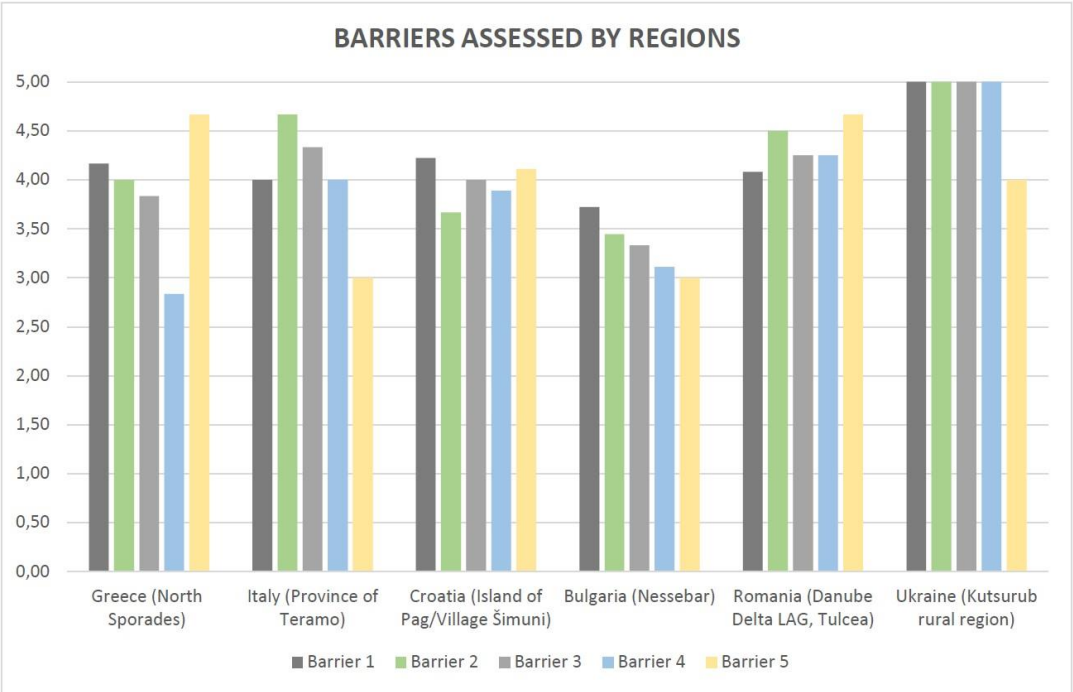

Figure 3 Barrier's importance assessment, distributed by region, and by type of barrier.

3.3 Mitigation prescriptions

3.3.1 Prescriptions/solutions described so far in the project

Similarly to the assessment of the barriers, during the TOURAL project execution, there was a process of identification of the opportunities, solutions and advantages, in regard to the pilot sites regions, which can be described as initial definitions of the mitigation prescriptions to overcoming barriers to the project model implementation, considered in this chapter.

Starting again with the D2.1 data, there is a list of opportunities defined there, and on the regional level they are: Sustainable, accessible and green destinations; Cultural and natural assets; Diversity of touristic offer; The possibility of developing specific forms of tourism (culture, nature, creative sector, etc.); The potential of UCCST/CCT tourism for development in the pre- and post-season; The recognized necessity of association (associations or joint work between tourism companies from the countries in the same area); Digitalization of the tourism product; Geographical proximity to major emitting tourist markets; Available EU funding sources; Tourists' sense of security in most of the project area.

An instrument named “Solutions” was defined and assessed during the conducted Living labs in the six pilot sites. Seven solutions were assessed by the stakeholders: Tailor-made tourism packages to attract diverse tourists, such as artists, scientists & silver tourists; Integration of the local community and traditions into the tourism industry for better promotion of local natural & cultural resources; Trainings to upskill and reskill the tourism operators in the field of UCCST; Development of tourist learning experiences through engaging activities with locals and the use of digital tools; Offering of low-cost and off-season vacation packages; Citizen-science campaigns and volunteering activities related to the protection of natural & cultural resources.

Three of the seven solutions in the Living labs process were assessed as most important for each TOURAL UCCST region, and e.g. for Bulgaria those are: Tailor-made tourism packages to attract diverse tourists, such as artists, scientists & silver tourists; Integration of the local community and traditions into the tourism industry for better promotion of local natural & cultural resources; Trainings to upskill and reskill the tourism operators in the field of UCCST.

In D3.1 a number of advantages is reported for every pilot region, such as: expansion of dive routes, training local guides, providing advanced equipment, Investments in infrastructure, marketing campaigns, Collaborative efforts among local authorities, businesses, and stakeholders.

Most of the insights above, together with this task data, can be implemented from the pilot sites partners in the prosses of individualizing the design of the UCCST model.

3.3.2 Analysis of currently rated mitigation prescriptions

For the purposes of this analysis a list of 10 mitigation prescriptions (MP) was set in the questionary used, and project partners and stakeholders made their assessment, rated the most imported ones. Some of the MP are kept from already identified ones to check/confirm their importance, some are new ones and are assessed for the first time.

The MP rated with scale (1 is very low, 5 is very high) are:

- Create diversified packages with incentives (MP1);
- Organize spatialized training workshops (MP2);
- Local communities’ synergies and joint planning (MP3);
- Very targeted marketing campaigns (MP4);
- New digital services offering (MP5);
- New/extended business models implementing (MP6);
- Put local products into tourism value chain (MP7);
- Programs for exchanging best practices with other regions/countries (MP8);
- Wider digital/electric infrastructure (MP9);
- Implementing green regulatory frameworks (MP10).

The data analyses show that with a highest average result of 4.42 (close to 5 or very important) are the MP 3 and MP7, as the first results confirm the established at the Living Labs high-scored "Integration of the local community and traditions into the tourism industry" – equal to "Local communities' synergies and joint planning". The importance of "Put local products into tourism value chain" (MP7) is firstly assessed and its high rate shows the significance of this MP and confirm the weight of using the local values in the UCCST models.

The lowest average result of 3.63 have MP10 (Implementing green regulatory frameworks) but should be noted that all MPs have a score over 3.5 – in the upper half of the scale or all are important to varying degrees. All other MPs average assessments are grouped in the small range of 3.82 – 3.96.

In the distributed by region data shows a different preference among TOURAL pilot sites:

For Greece (North Sporades) most important are MP6 and MP1 (New/extended business models implementing, and create diversified packages with incentives), as the least rated as valuable is MP9 - Wider digital/electric infrastructure.

In Italy (Province of Teramo) most preferred are MP7 and MP4 (Put local products into tourism value chain, and targeted marketing campaigns), while the lowest score has MP10 - Implementing green regulatory frameworks.

For Croatia (Island of Pag/Village Šimuni) the most important are MP7 and MP3 (Put local products into tourism value chain, and Local communities' synergies and joint planning), and the last place is for MP8 (Programs for exchanging best practices with other regions/countries).

Data from Bulgaria (Nessebar) shows as most preferred MP3 and MP4 (Local communities' synergies and joint planning, and very targeted marketing campaigns), while least rated is MP2 - Organize spatialized training workshops, but all the data is within thin range of 3.67-4.33 (meaning no big assessment difference).

In Romania (Danube Delta LAG, Tulcea) the best assessment has MP7, MP5 and MP3 (Put local products into tourism value chain, New digital services offering, and Local communities synergies and joint planning), while the less preferred is MP1 - Create diversified packages with incentives, but we have to note that is the highest overall rate for all MPs – 9 of 10 are over 4.

For Ukraine (Kutsurub rural region) the most important are MP2 MP3 MP8 (Organize spatialized training workshops, Local communities' synergies and joint planning, and Programs for exchanging best practices with other regions/countries), while the last place is for MP10 - Implementing green regulatory frameworks, and the preferences can be explained by the ongoing war in the country.

All the pilot sites average assessments are on the level about/above 4, except Italy – 3.53, that means almost all describe the MPs as important to very important, so these MPs can be used in the process of individualizing the design of the UCCST model, including the data from chapter 7.1.

See the figures in

Table 31.

Table 31: Mitigation Prescriptions

		MITIGATION PRESCRIPTIONS									
	Prescription No	1	2	3	4	5	6	7	8	9	10
	Average result by Prescription	3,89	3,90	4,42	4,11	3,82	3,92	4,42	3,96	3,88	3,63
REGION	Greece (North Sporades)	4,67	4,00	4,33	4,17	3,50	4,83	4,33	3,83	3,17	4,50
	Italy (Province of Teramo)	3,00	2,67	4,00	4,33	3,33	3,67	4,67	3,67	3,67	2,33
	Croatia (Island of Pag/Village Šimuni)	3,78	4,00	4,44	3,89	3,89	3,89	4,56	3,33	4,22	4,00
	Bulgaria (Nessebar)	4,06	3,67	4,33	4,17	3,78	3,89	3,94	3,83	3,94	3,89
	Romania (Danube Delta LAG, Tulcea)	3,83	4,08	4,42	4,08	4,42	4,25	5,00	4,08	4,25	4,08
	Ukraine (Kutsurub rural region)	4,00	5,00	5,00	4,00	4,00	3,00	4,00	5,00	4,00	3,00

Data/Importance:
Scale:
1 is very low, 5 is very high

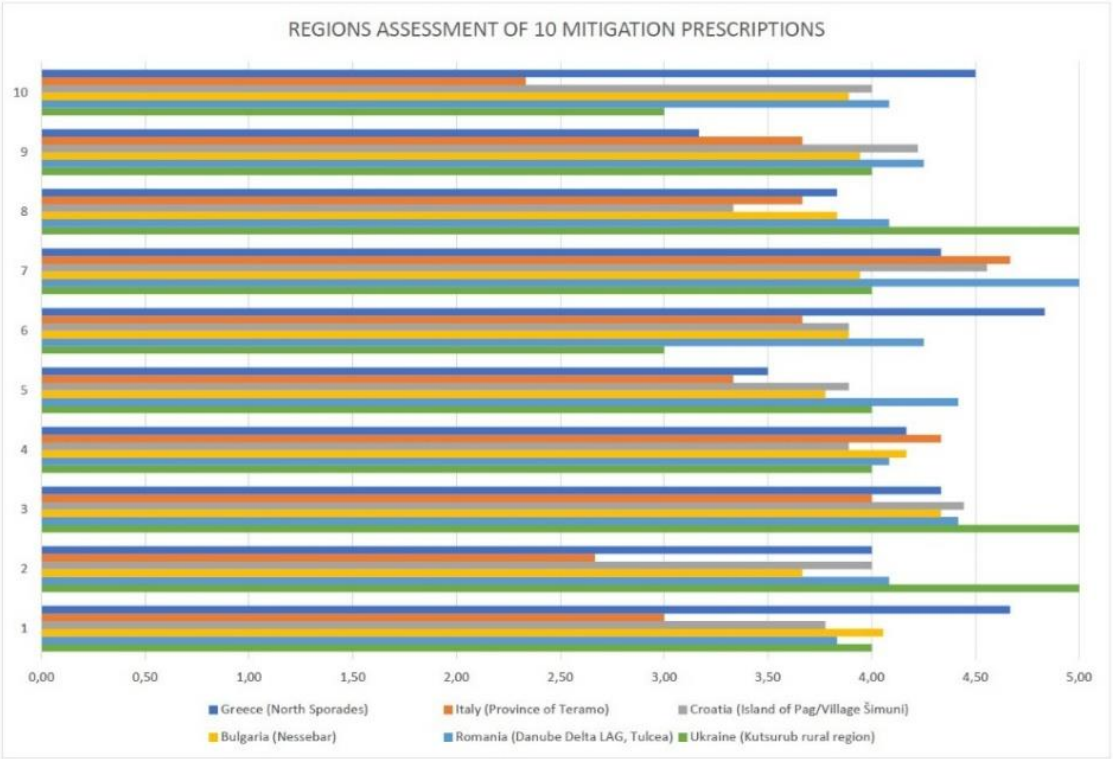

Figure 4 Assessment of 10 mitigation prescriptions, made by TOURAL partners.

3.4 Task 3.3 Conclusions

The work undertaken in Task 3.3 confirms that the multidimensional UCCST model proposed by TOURAL is both feasible and adaptable across a wide range of contexts, provided that its implementation is aligned with local policy priorities and supported by multi-level governance frameworks. The comparative assessment of pilot sites illustrates that each location holds a distinctive combination of cultural, natural, and socio-economic resources which can underpin niche tourism development in the areas of Underwater Cultural & Nature Heritage Tourism (UCNHT), Cultural & Creative Tourism (CCT), Cultural Science Tourism (CST), and Silver Tourism (SLT). These findings carry several policy implications.

Firstly, while the resource base across all pilot sites is strong, their readiness to transform such assets into sustainable tourism offerings is uneven. Mature destinations, such as Nessebar and Teramo, demonstrate relatively advanced infrastructure and visibility within national tourism

strategies, whereas sites such as Kutsurub and the Danube Delta face more profound challenges that require dedicated policy interventions, including infrastructure investment, capacity-building measures, and stronger institutional coordination.

Secondly, the results emphasize the importance of ensuring that tourism development is not pursued in isolation but integrated with environmental protection and heritage preservation policies. Particularly sensitive ecosystems, such as those of the Danube Delta and the North Sporades, require regulatory frameworks that safeguard natural resources while allowing for controlled and responsible growth. The policy priority here is to ensure that UCCST contributes to long-term resilience and sustainability, rather than short-term gains.

Thirdly, community engagement emerges as a decisive factor for success. Where local communities are mobilized—through initiatives such as Living Labs, citizen science programs, or cultural festivals—the legitimacy and sustainability of UCCST initiatives are greatly enhanced. Policymakers should therefore design mechanisms that systematically embed local actors into planning and governance processes, ensuring that UCCST becomes a shared endeavour rather than an externally driven intervention.

Fourthly, the analysis highlights the need to align UCCST with national and regional policy frameworks and to mobilize multi-level support. This requires embedding UCCST priorities into local development strategies, integrating them within national tourism and heritage agendas, and connecting them to European funding instruments and cultural cooperation mechanisms. Establishing regulatory clarity, facilitating public-private partnerships, and encouraging cross-border cooperation are all policy measures that will help scale and mainstream the model.

Finally, the four niche areas should not be treated as isolated domains but as mutually reinforcing pillars of a holistic approach. Policy frameworks should therefore incentivise synergies—for instance, by linking Silver Tourism with accessible cultural and scientific programming, or by supporting the use of creative and digital tools to valorise underwater heritage throughout the year. By recognizing and fostering such cross-niche complementarities, policymakers can maximize the impact of UCCST interventions and secure broader benefits for local economies and societies.

In conclusion, the outcomes of Task 3.3 validate the strategic relevance of UCCST as a driver of sustainable regional development. They also underline the need for differentiated policy responses: infrastructure and institutional investment for less developed sites, branding and product diversification for mature destinations, and transversal measures in training, environmental management, and networking. Taken together, these policy directions create the conditions for TOURAL pilot implementations that are not only sustainable at the local level but also replicable in other European rural and coastal contexts, thereby contributing to the long-term objectives of EU cultural, tourism, and cohesion policies.

According to the last part of description of Task 3.3 – “Subsequently, consortium partners from each region (in consultation with stakeholders following the methods of T2.3) will individualise the design of the UCCST model, co-designing/co-creating their tourism offerings/services based on regions’ unique assets and own merits.”, and the description of next Task 3.4 where it is noted that T3.4 “will develop Action Plans (1/region) for implementing the individualised UCCST Model (T3.3+output)”, the pilot sites partners should create their individualised UCCST Models in the coming months to feed the T3.4 activities and related deliverable D3.3, and the follow-up works of the project.

4 Overall Conclusions

The combined insights from Task 3.2 and Task 3.3 confirm the viability and strategic relevance of the TOURAL multidimensional UCCST model. The activities undertaken under these tasks highlight both the progress achieved and the remaining challenges to be addressed in order to secure long-term sustainability and replicability across European regions.

Task 3.2 underscored the significance of building the UCCST model around stakeholder-driven methodologies, structured data collection and analysis confirming the importance of adopting a structured, participatory, and data-driven approach. The task demonstrated that questionnaires, complemented by stakeholder engagement activities, are effective tools for identifying site-specific assets, challenges, and opportunities across the four UCCST niches. This analytical methodology ensured comparability across pilot sites while also capturing the diversity of local contexts.

The survey method provided comprehensive and reliable information on pilot site conditions. Active participation of local authorities, cultural institutions, and communities enhanced the legitimacy and acceptance of the UCCST framework. The methodology developed in Task 3.2 offers a transferable model for other regions seeking to integrate cultural, creative, scientific, and senior-friendly tourism.

Task 3.3 validated the adaptability of the UCCST model across the six pilot sites and highlighted the specific conditions required for its effective implementation. The analysis showed that while all sites possess valuable cultural and natural assets, their readiness levels vary, with mature destinations needing product diversification and less developed regions requiring infrastructure and governance support.

Some sites are well-positioned to implement UCCST, while others face significant infrastructural and institutional challenges. Environmental safeguards and heritage preservation must be central to tourism development. Local involvement is essential for legitimacy, ownership, and long-term success. Embedding UCCST in local, national, and EU policy frameworks ensures scalability and sustainability.

Taken together, the findings from Tasks 3.2 and 3.3 validate the multidimensional UCCST approach as a promising model for sustainable and inclusive tourism. They also indicate that the success of future implementation will depend on several key factors: strengthening infrastructure where it is lacking, embedding sustainability safeguards into all stages of tourism development, investing in human capacity and community empowerment, and ensuring strong policy support through multi-level governance and funding frameworks. By integrating these elements, TOURAL can not only deliver tangible benefits to its pilot sites but also establish replicable practices for other European rural and coastal regions.

5 Appendix

5.1 Appendix A – Pilot Sites Comparative Analysis

Table 32: Pilot Sites Comparative Analysis

	Nessebar	Danube Delta, Tulcea	Kutsurub	North Sporades	Teramo Province	Šimuni, Island of Pag
Cultural & Creative Tourism	3	3	3	4	4	3
Cultural Science Tourism	4	5	3	5	5	4
Silver Tourism	3	3	2	3	5	3
Underwater Cultural & Nature Heritage Tourism	4	4	2	5	4	3

5.2 Appendix B – Questionnaire - T3.3

Below is a blank questionnaire used in T3.3 research, as well as a link to the folder containing data of received questionnaires (Questionnaires).

QUESTIONNAIRE

Sustainability assessment of TOURAL UCCST regions; Analysis of implementation barriers; mitigation prescriptions

(Task T3.3 - Sustainability/Barriers Assessment in TOURAL Sites & UCCST Model Individualization Thru Co-Design)

Objective: To assess the present state of TOURAL UCCST regions sustainability, barriers to implementation of UCCST Model, and mitigation prescriptions for successfully model implementation.

Please kindly to return the completed questionnaire by 15th August 2025.

GENERAL INFORMATION

a) Name of respondent: ……..
b) Name of organization: …….
c) Which region/pilot site will be assessed (please choose only one):

☐ North Sporades (Greece)
☐ Province of Teramo (Italy)
☐ Island of Pag / Village Šimuni (Croatia)
☐ Nessebar (Bulgaria)
☐ Danube Delta LAG, Tulcea (Romania)
☐ Kutsurub rural region (Ukraine)

SECTION 1. SUSTAINABILITY ASSESSMENT OF TOURAL UCCST REGIONS
Please answer assessing the dynamics for the past year and half (2024 - 1H 2025).

A. Environmental Sustainability

1. How do you assess the dynamics in development of the efficient use of natural resources in your region?

- ☐ Significant progress
- ☐ Moderate progress
- ☐ No progress

2. How do you assess the dynamics in widespread usage of renewable energy sources in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
3. How do you assess the dynamics in the implementation of waste recycling & circular material in use practices in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
4. How do you assess the dynamics in implementation of local initiatives to adapt to climate change, if there are any?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
   - ☐ No such initiatives available

B. Social Sustainability

5. How do you assess the dynamics in quality of living environment (housing, air, traffic, etc.) in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
6. How do you assess the dynamics in availability and equitable of healthcare and social services in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
7. How do you assess the dynamics in the accessibility of education and training in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
8. How do you assess the implementation of programs to support youth citizens and prevent depopulation, if there are any?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress

- ☐ No such programs available

C. Cultural Sustainability

9. How do you assess the dynamics in level/number of measures for preservation and promotion of intangible cultural heritage (local traditions, languages, etc.) in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
10. How do you assess the dynamics in level/number of measures for maintaining and integrating the cultural heritage sites into community life in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
11. How do you assess the dynamics in the level of involvement of local cultural actors (artists and cultural practitioners) into economic development of your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
12. How do you assess the level of partnerships between cultural institutions and other sectors (e.g. tourism actors) in your region, if there are any?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
   - ☐ No such partnerships available

D. Economic Sustainability

13. How do you assess the dynamics in resilient/stability level of local economy to seasonal & global (wars, crises) challenges in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
14. How do you assess the dynamics in employment opportunities (different sex, age, skills group) in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress
15. How do you assess the dynamics in the accessibility of digital services (e.g. hi-speed internet) in your region?
   - ☐ Significant progress
   - ☐ Moderate progress
   - ☐ No progress

16. How do you assess the implementation of strategies to promote sustainable tourism, if there are any?
    - ☐ Significant progress
    - ☐ Moderate progress
    - ☐ No progress
    - ☐ No such strategies available

SECTION 2. BARRIERS TO IMPLEMENTATION OF UCCST MODEL

The 5 questions are linked to the 5 base points of TOURAL UCCST Model Framework est. in D3.1
(Please rate - 1 is very low, 5 is very high)

17. How do you asses the importance of lack of effective platforms for collaboration between different sectors/actors (e.g. cultural heritage, arts, education, healthcare, accommodation), leading to missed opportunities for tourist offerings, in your region?

1	2	3	4	5
☐	☐	☐	☐	☐

18. How do you asses the importance of unequal distribution of economic benefits between tourist market participants (discouraging local community participation and leading to limited economic opportunities/activities) in your region?

1	2	3	4	5
☐	☐	☐	☐	☐

19. How do you asses the importance of insufficient data-driven planning and marketing (big data collection and systems about visitor patterns, preferences, local capacities, leading to targeted marketing and specialized trainings) in your region?

1	2	3	4	5
☐	☐	☐	☐	☐

20. How do you asses the importance of lack of good digital infrastructure supply, (e.g. insufficient access to hi-speed internet or digital literacy, leading to ineffective usage of AR/VR, mobile apps, virtual museums) in your region?

1	2	3	4	5
☐	☐	☐	☐	☐

21. How do you asses the importance of missing/imperfect environmental regulatory frameworks (insufficient monitoring, and lax enforcement of environmental protection laws) in your region?

1	2	3	4	5
☐	☐	☐	☐	☐

22. If you wish to add another important barrier to implementing UCCST model in your region, please describe it, and rate it below.

SECTION 3. MITIGATION PRESCRIPTIONS

23. Please rate the mitigation prescriptions in the table below as most suitable for implementation in your region (1 is very low, 5 is very high).

Prescription / rate	1	2	3	4	5
Create diversified packages with incentives	☐	☐	☐	☐	☐
Organize spatialized training workshops	☐	☐	☐	☐	☐
Local communities synergies and joint planning	☐	☐	☐	☐	☐
Very targeted marketing campaigns	☐	☐	☐	☐	☐
New digital services offering	☐	☐	☐	☐	☐
New/extended business models implementing	☐	☐	☐	☐	☐
Put local products into tourism value chain	☐	☐	☐	☐	☐
Programs for exchanging best practices with other regions/countries	☐	☐	☐	☐	☐
Wider digital/electric infrastructure	☐	☐	☐	☐	☐
Implementing green regulatory frameworks	☐	☐	☐	☐	☐

24. If you wish to add another important barrier mitigation prescription about implementing of UCCST model in your region, please describe it, and rate it below.

Please, do not forget to return the completed questionnaire by 15th August 2025.

THANK YOU !

6 References

[1] A. Q. Jiang, A. Sablayrolles, A. Mensch, C. Bamford, D. S. Chaplot, D. de las Casas, F. Bressand, G. Lengyel, G. Lample, L. Saulnier, L. R. Lavaud, M.-A. Lachaux, P. Stock, T. L. Scao, T. Lavril, T. Wang, T. Lacroix and W. El Sayed, "Mistral 7B," *arXiv,* 2023.

[2] O. I. (2025), "[Software]," [Online]. Available: https://ollama.com/.

[3] P. Virtanen, R. Gommers, T. E. Oliphant, M. Haberland, T. Reddy, D. Cournapeau and S. 1. Contributors, "SciPy 1.0: Fundamental algorithms for scientific computing in Python.," *Nature Methods,* vol. 17, no. 3, p. 261–272, 2020.

[4] "Sustainable development in the European Union, Monitoring report on progress towards the SDGs in an EU context, 2025 edition," [Online]. Available: https://op.europa.eu/en/publication-detail/-/publication/a356a940-4cc1-11f0-a9d0-01aa75ed71a1/language-en.

[5] "OECD Regional Development Papers, 2023," [Online]. Available: https://www.oecd.org/en/publications/localising-the-sdgs-in-a-changing-landscape_a76810d7-en.html.