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Future Low-Carbon Transport Scenarios: Practice Theory-Based Visioning for Backcasting Studies

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Abstract: Backcasting is a well-established methodology particularly suitable for analyzing complex problems where the business-as-usual projection is no longer appropriate, which can be used to effectively address the challenges of climate change mitigation in transport. It is characterised by designing endpoints in the future and working backward from these visions to establish policy pathways that can achieve desired futures. The visioning phase, which involves the construction of a set of scenarios describing alternative futures, is the first phase in backcasting, and engaging different stakeholders during the visioning phase is considered an important aspect in transport studies. This paper aims to demonstrate the findings from a participatory visioning exercise carried out as part of a backcasting study on sustainable transport in the islands of Malta. It is based on a methodological approach that combines social practice theory with stakeholder workshops. The visioning exercise resulted in the development of four different scenarios: the business-as-usual scenario and three alternative scenarios for transport in 2050 in Malta; High-Tech Mobility (with a focus on clean technology); Local Mobility (with more local travel and reducing the need to travel over longer distances); and Green and Active Mobility (where active forms of travel are prioritised over motorised forms of transport). In the alternative scenarios, the elements of mobility practices and other social practices influencing mobility have been reconfigured to allow for low-carbon travel and significantly reducing GHG emissions. The results of this study demonstrate how insights from a theory of social practices approach can be utilized to provide narratives for future visions in transport backcasting studies, and how this approach could open new possibilities for the transition towards more sustainable mobility through the reconfiguration of mobility and other everyday social practices.

Keywords: transport climate policy; participatory approaches; social practices; climate change mitigation

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1. Introduction

Climate change mitigation and reducing greenhouse gas (GHG) emissions have become one of the most important global challenges [1]. As the global population continues to grow and gaseous emissions from increased urban development continue to rise, limiting the effects of climate change becomes more difficult. Transport is one of the sectors that contribute significantly to GHG emissions, accounting for 23% of the total CO_2 emissions and 61% of the global oil consumption [2]. It is one of the few sectors where emissions have continued to grow [3]. This growth is the result of the increasing demand for mobility. Further growth in the demand for transport is forecast factoring in the total distance travelled by the world population estimated to nearly double by 2050 [4].

Within the transport sector, road transport is the largest contributor to GHG emissions, accounting for nearly 73% of the total transport CO_2 emissions worldwide [5]. Cars are the most frequently-used passenger mode of transport and account for more than 6% of global CO_2 emissions [6]. Despite the significant contribution of transport to the global levels of

CO_2, the sector has taken a relatively low profile in its role as a carbon reduction target. Transitions to more sustainable travel are proving to be difficult to achieve, and if the Paris climate change mitigation targets are to be attained, alternative and trend-breaking futures are required. Mitigating the effects of climate change and limiting global warming to 1.5 °C would require unprecedented efforts [7]. In order to reduce the emissions from transport, a variety of policy responses have been developed [8]. These policies broadly fall within five groups which include those aimed at bringing about technological innovation, provide for new or added economic and regulatory instruments, provide new infrastructures and policies aimed at changing individual behaviour through information campaigns, and social marketing. While such approaches effectively reduce transport emissions, they have so far failed to bring about the required changes. The limitation of such approaches is often attributed to their dependence on individualised patterns of consumption, while at the same time overlooking other important facets such as the non-linear and non-rational dimension of behaviours. These approaches also tend to overlook the limitations imposed by socio-cultural and institutional settings that contribute to locked-in patterns of mobility [9].

An alternative approach to the conventional climate mitigation policies, which is promising and may be more effective at initiating the required transitions in transport, lies within the social practice theory [10]. This theory conceptualises daily activities, like travelling as a form of routinised social practices [11–17]. Social practices are said to consist of an interconnected set of elements [11] and are nested within the approaches of sustainability transitions [18]. Several studies have started to adopt a social practices theoretical framework to analyse how a transition towards more sustainable mobility can be brought about [19–23]. However, the application of practice theory to guide policies and interventions aimed at bringing a transition towards sustainable transport is still being developed, and studies in this research direction are not exhaustive. The potential is that transport strategies and projects can be given a wider framing, set within the societal and cultural context; hence a new intervention is more likely to be used when applied.

Scenario analysis is increasingly being used in transport planning to develop alternative transport policies that might help to achieve future targets for climate change mitigation. Three classes of future scenarios can be described: scenarios can be of a forecasting, explorative, or normative nature [24,25]. In particular, the normative scenarios or backcasting approach has found application in the design of transport climate policies. The technique is a multi-phased iterative process that starts with constructing a series of images of desirable future alternatives in the longer term. A range of methodologies are possible within the backcasting approach, and these include different techniques through which the normative scenarios are developed and various approaches by means of which policy pathways are designed [26–33].

This research aims to explore how a practice-oriented approach can be combined with a backcasting approach to design alternative transport futures. The innovation in this research is the application of a practice-based for the construction of alternative transport future scenarios in the long-term that could provide the starting point for a backcasting study. Practice-based approaches can open new possibilities and promote a creative development of alternative and interdisciplinary perspectives, in a situation where other perspectives have failed to move the transition to more sustainable transport. By examining everyday mobility practices and participatory stakeholder engagement, this research assesses the application and usefulness of a practice perspective during the visioning phase of the backcasting analysis for transport futures. In doing so, the practice-based scenarios will become more-than-technocratic, rooted in the views of participants and also reflective of the wider societal framing; hence the scenarios become more resonant. The case study of Malta provides the empirical basis for demonstrating the methodological approach. The outcomes of this exercise are a set of future visions for the transport system in 2050 in the islands of Malta, as the starting point for a wider backcasting analysis beyond the scope of this paper.

This paper is structured as follows: Section 2 will provide an overview of the literature on the topic and introduce the theoretical framework at the basis of this study; Section 3 presents the case study used; Section 4 outlines the methodology and the process of backcasting. In Section 5, the results of the research are presented. The results and their relevance to climate change mitigation transport policy are discussed in Section 6, while Section 7 provides a summary of the main conclusions of the paper.

2. Literature Review

2.1. Theory of Social Practices

The social practices theory framework describes practices as a complex configuration of a set of elements. The theory looks at how everyday practices such as travelling are embedded in material and institutional settings, and the individuals and their attitudes are no longer the focus of the analysis. An analytical framework for studying social practices developed by Shove et al. [34] has been widely applied to studies on sustainability transitions. In this framework, practices are defined as a configuration of material elements interlinked with elements of meaning and competence. Materials include objects, infrastructures, tools, hardware, and the body itself. Competences or skills, on the other hand, refer to the multiple forms of understanding and knowledgeability. Meanings or images are socially shared ideas or concepts within a practice that give meanings and reasons for engaging in the practice. Meanings are often based on concepts of association, relative positioning, norms, values, and ideologies [35].

Practices emerge, persist, change, and disappear as the various elements of a practice network are linked, maintained, or broken [34]. While the individuals are not the central unit of analysis in practice theory, they play an important role as carriers of practice [11]. The recruitment of individuals to a particular mode of mobility depends on the availability of the material elements, having developed the necessary competencies and the societally-valued meanings concerning that practice [35]. Individuals are also crucial to the performance and continuity of a practice and key for changes in practice by adapting, improvising, and experimenting in changing circumstances of everyday life [15]. Social practices form complexes and interlock with other social practices. A change in one practice can therefore affect other practices which co-exist with or are dependant or co-dependant on the practice undergoing a transformation. Mobility practices are complex and bundle with other social practices, and an analysis of these interdependencies can reveal what interventions may be suited to shift to low-carbon forms of mobility [36].

Literature demonstrates the validity and the value that practice theories can contribute towards transitions to low-carbon lifestyles. Watson [37] identifies at least two characteristics of practice theories that can help sustain transitions towards sustainability. First, the elements of practice (technologies and materials), the people carrying the practice, and the relationships of one practice to another are subject to change. In agreement, Birtchnell argues that the reconfiguration of the elements (including practices, technologies, and products) by elites (exemplars that champion and perform new practices) and events are important in the process of systemic transitions. This dynamism, characteristic of practices, allows for innovation, a requisite in socio-technical transitions [38].

Applications of practice theories to the study of sustainable mobility focus on understanding how practices have evolved, the elements that make up these practices, and how practices are embedded in everyday life. Such an understanding helps reveal how some mobility practices become prevalent while others are less successfully embedded into daily life [34,37]. For example, Shove and Walker (2010) use the theory of social practices to study the case of congestion charging in London. This examination allowed them to identify how the movements of people and objects around the city result from the spatial-temporal demands and the integration of constitutive elements of different social practices and the interaction of these practices with one another. Such an examination usefully demonstrates how a policy action such as congestion charging can influence different practices, their com-

plex interaction, and the flow of materials, causing reconfigurations and self-organisation of practices.

This approach is gaining popularity amongst researchers. One such example is the empirical case of car sharing in Sydney, Australia [20,21]. The research is focused on exploring the modal shift from car to carsharing forms of mobility from the perspective of social practice. The examination has served to demonstrate how such a form of mobility can be understood as being characterised by a distinctive assemblage of materials, meanings, and skills. In this view, the success of carsharing (as an innovative practice) can be said to be possible through the reconfiguration of existing elements in new different ways. Empirical studies using qualitative data and mobility biographies have been at the basis of the analysis of mobility practices and the shift to lower-carbon travel alternatives [39–43]. For example, the theoretical approach has been used to understand the barriers to a modal shift from car to low-carbon forms of transport in commuting [39]. The findings of this study suggest how policy can intervene to address the missing elements of low-carbon communing and how interventions in other areas of social life can influence the modal shift. Similarly, a study based on a social practice perspective served to show that modal shifts can be catalysed by disruptions in everyday life or through the re-ordering of existing mobility practices [40]. Uteng et al. [42] adopt practice theories and mobility biographies research for capturing the heterogeneity of mobility practices and the micro-dynamics of adoption and retention processes at different life stages. They highlight how practice theorys' biggest potential contribution is in highlighting and explaining user adoption of innovations as a process of recruitment and retention that results in the integration and reproduction of new practices that replace old ones. Other studies examine the biographical aspects of people's everyday mobility through a social practices lens. The findings suggest that social relations play a key role in holding mobility practices together, and that shifts in social relations and roles can have implications for mobility practices [41].

A practice perspective, along the lines demonstrated throughout this section of the literature review, has important consequences for policy interventions. The key innovation in this approach is to identify unsustainable practices and focus on how these practices can be substituted for. The concept of interlocking practices also suggests intervention in other policy areas if a transition to sustainable mobility is to be achieved. The analysis from a social practice point of view also highlights the direction policymakers should take to aid transitions towards less carbon-intensive and more sustainable practices. The approach suggests that policymakers should focus on influencing the constituent elements of a practice if the shift to different practices is to be made more productive [34]. Interventions should also be made at the institutional and infrastructural levels, which are known to hold different practices together (Kent and Dowling, 2013).

2.2. Backcasting

Backcasting is recognised as a useful approach to explore how a certain target could be met when contemporary structures block the changes sought [44,45]. The main advantage of using backcasting is that it stimulates scenario developers to focus on a desired future state, which may be more progressive than the existing structures. In this manner, backcasting allows the path-dependency of the present situation to be evaded and societal changes to differ developmentally from the current trends [46]. The fundamental idea behind backcasting is that the business as usual (BAU) pathway is unsustainable, and the current policy measures cannot achieve the climate change targets for transport. To overcome these barriers, the backcasting approach proposes a methodology where desirable futures are first identified and then looks at the different pathways that can be followed to achieve the targets [24,47] (Figure 1).

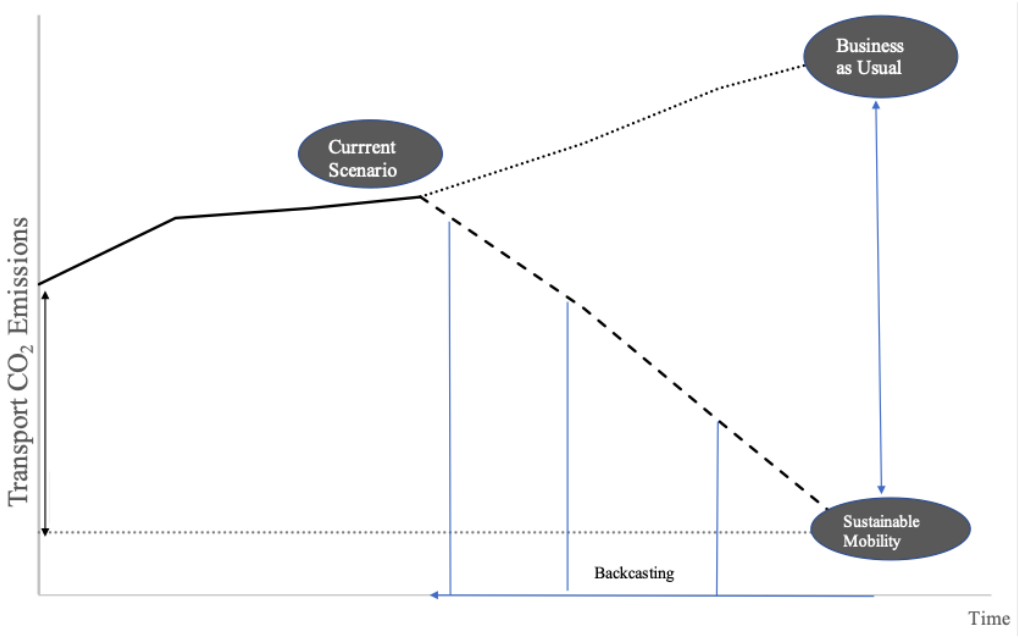

Figure 1. Backcasting framework.

The technique can be described as an iterative process composed of several phases. The number of phases differs among studies using the methodology, with some methodologies based on three stages while others propose up to five stages. Three-phase methodologies are based on an initial visioning or establishing of future images, identification of policy packages, policy pathways that could lead to desired future visions, and appraisal of policy packages to determine their effectiveness and implementation [28,48]. Others suggest a methodology that includes additional stages, with an initial phase that establishes the strategic objectives and a final stage that monitors the overall evolution of the process [49].

This paper will focus on the visioning phase of the backcasting process. The following section will give an overview of this step, which involves constructing a series of alternative images in the long-term future. A range of methodologies for the visioning phase during the backcasting is documented in literature covering future studies [33,47,48,50–54]. The methods differ not only in the number of methodological steps involved, but also show differences in the targets adopted, the number of visions generated, and the degree of participant engagement. Visioning methodologies can be broadly classified as path-oriented, target-oriented, or participatory [44,49,55]. Target-oriented backcasting focuses on the importance of developing images of the future as target-fulfilling, while in pathway-orientated backcasting the target is seen as less important than developing pathways of transition. In participation-oriented backcasting, the benefit of incorporating the input of different stakeholders and aspects of social learning are prioritized over other methodological aspects [46]. The involvement of key actors that can help in the required transition to sustainability is increasingly being emphasised in literature dealing with backcasting, aimed at achieving scenarios that are more likely to be realised.

Increasingly, communicative approaches based on stakeholders' participation and interaction are finding application in the context of transport planning [56–58] and backcasting approaches. Communicative approaches consist of the interaction of different stakeholders rather than the deliberation of experts solely or one group of actors. This approach focuses on participation, stakeholder learning, and the reconciliation of different ideas from a diverse group of actors [59]. Participatory approaches allow for reconfiguration of the transport planning process from one based on instrumental rationality to one based on discussion and consensus-seeking [58,60]. Participatory backcasting exercises integrate diverse actors, including expert and non-expert participation at various points in the process, introducing a range of inputs, mindsets, and interests [61,62]. The collective

visioning process allows for the stimulation of higher order learning where participants are involved in the process of learning not only on the cognitive level but also with respect to values, attitudes, and underlying convictions [49].

The choice of the visioning methodology during the backcasting process depends primarily on the aim of the study. The use of participatory methods for developing future scenarios and the pathways to attain them becomes more important when the aim is to use future scenario studies for policy recommendation or an action plan where the involvement of stakeholders is critical. The application of participatory methods during backcasting is also beneficial when the problem is characterized by conflicting interests and high uncertainties, as in the case of sustainable transport [63]. The use of participatory methods in these situations can help bring diverging views together [25].

The degree of stakeholder involvement and methods through which these are engaged is wide-ranging [49,61]. Some studies rely on simple participant involvement, where participants are tasked with providing their views on the type of desirable futures. Others involve higher levels of stakeholder participation with a larger number and broader range of actors [64]. Various tools are also available for use in the participatory visioning phase of backcasting [49], enabling the involvement of stakeholders and generating the interactivity between participants and subsequently scenario development [65]. Face-to-face stakeholder workshops have been identified as a powerful tool for achieving stakeholder involvement [66] and constitute the most popular technique in participatory backcasting [64,67–73]. As a general format, the approach consists of a group meeting which starts with the presentation of the statement of a problem and is followed by semi-structured group discussions for generating ideas and later, through debate or a voting procedure, for identifying priorities and the consensus decision [74,75]. One of the main advantages of workshops is that the technique enhances creativity as a means of vision development. Workshops allow for greater interaction between relevant actors and the exchange of various viewpoints [25]. The interactive nature of the workshops provides opportunities for participants to enter into negotiation with one another, facilitating social learning, an important aspect of participatory backcasting [76]. Workshops are also known to be a well-suited methodology for bringing different stakeholders' ideas together and envisioning radical changes in unsustainable patterns [77]. This advantage stems from the fact that achieving a sustainable future requires the enrolment and cooperation between stakeholders from different societal groups [61]. The integration between different stakeholders who create and maintain elements of a given socio-technical system (in this case the transport system) serves to overcome a common system inertia and path dependence that inhibit transitions [78].

3. The Case Study

In order to test the theoretical framework and the development of practice theory-based climate policies in transport, the case study of Malta was used. The practices approach had not yet been applied to the study of mobility in small island states such as Malta, and research in this field remains focused on a relatively narrow geographical context, with most of the studies limited to the UK or mainland Europe [19,21,36,39]. Island states present a unique case in demographics, geography, culture, and transport trends, and provide a good opportunity to test the theoretical approach in different contexts. And despite the wide range of islands across Europe and the world, Southern European Mediterranean islands share some common characteristics and challenges related to geography, socio-economic development, and transport. A comparative analysis done by Maas et al. [79] shows how three islands share common objectives for sustainable transport but also share challenges in the implementation of policy aimed towards shifting to more environmentally friendly modes of transport such as cycling.

Malta is an island state located in the Mediterranean with a surface area of 316 km^2 and a population of 475,701 in 2017 [80]. It is the smallest of the European Union member states and is divided into six districts further sub-divided into 68 local councils (Figure 2).

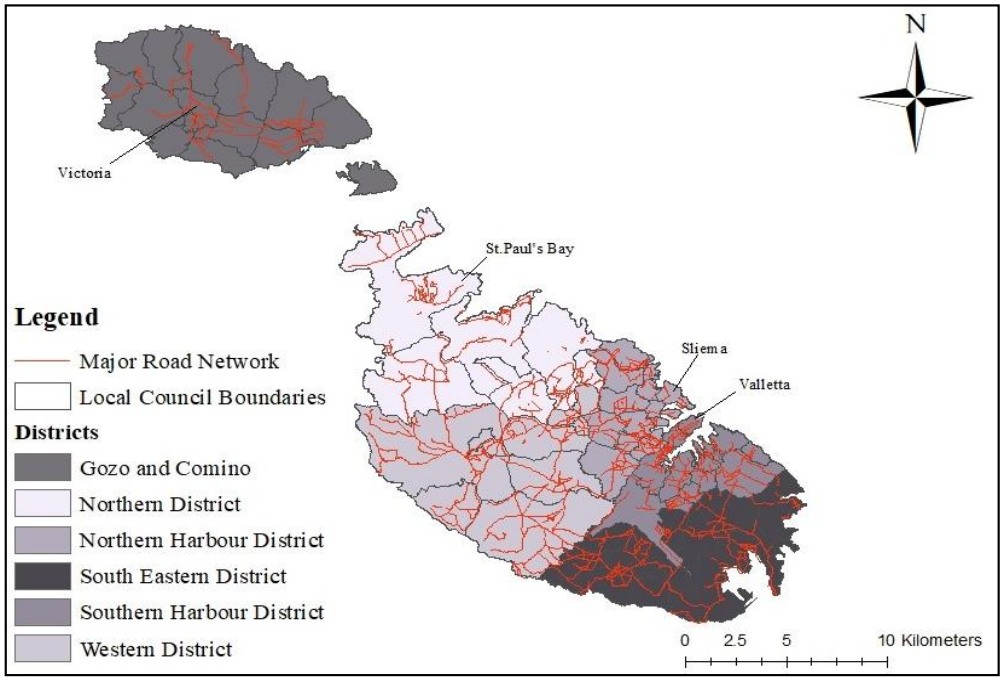

Figure 2. An overview of the islands of Malta. (Drawn by author).

Malta experienced a rapid rate of growth in motor vehicle ownership and use during the end of the last century [81]. Today Malta is characterised by one of the highest rates of motorisation in the EU, with 608 cars per 1000 inhabitants [82]. The personal car is clearly the preferred mode of travel amongst the Maltese population, with other forms of transport having only a small share of the modal split. For example, during a typical weekday, the modal share of bus-based trips is 11.3% of all trips [83]. As for active modes of transport use, only 7.6% of trips are made on foot [84]. Furthermore, according to a Eurobarometer survey on mobility in 2013, Malta had one of the lowest cycling rates in the European Union, with only 1% of the respondents cycling every day and 93% never cycling [85].

As a consequence of the rapid development and the increase in the demand for mobility, Malta has experienced a general growth in GHG emissions from 1990 levels until 2012. In more recent years, a reduction in the levels of gases was observed due to the installation of more efficient technology in the energy generating sector. However, unlike the energy generating category, emissions from transport clearly show a persistent increase since 1990. Transport is the second highest emission contributor, and in more recent years, the sector has shown a contribution similar to that of the energy industries. The emissions from the transport source category are dominated by emissions from road transport, accounting for 86% of the sectors' emissions, with CO_2 accounting for the bulk of the total GHG emissions. The GHG emissions from road transport account for around 25% of the total emissions from all sectors, making the sub-sector a key source of GHG emissions [86].

In terms of policy, the Government published in 2016 a transport strategy for 2050 and a master plan for 2025 [83,87]. These documents lay out the long term vision for transport, with the master plan listing specific measures to be implemented to tackle some of the major concerns in transport on the islands, which include the high costs associated with unsustainable levels of congestion, air and noise pollution, accidents, climate change impacts, and public health concerns (see for example [88]). These plans were an ex-ante conditionality on the islands to obtain further funds from the EU for transport. Many of the measures described in these plans have not been implemented, with much of the effort of the Government in the past decade focusing on road building projects and upgrading the road infrastructure to cater to growing (car) traffic. The more recent submission of the 2030 National Energy and Climate Plan in 2019 [89] has been heavily criticised by the European

Commission, identifying *"unexploited emission reduction potential in the transport sector, which forms the largest sources of non-ETS GHG emissions"*. The Commission states in its assessment that the *"approach Malta has taken seems to be in contrast with its vision document for the low carbon development strategy from 2018 and is at odds with the long-term strategy to fulfill the European Union and Member States' commitments under the Paris Agreement"* [90].

This lack of policy vision necessary for achieving the climate targets reflects the urgency for studies similar to this one and the approaches that are being presented here. The relatively short planning and policy history experienced in the islands, where land use planning was instituted only in 1992, also need to be taken into consideration and are also reflected in the subsequent sections and workshop outputs. Nonetheless, case studies such as Malta provide for an understanding across a range of islands sharing common challenges and opportunities. The objective is for such a methodology to be applied in other these similar geographies to support policy development in the field of transport and climate change.

4. Materials and Methods

This section describes the methodology used for the visioning process of the backcasting exercise. The method involved a number of steps starting with problem orientation, followed by a stakeholder visioning workshop, development of future visions, and elaboration of the resulting scenarios Figure 3. The aim of the visioning exercise was to develop a set of future alternative scenarios that are more suited to meeting the climate change mitigation targets than the business-as-usual scenario.

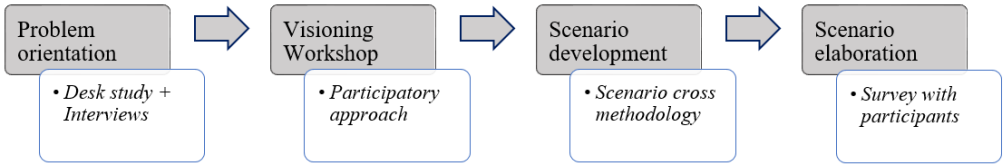

Figure 3. Steps involved in the practice-based participatory backcasting methodology.

4.1. Problem Orientation

The first step in the visioning process consisted of a problem orientation exercise. This step was necessary to distinguish the key challenges in the context of sustainable mobility in Malta. A review exercise was conducted to identify the key trends in mobility and the corresponding emissions from the transport sector. This was made possible through reviewing national reports and emission inventories [86].

In addition, a field study was conducted to look at the elements of current mobility practices in Malta to understand which wider social practices influence mobility. Semi-structured interviews were used to draw information on the elements of the social practices. This qualitative method of data collection allowed for an in-depth analysis that could explore the range, variety, and extent of different elements of practices within the context of everyday life [39]. The interview consisted of questions centered around the respondent's experience of the types of mobility that they make use of, their perceptions, beliefs, skills required to perform the mobility practices, and meanings they attribute to how they travel [19,91]. Twenty (20) semi-structured interviews were carried out with a set of participants. The choice of the participants for the semi-structured was not meant to be representative of the population but was purposively selected to provide a range of experiences about daily travel (Table 1). Thematic analysis of the interview transcripts based on an inductive-deductive methodology produced a picture of the constituent elements of the different mobility practices (the materials, competencies, and meanings).

Table 1. Participants in semi-structured interviews.

Participant	Gender	Age	Preferred Mode of Travel	Lifestyle
1	Male	22	Motorcycle	Student
2	Male	29	Car	Middle Management
3	Male	24	Bus	Professional
4	Female	40	Car	Management
5	Male	38	Bike	Teacher/Buiseness Owner
6	Female	40	Bus	Self-employed/Stay at home
7	Male	40	Bike	Administrative
8	Female	58	Car	Professional
9	Female	31	Car	Professional
10	Female	34	Car	Professional
11	Female	34	Bus	Lecturer
12	Male	42	Bus/Taxi	Administrative/Clerical
13	Male	65	Car	Retired
14	Female	32	Car	Professional
15	Female	58	Walk	Administrative
16	Male	36	Car	Professional
17	Female	19	Bus	Unemployed
18	Male	18	Bus	Unemployed
19	Female	45	Walk/Car	Administrative
20	Male	55	Electric Car	Senior Management

4.2. The Visioning Workshop

The next step consisted of engaging different stakeholders and experts with different backgrounds in a collaborative workshop. Discussion and collaboration between a wide range of participants was considered an important factor in the process. Stakeholder identification was carried out prior to the visioning workshop, which resulted in the recruitment of a set of participants, including policymakers, academic researchers, planners, members of the public, car importers, and NGOs, all with a high level of interest and expertise in the field of mobility and sustainable transitions as summarised in Table 2.

Table 2. Participants in the visioning workshop.

Sector	Visioning Workshop Representatives
Public and State	National energy regulator (3) National Environmental Authority (2) National Transport Regulator (1) Department of Transport and Infrastructure (1) Climate change Directorate (1)
Private	Members of the public (1) Independent Cyclist (1) Public Transport Provider (2) Architects and Civil Engineer (1)
NGO/Research	Academics (1) Researchers (4) Environmental NGO (3)

The visioning took the form of a two-hour workshop consisting of two parts. The participants were first introduced to the research problem and the key sustainability challenges. The current sustainability problems and constituent elements of mobility practices, determined during the problem orientation stage, served as the starting point of the visioning exercise. Interactive material was used during the workshop to show the participants how the current trends and business-as-usual were unsustainable. It was also emphasised that given that the transport sector is a significant contributor to total CO_2 emissions, drastic cuts are needed if the emission reduction targets are to be achieved. This part of

the workshop was also critical for the participants to be able to comprehend the concept of social practices and to understand the constituent elements of materials, competencies, and meanings.

Following the initial presentation, the participants were asked to imagine it was 2050 in Malta. The research team guided the participants to describe visions for sustainable transport in this future. The year 2050 was chosen since this timeframe allows freedom from the constraints of the current trends and conditions, and the need for solving the obstructions caused by them [92]. The interactive part of the workshop was facilitated by an online tool. Mentimeter is a real-time online application that allows participants to answer questions and provide personal views and discussions through a device connected to the internet (such as mobile phone, laptop, or tablet). The application allows participants to view the responses submitted in real-time hence promoting interaction between participants and enhancing group discussion through a social-learning process.

After the first part of the interactive workshop was completed, the concepts generated were screened by the researcher, and similar concepts were grouped together. From this clustering and elaboration exercise, two main themes under which the concepts could be classified became evident. On the one hand, there were those visions where the stakeholders imagined a sustainable future based on technological innovations. In contrast, the other group of concepts showed visions of sustainable transport where active travel was at the centre of mobility and urban planning. For the second part of the workshop, the participants were again provided with visual representations of the elements of the current mobility practices in Malta and how these mobility practices interact with other social practices. The workshop participants were split into two groups. One group was asked to focus on the visions relating to technology, the other group on visions focused more on active travel.

Each of the two groups was then asked to use the data on the elements of mobility practices in Malta to answer the following questions:

- What elements of the current mobility practices need to change to achieve the sustainable mobility vision?
- Which innovative or alternative mobility practices can replace current and less sustainable practices?
- How can the interactions between activities and mobility practices change to achieve mobility practices?

Participants were encouraged to discuss with their respective groups and come up with ideas for each of the questions. After the brainstorming session, the stakeholders were directed to rank the concepts as high priority, medium priority, and low priority. This exercise generated a total of 123 concepts. These concepts were related to material elements of mobility practices as well as the competencies and meanings. The materials category accounted for the largest proportion of concepts

4.3. Scenario Development

The data gathered from the stakeholder workshop was used to guide the scenario development exercise carried out by the researcher following the workshop. The scenario matrix methodology [93] was employed for developing the scenarios. The two themes generated during the first part of the workshop were used to set the axes, where one of the axes was to represent high and low technological innovations. The other axes represented a high degree of active mobility at one end and a low degree of active mobility at the other (Figure 4).

The concepts generated by the stakeholders during the interactive workshop were fitted into the different scenario matrix categories. The concepts were then further elaborated into scenario narratives. The results of this exercise generated four different scenarios. One business-as-usual scenario represented low active mobility, low technology, and three alternative scenarios.

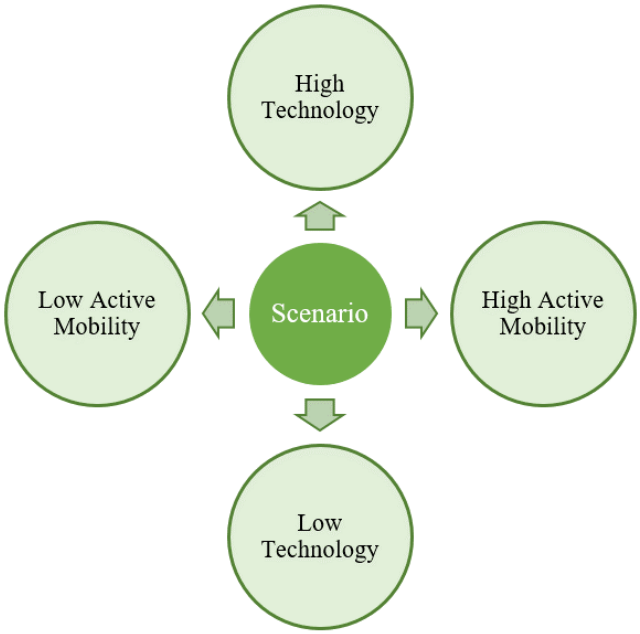

Figure 4. Matrix-method for scenario development.

4.4. Scenario Elaboration

The initial scenario narratives were made available to visioning workshop participants for comment via an online survey following the initial workshop. The participants responded well to this scenario elaboration exercise with a 71% response rate. This survey allowed the participants to add additional concepts and elaborate further or merge those already part of the initial scenarios. This further elaboration of the scenario was an important step that allowed the stakeholders to have a sense of ownership of the proposed scenarios and enhance further the participatory and collaborative manner in which this approach was developed.

5. Results

The visioning exercise resulted in the development of four different scenarios: the business-as-usual scenario, and three alternative scenarios for transport in 2050 in Malta. The alternative scenarios describe transport futures which have the potential of significantly reducing GHG emissions in the context of the current case study and achieve the climate change mitigation targets (80% reduction from 1990 levels). The following list describes the practice-oriented scenarios developed during the visioning exercise:

1. Business-as-usual (little improvement in technology and slow shift to active forms of travel)
2. High-Tech Mobility (with a focus on clean technology)
3. Local Mobility (with more local travel and reducing the need to travel over longer distances)
4. Green and Active Mobility (where active forms of travel are prioritised over motorised forms of transport)

The narratives of these scenarios are presented in Table 3. The practice-oriented approach to visioning means that the scenarios developed allow for a better representation of individuals and their ability to engage in their required day-to-day practices while at the same time shifting to more sustainable forms of travel. This form of visioning is only possible when mobility practices, and other social practices that influence mobility, are taken as the starting point of the visioning process.

Table 3. Transport Futures: Narratives of three alternative scenarios.

High-Tech Mobility:
This scenario describes a future where the demand for travel is still strong. Individuals have very busy lifestyles and are moving fast between sites of different social practices. In this future, technology has enabled the transition from private car to mass transport. *The mass transport system is composed of a dense network of public transport (capsule served) lines which allows very fast movement of people from one place to another. The network is designed in such a way as to allow for easy changes between other modes of transport. Bike-sharing facilities are available close to the stops of the lines, and bicycles can be transported inside the capsules. In addition to the mass transport network, a fully electric bus fleet with segregated lanes provides quality public transport that together with the transport capsules provide efficient transport corridors which meet the mobility needs of the individuals. In this scenario, personal transport consists mainly of connected and autonomous vehicles (CAVS). The CAVS are electrically powered, and through various educational programs set in place, individuals are capable of operating and using the CAVS very easily. Sharing trips in CAVS also serves as a means of social integration where individuals are no longer isolated within their personal cars but can socialize during their day-to-day travel.* *Time spent traveling using either the capsule lines or the CAVS is transformed into productive time. In this future, individuals can use the journey time to engage in other activities, such as reading or working.*
Local Mobility:
In this scenario, the use of technology is focused on enabling lifestyles with high mobility at the local scale. Individuals do not have to travel long distances to perform their day-to-day activities. Sites of different social practices are brought closer, facilitating movement between different activities. *There is a strong shift to remote working, and major employers make use of e-working as part of their methods. The automation of many processes and the development of technology facilitates work from home. This has greatly reduced the need to travel to and from the workplace. Where travelling to work is necessary, this is done through communal transport provided for free to the employees.* *Improvements in IT enable easy access to education and make e-learning an enjoyable experience for students. Local centers complement the e-learning facilities. These centers provide a space where students can utilise and interact with other students.* *This scenario also represents a future where electric scooters and travel escalators help individuals to travel over short distances. Shopping for goods is done at the local stores or over the internet. Goods are delivered to homes* via *clean transport modes.* *A managed fleet of autonomous vehicles, which are not owned privately but managed centrally or through Mobility as a Service (MaaS) (highly regulated) and a dense network of public transport provide the citizens with transport options over longer distances. These provisions facilitate travel for some social practices (e.g., visiting friends, leisure activities) which might require travel to different towns. Skills in mobile application use have greatly improved, allowing individuals to efficiently plan their journey with the forms of transport.*
Green and Active Mobility:
This future focuses on an improved urban design that prioritises active travel over other forms of transport. A network of interconnected green spaces with paths wide, safe, and free from obstructions facilitates active travel such as walking. *The urban community is aware of the health benefits of active travel over other modes of transport. Tax benefits are in place for those who choose to travel using active modes of travel, including walking and the electric bicycle. Low-emission zones and parking taxes mean that the use of cars is greatly discouraged. Fewer cars on the road means that cycling and walking are now safer for the users. Signs along walking paths that show actual distances between localities provide pedestrians with knowledge about the actual distances and the best route they need to take. Cycle training carried out in schools and available for adults provides the individuals with the necessary skills to use the bicycle.* *Buses are available at the periphery of this new urban plan, and they run on separate lanes from those used for walking or cycling. Buses connect towns, allowing for travel over longer distances. A dense network of public transport provision means that the buses run on time, are frequent, and can compete with the efficiency of the car. Inside the towns, autonomous electric shuttles connect to the bus system. This system of autonomous shuttles allows for people to carry out other activities such as social activities, carrying of goods from food stores, and other leisure-related activities.*

The first scenario depicts a future with a high demand for mobility but a strong shift to mass transport systems. This scenario takes an integrated perspective into the elements required for the shift from the use of the private car to mass transport. The narrative of the

first scenario illustrates how the material elements include public transport infrastructure, such as an extensive network and modern vehicles, perhaps capsule-designed. However, the vision also shows how related competencies and meanings are critical for the shift. For example, the shift to mass transport is facilitated by providing an accessible transport system, including infrastructure design and perceived system efficiency. Efficiency is understood to have important meaning, where journeys are perceived to be quick and easy to undertake, shaping the individuals' choice between different forms of transport. The provision of efficient mass transport helps individuals choose public transport over the car. Urban planning and road space reallocation is used to give priority to public transport so that public transport is much quicker than travel by car. Traffic filters are used to purposively slow cars and prioritise public transport, walking, and cycling, especially for shorter distances. The vision also emphasises providing information for travel with the mass transport system, ensuring the skills required are present for individuals to shift to this form of mobility practice. This may include information on energy and carbon usage, so that public transport users are aware that they are making travel choices that benefit the environment. The cost of public transport is also critical, including for low-income groups to be able to access the system. Some form of subsidy, perhaps derived from the car or general taxation, can help keep public transport inexpensive.

The second scenario focuses on reducing the distance individuals need to travel to meet their day-to-day activities. This scenario also looks at all the three elements (materials, competencies, and meanings) needed to shift to more local forms of travel and reduce travel over long distances. This future identifies changes not solely restricted to the transport system but also other spheres of social activities. Urban planning is used to develop compact and mixed-use centres, so that people can access most of their daily requirements with a 15 or less minute walk. Major changes are evident concerning how individuals work or complete their education by shifting to teleworking or online study programmes. There is widespread adoption of home working, where employees work 3–4 days a week from home wherever possible and only travel to a workplace 1–2 days a week to maintain social connections. Some employees, however, still work face-to-face. Consumer products are mostly ordered online and home delivered by robot or cycle cargo bikes. Lifestyles are much more locally-orientated for physical travel, though there is broader awareness and interaction via electronic means.

Finally, the green and active scenario illustrates a future with a high degree of active travel. As the scenario narrative shows, this shift would need infrastructural changes such as providing walking networks, (green) public spaces, and segregated cycle routes, representing the material elements of active forms of mobility. The social-practice perspective also allowed the workshop participants to reflect on other needs that would otherwise have been overseen. For example, the addition of signage showing distance and routes to destinations helps individuals navigate their way to their destination, improving the competencies of active modes of travel. Cycle training is carried out in schools and is also available for adults. This scenario also emphasises that a future with more active travel requires a change in the meanings related to these forms of mobility, such as the feeling of safety and the awareness of health benefits. Active travel is heavily advertised and marketed so that these forms of travel become associated with high status.

6. Discussion

The research is based on an innovative methodology for developing alternative policy scenarios for a more sustainable transport future in Malta. This approach is based on the backcasting framework and integrates this withthe theory of social practice. This study provides a number of insights on the advantages of this methodological approach. This section gives an overview of the lessons learned and concepts developed during the research and how these can be applied to other studies and contexts, particularly to other islands states where car dependence is high.

This study has shown that using a participatory approach and engaging with a wide range of stakeholders helps considerably in the creation of visions which can serve as the basis for designing policies in a backcasting framework. The participatory approach adopted for the visioning process has enabled discussion between participants, bringing different perspectives together in the normative scenario development. This approach has the benefit of enhancing social learning and opens up discussions about new perspectives that would not have been possible with other approaches. Participatory methods are also known to facilitate the implementation of the outcomes of backcasting studies into policy which has often proved to be a barrier between research and policy actions [48]. The scenarios developed are owned and resonate more with the public, and are hence more likely to be implemented successfully. The participation of different stakeholders should occur at all stages of the backcasting process, as this brings focus to the effectiveness of such methods during the visioning stage.

The use of social practices in combination with backcasting is important to allow for a greater reflection of the social and cultural context when considering transport policy and planning. Without this understanding of meanings and competencies, the infrastructure (and wider materials) often fail once implemented. The islands have experienced a number of similar conditions that lead to poor implementation of (material) infrastructure and criticism by users (see for example [94]). The innovation that the theory of social approach can bring to transport policy making is exemplified by the scenario types developed in this study. The narratives created from the visioning consider the reconfiguration of all three elements (materials, competencies, and meanings) of the mobility practices for a more sustainable transport future. For example, the visions created in this study depict a future where individuals are using more active forms of travel to meet their mobility needs. Such futures are indeed similar to transport future scenarios created in similar backcasting studies [27,95,96]. However, the visions created in this study go beyond the provision of material elements such as walking infrastructure to promote active travel. The practice-based visioning exercise recognises that engaging in walking not only necessitates the availability of walking paths, but also the information necessary to help individuals navigate their way to their destination. The availability of information on distances between towns is one way in which the need for these skills can be addressed. Transport futures for this study factor in the meanings which are also important for participants to shift to low-carbon forms of travel and suggest how policy can intervene to instill awareness regarding the health benefits of walking.

Similarly, the visions created through a practice-based approach provide an example of how policy intervention may be more successful in bringing about a reduction in transport emissions if all three interrelated practice elements are included in transport futures. For example, rather than having alternative transport futures with a strong focus on technological innovation in public transport [28], the visions in this study also focus on the meanings that individuals often associate with forms of travel. The futures created in this research show how a shift to public transport use will be more effective if journeys are perceived to be quick and easy to undertake, allowing the individuals to accomplish all their day-to-day activities in the limited time they have available.

A practice-oriented approach to transport visioning also suggests that sustainable transport futures need to include changes not only in transport but in other non-transport practices which have implications for mobility demand and the possibility of low carbon commuting. Different from other forms of visioning studies which have focused on how changes in vehicle technology or land-use planning might bring about the required cut in GHG emissions from the transport sector, scenarios developed using insights from social practices allow for shifts in other realms of social life and not only in transport. For example, from the transport futures created in this study, we can see how changes in the way individuals work, engage in education, or do their shopping might decrease the mobility needs or allow individuals to move away from car-dependent travel. ICT and urban planning play an important role in shaping futures with low-carbon forms of

mobility, and to some extent current transport policies have started to address the issues identified in this research [57,97]. However, a more radical approach that encompasses all elements of mobility practices and the influence of other social practices on mobility is needed. The futures presented in this paper are different from other transport policy scenarios since they ensure that the elements of low-carbon commuting practices are made available, and other social practices are reconfigured to allow individuals to adopt forms of transport which is not the car.

The selection of participants is a critical aspect of the outcomes of the scenario development in this study. Bringing together a wide range of different actors, including members of the public, decision-makers, NGOs, academics, and other interest groups has the advantage of integrating multiple perspectives [46]. This form of visioning, as a bottom-up participatory approach, contrasts with the expert-led process, which is more common in backcasting studies [48,98,99]. Engaging different stakeholders opens the possibility of having different views on what a sustainable transport future might be. These differences between stakeholders can provide more radical and innovative images of the future. Involving different stakeholders is also regarded as a more democratic way of thinking of desired futures rather than relying on a single group of actors or professional views [95]. Furthermore, adding actors from different backgrounds also allows for a greater difference in opinion to be incorporated, including the integration of ideas on how varied aspects of social life affect mobility. It also brings into the discussion insights related to the participant's experience with the transport system. These ideas are crucial when adopting a practice-oriented visioning exercise that focuses on a range of elements of mobility as a social practice.

The size of the sample used for the visioning workshop was also considered an important factor in the outcomes of the study. A small sample size ($n = 21$) was used for this backcasting study. The choice of sample size is not straightforward and depends on several factors and considerations. A small group was necessary for a workshop to be carried out effectively, i.e., to allow all participants to provide their input and have enough time to participate in the discussion [100,101]. The sample size used in this research is in-line with other transport backcasting studies [63,98] which have limited the number of participants to a small group.

Two limitations have been identified in this study. The first limitation is tied to the long-term visioning aspect of the backcasting study. The main aim for adopting a backcasting approach is to break the current trends in situations where the business-as-usual is unsustainable and radical changes are required to meet the sustainability goals [65]. Long-term visioning allows enough time for systemic changes to be implemented and is needed if the current trends are to be broken. Hence, the backcasting is usually based on visions that are 15–30 years in the future. However, it was noted that many of the participants found this long-term visioning a difficult process to conceptualise and adapt when asked to envision transport futures. To help overcome this difficulty during the visioning workshop, the participants were presented with examples from other future visioning projects [102]. Furthermore, during the duration of the visioning process, the research team encouraged and reminded the participants to think in terms of a long-term time horizon. Another solution could be preparing training activities to help participants understand the long-term visioning process.

Secondly, it was noted that most of the stakeholders were unfamiliar with the theory of social practices. The introductory session of the visioning workshop included a presentation on social practice intended to familiarise the participants with the concepts of this theory. However, the researcher team still felt it was difficult for the participants to understand this theoretical framework and use it as the basis for creating future visions. The same issue was observed in other studies where the theory of social practices guided the visioning of alternative futures [103]. It is therefore suggested that greater emphasis is placed on ensuring participants have a better understanding of the theory before engaging in the

participatory activity. A solution could be an introductory session describing the elements of the theory, including examples of how it can be applied to sustainability transitions.

7. Conclusions

This research has demonstrated how a participatory visioning approach can be applied to create future visions for transport in Malta (2050). The visioning exercise was focused on using a face-to-face stakeholder workshop to envision a transport future that is more sustainable and that can help achieve the islands' climate change mitigation targets. The study results show how the inclusion of different actors in the discussion process brings together multiple perspectives. Such a bottom-up participatory approach offers advantages over the expert-led process by fostering a collaborative learning process that reflects different views.

This research is innovative as it shows how a social-practice-based approach can be combined with backcasting studies to produce alternative transport futures that are more inclusive and focused on systemic change than other approaches. Thorough examination of the materials, the necessary competencies, and societally-valued meanings that together constitute and define the mobility practice provide more opportunities for influence when compared to other approaches that target individual behaviour. In addition, rather than viewing mobility as a practice on its own, as is done in other approaches to modal shift, this approach allows for intervention in the wider system of practices which produces the need for mobility. It also provides insights about how social practice elements and other social practices that influence mobility may be specific to the geographical region as identified in this case study about Malta. In this way, this approach to transport backcasting can help develop strategies and projects that lead to more sustainable travel behaviours in future years.

While the main aim of the study was to demonstrate how a social-practice approach can be combined with a backcasting process, the research also resulted in narratives for future images for the transport sector in Malta for 2050. These results can serve as a starting point for a wider backcasting study. Future research can focus on assessing the alternative scenarios developed in this study regarding their potential for achieving climate change mitigation targets. Additionally, this study can also feed into further research that investigates which policy packages and pathways can be developed to reach the alternative, practice-based future transport scenarios.

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