An Roinn Iompair
Department of Transport

Project Ireland 2040

National Investment Framework for Transport in Ireland

Background Paper 11: Interurban Connectivity

Prepared by the
Department of Transport
gov.ie/transport

Disclaimer

This Background Paper has been prepared as part of the supporting analysis for the National Investment Framework for Transport in Ireland. It reflects the latest data and information available to the author at the time of writing. The views presented in this paper do not represent the official views of the Department of Transport or the Minister for Transport.

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Summary

- Fast and safe interurban transport delivers benefits in terms of accessibility between urban areas to users in Ireland, the efficient movement of freight, and wider economic, social and regional benefits.
- For NIFTI, the key priorities for urban transport are to deliver a network which can support the increased travel demand arising from population growth, provide a high level of service, ensure accessibility to employment opportunities, and encourages modal shift towards sustainable modes.
- The National Development Plan is expected to deliver significantly improved interurban connectivity on some routes. However, pressures are expected to develop over the lifetime of Project Ireland 2040. These include:
    - Congestion on radial road routes into our cities, particularly Dublin and Cork;
    - Interurban connectivity in the South, particularly in the South East and Waterford's connections to both Limerick and Cork;
    - Transport capacity in the North-West and North-East; and,
    - Delivering a rail network suited to Ireland's needs.
- Coordination between relevant bodies and improvements to planning and development processes will need to be made in order to avoid interurban transport investment leading to urban sprawl.
- Technologies such as electric vehicles are set to play a major role in Ireland meeting its decarbonisation commitments. Enabling these technologies will require investment in supporting infrastructure.

1. Introduction

On 16 February 2018 Government launched Project Ireland 2040 with the publication of the National Planning Framework (NPF) and National Development Plan (NDP). The aim of this policy initiative is to guide planning and infrastructure investment over coming decades in order to cater for a projected population increase of one million people in a balanced and sustainable manner. To support this vision, the NDP sets out a €116bn public capital investment programme to cover the first decade of the NPF to 2027. Major transport projects to be delivered include BusConnects in all five cities, MetroLink and the M20 Cork to Limerick.

The National Investment Frame 2040 (NIFTI) is the Department of Transport's contribution to Project Ireland 2040. NIFTI's objective is to develop a framework to inform and guide future investment in land transport, which delivers a transport network that meets the travel needs of the population in the coming decades and supports the realisation of the National Strategic Outcomes. As part of the development of this framework, five areas relating to the future transport network are being analysed. These are:

1. Compact growth;
2. Interurban connectivity;
3. Rural and regional accessibility;
4. Supporting international connectivity; and,
5. Alternative demand scenarios.

This paper considers the second of these themes, interurban connectivity. Transport will play a key enabling role in the achievement of this strategic outcome, aiming to ensure accessibility between urban centres of scale and

their regions, in parallel with compact growth within the urban centres. This has a crucial role to play in maximising the growth potential of our regions and the economy as a whole.

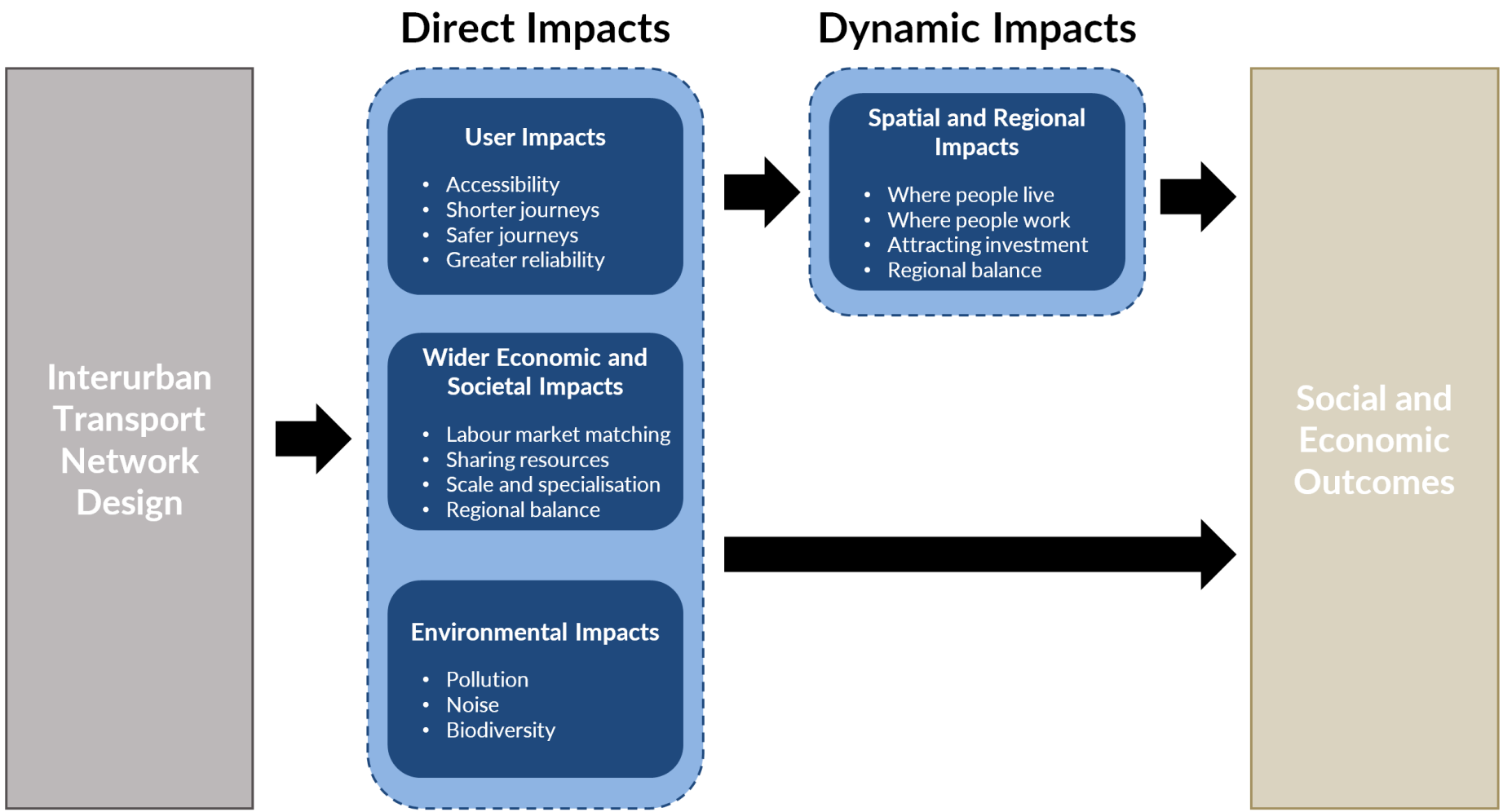
Section 2 discusses why interurban connectivity is important, drawing on the social and economic benefits that result from high-quality links between centres of population. Section 3 draws that contextual analysis together to develop a set of relevant outcomes and indicators relating to interurban transport, each linked back to the overarching priorities for NIFTI. Section 4 discusses the current status of the network in terms of achieving these priorities. Section 5 describes the developments in demand and infrastructure which could arise out of the National Planning Framework and National Development Plan. Section 6 discusses potential service levels in two 2040 scenarios. Section 7 discusses key issues arising from the analysis, centred on the NIFTI priorities. Section 8 sets out the high-level conclusions of the analysis.

2. Why Interurban Connectivity Matters

Enabling people and goods to efficiently travel between urban areas can deliver a range of economic and social benefits. Specifically, a well-designed national transport network can achieve the following societal benefits:

- **User benefits**: A high-quality interurban network can ensure that travellers are able to get from point-to-point quicker, meaning they have more time to engage in productive (either business or leisure) activity. Higher quality infrastructure can also significantly increase safety levels.
- **Wider economic and social benefits**: A 2016 Frontier Economics report, prepared for the UK National Infrastructure Commission, notes that "transport can stimulate the economy by bringing people, firms and places effectively closer together and generate 'agglomeration benefits'" (Frontier, 2016). It goes on to explain that these are created through first-order effects, increasing the productivity of existing workers and firms by enabling scale and specialisation, better matching among workers and firms, and learning and knowledge spill-overs. Agglomeration benefits are also created through second-order effects, allowing workers and investment to be attracted into areas in response to reduced travel times and associated wage rises and returns to investment. A well-functioning interurban transport network is also necessary for the efficient transportation of goods around Ireland and to ports and airports.
- **Environmental benefits**: Transport infrastructure and services can have both positive and negative environmental impacts. A well-designed network can reduce pollution and noise levels in populated areas, encourage decarbonisation, and protect biodiversity.
- **Spatial and regional benefits**: A second-order impact that can occur as a result of the specific layout and quality of the transport network is on where people choose to live and work. Better access to and between urban areas can, over time, strengthen those areas and surrounding regions by making them more attractive to live, work and do business in. Conversely, transport planning which is poorly integrated with wider spatial and economic objectives can have adverse impacts. The NPF sets out the need to achieve "'regional parity'…whereby the targeted growth of the Northern and Western and Southern Regional Assembly areas would exceed that projected under a 'business as usual' scenario and would at least equate to that projected for the Eastern and Midland Region". The NPF also discusses the need to achieve "compact development that focuses on reusing previously developed, 'brownfield' land" in order to limit urban sprawl (this is discussed in more detail in NIFTI Background Paper 10). Ensuring that our transport network enables these objectives is a key priority of NIFTI.

Figure 2.1: Impacts of Interurban network design



3. Supporting the National Strategic Outcomes

The Project Ireland 2040 National Strategic Outcomes are a single vision and shared set of goals for every community in Ireland. In some cases transport's role in realising these outcomes is explicit, such as delivering sustainable mobility, while in others transport has a facilitating role, such as access to high-quality childcare, education and health services. In support of Project Ireland 2040, transport investment can deliver positive outcomes in the following areas:

1. **Delivering clean, low-carbon and environmentally sustainable mobility**

   A sustainable transport system is one which can meet the needs of the population today without compromising its ability to meet the needs of the population tomorrow. In terms of environmental sustainability, the reduction in greenhouse gas emissions is a foremost priority. This is reflected in National Strategic Outcome 8, which is the transition to a low-carbon and climate resilient society. It is also a national objective to achieve a low-carbon, economically competitive and environmentally sustainable economy by 2050. As the second largest source of greenhouse gas emissions in Ireland, the transport sector has a key role to play in achieving these objectives.

2. **Supporting successful places and vibrant communities**

   The National Planning Framework estimates that the population of Ireland will grow by one million over the next twenty years to almost six million people. Where this population lives and works will be a key factor in how Ireland develops, socially and economically, and the National Planning Framework has set the objective of accommodating one quarter of the growth in Dublin, one quarter in the other four cities, and the remaining half in towns and rural areas. The provision of appropriate transport infrastructure will play a crucial enabling role in the delivery of this objective and supporting quality of life for all Ireland's inhabitants.

3. **Facilitating safe, accessible, reliable and efficient travel on the network**

   Delivering a high level of service means the provision of a transport network that is safe, reliable, efficient and accessible. The growth in population forecast between now and 2040 will result in a significant increase in trips, for both people and goods. Investment in the land transport network must enable this growth without compromising on service levels. Moreover, investment must be financially sustainable, and among other things this means ensuring that the transport network is appropriate to the population's needs rather than delivering high levels of excess capacity.

4. **Promoting a strong and balanced economy**

   Ireland is a small open economy, dependent on high-quality international connectivity. The land transport network plays a key role in our economy by providing access to both national and international markets, the latter through our airports, ports and links with Northern Ireland. Within our towns and cities, the transport network can ensure equitable access to jobs and opportunities for our population.

These headings provide a framework for discussing how transport investment can help to realise Project Ireland 2040 on the interurban network.

Figure 3.1: Project Ireland 2040 National Strategic Outcomes

3.1 Delivering clean, low-carbon and environmentally sustainable mobility

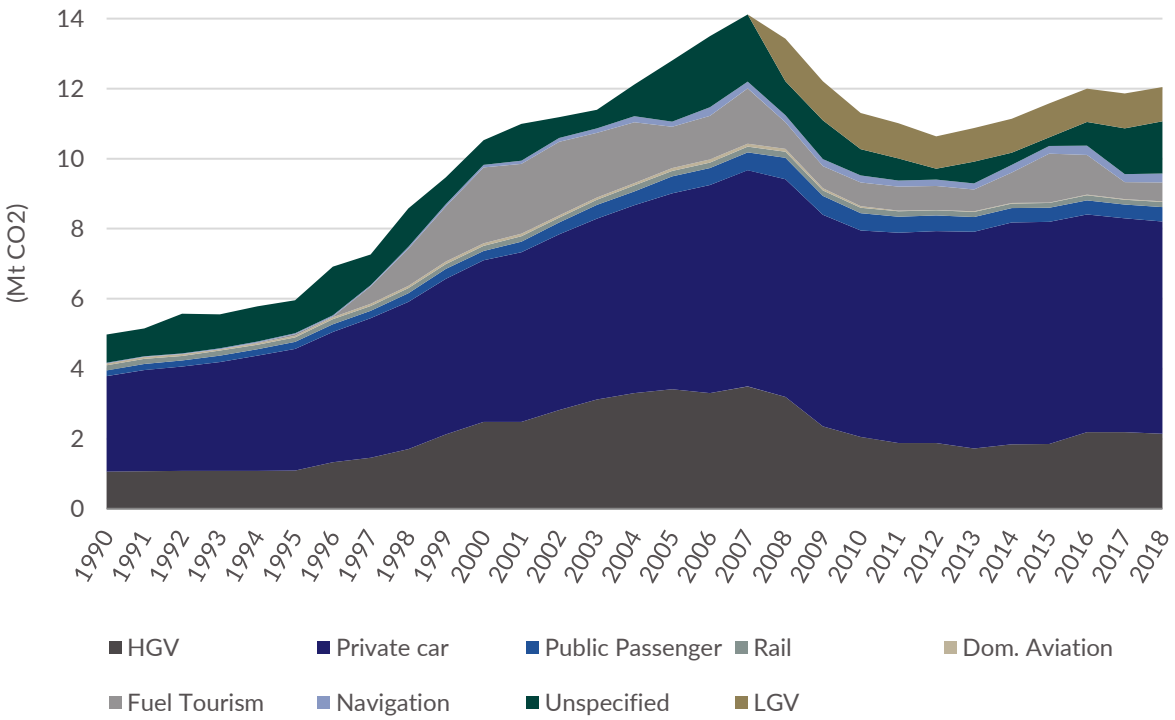
The eighth Project Ireland 2040 National Strategic Objective (NSO8) is to 'Transition to a Low Carbon and Climate Resilient Society'. The Climate Action Plan builds on the objectives of the Project Ireland 2040 and sets a reduction target for the transport sector of 7 to 8 million tonnes of CO_2 over the period 2021 to 2030. NIFTI Background Paper 3 discusses greenhouse gas reductions in the transport sector in detail.

Figure 3.2 shows annual emissions from the transport sector, broken down by mode. In 2016, private cars and goods vehicles made up nearly 80% of total emissions in the sector. Substantially decarbonising these modes, therefore, will be necessary to meeting Ireland's emissions targets.

While the potential for mitigation in urban areas is greater due to the higher availability of public transport and active travel opportunities, interurban and rural travel make up a large proportion of Irish journeys, and thus will play a significant their role in decarbonising Irelands transport sector.

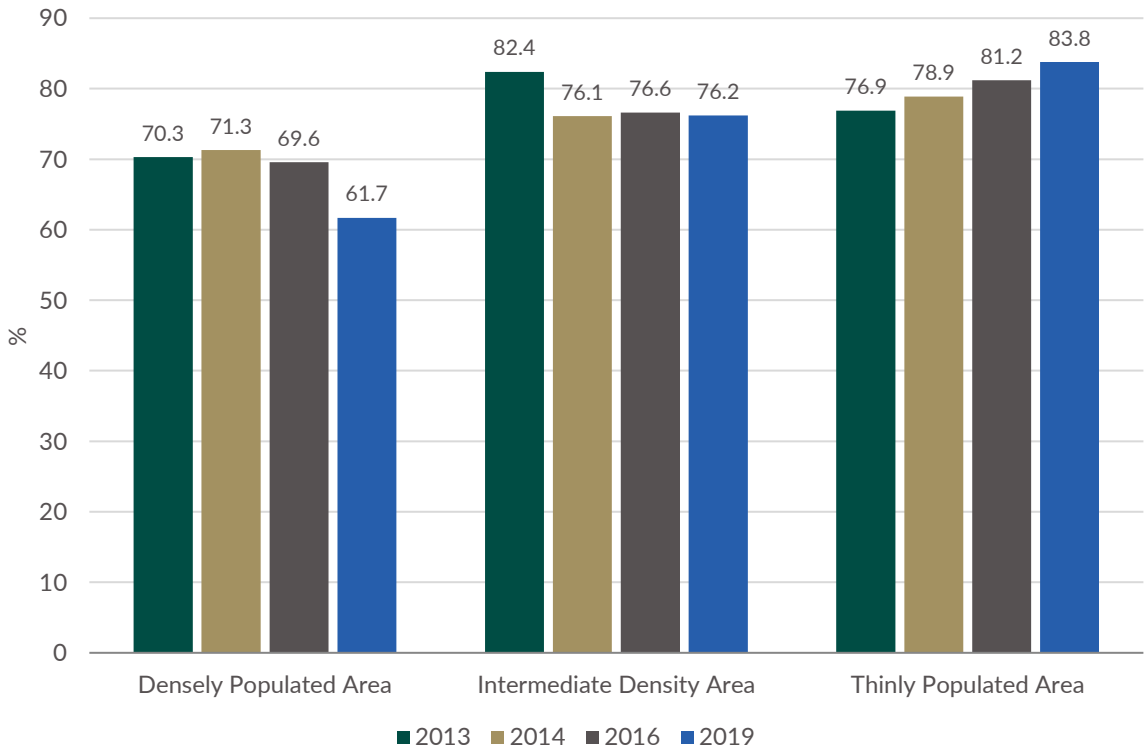
Figure 3.3 shows the overall percentage of journeys made by private car in 2013, 2014, 2016 and 2019, broken down by degree of urbanisation. A much higher proportion of journeys are made by car in non-densely populated areas, with a difference of over 20 percentage points between the most and least densely populated areas according to the most recent figures. For NIFTI and to enable Project Ireland 2040, the challenge is to support interurban travel is while contributing to Ireland's decarbonisation.

Figure 3.2: Transport CO_2 emissions by mode, 1990 to 2018



Source: SEAI

Figure 3.3: Percentage of journeys made by private car, by degree of urbanisation



Source: CSO

3.2 Supporting successful places and vibrant communities

The second Project Ireland 2040 National Strategic Objective (NSO2) is 'Enhanced Regional Accessibility'. As part of this, the NPF sets out that "accessibility from the north-west of Ireland and between centres of scale separate from Dublin will be significantly improved, focused on cities and larger regionally distributed centres and on key east-west and north-south routes". The goal is that "future population and jobs growth would be geographically more aligned", "future jobs growth would be geographically more distributed" and "the significant growth potential of Cork, Limerick, Galway and Waterford…would be realised".

Achieving NSO2 will require investment in infrastructure and services to reduce travel times between those identified regions and cities of scale other than Dublin. Section 4 will look in more detail at the current status of interurban accessibility between these areas, including the NDP's investment priorities to improve interurban transport.

In addition to the direct relationship between interurban connectivity and regional accessibility, the interurban network can have a second-order effect on the first National Strategic Objective, which is to achieve Compact Growth within our urban areas. Without careful planning, improved interurban connectivity can incentivise urban sprawl by reducing travel times into cities from outside the urban areas. Therefore, the challenge is to achieve enhanced regional accessibility without materially reducing our ability to develop compact urban areas.

3.3 Facilitating safe, accessible, reliable and efficient travel on the network

As set out in Section 2, a key set of outcomes delivered by investment in interurban transport are those outcomes realised directly by the users of the network and its services. These include journey times, journey time reliability and safety. In broad terms, levels of service can be broken down into:

- **Capability**: the level of service the network provides in ideal conditions. The key indicators here are journey times and safety levels.
- **Capacity:** how number of travellers using the network before those levels of service begin to deteriorate. As volumes on the network increase, both journey times and journey time reliability will get worse.

We discuss both of these in more detail below.

3.3.1 Capability

Journey Times

Time spent in transit is time which could have been spent doing other things, so there is an 'opportunity cost' associated with travelling. As such, the Common Appraisal Framework for Transport Projects and Programmes (DTTaS, 2015), notes that "time savings generally account for a significant share of the benefits of transport schemes".

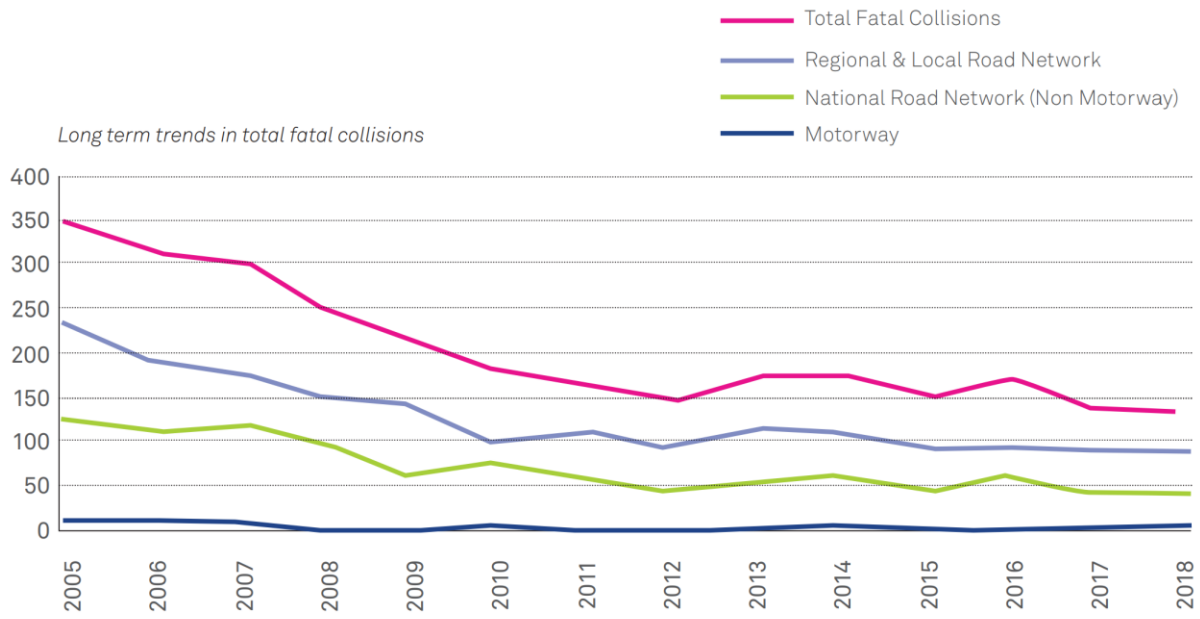
Safety

The other key area of focus on Ireland's interurban network capability is safety. The Road Safety Authority's (RSA) Road Safety Strategy 2013-2020 (RSA, 2011) sets a target of reducing annual deaths on Irish roads to 124 or fewer by 2020, as well as a provisional target for serious injuries of 330 by 2020, or 61 per million population.

Figure 3.4 is from TII's 2018 National Roads Indicators report (TII, 2019), and shows annual fatal collisions broken down by road type. It shows that total fatal collisions decreased by more than half between 2005 and 2018, with the decrease driven by improved safety levels on both non-motorway national roads, and regional and local roads. Fatal collision levels on motorways have remained very low even as traffic volumes have increased.

TII uses NRA Standard HD 15 to identify sections of the national road network which have a high concentration of collisions and to rank the safety of the road network. The ranking is based on the collision rate (number of collisions per 100 million vehicle kilometres travelled) on road sections of approximately 1km compared against the national average collision rate for a similar road type. This ranking system is taken account of when identifying and prioritising investment needs.

Figure 3.4: Fatal collisions broken down by road type, 2005 to 2018



Safety on the Irish rail network is regulated by the Commission for Railway Regulation. It does this through[1]:

- Conformity assessment (i.e., assessing Safety Management Systems (SMS));
- Compliance supervision and enforcement; and,
- European and legislative harmonisation.

Aside from the need to be well managed and regulated, railway safety is also dependent on the quality and type of infrastructure. Assets in sub-optimal condition reduce safety levels on the network, everything else remaining constant. Indeed, given the primacy of safety and minimising deaths and injuries, deterioration in asset condition has led to reduced line speeds in a number of parts of the rail network.

The 2016 Rail Review discussed the need for "adequate and timely funding provision…for the upgrading and replacement of safety critical control (NTCC, train protection ATP / CAWS) and communications (GSM-R) systems" (NTA and IÉ, 2016). The NDP builds on the recommendations in the Rail Review by prioritising funding

[1] For more information on CRR, see https://www.crr.ie/about/

for "maintenance and safety projects needed to maintain safety and service levels in railway operations" Government of Ireland, 2018a).

3.3.2 Capacity

Congestion

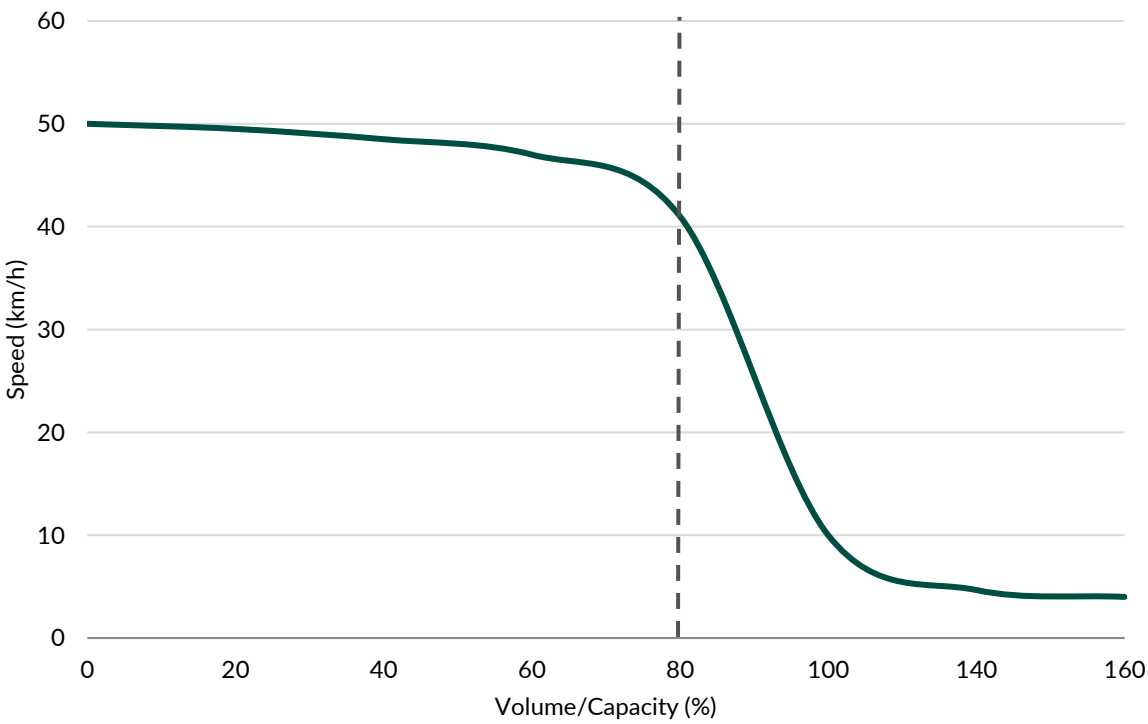
Drawing on previous research in the area, two different forms of congestion are defined in the 2017 report 'The Costs of Congestion – An Analysis of the Greater Dublin Area' (DTTaS, 2017). These definitions are summarised in Table 3.1.

Table 3.1: Forms of Congestion

Type	Description
Recurrent	Generally the consequence of factors that act regularly or periodically on the transportation system, such as daily commuting or weekend trips. However, even recurrent congestion can display a large degree of randomness, especially in its duration and severity.
Non-recurrent	Occurs at non-regular times at a site. It is unexpected and not predictable by road users and often due to collisions, vehicle breakdowns or other unforeseen losses of carriageway capacity.

Recurrent congestion occurs when the capacity of a link, in terms of traffic volumes, is exceeded by demand. Put simply, as the number of vehicles on a road increases, speeds on that road decrease. Furthermore, research shows that a road approaches full capacity, the rate at which service levels decline increases. Figure 3.5 illustrates this relationship.

Figure 3.5: Relationship between Speed and Volume/Capacity on roads



Note: This is an illustrative example of a generally observed relationship, and does not refer to any specific road.

TII's National Road Indicators reports set out the level of service on National Roads in terms of volume to capacity ratio. This is a useful measure of the level of congestion. However, it may be of value to augment this with other metrics, which provide a wider picture of service levels on the network, and to set clear targets to aid asset management policy and investment planning.

As an example, Highways England has eight Performance Specifications, as set out in its 2016/2017 Performance Monitoring Statements (Highways England, 2017). PS3 focuses on network reliability and availability, including a focus on lane availability, incident management, Planning Time Index (the ratio of the 95th percentile journey time and the free-flow time) and Acceptable Journeys, a measure of the percentage of journeys deemed to have been completed in an acceptable journey time (less than 4/3 of the free flow time).

Crowding

Ensuring public transport has sufficient capacity to meet demand and avoid crowding is important in a number of ways. While services should ideally be well-utilised, excessive crowding can deter passengers from using public transport. This can have negative consequences for decarbonisation if people instead travel by private car, and it also raises social inclusion issues for those who may not have access to an alternative means of travel. Moreover, if public transport services are operating at, or potentially above, capacity it implies that there is some level of unmet demand and could also create safety issues. Supplying adequate capacity to meet travel demand and avoid excessive crowding is therefore a key objective to ensure comfort for travellers and to make public transport an attractive mode choice.

Reliability

As well as leading to increased journey times, congestion can reduce the predictability of journey times, known as 'journey time reliability'. Low reliability has associated user costs. Unreliability creates a risk of travellers arriving at the destination late, or having to depart earlier than would otherwise have been necessary to ensure that they are not late. In this sense, the user impacts of reliability are analogous to that of journey times in general—the users value their time.

Improving reliability on interurban roads can be done in two main ways. Increasing capacity can reduce the likelihood and severity of congestion, making journey times more predictable. In addition, increasing safety levels reduces the possibility of delays caused by collisions.

3.4 Promoting a strong and balanced economy

The fifth Project Ireland 2040 National Strategic Objective (NSO5) is to create 'a strong economy supported by enterprise, innovation and skills'. As set out in Section 2, transport investment can have a key role in enabling economic benefits, bringing firms and workers closer together, allowing better use of resources and supporting economies of scale through increasing the size of economic areas.

Ireland does not currently have official research and guidance on agglomeration, but TAG (Transport Appraisal Guidance) Unit A2.4 (DfT, 2018) discusses agglomeration, noting that productivity impacts are generated in two ways by agglomeration: localisation and urbanisation economies. Urbanisation economies are of relevance to interurban transport, and are derived from "productive advantages from [firms] locating close to workers and firms in other industries." The NPF notes that "the two key variables are the scale of concentration of activity and the

relative distance, or ease of accessibility, to larger centres of population". That is, reducing the distance (or journey time) to and between areas of scale yields productivity benefits.

3.5 Interurban Transport and the National Strategic Outcomes

Further to these high-level priorities, the discussion in the preceding sections of this paper has established why we should pursue improved regional and interurban accessibility. Combining this analysis with the National Strategic Outcomes and the high-level objectives for transport investment listed above, it is possible to derive a number of concrete questions to ask of our interurban transport networks. To summarise this section, high-level questions for the interurban transport network have been defined for each example outcome discussed above, along with some key indicators by which we can assess the performance of the network against those outcomes. These are set out in Table 3.2.

Table 3.2: Interurban network questions and performance indicators

Outcome	Question	Indicator
Delivering clean, low-carbon and environmentally sustainable mobility	What share of journeys is made using sustainable transport modes or technologies?	Interurban mode share; Total emissions.
Supporting successful places and vibrant communities	To what extent does the interurban network deliver Project Ireland 2040's regional development and accessibility goals? Is the current or future network going to encourage urban sprawl?	Population change by region, county, city, and electoral district.
Facilitating safe, accessible, reliable and efficient travel on the network	How quickly can travellers get between urban centres? How congested are interurban roads?	Journey times; Average speeds; Volume / capacity.
Promoting a strong and balanced economy	How accessible are employment opportunities? Is the interurban network enabling the development of economic centres of scale?	Local and regional level economic output; Journey times into and between urban centres.

4. Ireland's Interurban Network

There is around 99,000km of roads in Ireland. The National Roads network, which caters for interurban travel, consists of some 5,332km (5.4%). Of this, just less than 1,000km is motorways. Figure 4.1 is a map of Ireland's existing national road network, broken down by motorway, dual carriageway, and single carriageway.

Figure 4.1: Ireland's National Road Network

Table 4.1: Ireland's Motorways lists the motorways of Ireland, and their respective origin-destination routes.

Table 4.1: Ireland's Motorways

Motorway	Route
M1	Dublin-Belfast
M2	Dublin-Derry
M3	Dublin-Ballyshannon
M4	Dublin-Sligo
M6	Dublin-Galway
M7	Dublin-Limerick
M8	Dublin-Cork
M9	Dublin-Waterford
M11	Dublin-Wexford
M17	Galway-Sligo
M18	Limerick-Galway
M20	Limerick-Patrickswell
M50	Dublin ring road

Given it links Ireland's major urban centres with one another, it is unsurprising that the usage of the national road network is proportionally higher than the network as a whole, and this is even more so on the motorway network. CSO figures indicate that just over 47.5 billion vehicle kilometres were driven on Ireland's roads in 2018. TII figures indicate that just less than 20 billion vehicle kilometres were driven on national roads in 2016, accounting for around 40% of all traffic volume in that year. Table 4.2 shows traffic volumes on Ireland's national road network in 2016.

Table 4.2: Traffic Volumes on National Roads, 2016

Road Category	Vehicle km travelled (billion, all vehicles)
Motorways	7,949
National Primary Roads (excl. motorways)	7,582
National Secondary Roads	4,349
Total (national roads)	19,880

In addition to the national road network, Ireland also has an interurban rail network. Figure 4.2 is a map of the network, while Table 4.3 lists the currently operating routes.

According to data from the NTA, there were approximately 13.7 million journeys made on Ireland's heavy rail network in 2018 when DART and Dublin suburban services are excluded. As Figure 4.3: Heavy Rail Passenger Journeys (excluding DART and Dublin Commuter), 2007 to 2018 shows, in recent years passenger levels have grown above pre-recession levels.

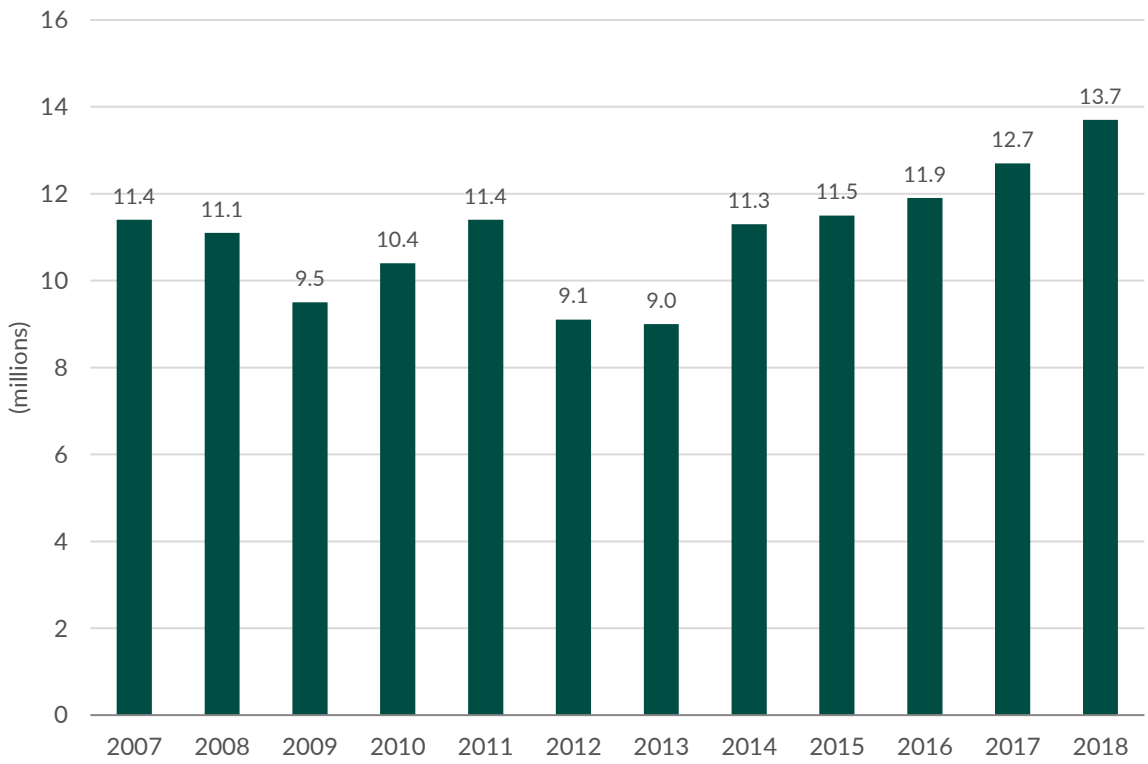
Figure 4.2: Ireland's Interurban rail network

Table 4.3: Ireland's Rail Network

Route	Service Frequencies (both directions, weekday)
Dublin-Belfast	16
Dublin-Cork/Limerick	29
Dublin-Galway	18
Dublin-Mayo (Westport or Ballina)	8
Dublin-Sligo	14
Dublin-Waterford	14
Dublin-Rosslare	8
Dublin-Limerick	7
Limerick-Galway	9
Dublin-Tralee	2
Limerick-Waterford	4
Cork-Tralee	5

Note: Service frequencies taken from the 2016 Rail Review

Figure 4.3: Heavy Rail Passenger Journeys (excluding DART and Dublin Commuter), 2007 to 2018



5. Project Ireland 2040

5.1 The National Planning Framework

The NPF sets out a targeted pattern of growth to 2040 for Ireland's regions and cities, as summarised in Table 5.1.

Table 5.1: Project Ireland 2040 Population and Settlement Targets

Eastern and Midland	Southern	Northern and Western
+ 490,000 - 540,000 people (2.85m total) +320,000 in employment (1.34m total)	+ 340,000 - 380,000 people (2m total) +225,000 in employment (880,000 total)	+160,000 - 180,000 people (1m total) +115,000 in employment (450,000 total)
Dublin City and Suburbs: +235,000 - 290,000 people (at least 1.41 million total) Regional Spatial and Economic Strategy to set out a strategic development framework for the Region, leading with the key role of Athlone in the Midlands and the Drogheda-Dundalk-Newry cross-border network	Cork City and Suburbs: +105,000 - 125,000 people (at least 315,000 total) Limerick City and Suburbs: +50,000 - 55,000 people (at least 145,000 total) Waterford City and Suburbs: +30,000 - 35,000 people (at least 85,000 total) Regional Spatial and Economic Strategy to set out a strategic development framework for the Region	Galway City and Suburbs: +40,000 - 45,000 people (at least 120,000 total) Regional Spatial and Economic Strategy to set out a strategic development framework for the Region, leading with the key role of Sligo in the North-West, Athlone in the Midlands and the Letterkenny-Derry cross-border network

While there are a number of factors which affect travel demand—meaning we cannot simply assume a one-to-one relationship with population growth—it is clear that the population growth targeted in the NPF will lead to a substantial increase in journeys, including interurban journeys.

Project Ireland 2040 establishes specific priority areas to enhance regional accessibility. These are interurban roads, accessibility to the North-West and public transport. The NPF contains a target for "improving average journey times targeting an average interurban speed of 90km/h." It also discusses "[strengthening] public transport connectivity between cities and large growth towns in Ireland and Northern Ireland with improved services and reliable journey times."

For the purposes of NIFTI, we define more specifically what is meant by the interurban network in order to be able to identify the road corridors to which the 90km/h target applies. The NPF itself highlights the following urban centres:

- The five cities;
- Sligo and Athlone are identified as regional centres;
- Letterkenny is important in the context of the North-West Gateway Initiative;
- Drogheda and Dundalk are important in the context of the Dublin-Belfast economic corridor.

These 10 urban centres are a sensible basis upon which to define the interurban network. We will therefore define interurban routes as covering travel between:

1. Dublin and all other urban centres:
2. Each of the regional cities;
3. All urban centres within a specific region;
4. Athlone and Limerick, Galway and Waterford, due to Athlone being located in the Midlands.

As well as modelling the current national road network, and the national road network incorporating the NDP schemes, TII has modelled the national road network incorporating NDP schemes under 2040 NPF population projections. This modelling provides an insight into where potential pressures could develop on the network, informing the investment and policy priorities which of NIFTI.

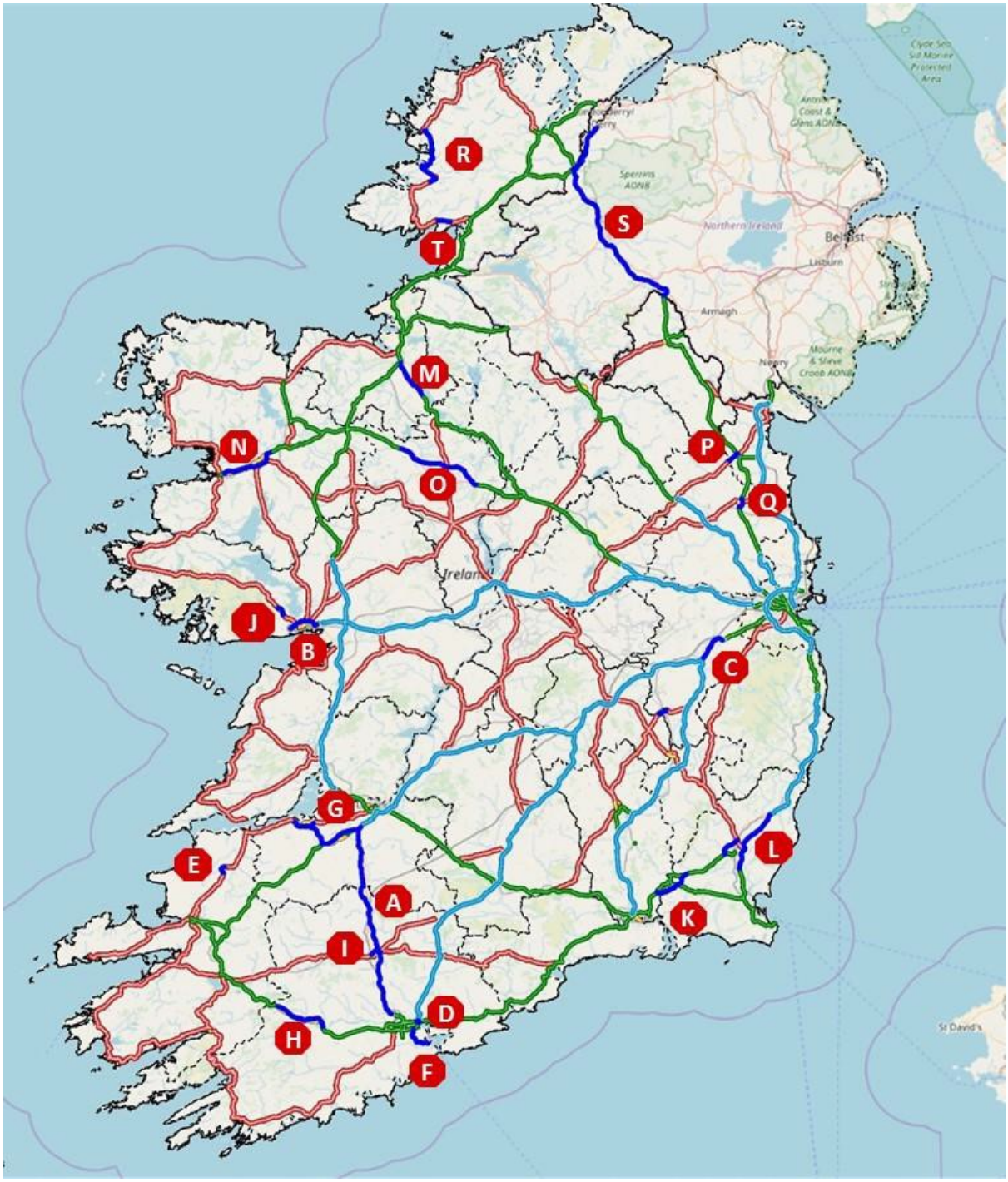
5.2 The National Development Plan

The NDP has earmarked €7.3bn for investment in the regional roads network and accessibility to the North-West. The major objectives of this investment are to complete linkages so that "every region and all the major urban areas, particularly those in the North-West, which have been comparatively neglected until recently, are linked to Dublin by a high-quality road network" and to "make substantial progress in linking our regions and urban areas not just to Dublin but to each other". Table 5.2 lists the national roads projects for which funding has been allocated in the NDP, while Figure 5.1illustrates where these schemes will sit on the network. In addition to these projects, the NDP identifies 22 sections of the national road network to be progressed through pre-appraisal and early planning.

Table 5.2: National roads projects in the National Development Plan

Interurban roads		Accessibility to the North-West	
A.	M20 Cork to Limerick	M.	N4 Collooney to Castlebaldwin
B.	N6 Galway City Ring Road	N.	N5 Westport to Turlough
C.	M7 Naas to Newbridge bypass widening, Osberstown Interchange and Sallins Bypass	O.	N5 Ballaghadereen to Scramogue
D.	N8/N25 Dunkettle Interchange	P.	N52 Ardee Bypass
E.	N69 Listowel Bypass	Q.	N2 Slane Bypass
F.	N28 Cork to Ringaskiddy Road	R.	N56 Dungloe to Glenties
G.	N21/N69 Limerick to Adare to Foynes	S.	A5 Road Development
H.	N22 Ballyvourney to Macroom	T.	N56 Mountcharles to Inver
I.	N72/N73 Mallow Relief Road		
J.	N59 Moycullen Bypass		
K.	N25 New Ross Bypass		
L.	M11 Gorey to Enniscorthy		

Figure 5.1: National roads projects in the National Development Plan



The NDP sets out that "the funding priority for the interurban rail network is to protect the investment already made in our national railway system by funding maintenance and safety projects needed to maintain safety and service levels in railway operations". It further commits to feasibility studies and evaluations of future expansionary investment but, unlike with national roads, no specific schemes are committed to. The interurban rail projects included in the NDP can be summarised as:

- Protect investment in existing interurban rail network
- A feasibility study of high-speed rail between Dublin and Belfast, and Dublin and Limerick Junction/Cork, and an evaluation of its economic benefits against improvements to existing line speeds.

- An independent review of Western Rail Corridor Phase 2 from Athenry to Tuam, and Phase 3 to Claremorris.
- A reappraisal of the Dunboyne/M3 Parkway line to Dunshaughlin and Navan.

As an example of potential improvements to line speeds which could be delivered, Table 5.3 is from the 2016 Rail Review and shows some previously identified journey time improvements and associated costs based on removing line speed restrictions on the network.

Table 5.3: Identified line speed improvements on rail network, 2016 Rail Review

Route	Incremental Capital Cost (€m)	Time saving (mins)	Incremental annual Revenue (€m)
Cork	5.8	14	2.4
Limerick	-	11	1.0
Kerry	-	20	0.8
Belfast	-	10	0.4
Galway	8.6	17	1.8

Outside of these schemes, cases have not yet been made for other expansions to Ireland's rail network. This is primarily because Ireland's low population density means there is not a strong economic case for a more extensive rail network. For the purposes of the analysis in the following two sections, we therefore assume that that the scope of the rail network and the frequency of services remains unchanged from today. However, in the context of the 90km/h average interurban speeds objective in the NPF, the line speed improvements outlined in Table 5.3 will be examined.

6. Assessing Interurban Network Service Levels

Building on the previous sections, we now assess the capability and capacity of the network in the following scenarios:

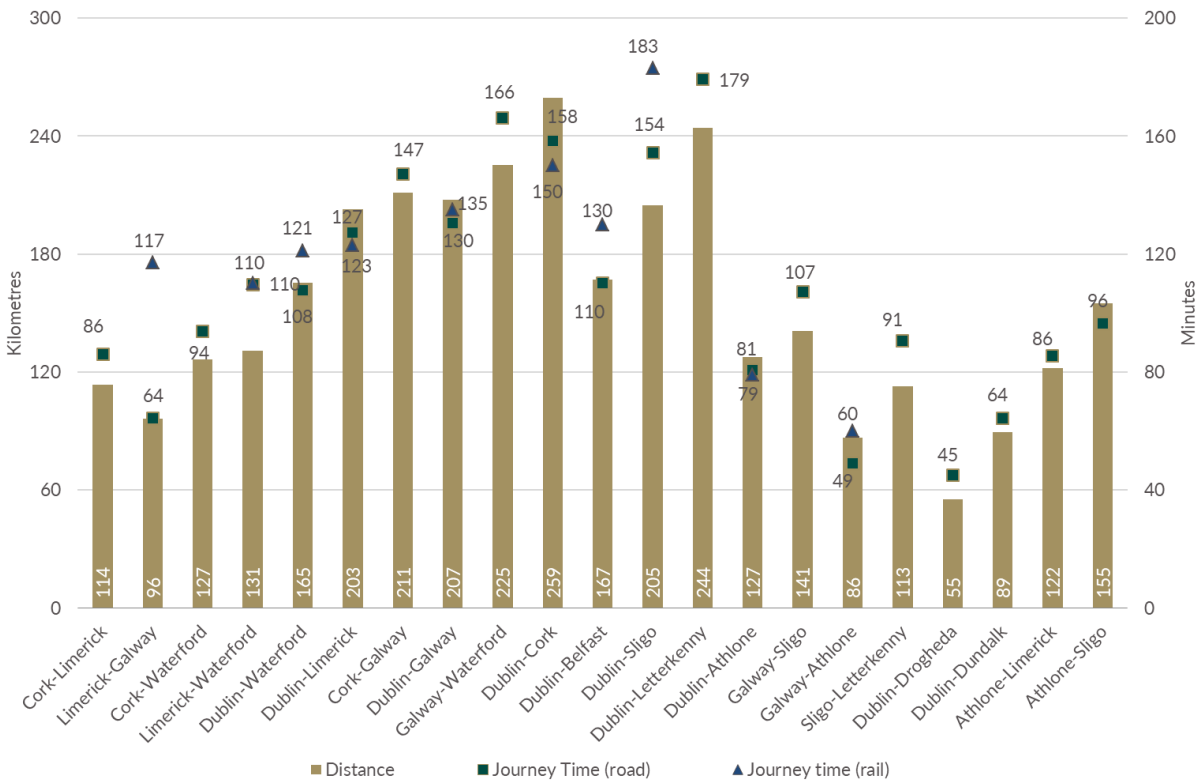
- **Base Scenario (Current and 2017):** Based on recent journey time data and TII's National Transport Model (NTpM) for 2017;
- **Do-Nothing Scenario (2040)**: This scenario assumes the NPF's population projections are achieved but that the transport network infrastructure is the same as it is today;
- **Do-Minimum Scenario (2040)**: This scenario assumes the NPF's population projections are achieved and that the projects committed to in the NDP have been delivered.

6.1 Overall Network Capability

A useful way to begin looking at Ireland's interurban transport network is to consider current levels of service. One of the key level of service metrics is journey times. Figure 6.1 shows distances and journey times between Ireland's cities for both road and rail.[2]

For road travel, journey times on the routes Cork-Galway, Cork-Waterford, and Galway-Waterford each appear to be high, taking account of travel distance. For rail, Dublin-Waterford and Limerick-Galway appear to have particularly high journey times, relative to distance.

Figure 6.1: Distances and journey times between Ireland's cities and selected towns



[2] Rail journey times are an average of zero-stop journeys on a Monday based on Irish Rail timetabling information. Car journey times are from Google Maps departing Monday at 8am from the main railway station (Heuston in the case of Dublin, except to Belfast, where Connolly was chosen).

Table 6.1, based on the data above, shows the average speeds between each Irish city and Project Ireland 2040 regional centre, with the left-hand column representing the city of origin and the right-hand column representing the destination.

Table 6.1: Average road-based journey speeds between Irish cities and selected towns

2017 AM Peak Speed (km/h)	Dublin	Cork	Limerick	Galway	Waterford	Drogheda	Dundalk	Letterkenny	Athlone	Sligo
Dublin		98	96	95	92	74	83	82	95	80
Cork	92		79		81					
Limerick	87	79		90	72				111	
Galway	99		95						106	79
Waterford	81	77	69						81	
Drogheda	73						70			
Dundalk	80					70				
Letterkenny	79									73
Athlone	96		112	101	80					77
Sligo	89			84				75	76	

Journey speeds by road between Cork and Limerick, and between Waterford and each Irish city other than Dublin, are slower than the NPF target of 90 km/h.[3] In addition, average speeds between Dublin and three key urban areas in the north of the island, Letterkenny, Belfast and Derry, as well as Drogheda and Dundalk, are also below 90 km/h. This analysis also indicates that the radial routes into Dublin are highly congested, as journeys into Dublin are slower than journeys out of Dublin, at least in the morning peak period.

To assess performance on the national primary network as a whole, Table 6.2 shows total vehicle kilometres, average speed, and delay minutes as a percentage of total travel time in the Base Scenario and both 2040 scenarios. Increased demand in 2040 leads to an overall drop in average speeds and an increase in delays. The NDP schemes mitigate this partially but not completely.

Table 6.2: National primary network indicators

	Base Scenario	Do-Nothing Scenario	Do-Minimum Scenario
Total vehicle km	15,650,998,429	19,923,335,202	20,253,266,622
Average Speed (km/h)	85.21	80.36	82.45
Delay as % of total journey time	14.03	19.20	18.32

Extending this analysis, Table 6.3 shows total vehicle kilometres, average speed, and delay minutes as a percentage of total travel time in the Base Scenario and both 2040 scenarios on the national secondary road network. Again, increased traffic demand in 2040 leads to an overall drop in average speeds and an increase in delays. The NDP schemes in this instance bring service levels more closely back to 2017 levels, likely because they started at a lower level.

[3] This is not a perfect measure, as the NPF target states that each national road should have an average speed of 90km/h. This analysis is looking at fastest peak travel time between city centres. Nevertheless, it provides a useful approximation and illustration.

Table 6.3: National secondary network indicators

	Base Scenario	Do-Nothing Scenario	Do-Minimum Scenario
Total vehicle km	4,693,125,778	5,788,856,406	6,019,943,661
Average Speed (km/h)	64.41	60.59	63.50
Delay as % of total journey time	13.99	19.28	14.87

Interurban bus services are provided by Bus Éireann's Expressway service and a number of private operators. While it is beyond the scope of NIFTI to consider the provision of commercial bus services, these intercity services play an important role in achieving a number of National Strategic Outcomes of Project Ireland 2040, most notably:

- NSO 2 – Enhanced Regional Accessibility
- NSO 4 – Sustainable Mobility
- NSO 8 – Transition to a Low Carbon and Climate Resilient Society.

Any improvement to journey times on the national road network will benefit interurban bus services. However, given that these services can avail of bus lanes on radial routes around urban centres they are, perhaps, less likely to be impacted by congestion projected to arise on these routes in 2040.

Finally, Table 6.4 shows that the average speed by rail on four interurban routes is less than 80 km/h. Between Limerick and Galway it is less than 60 km/h. Operating rail infrastructure and services encompasses significant fixed costs, meaning there can be substantial negative implications on value for money if service levels are low enough to discourage demand. It is not surprising, then, that according to analysis conducted for the 2016 Rail Review, this route is among the worst performing, on a cash result per passenger journey basis, losing €44 per passenger journey in 2015.

Table 6.4 Speeds on Ireland's interurban rail routes

Route	Average Speed (km/h)
Dublin-Cork	103
Dublin-Galway	97
Dublin-Limerick	97
Dublin-Waterford	78
Dublin-Belfast	77
Dublin-Sligo	71
Limerick-Galway	54

From this analysis, the following observations can be made:

- Road links from Dublin to each of Ireland's other cities appear to be able to offer a high level of service, when operating within capacity;
- Journey speeds from Dublin to Letterkenny, Derry and Belfast are quite low;
- Ireland's national road network does not achieve the 90km/h average speed target in the base scenario. Population growth means that average speeds will be slightly lower than this in 2040 in the absence of intervention, even with NDP investment.

- Cork and Limerick are separated by just over 100km, but it can take 80 to 100 minutes to get between them by road. Furthermore, there is no direct rail connection between the two cities. There appears to be a significant opportunity to achieve wider economic benefits by improving the transport connections between the two cities.
- With the exception of its road link to Dublin, Waterford appears to be rather poorly linked to Ireland's other cities.
- Journey times on a number of interurban rail routes appear to be very high, with Limerick-Galway particularly so.

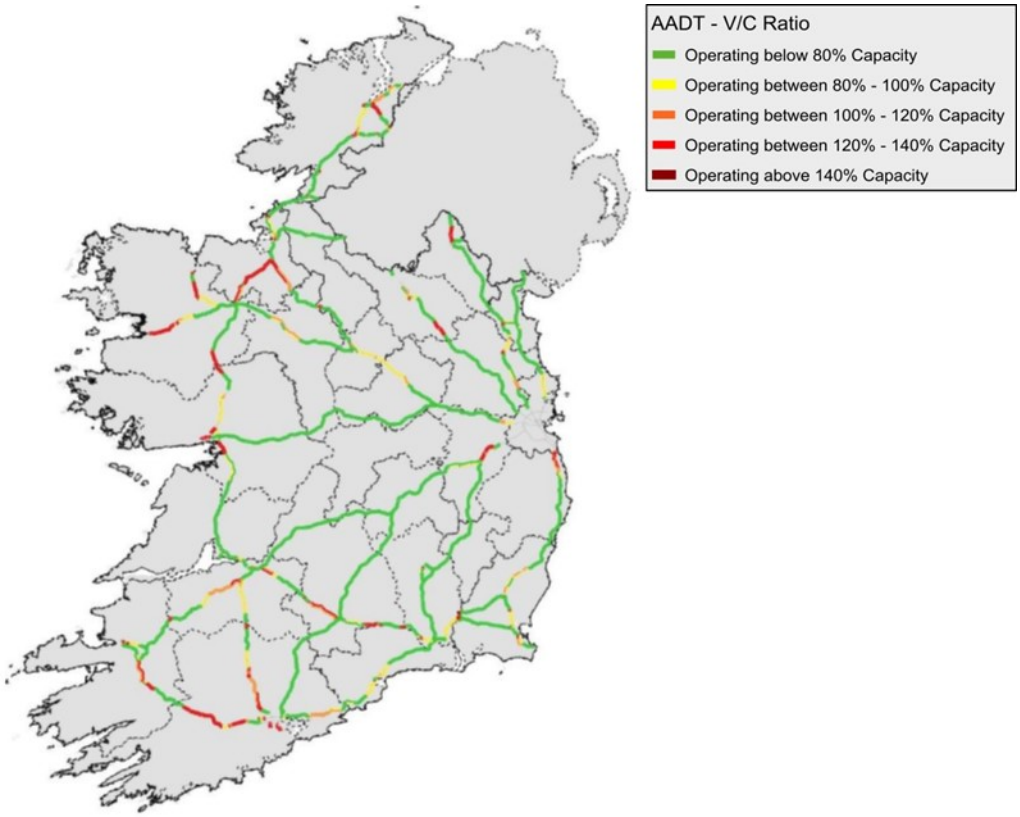
6.2 Service Levels on the National Primary Road Network

We now examine service levels on the National Primary Road network at a route level for each of the three modelling scenarios.

6.2.1 Base Scenario

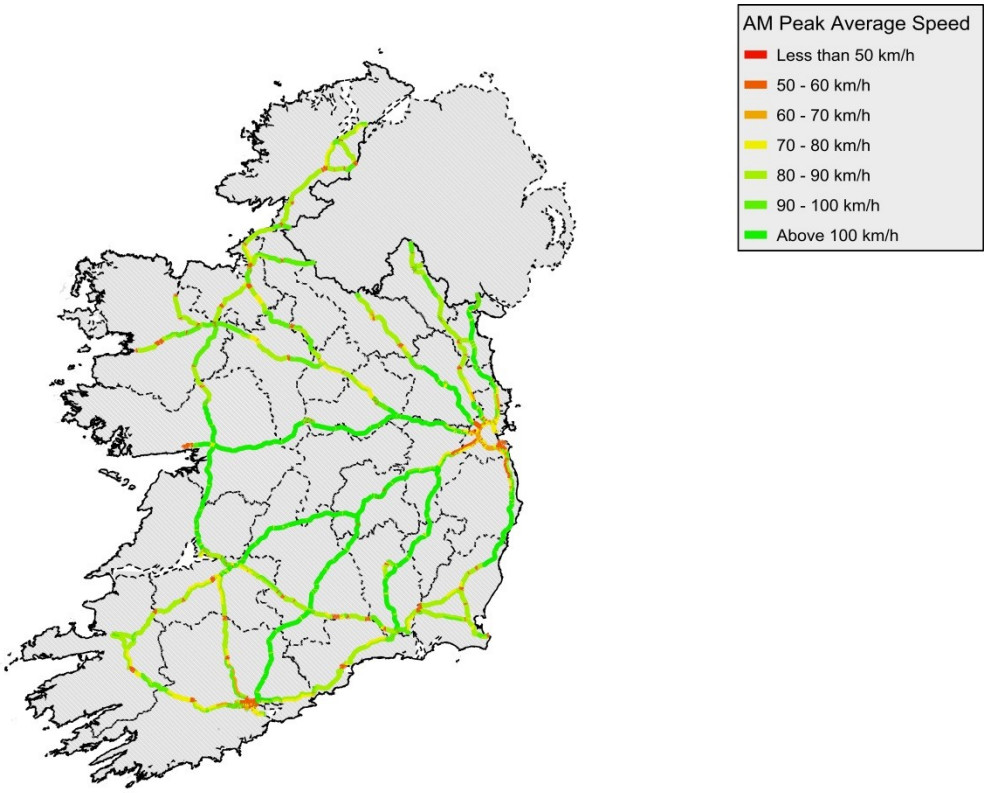
Figure 6.2 shows the ratio of traffic volumes to capacity (AADT Flows/NRA TD 9 LoS D Capacity[4]), hereafter referred to as V/C, on the national primary road network in the Base Scenario. Figure 6.3 shows average speeds during the AM peak period.

Figure 6.2: Volume/Capacity on national primary network, Base Scenario



[4] AADT means Annual Average Daily Traffic. NRA TD 9 LoS D Capacity means LOS D is the level at which speeds begin to decline slightly with increasing flows and density begins to increase somewhat more quickly. This ratio is used to measure volume/capacity.

Figure 6.3: Average speeds on national primary network, Base Scenario



Based on Figure 6.2 and Figure 6.3 we can make the following observations of conditions on the national primary network:

- Radial routes into Dublin, Cork, Galway and Limerick are operating at or above capacity in most instances, leading to lower levels of service.
- A large part of the network in the west of Ireland is over capacity, particularly the routes around Sligo, Ballina and Castlebar.
- Large parts of Ireland's interurban motorway network are operating within capacity, and could accommodate further growth. This is reflective of the fact that most of the infrastructure has been developed rather recently.

6.2.2 Do-Nothing and Do-Minimum Scenarios

Figure 6.4 and Figure 6.5 show the level of service on the national primary road network in terms of volume-capacity ratio for the Do-Nothing and Do-Minimum scenarios respectively. Figure 6.6 and Figure 6.7 show the level of service on the national primary road network in terms of average speeds in the AM peak for the Do-Nothing and Do-Minimum scenarios respectively.

Figure 6.4: Volume/Capacity on national primary network, Do-Nothing Scenario

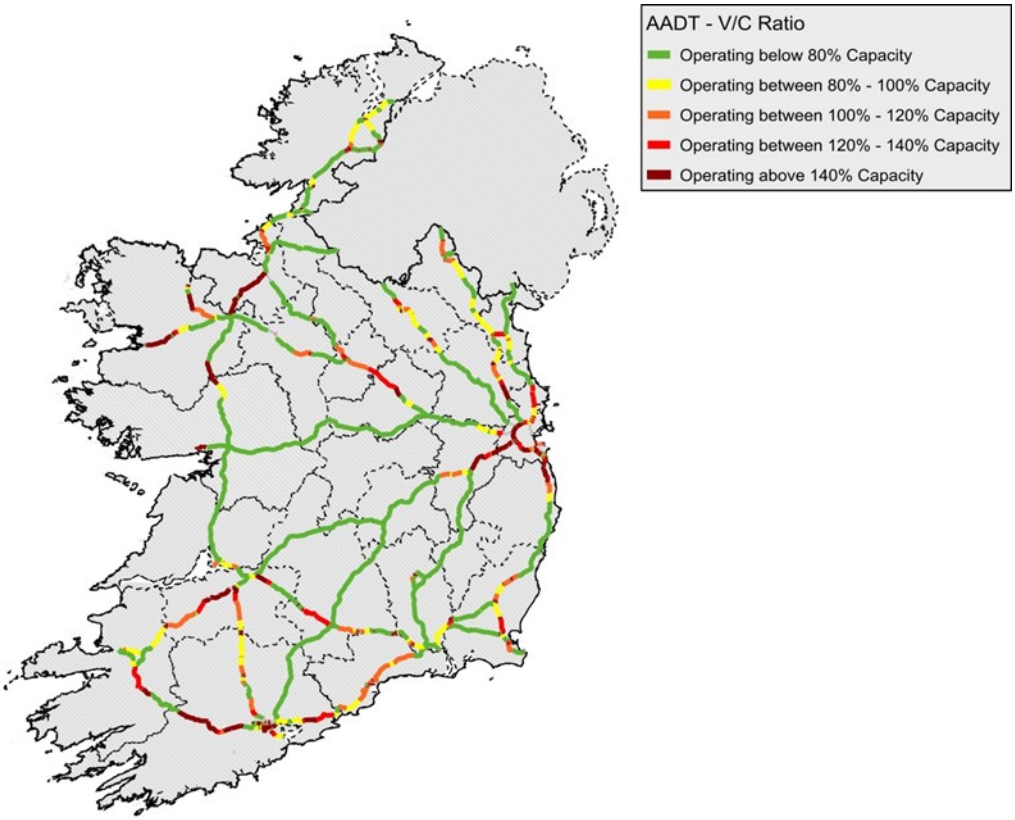


Figure 6.5: Volume/Capacity on national primary network, Do-Minimum Scenario

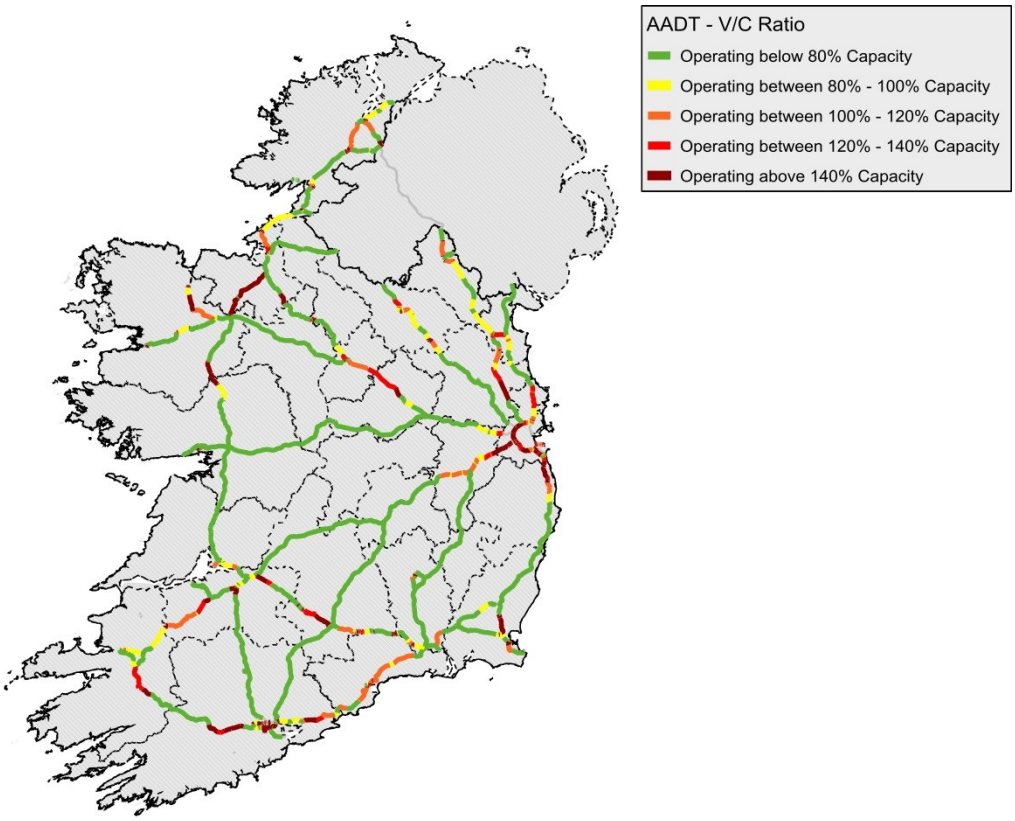


Figure 6.6: Average speeds on national primary network, Do-Nothing Scenario

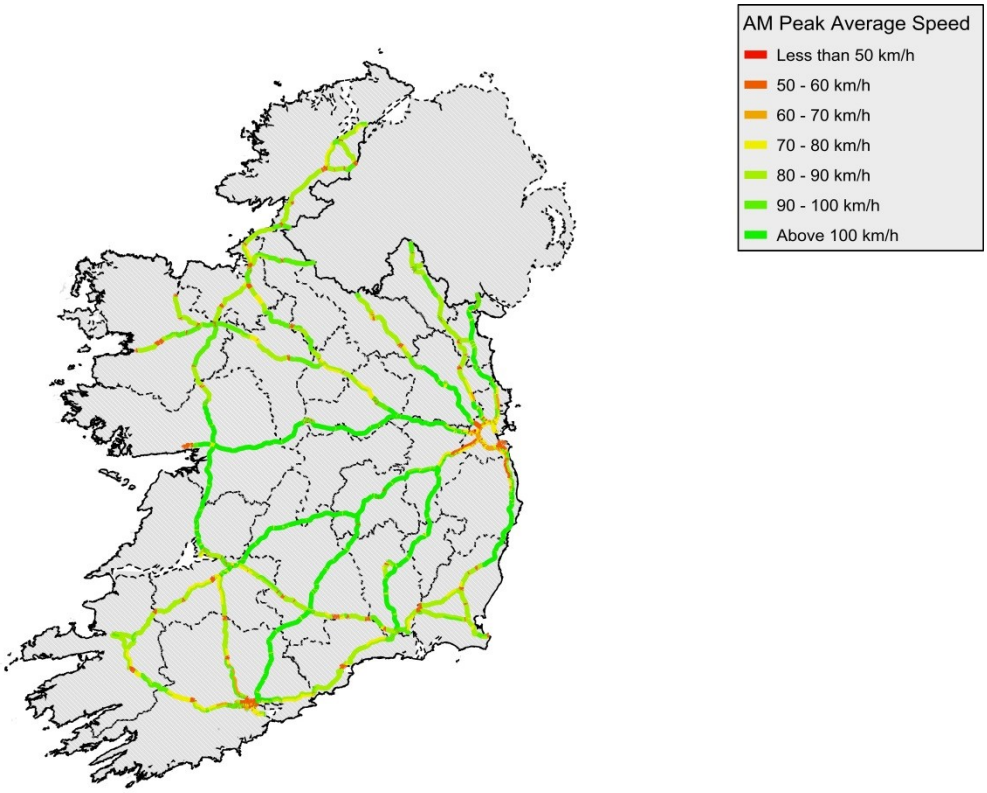
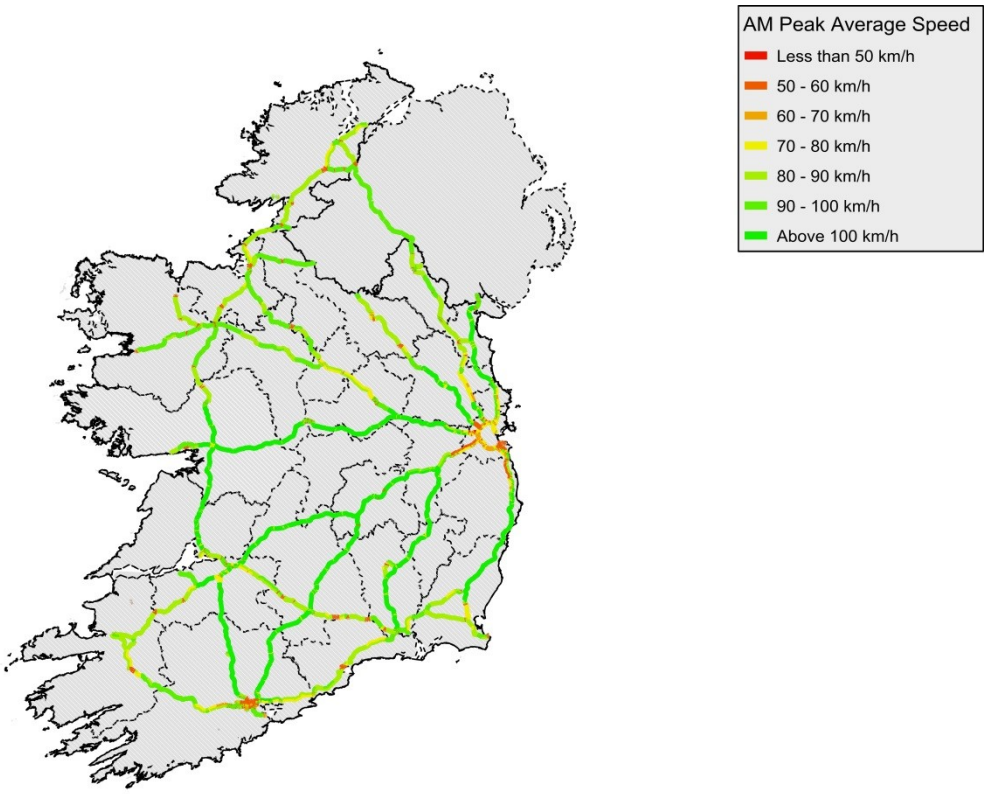


Figure 6.7: Average speeds on national primary network, Do-Minimum Scenario



Based on the above figures, we can make the following observations on conditions on the national primary network in 2040, both with the existing network and with the inclusion of NDP schemes:

- Service levels in the South-West, particularly between Limerick and Cork are greatly improved in the Do-Minimum Scenario, though pressures remain on routes between both cities and Tralee.
- A significant portion of the Dublin-Derry-Letterkenny corridor is projected, in the Do-Minimum Scenario, to be at or above capacity, including the N14 between Strabane and Letterkenny and the N2 south of the border to Ashbourne.
- There will be pressures on the national road network around the North-East Dublin-Belfast cross-border network, particularly on the M1 outside Dublin, on much of the M2/N2, and around Drogheda.
- The NPF target of 90km/h average speeds is not currently met on some of the routes between the regional cities and a number of other important routes. Cork to Waterford, Limerick to Waterford, Galway to Sligo, and Sligo to Letterkenny are all important strategic routes which fall significantly short of this target.
- The Dublin-Sligo corridor is projected to be above capacity between Mullingar and Longford
- The Dublin-Wexford-Rosslare corridor will be over capacity on the N11 between the M50 and Wicklow and on N11/N25 between Oilgate and Rosslare
- Transport demand on urban radial routes into Dublin and Cork will result in further congestion.

6.3 Service Levels on the National Secondary Road Network

We now examine service levels on the National Secondary Road network at a route level for each of the three modelling scenarios.

6.3.1 Base Scenario

Figure 6.8 shows V/C on the national secondary road network in the Base Scenario. Figure 6.9 shows average speeds during the AM peak period.

Based on these figures, we can make the following observations of conditions on the national secondary network:

- In contrast to the national primary network, large portions of the national secondary network are currently congested.
- Areas under particular pressure include:
    - Large parts of the network in the Midlands, in particular routes north and northwest of Athlone, and the South-Eastern routes from Tullamore and Portlaoise.
    - The network between West Cork and Cork City.
    - The network into Galway city from Connemara to the West and Castlebar to the North.

Figure 6.8: Volume/Capacity on national secondary network, Base Scenario

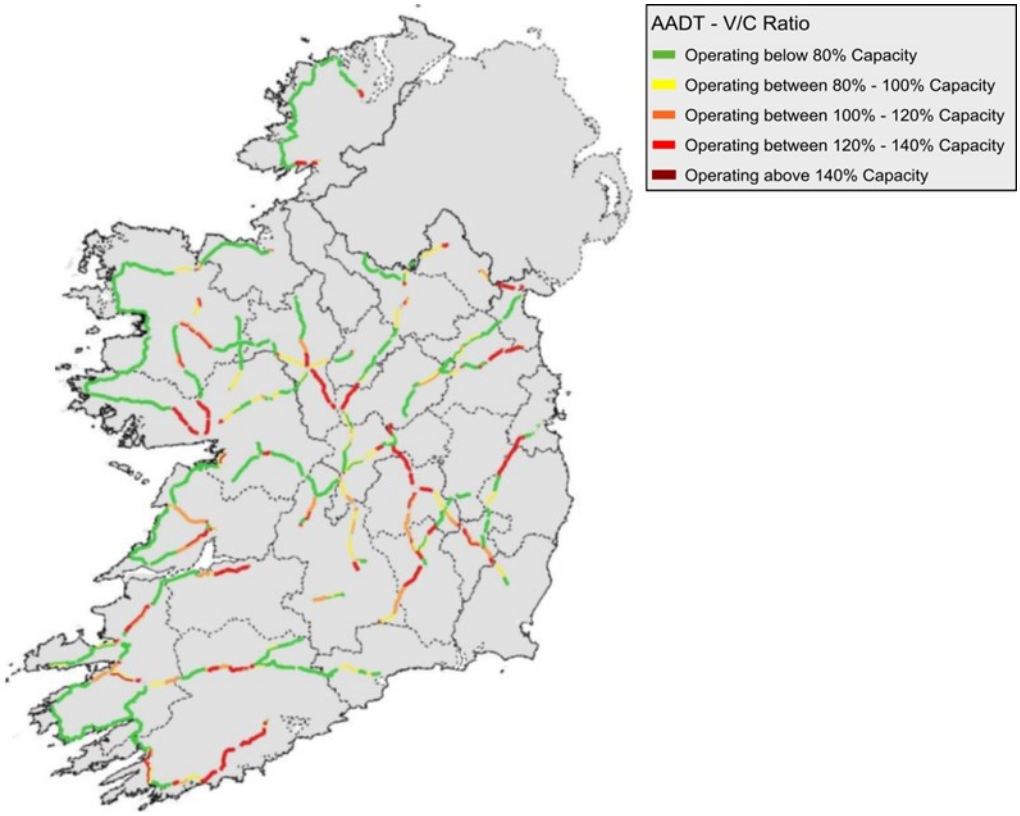
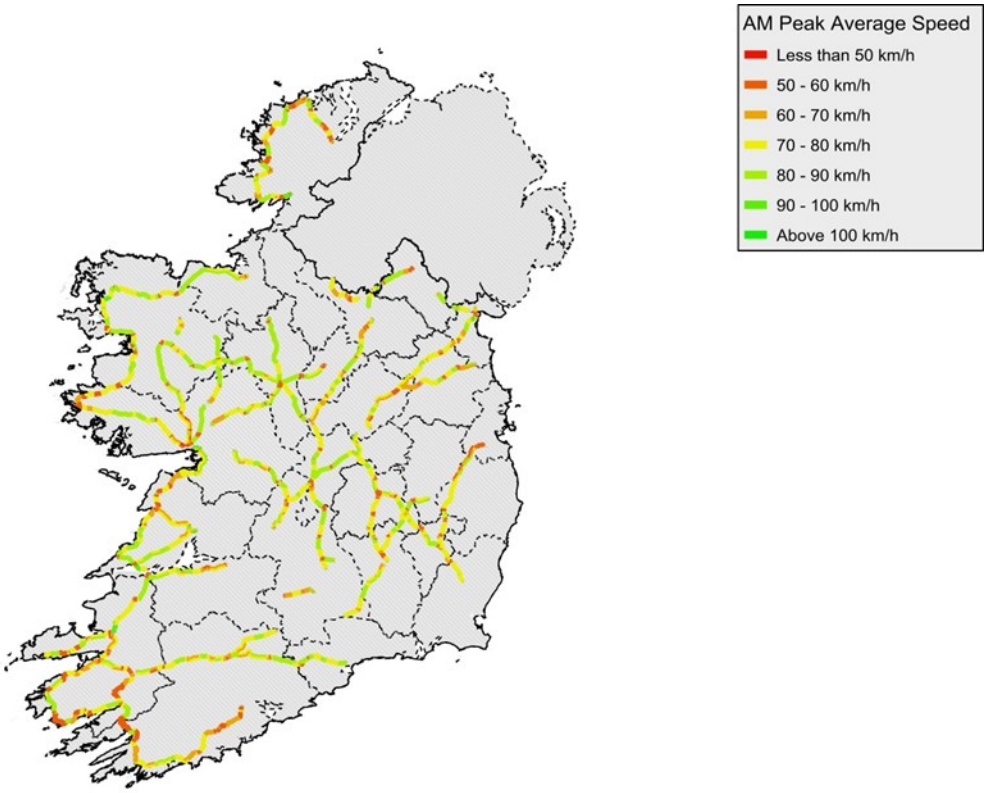


Figure 6.9: Average speeds on national secondary network, Base Scenario



6.3.2 Do-Nothing and Do-Minimum Scenarios

Figure 6.10 and Figure 6.11 show the level of service on the national secondary road network in terms of volume-capacity ratio for the Do-Nothing and Do-Minimum scenarios respectively. Figure 6.12 and Figure 6.13 show the level of service on the national secondary road network in terms of average speeds in the AM peak for the Do-Nothing and Do-Minimum scenarios respectively.

Figure 6.10: Volume/Capacity on national secondary network, Do-Nothing Scenario

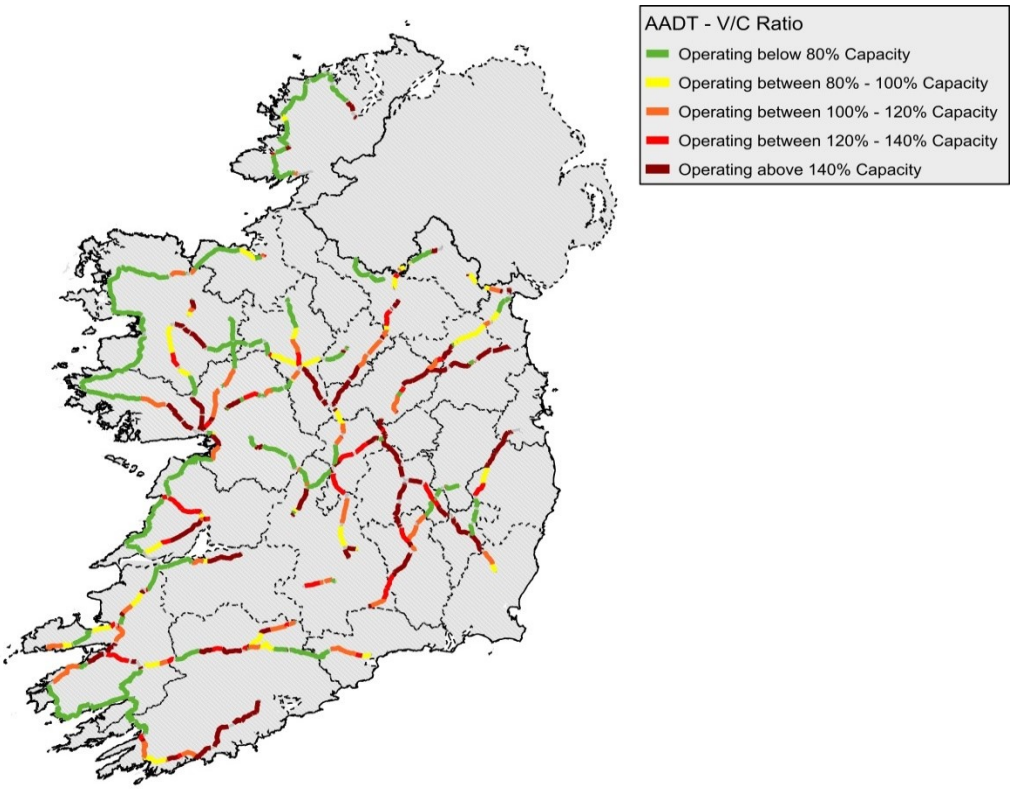


Figure 6.11: Volume/Capacity on national secondary network, Do-Minimum Scenario

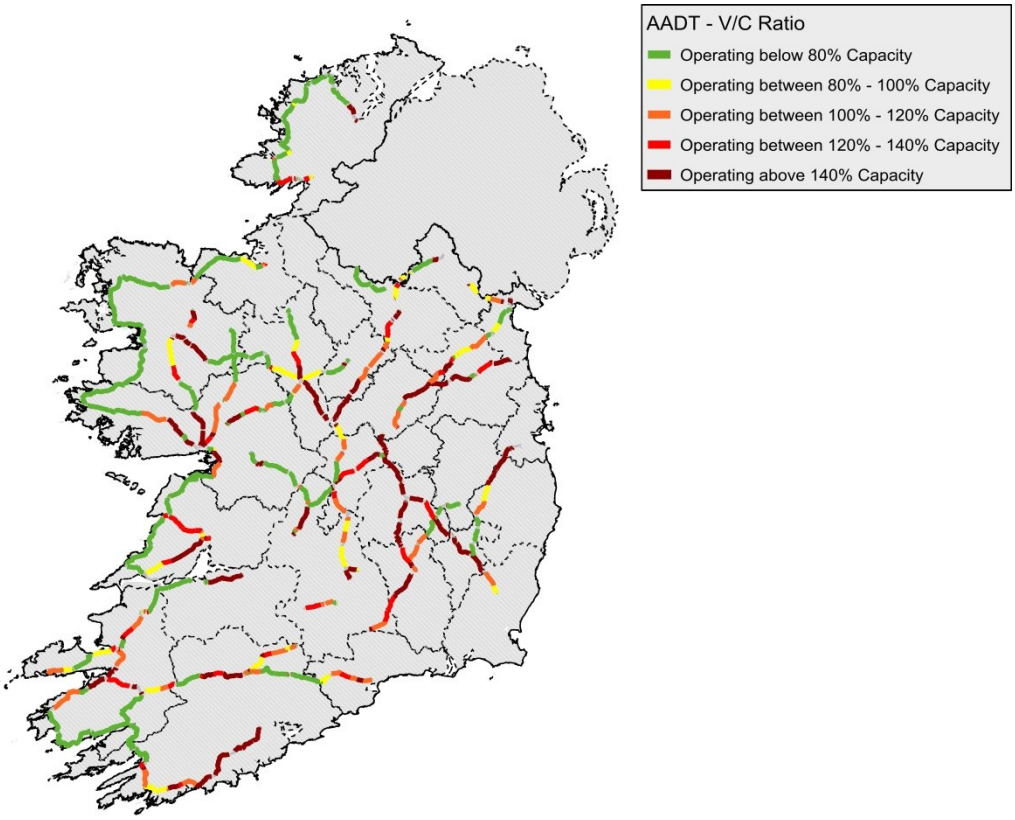


Figure 6.12: Average speeds on national secondary network, Do-Nothing Scenario

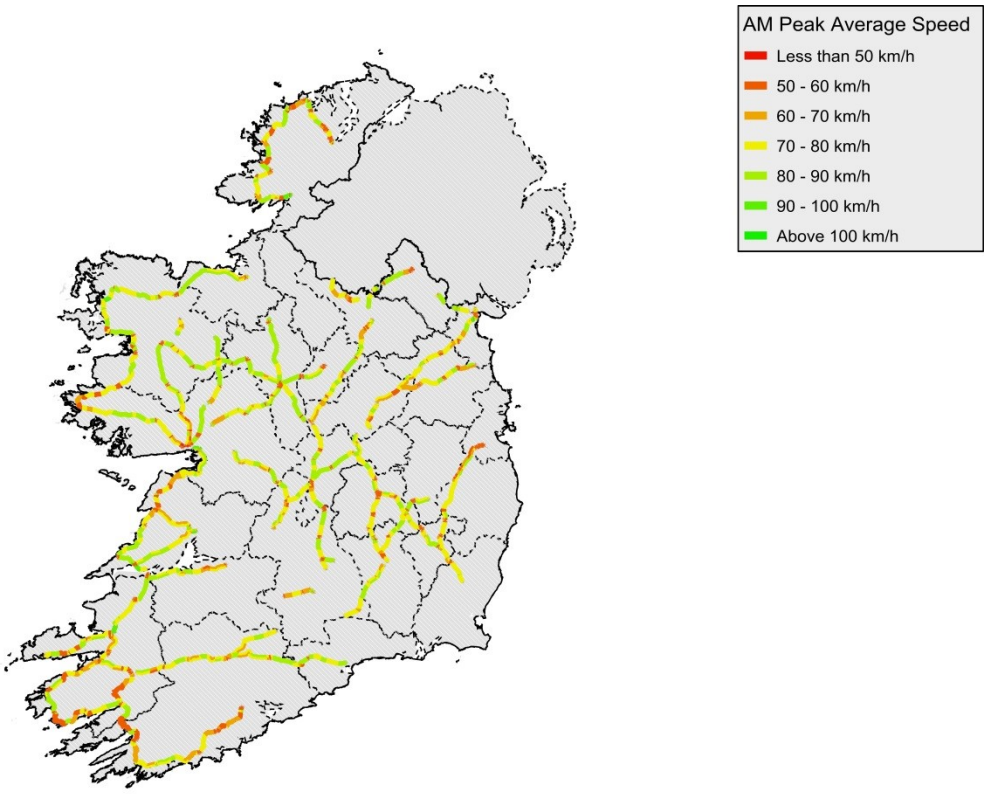
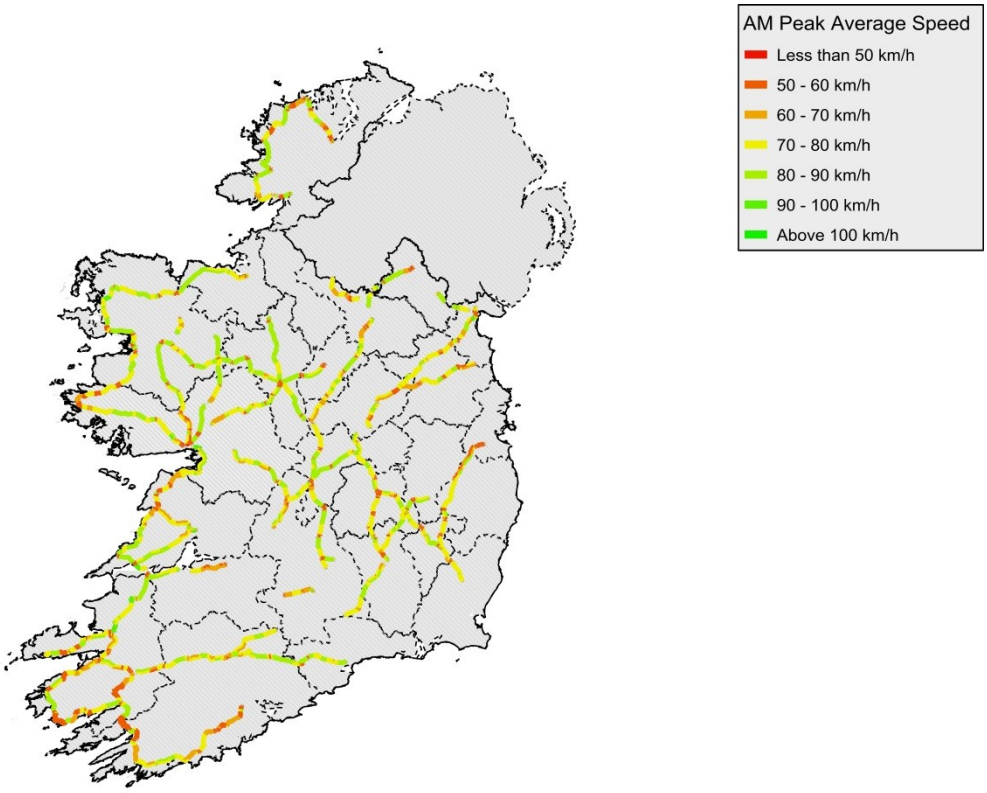


Figure 6.13: Average speeds on national secondary network, Do-Minimum Scenario



Based on the figures above, we can make the following observations of conditions on the national secondary network in 2040, on the existing network and with the inclusion of NDP schemes:

- Generally speaking, the majority of the National Secondary Road network is projected to experience congestion issues by 2040.
- In particular, increased pressures on the National Secondary Road network are projected in the midlands.
- The National Secondary Road network in the vicinity of the regional cities is also projected to operate in excess of capacity by 2040.

6.4 Service Levels on the Interurban Rail Network

We now examine service levels on the interurban rail network for each of the three modelling scenarios.

6.4.1 Base Scenario

Public transport does not have the same flexibility as private transport, whereby an individual has freedom over when to travel. Therefore, service frequency is very important when considering public transport service levels, as it determines both the capacity of the public transport service and the degree of flexibility for users over when they can travel. Also of importance are the times of the earliest and latest services, particularly for commuters and business travellers. Table 6.5 sets out these key parameters for current Irish Rail services. The orange highlighted cells indicate an earliest arrival time of later than 9:30am or a latest departure time of earlier than 19:00.

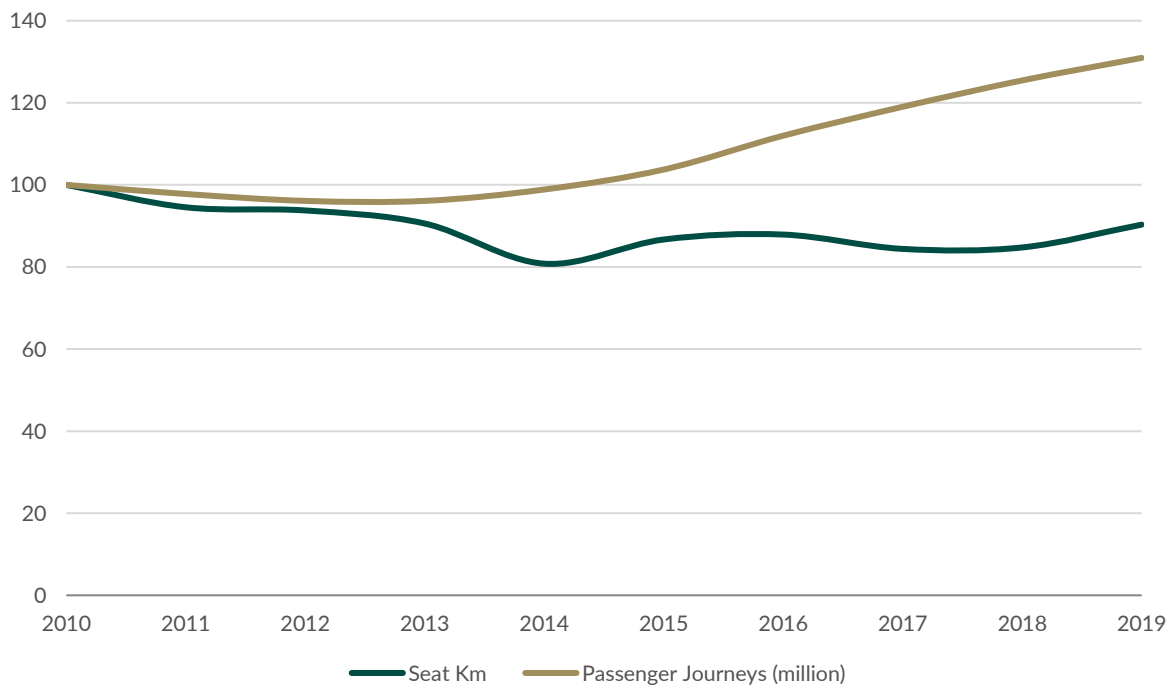
In addition to journey times and service frequencies, another important consideration is service capacity, and in particular whether sufficient capacity exists to accommodate growth in interurban rail journeys. Figure 6.14 shows

seat kilometres (number or seats multiplied by the number of kilometres) and passenger journeys, from 2010 to 2019, both indexed to 2010.

Table 6.5: Frequencies and earliest/latest services on interurban rail network

Route	Service Frequencies (both directions, weekday)	From	To	Earliest Arrive Time	Latest Leave Time
Dublin-Galway	18 (plus 8 between Westport and Ballina)	Galway	Dublin	07:59	19:20
		Dublin	Galway	10:08	19:35
Dublin-Cork/Limerick	29	Cork	Dublin	08:20	20:25
		Dublin	Cork	09:30	21:00
Dublin-Limerick	7	Limerick	Dublin	07:50	20:55
		Dublin	Limerick	09:04	21:00
Dublin-Waterford	14	Waterford	Dublin	08:07	18:25
		Dublin	Waterford	09:39	18:35
Dublin-Sligo	14	Sligo	Dublin	08:49	19:00
		Dublin	Sligo	10:15	19:15
Dublin-Belfast	16	Belfast	Dublin	09:00	20:15
		Dublin	Belfast	09:45	20:50
Limerick-Waterford	4	Limerick	Waterford	09:39	17:50
		Waterford	Limerick	10:03	16:25
Limerick-Galway	9	Limerick	Galway	08:10	19:50
		Galway	Limerick	08:26	17:50
Dublin-Wexford	9	Dublin	Wexford	12:07	18:35
		Wexford	Dublin	08:47	17:53

Figure 6.14: Seat km and passenger journeys on Iarnród Éireann, 2010-2019 (2010=100)



Although the economic downturn led both passenger numbers and service numbers to fall in the early part of the decade, passenger numbers are now more than 30% higher than they were in 2010, at 50.1m, while seat kilometres remain 10% below their 2010 level. Rail capacity analysis would need to consider the issue at a route level, look at peak and off-peak occupancy levels, and ideally use a more comparable set of measures such as passenger kilometres and seat kilometres. However, passenger numbers cannot continue to grow indefinitely, without capacity increasing. It will be important to ensure capacity can continue to cater for demand, and that infrastructure is capable of handling larger or more frequent trains, if they become necessary.

6.4.2 Do-Nothing and Do-Minimum Scenarios

As set out in Section 5, the NDP does not contain committed investments in interurban rail, although the Department is considering an independent study in Western Rail Corridor Phases 2 and 3, as well as progressing a study into high and higher speed rail between Belfast and Cork.

Assuming that the NDP does not directly fund expansions to the interurban rail network, but does allow the line speed improvements identified the 2016 Rail Review and discussed in Section 4 (see Table 5.3), service levels on the main intercity routes in 2040 can be categorised in the following way:

1. The following routes have average speeds in excess of 100 km/h: Dublin-Cork; Dublin-Galway; and Dublin-Limerick
2. The following routes have average speeds between 80km/h and 90km/h: Dublin-Belfast and Dublin-Waterford
3. The following routes have average speeds of less than 70km/h: Dublin-Sligo; Limerick-Waterford; and Limerick-Galway.

6.5 Summary

The analysis in this section suggests the following conclusions:

- Average speeds on a number of routes are likely to remain below the NPF's goal of 90km/h by 2040, without action above and beyond that set out in the NDP.
- The national roads into Dublin and Cork will be experiencing significant congestion by 2040, and this may affect the economic performance of those cities.
- The proposed M20 upgrade will significantly improve capacity between Cork and Limerick, but there will remain pressure on service levels in the South, particularly between Limerick-Waterford and Cork-Waterford, with road traffic volumes exceeding capacity and limited rail services. With the exception of the Waterford-Dublin link, there is scope for improvement to the network around Waterford and the South East in general.
- Service levels on the on the national secondary network are generally poor, meaning high journey times between many parts of the midlands, north-west and south-west. Not acting on this may jeopardise the success of regional and economic development in those areas.
- Transport connections to and from the North-West will be under pressure, with road links between that region and both Dublin and Galway experiencing capacity constraints, particularly the national roads around Sligo. In addition, rail services between Dublin and Sligo are significantly slower than road. The national roads in county Donegal, particularly around Letterkenny, will be above capacity by 2040. Donegal is Ireland's most peripheral region, and the area most at risk from Brexit.

- Some intercity rail services are characterised by low average speeds, low frequencies or timetables which may reduce the scope for services to be utilised by commuters or business travellers.

7. Identifying Needs for the Interurban Transport Network

Drawing on the analysis and modelling in Section 6, the following section considers the potential investment needs and requirements across the interurban transport network in order to facilitate Project Ireland 2040.

7.1 Delivering clean, low-carbon and environmentally sustainable mobility

NIFTI Background Paper 3 discusses the challenge facing the transport sector in terms of decarbonisation, noting that "the transport sector, as one of the largest producers of GHG emissions, will need to take a lead role in contributing to the overall reduction in carbon emissions and an increase in the use of renewable energy sources".

According to the CSO's Transport Omnibus 2016, there were 48,519 million vehicle kilometres travelled in 2016. Approximately 19,880 (41%) of these were on national roads. It is therefore infeasible to try to decarbonise the transport sector without interurban travel playing a major role. However, based on the modelling discussed in Section 6, high-level Department of Transport analysis suggests that emissions on the national road network are likely to increase without further intervention.[5]

Figure 7.1: Growth in emissions on the national road network compared to Base Scenario

	Do-Nothing Scenario	Do-Minimum Scenario
National Primary Roads	18.8%	20.8%
National Secondary Road	15.1%	19.7%

NIFTI Background Paper 3 identifies a number of ways in which transport emissions could be reduced. These are:

1. Promoting modal shift away from cars;
2. Adapting to technological advances; and,
3. Demand management.

We now discuss each of these with specific regard to interurban travel.

7.1.1 Promoting Modal Shift

When we discuss modal shift, we are primarily discussing a shift from private car transport, the most emissions-intensive (and dominant) form of transport, to either public transport or active travel.

When discussing the potential for shifting travel to active modes (walking or cycling), it is worth considering travel distances. Table 7.1 shows the average journey distance on national roads across the three modelling scenarios.

Table 7.1: Average Journey Distance, National Roads

	Base Scenario	Do-Nothing Scenario	Do-Minimum Scenario
Average Journey Distance (km)	21.74	22.27	22.32

The average journey distance on national roads is around 22km. It is unrealistic to expect more than a small number of journeys of this length or longer to be undertaken by active travel modes, meaning the scope for a modal shift of this type is likely to be quite small.

[5] This analysis assumes a modest (0.3%) annual improvement in vehicle efficiency and a 60/40 petrol/diesel split of passenger cars.

Turning to public transport, we can estimate that in 2015, 43.6m travelled by interurban bus services,[6] while 10.45m journeys were made on Interurban rail services according to the 2016 Rail Review. While these figures represent different years, we can say that approximately 54m journeys are made by interurban public transport annually. By contrast, around 3.7bn total vehicle trips were made on the national road network, the vast majority of which were by private cars with relatively low occupancy rates.

While economies of scale mean public transport will have a smaller modal share for interurban transport than for urban transport, it is important to ensure that where public transport is a viable option our transport network is suitably designed to accommodate it.

Measures to encourage interurban public transport
Provision of park and ride facilities
Improved rail speeds and frequencies where viable
Provision of necessary bus priority for highly trafficked arterial routes outside cities

7.1.2 Demand Management

Demand management—reducing the number or length of journeys made—can be achieved in two ways:

- **Static**: Managing demand given economic and spatial conditions, through mechanisms such as road pricing;
- **Dynamic:** Managing demand through spatial planning, such as encouraging compact growth, thereby reducing required travel distances.

Drawing on TII's *Demand Management on National Roads* (2014), Table 7.2 sets out a high-level summary of the wide variety of demand management options that can be deployed. The NPF explicitly encourages compact growth as one of its core objectives, so the NTpM travel demand projections and modelling discussed in Section 6 already incorporate its population targets. Therefore, we will consider static demand management mechanisms.

Table 7.2: Summary of Demand Management Measures and Benefits

Category	Implementation Type	Summary
Fiscal Measures	**Single Point Tolls**	Provide a demand management option specifically at one critical pinch point on the network primarily to influence route choice and more evenly distribute traffic.
	Distance Based Tolls	Road user charging based on usage. Leads to more efficient network use through reduced congestion where implemented.
	Cordon Charging	Aimed at improving network efficiency across a large area and is normally implemented in city centres with positive impacts on travel times and the environment.
	Variable Tolls	Users charged based on traffic demand/congestion, variable tolling is the most effective demand management as opposed to revenue raising tool.

[6] From CSO Transport Omnibus. Includes all journeys for Bus Éireann's Stagecoach, Commuter and Expressway services, and all commercial bus services.

	Selective Vehicle Tolls	Primarily aimed at heavy goods vehicles as they have a disproportionately negative impact on pavement deterioration when compared with private car use, selective vehicle tolls target one specific group to reduce demand or raise revenue.
	Others	By looking at financial methods other than tolling, for example, vehicle quota systems or biofuel tax relief, road authorities are able to have a certain desired impact such as limiting the number of cars or benefiting more environmentally friendly options respectively.
Intelligent Transport Systems (ITS) Measures	**Additional Capacity**	Additional capacity measures include hard shoulder running and concentrate on more efficient use of existing road space. Such developments challenge pre-conceived ideals with benefits from improved throughput considered to outweigh the negative of hard shoulder removal.
	Access Control	Mainly ramp metering access control attempts to delay vehicles on the local network to stop flow breakdown on the mainline to benefit network efficiency as a whole.
	Incident Detection	Fast and effective incident detection has become increasingly important for hazard warning to reduce the number of secondary incidents and to reduce incident clearance times.
	Reversible Lanes	Only relevant when high tidal flow is causing congestion in one direction. By altering the direction of travel in one or more lanes, throughput can be increased often alongside reduced accident benefits.
	Variable Speed Limits	Variable speed limits can be applied due to different network conditions (adverse weather, congestion, etc.) and provide an enforceable method of traffic management to increase safety by reducing the likelihood in incidents, improve journey time reliability, and reduce emissions.
	Intelligent Road Markings	Intelligent road markings allow for the implementation of dynamic lanes to assist with access control or reversible lanes, and can also be used for hazard warning.
	Sustainable Lanes	Reallocates or constructs road space primarily for the use of sustainable transport such as multiple occupancy cars and buses. They generally benefit these users while disbenefiting single occupancy traffic.
	Traveller Information Systems	Provision of information through roadside information and, increasingly, in-car units provides travellers with timely information which can lead to a more relaxed travelling experience, increased safety and more efficient network use.
	Measures for Freight	As a key user group on the road network, the need for effective freight services is essential for improving safety and reducing the impact of freight on the network.
Control Centres	**National Control Centres**	National control centres ensure the effective management of data and information and coordinate regional control centres which concentrate on network management in their own areas.
	Regional Control	Regional control centres concentrate on areas of the network or on

	Centres	specific city regions. With the best possible knowledge of the network through real-time traffic monitoring and past experience, regional control centres concentrate on minimising travel times on the network as whole.
Influencing Travel Behaviour	**Internet**	The internet is an important source of pre-trip (and increasingly on-trip) travel information to lead to more effective mode choice and routing decisions. Online tools are a valuable method for increasing public knowledge of travel options and the resultant impacts of each option in terms of journey times, cost, fuel use, health etc.
	Telephony	The development of new mobile phones allows for information to be obtained through direct calling (information lines), GPS and internet based applications.
	Personal Travel Information	This information is personalised which allows for the best possible use of information by the driver/traveller.
	In-Car Systems	Satellite Navigation Systems provide in-car traveller information of both static and, increasingly, dynamic traffic information. Provision of accident information and alternative routing direct to an in-car device can prove an extremely effective tool for network management.
	Planning Policy	Addressing traffic problems at their core can often be one of the most appropriate methods for reducing the impact of traffic on the network, reducing reliance on private car use through planning.
Other Non-Fiscal	**Public Transport Priority**	If travel times by public transport are comparable or better than private car travel time, travellers are more likely to make the switch.
	Interchange	Providing high-quality interchange facilities at park and ride sites to allow for easier interchange between modes.
	Network Patrols	Network patrols provide free assistance to stranded motorists, which reduces the impact of incidents on the network and can provide confirmation of events to the control centre.
	Others	Banning overtaking by heavy goods vehicles at certain points on the network can increase average speeds in free flow conditions and improve safety.
Combined Measures	**Integrated Demand Management**	Combining measures, such as ramp metering, dynamic lane markings and variable tolling, to ensure a coordinated approach to traffic management which can help lock in the benefits of all the measures being implemented.

In addition to helping reduce greenhouse gas emissions, demand management measures have the potential to alleviate issue of congestion and reduce the incidence of collisions on the national road network. A 2014 report on Demand Management options for the M50 found that "in the absence of the introduction of demand management measures by 2023… some 50% of the M50 will experience traffic flows in the busiest lanes that exceed safe capacity" (AECOM, 2014). It will be important to consider the most appropriate combinations of these measures for given situations.

Road pricing has potential for managing or reducing travel demand. As most road infrastructure in Ireland is free at the point of use, standard economic theory suggests that demand will be above the optimal level, creating negative consequences such as congestion and, pertinently, greenhouse gas emissions. By pricing its use appropriately, use of the network can be optimised. However, road pricing is administratively and technologically complex. Also, if not designed carefully, it can have undesirable socioeconomic impacts, risking a situation where the network is used by those who can most afford it, rather than those who most need it. Any system of road pricing in Ireland would need to be carefully considered and designed, in order to maximise the benefits while minimising adverse impacts.

Another reason exists to prioritise consideration of road pricing—that a shift away from petrol or diesel-based vehicles could lead to a hole in Exchequer Revenue currently filled by fuel excise. The Department of Finance's Budget 2019 Tax Strategy Group published a paper noting that "the possibilities of shifting taxes to road usage should be considered in the context of the uptake of EVs or 'super low' emission vehicles" (D/Fin, 2018).

7.1.3 Technological Advances

When we discuss technological advances, we are discussing step-changes in the energy efficiency of travelling, without an explicit change of 'mode' as it is commonly understood. That is, we are talking about the increased use of renewable fuel sources such as electricity, or alternative fuels. Vehicles fuelled by non-emissions-intensive fuels are referred to as Lower Emission Vehicles (LEVs).

The *National Policy Framework: Alternative Fuels Infrastructure for Transport in Ireland, 2017-2030* notes that "the transport sector must transition away from the use of oil over the next two decades, moving predominantly to electricity for passenger cars" (DTTaS, 2017). The Climate Action Plan sets out the need to "Develop the EV charging network necessary to support the growth of EVs to at least 800,000 by 2030 and set a target for the supply of infrastructure to stay sufficiently ahead of demand" (GoI, 2019).

There are types of LEVs other than electric vehicles. Namely, vehicles powered by natural gas, hydrogen, biofuels, LPG or synthetic and paraffinic fuels. At the time of writing, however, these technologies are at an earlier stage of development with regard to being ready for mass market deployment when compared to electric vehicles.

The immediate priorities for transport infrastructure, in relation to alternative fuels and propulsion types, should therefore be:

1. Determining the number, types and locations of electric vehicle charging infrastructure which will be needed to enable to delivery of the Climate Action Plan; and,
2. Continued monitoring and policy analysis of less developed alternative fuel technologies, to ensure we are in a position to provide appropriate support in the event that any of them become viable to be a substantial proportion of the vehicle stock.

In addition to the changes in infrastructure required to accommodate a higher proportion of LEVs on the road network, changes are also likely to be required to facilitate other technological advances. These technological changes are discussed in NIFTI Background Paper 5, and include the development of Connected and Autonomous Vehicles (CAVs), which could require the provision of dedicated CAV lanes on interurban roads.

7.2 Ensuring Reliable Access into Our Cities

As the analysis in Section 6 shows, volume-capacity ratios tend to become particularly high when entering and leaving the cities. Therefore, some of the biggest capacity constraints can take place on relatively small parts of the network. Investing in road capacity increases will continue to be necessary in order to enable travel to and from our cities and large towns. Indeed, the NDP identifies a number of such projects, including the N6 Galway City Ring Road.

However, as the scope for more capacity is reduced, we will need to consider alternatives, including modal shifts to public transport and maximising existing capacity.

Section 7.1 set out the need to promote modal shift as well as a growing need to implement demand management measures. We will need to ensure the provision of interurban public transport services, combined with measures to encourage use of these services, so that the ability to travel between our urban centres does not become constrained by congestion.

7.3 Delivering a Rail Network Suited to Ireland's Needs

The NDP's main priority for the rail network is to protect the investment already made in it, directing spending towards protection and renewal work necessary to have the infrastructure operating in an adequate condition in terms of safety and performance. Achieving this will, in itself, lead to improvements in service quality. The next step is determining where the rail network fits in the overall picture, and what we want our interurban rail network to deliver for the people of Ireland in the coming decades.

It is clear—due to our small, dispersed population—that Ireland will never have need for a truly extensive interurban rail network. However, it is, and will continue to be, an important mode of transit for people and goods. The heavy rail network (mainline services and non-Dublin commuter services) accounts for more than 10 million passenger journeys per year and more than 500,000 tonnes of freight traffic.

The Rail Review provided important analysis and considerations regarding the future of rail in Ireland, and made the case that further investment is needed to reverse recent declines in the value and quality of our rail assets, which formed the basis of NDP investment commitments. However, questions remain for rail, including:

- **What is the potential for rail freight?** In terms of tonne-kms, rail accounts for less than 1% of total land freight. While road is likely to remain the dominant mode for freight in Ireland—the cost-effectiveness of rail freight improves relative to road as distances increase beyond the size of Ireland—it is worth considering the potential of rail, particularly in the context of access to our ports.[7]
- **What is the scope for electrification of our existing network?** The NDP sets out increased investment in public transport, including the DART expansion programme which includes electrification of existing lines around Dublin. Electrification has the potential to play a key role in decarbonising rail in Ireland. However, the investment required to electrify rail lines is substantial. Further analysis should be conducted on the costs and benefits of electrifying further sections of the network, including consideration of what traffic levels are likely to be necessary to render such investment value for money.
- **When should we consider service expansions?** Services on the network can be expanded by increasing frequencies, increasing train capacity, increasing speeds, or a combination of these. Each of these

[7] Surface access to ports is considered in detail in NIFTI Background Paper 13.

requires investment in physical infrastructure, either by increasing the required protection and renewal on the track (the number, weight and speed of trains all have an impact on the rate of infrastructure degradation) or by requiring improvements in baseline capability. Section 6 showed there will be capacity constraints on the outskirts of our cities, which could be eased by encouraging modal shift to rail. On the other hand, substantial investment has been made in developing our motorway and national roads network, much of which is forecast to have traffic volumes below capacity in 2040.

7.4 Improving Connectivity in the South

A key aim of Project Ireland 2040 is balanced regional growth. In combination with the desire for that to be primarily made up of compact urban growth, the ambition in the south will be for significant growth in Cork, Limerick and Waterford. There is significant potential for these three cities, along with Galway, to develop as a regional network and provide an economic counterbalance to Dublin.

The analysis in Section 6 identifies good transport connections between Dublin and each of the three southern cities, with favourable journey times and capacity. However, connections between each of the three cities are less strong. The NDP will fund a number of transport schemes in the south, including an improved link between Cork to Limerick. These schemes will serve to improve the connectivity within the region, but capacity constraints will still exist between Limerick and Waterford, and between Cork and Waterford. Improving service levels on these routes will support these three cities to become cities of scale and develop as partners in a regional network.

7.5 Improving Transport Links to the North-West

National Policy Objective 2c in the NPF sets out that "accessibility from the north-west of Ireland…will be significantly improved". It recognises Sligo's role as a regional centre, as well as Letterkenny's importance in the context of the North-West Gateway Initiative. Enabling development of the north-west region will be a necessary part of the Atlantic Economic Corridor initiative, which is intended to develop the Western seaboard as a counterbalance to Dublin and the east coast. Therefore, as the NPF states, "The improvement of regional connectivity along the Western seaboard, linking together the major urban areas to allow the AEC achieve its potential, is a major priority".

The NDP has specified a number of transport infrastructure projects in the north-west, but the analysis in Section 6 forecasts that, even with the delivery of the NDP, the national road network will be significantly above capacity in many parts of the region without further intervention. In addition, there are no rail services to Donegal, and the Dublin-Sligo railway service has relatively long journey times compared to road. It will therefore be a priority to continue to invest in transport infrastructure in the region beyond the lifetime of the NDP.

7.6 Improving Transport Links to the North-East

The NPF notes that the "key driver for [Louth/North-East] is the Dublin-Belfast cross-border network, focused on Drogheda, Dundalk and Newry". The analysis in Section 6 identified significant capacity pressures on this corridor. Recognising the economic importance of this and the target for growth at regional and town level for Drogheda and Dundalk, further investment in the transport network is likely to be necessary. Further analysis of the transport network in this region should be conducted to determine the mix of rail and road infrastructure required.

7.7 Ensuring transport planning supports successful places and vibrant communities

The preceding discussion of the needs of the network aligns to a large degree with National Strategic Objective 2, which is to achieve enhanced regional accessibility. Improving the capability and capacity of the network will, by definition, enhance regional accessibility.

The European Environmental Agency notes that urban sprawl is caused by a "mix of forces including both micro and macro socio-economic trends such as the means of transportation, the price of land, individual housing preferences, demographic trends, cultural traditions and constraints, the attractiveness of existing urban areas, and, not least, the application of land use planning policies at both local and regional scales" (EEA, 2006).

The primary issue here, then, is to consider the impact of further investment in the interurban network on the development of our cities and, in particular, our ability to achieve compact growth. Morgenroth (2017) suggests that, to achieve compact growth and avoid sprawl, "development of infrastructure between cities [needs to] be limited". Certainly, it will be very important to carefully consider future infrastructure development and how it is sequenced to avoid creating favourable conditions for further urban sprawl.

The NPF's objectives around the strategic development of Ireland's regions also specifically require improved interurban transport links to be achieved in some cases. For example, with regard to the Atlantic Economic Corridor, the NPF states, "the lack of high-quality connectivity between the regions within the AEC has been a major impediment to its development as a counter-balance to Dublin and the East Coast". With regional development and accessibility in mind, the NDP has committed to a number of major interurban schemes, and the analysis in Section 6 highlights the need for further investment in the network beyond that.

The challenge, therefore, is to develop our interurban network without creating significant opportunities for sprawl. This suggests the following two actions:

1. Ensuring that NDP investment, and any investment stemming from priorities in this document, does not enable unwanted urban sprawl. This will require working closely with transport agencies, the Department of Housing, Planning and Local Government, Local Authorities, Regional Assemblies and planning authorities to ensure a coordinated approach.
2. Requiring business cases for future transport projects to explicitly demonstrate that they will not cause, or can mitigate, urban sprawl.

8. Conclusions

The interurban transport network provides benefits in terms of access between urban areas to users in Ireland, enabling the efficient movement of freight, and also wider economic, social and regional benefits. Improvements in connectivity are likely to be needed in order to enable Ireland's continuing development, particularly given the regional development goals of Project Ireland 2040.

The NDP contains significant investment in the interurban network which is projected to lead to improvements in service levels on some interurban routes. However, as population continues to grow out to 2040, the network will experience significant capacity pressures in a number of key areas. Not addressing these pressures is likely to jeopardise the vision set out for Ireland in Project Ireland 2040.

In terms of enabling Ireland's future development, some areas of concern in terms of connectivity include:

- Congestion on radial road routes into our cities, particularly Dublin and Cork;
- Interurban connectivity in the South, particularly in relation to the South East and Waterford's connections to both Limerick and Cork
- Transport capacity in the North-West and North-East corridors; and,
- The need to ensure a rail network suited to Ireland's needs.

It is necessary that future transport investment priorities and the roadmap for ensuring the delivery of NIFTI mitigate unintended negative consequences resulting from investment in the interurban transport network. A primary objective of Project Ireland 2040 is to encourage compact urban growth. Improving interurban connectivity can lead to urban sprawl. Mitigating this risk while improving service levels on the network will require close coordination between relevant bodies and changes to the project planning and development processes.

Finally, meeting Ireland's climate change commitments in the transport sector is likely to require a combination of modal shift from private car to public transport and widespread uptake of alternative technologies, such as electric vehicles. There are significant infrastructure requirements involved in enabling these, and an investment roadmap will need to be developed to ensure Ireland can meet its targets.

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