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esade
EsadeEcPol - Center for Economic Policy

Assessment of social impacts in the context of the transition to zero emissions mobility

Case study and methodology for the inclusion of social aspects in transport plans

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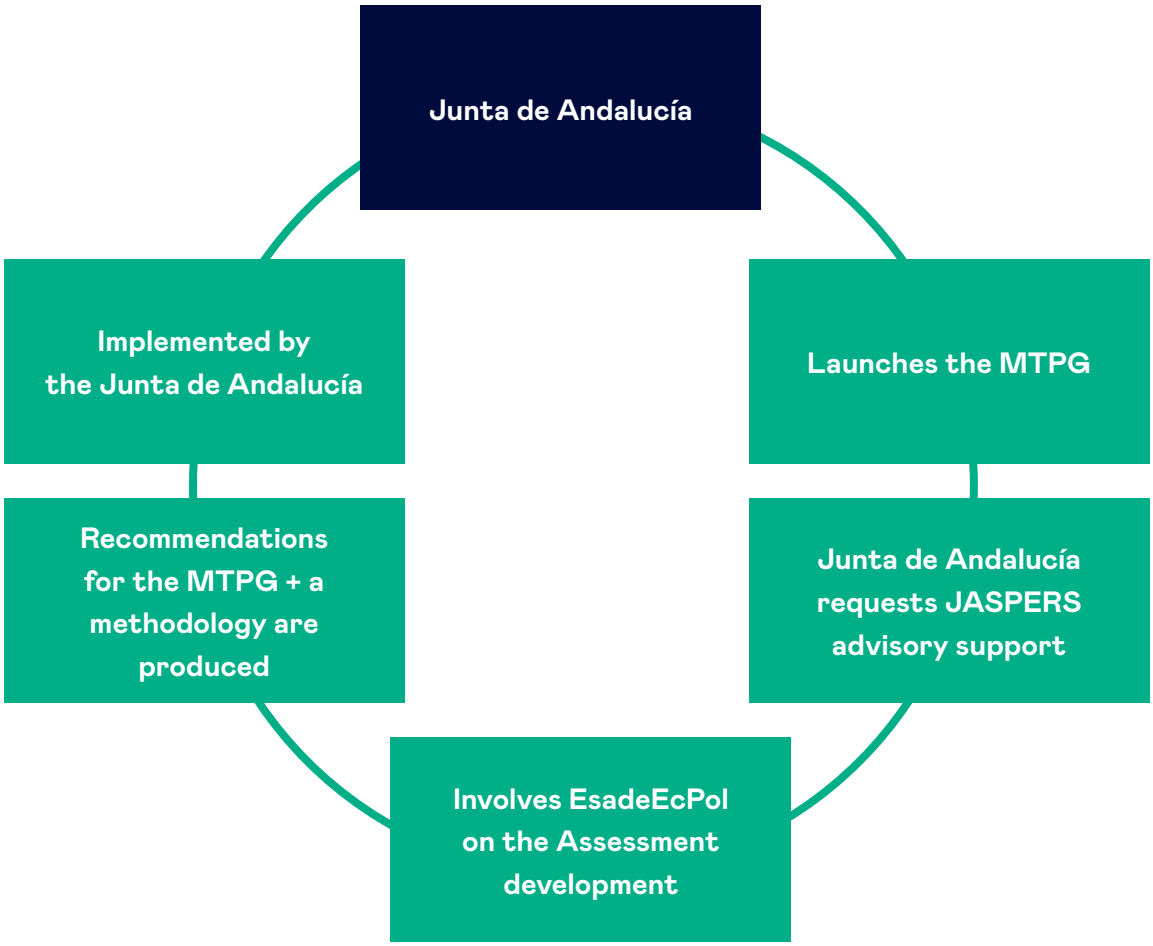
Introduction

The urgent need for decarbonization has broadened the scope of transportation policy from improving network conditions, such as reducing congestion or improving accessibility, to include sustainability considerations, promoting zero-emission mobility, and climate change adaptation measures. While these measures are critical in reducing the carbon footprint of the transportation sector, they can also have unintended social impacts that may disproportionately affect certain populations. For example, imposing new tolls or taxes on gasoline may disproportionately affect low-income communities that have less disposable income and rely on personal vehicles. Therefore, **the inclusion of social criteria in the design of transport plans takes on particular significance.**

In the pursuit of a more sustainable transportation sector, **it is critical to ensure that the burdens of these transformations are not disproportionately placed on the vulnerable or marginalized groups**. Furthermore, when developing decarbonization strategies, there must be a clear understanding of the potential social impacts and how they relate to existing social inequalities and context. However, the intertwining of environmental and social, which sometimes leads to conflicting outcomes, adds to the complexity. Moreover, because sustainability issues have only been incorporated into the transportation sector in recent years, **there is a lack of specific methodologies to successfully incorporate these social aspects into current planning processes.**

Against this background, the **project Assessment of social impacts in the context of the transition to zero emissions mobility, developed by JASPERS-European Investment Bank** (EIB) together with **Esade's Centre for Economic Policy** (hereafter EsadeEcPol) and **Andalucía's Autonomous Government (hereafter Junta de Andalucía)** aims at providing external guidance to ensure that the Metropolitan Transport Plan of Granada (hereafter MTPG) aligns the social sphere and its strategic objectives and policies. In a nutshell, the Junta de Andalucía launched the development of the MTPG, involving JASPERS-EIB advisory support during the process, which in turn made EsadeEcPol its partner for executing the present assessment to be incorporated and implemented by the Junta.

Figure 1. Institutional process to produce the present Assessment



The scope of the project, however, is more ambitious as the ultimate goal is to develop a practical methodology for the inclusion of social aspects in transport plans.

This report includes this final milestone and summarises the results and findings obtained throughout the project. The remainder of the document is structured as follows. First, an introduction of two of the institutional partners involved in the project, i.e. JASPERS-EIB and EsadeEcPol, and their roles is provided together with a brief overview of the role of the Junta de Andalucía in the development of the Granada's Metropolitan Transport Plan and the Plan itself. Secondly, the proposed methodology for the inclusion of social aspects in transport plans is presented and its potential applicability is discussed. Then, the main takeaways of a workshop hosted to disseminate among practitioners and policy makers the methodology are considered, followed by some conclusions and next steps to move forward in this new era of transport planning.

JASPERS

JASPERS, the **Joint Assistance to Support Projects in European Regions**, is an advisory programme run by the European Investment Bank (EIB) and funded by the European Commission and the EIB.

We help cities and regions deliver high-quality projects. Our experts **provide independent, hands-on support in strategies, programmes and projects** to make EU-funded investments that promote growth and pave the way to a greener, more connected and more innovative Europe.

We work with national Managing Authorities that handle EU funds and project promoters from all sectors. Together we prepare projects to build sustainable transport, reduce pollution, cut fossil fuel use, expand innovation, offer better healthcare, help prevent natural disasters, promote a circular economy and support the green transition.

JASPERS offers project advice and technical training to national, regional and local authorities, as well as other beneficiaries of EU funds, **to ensure that projects are carried out to the highest social and environmental standards.** This enables beneficiaries to develop projects independently and thoroughly, considering a wide variety of factors and complexities, and increases their chances of receiving and deploying EU funding.

Since 2022, **JASPERS has been embedded in the InvestEU Advisory Hub**, with dedicated financing, governance, and supervision mechanisms from the European Commission's Directorate-General for Regional and Urban Policy, the Directorate-General for Mobility and Transport, and the EIB.

The JASPERS team is composed of more than 120 staff within the EIB who cover a broad range of expertise and deal with the whole project cycle, from planning to execution. To be closer to our beneficiaries, we work from six locations: Beyond the Luxembourg headquarters, more than 70% of our experts are based in Brussels, Bucharest, Sofia, Vienna and Warsaw.

JASPERS assistance is free of charge for local authorities and promoters, and is available to most EU and pre-accession countries.

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EsadeEcPol's role as project lead

EsadeEcPol, Esade's Center for Economic Policy, maintains since its birth in early 2020 a **rigorous, independent and evidence-based approach to public policy analysis and evaluation.** Our team, economically and quantitatively based but with a cross-cutting approach, applies sound analytical methods to produce methodologies, results and recommendations, seeking a significant impact on the formulation of better policies.

Green transition has been one of our core areas of work since the Center's inception. We understand our work on this front as **bringing the socioeconomic perspective to a decision-making process** that needs it: we start from the premise that achieving the ultimate goal of decarbonization requires a balanced approach, to minimize transition costs and distribute them with equity criteria, ensuring that the derived benefits (or compensatory ones when necessary) also follow the same path. This can only be achieved with a precise, in-depth and independent knowledge of the available policy options, precisely the founding objective of EsadeEcPol.

In the context of **this project, EsadeEcPol's role** as executors together with JASPERS-EIB has **consisted precisely in bringing this perspective** to such a crucial area for decarbonization as **urban and metropolitan transport.** According to Eurostat data, around 28% of GHG emissions in Spain are attributable to transport. The cost of these emissions, both in their immediate forms of particulate pollution and congestion and in the longer term, is reflected in multiple dimensions: from air quality and public health to economic productivity and quality of life. Transport planning comprises the fundamental public policy instruments for moving to a decarbonized equilibrium, but it is at the same time one of the areas with the greatest impact on the socio-economic dynamics of any territory: mobility is the natural means for achieving all the purposes that are comprised in this dynamic. This is why it makes perfect sense to try to align as much as possible the two sets of objectives: climate and socioeconomic, with methodologies adapted to the work of the policy designer. On this, a **close collaboration between the engineering realm** – traditionally in charge of transport planning – **and the economic discipline is set to be extremely fruitful, even essential.**

In order to contribute to the production of these methodologies, **EsadeEcPol starts from the case of the Granada's Metropolitan Transport Plan**, an example of this in its conceptualization and development, **to build from there generalizable tools.** Its design has taken the form of a sequenced series of analyses, each with a different structure and purpose, but interconnected to offer a relevant and useful methodology together with a comprehensive and practical socioeconomic evaluation of the Plan, which has served both as an example and as food for thought for the methodology.

The process has gone from the concrete to the general: as an **initial step**, we have produced a **socioeconomic profile of the Metropolitan Area of Granada**, relying on various data sources such as the National Institute of Statistics (INE), the Directorate General of Traffic (DGT) and the Metropolitan Mobility Observatory (OMM), among others. This profile covers key aspects such as income distribution, demographic characteristics, labor market and socio-ethnic composition. Our objective has been to define and prioritize the most relevant aspects that may affect the MTPG, thus allowing for meaningful comparisons later on, and starting to build the central data-driven analytical tool that will be used in the evaluation.

The other key framework tool has been the analysis of the socioeconomic implications of supra-municipal policies. On this front, we have carried out an extensive study of the regulations, laws and policies that directly affect Granada's Plan. To this end, we have reviewed the academic literature, choosing with quality criteria the most rigorous as well as relevant, in parallel to the in-depth exploration of institutional documents. We have given priority to inputs with quantitative evaluations that present identifications that approximate causal impacts, as well as those that can be transferable to the Spanish, Andalusian or Granadian context, in order to understand the socioeconomic implications that could arise from such policies.

The socioeconomic evaluation of the Plan closes this first, more specific phase. This is based on all of the above to identify key areas that can be aligned or misaligned with the socioeconomic context of Granada, always with the framework of supra-municipal policies as a reference.

From this first part we make the leap to the generalizable, working on a methodology to include socioeconomic aspects in metropolitan transport plans. We have developed a practical and user-oriented methodology (the designer of public policies), based both on the case of Granada and the lessons learned from experiences and methods across Europe. More than a single tool, we understand this methodology as an ordered toolbox, a complex checklist, structured and articulated around evidence, at the same time accessible, for public administrations embarking on transport planning processes.

As a culmination of our role as executors, Esade hosted a workshop focused on presenting both the Metropolitan Transport Plan of Granada and our methodology, as well as opening a debate rich in the most updated and rigorous evidence, thanks to the participation of academics and researchers of high relevance within the Spanish and European scope in conjunction with decision makers from all administrative levels, to continue feeding decision making. On this workshop, the interaction of "thinkers" and "doers" is of essential importance to adjust and improve the role of both sides of the necessary equation for bettering public policies.

The combination of all the above results in what we understand as a deep and evidence-based analysis, with the goal of contributing to the design and implementation of more efficient, equitable and sustainable transport policies.

Junta de Andalucía's role - General Direction of Mobility and Transport - in the development of the Metropolitan Transport Plan of Granada.

The **Statute of Autonomy of Andalucía** provides in Article 64. 1 the exclusive competence of the **Autonomous Community of Andalucía** in matters of land transport of individuals and goods by road, rail, cable or any other means whose itinerary is developed entirely in the Andalusian territory, regardless of the ownership of the infrastructure on which it is developed; for transport, logistics and distribution centres located in Andalucía, as well as for operators of activities related to the organisation of transport, logistics and distribution in Andalucía, and for other transport infrastructures located in Andalusian territory which do not have the legal qualification of general interest of the State.

On the other hand, **Presidential Decree 10/2022 of 25 July** on the reorganisation of Regional Ministries, establishes that the **Regional Ministry of Development, Territorial Articulation and Housing** is responsible for the competences assigned to the Autonomous Community of Andalucía in the field of mobility and road and transport infrastructures whose itineraries are developed entirely on Andalusian territory, in addition to promoting intermodality, the General Directorate of Mobility and Transport, as established in Article 10 of the aforementioned Decree, is the administrative and development body for transport and mobility in the Autonomous Community and exercises the powers of the Ministry in these areas conferred on it by the applicable legislation. It is responsible for, among other things:

A) *"The elaboration of strategies, plans and programs in the field of mobility, linked to the transportation of the Autonomous Community within the framework of the general planning established by the Vice Ministry; as well as their approval, development and follow-up within the framework of its competences.*

B) *The development of standards and the drafting of studies and plans in the field of transport management, as well as the coordination tasks that allow the definition of mobility and transport policy based on the needs of the population in the different Andalusian territorial areas and their characteristics in terms of gender, all with criteria of sustainability and accessibility [...] "*

Furthermore, paragraph 3 of the above-mentioned Article 10 stipulates that the **Metropolitan Transport Consortiums** are subject to the General Directorate.

Law 2/2003 of 12 May 2003 on the Management of Urban and Metropolitan Passenger Transport in Andalusia establishes in its Article 25.1 that the management and coordination of transport in each of the delimited metropolitan areas and the **management of the corresponding Metropolitan Transport Plan may be carried out by a consortium that has the necessary powers to ensure the efficient functioning of the transport system.**

Therefore, the **Directorate General of Mobility and Transport is the body responsible for the development of the Metropolitan Transport Plans** for the nine metropolitan areas that exist in Andalusia, **in coordination with the Territorial Delegations of the Regional Ministry of Development, Territorial Planning and Housing and the different Metropolitan Consortiums.**

In the case of the Granada Metropolitan Area, the **Metropolitan Transport Plan of Granada, The Sustainable Mobility Plan (MTPG)**, the formulation of which was approved by the Agreement of the Council of Government of the Andalusian Regional Government of 11 December 2012, is therefore prepared by the General Directorate of Mobility in coordination with the Territorial Delegation of the Ministry of Development, Territorial Planning and Housing in Granada and the Metropolitan Consortium of the Granada Area, also taking into account the provisions of Article 4 of the Statutes of the Urban Transport Consortium of Greater Granada, which establishes its powers to participate in the preparation and modification of the Metropolitan Transport Plan.

The MTPG is the basic instrument for the planning of the transport system of the metropolitan area of Granada and for the coordination of the three levels of Administration with competences in transport matters, the General State, Autonomous and Local Administrations. Its main objective is the promotion of public transport and non-motorized modes, walking and cycling.

Its content refers to the possibilities of the elements that belong to this system: Infrastructures, equipment and facilities, public transport services, parking and traffic management, and all modes of transport that make up the system.

In order to carry out the mobility diagnosis of the plan, a data collection campaign was carried out, including surveys, measurements, Big Data technologies and consultations with key stakeholders, which made it possible to identify the main problems, needs and challenges, including a socio-economic characterisation (income, gender, age, reasons, etc.). In addition, the transport system was modelled, and the main strategic lines and objectives were defined to identify the main actions to be studied through cost-benefit and multi-criteria analyses. Throughout the process, socio-economic aspects were identified as crucial for the plan to achieve the expected results.

On the other hand, the Strategic Environmental and Health Impact Assessments have measured and calibrated the environmental and public health impacts that the implementation of the measures will bring, and the methodology developed by the Andalusian Institute of Public Administration for the evaluation of public policies has made it possible to strengthen the measures related to governance, the active participation of citizens and social actors, and the inclusion of the gender perspective in the Plan.

Therefore, in the preparation of the MTPG, as in the other urban transport plans and mobility planning in general, social aspects have been identified as key to the appropriate development and implementation of the different documents and policies. These aspects not only have a significant impact on the quality of life of citizens but are also crucial in promoting sustainable and equitable development. Issues such as congestion, accessibility, equal access to public transport and safety are just some of the key elements that need to be considered to ensure that the plans are effective and benefit the whole community.

It is therefore necessary that these social aspects are examined more comprehensively and concretely in the MTPG as a pilot experience in order to take them into account in the best possible way in the various planning documents, with the aim of minimising the risks and favouring the chances of success in their implementation. For this reason, the Directorate General for Mobility and Transport has requested cooperation with JASPERS (Joint Assistance to Support Projects in European Regions) on this important aspect, which reflects the commitment to address these aspects comprehensively so that the conclusions drawn can be applied to the other plans currently being prepared and to the other planning documents.

Under the supervision of Jaspers and in coordination with the General Directorate of Mobility and the Granada Metropolitan Transport Consortium, a study has been carried out to assess the impact of social aspects in the Granada Plan prepared by EsadeEcPol.

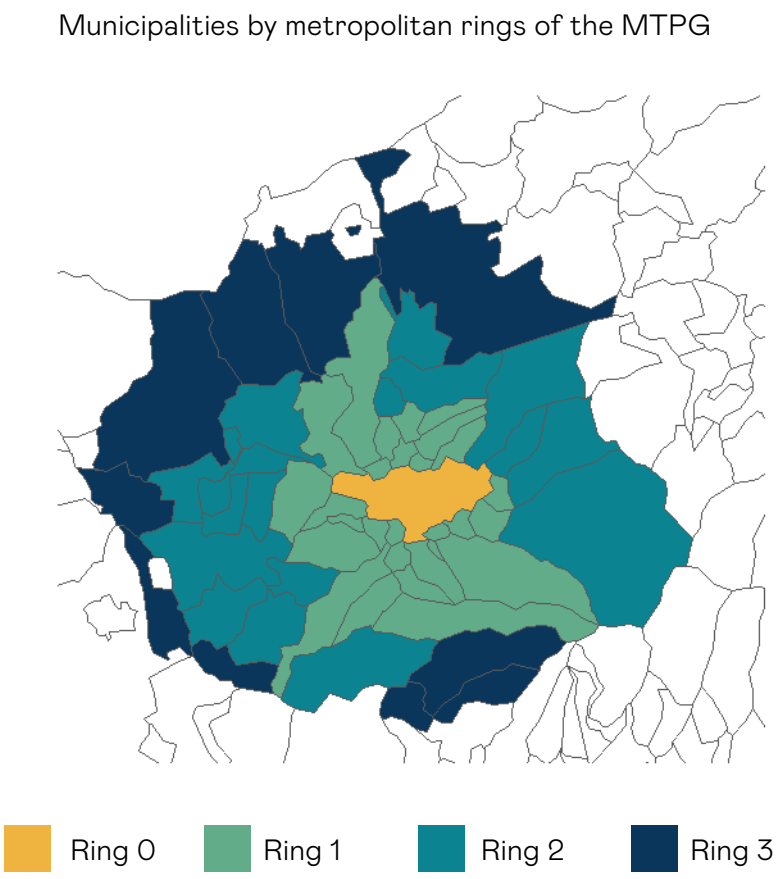
The Metropolitan Transport Plan of Granada

The need for a Metropolitan Transport Plan in Granada (MTPG) becomes clear when considering the multiple challenges facing the region in terms of mobility and sustainability. The main problems include the high level of motorisation, which leads to traffic congestion, especially during peak hours, and the inefficiency of the public transport network. In addition, the existing infrastructure for more sustainable modes of transport such as bicycles and personal mobility vehicles is inadequate and lacks effective connectivity. All these elements have negative impacts on environmental quality, including air pollution and noise pollution. In order to overcome these challenges, it is crucial to orient the transport system towards a more efficient and sustainable network through various measures. In this context, a well-designed and executed Metropolitan Transport Plan is essential to improve mobility in Granada, as well as the quality of life and well-being of its inhabitants.

The overall objective of the PMTG is to develop a set of programmes, measures and actions that will enable a more efficient ways of mobility while minimising environmental impacts. At the same time, the plan aims to contribute to energy savings and efficiency, improve air quality and public health, and align its strategies with other efforts to mitigate and adapt to climate change (Sustainable Development Goals, Agenda 2030, European Green Deal, Plan Nacional de Adaptación al Cambio Climático).

The spatial scope of the plan includes 57 municipalities where 65% of the total population of the province resides (595,832 inhabitants), and cover about 21% of the total provincial area (about 2,623 km²). The area was divided into three rings based on proximity to Granada and mobility characteristics as shown in Figure below.

Figure 2. Municipalities by metropolitan rings of the Metropolitan Transport Plan of Granada



Data from "Instituto Nacional de Estadística" (INE), 2020

In the first ring are the municipalities closest to Granada, where the relationship with the city is stronger, there are more areas that attract movement (shopping centres, industrial areas, etc.) and there are also more opportunities to reach Granada by public transport. The second ring includes municipalities that are more than 10 km away from Granada, where connections by public transport are not too numerous and there are also not many centres that invite travel. Finally, the third ring includes the municipalities in the metropolitan area that are the furthest from the city, at more than 20 km.

Table 1 below provides a comprehensive list of the municipalities and categorizes them according to the specific ring they fall under the Plan.

Table 1. Municipalities in Granada's Metropolitan Transport Plan

Ring 0	– Granada	
Ring 1	– Albolote – Alfacar – Alhendín – Armilla – Atarfe – Cájar – Cenes de la Vega – Churriana de la Vega – Cúllar Vega	– Dílar – Dúdar – Gabias (Las) – Gójar – Güevéjar – Huétor Vega – Jun – Maracena – Monachil
Ring 2	– Beas de Granada – Calicasas – Chauchina – Chimeneas – Cijuela – Cogollos de la Vega – Deifontes – Escúzar – Fuente Vaqueros	– Güéjar Sierra – Huétor de Santillán – Láchar – Malahá (La) – Padul – Pinos Puente – Quéntar – Valderrubio – Ventas de Huelma
Ring 3	– Agrón – Cacín – Colomera – Dúrcal – Íllora	– Iznalloz – Moraleda de Zafayona – Moclín – Nigüelas – Villamena

After analyzing the mobility and sustainability needs of the various municipalities, the **strategic objectives of the Metropolitan Transport Plan of Granada** are the following:

- Reduce greenhouse gas emissions and energy consumption by approximately 30% between 2020 and 2030.
- Lower the level of risk of the metropolitan transport system with respect to climate threats (climate change adaptation).
- Contribute to achieving air and noise quality standards.
- Improve road safety and reduce incidents of violence and harassment in transport and public spaces.
- Enhance metropolitan accessibility, considering the perspective of gender and people with disabilities (visual impairment, deaf or hearing-impaired individuals, people with cognitive difficulties, etc.).
- Ensure the financial sustainability of the metropolitan transport system.
- Guarantee the affordability of the metropolitan transport system.

To achieve these objectives, the Plan outlines three main strategic lines that are mandatory and whose objectives and outcomes are interrelated:

- Improvement of the infrastructure and vehicles of the metropolitan transport system.
- Improvement of the operations and maintenance of the metropolitan transport system.
- Improvement of the organization of the metropolitan transport system.

The first line of action refers to the improvement of the infrastructure and vehicles of the urban transport system. This dimension deals with aspects such as the widening of pavements, the creation of a pedestrian and bicycle network, and secure parking for bicycles. The removal of barriers that hinder active mobility and the improvement of the urban environment through trees and shaded areas are also considered. In terms of public transport, the expansion of the Granada Metro, the creation of high-capacity corridors and investments in road infrastructure are planned to give priority to public transport. In addition, measures such as deterrent parking, interchanges, and the renewal of the public transport fleet towards zero- and low-emission models are planned. Finally, issues such as reducing vulnerability to climate change and introducing new transport infrastructure in certain areas such as the Sierra Nevada are also addressed.

The second strategic line aims to advance the operation and maintenance of the urban transport system. For its implementation, measures such as the establishment of an environmental zone and the regulation of parking in the city of Granada are being considered. A comprehensive restructuring of the public transport network is planned to improve accessibility to important facilities, consider the special needs of women and increase efficiency in terms of frequency and speed. Furthermore, real-time control of public transport is suggested to improve the user experience. Finally, operational measures are considered to reduce the vulnerability of the transport system to climate change.

The third line of action aims to improve the organisational structure of the urban transport system through several key measures. These measures include revising the fare framework and integrating ticketing and payment methods to facilitate access to and use of public transport, establishing a legal framework for low-emission zones, improving coordination between mobility agencies, and promoting the use of low-emission vehicles and bicycles. The overall objective of these strategies is to create a more integrated, sustainable, and accessible system for all citizens.

The plan envisages four possible action scenarios, and a **dual analytical approach was used to identify the optimal scenario.** First, a cost-benefit analysis was carried out. However, as there are some relevant variables that cannot be captured by this technique, a multi-criteria evaluation was also carried out. Using the weighted scoring method PATTERN, this assessment considers environmental, functional and economic criteria for each technically feasible alternative. Specific scores and weights are assigned to each criterion, culminating in an overall score that identifies the most suitable scenario for the Granada metropolitan area.

Finally, citizen participation and expert consultation have been a fundamental pillar in the development of the Urban Transport Plan for the Granada area. Participation meetings were held involving different stakeholders such as municipalities, citizens, transport companies and different councils to enrich the preliminary version of the plan. In addition, 6 recognised experts analysed different aspects of the preliminary version and a 45-day period was set to receive objections from different entities, including public administrations and non-profit organisations. This inclusive approach not only validates the plan from different perspectives, but also ensures that the planned measures are socially effective and sustainable.

A step-by-step methodology for the inclusion of social aspects in metropolitan transport plans

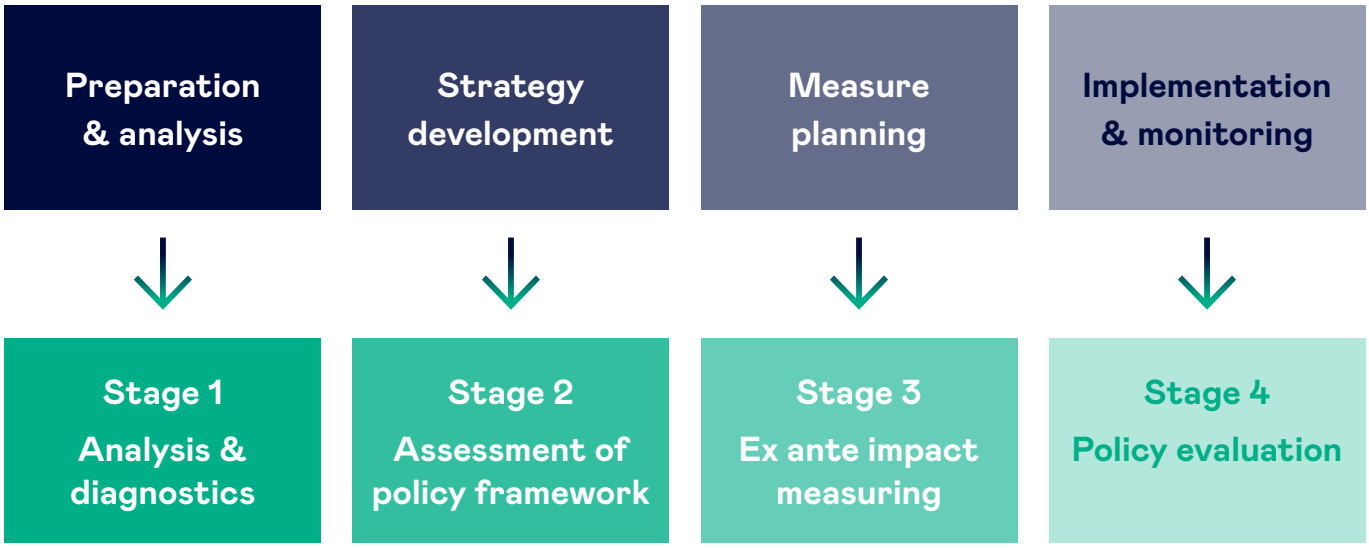
As mentioned in the introduction, **this methodology is born with a dual objective: to help bridge the gap between policy formulation and social reality in the MTPG and also become a proactive tool in the hands of policymakers.** It will enable them to ensure that future urban transportation plans align their strategic objectives and policies with social needs in the transition to net-zero mobility.

Throughout the methodology, we emphasize that the **social aspects should be considered at each stage of the planning process**, so the report reflects these stages. In doing so, we follow the four planning phases defined in the Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan[1] from ELTIS, Europe's main observatory on urban mobility financed by the European Commission's Directorate General for Mobility and Transport. This guide is the result of a compilation of key urban mobility trends and practical experiences from across Europe and it is the reference document for practitioners involved in the development and implementation of sustainable urban mobility plans. Then, we add a socioeconomic assessment work in each of these phases.

The process begins with the **diagnostic analysis**, which examines the current socioeconomic context and identifies the key challenges that need to be addressed. This analysis forms the basis for subsequent **strategy development**. In this phase, the approach to addressing the identified challenges and identify the principles underlying the strategic plan and objectives is outlined. Also, an **assessment of the current policy framework**, both national and European, is useful to further understand the context. Then, the next stage focuses on the **concrete planning of actions**, paying attention to how they can contribute to the achievement of the strategic goals while trying to anticipate its social impact and minimizing any negative aspects. The final phase focuses on the **implementation and monitoring of the proposed measures** and the need to **evaluate their effectiveness *ex post*.**

1 See Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan. Second Edition (2019)

Figure 3. Phases of the planning process and corresponding stages for assessing social impacts



Each of these stages follows a series of steps, which we explain in more detail below and which can be understood as **checklists or sequential phases.** When all these stages are completed, they combine to produce a comprehensive social assessment. To illustrate how this can be done in practice, we will use the case study of Granada's Metropolitan Transport Plan. Due to its urban and metropolitan mobility and population dynamics, it is an ideal example to illustrate the applicability of the proposed approach. By applying these guidelines to a real scenario, we hope to demonstrate the importance of this methodology for the transition to climate neutrality in the transport sector, with the social dimension at the heart of the process.

Analysis and diagnostics

Steps of Stage 1: Analysis and Diagnosis

Step 1.1. | Selection of indicators in key areas

- ✓ Population
- ✓ Labour market
- ✓ Income
- ✓ Vehicle fleet

Step 1.2. | Data sources and variable definition

- ✓ Assign data sources
- ✓ Explore and reassess indicators list, including now additional variables
- ✓ Choose disaggregation level
- ✓ Define

Step 1.3. | Enhancing and complementing mobility survey data

- ✓ Synchronization and calibration
- ✓ Complementarity with socioeconomic indicators
- ✓ Data gathering through multi-year surveys to the same individuals/households

Step 1.4. | Developing the socioeconomic assessment

- ✓ Extract key insights for mobility patterns

In addition to characterizing the transportation system and analyzing mobility patterns, it is of critical importance to conduct an **in-depth socioeconomic analysis when developing a transportation plan.** This should include not only the socioeconomic conditions of the affected communities/groups, but also their exposure to environmental issues and the feasibility of decarbonizing their mobility within pre-determined timeframes and at a given cost. This comprehensive understanding can illuminate the multi-faceted nature of transportation needs, from improving accessibility to ensuring environmental sustainability.

The process of socioeconomic characterization should ideally be conducted along with the analysis of the transportation system and mobility patterns. This integrated approach allows us to identify and better understand the mobility patterns of different social groups, their exposure to carbon-intensive modes, and the opportunities and barriers to transitioning to low-carbon alternatives.

For example, certain areas or demographic groups may rely disproportionately on carbon-intensive modes due to socioeconomic factors, making them more vulnerable to policy changes aimed at decarbonizing transportation. Understanding these patterns, combined with an analysis of the transportation system, allows us to design policies that are not only consistent with broader environmental goals but also take into account the specific conditions and needs of different social groups. In this way, we can contribute to a more inclusive and equitable transition to sustainable transportation.

The socioeconomic analysis should begin with a well-structured choice of key indicators, and then moves into appropriate data sources to fill them. This will take us into an iterative process (i.e. completing or amending our initial indicator list) that should be nonetheless limited to the planning authority resource availability in terms of time and work capacity. The final step consists of gathering and analytically laying out these indicators into the final socioeconomic analysis.

1.1. Selection of indicators in key areas

The **economic and social landscape of an area is complex and composed of various factors that influence each other and are intertwined.** To enable a thorough analysis, it is useful to divide these factors into different levels. There are two reasons for this division: (1) to structure the analysis into self-contained, coherent areas and (2) to structure the search for indicators itself, as outlined in **Step 1.2.** Figure below provides an initial list of indicators, divided into levels based on our case study, which can be readily applied to Spanish municipalities and can at least serve as a point of reference for other EU countries.

Population

The first level includes demographic characteristics such as age, gender, nationality, and household composition. These elements are inextricably linked to economic conditions, which are presented at the second level.

Labour market

The second level considers labor market factors, income, and living conditions. Regarding the labor market, the key variables are signed contracts, unemployment and employment rates, and social security enrolments by place of work and residence.

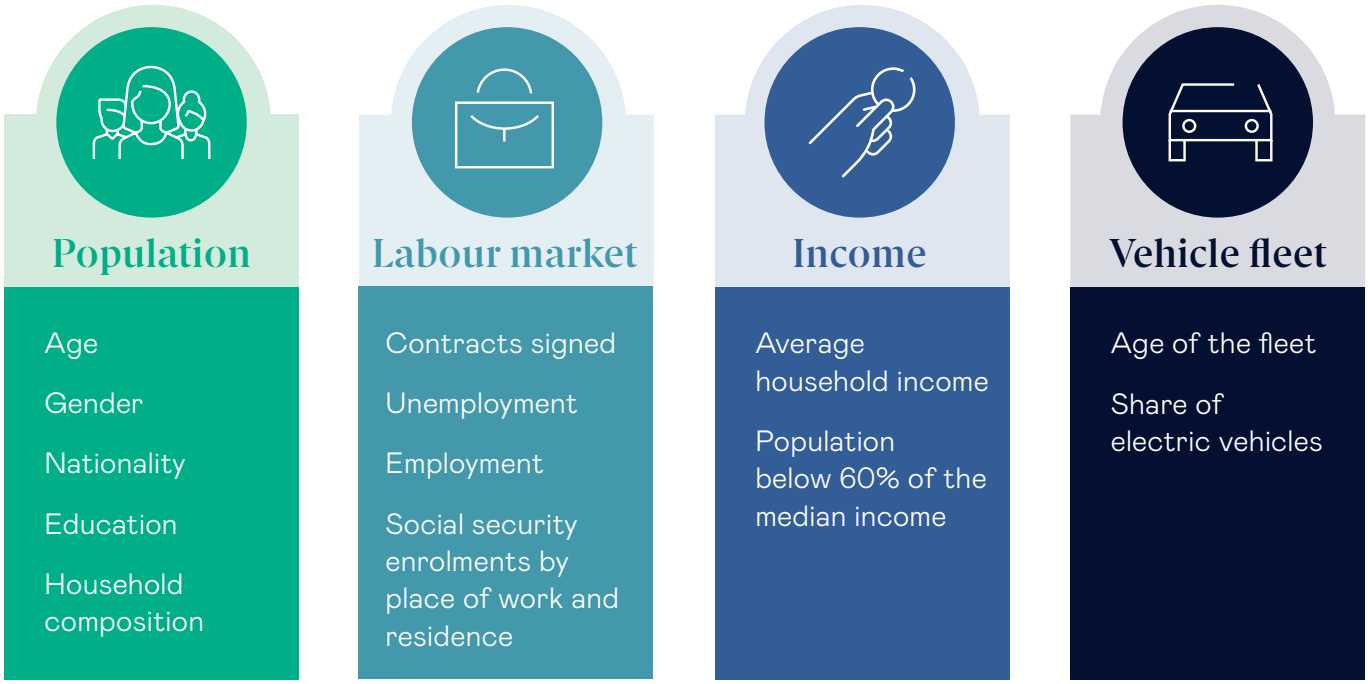
Income and living conditions

The above conditions the income and living conditions represented by the average household income and the population at risk of relative poverty (population below 60% of the median income).

Material conditions

The final level is determined by the financial capacity of the population, which embodies the material conditions of the area and, in particular, their mobility opportunities. This group should analyse the composition and characteristics of the vehicle fleet so that it complements data on the availability of public transport and the proportion of the population that relies on it due to lack of access to private cars.

Figure 4. Layers of the socioeconomic context and indicators



In taking this approach, **it is critical to emphasize the importance of including a gender and diversity perspective in our analysis.** Women tend to be the primary users of public transportation systems and, as such, are more vulnerable to the effects of changes in those systems. As we address economic conditions and mobility opportunities at the demographic level, we must specifically consider how changes in the transportation system will affect women (i.e., women who perform the majority of care duties and that have different travelling patterns than men) and other vulnerable groups (i.e., LGTBIQ+, people with disabilities or living in rural/remote areas, etc).

Focusing on women, a wealth of literature sources on gender issues and transport confirm that most public transport systems do not sufficiently address women's travel patterns and needs, although women tend to be more dependent on public transport services. This leaves out many mobility needs that arise from diverse and dynamic life realities, including care-giving activities that typically represent 40% of the daily trips (increasing to 60% during COVID-19 restrictions) as well as barriers due to socio-economic disadvantages, physical and psychological reasons[2]. Moreover, special attention must be paid to the aspect of safety in public transport systems from a gender perspective. A lack of safety features and protocols has a disproportionate impact on women, who are more likely to be targets of harassment, discrimination, or violence on their daily commutes. However, concerns about safety go beyond the physical to include psychological well-being, as fear of such incidents can severely limit women's mobility and freedom to pursue opportunities. It is important that the issue of safety not only manifests itself in the vehicles, but also in the peripheral areas such as bus stops, train stations and the footpaths to and from these points.

2 Di Ciommo, F., G. Rondinella, T. Ruiz, and R. Arroyo, "Travel Behavior of Care Trips: Data Analysis, Modeling and Transport Policy Insights - TRB Paper 20-04287," in Transportation Research Board 99th Annual Meeting, 2020.

As a result, their needs and potential vulnerabilities should be considered to ensure that the changes to be implemented promote equal access and opportunities for all. By incorporating a social and gender perspective into the diagnosis, we work toward transportation solutions that are inclusive, fair, and beneficial to all members of the community.

The proposed indicators are intended to provide a simplified yet comprehensive picture of the social impacts at play. They can guide policymakers in designing, evaluating, and modifying plans as needed to ensure that they are consistent with the social fabric of affected communities and, most importantly, do not exacerbate social inequalities. However, this by no means is an exhaustive **list of indicators** but rather **a foundational guide to be complemented and adapted throughout the planning process.**

1.2. Data sources

To gather data for analyzing the socioeconomic context of a metropolitan area, it is **essential to integrate multiple data sources.** These sources come from public agencies at the EU, national, regional, and local level.

However, this process is not without limitations. Data availability and accessibility can vary widely by country, region and institution. In addition, data sources are not always updated with the same frequency, which requires careful harmonization to avoid biased conclusions. For example, in this project, it was important to consider the impact of significant events such as the COVID -19 pandemic on certain variables such as income. In addition, data for different socioeconomic and demographic groups are not always available at the same level of disaggregation, which can hinder detailed analysis.

To mitigate these issues, careful, methodical data collection and collaboration among different administrations are key to ensure access to the most comprehensive and accurate data possible and to obtain an accurate representation of the area of analysis.

It is now that becomes clear the second motive for boxing our initial indicator list: for each of the areas we should be able to assign one or several data sources to guide our initial exploration. Then, **the actual exploration will unavoidably amend the original indicator list**, hopefully not only eliminating unavailable data due to the aforementioned limitations, but also adding previously unforeseen indicators that are relevant to each context.

For a more comprehensive and detailed overview of the analysis carried out in the metropolitan area of Granada, a list of indicators used for this study can be found in **Appendix 1. Indicators used in the socioeconomic assessment** of the Metropolitan Transport of Granada of this report. Although these indicators were specifically chosen to reflect the unique context of Granada, their applicability can be extended to other regions in Andalusia, Spain, but also to other EU countries.

In addition, it is critical to use these indicators with the highest possible geographic disaggregation within reasonable data processing boundaries. Many transportation measures impact areas smaller than the municipal level, so detailed local data can greatly improve the effectiveness and relevance of the planning process. In this way, we can ensure that transportation measures are targeted and reflect and address the unique circumstances and needs of individual communities.

Once we have confirmed the data we can count on and the disaggregation level of our choice, it is advisable to define an across-the-board geographical division that produces a good compromise between nuance and readability of the forthcoming data.

Case Study Snapshot 1

Socioeconomic context of the metropolitan area of Granada

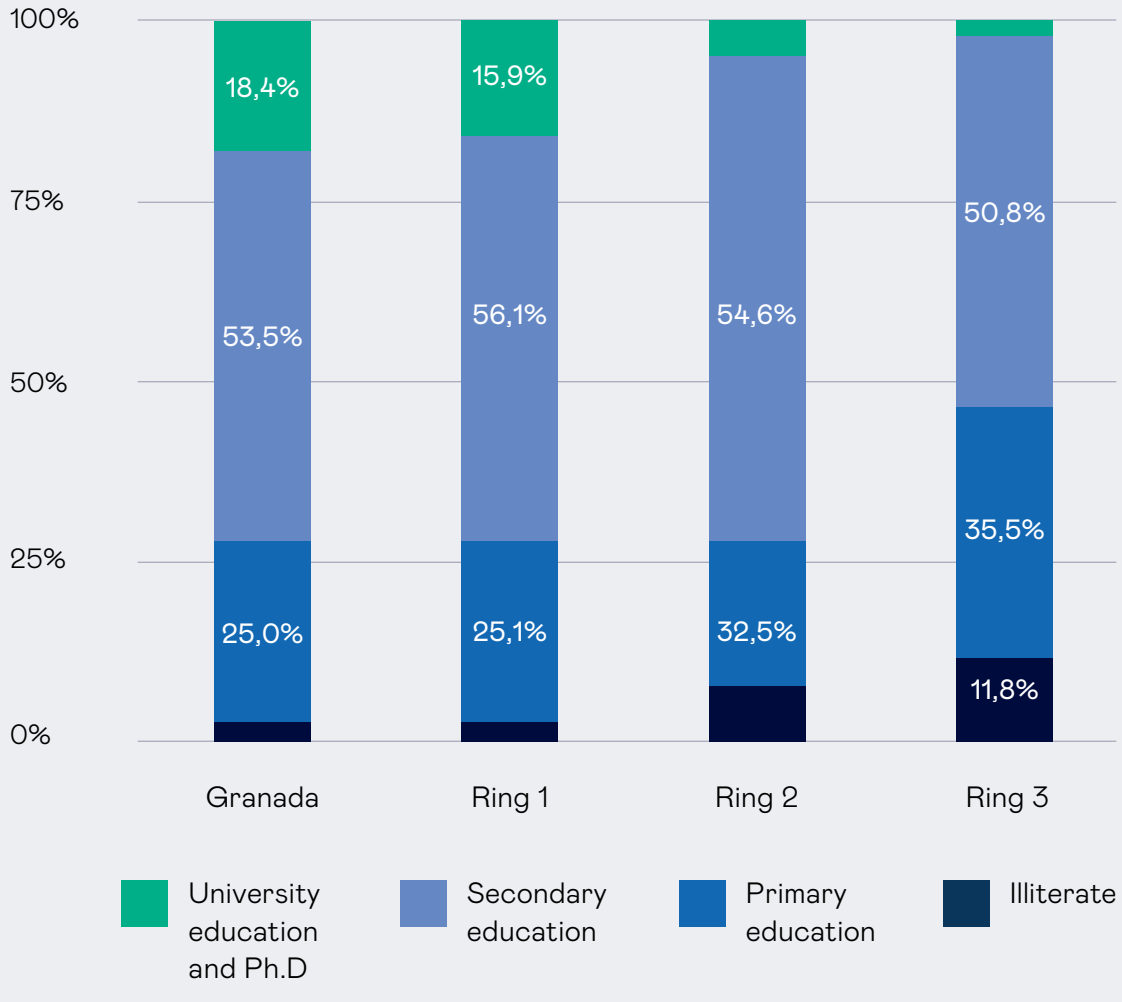
In the case of Granada, the different metropolitan rings defined in the transportation plan were the main geographic subdivision, as they show the different population and mobility dynamics.

The following graph, which comes from the analysis of the socioeconomic context helps us understand how the skill level of those who go to work, which can be addressed through the education attained, could affect mobility in the different metropolitan areas. In all areas, contracts with people who have a secondary education predominate. Nevertheless, the proportion of workers without secondary education is not homogeneous throughout the metropolitan area. In the outer rings, the share of contracts with illiterates or persons with primary education is over 40% of the total contracts signed. This could be related to the fact that the proportion of the elderly population is increasing in these areas and companies involved in agriculture and construction are more present. In Granada and the first metropolitan ring, on the other hand, the proportion of people with higher education and doctorates is over 15%.

It is expected that these **differences lead to different mobility patterns and needs:**

- → The combination of a high proportion of contracts with people without secondary education and an ageing population in the **outer rings suggests a particular need for accessible and convenient public transport for older people.**
- → In contrast, **in Granada and the first metropolitan ring**, the higher education level of the workforce indicates a **stronger focus on efficient commuting solutions for working people and possibly higher expectations for digital connectivity and convenience of the transport system.**

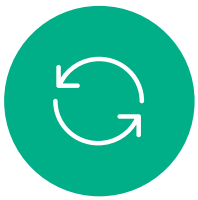
Figure 5. Contracts signed by education level in the metropolitan area of Granada



Data from "Instituto Nacional de Estadística y Cartografía de Andalucía" (IECA), 2021

1.3. Enhancing and complementing mobility survey data

Mobility survey data is normally focused on assessing current transportation patterns. But they also **offer a great opportunity to complement data gathered through other means** and listed above to help considering the socioeconomic context or anticipating changes that might occur in response to policy changes. **Taking a comprehensive approach to mobility survey design would contribute to capture the complexity and evolution of the transportation landscape.** This could be done through three separate layers.



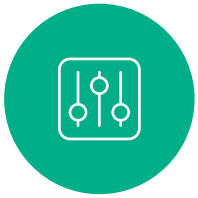
Synchronization

First, the various data sets mentioned above must be effectively synchronized with the mobility survey results to calibrate accuracy ex post[3]. Comparing and calibrating a small set (2-3) of indicators that are available outside the survey but that could be also gathered through the survey will help to ensure consistency and reliability of the data used, and to recalibrate/reassess other indicators.

Complementarity

Perhaps the largest and most easily accessible potential coming from mobility surveys within the present methodology lies on the inclusion of additional questions and indicators that would be complementary to their usual core of identifying mobility patterns while filling gaps not met by externally gathered data. In that regard, a reconsideration under the socio-economic view of the survey questionnaire before getting it into fieldwork will help making it more comprehensive and robust by adding specific, socioeconomic-oriented questions for indicators not achievable through third-party data gathering.

3 Synchronization in this context refers to the process of aligning multiple data sets to ensure that they are compatible, accurate when analysed together, and offer the same conclusions. In particular, indicators that can be obtained from both the mobility survey and other external data sources are compared and calibrated for consistency. This dual-source approach allows for cross-validation of the data, making it more reliable. It also provides a mechanism for fine-tuning (recalibrating) other indicators that may only be present in one data set but are influenced by those that appear in both data sets. This is particularly important when studying complex systems such as urban mobility, where different factors interact in complicated ways. The aim is to draw a coherent and accurate picture of the transport landscape based on multiple data sources.



Panel data

While mobility surveys are an unparalleled tool to identify prevailing travel patterns, whenever they are designed as one-shot fieldworks, they cannot adequately capture the dynamic equilibrium and potential shifts triggered by certain policies such as low-emission zones or penalizing car use. Therefore, survey design should ideally incorporate these dimensions to provide more contextual data. Establishing survey frameworks in the form of panel studies, while often costly, could provide longitudinal data that better capture changes in behavior over time. In addition, collaboration with agencies such as the National Institute of Statistics or regional statistical offices can greatly increase the scope and reliability of these surveys, improving their ability to shape transportation planning in ways that are both environmentally sustainable and socially equitable. This last layer should actually constitute a first step towards sustaining an ongoing system of data gathering during the implementation phase of the Plan, so measures can be evaluated and, if needed, reviewed based on top-quality evidence.

1.4. Developing the socioeconomic assessment

The next step is now to use this information **to create a multidimensional analytical setup for characterizing different areas within the metropolitan region in dynamic**, complex **terms** that allow us to consider more than one variable at a time.

Ideally, **the analytical result should be not only data-rich, but also produce already actionable knowledge in the form of key takeaways able to guide decision making** going forward. And, as a matter of fact, in the next steps we will be able to use these characterizations as a reference point for evaluating and anticipating the impacts of specific policy goals and measures, both from the supra-municipal regulatory environment and from the metropolitan transportation plan itself.

Case Study Snapshot 2

Socioeconomic assessment of the MTPG

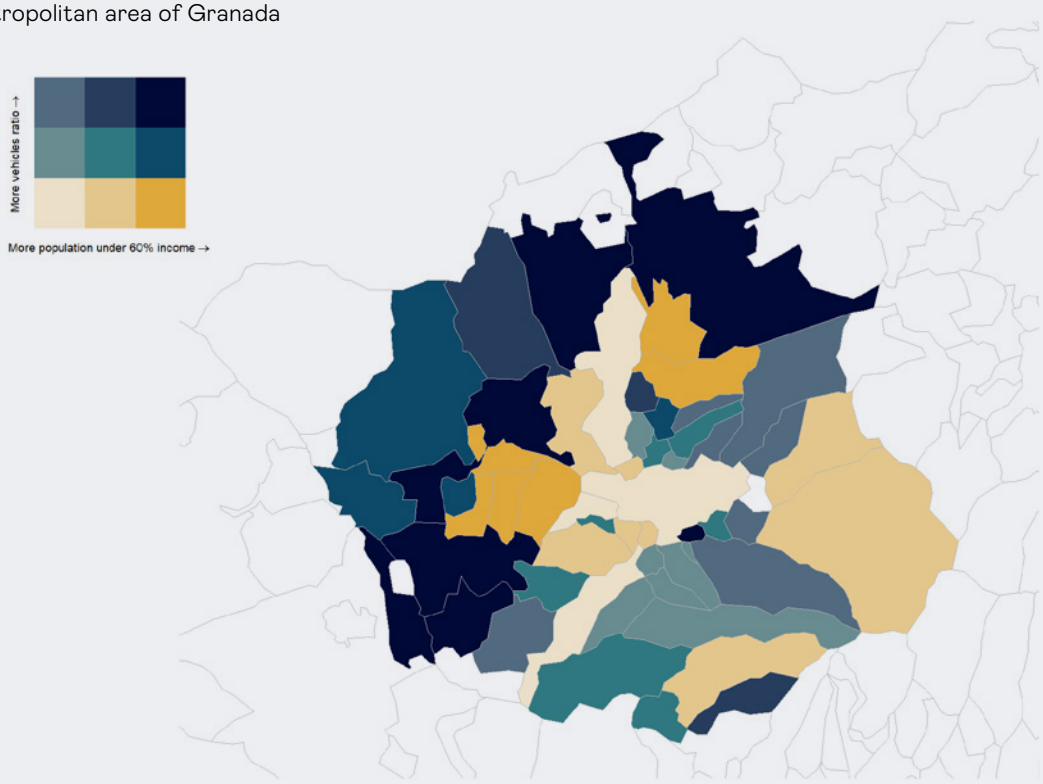
To produce the socioeconomic assessment of the Metropolitan Transport Plan of Granada we used maps that could reflect more than one variable at the same time.

For example, the next map shows the population at risk of relative poverty (income below 60% of the median) and the ratio of vehicles per thousand people ratio. We can see how there is a high percentage of the population at risk of relative poverty together with a greater dependency on private vehicles as we move further away from the capital.

Then, considering the implementation of a Low Emission Zone (LEZ) as envisioned in the Metropolitan Transport Plan of Granada and how this policy tends to impact more low-income households, we could infer that this policy might have a negative distributive impact on the population of the external rings.

Figure 6. Population at risk of relative poverty and private vehicle dependence

Percentage of population under 60% of median income and ratio vehicles/person by municipality in the metropolitan area of Granada



Data from "Atlas de distribución de renta de los hogares (INE)", 2019 and "Dirección general de tráfico", 2021

Assessment of the policy framework

Steps of Stage 2: Assessment of the policy framework

Step 2.1. | Definition of indicators and evaluation criteria

- ✓ Selection of quantitative indicators from those mentioned in Step 1.2
- ✓ Assessment of whether it is necessary to add additional indicators

Step 2.2. | Assessment of the conditioning policy framework

- ✓ Identify key policies and legislation at the European, national and regional levels
- ✓ Understand potential trade-offs and review the literature to anticipate potential impacts
- ✓ Extract key takeaways

On the overarching transport plan elaboration, and according to Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, **this phase consists of several interrelated stages to ensure a comprehensive and forward-looking approach. It begins with the development and evaluation of future scenarios.** This includes analyzing potential changes in key external drivers of urban mobility, such as demographics, information technology, and climate. These scenarios aim at capturing the range of uncertainties in predicting the future and providing a solid foundation for strategic decision-making. Next, a shared vision for the desired transportation system must be developed with stakeholders and citizens. These visioning exercises, based on the preceding mobility analysis and scenario impacts, foster a shared understanding of the desirable future. The resulting shared vision and goals form the cornerstone of the plan. Finally, we must determine how we will measure success by establishing goals and indicators that align with the objectives. These strategic indicators should monitor progress toward all goals and must be ambitious but feasible and consistent with other policies.

Given the practical and social-oriented nature of the methodology presented here, we limit this exercise to two steps: defining additional indicators of success and criteria for evaluating the alternative options, with greater emphasis on the social dimension and, in particular, the gender perspective; and considering the existing policy framework at national and European level.

2.1. Definition of indicators and evaluation criteria

An important aspect of incorporating a gender perspective into our strategic planning process is the **use of quantitative indicators to complement the qualitative indicators used to assess the different scenarios.**

In this step, it is essential to revisit the list of indicators identified in the previous phase and select those that are most relevant to assess the success of the different initiatives. It might also be necessary to consider introducing additional methods or indicators if there are any significant gaps in the current set. This could be particularly important when trying to understand complex or nuanced effects, such as the differential social impacts of various decarbonization strategies. For example, we should consider the differential impact that certain policies may have on women compared to men. Low-emission zones and increased access to public transportation, while beneficial overall for the decarbonization, could have the opposite effect on women's labor force participation. In fact, according to the latest evaluation of Barcelona's LEW[4], the groups that reduced their mobility the most were women, people with higher education and residents of low-income municipalities.

In this sense, the safety of women and other vulnerable populations in transport systems is also an important element. To effectively address this issue, it is important to include specific indicators that help quantify and localise the problem. For example, data on assaults can be analysed to identify the frequency and routes where such incidents occur on public transport. This data-driven approach would not only allow for targeted interventions — such as the introduction of night buses with demand-responsive stops, as envisaged in the Metropolitan Transport Plan of Granada— but also make it easier to monitor the effectiveness of interventions over time.

Thus, trying to include labour participation of women with children at the municipality level and the number of violent acts in public transport in the evaluation criteria is crucial to rank the different scenarios and policies.

By quantifying expected impacts using relevant indicators, we can identify these inequalities early in the planning process. This approach allows us to proactively address potential inequalities and ensure that proposed policies contribute to gender equity and do not unintentionally perpetuate existing inequalities.

4 Adán, R., Laffaire, M., Sánchez, M., & Tucat, P. (2022). *Evaluación del impacto económico de la zona de bajas emisiones de Barcelona.* https://www.ksnet.eu/wp-content/uploads/2023/03/ZBE_final_cast.pdf

2.2. Assessment of conditioning policy framework

Developing a metropolitan transportation plan requires a comprehensive understanding of both EU and national policies, as these guidelines set the stage and boundaries for such strategies. Given the current emphasis on decarbonization, understanding these policies is critical. They articulate the specific targets and timeframes for reducing emissions to achieve broader environmental goals. Consequently, urban transportation plans must be designed to support these goals while ensuring efficient and sustainable transportation for all citizens. By understanding the policy landscape, planners are better able to set precise goals for the plan and translate them into actionable steps. Therefore, EU and national policies are an essential part of designing urban transportation plans that are not only sustainable and efficient, but also contribute to the broader goal of decarbonization.

The first task in this analysis is to compile a complete list of policies at the European, national, and, where appropriate, regional levels. This comprehensive list should include all relevant policies currently in effect that have a significant impact on the planning and execution of a metropolitan transportation system. In addition, it may also be beneficial to include temporary policies or legislation that, while currently temporary in nature, have the potential to become structural or long-term components of the political landscape because of their significant influence or effectiveness.

Case Study Snapshot 3.

Relevant European and national legislation and policies for the design of the MTPG

To assess the policy environment, it is provided a brief overview of the main European and Spanish transport measures and their potential impact on the population and the economy is examined. In particular, the following supranational and national policies as constraints for the design and implementation of the Metropolitan Transport Plan of Granada have been identified.

European policies and relevant legislation

In exploring current European policies on transport, energy and sustainability, it is important to recognise the overarching framework that guides these initiatives: the European Green Deal. This ambitious policy roadmap serves as the lynchpin for the European Union's efforts to transition to a more sustainable and resilient future.

Within this framework, various strategies and policies are being developed to address challenges ranging from reducing greenhouse gas emissions to promoting the circular economy and improving biodiversity. The European Green Deal not only sets the tone, but also provides the structural backbone for regional and national policies aimed at realising a green and just transition. Its influence is pervasive, affecting the definition of targets, allocation of resources and measurement of success across many sectors, including the complex landscape of transport. Several key initiatives under the European Green Deal that are particularly relevant for the design and implementation of sustainable transport plans are outlined below.

- → Extension of the EU Emission Trading System to road transport
- → Social Climate Fund
- → Alternative Fuels Infrastructure
- → CO_2 emissions standard for cars and vans and banning the sale of new petrol and diesel cars from 2035
- → Revising energy taxation

National policies and relevant legislation

- → Low Emission Zones
- → Subsidy programs to increase take-up of electric vehicles
- → Public transport subsidies

Once the list of policies is developed, the next phase is a careful review of the listed policies and a thorough examination of the existing literature. This comprehensive review should include policy documents, academic research, industry reports, and other credible sources of information that provide insightful perspectives on the population, economic, and decarbonization impacts of each policy.

The final part of this analysis is to extract the key findings from the completed review. This includes identifying the key goals, constraints, and impacts that these policies collectively represent for the design and implementation of a metropolitan transportation plan. This summarized information provides planners with important insights into the broader policy landscape in which they must operate and guides their strategic planning process.

Case Study Snapshot 4

Relevant takeaways from the literature for metropolitan transport policymaking regarding low emission zones

- → There is an across-the-board agreement in the academic literature about the positive effect of LEZ on air quality and congestion.
- → However,
  - there might exist a negative impact on the economy in the area, especially for small business.
  - The impact on traffic might be just transitory and even have spillover effects to bordering zones.
- → Despite its potential complementarity with urban tolls, when implemented alone, LEZs are less efficient since they reduce pollution but not necessarily congestion. Nevertheless, its popularity can be explained by its relatively higher social acceptability.

See Appendix 2. Review and assessment of key transport measures at European and national level relevant for transport planning in metropolitan areas at the end of the document for a detailed analysis of key transport measures at European and national level relevant for transport planning in metropolitan areas, including key legislation and policies, as well as a literature review of potential impacts and key findings.

Ex ante impact measuring

Steps of Stage 3: Measure impact anticipation

Step 3.1. | Define the measures and review its potential impact

- ✓ Select specific actions
- ✓ Survey the literature to anticipate potential impact
- ✓ Assign a level of risk and potential social impact to each measure

Step 3.2. | Review with the specific socioeconomic context

- ✓ Check whether the impacts identified in the previous step are consistent with the specific socioeconomic context of the area in question

Step 3.3. | Consultations with experts and stakeholders

- ✓ Direct consultations and dialogues with experts, community members and stakeholders

Step 3.4. | Recommendations

- ✓ Propose a set of actionable recommendations

3.1. Define the measures and review its potential impact

Developing policies for a metropolitan transportation plan requires a solid framework based on a multidimensional approach. Social impact analysis is a key component of this approach, and the last milestone in our process. **The purpose of this analysis is to assess how proposed measures to reduce transportation-related greenhouse gas emissions will affect various social groups.** Measures may include promoting public transportation through the creation of reserved platforms or park-and-ride facilities and promoting electric vehicles through subsidies for their purchase. **A thorough review of the existing scientific literature on these measures, as well as previous assessments, is an essential part in this step.** It allows us to anticipate potential impacts, which can guide the adaptation of policies accordingly.

Continuing our multidimensional approach, we categorize the proposed interventions according to their degree of risk and potential social impact, after gathering all the necessary data. Here, risk refers to the potential negative impact a measure could have on specific social groups, while social impact is defined in terms of the measure's effectiveness in achieving the objectives set out in the plan. High-risk measures, i.e., those that may have a significant negative impact on specific social groups, are marked with the color red. Conversely, lower risk measures are identified as green. Similarly, measures with a high potential for social impact - i.e., expected to contribute significantly to the plan's goals - are identified as green, while those with a lower potential are identified as red. This color-coding system provides a clear, visual representation of the potential risks and impacts of the various measures and facilitates understanding and discussion during the decision-making process.

3.2 Review with the specific socioeconomic context

However, the analysis is not exhausted by predicting potential impacts. **It is equally important to compare these impacts with the data from the socioeconomic diagnostic phase described in the first stage of Analysis and diagnostics.** This comparison allows us to assess the different levels of exposure to potential negative impacts across the different areas. Recognizing this exposure can help inform the development of policies that address these differences and promote an equitable transportation plan. In addition, considerations of accessibility, equitable access to transportation, changes in travel behavior, costs to users, air quality impacts, and public health impacts should be central to policy design.

3.3 Consultations with experts and stakeholders

Direct consultations and dialogues with experts from the academia in transport planning and cost-benefit analysis, **community members, town halls and stakeholders** such as transport operators and business associations **are also an important part of this process.** These conversations allow us to capture the realities on the ground and adjust measures accordingly. It should be noted that these dialogues are not one-time events. They should be an ongoing process that promotes continuous feedback and adjustment of measures as will be highlighted in the following section.

3.4 Recommendations

The last step takes us into recommendations. **Based on the analysis of potential impacts, review of the socioeconomic context, and findings from consultations with experts and stakeholders, we propose a set of actionable recommendations**. These recommendations are tailored to the specific actions that were evaluated and are intended to enhance positive social impacts and mitigate negative ones. It is critical that these recommendations reflect the local context and address the expressed needs and concerns of stakeholders.

The final objective should be to produce a summary of the various measures, as shown below in Case Study Snapshot 5. In essence, the **output should be a table or similar analytical system, with each measure representing a row and each of the above steps representing a column in this table**, reflecting the level of risk for each measure together with the potential social impacts and recommendations to improve or minimize the negative aspects. **This allows prioritization of the different actions** and complements the cost-benefit analysis and multi-criteria analysis developed in earlier phases with real world evidence. This multi-layered approach ensures that we do not overlook any important considerations. However, as these complementary insights often come from other contexts, it is still essential to carry out specific assessments tailored to our local context for a more accurate and comprehensive understanding.

Overall, by integrating data-driven analysis, comprehensive reviews of the scientific literature, and meaningful stakeholder engagement, we can create a transportation plan that reduces emissions while promoting social equity and inclusion.

Case Study Snapshot 5

Example of an assessment of the actions included in a typical Metropolitan Transport Plan

Measure	Risk level	Potential social impact	Expected results	Recommendations to boost the social impact of the plan
Active Mobility: Cycling		Low	Increases safe and sustainable mobility options available to all users and incentivizes its use, regardless of their socio-economic background	Promotion of safe parking and ridding classes.
Extension of the metro network[5]		High	Can help address traffic congestion and pollution in the capital city and its immediate surroundings	Allow free multimodal combinations between metro, urban and intercity buses to promote multimodal sustainable mobility and improve affordability.
Prioritization of public transport: High-occupancy vehicle lane		Medium	Mixed evidence regarding the impacts on encouraging carpooling, reducing congestion, and shortening travel times. It might encourage private vehicle use	Accompanying the creation of an efficient bus (and public transport) network to reduce the use of private vehicles and improve affordability.

5 While it is not the case of the Metropolitan Transport Plan of Granada, the development and extension of the metro networks (as well as other high-capacity transport infrastructures) might imply the resettlement of populations. This would imply, as a result, a high risk-level for this measure (and, therefore, the expected results and recommendations should be adapted to address this potential risk.

Measure	Risk level	Potential social impact	Expected results	Recommendations to boost the social impact of the plan
Low emission zones		High	Strong impacts on low-income households, women, and traditional businesses in the more restricted area	Whenever possible, the LEZs should integrate pricing mechanism allowing owners of non-compliant vehicles to circulate occasionally. As a result, low-income citizens will not be obliged to buy a new vehicle to circulate occasionally, and additional revenues will be obtained (which could contribute to the financing of the plan). Combination of the low emission zones with a road pricing/urban tool system Public transport improvements in the areas covered by the LEZs.
On-demand public transport		Medium	The assessment of effectiveness can vary greatly depending on the indicators of success used, be they economic, social or environmental. Each set of indicators provides a different perspective through which to evaluate the policy, which can lead to different conclusions about the overall impact and effectiveness of the policy. The level of digital literacy in rural areas is also a challenge to success	Maintain a traditional communication channel (eg. Phone) to book the service Ensure affordability

Measure	Risk level	Potential social impact	Expected results	Recommendations to boost the social impact of the plan
Restructuring of the public transport network: women's needs		High	A well-developed and safe transport system is important for gender equality, as it can have a significant impact on women's participation in the labour force	Collect and analyze sex disaggregated user data to identify any gender gaps in transport. Encourage women's participation in the design and planning of the transport system through participatory workshops, focus groups, and surveys. Providing better access to public transport in areas with high levels of female unemployment and under-18 population, as well as in areas with high levels of female employment and households with children Ensure public transport access to public services areas (schools, hospitals, sports centre...)
Support measures for the purchase of low/zero emission vehicles		Medium	Wealthier households benefit the most, which could exacerbate existing inequities, and these programmes could lead to price increases for eligible vehicles	Target and prioritize support to vulnerable groups (low income, rural areas, family characteristics) Ensure on-street charging facilities are available especially in areas with lower income (as such households are less likely to own a garage with possibility of charging).

Policy evaluation

Steps of Stage 4

Step 4.1. | Implementation

- ✓ Strategic priorities and Key Performance Indicators (KPIs)
- ✓ Performance and outcome indicators

Step 4.2. | Monitoring and evaluation

- ✓ Ex-post evaluation of the policies
- ✓ Collect feedback from users
- ✓ Make adjustments if necessary

In the current context, where resources are limited, the importance of using them efficiently becomes paramount. Consequently, the role of monitoring and evaluation in assessing the effects of metropolitan transportation plans is heightened. The nature of these plans, particularly their ties to social and environmental conditions, demands a responsive approach. As the social and climate landscape is continuously evolving, the transportation plans must adapt accordingly to remain relevant and effective.

4.1. Implementation

Prior to the implementation phase of a metropolitan transportation plan, an essential step is the strategic identification of priorities and key actions. In doing so, these elements must be carefully tailored to the unique context of the functional area in question to provide a sound and nuanced framework for the phases ahead. The strategic priorities guide the implementation and evaluation of the plan, ensuring that it is aligned with the specific needs and goals of the community.

These strategic priorities should then be turned into Key Performance Indicators (KPIs). Those serve as quantifiable measures of the plan's effectiveness and provide a systematic approach to tracking and evaluating the performance of specific aspects of the plan. Essentially, these KPIs serve as a tangible means by which success is measured against the strategic priorities established at the outset.

KPIs could include, for example, assessing the average time spent on daily or weekly commuting activities, with a particular focus on those at the bottom of the income distribution who are disproportionately affected by longer commuting times. Another indicator could be the proportion of income spent on transport and commuting, especially for low- and middle-income households and other vulnerable groups such as those living in rural areas. We could also look at the proportion of the population that regularly uses public transport, both in the metropolitan region as a whole and in specific destination areas. Finally, women's self-perceived safety on public transport could be another key KPI. These KPIs serve not only as indicators of the plan's performance, but also as important data points for ongoing evaluation and adjustment.

They also work in tandem with broader implementation and outcome indicators that provide a more comprehensive overview of the project's success in achieving its objectives. Implementation indicators are used to monitor whether the plan is being implemented as intended and to ensure that each phase is proceeding according to the established schedule and scope. They are a reliable gauge of operational performance and provide real-time information on progress and potential bottlenecks in the implementation process. Outcome indicators, on the other hand, are central to assessing the effectiveness of the plan in achieving its stated objectives. These indicators quantify the social, economic and environmental impacts of the plan and provide a comprehensive understanding of the real-world consequences of the plan's implementation. One example of concrete indicators of this type is the change in the overall distribution of time spent commuting among the population of the metropolitan region to determine which groups are most positively affected by the new policies. Another indicator is the change in multimodal transport patterns in the affected areas. It provides a differentiated analysis of people who have switched to new modes of transport, the reasons for the switch and the impact on costs, time spent and self-reported satisfaction.

In that regard, **KPIs**, as seen above, **can be a real-time version of the implementation and outcome indicators based on their relevance to evaluating the success of the plan, and should be limited in number** (no more than 5-6) to reflect and encourage prioritization as well as to allow clear tracking.

Then, the defined KPIs, along with implementation and outcome indicators are integral to the implementation phase and subsequent evaluation. Together, they allow for a thorough and accurate assessment of both the process and the results of the local transportation plan.

This two-layered approach ensures a comprehensive feedback mechanism that not only assesses the successes of the current plan and areas for improvement, but also helps inform and improve future planning and decision-making. The result is a continually evolving, effective, and context-sensitive transportation planning process that is responsive to the socioeconomic and environmental needs of the metropolitan region.

4.2. Monitoring and evaluation

By implementing a thorough post-implementation evaluation of policy outcomes, a deeper understanding of their actual impacts, both intended and unintended, can be gained. This **ex-post assessment allows policymakers to identify the efficacy of the measures employed and their ramifications on different social groups.** It also provides insights into how well the initial objectives of decarbonization and climate change adaptation are being met.

Moreover, **feedback from the community plays a crucial role in this process.** Active consultations and dialogues with the community offer a rich source of qualitative information about the lived experiences of the inhabitants, including how they perceive and are affected by the measures enacted. This citizen feedback loop becomes an essential aspect of the iterative learning process, ensuring that the transportation plans genuinely respond to the community's needs.

Based on these assessments and feedback, necessary adjustments can be made to the plans. The lessons learned from the evaluation and community engagement inform future strategic decisions, help refine interventions, and guide the overall direction of the transportation plans. In essence, the evaluation findings act as a vital tool for ensuring the transportation plans' sustained progress towards both decarbonization and social equity, while also preserving the efficient use of resources.

Workshop – How to drive sustainable and socially responsible metropolitan transport planning

A workshop entitled "How to advance sustainable and socially responsible metropolitan transport planning" was organised to bring together a diverse group of experts and policy makers from the fields of sustainable transport and social policy to gain different perspectives on the challenges of incorporating the social dimension into metropolitan transport planning.

Natalia Collado Van-Baumberghen, green transition economist at EsadeEcPol and project leader, presented the methodology - developed with Jaspers-BEI and included in the present document - to integrate socio-economic aspects into the development of transport planning. The considerations mentioned in the methodology presentation were discussed in three specific areas: policies to reduce emissions by Xavier Fageda (University of Barcelona); the inclusion of the gender dimension in transport policies by Ana Moreno Maldonado (University of Mannheim); and the future steps towards decarbonisation of transport by Pedro Linares (ICAI-Comillas and Senior Fellow at EsadeEcPol).

In addition to the open participation of the other participants, these debates were complemented by the contributions to the discussion by Juan Ortiz (Executive Director of the Transport Consortium of Zaragoza), Julio Lumbreras (Polytechnic University of Madrid / Mission Cities 2030), Nel.la Saborit (Director General of the Urban Agenda of the Generalitat de Catalunya) and Javier Ortigosa (Barcelona Metropolitan Region).

As the workshop participants emphasised, progress in sustainable and socially responsible urban transport planning requires a comprehensive, evidence-based, and multi-stakeholder approach. A metropolitan transport plan is not just a logistical design, but fundamentally a territorial organisation plan that requires a deep understanding of the socio-economic context. Therefore, it should not exist in isolation but be integrated into a broader strategy that includes urban and spatial planning among other elements. Unfortunately, in many cases, the Transport Plan is the closest approximation to a broader territorial plan. This underlines the importance of including the social dimension in the planning process and ensuring that the needs and perspectives of different stakeholders in the community are adequately addressed.

For example, **gender-specific needs and concerns are often left out of traditional transport planning, even though women and men use public transport differently and face different risks and challenges.** Moreover, individual stakeholders, be they private companies renewing their fleets or families, are very much affected by transport plans and much of the effort required will come from these stakeholders. This is why it is so important to have a common understanding of how these measures can be implemented by the cities.

Finally, it was mentioned that **the development of more robust, data-based analytical tools is crucial for the success of the measures.** While the data may be imperfect, it is critical to evaluate the available alternatives based on the best available evidence. This evidence-based approach allows for a more accurate approximation of realities on the ground and thus more effective and sustainable decision-making.

By following rigorous, evidence-based methods, planners can better assess the likely outcomes of different scenarios and make informed decisions that benefit the whole community. These tools allow for more effective monitoring, accurate impact assessment and thus more efficient implementation of proposed measures.

Conclusions and next steps

In the present work, a dual-pronged approach aimed to provide insights at both specific and generalizable levels is presented. Specifically, a comprehensive **socio-economic assessment of the Plan de Transporte Metropolitano de Granada (MTPG)** was conducted. This focused evaluation s**erved as a cornerstone for developing a broader, more generalizable toolbox methodology designed to seamlessly incorporate socio-economic dimensions into the planning process of metropolitan transport plans.** The toolbox not only allows for a nuanced understanding of the immediate impacts of such policies but also provides a framework for assessing long-term outcomes, thereby serving as a valuable asset for policymakers and planners across different contexts and geographies.

These metropolitan plans play a critical role in decarbonization efforts, and simultaneously act as a significant policy instrument affecting the lives of millions. The realm of mobility impacts daily life at the most granular levels—be it commuting to work or school—and also influences aggregate variables that determine the success or failure of large urban areas and, by extension, entire countries. **Effective transport and infrastructure planning, therefore, are not merely logistical concerns; they are critical economic instruments with far-reaching implications for social equity, environmental sustainability, and national prosperity.** Given this, our work aims to contribute rigorously derived, evidence-based insights to assist in the formulation of more effective, equitable, and sustainable transport policies.

In an era where decarbonization has ascended to a top-tier economic objective, metropolitan transport plans serve as a crucial instrument for aligning this goal with both everyday realities and broader socio-economic considerations. Decarbonization essentially means eliminating a pervasive negative externality, thereby addressing the long-overdue debt that our economies, urban systems, and daily lives have been accruing for generations. In the long term, the economic and social impact of decarbonization is unequivocally positive. However, it is imperative to ensure that the benefits of this transition are equitably distributed. Toward this end, our policy frameworks must be intentionally designed to achieve this goal, and efforts must be concerted to minimize transition costs, distributing any remaining burdens according to principles of social equity.

Quantitative instruments in transport planning are highly advanced and excel in measuring mobility patterns and flows. These tools also incorporate cost-benefit analysis and utilize state-of-the-art multi-variable modeling techniques. The Metropolitan Transport Plan of Granada serves as a top-tier example of this sophistication. The objective has been—and will continue to be—to augment these existing methods by introducing a complementary toolset designed to broaden the policymaker's perspective.

The **unique contribution of the work developed in this project** lies in three key areas:

1. **Recognizing the importance of social and economic variables that extend beyond mere mobility and infrastructure patterns.** Our approach aims to precisely capture all the dimensions impacting mobility. Those that, as a sum, end up translated into both emissions data (or lack thereof) and simultaneous economic impact.
2. **Incorporating systematic knowledge of economic evidence regarding the impact of any considered measures,** whether within the plan or in broader, supra-municipal policies that must inevitably be included. The criteria for selecting this evidence strives for the gold standard of credible causal identification, is contextually relevant and closely aligned with the nature of the policy being evaluated, up-to-date, and make use of the best and most granular data available.
3. **Guiding both the data that goes beyond mobility and the highest-quality existing evidence into decision-making, making it both pragmatic and ambitious in its objectives.** This helps precisely align policy implementation with overarching goals, such as social equity and environmental sustainability.

A fourth transversal goal of our methodology is to make these analytical tools accessible for stakeholders who may lack the time or specialized quantitative skills for in-depth analysis. This is why our approach incorporates a checklist feature, designed to be user-friendly while maintaining analytical rigor.

From this experience, **three key learnings** that should be integral to any future efforts in transportation and urban planning are distilled.

1. First, **the value of interdisciplinary engagement cannot be overstated.** The confluence of engineering with economics—and indeed, all social sciences—proves mutually enriching and reinforcing. Each discipline uncovers the other's blind spots, offering complementary perspectives but unified by a data-driven language.
2. Second, the **symbiotic relationship between academics and policymakers is vital.** While academics provide rigorous evidence, policymakers offer a grounded perspective on the realities of policy implementation. This synergy becomes particularly effective when the engagement is proactive, allowing for a more coordinated and evidence-based policy design.
3. Lastly, rooted in the previous point, is **the importance of focusing on the fine details—the nuances of policy implementation—where the actual alignment or misalignment of goals takes place.** Echoing Esther Duflo's notion of economists as plumbers ("plumbers try to predict as well as possible what may work in the real world, mindful that tinkering and adjusting will be necessary since our models gives us very little theoretical guidance on what and how details will matter") we must also consider the political economy of such complex, long-term endeavors as decarbonization. Taking into account factors like path dependencies and intersecting interests is what will ultimately make these projects both viable and socially sustainable in the long term.

Appendix 1. Indicators used in the socioeconomic assessment of the Metropolitan Transport Plan of Granada

This appendix provides a comprehensive list of the indicators used for the Metropolitan Transport Plan of Granada, the case study and the socio-economic context analysis, as well as the corresponding data sources and links to access the data. Although these indicators were specifically selected to reflect the unique context of Granada, their applicability can be extended to other regions in Andalusia, Spain and other EU countries.

Population

→ Population by sex, IECA (2021)
https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_128&idNode=7488

→ Population by age, IECA (2021)
https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/6709?CodOper=b3_128&codConsulta=6709

→ Single-person households, Atlas de distribución de renta de los hogares 2020 (INE)
https://www.ine.es/jaxiT3/Tabla.htm?t=31033&L=0

→ Population by nationality, IECA (2021)
https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_128&idNode=7488

Labour market

- → Contracts by sex, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Contracts by sex and nationality, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Contracts by sex and education level, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Social security enrolments by sex and place of work, IECA (Jun. 2022)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/858?CodOper=b3_291&codConsulta=858 (men)

  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/859?CodOper=b3_291&codConsulta=859 (women)
- → Social security enrolments by sex and place of residence, IECA (Jun. 2022)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/877?CodOper=b3_291&codConsulta=877 (men)

  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/878?CodOper=b3_291&codConsulta=878 (women)
- → Unemployed by sex, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Unemployed by sex and nationality, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Unemployed by sex and education level, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/informe/anual?CodOper=b3_151&idNode=23204
- → Unemployment rate by municipalities, IECA (2021)
  https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/26168?CodOper=b3_151&codConsulta=26168

Income and living conditions

→ Average household income by municipality, Atlas de distribución de renta de los hogares 2019 (INE)
https://www.ine.es/dynt3/inebase/index.htm?padre=7132

→ Income below 60% of the median, Atlas de distribución de renta de los hogares 2019 (INE)
https://www.ine.es/dynt3/inebase/index.htm?padre=7132

→ Average household income by census section, Atlas de distribución de renta de los hogares 2019 (INE)
https://www.ine.es/dynt3/inebase/index.htm?padre=7132

Material Conditions. Vehicle fleet

→ Vehicles per thousand inhabitants, 2021 (DGT and IECA)
https://www.dgt.es/menusecundario/dgt-en-cifras/dgt-en-cifras-resultados/dgt-en-cifras-detalle/?id=00839

https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/6775?CodOper=b3_128&codConsulta=6775

→ Average age, Datos Municipales 2021 (DGT)
https://www.dgt.es/menusecundario/dgt-en-cifras/dgt-en-cifras-resultados/dgt-en-cifras-detalle/?id=00839

→ Electric vehicles, Sept. 2022 (DGT)
https://sedeapl.dgt.gob.es/WEB_IEST_CONSULTA/buscadorInformePredefinido.faces

Appendix 2. Review and assessment of key transport measures at European and national level relevant for transport planning in metropolitan areas

This Appendix is an integral part of the comprehensive review conducted for the case study of the Metropolitan Transport Plan of Granada. It aims to critically assess key transport measures at both European and national levels that are pertinent for effective transport planning in metropolitan areas.

European policies and relevant legislation

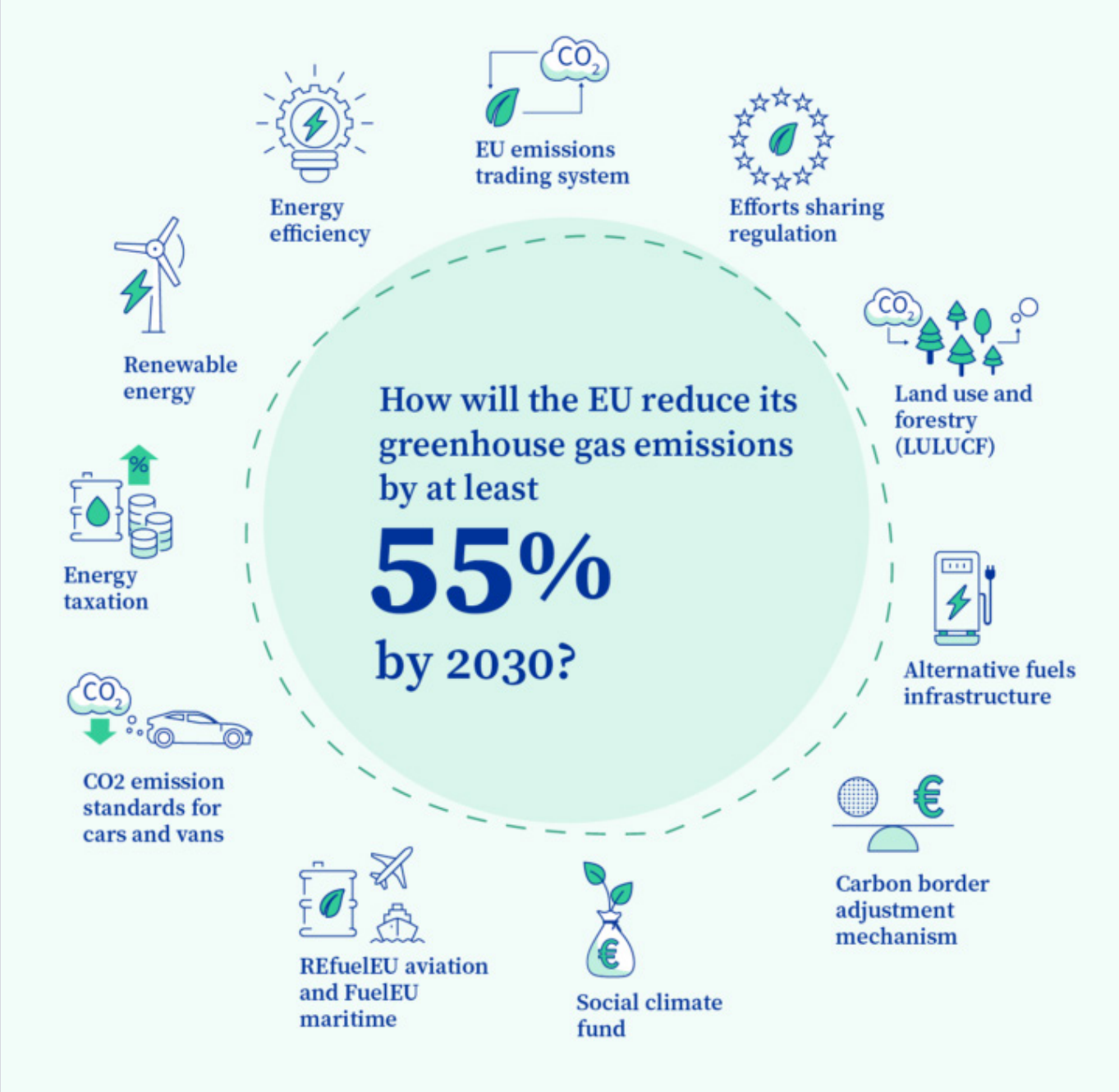
After the COVID-19 pandemic, there was an impulse to revise and update EU legislation to renew European ambition in the fight against climate change. The result was the Fit for 55 package that set the EU target of reducing net greenhouse gas emissions by at least 55% by 2030, representing an increase of 15 percentage points compared to the previously agreed 40% reduction goal.

The package includes several proposals to achieve that objective by turning climate goals into law, acting on different fronts (see **Figure 1**), from taxation and energy efficiency to land use and forestry. However, considering the project's scope, in this report, we will focus on legislative items that directly or indirectly impact the transport sector that will shape the environment where metropolitan transport plans will be implemented. Those will be analyzed separately and include the following:

- → Creating a new self-standing emissions trading system for buildings and road transport and the Social Climate Fund to address its potential negative social and distributional impact.
- → Alternative fuels infrastructure.
- → CO_2 emissions standard for cars and vans and banning the sale of new petrol and diesel cars from 2035.
- → Energy taxation

Figure 1. Legislative proposals included in the Fit for 55 package

Fit for 55: how the EU will turn climate goals into law



Source: European Commission

Extension of the EU Emission Trading System to road transport

The European Union Emissions Trading Scheme (EU ETS) is a market-based mechanism designed to reduce greenhouse gas emissions at the lowest possible economic cost. Introduced in 2005, it works by setting a cap on emissions and allowing companies to buy and sell allowances, creating a price for carbon[6]. This cap is reduced over time so that total emissions fall in the sectors covered by the mechanism, namely power and heat generation, energy-intensive industrial installations and aviation within Europe. So far, emissions in those sectors have been cut by more than 40%[7].

In order to align the EU ETS Directive[8] with the updated emission reduction targets proposed in the Fit for 55 Package, the European Commission proposed to create a separate emission trading system for fuel distribution for road transport, buildings and manufacturing (ETS II). Distributors would be responsible for reporting the amount of fuel supplied to the market and surrendering the corresponding number of allowances, contrary to what happens in the original ETS due to the difficulties in establishing the regulation point at the level of entities directly emitting greenhouse gases, that is households and car drivers.

On the 9th of February, the European Parliament and the Council reached a provisional agreement on this new system[9]. The issuance of allowances and compliance obligations would be applicable from 2027. Still, it can be delayed one year if gas or oil wholesale prices are exceptionally high compared to historical trends. However, since 2024 the regulated entities should be required to hold a greenhouse gas emissions permit and to report their emissions, while trading will start in 2025. Regarding the cap, this will be reduced annually to yield emissions reductions of 43% in 2030 compared to 2005. Since both the buildings and road transport sectors face slight competitive pressure from outside the EU and are not exposed to a risk of carbon leakage, compared to the energy-intensive industry of the ETS I, there will be no free allowances, and all of them will be auctioned off.

6 While a carbon tax sets the price of CO2 emissions and allows the market to determine the amount of reduced emissions, a cap-and-trade system, as the EU ETS, sets the quantity of emissions allowed and lets the market determine the price.

7 See Questions and Answers - Emissions Trading – Putting a Price on carbon. European Commission, July 2021

8 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

9 See Proposal for DIRECTIVE (EU) 2023/... OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of ... amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and op

Since the activity subject to regulation occurs upstream, fuel distributors are expected to pass this extra cost down the supply chain until it reaches consumers (see, for example, Alexeeva-Talebi, 2011; Marion & Muehlegger, 2011). Despite this approach being meant to incentivize firms to reduce the carbon content of the fuels so that they do not make undue profits by passing on more carbon costs to consumers than they incur, the European Commission will monitor it.

Cambridge Econometrics (2020) find that expanding the ETS cap to include buildings and transport would, without factoring in any potential demand reduction, increase average spending in 2030 on gas-fueled household heating by 30% and the cost of fueling a fossil fuel vehicle by 16% due to higher prices. Nevertheless, it should be noted that how consumption reacts to the new system is key and has implications for both its impact on household and government budgets. If the demand for fuels is reduced, so will the demand for permits and, with it, the prices of these, pushing down the final prices and reducing their impact. This, in turn, would mean lower tax revenues for the government. In practice, whether the measure will reduce demand and thus emissions and the speed of such process depend on the consumer's price elasticity, i.e., how demand responds to price changes. Labandeira et al. (2017) estimate the price elasticity of transport fuels in the short run and conclude that it is remarkably higher in the short term than industrial or aggregate energy demand. Specifically, a 10% increase in the price of diesel in the short run reduces demand by 1.5%, while a similar increase in the price of gasoline reduces it by 3%. This suggests that creating the new ETS might encourage a progressive reduction in fossil fuel consumption.

Nevertheless, including a carbon price for road transport would disproportionately impact low-income households with limited financial flexibility and few options for reducing their spending on transport. In fact, the legislation acknowledges that introducing a carbon price on road transport and buildings should be accompanied by effective social compensation (see next section).

Box 1. Relevant takeaways from the literature for metropolitan transport policymaking regarding the introduction of a carbon price to road transport

- → The EU ETS system has helped curb emissions in the EU.
- → The creation of an analogous system that covers road transport aims to have comparable results.
- → However, the introduction of a carbon price for road transport will have negative distributive effects that might exacerbate previous levels of energy and transport poverty.

Social Climate Fund

Vulnerable households, micro-enterprises and transport users who already spend a significant portion of their income on energy and transportation are disproportionately affected by the rising prices of fossil fuels (Martínez & Martínez, 2023). Since the extension of the EU ETS to road transport will be, *de facto*, a price increase at refueling, it might have a negative social impact with unintended distributive effects. Moreover, this impact may be further severe in certain regions where affordable and alternative mobility options are limited, and there may be insufficient financial resources to invest in reducing fossil fuel consumption. Geographical factors such as living in remote areas, mountainous regions, less accessible peripheries, or lagging areas may exacerbate the vulnerability of certain groups.

In order to compensate for the negative social impact, the extension of the EU ETS to road transport might have, a Social Climate Fund will be created to support the most vulnerable groups, especially households in energy or transport poverty. Article 2 of the provisional agreement reached by the Parliament and the Council on the 9th of February[10] introduces a definition for transport poverty, until now not defined at the Union level, energy poverty and specific vulnerable groups that should be bear in mind:

- Regarding energy poverty, it makes a broader definition than the one already established at EU level[11], focusing on a "household's lack of access to essential energy services that underpin a decent standard of living and health, including adequate warmth, cooling, lighting, and energy to power appliances, in the relevant national context, existing social policy and other relevant policies".
- Transport poverty then relates to "individuals' and households' inability or difficulty to meet the costs of private or public transport, or their lack of or limited access to transport needed for their access to essential socio-economic services and activities, taking into account the national and spatial context".
- Vulnerable micro-enterprises are those "that are significantly affected by the price impacts of the inclusion of greenhouse gas emissions from buildings or road transport into the scope of Directive 2003/87/EC and for the purpose of their activity, lack the means either to renovate the building they occupy or to purchase zero and low-emission vehicles or to switch to alternative sustainable modes of transport, including public transport".
- Finally, vulnerable transport users are "individuals and households in transport poverty, but also those, including from low-income and lower middle-income households, that are significantly affected by the price impacts of the inclusion of road transport into the scope of Directive 2003/87/EC and lack the means to purchase zero and low-emission vehicles or to switch to alternative sustainable modes of transport, including public transport".

10 Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a Social Climate Fund

11 See for example Energy poverty in the EU

The incidence of energy poverty across the EU and the identification of vulnerable groups has been increasingly studied in the literature (see, for example Adom et al., 2021; Bednar & Reames, 2020; Castaño-Rosa et al., 2019; Dong et al., 2021; Halkos & Gkampoura, 2021; Koukoufikis & Uihlein, 2022). However, academic research has paid less attention to poverty related to mobility or transport. New studies propose indicators to measure this phenomenon (Berry et al., 2016; Lovelace & Philips, 2014; Lucas et al., 2016; Mattioli et al., 2016, 2018; Tao et al., 2020). In particular, Alonso-Espelde et al. (2023) propose and estimate the incidence of transport vulnerability in Spain with novel indicators for affordability and accessibility. They conclude that the share of households living in transport poverty has increased over time, and, in 2019, it affected over 350.000-560.000 families. The authors also highlight that specific demographic and socio-economic groups, such as women, low-income households, rural areas, increase the probability of suffering from transport poverty.

One aspect of transport poverty that is difficult to measure but is nonetheless essential is the loss of labor opportunities resulting from inadequate access to transportation. Without reliable transportation options, individuals may be able to access job opportunities outside their immediate area, which can limit their earning potential and career prospects. This can lead to a cycle of poverty, where individuals and communities lack the economic resources to improve their access to transportation and, in turn, their employment prospects. Several studies have explored the relationship between transportation and labor market outcomes, highlighting the challenges that can arise from inadequate transportation options. Sari (2015) evaluates the impact of constructing a tramway line in certain neighborhoods and municipalities previously isolated and characterized by unfavorable socio-economic conditions in Bordeaux. The author finds that although the overall unemployment rate has decreased over the observed period, the decrease is more significant for neighborhoods close to tramway stations. Bastiaanssen et al. (2020) conduct a meta-analysis based on 20 methodologically comparable studies and suggest that better access to public transport and higher levels of job accessibility increases employment probabilities but highlight the need to find more consistent transport measures to establish a robust relationship.

It is in that context that Member states should develop a Social Climate Plan, that should be submitted by the 30th of June 2025, containing a coherent set of existing or new national, and, where relevant, regional and local measures and investments to address the impact of carbon pricing in the groups defined above. The plans should include an investment element encouraging a long-term solution to reduce reliance on fossil fuels and potential measures like temporary direct income support to address short-term adverse income effects. The Plans should have two main objectives:

1) Furnish vulnerable households, micro-enterprises, and transport users with the necessary resources to finance and invest in energy efficiency, decarbonization of heating and cooling, low or zero-emission vehicles, sustainable mobility and public transport access. These resources could come in the form of vouchers, subsidies, or zero-interest loans.

2) Alleviate the impact of the increase in fossil fuel costs on the most vulnerable members of society, thereby preventing energy and transport poverty during the transition period until the investments above have been implemented.

A potential risk is that the resources devoted do not reach the target groups, thus reducing the effectiveness of the Fund. Below it is explained why this is important when evaluating the provision of subsidies to increase the take-up of low-emission vehicles. To avoid it, Article 8 outlines that Member States shall provide the necessary statutory and contractual safeguards to ensure the full benefit is passed on.

Finally, the Fund would be financed by the EU budget, using an amount equivalent to 25% of the expected emissions trading revenues for this new system. Member States should use their auction revenues to finance parts of their national contributions to the Fund.

Box 2. Relevant takeaways from the literature for metropolitan transport policymaking regarding a just transition for the most vulnerable

- → The introduction of the EU ETS II will have a disproportionate impact on households that are vulnerable, micro-enterprises, and transport users who already allocate a significant portion of their income to energy and transportation.
- → Transport and energy poverty indicators already show an increasing trend.
- → To tackle poverty and help vulnerable groups choose cleaner mobility options, both targeted direct transfers and investment programs are needed.

Alternative fuels infrastructure

The Alternative Fuels Infrastructure Directive[12] was adopted in 2014 to address the lack of coordinated deployment of alternative fuel refueling and recharging infrastructure across the EU. The directive required EU countries to develop national policy frameworks (to put in place enough refueling and recharging points for certain alternative fuel vehicles and vessels, including electric recharging points, compressed natural gas (CNG) and liquified natural gas (LNG) refueling points, and hydrogen refueling infrastructure.

The Fit for 55 package proposes a more ambitious approach to repeal the directive and replace it with a regulation, to ensure a swift and coherent development of the EU infrastructure network. In particular, the proposed regulation sets several mandatory national targets for deploying alternative fuel infrastructure in the EU for road vehicles, vessels and stationary aircraft.

12 See Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure Text with EEA relevance

Regarding road transport and focusing on electric vehicles, the proposed regulation establishes that there should be recharging stations at least every 60 km on main roads for light vehicles (passenger cars and trucks below 3.5 tones) by 2025 and, every year, total power output provided through those should grow with the number of EV registered cars. The same distance regulation is applied to heavy vehicles (trucks above 3.5 tones), but its enforcement is delayed until 2030. By the end of that decade, there should be at least one recharging station in each parking area and in urban areas. The regulation also sets certain conditions for this new infrastructure, namely, the possibility of ad-hoc charging, acceptance of electronic payments and transparent and clear information for users about pricing options.

Considering range anxiety[13] is one of the main deterrents of EV vehicle purchases (Sierzchula et al., 2014), this regulation is expected to affect the take-up of his type of private mobility positively. Although the vehicle fleet's electrification will occur gradually over the next decade, the pace is accelerating: for example, in Spain, in 2022, electric vehicle registrations grew by 30% over the previous year. However, we must catch up to the targets set in the National Energy Plan for installing recharging points. It remains to streamline and standardize administrative processes throughout the country and ensure accessibility in refueling, paying attention to the different needs of urban and rural users.

Box 3. Relevant takeaways from the literature for metropolitan transport policymaking regarding recharging infrastructure

- → Increasing the recharging infrastructure available will incentivize EV adoption.
- → Its territorial distribution should avoid deepening existing divides.
- → The tariff system should be transparent.

13 This concept refers to driver's fear that a vehicle has insufficient energy storage (fuel and/or battery capacity) to cover the road distance needed to reach its intended destination, and would thus strand the vehicle's occupants mid-way.

CO_2 emissions standard for cars and vans and banning the sale of new petrol and diesel cars from 2035

On the 14th of February, the Parliament endorsed the deal reached with the Council on CO_2 emissions reduction targets for new passenger cars and light commercial vehicles and on the ban of new sales of new petrol and diesel cars from 2035[14]. The new legislation sets an EU fleet-wide target to reduce CO_2 emissions produced by new cars and vans by 100% compared to 2021. Intermediate targets for 2030 are set at 55% for cars and 50% for vans.

As Davis and Knittel (2019) point out, fuel and vehicle standards "impose a constraint on automakers that creates an implicit subsidy for fuel-efficient vehicles and an implicit tax on fuel-inefficient vehicles". Clerides and Zachariadis (2008) found that the average annual fuel consumption of new cars in 18 developed countries decreased more rapidly after the implementation of standards, with an average decrease of 0.5% in the European Union and the United States and 1.3% in Japan compared to before the regulations.

Clerides and Zachariadis (2008) also compare the aggregate and redistributive effects of the regulatory standard with that of fuel taxes in the European Union. Their research showed that the standards evaluated would produce up to 15% aggregate savings in gasoline consumption over 10 to 15 years. To have the same effect through taxes, the necessary price increase would have to be 24%, meaning a 50% increase in taxes. This, results highlight the trade-off between effectiveness and political viability that several policies to fight climate change pose.

Box 4. Relevant takeaway from the literature for metropolitan transport policymaking regarding emissions standards

→ Standards are a useful tool to reduce emissions and have a low cost, both economically and in terms of social acceptability, compared to fuel taxes.

14 See the Press Release

Revising energy taxation

Energy taxes and carbon prices can be considered the first best instruments to reduce emissions and encourage a transition to cleaner energy. On the one hand, they stimulate the uptake of CO_2 reduction options while leaving the actual choice of how to reduce emissions to the agents. In this context, within the Fit for 55 package framework, the EU plans to revise the existing energy taxation directive to align it with the EU's current energy and climate policies.

Despite there yet to be a political agreement, the objective is that the revised directive ensures the taxation of motor and heating fuels and electricity reflects its environmental costs encouraging businesses and consumers to make greener choices. Specifically, the review focuses on two main areas: the structure of tax rates and broadening the taxable base. The former refers to linking the tax rates to the real energy content and environmental performance of fuels and electricity rather than to volume. The latter aims to broaden product coverage and remove some current exemptions and reductions.

Comité de Personas Expertas (2022) analyzes the current context of energy taxation in Spain and makes recommendations in the same direction as the EU proposal. They conclude that the current weight of environmental taxes in Spain is very low: in 2019, environmental tax revenues in Spain stood at 1.8% of GDP compared to 2.4% of the EU average. The authors also highlight how the current regulation is complex and unsystematic and that it does not contribute to the fulfillment of Spain's environmental objectives. Despite the need to implement the "pollutant pays" principle, they recognize the regressive effects of such a reform and propose compensations for the affected groups. Other studies present similar conclusions (see, for example, Gago et al., 2021).

Regarding the political viability, if such reform does not go together with effective compensation schemes, it would face significant social backlash. The *gilets jaunes* movement that appeared in France in 2018 is an example and can help explain why the approval of the review has been postponed at the EU level. Moreover, the current energy crisis has prompted governments across the EU to act in the opposite direction: to cushion the impact of high energy prices, member states have approved tax cuts and fuel subsidies.

Box 5. Relevant takeaways from the literature for metropolitan transport policymaking regarding energy taxation

- → Increasing taxation is the most efficient option to tackle emissions.
- → However, it disproportionately impacts the most vulnerable groups, thus making the policy regressive.
- → To compensate for such effects and avoid general social backlash, the revenue generated by the tax should be reinvested in vulnerable consumers.

National policies and relevant legislation

To ensure there is a clear path towards climate neutrality, the UE mandates the different member states to develop national energy and climate plans[15]. Those should be updated every ten years and outline how the EU countries intend to address: energy efficiency, renewables, greenhouse gas emissions reductions, interconnections and research and innovation.

Spain approved the plan's final version (hereafter PNIEC[16] for its Spanish acronym) in 2021, and, with the approval of Law 7/2021[17], the results contemplated in the PNIEC became minimum national objectives for 2030. The specific goals are:

- → At least a 20% reduction in greenhouse gas (GHG) emissions compared to 1990.
- → 42% of renewables over final energy use.
- → 39.5% improvement in energy efficiency.
- → 74% renewable energy in electricity generation.

Focusing on the transport sector, the PNIEC considers the modal shift the main driving force behind its decarbonization. To this end, it envisaged that from 2023 the delimitation of low-emission zones with limited access to the most emitting and polluting vehicles would be generalized to all cities with more than 50,000 inhabitants and in those with more than 20,000 inhabitants that show pollution problems. The autonomous and local administrations should implement those, and their potential environmental, economic and social effects will be analyzed in the following section. Another driving force behind the sector's decarbonization will be renewables in mobility transport through electrification and the use of biofuels.

Before analyzing the specific policies in detail, it must be noted that the first draft update of the PNIEC was presented in June 2023 and is open to public consultation. In view of the increased climate ambitions at the European level following the pandemic and the invasion of Ukraine, the targets have been revised upward:

- → 32% reduction in greenhouse gas emissions compared to 1990.
- → 48% renewables over final energy use
- → 44% improvement in energy efficiency
- → 81% renewable energy in electricity generation

15 See **European Parliament (2018) in the References.**

16 See Plan Nacional Integrado de Energía y Clima (PNIEC) 2021-2030

17 See https://www.boe.es/diario_boe/txt.php?id=BOE-A-2021-8447

Low Emission Zones

Reducing the impact of worsening air quality on citizens and the environment has been one of the EU's priority objectives and has been reflected in legislation. Directive 2008/50/EC[18] limits air pollutants that the Member States must comply with. In the event of an infringement, Member States must implement measures to reverse the situation. If inaction is prolonged, the European Commission may refer the matter to the EU Court of Justice.

Several European cities have resorted to low-emission zones to improve air quality and reduce pollution levels in line with the standards set by legislation. In LEZs, by designating an area where restrictions are applied to the most polluting vehicles, the aim is to reduce emissions of gases that are harmful to health. However, there are different ways to implement an LEZ, as restrictions can be set based on different criteria (such as time of day, type of vehicle, the purpose of the trip and license plate number) depending on the particularities of the city in which it is implemented.

In February 2017, the European Commission warned Spain of non-compliance with the directive in Madrid and Barcelona, two of the most populated Spanish cities. In this context, Madrid was the first city in Spain to implement a low-emission zone, called Madrid Central, in November 2018. The regulation restricted car entry in the area reserved for public transport and lower emission vehicle category according to the classification developed by the Central Traffic Headquarters (DGT for its Spanish acronym). The norm elaborated several exceptions for residents, delivery, commercial and industrial vehicles, and taxis and ride-hailing vehicles. During its first three months, drivers who violated the rule were notified by post, and, since March 2019, fines were issued until its derogation at the end of 2021.

Salas et al. (2021) estimate that, after its implementation, there was a reduction of NO_2 levels ranging from 23% to 34% in the only monitoring station within the LEZ. The authors also show no negative spillover effects on other monitoring stations outside the restricted area. In fact, in four nearby air-quality monitoring stations outside the Madrid Central LEZ, they find significant, although lower in magnitude, reductions in NO_2 concentration.

Similarly, Galdon-Sanchez et al. (2022) find that during the first months of implementation, the number of cars per hour within the Madrid Central area decreased by 16.1% and the concentration of NO2 decreased by 18.6%. Additionally, the authors indicate the existence of suggestive evidence of a reduction in traffic in close-by areas in the short run. Once monetary fines were imposed, the concentration of NO2 dropped further to more than 41% below its pre-intervention levels. They also evaluate the trade-off this kind of policy raises: its effectiveness in reducing congestion and pollution and a potential disincentive for consumption and hence a decrease in retail sales within the restricted area due to increased transportation costs. Using data on credit card spending, they find a 20.6% decrease in the value of brick-and-mortar spending and a 12.1% increase in the value of online spending of buyers residing in zip codes outside the regulated area in establishments located within the Madrid Central area. However, there is heterogeneity between zip codes: those facing larger transportation constraints (higher numbers of cars per person or worse access to public transportation) reduce their spending in the affected area more. The authors highlight that these substitutions usually occur at different types of sellers, suggesting this policy might have unintended distributional effects on smaller businesses.

18 Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

Tassinari (2022) analyses whether LEZ schemes effectively reduce traffic within the implementation area and whether they generate a displacement effect. Results suggest that the implementation of Madrid Central led to an overall slight increase in traffic for the whole city: the implementation did reduce traffic in the restricted area, but it was offset by an overall increase in transit in the other areas of the city. Moreover, the author finds that the reduction in the city center decreases over time and disappears seven months after the implementation, partly due to a renewal of the vehicle fleet towards cleaner vehicles. The paper also identifies a switch to public transport for commutes directed to the restricted area and rerouting of trips for destinations outside Madrid Central.

Adán et al. (2022) analyse the impact of Barcelona's low emission zone on car mobility and, in particular, the impact on different population groups. They find that women reduce their car use more than men and that people with higher education reduce their car trip share more than people with lower education levels. In terms of income, the results show that people living in low-income municipalities reduce their car use the most (48 percentage points more than people in middle-income municipalities). The authors also consider travel time and conclude that people whose travel time is 20 minutes or less reduce their mobility more than people who have longer travel times.

A final aspect to take into consideration is how the effectiveness of LEZ compares to alternative policies such as urban tolls. Bernardo et al. (2021) analyze 130 large cities in the European Union and the United Kingdom and find that urban tolls are more effective than LEZ. The reason is that the former is effective in simultaneously mitigating pollution and congestion, while the latter is an effective instrument to reduce pollution but not congestion. All this contrasts with the growing application of low-emission zones and the sporadic application of urban tolls in Europe, a trend reinforced in Spain with the aforementioned obligation established in the PNIEC and transposed in the new Climate Change Law[19]. The authors point out that the success of LEZ is explained by its greater popularity among citizens.

These results are relevant given the provisions of the Draft Sustainable Mobility Law of December 2022[20] The document updates the Royal Decree that regulates LEZ[21] to make them compatible with circulation fees. In particular, it allows municipal governments to charge a fee to the owners of the most polluting vehicles that want to access Low Emission Zones. The final design of such policy remains to be defined. However, if it is extended to all types of vehicles and the fee varies depending on their emissions, it will resemble urban tolls and might enhance pollution and congestion reductions.

19 Ley 7/2021, de 20 de mayo, de cambio climático y transición energética

20 Anteproyecto de Ley de Movilidad Sostenible

21 Real Decreto 1052/2022, de 27 de diciembre, por el que se regulan las zonas de bajas emisiones

Box 6. Relevant takeaways from the literature for metropolitan transport policymaking regarding LEZ

- → There is an across-the-board agreement in the academic literature about the positive effect of LEZ on air quality and congestion.
- → Moreover, there is evidence of fleet renewal with cleaner vehicles in the area and a switch to public transport for commutes directed towards the restricted area.
- → However,
  - It might exist a negative impact on the economy in the area, especially for small business.
  - The impact on traffic might be just transitory and even have spillover effects to bordering zones.
  - The groups that may be more affected are women and residents of low-income municipalities.
- → Despite its complementarity with urban tolls, when implemented alone, LEZs are less efficient since they reduce pollution but not congestion. Nevertheless, its popularity can be explained by its relatively higher social acceptability

Subsidy programs to increase take-up of electric vehicles

In 2019, the Spanish government introduced the MOVES Plan (Alternative and Sustainable Mobility[22]), a program aimed at promoting sustainable mobility and reducing greenhouse gas emissions through financial aid for the purchase of alternative vehicles, installation of electric vehicle charging infrastructures, electric bicycle loan systems and implementation of measures included in Transport Plans at workplaces. The Communities and autonomous cities were in charge of distributing the aid among the final beneficiaries under the Institute for Energy Diversification and Saving (IDEA) coordination.

Divided into three phases, the first MOVES Plan had a budget of 45 million euros and established that:

- → Financial aid varied according to the type of vehicle and its electric autonomy in the case of vehicle purchases.
- → In the case of installing recharging infrastructures or loan systems for an electric two-wheeler, the subsidy could not exceed a certain percentage of the installation cost, with a maximum limit of 100,000€.
- → In implementing a Workplace Transport Plan, the aid could not exceed 50% of the eligible cost, with a maximum limit of 200,000€.

22 Real Decreto 132/2019, de 8 de marzo, por el que se acuerda la concesión directa de las ayudas del programa MOVES a las comunidades autónomas y las ciudades de Ceuta y Melilla

After its completion, the second edition of the Plan[23] was approved, called MOVES II, which had an initial budget of 100 million euros and modified certain aspects to improve the execution of the funds and their integration with the objectives of decarbonization of the transport sector included in the PNIEC 2021-2030.

In April 2021, the third edition of the plan (MOVES III) was approved[24], with an initial budget allocation of 400 million euros to continue promoting the renewal of professional and private vehicles and the implementation of infrastructures necessary for sustainable mobility. After the latest budget increase, the program's total budget amounts to approximately 700 million euros.

Although the ultimate objective of these plans is accelerating the take-up of sustainable vehicles, the evidence shows that the effectiveness of this and similar schemes is mixed. Moreover, some undesired effects might arise. Anghel et al. (2022) report that the impact of the MOVES II program, launched in June 2020, on electric vehicle registrations had a very heterogeneous impact within the different autonomous communities. In particular, the program would have increased on average by at least one percentage point the percentage of new EV registrations in Asturias, Madrid, Navarra, Baleares and in the average of the provinces of Catalonia from its implementation until December 2020. In contrast, the average impact in the provinces within the other regions cannot be ruled out as inexistent. According to the literature, the authors point to the lack of public charging infrastructure as one of the factors driving the results.

About the previous scrappage scheme, there are some studies. Plan 2000E was implemented in 2009 for thirteen months to reactivate the automobile sector in Spain after the financial crisis. The program subsidized replacing a vehicle of at least ten years or with a minimum of 250,000 km on the clock for a new one that costs less than 30,000€ (including taxes) and had certain CO_2 emissions per km. It was co-financed by the National Government (25%), the Autonomous Communities (25%) and manufacturers (50%) to provide a total of 2000€ per vehicle.

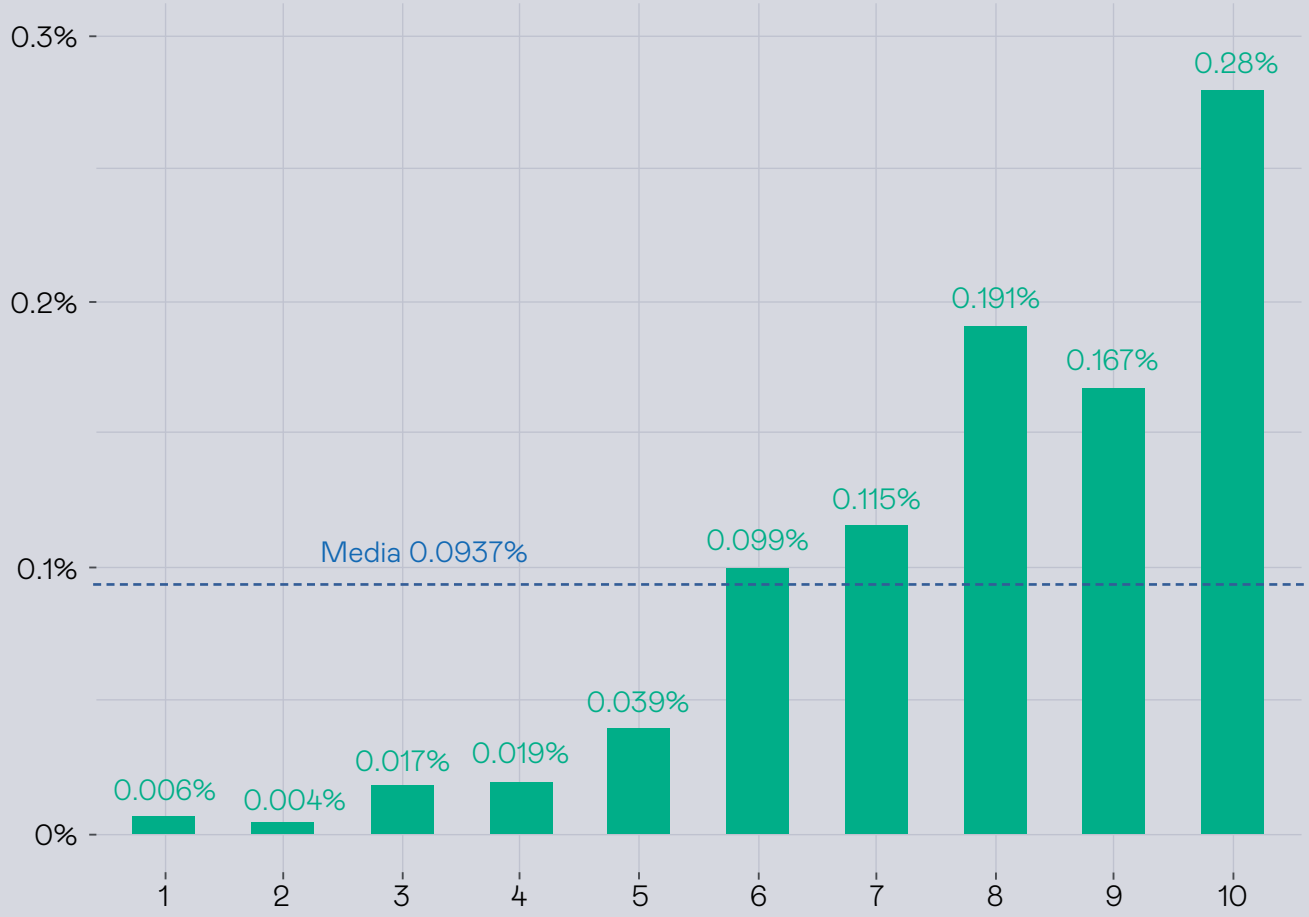
Jiménez et al. (2016) conducted one of the first evaluations. They observed that the Plan caused an increase of 650€ in the price of subsidized cars. That is, the 2000€ ended up being shared between the consumers, who would receive a net discount of 1350€, and the manufacturers, who would receive the remaining 650€. Regarding its effect on sales, the authors concluded that those increased in the initial months. Still, its overall effect over its lifetime was negligible. Comparing the costs (invested quantity of money) and the benefits of the program (reductions in polluting emissions and additional fiscal revenues), they find the Plan to be inefficient and suggest the use of different mechanisms (energy efficiency standards or increasing fuel taxes) to incentivize emissions reductions.

Using different empirical strategies, Cantos-Sánchez et al. (2018) conclude that the program positively affects the probability of purchasing a new vehicle in the short run. However, the overall effect seems to be moderate. They also analyze household car expenditures and observe a notable reduction six months after the implementation of the Plan compared to the previous 6-month period. Additionally, the authors find that consumers' welfare increases but point out that the gains increase with the total expenditure per household. Considering total expenditures as a proxy for household income, their results suggest that the relatively wealthier families are those who gain the most from Plan 2000E.

24 Real Decreto 266/2021, de 13 de abril, por el que se aprueba la concesión directa de ayudas a las comunidades autónomas y a las ciudades de Ceuta y Melilla para la ejecución de programas de incentivos ligados a la movilidad eléctrica (MOVES III) en el marco del Plan de Recuperación, Transformación y Resiliencia Europeo

Looking at the distributional effects, Gago et al. (2021) compute, using data on household expenditure, the overall probability of buying a car is almost seven times higher in wealthy households and the likelihood of purchasing a new car is more than 200 times higher. They simulate the introduction of a 1.000€ subsidy for buying a new, clean vehicle, assuming that all households that purchased a vehicle complied with these conditions. The following figure shows the regressive distributional impact of such a measure: the increase in equivalent household income grows with the deciles, particularly benefiting the richest households, which receive in relative terms 47 times more than those in the poorest (first) decile. The authors conclude that this effect illustrates the so-called paradox of additionality, evidencing an inefficient use of public instruments to finance and encourage behavior that does not require incentives. Since wealthier households are the ones with enough economic liquidity to make such purchases, the subsidy reaches families that might have potentially made the purchase without it.

Figure 2. Distributional impact by equivalent income deciles generated by a 1.000€ subsidy for purchasing new and clean vehicles.



Source: Gago, A., Labeaga, J. M., & López-Otero, X. (2021). Cómo utilizar la fiscalidad energético-ambiental para una transición ecológica justa en España: una propuesta enfocada a los carburantes. *EsadeEcPol Brief, #11 Mayo 2021*

With a broader geographical scope, Grigolon et al. (2016) study the impact of the scrapping schemes adopted across Europe during the 2008 economic crisis. Their findings indicate that, on aggregate, the programs had a significantly stabilizing impact on total car sales, but heterogeneity exists among the different countries. In the case of Spain, they estimate that a 1% increase in the Plan 2000E boosted sales for eligible vehicles by 1.6% while those for non-eligible vehicles slightly decreased. Regarding the environment, they find there was a beneficial impact due to substituting more fuel-efficient cars. Again, the effect is heterogeneous, and, in Spain, the scheme only improved fuel consumption by 2%.

Box 7. Relevant takeaways from the literature for metropolitan transport policymaking regarding EV subsidies

- → The literature indicates the effectiveness of scrapping schemes in reducing emissions is moderate.
- → Moreover, if it is not targeted to specific groups, wealthier households are the ones that benefit the most.
- → Some studies also point out to undesired effects such as price increases in the elegible cars.

Public transport subsidies

The increase in energy and electricity prices during 2022 led the Spanish government to establish several measures to promote the use and accessibility of the national public transport network. The first package of measures[25] approved in June includes direct aid for passenger transport equivalent to half the amount for rail tickets provided by Renfe (Cercanías, Media Distancia and Avant), and one-third for regular bus transport journeys.

In August, Royal Decree 14/2022 extended the price reduction to 100% for the services of each of the Cercanías and Rodalies hubs and the Medium Distance rail services declared as a public service obligation by the competent administrations from September 1, 2022, to December 31, 2022. In December, Royal Decree 20/2022 extended its validity for the first half of 2023. It established a direct aid system, corresponding to the first half of 2023, to grant financial support to autonomous communities and local entities that provide urban or interurban public transport services. The aid will allow a 30% rebate on the price of urban and interurban transport of regional or municipal competence for those communities and municipalities that agree on an additional 20% rebate. With this, it will be possible to achieve a 50% price reduction for regular public transport passengers throughout the national territory.

25 Real Decreto-ley 11/2022, de 25 de junio, por el que se adoptan y se prorrogan determinadas medidas para responder a las consecuencias económicas y sociales de la guerra en Ucrania, para hacer frente a situaciones de vulnerabilidad social y económica, y para la recuperación económica y social de la isla de La Palma

Regarding the effects of this policy, it should be noted that subsidies for public transportation are common worldwide, and its use is justified for different reasons: to tackle the congestion caused by private mobility, to improve labor market outcomes and, finally, for redistribution (Matas & Perdiguero, 2022). Focusing on the latter, there is evidence of a progressive effect of urban transport subsidies in Spain. Cadena et al. (2016) explore the equity implications of the monthly travel pass in Madrid. They conclude that travel pass usage is negatively correlated with income and, as a result, the subsidy benefits associated with it increase when the average income per capita decreases. Similarly, Matas et al. (2020) find that subsidies in the Metropolitan Region of Barcelona have a moderate progressive effect explained by low-income groups' higher use of public transport.

However, different studies find that non-targeted subsidies might have mild or negative distributive effects. Arranz et al. (2019) finds that a reduction of the monthly travel pass for young people in Madrid benefited the most to medium and high-medium income households. Nonetheless, authors point out that the measure has made the pass more accessible for the poorest ones. Analyzing transit subsidies in Stockholm, Börjesson et al. (2020) show that their progressivity is weak because different income groups get roughly equal subsidies.

Even though the explicit objective of transport subsidies is not generally to reduce emissions, in theory, they could help reduce emissions and congestion by encouraging travelers to a modal shift (Timilsina & Dulal, 2008). However, the evidence in that regard has not been very encouraging. Cats et al. (2017), assessing the effects of free transport in Tallinn, conclude that although public transport use increased by 14%, especially among lower-income families, car use did not decrease substantially. They point to the resulting reduction in congestion as an incentive for users with higher income and higher time value to continue using their vehicles. Bull et al. (2021) compared the transportation decisions of a group of people who were granted a free public transportation pass for two weeks versus another group that did not have such an advantage. The results show that although public transport use increased for the first group, such an increase was more relevant in off-peak periods. The implication is that the free policy promoted mobility not for work or study purposes but for leisure and non-working days. Finally, they find no significant impact on car use. Regarding the current policy in Spain, Albalate et al. (2022) evaluate whether the increase in train commuters reduced private vehicle use. They argue that, if the policy took cars off the roads, an improvement in air quality might be observed. The authors conclude that there wasn´t a statistically significant reduction effect of the subsidy on the concentration of different pollutants. Thus, there was no switch from private to public means of transport.

By contrast, Gohl and Schrauth (2022) show that reducing transit fees without fully subsidizing them might improve air quality and promote a modal shift. They assess the impact of the flat tariff of 9€ that Germany introduced from June to August for all urban and interurban public transport, aiming to reduce fuel consumption after the Russian invasion of Ukraine.

The authors find that air pollution levels fell by up to more than 8% in response to introducing the low-cost ticket. However, the magnitude of the effect varies depending on the days of the week and the characteristics of the regions. In particular, they document that the impact is largest during working days and in urban areas and regions with a well-developed public transport network.

The Association of German Transport Companies (VDV) points in the same direction. In its final study of the policy[26], they conclude that 17% of the 9-euro ticket switched from other means of transport (cars, bicycles, etc.) to public transport in August. Moreover, 10 percent of the buyers have cut at least one of their daily car trips. Aside from the price, not using the car is the second most important reason for buying the ticket for 43% of people. On the other hand, they also report that more than 30% of the buyers' daily trips were related to leisure. Finally, VDV estimates the environmental impact was positive: 1.8 million tones of CO_2 were avoided.

Box 8. Relevant takeaways from the literature for metropolitan transport policymaking regarding public transport subsidies

- → The evidence suggests the progressivity of non-targeted public transport subsidies is weak.
- → The literature agrees about its effectiveness in promoting public transport use.
- → However, the evidence regarding its impact in private car use and emission reductions depends on the degree of the discount: it seems that fully subsidized transit fees do not reduce private vehicle use while partial subsidies do.

26 Available at (only in german): https://www.vdv.de/bilanz-9-euro-ticket.aspx

Conclusions of the review and assessment of key European and national transport measures

Designing a metropolitan transport plan requires a deep understanding of EU and national policies since those provide the context and constraints for such plans. With the current focus on decarbonization, this has become even more important: transport policies at the supranational and national levels have adopted a new carbon neutrality objective. Those outline the specific emission reduction targets and timelines that must be met to achieve broader climate goals. As a result, metropolitan transport plans must be aligned and contribute to these goals while covering the population's needs for efficient and sustainable transport. By understanding the policy context, planners can better define the specific objectives the plan should achieve and how to transpose them into concrete actions. Therefore, EU and national policies play a crucial role in shaping metropolitan transport plans that are sustainable and efficient and contribute to the broader goal of decarbonization.

Additionally, supranational and national policies may have various impacts on the population that go beyond reducing emissions, such as changing transport system organization or affecting car ownership costs. Specifically, they can have socio-economic effects that condition the local context in which a metropolitan transport plan will be implemented. For example, a carbon tax might affect certain demographic groups more than others deepening existing economic inequalities in the area. These socio-economic impacts can significantly influence the success of the metropolitan transportation plan and should be considered during the planning process.

References of the review and assessment of key European and national transport measures

Adán, R., Laffaire, M., Sánchez, M., & Tucat, P. (2022). *Evaluación del impacto económico de la zona de bajas emisiones de Barcelona*. https://www.ksnet.eu/wp-content/uploads/2023/03/ZBE_final_cast.pdf

Adom, P. K., Amuakwa-Mensah, F., Agradi, M. P., & Nsabimana, A. (2021). Energy poverty, development outcomes, and transition to green energy. *Renewable Energy, 178*, 1337–1352. https://doi.org/10.1016/j.renene.2021.06.120

Albalate, D., Borsati, M., & Gragera, A. (2022, December 16). *Resultados preliminares del impacto de los descuentos masivos en transporte público sobre la calidad del aire.* Nada Es Gratis. https://nadaesgratis.es/admin/resultados-preliminares-del-impacto-de-los-descuentos-masivos-en-transporte-publico-sobre-la-calidad-del-aire

Alexeeva-Talebi, V. (2011). Cost pass-through of the EU emissions allowances: Examining the European petroleum markets. *Energy Economics, 33*, S75–S83. https://doi.org/10.1016/j.eneco.2011.07.029

Alonso-Espelde, E., García-Muros, X., & González-Eguino, M. (2023). Análisis de los usuarios vulnerables al transporte. *Observatorio de La Transición Energética y La Acción Climática, Enero 2023.*

Anghel, B., Auciello Estévez, I., & Lacuesta Gabarain, A. (2022). Heterogeneity of the impact of the Spanish programme of incentives for the purchase of electric vehicles. *Economic Bulletin, Analytical Articles* (No 4 2022). https://repositorio.bde.es/bitstream/123456789/23390/1/be2204-art28e.pdf

Arranz, J. M., Burguillo, M., & Rubio, J. (2019). Subsidisation of public transport fares for the young: An impact evaluation analysis for the Madrid Metropolitan *Area. Transport Policy, 74*, 84–92. https://doi.org/10.1016/j.tranpol.2018.11.008

Bastiaanssen, J., Johnson, D., & Lucas, K. (2020). Does transport help people to gain employment? A systematic review and meta-analysis of the empirical evidence. *Transport Reviews, 40*(5), 607–628. https://doi.org/10.1080/01441647.2020.1747569

Bednar, D. J., & Reames, T. G. (2020). Recognition of and response to energy poverty in the United States. *Nature Energy, 5*(6), 432–439. https://doi.org/10.1038/s41560-020-0582-0

Bernardo, V., Fageda, X., & Flores-Fillol, R. (2021). Políticas para reducir contaminación y congestión en áreas urbanas: ¿peajes urbanos o zonas de bajas emisiones? *EsadeEcPol Brief, #8 Abril 2021*. https://www.esade.edu/ecpol/es/publicaciones/politicas-reducir-contaminacion-congestion/

Berry, A., Jouffe, Y., Coulombel, N., & Guivarch, C. (2016). Investigating fuel poverty in the transport sector: Toward a composite indicator of vulnerability. *Energy Research & Social Science, 18*, 7–20. https://doi.org/10.1016/j.erss.2016.02.001

Börjesson, M., Eliasson, J., & Rubensson, I. (2020). Distributional effects of public transport subsidies. *Journal of Transport Geography, 84*, 102674. https://doi.org/10.1016/j.jtrangeo.2020.102674

Bull, O., Muñoz, J. C., & Silva, H. E. (2021). The impact of fare-free public transport on travel behavior: Evidence from a randomized controlled trial. *Regional Science and Urban Economics, 86*, 103616. https://doi.org/10.1016/j.regsciurbeco.2020.103616

Cadena, P. C. B., Vassallo, J. M., Herraiz, I., & Loro, M. (2016). Social and Distributional Effects of Public Transport Fares and Subsidy Policies: Case of Madrid, Spain. *Transportation Research Record: Journal of the Transportation Research Board, 2544*(1), 47–54. https://doi.org/10.3141/2544-06

Cambridge Econometrics. (2020). *Decarbonising European transport and heating fuels - Is the EU ETS the right tool?* https://europeanclimate.org/wp-content/uploads/2020/06/01-07-2020-decarbonising-european-transport-and-heating-fuels-full-report.pdf

Cantos-Sánchez, P., Gutiérrez-i-Puigarnau, E., & Mulalic, I. (2018). The impact of scrappage programmes on the demand for new vehicles: Evidence from Spain. *Research in Transportation Economics, 70*. https://doi.org/10.1016/j.retrec.2017.11.006

Castaño-Rosa, R., Solís-Guzmán, J., Rubio-Bellido, C., & Marrero, M. (2019). Towards a multiple-indicator approach to energy poverty in the European Union: A review. *Energy and Buildings, 193*, 36–48. https://doi.org/10.1016/j.enbuild.2019.03.039

Cats, O., Susilo, Y. O., & Reimal, T. (2017). The prospects of fare-free public transport: evidence from Tallinn. *Transportation, 44*(5), 1083–1104. https://doi.org/10.1007/s11116-016-9695-5

Clerides, S., & Zachariadis, T. (2008). The effect of standards and fuel prices on automobile fuel economy: An international analysis. *Energy Economics, 30*(5), 2657–2672. https://doi.org/10.1016/j.eneco.2008.06.001

Comité de Personas Expertas. (2022). Fiscalidad medioambiental. In *Libro blanco sobre la reforma tributaria* (pp. 207–313). https://www.ief.es/docs/investigacion/comiteexpertos/LibroBlancoReformaTributaria_2022.pdf

Davis, L. W., & Knittel, C. R. (2019). Are Fuel Economy Standards Regressive? *Journal of the Association of Environmental and Resource Economists, 6*(S1), S37–S63. https://doi.org/10.1086/701187

Dong, K., Ren, X., & Zhao, J. (2021). How does low-carbon energy transition alleviate energy poverty in China? A nonparametric panel causality analysis. *Energy Economics, 103*, 105620. https://doi.org/10.1016/j.eneco.2021.105620

European Parliament. (2018). *Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action*. European Parliament and Council. http://data.europa.eu/eli/reg/2018/1999/oj

Gago, A., Labeaga, J. M., & López-Otero, V. (2021a). Cómo utilizar la fiscalidad energético-ambiental para una transición ecológica justa en España: una propuesta enfocada a los carburantes. EsadeEcPol Brief, #11 Mayo 2021.

Gago, A., Labeaga, J. M., & López-Otero, X. (2021b). Cómo utilizar la fiscalidad energético-ambiental para una transición ecológica justa en España: una propuesta enfocada a los carburantes. EsadeEcPol Brief , #11 Mayo 2021.

Galdon-Sanchez, J. E., Gil, R., Holub, F., & Uriz-Uharte, G. (2022). Social Benefits and Private Costs of Driving Restriction Policies: The Impact of Madrid Central on Congestion, Pollution, and Consumer *Spending. Journal of the European Economic Association* https://doi.org/10.1093/jeea/jvac064

Gohl, N., & Schrauth, P. (2022). Ticket to Paradise? *The Effect of a Public Transport Subsidy on Air Quality* (No. 50; CEPA Discussion Papers).

Grigolon, L., Leheyda, N., & Verboven, F. (2016). Scrapping subsidies during the financial crisis - Evidence from Europe. *International Journal of Industrial Organization, 44*. https://doi.org/10.1016/j.ijindorg.2015.10.004

Halkos, G. E., & Gkampoura, E.-C. (2021). Evaluating the effect of economic crisis on energy poverty in Europe. *Renewable and Sustainable Energy Reviews, 144*, 110981. https://doi.org/10.1016/j.rser.2021.110981

Jiménez, J. L., Perdiguero, J., & García, C. (2016). Evaluation of subsidies programs to sell green cars: Impact on prices, quantities and efficiency. *Transport Policy, 47*. https://doi.org/10.1016/j.tranpol.2016.01.002

Koukoufikis, G., & Uihlein, A. (2022). Energy poverty, transport poverty and living conditions - An analysis of EU data and socioeconomic indicators. *Publications Office of the European Union, JRC*128084. https://doi.org/10.2760/198712

Labandeira, X., Labeaga, J. M., & López-Otero, X. (2017). A meta-analysis on the price elasticity of energy demand. *Energy Policy, 102*, 549–568. https://doi.org/10.1016/j.enpol.2017.01.002

Lovelace, R., & Philips, I. (2014). The 'oil vulnerability' of commuter patterns: A case study from Yorkshire and the Humber, UK. *Geoforum, 51*, 169–182. https://doi.org/10.1016/j.geoforum.2013.11.005

Lucas, K., Mattioli, G., Verlinghieri, E., & Guzman, A. (2016). Transport poverty and its adverse social consequences. *Proceedings of the Institution of Civil Engineers - Transport, 169*(6), 353–365. https://doi.org/10.1680/jtran.15.00073

Marion, J., & Muehlegger, E. (2011). Fuel tax incidence and supply conditions. *Journal of Public Economics, 95*(9–10), 1202–1212. https://doi.org/10.1016/j.jpubeco.2011.04.003

Martínez, Á., & Martínez, J. (2023). Las desigualdades en el impacto de la inflación en 2022, compensadas por la electricidad. *EsadeEcPol Blog*.

Matas, A., & Perdiguero, J. (2022). El transporte público urbano: financiación y uso. *Papeles de Economía Española, 171*, 109–176.

Matas, A., Raymond, J.-L., & Ruiz, A. (2020). Economic and distributional effects of different fare schemes: Evidence from the Metropolitan Region of Barcelona. *Transportation Research Part A: Policy and Practice, 138*, 1–14. https://doi.org/10.1016/j.tra.2020.05.014

Mattioli, G., Wadud, Z., & Lucas, K. (2016). Developing a novel approach for assessing the transport vulnerability to fuel price rises at the household level. *In 14th World Conference on Transport Research*, 10–15.

Mattioli, G., Wadud, Z., & Lucas, K. (2018). Vulnerability to fuel price increases in the UK: A household level analysis. *Transportation Research Part A: Policy and Practice, 113*, 227–242. https://doi.org/10.1016/j.tra.2018.04.002

Salas, R., Perez-Villadoniga, M. J., Prieto-Rodriguez, J., & Russo, A. (2021). Were traffic restrictions in Madrid effective at reducing NO2 levels? Transportation Research Part D: *Transport and Environment, 91,* 102689. https://doi.org/10.1016/j.trd.2020.102689

Sari, F. (2015). Public transit and labor market outcomes: Analysis of the connections in the French agglomeration of Bordeaux. *Transportation Research Part A: Policy and Practice, 78*, 231–251. https://doi.org/10.1016/j.tra.2015.04.015

Sierzchula, W., Bakker, S., Maat, K., & van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy, 68*, 183–194. https://doi.org/10.1016/j.enpol.2014.01.043

Tao, S., He, S. Y., Kwan, M.-P., & Luo, S. (2020). Does low income translate into lower mobility? An investigation of activity space in Hong Kong between 2002 and 2011. *Journal of Transport Geography, 82*, 102583. https://doi.org/10.1016/j.jtrangeo.2019.102583

Tassinari, F. (2022). Low Emission Zones and Traffic Congestion: Evidence from Madrid Central. *IEB Working Paper, 2022*/04. http://hdl.handle.net/2445/184409

Timilsina, G. R., & Dulal, H. B. (2008). *Fiscal Policy Instruments for Reducing Congestion and Atmospheric Emissions in the Transport Sector: A Review* (World Bank Policy Research Working Paper No. 4652,). https://ssrn.com/abstract=1149604

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