Redesigning Ireland's Transport for Net Zero

TOWARDS SYSTEMS THAT WORK FOR PEOPLE AND THE PLANET

OECD

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BETTER POLICIES FOR BETTER LIVES

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Foreword

As part of its net-zero goal, Ireland has committed to halve transport-related carbon emissions by 2030 compared to 2018 (excluding international aviation and maritime). Meeting net-zero targets implies economy-wide systemic change, specifically requiring transformative changes in the transport sector, as highlighted by the latest IPCC report. In line with this, the OECD and the Irish Climate Change Advisory Council collaborated to identify ways to trigger deep systemic change in the Irish surface passenger transport sector.

The OECD's innovative approach brings systems thinking to the core of climate action and helps identify policies with the highest potential to bring about the needed transformation. This systemic approach emphasises that a transport system that fosters – and often imposes – growing car use will be unlikely to lead to increasing well-being and reducing GHG emissions at the scale and pace needed. Car dependency hinders the possibility of efficiently managing public space to foster quality access via more sustainable and healthy transport modes. It also limits the effectiveness of improved technologies such as more fuel efficient and electric vehicles as increased car use offsets vehicle efficiency gains. Furthermore, if vehicle fleets continue to grow this will hinder achieving high shares of fuel efficient and electric vehicles on the road. From a life-cycle perspective, too, simply electrifying a growing number of motorised vehicles results in higher emissions linked to production and disposal of vehicles, and the carbon-intensity of electricity production.

Thinking in systems shows that car-dependent systems are not a given. With the right policies car-dependent systems can be redesigned so that the most environmentally friendly modes, such as walking, cycling, micro-mobility and shared modes (including public transport) would be the most attractive and therefore the most used. Prioritising policies with a high transformative potential to redesign the Irish transport system, such as wide-scale road space reallocation, can trigger large-scale behavioural change to achieve what was previously considered unreachable. As shown in this study, which had a specific focus on different types of territories (Dublin, Cork, Kildare, Sligo), moving away from car dependency is possible and desirable across different contexts, although the pace and scope of the change might differ.

This OECD study shows that Ireland has ambitious stakeholders ready for joined-up thinking and for action to address the current car-dependent system and meet its climate and well-being objectives. During exchanges with the OECD, a number of stakeholders acknowledged that achieving such goals requires reducing both private car journeys and the need for long trips, while in the meantime ensuring equitable and safe access to places and opportunities for all. Ireland has already paved the way for this process through proposing policies to reallocate road space, mainstream on-demand shared services, and build awareness to address car-centric mindsets. This provides fertile ground to upscale such policies, drawing on the recommendations in this report.

There is an enormous amount of untapped potential for systems innovation in Ireland. These opportunities will not only improve well-being, but also result in lower energy and materials consumption, and fewer emissions. At the OECD, we welcome Ireland's efforts to harness such opportunities and transition towards better transport systems for better lives.

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Executive summary

Ireland plans to achieve an economy-wide 51% greenhouse gas emission reduction by 2030 (relative to 2018 levels), for which the transport sector is required to reduce its emissions by 50% by 2030. With three out of four citizens (on average) opting to travel by car on a daily basis, current mobility patterns in Ireland are incompatible with the country's greenhouse gas reduction targets.

Ireland has an opportunity to increase the pace of emission reductions in the transport sector while improving well-being. To unleash this opportunity, Irish efforts and attention need to prioritise policies with the transformative potential to shift the country's transport systems away from car dependency.

This report assesses implemented and planned Irish policy efforts to reduce emissions in the transport sector. It identifies the transformative policies that could help the country redesign its passenger surface transport system (transport system, hereafter) to meet its climate goals for the sector.

The analysis is guided by the OECD "Systems Innovation for Net Zero" process. The process is designed to help policy makers take a systemic approach for identifying policies with high transformative potential, via three steps:

1. **envision** the goal(s) and the patterns of behaviours a properly functioning system fosters, and challenge ingrained mental models underlying poorly functioning systems;
2. **understand** why the current system is not achieving envisioned goals and patterns of behaviour, and determine whether implemented and planned policies have the potential to redesign the system;
3. prioritise and scale up the policies which can **redesign** systems to foster desirable patterns of behaviour.

Key findings

The Irish transport system fosters growing car use and emissions by design, and is thus unfit to enable the country to meet its greenhouse gas reduction goals while improving well-being. Growing car use in Ireland is largely determined by car-dependent transport and urban systems, organised around increased mobility and characterised by three unsustainable dynamics: induced car demand, urban sprawl, and the sustainable modes low-attractiveness trap.

Aiming at decarbonising the system via private vehicle improvements is unlikely to lead to substantially different patterns of behaviour, rapid emissions reductions, and large well-being improvements. Car-dependent systems make rapid electrification slow and difficult, by locking-in large and growing vehicle fleets. Even with improved (and fully-electric) vehicles, they also fail to reduce life-cycle emissions, address accessibility gaps and other negative impacts (e.g. road fatalities).

Implemented policies and those expected to bring the highest emission reduction shares according to Ireland's Climate Action Plan 2021 are unlikely to help the country transform its car-dependent system. Most efforts in Ireland have been allocated to policies with a low to medium potential to transform the current system (e.g. electric vehicle incentives for private cars, increasing the budget

allocated to public transport infrastructure compared to what is allocated to car infrastructure, carbon and road prices, infill/brownfield development targets). Currently prioritised policies, such as electric vehicle incentives, also reinforce car dependency, further locking the country into a system that fosters growing car use and emissions by design.

Ireland could unleash enormous opportunities by prioritising policies with a high potential for transforming its car-dependent system. While taking different shapes, transformation of the transport system away from car dependency is possible in different types of territories (e.g. Dublin, Cork, Sligo, and Kildare).

Policies with a high transformative potential include road space reallocation, the mainstream of on-demand shared services and communication efforts to address car-centric mindsets. Currently, these policies are marginal and implemented on a small scale. The recently issued (2022) Sustainable Mobility Policy increases the centrality of transformative policies, reflecting an effort towards transformative change**.**

Key recommendations

Redefine the goal of the transport system as sustainable accessibility. This calls for challenging ingrained mindsets and shifting away from identifying high/growing mobility with well-being. Revisiting measurement frameworks and models is also relevant. Setting sustainable accessibility as a goal for land-use/housing planning is also necessary, as ensuring proximity is key for delivering sustainable accessibility.

Prioritise the up-scale of policies with high potential to transform the car-dependent system. While no single policy can transform a complex system, policies with a high transformative potential can help Ireland redesign the structure of its transport system so that sustainable transport modes are the first choice for the bulk of trips. As mentioned above, the actions included in the recently issued Sustainable Mobility Policy have a higher focus on transformative policies. These actions can be complemented and enlarged with the actions recommended in this report to ensure the upscale of such policies**.** Reflecting the recommendations in this report in the upcoming update of the Climate Action Plan will also be relevant. The effectiveness of the policies identified as having a low or medium transformative potential in car-dependent systems can increase when implemented alongside transformative policies.

Redefine the electrification strategy to support the transition towards a sustainable transport system. Embed the electrification strategy in the goal of sustainable accessibility and reduced car travel, and make sure the strategy prioritises walking, cycling, micro-mobility and high occupancy and shared travel where larger vehicles are the only option. In line with this recommendation, the current target (included in both the Climate Action Plan and the new Sustainable Mobility Policy) for reducing car travel should include total (rather than solely fossil-fuel-based) car kilometres and be set along with a target on the share of car-kilometres travelled by battery-electric vehicles. More ambitious targets on modal shifts, and targets aiming at delivering improved proximity and access with active and shared modes (including public transport and micro-mobility) need to be set.

Embrace a systemic approach to policy decision-making across government departments. Achieving transformative change will require aligning action across government and addressing existing inconsistencies. Transformative policies can be prioritised by mainstreaming system-focused policy analysis and decisions to ensure a shared understanding of root causes by all stakeholders and to expose ingrained ideas (and related actions) that hinder progress. Rethinking multi-level governance is also required to improve government engagement with stakeholders, promote bottom-up and participatory approaches, increase local capacity to think in terms of systems, and communicate and implement transformative policies.

Abbreviations

AMB	Àrea Metropolitana de Barcelona (Metropolitan Area of Barcelona)
ATM	Autoritat del Transport Metropolità (Metropolitan Transport Authority)
BAU	Business-as-usual
CABERNET	Concerted Action of Brownfield and Economic Regeneration Network
CAF	Common Appraisal Framework
CAP	Climate Action Plan
CCAC	Climate Change Advisory Council
CCCC	Climate Communications Coordination Committee
CIÉ	Córas Iompair Éireann (Irish Transport System)
CLD	Causal loop diagram
CO2	Carbon dioxide
CREATE	Congestion Reduction in Europe: Advancing Transport Efficiency
DECC	Department of Environment, Climate and Communications
DHLGH	Department of Housing, Local Government and Heritage
DMURS	Design Manual for Urban Roads and Streets
DRT	Demand-responsive transport
DtF	Department for Transport
EPA	Environmental Protection Agency
ESRI	Economic, Social and Research Institute
EU	European Union
EV	Electric vehicle
FUA	Functional urban area
GDP	Gross domestic product
GHG	Greenhouse gas (emissions)
GLA	Greater London Authority
GPS	Global positioning system
HGV	Heavy goods vehicle (e.g. large trucks, freight trucks)

HOV	High-occupancy vehicles
ICE	Internal combustion engine
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITF	International Transport Forum
LDA	Land Development Agency
LRR	Land remediation relief
MaaS	Mobility as a service
MtCO2	Metric tonnes of carbon dioxide
NDCA	National Dialogue on Climate Action
NESC	National Economic and Social Council
NIFTI	National Investment Framework for Transport in Ireland
NTA	National Transport Authority
OECD	Organization for Economic Co-operation and Development
ONF	One-network-framework
ONRC	One Network Road Classification
OZ	Opportunity Zone
PHEV	Plug-in hybrid electric vehicle
PPP	Public Private Partnership
PTAL	Public Transport Accessibility Levels
RTF	Road Task Force
SCSI	Society of Chartered Surveyors Ireland
SMP	Sustainable Mobility Policy
SUMP	Sustainable urban mobility planning
SUV	Sports utility vehicle
tCO2eq	Tonne of carbon dioxide equivalent
TAF	Transport Appraisal Framework
TFI	Transport for Ireland
TfL	Transport for London
TII	Transport Infrastructure Ireland
VAT	Value-added tax
ZEV	Zero-emission vehicle
ZEVI	Zero-Emission Vehicle Initiative

1 Overview

This chapter explains why a systemic approach is needed for Ireland to meet its ambitious climate targets and improve well-being. The OECD Systems Innovation for Net Zero process is introduced as a way forward to apply such an approach for innovative policy decision-making in the transport sector. It illustrates why car-dependent systems are unfit for purpose and how these systems can be redesigned via transformative policies. The chapter also provides an overview of the main findings and recommendations of the report.

Current mobility patterns in Ireland show that three out of four citizens, on average, opt to travel by car on a daily basis (CSO, 2019[1]). These mobility patterns are incompatible with the 1.5°C warming limit target and a stable climate. They are also incompatible with the Irish GHG targets of reducing transport emissions by 50% by 2030[1], and with sectoral ceilings limiting emissions in the sector to 54 Mt between 2021-2025 and 37 Mt for 2026-2030 (Department of the Taoiseach, 2022[2]). To meet the 2030 climate target for transport, electrification is necessary but insufficient. Rapid reductions in travel demand and shifts to sustainable modes are needed (Department of Transport, 2022[3]; Society of the Irish Motor Industry, 2022[4]).

Ireland has identified a gap of 13% between the 2030 target and the estimated emission reductions resulting from policies planned for the transport sector. It is becoming increasingly evident that the gap will be larger, since the abatement from electrification, as envisioned in the Climate Action Plan 2021, will be difficult to achieve. Thus, reductions in travel demand and shifts to sustainable modes will need to be larger than initially expected.

Patterns of behaviour (including mobility) are the product of the systems they are embedded in (rather than independent from them) (OECD, 2021[5]). Policies have significantly shaped current systems, and have a huge potential for redesigning them and enabling large-scale behavioural change (see Box 1.1), which would otherwise be unfeasible.

According to complexity science, changes in system structure[2] (i.e. transformative or systemic change) are necessary if patterns of behaviour are to be significantly altered (Meadows, 2008[6]; Monat and Gannon, 2015[7]; Zimmerman, Lindberg and Plsek, 2009[8]). In line with this, the IPCC calls for transformative change in the transport sector to reverse current patterns of behaviour (e.g. people choosing cars over other transport modes for the bulk of trips) and meet climate change mitigation goals (IPCC, 2022[9]). The IPCC defines transformative change as "a system-wide change that requires more than technological change through consideration of social and economic factors that, with technology, can bring about rapid change at scale" (IPCC, 2018[10]).

Box 1.1. What is meant (and what is not) by "behavioural change" in this report

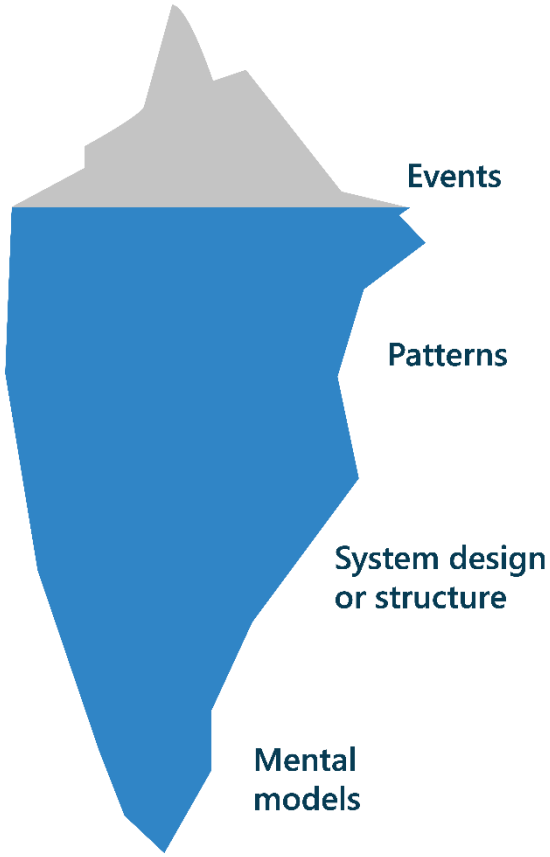
The term "behavioural change" as used in this report is based on the findings of complexity science, which argues that individual preferences and patterns of behaviour largely result from the system structure in which they are embedded (e.g. car-dependent systems) and the mental models (e.g. car-centric thinking) that have shaped such structure. Government policies have been fundamental to shaping current systems and have also had a major influence on prevalent mental models. They will also be fundamental moving forward: with the right policies, systems could be deliberately redesigned to promote and facilitate other choices and trigger large-scale behavioural change which is otherwise unlikely.

This is radically different from a conception of behavioural change that places the emphasis on individual behaviour rather than corporate responsibility and government intervention in shaping systems functioning. Using the term with that meaning creates the erroneous impression that the government's role is mainly to heighten awareness so that people can make better choices. On that interpretation, large-scale behavioural change will result from the aggregation of individuals who become more aware and make "better" choices. This disregards the role of the system, its structure, and prevailing rules in making such choices feasible and attractive for a majority of the population, thus shaping preferences.

Policy rarely focuses on improving the structure of systems by redesigning or transforming them. Instead, most policies focus on improving specific parts of the system. For example, in Ireland, 67%[3] of emission reductions are expected to come from developing better vehicles and fuels.

Making transformative policies the priority can increase the chances that Ireland will meet its climate targets. Identifying transformative policies is a prerequisite for prioritising them, and requires taking a systemic approach (Box 1.2). The iceberg analogy is used throughout the report to illustrate the added value of taking a systemic approach (Figure 1.1). This analogy is a reminder that observed outcomes or events, what we hear on the news (e.g. traffic jams, pollution peaks, road fatalities, growing emissions) are just the "tip of the iceberg". These events (patterns, when observed over time) are the result of systems that have been designed in a certain way and built on dominant mental models. Both the system design or structure and the mental models are invisible to the naked eye – "under the surface" – and a systemic approach brings them to light.

Figure 1.1. The iceberg model



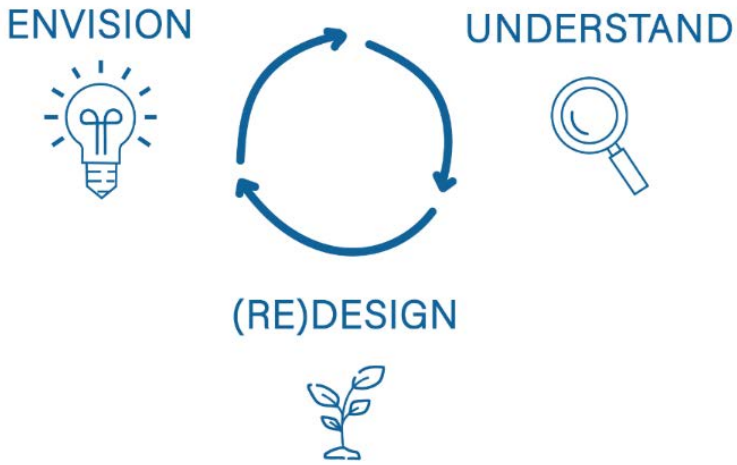
Source: Adapted from (Systems Innovation, 2021[11])

A systemic approach can identify truly transformative policies, based on a deep understanding of the design of the system that needs to be transformed, and the mental models that have shaped it. A systemic approach also leads to a deeper understanding of how policies affect the system's structure and mental models and, conversely, how the system affects policy decisions.

The report focuses on emissions from the passenger surface transport sector and aims to identify the transformative policies that could help Ireland redesign its passenger surface transport system (referred to subsequently as its transport system) in different types of territories[4] and meet its climate goals for this sector. It follows the OECD "Systems Innovation for Net Zero" process (Figure 1.2), designed to help policy makers take a systemic approach via three steps:

1. envision the goal(s) and the patterns of behaviours that a properly functioning system would foster, and challenge ingrained mental models underlying poorly functioning systems;
2. understand why the current system is not achieving envisioned goals and patterns of behaviour and whether implemented and planned policies have the potential to redesign the system;
3. prioritise and scale up the policies that can redesign systems to foster desirable patterns of behaviour and goals.

Figure 1.2. Systems innovation for net-zero process



The analysis is based on information gathered via desk reviews, interviews and workshops with Irish public and private stakeholders, as well as visits to the four territories analysed in more detail: Cork, Dublin, Kildare, and Sligo. A combination of systemic tools was used to understand the system structure and underlying mental models and to categorise policies by their transformative potential (Box 1.2). In addition to guiding the analysis in this report, the methodology developed by the OECD is intended to become a tool that Irish stakeholders can integrate into their decision-making processes.

Box 1.2. Policies through a systemic lens

Policies are transformative or systemic when they focus on transforming the way the parts of a system are organised or interrelated. This focus is based on findings from complexity science, which demonstrate that the outcomes of complex systems depend more on the way in which the system as a whole functions, i.e. the way in which its parts interact (e.g. how road space is allocated across modes and functions), than on the properties of its individual parts (e.g. vehicles' energy efficiency) (Zimmerman, Lindberg and Plsek, 2009[8]).

We rarely think about systems and often attempt to solve problems by subdividing them into parts and trying to improve the efficiency of those parts. This approach, referred to as analytical thinking or reductionism, leads to policies that react to or anticipate patterns of behaviour but do not transform the systems that foster such patterns in the first place.

The OECD "Systems Innovation for Net Zero" process aims to help policy makers identify policy packages with the potential to transform systems and influence future patterns of behaviour. Identifying policies with high transformative potential requires a deep understanding of the system the policy is trying to transform, as well as how the policy affects the system.

The systemic tools guiding this report include:

- the iceberg model (see above) as a visual guide to a systemic perspective
- causal loop diagrams showing the system's interconnections (or structure) and the dynamics at the source of the patterns of behaviour that policies seek to influence
- stock and flow analysis showing the transformative potential of policies affecting flows given current stock levels in the system
- Meadows' leverage points framework, which combines the tools listed above, and is a useful guide to assessing the transformational potential of policies.

See section 3.2.1 for further discussion.

The report also emphasises the need to bring about public acceptance of transformative[1] policies. It highlights the role of communication strategies in transforming mindsets (see sections 3.2.2 and 4.7) and in showing the benefits of transformative policies such as road space reallocation (see section 3.2.2).

1 The terms "transformative policies" and "policies with a high transformative potential" are used interchangeably throughout the report.

The report finds that Ireland has a car-dependent transport system and that this system is unfit to help the country meet its GHG emission reduction goals for the sector while improving well-being. Citizens' preferences, leading to growing car use, are largely determined by transport and urban systems organised around car driving, rather than being exogenous, as often perceived (Box 1.3). Car-dependent systems are mobility-intensive but are ill-equipped to deliver sustainable access (see chapter 2). These systems are characterised by three unsustainable dynamics: induced demand, urban sprawl and the sustainable modes low-attractiveness trap (see chapter 3). Car-dependent systems foster growing car use, leading to high emissions and negative impacts on well-being, such as air and noise pollution, congestion, road injuries and fatalities, reduced travel options, and unequal access to opportunities (OECD, 2021[5]).

Redefining the Irish transport system's goal is a necessary step to move away from the car-dependent system, according to this analysis. Evidence suggests that transport systems designed to deliver sustainable accessibility (rather than increased mobility) can trigger patterns of behaviour aligned with GHG emission reduction targets and lead to improved well-being via better air quality, health and safety, as well as stronger communities and equity (Silva and Larsson, 2018[12]; ITF, 2019[13]; OECD, 2019[14]); (see chapter 2).

For a number of years Ireland has prioritized efforts and attention on policies that this analysis finds have a low potential to help the country transition away from car dependency and towards systems able to deliver sustainable accessibility. This is still reflected in documents such as the 2021 Climate Action Plan (Department of the Taoiseach Ireland, 2021[15]). These policies include EV incentives for private vehicles, increasing the budget allocated to public transport infrastructure compared to what is allocated to car infrastructure, and infill/brownfield development targets. In particular, EV incentives for private cars are often assumed to be a sure and fast route to decarbonising the sector. However, this analysis shows that when implemented within car-dependent systems their potential is limited for several reasons. Firstly, because fleets are "hard-to-change" stocks and replacement will take several decades longer than usually perceived. Secondly, because EV incentives for private cars, rather than reversing, reinforce car-dependency, further encouraging car use and making it more challenging to replace a large and growing car fleet. Thirdly, because when vehicle life-cycle is taken into account, electrifying a growing number of motorised vehicles leads to high emissions produced in the manufacturing and disposal process of vehicles (Hawkins et al., 2012[16]); as well as from electricity production (Holdway et al., 2010[17]).

Ireland has enormous untapped opportunities to reduce emissions, which could be unleashed by prioritising policies with a high potential to transform the car-dependent system and ensuring these policies are implemented (and adapted) across the country. Transformative policies identified by this report (see

more in chapter 3) include road space reallocation, the mainstreaming of on-demand shared services, and communication strategies that shed light on the benefits of a transition towards sustainable transport systems and the consequences of inaction. Chapter 4 focuses on providing recommendations for Ireland to upscale and expand the use of such policies.

By shifting the system away from the dynamics that foster car-dependency, transformative policies can foster behavioural change at scale and increase the effectiveness of electrification efforts. Such an electrification strategy needs, however, to foster rather than hinder the transition away from car dependency and focus on an array of shared vehicles (e.g. e-bikes, shared cars, electric buses – see Chapter 4).

Recommending that policies with high transformative potential should be scaled up does not imply that policies with low or medium transformative potential are necessarily "wrong" or useless. The analysis reveals, however, that these policies are unable on their own to trigger behavioural change away from car use since they do not transform the system that influences these behaviours; the system remains car-dependent and cars are still the most convenient transport mode (see Chapter 3). The effectiveness of the policies identified as having a low or medium transformative potential in car-dependent systems (e.g. carbon and road prices, programmes to improve public and active modes) can increase when implemented alongside transformative policies.

Actions with medium to high transformative potential exist in Ireland, and more recent documents, such as the new Sustainable Mobility Policy (SMP), reflect an effort to make these more central. In line with the recommendations of this report and previous OECD work (see (OECD, 2021[5])), the SMP and the mechanisms for overseeing and supporting its implementation (e.g. the Pathfinder Programme – see Box 1.3) are an important step towards the prioritisation of policies with high and medium transformative potential. As of 2022, however, transformative policies are still marginal and implemented only on a small scale or as pilot projects. The recommendations in this report can complement the action list in the SMP[5] and guide the formulation and revision of other strategic documents (e.g. the 2023 Climate Action Plan) with the aim that transformative policies are effectively and rapidly scaled-up.

Box 1.3. "Car culture" from a systemic approach and its policy implications

In interviews, Irish stakeholders often referred to the "car culture" as a barrier to implementing ambitious climate action. The choice to drive a car or motorcycle is often perceived as an individual preference, exogenous to the system in which the choice is embedded.

Quantitative models guiding transport policy decisions also contribute to this perception, as the estimated (growing) pattern of car use is treated as an exogenous variable, with the implication that the pattern is outside the policy realm. For example, the Marginal Abatement Cost Curve approach that informed Ireland's Climate Action Plan 2021 takes the level of car use as an exogenous input and seeks to decarbonise it using the cheapest technology (considering only direct costs such as vehicle purchase and operation). Similarly, Ireland's national transport models project continued growth in car ownership based on income and demographic projections, and car occupancy is assumed to be constant in standard transport model runs. Alternative futures for car ownership and car occupancy are simply absent from standard national transport modelling (DoT et al., 2021[18]).

Housing preferences are also seen as exogenous. Interviews reveal a sense of inevitability, of being at the mercy of market forces, and a preference for detached houses.

The perception of certain patterns of behaviour (e.g. driving a car) as exogenous from the system in which they are embedded reflects a non-systemic mindset which constrains policy action. Without a systemic mindset and the systemic tools that support it, the system structure and the underlying mental models at the root of the patterns of behaviour and the outcomes observed (the "tip of the iceberg") are invisible, leading to the perception that certain patterns and outcomes are "inevitable". Based on this assumption, policies are constrained to react or adapt to observed patterns of behaviour. For example, growing car use is perceived as inevitable and restricts emission reduction policy to the improvement of the type of vehicle. The fact that 67% of emission reductions are expected to come from better vehicles and fuels according to Ireland's climate strategy suggests that the strategy may have been designed based on the assumption that vehicle use will continue to increase.

The findings of this report are consistent with recent modelling exercises, which suggest the need to scale up policies that can shift travel away from cars (Fulton, Mason and Meroux, 2017[19]; Fulton, 2018[20]; ITF, 2021[21]; Barrett et al., 2022[22]). Recent exercises[6] find that scenarios coupling technological change with large-scale behavioural change can lead to higher accessibility and lower mobility than scenarios focused only on technology, and be more closely aligned with net-zero goals. Scenarios focused on improving vehicles and fuels and taking growing mobility demand as a given fall behind in achieving these goals. The exercises also show that policies that deliver behavioural change will account for a higher share of emission reductions, compared to those delivered by technological change (especially before 2050), than previously estimated.

Focusing climate action on redesigning systems can provide opportunities for a just transition and for a more just system in the end[7]. The characteristics of the transition and those of the resulting system are equally important. Not only the transition process but also the resulting systems should deliver more equitable access to opportunities (including jobs), the regeneration of local businesses, people-friendly neighbourhoods and better health (cleaner air, less noise, more green space, more physical activity) for the wider population.

The rest of the report is structured as follows: Chapter 2 describes the mental models underlying transport systems and policies guided by the goal of mobility. It explains why a system focused on mobility is not fit for purpose and calls for the redefinition of the transport system goal as sustainable accessibility. It shows that systems organised around sustainable accessibility can take different shapes in different areas, building on insights from an exercise covering Dublin, Cork, Sligo and Kildare. Chapter 3 sheds light on the system dynamics underlying growing car use and GHG emissions, and assesses the potential of implemented and planned policies in Ireland to reverse these dynamics. Finally, Chapter 4 makes recommendations for prioritising and scaling up policies identified as having a high potential to accelerate the transition away from car-dependent systems and towards transport systems that (via delivering sustainable accessibility) work for people and the planet.

Box 1.4. Ireland's SMP delivery team and the Pathfinder Programme

The National Sustainable Mobility Policy (SMP), published in April 2022, establishes a strategy for active travel (walking and cycling) and public transportation until 2030 to assist Ireland in meeting its climate commitments (Department of Transport, 2022[3]).

The strategy was developed in response to the transport criteria outlined in the Climate Action Plan 2021. Starting in 2021, the goal is to achieve at least 500 000 additional daily active travel and public transportation journeys, as well as a 10% decrease in kilometres travelled by fossil-fuelled automobiles by 2030. A leadership group has been designated to oversee and deliver the policy's actions and targets (Department of the Taoiseach Ireland, 2021[15]). The leadership group is made up of representatives from various organisations who meet once a month to supervise SMP implementation, making use of their members' knowledge and connections to handle potential risks or overcome hurdles. These regular meetings, to be held until 2025, assess the action plan's development and gather information for the quarterly reports to the Minister of Transportation. The first of these reports, which will describe the degree of success achieved thus far, is scheduled for completion in September 2022. The leadership group has established the SMP delivery team, consisting of representatives from the organizations that currently form part of the leadership group as well as other individuals from academia, community organisations and other parts of the public sector. Their role is to establish the Pathfinder Programme.

The Pathfinder Programme includes projects and activities to implement the completion of the SMP at a local level. The projects must fulfil key criteria such as health, well-being, place-making, permeability and universal design. They include improving cycling infrastructure, electrifying bus services, refocusing on active travel modes (using the "10-minute town" concept), developing a community-based transportation system in rural areas, and upskilling local government staff responsible for meeting sustainable mobility targets. Aspects of road space reallocation, mobility as a service, shared mobility, rural solutions, and the mobility mindset will be incorporated into these initiatives (Department of Transport, 2022[23]).

References

Barrett, J. et al. (2022), "Energy demand reduction options for meeting national zero-emission targets in the United Kingdom", *Nature Energy*, Vol. 7/8, pp. 726-735, https://doi.org/10.1038/s41560-022-01057-y. [22]

CSO (2019), *National Travel Survey 2019*, Central Statistics Office (CSO), Cork, Ireland, https://www.cso.ie/en/releasesandpublications/ep/p-nts/nationaltravelsurvey2019/ (accessed on 23 August 2022). [1]

CSO Ireland (2019), *Urban and Rural Life in Ireland, 2019*, CSO, https://www.cso.ie/en/releasesandpublications/ep/p-urli/urbanandrurallifeinireland2019/introduction/ (accessed on 20 September 2022). [24]

Department of the Taoiseach (2022), "Government announces sectoral emissions ceilings, setting Ireland on a pathway to turn the tide on climate change", https://www.gov.ie/en/press-release/dab6d-government-announces-sectoral-emissions-ceilings-setting-ireland-on-a-pathway-to-turn-the-tide-on-climate-change/ (accessed on 5 September 2022). [2]

Department of the Taoiseach Ireland (2021), *Climate Action Plan 2021*, Department of the Environment, Climate, and Communications; Department of the Taoiseach, https://www.gov.ie/en/campaigns/2f87c-climate-action-plan-2021/# (accessed on 14 June 2022). [15]

Department of Transport (2022), "Interview with the Climate Engagement & Governance Division, Department of Transport". [23]

Department of Transport (2022), *National Sustainable Mobility Policy*, Department of Transport, https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/. [3]

DoT et al. (2021), *Interviews with Irish stakeholders*. [18]

Fulton, L. (2018), "Three Revolutions in Urban Passenger Travel", *Joule*, Vol. 2/4, pp. 575-578, https://doi.org/10.1016/J.JOULE.2018.03.005. [20]

Fulton, L., J. Mason and D. Meroux (2017), "Three Revolutions in Urban Transportation: How To Achieve the Full Potential of Vehicle Electrification, Automation, and Shared Mobility in Urban Transportation Systems Around the World by 2050", *undefined*. [19]

Hawkins, T. et al. (2012), "Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles", *Journal of Industrial Ecology*, Vol. 17/1, pp. 53-64, https://doi.org/10.1111/j.1530-9290.2012.00532.x. [16]

Holdway, A. et al. (2010), "Indirect emissions from electric vehicles: emissions from electricity generation", *Energy & Environmental Science*, Vol. 3/12, p. 1825, https://doi.org/10.1039/c0ee00031k. [17]

IPCC (2022), "Climate Change 2022: Mitigation of Climate Change. Summary for Policymakers", http://www.ipcc.ch (accessed on 13 June 2022). [9]

IPCC (2018), "Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty". [10]

ITF (2021), *ITF Transport Outlook 2021*, OECD Publishing, Paris, https://doi.org/10.1787/16826a30-en. [21]

ITF (2019), "Improving transport planning and investment through the use of accessibility indicators", *International Transport Forum Policy Papers,*, No. 66, OECD Publishing, Paris, https://doi.org/10.1787/24108871 (accessed on 10 June 2022). [13]

Meadows, D. (2008), *Thinking in Systems*, https://www.chelseagreen.com/product/thinking-in-systems/ (accessed on 8 March 2021). [6]

Monat, J. and T. Gannon (2015), "What is Systems Thinking? A Review of Selected Literature Plus Recommendations", *American Journal of Systems Science*, Vol. 2015/1, pp. 11-26, https://doi.org/10.5923/j.ajss.20150401.02. [7]

OECD (2021), *Transport Strategies for Net-Zero Systems by Design*, OECD Publishing, Paris, https://doi.org/10.1787/0a20f779-en (accessed on 10 June 2022). [5]

OECD (2019), *Accelerating Climate Action: Refocusing Policies through a Well-being Lens*, https://doi.org/10.1787/2f4c8c9a-en (accessed on 10 June 2022). [14]

Silva, C. and A. Larsson (2018), "Challenges for accessibility planning and research in the context of sustainable mobility", *International Transport Forum Discussion Papers*, No. 2018/07, OECD Publishing, Paris, https://doi.org/10.1787/8e37f587-en. [12]

Society of the Irish Motor Industry (2022), *Reducing Light Fleet Carbon Emissions to Achieve Irish Government Targets*, SIMI, https://www.simi.ie/en/environment/publications. [4]

Systems Innovation (2021), *Leverage Points A Guide For Systems Innovators*. [11]

Zimmerman, B., C. Lindberg and P. Plsek (2009), "A complexity science primer: What is complexity science and why should I learn about it?", https://www.napcrg.org/media/1278/beginner-complexity-science-module.pdf (accessed on 5 July 2022). [8]

Notes

[1] Compared to 2018.

[2] The terms "system structure", "system functioning" and "system design" are used interchangeably throughout the report.

[3] This figure rises to nearly 80% when only the defined emission reduction measures are considered, ignoring an abatement gap of 0.9 MtCO2eq for which Ireland still has to define measures to achieve its 2030 transport sector climate target (Climate Action Plan 2021).

[4] Four focus areas were selected by the Advisory Council for Climate Change to ensure that insights from this project were relevant for the whole of Ireland. These include Dublin, Cork, Kildare and Sligo. Based on the CSO (2019[24]) Ireland categorisation, Dublin and Cork are cities with adjacent areas including satellite urban towns and rural areas with high urban influence. Sligo is an independent urban town; and Kildare is a town whose rural hinterlands have a high urban influence.

[5] For instance, actions targeting road space reallocation in the SMP explicitly mention the need to "review, develop and update guidelines, standards and supporting legislation to allow for a range of solutions to be developed for road space reallocation/redesign to repurpose existing legacy car-based road design" (Department of Transport, 2022[3]). As discussed in Chapter 4, a number of actions undertaken by governments in other countries, which go beyond guidelines, standards and supporting legislation, have proven useful and, in many cases, necessary to trigger large-scale road space reallocation and redesign.

[6] Fulton, Mason and Meroux (2017[19]) and Fulton (2018[20]) develop world urban transport scenarios. They find that emissions can be reduced by about 44% by 2050 (relative to 2015) in a scenario that reinforces high mobility patterns and focuses on improving vehicle technology. A 76% reduction in emissions could be achieved in a scenario in which technological improvements are embedded in a wider policy package that promotes the use of active modes and shared/high-occupancy vehicles, and includes major changes in urban planning. ITF (2021[21]) concludes that the highest emission reductions for the sector (-87% by 2050 relative to 2015) would be achieved if technological change was embedded in a policy package aimed at "reshaping" transport systems and building on recovery to accelerate the pace of change. This scenario would result in much lower total travel (passenger-kilometres) than a business-as-usual one; however, accessibility by both car and public transport, and the relative competitiveness of public transport compared to the car, would be improved. Barrett et al. (2022[22]) develop a transformative scenario for the UK (see more in Chapter 4) and find that the highest emission reductions would be achieved by a policy package that produces "shift and avoid" effects that would account for 60% of total GHG emission reductions, while improving vehicle technologies would account for only 40%.

[7] As will be discussed in Chapter 4, implementing transformative policies can bring benefits in the form of employment creation during the transition away from car dependency.

2 Envision

This Chapter describes the mental models underlying transport systems and policies guided by the goal of mobility. It explains why a system focused on mobility is not fit for the purpose of achieving emission reductions and high well-being outcomes and calls for the redefinition of the transport system goal as sustainable accessibility. It shows that systems organised around sustainable accessibility can take different shapes in different areas, building on insights from an exercise covering Dublin, Cork, Sligo and Kildare.

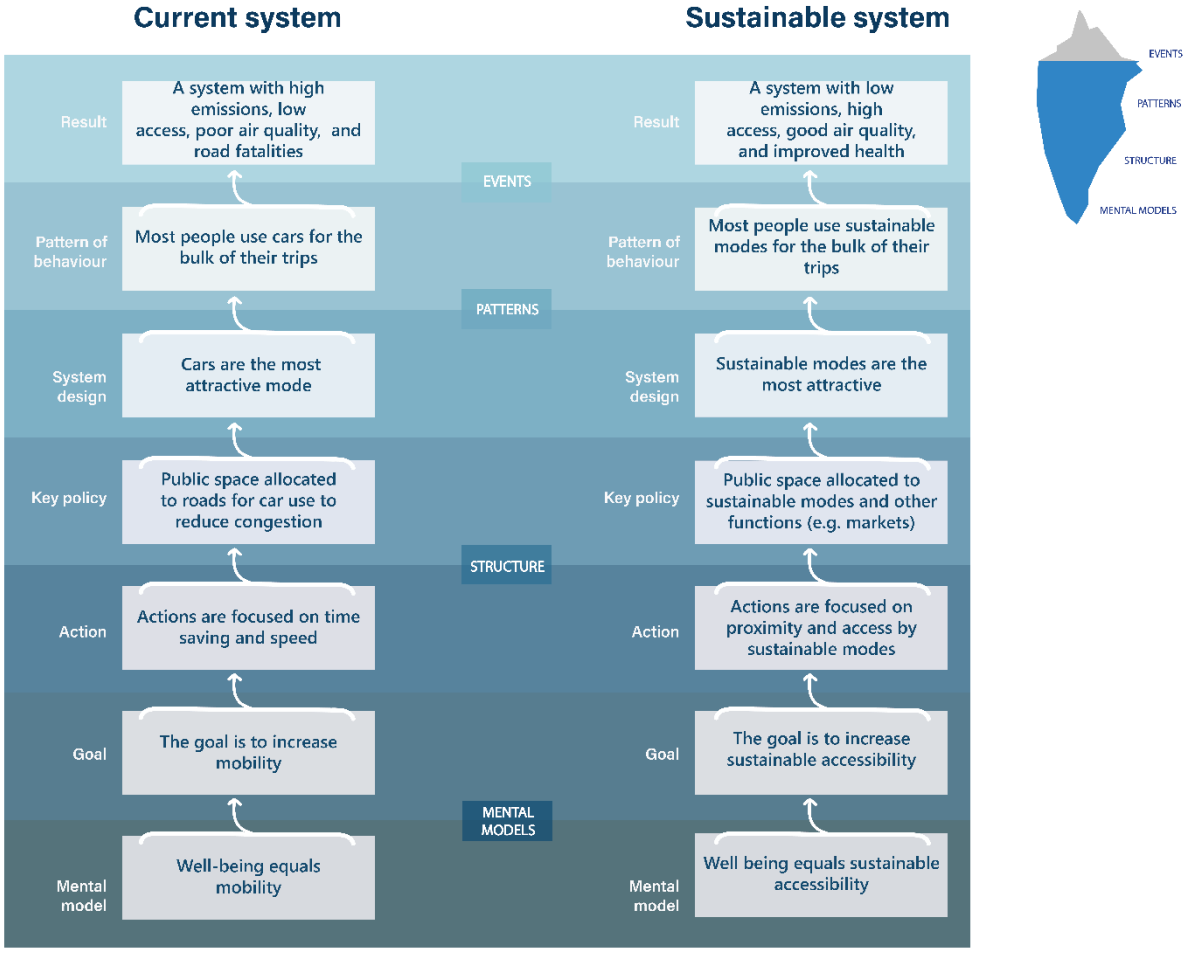
A system's goal establishes its purpose or function (Meadows, 2008[1]). It can be thought of as the system's "guiding star". A crucial step towards achieving desired outcomes in transport systems is thus to understand whether the goals guiding the design of these systems can make them fit for the purpose that is established as desirable (e.g. improving well-being, significantly reducing GHG emissions).

Goals are, in turn, greatly influenced by mental models.[1] Mental models are the unquestioned, often implicit and unconscious, assumptions through which humans understand the world. They determine what people see and fail to see, and influence the targets they set, the actions they take and the types of systems they create (Systems Innovation, 2021[2]; Saltmarshe, 2018[3]).

Irish transport systems (and transport systems across the globe) have been shaped around the goal of mobility[2] (physical movement), based on the perception (mental model) that high mobility leads to high well-being. Evidence suggests that this is not necessarily true and that systems structured around the goal of mobility foster (and sometimes impose) growing car use, whereas the opposite is needed to meet Ireland's GHG reduction targets (see Chapter 3 for more on this). This is not to say that all mobility increases are bad, and indeed different transport volumes (e.g. vehicle-kilometres, passenger-kilometres, trips) may vary in different ways due to different circumstances (e.g. a shift from car travel to public transport could make vehicle-kilometres go down while maintaining the same amount of passenger-kilometres, due to higher load factors in public transport). Nonetheless, what this chapter argues is that a system structured around accessibility, where there is proximity between people and places, will tend to reduce overall transport volumes (total vehicle and passenger-kilometres travelled) for a number of reasons: not only trips can be shifted from car to public transport, but distances can also be shortened; which increases the viability of active and micro-mobility modes for trips currently made by cars and public transport, while also shortening the distances of trips remaining in cars and public transport. Finally, an enhanced accessibility system would be more conducive to people having the possibility to fulfil multiple needs with one rather than multiple trips, which can result in a lower number of overall trips. When mobility is the proxy for increased well-being, future scenarios where total mobility is reduced may be discarded (including because accessibility improvements are not measured); closing the door to actions and policies (such as those discussed in chapter 3) that could importantly improve well-being and significantly reduce GHG emissions (including via mobility reductions).

Based on the iceberg analogy outlined in the Overview Chapter, Figure 2.1 illustrates the power of challenging ingrained mindsets and redefining system goals. The left-hand side shows how the perception of mobility as a proxy for well-being has led to policies that prioritise time savings and speed, ignoring the importance of creating proximity, and as a consequence, allocating the majority of public space to cars. These actions have led to systems structured around driving, which foster growing car use, which in turn leads to high emissions, air pollution, poor health and unequal access to opportunities. The right-hand side shows how the perception of sustainable accessibility in transport systems as the proxy for well-being can lead to policies that prioritise creating proximity, the allocation of roads in a balanced manner that grants priority to less carbon and space intensive modes, and the redesign of transport systems. Systems designed to deliver sustainable accessibility foster the use of active and shared modes, a pattern of behaviour more aligned with the Irish GHG reduction targets and the improvement of well-being. The growing use of active and shared modes can lead to low emissions, improved air quality and health, and more equal access to opportunities (OECD, 2021[4]).

Figure 2.1. The transformative potential of redefining policies and system goals



Redefining the Irish transport system's goal is necessary for meeting climate targets and is therefore the first recommendation of this report. While not an easy step, as it requires challenging ingrained mindsets as well as revisiting measurement frameworks and models, redefining the system's goal has the potential to help Ireland meet its targets while improving well-being. Evidence suggests that transport systems designed to deliver sustainable accessibility can trigger patterns of behaviour aligned with GHG reduction targets while improving air quality, health, safety and equity (Silva and Larsson, 2018[5]; ITF, 2019[6]).

Section 2.1 explains why mobility is neither a good proxy for well-being nor a good system and policy goal. Section 2.2 shows why redefining the transport system's goal can help Ireland meet its reduction targets while improving well-being. Section 2.3 summarises views expressed during a series of workshops held in Ireland in April 2022 in which Irish stakeholders envisioned transport systems guided by the goal of sustainable accessibility in urban, suburban and rural areas.

2.1. Transport systems with mobility as their goal

Transport systems in Ireland and across the globe are organised to increase mobility (maximising physical movement) (Chapman, 2019[7]). The focus on mobility is linked to a deeply ingrained idea that people are better off when they can travel as fast, as far and as flexibly as possible (OECD, 2021[4]) (Box 2.1).

Box 2.1. Mobility and GDP: a similar mindset

The focus on mobility at the transport system level is similar to the focus on GDP at the economy level. In both cases, means and ends are conflated, and the conflation has locked countries into unsustainable systems.

Measuring well-being using GDP can be misleading: for example, GDP can correlate negatively with well-being dimensions such as air quality (OECD, 2011[8]). Treating GDP as an indicator of social progress sustains a growth-oriented system, leading to energy demand increase in the upcoming decades (Hickel et al., 2021[9]).

Furthermore, linking well-being to high demand and seeing high demand as inevitable has hindered policy makers from envisioning an increase in well-being through low-demand systems. It has also led to an under-appreciation of the potential of so-called low-demand scenarios (Grubler et al., 2018[10]). Yet, as the Intergovernmental Panel on Climate Change (IPCC) points out, rapid growth in demand for energy and materials reduces the chances of reaching stringent emissions reduction targets (IPCC, 2018[11]), making current high-demand systems ill-adapted to meeting international climate goals (and to promoting well-being).

According to IPCC authors, demand-side mitigation policies, encompassing "changes in infrastructure use, end-use technology adoption, and socio-cultural and behavioural change", could unleash emission reductions of 40 to 70% in end-use sector, compared to baseline scenarios (IPCC, 2018[12]).

Evidence suggests that mobility is a misleading proxy for well-being, as high or growing mobility can reflect deteriorating, rather than improved, access and well-being (Ferreira, Beukers and Brömmelstroet, 2012[13]; ITF, 2019[6]). For example, mobility increases when everyday services are further away (e.g. when local grocery stores close down) and people need to drive further to meet their daily needs. In this case, well-being does not improve and can even deteriorate. High mobility (e.g. traffic volumes) can also be associated with well-being reductions via air pollution, road injuries and lack of physical activity (TfL, 2017[14]), and can conceal widening accessibility gaps between population groups: when private cars are the only or most convenient way to travel to places of interest, total traffic volumes are high but less affluent population groups may increasingly have less access to opportunities (Mattioli, 2013[15]).

The idea of mobility as a good proxy for well-being leads to policy action that:

- ignores the need for proximity and disregards the trade-offs between using space for transport and other functions
- maximises time savings and speed
- sees congestion as the problem to be solved and road capacity expansion as the solution
- closes the door to actions that could increase accessibility and reduce emissions via mobility reductions.

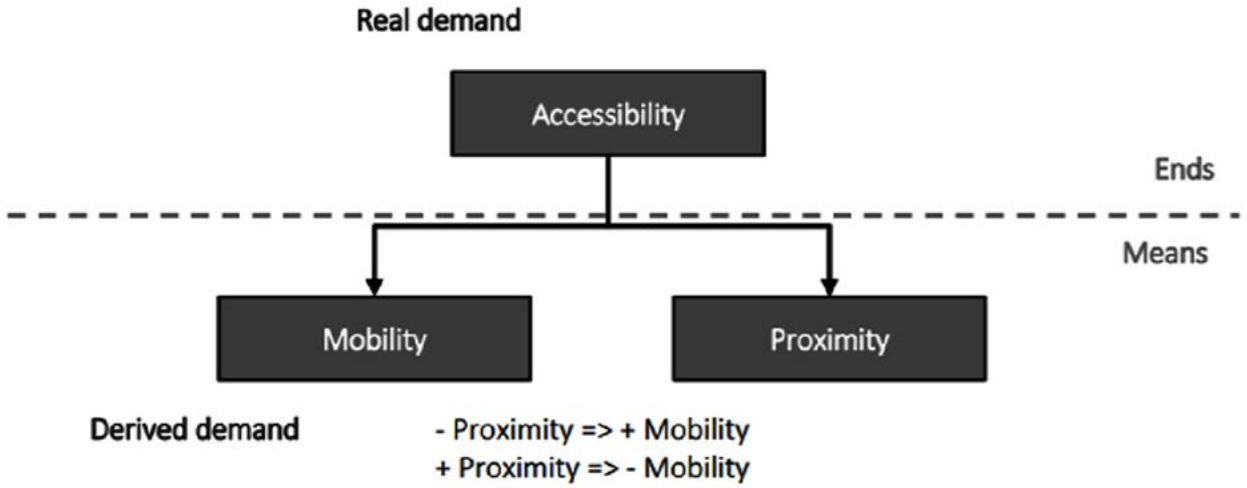
A focus on mobility has diverted policy makers' attention away from land use considerations that could bring daily services closer to people (ITF, 2017[16]). This has in turn segmented the planning and responsibilities of transport and land-use/housing authorities, often minimising (if at all considering) the role that land-use and housing decisions play in the performance of transport systems (including in terms of GHG emissions). The result is mobility-intensive and proximity-poor systems in which space-intensive and "fast" transport modes (e.g. private cars) are privileged.

In Dublin, cycling was ubiquitous until the 1950s (Hanna, 2015[17]). However, as cars became more affordable and a symbol of middle-class success and modernity, the city was remade for the motor age, and cyclists started to disappear from statistics, maps and urban plans (Hanna, 2015[17]). Traffic

regulations, street design and the construction of inner-city motorways shifted responsibility for safety away from motorists. Instead, non-motorists were to remain in their allocated street sections, make themselves visible to motorists, and not slow car traffic down (Hanna, 2015[17]). This is a tendency observed in other parts of the world. Te Brömmestroet (2020[18]) finds that efficiency became the new frame for mobility, replacing the earlier social construct of the street as a place to socialise, play and move at human speed.

Proximity is essential for creating accessibility. As Figure 2.2 illustrates, accessibility is the interaction of mobility and proximity (Silva and Larsson, 2018[5]). When attention is placed on mobility (one of the means), the importance of creating proximity is automatically ignored. Contrarily, shifting attention towards accessibility (the ends) allows policy makers to see the importance of creating proximity of people to places. It also allows to see that creating proximity is challenging in systems in which a majority of the space is allocated to creating mobility, especially via space-intensive modes such as private cars (Crozet, 2020[19]), and where land-use decisions have separated uses (e.g. residential from commercial).

Figure 2.2. Accessibility, mobility and proximity



Source: (Silva and Larsson, 2018[5]), https://doi.org/10.1787/2223439X.

When mobility is the goal, metrics such as vehicle-kilometres or number of trips are the measures of "success" (ITF, 2017[16]; Silva and Larsson, 2018[5]; OECD, 2019[20]) and infrastructure official's role is to cater for increasing travel (ITF, 2019[6]). Mobility indicators narrow down the problem to maximising physical movement, and in this way, they fail to provide accurate information about changes in access to goods, services, activities and destinations (ITF, 2017[16]). The importance of nonmotorised modes, land-use decisions, mobility substitutes (e.g. home office, delivery services), etc. are not reflected. Vehicle-kilometres, or other indicators focused on traffic, disregard or at least reduce the value of public transport, as these indicators do not account for public transport's high load factors (passengers per kilometre travelled). Indicators such as passenger-kilometres capture the value of public transport in a better way. Nonetheless, passenger-kilometres poorly reflect the value of active modes and many shared services (e.g. micro-mobility and e-bikes), as these are not high-occupancy services. Measuring the number of trips can better reflect, to a certain extent, the value of non-motorised modes; however, measuring the number of trips still gets policy making into a "more [mobility] is better" logic as, for instance, the fact that people could be better off if they could meet several needs in one single trip is ignored (ITF, 2017[16]; Silva and Larsson, 2018[5]; OECD, 2019[20]).

The Common Appraisal Framework (CAF) for Transport, which guides transport investment projects in Ireland, is an example of a mobility-focused framework. While qualitative aspects such as social inclusion and environmental sustainability have been included in the latest update (since 2016), the framework still

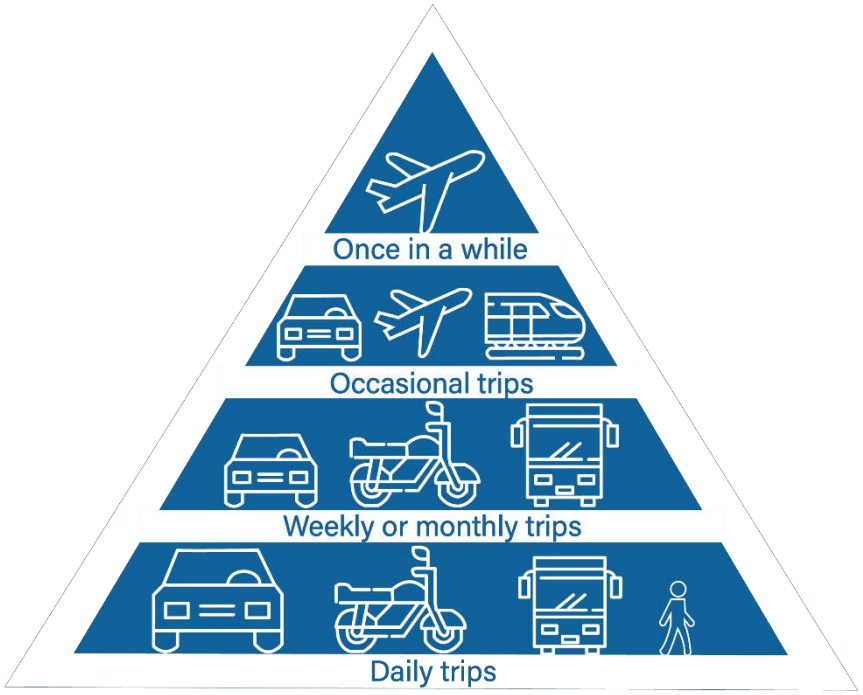
focuses on transport investment that shortens travel times and boosts economic growth (Department of Transport, 2021[21]). According to the Department of Transport, the Common Assessment Framework (CAF) is currently undergoing a substantial update. As part of this update, the new draft Transport Appraisal Framework (TAF) is planned to be published later this year. One of the issues which the TAF is attempting to address is the centrality of the value of time in the appraisal process. The new TAF will give a greater weight and consideration to environmental benefits and costs and other issues related to the strategic alignment of projects. In the draft update of the CAF, the weighting of multi-criteria analysis results is still considered optional, although the text noting that the economic criterion should be given a higher weight has been removed. The new SMP also includes, as part of its action list, the development and update of appraisal guidance and review processes based on the most relevant and applicable evidence (Department of Transport, 2022[22]), and the Department of Public Expenditure and Reform is working with the OECD regarding this.

The conflation of increased mobility with increased well-being also leads to the notion that travel demand (especially car-based) needs to keep growing, or at least cannot decrease. With this mindset (coupled with the emphasis on travel time savings), a large part of policy makers' role is to solve the problem of traffic congestion in order to shorten travel times for motorists. Since congestion results from the mismatch between the number of vehicles on the roads and the roads' capacity to handle them, if the number of vehicles cannot decrease, then road capacity needs to increase. As shown in Chapter 3, the number of vehicles is not a given, nor does the expansion of road capacity solve congestion.

Organised around mobility, it is not surprising that the current transport system in Ireland has led to high average annual distances travelled by car and low performance in international comparisons for sustainable accessibility. Between 2010 and 2019, Irish people travelled 16,400 kilometres per year on average, above the EU average of 11,300 kilometres (Odyssee-Mure, 2022[23]). Dublin ranks 108th out of 121 European cities in terms of the number of places of interest (e.g. schools, hospitals, shops and green spaces) accessible within 15 minutes' walk (ITF, 2022[24]). Recent work by the International Transport Forum (ITF) finds that more than 10% of the city's population lives in neighbourhoods where walking is difficult due to poor planning, lack of dedicated paths and high traffic volumes (ITF, 2019[25]). Public transport coverage is also poor in the Dublin area: the public transport network covers less than one quarter (23%) of the commuting zone (ITF, 2019[25]). Efforts are, however, on-going (e.g. via the initiative BusConnects, Metrolink) to increase network coverage (see chapter 3).

The pyramid in Figure 2.3 illustrates the behaviour that mobility-centred systems encourage in terms of the modal share chosen. The figure uses the food pyramid analogy. Transport systems structured around the goal of mobility foster an "unhealthy" transport diet: most people use (or would rather use if they could afford them) motorised vehicles for the majority of their trips – the sugar and the fat in the diet analogy. People make this "unhealthy" choice, represented at the bottom of the pyramid, because cars are the most convenient (and sometimes only) transport option.

Figure 2.3. The patterns of behaviour mobility-centred systems encourage



Source: (OECD, 2021[4]), 10.1787/0a20f779-en

The patterns of behaviour fostered by mobility-centred transport systems are problematic from a well-being and environmental perspective. High traffic volumes are associated with high road fatalities, levels of air pollution and emissions (ITF, 2019[6]), while growing car use increases the demand for energy and materials. These patterns of behaviour reduce the likelihood of meeting international climate goals (IPCC, 2018[11]) and Irish GHG reduction targets.

2.2. Transport systems with sustainable accessibility as their goal

Transport policy literature suggests that transport systems' contribution to human well-being ought to lie in the provision of accessibility, meaning easy access to opportunities and places of interest (e.g. jobs, consumption, leisure or health services) (OECD, 2019[20]; ITF, 2017[16]). Transport systems whose goal is sustainable accessibility, meaning the provision of access via sustainable transport modes (active modes and micro-mobility, public transport and other shared services), can ensure this provision over time and thus support present and future well-being. The results of the public consultations informing the Sligo Vision for Well-being confirms that people consider the provision of access to schools, friends' places and services via sustainable modes as the main contribution that the transport sector can make to improve their lives (Sligo Public Participation Network, 2021[26]).

The redefinition of transport system goals in the direction of sustainable accessibility could lead to policy action that:

- acknowledges the importance of creating proximity (see Figure 2.2)
- values space-efficient transport modes and focuses on facilitating access to places via such modes
- sees high traffic volume as the problem to solve and road space reallocation as the solution (see more in Chapter 3)

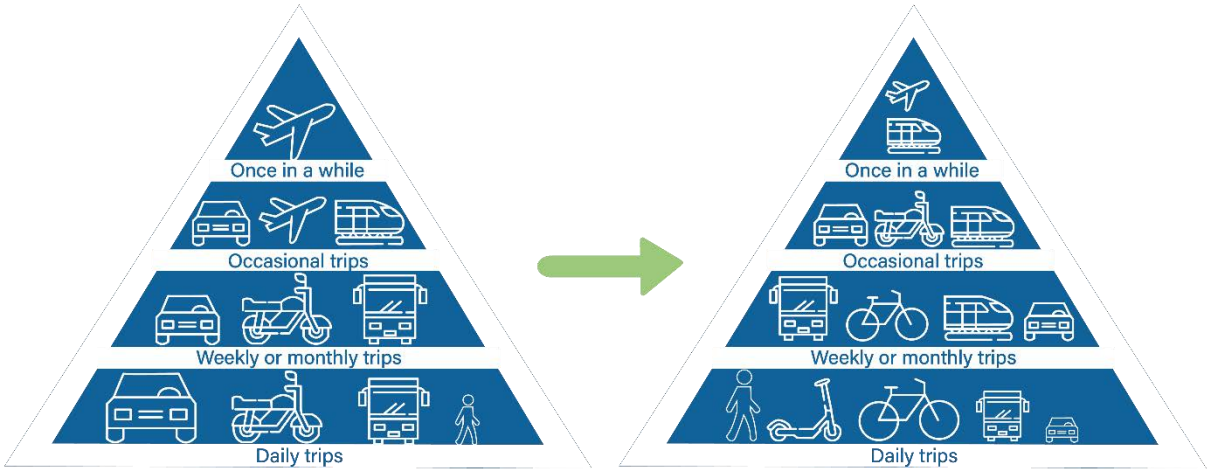
- opens the door to actions that could increase accessibility and reduce emissions via mobility reductions.

With a focus on sustainable accessibility, land use and mixed-use development considerations would become central in transport policy-making; bringing decisions from transport and land-use/housing authorities together on a systematic basis. Policy decisions would focus, not only on creating good transport links via sustainable modes, but also on shortening the distances between people and places of interest.

Measurement frameworks supporting policy decisions in favour of sustainable accessibility[3] would also become key. Chapter 4 discusses accessibility indicators in detail.

Accessibility-oriented transport systems can foster sustainable patterns of behaviour and help Ireland meet its reduction targets. Figure 2.4 builds on Figure 2.3 and illustrates patterns of behaviour triggered by accessibility-oriented systems. Irish transport systems structured around the goal of sustainable accessibility could encourage a "healthy" transport diet: most people could use active and shared modes for the majority of the trips – the vegetables, in the diet analogy. Such a "diet" would be possible if policies focused on creating proximity between people and places, and the allocation of public space and investment for making active and shared modes the most convenient choices.

Figure 2.4. The patterns of behaviour in "healthy" transport systems



Note: The size of the icons represents the frequency of the means of transportation used per type of trip.
Source: (OECD, 2021[4]), 10.1787/0a20f779-en

Several policy documents and decision-making processes are taking steps in the right direction. For example, the Irish well-being framework includes access to services and the environment as key components of better living (Department of the Taoiseach, 2021[27]). The new Sustainable Mobility Policy also reflects an effort to move away from a car-centric mentality. Sustainable mobility is defined by the SMP as "connecting people and places" (Department of Transport, 2022[22]), appropriately shifting attention towards access. At the same time, however, the focus on how to deliver such access is kept on mobility, even if via sustainable modes. The document states that the support of: [s]afe, accessible, comfortable and affordable journeys to and from home, work, education, shops and leisure; [t]ravel by cleaner and greener public transport; [and a] shift away from the private car to greater use of active travel and public transport" (Department of Transport, 2022[22]) are the main ways in which it will connect people and places. Attention is therefore mostly directed throughout the document to the transport links between people and places rather than to the location and characteristics of places and the need to create proximity (land use).

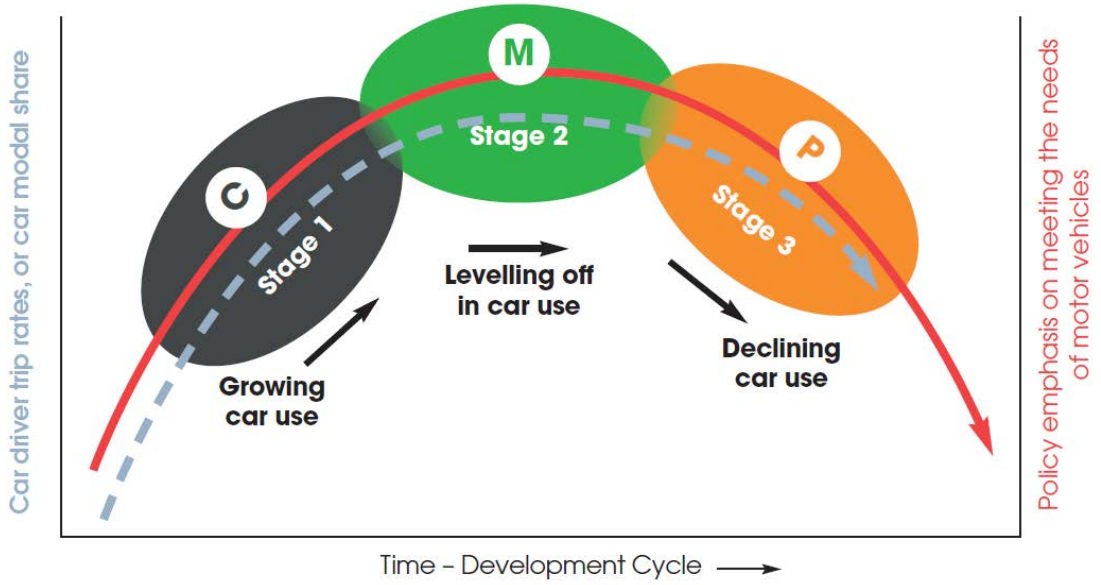
To some extent, this is unsurprising, as the SMP is a document produced by the DoT, which is in charge of the links between places rather than their location and characteristics. However, a focus on mobility may hinder thinking about how the planning of such links can contribute to place-making. Overall, an important limitation is precisely that the DoT (via actions focused on mobility) is responsible for delivering results that are also highly dependent on the creation of proximity (land-use decisions)[4]. This difficulty is partly addressed in the document, which lists as one of its ten goals the integration of transport and land use via the promotion of compact growth and transit-oriented development and calls for involving the authorities responsible for housing and land use in the delivery of this goal.[5] The document also discusses the importance of encouraging the "15-minute city" model (Department of Transport, 2022[22])[6].

Shifting towards a focus on sustainable accessibility is recommended as a next step. This would call for defining sustainable accessibility as the goal (and responsibility) shared between transport and land-use/housing authorities. This could systemically break down "silo planning", bring transport and housing/land-use policy closer together; increasing certainty and visibility on the way in which land-use/housing decisions complement and are coherent with actions in the SMP. The inclusion and increased use of accessibility indicators by authorities from both sectors (which are not present in the current SMP) would allow to establish shared accessibility goals and monitor their delivery. As noted by the OECD (2021[4]), accessibility-based planning and accessibility indicators are indispensable for "15-minute city" strategies, among other things.

The newly established SMP leadership group (which brings together the planning and transport departments) could create an opportunity to move forward in this direction.

Changing focus from sustainable mobility to sustainable accessibility is in line with findings from the (EU-funded) Congestion Reduction in Europe: Advancing Transport Efficiency (CREATE) project (Jones, 2018[28]). The project analyses how visions of cities (or regions) have evolved in their attempt to shift away from car dependency. The project finds that visions follow an "evolutionary process": with the car-based city as the starting point, city visions evolve towards the sustainable mobility city, and the city of places. It emphasises that a focus on sustainable mobility (and thus, on travel, even when the emphasis is on sustainable travel) can, at best, enable the stabilisation of car use levels. Redefining the goal to sustainable accessibility and transitioning to a vision of city of places (i.e. emphasising not only links but places such as the public sphere and street activities) has the potential to trigger behavioural change at scale and reduce car use while improving people's well-being (see Figure 2.5).

Figure 2.5. U-shaped' trajectory of car use intensity linked to the different stages



Note: The grey oval represents the car-oriented city, the green oval the sustainable-mobility city and the orange oval the city of places
Source: (Jones, 2018[28]), 10.13140/RG.2.2.16026.18886.

2.3. Insights from Irish stakeholders: are sustainable transport systems possible in Ireland?

The previous sections discussed the need to redefine the goal of the Irish transport system towards sustainable accessibility, and described the patterns of behaviour such change could foster: people choose to walk, cycle or use shared transport for the bulk of their trips (Figure 2.4). While such change is perceived as possible in urban settings, and particularly in inner cities, it is often perceived as "utopian" in peri-urban and rural areas.

In April 2022, the OECD organised a workshop with Irish stakeholders in Dublin, where participants imagined future transport systems for the different selected territories (Dublin, Kildare, Cork and Sligo). Participants envisioned and designed transport systems guided by the goal of sustainable accessibility, enabling people to meet their needs without private cars (Box 2.2).

Box 2.2. Envisioning better transport systems: workshop exercise

Four focus areas were selected by the Advisory Council for Climate Change to ensure that insights from this project were relevant for the whole of Ireland. These include Dublin, Cork, Kildare and Sligo. Based on the CSO (2019[29]) Ireland categorisation[1], Dublin and Cork are cities with adjacent areas including satellite urban towns and rural areas with high urban influence. Sligo is an independent urban town; and Kildare is a town whose rural hinterlands have a high urban influence.

Each breakout group in the workshop focused on one of the territories: two groups were dedicated to Dublin, one focusing on Dublin city and the other on the Dublin metropolitan area. The groups included participants from local and national government, universities, and non-governmental organisations.

Mental models or visions relative to car use can often prevent policy makers from imagining and implementing transformative policies, to move the country away from car dependency. To avoid this, the exercise's starting point was a situation in which private car ownership[2] had become culturally unpopular or even unacceptable. Participants were invited to reflect on and discuss the following:

- Imagine a typical street or road in your area in 2050. What does the street look like? Who do you see and what are they doing?
- Imagine a broader picture ("helicopter view") of the area in 2050. Where are homes and destinations located? What connects them? What is there more or less of?
- Think about who (e.g. children going to school, the elderly, delivery workers) could already be using each transport mode more often by 2025 and what would need to happen (e.g. easy to implement changes in infrastructure, increases in public transport services) to enable this.

1. According to CSO Ireland (2019[29]), urban areas can be broken into three categories: "cities", "satellite urban towns" and "independent urban towns". Rural areas are broken into three categories: "rural areas with high urban influence", "rural areas with moderate urban influence" and "highly rural / remote areas".
2. Shared cars were still culturally acceptable.

While the design of transport systems envisioned varied according to each area's characteristics, in each case, participants were able to imagine car-independent systems and actions to transition towards them. Many of these actions became conceivable thanks to the vision shift towards sustainable accessibility, and to the imagined (but potentially realistic) condition that transport systems were no longer organised around car use.

Similar ideas emerged in the breakout groups, despite the different characteristics of the territories analysed. All groups were able to imagine a transport system that performed better than the current one, both in terms of well-being and emissions.

The first idea that emerged was that streets would be friendlier and less dominated by cars. Streets and roads would have multiple functions, and some streets might not have mobility as their main function. The Sligo group came up with the slogan "shared spaces and friendly faces", expressing the importance of human connection for well-being, which scientific literature supports (see, for example, (Okabe-Miyamoto and Lyubomirsky, 2021[30])). The Dublin group saw more people living in central areas, where houses are smaller. To compensate for that, public spaces in the city would become available for activities once carried out in people's own gardens, such as barbecues, safe playgrounds for children to meet and play, and places for older people to rest.

The second shared idea across breakout groups concerned the synergies that transport systems could trigger in terms of social, economic and environmental sustainability when no longer structured around cars. For example, the Dublin group reallocated some of the space currently used by cars to local markets,

which could enable local and healthy diets, support local farmers' businesses,[7] and foster neighbours' connections. All groups imagined the streets to be greener than today, which would also make them more resilient during heat waves (UNDP, 2022[31]).

Finally, all groups highlighted the importance of planning from a proximity perspective. The groups identified the need to reverse urban sprawl via increased density of people and services in inner cities or towns.[8] During the workshops and the OECD team visits to the different territories, participants identified the re-employment of unused buildings and premises in central areas as a means to increase proximity cost-effectively (see section 3.2.2.3 on why this is not already being done). Though not yet dominant, the importance of re-employing unused buildings has started to emerge in Irish policy-making. For example, the Town Centre First policy aims to increase town centres attractiveness with the re-employment of vacant properties as a primary strategy (Dept of Rural and Community Development and Dept of Housing Local Government and Heritage, 2022[32]).

The main difference between the systems envisioned in larger urban areas and areas with more rural territories lay in their approaches to creating proximity and ensuring travel via sustainable modes. In larger urban areas, the envisioned design looked like dense networks of 15-minute neighbourhoods within which people could meet all their daily needs (e.g. access to food and services such as pharmacies). A public transport network offering radial and orbital routes coupled to mobility hubs (with shared bikes, scooters and cars) would ensure connectivity across and within these neighbourhoods. Participants described rural areas as networks of towns and villages connected by public transport and separated by green areas. A densely inhabited central town would concentrate services (supermarkets, health services) and be designed following the 15-minute town framework. The satellite towns or villages would also provide daily services, but might not have all of the necessary health or education facilities. Regular public transport and on-demand shared services would connect the villages both to the central town and to each other. The group focusing on Sligo imagined that automated shared vehicles could ensure a constant flow of people between the towns and villages in the area. While this might be possible, attention to employment will be needed when deciding whether automated or non-automated vehicles should be the best option. As in urban areas, mobility hubs would offer a variety of transport services.

References

Chapman, R. (2019), "Managing the Transition to a Climate-Neutral Economy in Cities and Regions", Background paper for an OECD/EC Workshop on 17 May 2019 within the workshop series "Managing environmental and energy transitions for regions and cities", Paris, https://www.oecd.org/cfe/regionaldevelopment/Chapman-2019-Managing-Transition-Regions-Cities.pdf?_ga=2.16879098.23491596.1655119569-1067012004.1649249692 (accessed on 13 June 2022). [7]

Crozet, Y. (2020), "Cars and Space Consumption: Rethinking the Regulation of Urban Mobility", *International Transport Forum Discussion Papers*, No. 2020/13, OECD Publishing, Paris, https://doi.org/10.1787/8abaa384-en. [19]

CSO Ireland (2019), *Urban and Rural Life in Ireland, 2019*, CSO, https://www.cso.ie/en/releasesandpublications/ep/p-urli/urbanandrurallifeinireland2019/introduction/ (accessed on 20 September 2022). [29]

Department of the Taoiseach (2021), *A Well-being Framework for Ireland*, Department of the Taoiseach, https://www.gov.ie/en/campaigns/1fb9b-a-well-being-framework-for-ireland-join-the-conversation/ (accessed on 10 June 2022). [27]

Department of Transport (2022), "Interview with the Climate Engagement & Governance Division, Department of Transport". [37]

Department of Transport (2022), *National Sustainable Mobility Policy*, Department of Transport, https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/ (accessed on 13 June 2022). [22]

Department of Transport (2021), *Common Appraisal Framework for Transport Projects and Programmes*, https://www.gov.ie/en/organisation-information/800ea3-common-appraisal-framework/ (accessed on 13 June 2022). [21]

Dept of Rural and Community Development and Dept of Housing Local Government and Heritage (2022), *Town Centre First Policy*, https://www.gov.ie/en/publication/473d3-town-centre-first-policy/ (accessed on 13 June 2022). [32]

Ewing, R. et al. (2017), "Testing Newman and Kenworthy's Theory of Density and Automobile Dependence", *https://doi.org/10.1177/0739456X16688767*, Vol. 38/2, pp. 167-182, https://doi.org/10.1177/0739456X16688767. [34]

Ferreira, A., E. Beukers and M. Brömmelstroet (2012), "Accessibility is gold, mobility is not: A proposal for the improvement of Dutch transport-related cost-benefit analysis", *Environment and Planning B: Planning and Design*, Vol. 39/4, pp. 683-697, https://doi.org/10.1068/B38073. [13]

Grubler, A. et al. (2018), "A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies", *Nature Energy*, Vol. 3/6, pp. 515-527, https://doi.org/10.1038/s41560-018-0172-6. [10]

Hanna, E. (2015), *Seeing like a cyclist: visibility and mobility in modern Dublin, c. 1930–1980*, Cambridge University Press, https://www-cambridge-org.proxy.ub.umu.se/core/journals/urban-history/article/seeing-like-a-cyclist-visibility-and-mobility-in-modern-dublin-c-19301980/ADD1182926E7F64D84D6C0083B8D0B96. [17]

Hickel, J. et al. (2021), "Urgent need for post-growth climate mitigation scenarios", *Nature Energy*, Vol. 6/8, pp. 766-768, https://doi.org/10.1038/s41560-021-00884-9. [9]

IPCC (2018), ": Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty". [12]

IPCC (2018), *Global Warming of 1.5 ºC*, Intergovernmental Panel on Climate Change, Geneva, https://www.ipcc.ch/sr15/ (accessed on 13 June 2022). [11]

IrishCycle (2022), "Minister Ryan calls for councils to put forward 'Pathfinder' transport projects to "demonstrate a pathway to achieving climate goals"", https://irishcycle.com/2022/08/03/minister-ryan-calls-for-councils-to-put-forward-pathfinder-transport-projects-to-demonstrate-a-pathway-to-achieving-climate-goals/ (accessed on 2 September 2022). [36]

ITF (2022), *How accessible is your city?*, https://www.itf-oecd.org/urban-access-framework (accessed on 21 June 2022). [24]

ITF (2019), "Benchmarking Accessibility in Cities", *International Transport Forum Policy Papers*, No. 68, OECD Publishing, Paris, https://www.itf-oecd.org/benchmarking-accessibility-cities (accessed on 10 June 2022). [25]

ITF (2019), "Improving transport planning and investment through the use of accessibility indicators", *International Transport Forum Policy Papers,*, No. 66, OECD Publishing, Paris, https://doi.org/10.1787/24108871 (accessed on 10 June 2022). [6]

ITF (2017), *Income Inequality, Social Inclusion and Mobility*, ITF Roundtable Reports, No. 164, OECD Publishing, Paris, https://doi.org/10.1787/g2g7ae77-en. [16]

Jones, P. (2018), *Urban Mobility: Preparing for the Future, Learning from the Past*, https://doi.org/10.13140/RG.2.2.16026.18886 (accessed on 16 March 2021). [28]

Mattioli, G. (2013), "Car Dependence, Sustainability and the Transport Policy Stalemate", *The International Journal of Sustainability Policy and Practice*, Vol. 8/1, pp. 45-57, https://doi.org/10.18848/2325-1166/CGP/V08I01/55416. [15]

Meadows, D. (2008), *Thinking in Systems*, https://www.chelseagreen.com/product/thinking-in-systems/ (accessed on 8 March 2021). [1]

Odyssee-Mure (2022), *Change in distance travelled by car*, Sectoral profile - Transport, https://www.odyssee-mure.eu/publications/efficiency-by-sector/transport/distance-travelled-by-car.html (accessed on 21 June 2022). [23]

OECD (2021), *Transport Strategies for Net-Zero Systems by Design*, OECD Publishing, Paris, https://doi.org/10.1787/0a20f779-en (accessed on 10 June 2022). [4]

OECD (2019), *Accelerating Climate Action: Refocusing Policies through a Well-being Lens*, OECD Publishing, Paris, https://doi.org/10.1787/2f4c8c9a-en. [20]

OECD (2018), *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*, OECD Publishing, Paris, https://doi.org/10.1787/9789264189881-en. [35]

OECD (2011), *How's Life?: Measuring Well-being*, OECD Publishing, Paris, https://doi.org/10.1787/9789264121164-en. [8]

Okabe-Miyamoto, K. and S. Lyubomirsky (2021), "Social connection and well-being during COVID-19", in Helliwell, J. et al. (eds.), *World Happiness Report 2021*, Sustainable Development Solutions Network, New York, https://happiness-report.s3.amazonaws.com/2021/WHR+21_Ch6.pdf (accessed on 28 June 2022). [30]

Rubiera-Morollón, F. and R. Garrido-Yserte (2020), "Recent Literature about Urban Sprawl: A Renewed Relevance of the Phenomenon from the Perspective of Environmental Sustainability", *Sustainability 2020, Vol. 12, Page 6551*, Vol. 12/16, p. 6551, https://doi.org/10.3390/SU12166551. [33]

Saltmarshe, E. (2018), *Using Story to Change Systems*, https://ssir.org/articles/entry/using_story_to_change_systems (accessed on 19 March 2021). [3]

Silva, C. and A. Larsson (2018), "Challenges for Accessibility Planning and Research in the Context of Sustainable Mobility"*, International Transport Forum Discussion Papers*, No. No. 2018/07, OECD Publishing, Paris, https://doi.org/10.1787/2223439X (accessed on 10 June 2022). [5]

Sligo Public Participation Network (2021), *Vision for Community Wellbeing: Master Consultation Inputs Index*, Sligo PPN, https://www.sligoppn.com/wp-content/uploads/2021/11/Sligo-PPN-Master-consultation-Inputs-Index.pdf (accessed on 10 June 2022). [26]

Systems Innovation (2021), *Reflexive Thinking Canvas*, https://www.systemsinnovation.io/post/reflexive-thinking-canvas (accessed on 25 March 2021). [2]

te Brömmelstroet, M. (2020), "Framing systemic traffic violence: Media coverage of Dutch traffic crashes", *Transportation Research Interdisciplinary Perspectives*, Vol. 5, p. 100109, https://doi.org/10.1016/J.TRIP.2020.100109. [18]

TfL (2017), *Healthy Streets for London*, Transport for London, London, https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/healthy-streets (accessed on 13 June 2022). [14]

UNDP (2022), *As heatwaves blanket Europe, cities turn to nature for solutions*, https://www.unep.org/news-and-stories/story/heatwaves-blanket-europe-cities-turn-nature-solutions (accessed on 3 August 2022). [31]

Notes

[1] The terms “mental models”, “mindsets” and “paradigms” are used interchangeably throughout the report.

[2] As discussed by OECD (2021[4]) and ITF (2019[6]), a number of indicators are used to measure mobility. These, reflect either the movement of vehicles (e.g. vehicle-kilometres) or of people (passenger-kilometres, trips). Such indicators narrow down the problem to maximising physical movement, and in this way, they fail to provide

[3] As discussed by OECD (2021[4]) and ITF (2019[6]), accessibility is more complex to measure than mobility. This is because it depends on both mobility and proximity, as well as on various factors such as land use and transport availability. A number of indicators exist, however. Contour-based accessibility measures are the most common (and simplest) ones. They measure: a) the number of opportunities/services/facilities (e.g. jobs, green spaces, transport stations) which can be reached within a given travel time, distance or cost; or b) the time/cost (average) required to gain access to a fixed number of opportunities/services/facilities from different locations. To measure sustainable accessibility, this type of indicator should be calculated for different modes of transport and for different locations and population groups; and emphasis should be given to performance in terms of accessibility by sustainable modes.

[4] This is not a unique problem to Ireland. As said before, the mobility-centric mind-set, by disregarding the importance of proximity has also tended to break transport and land-use authorities into administrative siloes and assigned the responsibility for transport performance to transport authorities solely.

[5]The pursuit of this goal will be supported by a working group jointly chaired by the Department of Transport and the Department of Housing (Department of Transport, 2022[37]).

[6] While the document does not propose any specific actions in support of this goal, efforts in this direction are ongoing as part of the Pathfinder project (IrishCycle, 2022[36]).

[7] For example, by reducing the need for intermediaries and enabling farmers to make profits while not pushing prices up.

[8] While this is important, the literature suggests that increasing density is not sufficient to reverse urban sprawl, and shows that densification has coevolved with urban sprawl in many countries. See OECD (2018[35]), Rubiera-Morollón and Garrido-Yserte (2020[33]) and Ewing et al. (2017[34]).

3 Understand

This chapter explores the systems dynamics and mental models underlying car dependency. It also assesses the potential of current and planned Irish policies to shift away from car dependency and transition towards sustainable transport systems. The assessment of Irish policies builds on systemic tools (causal loop diagrams, stock and flow analyses, and the leverage points framework) and classifies policies according to their intent (reactive, anticipatory and transformative), and transformative potential (low, medium and high).

The previous chapter illustrated the importance of identifying the goal(s) a properly functioning system should be designed to deliver. It concluded that the transport system's current goal is to increase mobility, which leads to car-dependent systems. These systems perform poorly in terms of well-being, are environmentally unsustainable, and are difficult – if not impossible – to decarbonise in the needed timeframe. In contrast, transport policies and systems guided by sustainable accessibility with low mobility and low emissions can increase well-being. In these systems, most people would use active and shared modes for the bulk of their trips, and distances between people and places would be as short as possible.

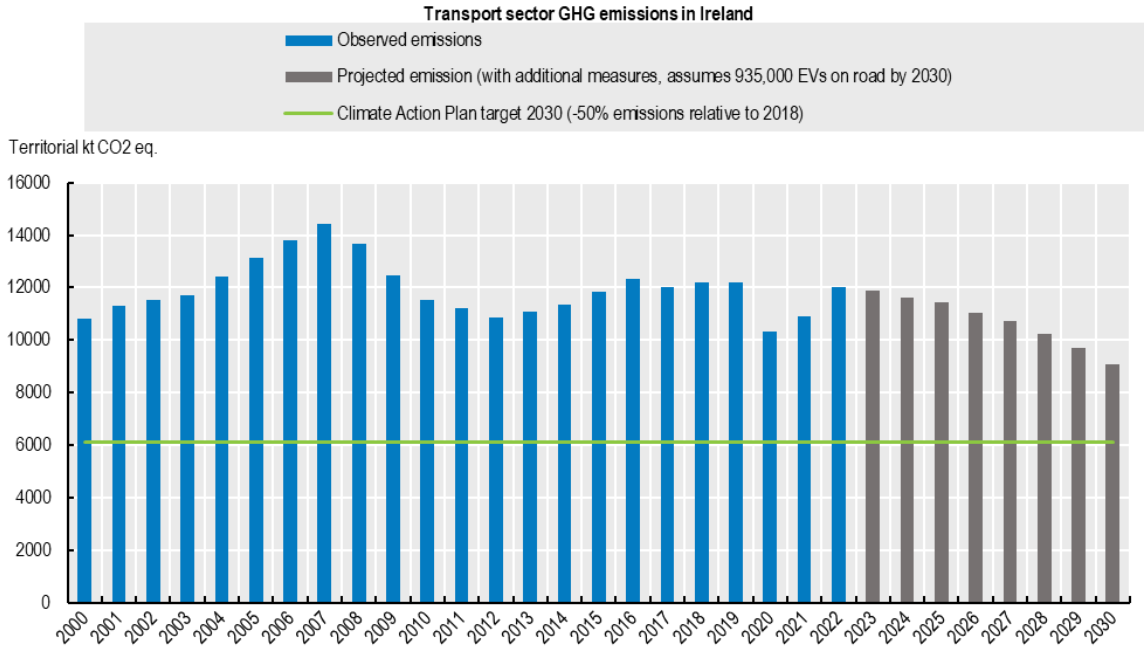
The first section of this chapter analyses the structure of the current transport system in Ireland. It describes three systems dynamics underlying growing car use and high emissions: induced car demand, urban sprawl, and the sustainable modes low-attractiveness trap. The second section assesses to what extent implemented and planned Irish policies have the intent, and the potential, to reverse these dynamics and help Ireland transition towards more sustainable systems.

3.1. What are the key dynamics underlying Ireland's car-dependent system?

The design of Ireland's transport system currently fosters car use and ownership by making the car the most convenient transport mode. Even though this might not have been policy makers' aim, the system leads to high traffic and emissions as well as other negative outcomes such as poor health and safety and unequal access to opportunities.

Passenger cars accounted for 54% of Ireland's road transport emissions in 2020. Partly driven by the growing car use (and increased size of cars) described above, transport GHG emissions remain well above the Climate Action Plan target for 2030 (Department of the Taoiseach Ireland, 2021[1]) (green line in Figure 3.1). The Environmental Protection Agency estimates that a scenario incorporating planned measures, and even including additional measures (such as electrification beyond current targets), would still fall short of the target (Environmental Protection Agency Ireland, 2022[2]).

Figure 3.1. Transport sector GHG emissions in Ireland



Source: Adapted from (Environmental Protection Agency Ireland, 2022[2]), www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/.

This report finds that the increased traffic volumes and car use observed in Ireland are not inevitable consequences of “progress”, which transport and climate policies need to accommodate. They are the result of unsustainable system dynamics, which can be redesigned.

The choice to drive a car is not solely the result of individual preferences (i.e. exogenous to the system), as is often argued. It is determined largely by transport and urban systems organised around car driving, and in particular by the three unsustainable dynamics of “induced car demand”, “urban sprawl” and the “sustainable modes low-attractiveness trap”. These three dynamics produce growing car use, high emissions, and negative impacts on well-being.

The following subsections illustrate each of the three unsustainable dynamics via causal loop diagrams (CLDs). CLDs shed light on the system’s structure and feedback loops underlying the patterns of behaviours observed. See Box 3.1 for more information (Meadows, 2008[3]).

Box 3.1. An introduction to Causal Loop Diagrams (CLDs)

This report is based on one of the key insights from systems science: the idea that the structure of a system causes the patterns of behaviour observed (Sterman, 2000[4]; Meadows, 2008[3]; Systems Innovation, 2020[5]). By shedding light on the system's structure, CLDs can help policymakers identify where to intervene in the system to address the root causes of the problems that their policies are trying to solve.

CLDs are used throughout the report to illustrate the structure underlying car dependency and the negative outcomes related to it (e.g. high emission levels, unequal access to opportunities). CLDs may seem intimidating at a first glance, but they are in reality easy to understand.

A causal loop diagram (CLD) is a map representing a system's structure by its causal relationships. A CLD includes the following elements:

- The individual elements of the system, represented by text variables.
- Causal relationships between the variables, represented by links or arrows. When taken individually, and depending on the type of causal relationship, variables will vary in the same or in the opposite direction. In this report, a pink arrow indicates a causal relationship in which variables vary in the same direction, e.g. as the attractiveness of driving cars increases/decreases, so does the number of people that choose to drive cars. A blue arrow represents a causal relationship in which variables vary in the opposite direction: as congestion increases, the attractiveness of driving a car decreases.
- Delays, represented by two lines crossing the arrows. A delay indicates that it will take time for changes in one variable to cause changes in the other.
- Feedback loop labels, indicating whether a loop is reinforcing (R) or balancing (B).

Feedback loops are non-linear causal relationships. In linear causal relationships, a variable (the cause) affects a second variable (the effect), and the causal chain stops there. In non-linear causal relationships, often referred to as feedback loops, a variable affects a second variable, which in turn affects the first variable again: the variables feed into each other, leading to circular – rather than linear – causal chains (Meadows, 2008[3]).

Feedback loops can be reinforcing or balancing. In reinforcing feedback loops, the effect of the first variable alters the second, which feeds back to affect the first variable again, in the same direction (e.g. more eggs, more chickens, more eggs). In balancing feedback loops, variables affect each other in opposite directions (e.g. more foxes, less rabbits, less foxes). Reinforcing feedback loops lead to acceleration: when observed over time, systems dominated by reinforcing feedback loops produce exponential curves (positive or negative)[1]. Systems dominated by balancing feedback loops seek an equilibrium – that may be above or below the current state of the system – which is generally reached by exponential decay. More complex behaviours, e.g. oscillations, s-shaped growth and overshoots, are produced by the interactions between several feedback loops and time delays.

1 Note that systems dominated by positive feedback cannot last over long periods of time (i.e. they are necessarily unsustainable) as all systems are embedded within an environment which will, at a certain point, place limits on exponential growth (Systems Innovation, 2021[6]).

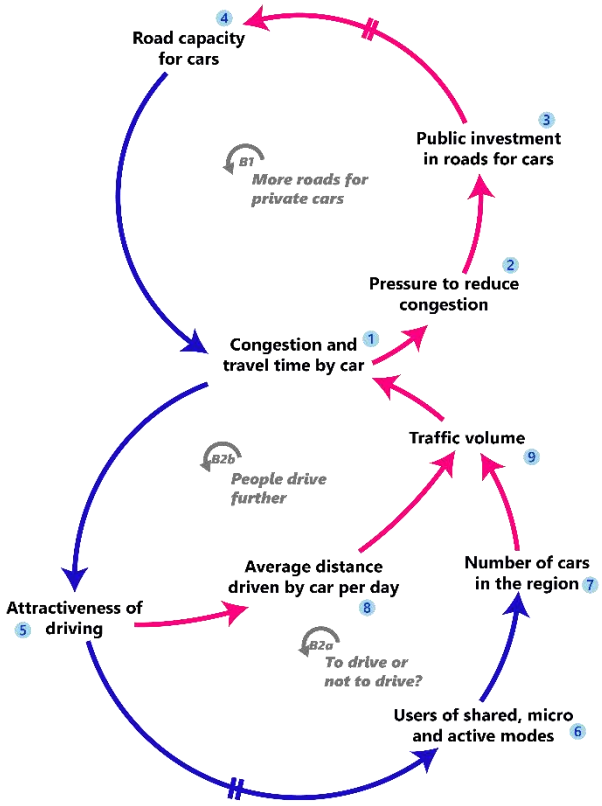
3.1.1. Induced car demand

Induced car demand refers to the way in which investment in road expansion intended to reduce congestion has the opposite effect (WSP and RAND Europe, 2018[7]).[1] Figure 3.2 illustrates the dynamic

of induced car demand. The more people choose to drive, the more congestion and travel time by car (1) increases. As congestion and travel time by car (1) increase, so does the pressure to reduce congestion (2) (no one likes to be stuck in traffic jams). The conventional policy response to this pressure has been to increase public investment in roads for cars (3). For example, in the late 20th century and beginning of the 21st, the road network in Ireland was expanded and upgraded by large public investment (Department of Transport Ireland, 2020[8]). Public investment in roads for cars (3) increases road capacity for cars (4), which, all else being equal, reduces congestion and travel time by car (1)[2].

However, as congestion and travel time by car are reduced (1), the attractiveness of driving (5) compared to other modes increases. This results in fewer users of shared, micro and active modes (6), a higher number of cars in the region (7), and longer average distance driven by car per day (8); all of which increases traffic volume (9), congestion and travel time by car (1). Note that this is the opposite effect that increased public investment in road for cars (3) intended to obtain. For example, Ireland's motorway M50 has been widened and upgraded at various times to accommodate increasing travel demand. Despite the upgrades, the motorway is constantly congested (Transport Infrastructure Ireland, 2017[9]).

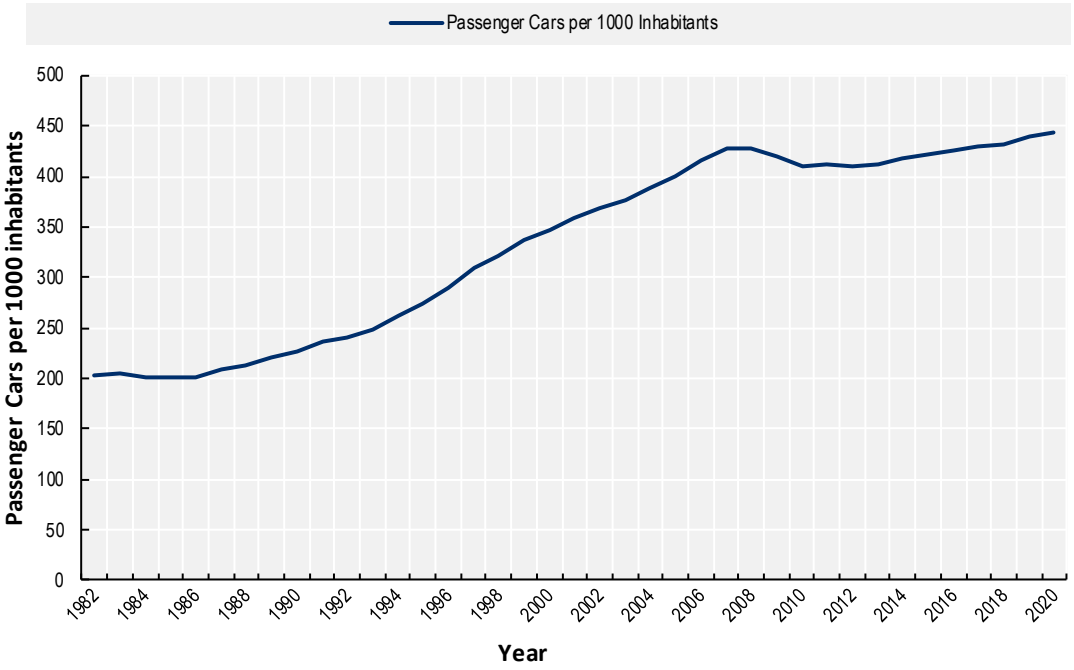
Figure 3.2. Systems dynamics underlying induced car demand



Note: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

While studies assessing the effect of induced car demand in Ireland could not be found during the literature review carried out for this report, data suggests that public investment in roads for cars has historically been favoured over other types of infrastructure in the country and that car ownership has grown over the same period. Between 2006 and 2019, the financial resources allocated to roads for cars more than doubled the resources allocated to infrastructure for public transport (OECD, 2021[10]) (see Section 3.2.2 for more). Between 1982 and 2020, the number of cars per 1000 inhabitants in Ireland increased from 203 to 444 passenger automobiles (Figure 3.3) and Transport Infrastructure Ireland (2019[11]) estimates that the total fleet of private vehicles would continue to rise 30% by 2030 (compared to 2016) (accessed from (Caulfield, Carroll and Ahern, 2020[12])). This trend is not unique to Ireland. For example, new passenger cars registered in the EU grew by almost 10% between 2015 and 2020 (Eurostat, 2022[13]).

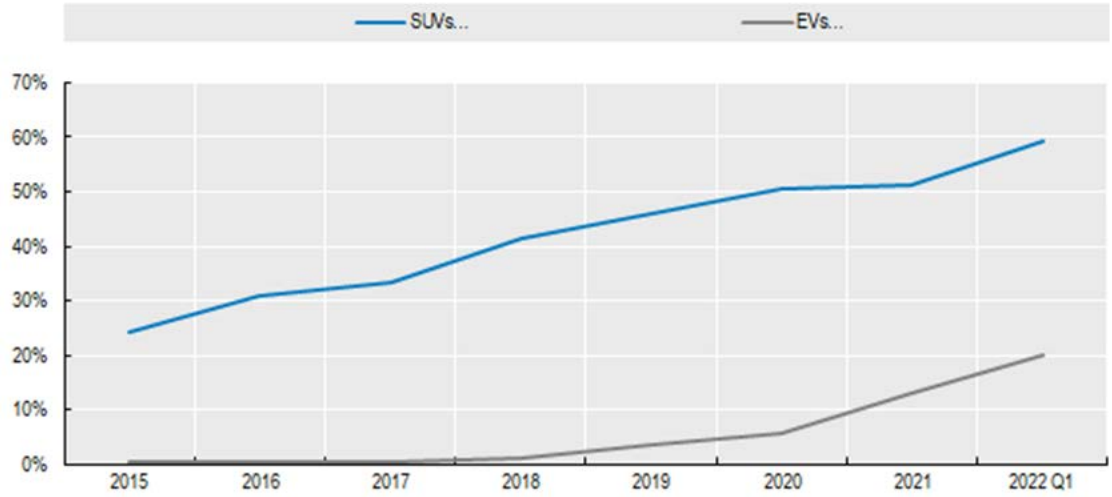
Figure 3.3. Passenger Cars per 1000 Inhabitants in Ireland



Source: Adapted from (CSO Ireland, 2022[14]), https://data.cso.ie/. Population figures (Eurostat, 2022[15]), https://ec.europa.eu/eurostat/web/population-demography/demography-population-stock-balance/database

A worrying trend towards larger cars (which require more energy) is also observed: sports utility vehicles (SUVs) accounted for half of new car registrations in Ireland in 2021, up from 24% in 2015 (Society of the Irish Motor Industry, 2022[16]).

Figure 3.4. Passenger SUV and EV registrations in Ireland (share of total registrations)



Note: The figures are not mutually exclusive (SUVs can be EVs) and refer to registration of new cars.
Source: Adapted from (Society of the Irish Motor Industry, 2022[16]), https://www.simi.ie/en/motorstats

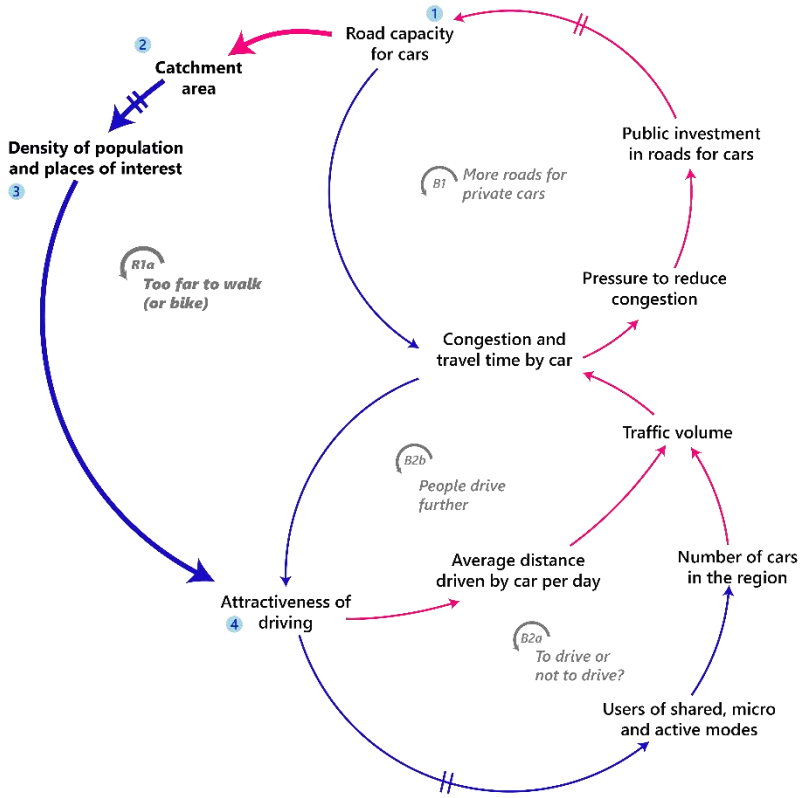
3.1.2. Urban sprawl

Urban sprawl occurs when people move away from the inner areas of a city or town. While the term is defined in multiple ways in literature, sprawl is often characterised as low-density development that is "discontinuous, strongly scattered and decentralised" (OECD, 2018[17]).

As road capacity for cars (1, in Figure 3.5) increases, so does the catchment area (2), that is, the region from which a city, service, or institution draws residents to use its services (Cambridge Dictionary, 2022[18]). Higher road capacity for cars (1) increases the catchment area (2) by increasing the number of places from which the inner area can be accessed within a reasonable time budget, such as 30 minutes by car.

As the catchment area (2) grows, previously inaccessible sites can be populated with suburbs. With more suburban development, often following a scattered and single-use development pattern, the density of the population and places of interest (3) declines. When densities of both kind decline, the attractiveness of driving (4) grows because distances increase (R1a in Figure 3.5).

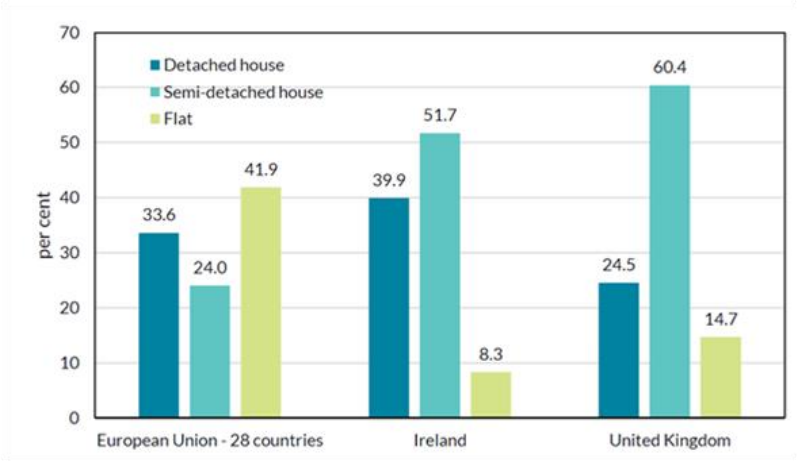
Figure 3.5. System dynamics underlying urban sprawl



Note: This diagram builds on Figure 3.2. The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

The construction of buildings and road infrastructure during periods of rapid economic growth, combined with a lack of spatial planning and poor public transport development, has contributed to Ireland's dispersed land use (Ahrens and Lyons, 2019[19]). Motorway access facilitates the development of new low-density areas (Ahrens and Lyons, 2019[19]), leading to developments in more scattered and remote locations compared to other European countries (Ahrens and Lyons, 2019[19]). For example, during 1991-2016, populations in outer urban and suburban areas, poorly connected by public transport (and thus car-dependent), grew while inner-city populations declined (Carroll and O'Sullivan, 2020[20]). As a result, Ireland's settlement patterns are highly and increasingly dispersed (Ahrens and Lyons, 2019[19]). Over 90% of the population – above the EU average – lives in detached or semi-detached houses, which further contributes to low-density living (Figure 3.6). This geographical situation is particularly challenging, as many people are currently isolated and do not have healthcare, education, shopping, employment, leisure, entertainment or culture accessible to them, and are thus extremely car dependent. Chapter 4 discusses policy recommendations and provides some insights on how these could be adapted to different contexts.

Figure 3.6. Population distribution by type of housing



Source: (Central Bank of Ireland, 2019[21]), based on Eurostat data

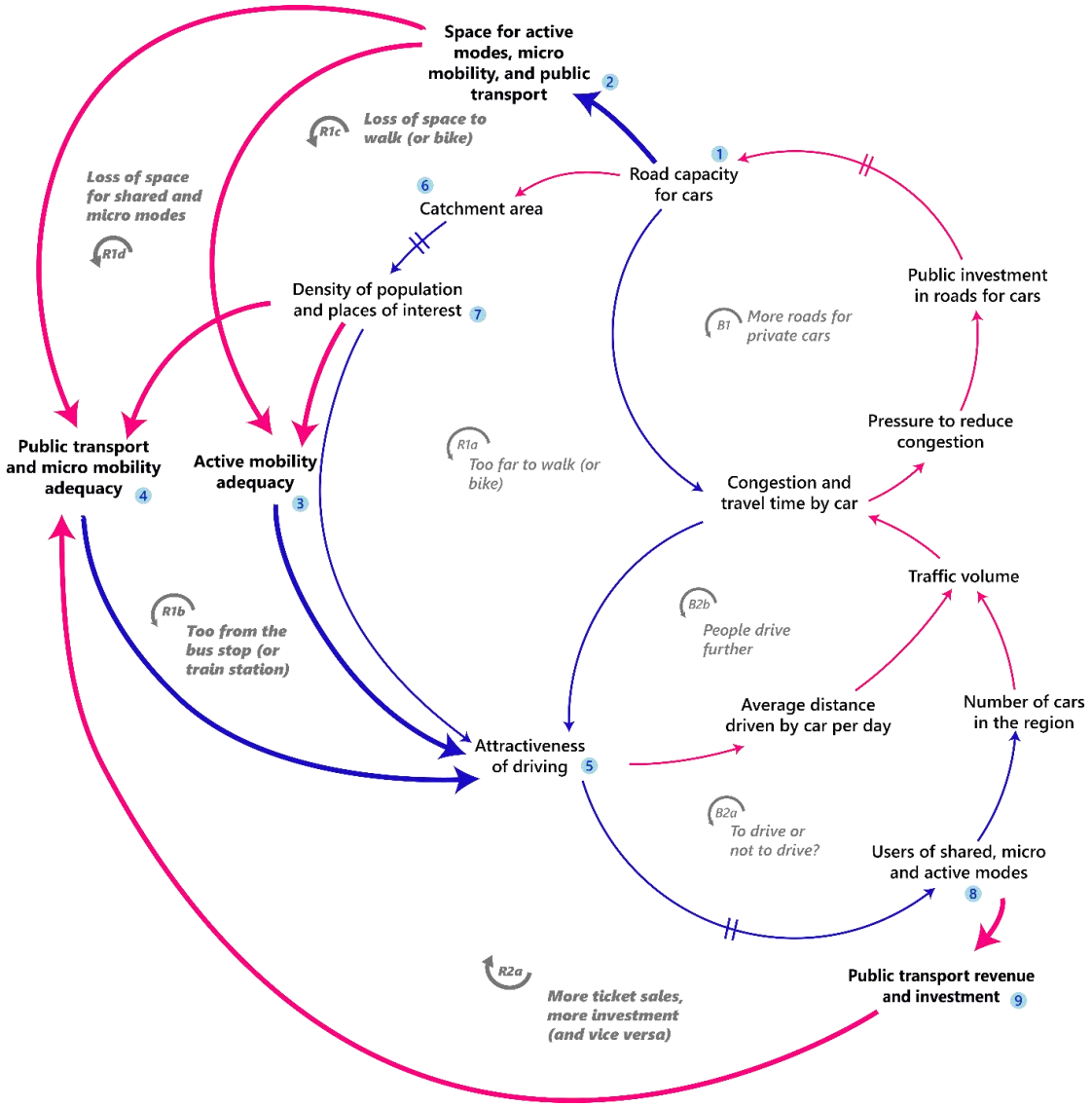
Both these dynamics (induced car demand and urban sprawl) erode the attractiveness of sustainable modes, as described in the next section.

3.1.3. Sustainable modes low-attractiveness trap

Prioritising public investment in road for cars reduces the total investment going to sustainable modes, as these investments compete with each other within countries' transport budgets (not shown in Figure 3.7). The prioritisation of investments to roads for cars has led to high road capacity for cars (1 in Figure 3.7), which has reduced the availability of safe and dedicated space for active modes, micro mobility and public transport (2), reducing their adequacy (3 and 4) which increases the attractiveness of driving (5).

As increasing road capacity for cars (1) expands the catchment area (6) and reduces the density of population and places of interest (7), the density reduction further jeopardises active mobility, public transport and micro mobility adequacy (3 and 4). The frequency of service decreases and fewer places are conveniently accessible by bus and train. The number of places of interest reachable by foot or bicycle also decrease as the catchment area expands; further contributing to the attractiveness (and necessity) of driving (5). For public transport and micro mobility, a decline in the number of users (8) also reduces public transport revenue and investment (9), which may further reduce the services' adequacy (4) and increase the attractiveness of driving (5).

Figure 3.7. System dynamics underlying the sustainable modes low-attractiveness trap



Note: This diagram builds on Figure 3.5. The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Decades of investment prioritisation towards road infrastructure for cars without ensuring dedicated space for public transport and active modes has greatly slowed the development of these modes in Ireland and increased perceptions of their unsuitability, particularly in low-density areas. As shown in Figure 3.21 in section 3.2.2, from 2006 to 2019 Ireland spent twice as much on roads for cars as on sustainable mobility. Meanwhile, the infrastructure for sustainable modes remains poor. In Dublin, for example, narrow, poor-quality footways create a barrier to pedestrian movement, particularly for people using mobility aids (National Transport Authority Ireland, 2021[22]), and only 16% of main commuting routes have segregated cycle lanes (compared to, for example, 77% in Copenhagen) (Conway et al., 2019[23]). As a result, public transport, walking and cycling represent a small share of trips in Ireland on average: 7, 14 and 2%,

respectively (CSO, 2019[24]). Decreasing densities and increasing distances have further reinforced the low-attractiveness of these modes and further hindered the development of adequate infrastructure, reflected by smaller shares of these trips in thinly populated areas of Ireland (2, 8 and 1% respectively), compared to densely populated ones (12, 19 and 3% respectively) (CSO, 2019[24]).

The next section assesses the potential of implemented and planned policies in Ireland to reverse the dynamics of induced car demand, urban sprawl and the sustainable modes low-attractiveness trap.

3.2. Are Irish policies transformative?

The previous section outlined the three dynamics leading to growing car use, unsustainable levels of emissions, and other negative outcomes (e.g. air pollution, limited accessibility, etc.) in Ireland. This section assesses the intent and transformative potential of implemented and planned policies, asking whether they can reverse these dynamics and lead to a system designed to deliver sustainable accessibility. The framework provides a practical way to discuss previously analysed policy options in the light of a systemic approach. Where relevant, findings from existing work are cited[3].

Section 3.2.1 describes the framework guiding the assessment. Section 3.2.2 presents the assessment results.

3.2.1. A framework to categorise policies according to their intent and transformative potential

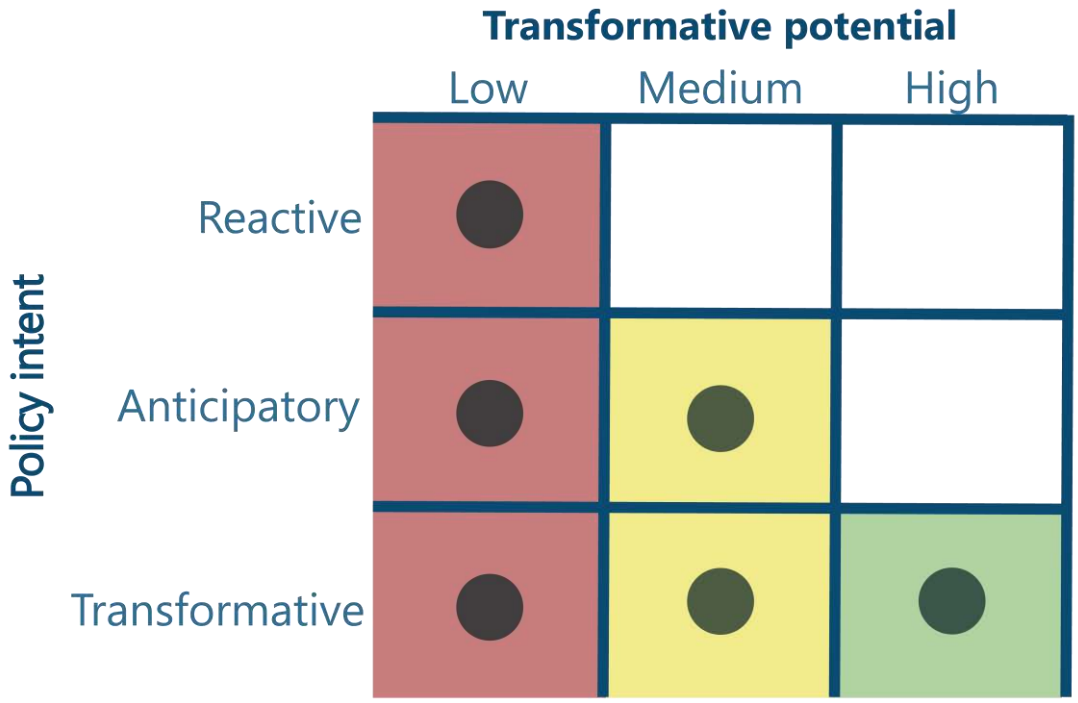
This section describes the framework used in this report to assess policies' intent and transformative potential. The framework is part of the "Understand" step of the "Systems Innovation for Net Zero" process described in the Overview chapter, and builds on a key insight of systems thinking – that the structure of a system (e.g. feedback loops, delays) causes the patterns of behaviour observed (Sterman, 2000[4]; Meadows, 2008[3]; Systems Innovation, 2020[5]).

The assessment classifies policies according to their intent and their transformative potential in current systems. Policies' intent is characterised as reactive, anticipatory, or transformative. The transformative potential is linked to the actual impact the policy has on current systems, which is characterised as low, medium, or high.

Figure 3.8 illustrates the two dimensions used in the assessment. As explained in more detail below, reactive and anticipatory policies have low to medium transformative potential since they do not aim to address root causes. The transformative potential of policies with a transformative intent can be low, medium, or high depending on the state of the system the policy is trying to influence and the policy's scale or level of ambition.

Note that while the framework assesses individual policy intent and transformative potential, no single policy can transform a complex system. An assessment of each one, however, can help policy makers identify policies with high transformative power and design policy packages that prioritise them. Furthermore, if the policy package is designed with a transformative intent, the power of policies with low or medium transformative potential when implemented in isolation may increase (e.g. carbon prices: see 3.2.2 and Table 4.1 in Chapter 4).

Figure 3.8. The transformative potential of reactive, anticipatory and transformative policies



The framework combines a number of systemic tools for identifying policies' intent and transformative potential. The rest of this section describes them.

Assessing policies' intent

The iceberg model, introduced in the Overview chapter, is used to identify the policy intent. The notion of "basins of attraction", described in Box 3.2, and the analysis of mental models discussed in Chapter 2, complement the iceberg analogy.

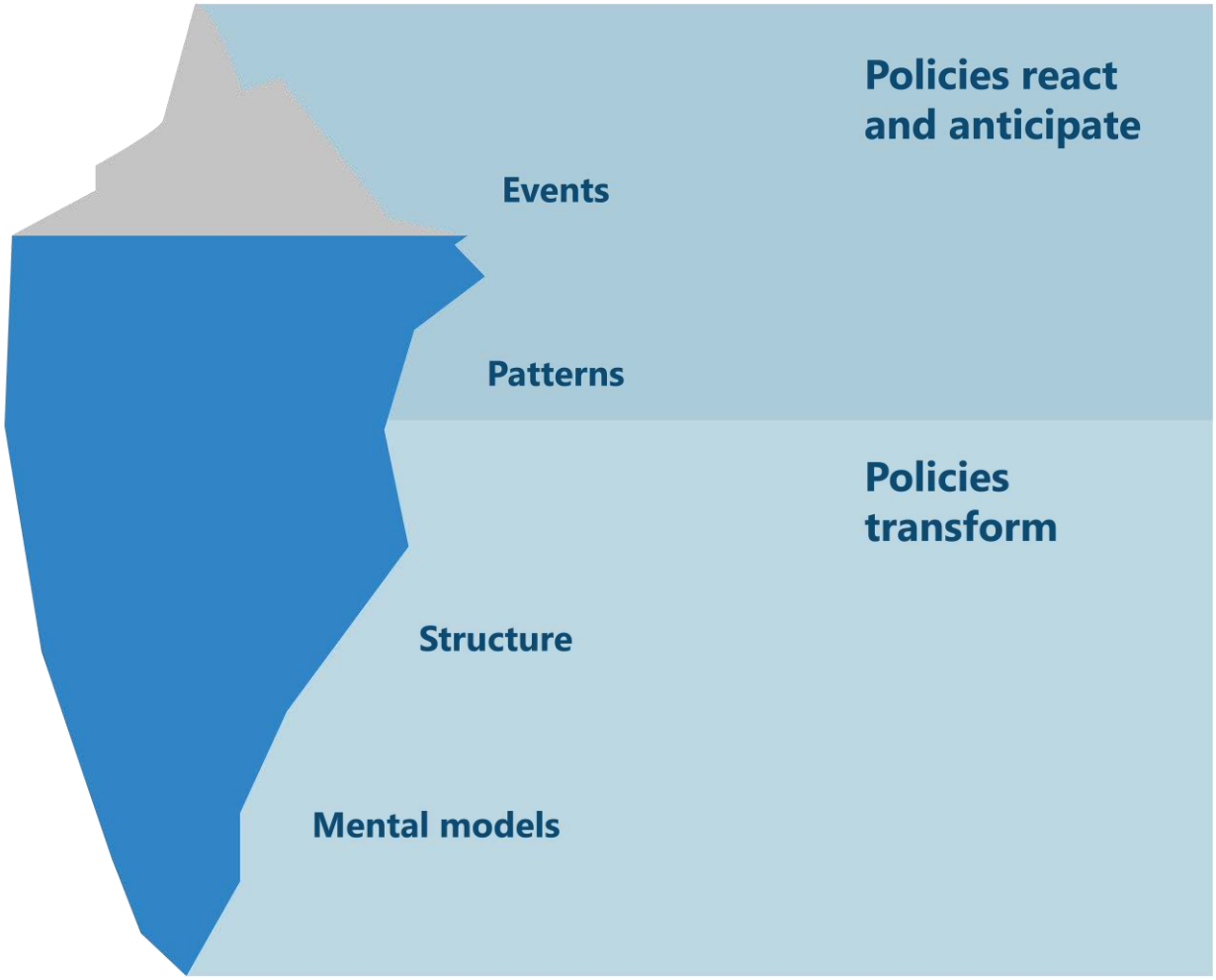
A focus on what is visible and immediate (the "tip of the iceberg") has led to decades of policies and actions that react to events or anticipate patterns. Reactive policies and actions minimise the harm of observed events and do not address their root causes. For example, on days of peak air pollution in Paris, cars with certain registration numbers are not allowed to circulate. While this is a necessary reaction, the policy does not decrease the likelihood or frequency of pollution peaks in the future. Opening parks at night during heat waves is another example of a reactive action (non-transport-related).

Anticipatory policies aim to reduce the harms of predicted trends; they aim to prevent the harms of expected events based on historical information. For example, a trend towards more frequent pollution peaks coupled with evidence of the effect of air pollution on children's health (e.g. asthma) may lead city officials to install air purifiers in schools so as to reduce children's exposure to polluted air. This action anticipates negative impacts on children's health and "gets the city ready" to reduce them. Like reactive policies, anticipatory policies do not decrease the likelihood that future patterns will be similar to those in the past since they do not address root causes.

While reacting to events and anticipating patterns can be fundamental, policy packages mainly focused on reacting or anticipating have a small chance to change existing patterns of behaviour. As the examples

above show, this is because the structure of the system, which lies at the source of such patterns, remains intact (Sterman, 2000[4]; Meadows, 2008[3]; Systems Innovation, 2020[5]).

Figure 3.9. The iceberg model for categorising policies by their intent



To influence current transport patterns of behavior (e.g. people choosing cars over sustainable transport modes for the bulk of their trips), and meet climate mitigation goals, the IPCC calls for transformative changes in the transport sector (IPCC, 2022[25]). Transformative policies aim to shift away from unsustainable systems dynamics and mental models towards systems that encourage patterns of behaviour in line with the envisioned results. Transformative policies can "dissolve" problems by dealing with their root causes. For example, road space reallocation (discussed in section 3.2.2) can dissolve the problem of air pollution from transport by contributing to creating a virtuous system structure in which public transport and active modes become the most attractive mode, safety-, time- and cost-wise, for the bulk of trips, and thus those most often chosen.

Identifying the intent underlying policy design is a necessary but insufficient step towards understanding policies' transformative potential. This potential is highly dependent on the level of physical (e.g. road infrastructure) and non-physical (e.g. mindsets) lock-in of the system the policy is trying to influence. For example, in car-dependent systems, where most public space and infrastructure is locked in for car use, road pricing can slow down the dynamic of induced car demand by increasing the cost of driving. It is however unlikely to trigger behavioural change at large scale (e.g. most people choosing sustainable modes for the bulk of their trips), as this would require not only slowing down but reversing induced car

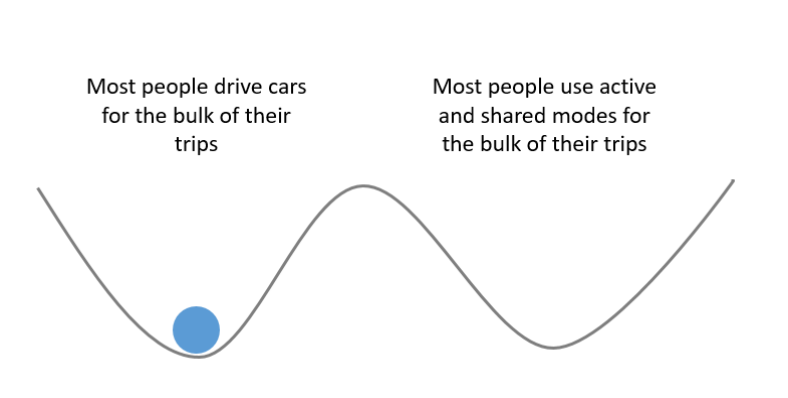
demand. In car-dependent systems, cars still remain the fastest mode of transport, and those that most people choose for the bulk of their trips. The policy may contain and even stabilise traffic volume, but the system design (based on the goal of mobility and high speed) is still pushing towards high car use (see further discussion in section 3.2.2).

Box 3.2. Flipping the basin of attraction for large-scale behavioural change

The transition that transformative policies are able to trigger can be illustrated by the notion of "basins of attraction", which complements the iceberg model.[1]

The left-hand side of Figure 3.10 represents the current state or basin of attraction in Ireland: most people drive cars for the bulk of their trips, since cars are the most attractive transport mode across the country. The right-hand side of the figure represents the desired system state[2]: most people use active and shared modes (the pattern of behaviour) for the bulk of their trips, which evidence suggests can lead to high well-being and low emissions (see Chapter 2).

Figure 3.10. Current and potential transport choices in Ireland



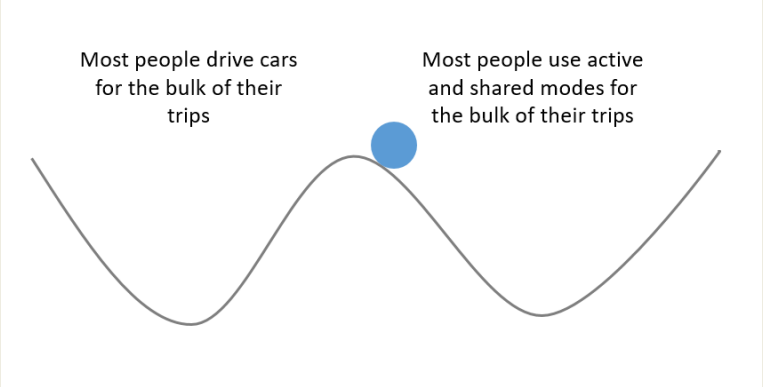
The difficulty of "flipping" the basin of attraction depends on the depth of the basin on the left, which is intrinsically related to the physical infrastructure in the system. In the case of Ireland, the transport system is locked into a high car use equilibrium (left-hand side of Figure 3.10) since most infrastructure is car-oriented. From a historical perspective, the basin on the left is deep, at least partly because of decades of investment in car-purposed road infrastructure, car-centric communication efforts and a lack of investment in public and active mode infrastructure.

The notion of basins of attraction can be linked to the policy categorisation described in this section:

- Reactive and anticipatory policies do not move the ball: by assuming that cars are the system's inevitable attractor, they aim to minimise the negative consequences of growing car use, for example by encouraging the purchase of fuel-efficient or electric vehicles instead of combustion vehicles.
- Transformative policies with low to medium transformative potential aim to trigger behavioural change in the direction of sustainable modes, but do not manage to flip the basin of attraction. For example, carbon prices push the ball towards the right by increasing the cost of driving. They are, however, insufficient to push the ball "up the hill" in car-dependent systems, since other factors such as safety, time savings and access lead to cars' remaining the system's attractor.
- Policies with high transformative potential can move the ball from the basin on the left to the top of the hill (Figure 3.11). When implemented on the right scale, they have the potential to "flip" the

basin of attraction by shifting away from unsustainable systems dynamics and mental models, so that the system deliberately encourages patterns of behaviour in line with the envisioned results.[3]

Figure 3.11. The effect of transformative policies



The notion of basins of attraction is linked to several characteristics of complex systems. First, complex systems can have more than one basin of attraction[4] (Systems Innovation, 2022[26]), and thus different patterns of behaviour can emerge. Second, in non-linear systems[5] change can be rapid once the right conditions are introduced. Note that transformative efforts do not need to "push" the ball down into the second basin: these efforts set the conditions for the ball to fall on its own as the system design reaches a new equilibrium. Third, the deeper the basin of attraction, the greater the need to prioritise transformative policies with high transformative potential ("deep under the surface" in the iceberg analogy). In locked-in systems like the Irish transport system, policies with low to medium transformative power are insufficient to trigger behavioural change at the pace and scale needed; the behaviour patterns emerging from car-dependent systems prevail and often offset any benefits of change (see, for example, (Lamb et al., 2021[27]) for more on this).

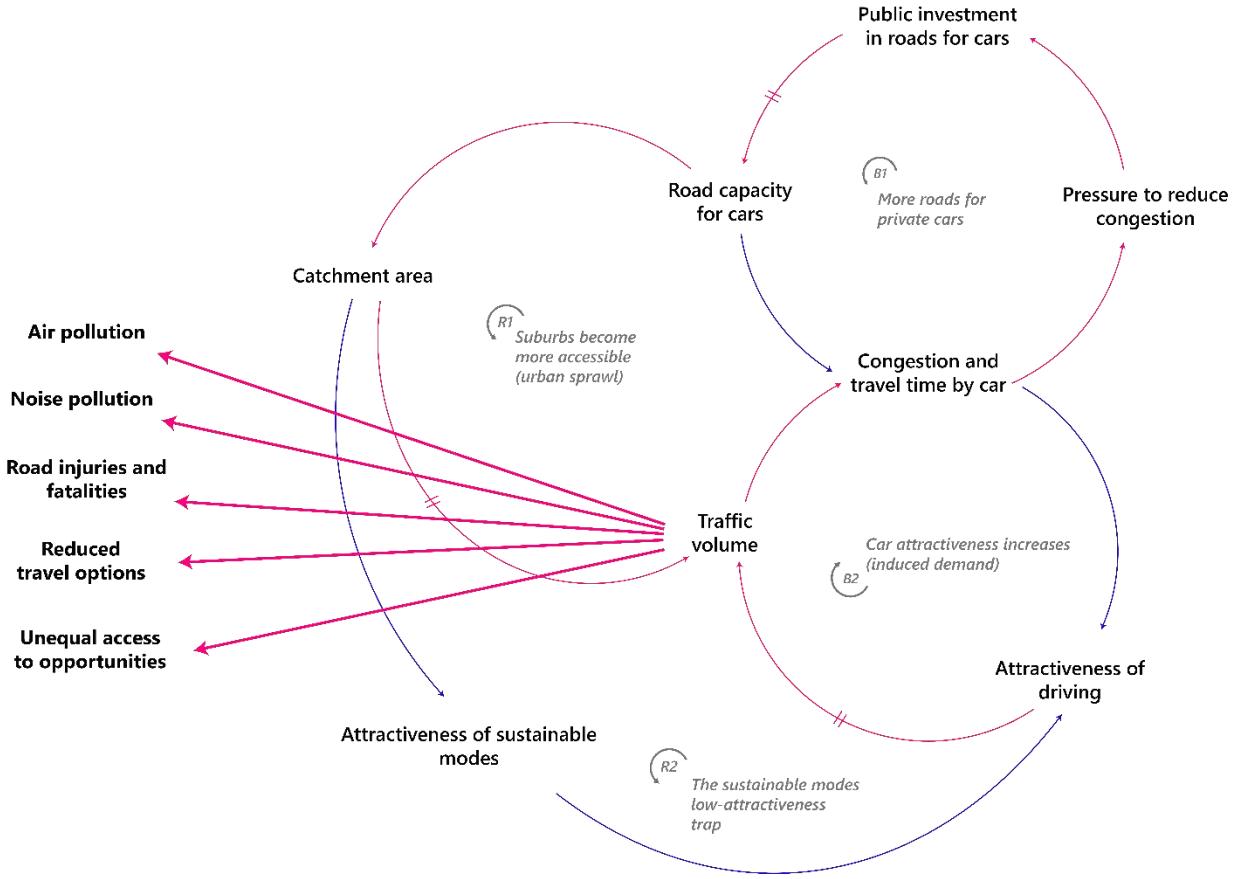
1 Metaphors, while necessary, are inherently limited. Linguists and cognitive scientists Lakoff and Johnson explain that "[b]ecause so many of the concepts that are important to us are either abstract or not clearly delineated in our experience (the emotions, ideas, time, etc.), we need to grasp them by means of other concepts that we understand in clearer terms (spatial orientations, objects, etc.)". However, "[t]he very systematicity that allows us to comprehend one aspect of a concept in terms of another … will necessarily hide other aspects of a concept" (Lakoff and Johnson, 2008[28]), accessed from (Te Brömmelstroet, 2020[29]).
2 Note that this second state becomes possible and desirable only after the system's goal has been redefined away from mobility towards sustainable accessibility, i.e. only once high mobility is no longer associated with high well-being. See Chapter 2 for more on this.
3 As noted before, no policy is able on its own to transform complex systems. Transformative policies need to be embedded in policy packages.
4 Two iceberg models, one for the current and one for the emergent system, would be another way of visualising this.
5 "Linearity implies that the size of the change is correlated with the magnitude of the input to the system. A small input will have a small effect and a large input will have a large effect in a linear system". In complex, non-linear, systems, the "size of the outcome may not be correlated to the size of the input": a small action may lead to big changes and vice versa (Zimmerman, Lindberg and Plsek, 2009[30]).

Assessing policies' transformative potential

Three systemic tools are used to identify policies' transformative potential: causal loop diagrams, stock and flow analysis, and Meadows leverage points framework, to be explained below. These tools trigger questions such as whether a policy strengthens or weakens feedback loops, can change a loop's dominance, or lead to the creation of new loops. The rest of the section describes these tools in detail.

To identify a policy's transformative potential—that is to say, the actual effect a policy can have on current systems—understanding the system's feedback loop structure is fundamental. Causal loop diagrams (CLDs), such as Figure 3.12 shed light on these structures. They can be seen as a deep dive into the iceberg model's "structure" level, enabling the analyst to better understand the interconnections or causal relationships that produce the results at the tip of the iceberg. Figure 3.12 summarises the dynamics explained in section 3.1 and the negative outcomes associated with them. An expanded version, tailored to the Irish transport system, is presented in Annex D.

Figure 3.12. System dynamics underlying car dependency and its effects



Note 1: Induced car demand occurs when public investment in roads for car use causes more, rather than less, traffic congestion. Urban sprawl is the simultaneous dynamic by which people move away from city centres while still commuting to those centres. Both induced car demand and urban sprawl exacerbate the sustainable modes low-attractiveness trap, the third vicious cycle at the source of increased car use and emissions. As more and more people are induced to drive cars, and policy makers respond by increasing the road capacity for cars, traffic volume of motorised vehicles and the space and funding allocated to them increase, while those allocated to public transport and active modes decrease. As more and more people move to peripheries, daily distances travelled increase and a good transport service becomes difficult and expensive. Active modes are also no longer feasible or competitive options. Unsurprisingly, in this type of system the attractiveness of sustainable modes is low.

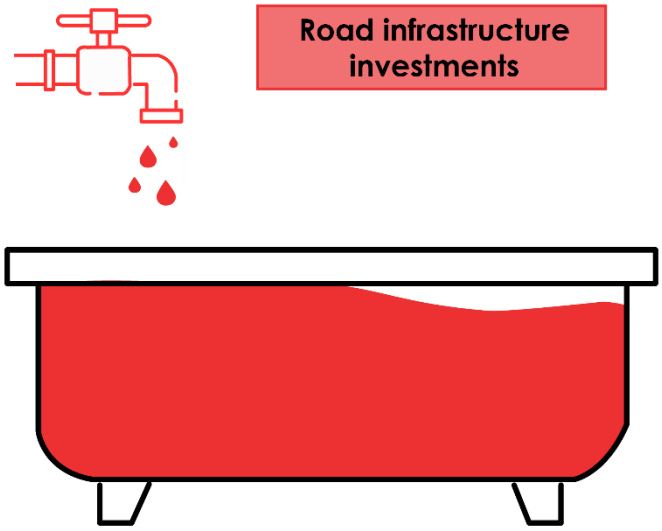
Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Source: (OECD, 2021[10]), www.oecd.org/environment/cc/policy-highlights-transport-strategies-for-net-zero-systems-by-design.pdf.

Stock and flow analyses complement CLDs in the study of policies' transformative potential by helping policy makers understand the system's physical lock-in.[4] Stock and flow analyses shed light on the magnitude of the stocks – one indication of a system's physical lock-in – and the magnitude and speed of change those variations in flows may trigger in existing stocks. Stocks and flows are the elements of a system; stocks (e.g. vehicle fleet, public transport infrastructure) change over time due to inflows and outflows, and are the "system memory". The systems that policies seek to influence have been shaped by decades of decisions made by the multiple stakeholders who act within the system.

Stocks and flows are often analysed using a bathtub analogy: Figure 3.13 applies this to transport infrastructure in Ireland. Investment in transport infrastructure creates flows, like water from a tap. Here the road infrastructure tap pours red water into a bathtub and the sustainable transport infrastructure tap pours blue water into the same bathtub. Over the years, the accumulation of investment becomes the country's transport infrastructure, illustrated by the water in the bathtub.

Figure 3.13. Stocks and flows: an illustration

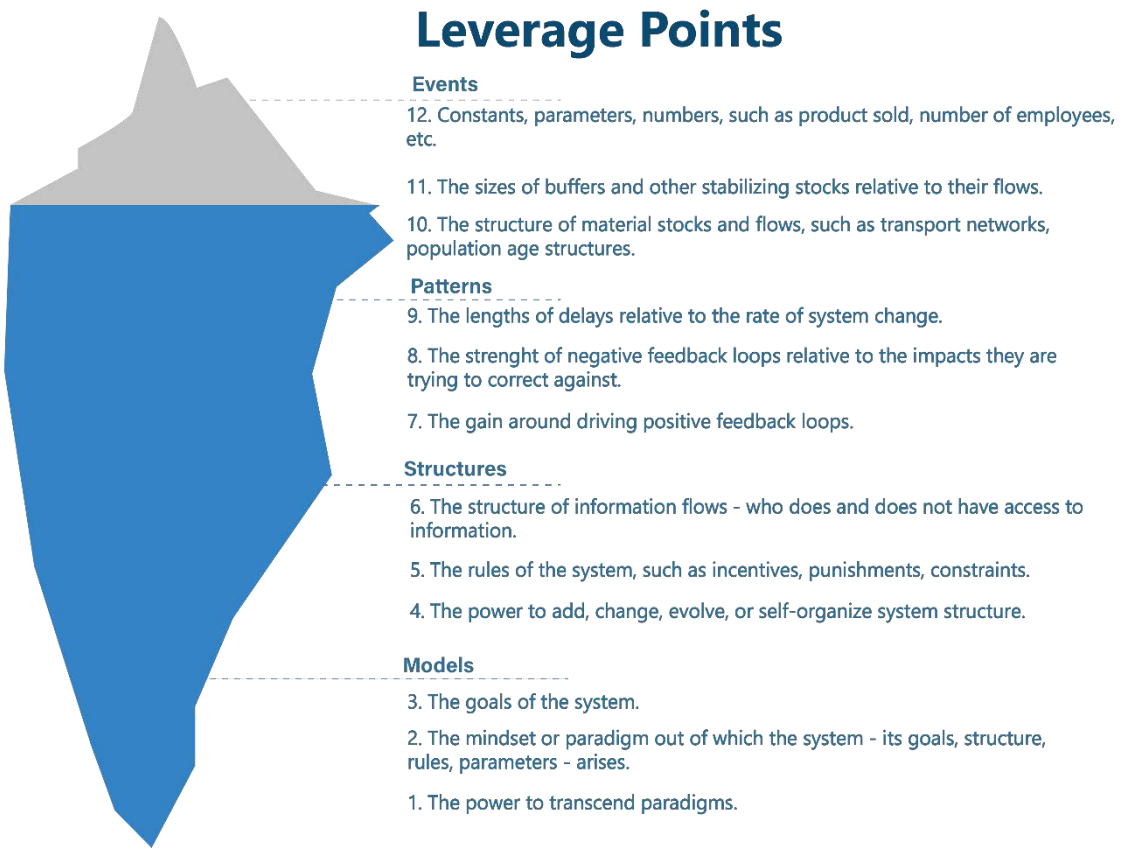


Understanding the magnitude of stocks and flows can shed light on policies' transformative potential in a number of ways. First, potential mismatches between the level of ambition or policy stringency and the magnitude of the stocks the policy is trying to influence can be identified. For example, while Irish efforts to improve public transport infrastructure have a transformative intent, their transformative power is limited in the current system. The transport system is characterised by decades of investment leading to an accumulation of the stock of car-purposed infrastructure. As a result, the system's lock-in highly favours cars and current efforts to reallocate budgets towards public transport (2:1 ratio, see section on budget reallocation), while substantial, are insufficient to "flip" the basin of attraction (see Box 3.2) and trigger behavioural change at the required pace[5]; alternative modes would remain less attractive than cars for decades at the current pace of change. Note that the same efforts made decades ago, when the gap between car and public transport infrastructure was smaller, could have had a higher transformative power, as the case of the Netherlands illustrates (see section 3.2.2.). Second, stock and flow analyses can remind policy makers that policy action is not limited to opening and closing taps (parameters, in Meadows' terminology (Meadows, 2008[3])- see below), but can also, for example, pull the plug and reduce stocks that lock systems into undesired equilibriums (e.g. road reallocation, see more below). Cognitive science argues that our brain prefers to add rather than subtract (Adams et al., 2021[31]). This biological tendency

may help explain why most policies focus on parameters (opening or closing faucets) rather than on reducing undesired stocks (pulling the plug).

Meadows' leverage points framework combines insights from CLDs and stock and flow analysis to identify 12 places to intervene in complex systems, referred to as "leverage points" (Meadows, 1999[32]) (Figure 3.14). High-leverage points are places in which a small intervention may lead to large behavioural changes. Low-leverage points are places in which small interventions lead to small changes. The leverage points can be mapped onto the four levels of the iceberg model, with the leverage point with the lowest potential to trigger change (the 12th) at the tip of the iceberg and the leverage point with the highest potential at the very bottom. More information on the framework is available at (Meadows, 1999[32]), and the categorisation of Irish policies using Meadows' 12 leverage points is available in the database in Annex C.

Figure 3.14. Leverage points on the iceberg model



Source: (Systems Innovation, 2021[33]), adapted from (Meadows, 1999[32]).

In this report, Meadows' framework guides the assessment of policies' transformative potential as follows:

- Policies that address leverage points 10 to 12 (top of Figure 3.14) aim to reduce harmful results but do not affect the underlying system structure. They are classified in this report as policies with low transformative potential. Examples are actions that limit or regulate the force of a certain flow, e.g. air quality or fuel efficiency standards regulate the force with which cars produce air pollution or GHG emissions. The expansion of stocks relative to the flows produced in the system is another type of action in this category. Meadows calls these actions "buffers", since making a stock larger

relative to a flow can allow the system to cope better with the negative consequences of the existing system. Again, these actions do not address the causes of the flow. A good example of a buffer is the widening and expansion of roads to cope with the growth in traffic.

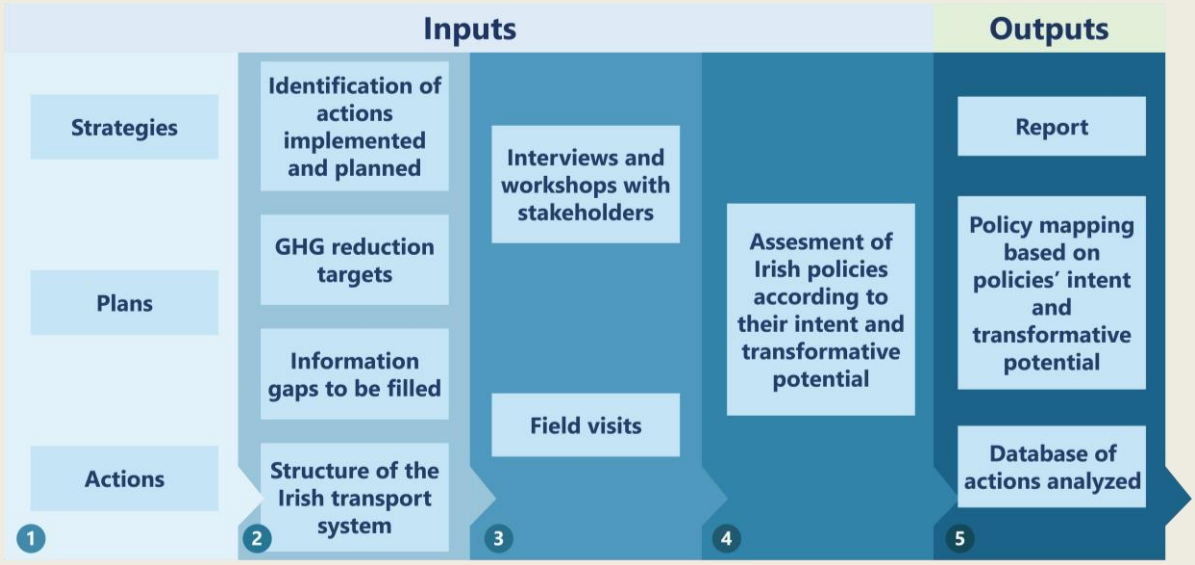
- Policies that address leverage points 7 to 9 affect the system structure by strengthening or weakening feedback loops, but they do not flip the basin of attraction (see Box 3.2). They are classified in this report as policies with medium transformative potential. Examples include investment in public transport to make this mode more attractive and weaken the sustainable modes low-attractiveness trap (see section 3.1) in car-dependent systems in which the dynamic of induced car demand continues to dominate.
- Policies that address leverage points 4 to 6 contribute to shifting away from unsustainable dynamics, transforming the system structure. They are classified in this report as policies with high transformative potential. Examples include actions that change the rules of the system (e.g. to whom and what uses public space is allocated), the criteria of success (e.g. in appraisal methodologies), or the feedback loop structure of the system (e.g. liberated space via road reallocation can restructure the way transport modes are organised).
- Policies that address leverage points 1 to 3 affect the mental models underlying system design. They are classified in this report as policies with high transformative potential. Examples include actions that establish and mainstream a new goal for the system (see the discussion of this in Chapter 2) and communication efforts challenging the car-centric paradigm.

The following section uses this classification to identify the transformative intent and potential of specific Irish policies.

Box 3.3. Data-gathering process, tools and outputs

Data was gathered via desk reviews, interviews and workshops with Irish stakeholders. First, the strategies, plans and actions to be included in the assessment were identified (Figure 3.15). The strategies and frameworks analysed included the National Planning Framework, National Development Plan, National Sustainable Mobility Policy, Climate Action Plan, Sustainable Mobility Policy, National Investment Framework for Transport in Ireland (NIFTI) and Common Appraisal Framework for Transport. The list of actions assessed is available in Annex C. Second, desk reviews were carried out, enabling the research team to identify and gather information on the actions being implemented and planned, the GHG reduction targets set, the structure of the Irish transport system, and the remaining information gaps. Third, interviews and workshops with Irish stakeholders and field visits to Dublin, Cork, Kildare and Sligo were carried out to fill these gaps. Fourth, the intent and transformative potential of planned and implemented Irish policies were assessed based on the framework described in this section.[1]

Figure 3.15. Data-gathering process, tools and outputs



[1] This process also informed the first step, "Envision", described in Chapter 2. The desk reviews, interviews and workshops shed light on what a better transport system would look like, the proxies used to measure success and guide policy decisions, and the assumptions that remain unquestioned.

3.2.2. Applying the framework: policy assessment results

Drawing on the framework just described, this section assesses the intent and transformative potential of implemented and planned policies in Ireland for the surface passenger transport sector. The assessment groups Irish individual actions into eight categories: EV incentives for private cars; budget reallocation in favour of public transport and active modes relative to car; brownfield/infill targets; efforts to improve public transport and active modes; carbon and road pricing; road space reallocation; mainstreaming of on-demand shared services; and communication efforts. A table with the assessment of selected individual actions analysed is available in Annex B. The list of selected actions is not comprehensive of everything being done by Ireland[6]. Rather the table takes some of the actions highlighted in different documents with the purpose of showing how the framework can apply to analysing disaggregated actions. The exercise shows that while some individual actions (e.g. adding specific infrastructure) might have a lower power, when taken as part of a policy category (e.g. efforts to improve public transport and active modes) their power might be higher.

The assessment finds that the policies with the highest transformative potential are mostly implemented at a pilot or very small scale. These policies, if prioritised and scaled up, could unleash huge emission reduction potential and help Ireland meet its ambitious GHG reduction targets on time.

Figure 3.16 provides a snapshot of the assessment results on the iceberg model, according to their transformative potential in car-dependent transport systems. A number of policies receiving high attention and funding[7] in Ireland – EV incentives for private vehicles, 2:1 budget allocation to new public transport infrastructure versus new roads, infill development targets, and carbon pricing – have low transformative potential. These policies react to or anticipate the negative consequences of car-dependent systems but do not transform them (sometimes the reverse, in fact). As a result, the system is still fostering car use (see sub-sections below).

The analysis suggests that road space reallocation, the mainstreaming of on-demand services, and communication efforts have the highest potential to reverse car dependency and reduce emissions via a just transition. If scaled up, these policies can transform the system structure to change patterns of behaviour.

Figure 3.16. Irish policies classified by transformational potential and intent

Note that the positioning and colour-coding of policies on the iceberg do not determine whether a policy is good or bad. Policies at the top of the iceberg may still be fundamental (e.g. carbon and road pricing policies are necessary to finance and accelerate the transition). This assessment aims to show that policy packages which only react to or anticipate undesired patterns of behaviour without transforming the system structure are unlikely to change those patterns in the future. A rebalancing of efforts towards transformative policies is needed.

The rest of this chapter presents the detailed results of the assessment for each policy type, outlining the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models (where relevant) underlying car dependency.

EV incentives for private cars

Ireland relies heavily on incentives[8] for private cars and support for electric (including traditional and plug-in hybrid) vehicles to deliver the GHG emission reductions it envisions by 2030 for its transport sector. 40% of Ireland's transport GHG emission reductions by 2030 (according to the Climate Action Plan 2021 (Department of the Taoiseach Ireland, 2021[1])) are expected to come from an increase in the uptake of electric private passenger cars, fostered by EV incentives. Overall, Ireland aims for 67% of GHG emission savings to come from different types of vehicle technology and fuel improvement (Department of the Taoiseach Ireland, 2021[1]).

EV incentives are included in the Climate Action Plan as one of the cross-cutting policies to reach 2030 targets (along with carbon pricing and other CO_2-based taxes) (Department of the Taoiseach Ireland, 2021[1]). They include subsidies for EV purchase and ownership (grants and tax relief for consumers and

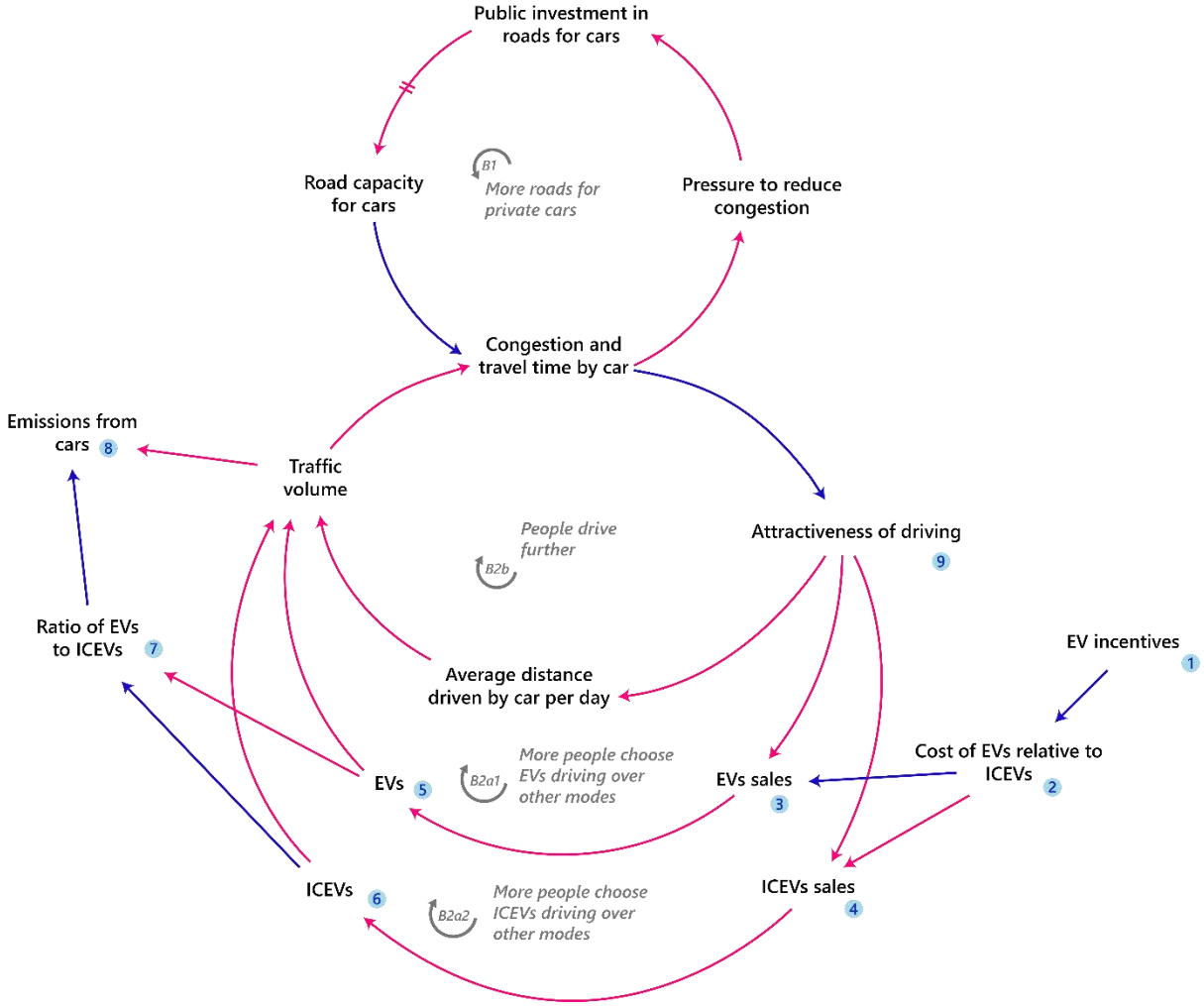
businesses), exemptions from benefit-in-kind taxation of company cars, and charging station grants (Department of Transport Ireland, 2022[34]; Department of the Taoiseach Ireland, 2021[1]; Parliamentary Budget Office Ireland, 2022[35]). According to the Parliamentary Budget Office (2022[35]), 322.42 million euros were provided between 2010 and 2021 to support the various schemes focused on lower emitting vehicles: battery electric vehicles, plug-in hybrid electric vehicles, traditional hybrids, alternatively fuelled vehicles, and for charging grants. Vehicle registration tax relief during the same period amounted 166.6 million euros; divided between conventional hybrids (64.4 million euros), plug-in hybrids (26.8 million euros), and battery-electric vehicles (75.4 million euros).

The rest of this section presents the detailed results of the assessment for EV incentives, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system's feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, EV incentives for private cars are anticipatory policies and have low potential to transform the current car-dependent system (Figure 3.16). EV incentives are anticipatory policies as they assume – and aim to anticipate the negative consequences of – continued growth in car use. They have a low potential to transform car-dependent systems because (as shown in the next sub-sections) the incentives leave the car-dependent structure of the system intact and may lock it in further by reinforcing induced car demand, urban sprawl, car-centric mental models and the belief that changes in technology are sufficient to achieve climate targets (potentially undermining political support for transformative climate policies). Furthermore, the analysis finds that the emission reduction expectations related to increased EV uptake in Ireland may not fully recognise the rebound effect and the difficulty of replacing large and growing vehicle fleets, which are hard and slow to change.

EV incentives for private vehicles do not transform and may reinforce the dynamic of induced car demand. Figure 3.17 replicates the dynamic leading to growing car use (induced car demand) introduced in section 3.1.1 to illustrate that EV incentives do not transform and may reinforce these dynamics. EV incentives (1 in Figure 3.17) decrease the cost of EVs relative to ICEVs (internal combustion engine vehicles) (2) via grants or tax relief and by providing easily accessible charging infrastructure for private vehicles. The cost of EVs relative to ICEVs (2) is reduced, which fosters EVs sales (3) and reduces ICEVs sales (4) (ceteris paribus). Vehicle sales affect the number of EVs (5) and ICEVs (6) in the vehicle fleet, and thus the ratio of EVs to ICEVs (7).

Note that EV incentives affect the properties of the car fleet in terms of the type of vehicle sold. This can reduce local emissions from cars (8) but do not transform the dynamic of induced car demand at the source of growing car use: cars remain the most attractive mode, and thus the mode that most people choose for the bulk of their trips. Moreover, by reducing the cost of driving and owning a car[9], EV incentives (1 in Figure 3.17) may increase the attractiveness of driving a car[10] (9) and further lock in the dynamic of induced car demand, leading to growing car use.

Figure 3.17. The effect of EV incentives on induced car demand



Note: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

The rebound effect may reduce the benefits of EV incentives in terms of emission reductions

The growing car use that may arise from increased attractiveness of driving a car increases the risk of a rebound effect[11] (Orsi, 2021[36]). Kampman et al. (2011[37]) developed EV scenarios for Europe and found that "funding, subsidies and non-financial incentives for EVs can create a rebound effect, where total passenger transport increases compared to the status quo". They find that this effect may increase congestion, energy consumption and GHG emissions. Orsi (2021[36]) estimates that a household's mileage could increase up to 18% due to the operation cost advantages of EVs. In addition, Caulfield, Carroll and Ahern (2020[12]) point out that in order to be competitive for buyers and provide positive payback, an EV needs to be used more than an ICEV, providing a further incentive for EV owners to drive more. Incentives such as the benefit-in-kind tax exemptions for EV company cars may also lead to an increase in the number of employees accessing (and intensively using) company cars.

Worryingly, the rebound effect and its associated costs in a future where car dependency persists are misrepresented (and sometimes ignored) in modelling and appraisal exercises. For example, the Irish national transport demand models do not capture the long-term feedback loops connecting transport policy, infrastructure development and land-use changes.

EV incentives may reinforce urban sprawl

EV incentives may also foster urban sprawl. As the cost of driving is reduced, EVs may reinforce the attractiveness of detached and large houses in the outskirts and lead to more built-up land surface (Orsi, 2021[36]). Ireland's regulation of private EV charging and car parking could aggravate this. The provision of EV charging in dwellings with parking spaces within their curtilage[12] – an action in the Climate Action Plan – can perpetuate car dependency and sprawl via requirements for private-car parking and charging in new developments. A development that needs a certain amount of car parking (now potentially with charging infrastructure) is more space-intensive and expensive, which means that more space needs to be used to deliver more housing, and housing in the outskirts (where land is cheaper) is further incentivised (OECD, 2021[10]). In Ireland, many counties (e.g. Sligo) have not shifted from minimum to maximum parking standards for new developments, and national legislation is vague in this respect.

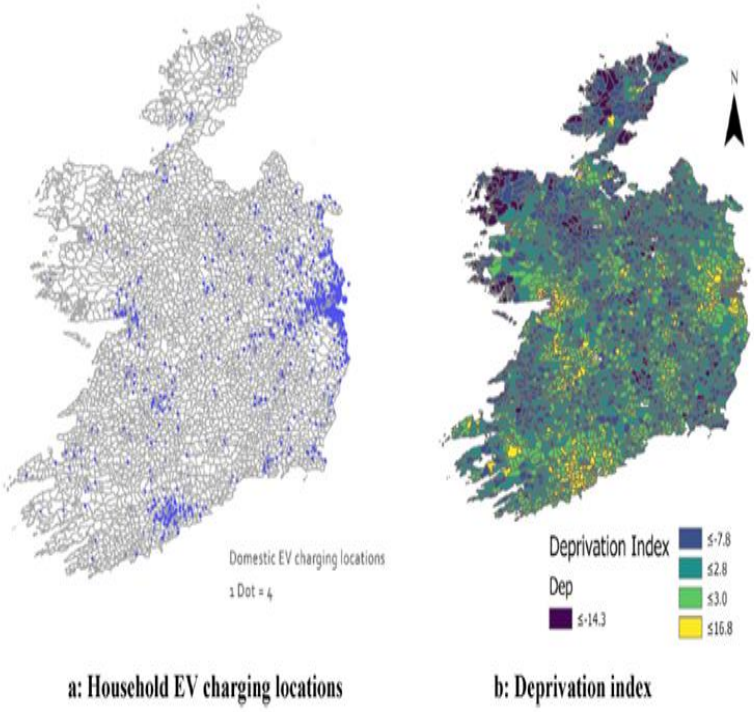
EV incentives may reinforce car-centric mental models and the idea of an unjust green transition

With respect to mental models, EV incentives, coupled with a climate strategy assuming that 67% of the ambitious emission reduction target for the sector can result from better vehicles and fuels, can reinforce the belief that the transport system is fit for purpose and that changes in technology are sufficient to achieve the targets – which evidence suggests is not the case (IPCC, 2022[25]). While it may seem minor, reinforcing this belief may undermine the political support, and thus the feasibility, of transformative policies, which may be perceived as requiring an unnecessary effort or lifestyle change. EV incentives and related communication can also give the false impression that, as long as it is electric, increased car ownership and use is not a problem. In fact, demand for electric car travel needs to be managed to reduce the cost of Ireland's energy grid upgrades and to reduce air pollution (to be discussed in section 4.5). Research suggests that reducing energy demand, including through reduced car travel, makes the Irish net-zero target achievable at substantially lower costs (Gaur et al., 2022[38]). Provision for private car parking and charging can also reinforce the idea that everyone is entitled to have a private car and a dedicated space for it, and that the duty of the government is to facilitate ease of use, further reinforcing car-centric mindsets.

The idea that the green transition is unjust may also be reinforced by EV-centric climate strategies. Public spending on EVs is rapidly accelerating (Parliamentary Budget Office Ireland, 2022[35]). Government incentives, however, predominantly benefit high-income households and businesses, who can afford new vehicles and the switch to an EV (Society of the Irish Motor Industry, 2022[39]; Parliamentary Budget Office Ireland, 2022[35]). Lower-income households may lack the savings to buy a new car (Aryanpur et al., 2022[40]). For households in rented accommodation and apartments, access to charging can be an additional barrier to EV adoption (Caulfield et al., 2022[41]; Mukherjee and Ryan, 2020[42]).

Early EV car owners in Ireland are concentrated in suburban neighbourhoods around the cities, in areas with higher home ownership, income, education and age (Figure 3.18) (Caulfield et al., 2022[41]; Mukherjee and Ryan, 2020[42]). Areas with higher levels of car ownership have more EV home charging points installed, indicating that EVs may represent a household's second or third car (Caulfield et al., 2022[41]). This aligns with Norway's experience, where buyers of battery-electric vehicles were found to be more likely to expand their household's car ownership than other car buyers (Bauer, 2018[43]).

Figure 3.18. EV home chargers concentrated in well-off suburbs around Ireland's largest urban areas



Source: (Caulfield et al., 2022[41]), doi.org/10.1016/j.energy.2022.123588.
Note: In order to investigate these phenomena, this article will look at the effects that employment decisions and levels of affluence have on the distribution of charging stations in Ireland. An indicator of relative prosperity and deprivation obtained from the Census was used to quantify this. This deprivation index calculates an overall index by taking into account variables including social class, educational attainment, employment status, and household type.

EV replacement may take longer than expected

Widespread electrification in the car fleet is a slow process (Brand and Anable, 2019[44]) and incentivising high shares of EVs in sales is challenging and costly. The stock and flows analysis in this report suggests that the emission reduction expectations related to increased private EV uptake stimulated by incentives may not fully incorporate the difficulty of replacing large and growing vehicle fleets. Furthermore, the current EV target in Ireland, set in terms of the number of electric vehicles sold (845,000 electric vehicles in the Irish passenger car fleet by 2030 (Department of the Taoiseach Ireland, 2021[1])), may set the wrong incentives as the more vehicles sold in total, the easier it is to achieve the target (see discussion on revisiting targets in Chapter 4).

Car fleets are what is referred in Meadows' leverage framework as a "hard to change stock". New car sales are flows and the vehicle fleet is the stock that accumulates through time via car sales. Even if the sale of new combustion vehicles were banned tomorrow, and those sales were entirely replaced by EV sales, it would still take time for the fleet in the country to be predominantly electric. This is because the stock of combustion vehicles is high and cars are expensive goods that last for decades: the usage period of a car is approximately 13 years in Ireland (Society of the Irish Motor Industry, 2022[39]).

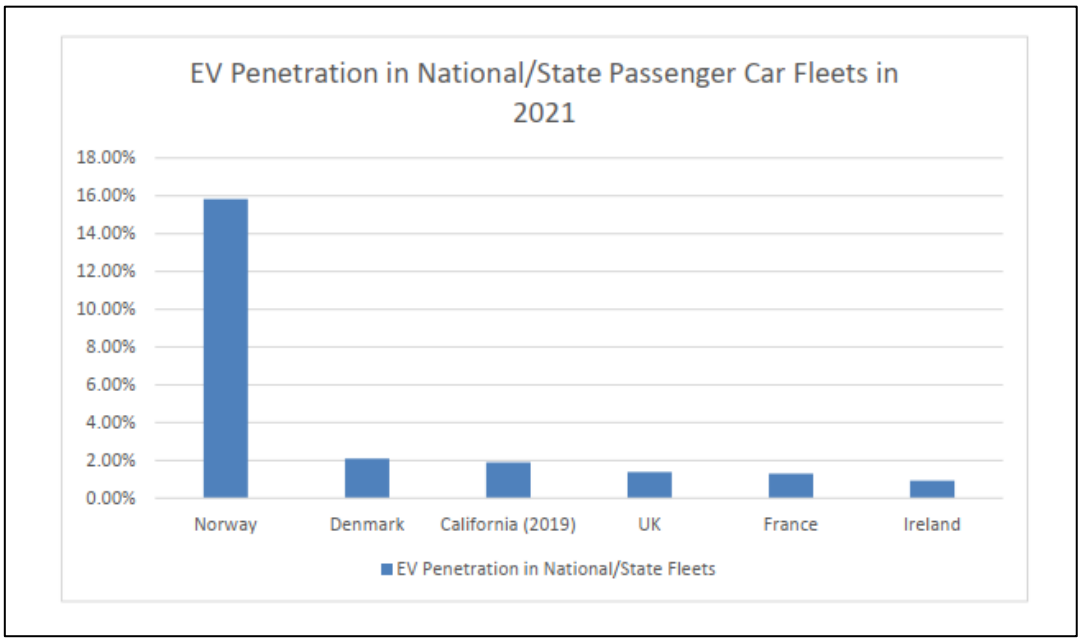
For this reason, even when Ireland has seen a steady increase in EV registrations, this is not enough to ensure that EVs will make a large part of the fleet (and reduce emissions at a fast pace) in the near future. The Irish fleet in 2022 counts around 2.2 million cars, 97% of which are combustion-based (i.e. gasoline or diesel) due to decades of combustion vehicle sales. Private EV sales have experienced a steady

increase since 2016 (Dowling, 2022[45]). In 2019, EV car sales (including hybrid and plug-in hybrids) accounted for 4% of total sales. In 2021, they accounted for 8% of total sales (Industry, Society of the Irish Motor, 2022[46]), and more recent statistics show 10,105 electric vehicles were registered in the first 7 months of 2022 – accounting for 21% of the sale shares during such period (RTÉ, 2022[47]). While this is a positive trend, still 79% of new private vehicles sold in the first half of 2022 were ICEVs, vehicles which will likely remain for approximately 13 years as part of the Irish vehicle fleet.

Furthermore, total car sales are growing, and thus a higher share of EVs does not necessarily imply that the absolute number of new ICEVs into the fleet will be smaller than in the past. For example, in 2021, 8,646 new EVs entered the fleet. Yet, total new car registrations were 104,932; meaning that 96,286 new ICEVs also entered the fleet (Industry, Society of the Irish Motor, 2022[46]). Registrations to date (September) are up by 2.1% in 2022 compared to 2021 (Industry, Society of the Irish Motor, 2022[46]) and Transport Infrastructure Ireland ((2019[11]), accessed from (Caulfield, Carroll and Ahern, 2020[12])) estimates that the total fleet of private vehicles would continue to rise 30% by 2030 (compared to 2016). The Department for Transport estimates that meeting the current EV target would require that by 2029 the share of EV sales reaches 100%, while the increase in the size of the 'on-the-road' fleet between 2019 and 2030 remains below 6.44%[13] (Department of Transport, 2022[48]).

The case of Norway provides a good illustration of the slow pace at which electric vehicle sales (despite reaching high levels) translate into electric vehicle shares in the total fleet. Norway is the global front-runner in incentivising EV sales. It has provided generous tax rebates for EVs over many years (Lévay, Drossinos and Thiel, 2017[49]), and EV incentives are mainstreamed into the country's fiscal system (OECD, 2021[10]), in which CO_2-related taxes are equivalent to a carbon tax higher than 1 250 euros per tonne. Despite years of large EV sale shares[14] (e.g. over three times the shares attained in Ireland in the first half of 2022), only 16 out of 100 cars in circulation were electric in Norway in 2021 (Department of Transport, 2021[50]) (Figure 3.19). The majority of the fleet (over 80%), remains fuel based.

Figure 3.19. A slow-to-change stock in selected countries



Source: (Department of Transport, 2021[50]), https://www.gov.ie/en/publication/e62e0-electric-vehicle-policy-pathway/

In line with this, different world scenarios also indicate that attaining high shares of EVs in total fleets before mid-century is unlikely. For instance, the EIA projects in its International Energy Outlook 2021 that EVs (including hybrids) will account for 31% of private vehicles in 2050 worldwide, which corresponds to a share of 34% in OECD and 28% in non-OECD countries. According to the IEA, under the assumption that governments accelerate efforts in its Sustainable Scenario, the global EV fleet will reach a 12% share by 2030 (IEA, 2022[51]). This is in line with findings from Caulfield, Carroll and Ahern (2020[12]) (2020[12]), which indicate – assuming the cost of EVs and ICEs reach parity by 2035[15] – that by 2040, EVs would account for only 11-28% of the world fleet (Caulfield, Carroll and Ahern, 2020[12]).

Among the many uncertainties around EV sales, and the cost that accelerating their uptake will entail, is the question of ICEV and EV parity. Some studies are more optimistic compared to (Caulfield, Carroll and Ahern, 2020[12]) (see above); indicating this could be earlier (2025) (Szymkowski, 2021[52]; Soulopoulos, 2017[53]). Yet some others, like the MIT Energy Initiative (2019[54]), consider that "a mid-sized battery electric vehicle with a range of 200-plus miles will likely remain upwards of $5,000 more expensive to manufacture than a similar internal combustion vehicle through 2030 [and] …the manufacturing cost differential between electric and conventional vehicles is expected to persist well beyond 2030". Although the MIT Energy Initiative (2019[54]) (2019[54])also mentions that lower operational costs could offset part of the differential, there seems to be relevant differences between vehicle types. For instance, a case study focusing on the US market highlights that the year for price parity varies between sedans and SUVs (Archsmith, Muehlegger and Rapson, 2021[55]). Price parity between EV SUVs and ICE SUVs is estimated to be reached only by 2040 (Archsmith, Muehlegger and Rapson, 2021[55]) – 10 years *after* median estimates for the sedan. Such differences are relevant for the case of Ireland, where SUVs[16] accounted for half of new car registrations in Ireland in 2021, up from 24% in 2015 (Society of the Irish Motor Industry, 2022[16]). The uptake of SUVs is also problematic for other reasons (space occupied, larger damage to roads, material use, etc.). Moreover, parity is not the only element that is relevant for ensuring uptake. For instance, the lack of availability and choice of models have been identified as barriers to increasing uptake according to Caulfield, Carroll and Ahern (2020[12]), along with price. Charging infrastructure (discussed in detail in chapter 4) is also relevant.

An additional problem is that, as reflected by statistics by the Parliamentary Budget Office Ireland (2022[35]), traditional and plug-in hybrids are being included in the incentives granted by the government for incentivising technological change in private car use. Not surprisingly, a lot of these vehicles are entering the fleet and constitute larger shares of sales than battery electric cars. For example, new car registrations show that in 2021 the sales share of traditional hybrids was much higher (16.22%), compared to that of battery-electric vehicles (8.24%). The share of plug-in hybrids was also 7.26%. Traditional and plug-in hybrid electric vehicles have shown a particularly large gap between laboratory (i.e. registered) and on-road (i.e. real) emissions. Studies conducted taking the most popular PHEVs in Europe show that emissions can be up to 8 times higher than registered emissions (for the least efficient vehicles) and up to 12 times higher when the vehicle is designed to do geo-fencing (i.e. when the engine can recharge the battery) (OECD, 2021[10]). Thus, including plug-in and traditional hybrid vehicles as part of EV incentives can, in addition to hindering emission reductions due to reinforcing car-dependency (see above), further delay the effect of technological change by incorporating vehicles into the fleet that have much higher tail-pipe emissions than expected (OECD, 2021[10]).

Budget reallocation in favour of public transport and active modes compared to car infrastructure

The Climate Action Plan (CAP) 2021 includes improvements for public transport and active modes among the measures to reduce GHG emissions in the transport sector (Department of the Taoiseach Ireland, 2021[1]). Together with demand management measures for ICEVs (see "Carbon and road pricing" section), more sustainable travel (with a target of 500 000 additional journeys by public transport and active modes

per day by 2030) accounts for approximately 23% of the CAP's GHG emissions targets for the transport sector (Department of the Taoiseach Ireland, 2021[1]).

Following recommendations from a citizens' assembly, the Irish government has introduced a 2:1 investment allocation ratio between public transport and road infrastructure: for every euro spent on road infrastructure, two are spent on public transport infrastructure. The Government has also earmarked a share of its transport budget for active modes. The transport budget for the period 2021–2030 allocates 46% of funding to public transport (15.7 billion euros), 11% to active modes (3.6 billion euros) and 43% to roads for car use (14.8 billion euros). 78% of the budget for public transport is allocated to new public transport infrastructure (11.6 billion euros). Out of the budget for roads for cars, 39% is allocated to new road infrastructure (5.8 billion euros), fulfilling the 2:1 allocation ratio (11.6 billion euros for new public transport infrastructure and 5.8 billion euros for new road infrastructure) (Department of Transport, 2021[56]).

The rest of this section presents the detailed results of the assessment for budget reallocation towards public transport and active modes, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, the planned budget reallocation has mixed intent and low potential to transform the current car-dependent system (Figure 3.16). In terms of its intent, on the one hand, the policy has the transformative intent of reducing the attractiveness gap between cars and public transport; on the other hand, it assumes and anticipates continued growth in car use and thus plans new road construction, reinforcing the idea that more roads will continue to be needed. In terms of its transformative potential, the current budget reallocation, while useful to slow down the sustainable modes low-attractiveness trap dynamic, is unlikely to reverse it and close the attractiveness gap between modes (see detail below).

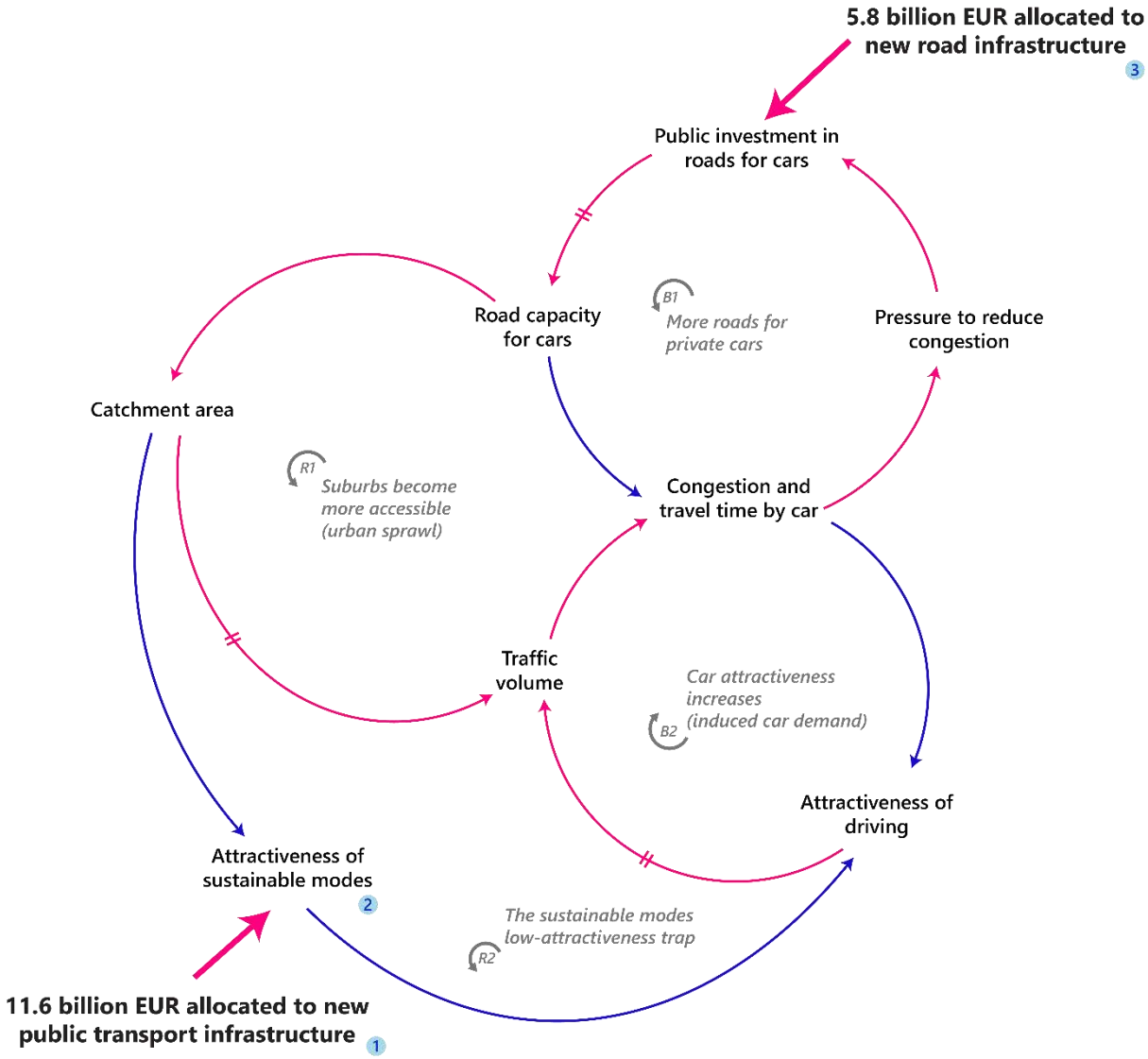
The budget reallocation may slow down the sustainable modes low attractiveness trap, but is unlikely to reverse it

As explained above, the transformative impact of policies greatly depends on the history and current state of the system. Decades of budget allocation favouring cars have led to an accumulation of road capacity for car use and a lag in the infrastructure for the use of public and active modes. For instance, between 2006 and 2019, the ratio of investment in Ireland (total, not only new infrastructure) was 2 to 1 in favour of roads for cars (OECD, 2021[57]) (Figure 3.21). Also, the behavioural change that improvements in public transport and active modes may trigger depends to a great extent on the attractiveness gap between car driving and other modes. In the case of Ireland, this gap is high: for example, the inner city of Dublin has 80 shops on average that are accessible within 15 minutes by car, but only 36 by public transport and 18 on foot (ITF, 2022[58]).

Furthermore, while funding for public transport and active modes makes them more appealing, funding for car use keeps reinforcing induced car demand, and (at least partially) offsets improvements in public and active modes[17] (Figure 3.20). The fact that the budget reallocation is set as a ratio implies that, in principle, a higher investment for public transport also entails a higher investment for car-infrastructure; which means this off-setting of efforts for improving public and active mode is likely to keep on happening.

If implemented decades ago, a budget reallocation like the one currently planned could have created virtuous dynamics towards sustainable modes. However, after decades of public investment favouring car use, and given the urgency of the situation, efforts to improve public transport and active modes need to be quantitatively more ambitious and also qualitatively different. Reallocating public space (described in greater detail later in this section) is one example of a qualitatively different action. Rather than affect flows (open or close faucets, using the bathtub analogy introduced in section 3.1), road space reallocation (see more below) can reduce an existing stock (pull the plug of the bathtub) that is key to the car-dependent system's functioning: the large stock of infrastructure allocated to car use.

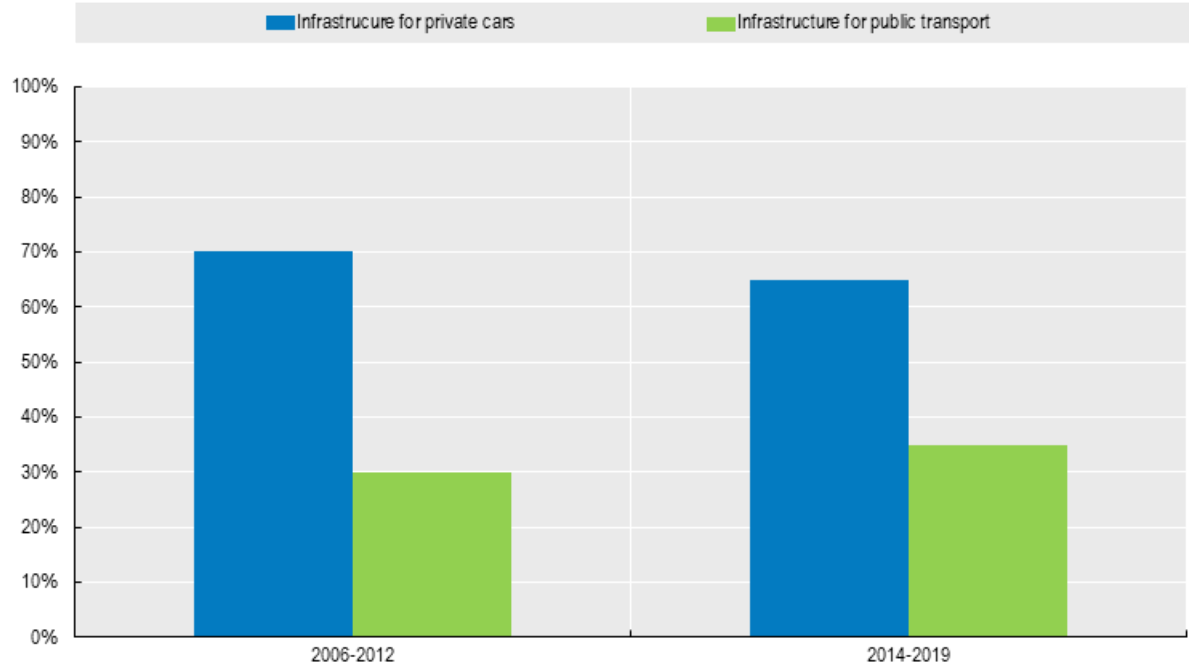
Figure 3.20. The effect of budget reallocation on the system dynamics underlying car dependency



Note 1: The 11.6 billion EUR allocated to new public transport infrastructure (1) can increase the attractiveness of sustainable modes (2) vis-à-vis the car, and thus encourage people to choose sustainable modes more frequently. In parallel, the 5.8 billion EUR allocated to public investments in new road infrastructure (3) can reinforce the dynamics of induced car demand (B2), urban sprawl (R1), and the sustainability modes low-attractiveness trap (R2).

Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Figure 3.21. Budget allocation in Ireland for infrastructure for private cars and public transport (share of total, 2006–2019)



Source: Authors, based on (OECD, 2021[57]), https://doi.org/*10.1787/9ef10b4f-en*

The budget reallocation still reflects car-oriented planning

Finally, efforts to improve public transport and active modes without a profound shift in mindset may produce only short-lived change. The 2:1 ratio implies that roads still need to be expanded systematically. Commitment to the need for more roads is evident from the fact that, in an effort to meet the 2:1 target, a number of road projects were postponed (by five years) rather than cancelled. Such projects remain in the pipeline and may be reactivated if road infrastructure is still seen as the main means to curb congestion. Revising appraisal methodologies could help avoid bias in favour of mobility-oriented policy decisions and foster accessibility-centred decision-making in the future. In this regard, the new SMP includes as an explicit action the updating of the Common Appraisal Framework for Transport Projects and Programmes (CAF). In parallel, the Department of Public Expenditure and Reform is reviewing the Public Spending Code with the aim of strengthening the government's capacity to account for environmental aspects (including climate risks and uncertainty) in the public investment decision-making process (Department of Transport, 2022[59]).

Brownfield/infill development targets

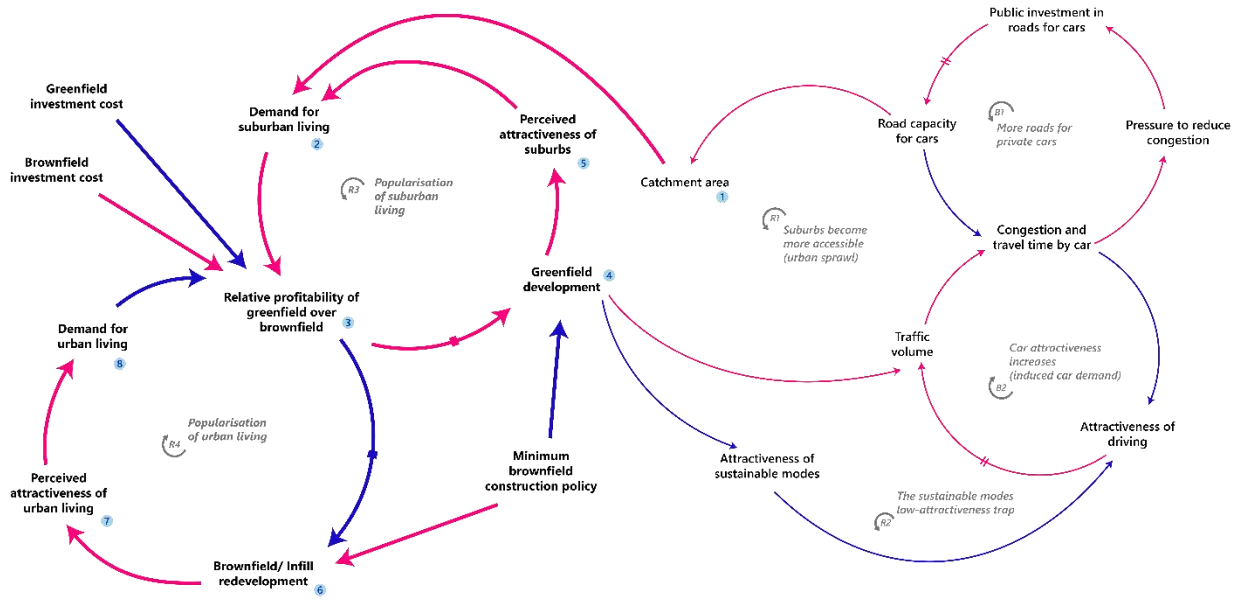
Housing development trends in Ireland show a clear dominance of greenfield development, in the form of detached and one-off[18] housing in the outskirts and countryside around cities and towns. Between 2002 and 2016, detached houses (typically built outside of city and town centres due to the space they require) represented a steady share of around 45% of housing, while semi-detached houses accounted for around 28% (CSO, 2016[60]). In 2016, 98% of one-off houses were outside towns or settlements,[19] with 65% located within one to five kilometres of towns or settlements and 15% more than five kilometres away (CSO, 2016[60]).

Ireland has recently set a target (via its National Planning Framework) for 40%[20] of new construction in urban areas to be built on brownfield/infill [21] sites (Government of Ireland, 2018[61]; Dept of Rural and Community Development and Dept of Housing Local Government and Heritage, 2022[62]). The aim is to limit development in greenfield areas[22], since this form of development fosters urban sprawl and is associated with higher infrastructure costs and emissions than brownfield development (Wilson and Chakraborty, 2001[63]; OECD, 2018[17]; Rubiera-Morollón and Garrido-Yserte, 2020[64]). While the Climate Action Plan (CAP) does not allocate a specific share of emissions reduction to increasing brownfield development, it does specify that the 40% target for brownfield/infill development should be fully achieved by 2040 (Department of the Taoiseach Ireland, 2021[1]). A number of stakeholders interviewed or participating in the April 2022 workshops considered brownfield/infill targets as one of the key measures taken by the government to address sprawl.

The rest of this section presents the detailed results of the assessment for brownfield/infill development targets, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, the brownfield/infill development targets have an anticipatory intent and a low transformative potential Figure 3.16. The policy has an anticipatory intent as it assumes that developers and the population[23] will continue to prefer greenfield development and imposes limits in order to reduce the negative consequences of that pattern. It has a low transformative potential in the current car-dependent system because the target does not address the reasons for the greater attractiveness of greenfield development (see more below) and still allows for 60% of urban development and 70% of rural development to take place in greenfield areas (Government of Ireland, 2022[65]), thus enabling urban sprawl to continue (Figure 3.22).

As shown in Figure 3.22, the relatively high profitability of greenfield development over brownfield development is an important factor behind continued sprawl. Greenfield development is currently more profitable than brownfield development because of many reasons. Among the most relevant is the fact that land prices (and thus investment costs) are lower on the outskirts, and because developing in empty areas is often technically easier and cheaper than refurbishing existing buildings or sites. There are large cost differences in the site itself as well as in construction costs, which together constitute more than half of the overall development costs. For example, the cost of a site for a medium-rise apartment building in a suburban greenfield area is between €46 000 and €59 000, while construction costs (including substructures, external site works, and elements of the building itself) vary from €191 000 to €253 000. The site purchase and construction costs for a similar building on an urban brownfield site are €65 000–80 000 and €219 000–262 000, respectively (SCSI, 2021[66]). Calculations by SCSI (2021[66]) show that delivering a new two-bedroom apartment on a greenfield site in a suburban area is more profitable than delivering the same property on a brownfield site in an urban area.[24] The suburban development produces a profit margin of 16 to 21%, while that of the urban development is 11 to 13%.

Figure 3.22. The effect of brownfield/infill development on the system dynamics underlying car dependency



Note 1: With an increasing catchment area (1) the demand for suburban living (2) grows. The higher demand makes the relative profitability of greenfield over brownfield (3) in the region higher, which incentivises greenfield development (4) for developers. With more investment going into greenfield areas the perceived attractiveness of suburbs (5) rises which drives demand for suburban living (2) yet higher. Additionally, when the relative profitability of greenfield over brownfield (3) development rises, brownfield/infill redevelopment (6) is disincentivised. Less investments into those areas reduces the perceived attractiveness of urban living (7), driving down the demand for urban living (8). With less demand for urban living (8) the relative profitability of greenfield over brownfield (3) grows yet again, creating a vicious cycle where the popularity of urban living slumps (R4), and the popularity of suburban living grows (R3).
Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Without targeting key factors and dynamics that hinder the profitability and attractiveness of brownfield areas, setting a more stringent target (and enforcing it) is likely unfeasible. Actions that more directly increase the profitability and attractiveness of brownfield development might be more effective. While more in-depth analysis would be needed to understand the systems dynamics underlying the profitability gap between greenfield and brownfield development, Chapter 4 offers some guidance for actions that could change the relative profitability of greenfield compared to brownfield development and thus trigger behavioural change in the direction of brownfield investment. These actions could be accompanied by a more stringent target, which would send a clear message about the direction of change, and if accompanied by measures that effectively address the source of the problem, would also be more feasible.

Efforts to improve public transport and active modes

As noted previously, the CAP (and its emissions reduction targets for the transport sector) include measures for increasing the use of public transport and active modes (Department of the Taoiseach Ireland, 2021[1]). Together with demand management measures for ICEVs (see “Carbon and road pricing” section), increasing the use of sustainable modes (via an additional 500 000 public transport and active journeys per day by 2030) is expected to account for 23% of the GHG emissions savings targeted in the CAP (Department of the Taoiseach Ireland, 2021[1]).

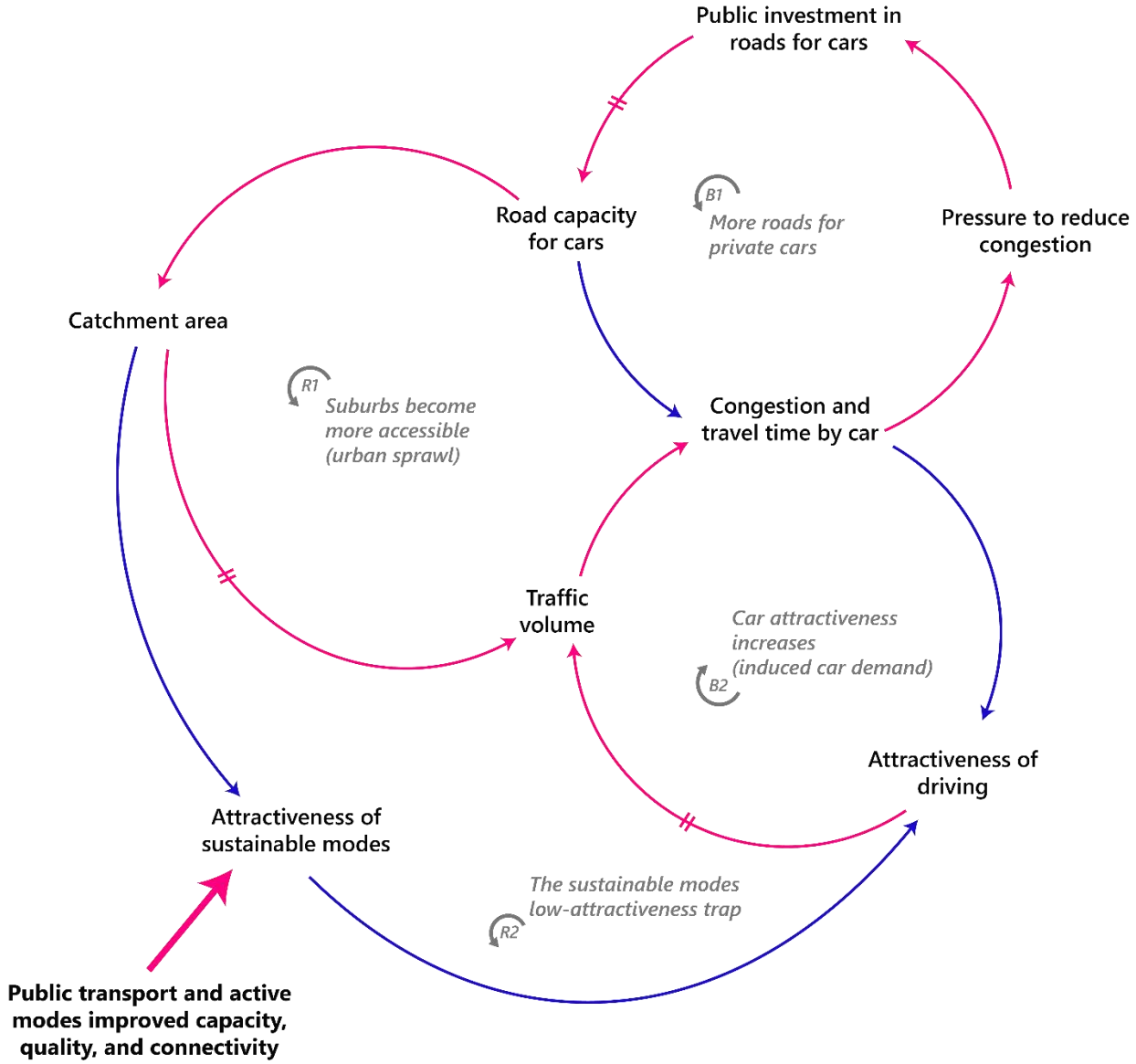
Initiatives to improve public transport and active modes in Ireland include BusConnects (a programme for sustainable transport in the five Irish cities: Dublin, Cork, Galway, Limerick and Waterford), Connecting Ireland (mobility plan for rural areas), public transport infrastructure projects (Metrolink, DART+, Dublin-Cork rail connection), the Safe Routes to School infrastructure programme, and investment in active travel infrastructure and greenways (including the Rural Active Travel Investment Programme and National Cycling Network Plan). Initiatives such as Next Generation Ticketing, new fares as part of BusConnects (e.g. 90-minute fare for buses, commuter rail and Luas in Dublin) and National Journey Planner aim to increase affordability and facilitate public transport use. Actions in the SMP also include the development of pedestrian enhancement plans for the five metropolitan areas, the regional growth centres and key towns; the development and implementation of active travel infrastructure plans for regional growth centres and key towns; and the development of cycling network plans for all counties (Department of Transport, 2022[59]).

The rest of this section presents the detailed results of the assessment for efforts to improve public transport and active modes, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, efforts to improve public transport have transformative intent and medium transformative potential (Figure 3.16). It has transformative intent because via infrastructure improvements, more efficient routes and improved quality of services, the various programmes[25] aim to set the conditions for increasing the attractiveness of public transport compared to the car. These efforts have, however, medium transformative potential in the current car-dependent system, as, given the current stocks in the system, they are unlikely to reverse the sustainable transport low-attractiveness trap on their own.

Existing infrastructure limits the potential of efforts to improve public and active transport to reverse the sustainable transport low-attractiveness trap

Figure 3.23 shows that infrastructure improvements, more efficient routes and improved quality of services, can have an effect in weakening the sustainable transport low-attractiveness trap. Nonetheless, after decades of investment privileging cars (see discussion on budget reallocation), infrastructure for active modes and public transport lags behind, while the large road infrastructure dedicated to car use (and still in expansion) continues to widen the attractiveness gap between the car and its alternatives. The low capacity of public transport infrastructure means that increasing its attractiveness will require significant infrastructure development and take time (Caulfield, Carroll and Ahern, 2020[12]).

Figure 3.23. The effect of efforts to improve public transport and active modes on the system dynamics underlying car dependency



Note 1: The behavioural change that improvements in public transport, micro-transit and active modes may trigger depends to a great extent on the attractiveness gap between car driving and other modes. Efforts to improve public transport, micro-transit and active modes can increase the attractiveness of these modes and lessen the sustainable modes low-attractiveness trap (R2). However, on their own, they fail to address induced car demand (B1 and B2) and make these modes more attractive than the car. The attractiveness gap between modes being high in Ireland, this analysis suggests that efforts to lessen the dynamics of induced car demand and urban sprawl are necessary in parallel.
The coloured arrows show the relationship between variables.
Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Combining efforts to improve public and active modes with transformative policies can increase their potential

In parallel to efforts to improve public transport, it would be necessary to prioritise transformative actions such as road space reallocation and the mainstreaming of on-demand services (see below) to close the attractiveness gap. Road space reallocation can reverse induced car demand and set the conditions for rapidly improving the performance of public transport and active modes. At the same time, mainstreaming shared on-demand services would significantly accelerate the development of a network of sustainable alternatives, which would take much longer if reliant solely on public transport and the use of private active modes. This combination of policies can help to close the attractiveness gap more rapidly and effectively, increasing the transformative potential of programmes and investments focused on public and active transport.

Current efforts to improve public transport in Ireland do not explicitly incorporate road reallocation, although many of the major projects have been, in line with this report, integrating this element. The BusConnects programme in Dublin includes good road space reallocation measures (NTA, 2022[67]), potentially becoming exemplary as long as all planned reallocations are realised and private car use is further disincentivised (e.g. through more extensive reallocation of space across the city, reduced parking, pricing measures). The Rural Active Travel programme reallocates space for active modes, but only on a small scale. The Safe Routes to School aims to create safer space for active modes, but it is unclear whether this will be done by reallocating space away from cars. In addition, presumably, the different plans for the development and enhancement of active travel infrastructure mentioned above (e.g. pedestrian enhancement plans, active travel plans) will also include and be part of a major effort for the reallocation of road space (although this is not made explicit). The SMP also includes actions to update standards and revisit legislation to support road space reallocation, and engages both housing and transport authorities to further develop and ensure implementation of the Design Manual for Urban Roads (DMURS). All of these efforts (which can be complemented with recommendations set out in chapter 4 to mainstream road space reallocation) could significantly boost the effects of the impressive efforts that the country is making to bridge the gap in active and public transport infrastructure and services.

Carbon and road pricing

Across OECD countries, fuel excise taxes are a commonly used instrument that effectively results in carbon prices (OECD, 2019[68]). Fuel excise taxes are considered to be the most efficient policy instrument for promoting behavioural change to lower carbon emissions via reduced driving, a shift towards fuel-efficient vehicles and the use of more sustainable transport modes (van Dender, 2019[69]). Road pricing schemes are schemes for charging for road use, such as toll roads, parking taxes (Small and Gomez-Ilbanez, 1998[70]), or congestion charging.

Carbon pricing, along with measures that include some of the EV incentives discussed in 2.2.1, forms one of the cross-cutting policies put forward by the Climate Action Plan (Department of the Taoiseach Ireland, 2021[1]). A carbon tax applying to heating fuels and transport was introduced in Ireland in 2010, and legislation to increase it annually until 2030 is in place. According to the CAP, the implementation of successive increases to the carbon tax is key to reaching the 2030 target, although there is no indication of the expected emissions reductions (Department of the Taoiseach Ireland, 2021[1]). Between 2021 and 2030, Ireland expects to receive an additional 9.5 billion euros from increases in carbon taxes.[26] The Irish authorities have planned for this revenue stream to be dedicated to fund specific actions linked to climate action and the just transition. Around half of this revenue will be allocated to a socially progressive national retrofitting programme for buildings, one third to targeted social welfare and other initiatives to prevent fuel

poverty, and the remainder to incentives for green farming practices (Department of Public Expenditure and Reform, 2022[71]).

Road pricing is part of the travel demand management measures considered to help the country achieve its target of -10% ICEVs kilometres by 2030[27] (Department of the Taoiseach Ireland, 2021[1]). Travel demand management measures, coupled with more public transport journeys, would cover 23% of the GHG emissions reductions included in the CAP (Department of the Taoiseach Ireland, 2021[1]). As part of the Regional Assemblies, working groups were established in three regions to discuss the role of transport demand management, including road pricing (along with low-emission zones[28]). According to interviews (Department of Transport, 2022[48]), discussions in these working groups (set up by the Regional Assemblies) have informed decisions on further measures needed to close the estimated gap between planned policies and the GHG reduction target (see Chapter 4 for more).

The rest of this section presents the detailed results of the assessment for carbon and road pricing, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, carbon and road prices are categorised as having an anticipatory intent, as both policies anticipate, and aim to contain the growth of car use by increasing the cost of driving.[29] In addition, analysis of their effects on the system's feedback loops, physical stocks, as well as on mental models (discussed in detail in the next subsections), concludes that they have a low to medium transformative potential in the current car-dependent system (Figure 3.16).

As already explained, policies with low or medium transformative potential, such as carbon and road pricing, are still needed in policy packages. They do not have a large power to change the structure of the car-dependent system and "flip" the basin of attraction (see Box 3.2), but they can accelerate the transition once policies with higher transformational capacity are put in place. Moreover, when combined with policies with high transformative potential (e.g. road reallocation; see section 3.2.2.6), pricing signals can increase the speed of change (and may also become more feasible as alternatives to driving become more available).

The revenue from carbon and road prices, when earmarked to develop sustainable modes, can also increase the political support of pricing schemes (ITF-OECD, 2017[72]), and facilitate the development of these modes (e.g. by allowing for multi-annual budgeting, unusual in Irish policy). Experience from British Columbia, Sweden and France has shown that using revenues from carbon taxes to correct inequities as well as build trust in the state, may help increase public acceptance (Douenne and Fabre, 2020[73]; Murray and Rivers, 2015[74]).

Carbon pricing weakens induced demand but the effect is limited and may be reduced in the long-term

Increasing the cost of driving (via increasing fuel costs[30]) can reduce its attractiveness and weaken the dynamic of induced car demand (see Figure 3.25 below). Transforming the car-dependent system would require, however, reversing rather than only weakening unsustainable dynamics. In addition, the effect that carbon pricing can have in weakening induced demand is limited, especially in the long run, for at least three reasons.

Firstly, the impact of carbon pricing on reducing car use is limited by the fact that prices do not affect all cars equally. While drivers of the most inefficient cars can be largely discouraged from driving, the impact will be less for more efficient and electric vehicles (as the cost of driving increases less, or not at all, for these vehicles[31]). Secondly, while carbon prices can steer and accelerate the purchase of fuel-efficient or electric vehicles (Leard, Linn and Cleary, 2020[75]), the emission reductions gained via fuel efficiency improvements may be off-set in the long run by the rebound effect (Dimitropoulos, Oueslati and Sintek, 2016[76]). On the one hand, pricing can help mitigate rebound effects from technological improvements (Dimitropoulos, Oueslati and Sintek, 2016[76]). Nonetheless, they can also increase the incentives for

vehicle fleet renewal and accelerate it (Leard, Linn and Cleary, 2020[75]). Thus, similarly to the outcome of EV incentives, the increased efficiency of vehicles (as the fleet is renewed) reduces their use cost and may incentivise people to drive more in the future[32] (Dimitropoulos, Oueslati and Sintek, 2016[76]). This phenomenon has been observed in Ireland, where increasing car travel (and larger vehicles) has counteracted emissions reductions gained via fuel efficiency improvements (SEAI, 2022[77]).

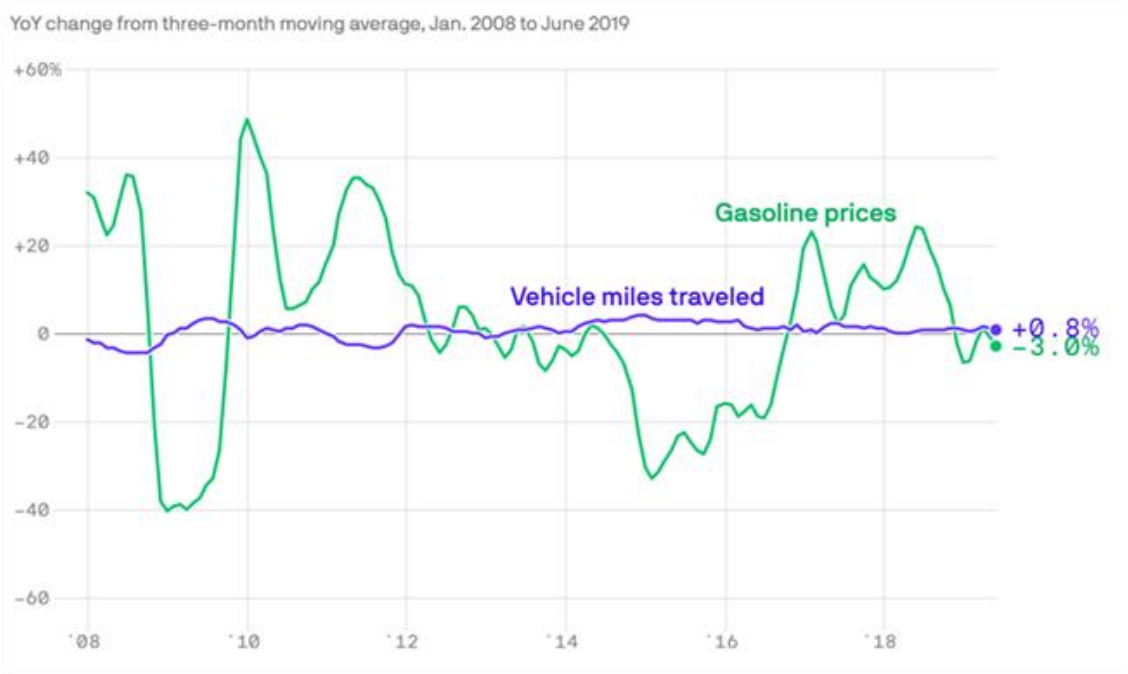
Thirdly, within car-dependent systems, carbon pricing is more likely to contribute to increasing the efficiency of the vehicle stock, while its effect on modal shift remains limited. While in principle, carbon pricing could incentivise modal shifts towards sustainable transport modes, in systems in which alternatives to car driving are not available or convenient, this effect is also limited. Evidence suggests that the impact of fuel prices on driving is low when alternatives to car driving are not available or limited (Geman, 2019[78]), as illustrated in Figure 3.24. Gillingham and Munk-Nielsen (2019[79]) observe that where access to public transport is limited (e.g. in much of the United States), the price elasticity of driving is low, since there is no easy way to shift away from car use. Mattioli, Wadud and Lucas (2018[80]) also find that, in the United Kingdom, low-income households with car-related economic stress (where transport represents a large share of the budget) show the lowest price elasticity in the face of fuel price increases, likely due to a lack of alternatives.[33] Avner, Rentschler and Hallegatte (2014[81]) estimate that the price elasticity of private car travel is twice as high in the presence of a dense public transport network in Paris, than in alternative scenarios where this would not be the case. Similarly, Gillingham and Munk-Nielsen (2019[79]) find that in Denmark, the price elasticity of driving is higher among people who live centrally in urban areas and have the shortest commutes.

The lack of alternative modes in car-dependent systems also limits the political feasibility of introducing high and increasing carbon pricing in Ireland. As mentioned above, changing pricing, on its own, does not change the fact that the Irish transport system (as many transport systems across the globe) fosters – by its design - car use and dependence.

In a number of countries, public resistance has led to policy roll-back or stagnation (Douenne and Fabre, 2020[82]); and almost 40% of emissions in road transport in 44 OECD and G20 countries are priced below estimates of the carbon price that would be needed by 2030 to decarbonise the economy by mid-century (OECD, 2021[83]). Ireland has experienced protests against carbon pricing and the resulting higher fuel prices. For example, in April 2022, The People of Ireland against Fuel Prices protested against the carbon price increase introduced on the 1st of May (The Irish Times, 2022[84]). The lack of alternatives to car driving also affects the political feasibility of road pricing (discussed just below), making it a policy with limited implementation worldwide (ITF-OECD, 2017[72]).

The political feasibility of carbon and road pricing can increase if coupled with policies that improve the attractiveness and availability of alternatives to cars.

Figure 3.24. Gasoline prices and vehicle miles travelled in the United States

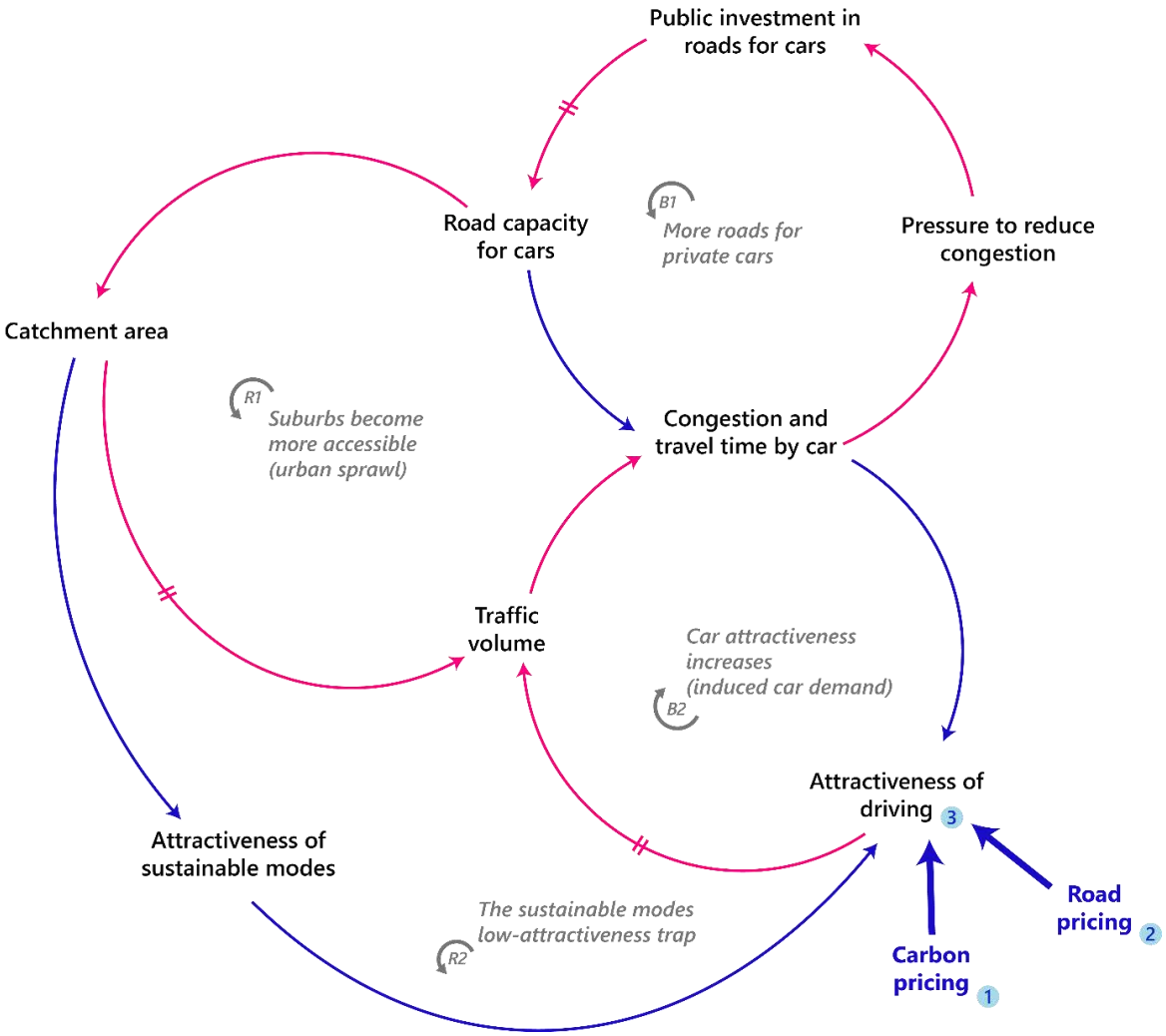


Note: YoY = Year on year.
Source: (Geman, 2019[78]), www.axios.com/carbon-pricing-difficult-to-reduce-transportation-emissions-b6cf8a74-6cfe-47ca-9f6e-c5b4d266d96c.html

Road pricing has a stronger effect on weakening induced demand but this is still not enough to reverse it

Like carbon pricing, road pricing reduces the attractiveness of driving a car by increasing its cost and weakens, in this way, induced demand (see Figure 3.25). Since people must pay the charge regardless of the type of vehicle they drive, the reduced traffic volume incentivised by road pricing is not offset by the rebound effect described above. The effect on induced demand is also larger than the one that carbon pricing can produce, as disincentives for driving affect all car users unless exceptions are granted (e.g. to EVs). Nevertheless, on its own, road pricing doesn't radically change the structure of the car-dependent system: it does not reverse induced demand nor car-dependency. For this reason, while improvements (e.g. more efficient use of road capacity-and thus lower congestion) can be expected from its implementation, it cannot be expected to result in radically different equilibriums (e.g. radically different modal shares or significant reductions in car use). To an important extent, this is due to the fact that road pricing does not address the problem of the over-dimensioned car-purposed capacity that characterises, and is at the centre, of car-dependent systems (see more discussion in the next subsection).

Figure 3.25. The effect of carbon and road prices on the system dynamics underlying car dependency



Note 1: Carbon pricing (1) and road pricing (2) can reduce the attractiveness of driving (3) by increasing its cost. However, when implemented in car-dependent systems, their impact is limited by the lack of alternatives to cars.
Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Carbon and road pricing do not reduce an over-dimensioned stock of car-purposed road capacity

By slowing down induced demand, both carbon and road pricing can reduce the extent and speed at which new road infrastructure capacity is added to the system and traffic volume is increased. In this way, they may lead to lower traffic volumes compared to those that would result from having the same infrastructure in place without introducing pricing. The effect of road pricing can be expected to be higher: making the use of roads more efficient rather than focusing on building more infrastructure is a central goal of road pricing; while this is not the case for carbon pricing.

Nonetheless, transforming car-dependent systems, which have already developed a large road capacity (as in Ireland), requires more than slowing down (or even stopping) car-centred road capacity development. As much as road pricing can make more efficient the use of existing roads, a large capacity of road space is likely to result in a high amount of overall traffic volumes, as an efficient use can be achieved while coping with a large number of vehicles. As pointed out in (OECD, 2021[10]), introducing road pricing without revisiting the over dimensioned road space supply allocated for driving and parking in car-dependent systems (and without investing in public and active modes) may result in reduced congestion, but is still likely to result in high traffic volumes and emissions. The case of London is a good example of the way in which combining road pricing with road space reallocation (see discussion on this policy below) is a better strategy to reduce car use and promote changes in modal shares (ITF-OECD, 2017[72]).

Ireland is still in the phase of planning the introduction of road pricing, but the limited effect of carbon pricing on traffic levels has already been seen in the past: substantial increases in petrol and diesel prices (12% and 17% respectively) in 2017 and 2019 stabilised car use per capita in 2017, and reduced it by 2% in 2018.34 In other words, a large change in prices led to a small change in behaviour, the opposite of what would be expected when pushing on a high leverage point (see section 3.1).

Carbon and road pricing may reinforce the perception of climate action being unjust

In terms of mental models, when implemented on their own in car-dependent systems, carbon and road prices may reinforce the perception that climate action is unjust, reducing the political support for such actions (see Figure 3.24). People who can afford to purchase a more efficient (or electric) car will likely do so and eventually drive more often than before (as explained above), offsetting some, if not all, of the environmental benefits of technological efficiency gain (IPCC, 2014[85]). Those who cannot afford a more efficient car, often low-income households living on the periphery and thus with the least access to alternatives, will be negatively impacted by the price increase. They may, for example, be constrained to spend a higher share of their budget on transport to the detriment of other expenses such as leisure or healthy food (Font Vivanco et al., 2014[86]), especially if connections by alternative transport modes are poor where they live. In Dublin, for example, the public transport network covers only 23% of the commuting zone (ITF, 2019[87]). Poor access by both public transport and active modes is reflected in ITF indicators on accessibility (ITF, 2019[87]): for example, while people in the inner city can find on average 36 shops within 15 minutes by public transport and 18 within 15 minutes on foot, those living in the commuting zone can only reach 12 shops by public transport and 5 on foot in the same time period (ITF, 2022[58]). The Gilets Jaunes movement in France was at least partly a reaction to the consequences of unequal access to good alternatives to cars.

Road space reallocation and street redesign

Road space reallocation and street redesign (road space reallocation hereafter) refers to the rebalancing of road and street space from cars to different transport modes and functions beyond transport (e.g. recreation, bus lanes, markets)[35]. Road space reallocation is one of the demand management measures being considered to meet the target of a 10% reduction in ICEV kilometres by 2030 in the Climate Action Plan (Department of the Taoiseach Ireland, 2021[1]). Together with an increase in sustainable travel, demand management measures are expected to produce approximately 23% of the CAP's emissions reduction target for the transport sector.

While some road space reallocation projects already exist, they are at the pilot stage and would need to be scaled up to unleash their transformative potential. As mentioned before, the 5-year plan of the new SMP includes actions in this direction that may help revert this situation (in particular if complemented with the recommendations in Chapter 4).

The rest of this section presents the detailed results of the assessment for road space reallocation, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its

transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, road space reallocation is categorised as a policy with a transformative intent and a high potential to transform the current car-dependent system (Figure 3.16). Road space reallocation is designed on the understanding that traffic volume, rather than congestion, is the problem. It aims to transform the system by creating the conditions for shared transport and active modes to become the most attractive. By doing so, the policy intends to trigger behavioural change and lead to disappearing traffic (Box 3.4). As discussed in detail in the below subsections, the policy can transform the current car-dependent system in various ways. First, it breaks an important link in the car-dependent system. Secondly, it reduces a key stock (car-purposed road capacity) that (as discussed in section 3.1) is at the source of car dependency. Thirdly, it creates a new stock of liberated space that can be used for shared transport and active modes to become the most attractive modes, and for places of interest to be reallocated; thus facilitating proximity. This new stock gives rise to different (and more virtuous) loops in the system that replace those of the car-dependent system.

Box 3.4. Evidence on disappearing traffic

As discussed in (OECD, 2021[10]) one of the main barriers that can impede implementing and expanding road space reallocation away from car use is the claim that traffic is displaced, rather than disappearing. Evidence on disappearing traffic has been documented for several years now. After examining over 70 case studies of road space reallocation in 11 different countries, Cairns, Atkins and Goodwin (2002) concluded that, given the right conditions, road space reallocation can result in significant reductions in traffic: on average, the case studies examined resulted in a 21.9% traffic reduction, while in half of the cases, at least a 10.6% drop in car traffic was found. The authors find that the claim that road space reallocation is associated with "traffic problems" is "unnecessarily alarmist".

More recent studies, dedicated to looking into the impacts of road space reallocation, e.g. across European cities, have concluded that, while there might be a period of adjustment, there is indeed a phenomenon of "disappearing" or "evaporated" traffic (EC, 2009[88]).

This is in line with evidence on recent interventions in Oslo and Copenhagen discussed in (ITF, 2021[89]). In the case of Oslo, interventions reducing road capacity for car use on three main roads resulted in a reduction of car use for commuting of between 16% and 21% without severe consequences in terms of delays or congestion. In Copenhagen, traffic was also reduced after space was designated to increase space dedicated to walking, cycling and public transport (ITF, 2021[89]).

As pointed out by (Cairns, Atkins and Goodwin, 2002[90]), creating the right conditions for road space reallocation is nonetheless key. Among the elements for creating such conditions, they point out careful design and monitoring, as well as communication and consultation. The authors find that the way schemes are perceived by the public and reported in the media is particularly important. The role of communication strategies and the potential synergies with road space reallocation are also emphasised later in this chapter, while Chapter 4 provides recommendations for Ireland in terms of scaling up road space reallocation as well as developing an effective communication strategy to facilitate change.

Source: (EC, 2009[88]).; (ITF, 2021[89]). (Cairns, Atkins and Goodwin, 2002[90]), (OECD, 2021[10])

Road space reallocation "breaks" a link in the car-dependent system and leads to a new system structure

Road space reallocation has the potential to "break" a key link in the car-dependent system (see top, right-hand side of Figure 3.26). As explained in section 3.1, for decades, transport policies have responded to the pressure to reduce congestion with public investments in roads for cars (1 in Figure 3.26), increasing

the road capacity for cars (2), which has led to the opposite result: congestion has increased. If instead of trying to reduce congestion by increasing public investment in roads for cars (1), policy focused on liberating space (3) for sustainable modes, these could become more attractive (4), and those that most people use for the bulk of their trips. As noted by Caulfield, Carroll and Ahern (2020[12]), "the main problem that is faced in changing transport behaviours to more sustainable modes of transport is that they have to compete with the private car for investment and road space".

The liberated space (3, Figure 3.26) could be used for walking, cycling and public transport infrastructure, enabling safer, faster and more pleasant travel, and thus increasing the attractiveness of sustainable modes (4). The liberated space (3) can also be used for functions other than transport, such as public seating, green spaces, markets, restaurant terraces or playgrounds. This can increase the attractiveness of inner-city areas, potentially reducing urban sprawl over time and leading to smaller catchment areas (5), in line with the "15-minute city" idea. Pontevedra in Spain is a good example of the effect that liberated space can have on the quality of life in inner cities. A public official in Pontevedra reports that they were able to "stop urban sprawl" and that "to encourage people to return to live in the city, it was necessary to improve the quality of life, reduce traffic, and create a human city" (Burgen, 2018[91]).

Note that the system featured in Figure 3.26 has a different structure to the one characterised by the car dependent system and described in section 3.1.

Road space reallocation addresses the over dimensioned stock of car-purposed capacity

From a stock and flow perspective, road space reallocation increases the stock of liberated space and reduces the stock of road capacity for cars (see Figure 3.26). This is quite unlike most policies, which focus on flows (road pricing focuses on traffic flows, for instance). Road space reallocation focuses instead on reducing a stock that leads to vicious cycles (car-purposed road capacity) and creating a new one (liberated space) that can lead to virtuous ones.

Road reallocation is also inexpensive and can be quickly implemented technically, since there is often no need for a lot of hard infrastructure and its benefits are almost immediate: buses are no longer stuck in traffic (being provided with an exclusive lane) and thus move faster than cars; children ride their bikes to school as cycling becomes safer; seniors ride e-bikes or walk more often as benches are available and walking is pleasant.

Numerous international examples of successful road reallocation projects confirm that road space reallocation is a high leverage point: a small change leads to large changes in the system. The Superblocks in Barcelona (see further discussion in Chapter 4.3) are an iconic example of complete street redesign that, once extended to the entire municipality, will increase the space allocated to pedestrians from 16 to 67% while reducing the space allocated to the road network by 61% (Rueda, 2019[92]). The transformation is low-cost as it does not require hard infrastructure; instead, the use of existing infrastructure is revised. It is estimated that the development of the planned 503 Superblocks (which would cover the entire municipality of Barcelona) will cost 300 million euros. If the 503 Superblocks were implemented over four years, they would cost the City Council 2% of its budget (Rueda, 2020[93]). In Paris, the rue de Rivoli has been gradually closed to private cars after the Covid-19 lockdown and the majority of the street space, signalled with simple markings and traffic signs, was dedicated to two-way cycle traffic (City of Paris, 2022[94]). These four kilometres of cycle lane in the heart of the city serve on average 15 000 cyclists per day (Le Parisien, 2021[95]). Similar small-scale but successful post-Covid-19 projects have taken place in Ireland. For example, a number of stakeholders interviewed expressed their surprise that so many more people now cycle as a response to the temporary bike lanes. This may reflect repressed demand that bursts out as soon as infrastructure becomes available. The reallocation of parking space to a pedestrian area on the Kildare Market Square is another example of public space reallocation. The initiative received positive feedback from citizens and businesses, and local authorities are now looking into expanding the transformed area.

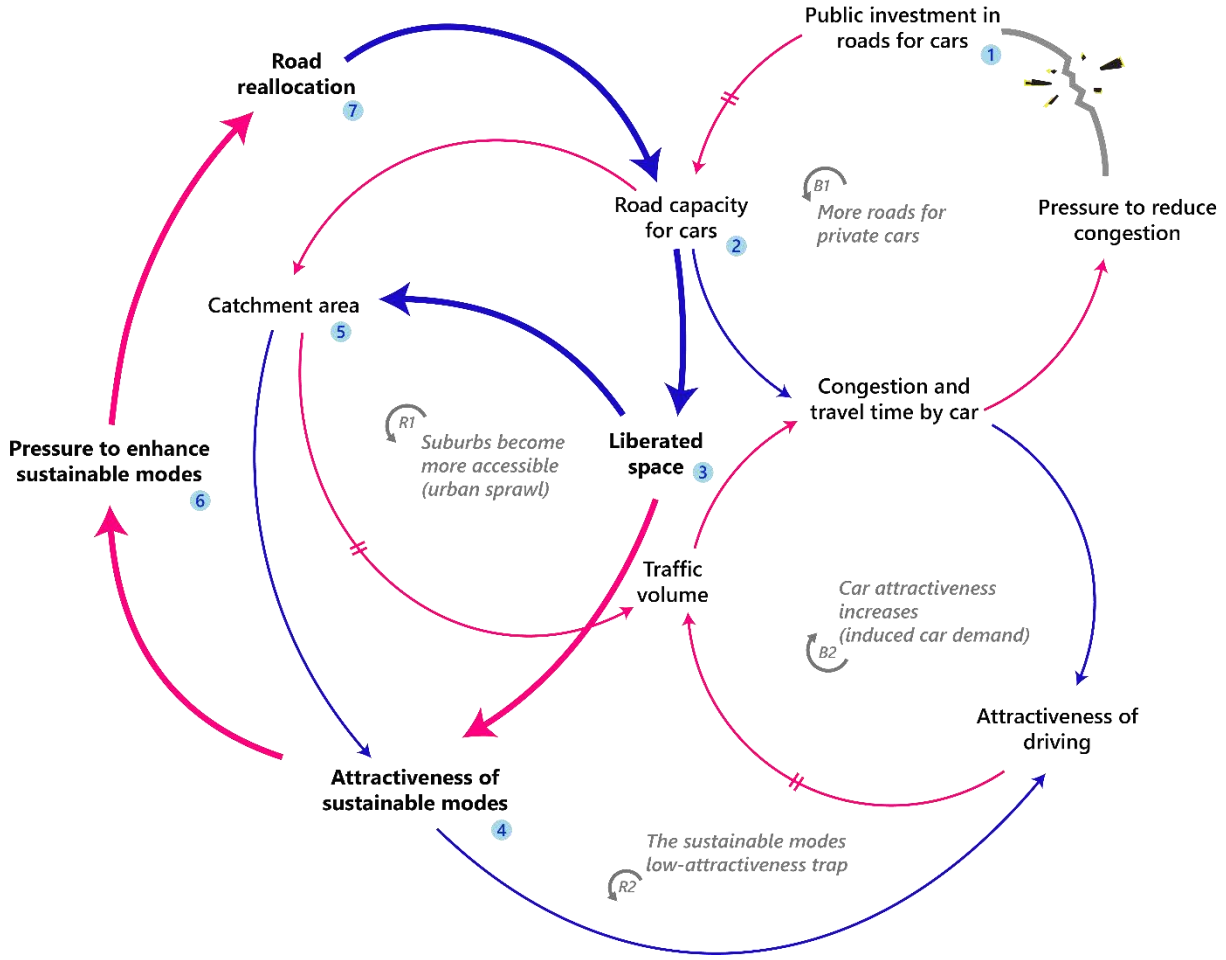
Extending road space reallocation beyond central areas will be necessary to ensure wide impact and avoid inequalities and gentrification. When projects are only implemented in central areas, they can introduce inequality problems, for example, by creating significantly greater benefits for central city dwellers than for commuters from the periphery. Another downside can be gentrification and eviction, since improving conditions in a constrained space can create price differentials between the reconfigured area and other areas (OECD, 2021[10]). Making large-scale changes and combining road space reallocation with the development of public transport and the creation of new shared services, can reduce these problems substantially. On the peripheries, reallocation can make alternative modes (e.g. shared bicycles, electric bicycles, electric cargo bicycles and scooters) viable as a link between residents and (new and existing) transport hubs. This can make commuting to central areas seamless, using only sustainable modes. Many suburbs also have some density of services already; in addition to bringing more services closer to people (using liberated space), road space reallocation can be especially leveraged in suburbs, linking people to services via networks of infrastructure (e.g. cycle lanes) that allow them to travel via sustainable modes.

The space liberated by road space reallocation can also facilitate the spread and uptake of on-demand services such as e-bikes and e-scooters. As discussed below, on-demand services can fill the gaps in connectivity that are sometimes difficult to fill with traditional public transport and can increase the overall functionality of public transport via multi-modal integration. They can also ease, and significantly reduce the cost of, the electrification of the vehicle fleet (see the section on refocusing the electrification strategy in Chapter Four).

Road space reallocation may facilitate a change in mental models

Road space reallocation may also have a positive impact on mental models and political support for policies aiming to transform car-dependent systems. Irish stakeholders have identified a lack of political support as a key barrier to the up-scaling of road space reallocation. However, a study conducted in 2020 showed that “84% of people in the… [Dublin Metropolitan Area] would be in favour of the government investing in segregated cycling infrastructure at the price of road space for other modes of transport” (Caulfield, Carroll and Ahern, 2020[12]). As people experience its well-being benefits (some of which are immediate, see Chapter 4 for a discussion on tactical urbanism), public pressure to enhance sustainable transport modes (6 in Figure 3.26) can increase, facilitating further road space reallocation (7), road capacity for cars (2) reduction, and further liberated space (3) for sustainable modes and other uses. While possible, triggering such a dynamic is not straightforward since sustainable modes need to function properly to ensure positive experiences with them. Investment in communication to showcase the well-being benefits of road space reallocation, such as days without cars, and fostering participatory approaches can accelerate political support for reallocating roads to sustainable modes. As WIRED UK (WIRED UK, 2022[96]) observes, “people hate the idea of car-free cities – until they live in one”.

Figure 3.26. The effect of road space reallocation on the system dynamics underlying car dependency



Note: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Mainstreaming on-demand shared services

In the Climate Action Plan, shared on-demand services (e.g. electric bicycles, electric cargo bicycles and, where legalised, e-scooters) are said to have the potential to extend "both the number and length of sustainable trips across Ireland" (Department of the Taoiseach Ireland, 2021[1]). However, their role in meeting the 2030 target of 500 000 additional journeys per day by sustainable modes is unclear.

While often small, initiatives for mainstreaming on-demand services exist in Ireland. Legislation to allow the use of e-scooters on streets and roads is being drafted (Department of Transport, 2022[59]). Bike-sharing schemes are available in the central areas of several cities, such as docked DublinBikes and station less Bleeper in Dublin (Citizen Information, 2022[97]) and docked TFI Bikes in Cork, Galway, Limerick and Waterford (TFI Bikes, 2022[98]). Car-sharing services also exist, though only in Dublin (e.g. GoCar, YUKO) (Movmi, 2019[99]). In rural areas, TFI Local Link offers bookable community transport services that offer door-to-door connections alongside its regular bus service (ITF, 2021[100]). Importantly, the new SMP includes a number of actions in its 5-year plan that are focused on the development of

different on-demand shared services. Among these are the expansion of bike (including electric) share schemes in the five major cities; the development of a model for deploying bike share schemes (including the potential for electric bikes) in regional growth centres and key towns; and the expansion of shared car, bike and powered personal transporters (which include micro-mobility) in transport hubs. A number of actions in the SMP also aim at developing supporting infrastructure that is key for these services. For instance, by developing active infrastructure programmes and cycling network plans, as well as secure bike parking. Some of these actions are small in terms of bridging the current infrastructure gap (e.g. the target for developing secure bike parking is to reach 1000 parking spots by 2025 in key towns and cities plus transport hubs). Thus, it could be good to revisit some of the targets in terms of the needs identified once active travel plans and other mentioned documents are developed. In addition, more ambitious modal shift targets (as recommended in this report; see chapter 4) might also require the scaling up of some of these efforts, and thus targets set in the current SMP should also be revisited in the light of this.

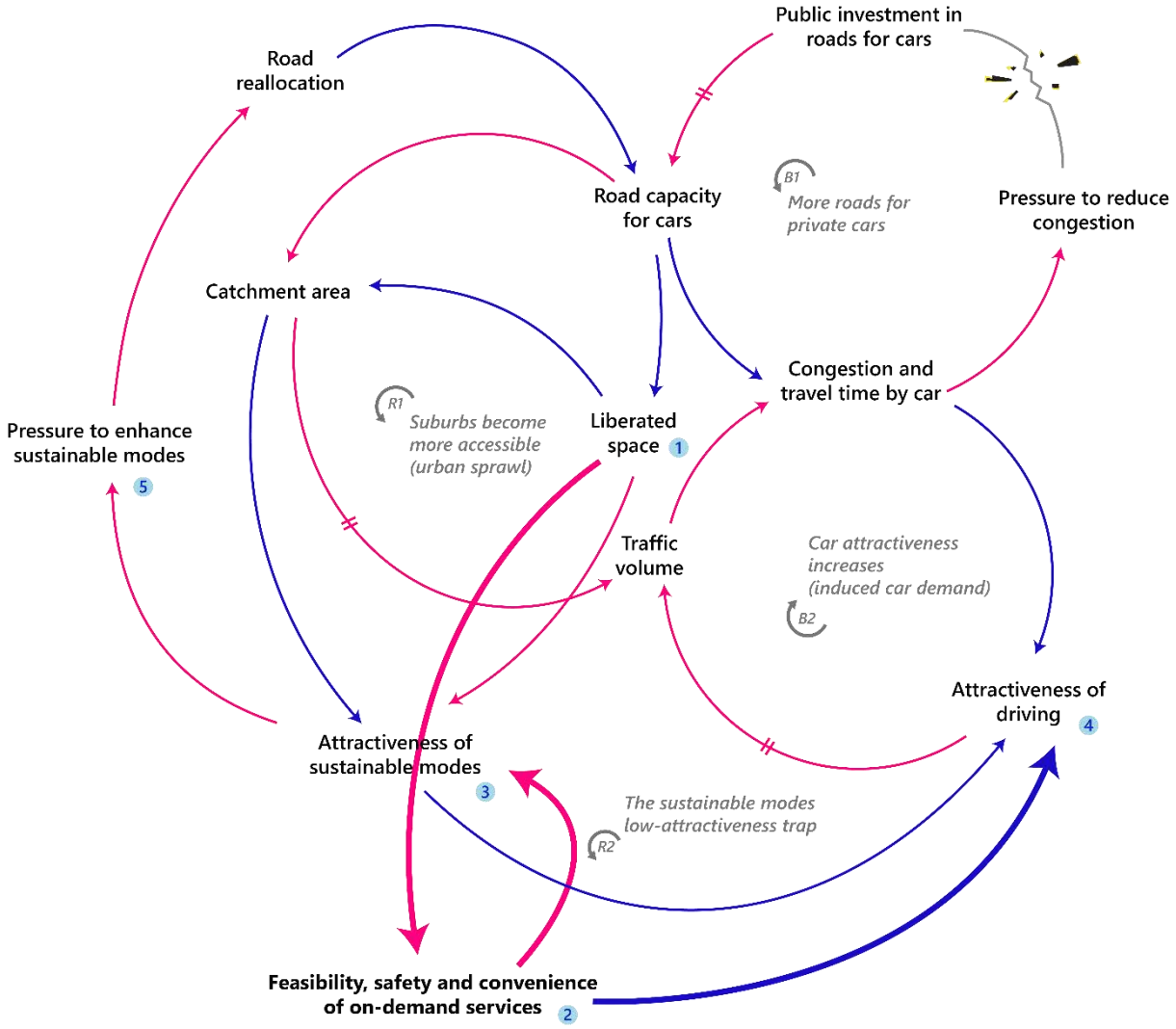
The rest of this section presents the detailed results of the assessment for the mainstream of on-demand shared services, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, efforts to mainstream on-demand services have transformative intent and high transformative potential (Figure 3.16). This policy has transformative intent as it aims at narrowing the attractiveness gap between shared transport and cars, and sees on-demand services as a cost- and time-effective way to do so. It has high transformative potential because, by creating connections and introducing new types of service (thus reorganising the system structure), it increases the attractiveness of existing modes (public transport and active modes) while also enlarging the offer of sustainable services. This analysis suggests that, when coupled with road space reallocation, main-streaming on-demand shared services has a high potential to trigger behavioural change through the creation of a network of safe, convenient and accessible alternatives to the car. Rapid acceleration of the development of a multi-modal transport system via on-demand services also has the potential to reduce the vehicle stock and thus facilitate electrification.

Mainstreaming on-demand shared services contribute to changing the structure of the system

In terms of systems dynamics, the mainstreaming of on-demand services (including bicycles, cargo bikes, micro-mobility and ride-sharing) has the potential to transform the transport system into a multi-modal system in which different forms of transport support each other seamlessly (Figure 3.27). While efforts to improve public transport and on-demand shared services complement each other, the mainstreaming of shared on-demand services is considered to have higher transformative potential than efforts to improve public transport: by increasing transport options, on-demand shared services can improve the system's connectivity in a cost-efficient manner and at a faster pace than public transport could do on its own.[36]

Space is an important limitation for the development of shared on-demand services (ITF, 2022[101]). The benefits of new shared mobility services depend greatly on a better allocation of scarce road space (e.g. bus corridors, ride-sharing lanes), which is now mainly allocated to space-consuming modes such as cars. The liberated space (1 in Figure 3.27) made available thanks to road space reallocation can be at least partly allocated to on-demand shared services, can increase their feasibility, safety and convenience (2, in Figure 3.27), and hence their attractiveness[37] (3): when (dedicated) space is available, on-demand shared services can become faster, safer and more pleasant than driving a car, whose attractiveness is reduced (4).

Figure 3.27. The effect of mainstreaming on-demand shared services on the dynamics underlying car dependency



Note: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

As people experience the benefits of a multi-modal transport network, the public pressure to enhance sustainable modes may increase (5), accelerating the virtuous cycle illustrated in Figure 3.27. This virtuous cycle can be further accelerated if the integration of on-demand services among themselves and with public and active modes is coupled with actions such as:

- Integrated ticketing allowing users to access all transport services with a single account, such as the TFI Go pilot, as the first stage of the Next Generation Ticketing programme.
- Subsidies and/or regulation to ensure on-demand services are available on the peripheries of cities where profitability may be lower, and to ensure that different modes (e.g. cargo bikes) are available.
- GPS technology and integrated apps providing users with real-time information, such as TFI's Real-time Information app (Box 3.5).

- Improvements in public transport infrastructure via initiatives such as BusConnects and Connecting Ireland. Public transport is the backbone of multi-modal networks (OECD, 2021[10]) and efforts in this direction should continue.

Mainstreaming on-demand shared services can reduce the vehicle stock and increase the effectiveness of electrification efforts

With respect to stocks and flows, a properly functioning multi-modal transport system reduces the need for (and dependence on) private cars, potentially reducing the size of the fleet and facilitating electrification. The electrification of a small and shrinking fleet is faster, cheaper and more environmentally friendly than the electrification of a big and growing fleet. Moreover, a system where modes such as micro-mobility (including e-bikes and e-scooters), buses and shared fleets increase their relative importance compared to private cars, will also increase the scope of electrification, as the uptake of electric mobility has been much faster for these vehicles compared to private cars (IPCC, 2022[25]).

Box 3.5. Systems innovation and the untapped potential of technology

The mainstreaming of on-demand services into public transport is an example of the potential of technology to trigger system innovation, that is, innovation focused on improving system functioning rather than just improving vehicles (e.g. by electrification). For example, GPS technologies and apps enable users to locate and combine multiple transport options in real time. They enable a system to be organised in such a way that people can reach their destinations without owning a car (the idea of mobility as a service).

On-demand shared services are also a good example of the complementary relationship between system innovation and business-as-usual innovation (i.e. innovation focused on improving the efficiency of parts of a system). For example, e-bikes (a technological change at the parts level) increase the convenience of cycling and expand its range of use (greater distances and more users), further reducing the need for cars (even shared). In combination with GPS, apps, and so on, e-bike-sharing systems can create a new service, so that not everyone needs to own an e-bike nor even use their own if a shared one is more convenient.

Source: (OECD, 2021[10])

Communication efforts

Ireland is making efforts to communicate the importance of reducing emissions in the transport sector. As part of its Climate Action Plan (Department of the Taoiseach Ireland, 2021[1]), the government has set up the Climate Communications Coordination Committee (CCCC),[38] the National Dialogue on Climate Action (NDCA) and the Zero Emission Vehicles Ireland Office (ZEVI). The CCCC aims to advise departments and agencies on overarching messaging content and support them in their climate communication initiatives (Department of the Taoiseach, 2022[102]). The NDCA was established in 2021 as the forum for engaging, enabling and empowering stakeholders and the public (DECC, 2022[103]). Established in 2022, the ZEVI aims to support "consumers, the public sector and businesses to continue to make the switch to zero emission vehicles" (Office of Zero Emission Vehicles, 2022[104]).

In addition, the new SMP sets out an explicit goal (goal 8) to improve research and engagement with citizens. The strategy also includes specific actions to support this goal by establishing new structures and mechanisms for engagement with the public and other stakeholders. Among these is the development and implementation of a public engagement strategy, which will have as objective to promote the benefits of and raise public awareness of sustainable transport options; and convening a National Sustainable Mobility Forum with the aim of communicating with the public on progress.

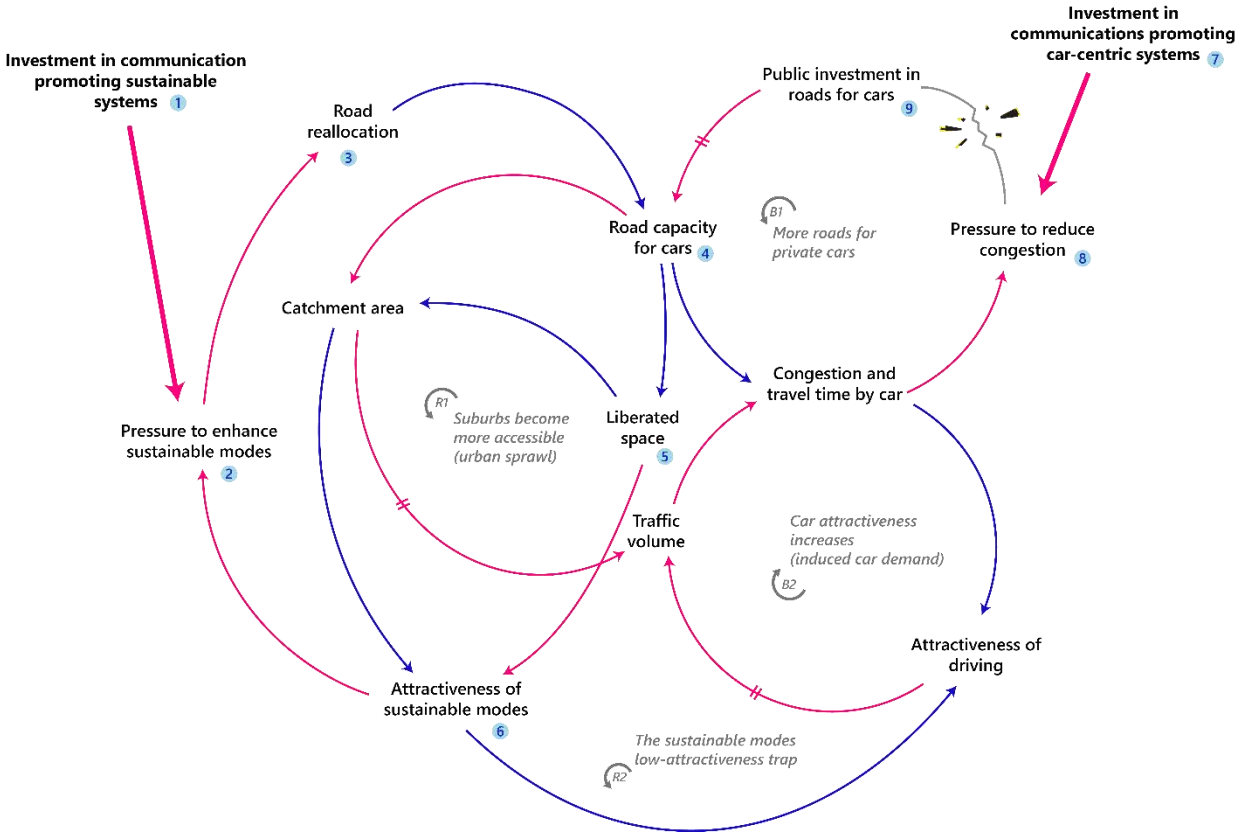
The rest of this section presents the detailed results of the assessment of communication efforts, based on the framework described in section 3.2.1. The section outlines the intent of the policy type and its transformative potential in terms of the effect on the system feedback loops, physical stocks and mental models underlying car dependency. Based on this analysis, this report concludes that when focused on sustainable transport systems, communication efforts have a transformative intent and a high transformative potential (Figure 3.16). Policy packages, including ambitious communication efforts, acknowledge the importance of mindsets in shaping and sustaining systems. By challenging existing mindsets and demonstrating the well-being benefits of sustainable transport systems (as defined in Chapter 2), communication efforts can increase political support for transformative policies, which is key to the transition towards such systems. At the same time, to be effective, communication efforts need to be coupled with policies that enable the conditions for sustainable modes to function properly, so that people can experience their benefits first-hand.

Communication efforts can increase feasibility for implementing other transformative policies

Investment in communication promoting sustainable systems (1 in Figure 3.28) can increase public pressure for public transport and active modes (e.g. by showing the well-being benefits of these systems), thus accelerating a virtuous cycle: as public pressure to enhance sustainable modes (2) increases, road space reallocation (3) becomes more feasible and can be accelerated, decreasing the road capacity for cars (4) and further liberating space (5) for public transport and active modes, increasing the attractiveness of sustainable modes (6) and the pressure to improve them further (2).

The benefits of these efforts and the virtuous cycle they could trigger may, however, be offset by investment in communication promoting car-centric systems (7). These investments reinforce the already present vicious cycle of induced demand (B2) by increasing the pressure to reduce congestion (8). As discussed earlier, road space reallocation “breaks the link” (upper right-hand side of Figure 3.28), between pressure to reduce congestion (8) and public investment in roads for cars (9). Communication promoting car-centric systems (7) can be an important barrier to doing this. Therefore, as discussed in chapter 4, regulating investments in communications promoting car-centric systems (7) may be necessary to increase political support for the transformative policies described in this report.

Figure 3.28. The effect of communication efforts on the systems dynamics underlying car dependency



Note 1: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Note 2: The coloured arrows show the relationship between variables. A pink arrow between variables means that they vary in the same direction: an increase in a variable leads to an increase in the variable it points at; a decrease in a variable leads to a decrease in the variable it points at. A blue arrow means that variables vary in the opposite direction: an increase in a variable leads to a decrease in the variable it points at; a decrease in a variable leads to an increase in the variable it points at. Each loop label (e.g. B1) denotes a feedback loop. A feedback loop is either reinforcing (R), or balancing (B). See Box 3.1 and section 3.1 for more information on how to read causal loop diagrams.

Reducing the "stock" of car-centric communication is as important as increasing communication promoting sustainable modes

Investment in communication promoting car-centric systems has been significantly higher than investment in communication promoting sustainable systems. The automobile industry spends between 400 and 600 euros per car sold on advertising (Ali, 2021[105]). With approximately 105 000 cars sold in Ireland in 2021, a rough estimate is that investment in car-centric advertising amounted to approximately 50 million euros for the year. By contrast, the Irish government estimates that spending on communication promoting sustainable transport modes will amount to 6 to 7 million euros in 2022 (Department of Transport, 2022[48]). While information on cumulative investment (stock) was not available, the size of the vehicle fleet can be used to calculate a rough proxy for it: if the estimated amount spent per car is applied to the entire vehicle fleet in Ireland, the stock of investment in advertising would be approximately 1 billion euros.

Furthermore, communication efforts by the Irish government may unintentionally reinforce the mindset promoted by commercial car-centric communication. The Irish Climate Action Plan 2021 expects 67% of emission reductions to come from better vehicles and fuels (Department of the Taoiseach Ireland, 2021[1]), which may reflect an implicit frame around technological optimism[39], which may narrow the conceivable solutions. For example, one of the strategy's goals is to reduce the kilometres travelled by ICEVs rather than the total number of kilometres travelled by car. Also, ZEVI highlights the benefits of switching to EVs (lower driving costs, the convenience of charging at home, driving the latest technology that looks and feels good, polluting less, benefit-in-kind tax exemptions) without mentioning alternatives to private car ownership or the consequences of car use (SEAI, 2022[106]; Office of Zero Emission Vehicles, 2022[104]). Chapter 4 provides initial suggestions for refocusing and scaling up communication efforts.

References

Adams, G. et al. (2021), "People systematically overlook subtractive changes", *Nature 2021 592:7853*, Vol. 592/7853, pp. 258-261, https://doi.org/10.1038/s41586-021-03380-y. [31]

Ahrens, A. and S. Lyons (2019), "Changes in Land Cover and Urban Sprawl in Ireland From a Comparative Perspective Over 1990–2012", *Land 2019, Vol. 8, Page 16*, Vol. 8/1, p. 16, https://doi.org/10.3390/LAND8010016. [19]

Ali, A. (2021), *Tesla's Spending on R&D and Marketing, Compared to Other Automakers*, Visual Capitalist, https://www.visualcapitalist.com/comparing-teslas-spending-on-rd-and-marketing-per-car-to-other-automakers/ (accessed on 1 July 2022). [105]

Archsmith, J., E. Muehlegger and D. Rapson (2021), *Future Paths of Electric Vehicle Adoption in the United States: Predictable Determinants, Obstacles and Opportunities*, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w28933. [55]

Aryanpur, V. et al. (2022), *Decarbonisation of passenger light-duty vehicles using spatially resolved TIMES-Ireland Model*, Elsevier. [40]

Avner, P., J. Rentschler and S. Hallegatte (2014), *Carbon Price Efficiency: Lock-in and Path Dependence in Urban Forms and Transport Infrastructure*, The World Bank, https://doi.org/10.1596/1813-9450-6941. [81]

Bauer, G. (2018), *The impact of battery electric vehicles on vehicle purchase and driving behavior in Norway*, Pergamon. [43]

Brand, C. and J. Anable (2019), *'Disruption' and 'continuity' in transport energy systems: the case of the ban on new conventional fossil fuel vehicles*, ECEEE 2019 Summer Study, Hyères France, https://eprints.whiterose.ac.uk/147678/ (accessed on 27 June 2022). [44]

Burgen, S. (2018), ""For me, this is paradise": Life in the Spanish city that banned cars", *The Guardian*, https://www.theguardian.com/cities/2018/sep/18/paradise-life-spanish-city-banned-cars-pontevedra (accessed on 20 July 2021). [91]

Cairns, S., S. Atkins and P. Goodwin (2002), "Disappearing traffic? The story so far", *Municipal Engineer*, Vol. 151/1, pp. 13-22, https://doi.org/10.1680/muen.151.1.13.38856. [90]

Cambridge Dictionary (2022), *Curtilage Definition*, Cambridge Dictionary. [109]

Cambridge Dictionary (2022), *Definition of catchment area*, https://dictionary.cambridge.org/dictionary/english/catchment-area (accessed on 9 August 2022). [18]

Carroll, P. and P. O'Sullivan (2020), *Forecasting the impact of the Planning, Land Use and Transport Outlook (PLUTO) Project – a 2040 Ireland case study*, Elsevier B.V., https://doi.org/10.1016/j.trpro.2020.09.007. [20]

Caulfield, B., P. Carroll and A. Ahern (2020), *Transitioning to low carbon and sustainable mobility*, Climate Change Advisory Council, http://hdl.handle.net/2262/93659 (accessed on 26 July 2022). [12]

Caulfield, B. et al. (2022), "Measuring the equity impacts of government subsidies for electric vehicles", *Energy*, Vol. 248, p. 123588, http://doi.org/10.1016/j.energy.2022.123588. [41]

Central Bank of Ireland (2019), *Population Change and Housing Demand in Ireland*. [21]

Citizen Information (2022), *Cycling in Ireland*, Citizen Information - Travel and Recreation - Cycling, https://www.citizensinformation.ie/en/travel_and_recreation/cycling/overview_cycling.html#lc562c (accessed on 24 June 2022). [97]

City of Paris (2022), *Toute la rue de Rivoli réservée aux piétons et aux*, https://www.paris.fr/pages/la-rue-de-rivoli-reservee-aux-pietons-et-aux-velos-7792 (accessed on 28 June 2022). [94]

Conway, R. et al. (2019), "The Current State of Cycling Infrastructure in Dublin and Copenhagen; A Comparison of Cycling Infrastructure in 8 Radial Routes into the City Centre of Dublin and Copenhagen", *Irish Medical Journal*, https://imj.ie/the-current-state-of-cycling-infrastructure-in-dublin-and-copenhagen-a-comparison-of-cycling-infrastructure-in-8-radial-routes-into-the-city-centre-of-dublin-and-copenhagen/ (accessed on 12 July 2022). [23]

CSO (2019), *National Travel Survey 2019*, Central Statistics Office (CSO), Cork, Ireland, https://www.cso.ie/en/releasesandpublications/ep/p-nts/nationaltravelsurvey2019/ (accessed on 23 August 2022). [24]

CSO (2016), *Occupied Dwellings*, Census of Population 2016 - Profile 1 Housing in Ireland, https://www.cso.ie/en/releasesandpublications/ep/p-cp1hii/cp1hii/od/ (accessed on 12 July 2022). [60]

CSO Ireland (2022), *Mechanically Propelled Vehicles under Current Licence*, http://Mechanically Propelled Vehicles under Current Licence (accessed on 23 September 2022). [14]

DECC (2022), *National Dialogue on Climate Action (NDCA)*, https://www.gov.ie/en/publication/4bf2c-national-dialogue-on-climate-action-ndca/ (accessed on 25 July 2022). [103]

Department of Public Expenditure and Reform (2022), *Budget 2022 The Use of Carbon Tax Funds 2022*. [71]

Department of the Taoiseach (2022), *Appendix 1 Climate Action Plan 2021 Progress Report*, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjHsO6UjpT5AhX8g84BHVoHCwAQFnoECAMQAQ&url=https%3A%2F%2Fassets.gov.ie%2F226640%2F455e596a-42c5-4d64-b261-21e63e7ccd49.pdf&usg=AOvVaw2oqVNH-GJGDmF766sD9Km7. [102]

Department of the Taoiseach Ireland (2021), *Climate Action Plan 2021*, https://www.gov.ie/en/campaigns/2f87c-climate-action-plan-2021/# (accessed on 14 June 2022). [1]

Department of Transport (2022), "Interviews with the Climate Engagement & Governance Division, Department of Transport". [48]

Department of Transport (2022), *National Sustainable Mobility Policy*, https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/ (accessed on 13 June 2022). [59]

Department of Transport (2021), *Electric Vehicle Policy Pathway*, gov.ie, https://www.gov.ie/en/publication/e62e0-electric-vehicle-policy-pathway/. [50]

Department of Transport (2021), *Revised National Development Plan will transform how we travel, with a 35 billion euro package prioritising investment in sustainable, active, accessible public transport*, https://www.gov.ie/en/press-release/35dfe-revised-national-development-plan-will-transform-how-we-travel-with-a-35-billion-euro-package-prioritising-investment-in-sustainable-active-accessible-public-transport/ (accessed on 27 June 2022). [56]

Department of Transport Ireland (2022), *The benefits of switching to an Electric Vehicle*, https://www.gov.ie/en/publication/fabfa-electric-vehicles/ (accessed on 10 June 2022). [34]

Department of Transport Ireland (2020), *Sustainable Mobility Policy Review - Background Paper 4 Congestion*. [8]

Dept of Rural and Community Development and Dept of Housing Local Government and Heritage (2022), *Town Centre First Policy*, https://www.gov.ie/en/publication/473d3-town-centre-first-policy/ (accessed on 13 June 2022). [62]

Dimitropoulos, A., W. Oueslati and C. Sintek (2016), "The Rebound Effect in Road Transport: A Meta-analysis of Empirical Studies", No. 113, OECD, Paris. [76]

Douenne, T. and A. Fabre (2020), *Yellow Vests, Carbon Tax Aversion, and Biased Beliefs*, Paris School of Economics, Paris, https://www.parisschoolofeconomics.eu/docs/douenne-thomas/job-market-paper--yellow-vests,-carbon-tax-aversion,-and-biased-beliefs.pdf (accessed on 27 June 2022). [82]

Douenne, T. and A. Fabre (2020), "French attitudes on climate change, carbon taxation and other climate policies", *Ecological Economics*, Vol. 169, p. 106496, https://doi.org/10.1016/J.ECOLECON.2019.106496. [73]

Dowling, K. (2022), *Over 8% of cars sold in 2021 were battery electric*, IEVOA. [45]

Dún Laoghaire-Rathdown County Council (2019), *Ballyogan & Environs: Local Area Plan 2019 - 2025*, https://www.dlrcoco.ie/sites/default/files/atoms/files/ballyogan_and_environs_local_area_plan_2019-2025.pdf (accessed on 27 June 2022). [108]

EC (2009), *Directorate-General for the Environment Reclaiming city streets for people Chaos or quality of life?*. [88]

Environmental Protection Agency Ireland (2022), *Environmental Protection Agency - Transport*, https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/ (accessed on 10 June 2022). [2]

Eurostat (2022), *Database - Population and demography*, https://ec.europa.eu/eurostat/web/population-demography/demography-population-stock-balance/database (accessed on 10 June 2022). [15]

Eurostat (2022), *Passenger Cars in the EU*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU#An_almost_10_.25_increase_in_EU-registered_passenger_cars_since_2015 (accessed on 26 September 2022). [13]

Font Vivanco, D. et al. (2014), "The Remarkable Environmental Rebound Effect of Electric Cars: A Microeconomic Approach", https://doi.org/10.1021/es5038063. [86]

Gaur, A. et al. (2022), "Low energy demand scenario for feasible deep decarbonisation: Whole energy systems modelling for Ireland", *Renewable and Sustainable Energy Transition*, Vol. 2, p. 100024, https://doi.org/10.1016/J.RSET.2022.100024. [38]

Geman, B. (2019), *Transportation emissions are a tough nut to crack*, Axios, https://www.axios.com/carbon-pricing-difficult-to-reduce-transportation-emissions-b6cf8a74-6cfe-47ca-9f6e-c5b4d266d96c.html (accessed on 30 August 2021). [78]

Gillingham, K. and A. Munk-Nielsen (2019), "A Tale Of two tails: Commuting and the fuel price response in driving", *Journal of Urban Economics*, Vol. 109, pp. 27-40, https://doi.org/10.1016/J.JUE.2018.09.007. [79]

Government of Ireland (2022), *Town Centre First: A Policy Approach for Irish Towns*, Department of Rural and Community Development; Department of Housing, Local Government and Heritage. [65]

Government of Ireland (2018), *Project Ireland 2040: National Planning Framework*, https://assets.gov.ie/7338/31f2c0e4ba744fd290206ac0da35f747.pdf (accessed on 27 June 2022). [61]

IEA (2022), *Global EV Outlook 2022 – Analysis - IEA*, https://www.iea.org/reports/global-ev-outlook-2022 (accessed on 24 June 2022). [51]

Industry, Society of the Irish Motor (2022), *222 Registration Begins: New car registrations marginally ahead first half of the year | SIMI*, https://www.simi.ie/en/news/222-registrations-begins-new-car-registrations-marginally-ahead-first-half-of-the-year (accessed on 20 September 2022). [46]

IPCC (2022), "Climate Change 2022: Mitigation of Climate Change. Summary for Policymakers", http://www.ipcc.ch (accessed on 13 June 2022). [25]

IPCC (2014), *Transport. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, https://www.ipcc.ch/report/ar5/wg3/transport/. [85]

ITF (2022), *How accessible is your city?*, https://www.itf-oecd.org/urban-access-framework (accessed on 21 June 2022). [58]

ITF (2022), "Streets That Fit: Re-allocating Space for Better Cities", *International Transport Forum Policy Papers*, No. 100, OECD Publishing, Paris, https://doi.org/10.1787/5593d3e2-en. [101]

ITF (2021), "Innovations for Better Rural Mobility", *ITF Research Reports*, OECD Publishing, Paris, https://www.itf-oecd.org/innovations-better-rural-mobility (accessed on 24 June 2022). [100]

ITF (2021), *Reversing Car Dependency | ITF*, https://www.itf-oecd.org/reversing-car-dependency (accessed on 22 June 2022). [89]

ITF (2019), "Benchmarking Accessibility in Cities", *International Transport Forum Policy Papers*, No. 68, OECD Publishing, Paris, https://www.itf-oecd.org/benchmarking-accessibility-cities (accessed on 10 June 2022). [87]

ITF-OECD (2017), *Income Inequality, Social Inclusion and Mobility Roundtable Report 2017 Income Inequality, Social Inclusion and Mobility*, https://www.itf-oecd.org/sites/default/files/docs/income-inequality-social-inclusion-mobility.pdf (accessed on 4 June 2019). [72]

Kampman et al. (2011), *Impacts of Electric Vehicles - Deliverable 5 Impact analysis for market uptake scenarios and policy implications*. [37]

Lakoff, G. and M. Johnson (2008), *Metaphors We Live By*, University of Chicago Press, https://books.google.com/books/about/Metaphors_We_Live_By.html?id=r6nOYYtxzUoC (accessed on 15 July 2022). [28]

Lamb, W. et al. (2021), "A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018", *Environmental Research Letters*, Vol. 16/7, p. 073005, https://doi.org/10.1088/1748-9326/abee4e. [27]

Le Parisien (2021), *Pérennisation des coronapistes : à Paris, la piste cyclable de la rue de Rivoli change de look*, https://www.leparisien.fr/paris-75/perennisation-des-coronapistes-a-paris-la-piste-cyclable-de-la-rue-de-rivoli-change-de-look-08-12-2021-OGDCK6N6OVA2PP7MUDYQKQBQRU.php (accessed on 28 June 2022). [95]

Leard, B., J. Linn and K. Cleary (2020), *Carbon Pricing 202: Pricing Carbon in the Transportation Sector: What are the effects of a carbon price on the transportation sector, from fuel prices to total miles traveled?*, Resources for the Future: Explainer, https://www.rff.org/publications/explainers/carbon-pricing-202-pricing-carbon-transportation-sector/ (accessed on 27 September 2022). [75]

Lévay, P., Y. Drossinos and C. Thiel (2017), "The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership", *Energy Policy*, Vol. 105, pp. 524-533, https://doi.org/10.1016/J.ENPOL.2017.02.054. [49]

Mattioli, G., Z. Wadud and K. Lucas (2018), "Vulnerability to fuel price increases in the UK: A household level analysis", *Transportation Research Part A: Policy and Practice*, Vol. 113, pp. 227-242, https://doi.org/10.1016/j.tra.2018.04.002. [80]

Meadows, D. (2008), *Thinking in Systems*, Chelsea Green, https://www.chelseagreen.com/product/thinking-in-systems/ (accessed on 8 March 2021). [3]

Meadows, D. (1999), *Leverage Points: Places to Intervene in a System*, The Donella Meadows Project: Academy for Systems Change, https://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/ (accessed on 11 July 2022). [32]

MIT Energy Initiative (2019), *Insights into Future Mobility - Executive Summary*, MIT Energy Initiative , Cambridge, MA. [54]

Movmi (2019), *Shared Mobility in by Region: UK and Ireland*, https://movmi.net/blog/shared-mobility-uk-ireland/ (accessed on 24 June 2022). [99]

Mukherjee, S. and L. Ryan (2020), "Factors influencing early battery electric vehicle adoption in Ireland", *Renewable and Sustainable Energy Reviews*, Vol. 118, p. 109504, https://doi.org/10.1016/J.RSER.2019.109504. [42]

Murray, B. and N. Rivers (2015), "British Columbia's revenue-neutral carbon tax: A review of the latest "grand experiment" in environmental policy", *Energy Policy*, Vol. 86, pp. 674-683, https://doi.org/10.1016/J.ENPOL.2015.08.011. [74]

National Transport Authority Ireland (2021), *Greater Dublin Area Transport Studies - Dublin City Center Area Report*. [22]

Norsk elbilforening (2021), *Norwegian EV market*, Norsk elbilforening. [111]

NTA (2022), *Core Bus Corridor*, BusConnects, https://busconnects.ie/initiatives/core-bus-corridors/ (accessed on 11 July 2022). [67]

OECD (2021), *Effective Carbon Rates 2021: Pricing Carbon Emissions through Taxes and Emissions Trading*, OECD Publishing, Paris, https://doi.org/10.1787/0e8e24f5-en. [83]

OECD (2021), *OECD Environmental Performance Reviews: Ireland 2021*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9ef10b4f-en. [57]

OECD (2021), *Transport Strategies for Net-Zero Systems by Design*, OECD Publishing, Paris, https://doi.org/10.1787/0a20f779-en (accessed on 10 June 2022). [10]

OECD (2019), *Taxing Energy Use 2019: Using Taxes for Climate Action*, OECD Publishing, Paris, https://doi.org/10.1787/058ca239-en. [68]

OECD (2018), *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*, OECD Publishing, Paris, https://doi.org/10.1787/9789264189881-en. [17]

Office of Zero Emission Vehicles (2022), *Zero Emission Vehicles Ireland: Information for the general public*, https://www.gov.ie/en/publication/ca752-zero-emission-vehicles-ireland-information-for-general-public/ (accessed on 25 July 2022). [104]

Orsi, F. (2021), *On the sustainability of electric vehicles: What about their impacts on land use?*, Elsevier. [36]

Parliamentary Budget Office Ireland (2022), *An Overview of Ireland's Electric Vehicle Incentives and a Comparison With International Peers*. [35]

Randall, C. (2021), *Norway: with stats from December, stronger EV sales in 2020*, electrive.com. [110]

RTÉ (2022), *New car sales down 25% but EV sales soar - CSO*, Raidió Teilifís Éireann (RTÉ). [47]

Rubiera-Morollón, F. and R. Garrido-Yserte (2020), "Recent Literature about Urban Sprawl: A Renewed Relevance of the Phenomenon from the Perspective of Environmental Sustainability", *Sustainability 2020, Vol. 12, Page 6551*, Vol. 12/16, p. 6551, https://doi.org/10.3390/SU12166551. [64]

Rueda, S. (2020), *Debats in the Official College Arquitects of Catalonia (COAC). Superilles, cap a un nou model de ciutat.*. [93]

Rueda, S. (2019), "Superblocks for the design of new cities and renovation of existing ones: Barcelona's case", in Nieuwenhuijsen, M. and K. Haneen (eds.), *Integrating Human Health into Urban and Transport Planning*, Springer International Publishing, https://doi.org/10.1007/978-3-319-74983-9_8/COVER/. [92]

SCSI (2021), *Real Cost of New Apartment Delivery Report*, Society of Chartered Surveyors Ireland, https://scsi.ie/real-cost-of-new-apartment-delivery/ (accessed on 27 June 2022). [66]

SEAI (2022), *Benefits Of Electric Cars: Why Drive An EV? | Electric Vehicles | SEAI*, https://www.seai.ie/technologies/electric-vehicles/why-drive-electric/ (accessed on 30 May 2022). [106]

SEAI (2022), *Energy Statistics In Ireland | SEAI*, Sustainable Energy Authority Ireland, https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/transport/ (accessed on 14 June 2022). [77]

Small, K. and J. Gomez-Ilbanez (1998), "Road Pricing for Congestion Management: The Transition from Theory to Policy", *University of California Transportation Center, Working Papers*, https://ideas.repec.org/p/cdl/uctcwp/qt8kk909p1.html (accessed on 26 September 2022). [70]

Society of the Irish Motor Industry (2022), *Reducing light fleet carbon emissions to achieve Irish Government targets.*. [39]

Society of the Irish Motor Industry (2022), *SIMI | Motorstats - New Online Vehicle Statistics System*, https://www.simi.ie/en/motorstats (accessed on 10 June 2022). [16]

Soulopoulos, N. (2017), *When Will Electric Vehicles be Cheaper than Conventional Vehicles?*, Bloomberg News Energy Finance. [53]

Sterman, J. (2000), *Business Dynamics*, http://jsterman.scripts.mit.edu/Business_Dynamics.html (accessed on 8 March 2021). [4]

Systems Innovation (2022), *Systems Ecology Introduction*. [26]

Systems Innovation (2021), *Leverage Points A Guide For Systems Innovators*, Si Network, https://media2-production.mightynetworks.com/asset/36886279/Leverage_Points_Guide.pdf?_gl=1*11t7147*_ga*MTk1ODAzODMyMS4xNjYwMjIyMzI5*_ga_T49FMYQ9FZ*MTY2MzA2NDQ1MC4xMS4xLjE2NjMwNjQ0NzUuMC4wLjA. (accessed on 18 July 2022). [33]

Systems Innovation (2021), *Nonlinear Systems: An Overview*. [6]

Systems Innovation (2020), *Systems Theory*, https://www.systemsinnovation.io/post/systems-theory-guide (accessed on 25 March 2021). [5]

Szymkowski, S. (2021), *Volkswagen foresees EV price parity with ICE by 2025, 50% EV sales by 2030*, CNET. [52]

Te Brömmelstroet, M. (2020), *Mobility Language Matters*, De Correspondent. [29]

TFI Bikes (2022), *Home - TFI Bikes*, https://www.bikeshare.ie/ (accessed on 24 June 2022). [98]

The Irish Times (2022), *What do the truckers protesting in Dublin want?*, https://www.irishtimes.com/news/ireland/irish-news/what-do-the-truckers-protesting-in-dublin-want-1.4849837 (accessed on 11 July 2022). [84]

The Irish Times (2019), *Sandyford site with planning for over 450 homes makes €38m*, https://www.irishtimes.com/business/commercial-property/sandyford-site-with-planning-for-over-450-homes-makes-38m-1.3804786 (accessed on 27 June 2022). [107]

TII (2019), *National Transport Model Update - Travel Demand Forecasting Report, NTpM Vol 3*, Transport Infrastructure Ireland. [11]

Transport Infrastructure Ireland (2017), *Submission to the Select Committee On Budgetary Oversight*. [9]

van Dender, K. (2019), "Taxing vehicles, fuels, and road use: Opportunities for improving transport tax practice", *OECD Taxation Working Papers*, No. 44, OECD Publishing, Paris, https://doi.org/10.1787/e7f1d771-en. [69]

Wilson, B. and A. Chakraborty (2001), "The Environmental Impacts of Sprawl: Emergent Themes from the Past Decade of Planning Research", Vol. 5, pp. 3302-3327, https://doi.org/10.3390/su5083302. [63]

WIRED UK (2022), *People Hate the Idea of Car-Free Cities—Until They Live in One*, https://www.wired.co.uk/article/car-free-cities-opposition (accessed on 11 July 2022). [96]

WSP and RAND Europe (2018), *Latest Evidence on Induced Travel Demand: an Evidence Review*, Department of Transport, London, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/762976/latest-evidence-on-induced-travel-demand-an-evidence-review.pdf (accessed on 27 June 2022). [7]

Zimmerman, B., C. Lindberg and P. Plsek (2009), "A Complexity Science Primer: What is Complexity Science and Why Should I Learn About It?". [30]

Notes

[1] The dynamic is often referred to as "induced demand" in literature, leaving implicit the fact that it refers to the increase in car traffic.

[2] Although induced traffic is highly dependent on the context, scale and location of the system, theoretical calculations show that an average road improvement will result in an increase in base traffic of 10% in the short term and 20% in the long term, assuming that the traffic growth caused by all other causes is projected properly. This is consistent with

other variables such as unexpected short-term growth in traffic, greater long-term overall growth in traffic, a growth in the "peak period" of traffic, and limited relief to alternative routes (Cairns, Atkins and Goodwin, 2002[90]).

[3] For instance, Caulfield, Carroll and Ahern (2020[12]) carry out a literature review and analysis of policy options to reduce emissions in the sector in Ireland. This work is referred to where relevant throughout this section.

[4] The system's physical lock-in is linked to the notion of hysteresis. The notion of hysteresis emphasises the dependence of a system state on its memory or history and the importance that past events have in shaping the system's results today (Systems Innovation, 2022[26]).

[5] By visually illustrating how long it may take to achieve a desired outcome, stock and flow analysis can trigger questions that may inform policy design, and not just their assessment (e.g. in policy co-creation exercises, as tried out during the April 2022 workshops). For example, if the speed of change is insufficient, discussions of qualitatively different actions (e.g. reducing stocks) can be triggered.

[6] For example, not all actions in the new SMP are included.

[7] The level of attention and funding is a dimension not shown in Figure 3.16.

[8] As well as other vehicle technology (e.g. hydrogen-powered vans) and fuel incentives.

[9] On average, the cost of driving EVs is 70% lower than the cost of driving ICEVs in Ireland (Department of Transport Ireland, 2022[34]).

[10] The larger the EV subsidies, the lower the cost of driving and owning a car, the higher the attractiveness of driving and owning a car.

[11] The direct rebound effect in transport is the degree to which a reduction in the cost of travel (by a change in technology) translates into increased kilometres driven (IPCC, 2014[85]), offsetting some, and sometimes all, environmental benefits from the technological efficiency gain.

[12] Curtilage refers to "the land surrounding a building that belongs to the owner of the building and for which he or she has responsibility" (Cambridge Dictionary, 2022[109]).

[13] According to the DoT, this is plausible if maintaining scrappage rates seen in the last 2 years (between 7%-7.5% in average and going up to 24% for gasoline vehicles with >18 years). The department will likely be making updates to the fleet model as data from the end of 2022 becomes available to gain a better understanding of the impact of Covid-19 on vehicle registrations/scrappage.

[14] EV sales accounted for 54.3% of total sales in 2020 (Randall, 2021[110]), which increased by 10% to 64.5% in 2021 (Norsk elbilforening, 2021[111]).

[15] Other studies indicate the process will take longer. As discussed in (Caulfield, Carroll and Ahern, 2020[12]), a study from the Massachusetts Institute of Technology projects a decrease of 50% in the cost of EV batteries by 2030, which is less than that reported in the CAP (67%).

16 Some EV models are SUVs, thus, the two are not mutually exclusive.

[17] Proposals to reduce public transport prices and make public transport free (Caulfield, Carroll and Ahern, 2020[12]) can also jeopardise efforts to increase investment aimed at improving the attractiveness of the mode.[17][17] As discussed in (OECD, 2021[10]), the idea of subsidising public transport should not be excluded and targeted subsidies (preferably based on affordability criteria) should be preferred. Correcting under-priced car use, which contributes to making public transport relatively expensive, must also be a priority (OECD, 2021[10]).

[18] Detached houses with their own sewerage system.

[19] The majority of these one-off houses were built before 2011.

[20] In rural areas, the target is 30%.

[21] The words “infill” and “brownfield” are used interchangeably to describe potential sites for development in the cited policy documents, but they are different concepts and should be treated differently (see section 4.6.1 for discussion and recommendations).

[22] Greenfield development is defined as development that extends the physical footprint of urban areas (Government of Ireland, 2018[61]).

[23] Interviewed officials pointed to cultural preferences in Ireland for detached/one-off houses with gardens as a key driver of greenfield development and urban sprawl (Department of Transport, 2022[48]).

[24] The report uses Ballyogan Road in Leopardstown and Sandyford Industrial Estate as examples of suburban development sites (SCSI, 2021[66]). They are both greenfield sites on the outskirts of Dublin near the M50 motorway (Dún Laoghaire-Rathdown County Council, 2019[108]; The Irish Times, 2019[107]). North of Dublin Docklands, a brownfield site in central Dublin, serves as an example of an urban site (SCSI, 2021[66]).

[25] The programmes are grouped together here as one policy; however, individual actions can be classified differently if evaluated on their own (see Annex B).

[26] The carbon tax rate will be gradually raised from €33.50 to €100 per tonne over the period 2021–2030.

[27] As discussed in chapter 4, setting a target that covers solely ICE kilometres (rather than total car travel) is not in line with the aim of reducing congestion and total traffic volumes, and more largely with the aim of shifting away from car dependency

[28] Low-emission zones can, in the short run, work like road pricing and help to slow down induced car demand (by restricting access to the dirtiest vehicles). However, evidence (e.g. from Milan) shows that they serve mostly to accelerate vehicle renewal, and as the fleet becomes cleaner traffic in the restricted area increases again. In Milan the low-emission zone was turned into a hybrid model that combines road pricing for all vehicles with a ban on the most polluting ones (OECD, 2021[10]). The presence of low-emission zones can incentivise hybrid vehicles to be driven in geo-fencing mode just before entering the zone (to charge the battery). The gap between on-road and laboratory-environment emissions is particularly high during driving in geo-fencing mode (OECD, 2021[10]).

[29] This is different from EV incentives, for instance, which are also anticipatory but aim at decarbonising growing car traffic rather than containing it.

[30] In the case of a uniform carbon price, the cost of fuel will increase proportionally to fuels carbon content

[31] The higher the uptake of electrification and the higher the improvements in fuel efficiency, the more this will become an issue.

[32] Regular updates in prices could help mitigate this phenomenon. However, acceptability of carbon pricing is challenging in car-dependent systems where good transport alternatives are limited or inexistent to many (see more discussion below).

[33] The authors develop a vulnerability index to fuel price increases by combining exposure (cost burden of motor fuel), sensitivity (income level) and adaptive capacity (access to alternative transport infrastructure) (Mattioli, Wadud and Lucas, 2018[80]). Analysis based on this type of index can help identify vulnerable households, infrastructure gaps and necessary compensatory measures, as well as potential acceptability issues related to carbon pricing increases.

[34] With a growing population, the effect on total as opposed to per-capita travel will be even smaller if trends continue.

[35] Including the reallocation of parking space, which makes up a large amount of the space granted to car use.

[36] On-demand schemes introduce new services, business models and types of vehicles unavailable or marginal in the current transport system. The mainstreaming of on-demand services facilitates the development of multi-modal networks able to offer door-to-door connections, and the private sector engagement can speed up this development. For example, e-scooters, e-bikes, e-cargo bikes, on-demand micro-transit and car-sharing schemes are offered to the public via leasing or other subscription modes. These newly available services increase the alternatives to the car and the length and type of trips possible via active modes (e.g. buying groceries, transporting family, facilitating use by the elderly), and strengthen public transport connectivity.

[37] Because they complement public transport, the expansion of on-demand services can also increase the attractiveness of public transport services.

[38] The CCCC replaces the Interdepartmental Group on Climate Communications established in 2019.

[39] Technological optimism refers to the idea that "technological improvements will allow countries to reduce emissions at the pace and scale needed. It sees technology as a way to increase vehicle performance (in terms of speed, fuel consumption, emissions, etc.), rather than improving the way systems are organised, where technological potential is mostly untapped and could lead to enormous emission reductions" (OECD, 2021[10]).

4 Redesign

This chapter builds upon the analysis of Ireland's existing and planned policies presented in Chapter 3. It offers recommendations on prioritising and scaling up transformative policies to accelerate Ireland's transition towards transport systems that work for people and the planet. The recommendations are developed based on information gathered from interviews, ideas generated in workshops, OECD expertise and international best practice. The chapter also explores the ways in which rethinking current government structures and institutions can both trigger and foster transformative change.

The previous chapter described the key dynamics driving car dependency in Ireland. It assessed the potential of current and planned policies to trigger a transformational move away from the car-dependent system and concluded that many of the interventions in Ireland have been channelled towards policies with a low potential to transform the car-dependent system. The analysis also identified some interventions that are focused on policies with a high transformative potential, although these are currently implemented on a small scale. It observed that Ireland has an opportunity to increase the pace and depth of climate action by refocusing its efforts and attention towards the transformative policies and actions identified. The new SMP already includes a number of actions that go in this direction, and this chapter provides recommendations that can serve to enlarge and complement its action plan. Ireland has also an opportunity to reflect the analysis and recommendations in this report in the new Climate Action Plan 2023. Because the car-dependent system is also at the source of many other negative impacts, refocusing efforts to shift away from car dependency is also an opportunity for Ireland to align its climate and wider well-being agendas.

This chapter is structured as follows:

- Sections 4.1 and 4.2 focus on how Ireland can better align its decision-making processes and priorities to trigger transformational change for the transport sector.
- Sections 4.3 and 4.4 focus on ways to mainstream and enlarge the scale of implementation of two policies with high potential to change the system structure via creating new feedback loops (see Chapter 3). The first (road space reallocation) touches directly on, and has the potential to shift the system away from, the induced demand dynamic, while also helping to reduce sprawl and provide better conditions for sustainable modes. The second (scaling up shared on-demand services) touches directly on, and has the potential to shift the system away from, the sustainable modes low-attractiveness trap, especially if combined with road space reallocation and increased efforts to improve public and active transport infrastructure and services.
- Section 4.5 addresses how Ireland can refocus its electrification strategy to support, rather than hinder, transformational change and the implementation of transformative policies. As discussed in Chapter 3, combining electrification efforts with transformative policies and shifting the system away from car dependency, can make these efforts more feasible and effective.
- Section 4.6 reflects on how Ireland could increase the attractiveness of brownfield development. This report does not include a full analysis of sprawl and the residential system, and thus does not offer a fully-fledged set of recommendations on how to address it. However, addressing car dependency leads to addressing sprawl. Improving the attractiveness of brownfield development was seen to be a key issue to help reverse sprawl throughout the project. Some of the discussions during the workshops focused on this point; this section builds on them and on good international practice.
- Section 4.7 discusses how a nationwide communication strategy could help enable and trigger transformational change. It describes the main components that would have to be included and suggests ways of developing each of the components
- Lastly, section 4.8 explores ways in which rethinking current governance structures and institutional arrangements could trigger transformational change.

As illustrated in Chapter 2, the pursuit of car independence will have a different shape and scope in different areas of Ireland. Nonetheless, a key message of this report is that **refocusing efforts towards transformative policies is not restricted to urban areas**. They should be applied, and can bring major benefits, to people living in diverse conditions. Recommendations should be particularly aware of and addressed to isolated populations. Box 4.1 makes some key distinctions in the shape and scope of the transformation in different areas and the role of different policies in different types of area.

Box 4.1. Transformational change in different territory types

The delivery of systems that are less mobility- and emission-intensive and improve accessibility should be the aim throughout Ireland. Such systems may look quite different in distinct areas, and policies recommended may be adapted accordingly. This box lists key differences that should be taken into account when implementing policies that have been identified by this report as having a high transformative potential for transforming the Irish transport system in different types of areas. It builds on urban and rural categories developed by the Central Statistics Office, as described in (CSO Ireland, 2019[1]). Throughout this chapter other discussions (e.g. road pricing in section 4.5) also address territorial differences.

Overall, land-use decisions and planning should make it a priority to avoid creating more of the type of development that leads to car dependency – low-density areas around cities and scattered development in both rural and urban areas. The newly formed taskforce, established by the government to conduct and complete a land use review and to develop a land use strategy, is a good opportunity to advance this goal (see also discussions in section 4.6). Communication strategies (see section 4.7) and public participation (see section 4.8) should support the implementation of transformative policies everywhere.

Cities and their surrounding areas: cities and their surroundings areas (made up of satellite urban towns[1] and rural areas with a high urban influence[2]) have the highest potential to reduce private car use and channel it to very specific, occasional trips where its social benefit exceeds its costs. In these areas, shared active and micro-mobility modes can fulfil a large number of short- and medium-distance trips (especially within cities and satellite urban towns). Meanwhile, enhanced public transport along with new shared services (e.g. shared micro-transit) can provide for the bulk of longer trips, and specifically those that connect different areas: connections between satellite urban towns and the city, connections between different satellite urban towns, and connections between rural areas with satellite urban towns and the city. Challenges, however, differ between implementing policies in the main city and beyond it. The greatest challenge will be to expand actions towards the areas beyond the city. In other words, to include the different satellite urban towns, and moreover to find ways of connecting the rural areas that are highly influenced by the main city but where more scattered development exists. Strategies that solely transform the main cities will be insufficient and their feasibility reduced.

- **Road space reallocation** must be focused on completely transforming and reshaping streets and roads, using tools proposed in section 4.3. There is an important opportunity for reallocating road space to sustainable modes (e.g. shared bikes, cargo bikes, e-bikes and scooters, and shared micro-transit) so that these become viable as a link between people's homes (especially those outside the main city) and (new and existing) transport hubs, including bus and train stations, with connections to the city or to other areas (e.g. other satellite urban towns). The existing density of services in city edges, and within urban satellite towns, can be leveraged by providing safe and dedicated space to sustainable modes. At the same time, bringing more services and amenities closer to people (using space liberated from car use) will be important and can increase the scope for sustainable modes and for implementing the "15-minute city" concept. Converting some of the liberated space to green space will also help increase acceptability of denser development and to make projects with this aim more attractive.
- Mainstreaming **shared mobility** services will be relatively easy inside city areas, and to a less, but still important extent, within satellite urban towns as density makes these more feasible without support from government. Road space reallocation will also help to increase their feasibility and attractiveness. However, the government should consider subsidising

unprofitable routes where these can bring social benefits. These may include providing services in more scattered areas, in satellite urban towns, or to connect some of the rural areas with close urban towns or with the city (in case of those rural areas that are close to city fringes). Servicing specific areas where more vulnerable (e.g. lower-income) people are concentrated, or providing targeted subsidies to specific groups could also be considered.

- There is **no strong rationale for EV subsidies for private cars** in these areas. Subsidies for private car use in these areas should be seriously reconsidered and either be converted into support for shared services and high-mileage vehicles (e.g. buses) or be channelled towards other areas where there might be some need for them.

Rural areas with moderate urban influence[3] and highly rural/remote areas[4]: rural areas contain some of the sparsest populations in Ireland. Reducing car dependency to the same extent as in urban areas will most likely be unfeasible. However, these regions can significantly reduce their car dependency from its current level.

- **Road space reallocation** will be key. As discussed in section 4.3, all road and street spaces, even those that today carry substantial freight traffic, have a "place" function that needs to be studied and taken into account. There is scope for identifying roads and greenway links that can support functional and recreational active travel within rural areas, and between these and other towns and larger cities in their functional area. Maintaining the mobility function of key roads should not come at the expense of sacrificing the safety and feasibility of trips that could be taken via sustainable travel. There is also scope to revisit the use of main roads going through small rural areas in order to recreate local services and commerce.[1]
- There is scope for **shared mobility services** – catering especially to those who cannot drive – to reduce car dependency and related emissions and increase well-being. The frequency and coverage of these services will need to be much more developed than they are now. One focus will need to be on how these services can complement and be connected to regular public transport services. Governmental support (via subsidies) will be especially necessary, to support services in low-density areas. Revenues from carbon taxes could be channelled towards supporting public transport and shared mobility services in such areas. Box 4.8 discusses different on-demand services for areas that combine different levels of density and sparseness; highlighting those services that could bring advantages to the most rural and scattered areas.
- There is likely **scope for EV subsidies for private car use** in areas where the population is very isolated. However, any support should be carefully considered in the light of alternatives (e.g. EV-based car-sharing schemes), and the elevated cost of providing and maintaining infrastructure (including charging) for private rather than shared use. Where careful analysis indicates that private EVs are the only solution for a specific population, these could be added to the list of high-mileage usage to be prioritised (see discussion in section 4.5).

Independent urban towns[5]: the role of private vehicles in independent urban towns will be somewhere in the middle between rural areas (remote or with moderate urban influence), and cities. The implementation of transformative policies will also be a mix of that described for both of the other categories. As demonstrated by the exercise in Sligo (see Chapter 2), special attention needs to be given to improving links with cities or towns within the functional area via public transport and other shared modes with high capacity, while promoting the 15-minute concept.

[1] Satellite Urban Towns are "towns/settlements with populations between 1,500 and 49,999, where 20 percent or more of the usually resident employed population's workplace address is in 'Cities'" (CSO Ireland, 2019[1]).

[2] Rural areas, while are themselves "defined as having an area type with a population less than 1,500 persons") are defined by "their dependence on urban areas" – with employment location being the defining variable (CSO Ireland, 2019[1]). Here, they are split into three sub-categories: rural areas with high urban influence, rural areas with low urban influence, and highly rural/remote areas. A "weighted percentage of resident employed adults of a rural [...] Area who work in an urban [...] area" is used to differentiate between these groups. The proportion of workers in each urban region were weighted using multipliers (CSO Ireland, 2019[1]). The multipliers made it possible for urban regions of various sizes to become more urbanised. For instance, the impact of the same percentage of rural residents working in a major metropolitan region was double that of the same percentage in a small urban area. The weighting takes into account the effect an urban area has on its surrounding area (CSO Ireland, 2019[1]).

[3]Using the same criteria as in footnote 2, rural areas with moderate urban influence are those in which an urban area has a little to moderate impact on a rural area (CSO Ireland, 2019[1]).

[4] Using the same criteria as in footnote 2, rural/remote areas are those where an urban area has no influence on them (CSO Ireland, 2019[1]).

[5]Independent Urban Towns are "towns/settlements with populations between 1,500 and 49,999, where less than 20 percent of the usually resident employed population's workplace address is in 'Cities'" (CSO Ireland, 2019[1]).

While the main topic of this chapter is how to scale up actions with a high transformative potential, as discussed in Chapter 3, this does not mean that other actions are not necessary. Policies with a low or medium transformative potential are important and their effectiveness can increase when embedded in transformative policy packages. Transformative policy packages are those in which policies with a high transformative potential, such as road space reallocation, the mainstream of on-demand shared services and communication efforts to reverse car-centric mindsets are prioritised. Non-transformative policy packages are those in which other policies (with low and medium transformative potential) are prioritised, while policies with high transformative potential remain on the margin, often implemented only as a pilot programme or on a small scale. Table 4.1 summarises the impact of policies when implemented in transformative and non-transformative policy packages. The Table also sheds light on the synergies that emerge between policies with a low or medium transformative potential and those with a high transformative potential when the latter are prioritised (i.e. in transformative policy packages).

Setting the conditions for policy synergies is also crucial to advance change. A common question for policy makers is how to sequence actions to balance constraining car use and creating alternatives to cars. Policies with high transformative potential make it easier to combine and harmonise both these aims. Road reallocation, for example, has the potential to simultaneously constrain car use and enable the conditions for sustainable transport modes to become significantly more attractive vis-à-vis the car. The mainstreaming of on-demand services can contribute to bridging the accessibility gap of sustainable alternatives much more rapidly and effectively than improvements in traditional public transport and active mode facilities could on their own. As a result, by shifting priorities towards transformative policies, restricting car use can be done much sooner, as this goes along the creation of alternatives.

The systemic approach promoted in this report also reveals the constraints that the current system creates and normalises. The inequalities that shifting away from car use may bring are often emphasised, while the constraints that privileging car use currently imposes on much of the population are ignored. As discussed in Chapters 1 and 2, redesigning transport systems to deliver sustainable accessibility can open the door to fulfilling ambitious climate goals as well as improved and more equal access to opportunities (see Box 4.2 for a summary of potential benefits). This said, the implementation of the recommendations in this chapter will require positioning equity, health and other priorities at the core of the redesigned system- along with the goal of reducing GHG emissions. Special attention should be paid to the way different changes and specific projects address local challenges, especially in highly rural/remote areas, and how they affect disfavoured groups. Communication efforts (see section 4.7) are also key to making

the real costs of the current transport system visible, and moving the discussion away from constraining or punishing car users towards the opportunities and benefits of the proposed transition.

Table 4.1. The impact of selected policies when implemented in transformative and non-transformative policy packages.

Policy type	When implemented as part of transformative policy packages	When implemented as part of non-transformative policy packages
Investments and programmes for increasing the attractiveness of public transport and active transport modes	The benefits of investment and programmes for increasing the attractiveness of public transport and active transport modes: - are not systematically offset by induced car demand. - can more rapidly contribute to developing a network of services that provides alternatives to the car when combined with the mainstreaming of on-demand shared services - can have larger effects when combined with road reallocation (since liberated space can increase the modes' attractiveness)	The benefits of investment and programmes for increasing the attractiveness of public transport and active transport modes: - can be offset by induced car demand - take time to be developed into a network of services that provides good alternatives to car use - are limited by the scarce (and often low-quality) space available in car-dependent systems
Road pricing (including parking pricing)	Road pricing (incl. parking pricing) can: - reduce the traffic volumes, rather than just reduce congestion (as combined with the reduction of car purposed road capacity and the rapid development of alternatives to cars) - become more politically feasibility as alternatives to car use are available and convenient	Road pricing (incl. parking pricing) can: - reduce congestion but has a limited capacity to reduce traffic volumes (pricing can lead to road capacity being used more efficiently. However, without reducing it, high road purposed road capacity will still result in high total traffic volumes, especially without good alternatives) - be politically unattractive if the cost of driving a car increasing and no convenient alternatives to cars are available
Carbon pricing	Carbon pricing can: - Steer large modal shifts, in addition to vehicle efficiency (as sustainable modes become the most attractive modes by design) - become more politically feasible as alternatives to car (and thus, road) use are available and convenient - help finance the green transition and ensure the financial sustainability of sustainable modes - reduce rebound effects via modal shifts as well as by increasing feasibility to conduct periodic revisions to pricing levels	Carbon pricing can: - steer mainly vehicle efficiency - be politically unattractive if the cost of driving a car increasing and no convenient alternatives to cars are available - help finance sustainable modes, but effects might be limited (see first row) - result in higher rebound effects as more people purchase efficient vehicles and because conducting periodic updates to price levels (which could help mitigate rebound effects) is challenging without good alternatives
EV incentives	EV incentives (focused on micro-mobility and shared services/vehicles) can: - foster the development of a multi-modal electric shared system and lead to an accelerated uptake of electrification (as car fleets would be downsized and vehicles for which electrification rates are higher – e.g. shared fleets, e-scooters, e-bikes– would become central) - reinforce the idea of the green transition being more just, as the benefits of electrification (focused on an array of services) are more widely distributed through the population	EV incentives (focused on private cars) can: - foster sales of electric private vehicles and continue to be challenged by the slow pace of car fleet renewal - reinforce induced car demand - reinforce car-centric and technology-optimistic[2] mindsets, as well as the idea that the green transition may be unjust (as EV incentives for private cars tend to benefit households with a higher purchasing power)

Note: Transformative policy packages are those in which policies with a high transformative potential, such as road space reallocation, the mainstream of on-demand shared services and communication efforts to reverse car-centric mindsets are prioritised. Non-transformative policy packages are those in which other policies (with low and medium transformative potential) are prioritised, while policies with high transformative potential remain at the margin, often implemented at pilot or small scale only.

Box 4.2. The benefits of transformative policies

The transformative policies recommended by this report would provide numerous benefits. This box summarises (actual or estimated) benefits from places where these policies have been implemented, some of them related to examples discussed in subsections of this chapter.

Road space reallocation and street redesign

- The Netherlands is reshaping its streets, especially to provide priority to cyclists. This has translated into an exceptionally high modal share for bicycles (27% of all journeys in 2018).
- According to Conway et al. (2019[2]), as a result of the provision of fully segregated cycle lanes in Dublin, 74% of a sample of respondents altered their perception of the safety of cycling, with 56% stating that they would consider an uptake of cycling if such facilities were in place.
- The Superblock model in Barcelona (see section 4.3) liberates 70% of space dedicated to cars while reducing traffic by 15%. The mobility plan aims to reduce traffic further (by 21%) in the Barcelona municipality by 2024. Six Superblocks have been implemented and 31 more are to be developed by 2024. It is estimated that by adopting this new model for organising space the city will be able to eliminate 36% of GHG transport emissions by 2024 and 45% by 2030. Improvements in air quality will allow 96% of the population to be exposed to air pollution below 40 micrograms / m3. Currently only 56% of the population is exposed to air pollution below this threshold. In addition, the model will allow 76% of the population to be exposed to noise below 65 dBA (rather than only 54% of the population) (Rueda, 2019[3]). Estimates for the development of Superblocks across the municipality (503 in all) indicate that 667 premature deaths could be prevented every year as a consequence of lower exposure to pollution, noise and heat (291, 163 and 117 preventable deaths respectively), increased physical activity (36 preventable deaths), and increased access to green space (60 preventable deaths) (Rueda, 2019[3]).
- In Pontevedra in Spain, a town with a population of 83 000, a combination of street redesign and a shift towards mixed land-use planning has reduced car traffic by 69% in the town centre and 90% in the downtown core. Air pollution and GHG emissions were reduced by 61% and 70% respectively. In addition, while in 1996–2006 30 people died in road accidents in main streets, only 3 have died since 2006 (with no road fatalities after 2009) (OECD, 2021[4]).
- In London, studies for renovation of an area dedicated to social housing compared the benefits of a design based on mixed-use planning and “Complete Streets” neighbourhoods to a business-as-usual design. Compared to a business-as-usual design, a “Complete Streets” design would allow the provision of more housing units (between 54 000 and 360 000).[1] The study also estimated that the cost per hectare of the renovated land would be lower (GBP 19.9 million) compared to the business-as-usual renovation cost per hectare (GBP 21.8 million) (Savillis, 2016[5]).
- Redesigning streets is a low-cost measure and can create jobs. The 503 Superblocks in Barcelona could be developed in 4 years and would only cost 2% of the municipal budget (OECD, 2021[4]). The IEA has also compared the cost of infrastructure per capacity (in USD/km) and finds that sustainable modes are superior to car infrastructure.[2] Evidence also suggests that active and shared modes (including public transport) could also generate jobs if their role was expanded, which would be the aim of scaled-up street redesign (coupled with investment and more support for new shared services). For example, in the United

States investment in public transport has created 31% more jobs per dollar spent than the construction of roads and bridges. In Korea, jobs generated by public transport, rail and cycling infrastructure investment accounted for 15% of the total jobs generated by the 2009 recovery package.

- Higher pedestrian and cyclist flows, created by pedestrianising streets and creating more biking infrastructure rather than maintaining infrastructure for car use, have also been associated with the creation of new businesses and jobs. For instance, the pedestrianisation of Madero Street, a large street in the heart of Mexico City, increased commercial activity by 30% and reduced reported crime by 96% (Watts, 2018[6]).

Shared on-demand mobility services

- Modelling conducted on a Europe-wide scale by EIT suggests that if 50% of trips under 8 km could be made via micro-mobility services, this would eliminate 30 million tonnes of GHG emissions by 2030, making energy savings equivalent to 127 terawatt hours every year. This could also create 1 million direct and indirect jobs.
- EIT also calculated that if micro-mobility was mainstreamed the liberated space would be equivalent to 48 000 hectares (four times the area of Paris). In its simulations for Lisbon, ITF (2017[7]) estimates that shared taxis and minibuses could reduce the space dedicated to car parking by 95%.
- ITF (2018[8]) calculates that shared taxis and minibuses, together with the current core public transport services, could reduce transport emissions by 30% and congestion by 38% in Dublin.
- A study in Boston found that micro-mobility combined with walking and public transport has contributed to citizens' accessing 60% more employment opportunities.
- A study by the e-scooter company Lime found that 72% of riders use its scooters to visit local shows and attractions.

[1] The bottom range is based on the assumption that density can increase from 78 to 109 homes per hectare. The top range assumes that density can increase to 279 homes per hectare.

[2] A dual highway has a capital cost (USD/km) per capacity (persons/hour/direction carried) that ranges between USD 5 000 and 10 000, and an urban street used solely for cars has a cost between USD 5 000 and 7 000 (Buckle et al., 2020[9]). Metro rail and commuter rail have a capital cost per capacity of USD 2 000–5 000 and USD 2 000 respectively (Buckle et al., 2020[9]). Other forms of public and active mode infrastructure have much lower capital costs per capacity: bus rapid transit costs between USD 200 and 250, bus lanes between USD 300 and 500, bicycle lanes USD 30, and pedestrian walkways USD 20 (Buckle et al., 2020[9]).

This chapter builds on the policy assessment in the previous section to provide guidance and policy direction for refocusing efforts and scaling up policies identified as having a high transformative potential. Recommendations pull together information from interviews, ideas generated in the workshops (see Box 4.3 describing the session dedicated to new strategies), OECD expertise and international best practice. It acknowledges a number of efforts in the right direction currently being implemented in Ireland, and suggests ways to build on them. These discussions are not exhaustive: further discussions among the stakeholders and a process of multi-level, multi-disciplinary and multi-stakeholder policy co-creation to explore other actions (and further explore the details of recommendations) will be needed.

Box 4.3. Workshop participants developed strategies for high-leverage actions

During the second day of the April 2022 workshops, stakeholders were divided into groups and invited to outline strategies for implementing high-leverage actions. Each group was assigned one of the following actions:

- scale up road space reallocation
- scale up shared on-demand services
- re-align electrification policy
- re-align compact growth policy
- bring in people's hearts and minds.

Participants were invited to develop success criteria for scaling up each action, and to identify required institutions, funding and programmes. They had to identify a leading authority for each action, and map other relevant actors in terms of their influence over and expected support for the action. Besides developing the key elements of each strategy, participants discussed how the five strategies can support each other. The workshop insights are integrated into the recommendations in this report.

4.1. Realign sub-targets with systemic transformation

Achieving Ireland's ambitious climate target – a 50% reduction in transport sector GHG emissions by 2030, relative to 2018 (Department of the Taoiseach Ireland, 2021[10]) – requires transformational change in the direction of a low-demand, high-access and low-emission system.

Ireland has ambitious stakeholders, as the workshops showed, ready to challenge the current system. Many good initiatives are under way. The National Sustainable Mobility Policy states that Ireland needs to switch away from private car use and revive city and town centres (Department of Transport, 2022[11]). It also explicitly states that "[t]here is a need to rebalance transport movement in metropolitan areas and other urban centres away from the private car and towards active travel and public transport. This will require a greater allocation of available road/street space to be given to sustainable mobility" (Department of Transport, 2022[11]). However, current sub-targets are misaligned with the goal of transforming the system. Priorities and efforts also need to be rethought across government to avoid contradictions.

Ireland's current sub-targets assign excessive weight to vehicle and fuel replacement, expecting this to account for 67% of the transport sector emission reductions by 2030 (Table 4.2). They reflect the assumption and reinforce the mindset that the current car-dependent system will prevail, needing only to be "fixed" via electrification and better fuels. The unambitious current sub-target for active travel and public transport further reflects this thinking. A target of 0.5 million additional public transport and active travel daily journeys in 2030 corresponds to fewer than 0.1 journeys per capita per day. These additional trips would raise the mode share of active travel and public transport from 21% in 2019 (Central Statistics Office, 2020[12]) to 25% by 2030. It is unclear to what extent these additional journeys would replace private car travel as opposed to further increasing mobility.

The current strategy and emission reduction estimates ignore systemic feedback loops, long-lasting stocks, and different actions' impacts on mental models (see the detailed discussions in Chapter 3). These include

- reinforcing car dependency in mindsets and behaviours by promoting private EVs as the main solution to climate mitigation in transport

- increased car use and urban sprawl due to reinforced car dependency, intensified by EVs' low operation costs (rebound effect)
- underestimating the time and effort it takes to change a large vehicle stock
- deepening inequality and putting public and political acceptance at risk with regressive EV subsidies.

These sub-targets are driving budget decisions and efforts towards actions now perceived as "the most certain", but which, as shown in Chapter 3, have low potential to trigger the transformational change needed to achieve climate targets. Meanwhile, actions with higher potential to trigger a systemic transformation, which this report recommends, remain marginal. Already, even when adopting the optimistic assumptions about the abatement potential of planned actions, Ireland has identified a shortfall of 13% in reaching its 2030 target for transport (see the second-last row in Table 4.2).

The rest of this chapter discusses how climate sub-targets for the transport sector, and policies and actions central to attaining them, could be revisited in the light of the findings of this report.

Table 4.2. Transport sector sub-targets set in Climate Action Plan 2021

Metric	Transport climate action sub-target	Absolute abatement by 2030 in MtCO2eq	Share of abatement of 2030 transport emissions	
Sustainable transport journeys and demand management	500,000 (14%) additional transport and active travel journeys per day; reduce ICE car kilometres by c. 10%	-1.4		20%
EVs and low-emission vehicles	Electrify Passenger cars: 845,000 with a focus on BEVs	-2.7	39%	67%
	Low-emission vans: 95,000 with a focus on BEVs	-0.2	3%	
	Improve HGV technology: 3,500 low emission HGVs	-0.3	4%	
	1,500 EV buses	-0.3	4%	
	Expanding electrified rail services	-0.1	1%	
Increased bio-fuel blend rate	E10, B20	-1.1	16%	
Undertake programme to further refine measures for additional abatement		-0.9		13%
Total		-7		100%

Source: (Department of the Taoiseach Ireland, 2021[10]), https://www.gov.ie/en/campaigns/2f87c-climate-action-plan-2021/

4.1.1. Revisit the weight given to different efforts

Ireland's climate policy needs to reduce its excessive reliance on actions that replace parts of the system (vehicles and fuels) while maintaining the system itself. As already noted, current estimates often ignore feedback loops between actions, longer-term feedback loops and wider well-being outcomes. They assume that many aspects of the current system are unchangeable, meaning that the current system must persist. While actions targeting demand management (including road space reallocation, congestion and parking charges), and shared on-demand services are now reflected in some policy documents (e.g. SMP), their role has not been translated into the sub-targets for the sector reflected on the CAP 2021 (as shown in Table 4.2.).

Discussions around the additional measures required to meet the 2030 transport sector target are already recognising the limitations of replacing private vehicles with electric ones and increasing focus on policies with higher transformative power. As mentioned in chapter 1 (and shown in Table 4.2), a 0.9 MtCO2 emission reduction (13% reduction) gap has been identified. Early discussions on the additional measures that might be required to close these gaps focused on road pricing and low-emission-zones. These discussions have been evolving, and according to the DoT, there is ongoing modelling addressing the 0.9 Mt gap to the target. The modelling is focused on delivering additional levels of abatement via a comprehensive set of measures that go beyond technological change. These include policies that this report has identified as having medium and high potential for transformative change and others: reduced trip rates based on a recalibrated *Alternative Future Scenario for Travel Demand*; parking constraints and the removal of free workplace parking; road space reallocation and pedestrianisation of city centres; congestion charging; improving capacity and frequency on public transport services; reduced public transport fares; increased fuel costs; targeted uptake of electric vehicles focused by intensity of use; behavioural change programmes & area-based mobility management (e.g., School Streets); reducing the number of 'Escort to Education' private car journeys; reduced car ownership levels; reduced speed limits; and eliminating fuel tourism. This Gap to Target modelling will inform discussions for this year's Climate Action Plan update (Department of Transport, 2022[13]).

The role of transformative policies will need to be increased beyond the .9 MtCO2 (13%) emission gap, given that analysis indicates that the EV target will be unlikely met (Caulfield, Carroll and Ahern, 2020[14]). Revisiting targets in this direction is consistent with new findings, from a study in the UK. This finds that a scenario that can transform the transport system will bring the most GHG emission reductions to 2050. In this scenario policies triggering avoid and shift results[3] contribute 60% of transport energy demand reductions, while energy efficiency measures contribute the remaining 40% (Barrett et al., 2022[15]). Note that this is opposite to the weighting in Ireland's Climate Action Plan 2021, where most transport emission reductions by 2030 are expected from vehicle and fuel efficiency improvements (Table 4.2.). The UK study highlights that many energy demand reductions can occur in the short term. Short-term climate targets are unlikely to be reached without energy demand reductions, and long-term targets would rely on unproven and expensive carbon dioxide removal technologies (Barrett et al., 2022[15]). Conversely, early demand reduction, achieved through transformative actions, reduces cumulative emissions over time (not only target year emissions), and it preserves the option to further strengthen climate ambition in the future (Barrett et al., 2022[15]).

4.1.2. Revisit targets and redefine success

The climate action indicators used for establishing sub-targets should also help Ireland measure progress towards transformational change. As noted above, the type of indicators linked to the climate sub-targets (e.g. 500 000 additional public transport and active travel journeys, 845 000 additional EVs) reflect a 2030 transport system much like that of today, except for more EVs and vehicles with cleaner fuel in the streets. Irish stakeholders observed in interviews that a focus on electrification is sometimes perceived as the convenient climate action route, despite its high public financial cost, because it does not challenge the current system. However, interviewees also commented that people are not satisfied with the state of the transport system, particularly the lack of safe, well-connected active travel infrastructure and limited accessibility by public transport.

Ireland's realigned transport climate action sub-targets need to be consistent with the transition towards a future of sustainable access, one in which streets are designed for human interaction and human speeds, most trips are short and active, and longer trips, when needed, are served by fewer, shared electric vehicles that are appropriately sized and efficiently utilised and designed. Public transport plays a key role in providing shared services in such a future. To accomplish this, the Climate Action Plan would have to include ambitious targets that reflect several needs:

- **Reduce car kilometres travelled for all types of cars.** Electrification is necessary but insufficient to meet the 2030 target. Rapid reductions in travel demand and shifts to sustainable modes are needed as well (Department of Transport, 2022[11]; Society of the Irish Motor Industry, 2022[16]) . The Sustainable Mobility Policy asserts the need to reduce total private car journeys (Department of Transport, 2022[11]). The current Climate Action Plan 2021 sub-targets, however, do not reflect the need for rapidly reduced car travel, but focus only on reducing ICEV travel (by 10%). Scotland, for instance, has set a target of reduction of total car kilometres by 20% by 2030, recognising the scale, urgency and interconnectedness of the climate action challenge. "While technological solutions will be key in some areas, transformational change is also required, with behaviour change and demand management needed to meet our emissions reduction targets. This is because transport is a derived demand – where people live, work, learn and access goods, services, amenities, and social connections are all key to the need to travel" (Transport Scotland, 2022[17]). Progress on this target would be measured simply in terms of reduced car-kilometres.
- **Increase proximity and access with active and shared (including public transport) modes.** While reducing car travel, Ireland needs to simultaneously improve proximity and access with active and shared modes (including micro-mobility, bike-sharing, public transport and other high-capacity shared vehicle and ride services) for people and businesses in different circumstances across the country. To measure progress towards increasing proximity and accessibility by active and shared modes, a combination of metrics could be applied: 1) Metrics like the ITF accessibility indicators (see (ITF-OECD, 2019[18])) (which includes data for Dublin) can help guide the transition to better access via sustainable modes vis-à-vis the car. The indicators measure proximity to opportunities and transport performance by different modes; allowing to understand how both elements play-out in ensuring good access. 2) Mode shares reveal the overall attractiveness of different modes within a given system, and ultimately help understand whether the changes made are translating into different behaviours. 3) Metrics to measure road space reallocation could help measure progress in mainstreaming this policy. Road space reallocation is a high-leverage action that supports proximity and access with active and shared modes, while reducing car-dedicated space and reversing induced car demand. (See the discussion of these indicators in section 4.3.)
- **Increase the battery-electric share of car-kilometres travelled** while reducing total car-kilometres (as discussed above). Ireland's electrification policy needs to support the system transformation summarised in the above targets, particularly the goal of reducing car travel. This requires prioritising the electrification of frequently used cars (such as taxis). Reducing the privileges of private cars compared to frequently used electric cars (e.g. parking privileges) can help to electrify the remaining car-kilometres more quickly. Defining the electrification target as the share of the remaining reduced car-kilometres has several benefits: it avoids rewarding efforts that increase overall car ownership and use, as the current sub-target does (see Chapter 3). It also focuses electrification efforts and resources on frequently used cars, which helps to favour shared over private car ownership and to speed up electrification.
- **Increase the share of low-emission vehicle kilometres for goods and public transport vehicles**. The most intensely used (and most fossil fuel-consuming) motor vehicles should be the first to transition to low-emission technology, including light and heavy goods vehicles and public transport vehicles. Increasing the low-emission vehicle share of vehicle kilometres in each category – vans, HGVs, buses, rail – would produce better results than the current target, which does not distinguish among low-emission vehicle types.
- **Reduce the number, size and raw-material use of cars in the national fleet.** During the current and coming decades Ireland needs to transition to fewer, smaller and less wasteful cars in the national fleet, taking account of vehicles' life-cycle impacts and reversing the trend of increasingly large cars, like SUVs, occupying public space. Cars and their batteries also need

to be integrated into the circular economy. Thus life-cycle emissions, material use, and the evolution of the fleet in terms of size needs to be measured and monitored as well.

4.2. Align decision processes, modelling and evidence with a systemic approach

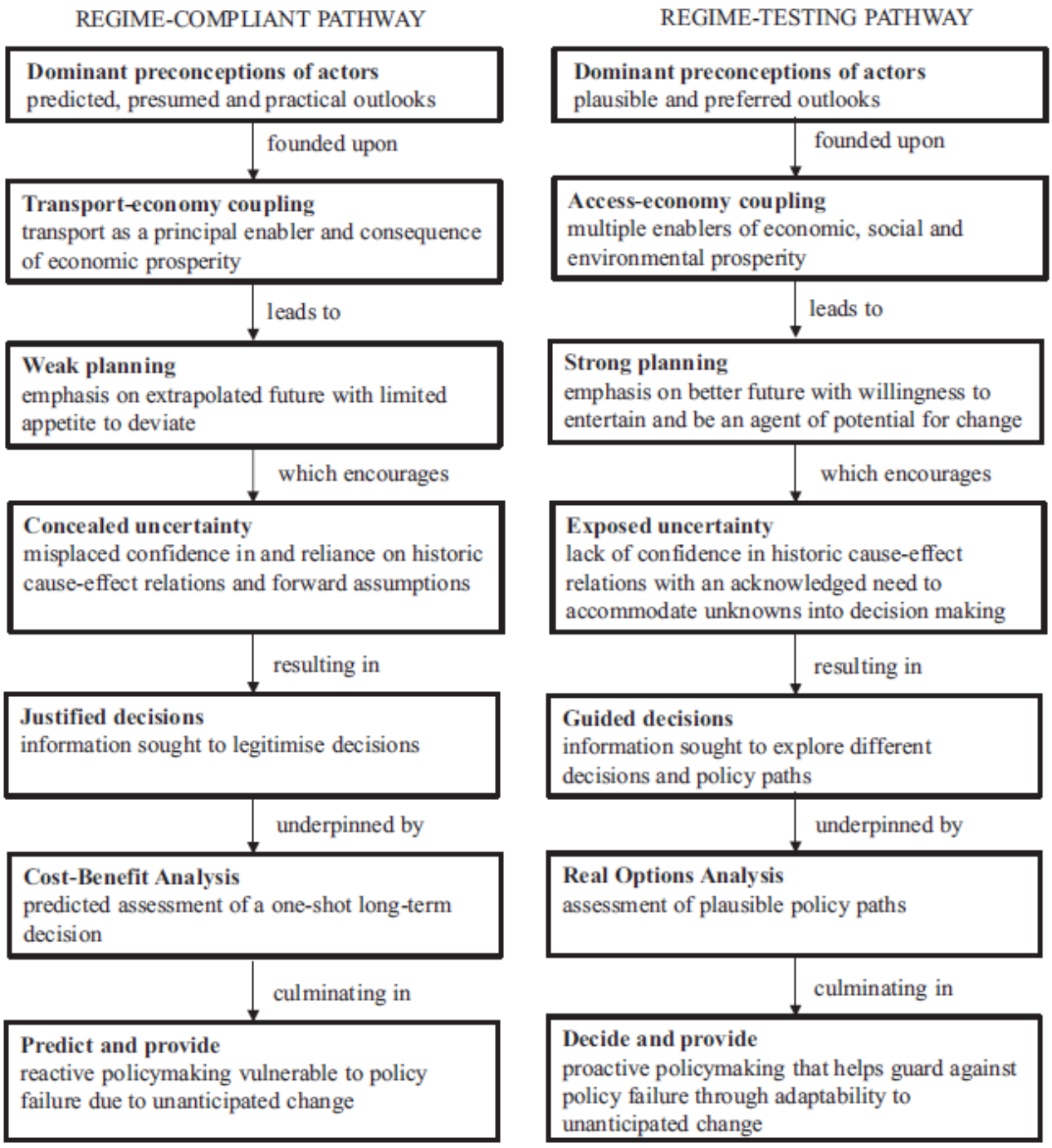
Bringing systems thinking into decision-making helps policy makers and other transport system actors to challenge assumptions, operations and values in the current system. Decision processes and policies become tools to help change the system, rather than adjust it. As described in Chapter 3, systems thinking looks beyond existing patterns of behaviour to understand the structures and mindsets that produce them. It helps decision-makers realise that past patterns are not inevitable, and extrapolating future trends from them is insufficient.

Ireland could benefit from applying wider, more systemic, problem framing in its transport strategy development, demand modelling and infrastructure appraisal. The assumptions of conventional forecast-led transport planning practices are inconsistent with climate targets. A recent Swedish climate policy evaluation (Marsden et al., 2019[19]) recommends adopting a scenario-based approach to transport infrastructure planning that does not take historical correlations as given, because the conventional approach risks creating induced demand. A UK evaluation comes to a similar conclusion: it recommends that road traffic forecasts no longer assume linear increases in car ownership and instead consider a range of vehicle ownership futures (Marsden et al., 2019[19]).

Figure 4.1 presents a summary of regime-compliant versus regime-testing pathways for transport planning and policy-making. A regime-compliant, forecast-based approach takes the current system as given and relies on extrapolating past patterns into the future (an approach also referred to as “predict-and-provide”). A regime-testing, scenario-based approach challenges the current system and its assumptions. It seeks (in line with discussions in Chapter 2) to proactively shape a desired future with policy, recognising that past patterns must not persist, and it prefers solutions that perform well in various possible futures (an approach referred to as “decide-and-provide”). Box 4.4 illustrates how Transport for London uses scenarios to ensure their plans perform well in a range of plausible futures.

Moving towards regime testing requires asking different questions. A conventional forecast-led approach might ask “What is the immediate and direct congestion and tailpipe-emissions impact of a specific modification?” Instead, a regime-testing approach might ask: “What infrastructure does Ireland need to support its well-being and climate vision?”

Figure 4.1. Regime-compliant vs. regime-testing pathways



Source: (Lyons and Davidson, 2016[20]), https://doi.org/10.1016/j.tra.2016.03.012.

Box 4.4. TfL scenarios for plausible futures

Transport for London uses scenarios to illustrate the conditions that might be in place by 2041, to help ensure their decisions turn out well in a range of plausible futures. Developing the scenarios involves consultation with diverse stakeholders who affect the context in which Transport for London operates, including their contextual environment (e.g. climate, demographics, technology) and transactional environment (e.g. residents, operators, interest groups). The following three scenarios outline a range of plausible futures for travel in London. Each scenario has different implications for where people live and how they travel.

- **Innovating London** is the story of London reinventing itself as a young, urban innovator, where technology changes how people live and work, but leaves some people behind.
- **Rebalancing London** is the story of a more equal but ageing society with lower economic growth, which focuses on self-sufficiency and liveability as world power moves east.
- **Accelerating London** is the story of an ever-growing, expanding London which is the beating heart of the world financial system but struggles to deliver high quality of life for all.

Source: (TfL, 2020[21])

National transport demand models in Ireland assume that historical patterns in car ownership and car occupancy persist. Moreover, transport planning processes and tools do not capture the long-term feedback loops between transport policy and infrastructure and land use, as interviewees pointed out. This is in part a technical choice but also an organisational one: population location scenarios and transport modelling are handled by separate organisations.[4] Separating location from transport questions aligns with the mobility mindset described in Chapter 2: the mobility mindset focuses on movement to ensure transport needs, and ignores proximity as a lever for access.

Workshop participants suggested that Ireland needs to further strengthen its strategic decision gates and systemic long-term perspective in infrastructure decision-making. Conversely, it should reduce emphasis on analytical comparisons, which are more suitable for choosing between similar proposals once strategic fit has been ensured. The Common Appraisal Framework already requires a Strategic Assessment Report as the first decision gate for transport investment over 10 million euros (Department of Transport, 2021[22]). Only after this initial decision gate has been passed are detailed multi-criteria and cost-benefit analyses required. This is helpful in moving towards a regime-testing approach. However, at the Strategic Assessment stage more weight should be given to the strategic fit of proposals with Ireland's vision of a future of well-being and low emissions. Current Strategy Assessment Reports are framed around a specific project and its problem statement; they require a preliminary transport demand analysis for the project alongside other inputs (Department of Transport, 2021[22]).

In the second appraisal stage, once proposals pass the Strategic Assessment, Ireland needs to reduce the importance of estimated travel-time savings. Travel-time savings are still a focus in transport infrastructure appraisal guidelines (Department of Transport, 2021[22]). As explained in Chapter 2, this focus reflects the mindset of car-dependent systems, which conflate high mobility with well-being. Guidelines need to be revised to strengthen the importance of proximity and wider well-being.

Ongoing updates to the CAF (included in the SMP and discussed in chapter 3) will be important to shift away from this overriding focus on travel time savings and economic criteria, and to better incorporate environmental criteria. As part of the development of Strategic Assessment Reports (SARs) and Preliminary Business Cases (PBCs) proposed projects in the transport sector are required to demonstrate that the project aligns with at least one of the four NIFTI Investment Priorities, one of which is decarbonisation. Project sponsors are also required to demonstrate how any potential negative impacts against one or more of the NIFTI Investment Priorities will be mitigated. It would be recommended to move

towards a more holistic approach where projects are assessed against a multiplicity of goals simultaneously (which could be linked to the new well-being framework). The webTAG (Web-based Transport Analysis Guidance) tool in the UK can be a good example to look at, and is discussed by ITF-OECD (2019[23]). Ultimately, integrating more scenario-based planning into the Strategic Assessment stage, and giving more weight to strategic fit, could be a helpful next step.

4.3. Reallocate public space for transforming the different territories across Ireland

Ireland needs to make widespread, large-scale road space reallocation and street redesign a priority. Chapter 3 argued that road space reallocation and street redesign have a high potential to shift the country away from a car-dependent system towards one better suited to delivering sustainable accessibility. While often disregarded, the way road space (and public space more generally) is allocated and designed largely determines the interactions of all the elements in the transport system. There is enormous potential to change transport systems by rethinking the allocation and design of road space.

As shown above, the creation and reinforcing of induced car demand is at the root of Ireland's continued car dependency. Given the large stock of car-purposed capacity already in place, even if no more car-purposed road capacity were developed car use would be at best stabilised or marginally reduced. Road reallocation and street redesign offer an opportunity to reverse induced demand by reducing this over-dimensioned stock. It also creates a new stock of liberated space that can give rise to a more sustainable system structure and help reverse other vicious cycles, namely sprawl and the sustainable modes low-attractiveness trap.

Revisiting parking policy and allocation must be a key component of road space reallocation. Parking space makes up a large share of the space dedicated to car use (Creutzig et al., 2020[24]). Parking availability is also linked to traffic: Franco (2020[25]) finds, for instance, that the availability of parking, particularly at residential and work sites, is closely related to vehicle ownership and use. Similarly, the availability of parking space dedicated to sustainable modes has been identified as key to increasing their convenience and use. As discussed by Caulfield, Carroll and Ahern (2020[14])[5], increasing available parking for bicycles has been identified as a key need in Ireland, including by standards with minimum levels of off-street bicycle spaces.

Seizing the opportunity to rethink road space allocation and street design is more than timely: new demands and pressures on space are growing along with new modes and new technologies (Halpern et al., 2019[26]), but so are opportunities to convert urban space to better uses. Given this potential, Ireland needs to make road space reallocation and street redesign a priority and find ways to scale it up from the pilot-project level. A number of projects (e.g. Kildare Market Square redesign and Cobh Public Realm Enhancement Plan) have established precedents and built capacity. However, the scale of the needed transformation calls for this to become a common, large-scale practice.

This is not a simple challenge, and no one country has yet overcome it. However, a number have started to make progress. This has usually started at a local level, with one of the main challenges being that local and national transport aims are not aligned. Ireland could have a real advantage if road space reallocation became a government-wide priority. Different actors could play different but complementary roles in triggering change.

In 2013, the Department for Transport published the Design Manual for Urban Roads and Streets (DMURS)[6] (Associates et al., 2013[27]). To develop the manual, a project team was assembled with stakeholders from Cork, Fingal, Kildare and South Dublin County Council. The DMURS is a practical guide that proposes new principles (based on good international practice) for designing and upgrading urban roads and streets. It explains why a change in mindset is needed for roads and streets and discusses the

many shortcomings of current road planning. It introduces tools such as quality and street design audits. There is also an ongoing programme of training and development work in relation to DMURS. This includes a recent online seminar series as well as the development of a certificate programme through ATU[7] (formerly Sligo IT). In parallel, the National Cycle Manual is to be updated to align cycle scheme design guidance with a safe system approach, ensuring that the infrastructure makes cycling safe.

The DMURS, related tools, and other guidance are a step in the right direction. However, mainstreaming road reallocation and street redesign will likely require going beyond high-level recommendations, examples of good practice, and useful but voluntary tools. The rest of this section discusses other recommended actions (based on international good practice) to scale up and mainstream road space reallocation across Ireland. Much of this can build on the work done to produce the DMURS, but some of its current limitations must also be overcome. Among these are:

- The DMURS only applies to roads within built-up areas where a speed limit of 60 km/h or less applies, and thus implies and sends the message that rural areas are excluded from the shift in thinking required for streets and roads (although Audit/Quality Tools now apply to all roads).
- While its provisions are mandatory in principle for all urban roads, the DMURS uses a range of verbs – shall/must (mandatory), should (recommended) and may (optional). Most proposals introduced use 'shall' accompanied by very ambiguous wording: for example, "local authorities shall facilitate the implementation of the principles". So it is hard to tell what effect the DMURS might have in practice.
- With the rationale that the guidelines should not impose a further layer of documentation on the development process, the tools introduced by the DMURS, such as the Street Design Audit, are only voluntary. They "may be used to complement or supplement the existing range of reports submitted in support of development". Consequently, they have not been widely implemented (DMURS, 2019[28]).
- The DMURS has created a community of people working together to transform practice regarding road space reallocation and design. However, this transformation needs to be expanded to many more actors from different levels of government, and to stakeholders in the street and road networks.

As mentioned in chapter 3, a number of actions included in the new SMP include the development of new plans and programmes to enhance and enlarge active transport infrastructure in the five metropolitan areas, regional growth centres and key towns. The development of such strategies and programmes can be an excellent opportunity to rethink road space reallocation and that work could feed into the development of the tools recommended in this chapter. In addition, the major transport projects that are being developed (e.g. as part of Bus Connect) across different cities can importantly serve to advance road space reallocation, as has already been shown in the case of Dublin.

Discussions in this chapter expose the need to work in parallel on two main pillars. The first is the creation of new tools to develop a shared, nationwide narrative about roads and streets and help implement it throughout Ireland. These tools are needed to go beyond the stage of pilot projects disconnected from a longer-term vision for the whole of the country. Otherwise, transformative projects and efforts will be undermined by their status as exceptions, swimming against the current of a system that continues to build and design roads for traffic.

This does not mean that innovation should be discouraged, or that piloting new ideas and adopting practices such as tactical urbanism should be abandoned. To the contrary, the need to enhance local authorities' capacity is the second pillar of action. The enhancement of local capacity for a number of activities (e.g. data collection and analysis, designing and managing locally adapted projects, consultation and participatory processes) can contribute to speeding up implementation and promote continued improvement in daily practice.

The rest of this section is dedicated to these two pillars.

4.3.1. Create a nationwide narrative for streets and roads

Scaling up road space reallocation and street redesign in Ireland requires radically shifting mindsets and conversations around roads and streets, and finding ways of putting new thinking into practice. One challenge will be to bring together actors from different levels of government along with other key stakeholders (e.g. transport providers) to change current practice. This challenge is not unique to Ireland. Halpern et al. (2019[26]) observe that a major problem throughout Europe is "the fragmentation of institutions responsible for road space across levels of government and within city administrations [which] can have conflicting ideological and professional perspectives on the priority given to vehicles, pedestrians and other activities".

The rest of this sub-section proposes the development of two tools that can help Ireland to create a new narrative for streets and roads: a framework for road and street categorisation and a set of indicators to measure progress and the impact of road space reallocation. National guidance[8], leadership and involvement by national level entities (e.g. NTA, TII, Transport Department) will be essential to develop and mainstream these tools. Ireland could consider creating a Roads and Streets Reallocation and Redesign office to oversee the process. The development and evolution of such tools should not be a top-down process, however; it should draw on experience from all levels of government and stakeholders. The tools developed should serve as a basis, but their use and evolution should be a dynamic process, and local authorities must be supported, encouraged and incentivised to innovate and improve them over time. Section 4.8 provides some ideas for embedding these tools in strategic planning. Overall, an effective communication strategy will also be key to creating and mainstreaming the new narrative (for streets and roads and a different transport system more generally): this is addressed in section 4.7.

Box 4.5 provides key principles for creating a new narrative for roads and streets, which build on international best practice

Box 4.5. A radically different narrative for roads and streets: key principles

There is a need to create general awareness of the crucial role played by road space in establishing the rules of interaction for the elements and users of transport and urban systems – and hence of the impact that changing the allocation, use, design and planning of road space can ultimately have on changing lifestyles to attain climate and well-being goals. As noted by McArthur et al. (2022[29]) roads and streets occupy around 70-80% of public space in cities, but this is rarely acknowledged.

Questioning the function of road space is central to reversing car dependency. The analysis in Chapter 3 shows that building road capacity that is mostly prioritised for car travel has been crucial in promoting car dependency and the vicious dynamics behind car-dependent systems. Halpern et al. (2019[26]) also argue that the belief that the main function of roads and streets is traffic movement has been central to creating car-oriented cities. Acknowledging that road space is public space, and that its function is not only to allow for the movement of people (rather than solely vehicles), but also to create places, is a crucial step towards modifying car-dependent systems. In line with this, the OECD (2021[4]) argues that the concepts of "Complete Streets" and "Place-making" should "guide the shift in mindset needed for more systemic street redesign and management".

"Complete Streets" approaches aim to safely balance the use of space among different transport modes and users (walking, cycling, public transport, private vehicles, commercial activities and residential areas) (OECD, 2021[4]).There is no single design prescription for Complete Streets, but primary features include creating space for pedestrians (via sidewalks, crosswalks), bicycles (via protected or dedicated bicycle lanes) and public transport (via bus rapid transit, transit signal priority, bus shelters), and using traffic calming measures (Litman, 2015[30]). As discussed by the OECD (2021[4]), planning for freight and delivery services as part of Complete Streets is key to their success.

"Place-making" emphasises the idea that streets have a "place" function as well as a "connection" or "link" function. The need to acknowledge the place function of road space is discussed in Halpern et al. (2019[26]), who recognise (as discussed in chapter 2) that when streets allow for travel by modes other than cars, cities can come to function on a sustainable mobility model rather than a car-oriented one. However, the focus on travel would only allow stabilisation of car use levels, whereas acknowledging the place function of roads and streets is necessary to create a "city of places", which can lead to declining car use.

There is also a need for a general understanding that, precisely because of its social, environmental and economic implications, road allocation is not a technical issue to be solved by engineers but a policy problem that requires multi-disciplinary thinking (Halpern et al., 2019[26]).

The new principles and examples of good international practice introduced by the DMURS go in the right direction. However, these principles need to go beyond conversations among a limited group (as at present) to inform thinking about, planning, designing and especially redesigning streets and roads throughout Ireland.

Develop a new framework for road classification and planning

A new nationwide road classification and planning framework, integrating best practices adapted to Ireland, could help to change conversations and guide changes in street and road networks. The DMURS includes a number of examples of useful frameworks from around the world that implement Complete Streets and Place-making principles. However, policy makers may find it difficult to understand how these principles apply to their specific context, and may even wonder whether they are suitable at all.

International examples show that when specific frameworks at a city or national scale are adapted to the local context, they can create consensus on the need to change mindsets about roads. They can also help stakeholders understand what new thinking means for different segments of the network and the different stakeholders involved. Practices in other places suggest that the actual process of crafting a shared framework, if participatory, contributes to getting stakeholders on board and creates ownership of the new framework.

Ireland could adopt frameworks that have already been developed elsewhere. For example, 'place and movement" frameworks, which construct a matrix to classify different streets according to their place (type of destination) and movement (type of transport link) functions, can start new conversations and create a "common language" for discussion of these issues. Such frameworks can also help in discussing how to resolve trade-offs between place and movement needs (McArthur et al., 2022[29]).

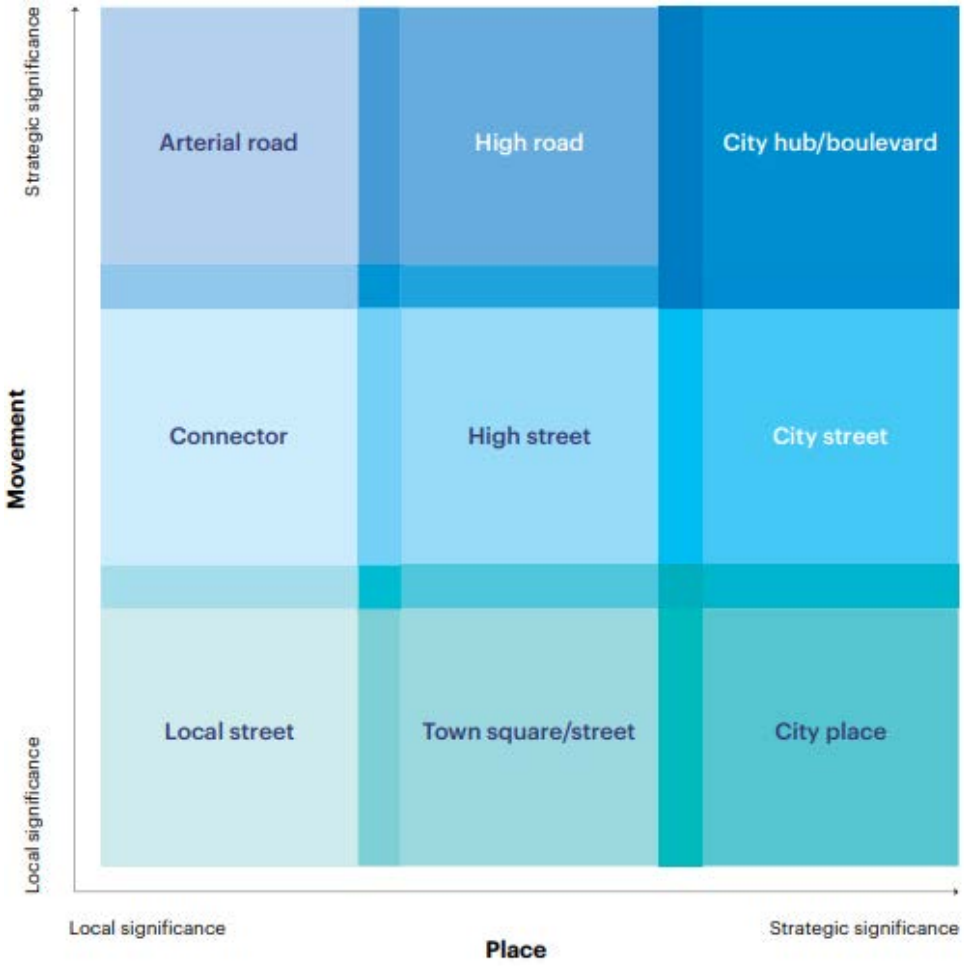
Barcelona provides a good example of the integration of place and function into road redesign. It aims to completely restructure the city into polygons of approximately 400 m x 400 m, each with 5 000–6 000 residents, known as Superblocks (OECD, 2021[4]). The model creates a "loop system" allowing cars to enter but not cross the Superblocks (they also have to obey a speed limit of 10 km per hour while inside the block). Pedestrians and cyclists can cross the blocks in both directions. The model liberates 70% of the space dedicated to traffic. To date, six Superblocks have been implemented (for a total of 143 hectares), and eventually the whole of the Barcelona municipality will follow this model (503 Superblocks in total) (OECD, 2021[4]).

In London, the mayor created an independent Roads Task Force (RTF) in 2012 to come up with a long-term strategy for the streets and roads in the city that would make them "better fit for the future" and contribute to the sustainability goals of the mayor's Transport Strategy. Three core aims were envisioned for the road network: 1) to enable people and vehicles to move more efficiently; 2) to transform the environment for cycling, walking and public transport; and 3) to improve the public environment and provide better and safer places for all the activities that take place on the city's streets, so as to enhance quality of life (Roads Task Force, 2013[31]).

A central component of the strategy is a "new strategic framework" to help the actors involved in road and street management to plan and manage roads in a coherent way and in alignment with the three priorities of the strategy. In the case of London, the Department for Transport (DfT) is in charge of planning for some roads of national interest (e.g. the M25, M1, M4 and M11), which are managed by Highways England. Of the other roads, 5% (the "red routes") are planned and managed by TfL. Although only 5% of the network, these roads account for around 30% of all transport traffic in London. The remaining streets are under individual boroughs' control (ITF, 2018[32]).

The framework developed by the RTF looks at streets in terms of their function (moving people and vehicles) as well as their place. Streets are classified in terms of both functions in a matrix of nine "families" (see Figure 4.2).

Figure 4.2. London's nine street families



Source: (TfL, 2013[33]), https://content.tfl.gov.uk/londons-street-family-chapters-1-2.pdf.

The RTF's progress report found that the new street typology enabled TfL and the boroughs to work collaboratively and take a holistic view of the network in order to better balance local and strategic needs and priorities (2015[34]). The framework produced in 2013 was used to develop a methodology for classifying streets, focusing on six case studies in five different boroughs. A senior stakeholder group established by TfL conducted the exercise, including members of the RTF panel, London Councils, the London Borough of Barnet, the City of London and the Greater London Authority (Transport for London, 2015[34]).

Although it has brought different stakeholders together, the fact that the framework has been developed for London alone has had its limitations: the problem of institutional fragmentation between levels of government has not been solved entirely (McArthur et al., 2022[29]). As illustrated by the MORE project, an EU-funded project focused on changing the way streets and roads are looked at and used, TfL's efforts to restrict traffic flows and encourage shifts towards public transport, walking and cycling are often hindered by Highway England's persistent focus on improving free-flow traffic (McArthur et al., 2022[29]).

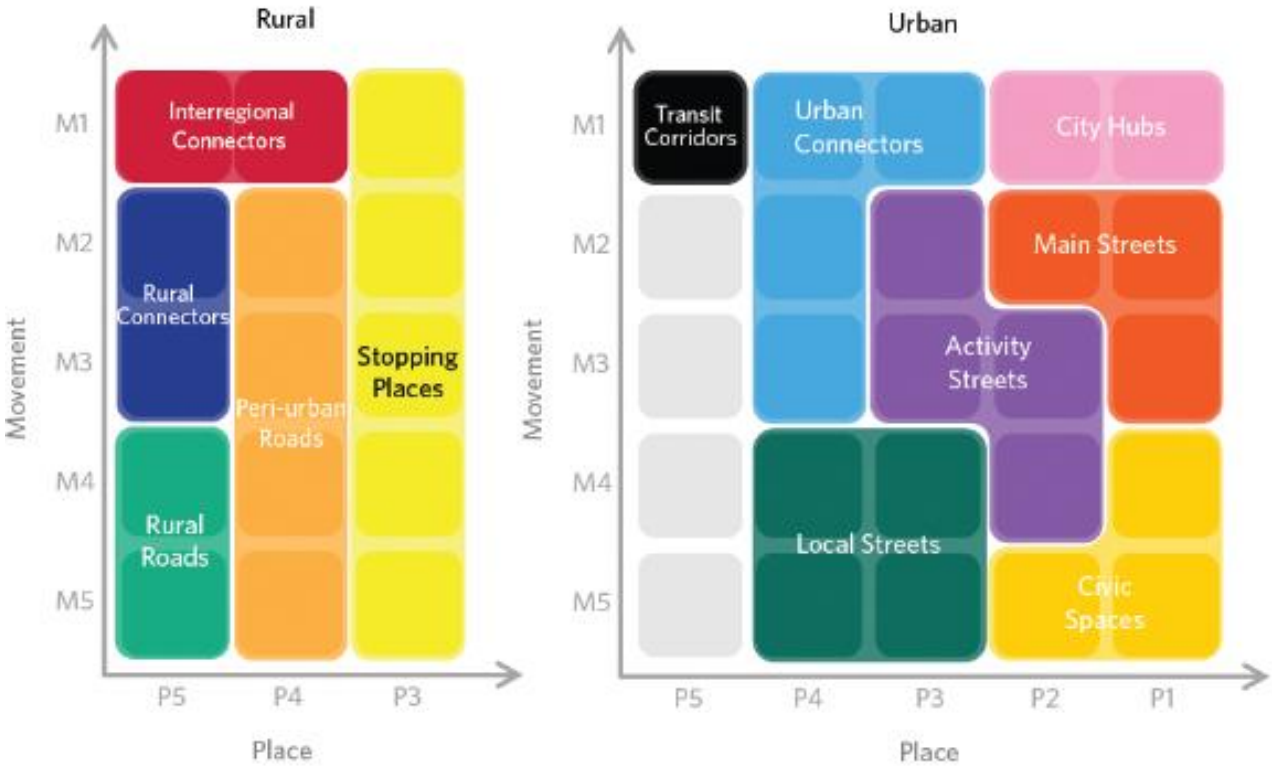
The development of a nationwide framework could give Ireland an advantage by making sure that the new narrative and practices are embraced by different government levels and stakeholders. In New Zealand, the One Network Framework (ONF), which is also based on a "movement and place" matrix (like that of London), has been developed at a national level (Figure 4.3). This framework also introduces

classifications for different modes, recognising that streets may perform diverse functions. The ONF is recognised as a core tool supporting a number of national goals and strategies. Among these are the Road to Zero (zero road deaths target) and the Keeping Cities Moving plan, which aims to increase the share of travel by public transport, walking and cycling (Waka Kotahi NZ Transport Agency, n.d.[35]).

One main objective of the ONF is to create a common language for transport, land-use and urban planners to talk about streets and roads and to steer conversations about roads and streets nationwide. The framework was constructed through a gradual, participatory process, beginning in 2013. A first step was the development of six simple categories under the One Network Road Classification (ONRC). The ONRC then evolved into the ONF as more detail was added. This better represents the differences between urban, metropolitan and rural environments, and adds granularity to the differences within each of them. For instance, the ONF better reflects the diverse geography traversed by rural roads, some of which include places (e.g. town centres, tourist attractions or schools) with specific needs for road management or design (Waka Kotahi NZ Transport Agency, n.d.[35]).

During the April 2022 workshops, concerns were raised about the pertinence of road space reallocation and redesign in rural areas or on roads carrying freight. As shown by the ONF, rural areas can and need to be part of new frameworks for categorising streets and roads. McArthur et al. (2022[29]) also indicates that while the place function is more evident and important in streets than in roads, high-capacity and fast-moving roads still have place functions (even if small). Thus, including TII and local authorities in distinct rural areas in Ireland in the process of creating the framework will be key.

Figure 4.3. One Network classification in New Zealand



Source: (Waka Kotahi NZ Transport Agency, n.d.[35]), https://www.nzta.govt.nz/planning-and-investment/planning/one-network-framework.

The ONF was developed in three stages. In the first stage (starting in 2019), a working group was formed including members of New Zealand's national Waka Kotahi NZ Transport Agency and the various road-controlling authorities. The group had varied expertise (e.g. safety, planning and urban design), and worked on definitions and drafting core elements for a "Movement and Place"-based framework that would go beyond the ONRC. Outputs were shared with a wider group of experts, and in late 2019 both groups agreed on a series of high-level design elements for the framework (Waka Kotahi NZ Transport Agency, n.d.[35]).

In 2020, the high-level design elements were developed into a more detailed framework and set of tools, bringing together a wider group of experts in public transport, walking, cycling, safety and investment. A survey was launched, several workshops were organised, and finally the Movement and Place classification was developed.

The third stage of the process, which started in 2021 and is expected to end in 2024, has been dedicated to the implementation of the framework. This will include training and the development of tools for authorities and stakeholders to assess performance and produce reports based on the street classification.

Create indicators to measure progress, set targets and track benefits

Ireland would benefit from developing a set of indicators to measure street and road performance and progress made in road space reallocation. A framework should be constructed to enable viewing, discussing and then planning streets and roads differently. If road space reallocation is to become a priority (as called for in this report), tools will be needed to monitor progress and outcomes. Using these indicators to systematically change the decision-making process and planning practice, and to contribute to raising the profile of road space reallocation, will be paramount. As Wheeler (2004[36]) points out, "without political commitment to act on them, the development of indicators is a symbolic exercise". Ways in which such indicators could be used are suggested below.

Various interviewees remarked that hardly any evaluations are being conducted to monitor changes in mode shares, increased active travel, accessibility improvements, or health and environmental benefits from road space reallocation and redesign projects[9], and that this lack of evidence makes it difficult for such projects to gain visibility and priority. McArthur et al. (2022[29]) identify the lack of indicators for assessing, monitoring and evaluating road space allocation as one of the barriers to progress as well. In Ireland, the DoT will launch, as part of the new Sustainable Mobility Policy a new annual National Household Travel Survey, which could importantly contribute to the development of such a framework. Considering the types of indicators that could be useful (see discussions below) could help to shape the survey in ways that useful data for the development of this framework is collected.

Like the road classification framework discussed above, a shared set of indicators could be developed on a national scale. Development should be participatory, involving multiple levels of government, sectors and disciplines as well as stakeholders, academics and citizen groups. Emphasis could be put on the inclusion of particular segments of the population (e.g. children and parents, the elderly, teenagers, women). This exercise should not pre-empt the local development of more detailed or sophisticated frameworks.

Building such a framework would have numerous advantages, as it would:

- Complement the development of the new framework for road classification. Indicators could help measure how well different segments of the network are fulfilling its place and movement functions (McArthur et al., 2022[29]). They could also help measure the contribution of different types of roads towards prioritising sustainable modes.
- Help set common measures and standards for the "success" of a street or road. The performance of streets and roads could be linked to the new well-being framework outcomes, demonstrating to policy makers and the public how road space reallocation and redesign can

help achieve national goals. It would also give the well-being framework a practical focus and mainstream it into the policy-making process.

- Help measure (and communicate) the environmental benefits of road space reallocation and street redesign projects.
- Assess projects against common standards and compare alternatives. Quality and street audits exist for this purpose in Ireland, but they are neither compulsory nor mainstreamed, and their main focus depends on the objectives of a given project, rather than wider, more standardised goals. Projects can indeed have specific goals, and their attainment needs to be monitored. However, moving beyond a project-based vision and aligning individual efforts to advance the overall strategy is also necessary. This is especially so at present, when new funds are being channelled to active travel and public transport projects. In 2022, Ireland allocated 359 million euros (10% of the transport budget) to active travel infrastructure and greenways, up by 9% from the previous year.
- Set targets nationally (e.g. as an input to the CAP sub-targets and complementing indicators set out by the new SMP) and locally, reflecting the long-term vision for the road and street networks. These targets would bring together actors involved in road infrastructure and street planning, who would have to cooperate to meet them. The targets and associated indicators could facilitate multi-disciplinary, multi-sectoral, cross-government coordination and produce a shared vision of progress. As noted by McArthur et al. (2022[29]), "conflicting performance targets across the different institutions responsible for allocating streetspace" create a major barrier to road reallocation.
- Conduct benchmarking exercises in various areas, which could encourage policy makers to reflect on how they compare to other territories (e.g. other cities or towns, or even across neighbourhoods) in terms of street and road performance and progress in reallocating space and improving streets. This could give visibility to territories that have been making efforts in this direction. It could also make the gaps between different territories more visible. Overall, this could help create a narrative in which having successful streets is seen as a key component to developing a successful territory. In London, for instance, "healthy score cards" provide results for selected indicators across boroughs. Input indicators show success in the implementation of different measures (physically protected cycle tracks, low-traffic neighbourhoods, 20 mph speed limits, controlled parking zones and school bus priority); outcome indicators show success in achieving certain results (sustainable mode share, active travel rate, car ownership rate, road collision casualties) (TfL, n.d.[37]).
- Establish criteria for funding allocation. Indicators could be used to guide the allocation of funding to national and local authorities (e.g. funds for active mobility and public transport enhancement, or for urban renewal).

The applicability of the framework to different uses would, of course, depend on the indicators selected. Ireland could build on some frameworks from other countries, for example the Healthy Streets framework developed by Transport for London. This framework has ten guiding principles or indicators that help establish how healthy a street is. The assumption behind the framework is that while no street is 100% unhealthy or healthy, every street can be improved via redesign guided by the ten principles. These incorporate both movement and place elements and link to overall benefits for the community and the city (e.g. noise reduction, clean air, safety). According to (TfL, 2022[38]), each principle "is backed by scientific evidence that it improves health, reduces inequalities and encourages people to walk and cycle". The principles for a healthy street are:

- It is a welcoming place for everyone to walk, spend time in and engage in community life.
- People choose to walk, cycle and use public transport.
- There is clean air.

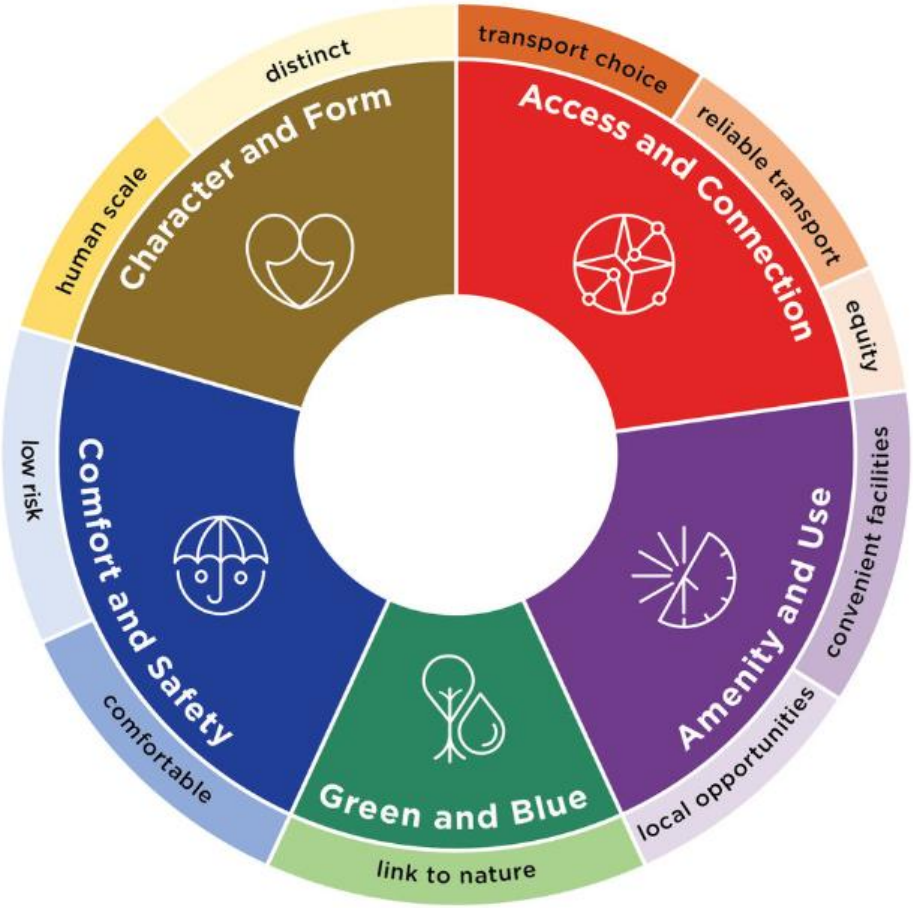
- People feel safe.
- The street is not too noisy.
- It is easy to cross, encouraging more walking and enabling connections between communities.
- It has places where people can stop and rest.
- It has facilities that provide shade and shelter.
- Its features make people feel relaxed (e.g. pavement and cycle paths that are not overcrowded, in poor condition or dirty).
- There are “things to see and do”, such as street art and attractive views.

A series of questions determine whether a given street fulfils each of the ten principles. A healthy street check enables designers to evaluate the consistency of a scheme with the principles; it includes 31 metrics, to be scored from 0 to 3. For instance, one of the metrics is the interaction between large vehicles and cyclists. A score of 0 is assigned to streets where large vehicles make up more than 5% of motorised traffic and either there is no dedicated lane for cyclists or the combined width of a cycle lane and the next general traffic lane is less than 4.5 metres. A score of 3 can be assigned to a street in which there is either no large vehicle traffic or cycle traffic is separated from it (TfL, 2022[38]). Another function of the framework is to help assess the changes that project proposals would introduce to existing streets. For example, the current and the future situation that would result from proposed changes in a street can be ranked and compared according to the ten principles.

The Built Environment Indicators developed for New South Wales, Australia, are another example of the use of frameworks to monitor and align road space redesign and reallocation. As part of the NSW Movement and Place Framework, the indicators help to assess projects by measuring their movement and place performance and related outcomes. For example, several measures assess cycling accessibility: one is the connected cycling network, which measures the percentage of cycling infrastructure that is connected to a network and the average distance to the cycling network.

The framework includes five different themes and ten outcomes (see Figure 4.4 and Table 4.3 below). A total of 36 indicators are linked to the themes and outcomes. Some of these are featured as core indicators: those that constitute the minimum project data inputs needed. Indicators are used in several ways: to establish evaluation criteria, present a gap analysis between the current situation and the desired performance of the area, and develop and compare different project options (NSW, 2022[39]).

Figure 4.4. NSW Built Environment Indicators: Themes and Outcomes



Note: A total of 36 indicators are linked to the different themes and outcomes, as presented in the table below. Within these 36 indicators are a group of core indicators that constitute the minimum data inputs needed for project to report against.
Source: (NSW, 2022[39]), https://www.transport.nsw.gov.au/industry/nsw-movement-and-place-framework.

Table 4.3. Indicators corresponding to the five themes

	Indicators used	Core indicators
Access and Connections	Mode share Walking paths Cycling accessibility Public transport accessibility Freight network accessibility Bus and strategic freight reliability Equitable access Steepness	Mode share Public transport accessibility Freight network accessibility
Amenity and Use	Public space Local living Primary schools Transport node facilities Places to stop and rest Mix of uses Population density Housing diversity Local jobs Economic development	Mix of uses
Green and Blue	Tree canopy Biodiversity Impervious surfaces Waterways	Tree canopy
Comfort and Safety	Road safety Pedestrian crowding Safe speed for environment Community safety Air quality and noise Urban heat	Road safety Air quality and noise
Character and Form	Permeability Building height Street enclosure Street space for pedestrians Culture and heritage Land division Legibility Building density	

Source: Authors, based on (NSW, 2022[39])

Indicator frameworks like the two just presented would help Irish authorities to monitor the outcome of changes in streets and roads, and especially to track whether changes increase the comfort of sustainable modes and, consequently, their use. Applying them can, for instance, help avoid projects labelled "successful" that consist of painting bicycle lanes in areas shared with buses or other traffic, or adding bike lanes at the expense of pedestrians while leaving space for car use untouched. Several indicators are particularly useful in this respect:

- Indicators of whether cycling, walking and public transport are easy to use.
- Indicators that measure accessibility by different modes (and the relative change of accessibility between modes).
- Indicators that measure road reallocation in itself (such as those included in the Clean Cities campaign (Stoll et al., 2022[40])). Indicators include for instance, the total length of separate infrastructure for pedestrians and for cyclists (separately) as a percentage of total length of roads.

Useful indicators of accessibility by different modes (and relative accessibility compared to the car) are those that measure the number of amenities reachable by different modes at a given time. A database developed by the International Transport Forum applied this type of indicator to 120 metropolitan areas in Europe, including Dublin. The database and interactive tool show how competitive different modes are for providing access to amenities such as schools, shops, hospitals and green spaces at a given time (15, 30 or 45 minutes). Data from the city and functional urban areas captures differences between central and peripheral areas. The accessibility indicator can be broken out into one that reflects the performance of the transport infrastructure, and another that reflects the role of the location of the amenities. This enables conversations among transport and land-use stakeholders, and is consistent with integrated movement and place thinking (see (ITF, 2022[41])).

Ireland could build on and expand efforts already being made by the NTA. The NTA has been developing accessibility indicators for Ireland, including the level of public transport accessibility (similar to the PTAL index[10] developed by Transport for London). The creation of a set of indicators to be mainstreamed into the planning and assessment of road space reallocation across Ireland could build on the work already done, with a focus on enlarging the set of accessibility indicators across modes and regions.

As argued by McArthur et al. (2022[29]), indicators drawing on surveys and data about user perceptions are also needed. London's Healthy Streets framework discussed above generates surveys and monitors the attainment of the ten principles based on data from users on how well a given project is fulfilling its goals.

Embed the new narrative and tools in planning practice

Spatial planning is key to transforming and improving streets. As emphasised in the Healthy Streets framework, action needs to be taken at three levels: "the street level, the network level and the spatial planning level" (TfL, 2022[38]). The sections above outline the ways in which the two tools presented can help with the first two levels – providing support for planning individual projects and for planning and evaluating changes at the network level. Embedding these tools, linking them with efforts at the spatial planning level, and mainstreaming them in day-to-day planning practice will also be essential.

Planning documents for metropolitan and other areas need to build on analyses that make use of the new road classification and the indicators discussed. Short-, medium- and long-term targets for road space reallocation and road and street performance should also be incorporated into these documents.

Planning for new development can also make use of the tools to set priorities for improving existing development and guide new development. For example, the London plan singles out the 10% least walkable areas in the city for special attention. "Growth areas" are also identified, with the aim of setting stricter standards for their development in line with the Healthy Streets framework (TfL, 2022[38]).

Incorporating street performance standards into the planning permission process would also help systematise good practice, and link transport and land-use planning in ways that promote Complete Streets and Place-making. In London, planning applications need to include Transport Assessments, showing that they encourage and create more space for walking and cycling. TfL can advise boroughs and the mayor to refuse planning permission if the development is not in line with the Healthy Streets or Vision Zero strategies (among others) (TfL, n.d.[42]).

4.3.2. Enhance local capacity

Accelerating the widespread development of street redesign and road space reallocation projects requires enhancing the local capacity for assessing, designing and implementing them. As noted by McArthur et al. (2022[29]) place and movement road classifications provide higher-level guidance, but tailored case-by-case project planning is crucial. Involving local authorities in developing new tools (such as those described above) and a new narrative can promote exchange between local authorities with different expertise, and can also improve the understanding of new practices. In addition, a number of actions in the SMP are also

relevant. For example, the further development of DMURS (jointly by the departments of housing and transport), and the update of guidelines, standards and supporting legislation to allow for road space reallocation / redesign project development

As shown by the MORE project (see above), rethinking and transforming streets into places and enablers of high quality of life calls for local authorities to become "streetspace managers" and to make use of tools such as pricing, land-use planning and prioritisation of mobility modes to "govern their streetspace" (McArthur et al., 2022[29]). The development of new sets of indicators also calls for local authorities to increase their capacity to collect and interpret the right data.

In this context, funding channelled to local authorities must be used not only to develop infrastructure but also to create adequate capacity. Funding levels should be assessed in light of this need. The SMP already goes in this direction by funding, for instance, the establishment of units within local authorities to implement active travel schemes. In particular, enhanced skills will be needed for:

- Supporting the technology that will allow local authorities to collect key data for developing pedestrian, cycling activity, etc. (Colville-Andersen, 2018[43]).
- Ensuring local authorities have the right skills. Interviews revealed that private consultancies are significantly involved in project development in Ireland. This can bring a lot of value. Nonetheless, making sure expertise is also developed within the public sector is also needed. Interviews and conversations also revealed that enlarged cross-disciplinary teams might be needed in some places. Workshop participants described, for instance, that road planning is often viewed as solely an engineering task, and local authorities would benefit from integrating other disciplines too. In particular, enhancing skills will be needed for:
- Conducting data analysis and interpretation, and integrating new technologies into practice (e.g. using dynamic road reallocation).
- Adequately enforcing new rules.
- Better engagement and communication with the population.
- Application of practices that have proved useful elsewhere, such as tactical urbanism. A number of participants mentioned in the workshop that tactical urbanism has remained marginal in Irish practice (see Box 4.6).

Revisiting parking policy and regulations will be paramount, and often requires close coordination between national and local governments. Greater local expertise will be needed to develop parking policies and strategies that are coherent and support the transformation of the transport sector, which will then need to be promoted and sometimes mandated by the national government. One major change should be the shift from minimum to maximum parking standards for new developments. Free or cheap off-street parking, in particular near workplaces, schools and colleges, should also be reassessed, as previous evaluations have proposed (OECD, 2021[44]; Caulfield, Carroll and Ahern, 2020[14]).

An important challenge will also be to create a coordinated vision and strategy for the metropolitan/functional area that prioritises road space reallocation. The SUMP strategy, offering best practice guidelines for sustainable urban mobility planning, considers that transport planning is often best done for an entire functional urban area (FUA), building on the basis of actual flows of people and goods that connect a city to its surroundings (Eltis, 2021[45]). Strategic transport planning that encompasses the core city and its surrounding areas is already happening in some places in Ireland. At present, the NTA has been given statutory transport planning power over major metropolitan areas (Dublin, and more recently Cork, Galway, Limerick and Waterford); with the aim of enhancing coordination and strategic planning. Each of Ireland's five cities has (or is finalising) multi-modal metropolitan area transport strategies which, are developed in line with the EU guiding principles for sustainable urban mobility plans (Department of Transport, 2022[11]). It would be important that building capacity to advance road space reallocation in these areas is given priority by the NTA.

Discussions in the last section of this chapter raise the questions, however, of whether such coordinating bodies should remain at the national level and whether they should be created for territories outside major metropolitan areas as well. As discussed by McArthur et al. (2022[29]), building leadership and guiding engagement with the public is particularly needed for road space reallocation. Therefore, a question is whether the setting up of metropolitan or functional area-wide technical bodies, designated for transport (and possibly other matters – e.g. land-use), and with large local representation in their governing bodies, could better strike the balance between avoiding fragmented decisions while constructing local visions and leadership.

In the particular case of road space reallocation, these types of metropolitan/ functional area-wide bodies could, for instance, carry out data collection and analysis functions (ITF, 2018[32]), and help gather and analyse data so that indicators identified as important to assess street performance and measure progress can more easily be developed for different territories. Dedicated, capable staff hired by these institutions could create a positive dynamic, enabling different territories to build on and improve the national frameworks. The NTA could then better utilise its capacity to develop new indicators and data without having to do so for every territory. These bodies could also take responsibility for strategic planning (ITF, 2018[32]) and enhance capacity to collect inputs from local governments, stakeholders and the public, to create a shared vision for the future of roads and streets. They could also develop regional strategies to communicate with citizens about the benefits and urgency of road space reallocation.

The question of what tasks would be assigned to MTAs and which would remain a national or more local (i.e. county) responsibility will need to be carefully considered. Different allocations of tasks exist internationally (ITF, 2018[32]), and these can provide guidance. There will still be a need to enlarge and enhance capacity at the local level (i.e. at county level), even if these bodies are created. Assessing the needs at each scale of government would be crucial to ending up with a division of powers that makes sense for Ireland.

Box 4.6. Tactical urbanism and road redesign

Tactical urbanism involves making quick, low-cost interventions that can show the population what a particular change would look like without building any permanent infrastructure. It has proven a useful tool for overcoming behavioural biases such as loss aversion (naturally giving more weight to losses than gains) and the status quo bias (the tendency to prefer the current situation and oppose change) (Rowe, 2013[46]).

When changes, for example in road space reallocation and redesign, are introduced with “soft” infrastructure modifications, authorities can easily adapt them to the needs and views of the population (or retract them). Projects are often introduced as something temporary, making them less threatening to individuals. By allowing stakeholders and others to see a new version of their street or neighbourhood, tactical urbanism enables them to experience a new situation and make the change less of an unknown (Rowe, 2013[46]).

A number of cities have used temporary projects and tactical urbanism to reallocate road space, including Copenhagen, New York, Melbourne, San Francisco and Brussels (Rowe, 2013[46]). This was how Superblocks were introduced in Barcelona (see section 3.3.1). For political reasons the first Superblock was put in place overnight, without a solid process of consultation; nonetheless, the administration was able to move the conversation rapidly from why public space had been taken away from cars, and to what to do with the new space (Roberts, 2019[47]).

The Barcelona example shows that introducing a scheme via tactical urbanism can be an opportunity to understand better what people want before constructing more permanent infrastructure (playgrounds,

outdoor sitting areas, changes to pavement level, etc.). Giving people the opportunity to shape the project once they have experienced the initial changes can help it gain acceptance (Roberts, 2019[47]).

In light of the COVID-19 pandemic, cities were forced to re-envision their modes of transportation for the health of their citizens (Pradifta et al., 2021[48]); (2021[48]). Note that cities such as New York (US), Paris (France), Toronto (Canada), Chicago (US), and Berlin (Germany) all utilised tactical urbanism to support a safe transition to help citizens move around cities without contracting COVID-19. These examples include opening up streets for socially responsible recreation, rolling out emergency bike lanes to ensure social distancing and prevent an increase in car use, creating bigger sidewalks so walking is more comfortable for citizens, offering reduced bike sharing membership fees for a more inclusive transition towards active modes of transportation (Pradifta et al., 2021[48]).

Source: (OECD, 2021[4])

4.4. Scale up shared on-demand services to boost the delivery of sustainable accessibility

Scaling up shared on-demand services (see Box 4.7) is a policy that has also been found to have a high transformative potential to shift Ireland towards a transport system that delivers sustainable accessibility. As noted in Chapter 3, this can help restructure the car-dependent system by offering new connections and services via sustainable solutions and enlarging the scope of multi-modality, thus helping to reverse the sustainable modes low-attractiveness trap. It can also contribute to changing land-use patterns by freeing up parking space. Additionally, it can reduce the stock of vehicles needed to provide mobility, while making vehicles for which the uptake of electrification has been the fastest (e.g. e-bikes and e-scooters) more relevant in modal shares; thereby enabling more effective electrification efforts.

Both international experience and previous studies conducted in Ireland confirm the potential of shared on-demand services to create rapid change and produce environmental and well-being benefits. ITF (2018[8]) calculates that, combined with current core public transport services, introducing shared taxis and minibuses could reduce transport emissions by 30% and congestion by 38% in Dublin. This reduction is equivalent to around 200 000 tonnes of emissions, equivalent to the average yearly carbon footprint of around 8% (41 000) of Dublin's inhabitants.[11] Incorporating other shared modes suitable for shorter distances (especially micro-mobility modes such as bikes and e-scooters) would lead to even further reductions in emissions and congestion. For comparison, a "systemic, electric and integrated" roll-out of micro-mobility services by 2030 in Europe, to the point that these would account for 50% of all trips under eight kilometres, would result in a 30 million tonne of emissions reduction (EIT and McKinsey, 2019[49]).

Because these services can help to build a functioning, multi-modal transport network, they can contribute to providing a convenient option for daily travel and reducing car dependency. ITF's study of shared taxis and minibuses in Dublin (ITF, 2018[8]) showed that these services can improve the performance of the whole transport system by acting as feeders to the core public transport network or replacing public transport routes that currently operate rarely or ineffectively. Shared taxis and minibuses can substantially improve regional accessibility (ITF, 2017[7]) and enhance access to opportunities. A study in Boston also showed that micro-mobility has helped citizens access 60% more employment opportunities when combined with public transport and walking (Climateworks Foundation, 2021[50]).

Studies also confirm the potential of shared on-demand services to make better use of public space. Even if all such services needed parking space, shifting away from private cars, which are parked for most of the time, frees a great amount of public space. In its simulations for Lisbon, ITF (2017[7]) estimated that shared taxis and minibuses could reduce the overall space used for parking by 95%, noting that other

studies have produced similar findings. Modelling a systemic roll-out of micro-mobility in Europe showed that it could liberate 48 000 hectares of inner-city land (the equivalent of about 4 times the land area of Dublin) (EIT and McKinsey, 2019[49]).

In addition to making streets more people-friendly, bringing services closer to visitors (especially via shared scooters and bikes) can boost local economies. A study by the scooter company Lime showed that 72% of riders use its scooters to visit local shows and attractions (Eltis, 2021[51]). Scaling up these services could contribute to other Irish policy objectives, such as the revival of central areas in towns as part of the Town Centre First Policy (Dept of Rural and Community Development and Dept of Housing Local Government and Heritage, 2022[52]).

As noted in Chapter 3, a number of synergies link the scaling up of on-demand services and the mainstreaming of road space reallocation and street redesign (see section 3.3). These synergies are also confirmed and explored by (ITF, 2021[53]).

Box 4.7. What are shared on-demand services?

In this report, "shared on-demand services" refers to vehicle and ride sharing schemes. The former includes bike, (e-) bike, micro-mobility and car-sharing schemes. The latter includes a number of ride-sharing schemes performed in high occupancy vehicles, such as on-demand micro-transit, volunteer-based transport, and peer-to-peer ride-sharing (ITF, 2017[7]; OECD, 2021[4]) (see more in Box 4.8, where differences in these services are addressed and their feasibility in rural areas is explored).

According to Crozet (2020[54]), technology-based mobility, when focused on cars and high occupancy vehicles, falls into three categories: 1) peer-to-peer car rental; 2) short-term rental of vehicles managed and owned by a provider; 3) ride-hailing, ride-sourcing, e-hailing (Uber-type services); and 4) ride-sharing, micro-transit or on-demand public transport. As discussed in (Crozet, 2020[54]) the fourth category should be prioritised, since only these options can effectively tackle low-occupancy rates and thus reduce emissions, air pollution and congestion. Moreover, some technology-based solutions, such as ride-hailing, are rarely shared in practice; consequently, these solutions can undermine the objectives of sustainable transport systems. For example, the large-scale use of ride-hailing has led to increased congestion and emissions and low efficiency of road space use in many countries (OECD, 2021[4]). However, this report acknowledges that services in the first and second categories may be the only options in the least dense and sparsest locations.

Ireland is making efforts to develop shared on-demand services, but these need to be scaled up. New legislation to allow the use of e-scooters is being drafted (Department of Transport, 2022[11]). NTA bike sharing schemes operate in each of the five cities in Ireland with private bike sharing schemes active in Dublin, Athlone, Mullingar, Sligo and other cities/towns. In addition, the new SMP includes in its action plan the expansion of bike-share (including e-bikes) scheme operations in cities (starting with Waterford) and the development of a model for deploying shared bike schemes (potentially including e-bikes as well in regional growth centres and key towns). Alongside its regular rural bus service, TFI Local Link offers bookable community transport services with door-to-door connections. These services are an integral part of the national transport network, and are increasingly included in the national multi-modal travel information system (National Journey Planner) and national fare system (LEAP card) (ITF, 2021[55]).

The integration of different mobility solutions is also advancing. Along with appropriate regulation, the new National Sustainable Mobility Policy emphasises the role of smart digital solutions to make the interchange between modes and thus the use of sustainable mobility easier. This strategy points to initiatives that prepare for a "Mobility as a Service" (MaaS) system to be implemented (including Next Generation Ticketing, Automated Vehicle Location and National Journey Planner). The SMP also includes an action dedicated to the development of a governance framework for the implementation of MaaS (Department of

Transport, 2022[11]). Smart Dublin, an entity formed by the four Dublin local authorities, has started to work on a MaaS strategy for Ireland in which public authorities would lead work on a Data and Services hub for scaling up new mobility solutions (Smart Dublin, 2022[56]). MaaS has been defined as "a distribution model for mobility services that uses shared data and a digital interface to efficiently source and manage the provision of transport-related services into a seamless offer" (ITF, 2021[57]).

A clear distinction must be made, and is made in this report, between scaling up on-demand shared services and integrating different sustainable mobility solutions into a MaaS system. Creating a MaaS platform with data and service integration can contribute to the scaling up of shared on-demand services by enabling seamless door-to-door connections. However, it should be kept separate from the scaling up of shared on-demand services themselves. In its recent report, ITF (2021[57]) emphasises that MaaS has not been deployed on a large scale in any city or country, and thus its potential role in promoting sustainable travel remains unclear (ITF, 2021[57]). For this reason, it concludes that MaaS is not a "panacea for achieving sustainable mobility outcomes" and that sustainable mobility should be primarily pursued via other initiatives. That said, the scaling up of shared on-demand services should leave open the opportunity to develop MaaS (ITF, 2021[57]). While this section focuses on recommendations for scaling up shared on-demand services, it highlights some areas, such as data-sharing requirements, where the management of these services can facilitate the eventual development of MaaS.

Scaling up shared on-demand services far enough to make them a convenient alternative to car travel will require an integrated planning approach, regulatory measures that go beyond data and digitalisation, new financing priorities, and communication and educational measures. These services should not be implemented only in urban areas. Representatives of both urban and rural areas in the April 2022 workshops emphasised that shared on-demand services can and should be scaled up throughout Ireland.

The potential to increase the use of shared and active modes in Ireland is significant. Travel data from different regions shows that there is considerable scope for replacing shorter car trips with shared modes. According to the National Travel Survey in 2019, almost 75% of trips in Dublin and 60% of trips in other regions in Ireland were less than 8 kilometres in length; private cars accounted for 51 to 70% of all these trips (CSO, 2020[58]). Public transport and higher-occupancy shared services (e.g. demand-responsive transport) could replace longer trips and reduce private car travel. An array of shared services exists, with different advantages in different situations, including rural areas (ITF, 2021[55]).

The rest of this section discusses ways to scale up shared on-demand services across Ireland. Like the other recommendations in the report, it builds on discussions during the April 2022 workshops, visits to different regions, interviews with stakeholders and good international practice.

4.4.1. Integrate shared on-demand services as part of transport strategic planning

Ireland needs to plan shared on-demand services in ways that ensure their social value. Making them part of strategic plans, visions and goals is key to ensuring that these and other sustainable modes are developed in an integrated way (Arndt et al., 2019[59]). A best practice sustainable mobility plan (following the SUMP model[12]) addresses all forms of collective mobility (traditional public transport as well as new sharing services) and active modes (walking and cycling), while ensuring the integration of all modes for door-to-door connections (Eltis, 2021[45]).

London is a good example of integrated planning. London's transport strategy sets a target for 80% of all trips in the metropolitan area to be either by end-to-end fully active modes of travel (mostly walking and cycling but also, for example, using scooters and wheelchairs) or by public transport (including higher-occupancy services) by 2041. Planning for all sustainable modes together helps to improve accessibility and ensure seamless interchange between modes across the city, thus providing a real alternative to car travel. In particular, its "whole journey" approach, which combines public transport with attractive street environments and includes facilities for sustainable onward journeys (e.g. walking directions or bike hire

stations), facilitates the planning of seamless and accessible interchanges (Greater London Authority, 2018[60]).

Brussels offers another good example of integrated transport planning. Its sustainable mobility strategy ("Good Move") is the first SUMP developed through stakeholder consultations that prioritises the integration of shared mobility with public transport. The hubs that facilitate interchange between modes, partly by repurposing current parking areas (e.g. as shared car and bike stations), are central to the plan. The inclusion of new shared services in planning has been accompanied by the development of services and regulations for shared bikes and scooters (Brussels Mobility, 2021[61]). The following sub-sections present recommendations related to these initiatives.

Integrating shared on-demand services into strategic planning can be combined with assessing their contribution to equity objectives. ITF (2017[7]) notes that authorities need to understand how these services can help deliver accessibility in an equitable way. Irish transport planning should assess where and for whom these services could improve accessibility (Arndt et al., 2019[59]). Ensuring equity means that these services are available particularly to vulnerable groups such as low-income or elderly people (Smorto, 2020[62]). Planning should leverage the potential of shared on-demand services to serve poorly connected neighbourhoods and offer first- and last-mile connections where public transport gaps exist. ITF (2021[55]) discusses how different options could suit areas with varying combinations of density and sparseness (see Box 4.8). To facilitate service provision in all areas, regulation should take into account the costs and coverage areas of these services (Smorto, 2020[62]).

Box 4.8. Shared on-demand solutions in rural areas

ITF (2021[55]) classifies shared mobility solutions by typical distances, settlement patterns (sparse vs. nuclear) and population densities. Its classification shows that shared on-demand services can indeed offer valid transport options and greatly improve accessibility in rural areas. Options are mapped based on their viability (depending on the density of the area) in Figure 4.5 and described in more detail below. The work includes bike-sharing schemes but does not include shared micro-mobility (e.g. e-bikes and e-scooter) schemes.

Demand-responsive transport (DRT)

DRT refers to shared services with flexible routing and scheduling, using small- and medium-sized vehicles (taxis or (mini)buses) and offering either door-to-door services or pick-ups and drop-offs at predefined or virtual stops. These services leverage technology to schedule orders and optimise routes. Examples from other countries demonstrate that these services can play a key role in delivering sustainable accessibility. In Porvoo, Finland, for example, 67% of the trips in the DRT service trial would otherwise have been made by car, and 27% would not have been made at all. However, the successful delivery of DRT services depends on careful consideration of the operational environment as well as user needs and preferences. Frequent problems include uncertainty about schedules, long waiting times, and disruptions in pre-booked journeys. Thus, managing booking of journeys and integration with other transport services is important for the development of DRT services in rural areas.

As Figure 4.5 shows, these services work best in areas with higher densities. In nuclear settlements, a larger fleet of micro-transit vehicles can provide enough capacity to enable instant booking. In sparser settlements, a smaller fleet will cover a wider area and thus require pre-booking. Another aspect for planners to consider is whether DRT should offer substitute or interchange services. In the first case, DRT can replace or enhance fixed-route services at certain times and in certain areas (especially where long distances, sparse populations, and varying mobility needs make fixed routes inefficient and costly). In the second case, DRT offers first- and last-mile connections with fixed-route transport services,

coordinated with public transport through adjusted timetables and ensuring connections to hubs and major transport links.

Volunteer-based transport

Volunteer-based or community transport refers to not-for-profit services organised by local residents for local needs, including both fixed-schedule and DRT services. Such services can improve transport coverage at a low cost in a locally tailored manner (either in areas where public transport is costly to maintain or as first- and last-mile connections to it), while also improving social cohesion. Local Link services are a good example of community transport services increasingly being integrated into the rest of the Irish transport system.

Station-based car-sharing

Car-sharing schemes separate ownership of vehicles from their use and differ from traditional car rental by offering immediate or short-term availability and convenience. A station-based model is usually recommended for rural areas, because large distances and a widely scattered customer base mean that station-less vehicles are unlikely to be near enough to would-be users, making a free-floating model impractical despite its flexibility. Since car-sharing in rural areas tends to be uneconomical and requires high vehicle investment and maintenance costs, it is often subsidised by municipalities and uses volunteers as drivers. In Germany, for example, car-sharing provider E-Wald has made underutilised municipal fleets available to the public: it takes care of operations, insurance and maintenance, returning 50% of revenues to the municipality. Policy makers need to plan the car-sharing offer carefully, integrating it into other transport systems to avoid making it a competitor or a substitute for public transit.

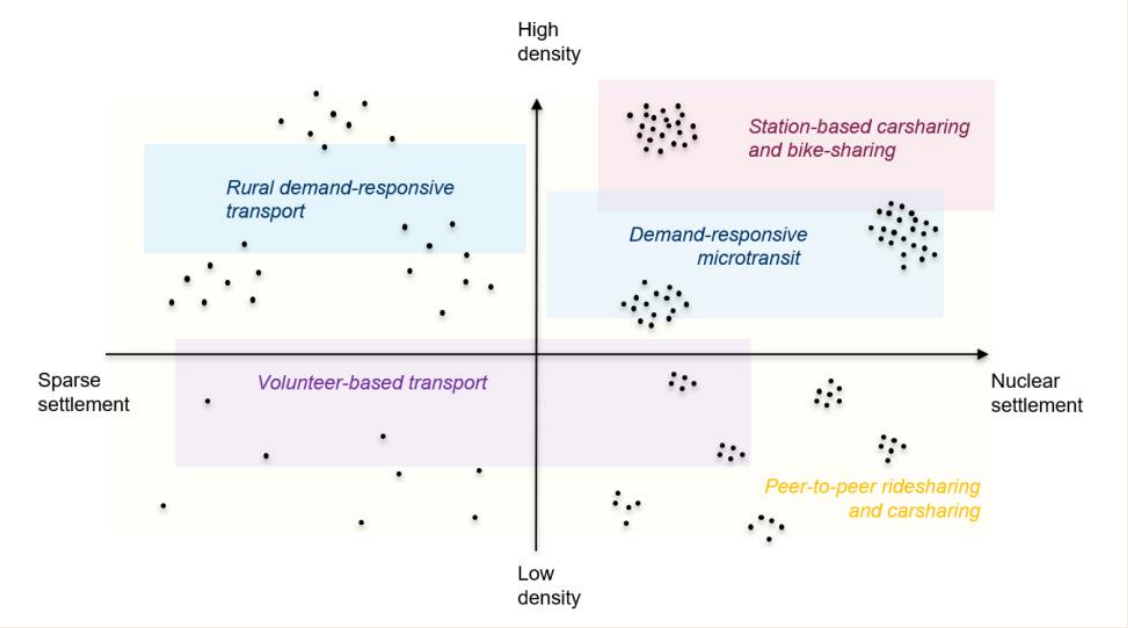
Peer-to-peer ride-sharing

By adding passengers to journeys that would have taken place anyway (thus building on existing assets and trips), peer-to-peer ride-sharing services have a lot of potential, especially in areas where demand is low and dispersed. Policies related to these services include raising awareness about them (to encourage use and thus build a critical pool of services), possibly incentivising drivers through subsidies, and building dedicated infrastructure (such as parking slots and hitchhiking benches integrated with public transport or service hubs). Rural France, for example, has seen the emergence of a car-pooling solution (Synchro) in which travellers indicate their destination on a pushbutton panel by the road or in an application, sending a signal to registered drivers and another signal back to the traveller when a pickup is confirmed. In the Grand Chambéry and Les Bauges regions, this solution provides up to 200 car-pooling trips per week with an average waiting time of 3 to 6 minutes.

Bike-sharing

Bike-sharing schemes can be a key element in multi-modal transport systems in rural areas by offering first- and last-mile solutions. Since rural areas can be hilly and distances are long, shared e-bikes are often seen as the most valuable option. A highly successful example comes from Mettingen, Germany, where citizens can rent e-bikes and park them in storage provided at bus stops. During the first seven years of operation, the number of public transport subscribers in the area increased tenfold. Another good example comes from Velenje, Slovenia, where shared e-bike riders use a digital tool (integrated registration, booking, payments and information) and sharing stations to access a semi-flexible DRT bus service.

Figure 4.5 Shared mobility services for different types of settlement



Source: (ITF, 2021[55]), https://www.itf-oecd.org/sites/default/files/docs/innovation-rural-mobility.pdf.

Integrating shared on-demand services into planning requires enhancing the capacity of transport planners in Ireland to analyse, interpret and collect data. Transport data (e.g. user itineraries, travel conditions, vehicle traffic) is essential for assessing the performance of urban transport systems and improving them (ITF, 2018[32]). The scaling up of shared on-demand services creates further requirements and opportunities for data management and collection. Monitoring the performance of shared services might require new indicators and new expertise (e.g. about new vehicle technologies) (Arndt et al., 2019[59]). Data reporting by service providers could give information on operational costs, indicating the level of subsidy needed to serve rural areas. Meanwhile, the introduction of new shared vehicles with new technologies (such as advanced sensor equipment in micro-mobility vehicles) enables the collection of more and better data, even in real time (ITF, 2018[32]). Monitoring is linked to the allocation of concessions (discussed below), since data reporting requirements underpin data collection by planning authorities.

Incorporating service hubs

As noted above, shared on-demand services can greatly contribute to a properly functioning multi-modal network. Digital platforms can play a key role in enabling interchange between different modes, but infrastructure solutions are also key (SHARE-North Academy, 2021[63]). Ireland should focus its strategic transport planning in part on building service hubs, points where multiple modes and service operators meet (American Planning Association, 2022[64]). Beyond offering shared and public transport services, these hubs could include other mobility-related components (such as private bike parking and repair, or rentable child seats) and public sphere improvements (such as parcel delivery, cafés, accessible and covered waiting areas, and phone charging) (CoMoUK, 2019[65]). In this way, they can contribute to creating the required balance between movement and place on the streets. These hubs should also include supportive infrastructure (such as shelters, way-finding signage, real-time travel information, and ticketing) to enable users to switch seamlessly from one mode to another (American Planning Association, 2022[64]; CoMoUK, 2019[65]). Developing a visible brand (possibly linked to the Transport for Ireland brand) for these service hubs would help market the services; in one example, 85% of citizens in Bremen know about car-

sharing thanks to the clearly visible brand on the streets. It would also help build political support by creating a concept that policy makers could rally behind (SHARE-North Academy, 2021[63]).

Service hubs can be located in different places and must be tailored to the specific needs of the location. Typical locations include public transport stations, housing developments, business parks and shopping centres (CoMoUK, 2019[65]; SHARE-North Academy, 2021[63]). Since there is no one-size-fits-all model for these hubs, stakeholder engagement is essential to map specific local needs (SHARE-North Academy, 2021[63]) and inform planning. When the hubs are connected to public transport stations, the increased number of travellers (using shared modes as first-mile solutions to access the stations) must be matched by the capacity of public transport (ITF, 2018[8]). One good prototype for service hubs in public transport stations is Heuston Station in Dublin; while the range of shared services, public-sphere elements and supportive infrastructure could be extended, the station already provides a good selection of transport services (train, bus and Luas services as well as shared DublinBikes) to connect travellers to other places in the city, as well as some shops and cafés.

Since shared on-demand services are meant to accelerate the shift away from private car use, service hubs should be located "closer to a user's front door than the privately-owned car" (SHARE-North Academy, 2021[63]). New development (which should be preferably on brownfield sites, as explained in section 4.6) presents the opportunity to start making this a reality across the country. Such developments, particularly in urban settings, should limit parking for private cars and instead build local hubs with alternative modes nearby.

Service hubs could leverage locations that used to be designated for car use and thus are already strategically located along transport networks and close to services. For example, locations where Park & Ride services were planned could be turned into hubs providing shared services rather than (only) parking for private cars. During the workshops, participants suggested that multi-storey car parks in urban areas and petrol stations in more rural areas could be transformed into multi-modal service hubs. Similar ideas have already been pursued in other countries: for example, Brussels' sustainable urban mobility plan identifies repurposing public and private parking spaces as an opportunity to create service hubs (with car- and bike-sharing and other mobility-related services such as bike repair), while giving priority to shared modes over private ones in parking allocation (Brussels Mobility, 2021[61]).

Different charging solutions for electric vehicles must be considered when designing multi-modal service hubs and other stations for shared on-demand services. Charging needs vary by location: for example, shared e-bikes next to public transport stations have to charge quickly, while shared cars in bigger hubs could use slower chargers (see further discussions on the charging strategy in section 4.5).

4.4.2. Regulate services to maximise social benefits

As Ireland introduces more types of shared on-demand services and scales them up, it is crucial to learn from past mistakes. In many places (including Ireland), these services have emerged rapidly, with little planning and without a regulatory framework to ensure their success. Results are likely to be suboptimal and even counterproductive, and the reputation and acceptance of these modes can suffer in consequence. For example, in Barcelona, private service providers faced little regulation, and focused on servicing only the large, more profitable transport nodes rather than providing equitable access (Interreg Europe, 2019[66]). Unmanaged growth, especially of low-occupancy services (e.g. car-sharing and ride-pooling), can also mean fewer people use active modes or public transport, thus failing to reduce car ownership and undermining the objectives of sustainable mobility (Greater London Authority, 2018[60]). In some cities, including Dublin, citizens complain that shared bicycles take up all the parking space in central locations, leaving nowhere to park private bicycles (IrishCycle, 2022[67]). As discussed by the ITF (2018[8]), regulation by public authorities is needed to make sure the scaling up of these services creates the best possible value for society. The need for regulation is also acknowledged in the National Sustainable

Mobility Strategy, which emphasises safety as well as environmental and consumer protection (Department of Transport, 2022[11]).

As noted in the introduction to this section, this report addresses the scaling up of shared on-demand services separately from the development of MaaS, distinguishing between the regulation of shared service providers and MaaS providers. Some operators will continue to provide only shared on-demand services in the future, thus requiring specific regulation. Conversely, some MaaS providers can function without owning their transport services, and will require new regulations specific to their operations (ITF, 2021[57]). The specificities and challenges of MaaS regulation are discussed, for example, by ITF (2021[57]). The two sets of regulations will need to support each other in ways discussed in the following subsection.

Avoiding regulation that inhibits the development of services or MaaS

Regulation should not aim to limit the development or offer of shared on-demand services, but rather to create a stable, predictable market environment for private operators (ITF, 2018[8]). ITF (2019[68]) notes that any regulation should reflect the objectives of transport policy, such as creating accessibility via sustainable modes, and avoid imposing restrictions that might inhibit the attainment of these objectives or associated innovative thinking. Regulation should find a balance between specifying technical details needed for better planning and requiring over-complicated systems for providers, especially smaller ones. In principle, regulatory requirements should minimise the cost to providers.

Similarly, the regulation of shared on-demand service providers in Ireland should not inhibit the potential development of MaaS services. Data-sharing and access between service operators and MaaS providers is essential for creating a MaaS ecosystem in the future. With this objective in mind, imposing minimum data-sharing responsibilities (necessary for informational, operational and transactional integration) on mobility operators and granting data access rights to MaaS providers should be included in the regulation of shared on-demand services (ITF, 2021[57]).

Banning or capping the number of operators or vehicles allowed in shared on-demand services, or disproportionate operating fees, can potentially inhibit the development of new services and MaaS. Banning and capping should be avoided since it conveys the message that shared on-demand services are somehow detrimental to society (while, for example, private cars with many detrimental effects on the environment are not capped) (OECD, 2021[4]). Rigid caps on fleet numbers also constrain the development of MaaS (ITF, 2021[57]). Excessive operating fees can make many operators' business models unviable (ITF, 2019[68]); (OECD, 2021[4]). The fees for shared on-demand services should reflect their promising contribution to achieving a modal shift and environmental goals and should not be higher than those for (single-occupancy) taxis or the overall cost of using private cars, as has happened in some cities across the world (ITF, 2021[57]).

Ensuring social value

A "softer", more balanced approach can be better suited to making the most of these services (OECD, 2021[4]). Rather than treating new services as a nuisance, active regulation in Ireland should aim at:

- Introducing **data reporting requirements**[13] to inform strategic planning, ensure that supply levels match demand, help monitor service performance and improve understanding of modal shift and accessibility effects.
- Exploring the opportunities and synergies that **new technologies** (e.g. sensor cameras in scooters) can provide to ensure the safe use of new modes, including by improving the infrastructure dedicated to these modes.
- Imposing **minimum safety standards** for micro-mobility via speed limits, as in the planned regulations for e-scooters, and improving road safety in other ways, including avoiding by-the-minute charging that encourages speedy driving. Requiring indicator lights on powered micro-

vehicles, and reducing the speed limits of motor vehicles which are often involved in micro-mobility accidents (see more in (ITF, 2020[69]).

- Ensuring that shared on-demand services can **serve all population groups** by, for example, requiring larger vehicles to be wheelchair-friendly and some shared cars and other services to accept domestic animals, including baby seats, or choosing service providers who offer a variety of vehicles such as cargo bikes, bikes with seats for children or bikes for children, alongside traditional shared bikes.
- Establishing rules regarding the **use of infrastructure**, specifically ensuring access to dedicated infrastructure for bikes and scooters, while not endangering pedestrians (linked to street redesign recommendations), and allocating dedicated parking spaces that are numerous and well connected to the transport network but do not compromise the use of private vehicles.
- Requiring that the **servicing and lifespan of vehicles** are in line with climate goals (see Box 4.9 below).
- Ensuring that services **offer wide accessibility** by, for example, setting a minimum coverage area for providers (see (Interreg Europe, 2019[66]) for an example in Barcelona) or requiring providers to place a proportion of their vehicles in poorly covered areas (see (Copenhagenize EU, 2019[70]) for an example in Seattle), while providing the necessary subsidies linked to these measures.

Box 4.9. Servicing and lifespan of micro-mobility

Beyond using low-carbon energy for charging electric vehicles, sustainable servicing and longer vehicle lifespan also ensure that electric micro-mobility does not undermine environmental objectives. A study conducted on sustainability of e-scooters in Paris showed that two thirds of emissions came from servicing and maintenance (petrol- or diesel-fuelled vans collecting and redistributing the scooters across the city from warehouses located outside the city) and one third from the design of the scooters (energy-intensive aluminium and lithium-ion batteries) (de Bortoli, 2020[71]). Efforts to ensure the sustainability of micro-mobility should thus focus on:

- Prolonging vehicle lifespan with higher-quality parts.
- Encouraging local manufacturing and recycling of vehicle parts and batteries.
- Reducing the need to transport vehicles by setting up battery swapping and charge-and-lock stations, for example at mobility hubs (EIT and McKinsey, 2019[49]). E-scooter companies are already developing more sustainable practices. For example, TIER's comprehensive sustainability plan includes:
  - swappable batteries (which allow check-ups and simple maintenance of vehicles on the street instead of transporting them to warehouses)
  - measures to extend vehicle lifespan
  - green operations fleet (replacing the majority of vans with e-cargo bikes that transport and swap batteries, while the remaining vans would primarily redistribute e-scooters in the operating area)
  - renewable energy in warehouses where batteries are charged (which would also be smaller, since less space is needed to charge batteries and repair some vehicles rather than charging all vehicles) (TIER, 2021[72]).

With respect to data reporting, operating concessions (which require data reporting by service providers) could be reorganised at the functional urban area (FUA) level together with transport planning. Currently, the county and city councils commission shared services in their administrative areas, which cover parts

of the FUAs of cities. Different municipalities within a single FUA could coordinate and align their regulation of operating licences. However, daily travel patterns often cross the borders of municipalities in the same FUA, making it more efficient to issue licences at the FUA level (ITF, 2016[73]). This has been done in London, for example, where TfL, London councils and London boroughs worked together to launch a tendering competition for an e-scooter pilot scheme (CiTTi Magazine, 2020[74]).

Addressing exclusive occupancy as an inefficient use of public space

Low occupancy is a problem, especially in car-based shared services, undermining the objectives of reducing private car travel, traffic volumes and CO_2 emissions (ITF, 2017[7]). While it is inevitable that vehicles originally dedicated to shared travel sometimes transport only one person, public authorities should discourage this suboptimal use of shared services and public space by differentiating between cars with single and multiple users. Access to certain public roads could be limited to vehicles transporting only one user, and dedicated lanes could be created for vehicles transporting multiple users (high-occupancy vehicles, or HOVs) (Crozet, Santos and Coldefy, 2019[75]). Planned travel demand management measures could also treat vehicles differentially based on the number of users. Congestion tolls could target empty vehicles based on their over-consumption of public space (Crozet, Santos and Coldefy, 2019[75]). Service prices could be higher for single users (ITF, 2017[7]). These measures should, however, be more or less stringent depending on location (single users are more likely in less dense areas) and type of service.

4.4.3. Increase the financial viability of shared on-demand services

Since a primary purpose of shared on-demand modes is to shift people away from private car use, reducing the overall cost of these modes to be cheaper than private cars is as important as ensuring high-quality services (ITF, 2017[7]). The cost structure of private cars compared to shared mobility will be discussed further in the section on recommendations for the EV strategy (section 4.5). The present section discusses other ways in which public authorities could make the development and scaling up of shared on-demand services more financially viable.

Targeting subsidies to vulnerable areas and groups

Once shared on-demand services are recognised as a public good, given the environmental and social benefits of helping to provide sustainable accessibility for everyone, there is a rationale for subsidising them (Mattioli et al., 2020[76]). This rationale has been cited in previous policy evaluations (Caulfield, Carroll and Ahern, 2020[14]). Changing the goal of the entire transport system requires redirecting funding away from private car travel and towards shared and sustainable options. In particular, the subsidies now available for purchasing private EVs could instead be used to support the scaling up of shared on-demand services, among other sustainable modes.

Ireland should support shared on-demand services in areas with lower density and fewer current transport options, where their role in improving sustainable accessibility is evident. Subsidies can ensure high-quality, affordable services in such areas, where otherwise lower profitability discourages service providers (ITF, 2019[68]; ITF, 2018[8]). As in many other countries, the current availability of shared on-demand services is uneven since the majority are concentrated in central areas of cities or bigger towns. For example, the private bike-share scheme in Dublin only operates in the central areas; the great majority of car rental service GoCar's stations are in Dublin and its inner suburbs, while rural towns like Sligo have no stations. Future subsidies should be based on calculations of the operational costs of service providers (partly to find out whether cross-subsidisation between different service areas could be done by the providers themselves or if additional support is needed) – another strategy that would require collecting relevant data (see discussions in 4.4.2).

Subsidies should also make shared on-demand services affordable for all population groups. An example from Boston shows that subsidised prices are an effective way to scale up the use of these services among lower-income groups. With the support of grants from the city, the Boston Hubway bike-share system offers a reduced fee (USD 5 rather than USD 85) for low-income populations, and has a significantly higher (11%) share of low-income users compared with other bike-share systems (a 5% share on average) (Kodransky and Lewenstein, 2014[77]).

To improve the financial viability of shared services and public transport in low-density areas, Ireland needs to work towards aggregating travel demand spatially (by establishing hubs, Park & Ride stations, and in the long-term encouraging compact development), coordinating trips at similar times with similar routes, and planning for high utilisation of vehicles. Several workshop participants suggested exploring synergies by integrating existing resources in the school bus system and the public transport system (seats, vehicles, drivers, planning), which are currently managed by different departments. For example, in Finland, municipalities purchase regular public transport tickets to provide elementary and secondary school transport where suitable, among other solutions (ITF, 2015[78]). Ireland could fund local communities to develop shared mobility solutions that fit local needs, coupled with centralised expert support (ITF, 2021[55]). For example, the Fingal local authority already operates a pilot scheme with community electric cars driven by volunteers, to improve access to local services (Fingal County Council, 2022[79]).

Creating a cross-governmental programme

The benefits achieved in several policy domains, such as transport, housing and education, by scaling up shared on-demand services is an argument for cross-governmental cooperation and financing. Workshop participants believed that a common, cross-governmental programme promoting shared on-demand services was possible; along with large-scale investment in dedicated infrastructure for active and shared modes in general (linking it to the road reallocation recommendations), this programme could fund pilot projects for new mobility solutions. In the United Kingdom, for example, the government has allocated £90 million to the Transforming Cities Funds for future mobility zones. Local authorities can apply for a share of these funds to test mobility services, modes and models in their area, with the aim of developing initiatives replicable elsewhere (UK Department for Transport, 2019[80]). Some examples of funded pilot projects already exist in Ireland, such as the one in Fingal just mentioned. The programme could implement, among other projects, a replication of this type of effort around the country.

One of the programme's ultimate objectives should be to go beyond implementation based on pilot projects to a more strategic development of shared on-demand services. Although some experimentation is valuable, pilots should also function to advance a wider, integrated strategy. As Ireland begins to make such services part of strategic planning, the programme could also start giving preference to funding pilot projects that contribute to a wider strategy for a given region.

Ensuring funding for further innovation

Further innovation for micro-mobility and other shared solutions is essential to increase their usage across population groups. One study suggests that the current micro-mobility fleet cannot support a large share of short trips because these involve, for instance, carrying groceries or transporting children, and it cannot serve disabled people at all (EIT and McKinsey, 2019[49]). It is difficult for micro-mobility providers to offer even traditional, but customised, solutions at scale due to financing challenges; more financing options, currently not offered by financial institutions apart from venture capital, are needed to scale up these solutions (EIT and McKinsey, 2019[49]). New financing options, possibly complemented by insurance options, could enable service providers to make services more attractive to more people through different leasing and subscription models and to cover upfront capital expenditure costs for purchasing vehicles, thus scaling up services more quickly (EIT and McKinsey, 2019[49]). Irish policy makers should explore how to make these options available to enable micro-mobility to serve the needs of a wide range of citizens.

4.4.4. Create awareness, acceptance and relevant skills

Creating awareness and acceptance of new shared on-demand modes should be a key element of the scaling-up process. During the April 2022 workshops, participants pointed out that the use of these services, alongside other public transport, ought to feel easy and natural. To start working towards this objective, public campaigns, in cooperation with service providers, should inform citizens about the new services and stress their overall societal benefits (explained in the Introduction) (ITF, 2018[8]). The public awareness measures planned as part of Ireland's Sustainable Mobility Policy are a great opportunity for this (see section 4.7). Similarly, the Smarter Travel Plans (created by various employers in the NTA's Smarter Travel for Workplaces programme) can promote the use of shared services, including car-pooling, shared active modes and public transport, initially in commuting but then more generally as people experience positive results. Perceptions of the collective benefits could be reinforced by scaling up these services in a series of steps, each one reaching a sub-target of the key objectives (e.g. emissions reduction, congestion reduction or improved access to services) (ITF, 2017[7]). Aligning clear communication about the targets achieved with positive user experiences (discovering how seamless and easy car-less travel can be) would facilitate public acceptance and boost adoption of shared and on-demand services (ITF, 2017[7]).

Education plays a key role in road safety. Some education measures have already been planned, such as the Road Safety Authority's measures for the use of (e-)scooters (Department of Transport, 2022[81]). Workshop participants raised an important point: national education will need to evolve once driving a car becomes less common and not everyone will necessarily take driving lessons, at least those living in urban areas and/or younger in age. Rules for safe road use normally taught during driving lessons will need to be taught in other ways. The participants proposed that the Department of Education take the responsibility for including classes about road use (by a wide variety of modes, not only cars) in the core school curriculum, since such knowledge would be useful when using any transport mode.

Digital knowledge also plays a part in scaling up on -demand shared services, given that these are usually linked to apps and MaaS platforms. This raises another issue of equity, since digital skills and literacy are essential for access to these transport services (Smorto, 2020[62]). Public authorities should make sure that education measures address this and offer guidance in the use of digital tools for anyone who needs it. This will also reinforce the message that these services are accessible for everyone, thus supporting their acceptance.

Building acceptance needs to involve engagement with the multiple stakeholders affected by the scaling up of these services. Workshop participants emphasised that certain influential interest groups, in particular business owners, car park owners and taxi drivers, could be hostile, and that public authorities need to address their concerns. Several measures were proposed:

- Business owners could be more easily brought on board by demonstrating that shared on-demand services can bring them more customers (especially in the case of micro-mobility, as noted in the introduction to this section), while road reallocation can make streets in front of stores friendlier for pedestrians.
- Car park (and forecourt station) owners could collaborate in building hubs for shared services and adapt their facilities to accommodate other vehicles than cars.
- Taxi drivers, especially in rural areas, could participate in providing DRT and volunteer-based services, for instance. In urban areas, public authorities could incentivise taxi services to carry multiple passengers at the same time, thus making them part of shared services.

4.5. Refocus the electrification strategy to support high well-being and low emissions

Ireland's transport electrification strategy needs to enable and support the other recommendations outlined in this report. Together, the recommendations envision a future with equitable access in which streets are designed for human interaction and human speeds, most trips are active and short, and longer trips are served by fewer, efficiently used and designed electric vehicles. This requires redirecting the electrification goals to

- create proximity, supporting liveable urban areas designed for human interaction and speeds
- prioritise walking, cycling and micro-mobility
- where larger motor vehicles are required, shift towards shared trips with high passenger occupancy, in which fewer vehicles are efficiently utilised over time (including cars, vans and public transport vehicles)
- reduce car-kilometres travelled
- electrify a large share of the remaining motor vehicle kilometres travelled (cars and larger motor vehicles)
- reduce excess in the number, size, weight and raw-material consumption of cars in the Irish fleet, to reduce life-cycle impacts and cars' dominance over space.

By redirecting its nationwide EV support and planning practices towards shared, electric, integrated mobility services, including public transport, Ireland would address a key equity concern (National Dialogue on Climate Action Ireland, 2021[82]), namely the need to pay for an expensive vehicle.

The following section outlines key elements for scaling up electrification to support an equitable, well-being, low-emission system.

4.5.1. Coordinate and consistently communicate the aim of transport electrification efforts

Ireland would benefit from a coordinating authority for ground transport electrification. With coordination and communication, electrification efforts would support transformative transport system change in the direction of a less car-dependent future. They need to be closely aligned with efforts to promote shared mobility services and public transport, integrated information and payment solutions, compact development, and living well locally (see discussions in previous sections). The coordination of electrification must take into account aspects of urban planning, charging infrastructure, power-grid solutions, power supply, and vehicle fleets, including public transport and goods vehicle fleets and their charging infrastructure. It also needs to ensure that the life-cycle impacts of vehicles and batteries are taken into account and effectively communicated. Ireland already plans to establish an Office for Zero Emission Vehicles (Parliamentary Budget Office Ireland, 2022[83]), which could become this coordinating authority or be closely integrated with it.

To reduce car travel and its detrimental effects on society requires a broader redesign of transport policy. This is a complicated process that must be managed proactively, probably in several stages. However, the overall direction of future transport policy must be consistently signalled: limited trust in the continuity of national priorities and funds can be a barrier to implementing strategy, as several interviewees pointed out. Communication about EVs needs to convey that: 1) active and shared mobility solutions will be prioritised, including public transport; 2) electric cars will also have to pay for road use; 3) new ICE vehicles risk becoming stranded assets; and 4) Ireland needs to transition to fewer, better-utilised, smaller, less wasteful cars in order to reduce life-cycle impacts and cars' dominance over space.

A key next step is to establish the goal of markedly reducing car travel (as discussed in section 4.1) and to develop a roadmap for it. Delay will only make this necessary step more costly and difficult later on.

4.5.2. Reassess priorities for providing incentives

Subsidies for private electric cars are an expensive and regressive way to reduce GHG emissions and have also shown low economic return, even at high carbon prices (Caulfield, Carroll and Ahern, 2020[14]). Ireland supports each private battery-electric car with up to 11 300 euros in direct subsidies and tax reductions, excluding future lost tax revenues from fuel excise duties and value added tax (Parliamentary Budget Office Ireland, 2022[83]). The total Exchequer support for EVs has risen rapidly in line with the rising EV market share (Parliamentary Budget Office Ireland, 2022[83]). Over 35 million euros in grants were awarded in Ireland up until 2019 (Caulfield, Carroll and Ahern, 2020[14]).From 2019 to 2030, EV subsidies and tax rebates in Ireland are estimated to cost the public the equivalent of 254 to 681 euros per saved tonne of carbon (Department of Public Expenditure and Reform Ireland, 2019[84]). As calculated by Caulfield, Carroll and Ahern (2020[14]), if both the incentives and tax loss are included, then the cost per tonne abated in 2019 was 1 241 euros. In contrast, Ireland's carbon tax valued a tonne of carbon at 26 to 100 euros during the same period (Department of Transport, 2021[85]). Public funds clearly need to be reallocated to more transformative, equitable; and financially sustainable actions.

Prioritising funding for private vehicles, even electric ones, is not in line with the principles outlined at the beginning of this section: other modes need to be prioritised if electrification is to support and be in line with transformational change. Aligning climate and wider well-being goals should be a priority. Using funds to promote active, shared and micro-mobility modes could be more effective in driving emission reductions and avoid the negative distributional impacts of the current EV subsidies (discussed in Chapter 3).

Ireland already has income tax breaks for employer-funded e-bikes (Irish Tax and Customs, 2022[86]), which is helpful but limited to willing employers. Support for both e-bikes and regular bikes could be expanded. Scotland, for example, funds manual bicycles for children who cannot afford them (Transport Scotland, 2022[17]). In Switzerland, e-bike trial programmes for car owners have proven effective in changing travel habits (Moser, Blumer and Hille, 2018[87]). Some of the funding currently directed to private electric cars could be transferred to local authorities to promote shared e-mobility and equitable access solutions via parking and vehicle access policies, charging solutions, and mobility hubs (Transport & Environment, 2020[88]). Scaling up micro-mobility efforts could also be integrated with efforts to improve access to manual bicycles and convenient bicycle parking. Only one third of Irish households own a functioning bicycle (NTA, 2018[89]).

The principle of first electrifying frequently used vehicles also needs to be applied. To encourage the electrification of these vehicles, Ireland already offers taxi operators EV purchase grants of 10 000 to 25 000 euros per vehicle (Parliamentary Budget Office Ireland, 2022[83]). Government procurement is directed to favour vehicles with zero tailpipe emissions (Society of the Irish Motor Industry, 2022[16]). However, the workshops revealed that incentives for private bus operators to invest in low-emission vehicles[14] might be inadequate, and that the risk of stranded ICE vehicle assets in the public transport fleet appears to be insufficiently explored, understood and addressed. ICE vehicles should not be left stranded, nor should the problem be exported to other countries. Interviews also revealed that operators have limited incentives to adopt the right-sized buses and on-demand vans. As noted in section 3.4, a number of other services that use vehicles intensively (e.g. micro-transit, community car schemes) can have important social and environmental benefits, and diverting funds to providers of these services should also be a priority.

4.5.3. Revisit policy for commercially owned cars and employee travel

Ireland needs to revisit its benefit-in-kind policy. Generous company car tax systems have driven car ownership and car commuting in Europe and contributed to cars' dominance over scarce urban space

(Transport & Environment, 2019[90]), for all engine types. To align with climate and well-being goals, company car tax benefits for employees and executives with few business-travel needs that require a car should be phased out. Ireland's benefit-in-kind policy is already moving in this direction, applying higher taxes where company cars are used for fewer business miles. However, this crude approach simply incentivises higher business mileage. This became apparent in 2020, when benefit-in-kind regulations had to be temporarily altered to avoid penalising employees for not driving enough during pandemic restrictions (Irish Tax and Customs, 2022[91]). Future policies should also take into account how much an employee chooses to drive for private purposes.

Benefit-in-kind tax exemptions for battery-electric company cars are in place until 2025, including tax-free electricity at employment sites (Parliamentary Budget Office Ireland, 2022[83]). From 2023, benefit-in-kind taxes will be differentiated by the vehicles' CO_2 emission class (Parliamentary Budget Office Ireland, 2022[83]). Where a vehicle has to be purchased, low-emission technology should, of course, be favoured. However, government company-car policy risks contributing to higher car ownership and use. At present, the tax exemptions for battery-electric cars do not consider the vehicle's size, which risks incentivising unnecessarily large vehicles (Lévay, Drossinos and Thiel, 2017[92]). The target should be fewer cars in company fleets and in the national fleet, and remaining company vehicles need to be right-sized and battery-electric wherever possible.

To promote sustainable travel choices, employers and employees should be jointly accountable for their commuting and business travel choices. Ireland already has income tax exemptions for employer-provided public transport passes and e-bikes (Department of Transport, 2022[11]; Irish Tax and Customs, 2022[91]). A next step could be requiring employers to pay half of employees' public transport passes, as is done in France. These passes could be expanded into credits for various shared mobility services. Employers could also affect employees' travel choices by providing convenient parking and changing rooms for cyclists and enabling remote work. They could reserve parking spaces for employees who share rides (Marsden et al., 2019[19]). Climate accounting standards could also be explored: by shifting from the Scope 2 to Scope 3 accounting standard, employers would become accountable for emissions from employees' commutes (Marsden et al., 2019[19]). In the longer term, car taxation policy should be part of a wider effort to shift tax burdens from labour to polluting consumption (Transport & Environment, 2019[90]).

4.5.4. Embed EV policy in a wider policy framework aimed at reducing car travel

As stated throughout this report, Ireland needs to clearly establish a goal to markedly reduce car travel. The low operation costs of EVs risk establishing higher car dependency and urban sprawl as the new "normal" in Ireland, as described in Chapter 3.

In the transformation of its transport system, Ireland needs to assess the different cost structures of private car ownership versus shared services and public transport. Once a consumer or business has made the investment in a private car, especially an electric one, its low variable cost and convenience in the current system make it difficult for shared services and public transport to compete on a per-trip basis (Mattioli et al., 2020[76]). A combination of measures can help address this gap and make shared vehicles the most convenient default option; they include road pricing; season passes for shared services and public transport (Simma and Axhausen, 2001[93]); and the management of parking, charging, access (in part through road space reallocation), interchanges, booking, market design and pricing. As other modes become more available, private car ownership and use need to become practically and financially less attractive (Gössling et al., 2019[94]).

Congestion charges are an excellent step towards reducing cars' dominance over city space, as experiences in London and Stockholm have shown (ITF, 2010[95]). Besides careful design, both framing and communication are key to such schemes' success (ITF, 2010[95]). In London and Stockholm, authorities characterised the charges as part of a wider plan (in each case, to reduce air pollution) (ITF, 2017[96]). Complementary public transport improvements were implemented before the charges took effect,

helping to gain acceptance of the innovation (ITF, 2017[96]). The prospect of congestion charges may arouse fears of increased traffic around the zone boundaries (Börjesson et al., 2012[97]). However, there is no evidence of traffic increase due to re-routing in the well-designed London and Stockholm schemes (Broaddus, Browne and Allen, 2015[98]; Börjesson et al., 2012[97]).

Ireland needs to primarily reduce cars' access to streets and parking in cities, regardless of engine type (KTH et al., 2022[99]; Transport & Environment, 2020[88]). The introduction of road pricing is under discussion and discussing this measure is a priority of the working groups established via the Regional Assemblies to look into demand management. The purpose of congestion charges needs to be the reduction of car traffic and its disadvantages, in synergy with road space reallocation, not merely to reduce congestion. One of the stated aims of the London congestion charge was to reallocate road space to public transport (Leape, 2006[100]). Stockholm and London combine their congestion charge and low-emission zone schemes with prioritising space for social interaction, active travel and public transport (City of Stockholm, 2022[101]; TfL, 2022[102]). London's aim is for 80% of all trips to be by active travel or public transport by 2041 (TfL, 2022[102]). As noted, an additional measure that Ireland could introduce to promote shared services and the efficient use of scarce urban space would be to differentiate congestion charges by vehicle occupancy (Crozet and Mercier, 2018[103]; OECD, 2021[4]). ICE cars and vans will be banned from Irish cities from 2030 (Parliamentary Budget Office Ireland, 2021[104]). Urban access policies that differentiate by vehicle emission type can indeed drive vehicle purchase choices well beyond the city's boundaries, as Stockholm's experience suggests (Börjesson et al., 2021[105]; Börjesson et al., 2012[97]). However, allowing EVs unrestricted access to Ireland's cities would reinforce the cars' dominance over city space and send the message that battery-electric cars are unproblematic.

All urban areas in Ireland need to align vehicle access restrictions, road space reallocation, parking supply, parking regulations and pricing consistently with modal shift objectives, mobility hubs and electric charging to support the targets outlined earlier. One goal should be to reduce and eventually eliminate the practice of parking cars and other large vehicles on streets for longer periods (KTH et al., 2022[99]). Transport & Environment (2020[88]) suggests placing mobility hubs, with shared electric cars (and other modes) and car charging points, in outer urban areas to help reduce cars' dominance over central cities while still enabling access to shared cars where needed. Interviews suggest that Ireland lacks a holistic, proactive approach to developing car-sharing and shared micro-mobility services beyond their technical aspects (see discussions in Section 4.4).

In low-density areas, Ireland needs to improve proximity and walkability for everyday needs, expand access to attractive shared mobility solutions, including public transport, and disincentivise private car use and further sprawl. Parking pricing and parking regulation are among the tools to reduce the privileges of private car use. For example, parking regulations can help make travelling by shared services (or Park & Ride) to the nearest larger town more attractive. Road pricing is a key policy for disincentivising car use, including in low-density areas. However, these transitions must be managed in parallel. As noted in chapter 3, simply raising the price of car use would worsen the deprivation of some car-dependent households. Simply improving active and shared mobility services without adequately pricing private use however, risks maintaining high levels of private car use (ITF, 2021[106]).

In the longer term, a nationwide road charging system would help achieve Ireland's goals by varying the cost of driving by specific trip and vehicle attributes. Road charging would also apply to EVs and would help reduce the rebound effect (Dimitropoulos, Oueslati and Sintek, 2018[107]; Axsen, Plötz and Wolinetz, 2020[108]). In designing the scheme, EU regulations and initiatives should be consulted (European Commission, 2022[109]). Road charging can catalyse the adoption of shared services (ITF, 2018[110]). To improve public acceptance and equity when introducing national road charges, they could be determined in part by the availability of alternative means of access (Phillips et al., 2020[111]). However, this would have to be combined with improving local access to avoid incentivising urban sprawl. Tax revenue projections also illustrate the need for transport taxation reform: it is estimated that a fully electrified vehicle fleet would reduce total Exchequer revenues by 8% due to the loss of taxes on fuels (Parliamentary Budget Office

Ireland, 2021[104]). Ireland is working on evaluating road charging. The CAP includes, as an explicit action, exploring the potential of road charging via conducting the Better Road User Charging Evaluation (led by TII). As part of the SMP, by 2023, the government plans to have a draft implementation plan (Department of Transport, 2022[11]).

4.5.5. Integrate life-cycle emissions and wider social and environmental impacts into policy and communication with the public

Ireland needs to continue regulating the purchase and ownership of motor vehicles to guide the national vehicle fleet's size, composition and life-cycle impacts. Vehicle registration taxes are already steeply differentiated by CO_2 emission class (Parliamentary Budget Office Ireland, 2021[104]), which is an effective tool (Transport & Environment, 2019[90]). There is no plan to reduce the number of cars in the national fleet, and vehicles' consumption of space and raw materials is not considered in current vehicle policy. Norway, by contrast, treats vehicle weight as one component in vehicle registration taxes (Norwegian EV Association, 2022[112]), which is a helpful first step to disincentivise unnecessary weight and size. However, addressing vehicles' life-cycle impacts requires systemic change, including a reduction in the number and size of cars in the national fleet and more efficient use of the remaining vehicles.

Motor vehicles and batteries should also be included in the circular economy strategy and targets. The European Circular Cars Initiative (Systemiq, 2021[113]) outlines high-level principles; these will become even more important as Ireland's vehicle fleet comes to contain more battery-electric vehicles, in which a larger share of life-cycle emissions is produced by the vehicle and battery. The transport sector needs to decarbonise globally, given limited battery material supply and the environmental and social risks linked to battery material extraction (IEA, 2021[114]). An international trend towards larger and heavier cars is undermining these efforts (IEA, 2019[115]), including in Ireland, as the rapid adoption of SUVs shows.

Ireland currently lacks policies that take into account the size of vehicles and the raw materials consumed in manufacturing new cars and their batteries. Promoting the uptake of shared mobility services over private car ownership could also help reduce the life-cycle impact and space consumption of motor vehicles (Systemiq, 2021[113]). Insufficient systemic integration can limit the attention paid by policy makers and the public to the social and ecological impacts of a large car fleet (even if electric). Ireland already has good examples of "joined-up" thinking, which could be scaled up or emulated. For example, Dublin City Council has developed a Climate Readiness Toolkit to help local planners consider the wider social and environmental impacts of projects. The Department of Health Strategy repeatedly highlights the wider context in which the health sector is embedded.

EVs need to be presented realistically to the public, who should be informed about their life-cycle emissions and wider impacts. Currently, Ireland uses the term "Zero Emission Vehicle" (ZEV) in policy documents to refer to motor vehicles with zero tailpipe emissions. An Office for Zero Emission Vehicles is also projected (Parliamentary Budget Office Ireland, 2021[104]). This choice of language can be problematic in communication efforts: using the term ZEV implies that only tailpipe emissions matter, since only those are included in transport sector GHG emission accounting. It distracts from the global GHG emission and material extraction impacts of vehicle and battery production, power supply and infrastructure supply, and also glosses over the fact that battery-electric cars contribute to urban air pollution with fine particles via abrasion.

The mandate and focus of the Office for Zero Emission Vehicles should not be restricted to communicating about private EVs; rather, it should contribute to steering conversations towards making electrification part of a wider transition towards a different type of transport system. As such, information about and links to micro-mobility, shared on-demand micro-transit and shared car initiatives should be central to its activities.

4.5.6. Revisit priorities for EV charging strategy

Ireland's charging infrastructure needs to support efforts to promote shared transport services and electrify the public transport fleet. Workshop participants suggested that charging infrastructure for buses could be better coordinated among different operators, helping to promote EV uptake by private bus operators. How the EV charging infrastructure is developed will also influence management of energy demand loads (Ramirez-Mendiola et al., 2022[116]), which will become increasingly important as EV adoption grows after 2030 (IEA, 2022[117]).

Reducing total energy demand, including through reductions in car use, can increase the feasibility of achieving high shares of renewable energy supply as well as substantially lower the cost of achieving the climate targets. One of these cost savings would be a reduced need for energy grid upgrades (Gaur et al., 2022[118]). Transport energy demand can be reduced by promoting higher occupancy of (electric) vehicles, as well as proximity and shifts to more sustainable modes (Department of Transport Ireland, 2022[119]). Vehicle-to-grid charging can help to flatten energy demand peaks (Department of Transport Ireland, 2022[119]). Commercial car-sharing businesses are particularly suitable for early vehicle-to-grid technology uptake since they manage whole fleets of cars (Gschwendtner, 2021[120]).

Ensure that charging infrastructure supports shared and on-demand services and reduced private car use

In line with the overall EV strategy, the charging and parking infrastructure for EVs of all sizes needs to support reducing the dominance of cars over public space, promote active travel and micro-mobility, promote public transport for longer trips, and ensure that cars, where needed, are predominantly shared and electric.

In central urban areas, charging infrastructure and parking policy needs to support reducing and eventually eliminating the practice of parking cars and other large vehicles on streets for longer periods, as noted above (KTH et al., 2022[99]). Urban planners need to prioritise social interaction and pedestrians, followed by micro-mobility, with mobility hubs and dedicated charging solutions (KTH et al., 2022[99]), and integrate mobility hubs with public transport nodes. Seating and weather protection could help create pleasant locations to meet, charge small vehicles or wait for the bus (KTH et al., 2022[99]). Planning of central urban areas needs to support flexible street use throughout the day to help accommodate the many demands on scarce urban space; mobility hub designs and charging infrastructure also need to be flexible to adapt to possible changes in technology and business models (KTH et al., 2022[99]). Parking and charging for cars therefore needs to shift towards outer, less dense urban areas rather than dominating space in central locations (Transport & Environment, 2020[88]). This includes mobility hubs that offer shared electric car rental and charging solutions for various types of electric car – for example, slow chargers for Park & Ride and fast chargers for taxis and delivery vans (Transport & Environment, 2020[88]). Mobility hubs in central urban areas, where space is most scarce, need to offer micro-mobility (rather than shared cars) and facilitate integration with public transport nodes.

Ireland already plans to support local authorities to develop local area network plans for EV infrastructure (Department of Transport Ireland, 2022[119]). These plans ought to prioritise micro-mobility and its integration with public transport nodes and shared cars over private cars, for example through charging stations at mobility hubs and other points of passenger interchange. To reinforce the move away from car dependency, local area network plans should outline how they support and prioritise the uptake of shared vehicles. While the details and scale of support for local area network plans are still unclear, Ireland has already recognised the role of local authorities in determining the location and number of public charging points, and the need to support them with centralised experts who can assist with planning (Department of Transport Ireland, 2022[119]). If established, MTAs (see section 4.8) could also play an important role.

To ensure that car-sharing fleets are fully battery-electric, local authorities can favour EVs in parking policy in locations where car parking is adequate, while maintaining the principle of phasing out car parking in dense central areas. Madrid favours EVs in its parking pricing, and Amsterdam requires shared-car fleets to be electric; car-sharing fleets are fully electric in both cities (Sprei et al., 2019[121]). In smaller urban areas (100 000 inhabitants or fewer), station-based car-sharing is more appropriate than the free-floating models deployed in larger cities like Amsterdam (ICCT, 2021[122]). Ireland's recently released EV Charging Infrastructure Strategy already plans to support the charging needs of the car-sharing sector in collaboration with local authorities. However, this strategy only operates at a pilot level (Department of Transport Ireland, 2022[119]); Ireland needs to scale up its plans for shared electric cars to serve access needs where car use is the only option.

A disproportionate focus on home charging risks reinforcing private car ownership and sparse settlement patterns, as described in Chapter 3. The EV Charging Infrastructure Strategy assumes that home charging will remain the main solution for the majority of EV users, noting that three-quarters of current car owners have private off-street parking (Department of Transport Ireland, 2022[119]). The strategy needs to instead prioritise public EV charging to reverse car dependency and support the adoption of shared mobility services. Public charging stations in urban locations and passenger interchange points need to be integrated with mobility hubs, as already noted. Future regulation of car charging in curtilage should not undermine compact development goals and the adoption of shared transport solutions (see Chapter 3); one necessary measure is the shift from minimum to maximum parking requirements.

The public charging infrastructure for longer trips still has gaps, particularly in rural areas outside major national road corridors. To help secure a complete network even in rural areas, the network planning approach should not rely purely on market forces (Society of the Irish Motor Industry, 2022[16]). Planning for the location of public charging stations needs to ensure that even remote areas, where stations are less commercially viable, are sufficiently served.

Electrification is a technical revolution in passenger travel that is widely accepted in Ireland. A window of opportunity now exists to ensure that it supports another, more transformative, revolution: the adoption of active, shared and on-demand travel. Policies should be developed to support the interaction of these revolutions to support climate, equity and well-being goals (Fulton et al., 2017[123]). Successful large-scale adoption of shared and on-demand travel will have major impacts on the transport system and on community well-being, going beyond large GHG emission reduction (Fulton et al., 2017[123]). Ireland can choose to deploy its EV charging infrastructure to reinforce the current system, by prioritising private car use, or to enable change towards a less car-dependent future.

4.6. Steer compact growth policy towards tackling the causes of sprawl

Systemic analysis of car dependency inevitably brings up the need to reverse sprawl. Complete mapping and analysis of sprawl and the residential sector is beyond the scope of this report[15]. However, a number of the dynamics driving this complex phenomenon were studied in preparing it.

As noted above, due to a number of causal relations and factors, today brownfield development is less attractive and less profitable than greenfield development. Rather than looking for solutions that merely address the symptoms, for example requiring a certain proportion of development to be built on brownfield sites (via infill/brownfield targets), ways need to be found to increase the attractiveness and profitability of brownfield development projects. This section assesses some policy recommendations for achieving this goal. As noted in Chapter 3, more stringent brownfield targets are not necessarily bad, but they would be more feasible (and could be more stringent) if combined with actions that address core issues and could send an important message to this sector about the direction of change.

4.6.1. Improve government capacity to support, guide and monitor brownfield redevelopment

As part of Project Ireland 2040, the Irish government has taken a number of actions to speed and scale up redevelopment projects nationwide. Among the most important is the creation of the National Regeneration and Development Agency (also referred to as the Land Development Agency), part of whose planned mandate is to coordinate and secure the best use of public land (Government of Ireland, 2018[124]). This mandate gives this institution a vantage point from which to weigh profitability concerns and policy objectives. The agency will have compulsory purchase powers, which should "ensure that the necessary transformation of the places most in need of regeneration can take place more swiftly and effectively" than before (Government of Ireland, 2018[124]). At the same time, a 3-billion-euro fund (the Regeneration and Development fund) has been made available for urban and rural regeneration projects.

While these are valuable institutions and projects with great potential, Ireland will need to ensure that efforts are focused on sites that can strike a good balance between bringing in private investment and creating social value. Unlocking this potential largely depends on creating government capacity to better prioritise funding and to guide and set standards for redevelopment that will promote transport, land-use and environmental goals. For decades, development in Ireland has been managed privately with little intervention or planning from public bodies. As discussed in Chapter 2, assuming that government has little influence over development is part of the mental model that has driven sprawl and car dependency. This can change, but strengthening the government's role in the process is key (as noted by various workshop participants and the specific group focused on this recommendation during the April 2022 workshops).

Improve understanding of different types of brownfield area

A number of interviewees commented that getting developers interested in developing brownfield sites is challenging. In many cases (e.g. Sligo County), brownfield sites have been developed by private developers with the understanding that the local government will purchase them for affordable housing (if the local authority does not develop them directly for this same purpose). Developing high-quality and centrally located social housing is, of course, crucial. However, reversing urban sprawl and associated car dependency calls for making brownfield sites attractive for a mix of housing types suitable for a range of population groups. Moreover, if brownfield development projects are mostly developed for social housing, this may reinforce assumptions about the superiority and desirability of detached housing.

Authorities need to understand how to prioritise brownfield development efforts. Workshop participants emphasised the need to distinguish clearly between infill and brownfield. Policy documents about urban development use "brownfield sites" and "infill sites" interchangeably (Government of Ireland, 2018[124]; Government of Ireland, 2021[125]; Government of Ireland, 2022[126]). However, (re)developing these two types of sites poses different challenges and produces different benefits, and they should be understood and treated differently. Loures and Vaz (2018[127]) point out that "brownfield" has been used to mean many different things, unduly complicating redevelopment. "Infill development" can refer to redevelopment of previously developed areas (including brownfield development), but it means more broadly "construction on any under- or undeveloped land within an urbanized area" (Mcconnell and Wiley, 2010[128]). Using the two terms interchangeably can lead to developing inappropriate or undesirable sites and even undermine the goal of making inner cities and towns' attractive places. For example, if a prospective infill site is also a green space, it could be advantageous to leave it untouched. The presence of green spaces makes newly developed residential areas more marketable (De Sousa, 2011[129]), and areas for recreation make developments more attractive. If green spaces in cities or denser areas around cities (e.g. urban satellite towns) become commonplace, people can stop assuming that nature is only accessible outside the city, and families can be attracted to city centres. Green spaces that are located close to people also reduce transport needs, since there is less need to travel long distances to enjoy natural amenities.

Irish authorities could map brownfield sites by profitability to get a clearer picture of where (and how much) funding would be needed to make such sites profitable for private developers (McCarthy, 2002[130]). This could help to plan investment and allocation of the newly created funds. Redeveloping different types of brownfield site requires different levels of government involvement (funding, coordination, guidance, etc.). For example, large sites allow for economies of scale (Squires and Hutchison, 2021[131]), and different levels of contamination have implications for reclamation costs (Page and Rabinowitz, 1994[132]). Whether the site was previously residential or industrial might also affect the potential for reuse of its infrastructure (Loures and Vaz, 2018[127]).

Endorsed by the EU (European Commission, 2016[133]), the Concerted Action of Brownfield and Economic Regeneration Network (CABERNET) has developed a categorisation framework (the A, B, C model) for brownfield sites that can be used as a reference. Developing profitability-based site maps can help distribute funding only where it is needed. However, such mapping should not lead to assigning funding and other interventions to sites that need the smallest amount of public money; instead, it should provide clear information relevant to government requirements for different sites, so that this information, in conjunction with the potential to create social value, can drive decisions. The A, B, C model rightly specifies that its classifications should incorporate future as well as immediate costs (Dolezelova, 2014[134]). For instance, the cost to the government of installing the services (including transport) necessary to make a redevelopment site liveable and attractive can be substantial. This is often ignored but must be taken into account when classifying sites (see more on this below in discussion of the Opportunity Area framework in London).

Ensure social value and compact growth goals

Profitability is only one of the considerations for redevelopment. Every redevelopment project, however funded, needs to advance compact growth goals and make places attractive, including through urban greening, to support climate and well-being goals (IPCC, 2022[135]). Projects also need to ensure their type of housing meets the needs of future residents.

To ensure that large developments are located and designed to support compact growth, sustainable accessibility and other sustainability goals, London's city plan has designated Opportunity Areas, meaning locations with significant capacity for new homes, jobs and infrastructure (Mayor of London, 2022[136]). An Opportunity Area Framework is created jointly with local boroughs and communities for each location. The framework specifies the location-appropriate intensity and type of development, taking public sphere, transport, environment, social and funding aspects into account. It describes existing public transport access with different modes and specifies how public transport and active travel infrastructure need to be adapted to match the potential of the location (Mayor of London, 2022[136]). Indicators such as Public Transport Accessibility Levels (PTAL) are used to inform transport planning appropriate for the location and its development potential (ITF, 2016[137]). If Opportunity Area-like Frameworks were introduced in Ireland, they could assist authorities in estimating the overall potential of redevelopment, such as the number of new houses that could be built. Where the available redevelopment sites are insufficient and greenfield development cannot be avoided, they still need to ensure this follows compact development and sustainable accessibility principles (see discussion below).

To ensure that sufficient green space is included in new developments, Ireland could also follow the example of Malmö, which applies Green Space Factors as a regulatory tool (City of Malmö, 2022[138]). Green Space Factors are a point system that lets developers choose among different green space solutions while setting a minimum standard for green space quality and quantity (Vartholomaios et al., 2013[139]). Requirements can be met by greening courtyards, roofs and vertical facades, for example. Green spaces help provide wildlife habitat, manage storm water, regulate heat and improve liveability for residents (Vartholomaios et al., 2013[139]).

Irish regulations should also support the development of a mix of attractive housing solutions in brownfield areas, catering to people with various needs. Several workshop participants brought up the need for a greater variety of housing. Besides allowing sufficient flexibility in building codes, incentives should support innovation in housing solutions that suit various target groups while still ensuring compact development with high environmental standards. For example, the Housing Committee of the Royal Institute of the Architects of Ireland has pointed out that some terraced houses can achieve medium densities but do not always comply with Dublin City Council Open Space standards (DCC Housing Commitee, 2020[140]). The Committee also points out that walk-up apartments are an affordable solution that is not encouraged by Irish and Dublin City Council building codes.

Plan for necessary greenfield development

A better understanding and categorisation of brownfield sites would provide an estimate of how much population growth they could absorb, and thus how much of the population would still require housing in new greenfield development.

The specifics of greenfield development are not explicitly discussed in Irish reports and policy documents. Meeting the goals of more compact development, greater proximity of people and places, and sustainable mobility requires making the best of the envisioned brownfield and infill projects. However, any greenfield projects should also help fulfil these goals, especially the avoidance of single-use development and detached housing and the implementation of proximity. In this way, transport demand, and ultimately the carbon footprint, can be lowered even when greenfield sites are developed.

Successful strategic greenfield development is superior to containment policies. In interviews conducted with Irish stakeholders, many brought up containment policies as a potential remedy for sprawl. Green belts, containment and zoning laws have sometimes proven effective in the past, but have serious negative externalities. By limiting the long-term supply of housing, containment policies contribute to the affordability crisis as housing becomes more and more scarce, as has been observed in countries like Norway and Sweden (Ehrlich, Hilber and Schöni, 2018[141]). Another danger is the “leapfrog development” found in cities like London, Cambridge and Oxford, where developers simply started to build outside the green belts designed to contain sprawl (Ehrlich, Hilber and Schöni, 2018[141]).

Strategic greenfield development can avoid both of these outcomes. OECD (2018[142]) argues for strategic planning for growth. Ireland will see continued population growth, and if the growing housing market cannot be served exclusively by brownfield redevelopment projects, then it is crucial to develop communities with high accessibility via low mobility demand, where proximity is central and sustainable modes of transport are planned in from the start – even on greenfield sites.

Revisit the tax structure

In order to increase feasibility and profitability for developers, Ireland could revisit the current taxation system. Project Ireland 2040 has explicit compact growth goals (Government of Ireland, 2018[124]). As part of this project, the Town Centre First report states (Government of Ireland, 2022[126]), the goal for people at all stages of life is to find a home in town and city centres. A way to discourage greenfield development or low-density housing construction is by adopting fiscal incentives to encourage brownfield development (Moreno Monroy et al., 2020[143]). Tax instruments can be leveraged to that end. Ireland plans to introduce a new tax to activate vacant urban land for residential purposes, along with actions to convert vacant commercial and residential properties into attractive housing (Government of Ireland, 2021[125]).

In addition, taxes levied on compact brownfield relative to low-density greenfield development could be reviewed. In 2020, the Housing Committee of the Royal Institute of the Architects of Ireland (DCC Housing Commitee, 2020[140]) proposed a revision to the VAT system to make housing in existing areas of towns, cities and suburbs (as opposed to greenfield areas) viable and affordable. It emphasised that current

taxation makes greenfield development much more viable than development in towns and suburbs or redevelopment of the existing building stock, and that five times more tax is levied on medium-density than on low-density development, although this fails to reflect the difference in costs incurred by the government to service the different areas (DCC Housing Commitee, 2020[140]). The Committee proposes a 0% VAT rate on brownfield development, if the apartments are sold for affordable prices[16], calculating that this would be equivalent to an affordability grant of 41 630 euros per apartment.

Ireland could also consider other instruments and taxes. For example, a "greenfield surcharge" is proposed by the Environmental Industries Commission (EIC) in the UK, which would further incentivise brownfield redevelopment (EIC, 2021[144]); beyond that, destined for affordable housing. This forms part of the UK government's "Levelling Up" programme, designed to spread opportunity more equally across society. The US too is leveraging tax incentives for redeveloping brownfield sites by introducing Opportunity Zones (OZs) similar to the UK's Opportunity Areas. Unlike the UK, the US OZs are exclusively low-income and distressed communities in need of rejuvenation. Companies willing to invest in developing them can defer or reduce their capital gains tax burden (EPA, 2022[145]). The Historic Rehabilitation Tax Credit is another taxation instrument in the US that uses tax credits to encourage private investment in clean-up and rehabilitation of historical properties in order to "discourage unnecessary demolition of sound older buildings and to slow the loss of businesses from older urban areas" (EPA, 2022[145]).

Land remediation relief is another instrument for incentivising brownfield redevelopment. Since 2009, the UK has had a scheme that applies to corporate expenditures for clean-up of contaminated brownfield sites (HM Revenue & Customs, 2016[146]), effectively eliminating large portions of the costs of clean-up incurred by companies choosing to redevelop derelict land. The policy "provides a deduction of 100% of remediation costs from taxable profits, plus an additional deduction of 50%, for qualifying expenditure incurred by companies in cleaning up land acquired from a third party in a contaminated state" (HM Revenue & Customs, 2016[146]).

4.6.2. Leverage housing programmes to steer demand for more central and mixed-use living

To reverse sprawl, authorities in Ireland need to go beyond supporting and scaling up brownfield development. As discussed above, the Land Development Agency (LDA) as well as new funds (e.g. the Urban Regeneration Development Fund), especially if strengthened by other actions, will encourage the (re)development of more and better brownfield sites in the heart of towns and cities (as well as in existing suburbs). The danger is that there will be insufficient demand for the finished projects, which would in turn discourage developers from taking on other sites. Setting clear standards for the development of such sites (as discussed in the previous subsection) can help increase their attractiveness and avoid this outcome.

The strategy for supporting housing and the rules for some of the programmes included in the Housing for All and Town Centres First initiatives should also be revisited. Firstly, eligibility and other rules for specific programmes should be reviewed to ensure that funds are truly aligned with the attainment of compact growth goals. Secondly, as noted by workshop participants, ownership currently receives preferential treatment; a better balance between ownership and rental support could create opportunities for better aligning housing affordability with compact growth goals.

Programmes like the national "first home scheme", which is intended to support first-time buyers (Government of Ireland, 2021[125]), could be tailored more carefully. For instance, eligibility or preference could be granted to people who choose to move to redeveloped areas. Otherwise, the programme could very well become a source of continued sprawl, encouraging people to opt for detached housing and incentivising continued greenfield development on the urban margins.

The age and profile of programme beneficiaries should also be reviewed. Young people may be locked into sprawl at an age when ownership is less important to them and rental support programmes could

provide affordable and well-located housing. If a young individual or couple is eligible for the "first home scheme", it may seem rational for them to buy outside of the city/town, where housing is generally cheaper, instead of renting in the inner city or town, even with rental support. During the workshops, the group focusing on brownfield development agreed that rental support schemes could be particularly appropriate for students, since a positive experience with urban living in early life will increase people's appreciation of what a city can offer. Once they come to value dense modes of living, the chances are higher that they will stay in the city even when they need a larger home and have started a family.

Another target group could be Ireland's expanding older population. Workshop discussions focused on Sligo emphasised older people's need for access to health services and social connection. Participants described a need for housing in more central areas for older people, which would give them the option to downsize and live in more accessible locations, such as the nearest village centre or town, while not moving far from their community. This aligns with research findings by the Irish Housing Agency (Lyons and Sirr, 2016[147]).

Rentals should be leveraged for a more dynamic and flexible housing market (OECD, 2020[148]). Increasing immigration, starting families later, longer periods in education and other changes in Irish society are driving demand for rental housing (Government of Ireland, 2021[125]). The planned Cost Rental scheme, and the construction of student accommodation as outlined in the Housing for All (2021[125]) report, is a step in that direction. More student accommodation will free some capacity elsewhere in the market and has the potential to "showcase" the advantages of central, mixed-use living to younger generations (as noted above).

However, such supply-side policies are insufficient on their own. In France, income-dependent housing allowances are available to households, including students, enabling people to choose accommodation that suits their needs, whether rented or purchased, without linking the support to a particular property or tenancy model (Peppercorn and Taffin, 2013[149]). Such demand-side policies improve residential mobility and equity, and combining them with targeted supply-side policies (e.g. Ireland's Cost Rental scheme) can improve access to affordable rental housing in well-to-do, attractive urban areas (OECD, 2020[148]).

Moving away from a home-owner mindset supports compact growth. Ownership is encouraged as the best choice for everyone – at least implicitly, through various policy instruments (Government of Ireland, 2021[125]) – and owners are more likely to stay in their homes than renters are. The high-level Irish policy goal of increasing compact development is easier to implement when it is easier for people to move into newly built/ or redeveloped housing in more central areas– that is, when more of them are renters. The workshop group stressed that the quality standards for apartments need to be raised if this policy is to be successful. Moreover, not only the quality of the apartments themselves has to be considered, but also their surroundings. Green spaces and areas for recreation are important for marketability and community concerns, and ultimately for the economic viability of brownfield redevelopment. Evidence from three sites in the United States where green spaces were a central feature makes it clear that "the projects … contribute in many ways to personal and community quality of life, particularly in terms of enhancing scenic beauty and neighbourhood appeal … and raising property values" (De Sousa, 2011[129]). Having the chance to live in urban or better connected environments with less traffic and easy access to a natural environment without leaving the city or town can help change the assumption that these can only be found in faraway and remote rural areas.

4.7. Communicate the benefits of sustainable transport systems and enable people to experience them

What people find acceptable or unthinkable greatly depends on which narratives (sets of stories) dominate. Cognitive scientists Lakoff and Johnson write that "Our concepts structure what we perceive, how we get around in the world, and how we relate to other people, [and] thus [play] a central role in our everyday

realities". They also argue that "the people who get to impose their metaphors [and narratives] on the culture get to define what we consider to be true" (Lakoff and Johnson, 2008[150]).

"Car culture" is an example of the power of dominant narratives and metaphors to shape reality. Car culture in Ireland was perceived by stakeholders as a key barrier to the types of policy recommended in this report. However, this "culture" is not inevitable but rather the result of decades of communication efforts linking the car to notions such as freedom and status.

Envisioning and creating a different story, one of "car independence", is possible (see Box 4.10) and necessary if Ireland is to build political support for the transformative policies proposed in this report. Copenhagen is an interesting case. After the Second World War, its urban planning was inspired by American traffic engineering centred on cars and motorways. The 1973 oil crisis[17] was a turning-point for the city: car-free Sundays and petrol shortages helped build momentum for a civic movement that led to freezing motorway development. The city administration shifted focus to making public spaces people-friendly, pedestrianising a network of streets and encouraging cycling instead of car use. Citizens appreciated the shift, which started a virtuous cycle of political and public support for further interventions that continues to this day (Matan and Newman, 2016[151]) (see Chapter 3 for an illustration of this cycle). Successful communication campaigns framed the *Copenhagener* as an aspirational identity, for whom cycling promotes health and speed as well as good use of taxpayer resources (Gössling, 2020[152]).

The Netherlands provide another example of transitioning from car-centric to car-independent narratives. In the 1970s, cars were widely associated to notions such as progress, freedom and comfort (Norton, 2011[153]), and the Netherlands, Europe and other areas of the world stemmed a dramatic decrease in cycling rates (Bruno, Dekker and Lemos, 2021[154]). Bruno, Dekker and Lemos (2021[154]) find that the high cycling rates observed in the Netherlands today (23% of trips on average) are partly the result of citizens' mobilisation opposing the increasingly severe impacts of fast motorization, seeing streets as having other functions that roads for high speed vehicles, and collaborating with the government to advance changes. The collaboration advanced three innovations: i) the Woonerf, or "living street", in which pedestrians and cyclists have priority over cars; ii) car-restricted city centres; and iii) the "bottleneck-memoranda, a tool for communities to report obstacles to cycling (Bruno, Dekker and Lemos, 2021[154]). In Germany, a country with a strong "car culture" (Staples, 2019[155]), people are mobilising to challenge the car-centric narrative. In August 2022, for example, 8,500 cyclists hindered motorized vehicle access over a 40 km section of Germany's autobahn in demand for better public transportation and bike lanes (BBC News, 2022[156]).

As explained in Chapter 3, the scaling up of communication efforts has high transformative potential and is needed to build political support for the policies outlined in this report. Two recommendations are proposed for Ireland:

1. Develop a whole-government communication strategy to reverse car culture and demonstrate the well-being benefits of car-independent transport systems.
2. Regulate advertising that reinforces a car-centric mindset (Gössling, 2020[152]; Moran, 2021[157]).

Box 4.10. Communication and stories matter: how mindsets became car-centric

This box provides an example of communication efforts that have contributed to a dominant car-centric narrative. The significant resources invested in advertising reinforce this narrative. Efforts to counter the car-centric narrative, although less well funded, are also numerous, and examples are provided in the next section.

A communication campaign for car-centric cities

"A hundred years ago, if you were a pedestrian, crossing the street was simple: You walked across it. Today, if there is traffic in the area and you want to follow the law, you need to find a crosswalk. And if there's a traffic light, you need to wait for it to change to green… To most people, this seems part of the basic nature of roads. But it's actually the result of an aggressive, forgotten 1920s campaign led by auto groups and manufacturers that redefined who owned the city streets" (Stromberg, 2015[158]).

Mental models are highly dependent on the stories people have been exposed to (Saltmarshe, 2018[159]), which are in turn subject to political economy factors and power dynamics within systems. The in-depth analysis of these factors (e.g. the influence of the automobile industry in shaping the transport system) is beyond the scope of this report, but is an interesting area for future research.

The mass introduction of cars to cities was a disruptive change in which advertising played a significant role (Freund and Martin, 1993[160]; Stromberg, 2015[158]). As Norton (2011[153]) explains, at first the public considered it to be the driver's responsibility to pay attention, not the pedestrian's, and the skyrocketing number of road fatalities after the introduction of cars was met with outrage. Cars were considered to be violent intruders.

This assumption changed radically towards the belief that streets are for cars. Pedestrians became intruders who are responsible for paying attention (and who are blamed if they are hit by a car). This idea persists today. Indeed, if a child is hit by a car, the first thought that may come to mind is that the parents are irresponsible. There is also a general perception that pedestrian deaths caused by vehicles, while tragic, are inevitable. For example, in 2018 in the United States an average of 17 pedestrians – mainly from low-income, black and Latino neighbourhoods – were killed by vehicles every day: one person every 85 minutes (Moran, 2021[157]). These deaths do not receive the same media coverage, or government attention, as other tragedies.

Since the 1920s, the automobile industry has been dedicating significant resources to convincing the public of the acceptability and desirability of cars, which, as Norton (2011[153]) demonstrates, has reshaped cities and mainstreamed a number of now deeply ingrained ideas. Through communication efforts to individuals and governments alike, the car industry has conveyed the message that vehicles are essential to improving well-being (Freund and Martin, 1993[160]). The car has become a symbol of freedom, social status and power, and opposition to it is perceived as a direct threat to basic rights such as freedom and safety (Gössling, 2020[152]).

Norton (2011[153]) identifies the "jaywalking" campaign in the US as a turning-point. The campaign managed to redefine "what streets are for" and to normalise the belief that pedestrians have no right to walk freely on streets. It is an interesting example of how framing and communication efforts can change people's perception of reality and make them accept – and even fiercely support – what once was unacceptable or unthinkable. The term "jaywalker" became a pejorative term for people who do not know how to conduct themselves in a city (Norton, 2007[161]). It ridiculed people who failed to use the recently installed pedestrian crossings and helped redefine who owned the street, as well as who is to blame in the case of a road accident (jaywalkers were pictured as threatening public safety).

"The ridicule of their fellow citizens is far more effective than any other means which might be adopted" (Norton, 2007[161]). This quote, from one of the heads of the pro-automobile coalition Motordom,

highlights the importance of communication – in this case the technique of shaming – to switch public perception of what and whom streets are for, and whether the vehicle's or the pedestrian's "recklessness" is to blame for road fatalities. By the 1930s, pedestrians were viewed as being in the way of cars (Norton, 2007[161]), and the streets have belonged to cars ever since.

4.7.1. Develop a whole-government communication strategy for car independence

As part of its Climate Action Plan Ireland has launched numerous communication committees and initiatives, including the Climate Communications Coordination Committee (CCCC)[18], the National Dialogue on Climate Action (NDCA) and the Office of Zero Emission Vehicles Ireland (ZEVI). Communication efforts are also reflected in the new Sustainable Mobility Policy.

Subordinate to the Department of the Taoiseach and with representatives across the government at the national level, the CCCC is in charge of the "implementation of all-of-Government strategic communications activities and campaigns, general and specific attitudinal and behaviour research as well as public and stakeholder engagement". Members include heads of communication and principal officers from all relevant departments (Department of Transport, 2022[81]). The CCCC will advise departments and agencies on overarching messaging content and support them in their climate communication initiatives (Department of the Taoiseach, 2022[162]).

The NDCA is the vehicle for engaging, enabling and empowering stakeholders and the public with respect to climate action (DECC, 2022[163]). Led by the Department of Environment, Climate and Communications (DECC), and with the Environmental Protection Agency (EPA) acting as the programme secretariat, the NDCA aims to "empower everyone in society to help deliver on [the] goal of reducing Ireland's carbon emissions and to actively participate in the transition towards a climate neutral economy by 2050". The NDCA's three pillars are: 1) improving climate literacy and awareness, for example via education modules at school and in adult education; 2) fostering active engagement in climate action, for example through public consultations such as the Climate Conversation 2022 and sustainable behaviour by the public; and 3) conducting behavioural research and collecting insights from engagement activities to inform climate policies (DECC, 2022[163]). In 2022, the NDCA established the National Climate Stakeholder Forum (NCSF), a consultative forum on climate issues and a vehicle to discuss the review of the annual Climate Action Plan. One-day deliberative workshops are organised three times per year (in 2022, the NCSF met in March, July, and will meet again in November), bringing policy makers and key stakeholders together to discuss potential ways forward for the transition to carbon neutrality. Sustainable mobility was discussed in breakout sessions in both the March and July meetings held in 2022. The third meeting, to be held in November, aims to foster discussions between the Taoiseach, Tánaiste, and the Committee on Environment and Climate Action (Department of the Environment, 2022[164]).

Established in July 2022 as a separate initiative, ZEVI supports "consumers, the public sector and businesses to continue to make the switch to zero emission vehicles" (Office of Zero Emission Vehicles, 2022[165]). As observed in Chapter 3, messages from this initiative may reinforce car-centric mindsets. The initiative name may also be misleading, as EVs are not zero-emission vehicles from a life-cycle perspective.

The 2022 Sustainable Mobility Policy (SMP) (Department of Transport, 2022[11]) includes an explicit goal (goal 8) to improve engagement with citizens. Communication-related actions within this goal include, for example, developing and implementing a public engagement and awareness strategy to highlight the benefits of sustainable mobility and organising a yearly National Sustainable Mobility Forum to engage with stakeholders and discuss the SMP progress.

This report recommends that Ireland should develop a whole-government communication strategy in support of the transport system's transformation away from car dependence. The communication strategy

should be implemented in coordination with the CCCC, NDCA and ZEVI. Coordination with ZEVI is of particular importance to avoid contradictory messages.

Based on interviews with officials, the Department of Transport recognises itself as the leading entity to develop and implement a whole-of-the-government communication strategy. To ensure the strategy success, however, additional resources and staff with communication skills would be needed. The communication strategy can build on insights generated by the Sustainable Mobility Policy (SMP) Leadership Group and on actions already planned under the SMP. For example, action 68 in the SMP, aiming to "develop and implement a public engagement strategy to promote the benefits of sustainable mobility and raise public awareness of options", could be expanded to also communicate the negative consequences of car-dependent systems, and the need for transformative change to allow sustainable modes to become the most attractive options.

The design and implementation of the strategy should engage local and regional actors and not be limited to the national level. Engaging these actors is fundamental if they are to feel part of and own the process, as well as and tailor strategies to their context and audiences.

This communication strategy could be an opportunity to introduce both internal and external change. Internally, it would:

- Increase the coherence of government communication about climate action in the transport sector and avoid potentially contradictory messages. Current communication efforts are scattered, with some (e.g. the Office of Zero Emission Vehicles) promoting vehicle electrification as sufficient to achieve the climate goals, and others (e.g. Climate Conversation) advocating for transformative and lifestyle changes.
- Foster stakeholder understanding and alignment with respect to the need to transform transport systems, rather than just decarbonise existing ones via electrification (see Box 4.11).
- Harness the creative potential[19] and context-specific knowledge of stakeholders at the local and regional levels via bottom-up approaches (see section 4.8.1).

Externally, it would:

- increase the political feasibility of the implementation at scale of transformative policies by conveying the benefits of sustainable transport and the negative consequences of inaction
- explain the new services and alternatives to cars that will be available once road reallocation and the mainstreaming of on-demand shared services have been implemented.

To increase the strategy's effectiveness, this report recommends making systems thinking and cognitive science findings central to its design and harnessing the potential of tactical urbanism to communicate the benefits of sustainable transport systems as rapidly and cost-effectively as possible.

Box 4.11. Fostering alignment for transformative change

This report calls for the redesign of Irish transport systems. A whole-government communication strategy for car independence can foster stakeholder alignment with this goal. Stakeholder alignment may, however, also be a prerequisite for this strategy.

A shared understanding and alignment on the need to transform the transport systems, stakeholders' role in such transformation (at the local, regional and national level), as well as the steps stakeholders could take to advance in that direction are fundamental to launch a coherent process of systems change in the country. The workshops held in April 2022 to prepare this report shed light on the importance of creating spaces for stakeholders at all levels of government to meet, discuss and experiment with systemic tools to co-create and implement transformative policies.

Government efforts to reach this understanding and alignment could include:

- Hands-on training in systems thinking to show how systemic tools could inform transformative policy-making and its implementation.
- Working sessions/workshops for co-creating policies guided by systemic tools. This was a request, for example, made by Kildare officials during the April 2022 workshops. These workshops should challenge ingrained mental models and practices in a safe environment, and brainstorm ways to foster change in both the public and private sectors. The NDCA National Climate Stakeholder Forums and the newly created Mobility Stakeholder Forum could be occasions to foster systemic policy co-creation.
- Trainings in cognitive science findings, examples of applications, and study visits to countries which have introduced road reallocation (e.g. visits to cities like those organised by the Dutch Cycling Embassy) could help officials visualise and communicate the benefits of the policies described in this report.
- Revising measurement frameworks and quantitative models, increasing the coherence of strategies and plans (e.g. by making explicit the redefined goal of sustainable accessibility), and linking the different strategies to the Irish well-being framework (see section 4.3.1).

Making systems thinking and cognitive science findings central to the strategy design

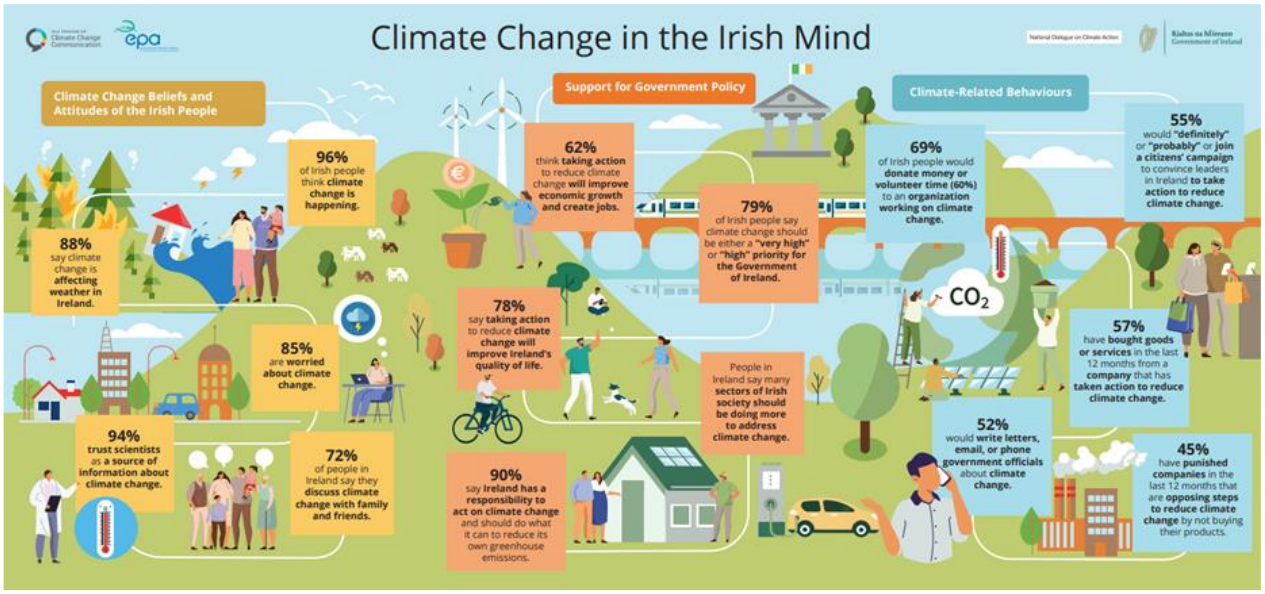
The key recommendation of this report – that the Irish transport system needs to be redesigned to become sustainable and improve well-being – needs to be clearly communicated. The link between systems design and behaviour needs to be explained to eliminate the perception that individual behavioural changes may be sufficient or are possible at large scale without a shift away from car dependence. Exposing the system design underlying unsustainable choices can help people understand the need to redesign it and increase the political support for the transformative policies recommended in this report.

By demonstrating what makes communication strategies successful, cognitive science can significantly increase their effectiveness. Identifying a target audience, communicating with images, invoking emotion via stories and experimentation, and sending clear calls for action are among the recommendations of communication experts (Christiano and Neimand, 2018[166]) (see Box 4.12).

The NDCA facilitated a project with Yale University with great potential to identify target audiences for the communication strategy. The project focuses on understanding "the attitudes, behaviours, policy preferences and beliefs of the Irish public to climate change" via a nationally representative survey (EPA and Yale University, 2021[167]), including audience segmentation. Preliminary results are encouraging, as illustrated in Figure 4.6. With respect to transport, 68% of the population "strongly support" and 24% "somewhat support" higher investment in public transport rather than motorways. The study also reveals

strong support for electric vehicles (70% "strongly support" and 22% "somewhat support" government grants to make EVs more affordable) (EPA and Yale University, 2021[167]). In parallel, the Economic, Social and Research Institute (ESRI) conducted a national survey to measure the population's understanding of the causes and effects of climate change (Timmons and Lunn, 2022[168]). ESRI found that a large majority of Irish people are concerned about climate change, have a good understanding of the subject, and are "willing to change their mind" (Timmons and Lunn, 2022[168]). A 2020 survey found that 75% of respondents were in favour of higher government spending on cycling, and 71% and 61% favour higher spending on public transport and walking respectively. Only 34% of respondents favoured higher spending on car infrastructure ((NTA and Sustrans, 2019[169]), accessed from Caulfield, Carroll and Ahern (2020[14])).

Figure 4.6. Climate change in the Irish mind



Source: (EPA and Yale University, 2021[167]), https://www.epa.ie/publications/monitoring--assessment/climate-change/EPA-Climate-in-the-Irish-Mind-INFOGRAPHICS-19.pdf

Communication efforts about the benefits of sustainable transport systems, via images and direct experience, are happening in cities worldwide and could provide examples for Ireland to inspire from. The following initiatives focus on enabling people to experience the benefits of sustainable transport systems and recognise the benefits for different segments of the population (workers, families, women, children).

- Bike to Work Day is an annual, national event in the United States: people can try out commuting to work by bike via pre-planned convoys across their city (BTWD, 2022[170]). Partially government-driven and supported by volunteer sponsors (BTWD, 2022[170]), its popularity has increased over the 20 years since its inception, including during the Covid pandemic (Salmon, 2021[171]; Partman, 2022[172]).
- On one Sunday a year, the *Journée sans voiture* (Day without cars), Paris streets are closed to cars and open to people (Ville de Paris, 2021[173]). The event is particularly interesting for families with children, who often have no opportunity to play on the streets or ride a bike safely. Such events, in particular if organised more frequently (e.g. once a month), could increase the acceptability of car-independent transport systems.
- Fancy Women Bike Ride aims to foster bicycle use by women worldwide by inviting women to ride their bikes dressed in "fancy clothes" so as to challenge the ingrained ideas that bikes are for men and purely for sport (Copenhagenize Index, 2019[174]). It coincides with World Car Free

Day (Fidler, 2019[175]), a similar initiative to the *Journée sans voiture*. Fancy Women Bike Ride started as a single Facebook event and has become an annual parade of over 30 thousand women in 50 cities in Turkey and 120 other cities around the globe (Copenhagenize Index, 2019[174]).

- *Bicibús* (Bike Bus) is a grassroots project that enables children to safely ride their bikes to school in Barcelona. At 8 a.m. on weekdays, hundreds of schoolchildren ride their bikes on streets closed to car traffic under the supervision of parents and a police escort. The initiative works like a school bus, with three "stops" along the way for children to join. *Bicibús* shows children from an early age, and their parents, that streets can have other uses than car traffic (Shivaram, 2021[176]). Since the project started, political support for safe cycling conditions has gained traction in families with children (Shivaram, 2021[176]).
- *La Rue est à Nous* (The street belongs to us) and Parking Day are examples of citizen-led campaigns that aim to build a collective vision of cities with fewer cars. They show how urban space could be used differently and, in the case of *La Rue est à Nous*, stress the health benefits arising from improved air quality and physical activity, in particular for children (La Rue est à Nous, 2021[177]; Parking Day, n.d.[178]). Similarly, Possible, a UK charity, compiles stories about traffic reduction measures and allows participants to "explore a world of Car Free Cities" to encourage changing to people-friendly, clean-air cities (Possible, 2021[179]; Possible, 2021[180]).

In addition to direct experience, humour is a powerful tool for getting attention and engagement (Eisend, 2009[181]). Communication efforts that use humour to promote sustainable transport modes include the Bruxelles Mobilité campaign *Les Pieds*, No Ridiculous Car Trips in Malmö, and Bike is Best.

- Bruxelles Mobilité launched a communication campaign around walking called *Les Pieds* (The Feet) (Bruxelles Mobilité, 2021[182]). The campaign uses humour and ridicule to convey the practicality of walking by presenting it as a form of high-tech technology (alluding to the ingrained "technological solutionism" discourse).
- No Ridiculous Car Trips in Malmö encourages people to use bikes for short trips. The project was spurred by the observation that half of all car trips in Malmö were five kilometres or less, a distance easily covered by bicycle.[20] One feature of the campaign received particular attention: a competition where people, in return for "confessing" their most ridiculously short car trip, could win a bike (Inherit, 2017[183]). A poll showed that almost half of Malmö residents were familiar with the campaign, 15% of them stating that it had led to reductions in their car travel (The Urban Observer, 2013[184]; Copenhagenize, 2010[185]; Inherit, 2017[183]).
- Similarly, Bike is Best is a video campaign conveying the message that bikes are the best tools for short journeys (BikeIsBest, 2021[186]).

Scholars such as Marco Te Brömmelstroet from the University of Amsterdam (and Director of the Urban Cycling Institute), and artists such as Jan Kamensky, are communicating on social media (e.g. LinkedIn), via online courses, creative videos, video repositories and talks, to counter the car-centric narrative. Their work could be adapted for the content of a communication strategy for Ireland – see for example Te Brömmelstroet (2020[187]; 2020[188]) and Kamensky (2021[189]).

Box 4.12. Beware of data: five principles of successful communication

Influencing others requires an understanding of what compels them to act. Drawing on multiple research fields, Christiano and Neimand (2018[166]) find that appeals to emotion and values are more powerful than facts alone. Research by cognitive scientist and linguist George Lakoff has found that "facts matter enormously, but to be meaningful they must be framed in terms of their moral importance" (Lakoff, 2014[190]). Lakoff argues that the ingrained idea that "the truth will set us free" contradicts the findings of cognitive science, which shows that "to be accepted, the truth must fit people's frames. If the facts do not fit a frame, the frame stays and the facts bounce off" (Lakoff, 2014[190]).

Christiano and Neimand (2018[166]) find that "people fail to act not because they do not have enough information, but because they don't care or they don't know what to do". They summarise findings from the behavioural, cognitive and social sciences in the form of five principles of effective communication:

- Affirm existing beliefs and identities as much as possible. For example, make efforts to find an angle that corresponds to people's existing beliefs (e.g. the importance of child safety). The "Copenhagener" identity previously mentioned applies this principle.
- Communicate in images. The brain is wired for imagery, and research shows that images are more successful in catching people's attention and triggering action than abstract terms such as "just transition" and "climate change". Images are also easier to remember.
- Invoke positive emotions to trigger action, and avoid negative emotions such as sadness, fear and guilt. For example, avoid blaming motorists and focus instead on the benefits of alternatives to cars.
- Create meaningful calls to action and spell out clearly how the audience being targeted can make a difference.
- Tell stories that evoke emotions rather than just share facts. For example, a cyclist sharing their experience on how riding a bike has improved their daily life can be more powerful than data on the CO_2 emissions reduction achieved by biking.

Leveraging tactical urbanism

Another successful communication strategy proposed in this report concerns tactical urbanism. Tactical urbanism involves making quick, low-cost interventions that can show the population what a particular change would look like without building any permanent infrastructure (see Box 4.6).

As demonstrated by Barcelona's Superblocks project (see section 3.3.1), tactical urbanism has great potential to support communication efforts about sustainable transport systems. In Barcelona, the conversation was reframed away from the need to introduce Superblocks in the city towards what Superblocks should look like, thus diverting opposition.

Tactical urbanism can also help build support for bike infrastructure. For example, introducing bike lanes via light infrastructure (e.g. painted road markings, easily installed bike lane separators) can speed up their implementation, enabling the population to experience the benefits of bikes without waiting for hard infrastructure to be installed. Light infrastructure can leave time for citizen input on the final infrastructure, thus improving its design through better knowledge of local needs and increasing citizen support and ownership of the project. Light infrastructure can also delay the start of disruptive public works until political support has been built, thus potentially reducing opposition. During COVID, Ireland experienced with tactical urbanism (DMURS, 2020[191]). Car parking space was reallocated to allow social distancing and queuing outside of shops and to widen footpaths. Protected cycling facilities were also created via painting and plastic wands (Figure 4.7).

Figure 4.7. Cycling facilities created during COVID in Dublin

Source: (DMURS, 2020[191]), https://www.dmurs.ie/_files/ugd/f378bf_0a66fb5405a544e087e38eb23319ee9e.pdf.

4.7.2. Regulate communication that reinforces car-centric mindsets

Participants in the April 2022 workshops identified the regulation of car-centric advertising as a way to accelerate the transition towards sustainable transport systems. This is in line with the latest IPCC report, which sees the regulation of advertising as a policy with a potentially "major influence on mitigative capacity" (Table 4.1) (IPCC, 2022[192]).

Much of current advertising by the private sector, in particular the automobile industry, reinforces car-centric mindsets, and may undermine the effectiveness of the Irish government's communication strategy in favour of sustainable transport systems. As noted in Chapter 3, estimates suggest that car-centric advertising receives seven to eight times more funding than communication about sustainable transport modes (Department of Transport, 2022[81]; Ali, n.d.[193]).

The regulation of car-centric advertising could be compared to the regulation of cigarette advertising (New Scientist, 2022[194]), implemented via the Public Health (Standardised Packaging of Tobacco) Act 2015 in Ireland (Law reform commission, 2015[195]). Weitzman and Lee (2020[196]) observe that "the conclusion that the observed associations between exposure to tobacco advertising and adolescent tobacco use are causal in nature, allowed for further regulation of tobacco advertising aimed at youth".

Evidence suggests that car-centric transport systems negatively impact health (e.g. via air pollution, obesity, reduced opportunities for physical activity) (Chai, 2015[197]; OECD, 2021[4]), safety (e.g. road fatalities) (ITF, 2020[198]), as well as environmental sustainability (e.g. emissions) (Colville-Andersen, 2018[43]; OECD, 2021[4]). Colville-Anderson (2018[43]) monetised these costs for Copenhagen and found that 100 kilometres driven by car cost society 89 euros, while biking could lead to savings of 26 euros for the same distance.

Regulations like those imposed on alcohol and tobacco may be needed to accelerate the transition towards sustainable transport systems and government departments that regulate advertising could be partners in the transition.

4.8. Rethink governance for transformational change

To transform Ireland's transport system at the speed and scale required by climate action targets calls for an integrated approach to rapid action and the transformation of mindsets throughout society. Authorities' resources, capacity and strengths all need to be aligned with their task. This section describes actions and changes Ireland can introduce to align its governance and wider transport stakeholder networks for the transformation ahead.

4.8.1. Take an integrated approach and embrace collaborative approaches

Transforming Ireland's transport system in the ways set out in this report is a challenge that requires the integration of a wide range of actors, including public, private and civic organisations, in the light of EU regulation and strategies. It touches the areas of responsibility of most national government departments, particularly the departments of Finance, Transport, Public Expenditure and Reform, Housing, Local Government and Heritage, and the Environment, Climate and Communications. Regional and local authorities also play key roles.

To promote integration beyond government, a National Climate Stakeholder forum, held in March 2022, discussed transport modal shifts and climate action among other topics (Department of the Environment, 2022[199]). In April 2022, Dublin and Cork were selected to join the EU Mission for 100 Climate Neutral Cities (Department of the Taoiseach, 2022[200]). The Missions approach[21] could not only benefit Dublin and Cork, but also provide practical inspiration for implementing multi-stakeholder platforms throughout Ireland. Missions address concrete societal challenges through directed and participative innovation, emphasising the integration of multiple stakeholders and levels of governance, and bottom-up participation (EU Commission, 2021[201]). Ireland's Department of Public Expenditure and Reform is already tasked with leading and enabling reform in the civil and public service as well as governing public expenditure (Department of Public Expenditure and Reform, 2021[202]). However, meeting major societal challenges like transport system transformation requires creating and directing networks of actors beyond public-sector institutions. Citizen organisations, academia, businesses of different sizes and NGOs all need to be engaged (EU Commission, 2021[201]).

In Sweden, a National Innovation Agency is tasked with connecting initiatives with stakeholders and stimulating collaboration to meet societal challenges (Vinnova, 2022[203]). This agency has applied the Missions approach (including system innovation and high-leverage action principles) to street redesign, and has released a practical guide to organising societal innovation, with emphasis on directing bottom-up efforts and including appropriate actors in all sectors (Vinnova, 2022[204]). The guide highlights the longer-term possibility of reducing public expenditure on health by promoting active travel and liveable urban spaces (Vinnova, 2022[204]). In Ireland, the Department of Health strategy already emphasises collaboration for wider social and economic goals (Department of Health Ireland, 2021[205]).

The main message of this report with regard to transport system innovation is that an integrated approach, guided by a well-being, zero-emission vision, is essential. Ireland's challenge is to achieve the realigned targets simultaneously and rapidly. As the April 2022 workshop participants concluded, this can only be done through integrated thinking and action, examining the wider impacts of actions and their fit with the overall strategy, avoiding locking in mistakes in infrastructure, improving resilience in the face of foreseen and unforeseen change, and scaling up actions with the speed and level of ambition demanded by climate targets. The workshop participants are ready to help with transport system innovation and keeping the group active (and enlarging it) could be a valuable resource for the future.

4.8.2. Multi-level governance for transformative change in the transport sector

Transformational change brings huge opportunities to enhance well-being, but it also brings new challenges for the public sector, raising the question of whether the current allocation of powers and responsibilities across Irish government levels can be improved. Fostering transformative change (and implementing the types of action recommended in this report) requires the rapid evolution of guidance at the national level, and rapid change in many operational and planning functions in parallel.

Ireland has a relatively centralised governance system. Interviews indicated that two general beliefs support this. Firstly, there is a feeling that because the country is small a lot can be done effectively at the national level. Secondly, there is a perception that assigning greater power to the local level will increase the influence of local politics in decision-making, leading to fragmented decisions and implementation. At the regional level, three Regional Assemblies[22] exist. These bodies were created in 2015. They now incorporate the functions of the previous regional authorities and assemblies and have extended power over spatial planning and economic development compared to the former bodies (European Committee of the Regions, n.d.[206])[23].

The rest of this sub-section discusses some useful ways of rethinking governance, based on analysis of international experience. It suggests Metropolitan Transport Authorities (MTAs) as a potential way forward to scale up transformative action in the transport sector.

Discussions around elected mayors and different governance arrangements in Ireland are being held in different places. An ongoing Dublin Citizen's Assembly – a citizen led body – is considering the type of directly elected mayor and the type of local government structures that may be best suited for Dublin (The Citizens' Assembly, n.d.[207]). Similarly, the Department of Housing, Local Government and Heritage (2021[208]) are leading the development of a new Bill to establish a Directly Elected Mayor for Limerick. Discussions in this sub-section could bring value to these two processes, as MTAs have been set in some cases under directly elected mayors. Experience gained in both of these cities might also inform general government practices across Ireland in the near future.

Current governance arrangements and challenges

The scaling up of policies with high transformative potential presented in this report requires significant changes in the way the government operates. These include: i) strengthened horizontal coordination for implementation; ii) change in government practices (and mindsets); iii) increased capacity for fostering mindset shifts across the population; and iv) increased leadership, policy implementation, communication, and innovation capacities at the local level. Discussions below focus on each of these changes. As will be discussed, Ireland's actions have been particularly important to address the first of these challenges. However, international practice suggests that successfully addressing the latter three might require setting functional wide area/metropolitan institutions (as discussed in the next subsection), with formal mandates (beyond the functions currently placed in Regional Assemblies), with specific authority over transport (and often land-use) (ITF, 2018[32]), and with predominant representation from the local level, may be required. The next sub-section presents Metropolitan Transport Authorities (MTAs[24]) as a potential way forward to scale up transformative action in the transport sector and solve some of the challenges described above.

The implementation of transformative policies requires horizontal coordination. Horizontal coordination has been a long-standing challenge for many countries, including Ireland. As discussed in (OECD, 2015[209]) "[a]t the horizontal level, the sheer increase in the number of municipalities comprised in the functional metropolitan area automatically entails a rise in the number of municipal actors dealing with transport". The lack of strategic planning at the metropolitan level is identified as one of the main barriers to the scaling up of street space reallocation and redesign in particular (McArthur et al., 2022[29]).

Efforts to increase horizontal coordination and coherent policy implementation exist in Ireland. For example, the government has:

- Increased monitoring of local actions to ensure alignment with national goals and standards (e.g. the recently created Office of the Planning Regulator, as well as the National Oversight and Audit Commission were established with this aim).
- Created local level offices to bring local authorities closer to the field.
- Given national authorities statutory power over territories to perform some functions (e.g. NTA was recently granted strategic planning functions over metropolitan cities- as part of SMP).
- Enhanced strategic planning and coordinated action. For example, the joint preparation of Regional Spatial and Economic Strategies by Regional Assemblies (see below) and the NTA, local transport plans for regional growth centres and key towns (jointly by NTA and local authorities), planning instruments such as active travel programmes as part of the SMP.
- Set up centres of expertise (via the Regional Climate Action Offices).

While efforts to increase coordination are numerous in Ireland, as mentioned above, in addition to better horizontal coordination, transforming the transport system entails not solely greater government intervention but also radical change in government practices (and mindsets). Functions that seemed straightforward, such as road design, traditionally seen as a purely technical issue (as discussed in section 3.3), call for developing and using more complex tools (e.g. link and place classifications), gathering a wider set of (multi-disciplinary and multi-sectoral) skills, building on inputs from a range of stakeholders (including citizens), and revamping measures of progress. The complexity that the public sector needs to address has also grown with the emergence of new mobility services and digital technologies. These have increased policy makers' opportunities to generate social value, but they have also brought new challenges in the areas of regulation, data collection, interpretation and management (McArthur et al., 2022[29]).

The question now is whether the national government, and in particular the National Transport Authority (NTA), will be able to deal with the growing challenge of providing strong guidance for change and innovative practice (not an easy or resource-light task), while continuing to be responsible for many of the functions needed to implement it (e.g. regulation, data analysis, strategic planning). Despite the NTA's solid expertise and recent efforts to expand its staff (as mentioned in the interviews), there are indications that it may already be overextended. For instance, it has the expertise and is already engaged in developing the new indicators (e.g. accessibility indicators) needed to shift thinking and practice (e.g. moving from mobility to accessibility). Interviews showed, however, that the development of these indicators and of tools for their practical use and analysis in policy decision-making has proven challenging for the NTA, given the many other tasks assigned to it. Studies also reveal that despite the setting up of Transport Coordination Units by the NTA, accessibility gaps remain in rural areas, in particular for disadvantaged households (Carroll, Benevenuto and Caulfield, 2021[210]). The question arises of whether a redistribution of functions across government levels could liberate some of the NTA's capacity, enabling it to focus on functions for which it is the best positioned, and where the expertise it has acquired is most needed (e.g. leading the development of new tools and frameworks that can steer conversations, policies and practice in a new direction- as those recommended in this report).

Transformational change also requires a radical change in people's mindsets, in order to accept major alterations in the living environment and lifestyles and create a shared vision of what a desirable transport system looks like. Thus, another challenge concerns how to increase government engagement with an array of stakeholders, including citizens, to promote bottom-up and participatory approaches and create system change leadership (e.g. via policy champions). McArthur et al. (2022[29]) stress that in order to implement an integrated approach to streetspace reallocation – one of the policies with higher transformative potential according to the assessment in this report – governments must "create [d]ialogue with citizens and stakeholder groups … to engage the wider public alongside technical experts, planners and elected stakeholders and to understand the multiple trade-offs and tensions between modes and streetspace uses".

As discussed earlier in this report, Ireland has set out a number of fora and mechanisms for citizen engagement (e.g. National Climate Stakeholder Forum, see section 4.7.1), which are important initiatives. A question for Ireland, however, is whether the national government is the body best suited to implement a vision-led approach which will get citizens and stakeholders on board with the necessary changes. The question of decentralisation or devolution of power and decision-making does not merely concern the optimal size of a country or region to be managed: there is a rationale for incentivising bottom-up, place-based decision-making and solutions, and bringing decision-making closer to the citizens (ITF, 2018[32]). Examples of significant change in other countries' major cities (e.g. Lisbon and London) show that the creation of dense networks of relationships among government, business organisations, NGOs and other stakeholders has been key (McArthur et al., 2022[29]). As noted above, change also requires building leadership, and creating a narrative and framing for innovation as an effective solution. Strong local government actors (e.g. metropolitan transport agencies or integrated transport departments) have often been at the forefront (McArthur et al., 2022[29]). Also, while strategic planning is important in itself, one of its additional functions is to build a shared and strategic vision for the given territory, aligned with national goals but also embracing local realities, needs and expectations and encouraging buy-in from a number of stakeholders (ITF, 2018[32]).

A third challenge arises from the fact that tailoring approaches to context-specific needs increases the necessity for building and expanding implementation capacity at the local level, for avoiding "one-design-fits-all solutions" (McArthur et al., 2022[29]). While projects can benefit from national guidance, they have to balance different local needs and tailor their solutions appropriately. Implementing change ultimately depends on local authorities, and implementation capacity at this level of government has to be enhanced. As argued in section 3.3, cities have to become "streetspace managers", while also having the capacity to "regulate to innovate" (McArthur et al., 2022[29]). The lack of local government's capacity to follow through projects or actions in some cases, increases the difficulty of horizontal coordination (see the following paragraphs). Moreover, the lack of sufficient staff with expertise at the local level often results in the delegation of key functions to the private sector (McArthur et al., 2022[29]), a visible problem in Ireland.

Functional wide area/metropolitan transport authorities

Governance and coordination, in particular for transport and land use, has been a challenge for many countries. Questions and fears much like those that arise in Ireland have been voiced: while enhancing capacity at local level is important, to what extent will the devolution of functions lead to fragmentation and politicisation of decisions and practices?

Ireland could consider introducing transport authorities or other bodies at a level intermediate between national and county level. Such bodies are often called metropolitan transport authorities (ITF, 2018[32]), since they are responsible for a city and its metropolitan area or region (e.g. London, Paris, Barcelona, Manchester) (ITF, 2018[32]; TfGM, n.d.[211]). The exact scale of the territory may vary; for instance, in France *Ile-de-France Mobilité* covers the Ile-de-France region, with some rural areas as well as larger and smaller towns around Paris (ITF, 2018[32]). The EC and OECD have established the boundaries of functional urban areas[25] (OECD, 2013[212]), and the area covered by *Ile-de-France Mobilité* coincides closely with the functional urban area centred on Paris. In London, TfL has a mandate over the Greater London Authority area, which coincides with the urban core[26]. Authorities at different levels and with different functions can coexist: in Barcelona, for example, the Metropolitan Area of Barcelona (AMB) is responsible for land use, housing and the environment and transport (through its transport department) at the scale of the urban core (Barcelona and the surrounding 36 municipalities). AMB's transport department has more authority over the planning of bicycle traffic, walking and local buses. In addition, the Metropolitan Transport Authority (ATM) has been set up at the regional level and oversees the planning and delivery of heavier modes (e.g. commuter trains, regional buses). These authorities complement and collaborate with each other (ITF, 2018[32]). The establishment of this type of authority is not reserved to cities or urban areas.

Elsewhere in France, for example, some transport authorities have been instituted in non-urban areas as well (Richer, Hasiak and Jouve, 2022[213]).

In some countries elected mayors have been granted authority over these domains, but this is not always the case, and Ireland could establish these bodies whether or not it decides to involve elected mayors in the future.

The proposed bodies are meant to be technical, not political, in nature, and their personnel should therefore not change with the political cycle. Nonetheless, both political and non-political actors can form part of their governance structure, providing a space for multi-level, multi-disciplinary dialogue and decision-making processes. In Ireland the governance structure could include local authorities, giving them a more prominent role in decision-making, as well as the NTA and other national bodies. These bodies would benefit from technical expertise by hiring dedicated staff for the various functions assigned to the authority.

The advantages of MTAs could be multiple for Ireland. Based on the conclusions by the ITF (2018[32]), some of the main advantages could be the following:

- Some of the tasks performed today by the NTA (e.g. regulation and strategic planning) could be assigned to the MTAs. This could release capacity from the NTA, enabling it to concentrate on the development of national-level guidance and tools to advance practice and thinking in the many areas discussed in this report. At the same time, bringing strategic planning down to a more local level could encourage a more participative process, enabling local authorities and other local stakeholders to build ownership over the vision developed for their area. NTA expertise and inputs would still be key to the development of strategies, and different coordinating mechanisms throughout the process of developing the strategies could be established to ensure this. Giving these new bodies responsibility for strategic planning could also help to coordinate the planning of different modes. It would also allow to expand strategic planning at metropolitan/functional area scale more easily beyond the five largest cities (as this would not all rely on the NTA having to take the lead for all territories).
- This model can improve technical capacity while avoiding redundancy. A number of the stakeholders interviewed agreed that while capacity is lacking at the local level in Ireland, increasing it will not mean that every council has staff for everything. Sharing capacity among councils was proposed by various participants in the project, who pointed out that this could also help in fostering coordination. This said, careful consideration and analysis will be needed to decide which functions are to be assigned to the authority and the councils, and enhanced capacity at council level must be a priority.
- While these bodies would absorb some functions now performed at national level, other functions now performed by the councils could be moved up a level. For instance, TfL in London has authority over segments of the road/street network going through multiple boroughs, which facilitates coordination across the city[27]. MTAs could also regulate and tender different modes (e.g. buses and new mobility services) facilitating integration and better planning. For example, TfL tenders buses for the whole of Greater London and is piloting tendering for e-scooters at the same level.
- Data collection, management and analysis could also be managed by the new bodies (ITF, 2018[32]). This could help the government to rapidly evolve to meet new challenges. For example, NTA could provide guidance on data regulation (as is planned) while these metropolitan or functional scale authorities would be charged with implementing the regulation when organising tender to ensure coordinated implementation across territories. By building their own data collection and analysis capacity, the metropolitan or functional scale authorities could complement the NTA. They could perform the more detailed analysis for their area and facilitate the gathering of data from local authorities in ways (and formats) that can be seamlessly integrated into the national databases. In this way, these authorities could

strengthen strategic planning with more detailed analysis and indicators, instead of leaving it to the NTA to provide information and analysis for the whole country.

- The model could also help to rethink budgets for local transport. Efficiently functioning transport authorities need to have dedicated funding (including technical staff salaries) and decision-making authority over the transport budget. Various methods exist to source these budgets, including some direct funding from the national government, the channelling of car-related charges (e.g. fuel sur-charges, parking, ownership taxes in Paris and London), the levying of new taxes (e.g. business levies in Paris and London), the development of land capture mechanisms (in London), and other municipal taxes (e.g. in Barcelona). Ireland is providing new funding for active and public transport locally through both investment and through funding local authorities, which could become part of how these bodies are funded. It could also consider allocating other existing sources of income to them. Increasing the budget available for transport improvement has been crucial to getting local authorities on board with the establishment of these new bodies, as has adequate representation in decision-making (ITF, 2018[32]).
- Because MTAs would cover a larger area than current administrative boundaries, they can reduce the fragmentation of decision-making. The scale at which these could be implemented requires important reflection. Various configurations are possible. Among them are:
  - Set up metropolitan transport authorities for the larger cities and their functional urban areas, which could include smaller towns and rural areas, and then identify the areas without coverage and determine case by case what administrative scale is most appropriate for them. In this case, as the examples of Barcelona and London show, bigger cities within the functional area might be a case for establishing bodies at the core city level to plan active transport and in addition to local bus routes.
  - Alternatively, existing regional assemblies could determine the scale of these new bodies. However, these might include too many functional urban areas, hence losing some of the benefits of the model. This section provided a brief overview of MTA characteristics in selected OECD countries, which would need to be adapted to the Irish context should Ireland decide to take this avenue. A number of publications analyse MTAs in further detail (Kumar and Agarwal, 2013[214]). For example, via case studies, the ITF (2017[7]) analyses and discusses different governance models and decision-making rules, scales of authority, budget composition, delimitation of functions from other authorities, and coordination mechanisms with other levels of government, as well as the stages for establishing these authorities. If Ireland decides to go down this road, all of these decisions will need to be carefully adapted to its particular context, problems and objectives.

References

Ali, A. (n.d.), *Tesla's Spending on R&D and Marketing, Compared to Other Automakers*, https://www.visualcapitalist.com/comparing-teslas-spending-on-rd-and-marketing-per-car-to-other-automakers/ (accessed on 1 July 2022). [193]

American Planning Association (2022), *From Mobility Hubs to Mobility-Oriented Development*, APA Knowledge Center - Spotlight on Zoning Practice, https://www.planning.org/blog/9231280/from-mobility-hubs-to-mobility-oriented-development/ (accessed on 24 June 2022). [64]

Arndt, W. et al. (2019), *Integration of shared mobility approaches in Sustainable Urban Mobility Planning*, European Platform on Sustainable Urban Mobility Plans, https://www.eltis.org/sites/default/files/integration_of_shared_mobility_approaches_in_sumps.pdf (accessed on 15 June 2022). [59]

Associates, P. et al. (2013), "Design Manual for Urban Roads and Streets". [27]

Axsen, J., P. Plötz and M. Wolinetz (2020), "Crafting strong, integrated policy mixes for deep CO2 mitigation in road transport", *Nature Climate Change 2020 10:9*, Vol. 10/9, pp. 809-818, https://doi.org/10.1038/s41558-020-0877-y. [108]

Barrett, J. et al. (2022), "Energy demand reduction options for meeting national zero-emission targets in the United Kingdom", *Nature Energy 2022*, pp. 1-10, https://doi.org/10.1038/s41560-022-01057-y. [15]

BBC News (2022), *Bike protest takes over German motorway*, BBC News, https://www.bbc.com/news/av/world-europe-62710430 (accessed on 14 September 2022). [156]

BikeIsBest (2021), *The Best Tool For The Job*, https://www.youtube.com/watch?v=V6ChTqII-Yk (accessed on 21 July 2021). [186]

Börjesson et al. (2021), "The Economics of Low Emission Zones", *Transportation Research Part A: Policy and Practice*, Vol. 153, pp. 99-114, https://doi.org/10.1016/J.TRA.2021.08.016. [105]

Börjesson, M. et al. (2012), "The Stockholm congestion charges—5 years on. Effects, acceptability and lessons learnt", *Transport Policy*, Vol. 20, pp. 1-12, https://doi.org/10.1016/j.tranpol.2011.11.001. [97]

Broaddus, A., M. Browne and J. Allen (2015), "Sustainable Freight: Impacts of the London Congestion Charge and Low Emissions Zones", *https://doi.org/10.3141/2478-01*, Vol. 2478, pp. 1-11, https://doi.org/10.3141/2478-01. [98]

Bruno, M., H. Dekker and L. Lemos (2021), "Mobility protests in the Netherlands of the 1970s: Activism, innovation, and transitions", *Environmental Innovation and Societal Transitions*, Vol. 40, pp. 521-535, https://doi.org/10.1016/j.eist.2021.10.001. [154]

Brussels Mobility (2021), *Good Move - The Regional Mobility Plan 2020-2030*, https://mobilite-mobiliteit.brussels/en/good-move (accessed on 29 June 2022). [61]

Bruxelles Mobilité (2021), *Les Pieds*, https://www.youtube.com/watch?v=EAkm773d7RQ (accessed on 1 July 2021). [182]

BTWD (2022), *Bike To Work Day*, https://www.biketoworkmetrodc.org/ (accessed on 21 July 2022). [170]

Buckle, S. et al. (2020), "Addressing the COVID-19 and climate crises : Potential economic recovery pathways and their implications for climate change mitigation, NDCs and broader socio-economic goals", *OECD/IEA Climate Change Expert Group Papers*, No. 2020/04, OECD Publishing, Paris, https://doi.org/10.1787/50abd39c-en (accessed on 13 June 2022). [9]

Cachia, R. (2016), *Dublin city baseline emissions report*, Dublin City Council, Dublin City, https://www.seai.ie/publications/Dublin-City-Baseline-Report.pdf (accessed on 11 July 2022). [216]

Carroll, P., R. Benevenuto and B. Caulfield (2021), "Identifying hotspots of transport disadvantage and car dependency in rural Ireland", *Transport Policy*, Vol. 101, pp. 46-56, https://doi.org/10.1016/J.TRANPOL.2020.11.004. [210]

Caulfield, B., P. Carroll and A. Ahern (2020), "Transitioning to low carbon and sustainable mobility", http://hdl.handle.net/2262/93659 (accessed on 26 July 2022). [14]

Central Statistics Office (2020), *National Travel Survey 2019*, https://www.cso.ie/en/releasesandpublications/ep/p-nts/nationaltravelsurvey2019/. [12]

Chai, C. (2015), "Why your car-dependent neighbourhood is increasing your risk of obesity | Globalnews.ca", https://globalnews.ca/news/2109435/why-your-car-dependent-neighbourhood-is-increasing-your-risk-of-obesity/ (accessed on 21 July 2022). [197]

Christiano, A. and A. Neimand (2018), *The Science of What Makes People Care*, https://ssir.org/articles/entry/the_science_of_what_makes_people_care (accessed on 21 July 2022). [166]

CiTTi Magazine (2020), *TfL announces London e-scooter tender*, https://www.cittimagazine.co.uk/news/micromobility/tfl-announces-london-e-scooter-tender.html (accessed on 30 June 2022). [74]

City of Malmö (2022), *Green City - Malmö stad*, https://malmo.se/Welcome-to-Malmo/Sustainable-Malmo/Sustainable-Urban-Development/Western-Harbour/Green-City.html (accessed on 4 July 2022). [138]

City of Stockholm (2022), *Urban Mobility Strategy Stockholm*, https://start.stockholm/om-stockholms-stad/sa-arbetar-staden/trafik/framkomlighet/ (accessed on 22 June 2022). [101]

Climateworks Foundation (2021), *The pandemic showed why micromobility is crucial to urban resilience, mitigation, and adaptation*, https://www.climateworks.org/blog/the-pandemic-showed-why-micromobility-is-crucial-to-urban-resilience-mitigation-and-adaptation/ (accessed on 17 June 2022). [50]

Colville-Andersen, M. (2018), *Copenhagenize*, Island Press/Center for Resource Economics, Washington, DC, https://doi.org/10.5822/978-1-61091-939-5. [43]

CoMoUK (2019), *Mobility Hubs Guidance*, http://www.como.org.uk (accessed on 24 June 2022). [65]

Conway, R. et al. (2019), "The current state of cycling infrastructure in Dublin and Copenhagen:; A comparison of cycling infrastructure in 8 radial routes into the city centre of Dublin and Copenhagen", *Irish Medical Journal*, https://imj.ie/the-current-state-of-cycling-infrastructure-in-dublin-and-copenhagen-a-comparison-of-cycling-infrastructure-in-8-radial-routes-into-the-city-centre-of-dublin-and-copenhagen/ (accessed on 12 July 2022). [2]

Copenhagenize (2010), *No Ridiculous Car Journeys in Malmö, Sweden*, http://www.copenhagenize.com/2010/09/no-ridiculous-car-journeys-malmo-sweden.html (accessed on 21 July 2022). [185]

Copenhagenize EU (2019), *Success stories: Seattle Dockless Bike Share*, Copenhagenize index, https://copenhagenizeindex.eu/success-stories/seattle-dockless-bike-share (accessed on 17 June 2022). [70]

Copenhagenize Index (2019), *A TASTEFUL TURKISH INITIATIVE TO PROMOTE WOMEN ON BIKES.*, https://copenhagenizeindex.eu/success-stories/tasteful-turkish-initiative-to-promote-women-on-bikes (accessed on 21 July 2022). [174]

Creutzig, F. et al. (2020), "Fair street space allocation: ethical principles and empirical insights", *Transport Reviews*, Vol. 40/6, https://doi.org/10.1080/01441647.2020.1762795. [24]

Crozet, Y. (2020), "Cars and Space Consumption: Rethinking the Regulation of Urban Mobility", *International Transport Forum Discussion Papers*, No. 2020/13, OECD Publishing, Paris, https://doi.org/10.1787/8abaa384-en. [54]

Crozet, Y. and A. Mercier (2018), "Urban Toll: Rethinking Acceptability Through Accessibility", *International Transport Forum Discussion Papers*, No. 2018/16, OECD Publishing, Paris, https://doi.org/10.1787/af22477a-en. [103]

Crozet, Y., G. Santos and J. Coldefy (2019), *Shared Mobility, MaaS and the Regulatory Challenges of Urban Mobility*, Centre on Regulation in Europe, https://cerre.eu/wp-content/uploads/2020/07/190827_CERRE_MaaS_FinalReport.pdf (accessed on 16 June 2022). [75]

CSO (2020), *National Travel Survey 2019*, Central Statistics Office, https://www.cso.ie/en/releasesandpublications/ep/p-nts/nationaltravelsurvey2019/ (accessed on 13 June 2022). [58]

CSO Ireland (2019), *Urban and Rural Life in Ireland, 2019*, CSO, https://www.cso.ie/en/releasesandpublications/ep/p-urli/urbanandrurallifeinireland2019/introduction/ (accessed on 20 September 2022). [1]

DCC Housing Commitee (2020), *Urban Sprawl to Compact Growth*, https://councilmeetings.dublincity.ie/documents/s29770/4.Compact%20City%20Housing%20Presentation%20-%20RIAI.pdf (accessed on 21 June 2022). [140]

de Bortoli, A. (2020), *Are E-Scooters Good or Bad for the Environment?*, International Transport Forum, Paris, https://www.itf-oecd.org/are-e-scooters-good-or-bad-environment?_ga=2.93226781.1824617987.1657005448-1067012004.1649249692 (accessed on 5 July 2022). [71]

De Sousa, C. (2011), "Unearthing the benefits of brownfield to green space projects: An examination of project use and quality of life impacts", *https://doi.org/10.1080/13549830600853510*, Vol. 11/5, pp. 577-600, https://doi.org/10.1080/13549830600853510. [129]

DECC (2022), *National Dialogue on Climate Action (NDCA)*, https://www.gov.ie/en/publication/4bf2c-national-dialogue-on-climate-action-ndca/ (accessed on 25 July 2022). [163]

Department of Health Ireland (2021), *Department of Health Statement of Strategy 2021-2023*, https://www.gov.ie/en/organisation-information/0fd9c-department-of-health-statement-of-strategy-2021-2023/. [205]

Department of Housing, Local Government and Heritage (2021), *gov.ie - General Scheme of Local Government (Directly Elected Mayor with Executive Functions in Limerick City & County) Bill 2021*, https://www.gov.ie/en/publication/45a69-general-scheme-of-local-government-directly-elected-mayor-with-executive-functions-in-limerick-city-county-bill-2021/ (accessed on 5 September 2022). [208]

Department of Public Expenditure and Reform (2021), *About the Department of Public Expenditure and Reform*, https://www.gov.ie/en/organisation-information/919c7d-about-dper/. [202]

Department of Public Expenditure and Reform Ireland (2019), *Spending Review 2019 - Incentives for personal Electric Vehicle purchase*. [84]

Department of the Environment, C. (2022), *Minister Ryan opens first National Climate Stakeholder Forum*, https://www.gov.ie/en/press-release/087a0-minister-ryan-opens-first-national-climate-stakeholder-forum/. [199]

Department of the Environment, C. (2022), *National Climate Stakeholder Forum (NCSF)*, https://www.gov.ie/en/publication/1aecf-national-climate-stakeholder-forum-ncsf/. [164]

Department of the Taoiseach (2022), *Appendix 1 Climate Action Plan 2021 Progress Report*, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjHsO6UjpT5AhX8g84BHVoHCwAQFnoECAMQAQ&url=https%3A%2F%2Fassets.gov.ie%2F226640%2F455e596a-42c5-4d64-b261-21e63e7ccd49.pdf&usg=AOvVaw2oqVNH-GJGDmF766sD9Km7. [162]

Department of the Taoiseach (2022), *Taoiseach Micheál Martin congratulates Cork and Dublin on selection by European Commission for Climate-Neutral Smart Cities Mission*, https://www.gov.ie/en/press-release/cc0e1-taoiseach-micheal-martin-congratulates-cork-and-dublin-on-selection-by-european-commission-for-climate-neutral-smart-cities-mission/. [200]

Department of the Taoiseach Ireland (2021), *Climate Action Plan 2021*, https://www.gov.ie/en/campaigns/2f87c-climate-action-plan-2021/#. [10]

Department of Transport (2022), "Interview with the Climate Engagement & Governance Division, Department of Transport". [81]

Department of Transport (2022), "Interview with the Climate Engagement & Governance Division, Department of Transport". [13]

Department of Transport (2022), *National Sustainable Mobility Policy*, https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/ (accessed on 13 June 2022). [11]

Department of Transport (2021), *Electric Vehicle Policy Pathway*, https://www.gov.ie/en/publication/e62e0-electric-vehicle-policy-pathway/. [85]

Department of Transport (2021), *Common Appraisal Framework for Transport Projects and Programmes*, Department of Transport, https://www.gov.ie/en/organisation-information/800ea3-common-appraisal-framework/ (accessed on 13 June 2022). [22]

Department of Transport Ireland (2022), *Electric Vehicle Charging Infrastructure Strategy 2022-2025*, https://www.gov.ie/pdf/?file=https://assets.gov.ie/220099/2ee020ea-99a6-439e-851b-48d0b410e746.pdf#page=null (accessed on 20 June 2022). [119]

Dept of Rural and Community Development and Dept of Housing Local Government and Heritage (2022), *Town Centre First Policy*, https://www.gov.ie/en/publication/473d3-town-centre-first-policy/ (accessed on 13 June 2022). [52]

Dimitropoulos, A., W. Oueslati and C. Sintek (2018), "The rebound effect in road transport: A meta-analysis of empirical studies", *Energy Economics*, Vol. 75, pp. 163-179, https://doi.org/10.1016/J.ENECO.2018.07.021. [107]

DMURS (2020), *INTERIM ADVICE NOTE - Covid 19 Pandemic Response*, https://www.dmurs.ie/_files/ugd/f378bf_0a66fb5405a544e087e38eb23319ee9e.pdf. [191]

DMURS (2019), *ADVICE NOTE 4-Quality Audits*, http://www.dmurs.ie (accessed on 14 June 2022). [28]

Dolezelova, L. (2014), "Redevelopment potential of brownfields: A-B-C classification and its practical application", *E+M Ekonomie a Management*, Vol. 17/2, p. 34+. [134]

Ehrlich, M., C. Hilber and O. Schöni (2018), "Institutional settings and urban sprawl: Evidence from Europe", *Journal of Housing Economics*, Vol. 42, pp. 4-18, https://doi.org/10.1016/J.JHE.2017.12.002. [141]

EIC (2021), *Brownfield first: Supporting levelling up*. [144]

Eisend, M. (2009), "A meta-analysis of humor in advertising", *Journal of the Academy of Marketing Science*, Vol. 37/2, pp. 191-203, https://doi.org/10.1007/S11747-008-0096-Y/TABLES/7. [181]

EIT and McKinsey (2019), *Examining the impact of a sustainable electric micromobility approach in Europe*, EIT InnoEnergy, Eindhoven, https://www.innoenergy.com/discover-innovative-solutions/reports/micromobility-report/ (accessed on 24 June 2022). [49]

Eltis (2021), *Guidelines for developing and implementing a Sustainable Urban Mobility Plan (2nd edition)*, The Urban Mobility Observatory (Eltis), https://www.eltis.org/mobility-plans/sump-guidelines (accessed on 29 June 2022). [45]

Eltis (2021), *The Benefits of Micro-mobility for Cities*, Eltis - The Urban Mobility Observatory, https://www.eltis.org/in-brief/news/benefits-micro-mobility-cities (accessed on 17 June 2022). [51]

EPA (2022), *Supporting Brownfields Redevelopment using Tax Incentives and Credits*. [145]

EPA and Yale University (2021), "Climate change in the Irish mind", https://www.epa.ie/publications/monitoring--assessment/climate-change/EPA-Climate-in-the-Irish-Mind-REPORT-19.pdf (accessed on 25 July 2022). [167]

EU Commission (2021), *European Missions. 100 Climate-Neutral and Smart Cities by 2030. Info Kit for Cities. EU Commission 2021*. [201]

European Commission (2022), *Road charging*, https://transport.ec.europa.eu/transport-modes/road/road-charging_en. [109]

European Commission (2016), *Science for Environment No net land take by 2050?*, European Commission. [133]

European Commission (2013), *A Concept for Sustainable Urban Mobility Plans*, https://eur-lex.europa.eu/resource.html?uri=cellar:82155e82-67ca-11e3-a7e4-01aa75ed71a1.0011.02/DOC_4&format=PDF (accessed on 1 July 2022). [215]

European Committee of the Regions (n.d.), *CoR - Ireland-intro*, https://portal.cor.europa.eu/divisionpowers/Pages/Ireland-intro.aspx (accessed on 24 June 2022). [206]

Fidler, M. (2019), *World Car Free Day 2019 – in pictures | Cities | The Guardian*, The Guardian, https://www.theguardian.com/cities/gallery/2019/sep/22/world-car-free-day-2019-in-pictures?CMP=Share_iOSApp_Other (accessed on 25 July 2022). [175]

Fingal County Council (2022), *Fingal Community Car*, https://www.fingal.ie/fingal-community-car (accessed on 22 June 2022). [79]

Franco, S. (2020), "Parking Prices and Availability, Mode Choice and Urban Form Discussion Paper", http://www.itf-oecd.org (accessed on 9 July 2021). [25]

Freund, P. and G. Martin (1993), *The Ecology of the Automobile*, https://www.researchgate.net/publication/289117639_The_Ecology_of_the_Automobile (accessed on 24 June 2021). [160]

Fulton, L. et al. (2017), *TRANSPORTATION Three Revolutions in Urban*, https://itdpdotorg.wpengine.com/wp-content/uploads/2017/04/UCD-ITDP-3R-Report-FINAL.pdf (accessed on 30 June 2019). [123]

Gaur, A. et al. (2022), "Low energy demand scenario for feasible deep decarbonisation: Whole energy systems modelling for Ireland", *Renewable and Sustainable Energy Transition*, Vol. 2, p. 100024, https://doi.org/10.1016/J.RSET.2022.100024. [118]

Gössling, S. (2020), "Why cities need to take road space from cars - and how this could be done", *Journal of Urban Design*, Vol. 25/4, pp. 443-448, https://doi.org/10.1080/13574809.2020.1727318/FORMAT/EPUB. [152]

Gössling, S. et al. (2019), *The Social Cost of Automobility, Cycling and Walking in the European Union*, Elsevier. [94]

Government of Ireland (2022), *Town Centre First: A Policy Approach for Irish Towns*, Department of Rural and Community Development; Department of Housing, Local Government and Heritage. [126]

Government of Ireland (2021), *Housing for All: A new Housing Plan for Ireland*, Department of Housing, Local Government and Heritage. [125]

Government of Ireland (2018), *Project Ireland 2040 National Planning Framework*, https://assets.gov.ie/7338/31f2c0e4ba744fd290206ac0da35f747.pdf (accessed on 13 June 2022). [124]

Greater London Authority (2018), *Mayor's Transport Strategy*, https://www.london.gov.uk/what-we-do/transport/our-vision-transport/mayors-transport-strategy-2018?intcmp=46686 (accessed on 17 June 2022). [60]

Gschwendtner, C. (2021), *Vehicle-to-Grid and car sharing: Joining forces to decarbonize electricity and transport?*, https://blogs.ethz.ch/energy/v2g-and-car-sharing-joining-forces/ (accessed on 5 July 2022). [120]

Halpern, C. et al. (2019), *Road Space Re-Allocation: Organizational, Institutional and Political Dimensions.*, Sciences Po, http://halshs-02382074 (accessed on 13 January 2021). [26]

HM Revenue & Customs (2016), *Corporate Intangibles Research and Development Manual*, HMRC internal manual. [146]

ICCT (2021), *station-based carsharing is recommended in cities with less than 100,000 people, says ICCT*. [122]

IEA (2022), *Global EV Outlook 2022 – Analysis - IEA*, https://www.iea.org/reports/global-ev-outlook-2022. [117]

IEA (2021), *Mineral requirements for clean energy transitions – The Role of Critical Minerals in Clean Energy Transitions – Analysis*, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions. [114]

IEA (2019), *Growing preference for SUVs challenges emissions reductions in passenger car market – Analysis*, https://www.iea.org/commentaries/growing-preference-for-suvs-challenges-emissions-reductions-in-passenger-car-market. [115]

Inherit (2017), *No Ridiculous Car Trips" – a Bicycle Campaign*, https://inherit.eu/no-ridiculous-car-trips-a-bicycle-campaign/ (accessed on 25 July 2022). [183]

Interreg Europe (2019), *Regulation Framework for Sharing Mobility Services*, Interreg Europe, https://www.interregeurope.eu/good-practices/regulation-framework-for-sharing-mobility-services (accessed on 17 June 2022). [66]

IPCC (2022), "Chapter 4 IPCC WGIII AR6 Chapter 4: Mitigation and development pathways in the near-to mid-term". [192]

IPCC (2022), "Chapter 8 IPCC WGIII AR6 Chapter 8: Urban systems and other settlements". [135]

Irish Tax and Customs (2022), *Cycle to Work Scheme*, https://www.revenue.ie/en/jobs-and-pensions/taxation-of-employer-benefits/cycle-to-work-scheme.aspx. [86]

Irish Tax and Customs (2022), *Taxation of Employer Benefits*, Revenue, https://www.revenue.ie/en/jobs-and-pensions/taxation-of-employer-benefits/cycle-to-work-scheme.aspx (accessed on 26 September 2022). [91]

IrishCycle (2022), *Bolt to launch 100-bike electric bicycle share pilot scheme in Sligo*, https://irishcycle.com/2022/05/17/bolt-to-launch-100-bike-electric-bicycle-share-pilot-scheme-in-sligo/ (accessed on 30 June 2022). [67]

ITF (2022), *How Accessible Is Your City? | ITF*, https://www.itf-oecd.org/urban-access-framework (accessed on 17 June 2022). [41]

ITF (2021), "Developing Innovative Mobility Solutions in the Brussels-Capital Region", *International Transport Forum Policy Papers*, No. 97, OECD Publishing, Paris, https://www.itf-oecd.org/developing-innovative-mobility-brussels-capital-region (accessed on 29 June 2022). [57]

ITF (2021), "Innovations for better rural mobility", *ITF Research Reports*, OECD Publishing, Paris, https://www.itf-oecd.org/innovations-better-rural-mobility (accessed on 24 June 2022). [55]

ITF (2021), *Reversing Car Dependency | ITF*, https://www.itf-oecd.org/reversing-car-dependency. [106]

ITF (2021), "Streets That Fit Re-allocating Space for Better Cities Corporate Partnership Board Report". [53]

ITF (2020), *Road Safety Annual Report 2020*, OECD Publishing, Paris, https://doi.org/10.1787/f3e48023-en. [198]

ITF (2020), "Safe micromobility", *International Transport Forum Policy Papers*, No. 85, OECD Publishing, Paris, https://doi.org/10.1787/0b98fac1-en. [69]

ITF (2019), *Regulating App-Based Mobility Services: Summary and Conclusions*, ITF Roundtable Reports, No. 175, OECD Publishing, Paris, https://doi.org/10.1787/94d27a3a-en. [68]

ITF (2018), "Policy Directions for Establishing a Metropolitan Transport Authority for Korea's Capital Region", *International Transport Forum Policy Papers*, No. 61, OECD Publishing, Paris, https://doi.org/10.1787/8b87cefc-en. [32]

ITF (2018), "Shared Mobility Simulations for Dublin", *International Transport Forum Policy Papers*, No. 58, OECD Publishing, Paris, https://doi.org/10.1787/e7b26d59-en. [8]

ITF (2018), *The Social Impacts of Road Pricing | ITF*, https://www.itf-oecd.org/social-impacts-road-pricing. [110]

ITF (2017), *Income Inequality, Social Inclusion and Mobility Roundtable Report 2017*, https://www.itf-oecd.org/sites/default/files/docs/income-inequality-social-inclusion-mobility.pdf (accessed on 4 June 2019). [96]

ITF (2017), "Transition to Shared Mobility: How large cities can deliver inclusive transport services", *International Transport Forum Policy Papers*, No. 33, OECD Publishing, Paris, https://doi.org/10.1787/b1d47e43-en. [7]

ITF (2016), *Income Inequality, Social Inclusion and Mobility Roundtable | ITF*, https://www.itf-oecd.org/income-inequality-social-inclusion-and-mobility-roundtable-0 (accessed on 4 July 2022). [137]

ITF (2016), "Regulation of For-Hire Passenger Transport: Portugal in International Comparison", *International Transport Forum Policy Papers*, No. 24, OECD Publishing, Paris, https://doi.org/10.1787/bfa908a7-en. [73]

ITF (2015), *Publicly Funded Passenger Transport Services in Finland*, https://read.oecd-ilibrary.org/transport/publicly-funded-passenger-transport-services-in-finland_5jrvzrqmhc7h-en#page1 (accessed on 29 June 2022). [78]

ITF (2010), *Implementing Congestion Charges*, OECD, https://www.oecd-ilibrary.org/transport/implementing-congestion-charges_9789282102855-en. [95]

ITF-OECD (2019), *Benchmarking Accessibility in Cities*, https://www.itf-oecd.org/benchmarking-accessibility-cities (accessed on 3 July 2019). [18]

ITF-OECD (2019), *Improving Transport Planning and Investment Through the Use of Accessibility Indicators Case-Specific Policy Analysis*, http://www.itf-oecd.org (accessed on 28 June 2019). [23]

Kamensky, J. (2021), *Jan Kamensky website*, http://www.jan-kamensky.de/ (accessed on 20 September 2021). [189]

Kodransky, M. and G. Lewenstein (2014), *Connecting Low-Income People to Opportunity with Shared Mobility*, Institute for Transportation & Development Policy, https://www.itdp.in/wp-content/uploads/2016/06/Shared-Mobility_Full-Report.pdf (accessed on 27 June 2022). [77]

KTH, W. et al. (2022), *Design Guide for Smart Streets (report in Swedish). Designguide för smarta gator – Smarta gator & Framtidsgatan*, https://smartagator.wordpress.com/kontakta-oss/. (accessed on 16 June 2022). [99]

Kumar, A. and O. Agarwal (2013), "Institutional labyrinth : designing a way out for improving urban transport services - lessons from current practice", No. 84066, The World Bank, World. [214]

La Rue est à Nous (2021), *La rue est à nous*, https://larueestanous.fr/ (accessed on 1 July 2021). [177]

Lakoff, G. (2014), "Don't Think of an Elephant". [190]

Lakoff, G. and M. Johnson (2008), *Metaphors We Live By*, University of Chicago Press, https://books.google.com/books/about/Metaphors_We_Live_By.html?id=r6nOYYtxzUoC (accessed on 15 July 2022). [150]

Law reform commission (2015), *Public health (standardised packaging of tobacco) act 2015*, https://revisedacts.lawreform.ie/eli/2015/act/4/revised/en/html (accessed on 27 July 2022). [195]

Leape, J. (2006), *The London Congestion Charge*. [100]

Lévay, P., Y. Drossinos and C. Thiel (2017), "The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership", *Energy Policy*, Vol. 105, pp. 524-533, https://doi.org/10.1016/J.ENPOL.2017.02.054. [92]

Litman, T. (2015), *Evaluating Complete Streets The Value of Designing Roads For Diverse Modes, Users and Activities Evaluating Complete Streets: The Value of Designing Roads For Diverse Modes, Users and Activities Evaluating Complete Streets: The Value of Designing Roads For Diverse Modes, Users and Activities*, http://www.vtpi.orgInfo@vtpi.org (accessed on 19 August 2019). [30]

Loures, L. and E. Vaz (2018), "Exploring expert perception towards brownfield redevelopment benefits according to their typology", *Habitat International*, Vol. 72, pp. 66-76, https://doi.org/10.1016/j.habitatint.2016.11.003. [127]

Lyons, G. and C. Davidson (2016), "Guidance for transport planning and policymaking in the face of an uncertain future", *Transportation Research Part A: Policy and Practice*, Vol. 88, pp. 104-116, https://doi.org/10.1016/j.tra.2016.03.012. [20]

Lyons, R. and L. Sirr (2016), *Housing for Older People - Thinking Ahead - Irish Housing Agency*, http://www.housingagency.ie/publications/housing-older-people-thinking-ahead (accessed on 12 July 2022). [147]

Marsden, G. et al. (2019), *Shared mobility – where now, where next? Second report of the Commission on Travel Demand*, Centre for Reseach into Energy Demand Solutions Oxford. ISBN: 978-1-913299-01-9. [19]

Matan, A. and P. Newman (2016), *People Cities : the life and legacy of Jan Gehl*. [151]

Mattioli, G. et al. (2020), "The political economy of car dependence: A systems of provision approach", *Energy Research & Social Science*, Vol. 66, p. 101486, https://doi.org/10.1016/j.erss.2020.101486. [76]

Mayor of London (2022), *What are Opportunity Areas? | London City Hall*, https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/opportunity-areas/what-are-opportunity-areas (accessed on 4 July 2022). [136]

McArthur, J. et al. (2022), *Better Streets for Better Cities: A handbook for active street planning, design and management*, Multimodal Optimisation of Roadspace in Europe (MORE). [29]

McCarthy, L. (2002), "The brownfield dual land-use policy challenge: reducing barriers to private redevelopment while connecting reuse to broader community goals", *Land Use Policy*, Vol. 19/4, pp. 287-296, https://doi.org/10.1016/S0264-8377(02)00023-6. [130]

Mcconnell, V. and K. Wiley (2010), "Infill Development: Perspectives and Evidence from Economics and Planning", http://www.rff.org (accessed on 21 June 2022). [128]

Moran, M. (2021), "Right of Way: Race, Class, and the Silent Epidemic of Pedestrian Deaths in America", *Journal of the American Planning Association*, Vol. 87/2, pp. 302-303, https://doi.org/10.1080/01944363.2021.1885273. [157]

Moreno Monroy, A. et al. (2020), "Housing policies for sustainable and inclusive cities: How national governments can deliver affordable housing and compact urban development", *OECD Regional Development Working Papers*, No. 2020/03, OECD Publishing, Paris, https://doi.org/10.1787/d63e9434-en. [143]

Moser, C., Y. Blumer and S. Hille (2018), *E-bike trials' potential to promote sustained changes in car owners mobility habits*, IOP Publishing, https://iopscience.iop.org/article/10.1088/1748-9326/aaad73. [87]

National Dialogue on Climate Action Ireland (2021), *Climate Conversations Summary Report 2021*. [82]

New Scientist (2022), *It worked with cigarettes. Let's ban ads for climate-wrecking products*, https://www.newscientist.com/article/mg25433851-200-it-worked-with-cigarettes-lets-ban-ads-for-climate-wrecking-products/ (accessed on 1 July 2022). [194]

Norton, P. (2007), "Street Rivals: Jaywalking and the Invention of the Motor Age Street", *Technology and Culture*, Vol. 48/2, pp. 331-359, https://doi.org/10.1353/TECH.2007.0085. [161]

Norwegian EV Association (2022), *Norwegian EV policy - Norsk elbilforening*, https://elbil.no/english/norwegian-ev-policy/ (accessed on 30 June 2022). [112]

NSW (2022), *NSW Movement and Place Framework | Transport for NSW*, NSW Government, https://www.transport.nsw.gov.au/industry/nsw-movement-and-place-framework (accessed on 21 July 2022). [39]

NTA (2018), *National Household Travel Survey 2017: Final Report*, National Transport Authority, https://www.nationaltransport.ie/wp-content/uploads/2020/09/National_Household_Travel_Survey_2017_Report_-_December_2018.pdf (accessed on 15 September 2022). [89]

NTA and Sustrans (2019), *Bike life 2019 - Dublin Metropolitan Area*, http://www.sustrans.org.uk/bikelife (accessed on 28 July 2022). [169]

OECD (2021), *OECD Environmental Performance Reviews: Ireland 2021*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9ef10b4f-en. [44]

OECD (2021), *Transport Strategies for Net-Zero Systems by Design*, OECD Publishing, Paris, https://doi.org/10.1787/0a20f779-en. [4]

OECD (2020), *Housing policies for sustainable and inclusive cities : How national governments can deliver affordable housing and compact urban development | OECD Regional Development Working Papers*, https://www.oecd-ilibrary.org/urban-rural-and-regional-development/housing-policies-for-sustainable-and-inclusive-cities_d63e9434-en (accessed on 12 July 2022). [148]

OECD (2018), *OECD Economic Surveys: Ireland 2020*. [142]

OECD (2015), *Governing the City*, OECD Publishing, Paris, https://doi.org/10.1787/9789264226500-en. [209]

OECD (2013), *Definition of Functional Urban Areas (FUA) for the OECD metropolitan database*, http://measuringurban.oecd.org/ (accessed on 29 March 2021). [212]

OECD (n.d.), *OECD Work on National Urban Policy*, https://www.oecd.org/cfe/national-urban-policies.htm (accessed on 22 September 2022). [217]

Office of Zero Emission Vehicles (2022), *Zero Emission Vehicles Ireland: Information for the general public*, https://www.gov.ie/en/publication/ca752-zero-emission-vehicles-ireland-information-for-general-public/ (accessed on 25 July 2022). [165]

Page, G. and H. Rabinowitz (1994), "Potential for Redevelopment of Contaminated Brownfield Sites", *Economic Development Quarterly*, Vol. 8/4, pp. 353-363, https://doi.org/10.1177/089124249400800406. [132]

Parking Day (n.d.), *Parking Day*, http://www.parkingday.fr/ (accessed on 29 July 2021). [178]

Parliamentary Budget Office Ireland (2022), *An Overview of Ireland's Electric Vehicle Incentives and a Comparison With International Peers*. [83]

Parliamentary Budget Office Ireland (2021), *An Overview of Electric Vehicles and Their Impact on The Tax Base*. [104]

Partman, J. (2022), *Shift into Gear: Bike to Work Day 2022 Nearly Here - News Release - News | Metropolitan Washington Council of Governments*, https://www.mwcog.org/newsroom/2022/05/19/shift-into-gear-bike-to-work-day-2022-nearly-here-/ (accessed on 25 July 2022). [172]

Peppercorn, I. and C. Taffin (2013), "Rental Housing : Lessons from International Experience and Policies for Emerging Markets", *Rental Housing*, https://doi.org/10.1596/978-0-8213-9655-1. [149]

Phillips, C. et al. (2020), *Adjust urban and rural road pricing for fair mobility*, Nature Publishing Group, https://www-nature-com.proxy.ub.umu.se/articles/s41558-020-0793-1. [111]

Possible (2021), *Car Free Stories: The Irresistible Rise of People-Friendly, Clean Air Cities*, http://www.newweather.org (accessed on 22 September 2021). [179]

Possible (2021), *Explore a World of Car Free Cities*, https://wearepossible.github.io/carfreestories/ (accessed on 22 September 2021). [180]

Pradifta, F. et al. (2021), *The Application of Tactical Urbanism in Public Space on COVID-19 Transmission Prevention*, IOP Publishing Ltd, https://doi.org/10.1088/1755-1315/830/1/012087. [48]

Ramirez-Mendiola, J. et al. (2022), *I'm coming home (to charge): The relation between commuting practices and peak energy demand in the United Kingdom*, Elsevier. [116]

Richer, C., S. Hasiak and N. Jouve (2022), "(PDF) The mixed public transport authorities of the SRU law: A tool for the interterritorial governance of mobilities?", https://www.researchgate.net/publication/289751994_The_mixed_public_transport_authorities_of_the_SRU_law_A_tool_for_the_interterritorial_governance_of_mobilities (accessed on 1 July 2022). [213]

Roads Task Force (2013), *The vision and direction for London's streets and roads Roads Task Force Executive summary*. [31]

Roberts, D. (2019), *Barcelona, Spain, urban planning: What the city learned from the first superblocks*, https://www.vox.com/energy-and-environment/2019/4/9/18273894/barcelona-urban-planning-superblocks-poblenou (accessed on 26 September 2022). [47]

Rowe, H. (2013), "Smarter Ways to Change: Learning from Innovative Practice in Road Space Reallocation", http://www.sustainablecitiescollective.com, (accessed on 20 July 2021). [46]

Rueda, S. (2019), *Superblocks as the Base of New Urban Mobility and a New Model of Public Space: Barcelona as a Case Study.*. [3]

Salmon, M. (2021), *Biking and Trail Use Continues to Grow in Northern Virginia*, The Arlington Connetion, http://www.arlingtonconnection.com/news/2021/may/13/biking-and-trail-use-continues-grow-northern-virgi/ (accessed on 25 July 2022). [171]

Saltmarshe, E. (2018), *Using Story to Change Systems*, https://ssir.org/articles/entry/using_story_to_change_systems (accessed on 19 March 2021). [159]

Savillis (2016), *Completing London's Streets How the regeneration and intensification of housing estates could increase London's supply of homes and benefit residents*, https://pdf.euro.savills.co.uk/uk/residential---other/completing-london-s-streets-080116.pdf (accessed on 18 August 2021). [5]

SHARE-North Academy (2021), *A planner's guide to the shared mobility galaxy*, Interreg North Sea Region, https://share-north.eu/wp-content/uploads/2022/05/Shared-Mobility-Guide_ENGLISH.pdf (accessed on 24 June 2022). [63]

Shivaram, D. (2021), *Hundreds of kids and parents are biking to school together in Barcelona : NPR*, NPR, https://www.npr.org/2021/10/22/1047341052/barcelona-bicibus-kids-parents-bike-ride-to-school?t=1655483941694&t=1658411816327&t=1658754349228 (accessed on 25 July 2022). [176]

Simma, A. and K. Axhausen (2001), *Structures of commitment in mode use: a comparison of Switzerland, Germany and Great Britain*, Pergamon. [93]

Smart Dublin (2022), *Rethinking Mobility in Ireland – the case for MaaS - Smart Dublin*, https://smartdublin.ie/rethinking-mobility-in-ireland-the-case-for-maas/ (accessed on 7 July 2022). [56]

Smorto, G. (2020), "Regulating and Deregulating Sharing Mobility in Europe", in Smorto, G. and I. Vinci (eds.), *The Role of Sharing Mobility in Contemporary Cities: Legal, Social and Environmental Issues*, UNIPA Springer Series, https://doi.org/10.1007/978-3-030-57725-4_2. [62]

Society of the Irish Motor Industry (2022), *Reducing light fleet carbon emissions to achieve Irish Government targets.*. [16]

Sprei, F. et al. (2019), *Free-floating car-sharing electrification and mode displacement: Travel time and usage patterns from 12 cities in Europe and the United States*, Pergamon. [121]

Squires, G. and N. Hutchison (2021), "Barriers to affordable housing on brownfield sites", *Land Use Policy*, Vol. 102, p. 105276, https://doi.org/10.1016/j.landusepol.2020.105276. [131]

Staples, S. (2019), *How Germany became the country of cars*, BBC News, https://www.bbc.com/travel/article/20190821-how-germany-became-the-country-of-cars (accessed on 14 September 2022). [155]

Stoll, B. et al. (2022), "CLEAN CITIES Benchmarking European cities on creating the right conditions for zero-emission mobility". [40]

Stromberg, J. (2015), "The forgotten history of how automakers invented the crime of "jaywalking" - Vox", https://www.vox.com/2015/1/15/7551873/jaywalking-history (accessed on 10 March 2021). [158]

Systemiq (2021), *EU Policy Action For An Automotive Circular Economy | SYSTEMIQ*, https://www.systemiq.earth/resource-category/paving-the-way/. [113]

Te Brömmelstroet, M. (2020), *Library of Cycling Documentaries*, https://urbancyclinginstitute.com/library-of-cycling-documentaries/ (accessed on 3 August 2021). [188]

Te Brömmelstroet, M. (2020), *Library of Cycling Marketing*, https://urbancyclinginstitute.com/library-of-cycling-marketing/ (accessed on 3 August 2021). [187]

TfGM (n.d.), *About TfGM | Transport for Greater Manchester*, https://tfgm.com/about-tfgm (accessed on 1 July 2022). [211]

TfL (2022), *Encouraging cycling & walking - Transport for London*, https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/encouraging-cycling-and-walking (accessed on 22 June 2022). [102]

TfL (2022), *Healthy Streets Explained*, London Gov, https://content.tfl.gov.uk/healthy-streets-explained.pdf (accessed on 16 June 2022). [38]

TfL (2020), *Travel in London report 13 - Transport for London*, https://tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports. [21]

TfL (2013), "London's street family: Theory and case studies", https://content.tfl.gov.uk/londons-street-family-chapters-1-2.pdf (accessed on 5 September 2022). [33]

TfL (2012), *Public Transport Accessibility Levels*, https://data.london.gov.uk/dataset/public-transport-accessibility-levels#:~:text=PTALS%20are%20a%20detailed%20and,any%20location%20within%20Greater%20London. (accessed on 26 September 2022). [218]

TfL (n.d.), *Results – Healthy Streets Scorecard*, https://www.healthystreetsscorecard.london/results/ (accessed on 21 July 2022). [37]

TfL (n.d.), *Transport Assessments - Transport for London*, https://tfl.gov.uk/info-for/urban-planning-and-construction/transport-assessment-guide/transport-assessments?intcmp=10094 (accessed on 28 July 2022). [42]

The Citizens' Assembly (n.d.), *Home - The Citizens' Assembly*, https://www.citizensassembly.ie/en/ (accessed on 5 September 2022). [207]

The MIT Press (ed.) (2011), *Fighting Traffic*, https://mitpress.mit.edu/books/fighting-traffic (accessed on 19 March 2021). [153]

The Urban Observer (2013), *Malmö: No Ridiculous Car Journeys*, https://exploring-and-observing-cities.org/2013/05/25/malmo-no-ridiculous-car-journeys/ (accessed on 28 July 2022). [184]

TIER (2021), *The game-changing leap towards sustainable micro-mobility*, https://www.tier.app/en/blog/sustainable-micro-mobility (accessed on 5 July 2022). [72]

Timmons, S. and P. Lunn (2022), "PUBLIC UNDERSTANDING OF CLIMATE CHANGE AND SUPPORT FOR MITIGATION", https://doi.org/10.26504/rs135. [168]

Transport & Environment (2020), *Recharge How Many Charge Points will Europe and its member states need in the 2020s*, https://www.transportenvironment.org/discover/recharge-eu-how-many-charge-points-will-eu-countries-need-2030/. [88]

Transport & Environment (2019), *How vehicle taxes can accelerate electric car sales*. [90]

Transport for London (2015), *Roads Task Force 2015 Progress report: a successful first year*. [34]

Transport Scotland (2022), *A route map to achieve a 20 per cent reduction in car kilometres by 2030 | Transport Scotland*, https://www.transport.gov.scot/publication/a-route-map-to-achieve-a-20-per-cent-reduction-in-car-kilometres-by-2030/. [17]

UK Department for Transport (2019), *Future of Mobility: Urban Strategy*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/846593/future-of-mobility-strategy.pdf (accessed on 30 June 2022). [80]

Vartholomaios, A. et al. (2013), *The green space factor as a tool for regulating the urban microclimate in vegetation-deprived Greek cities.*, https://www.researchgate.net/publication/266402824_The_green_space_factor_as_a_tool_for_regulating_the_urban_microclimate_in_vegetation-deprived_Greek_cities (accessed on 4 July 2022). [139]

Ville de Paris (2021), *Retour en images sur une journée sans voiture*, https://www.paris.fr/pages/journee-sans-voiture-10107 (accessed on 22 September 2021). [173]

Vinnova (2022), *Mission-oriented innovation - a handbook from Vinnova*, https://www.vinnova.se/en/m/missions/. [204]

Vinnova (2022), *Vinnova's mission | Vinnova*, https://www.vinnova.se/en/about-us/vart-uppdrag/. [203]

Waka Kotahi NZ Transport Agency (n.d.), *One Network Framework - All updates | Waka Kotahi NZ Transport Agency*, https://www.nzta.govt.nz/planning-and-investment/planning/one-network-framework/ (accessed on 26 June 2022). [35]

Watts, M. (2018), *How walking & cycling is transforming cities*, C40. [6]

Weitzman, M. and L. Lee (2020), "Similarities between alcohol and tobacco advertising: Exposure and adolescent use of each of these substances", *Journal of Studies on Alcohol and Drugs, Supplement* s19, pp. 97-105, https://doi.org/10.15288/jsads.2020.s19.97. [196]

Wheeler, S. (2004), "Planning for Sustainability Creating livable, equitable, and ecological communities | ALI ALSHAHIBI - Academia.edu", https://www.academia.edu/38632874/Planning_for_Sustainability_Creating_livable_equitable_and_ecological_communities (accessed on 30 June 2022). [36]

Notes

[1] This will require stopping the development of outer malls solely accessed by car, and channelling such demand to towns' main streets and other nearby areas.

[2] Technological optimism refers to the idea that "technological improvements will allow countries to reduce emissions at the pace and scale needed. It sees technology as a way to increase vehicle performance (in terms of speed, fuel consumption, emissions, etc.), rather than improving the way systems are organised, where technological potential is mostly untapped and could lead to enormous emission reductions" (OECD, 2021[4])

[3] Avoid" refers to avoiding unnecessary travel or long distances; “shift” refers to shifting trips from more to lower carbon-intensive modes.

[4] NTA and TII handle transport modelling while assumptions about future population locations are agreed among various national and local stakeholders and experts.

[5] Caulfield, Carroll and Ahern (2020[14]) also discuss some complementary measures such as removing value added tax from bicycles and their equipment.

[6] The document has been regularly updated: this report takes into account the latest (2019) version.

[7] ATU is the Atlantic Technological University in Sligo, Ireland. Formerly named IT Sligo, the university specializes in a range of fields, including business and the sciences, such as engineering.

[8] Introducing tools such as National Urban Policies (NUPs) could play a role, as these aid in providing a national-wide narrative and support governments into achieving global agendas, such as the Paris Agreement (OECD, n.d.[217])

[9] This is a widespread problem in Ireland, not confined to transport projects.

[10] The Public Transport Accessibility Level (PTAL) indicator is a tool used by Transport for London, policymakers, and for communication with stakeholders, to detail and measure accessibility to public transport from a designated point of interest (TfL, 2012[218]). PTAL thus assists in guiding spatial and urban planning with the development of public transport access (OECD, 2021[4]). Not only does it assist with new development, but also with redevelopment strategies to meet environmental, social and economic goals (OECD, 2021[4]).

[11] In 2016, transport emissions in Dublin city were 702 700 tCO2eq (25% of the total of 2 810 800 tCO_2eq) (Cachia, 2016[216]). Assuming that emissions did not change significantly between 2016 and 2018, the 30% reduction calculated by ITF is equivalent to 210 810 tCO_2eq. The yearly carbon footprint of Dublin inhabitants was 5.1 tCO_2eq in 2016 (Cachia, 2016[216]), meaning that the 30% reduction was equivalent to the carbon footprint of 41 335 Dublin inhabitants.

[12] A Sustainable Urban Mobility Plan (SUMP) is a transport strategy with a central goal of “improving accessibility of urban areas and providing high-quality and sustainable mobility and transport to, through and within the urban area”. It was developed in cooperation with stakeholders and planning experts in the European Union, and represents a broad consensus on the main features of a best practice transport plan. It is not a one-size-fits-all approach to urban transport planning and has to be adapted to local circumstances (European Commission, 2013[215]).

[13] Of course, all data reporting should ensure respect for individuals’ data privacy and associated requirements such as GDPR.

[14] The issue of technology is also an issue in this space given private (commercial) operators are typically operating on longer distance, inter-urban routes with coaches, although this is outside the scope of this report.

[15] For more information on housing policies see (Moreno Monroy et al., 2020[143]).

[16] According to good international practice, defining what constitutes affordable housing, the residents’ transport and housing costs both need to be taken into account, and affordability should be based on the income and financial ability of different groups, not on market prices (ITF, 2016[137]).

[17] In some regards similar to the current energy crisis.

[18] The CCCC replaces the Interdepartmental Group on Climate Communications established in 2019.

[19] During the workshop held in April 2022, in the space of a few hours, stakeholders developed creative ideas for communication actions in their localities, revealing underutilised human resource potential.

[20] Irish statistics show a similar pattern: according to the 2019 National Travel Survey, almost 75% of trips by car in Dublin and 60% in other regions were less than eight kilometres in length (CSO, 2020[58]).

[21] Social Missions are inspired by society's most important challenges (climate change is one) and translate them into more concrete goals (e.g. a climate-neutral city by 2030). Missions require many actors to collaborate in defining and implementing them (across sectors of the economy, levels and sectors of government, and civil society). Missions embed public purpose as the direction of innovation, which includes social innovation and shaping markets. The concept was coined by Professor Mariana Mazzucato, Founding Director of the UCL Institute for Innovation and Public Purpose.

[22] Eastern and Midland Regional Assembly; Northern and Western Regional Assembly and Southern Regional Assembly

[23] Among the main functions of these bodies are to: Manage and monitor EU programmes of assistance; prepare and oversee the implementation of Regional Spatial & Economic Strategies; provide advice and statutory observations on the making and review of Local Authority Development Plans.

[24] From now on the term MTA is used indistinctively for authorities that could be set at different scales: e.g. entire functional area or urban core (e.g. city/town plus the continuous built-up area surrounding it).

[25] Functional urban area: integrates a city and its commuting zone. Importantly some rural areas can be part of functional urban areas.

[26] Urban core: (also called an urban centre) "a set of contiguous, high-density (1 500 residents per square kilometre) grid cells with a population of 50 000 in the contiguous cells".

[27] Although part of the network still remains under borough control (ITF, 2018[32])

Annex A. Glossary of terms

Accessibility results from the interaction of mobility and proximity (Silva and Larsson, 2018[1]). The term implies that well-being does not ultimately depend on how often and how far people can travel but on their ability to meet their needs with ease, including by not having to travel long distances, if at all. Accessibility can be measured in a number of ways, including the number of opportunities which can be reached within a given travel time, distance or cost; or the (average) time/cost required to gain access to a fixed number of opportunities from a given location. "Connectivity" is sometimes used instead of what in this report we define as accessibility, while "accessibility" may be used to mean ease of access for those with mobility impairments.

Brownfield development is the redevelopment of previously developed areas.

Car dependency is defined as the overuse of private motorised vehicles due to a combination of "high levels of per capita automobile travel, automobile-oriented land-use patterns, and reduced transport alternatives" (Litman, 2011[2]). In this report, the term is used to refer to dependency on cars and other private motorised vehicles such as motorcycles and sport utility vehicles.

Car-independent systems are those in which the bulk of daily activities can be done without a car or motorcycle. Car and motorcycle use is reserved for trips that can create more value than the costs they impose to society; they are not systematically the most convenient, nor the only, available option in most places. In these systems, distances between people and places are short, and active and shared modes (including public transport) are the fastest and safest ways for most people (including children) to travel.

Car overuse occurs when the harmful consequences of car use are greater than its benefits.

A **causal loop diagram** depicts a system structure, showing the feedback loops within the system being analysed.

A **detached house** is a separate residential construction that shares none of its exterior walls with another house or other structure.

A **feedback loop** is a non-linear cause-effect relationship. In a linear causal relationship, one variable affects a second, and the cause-effect chain stops there. In non-linear cause-effect relationships, one variable affects a second, which in turn affects the first one again, to produce a circular rather than a linear cause-effect chain. Feedback loops can be **reinforcing** or **balancing**. A **reinforcing feedback loop** is one in which a first variable alters the second, which then affects the first variable in the same direction (e.g. more eggs, more chickens, more eggs). Reinforcing feedback loops accelerate over time, and systems dominated by reinforcing feedback loops lead to exponential growth (positive or negative). A **balancing feedback loop** is a feedback loop in a system's structure in which variables affect each other in opposite directions (e.g. more predators, fewer prey).

The **iceberg model** is an analogy used to illustrate that much of what happens in our world is hidden from view. Events and patterns of behaviour are the part of the iceberg above the surface (the tip), while the structures and mindsets that cause them are the part below.

Induced demand refers to the phenomenon in which investment in road expansion to reduce congestion ends up producing the opposite effect. This happens because the more roads there are, the more attractive the car becomes and the more people choose to drive, thus creating more congestion.

Infill development refers to construction on any under- or undeveloped land within an urbanised area, including redevelopment of previously developed areas (brownfield development).

Leverage points are places to intervene in a system's structure (Meadows, 1999[3]), based on the idea that "different types of solutions have different amounts of leverage to change the system" (Hinton, 2021[4]). Low leverage points are those where an action generates little change in the system's behaviour and results. High leverage points are those where an action triggers important changes in the system's behaviour and results. The closer to the root causes of a problem, the higher the leverage.

Mental models are the unquestioned, often implicit and unconscious assumptions through which humans understand the world. They determine what people see and fail to see, influencing the goals they set, the actions they take, and the type of systems they create. The terms mental models, mindsets and paradigms are used interchangeably throughout the report.

Mobility is used in this report to designate physical movement, which can be measured in terms of vehicle-kilometres, passenger-kilometres, tonne-kilometres or number of trips.

Multi-modal planning is planning that takes account of various modes (walking, cycling, driving, public transit, etc.) and connections among them (Litman, 2020[5]).

On-demand shared services are vehicles available for shared use and shared vehicles. Shared-use vehicles include bicycles and micro-mobility (e.g. e-bikes, cargo e-bikes and e-scooters) (OECD, 2021[6]). Shared vehicles include high-occupancy vehicles as well as ride- and vehicle-sharing (OECD, 2021[6]; ITF, 2017[7]).

Road space management strategies are alternatives to the construction of new road infrastructure. They aim at the enhanced and more efficient utilisation of existing roadways while reducing or eliminating the costs associated with building new roads (Sharma, 2017[8]).

Road space reallocation refers to the rebalancing of road and street space from cars to different transport modes and functions beyond transport, such as recreation, bus lanes and markets.

Single-use development refers to a type of urban development in which each area focuses on a specific land use: suburbs tend to be residential neighbourhoods, places of interest are often concentrated in city centres or in specific areas (e.g. shopping malls), and offices are clustered in commercial districts.

Stocks and flows are the elements of a system. Stocks (e.g. vehicle fleet, car-purposed road capacity, public transport capacity) change over time due to inflows and outflows. They are the "system memory".

Sustainable accessibility refers to the delivery of accessibility for the bulk of trips via sustainable modes – active modes and micro-mobility (including via shared services), public transport and other high-capacity services.

Sustainable transport modes include active modes of transportation and micro-mobility, including shared services, public transport and other high-capacity services. As well as having minimal carbon emissions, sustainable forms of transportation take up less space than conventional ones.

A **system** is a set of elements whose interconnections determine its structure and behaviour. Elements include people, factories, bikes, etc. Interconnections organise the elements and include rules, incentives, sanctions and information.

Systems dynamics is an approach to understanding the cause-effect relationships that lead systems to behave as they do, and thus produce the results that we observe (e.g. unsustainable levels of emissions, traffic volume increase) (Sterman, 2002[9]).

Systems thinking (also referred to as taking a **systemic approach** or **thinking in systems**) is a way of thinking that allows to see systems and focus the analyst's attention on the interrelation between parts - rather than just the properties of the parts.

Tactical urbanism introduces rapid, "soft", low-cost infrastructure changes to show what a potentially permanent change would look like.

Transformational change refers to change in the way an entire system is organised and functions (Systems Innovation, 2020[10]). The IPCC defines it as "a system-wide change that requires more than technological change through consideration of social and economic factors that, with technology, can bring about rapid change at scale" (IPCC, 2018[11]).

Transformative policies aim to shift away from unsustainable systems dynamics and mental models towards systems that encourage patterns of behaviour in line with the envisioned results.

Transit-oriented development "is commonly defined as a type of mixed-use urban development within close proximity (walking distance) to mass transit facilities. Transit-oriented development principles are based on organising new development and redevelopment along mass transit corridors that serve as main transport axes, building high-density development along these corridors and fostering mixed land use and jobs" ((OECD, 2019[12]), based on ITF's Transport Outlook 2017 (2017[13])).

Urban sprawl occurs when populations of cities or towns move away from inner-city areas, often resulting in the construction of large, detached houses and car dependency, in turn leading to high-emission residential and transport systems. The term can be defined in multiple ways. The OECD (2018[14]) defines it as follows "an urban development pattern characterised by low population density that can be manifested in multiple ways". The report argues that "an urban area may be sprawled because the population density is, on average, low", "urban areas characterised by high average density can be considered sprawled if density varies widely across their footprint, leaving a substantial portion of urban land exposed to very low density levels" and that "[u]rban sprawl can also be manifested in development that is discontinuous, strongly scattered and decentralised, where a large number of unconnected fragments are separated by large parts of non-artificial surfaces".

Well-being is a concept that incorporates health, education, security, environmental quality, and political and social rights (OECD, 2019[12]). It goes beyond economic welfare and comprises both current well-being outcomes and the resources that help sustain these over time (OECD, 2019[12]). Well-being outcomes are captured in frameworks such as the Sustainable Development Goals and the OECD Well-Being Framework (OECD, 2011[15]).

References

Hinton, J. (2021), *Relationship-to-Profit: A Theory of Business, Markets, and Profit for Social Ecological Economics*, https://www.researchgate.net/publication/348742711_Relationship-to-Profit_A_Theory_of_Business_Markets_and_Profit_for_Social_Ecological_Economics (accessed on 5 July 2021). [4]

IPCC (2018), ": Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty". [11]

ITF (2017), *ITF Transport Outlook 2017*, OECD Publishing, Paris, https://doi.org/10.1787/9789282108000-en. [13]

ITF (2017), "Transition to shared mobility: How large cities can deliver inclusive transport services", *International Transport Forum Policy Papers*, No. 33, OECD Publishing, Paris, https://doi.org/10.1787/b1d47e43-en. [7]

Litman, T. (2020), *Introduction to multi-modal planning*, Victoria Transport Policy Institute, https://www.vtpi.org/multimodal_planning.pdf (accessed on 29 March 2021). [5]

Litman, T. (2011), *Mobility As A Positional Good Implications for Transport Policy and Planning*, Victoria Transport Policy Institute, https://www.taylorfrancis.com/chapters/edit/10.4324/9781315570846-21/mobility-positional-good-implications-transport-policy-planning-todd-litman. [2]

Meadows, D. (1999), *Leverage Points Places to Intervene in a System*, The Sustainability Institute, https://donellameadows.org/wp-content/userfiles/Leverage_Points.pdf (accessed on 16 June 2021). [3]

OECD (2021), *Transport Strategies for Net-Zero Systems by Design*, OECD Publishing, Paris, https://doi.org/10.1787/0a20f779-en. [6]

OECD (2019), *Affordable Housing Database - OECD*, OECD, https://www.oecd.org/social/affordable-housing-database.htm (accessed on 2 July 2019). [12]

OECD (2018), *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*, OECD Publishing, Paris, https://doi.org/10.1787/9789264189881-en. [14]

OECD (2011), *Better Policies to Support Eco-innovation*, OECD Studies on Environmental Innovation, OECD Publishing, Paris, https://doi.org/10.1787/9789264096684-en. [15]

Sharma, S. (2017), "Optimal Corridor Selection for a Road Space Management Strategy: Methodology and Tool", *Journal of Advanced Transportation*, Vol. 2017, pp. 1-12, https://doi.org/10.1155/2017/6354690. [8]

Silva, C. and A. Larsson (2018), "Challenges for accessibility planning and research in the context of sustainable mobility"*, International Transport Forum Discussion Papers*, No. No. 2018/07, OECD Publishing, Paris, https://doi.org/10.1787/2223439X (accessed on 10 June 2022). [1]

Sterman, J. (2002), "All models are wrong: reflections on becoming a systems scientist †", *Dyn. Rev*, Vol. 18, pp. 501-531, https://doi.org/10.1002/sdr.261. [9]

Systems Innovation (2020), *Introduction to Systems Innovation*, https://www.systemsinnovation.io/post/systems-innovation-guide (accessed on 29 March 2021). [10]

Annex B. Database of Irish actions classified by their transformative potential

The database of Irish actions categorised by their transformative potential is available here.

Annex C. List of stakeholders consulted in interviews and workshops

Table A C.1. Stakeholders and the organisation/institution they represent

Last Name	First Name	Organisation
Bambrick	Emer	Bus Éireann
Behan	Laura	Department of Transport/DHLGH
Bell	Benjamin	TIER Mobility
Bell	Michael	Nature Learn Sligo
Boyle	Evan	University College Cork
Brady	Derek	TII
Brogan	Ethna	Department of Transport
Brosnan	Paul	Department of Health
Browne	David	RKD Architects
Burke	Laura	EPA
Cahill	Noel	NESC
Cahill	Rachel	Transport Infrastructure Ireland (TII)
Callaghan	Niamh	Department of Public Expenditure and Reform
Campbell	Tomás	Department of Transport
Canny	Sinéad	Systra
Caulfield	Dr. Brian	Trinity College Dublin
Colleary	Barry	NTA
Conlon	David	NTA
Conway	Daniel	Sligo County Council
Cox	Des	Department of Transport
Creegan	Hugh	NTA
Crowe	David	OECD ECO
Cudden	Jamie	Dublin City Council
Curran	Róisín	Sligo County Council
Cussen	Niall	Office of the Planning Regulator
Daly	Hannah	University College Cork
Dekker	Sabrina	Dublin City Council
Devaney	Laura	Department of the Taoiseach
Donnelly	Caoimhe	CIE
Doocey	Garret	Department of Transport
Duvall	Phoebe	An Taisce – The National Trust for Ireland (NGO)
Farrell	Kate	CIÉ
Finn	Claire	Department of Transport
Furlong	Ronan	Dublin City University Innovation Campus
Garvey	Niamh	NESC
Gaston	Tim	NTA
Graham	Anne	NTA
Grisewood	Naoise	Department of Transport
Hodgins	Donal	Head of Sustainable Transport & Traffic Management
Hogan	Paul	DHLGH

Hussey	George	CCAC
Kelly	Edel	Dublin City Council
Kelly	Gina	EPA
Kenny	Karen	DHLGH
Kerry	Alan	Local Link
Leahy	Rory	Bus Éireann
Leddin	Brian	Chair of the Joint Oireachtas Committee on Climate Action; Green Party Limerick
Maher	Stephanie	Bus Éireann
Mansergh	Fiona	Department of Health
McGauran	Anne-Marie	NESC
Moore	Kyle	Department of Transport
Moran	Andrew	Department of the Taoiseach
Murphy	Alan	Smart Dublin
Murtagh	Pete	Sligo County Council
O'Ciaruain	Caoimhin	Department of Transport
Ó'Gallachóir	Prof. Brian	MaREI in University College Cork
O'Brien	Brendan	Dublin City Council
O'Connor	Kevin	Cork City
O'Grady	Aoife	Department of Transport – Climate Delivery Division
O'Hehir	Colin	Department of Health
O'Múirí	Cal	Department of Transport
O'Reilly	Carol	Department of Transport
O'Riordan	Vera	University College Cork
O'Rourke	Paula	Kildare County Council
O'Sullivan	Peter	NTA
Papailiou	Stylianos	NTA
Pickett	Alison	SYSTRA Ltd
Reidy	Fearghal	Cork City
Riondato	Emily	CIÉ
Rock	Noel	Pixel Strategic Consulting
Rogan	Fionn	University College Cork
Ryan	Áine	Office of the Planning Regulator
Schlebusch	Sebastian	DOTT
Spain	Tara	TII
Swift	Joan	Cycling Sligo
Taylor	Jason	DHLGH
Timmins	Caroline	DHLGH
Wetherald	Sarah	Sligo Public Participation Network
Whitney	Warren	NTA
Zhang	Wen	NTA

Annex D. Detailed causal loop diagram of the Irish transport system

Figure A D.1 presents a tailored causal loop diagram (CLD) of the Irish transport system. It is a more detailed version of the CLDs introduced in Chapter 3. Each loop label (B1, R1, etc.) denotes a feedback loop. A feedback loop is either positive and reinforcing or negative and balancing. This is represented in the loop labels with an “R” or a “B” respectively.

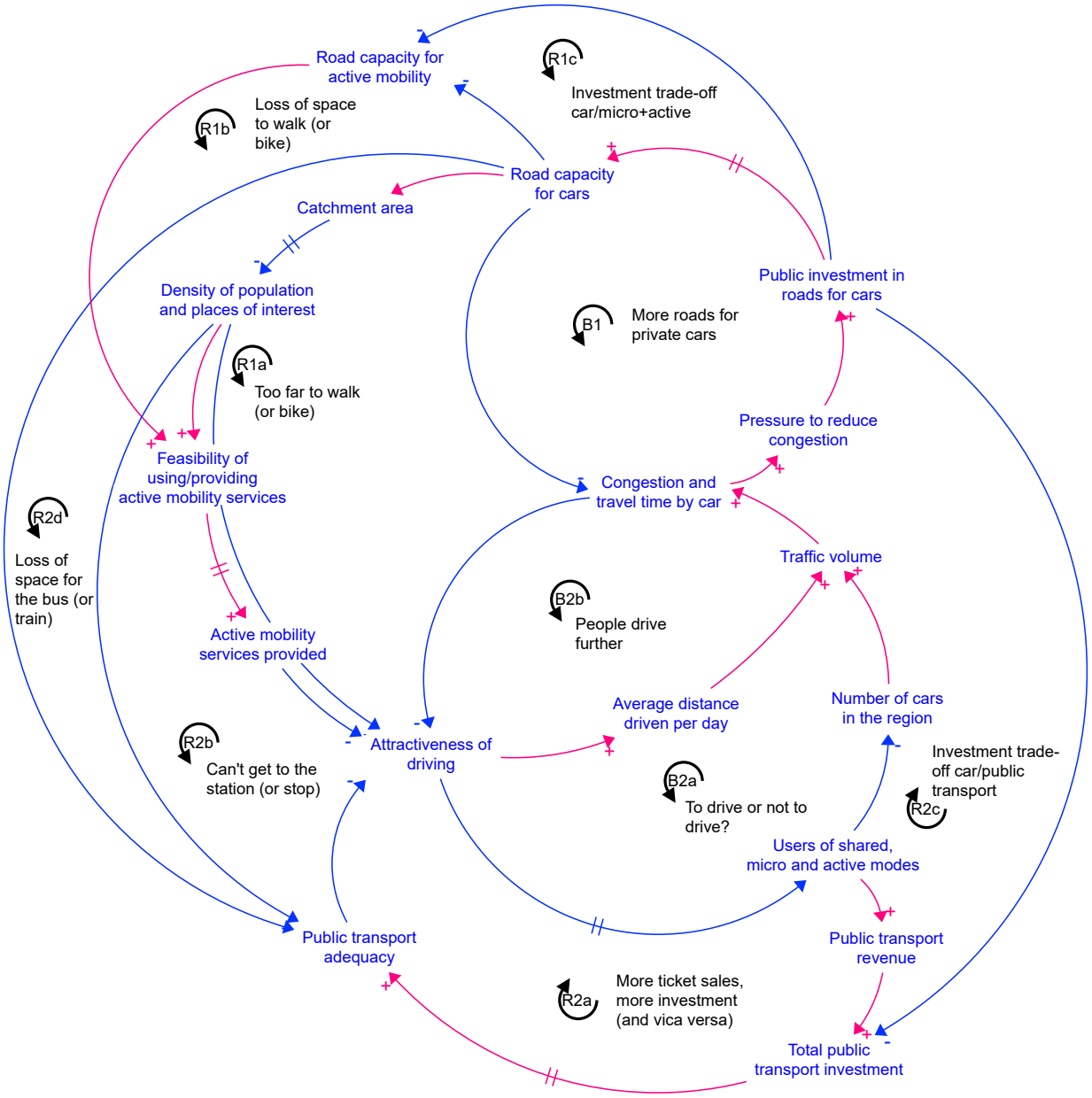
The coloured arrows show the relationship between variables. A red arrow between variables signifies that they vary in the same direction: an increase in one variable will lead to an increase in the other variable it “points” at, while a decrease in one will lead to a decrease in the other. When a blue arrow links two variables, they will vary in opposite directions: an increase in one leads to a decrease in the other.

For example, if the number of cars increases, then traffic volume will do so too, as shown by the red arrow between them. Conversely, if travel time by car increases, then attractiveness of driving relative to other modes will decrease, so they are connected by a blue arrow.

When two lines intersect an arrow, this represents a delay: a change in a variable will not affect the one it points at immediately, but after a period of time. For example, if there is an increase in investment in roads for cars, the full effect on car-purposed road capacity will only emerge after a delay, as it takes time to build roads.

By starting with a change in one variable and tracing the changes around a loop – variable by variable and link by link – back to the initial variable, the polarity of that loop (whether it is positive or negative) becomes clear. If the variable moves in the same direction as it initially did, it is a positive, reinforcing loop, while if it moves in the opposite direction, it is a negative, balancing loop. “B1: More roads to reduce congestion”, for example, is a balancing loop; “R1a: Single-use development proliferation” is a reinforcing loop.

Figure A D.1. Detailed causal loop diagram of the Irish transport system



Redesigning Ireland's Transport for Net Zero

TOWARDS SYSTEMS THAT WORK FOR PEOPLE AND THE PLANET

Current mobility patterns in Ireland are incompatible with the country's target to halve emissions in the transport sector by 2030. While important, electrification and fuel efficiency improvements in vehicles are insufficient to meet Ireland's ambitious target: large behavioural change in the direction of sustainable modes and travel reductions are needed. Such changes will only be possible if policies can shift Irish transport systems away from car dependency.

Building on the OECD process "Systems Innovation for Net Zero" and extensive consultation with Irish stakeholders, this report assesses the potential of implemented and planned Irish policies to transform car-dependent systems. It identifies transformative policies that can help Ireland transition to sustainable transport systems that work for people and the planet. It also provides recommendations to scale up such transformative policies and refocus the electrification strategy so that it fosters, rather than hinders, transformational change.

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