TECHNICAL UNIVERSITY OF CRETE (TUC)
SCHOOL OF ENVIRONMENTAL ENGINEERING
RENEWABLE AND SUSTAINABLE ENERGY
SYSTEMS LABORATORY

ASSESSMENT OF SUSTAINABLE URBAN MOBILITY MEASURES IN THE MEDITERRANEAN, INTEGRATING STAKEHOLDERS' VIEWPOINT THROUGH MULTI-CRITERIA DECISION MAKING

MASTER THESIS

ELENI FARMAKI

CHANIA, 2018

EXAMINATION COMMITTEE:

THEOCHARIS TSOUTSOS, PROFESSOR *(SUPERVISOR)*

TRYFON DARAS, ASSOC. PROFESSOR

DESPOINA DIMELLI, ASSIST. PROFESSOR

Abstract

Due to the identified environmental and health impacts of the current transport habits, a shift towards sustainable mobility is adopted by the European Commission and national and local authorities, that are actively establishing new policies. Numerous studies are exploring potential mobility solutions, taking into account the specific characteristics and needs of urban areas.

Aiming to address the complexity of prioritising the various mobility measures, this study performs an assessment of 11 sustainable urban mobility measures according to 10 criteria for European medium-sized touristic cities, through multi-criteria decision making, and more specifically, by using the PROMETHEE method. The study is also linked to the Horizon 2020 CIVITAS DESTINATIONS project, aiming to gap the link between tourism and mobility in 6 touristic insular areas with various mobility measures.

The study integrates the viewpoint of 6 European (EU) and 7 Greek (GR) stakeholder groups, identifying their interests and comparing their ranking on the selection of appropriate mobility policies. Moreover, tourism aspects are incorporated in the examined actions, the evaluation criteria selected and the stakeholders' groups involved. The CIVITAS DESTINATIONS network was actively involved during the formation of stakeholders' groups at European level.

Most EU and GR stakeholder groups presented very similar rankings, although Academic institutions and Mobility experts presented the most differences at EU and GR level. "Mobility management and travel plans" was ranked as the most suitable policy, for all EU and GR stakeholder groups, and was identified as a very stable option by a sensitivity analysis performed. In terms of interests, most EU and GR stakeholders give priority to the wellbeing of local

communities and the quality of life, while tourism sector's priorities were set on environmental criteria, acknowledging the links between tourism and transport-related pollution.

Overall, the study provides an assessment approach for decision-makers that manage mobility challenges in tourist destinations and suggests the incorporation of stakeholders' view as a vital element for sustainable mobility planning.

ΠΕΡΙΛΗΨΗ

Αναγνωρίζοντας τις επιπτώσεις των σύγχρονων μορφών μετακίνησης στο περιβάλλον και την υγεία, η Ευρωπαϊκή Επιτροπή και οι τοπικές αρχές έχουν υιοθετήσει ενεργά νέες στρατηγικές βιώσιμης μετακίνησης. Πολλές μελέτες στον τομέα αυτό αξιολογούν πιθανά μέτρα με βάση τις αναγκές και τα χαρακτηριστικά αστικών περιοχών.

Στόχος της εργασίας είναι να αντιμετωπίσει την πολυπλοκότητα κατά την επιλογή μέτρων βιώσιμης κινητικότητας, αξιολογώντας 11 μέτρα κινητικότητας για Ευρωπαϊκές τουριστικές αστικές περιοχές μετρίου μεγέθους σύμφωνα με 10 συγκεκριμένα κριτήρια, μέσω πολυκριτηριακής ανάλυσης και της μεθόδου PROMETHEE. Η συγκεκριμένη εργασία συνδέεται και με το Ευρωπαϊκό πρόγραμμα CIVITAS DESTINATIONS, που συνδέει την κινητικότητα και τον τουρισμό και εφαρμόζει στοχευμένα μέτρα κινητικότητας σε 6 τουριστικές νησιωτικές περιοχές.

Η ανάλυση ενσωματώνει επίσης τις απόψεις 6 Ευρωπαϊκών and 7 Ελληνικών ομάδων εμπλεκόμενων φορέων, αναδεικνύοντας τις προτιμήσεις τους και συγκρίνοντας την τελική κατάταξη των μέτρων στις επιμέρους ομάδες. Επιπλέον, το στοιχείο του τουρισμού έχει ενσωματωθεί στα εξεταζόμενα μέτρα, στα κριτήρια αξιολόγησης και στις εμπλεκόμενες ομάδες φορέων. Το δίκτυο φορέων του προγράμματος CIVITAS DESTINATIONS έχει εμπλακεί ενεργά στην διαμόρφωση των ομάδων φορέων σε Ευρωπαϊκό επίπεδο.

Οι περισσότερες ομάδες ενδιαφερομένων φορέων σε Ευρωπαϊκό και Ελληνικό επίπεδο παρουσίασαν παρόμοιες κατατάξεις στα μέτρα κινητικότητας, ενώ μόνο οι ομάδες «Ακαδημαϊκά ιδρύματα» και «Εμπειρογνώμονες/ ειδικοί» παρουσίασαν τις περισσότερες διαφορές στην τελική κατάταξη σε επίπεδο ΕΕ και Ελλάδας. Το μέτρο "Πρόγραμμα διαχείρισης της κινητικότητας και σχέδια μετακίνησης" κατατάχθηκε ως η πλέον κατάλληλη πολιτική για όλες τις ομάδες

ενδιαφερομένων φορέων σε Ευρωπαϊκό και Ελληνικό επίπεδο και χαρακτηρίστηκε ως μια πολύ σταθερή επιλογή μέσω της ανάλυσης ευαισθησίας. Όσον αφορά τα ενδιαφέροντα των ομάδων, οι περισσότεροι ενδιαφερόμενοι φορείς δίνουν προτεραιότητα στην ευημερία των τοπικών κοινοτήτων και στην ποιότητα ζωής, ενώ οι προτεραιότητες του τουριστικού τομέα καθορίστηκαν σε περιβαλλοντικά κριτήρια, αναδεικνύοντας τη σχέση μεταξύ τουρισμού και μεταφορών και την συνολική επίπτωση στο περιβάλλον.

Συνολικά, η εργασία παρέχει στους υπεύθυνους λήψης αποφάσεων μια προσέγγιση αξιολόγησης ώστε να διαχειρίζονται τις προκλήσεις της κινητικότητας σε τουριστικούς προορισμούς και προτείνει την ενσωμάτωση της άποψης των ενδιαφερομένων φορέων ως ένα απαραίτητο στοιχείο για τον σχεδιασμό βιώσιμης κινητικότητας.

Table of Contents

List of Figures

List of Tables

Abbreviation List

AHP	Analytic Hierarchy Process
CO_2	Carbon Dioxide
EU	European Union
EV	Electric Vehicle
GHGs	Green House Gas
ITS	Intelligent Transport Systems
LEZ	Low Emissions Zone
MCDA	Multi-Criteria Decision Analysis
MAMCA	Multi-Actor Multi-Criteria Analysis
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluation
SUMP	Sustainable Urban Mobility Plans
SULP	Sustainable Urban Logistics Plan

Chapter 1: Introduction

Peoples' commuting and products' transportation is an element of everyday life and also a consistent challenge. Transportation has a vital impact on financial and urban development, yet most urban transport modes cause air pollution and utilize a lot of land and fuel. Sustainable planning and update of transport systems according to the constantly changing needs are considered the basic elements to enhance the quality of life and sustainable urban development.

Currently, the transport trends in terms of energy consumption, emissions and environmental impacts have highlighted the need to establish advanced and sustainable transport systems and policies, worldwide. Globally, transportation accounts for almost 50% of world oil consumption and for 31.6% of the total final energy consumption [1], while in 2015, transport's share of global CO_2 emissions from fuel combustion was almost 23%, which increased by 2.5% per year over the period of 2010 and 2015 [2].

In European level, transport is one of the main sectors of greenhouse gas emissions (GHGs) production, responsible for around a quarter of Europe's GHGs and represents the main cause of air pollution in cities. Transport is the second GHGs source after the energy sector, with a 13,3% increase during 1990-2014, and despite the economic crisis, the constantly advanced technology and the promotion of clean vehicles and alternative fuel sources, transport was the only major sector with an increased rate of emissions over the last decade [3]. Emissions mitigation in the transport sector is more demanding compared to other sectors [4], mainly due to the unchallenged use of fossil fuels and the current transport energy intensity, which calls for a shift to alternative sources [5].

Road transport is a significant transport category, which accounts for 81,6% of citizens' personal transportation in EU, including mainly cars, bus/coach transportation and two-wheeler vehicles, and for 49% of EU freight transport activity. Road transport vehicles mainly use fossil

fuels, which leads to quantities of GHGs emissions and it is worth mentioning that nearly two-thirds of these emissions originate from light duty vehicles, while the remaining one-third originates from heavy duty vehicles [6]. As a result, road transport is the second main energy-consuming sector in the EU-28, following the residential sector, and accounts for approximately 73% of the total transport GHGs emissions in EU.

Greening the transportation sector and promoting sustainable urban mobility has become a priority for policy-makers worldwide, following the directions set for sustainable development and climate change mitigation [7]. However, transport is also responsible for the emissions of specific air pollutants which are proven to have a significant negative impact on human health [8]. Thousands of deaths per year can be attributed to road transport-related air pollution, while also crucial is number of deaths and injuries by road accidents, highlighting further the need to reconsider the urban mobility systems [9].

Another important, but often overlooked element related to urban mobility of certain areas is tourism. Incoming tourism puts weight on the transportation systems and increases car circulation, and this can have negative impacts, especially in touristic areas, such as a) increased congestion and delays on roads during peak times, b) decreased safety and security due to intense traffic flow and c) seasonality, forming different patterns of travel demand and overcrowding. Thus, sustainable tourism should be highly linked to sustainable mobility, not only in terms of transport means and technology, but also in terms of mobility habits, in order to link the future development of tourism and mobility services demand[10]–[12].

The overall impact of current transportation affects the environment and the quality of life of both large and small/medium-sized cities. However, small and medium-sized urban areas and cities are usually neglected in the discussions regarding the uptake of new transport systems and services. The discussion around new mobility services and its potential benefits in those

urban communities is distinctive to the one that must be had in metropolitan areas, especially if the area is also affected by tourism.

Taking into account all the above, it is clear, that sustainable mobility planning is a rather complicated process, especially for areas with particularities, such as small and medium-sized tourist destinations. Sustainable mobility, planned mainly by transport experts and authorities, requires not only a long-term strategic plan for the future, but also short-term and targeted mobility measures, taking into account the specific characteristics of the area and community' identified needs. As a result, decision-makers often have difficulties prioritising the various mobility measures and identifying the most effective ones.

This study aims to address the complexity of the process and incorporate the various factors of influence into the assessment of sustainable mobility measures for medium-sized, urban touristic areas of the Mediterranean, through a Multi-Criteria Decision Analysis method (MCDA).

The PROMETHEE method (Preference Ranking Organization Method for Enrichment Evaluation) is used to evaluate and rank mobility policies towards sustainable transportation in touristic cities. A total of 11 sustainable mobility policies (actions) are evaluated according to 10 specific criteria, covering 5 main categories: Environment, Mobility, Tourism, Economy and Society. Stakeholders' viewpoint, at European and local level, is integrated into this approach. The criteria have been evaluated by 6 European and 7 Greek stakeholder groups, according to their significance in the selection of appropriate mobility policies, and their ranking provided a valuable input for the calculation of corresponding weights for the analysis.

Although the multi-criteria analysis is a well-known and widely applied method for evaluation, the study incorporates additional elements to provide an advanced approach:

- Two-level multi-actor involvement and analysis: comparison of interests and results of European and Greek stakeholders
- Incorporation of the tourism aspects: elements included in the examined actions, the criteria selected and the stakeholders' groups involved.

The stakeholders' involvement in this study is also linked to the Horizon 2020 CIVITAS DESTINATIONS project, launched in 2016, aiming to gap the link between tourism and mobility. More specifically, in the frame of the project, 6 touristic insular areas integrate mobility and the tourist needs, with the implementation of various tailored mobility measures, under the 10 CIVITAS thematic areas related to sustainable transport mobility [10]. The project's network was actively involved during the conduction of criteria' evaluation, facilitating the formation of stakeholders' groups at European level.

Overall, this analysis is part of a wider effort to promote alternative and sustainable mobility solutions and provide a planning tool for public authorities and policy makers while managing mobility challenges. In the next chapters, the stages followed for the analysis of sustainable mobility policies are presented. More specifically:

Chapter 2 presents the overview of current trends in mobility planning and current policies in Europe, presenting the different approaches and measures implemented, along with the literature research of multi-criteria methodologies, applied for the evaluation of transport policies, incorporating a multi-actor approach.

Chapter 3 describes the main features and steps of the PROMETHEE methodology applied and the software used. The chapter includes the detailed description of the 11 sustainable mobility policies, the 10 criteria examined, the European and Greek stakeholder groups involved for the evaluation of criteria, along with the calculated and estimated input for the analysis.

Chapter 4 includes a detailed presentation of the results produced by VISUAL PROMETHEE software, along with complementary graphs and tables to facilitate the presentation and comparison of the policies' ranking for the different stakeholders' groups, at both European and local level.

Chapter 5 presents the results of the sensitivity analysis implemented for the evaluated sustainable mobility policies, by examining the stability intervals of criteria and the ranking in the case of equal weights. This chapter also includes an in-depth examination of the produced rankings and the top policies, along with a comparison of European and Greek stakeholders' interests.

Chapter 6 provides a short overview of the study performed, the keys conclusions and findings identified and recommendations for improvement and future research.

Chapter 2: State of the art

The heavy energy demand and emissions in global level consist the main environmental challenge, but more issues arise from the present transportation systems, such as quality of public spaces, intense traffic congestion, road accidents, accessibility and noise pollution, that urban communities need to adapt to.

According to the Kyoto Protocol, the EU needs to reduce the Greenhouse Gases (GHGs) emissions by 20% below 1990 levels by 2020 [13] and according to the "Green Paper - A 2030 framework for climate and energy policies", EU needs to reduce the GHGs emissions by 40% below 1990 levels by 2030, and by 80-to-95% by 2050 [14]. The European targets were already set clearly towards the sustainable growth of the transport sector. The "White Paper", was the primary critical EU report that underlined the need to diminish transport created GHGs emissions by reducing the reliance on carbon-based fuel, initiating a shift to sustainable low-carbon mobility. Transport will contribute to the goals by reducing its GHGs emissions by 60% by 2050, compared to 1990 and further be on the path towards zero emissions [15]. Numerous administrative communications and reports were published afterwards, to support the vision of green transportation, with the end goal to give direction towards sustainable mobility [16].

European Commission further established the reduction of energy consumption in the transportation sector as a priority pillar in national/regional and European environmental policies, in order to reflect the targets, set in the Paris Agreement on climate change [17], as well as the 2030 Agenda for Sustainable Development targets, as adopted in the same year [18]. The identification of new needs and the continuous update of the EU goals has led to new transport policies and complementary initiatives aiming to introduce a new era for the transport sector towards clean energy and smart systems, with the recent 2016 Communication "A European Strategy for Low-Emission Mobility" highlighting the EU areas of intervention

through new initiatives and funding opportunities [19]. In addition to emissions mitigation policies, the EU ambition expands on delivering clean, competitive and inclusive mobility for 2025 [20], along with enforcing road safety [21], including investments in infrastructure and technology, communicative and cooperation tools, replicable solutions, research and innovation projects.

Despite the worldwide recognition of the challenges and policies developed, the actual impact of the mobility challenge is still affecting urban areas and local communities. Especially, cities hold a key role in accomplishing sustainable mobility targets, since they have to address the needs of a big part of the population, and many metropolitan or medium-sized cities are focusing more on green spaces, better environmental quality, innovative energy efficient technologies, clean transportation and increased quality of life [22]. Thus, urban planners and local authorities continuous seek new solutions and implement local strategies towards sustainable mobility [23], according to the needs of the communities. Under this scope and as an additional element to the traditional planning process, a participative approach is often adopted, including stakeholders and citizen groups in the planning process [24]. Stakeholders are persons, groups or organizations that have interest, can affect or be affected by an organization's decisions, goals, strategies and policies. In the case of planning and implementing sustainable mobility policies, a variety of stakeholders can, directly or indirectly, be affected or influence the decision-making process, through their priorities and evaluation systems.

Sustainable Urban Mobility Plans (SUMP) have been acknowledged as one of the main tools that incorporate a set of strategic objectives and measures, covering the pillars of sustainability, with the active participation of stakeholders and community [25]. SUMP methodology incorporates the involvement of identified stakeholder groups in planning to improve decision-making, as also required by EU guidelines and international practices (Fig. 1) [26].

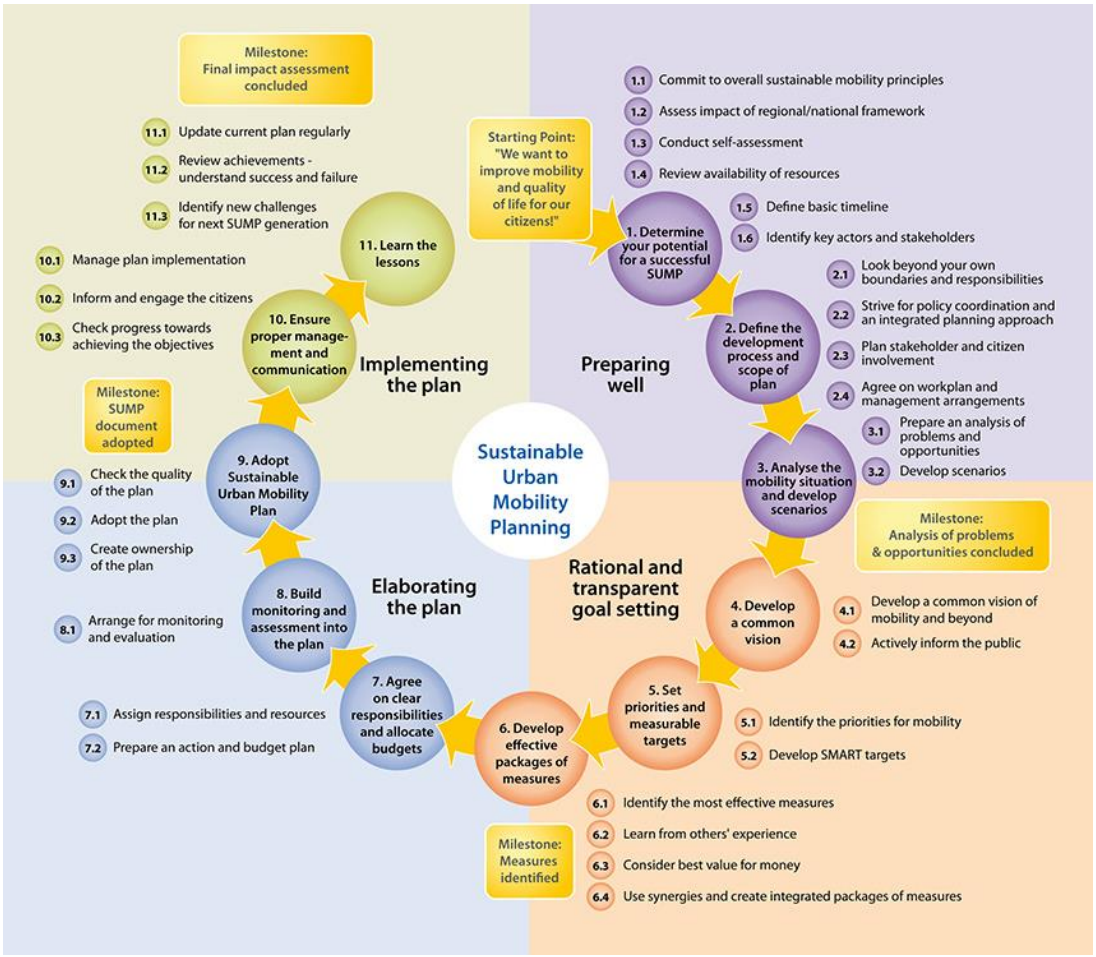


Figure 1: The SUMP planning cycle [26]

Road transport strategies and urban mobility plans incorporate a variety of mobility measures, that usually cover all transport modes, according to the local needs and specific characteristics of the cities. However, the current trend in transport planning is more citizen-oriented , aiming to develop liveable cities [23]. The mobility measures included in urban mobility plans can be grouped in several ways, either according to the transport mode involved (car, two-wheel motorized vehicles, public transport, cycling, walking), or by category of intervention (infrastructure, intelligent systems, “soft” or policy measures etc.). Currently, EU legislation and recent policies have identified the main categories of intervention, as follows:

- Urban Mobility, involving measures that focus on traffic, parking and access regulations, demand management and public transport services.

- Road Safety, actions aiming to eliminate road accidents and injuries, by improving road infrastructure, performing road audits, setting strict alcohol limits and enforced traffic laws, providing safe and eco-driving trainings.
- Environment and Health, including actions that aim at managing air pollution and improving health through new policies and legislation, for example setting specific emission limits.
- Intelligent Transport Systems (ITS), including various information and communication technologies for all passenger and freight modes, such as traffic management, data monitoring, multimodal management, journey planning, navigation systems, electronic fee collection systems.
- Clean Vehicles and Alternative Fuels, including energy efficient vehicles (hybrid, electric private or public vehicles), new equipment and alternative fuel, produced be clean energy sources.
- Walking and Cycling, including a measure that increases active mobility (cycling and walking) and provides new infrastructure and services, as the efficient means to improve the quality of public spaces, environment and health.

However, measures nowadays may include features of two or more categories and the numerous available solutions can be also applied independently or as supplementary actions, even if not included in a strategic plan.

Although, transport policies, so far, have actively acknowledged sustainable mobility as a key ingredient for sustainable development and new participative approaches are implemented, tourism-related mobility challenges within the urban environment are not taken into account often. Recent studies highlight the impact of tourist travel in environmental aspects and local traffic conditions, leading to a significant amount of air pollution, energy consumption, congestion and road accidents, due to incoming visitors [27]–[30]. Tourist destinations are encouraged to focus on the increase of alternative transport modes, such as public transport or

shared vehicles, the implementation of appropriate mobility solutions, the introduction of targeted, high-quality services for visitors [11]. By incorporating the tourist factor in the planning process, tourist destinations will address more efficiently the fluctuation of demand and the specialised needs of this target group.

Taking into account the vast amount of available information and rapid developments, structuring and assessing sustainable mobility strategies can be proven a rather complicated task, because it requires the examination and incorporation of a wide variety of factors covering different aspects, such as environmental, social, technical and financial implications. Although most of these factors can be assessed independently with various modelling tools or qualitative analysis, for example, a cost-benefit analysis, the calculation of the environmental footprint or a socio-economic analysis, most methods do not incorporate the whole scope of the parameters that impact on the examined issue. Despite what might be expected, various techniques provide a flexible approach, ready to deal with an extensive variety of factors which are assessed diversely so that gives significant assistant with decision making. An effective and viable approach in the decision-making for both simple and complex problems is the Multi-Criteria Decision Analysis (MCDA) method, that was developed as a mean of finding the optimal solution for a problem, taking into account several restrictions and various factors of influence. As a current application in the fields of statistics and research, this analysis facilitates the decision-making towards the most suitable and rational choice, taking into consideration all required restrictions, criteria and the preferences of interested/ involved parties.

MCDA has been applied in various fields of economic activity, including Agriculture, Forestry and Fishing, Manufacturing [31], [32], Energy supply, Electricity, Gas, Steam and Air conditioning supply [33], [34], Water supply, Sewerage, Waste management and Remediation activities. [35]–[37], Construction, Transportation and storage [38]. It also quite common to

combine MCDA with other appraisal techniques and methodologies in order to incorporate supplementary elements to the analysis or provide an advanced model for specific problems [39], [40]. The alternatives, parameters and scenarios examined in multi-criteria analysis vary significantly, even when applied in the same field [41], [42].

One of the basic characteristics of this method is the incorporation of the opinion of key stakeholders' groups and relevant involved community teams in the problem, thus mitigating the risk of subjectivity from the side of the analyst. The basic objective of a multi-criteria analysis is the creation of interrelations of preferences, as extracted according to the provided information of the problem (criteria), between the alternative choices that have been placed under study. MCDA has increasingly been used in the group decision making context when stakeholders, with often diverse objectives, participate in the decision-making [40]. Several studies have incorporated the interests of relevant stakeholders in the multi-criteria assessment [43]–[47].

MCDA methods have also numerous and increasing applications in the assessment of transport projects. According to Macharis et.al. [48], an passenger transport and mobility management are the most common categories of transport projects evaluated by MCDA, while Analytic Hierarchy Process (AHP) was identified as the most used method and the PROMETHEE method as the most recent and simple ranking method applied (Fig. 2). As a main conclusion of this research was the significance of stakeholders' integration in the decision-making process, which is increasing but not yet considered in most transport projects.

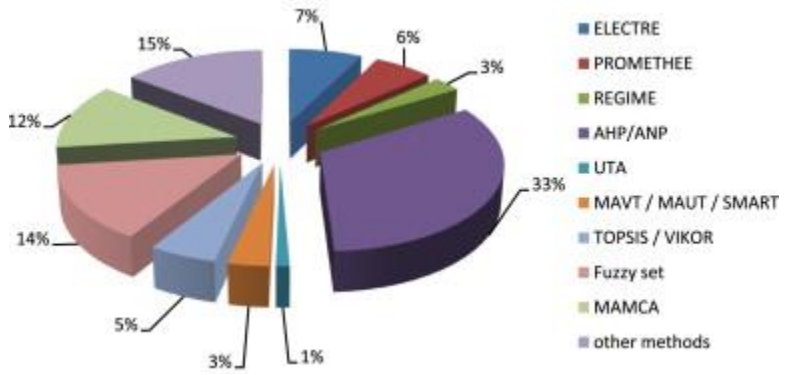


Figure 2: MCDA methods used for transport projects [48]

Macharis et. al. developed the Multi-Actor Multi-Criteria Analysis (MAMCA) methodology to evaluate transport projects [49], that was applied to evaluate ten policy measures, in terms of mobility and logistics, in the ‘‘Flanders in Action Process’’[47]. In their study, eleven stakeholder groups represented their own preferences, by evaluating the pre-defined criteria considered. More specifically, the groups were comprised of the users and suppliers of public transport, the users of logistic services and their suppliers, the building sector, the environmental organisations, the unions, the government, politicians, academics and others (Fig. 3). Overall, the results showed that the most preferred policy measures were the stimulation of multimodal transport, the coordination of policy measures and spatial planning.

Suppliers passenger transport	3%	38%	Users
Users passenger transport	1%		
Building sector	1%		
Environmental movement	1%		
Unions	13%		
Others	19%		
Logistics sector	15%	20%	Logistic companies
Users freight transport	5%		
Government	28%	42%	Government/Academics
Politicians	2%		
Academics	12%		

Figure 3: Categorization of respondents in MAMCA Finnish application [47].

The MAMCA methodology and stakeholders' involvement as a vital element was adopted by other researches, too. Sun et. al. evaluated 6 low-carbon transport policies in a Chinese city. The policies included tax and pricing adjustments, multi-operation mechanisms, environmental campaign, traffic demand management, and state funding and subsidies. Several stakeholders' groups (government supervisory authorities, end users, infrastructure operators, infrastructure suppliers, academics, the traffic management sector, the technology division and the planning department) were engaged in the process, by attributing weights to the criteria, that were based on stakeholders' objectives. Although the stakeholders' preferences varied most groups considered state funding and subsidies as the most effective policy, along with traffic demand management [50].

Bulckaen et.al., 2016, proposed a new framework to rank three small-scale urban and regional mobility projects that include various alternative measures, but all different in theme, country and objectives. The proposed framework is a combination of MCDA to assess the sustainability of the projects, MAMCA to assess stakeholder preferences and an additional rank correlation to compare the results of both methodologies. For both MCDA and MAMCA, the PROMETHEE method was preferred and 16 criteria were used, grouped under the three pillars of sustainability. MCDA Sustainability assessment ranked the policies per project and suggested a suitable policy, which was then compared to the corresponding outcome of stakeholders' rankings. The study identified also the correlations between the preferences of the stakeholder groups. In two cases, the government, the users and the citizens had a strong correlation in their preferences, while the third project identified that tourists and local government presented significant differences, thus the study identified it as a key point that should be taken into account for future planning.

As mentioned before, numerous studies have proceeded to assess transport measures or policies of specific categories. Anagnostopoulos et. al. applied the PROMETHEE method and the

GAIA visualisation to evaluate 20 transport infrastructure projects in Greece, according to 18 environmental, economic and social criteria. Taefi et.al undertook a multi-criteria analysis of policy measures to support the incorporation of electric vehicles in freight transport, based on the rating by two stakeholder groups, ‘‘policymakers” and ‘‘freight electric vehicle users”. The two groups rated 23 possible policy measures in a web-based survey, regarding four criteria: effectiveness, efficiency, feasibility, effort [51]. Lebeaua et.al. also applied the MAMCA methodology to identify the suitable sustainable strategies for city logistics, amongst five different scenarios, regarding the establishment of an urban consolidation centres (UCC) network. In their study, 15 criteria were assessed by 5 stakeholders (receivers, shippers, logistics service providers, citizens and authorities), that were also engage through targeted workshops [52].

Chapter 3: Methodology

3.1 The PROMETHEE-approach

The MCDA method in our study is based on the PROMETHEE method, which has been applied in numerous projects over the years [53]. PROMETHEE, an outranking method developed by Brans [54], determines the main stage of order with PROMETHEE I (Partial Ranking) and PROMETHEE II (Complete Ranking) Methods. The method is based on a binary comparison of the decision point by the evaluation factors. As in other multi criteria decision aid methods, the initial stage of the PROMETHEE method is the evaluation table, where the alternatives are evaluated on the different criteria. These evaluations include mainly numerical data, but also qualitative information, when necessary. This method ranks (partially or totally) a set of n alternatives a_i (i = 1, 2, . . ., n) based on a series of k criteria g_j (j = 1, 2, . . ., k) [55]. The evaluation $g_j(a_i)$ of each alternative action a_i for every criterion g_j should be maximized or minimized, depending on the criterion. All the evaluation data form a pairwise evaluation table (Fig. 4).

a	$g_1(\cdot)$	$g_2(\cdot)$	...	$g_j(\cdot)$	...	$g_k(\cdot)$
a_1	$g_1(a_1)$	$g_2(a_1)$	...	$g_j(a_1)$	...	$g_k(a_1)$
a_2	$g_1(a_2)$	$g_2(a_2)$	...	$g_j(a_2)$	...	$g_k(a_2)$
⋮	⋮	⋮	⋱	⋮	⋱	⋮
a_i	$g_1(a_i)$	$g_2(a_i)$	...	$g_j(a_i)$	...	$g_k(a_i)$
⋮	⋮	⋮	⋱	⋮	⋱	⋮
a_n	$g_1(a_n)$	$g_2(a_n)$	...	$g_j(a_n)$	...	$g_k(a_n)$

Figure 4: PROMETHEE Evaluation Table [3]

However, the main difference from other methods is that the implementation of PROMETHEE requires two additional types of information, concerning information on the relative importance of the criteria (i.e., the weights) and information on the decision-makers' preference function, comparing the contribution of the alternatives in terms of each separate criterion.

The process followed is briefly described below, in accordance with the specific features of the PROMETHEE I and II methods [43].

The first step of the PROMETHEE method includes the identification of preferred function for the criteria, amongst six different preference functions. The second step involves the creation of the data matrix for the comparison of the alternatives in pairs with respect to the preference function. The third step, the outcomes of these comparisons are presented in an evaluation matrix as the estimated values of every criterion for every alternative. The fourth step includes the determination of thresholds and the calculation of preference functions and indexes for every actor. Here the analyst reflects the preferences and the constraints of every actor in a quantitative format. Then the ranking is realized in two steps: at first, the PROMETHEE I method application for partial ranking and afterwards, the PROMETHEE II method for complete ranking of the alternatives [56]. Additionally, the GAIA plane (Geometrical Analysis for Interactive Aid) can be used as a tool to graphically present the position of the examined actions in relevance to the different criteria [40]. The final step of our study is a sensitivity analysis of the weights was conducted to assess how the different alternatives rank under different weights.

The weight factor w_j (j = 1, 2, . . ., k) is usually introduced for each criterion, in order to incorporate the priorities in the analysis. As mentioned above, the method inserts a preference function $P_j(a_i, a_x)$ (j = 1, 2, . . ., k), which gives the degree of preference of alternative a_i over a_x, for each criterion g_j. Preference function can be a number between 0 and 1, where:

- $P_j(a_i, a_x) = 0$ if there is no preference of a_i, over a_x
- $P_j(a_i, a_x) \approx 0$ if there is a weak preference of a_i, over a_x
- $P_j(a_i, a_x) \approx 1$ if there is strong preference of a_i, over a_x
- $P_j(a_i, a_x) = 1$ if there is strict preference of a_i, over a_x.

Then the multi-criteria preference index $\Pi_j(a_i, a_x)$ is formed as follows:

- Preference index $\Pi_j (a_i, a_x) = \Sigma w_j P_j (a_i, a_x) \ / \Sigma w_j$

Preference index is also a number between 0 and 1 and represents how much alternative action a_i is preferable over a_j with respect to all criteria:

- $\Pi_j (a_i, a_x) \approx 0$ if there is a weak preference of a_i, over a_x
- $\Pi_j (a_i, a_x) \approx 1$ if there is strong preference of a_i, over a_x

Subsequently, for the ranking of the examined actions, preference flows are produced to consolidating the results of the pair-wise comparisons. The preference flows are generated in three types as, presented below:

- Positive flow $\rightarrow$ $Phi^+ (a_i) = \Sigma [\Pi_j (a_i, a_x) / (n - 1)]$
- Negative flow $\rightarrow$ $Phi^- (a_i) = \Sigma [\Pi (a_i, a_x)/ (n - 1)]$
- Net flow $\rightarrow$ $Phi (a_i) = Phi^+ (a_i) - Phi^- (a_i)$

As mentioned above, PROMETHEE I provides an initial, partial ranking by the results of Phi+ and Phi−. Positive flow (Phi+) indicates how the a_i outranks all the others alternatives, while negative flow (Phi-) indicates how the a_i is outranked by all the others alternatives. That means for alternative a_i, a high Phi+ score indicates a powerful action, while a low Phi− score, indicates a weak action compared to other alternatives. However, the partial ranking may prove not sufficient for the total ranking of all alternatives in case of incomparable results, for example, equal alternatives. To decide which alternative is best, full ranking is accomplished with PROMETHEE II, where all alternatives are comparable, by introducing the net flow (Phi), the difference between the positive and the negative outranking flows.

For the conduction of the current study, Visual PROMETHEE was used. Visual PROMETHEE, an MCDA software, was firstly developed during 1985 and evolved into the recent version, becoming the most current, updated and thorough software for the implementation of the PROMETHEE and GAIA methods [45]. More, specifically the

Academic Edition of the software was used, offering non-restricted access to its available functions. The specific software is used in various research studies for a wide range of projects to facilitate evaluation and visualization of problems, as an acknowledged tool.

Summing up, Figure 5 presents a flow chart of the steps of the PROMETHEE methods.

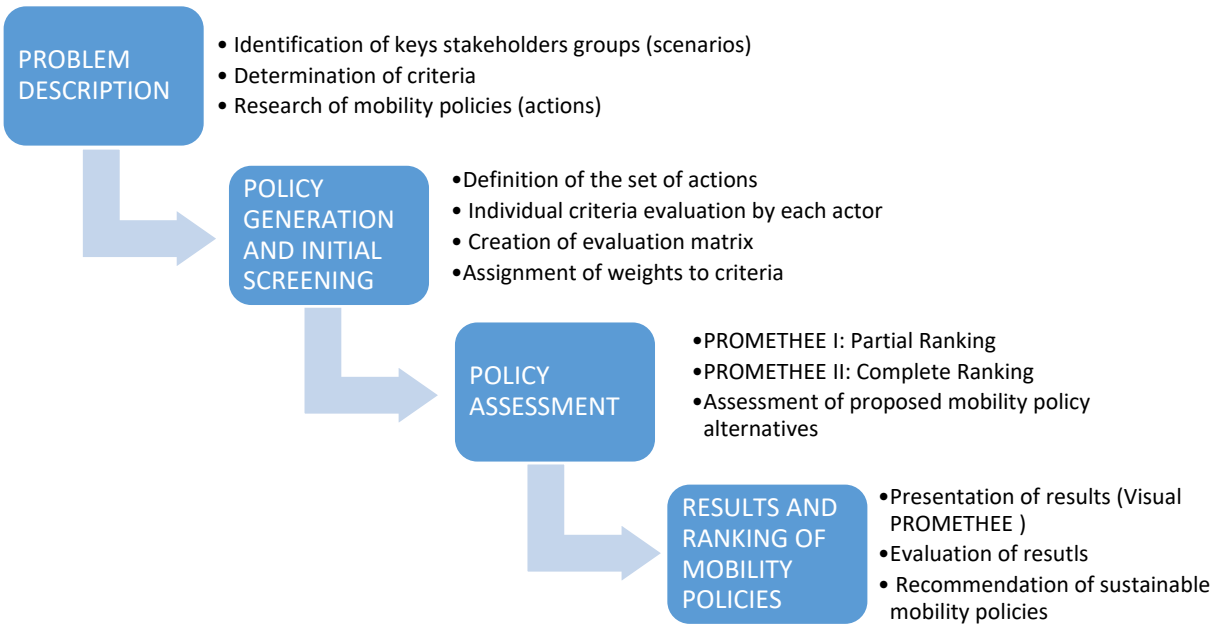


Figure 5: Applied procedure for the multi-criteria evaluation of sustainable mobility policies

3.2 Sustainable Mobility Policies alternatives

A total of 11 sustainable mobility policies are evaluated within this study. The selection of the specific strategies was a result of research of relative projects evaluating sustainable mobility policies and our goal is to evaluate a wide variety of mobility measures suitable for medium-sized tourist urban areas [7]. The number of mobility measures that can be implemented in urban areas is constantly increasing, however, the selection aims to include eco-friendly transport solutions, current trends that promote social cohesion, recent technologies, solutions for infrastructure and equipment, “soft” measures and tourist-oriented services. The policies were also highly influenced by the sustainable mobility policies, currently under

implementation, within the CIVITAS DESTINATIONS project and more specifically, the thematic areas of mobility measures that apply for the city of Rethymno [57]. The final mobility policies examined were adjusted for the specific objectives of the study, including most transport modes: car, public transport and active (cycling, walking) mobility.

The Sustainable Mobility Policies alternatives are described below:

- Sustainable Urban Mobility Plans / Sustainable Urban Logistic Plans

Strategic plans that address urban and freight transport, showcase a new planning approach for cities and regions, through the development of Sustainable Urban Mobility Plans that incorporate also the more targeted Sustainable Urban Logistic Plans. These plans set a strong long-term strategy for integrated planning practices towards sustainable mobility, including all transport modes, through participative approaches. This action includes various mobility measures, mainly road and traffic reorganisation, improving pedestrian and cycling mobility, goods distribution optimisation, accessibility and road safety measures and regulations.

- Smart metering systems / Real-time mobility information

This action includes the introduction or upgrade and operation of Intelligent Transport Systems (urban ITS) and applications, as tools to monitor the mobility services and analyse a variety of transport data, which can be used for the planning and upgrade of transportation by transport operators. This action includes the introduction of new systems that receive information of cameras and other traffic systems and the provision of telematic panels to increase the level of the information of traffic in real time provided to citizens and visitors.

- Increased traffic safety and security – Eco and safe driving training

This action focuses on the increase of road safety and security for all users, in terms of accidents prevention, but also as regards the feeling of security for vulnerable users (pedestrians, cyclists, children). Under this scope, it includes soft interventions in infrastructure and equipment for

increased road safety, including safe crossing points for pedestrians and cyclists, barriers separating cycling paths from footpaths, better signage and markings, reduction of the speed limit in affected areas (30-km-zones). The action also involves targeted safe and eco driving training programs for drivers/motorists/cyclists, to increase capacity.

- Mobility plans for school communities

This alternative includes the development of mobility plans for schools, including the promotion of intermodality and school travel plans that link public and private modes of transport with mild interventions on available routes to school and infrastructure (i.e. signage). The action aims to increase safety and enable a shift towards alternative and active mobility for school commuting and targets the school communities, especially in densely populated areas.

- Attractive and accessible public spaces

This action includes the upgrade of public spaces and their transformation to attractive, safe shared spaces for all, suitable for walking and cycling, through the expansion of cycling networks and reallocation of road space. The action also enhances accessibility, through improved road infrastructure, installation of traffic crossing systems and equipment for the accessibility of public attractions for disabled people.

- Shared mobility services

This mobility policy aims to enhance sharing mobility modes and reduce single occupancy vehicle use, through the development of mobility sharing services for all, including various transport modes, such as bike or car sharing systems. The action introduces vehicle sharing along with the provision of ridesourcing platforms used to source rides from driver pools, run by local operators. The sharing schemes include large-scale bike-sharing, car sharing and taxi sharing for residents and visitors.

- E-charging infrastructures and e-vehicles in public fleets

Electric mobility is a policy that aims to promote clean and energy-efficient transportation, though the incorporation of electric vehicles in the public fleets, as a 30% of small sized fleet, and the provision of charging infrastructure, including charging infrastructure in 10–20% of the parking facilities. The charging infrastructure will be available for residents and tourists to charge electric vehicles for free, while the electric vehicles purchased will be used strictly by the municipal /public services.

- Mobility management and travel plans

This action focuses on providing information on different services and on multi-modal journey planning options and times by public transport, walking and cycling, through the coordination of sustainable mobility modes by different providers. Personalised mobility plans can be produced for individuals or thematic plans for selected routes or selected target groups. The action also includes targeted informational actions, as part of the overall philosophy of the service, along with the provision of online information and mobile application. Mobility management is one of the policies that can be highly tourist – oriented.

- Behavioural change and informative actions

This policy is focused on communication and public involvement, through information campaigns and behavioural change techniques that promote sustainable mobility modes to the wider public. The promotion includes awareness raising and educational actions on the benefits of alternative modes, enhanced with additional thematic promotional activities on safety, promotion of EVs interactive approaches and the use of social media to shift users towards sustainable mobility. The action affects the whole city and it is addressed to residents and tourists.

- Low emission zones and parking management

This policy focuses on access restriction strategies for vehicles and the management of road and parking spaces. More specifically, the action includes the introduction of a Low Emission Zone (LEZ) in historic or tourists' city centres, partially accessed by certain vehicles (clean and low emission vehicles), that can be reinforced by a peripheral parking management scheme for residents and tourists.

- Improved and accessible PT services for tourists and residents

This policy aims to upgrade public transport and provide modern, efficient and accessible PT services. The action includes the rescheduled PT plans, efficient routes, links with other active modes, new signs, upgraded bus stops and accessible vehicles, for local and tourist PT users.

3.3 Sustainable mobility criteria

For the evaluation of mobility measures towards sustainable transportation in touristic cities, specific criteria had been incorporated in the analysis. The selection of the criteria was based on relevant researches and frameworks complied, to assess transport policies [58], and adapted to the specific objectives of the study. The package of sustainable mobility measures (actions) was evaluated according to specific criteria, covering 5 main categories: Environment, Mobility, Tourism, Economy and Society. The 10 criteria per category are presented in Table 1 with indicative arrows on whether a criterion should be minimised or optimised, and are described in more detail below.

Table 1: Description of evaluation criteria

CATEGORY	CRITERION	
Environment	C1 Energy ⬇	Reduction of energy/ fuel consumption, share of conventional fuel in the area of implementation
	C2 Environmental pollution ⬇	Reduction of average GHG emissions and noise levels in the area of implementation
Mobility	C3 Traffic conditions ⬆	Modal share shift towards alternative transport of the target group involved, Traffic flow improved in the examined area
	C4 Transport infrastructure ⬆	Level of intermodal integration of transport services, along with existing infrastructure

Tourism	C5 Tourist flow	⬆	Increased share of tourists using transport services, No. of incoming tourists, GDP generated by tourism
Economy	C6 Service finance	⬇	Cost of new services and infrastructure, including capital costs and maintenance
	C7 Local economy	⬆	Level of increased affordability of public transport services for the users, level of financial gain by new services and infrastructure for operators
Society	C8 Safety	⬆	Level of perceived road safety and security amongst target groups involved, reduction of No. of road incidents
	C9 Users Satisfaction	⬆	Level of satisfaction and of acceptance of the mobility policies amongst the target groups involved
	C10 Accessibility	⬆	Level of accessibility of transport services and infrastructure, perception of accessibility amongst users

3.4 Evaluation table

Extensive search of the current literature and evaluation reports of sustainable mobility measures implemented was the main tool for the completion of the evaluation matrix, as described in the steps followed. The table formed, includes an action per row and one criterion per column, plus the references of the sources used, in the last column. A 5-point scale is used to attribute the value estimated, corresponding to the qualitative ranking provided at the end of the table. The table cells include the values of each examined action as identified for each one of the criteria selected, as presented in Table 2.

Table 2: Evaluation table of sustainable mobility policies

EVALUATION TABLE		Criteria *										
Actions		ENVIRONMENT		MOBILITY		TOURISM	ECONOMY		SOCIETY			References
		C1	***C2***	***C3***	***C4***	***C5***	***C6***	***C7***	***C8***	***C9***	***C10***	
Strategic plans: Sustainable Urban Mobility Plans / Sustainable Urban Logistic Plans	1	2	1	2	5	3	1	2	3	3	4	[59]–[62]
Smart metering systems / Real-time mobility information	2	1	1	2	4	1	3	2	2	4	1	[63]–[68]
Increased traffic safety and security – Eco driving training	3	2	2	2	4	2	3	4	4	4	3	[69]–[73]
Mobility plans for school communities	4	2	2	2	3	1	5	2	3	4	4	[74]–[76]
Attractive and accessible public spaces	5	1	1	3	2	2	2	4	3	5	4	
Shared mobility services (bike, car, taxi)	6	1	2	2	3	3	3	2	1	3	2	[77]–[81]
E-charging infrastructures and e-vehicles in public fleets	7	2	3	1	2	2	3	2	1	3	1	[82]–[86]
Mobility management and travel plans	8	2	3	4	5	5	1	3	2	5	3	[87]–[90]
Behavioural change and informative actions	9	1	1	2	1	2	1	1	3	5	2	[91], [92]
Low emission zones and parking management	10	3	5	5	2	1	1	2	3	3	2	[93]–[96]
Improved and accessible PT services for tourists and residents	11	1	1	2	3	2	3	3	2	3	4	[97]–[100]

RANKING DESCRIPTION	5	Very high (41-50%)	Very high (41-50%)	Very high (41-50%)	Very high (all modes)	Very high (21-25%)	Very low (0 - 200,000 €)	Very high (21-25%)	Very high (81 -100%)	Very high (81 -100%)	Very high (81 -100%)	
	4	High (31-40%)	High (31-40%)	High (31-40%)	High (4 – 5 modes)	High (16-20%)	Low (200,001 - 400,000 €)	High (16-20%)	High (61 - 80%)	High (61 - 80%)	High (61 - 80%)	
	3	Moderate (21-30%)	Moderate (21-30%)	Moderate (21-30%)	Average (3 modes)	Moderate (11-15%)	Moderate (400,001 - 600,000)	Moderate (11-15%)	Moderate (41-60%)	Moderate (41-60%)	Moderate (41-60%)	
	2	Low (11-20%)	Low (11-20%)	Low (11-20%)	Low (1-2 mode)	Low (6-10%)	High (600,001-800,000)	Low (6-10%)	Low (21 - 40%)	Low (21 - 40%)	Low (21 - 40%)	
	1	Very low (0-10%)	Very low (0-10%)	Very low (0-10%)	Very low (no mode)	Very low (0-5%)	Very high (> 800.000 €)	Very low (0-5%)	Very low (0-20%)	Very low (0-20%)	Very low (0-20%)	

**C1. Energy, C2. Environmental pollution, C3. Traffic conditions, C4. Transport infrastructure, C5. Tourist flow, C6. Service finance, C7. Local economy, C8. Safety, C9. Users satisfaction, C10. Accessibility*

3.5 Preference function

In our research, the completion of the evaluation matrix required a significant amount of data, as various sources were used, with different formats. Due to that, the simplification and normalisation of data were preferred for better comprehension and easy comparability, and for this reason, the criteria were classified in a qualitative scale. More specifically, the values of the sustainable mobility alternatives for the evaluation criteria were ranked in a 5-point scale, as qualitative assessments. As explained above, for the evaluation with the Visual PROMETHEE software, the type of preference function that was selected for all criteria was "Usual type", as an appropriate option for best suited for qualitative criteria, while the threshold values were set according to the proposed methodology of the software [45].

3.6 Actors involved in sustainable mobility planning

The stakeholders' groups, included in the analysis, were initially mapped in order to include key categories, in terms of demand and offer (i.e. users/ operators), public and private experts (i.e. academics / consultants), governance and non-profit organisations, always in accordance to the pillars of sustainable development: environment, economy and society. The additional element as regards stakeholder groups involved in our study is the involvement of tourism actors, representing a significant segment of stakeholders, who are the ones taking into consideration the targeted needs and motivations of the visitors' mobility.

It is worth-mentioning, that the actors that participated in the evaluation of the criteria, consisted of six different groups and were additionally separated into two levels: European and Greek. This separation aims to identify the priorities of each group in European and local level and the potential differences in the evaluation of the policies. The European groups include stakeholders located in different European countries, mainly in Mediterranean touristic urban

areas, including Greece. At the Greek level, an additional group is included in the analysis, but it is not taken into account in the two-level comparison.

The stakeholder groups involved are described briefly below:

(a) Local authorities (LA)

Civil servants of local authorities (municipalities) of different European touristic cities were selected as representatives that are directly involved in the transport policies designed and applied in local level. This EU group consists of six participants and the Greek groups by two participants, who can all take into consideration both governance visions/ strategies and implementation issues.

(b) Transport Operators (TO)

Transport operators and mobility providers from different European touristic cities participated in this group. The group involves three EU public transport operators and two Greek representatives of mobility services (bike rental and taxi).

(c) Tourism sector (TS)

This group includes representative actors of the tourism sector, that are directly involved with incoming visitors, thus have a deeper understanding of the needs of this specific users' segment but also the views of other interested parties, such as hotel and tourism agencies. The group consists of an EU non-profit Tourism company representative, a Greek Municipal servant involved with the tourism sector and a representative of a Greek hoteliers' association, based all in Mediterranean touristic cities, highly affected by tourism fluctuation in terms of mobility.

(d) Academic institutions (AI)

This group includes four professors from various European Universities, whose scientific work and research are directly related to sustainable mobility and urban transport. The Greek groups are consisted by two professors of national Universities.

(e) Mobility experts (MS)

This group consists of five European mobility experts, highly competent in technical, financial and operational issues of various mobility measures. The actors involved represent mainly transport consultancy companies, while the specific Greek group includes a representative of the local Technical Chamber of Rethymno Unit and a representative of the National Technical Chamber - Regional Unit of West Crete.

(f) Environmental groups (EG)

This specific group included three representatives of local and worldwide NGO environmental organisations, providing insights for the preferences of a group focused on one of the main pillars of sustainability: the environment.

(g) Local communities (LC)

For this group, different citizens' associations and unions, dedicated to mobility issues, (such as pedestrian safety, cycling, accessibility etc.) were contacted, as representatives of current and potential transport users. The participants of this group represent two national organisations in Greece, the National Association of Disabled and the Road Safety Institute. Local communities are an additional stakeholders group, consisted only by Greek participants, thus it was not included in the analysis in EU level.

The following table (Table 3) presents the final share of contribution per group in the total answers.

Table 3: Share of contribution per group in criteria evaluation

Stakeholder Group	Share of participants in EU groups %	Share of participants in GR groups %
Local Authorities (LA)	22,22	14,29
Transport Operators (TO)	18,52	14,29
Tourism Sector (TS)	11,11	14,29

Academic Institutions (AI)	22,22	14,29
Mobility Experts (ME)	11,11	14,29
Environmental Groups (EG)	22,22	14,29
Local Communities (LC)	_	14,29
Total	100,00	100,00

3.7 Weight factors

The selected criteria were evaluated according to their significance in the selection of appropriate mobility policies and their ranking provided required data for the calculation of corresponding weights for the analysis. As described above, each participant was invited to complete a classification table, indicating his/her order of preference of the criteria, from the most important one (1) to the least important (10). The participants were encouraged to insert more than one criteria in the same row, if they consider that specific criteria are equally important and therefore cannot be differently ranked. For each response, the relative weights were calculated, while the weight of each criterion per stakeholder group was calculated as the average value of the relative weights of the specific group actors involved. The following table (Table 4) presents the process for the calculation of the relative weights for each participant of a specific group, taking as an example the processing of the responses of the "Academic institution" group.

In each classification table per participant, the absolute number of the created preference levels (1=most important, 10= least important) is attributed to each criterion (the first and second column). The third column includes the number of criteria of each level, while the fourth column includes the number per criterion as a result of the responder's ranking. Then, the mean weight of each criterion is calculated (fifth column) and finally, the normalization of weights is conducted in the sixth column, so that they become comparable [43].

Table 4: Weight factor calculation for the Academic Institutions group

Academic institution ¼						Academic institution 2/4					
Order of Preference *r-level*	Criterion	Number of r-level criteria [Nr]	Weight (Pr)	Mean weight [Q=SUM(Pr)/Nr]	Relative weight % [W= (Q/SUM(P)) * 100]	Order of Preference *r-level*	Criterion	Number of r-level criteria [Nr]	Weight (Pr)	Mean weight [Q=SUM(Pr)/Nr]	Relative weight % [W= (Q/SUM(P)) * 100]
8	Energy	1	3	3	5,5	4	Energy	1	5	5	9,1
2	Environmental pollution	1	9	9	16,4	3	Environmental pollution	1	6	6	10,9
6	Traffic conditions	1	5	5	9,1	1	Traffic conditions	3	10, 9, 8	(10+9+8)/3=9	16,4
10	Transport infrastructure	1	1	1	1,8	2	Transport infrastructure	1	7	0	12,7
5	Tourist flow	1	6	6	10,9	6	Tourist flow	1	3	3	5,5
9	Service finance	1	2	2	3,6	8	Service finance	1	1	1	1,8
7	Local economy	1	4	4	7,3	7	Local economy	1	2	2	3,6
3	Safety	1	8	8	14,5	1	Safety	3	10, 9, 8	(10+9+8)/3=9	16,4
4	Users satisfaction	1	7	7	12,7	5	Users satisfaction	1	4	4	7,3
1	Accessibility	1	10	10	18,2	1	Accessibility	3	10, 9, 8	(10+9+8)/3=9	16,4
Total sum			SUM(P) =55		Total = 100	Total sum			SUM(P) =55		Total = 100

Academic institution ¾						Academic institution 4/4						Academic institutions group	
Order of Preference *r-level*	Criterion	Number of r-level criteria [Nr]	Weight (Pr)	Mean weight [Q=SUM(Pr)/Nr]	Relative weight % [W= (Q/SUM(P)) * 100]	Order of Preference *r-level*	Criterion	Number of r-level criteria [Nr]	Weight (Pr)	Mean weight [Q=SUM(Pr)/Nr]	Relative weight % [W= (Q/SUM(P)) * 100]	Criterion	Average Relative weight %
6	Energy	1	5	5	9,1	10	Energy	1	1	1	1,8	Energy	6,4
2	Environmental pollution	1	9	9	16,4	2	Environmental pollution	1	9	9	16,4	Environmental pollution	15,0
8	Traffic conditions	1	3	3	5,5	3	Traffic conditions	1	8	8	14,5	Traffic conditions	11,4
7	Transport infrastructure	1	4	4	7,3	6	Transport infrastructure	1	5	5	9,1	Transport infrastructure	7,7
10	Tourist flow	1	1	1	1,8	5	Tourist flow	1	6	6	10,9	Tourist flow	7,3
9	Service finance	1	2	2	3,6	7	Service finance	1	4	4	7,3	Service finance	4,1
3	Local economy	1	8	8	14,5	1	Local economy	1	10	10	18,2	Local economy	10,9
1	Safety	1	10	10	18,2	4	Safety	1	7	7	12,7	Safety	15,5
5	Users satisfaction	1	6	6	10,9	8	Users satisfaction	1	3	3	5,5	Users satisfaction	9,1
4	Accessibility	1	7	7	12,7	9	Accessibility	1	2	2	3,6	Accessibility	12,7
Total sum			SUM(P) =55		100	Total sum			SUM(P) =55		100	Total sum	100,0

The abovementioned process was followed for each stakeholder group, and thus, the relative weights (%) for every stakeholder group, at EU and Greek level respectively, were calculated and presented in Tables 5 & 6.

Table 5: Weights (%) matrix for all stakeholder groups in EU level

Stakeholder Group	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Local authorities (LA)	11,36	13,79	11,82	11,52	6,21	3,64	3,48	11,97	11,21	15,00
Transport Operators (TO)	7,27	9,82	13,82	12,00	6,55	8,55	11,45	12,18	4,91	13,45
Tourism sector (TS)	15,76	16,97	8,79	10,30	9,70	3,94	7,58	9,70	6,36	10,91
Academic institutions (AI)	6,36	15,00	11,36	7,73	7,27	4,09	10,91	15,45	9,09	12,73
Mobility experts (MS)	8,64	9,85	12,27	10,76	10,76	6,21	7,73	8,33	12,27	13,18
Environmental groups (EG)	14,55	17,58	5,45	10,91	6,06	10,00	6,97	11,52	6,67	10,30

Table 6: Weights (%) matrix for Greek stakeholder groups

Stakeholder Group	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Local authorities (LA)	12,27	13,18	9,55	8,64	6,36	3,64	2,73	15,00	13,18	15,45
Transport Operators (TO)	9,09	15,45	14,55	11,82	8,18	4,55	6,36	14,55	1,82	13,64
Tourism sector (TS)	14,55	17,27	9,55	8,18	11,82	5,00	9,55	10,00	4,09	10,00
Academic institutions (AI)	3,64	10,00	8,18	9,09	11,82	4,55	8,18	17,27	15,45	11,82
Mobility experts (MS)	13,18	17,73	1,82	9,09	5,45	13,64	9,09	11,82	5,45	12,73
Environmental groups (EG)	5,45	10,91	9,09	13,64	2,73	5,45	8,18	17,27	11,82	15,45
Local communities (LO)	7,27	13,64	12,73	7,27	8,18	2,73	5,45	15,45	10,00	17,27

As the final stage of this work, a sensitivity analysis was conducted, using the tools offered by Visual PROMETHEE software, such as “Walking Weights” that allows altering values of weight factors, in order to observe their impact in the final classification and “Stability Intervals” that defines the alteration limits of weights inside which the final classification remains identical unchanged.

Chapter 4: Results

The objective of this work is the ranking of various sustainable mobility policies based on the relative bibliographic research and according to the preferences of European and Greek stakeholder groups, involved in mobility planning. According to the weights of criteria and the evaluation table of the examined sustainable mobility policies, their classification was generated with the VISUAL PROMETHEE software and is presented below for each stakeholder group in the form of tables. Although the classification is highly linked to the evaluation table, the ranking is determined by the scores of the action in the higher weighted criteria.

To support the understanding of this aspect, the following sections present the criteria preference and the classification of the sustainable mobility policies per group, at EU and Greek level. As a result, the classifications present differences, mainly between groups that had different preferences on the criteria. For each group, the results of the Phi values (Phi, Phi+ and Phi-) are presented per action, providing the ranking of the policies (starting from the "better" one and leading to the "worst") for each group.

4.1 Local authorities (LA)

For the EU Local Authorities group, the accessibility criterion was evaluated as the most important with 15.00%, followed by environmental pollution (13.79%). The least important criteria for this group were the economic ones, local economy (3.48%) and service finance (3,64 %). The GR Local Authorities group presents similar preferences and evaluated the accessibility and safety criteria as the most important, while the least important were also the economic criteria. The graphs below (Fig. 6) present the preference of criteria for these groups, where the corresponding weight appears above each criterion.

Table 7 presents the ranking of mobility measures for the Local Authorities group, at EU and GR level. Both EU and GR Local Authorities groups classified, according to the Net Flow Phi (PROMETHEE II Complete Ranking), the "Mobility management and travel plans" policy as the most suitable, followed by "Increased traffic safety and security – Eco driving training" and the "Low emission zones and parking management" as the second and third option respectively. The "E-charging infrastructures and e-vehicles in public fleets" is ranked as the worst option for both groups. The difference between the two groups is observed for the policies ranked in the 7th, 8th and 9th place.

Their total ranking or measures follows also the Phi+ and Phi- values, since "best" policies present the highest Phi+ values and the "worst" the highest Phi- values.

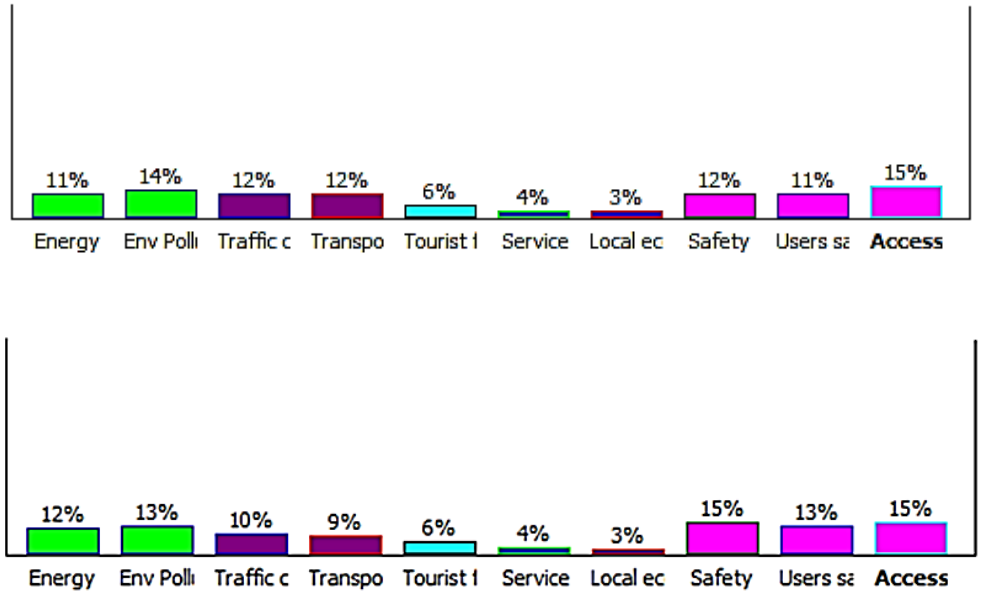


Figure 6: Weight factors of each criterion for EU (up) and GR (down) Local Authorities

Table 7: PROMETHEE II ranking for EU (left) and GR (right) Local Authorities

Local Authorities EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.457	0.678	0.221
2	Increased traffic safety and security – Eco driving training	0.351	0.578	0.227
3	Low emission zones and parking management	0.181	0.489	0.307
4	Sustainable Mobility Plans	0.114	0.402	0.288
5	Mobility plans for school communities	0.083	0.377	0.294
6	Attractive and accessible public spaces	0.052	0.396	0.343
7	Shared mobility services	-0.137	0.308	0.445
8	Improved and accessible PT services for tourists and residents	-0.168	0.243	0.412
9	Behavioural change and informative actions	-0.215	0.242	0.457
10	Smart metering systems	-0.236	0.251	0.488
11	E-charging infrastructures and e-vehicles in public fleets	-0.480	0.157	0.638

Local Authorities GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.447	0.677	0.230
2	Increased traffic safety and security – Eco driving training	0.362	0.578	0.216
3	Low emission zones and parking management	0.260	0.532	0.272
4	Sustainable Mobility Plans	0.146	0.415	0.269
5	Mobility plans for school communities	0.059	0.354	0.295
6	Attractive and accessible public spaces	0.000	0.372	0.373
7	Behavioural change and informative actions	-0.110	0.320	0.431
8	Shared mobility services	-0.121	0.272	0.393
9	Improved and accessible PT services for tourists and residents	-0.297	0.206	0.503
10	Smart metering systems	-0.300	0.194	0.493
11	E-charging infrastructures and e-vehicles in public fleets	-0.447	0.184	0.631

4.2 Transport Operators (TO)

Transport Operators group at EU level, showed a preference for technical and social criteria, giving the highest weight factors to the traffic conditions criterion (13.82%), followed by the accessibility criterion (13.45%) with a slight difference, while the least important criterion for this group was the tourist flow (6.55%). Greek Transport Operators presented a different preference, evaluating environmental pollution as the most important criterion (15.45%), followed by traffic conditions and safety, equally weighted. The least important criterion for the GR group was users' satisfaction (1.82%). Figure 7 below presents the preferences of criteria for each group.

Table 8 presents the ranking (complete and partial) of sustainable mobility policies for the Transport Operators group, at EU and GR level. The only difference between the two groups is observed for the policies ranked in the 7th and 8th place. Both EU and Greek Transport Operators present the same top and lowest ranking with the Local Authorities category, besides the second worst policy, which was "Behavioural change and informative actions". The ranking for both groups follows the Phi+ and Phi- values for most policies, but certain policies present higher Phi+ values or lower Phi- values than other policies, in higher ranking.

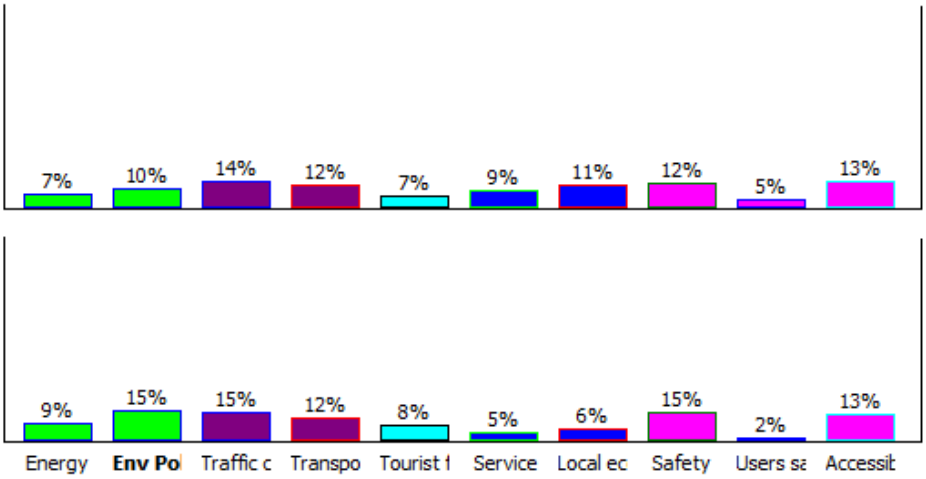


Figure 7: Weight factors of each criterion for EU (up) and GR (down) Transport Operators

Table 8: PROMETHEE II ranking for EU (left) and GR (right) Transport Operators

Transport Operators EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.474	0.684	0.210
2	Increased traffic safety and security – Eco driving training	0.355	0.572	0.217
3	Low emission zones and parking management	0.175	0.473	0.298
4	Sustainable Mobility Plans	0.083	0.384	0.302
5	Mobility plans for school communities	0.081	0.362	0.281
6	Attractive and accessible public spaces	0.079	0.429	0.349
7	Improved and accessible PT services for tourists and residents	-0.068	0.304	0.371
8	Shared mobility services	-0.163	0.277	0.440
9	Smart metering systems	-0.262	0.219	0.481
10	Behavioural change and informative actions	-0.264	0.227	0.491
11	E-charging infrastructures and e-vehicles in public fleets	-0.490	0.145	0.635

Transport Operators GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.447	0.677	0.230
2	Increased traffic safety and security – Eco driving training	0.362	0.578	0.216
3	Low emission zones and parking management	0.260	0.532	0.272
4	Sustainable Mobility Plans	0.146	0.415	0.269
5	Mobility plans for school communities	0.059	0.354	0.295
6	Attractive and accessible public spaces	0.000	0.372	0.373
7	Shared mobility services	-0.110	0.320	0.431
8	Improved and accessible PT services for tourists and residents	-0.121	0.272	0.393
9	Smart metering systems	-0.297	0.206	0.503
10	Behavioural change and informative actions	-0.300	0.194	0.493
11	E-charging infrastructures and e-vehicles in public fleets	-0.447	0.184	0.631

4.3 Tourism sector (TS)

The EU Tourism Sector group showed a preference for environmental criteria. Environmental pollution presents the highest weight factor (16.97%), followed by energy (15.76%). The rest of the criteria are almost equally weighted. However, the least important criterion, with a significant difference from the rest, was service finance (3.94%). Environmental criteria were also the most important for the Greek Tourism Sector, with minor differences in the values, but the least important criterion for the GR group was users' satisfaction (4.09%). The weights of criteria for each group are presented in the graphs below (Fig. 8).

The total ranking of mobility measures for the EU and GR Tourism Sector groups respectively is presented in Table 9. Both EU and GR Tourism Sector groups also classified the same policies as the most and least suitable ones. The medium ranked policies are very similar, with a difference between the two groups for the policies ranked in the 5th and 6th place. As previously mentioned, although the ranking follows the Phi+ and Phi- values for most policies, a few policies present slightly higher Phi+ values or lower Phi- values than other policies, in higher ranking.

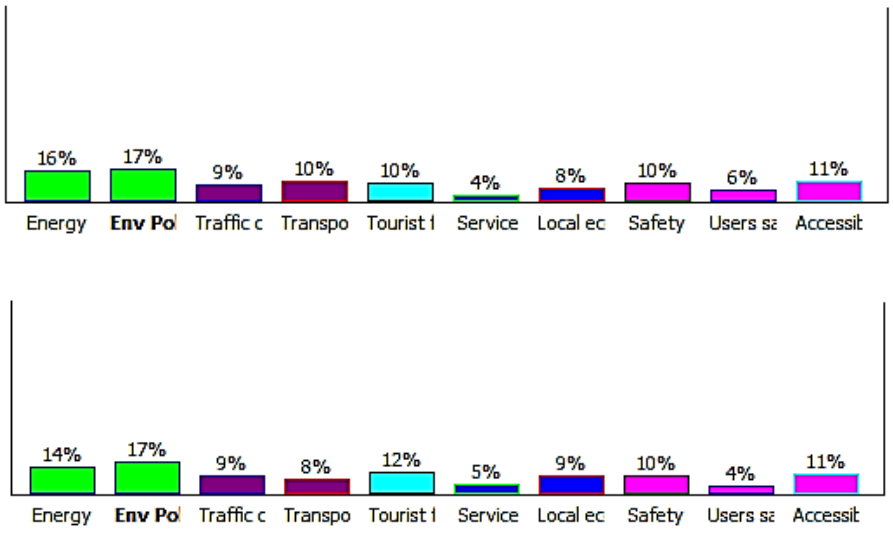


Figure 8: Weight factors of each criterion for EU (up) and GR (down) Tourism sector

Table 9: PROMETHEE II ranking for EU (left) and GR (right) Tourism Sector

Tourism Sector EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.467	0.689	0.222
2	Increased traffic safety and security – Eco driving training	0.400	0.606	0.205
3	Low emission zones and parking management	0.232	0.515	0.284
4	Sustainable Mobility Plans	0.103	0.406	0.303
5	Mobility plans for school communities	-0.013	0.327	0.340
6	Shared mobility services	-0.021	0.376	0.397
7	Attractive and accessible public spaces	-0.071	0.329	0.399
8	Improved and accessible PT services for tourists and residents	-0.175	0.246	0.420
9	Smart metering systems	-0.243	0.242	0.486
10	Behavioural change and informative actions	-0.309	0.196	0.506
11	E-charging infrastructures and e-vehicles in public fleets	-0.370	0.200	0.570

Tourism Sector GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.471	0.691	0.220
2	Increased traffic safety and security – Eco driving training	0.391	0.597	0.206
3	Low emission zones and parking management	0.243	0.519	0.276
4	Sustainable Mobility Plans	0.090	0.397	0.308
5	Shared mobility services	-0.011	0.378	0.389
6	Mobility plans for school communities	-0.024	0.317	0.341
7	Attractive and accessible public spaces	-0.070	0.332	0.401
8	Improved and accessible PT services for tourists and residents	-0.147	0.260	0.408
9	Smart metering systems	-0.287	0.212	0.499
10	Behavioural change and informative actions	-0.309	0.195	0.503
11	E-charging infrastructures and e-vehicles in public fleets	-0.347	0.211	0.559

4.4 Academic Institutions (AI)

EU Academic institutions groups attributed the highest weight factor to safety (15.45%), followed by environmental pollution (15.00%) with a slight difference and the lowest weights to service finance (4.09%). GR Academic institutions group considers accessibility as the most important criterion (17.27%), followed by safety, and the least important is service finance, as well, but with a lower value compared to the EU group (2.73%) (Fig. 9).

Table 10 presents the ranking of the policies for the EU and GR Academic Institutions groups, classified accordingly with the Net Flow Phi. Both groups present the same ranking as the previous stakeholders' categories for the three top policies and the same for the two low-ranked policies with the Local Authorities group. However, the medium ranked policies are not as similar as in the previous stakeholders' categories, with different policies ranked in the 5th, 6th, 8th and 9th places. Both groups' ranking follows the Phi+ values, but some differences are observed compared to the Phi- values, according to the PROMETHEE I Partial Ranking for both groups.

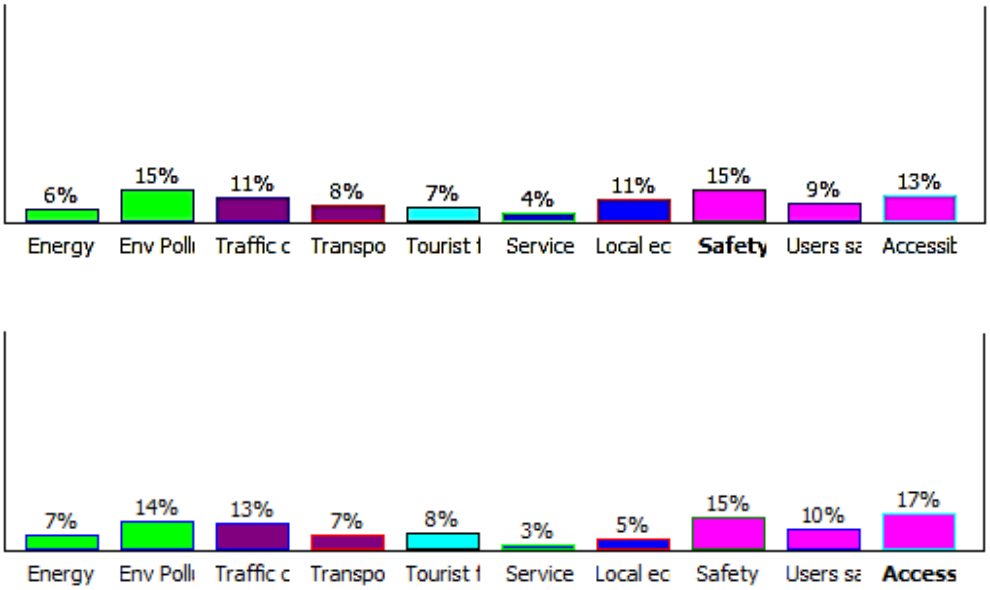


Figure 9: Weight factors of each criterion for EU (up) and GR (down) Academic Institutions

Table 10: PROMETHEE II ranking for EU (left) and GR (right) Academic Institutions

Academic Institutions EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.445	0.669	0.224
2	Increased traffic safety and security – Eco driving training	0.386	0.597	0.211
3	Low emission zones and parking management	0.176	0.471	0.295
4	Attractive and accessible public spaces	0.132	0.440	0.308
5	Mobility plans for school communities	0.083	0.369	0.285
6	Sustainable Mobility Plans	0.050	0.355	0.305
7	Improved and accessible PT services for tourists and residents	-0.125	0.276	0.400
8	Shared mobility services	-0.189	0.271	0.460
9	Behavioural change and informative actions	-0.218	0.245	0.462
10	Smart metering systems	-0.305	0.199	0.504
11	E-charging infrastructures and e-vehicles in public fleets	-0.435	0.176	0.611

Academic Institutions GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.426	0.662	0.235
2	Increased traffic safety and security – Eco driving training	0.347	0.575	0.228
3	Low emission zones and parking management	0.164	0.473	0.309
4	Attractive and accessible public spaces	0.140	0.439	0.299
5	Sustainable Mobility Plans	0.116	0.391	0.275
6	Mobility plans for school communities	0.106	0.383	0.276
7	Improved and accessible PT services for tourists and residents	-0.122	0.270	0.392
8	Behavioural change and informative actions	-0.178	0.256	0.435
9	Shared mobility services	-0.187	0.279	0.466
10	Smart metering systems	-0.326	0.199	0.525
11	E-charging infrastructures and e-vehicles in public fleets	-0.487	0.160	0.647

4.5 Mobility Experts (ME)

Mobility Experts at EU level expressed a preference mostly to social and technical criteria, although they presented fewer differences between the criteria weights. However, the highest weight factor was given to the accessibility criterion (13.18%) and the lowest to service finance (6.21%). Greek Mobility Experts consider as almost equally important criteria from most categories, but attributed high weights to safety (17.27%) and users' satisfaction (15.45%), while the lowest weight was attributed to energy (3.64%), with a significant difference from the rest criteria. The graph below (Fig. 10) presents the different preferences of criteria for the two groups.

Table 11 presents the ranking of the mobility measures for the EU and GR Mobility Experts groups. The two groups present the same ranking for the two top-ranked policies and for the lowest-ranked policy, as other stakeholder categories, as well. However, the rest of the ranked policies are completely different for the two groups, due to their difference in the criteria weights. This group's ranking follows the Phi+ values, but presents a difference compared to the Phi- values for two medium-ranked policies.

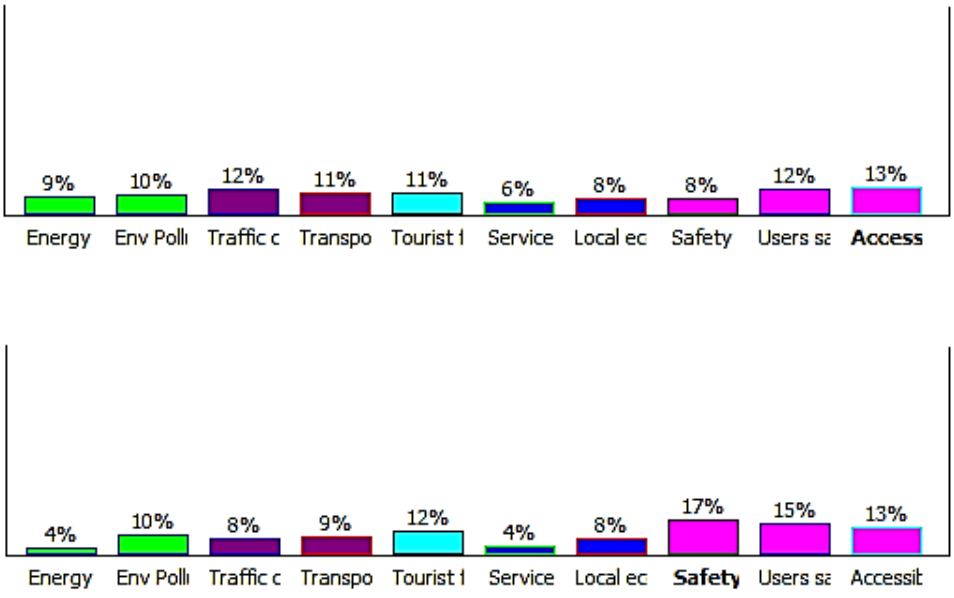


Figure 10: Weight factors of each criterion for EU (up) and GR (down) Mobility Experts

Table 11: PROMETHEE II ranking for EU (left) and GR (right) Mobility Experts

Mobility Experts EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.532	0.715	0.184
2	Increased traffic safety and security – Eco driving training	0.316	0.550	0.235
3	Low emission zones and parking management	0.086	0.429	0.343
4	Sustainable Mobility Plans	0.081	0.389	0.308
5	Attractive and accessible public spaces	0.066	0.417	0.350
6	Mobility plans for school communities	0.038	0.351	0.313
7	Improved and accessible PT services for tourists and residents	-0.113	0.274	0.387
8	Shared mobility services	-0.115	0.306	0.421
9	Behavioural change and informative actions	-0.187	0.265	0.452
10	Smart metering systems	-0.242	0.238	0.480
11	E-charging infrastructures and e-vehicles in public fleets	-0.462	0.153	0.615

Mobility Experts GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.470	0.676	0.206
2	Increased traffic safety and security – Eco driving training	0.370	0.592	0.222
3	Attractive and accessible public spaces	0.150	0.449	0.299
4	Mobility plans for school communities	0.097	0.385	0.288
5	Sustainable Mobility Plans	0.096	0.388	0.292
6	Low emission zones and parking management	0.008	0.371	0.363
7	Behavioural change and informative actions	-0.086	0.319	0.405
8	Improved and accessible PT services for tourists and residents	-0.122	0.281	0.404
9	Shared mobility services	-0.223	0.258	0.482
10	Smart metering systems	-0.289	0.220	0.509
11	E-charging infrastructures and e-vehicles in public fleets	-0.470	0.152	0.622

4.6 Environmental Groups (EG)

EU Environmental groups present relatively high differences between the criteria weights and put greater emphasis on environmental criteria, giving the highest weight factors to environmental pollution (17.58%) and energy (14.55%). The least important criterion for this group was “traffic conditions” (5.45%), although this group attributed low weights to several criteria. The GR Environmental groups expressed very similar preferences, as graphically presented in Figure 11.

Table 12 presents the ranking of the mobility measures for the EU and GR Environmental Groups group. The only difference between the two groups is observed for the policies ranked in the 8th and 9th place. Both EU and Gr Environmental Groups classified, accordingly with the Net Flow Phi, the “Mobility management and travel plans” as the most suitable policy and “E-charging infrastructures and e-vehicles in public fleets” as the worst, similarly with other stakeholder categories. The groups’ ranking also presents some differences according to the Phi+ and Phi- values for some medium- and low-ranked policies, according to the PROMETHEE I Partial Ranking.

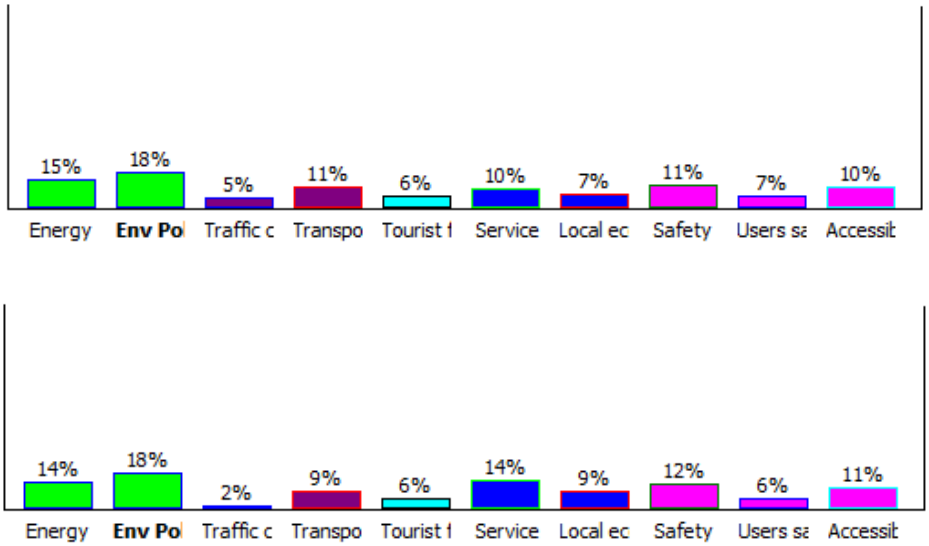


Figure 11: Weight factors of each criterion for EU (up) and GR (down) Environmental Groups

Table 12: PROMETHEE II ranking for EU (left) and GR (right) Environmental Groups

Environmental Groups EU				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.449	0.668	0.220
2	Increased traffic safety and security – Eco driving training	0.397	0.607	0.211
3	Low emission zones and parking management	0.267	0.527	0.260
4	Mobility plans for school communities	0.075	0.377	0.302
5	Sustainable Mobility Plans	0.025	0.376	0.351
6	Shared mobility services	-0.071	0.350	0.421
7	Attractive and accessible public spaces	-0.114	0.310	0.424
8	Improved and accessible PT services for tourists and residents	-0.197	0.237	0.434
9	Smart metering systems	-0.227	0.253	0.479
10	Behavioural change and informative actions	-0.249	0.231	0.480
11	E-charging infrastructures and e-vehicles in public fleets	-0.355	0.203	0.558

Environmental Groups GR				
Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.433	0.654	0.221
2	Increased traffic safety and security – Eco driving training	0.405	0.616	0.210
3	Low emission zones and parking management	0.270	0.520	0.251
4	Mobility plans for school communities	0.116	0.400	0.284
5	Sustainable Mobility Plans	-0.028	0.355	0.383
6	Shared mobility services	-0.088	0.341	0.429
7	Attractive and accessible public spaces	-0.135	0.301	0.436
8	Improved and accessible PT services for tourists and residents	-0.178	0.253	0.431
9	Behavioural change and informative actions	-0.226	0.249	0.474
10	Smart metering systems	-0.253	0.238	0.491
11	E-charging infrastructures and e-vehicles in public fleets	-0.316	0.214	0.531

4.7 Local communities (LC)

Local communities, as the additional Greek stakeholder group examined, presents a clear preference on social criteria, attributing high weights to the human factor. Safety was evaluated as the most important criterion (17.27%), followed by accessibility (15.45%). The rest of the criteria, except transport infrastructure, are weighted with lower values, while the least important criteria with a significant difference from the rest for this group was tourist flow (2.73%).

The following graph (Fig. 12) presents the reference of the criteria for this group. Above each criterion, the corresponding weight appears.

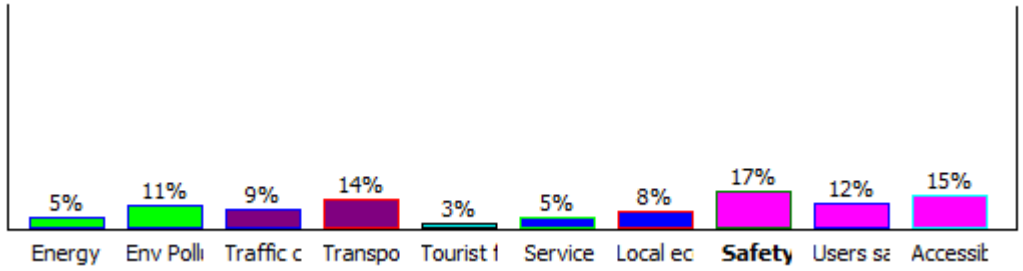


Figure 12: Weight factors of each criterion for GR Local Communities

The following table (Table 13) presents the ranking of the policies for the Local Communities group.

Table 13: PROMETHEE II ranking for GR Local Communities

Rank	Action	Phi	Phi+	Phi-
1	Mobility management and travel plans	0.419	0.648	0.229
2	Increased traffic safety and security – Eco driving training	0.398	0.613	0.215
3	Mobility plans for school communities	0.166	0.418	0.252
4	Attractive and accessible public spaces	0.157	0.455	0.297
5	Sustainable Mobility Plans	0.102	0.389	0.287
6	Low emission zones and parking management	0.098	0.426	0.328

7	Improved and accessible PT services for tourists and residents	-0.116	0.285	0.401
8	Behavioural change and informative actions	-0.192	0.270	0.462
9	Smart metering systems	-0.238	0.250	0.488
10	Shared mobility services	-0.268	0.234	0.502
11	E-charging infrastructures and e-vehicles in public fleets	-0.527	0.131	0.658

The Local Communities group also classified, accordingly with the Net Flow Phi, the "Mobility management and travel plans" as the most suitable policy, the "Increased traffic safety and security – Eco driving training" as the second most suitable and the "E-charging infrastructures and e-vehicles in public fleets" as the worst. However, the third policy for this group is "Mobility plans for school communities" and the second worst policy was "Shared mobility services", differentiating this group's ranking for these two policies from all other groups.

This groups ranking also presents some differences according to the Phi+ and Phi- values for certain policies, according to the PROMETHEE I Partial Ranking for this group.

4.8 Total Classification of alternatives solutions

The graphs below (Fig 13) present graphically the results of the PROMETHEE II Complete Ranking of mobility measures for all EU and GR stakeholder groups, according to the criteria preferences of all groups. "Mobility management and travel plans" is classified as the most suitable policy, followed by "Increased traffic safety and security – Eco driving training" and the "Low emission zones and parking management" as the second and third option correspondingly, at both EU and GR level.

The medium-ranked policies for EU groups, following in descending order: Sustainable Mobility Plans, Mobility plans for school communities, Attractive and accessible public spaces, Shared mobility services, Improved and accessible PT services for tourists and residents, Behavioural change and informative actions, while the second worst policy was

"Smart metering systems" and the "E-charging infrastructures and e-vehicles in public fleets" was classified as the worst.

The total classification of policies for all Greek stakeholder groups (Fig. 13) does not present significant differences compared to EU groups. The final ranking of the mobility policies is the same as described above for the EU groups and the only difference between the two levels is presented for the policies ranked in the 7th and 8th place.

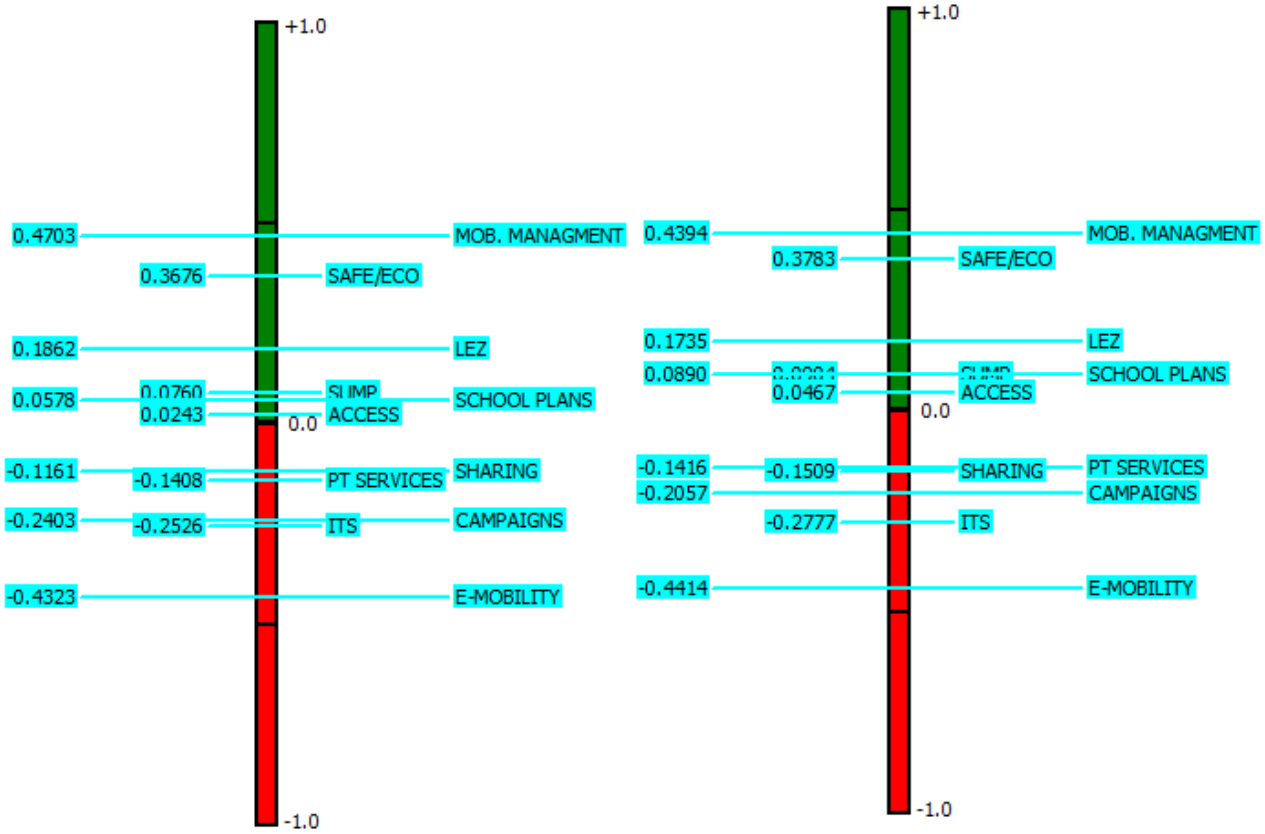


Figure 13: PROMETHEE II ranking for EU (left) and GR (right) stakeholder groups

Tables 14 & 15 below present the classification of the policies per group and the total ranking, as described previously, in the last column, for EU and Greek stakeholder groups respectively. The differences in the total ranking between the corresponding EU and GR groups are highlighted in red and as observed, Greek Academic institutions and Mobility experts present the most differences with the respective EU groups.

As observed, at EU level, Local authorities, Transport Operators and Tourist sector present the exact same ranking for 7 policies, and slight differences for the remaining. The groups "Academic institutions", "Mobility experts" and "Environmental groups" present similarities between them and with the first three groups for 3-5 policies.

For GR groups, Local authorities and Transport Operators present the exact same ranking for 6 policies, and minor differences for the remaining. However, the similarities of these groups with the GR Tourist Sector are not as strong as in the EU groups. The same applies to Greek Mobility experts and Environmental groups, which also present the same ranking for 6 policies. The Local communities group presents the least similarities in their total ranking with the other groups.

Table 14: PROMETHEE II ranking for all EU stakeholder groups

RANKING TABLE	Stakeholder Group						Total
Actions	***LA***	***TO***	***TS***	***AI***	***ME***	***EG***	
Sustainable Urban Mobility Plans / Sustainable Urban Logistic Plans	4	4	4	6	4	5	**4**
Smart metering systems / Real-time mobility information	10	9	9	10	10	9	**10**
Increased traffic safety and security – Eco driving training	2	2	2	2	2	2	**2**
Mobility plans for school communities	5	5	5	5	6	4	**5**
Attractive and accessible public spaces	6	6	7	4	5	7	**6**
Shared mobility services (bike, car, taxi)	7	8	6	8	8	6	**7**
E-charging infrastructures and e-vehicles in public fleets	11	11	11	11	11	11	**11**
Mobility management and travel plans	1	1	1	1	1	1	**1**
Behavioural change and informative actions	9	10	10	9	9	10	**9**
Low emission zones and parking management	3	3	3	3	3	3	**3**
Improved and accessible PT services for tourists and residents	8	7	8	7	7	8	**8**

** LA: Local authorities, TO: Transport Operators/ Provides / Services, TS: Tourist sector, AI: Academic institutions, ME: Mobility experts, EG: Environmental groups*

Table 15: PROMETHEE II ranking for all GR stakeholder groups

RANKING TABLE	Stakeholder Group							Total
Actions	***LA***	***TO***	***TS***	***AI***	***ME***	***EG***	***LC***	
Sustainable Urban Mobility Plans / Sustainable Urban Logistic Plans	4	4	4	5	5	5	5	**4**
Smart metering systems / Real-time mobility information	10	9	9	10	10	10	9	**10**
Increased traffic safety and security – Eco driving training	2	2	2	2	2	2	2	**2**
Mobility plans for school communities	5	5	6	6	4	4	3	**5**
Attractive and accessible public spaces	6	6	7	4	3	7	4	**6**
Shared mobility services (bike, car, taxi)	8	7	5	9	9	6	10	**8**
E-charging infrastructures and e-vehicles in public fleets	11	11	11	11	11	11	11	**11**
Mobility management and travel plans	1	1	1	1	1	1	1	**1**
Behavioural change and informative actions	7	10	10	8	7	9	8	**9**
Low emission zones and parking management	3	3	3	3	6	3	6	**3**
Improved and accessible PT services for tourists and residents	9	8	8	7	8	8	7	**7**

** LA: Local authorities, TO: Transport Operators/ Provides / Services, TS: Tourist sector, AI: Academic institutions, ME: Mobility experts, EG: Environmental groups, LC: Local communities,*

Chapter 5: Discussion

The results reflect the suitability of policies for the stakeholders involved based on their ranking and also the characteristics of each stakeholder group in criteria preferences, facilitating further comparison at both EU and GR level.

5.1 Scenarios Comparison

The following figures (Fig. 14 & 15) portray graphically the classification of PROMETHEE II for the all groups, comparing the different scenarios. For each group, a vertical green-and red line, is displayed (Phi+ = 1.0, Phi- = -1) and horizontal blue lines, representing each policy, cross the vertical lines, presenting the value that received each action separately and attributes the net flow values (Phi) for each criterion.

As presented in Figure 14, for all EU groups, the "Mobility management and travel plans" policy was ranked as the most suitable, the "Increased traffic safety and security – Eco driving training" policy as the second most suitable and the "E-charging infrastructures and e-vehicles in public fleets" as the worst one, due to their performance in highly-weighted criteria. However, the in-between ranking of the policies presents differences per group, in a higher or lower degree.

Respectively, all GR groups (Fig. 15) have ranked "Mobility management and travel plans" and "Increased traffic safety and security – Eco driving training" as the most suitable policies and the "E-charging infrastructures and e-vehicles in public fleets" as the worst one. The medium-ranked policies present more differences per group, compared to EU level, especially Greek Mobility Experts' ranking that differentiates significantly from other groups' ranking. The additional group examined, Greek Local Communities, also presents a similar ranking, especially for the top and low ranked policies.

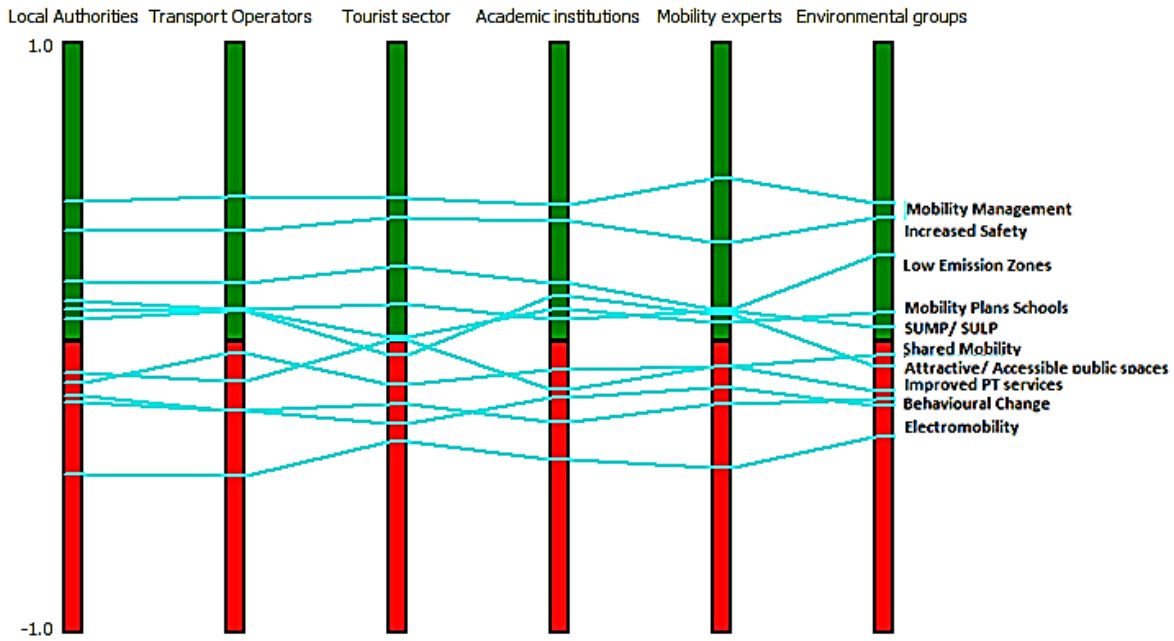


Figure 14: Scenarios comparison PROMETHEE II ranking for all EU stakeholder groups

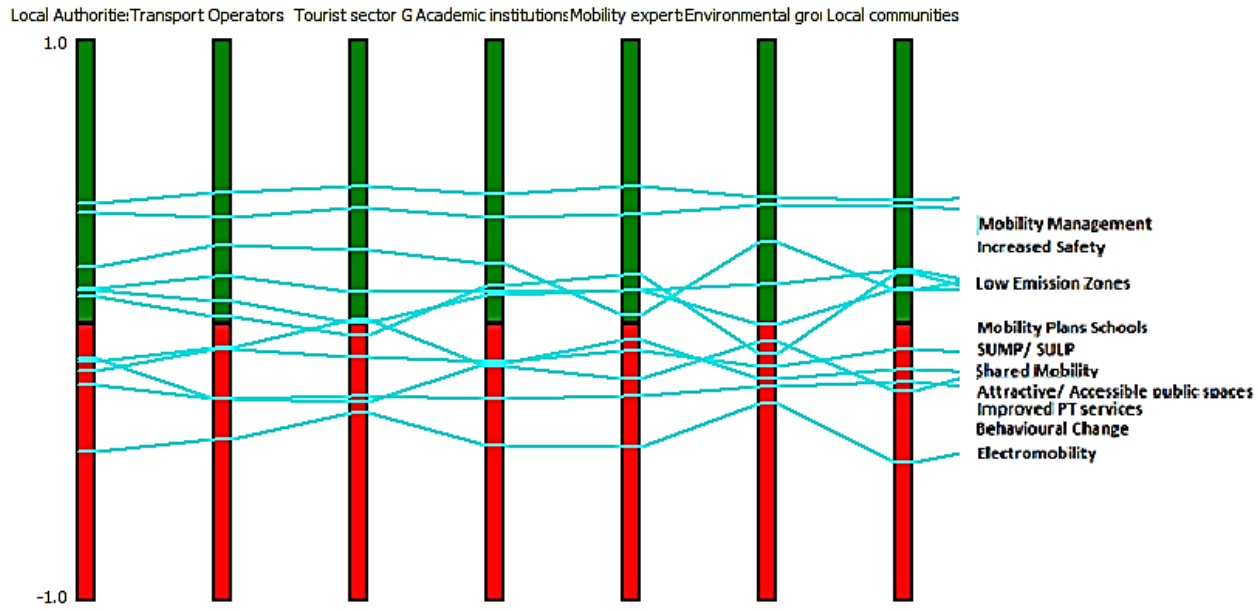


Figure 15: Scenarios comparison PROMETHEE II ranking for all GR stakeholder groups

5.2 Sensitivity Analysis

The abovementioned ranking of the sustainable mobility policies per group was finally determined by the weights given to the criteria, but the weights' impact in the final classification is not clear. Taking that into account, the "Walking weights" tool was used to identify whether the final ranking would change without the contribution of the weighted

factors. Figure 16 presents the final ranking of the policies in case of equal weights, setting a 10% weight factor per criterion (=100%/10 criteria).

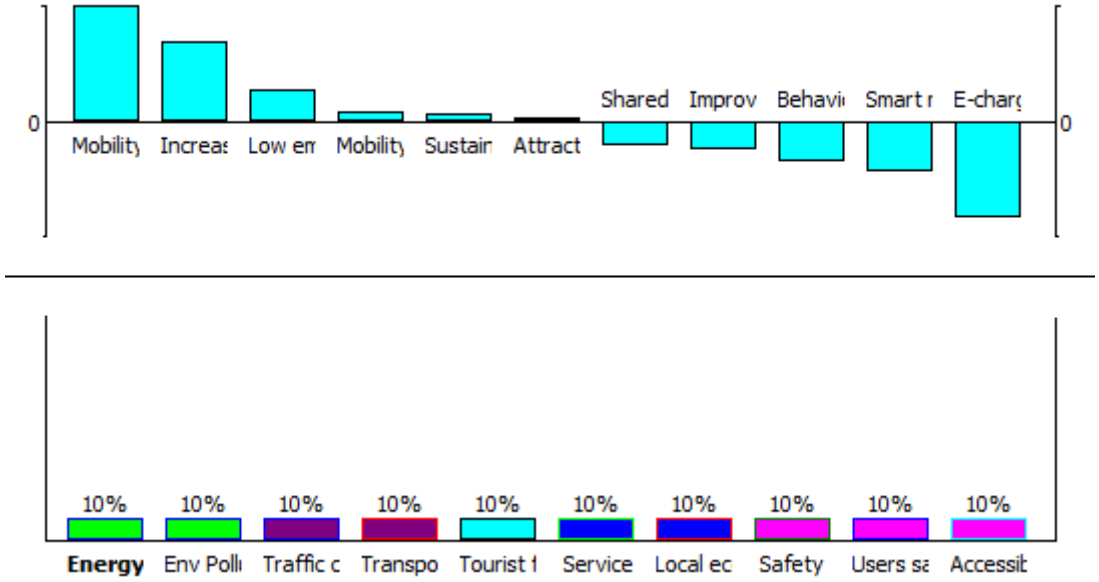


Figure 16: Walking weights for sustainable mobility criteria

It is observed that "Mobility management and travel plans" and "Increased traffic safety and security – Eco driving training" policies remain at the top of the PROMETHEE II ranking, the "E-charging infrastructures and e-vehicles in public fleets" remains at the bottom, while the ranking of the remaining policies change places for some groups. It is worth-mentioning that this ranking is not exactly the same with any of the rankings presented for EU and GR groups.

Additional tools for sensitivity analysis were applied, as provided by the Visual PROMETHEE software to explore the interval stability of the criteria. The "stability intervals" per criterion presents the alteration limits in reference to the calculated weights and this analysis can be applied in all policies in order to examine the potential alteration of the total ranking or it can even be applied to the top-ranked policies to examine how stable there are. Tables 16 & 17 present the stability interval of the weights for "Mobility management and travel plans", in reference to the weights calculated for all EU and GR groups. The minimum (2nd column) values for EU groups do not exceed 1.36% and for GR groups 8.05, while the maximum (3rd

column) values of the weights range from 17,72% to 100% for EU groups and from 15,11% to 100% for GR groups. In the case of the top ranked policy, these stability intervals indicate that this option is very stable, especially at EU level. As observed by the results, the criteria "Energy" and "Safety" are the most "sensitive" at both levels, since they present the lowest alteration limits, meaning that if the weights exceed the maximum value, the "Mobility management and travel plans" would no longer be the top ranked policy.

Table 16: Stability intervals per criterion for "Mobility management and travel plans"- EU level.

Criterion	Average Weight %	*Stability Intervals %*	
		min	*max*
C1. Energy	10.66	0.00	17.91
C2. Environmental pollution	13.83	0.00	56.45
C3. Traffic conditions	10.59	1.36	63.98
C4. Transport infrastructure	10.54	0.00	100.00
C5. Tourist flow	7.76	0.00	100.00
C6. Service finance	6.07	0.00	100.00
C7. Local economy	8.02	0.00	25.16
C8. Safety	11.53	0.00	17.72
C9. Users satisfaction	8.42	0.00	100.00
C10. Accessibility	12.59	0.00	47.00

Table 17: Stability intervals per criterion for "Mobility management and travel plans"- GR level.

Criterion	Average Weight %	*Stability Intervals %*	
		min	*max*
C1. Energy	9.35	0.00	15.11
C2. Environmental pollution	14.03	6.94	50.99
C3. Traffic conditions	9.35	6.43	58.05
C4. Transport infrastructure	9.68	0.24	100.00
C5. Tourist flow	7.79	2.73	100.00
C6. Service finance	5.65	0.00	100.00
C7. Local economy	7.08	0.00	10.33
C8. Safety	14.48	0.00	17.07

C9. Users satisfaction	8.83	8.05	100.00
C10. Accessibility	13.77	0.00	43.93

Tables 18 & 19 present in more detail the stability intervals of the weights for all stakeholders' groups in reference to the weights calculated for each criterion. In each case, the first column presents the corresponding weights per group, while the minimum (2nd column) and maximum (3rd column) values of the weights consist the stability internal, meaning that within these weight factors the final ranking remains the same.

For all groups, EU and GR, the stability intervals of the criteria were identified and it was observed that the intervals are rather narrow, often with a range below 10%. Taking that into account, it is understood that the ranking would be altered, if the weights slightly changed, especially for the medium-ranked policies.

Table 18: Stability intervals per criterion for all EU groups.

Stakeholder Group	Local authorities (LA)			Transport Operators (TO)			Tourist sector (TS)		
	Weight %	*min*	*max*	Weight %	*min*	*max*	Weight %	*min*	*max*
C1. Energy	11.36	8.99	13.39	7.27	7.07	14.10	15.76	12.12	16.28
C2. Environmental pollution	13.79	10.38	17.00	9.82	9.66	10.64	16.97	11.47	20.67
C3. Traffic conditions	11.82	6.54	15.05	13.82	6.64	13.97	8.79	2.25	14.12
C4. Transport infrastructure	11.52	8.37	12.75	12.00	11.88	17.10	10.30	6.17	17.36
C5. Tourist flow	6.21	4.09	10.54	6.55	6.42	6.79	9.70	6.38	10.18
C6. Service finance	3.64	1.64	5.36	8.55	8.47	8.65	3.94	3.13	10.11
C7. Local economy	3.48	0.36	5.87	11.45	11.19	11.55	7.58	0.00	11.25
C8. Safety	11.97	9.59	16.85	12.18	0.00	12.41	9.70	9.17	13.02
C9. Users satisfaction	11.21	7.98	14.09	4.91	0.00	5.13	6.36	5.47	9.57
C10. Accessibility	15.00	11.26	17.35	13.45	5.24	13.81	10.91	10.29	14.76

Stakeholder Group	Academic institutions (AI)			Mobility experts (MS)			Environmental groups (EG)		
	Weight %	*min*	*max*	Weight %	*min*	*max*	Weight %	*min*	*max*
C1. Energy	6.36	4.07	9.74	8.64	7.84	8.75	14.55	12.42	17.34
C2. Environmental pollution	15.00	12.60	19.87	9.85	9.55	10.01	17.58	12.89	23.81
C3. Traffic conditions	11.36	5.79	24.57	12.27	11.89	13.85	5.45	0.28	10.30
C4. Transport infrastructure	7.73	5.01	11.06	10.76	9.88	11.07	10.91	9.59	15.61
C5. Tourist flow	7.27	2.61	9.45	10.76	9.81	10.97	6.06	3.07	8.59
C6. Service finance	4.09	2.15	7.05	6.21	5.92	7.93	10.00	7.28	12.16
C7. Local economy	10.91	7.15	14.06	7.73	7.56	8.85	6.97	3.95	10.21
C8. Safety	15.45	5.11	17.28	8.33	8.07	13.19	11.52	4.39	13.81
C9. Users satisfaction	9.09	5.10	10.92	12.27	7.97	13.18	6.67	0.84	9.47
C10. Accessibility	12.73	7.28	16.09	13.18	13.07	13.59	10.30	8.58	13.70

Table 19: Stability intervals per criterion for all GR groups.

Stakeholder Group	Local authorities (LA)			Transport Operators (TO)			Tourist sector (TS)		
	Weight %	*min*	*max*	Weight %	*min*	*max*	Weight %	*min*	*max*
C1. Energy	12.27	11.89	13.48	9.09	8.84	16.74	14.55	13.54	21.45
C2. Environmental pollution	13.18	10.59	13.72	15.45	14.39	23.80	17.27	12.02	19.51
C3. Traffic conditions	9.55	6.43	12.20	14.55	6.67	20.47	9.55	4.85	14.41
C4. Transport infrastructure	8.64	8.22	10.12	11.82	11.68	18.07	8.18	6.76	16.23
C5. Tourist flow	6.36	6.09	8.82	8.18	6.61	8.50	11.82	10.93	14.04
C6. Service finance	3.64	2.11	3.91	4.55	0.63	4.84	5.00	1.93	6.23
C7. Local economy	2.73	0.00	4.36	6.36	6.01	7.55	9.55	6.57	12.82
C8. Safety	15.00	14.01	17.07	14.55	6.67	14.84	10.00	7.14	10.75
C9. Users satisfaction	13.18	12.24	13.72	1.82	0.00	2.26	4.09	1.32	5.50
C10. Accessibility	15.45	12.11	17.26	13.64	3.85	13.93	10.00	3.31	11.79

Stakeholder Group	Academic institutions (AI)			Mobility experts (MS)			Environmental groups (EG)			Local communities (LO)		
	Weight %	*min*	*max*	Weight %	*min*	*max*	Weight %	*min*	*max*	Weight %	*min*	*max*
C1. Energy	7.27	6.54	8.35	3.64	0.00	3.69	13.18	9.98	16.05	5.45	0.00	6.04
C2. Environmental pollution	13.64	9.94	15.30	10.00	9.77	14.58	17.73	13.35	21.97	10.91	9.89	11.12
C3. Traffic conditions	12.73	10.56	24.00	8.18	1.58	14.37	1.82	0.00	7.30	9.09	7.14	9.38
C4. Transport infrastructure	7.27	7.00	8.49	9.09	3.28	9.06	9.09	4.73	10.93	13.64	13.42	16.23
C5. Tourist flow	8.18	7.89	10.00	11.82	7.29	11.72	5.45	2.57	10.38	2.73	2.47	4.77
C6. Service finance	2.73	1.82	3.45	4.55	4.44	7.74	13.64	11.30	18.35	5.45	4.88	5.66
C7. Local economy	5.45	5.29	6.98	8.18	3.84	10.84	9.09	6.31	12.71	8.18	3.74	8.87
C8. Safety	15.45	15.57	16.87	17.27	13.09	22.55	11.82	9.02	13.83	17.27	12.19	18.49
C9. Users satisfaction	10.00	9.86	10.90	15.45	15.15	20.59	5.45	2.61	8.65	11.82	8.62	13.13
C10. Accessibility	17.27	12.81	19.02	11.82	5.41	15.78	12.73	6.47	14.22	15.45	15.16	20.24

5.3 Identifying stakeholders' interests

Although in this study, the weight factors do not change drastically the ranking of the policies, they can provide valuable insights on the interests of each stakeholder group and the potential differences at EU and GR level. According to the weighting process results in terms of preference, the priority criteria per group are the ones with the highest weights, as listed below (Table 20). It can be easily perceived that specific criteria have prevailed in the preferences of two or more groups, for both EU and GR level, highlighting the interdependencies between groups' interests.

Table 20: Priority and least important criteria for all EU and GR stakeholder groups

Stakeholder Group	Priority Criteria – EU level	Least Important Criteria – EU level	Priority Criteria – GR level	Least Important Criteria – GR level
Local authorities	Accessibility, Environmental pollution	Service finance	Accessibility, Safety	Local Economy
Transport Operators	Traffic conditions, Accessibility	Tourist flow	Environmental pollution, Traffic conditions	Users satisfaction
Tourist sector	Environmental pollution, Energy	Service finance	Environmental pollution, Energy	Users satisfaction
Academic institutions	Safety, Environmental pollution	Service finance	Accessibility, Safety	Service finance
Mobility experts	Accessibility, Traffic conditions, Users satisfaction	Service finance	Safety, Users satisfaction	Energy
Environmental groups	Environmental pollution, Energy	Traffic conditions	Environmental pollution, Energy	Traffic conditions
Local communities	-	-	Safety, Accessibility	Tourist flow

Most EU groups emphasise on at least two out of five criteria categories: Society and Environment or Society and Mobility. The most important criteria are Environmental pollution, Accessibility, Safety, Energy, and Traffic conditions. On the contrary, all GR groups, except Transport Operators, emphasize in one category, although the overall priority criteria are the same. Greek Local authorities, Academic Institutions, Mobility Experts and Local Communities give priority strictly to social criteria, indicating that Greek stakeholders express the strong need to increase the quality of mobility for users.

Overall, two stakeholder groups present specific but anticipated priorities: Local Communities and Environmental Groups (EU and GR) who give priority strictly to environmental criteria, as expected [47], [52], [101]. However, both EU and GR Tourism Sector also place the highest weights on environmental criteria [102], followed by social and tourism criteria, acknowledging the raised awareness on the links of tourism and environmental pollution [8].

Regarding the least important criteria, service finance prevailed for most EU level groups, indicating that the economic demands would not determine the implementation of a potential mobility policy. On the contrary, Greek groups do not share the same views, since the least important criteria differentiate almost per group and can be even contradicting, since one groups' priority criterion is considered the least important by another group (i.e. energy).

Overall, it is clear that most groups give priority to criteria regarding the wellbeing of local communities and the quality of life, despite the economic implications of services and the potential impact on incoming tourism.

5.4 Analysis of top-ranked policies

Given the importance of priority criteria, a further analysis of the top-ranked policies is provided in order to examine their performance on these criteria. The GAIA Web (a spider web display) is used for the graphical representation of the net flow of each action (-1 at the centre, +1 on the outer circle) with respect to each one of the criteria. The radial distance corresponds to the net flow score, while the criteria are displayed in a specific order. As an additional feature in the GAIA web, criteria that express similar preferences are located close to each other, to facilitate understanding. The following figures (Fig. 17-19) present the GAIA Webs for the three top-ranked policies.

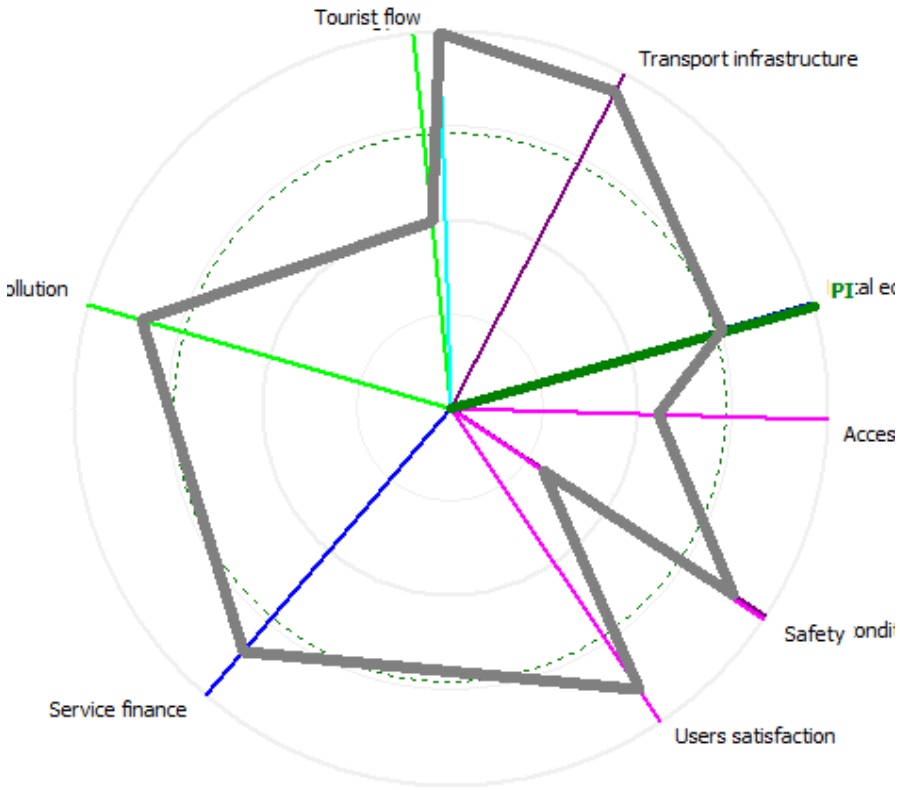


Figure 17: GAIA Web for "Mobility management and travel plans"

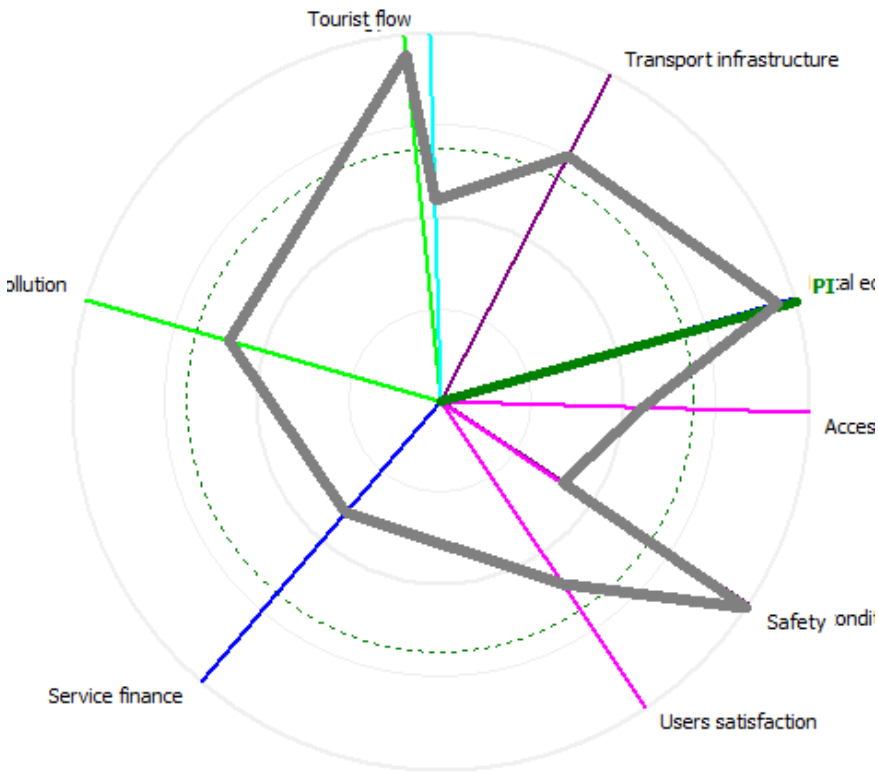


Figure 18: GAIA Web for "Increased traffic safety and security – Eco driving training"

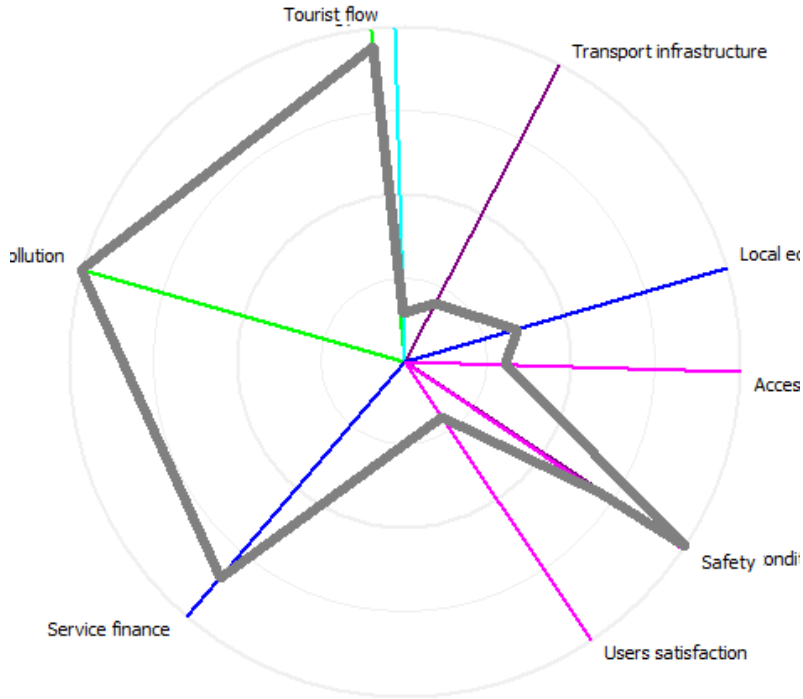


Figure 19: GAIA Web for "Low emission zones and parking management"

According to the graphs (Fig 17-19), their scores on the priority criteria vary. “Mobility management and travel plans” policy presents higher scores in traffic conditions and environmental pollution, but low scores in safety. “Increased traffic safety and security – Eco driving training” policy presents better scores in safety and energy, but low scores in environmental pollution. They both present high scores in accessibility, whereas “Low emission zones and parking management” policy presents high scores in environmental pollution, energy and traffic conditions, but a low score in accessibility. These scores, along with the net flows in the rest of the criteria, resulted in the final ranking of the policies, since “Mobility management and travel plans” policy displays good scores in other criteria too, although this policy does not display the optimal values in all priority criteria. Therefore, the ranking consists of a suggestion based on overall performance, but it can be adopted or rejected by a decision-maker in order to achieve optimal results according to specific needs.

5.5 Methodological difficulties and lessons learnt

This study, although it was based on a well-known methodology, presented some challenges during its conduction.

One of the main challenges was the collection of questionnaires sent to several stakeholders for the evaluation of the criteria. Some of the actors contacted were more easily accessible and cooperative, especially for the Greek groups, therefore the data were collected within days. However, other groups were difficult to be reached or did not respond to the request vigorously regarding the completion of the questionnaires, taking even more than a month in certain cases. However, even if the first attempt was not fruitful, several answers were provided after contacting the actors again. A general comment received during this process was that the questionnaire was

simple to complete but thorough enough to provide all vital information. The questionnaire's form was a key motivational factor for the successful collection of the required input.

Although the abovementioned challenge regarding delayed responses was faced for all stakeholder groups, certain group categories were even more challenging to access, thus risking the adequate representation of the groups. In terms of participation, the tourism sector and the local communities were particularly "difficult" teams to involve. This fact indicates the lack of awareness and/ or active engagement and participation in mobility planning processes. Exceptionally fast answers were provided by academic institutions and mobility experts, for both local and EU level. Tables 21 & 22 below, present the number of actors contacted per stakeholder group, the number of answers received and the final share of contribution per group in the total answers.

Table 21: Share of contribution per EU group in criteria evaluation

STAKEHOLDER GROUP	No. of actors contacted	Answers received
Local authorities (LA)	7	6
Transport Operators (TO)	8	5
Tourism sector (TS)	7	3
Academic institutions (AI)	6	4
Mobility experts (ME)	8	6
Environmental groups (EG)	4	3
Local communities (LC)	2	0
Total		27

Table 22: Share of contribution per Greek group in criteria evaluation

STAKEHOLDER GROUP	No. of actors contacted	Answers received
Local authorities (LA)	3	2
Transport Operators (TO)	3	2
Tourism sector (TS)	5	2

Academic institutions (AI)	3	2
Mobility experts (ME)	2	2
Environmental groups (EG)	3	2
Local communities (LC)	7	2
Total		29

Another great challenge faced concerned the data research to form the evaluation matrix for the sustainable mobility policies. More specifically, it was extremely difficult to gather the necessary data for this large scale analysis, because even when scientific researches for the specific policies were identified, most of them focused in quantitative elements of specialised cases and it was unlikely to include results regarding all criteria examined. However, sustainable mobility is a widely researched field with a significant range of publications available and also numerous demonstration projects, that have been implemented during the last decade. The evaluation results of already implemented activities can be a valuable source of data, that can be used for a high-quality estimation of the performance of sustainable mobility policies and a cross-reference between scientific evidence and practical implementation results.

Finally, regarding the selected method and tools to conduct the multi-criteria analysis for the evaluation of sustainable mobility policies, PROMETHEE is a well-established method, comprehensible and easy to apply. In addition, the widely-used Visual PROMETHEE and GAIA software was selected for the visual display of results, since the academic edition provides all main functionalities. The software was user-friendly and manageable, simplified the analysis, facilitating the scope of this research without any difficulties faced. However, it was observed that the presentation of results and the generated graphs can be complicated and even difficult to interpret, especially in cases of complex problems with numerous parameters.

Chapter 6: Conclusions and recommendations for the future

The study aimed to conduct an assessment of 11 sustainable urban mobility measures for European medium-sized touristic cities in the Mediterranean, integrating European and Greek stakeholders' viewpoint through multi-criteria decision making, and more specifically, by using the PROMETHEE model. As additional elements, the study incorporated a) the tourism aspects in various steps of the analysis and b) a two-level stakeholder involvement approach and comparison of European and local stakeholders' interest and results.

The sustainable mobility policies were evaluated according to 10 specific criteria, covering 5 main categories: Environment, Mobility, Tourism, Economy and Society. The criteria were evaluated by 6 European and 7 Greek stakeholder groups through a questionnaire, identifying their preferences and interests in the selection of appropriate mobility policies. This is a vital step in order to ensure the analysis is in line with identified needs and preferences, providing thus a holistic approach. At the Greek level, one additional group was included (Local Communities) that was not compared to an EU group, but provided useful insight on this group's views.

The study showed that most stakeholders give priority to the wellbeing of local communities and the quality of life, despite the economic implications of services and the potential impact on incoming tourism. Most EU groups emphasise on at least two out of five criteria categories: Society and Environment or Society and Mobility. Greek stakeholder groups emphasise on one criteria category per group and their priority criteria were mainly society-related. Greek Local authorities, Academic Institutions, Mobility Experts and Local Communities gave priority strictly to social criteria, expressing their preference to increase the quality of mobility for users. Interestingly, both EU and GR Tourism Sector groups expressed a preference for environmental

criteria, highlighting the continuously raising awareness on the links of tourism and environmental pollution.

Overall, environmental pollution, accessibility, safety, energy and traffic conditions were identified as the most important criteria. Service finance prevailed as the least important for most EU level groups, while for Greek groups the least important criteria differentiate almost per group and can be even contradicting

The criteria evaluation besides the comparison of interests between the EU and GR groups, was also the base for weights calculation that was incorporated in the analysis for the generation of the results through the VISUAL PROMETHEE software and the ranking of the policies for each stakeholder group.

For all EU and GR stakeholder groups, “Mobility management and travel plans” was classified as the most suitable policy, indicating that the provision of information, personalised plans and smart applications can increase the use of sustainable mobility modes and have a significant positive impact in all examined categories. On the other hand, the “E-charging infrastructures and e-vehicles in public fleets” was classified for all groups as the worst option, and although it is considered the “green” alternative to conventional vehicles, this policy doesn’t present significant impacts to all aspects examined.

During the sensitivity analysis, even when equal criteria weights were applied, “Mobility management and travel plans” remained at the top of the PROMETHEE II ranking. However, the total ranking was not exactly the same with any one of the rankings presented for the EU and GR groups. In the case of the top ranked policy, its stability was also confirmed by the stability intervals identified of all criteria. However, the total ranking of policies would be altered if the

weights slightly changes, especially for the medium-ranked policies, since for all groups, EU and GR, the stability intervals were rather narrow.

Overall, the total classification for all EU stakeholder groups did not present significant differences compared to Greek groups, since the only difference between the two levels were at two low-ranked policies. The same applied for the final rankings of most EU and Greek stakeholder groups, that presented very similar rankings. However, Greek Academic institutions and Mobility experts presented the highest number of differences with the respective EU groups.

Examining also the similarities between same level groups, it was observed that EU groups presented greater uniformity in their preferences and final ranking, compared to the GR groups, although strong similarities were observed between GR group pairs (Local authorities and Transport Operators, Greek Mobility experts and Environmental groups). Local communities present the least similarities in their total ranking with the other groups, but still present the same ranking for the top and low ranked policies.

As stated before, this analysis ranked and identified the optimal sustainable mobility policies, based on their overall performance to the weighted criteria. However, when the three top-ranked policies are further analysed according to their performance on priority criteria, it was observed that although they present a good overall performance, one may overcome the other on certain criteria. Taking that into account, it is understandable that the ranking consists of a suggestion and the final selection by a decision-maker can alter, according to targeted needs.

Finally, regarding the conduction of the analysis, PROMETHEE proved a comprehensible method to apply, suitable when handling numerous parameters and qualitative data, while Visual PROMETHEE and GAIA software simplified the analysis and the presentation of results. The main challenges faced concerned the participation of stakeholders and the delayed responses to the

questionnaires, especially the tourism sector and the local communities, who were the most "difficult" teams to involve. Follow-up communication and a simple questionnaire can be a motivation for actors' participation. Moreover, the complexity of the analysis required extensive search due to the highly heterogeneous data of relevant studies. However, evaluation results of already implemented activities can be a valuable source of data, in conjunction with scientific research.

The above mentioned conclusions led to the identification of possible improvements and recommendations for future research.

As mentioned above, the incorporation of stakeholders' view has been proven an essential element for a holistic approach. Although this analysis proposes the optimal alternative solution for each involved stakeholder group according to their preferences, this specific study could be further enhanced by the increase of the participating stakeholders, in order to create a more representative sample of actors. Especially the inclusion of local communities and users at EU level would make the comparison of the two levels feasible.

Regarding the examined criteria, a recommendation for further research would be the addition of a time-related criterion to evaluate the preparation and implementation period per policy required to present potential impact and, thus, identify short-term and long-term measures, that might be more suitable according to the specific areas. On the other hand, the financial criteria could be removed from the assessment, since they were considered the least important criteria and can be further examined through a cost-benefit analysis, if required. Moreover, the fact that external funding sources can be found makes financial implications even less concerning local authorities.

Additionally, the completion of the evaluation matrix with available data related to a very specific city/area type or with real data collected/ monitored in the examined city will strengthen the

analysis, providing more precision to the produced results and thus facilitate future local policy shaping. Moreover, it would be also interesting for decision-makers to conduct an assessment of different sustainable mobility policies that can be set under the same thematic area (for example different safety measures or various smart metering systems), in case a specific area of intervention of already identified, or even proceed to such approach as a "second" stage analysis, following the suggestions of the initial analysis.

Overall, the multi-criteria analysis performed in this study can be a valuable tool for decision-makers during the planning and forming future policies for sustainable mobility in urban tourist destinations, taking into account numerous parameters and stakeholders viewpoint, but also it can be further developed and adapted to specific needs.

References

[1] International Energy Agency, “Key world energy statistics,” 2018.

[2] International Energy Agency, “Key World Energy Trends - Excerpt from : World energy balances,” 2016.

[3] European Parliamentary Research Service, “Reducing CO2 emissions from transport,” 2015.

[4] G. Santos, “Road transport and CO2 emissions: What are the challenges ?,” *Transp. Policy*, vol. 59, no. November 2015, pp. 71–74, 2017.

[5] J. M. Downard and J. M. Downard, “Particulate emissions of tire combustion by,” 2014.

[6] European Commission, “EU Transport in figures: Statistical Pocketbook,” Publications Office of the European Union, Luxembourg, 2017.

[7] T. Letnik, G. Luppino, and A. Bardi, “Review of policies and measures for sustainable and energy ef fi cient urban transport,” vol. 163, 2018.

[8] S. Abdul, R. Khan, D. Qianli, W. Songbo, K. Zaman, and Y. Zhang, “Travel and tourism competitiveness index : The impact of air transportation , railways transportation , travel and transport services on international inbound and outbound tourism,” *J. Air Transp. Manag.*, vol. 58, pp. 125–134, 2017.

[9] Global Road Safety Facility, “Transport for Health - The Global Burden of Disease from Motorized Road Transport,” 2010.

[10] W. Gronau, “Encouraging behavioural change towards sustainable tourism : a German approach to free public transport for tourists a German approach to free public transport for

tourists," *J. Sustain. Tour.*, vol. 9582, no. November, 2016.

[11] W. Gronau, "On The Move : Emerging Fields of Transport Research in Urban Tourism," in *Tourism in the City.*, N. Bellini and C. Pasquinelli, Eds. Springer, Cham, 2017, pp. 81–91.

[12] G. Lohmann and D. T. Duval, "Destination morphology : A new framework to understand tourism – transport issues ?," *J. Destin. Mark. Manag.*, vol. 3, pp. 133–136, 2014.

[13] European Commission, "Commission Decision of 14 December 2006 determining the respective emission levels allocated to the Community and each of its Member States under the Kyoto Protocol pursuant to Council Decision 2002/358/EC (notified under document number C(2006) 6468) (20," 2006.

[14] European Commission, "Green Paper: A 2030 framework for climate and en." Brussels, 2013.

[15] Europen Commission, "White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM (2011) 144," 2011.

[16] M. Tsami, "A ' Greening Mobility ' framework towards s ustainability," *Transp. Res. Procedia*, vol. 24, pp. 131–136, 2017.

[17] United Nations, "Framework Convention on Climate Change," Paris, 2015.

[18] United Nations, "Transforming our world: the 2030 agenda for sustainable development," 2015.

[19] Europen Commission, "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A European Strategy for Low-Emission Mobility," 2016.

[20] Europen Commission, “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Europe on the move - An agenda for a socially fair transition towards clean, competitive and connected ,” 2017.

[21] Europen Commission, “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Europe on the move - Sustainable Mobility for Europe: safe, connected and clean, Brussels, 17.5.2018 CO,” Brussels, 2018.

[22] A. Martos, R. Pacheco-torres, J. Ordóñez, and E. Jadraque-gago, “Towards successful environmental performance of sustainable cities : Intervening sectors . A review,” *Renew. Sustain. Energy Rev.*, vol. 57, pp. 479–495, 2016.

[23] P. Jones, “The evolution of urban mobility : The interplay of academic and policy perspectives ☆,” *IATSSR*, vol. 38, no. 1, pp. 7–13, 2014.

[24] M. Lindenau and S. Böhler-baedeker, “Citizen and stakeholder involvement : a precondition for sustainable urban mobility,” *Transp. Res. Procedia*, vol. 4, pp. 347–360, 2014.

[25] E. Arsenio, K. Martens, and F. Di, “Research in Transportation Economics Sustainable urban mobility plans : Bridging climate change and equity targets ?,” *Res. Transp. Econ.*, vol. 55, pp. 30–39, 2016.

[26] ELTISplus, “Guidelines. Developing and Implementing a Sustainable Urban Mobility Plan.,” 2014.

[27] S. Page and Y. G. Ge, “Transportation and tourism: A symbiotic relationship?,” no. January 2009, 2016.

[28] E. Aguiló, T. Palmer, and J. Rosselló, “Road transport for tourism: evaluating policy measures from consumer profiles,” vol. 18, no. 2, pp. 281–293, 2012.

[29] J. Rosselló and O. Saenz-de-miera, “Road accidents and tourism : The case of the Balearic Islands (Spain),” vol. 43, pp. 675–683, 2011.

[30] O. Saenz-de-miera and J. Rosselló, “The responsibility of tourism in traffic congestion and hyper-congestion: A case study from Mallorca , Spain,” *Tour. Manag.*, vol. 33, no. 2, pp. 466–479, 2012.

[31] P. Ghadimi, A. H. Azadnia, N. M. Yusof, M. Zameri, and M. Saman, “A weighted fuzzy approach for product sustainability assessment : a case study in automotive industry,” *J. Clean. Prod.*, vol. 33, pp. 10–21, 2012.

[32] E. Topuz, I. Talinli, and E. Aydin, “Integration of environmental and human health risk assessment for industries using hazardous materials : A quantitative multi criteria approach for environmental decision makers,” *Environ. Int.*, vol. 37, no. 2, pp. 393–403, 2011.

[33] F. Cavallaro, “Multi-criteria decision aid to assess concentrated solar thermal technologies,” *Renew. Energy*, vol. 34, no. 7, pp. 1678–1685, 2009.

[34] D. Browne, B. O. Regan, and R. Moles, “Use of multi-criteria decision analysis to explore alternative domestic energy and electricity policy scenarios in an Irish city-region q,” *Energy*, vol. 35, no. 2, pp. 518–528, 2010.

[35] G. Tavares, Z. Zsigraiová, and V. Semiao, “Multi-criteria GIS-based siting of an incineration plant for municipal solid waste,” *Waste Manag.*, vol. 31, no. 9–10, pp. 1960–1972, 2011.

[36] N. Roussat, C. Dujet, and J. Méhu, “Choosing a sustainable demolition waste management strategy using multicriteria decision analysis,” *Waste Manag.*, vol. 29, no. 1, pp. 12–20, 2009.

[37] M. Bottero, E. Comino, and V. Riggio, “Environmental Modelling & Software Application of the Analytic Hierarchy Process and the Analytic Network Process for the assessment of different wastewater treatment systems,” *Environ. Model. Softw.*, vol. 26, no. 10, pp. 1211–1224, 2011.

[38] L. Diaz-balteiro, J. González-pachón, and C. Romero, “Measuring systems sustainability with multi-criteria methods : A critical review,” *Eur. J. Oper. Res.*, vol. 258, no. 2, pp. 607–616, 2017.

[39] M. B. Barfod, K. B. Salling, and S. Leleur, “Composite decision support by combining cost-bene fi t and multi-criteria decision analysis,” *Decis. Support Syst.*, vol. 51, no. 1, pp. 167–175, 2011.

[40] C. Macharis, J. Springael, K. De Brucker, and A. Verbeke, “PROMETHEE and AHP : The design of operational synergies in multicriteria analysis . Strengthening PROMETHEE with ideas of AHP,” vol. 153, pp. 307–317, 2004.

[41] K. Kowalski, S. Stagl, R. Madlener, and I. Omann, “Sustainable energy futures : Methodological challenges in combining scenarios and participatory multi-criteria analysis q,” *Eur. J. Oper. Res.*, vol. 197, no. 3, pp. 1063–1074, 2009.

[42] A. Papadopoulos and A. Karagiannidis, “Application of the multi-criteria analysis method Electre III for the optimisation of decentralised energy systems ̈,” vol. 36, pp. 766–776, 2008.

[43] T. Tsoutsos, M. Drandaki, N. Frantzeskaki, E. Iosifidis, and I. Kiosses, “Sustainable energy planning by using multi-criteria analysis application in the island of Crete,” vol. 37, pp. 1587–1600, 2009.

[44] J. Terrados, G. Almonacid, and P. Pe, “Proposal for a combined methodology for renewable energy planning . Application to a Spanish region,” vol. 13, pp. 2022–2030, 2009.

[45] A. Stamatakis, M. Mandalaki, and T. Tsoutsos, “Multi-criteria analysis for PV integrated in shading devices for Mediterranean region,” *Energy Build.*, vol. 117, pp. 128–137, 2016.

[46] L. Turcksin, C. Macharis, K. Lebeau, F. Boureima, J. Van Mierlo, S. Bram, J. De Ruyck, L. Mertens, J. Jossart, L. Gorissen, and L. Pelkmans, “A multi-actor multi-criteria framework to assess the stakeholder support for different biofuel options : The case of Belgium,” *Energy Policy*, vol. 39, no. 1, pp. 200–214, 2011.

[47] C. Macharis, A. De Witte, and L. Turcksin, “The Multi-Actor Multi-Criteria Analysis (MAMCA) application in the Flemish long-term decision making process on mobility and logistics,” *Transp. Policy*, vol. 17, no. 5, pp. 303–311, 2010.

[48] C. Macharis and A. Bernardini, “Reviewing the use of Multi-Criteria Decision Analysis for the evaluation of transport projects : Time for a multi-actor approach,” *Transp. Policy*, vol. 37, pp. 177–186, 2015.

[49] C. Macharis, “Multi-Criteria Analysis Methodology (MAMCA) for the Evaluation of Transport Projects : Theory and Practice,” vol. 43, no. 2, pp. 183–202, 2008.

[50] H. Sun, Y. Zhang, Y. Wang, L. Li, and Y. Sheng, “A social stakeholder support assessment of low-carbon transport policy based on multi-actor multi-criteria analysis : The case of Tianjin,” *Transp. Policy*, vol. 41, pp. 103–116, 2015.

[51] T. T. Taefi, J. Kreutzfeldt, T. Held, and A. Fink, “Supporting the adoption of electric vehicles in urban road freight transport – A multi-criteria analysis of policy measures in Germany,” vol. 91, pp. 61–79, 2016.

[52] P. Lebeau, C. Macharis, J. Van Mierlo, and M. Janjevic, “Improving policy support in city logistics : The contributions of a multi-actor multi-criteria analysis,” *Case Stud. Transp. Policy*, vol. 6, no. 4, pp. 554–563, 2018.

[53] M. Behzadian, R. B. Kazemzadeh, A. Albadvi, and M. Aghdasi, “PROMETHEE : A comprehensive literature review on methodologies and applications,” *Eur. J. Oper. Res.*, vol. 200, no. 1, pp. 198–215, 2010.

[54] J. P. Brans and P. Vincke, “Note — A Preference Ranking Organisation Method,” *Manage. Sci.*, vol. 31, no. 6, pp. 647–656, 1985.

[55] J.-P. Brans and B. Mareschal, *Promethee Methods. In: Multiple Criteria Decision Analysis: State of the Art Surveys. International Series in Operations Research & Management Science*, no. 78. Springer, New York, NY, 2005.

[56] K. Lidouh, Y. De Smet, and E. Zim, “GAIA Map : A Tool for Visual Ranking Analysis in Spatial Multicriteria Problems GAIA Map : A Tool for Visual Ranking Analysis in Spatial Multicriteria Problems,” no. May 2014, 2009.

[57] T. Tsoutsos, V. Mathioudakis, E. Farmaki, and S. Energy, “Impact assessment of sustainable mobility in touristic cities of Europe : The CIVITAS DESTINATIONS approach on energy , environment and economy.”

[58] A. Awasthi, H. Omrani, and P. Gerber, “Investigating ideal-solution based multicriteria decision making techniques for sustainability evaluation of urban mobility projects,”

Transp. Res. Part A, vol. 116, no. May, pp. 247–259, 2018.

[59] E. Pisoni, P. Christidis, P. Thunis, and M. Trombetti, "Evaluating the impact of ' Sustainable Urban Mobility Plans ' on urban background air quality," *J. Environ. Manage.*, vol. 231, no. August 2018, pp. 249–255, 2019.

[60] J. Maria, M. E. Lopez-lambas, H. Gonzalo, M. Rojo, and A. Garcia-martinez, "Methodology for assessing the cost effectiveness of Sustainable Urban Mobility Plans (SUMPs). The case of the city of Burgos," *J. Transp. Geogr.*, vol. 68, no. February, pp. 22–30, 2018.

[61] S. Nocera, S. Tonin, and F. Cavallaro, "Carbon estimation and urban mobility plans : Opportunities in a context of austerity," *Res. Transp. Econ.*, vol. 51, pp. 71–82, 2015.

[62] M. Á. Mozos-blanco, E. Pozo-menéndez, R. Arce-ruiz, and N. Baucells-aletà, "The way to sustainable mobility . A comparative analysis of sustainable mobility plans in Spain," *Transp. Policy*, vol. 72, no. February 2017, pp. 45–54, 2018.

[63] Various, "Traffic visualization system in Burgos, Measure implementation, Caravel Projet," Burgos.

[64] Various, "Info-mobility tools in Burgos, Measure implementation, Caravel Project," Burgos.

[65] M. Rannala and T. Metsvahi, "Measure Evaluation Results, TAL 8.3 Real-time information system, MIMOSA Proje," 2013.

[66] M. Rosa and M. Arce, "Smart Mobility Mobility and and Smart Smart Environment Environment in in the the Spanish Spanish cities cities," *Transp. Res. Procedia*, vol. 24, pp.

163–170, 2017.

[67] J. Zawieska and J. Pieriegud, “Smart city as a tool for sustainable mobility and transport decarbonisation,” *Transp. Policy*, vol. 63, no. November 2017, pp. 39–50, 2018.

[68] H. Jeekel and H. Jeekel, “Social Sustainability and Smart Mobility : Exploring the Social Sustainability and Smart Mobility : Exploring the relationship relationship,” *Transp. Res. Procedia*, vol. 25, pp. 4296–4310, 2017.

[69] J. N. Barkenbus, “Eco-driving : An overlooked climate change initiative,” *Energy Policy*, vol. 38, no. 2, pp. 762–769, 2010.

[70] P. Schepers, E. Fishman, R. Beelen, E. Heinen, W. Wijnen, and J. Parkin, “The mortality impact of bicycle paths and lanes related to physical activity , air pollution exposure and road safety,” vol. 2, pp. 460–473, 2015.

[71] Various, “Safe districts and 30km-zone + Road safety measures, ARCHIMEDES Project,” Donostia–San Sebastián.

[72] Various, “D5.1 – Development and Experience of Safety and Security Demonstrations in ARCHIMEDES,” no. November, pp. 1–29, 2012.

[73] R. Elvik, “Which are the relevant costs and benefits of road safety measures designed for pedestrians and cyclists ?,” vol. 32, pp. 37–45, 2000.

[74] J. Stark, J. Frühwirth, and F. Aschauer, “Exploring independent and active mobility in primary school children in Vienna,” *J. Transp. Geogr.*, vol. 68, no. January 2017, pp. 31–41, 2018.

[75] G. Pedr, “Evaluation of a walking school bus service as an intervention for a modal shift at

a primary school in Spain,” vol. 64, no. February, pp. 1–9, 2018.

[76] Various, “School Travel Plans in Monza, ARCHIMEDES Project,” Monza, 2012.

[77] Various, “Measure Evaluation Results UTR 6.2 Car sharing, MIMOSA Project,” no. February, 2013.

[78] Various, “Car-Sharing Scheme, ARCHIMEDES Project,” Donostia–San Sebastián.

[79] Various, “Measure Evaluation City Bike Scheme City, ARCHIMEDES Project,” 2011.

[80] Various, “Measure Evaluation Results UTR 6.1 Public and Rental bikes, MIMOSA Project,” 2013.

[81] W. Li and M. Kamargianni, “Providing quanti fi ed evidence to policy makers for promoting bike- sharing in heavily air-polluted cities : A mode choice model and policy simulation for Taiyuan-China,” *Transp. Res. Part A*, vol. 111, no. February 2017, pp. 277–291, 2018.

[82] E. Karaaslan, M. Noori, J. Lee, L. Wang, and O. Tatari, “Modeling the e ff ect of electric vehicle adoption on pedestrian tra ffi c safety : An agent-based approach,” vol. 93, no. October 2016, pp. 198–210, 2018.

[83] S. Bebelis, H. Karasali, and C. G. Vayenas, “Electrochemical promotion of CO2 hydrogenation on Rh/YSZ electrodes,” *J. Appl. Electrochem.*, vol. 38, no. 8, pp. 1127–1133, 2008.

[84] Various, “Measure Evaluation Results FUN 1.1 Sustainable Fleet, MIMOSA Projec,” 2013.

[85] C. Petit, “report Electric vehicles in municipal fleets in,” no. November 2016.

[86] Various, “Clean Municipal Fleet, SMILE Project,” pp. 1–26, 2008.

[87] Various, “Measure Evaluation - Mobility Centre, SMILE Project,” pp. 1–20.

[88] S. Bamberg and J. Rees, “The impact of voluntary travel behavior change measures – A meta-analytical comparison of quasi-experimental and experimental evidence,” *Transp. Res. Part A*, vol. 100, pp. 16–26, 2017.

[89] Various, “Measure Evaluation - New mobility services for visitors in Burgos, Caravel project,” pp. 1–19.

[90] B. O. L. M. Managers and D. Rossi, “Measure Evaluation Results BOL 4.1 Mobility Managers, MIMOSA Project,” 2013.

[91] A. R. A. V. L. Silva, “Measure Evaluation FUN 4.1 – Awareness Raising Campaign for Sustainable Mobility, MIMOSA Project,” 2013.

[92] Various, “Measure Evaluation Results GDA 4.4 Mobility Management – Advertising and Promotion, MIMOSA Project,” Gdansk, 2013.

[93] Various, “Access restriction policies in Craiova, MODERN Project,” Craiova.

[94] Various, “Superblocks Concept for Access Restriction, CIVITAS Modern,” Vitoria-Gasteiz, 2012.

[95] Various, “New Low Emission Zone, SMILE Project,” Norwich.

[96] Various, “Clear Zone in Brighton & Hove, ARCHIMEDES Project,” Brighton & Hove, 2012.

[97] A. Varley, L. County, M. Aubineau, U. Community, M. Lamandi, and P. Municipiului, “Deliverable 8 of the Success Project: Stimulation of Collective Transport Modes,” no. October, 2009.

[98] W. Gronau and A. Kagermeier, “Key factors for successful leisure and tourism public transport provision,” vol. 15, pp. 127–135, 2007.

[99] Various, “Measure Evaluation Results FUN 2.3 Public Urban Transport Planning Centre, MIMOSA Project,” 2013.

[100] R. Guglielmetti, M. Toni, H. Raharjo, L. Di, and S. Petros, “Does the service quality of urban public transport enhance sustainable mobility ?,” *J. Clean. Prod.*, vol. 174, pp. 1566–1587, 2018.

[101] R. Bergqvist, C. Macharis, D. Meers, and J. Woxenius, “Making hinterland transport more sustainable a multi actor multi criteria analysis,” *Res. Transp. Bus. Manag.*, vol. 14, pp. 80–89, 2015.

[102] A. V Michailidou, C. Vlachokostas, and N. Moussiopoulos, “Interactions between climate change and the tourism sector : Multiple-criteria decision analysis to assess mitigation and adaptation options in tourism areas,” vol. 55, 2016.

Annex

I. Evaluation of criteria: Guidelines and questionnaire

The following figures (Figures A1 and A2) present the guidelines and the questionnaire provided to all stakeholders for the evaluation of examined criteria.

TECHNICAL UNIVERSITY OF CRETE (TUC)
SCHOOL OF ENVIRONMENTAL ENGINEERING
RENEWABLE AND SUSTAINABLE ENERGY
SYSTEMS LABORATORY

A MULTI-CRITERIA ANALYSIS OF SUSTAINABLE MOBILITY POLICIES IN TOURISTIC AREAS

GUIDELINES FOR THE EVALUATION OF CRITERIA

The multi-criteria analysis will be used to evaluate mobility policies towards sustainable transportation in touristic cities. A package of sustainable mobility policies will be evaluated according to specific criteria, covering 5 main categories: Environment, Mobility, Tourism, Economy and Society. The 10 criteria will be evaluated according to their significance in the selection of appropriate mobility policies and their ranking will provide required data for the calculation of corresponding weights for the analysis.

This analysis is part of a wider effort to promote alternative and sustainable mobility solutions and to provide a planning tool for public authorities and policy makers while addressing mobility challenges.

A short presentation of the mobility policies package that will be evaluated is included bellow.

Sustainable Mobility Policies

- *Sustainable Urban Mobility Plans / Sustainable Urban Logistic Plans*
- *Smart metering systems / Real-time mobility information*
- *Increased traffic safety and security – Eco driving training*
- *Mobility plans for school communities*
- *Attractive and accessible public spaces*
- *Shared mobility services (bike, car, taxi)*
- *E-charging infrastructures and e-vehicles in public fleets*
- *Mobility management and travel plans*
- *Behavioural change and informative actions*
- *Low emission zones and parking management*
- *Improved and accessible PT services for tourists and residents*

For the evaluation of the mobility policies package, ten (10) criteria will be prioritised. The following table includes the 10 criteria and a sort description for each of them. Ideally, a sustainable mobility strategy will optimise the value of the green criteria and reduce the red criteria.

Table 2: Description of evaluation criteria

CATEGORY	CRITERION	DESCRIPTION
Environment	1. Energy ⬇	i.e. Energy consumption, share of conventional fuel
	2. Environmental pollution ⬇	i.e. Average GHG emissions, Noise level
Mobility	3. Traffic conditions ⬆	i.e. Modal share of alternative transport, Vehicles occupancy, Traffic

TECHNICAL UNIVERSITY OF CRETE (TUC)
SCHOOL OF ENVIRONMENTAL ENGINEERING
RENEWABLE AND SUSTAINABLE ENERGY
SYSTEMS LABORATORY

		flow
	4. Transport infrastructure ⬆	i.e. Intermodal intergration of transport services
Tourism	5. Tourist flow ⬆	i.e. No. of incoming tourists, GDP generated by tourism
Economy	6. Service finance ⬇	i.e. Cost of new services and infrastructure
	7. Local economy ⬆	i.e. Affordability of public transport services, Financial gain by new services and infrastructure
Society	8. Safety ⬆	i.e. Level of perceived safety and security, No. of road incidents
	9. Users Satisfaction ⬆	i.e. Level of satisfaction and level of acceptance of the mobility policies
	10. Accessibility ⬆	i.e. Level of accessibility of transport services, accessibility of public spaces

Figures A1: Guidelines for the completion of the questionnaire

TECHNICAL UNIVERSITY OF CRETE (TUC)
SCHOOL OF ENVIRONMENTAL ENGINEERING
RENEWABLE AND SUSTAINABLE ENERGY
SYSTEMS LABORATORY

A MULTI-CRITERIA ANALYSIS OF SUSTAINABLE MOBILITY POLICIES IN TOURISTIC AREAS

QUESTIONNAIRE FOR THE EVALUATION OF CRITERIA

The table below aims to present the prioritisation of specific criteria, that can be taken into account to evaluate different mobility policies, according to your opinion.

Please, complete in the last column of the Table 1 the criteria (insert each criterion in a row), based on your order of preference. You may insert more than one criteria in the same row, if you consider that specific criteria are equally important. The classification of the criteria starts from the most important criterion and gradually leading to the least important: **1- Most important, 10 - Least important.**

*The 10 criteria are: **Energy, Environmental pollution, Traffic conditions, Transport infrastructure, Tourist flow, Service finance, Local economy, Safety, Users satisfaction, Accessibility**.*

More information and guidelines can be found in the file "MULTI-CRITERIA ANALYSIS-GUIDELINES".

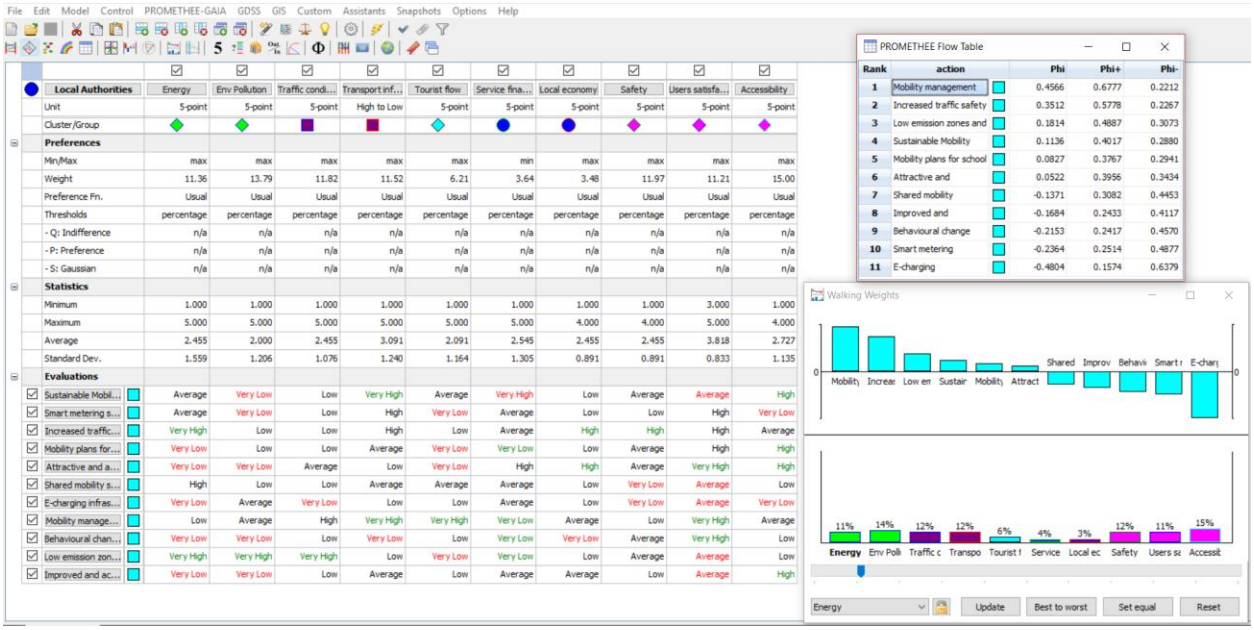
Table 1: Criteria prioritisation table

CRITERIA EVALUATION		
	Order of preference	Criterion
High importance	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
Low importance	10	

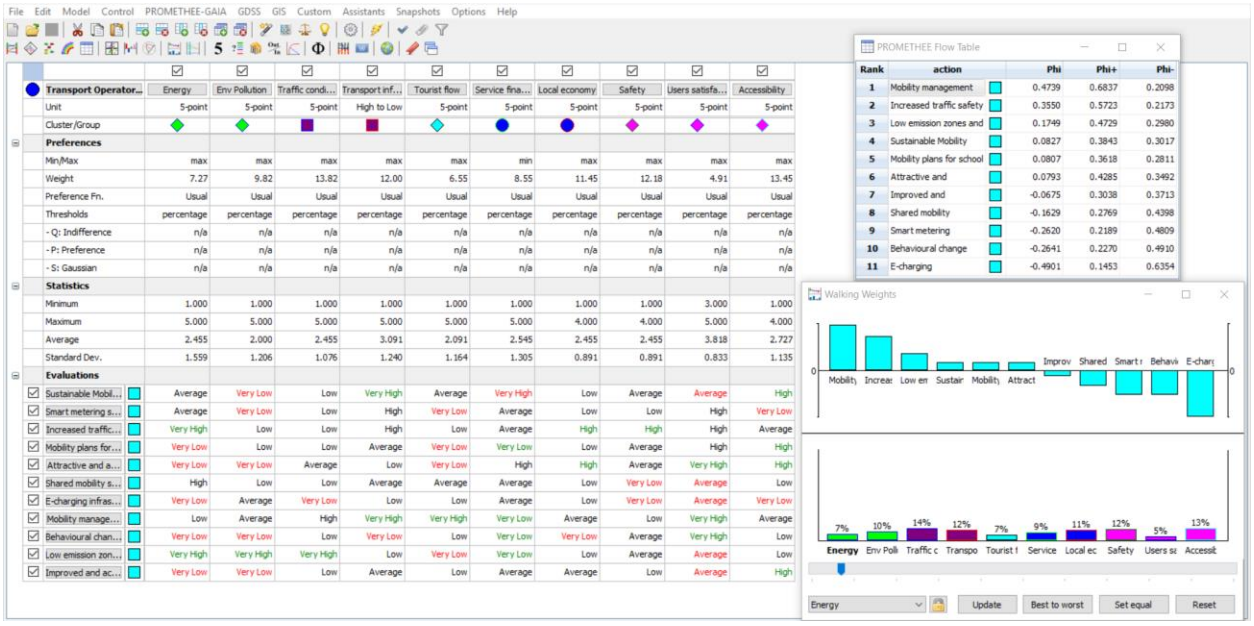
Figures A2: Questionnaire for the evaluation of criteria

II. Results of the VISUAL PROMETHEE and GAIA software

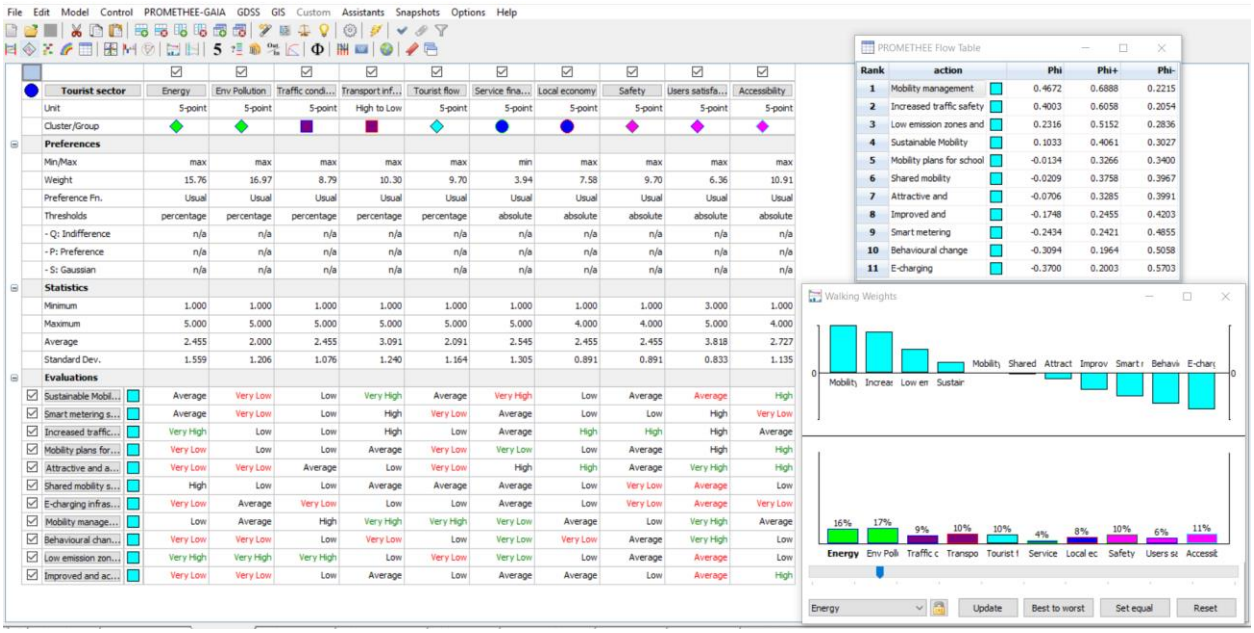
The following figures present the results of the VISUAL PROMETHEE and GAIA software per European and Greek stakeholder groups.



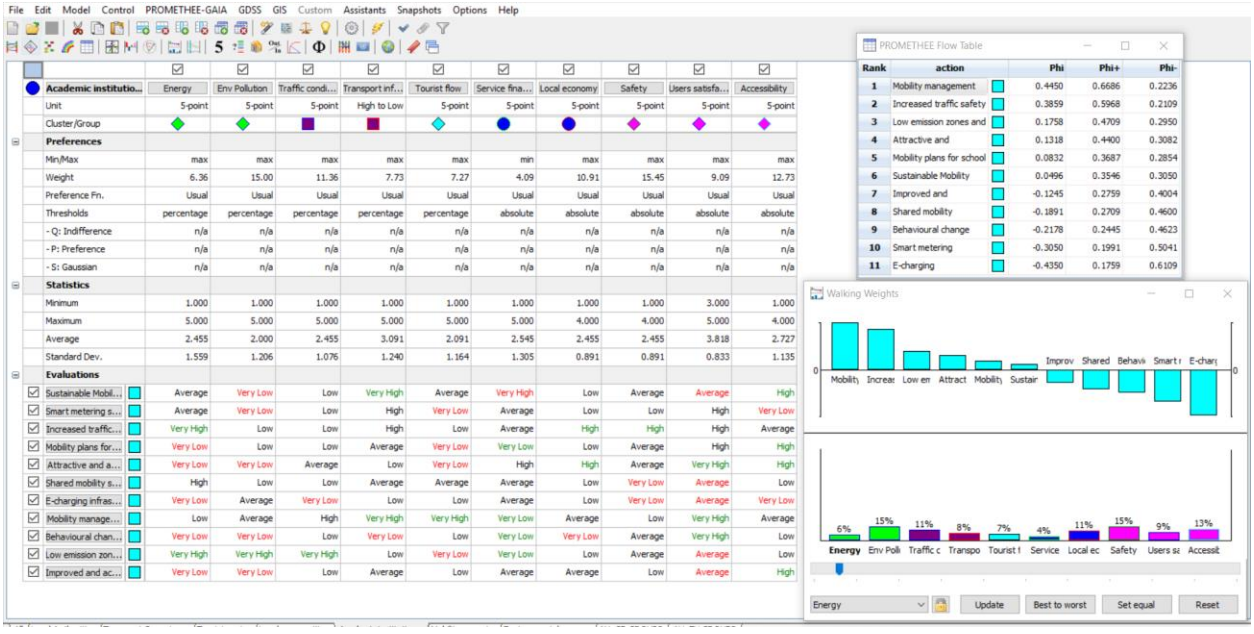
Figures A3: VISUAL PROMETHEE results for EU Local Authorities



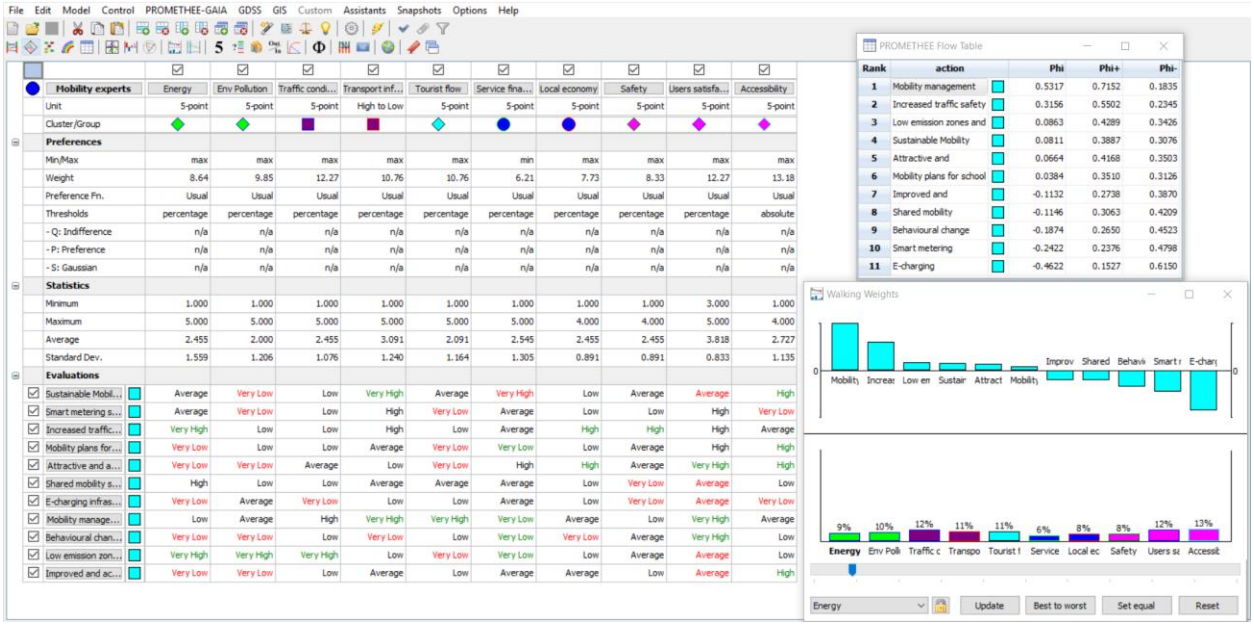
Figures A4: VISUAL PROMETHEE results for EU Transport Operators



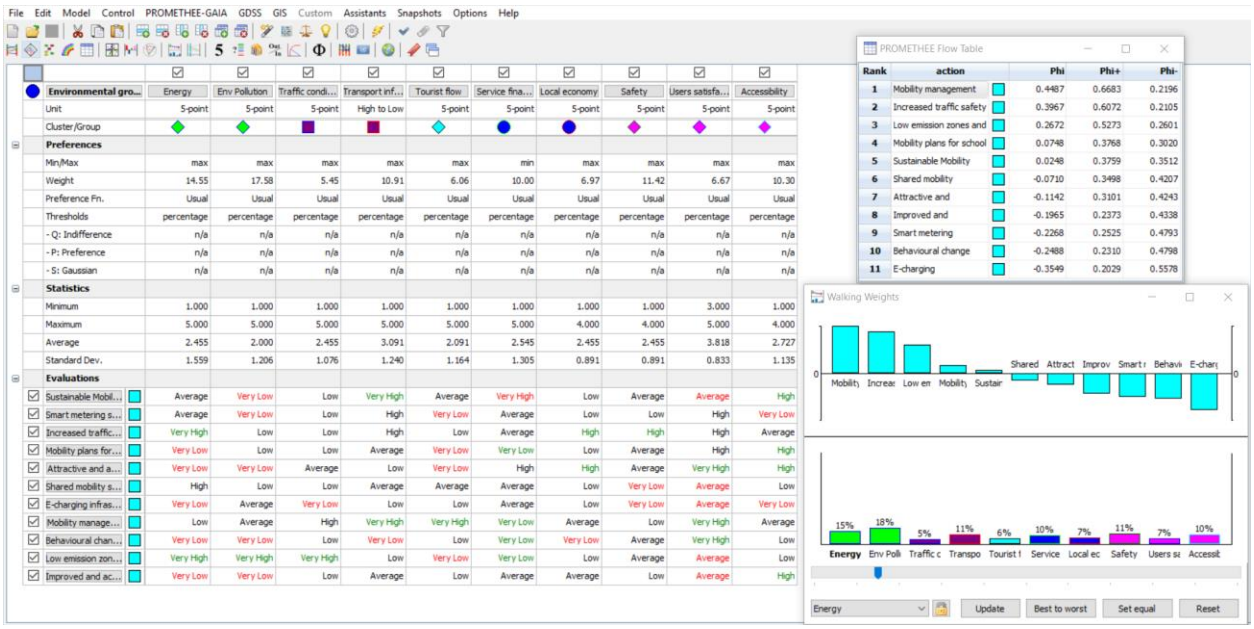
Figures A5: VISUAL PROMETHEE results for EU Tourism sector



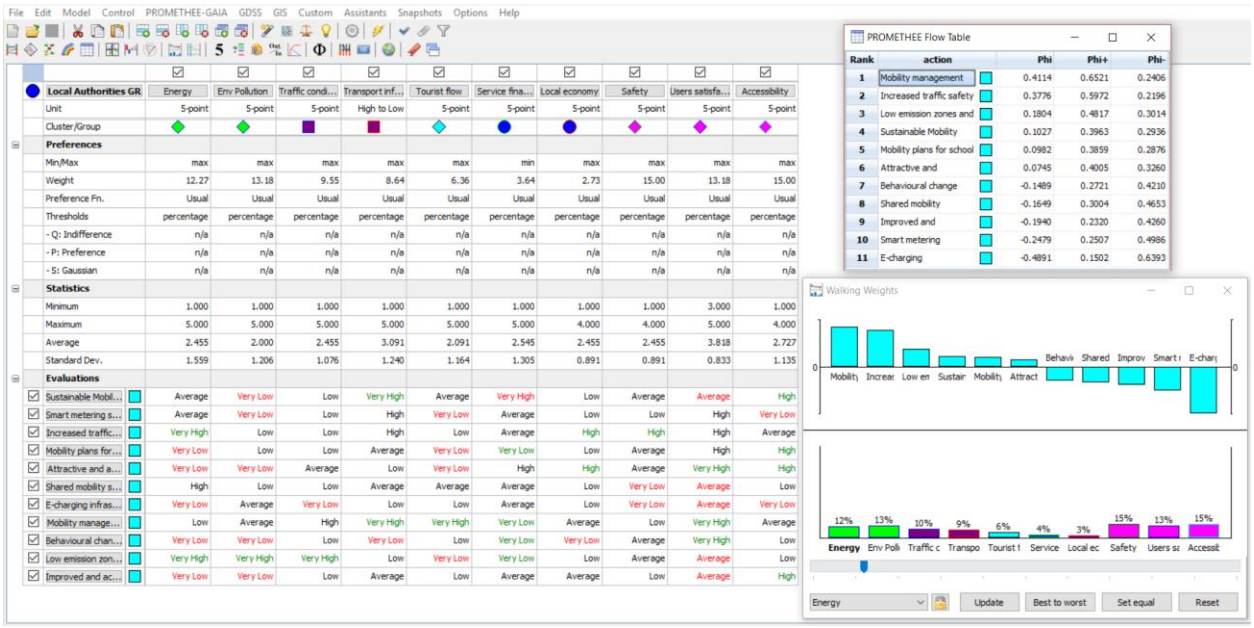
Figures A6: VISUAL PROMETHEE results for EU Academic Institutions



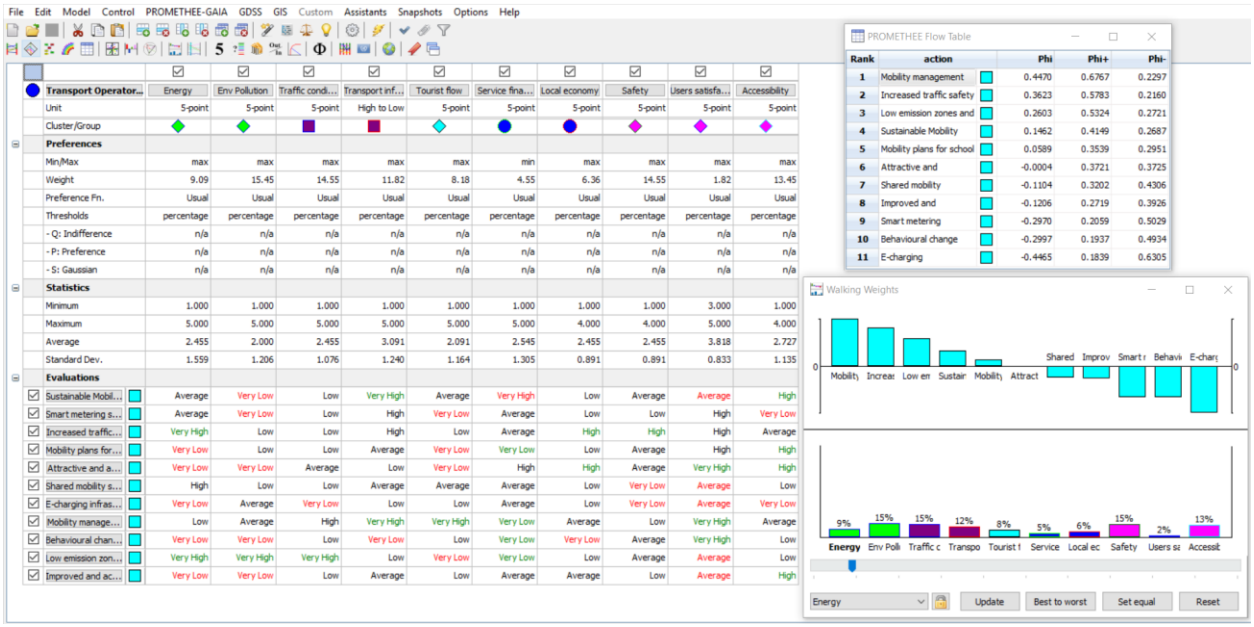
Figures A7: VISUAL PROMETHEE results for EU Mobility Experts



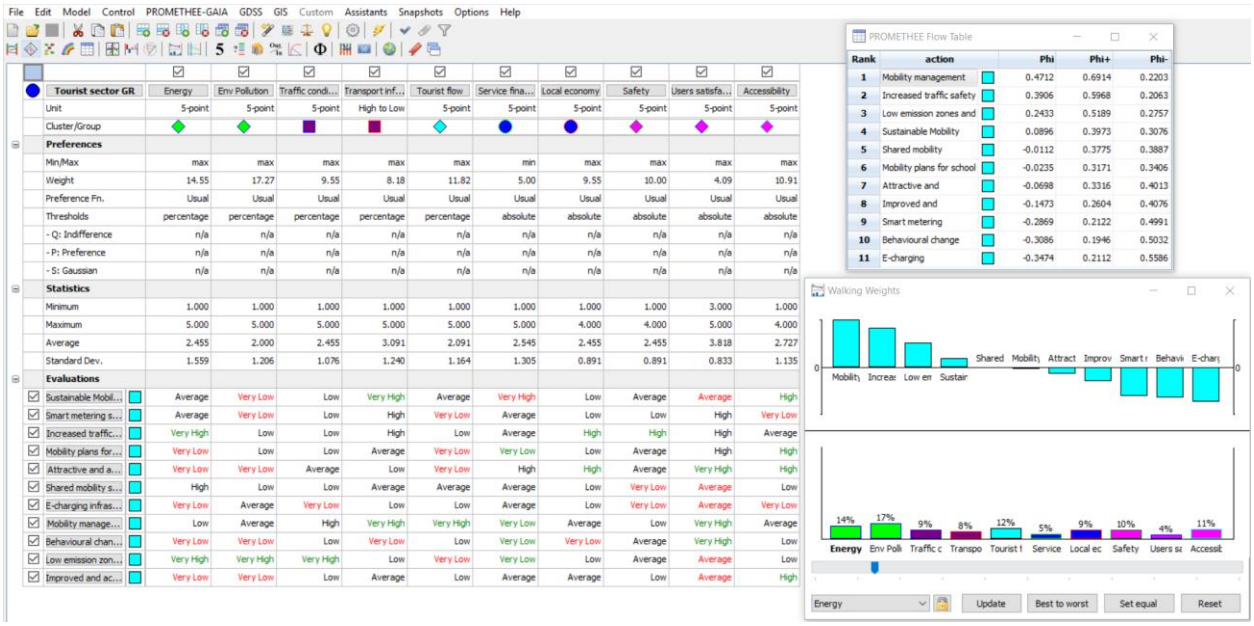
Figures A8: VISUAL PROMETHEE results for EU Environmental Groups



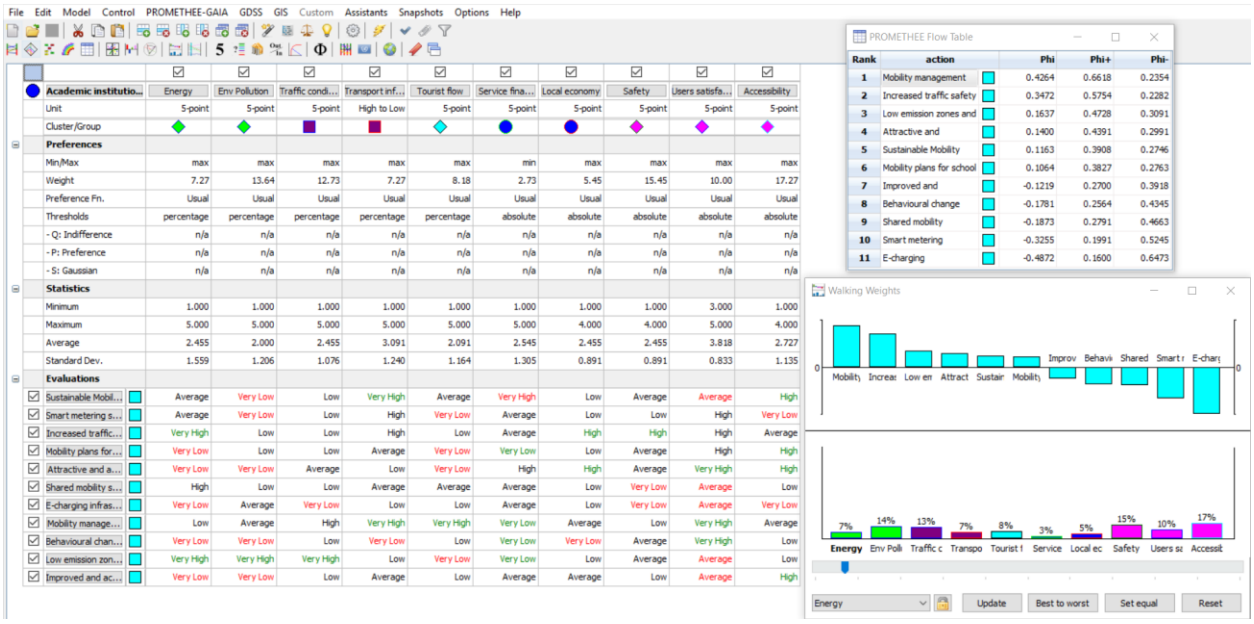
Figures A9: VISUAL PROMETHEE results for GR Local Authorities



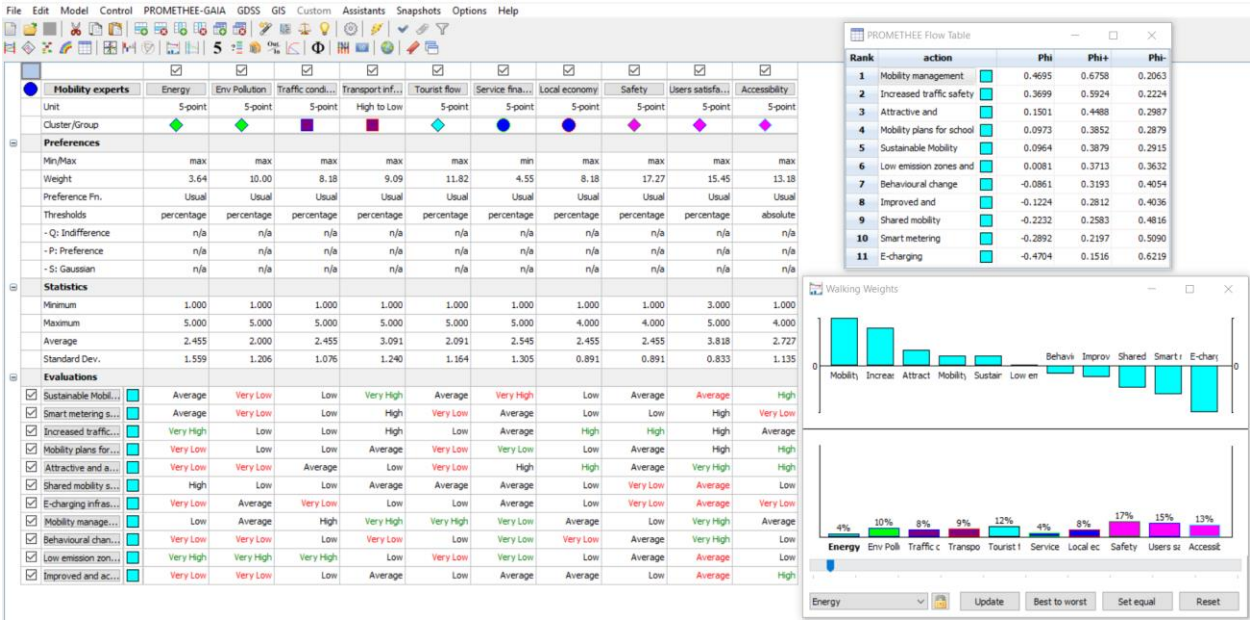
Figures A10: VISUAL PROMETHEE results for GR Transport Operators



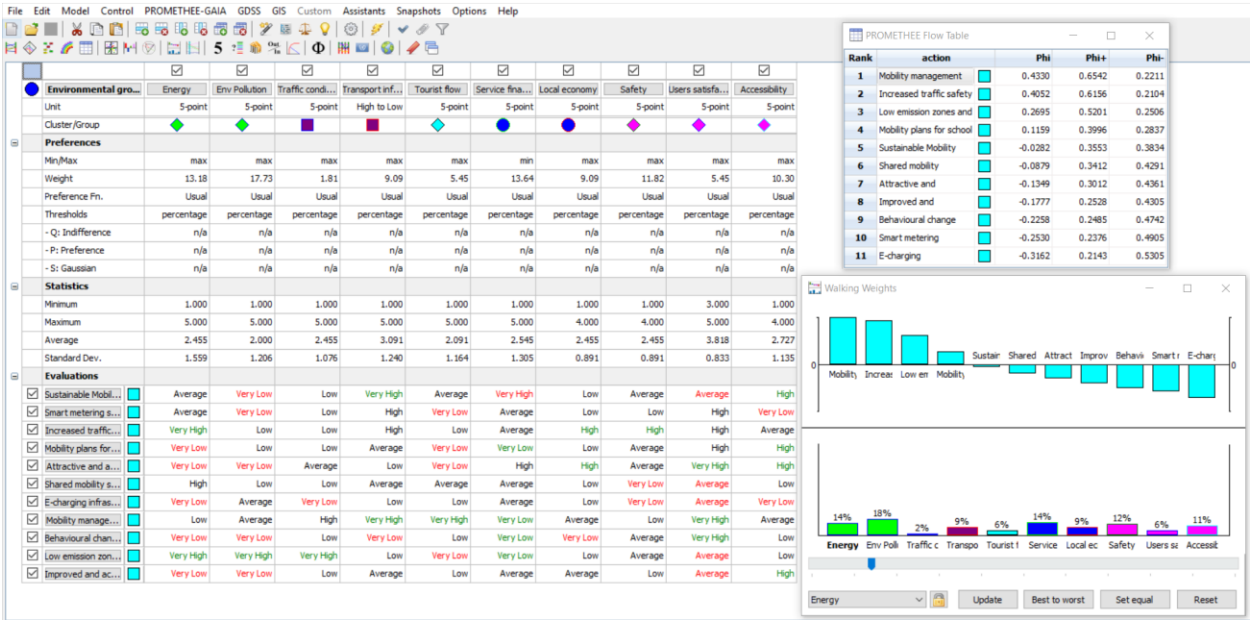
Figures A11: VISUAL PROMETHEE results for GR Tourism sector



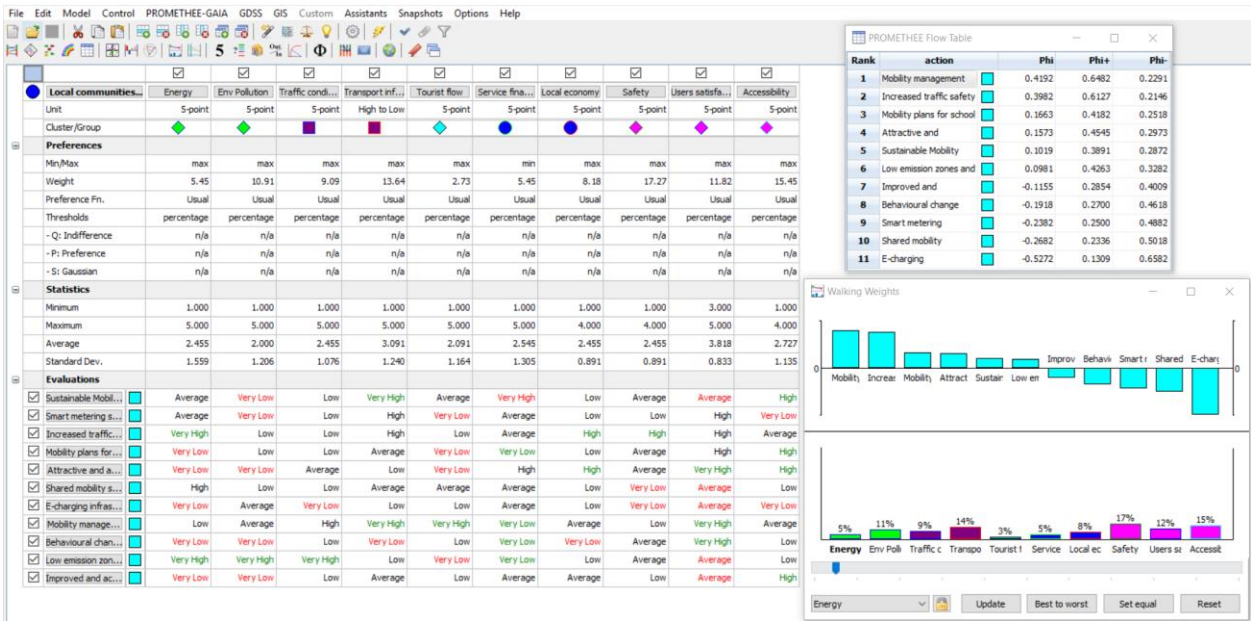
Figures A12: VISUAL PROMETHEE results for GR Academic Institutions



Figures A13: VISUAL PROMETHEE results for GR Mobility Experts



Figures A14: VISUAL PROMETHEE results for GR Environmental Groups



Figures A15: VISUAL PROMETHEE results for GR Local Communities