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Department of Transport and Department for Infrastructure

All-Island Strategic Rail Review

Work Package 2: Package Development and Sifting

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Introduction

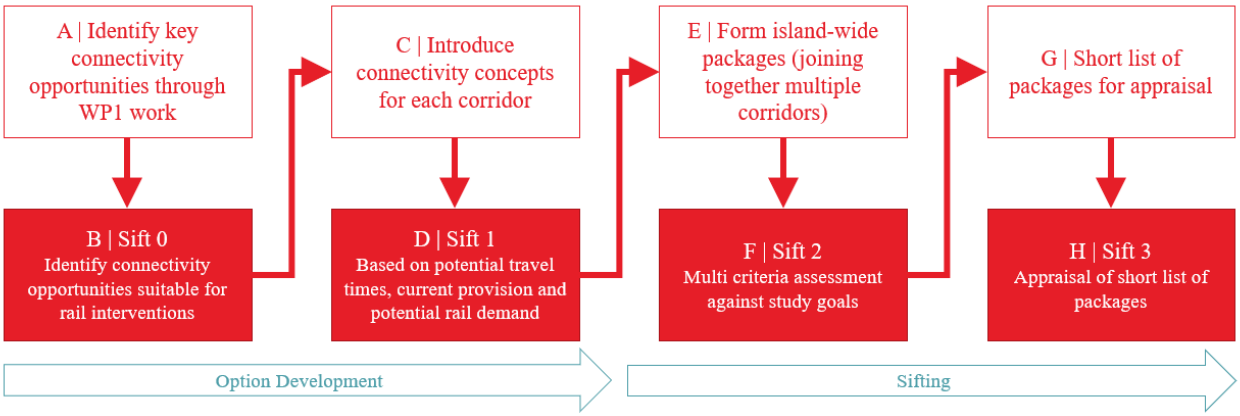
This document provides the technical detail to support the Work Package 2 (Package Development and Sifting) process by recording the methodology for how packages were assessed against each of the All-Island Strategic Rail Review Goals and Objectives. The assumptions and caveats that exist as part of the assessment process are captured.

1.1 Overview

This report summarises work undertaken for 'Work Package 2' for the All-Island Rail study. It summarises work done on **Stage F** which is the assessment of the 'island-wide' packages developed in Stage E of the study. A summary of project stages is shown in Figure 1.

This report also includes an **Emerging Rail Freight Strategy** for rail freight on the island of Ireland, which was developed in parallel to Stages E and F of this study, and which will inform the short list and appraisal of packages of intervention in Stages G and H.

Figure 1 – Study Stages



1.2 Package Development

Several potential approaches to packaging the outputs from Sift 1 were considered. It was necessary to generate packages that would show differentiation between each other and show impacts against the study goals using the multi-criteria assessment framework (MCAF). The output of the sift assessment of the packages needed to be able to demonstrate options to develop into packages to be fully appraised in Sift 3.

Thematic packages to directly reflect the study goals were considered initially:

1. Do minimum
2. High Speed network
3. High Speed spine
4. Electrification
5. Freight Connectivity
6. Rural Connectivity

However, it was agreed during the High-Level Steering Group meeting on the 12th May that these would not provide the level of differentiation and relative performance between study goals required to inform the Sift. It was agreed the packaging should focus on rail typologies so that trade-offs between study goals and opportunities could be more readily inferred.

In addition to a Do Minimum package (committed schemes), this led to the development of 3 packages based around high speed interventions (Transforming Intercity Connectivity packages), a package of Regional interventions and a package that focussed on Rural interventions (**Table 1**). A range of high speed packages

was developed because there are several ways to deliver high speed rail including locations, and largely whether it is a self-contained network or a network that integrates with the existing network.

The four developed packages (with three variations against high speed) are:

1. Do minimum
2. Transforming Intercity Connectivity
    a. Seven cities segregated network
    b. Core cities spine segregated network with services operating on the existing network
    c. Segregated network between capital cities with services extending onto the existing network
3. Compelling Regional Connectivity
4. Step Change in Rural Connectivity

This range will allow us to test the scale of benefits of the high speed network and consider where the network should be integrated or segregated.

Table 1: Proposed Packages defined in WP2 Sift 1

No	Package Title	Content	High-Level Description
1	Do Minimum	Only existing committed changes delivered	This will give us a baseline to compare with other packages
2A	Transforming Intercity Connectivity	All 7 cities High Speed network - with higher speed conventional upgrades	7 cities directly connected by new segregated high speed lines
2B		Large 5 cities[1] High Speed network with higher speed conventional upgrades	A segregated high speed spine with services that go onto the conventional network
2C		Two Capital Cities High Speed network with higher speed conventional upgrades	A segregated high speed line with services that join the conventional network
3	Compelling Regional Connectivity	Additional core regional locations with upgraded connectivity	Upgrades to existing lines to improve journey times with strategic new infill (conventional speed)
4	Step Change in Rural Connectivity	Improving the connections from Rural areas on the Island to increase prosperity	Improvements to existing rural lines with strategic new links to unserved locations

1.3 Do minimum package (Package 1)

The do minimum package is an important part of the assessment as it provides a basis for comparison to the proposed packages. It includes committed schemes set out in Work Package 1, listed in **Table 2** below. A Do Minimum future scenario notionally assumes delivery of existing committed interventions within the current and future operational constraints as the assumed growth in passenger and rail freight demand, as set out in the All-Island Rail Strategy, continues to be met by existing road and rail networks.

Table 2: Committed rail enhancements across Ireland

Title	Purpose	Location	Status
Additional Rail Fleet	41 Railcars are under construction and scheduled for service entry by 2023.	Greater Dublin Area (largely)	In construction

[1] Belfast, Dublin, Cork, Limerick, Derry~Londonderry

Title	Purpose	Location	Status
Belfast Transport Hub	Once complete the new Belfast Transport hub will be the main, transport gateway to Belfast, creating a sense of arrival in a modern, progressive city, with rail, bus and coach connections to all parts of Northern Ireland and beyond, scheduled for completion by 2025.	Belfast	Enabling Works
Cork Commuter Rail Programme	A series of projects to develop and expand rail infrastructure and services in the Cork Metropolitan Area. Phase 1 of the Programme has been included in Ireland's National Recovery & Resilience Plan for delivery by 2026.	Cork Metropolitan Area	Strategic Assessment
DART+	A series of projects to develop and expand the DART network in the Greater Dublin Area, with approval of the Preliminary Business Case expected by end 2021.	Greater Dublin Area	Preliminary Business Case
Dublin-Cork Line Speed Improvements	A programme of works over the coming years to improve line speeds on the Dublin – Cork line.	Dublin-Cork	In construction
Enterprise Rolling Stock Replacement	Replacement of the Enterprise fleet to provide 9 new inter-city train set for hourly service frequency on the Belfast-Dublin corridor by 2027. Rolling stock to be future proofed for electrification.	Belfast - Dublin	Pre-Planning
Lisburn Area Renewals	Renewal of existing Track and Signalling within the Lisburn Station Limits and enhanced capacity by 2024.	Lisburn	Pre-Construction
National Train Control Centre	The existing Iarnród Éireann central train control centre is due for replacement due to capacity constraints with the IT systems nearing life expiration, with the replacement system expected to be fully operational by 2026.	Dublin, with network wide benefits	In construction
New Trains 3 Programme	Provision of 21 additional carriages to integrate with existing class 4000 during 2022.	NIR Network Wide	Construction
Park and Ride Programme	Provision of additional Park and Ride spaces throughout the network at existing stations over the period 2023 to 2025.	Ballymena, Bellarena, Moira, Mossley West, Troopersla ne	Planning
Station Development Programme	Enhance facilities at existing Rail Stations on the network over the period 2023 to 2025.	Yorkgate, Lurgan, Ballymena, Posnett St.	Planning

1.4 Transforming Intercity Connectivity packages (Package 2A, 2B and 2C)

There are several important considerations for a high speed network that may impact the deliverability and business case detailed in **Table 3** below.

Table 3: High Speed Segregated vs. Integrated Comparison Table

	Segregated	Integrated
Network	Existing proven technology can be bought 'off the shelf'	Needs technology to be adapted to the network of Ireland
Rolling Stock	Existing high speed trains can be purchased 'off the shelf'	Will require bespoke rolling stock that can operate on the existing conventional network
Capacity	A segregated network will create significant capacity, both on the new line itself, but also on the conventional network through released capacity	Depending on how much of the network is integrated, services will need to operate on a mixed operational railway, potentially including freight, regional and rural passenger
Carbon	Potentially high levels of embedded carbon in the construction of a new dedicated railway. End-user carbon is still considerably lower than road-based transport.	Less embedded carbon as less new construction, the potential for end-user carbon dependent on the attractiveness of journeys and the resulting modal share
Environment	New alignments have the potential to impact a wide range of environmental designated sites or receptors.	Existing railways could run through areas of environmental significance or sensitivity, and any changes could still have an impact.

Around 20 different options for an All-Island high speed rail network were considered before narrowing down to the 3 packages. It was agreed not to create a high speed package with no segregation, this is due to some of the inherent constraints identified in the Work Package 1 report, particularly between Belfast and Dublin, where existing long-distance services interface and share tracks with local commuter networks which limit opportunities to improve journey times without an unacceptable level of impact on the existing network.

The first Intercity package (2A) includes a direct high speed rail link between all city pairing suggested in Sift 1.

The second Intercity package looks at a high speed north-south spine across the island. To establish the best routing options were considered that provide the high population centres that would be given direct access to high speed rail and normalised this by new track distance to establish the most efficient HSE routing across the island.

This review concluded that:

- The smaller estimated demand between Galway and Dublin meant this link was dropped for this package. However this corridor could be linked to a core high speed rail between Dublin and the South West. Similarly, a high speed link between Waterford and Dublin (alone) was estimated to have lower demand. In the table below, we examined serving Cork via both of these cities.
- There are several options for reaching Cork, which are presented in **Table 4** below. Clearly, any proposed new high speed rail between Dublin and South West Ireland would be subject to a rigorous business case that explored a range of route options. For the purposes of modelling a core high speed rail option, we have selected the route that delivers the highest population per km of new track.

Table 4: Options of reaching Cork from Dublin

Route	Approximate Distance (km)	Population served (excluding Dublin)	Population / new track (km)
Dublin – Cork (direct)	250	208,669	835
Dublin – Waterford – Cork	270	262,173	971
Dublin – Limerick – Cork	290	302,861	1,044
Dublin – Galway – Limerick – Cork	390	342,107	877

This Package represents the impact of an integrated high speed railway serving the "spine" of the Island, from Belfast to Dublin to Cork. It assumes Limerick, Waterford, and Galway services will be able to access this line for part of their journey to Dublin and rely on upgraded existing lines for the rest of their journey.

Package 2C assessed a segregated high speed line between Dublin and Belfast and upgraded existing links to all other cities on the island.

Figure 2, **Figure 3**, and **Figure 4** show indicative schematics of the three intercity packages considered for Sift 2.

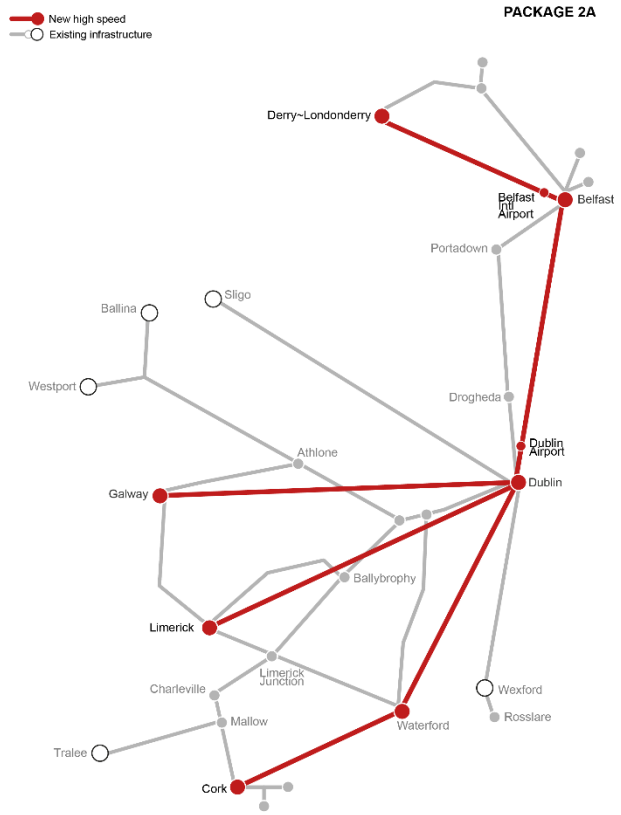


Figure 2: Package 2A – 7 Cities High Speed Rail

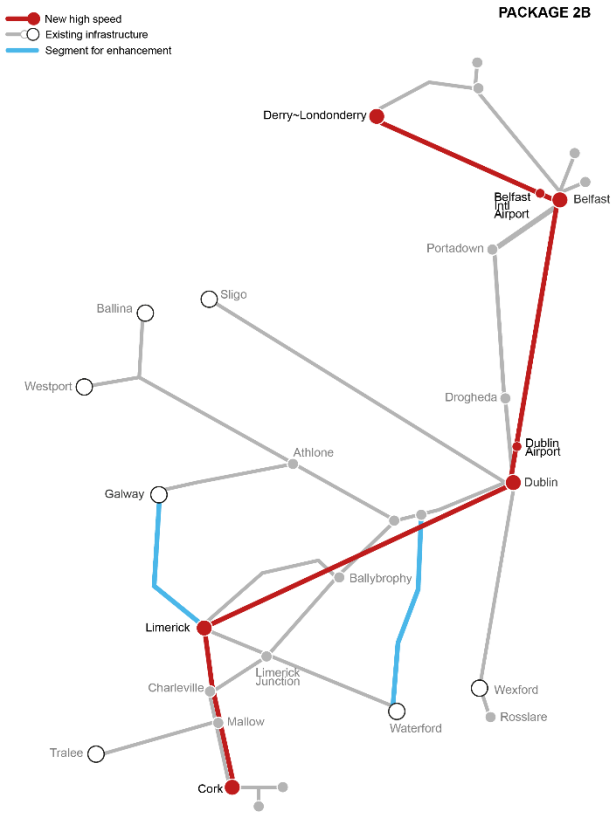


Figure 3: Package 2B – 5 Cities High Speed Rail

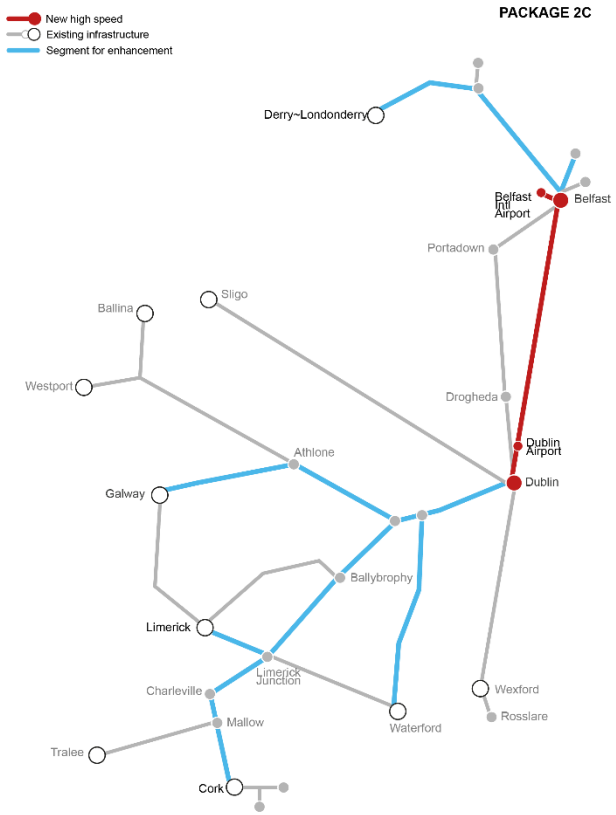


Figure 4: Package 2C – Capital Cities High Speed Rail

1.5 Compelling Regional Connectivity (Package 3)

This package includes the links that were included in Sift 1 either building new conventional lines or upgrading existing lines to higher speed– however with no high speed segregated rail (**Figure 5**). Transport needs on these links will be assessed against new or enhanced lines.

1.6 Step change in Rural Connectivity Package (Package 4)

This package includes the smaller settlements that progressed through Sift 1 on the basis of the potential socio-economic benefits of improving rail service provision (**Figure 6**). Interventions on these links are focused on improvements to existing routes and assessing potential new routes. A key element of this package will improve timetabling and interchange to maximise the opportunities to travel.

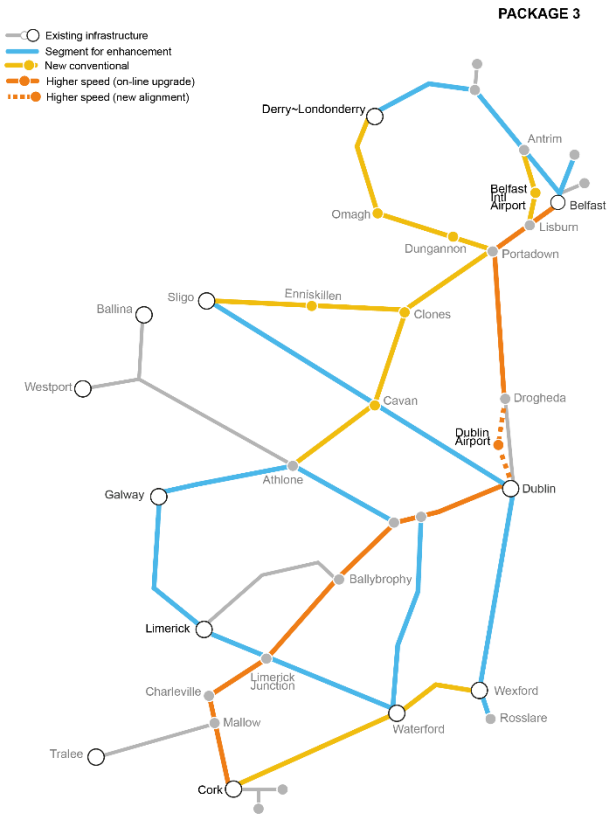


Figure 5: Package 3 – Compelling regional connectivity

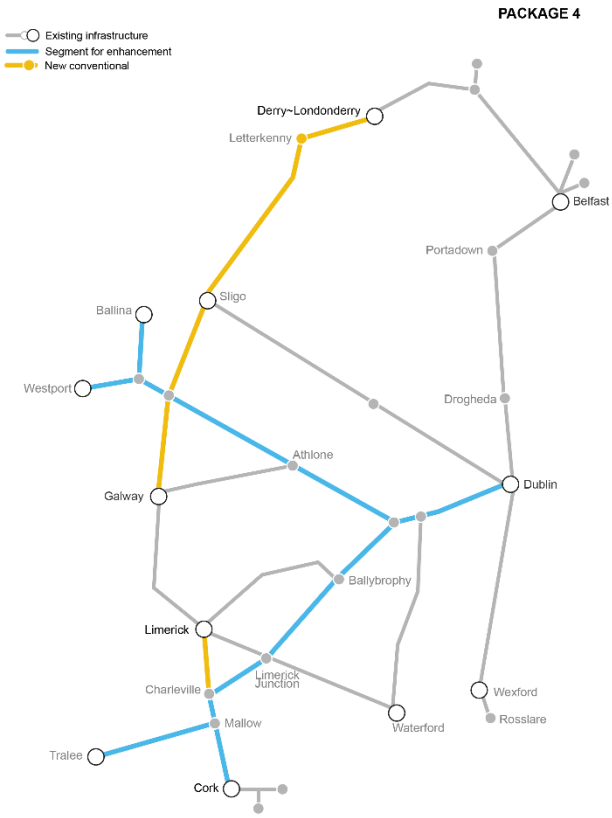


Figure 6: Package 4 – Step change in rural connectivity

Multi-Criteria Assessment Framework

In Sift 2 each package was qualitatively scored using a multi criteria assessment framework (MCAF) which relates potential impacts and outcomes of the packages against the goals and objectives underpinning the Rail Review.

2.1 Defined Strategic Goals and Objectives

Table 5 below outlines the strategic goals and objectives of the Rail Review (identified as part of Work Package 1) and maps the currently anticipated criteria and metrics on which the packages have been scored.

Table 5: Strategic goals, objectives, criteria and metrics

	Goal		Objective	Criteria	Metric
1	**Contribute to Decarbonisation**	1.1	To reduce the carbon emissions associated with rail's construction, operation, and maintenance	Reduction in rail carbon / GHG emissions over study period	Qualitative assessment reflecting scale of new infrastructure and extent of decarbonisation work e.g. electrification
		1.2	To reduce the carbon emissions from motor vehicle travel	Reduction in road carbon / GHG emissions over study period	Qualitative assessment reflecting the scale of improvement to the attractiveness of rail and potential for mode shift to rail
2	**Improve All-Island Connectivity between Major Cities**	2.1	To provide an attractive public transport choice for travel between the seven major cities of Belfast, Derry~Londonderry, Dublin, Waterford, Cork, Limerick, Galway.	Journey time benefits on intercity flows	Journey time (IVT) by rail for 7x7 city matrix, average change
				Increase in access to jobs and services available in the major cities	Population and employment catchments with improved rail accessibility
3	**Enhance Regional & Rural Accessibility**	3.1	To give people in rural and regional areas better access to economic opportunities, and health, education, and civic services	Increase in access to jobs and services in regional and rural areas	Population and employment catchments with improved rail accessibility
		3.2	To improve inter-regional accessibility	In vehicle time benefits on inter-regional flows	Degree to which there is a change in in vehicle time by rail
4	**Encourage Sustainable Mobility**	4.1	To help manage demand through compact growth and better integration of public transport with land use	Stations with transport-oriented development potential	Not assessed at this stage
		4.2	To enhance the integration of rail with other transport modes	Stations as multimodal transport hubs offering convenient interchange between modes	Not assessed at this stage
		4.3	To minimise the negative impact on the environment	Impact on 7 environmental topics (noise, air quality, landscape, townscape, biodiversity, historic environment, water environment)	Summary qualitative score, based on individual scores for each of the 7 environmental impact categories

5	**Foster Economic Activity**	5.1	To contribute to balanced economic growth between urban and regional areas	Wider economic impacts on productivity and distribution of jobs	Population and employment accessible morning commute of the jobs growth area, current vs option
		5.2	To support the efficient movement of goods to and from economic centres and international gateways	Matrix of freight paths between centres and gateways	Freight paths for city-gateway flows
		5.3	To support the efficient movement of people between economic centres and international gateways	Matrix of JTs between centres and gateways	Degree of change in end to end journey time by rail (within & between gateway cities)
6	**Achieve Economic & Financial Feasibility**	6.1	To plan investment in rail that is financially feasible	Overall funding requirement	High-level costs assessment to be based on benchmark 'costs per km' by typology
		6.2	To access potential funding	Source and certainty of funding & scalable to match available funding or to meet changing circumstances	Not assessed at this stage
		6.3	To ensure the benefit cost ratio of investment in the railway network is considered alongside meeting objectives	Value for money assessment	Not assessed at this stage

2.2 MCAF Scoring

A qualitative scoring scale is applied in the MCAF, using a positive (blue) to negative (red) range, to gauge potential scales of impacts and map these against the goals and objectives. The scoring scale is supplemented with a dark red indicator score for potentially 'showstopping' conditions or metrics; and a grey indicator to reflect criteria and metrics that are to be assessed in later stages. **Table 6** below depicts the qualitative scoring scale.

Table 6: MCA Scoring scale

Key	
	Showstopper
	Negative
	Slight Negative
	Neutral
	Slight Positive
	Positive
	N/A

The scoring is qualitative but in some cases is informed by quantifiable evidence, and this evidence is considered in determining appropriate scoring for the criteria. Thresholds between scores and categories are defined based on the spreads of the assessed quantified evidence between the options to provide relative scoring for option sifting and prioritisation purposes only. That is, the thresholds for each metric are set to reflect the ranges of values in any quantified evidence; and for some criteria, the thresholds have also considered the need to ensure that there is sufficient differentiation between options (e.g. it would not help sift options if every package or option scored identically). However, for other criteria it has been more acceptable for all options to receive the same score if there is very little natural variation or it is more of a 'pass/fail' criteria at this early stage – for example the road decarbonisation and environmental impacts topics.

Multi-Criteria Assessment of the Packages

This section discusses each of the goals and objectives, and the approaches to scoring.

3.1 Goal 1 – Contribute to Decarbonisation

The WP2 Sift 2 appraisal of decarbonisation provided an assessment of the six packages against the two decarbonisation metrics – the first focusing on creation of new infrastructure and upgrades to support reductions in traction energy; and the second focusing on likely magnitude of mode shift.

The aim in later sift stages will be to use a quantified approach to develop data which informs each of these metrics in a clearer numerical way, but at this stage the approach was constrained by the availability of data .

3.1.1 Objective 1.1

For **Objective 1.1** the aim was to assess the degree of new network of various types (assuming that new high speed rail requires the greatest degree of capital carbon), and implicit within these types an assumption on the likely timescales for the delivery of benefit (whereby development happening sooner is better). A qualitative approach was adopted for this objective but based on the lengths of new/upgraded lines contained within each option. It is broadly assumed that:

- The highest ranking options will be where there is a mix of upgrade, new conventional rail, and new high speed rail. Benefits accrue earlier in time for upgrades and conventional rail. High speed services deliver benefits in a longer timeframe, and have larger embodied carbon.
- For those packages relying more heavily on high speed rail the benefits are expected to accrue more slowly.
- For a 'Do minimum' situation there will be some improvement but less likely to actively encourage an increase rate of transport decarbonisation.

Data were provided from the project solutions development team detailing the km distances of new and upgraded lines within each option. These were used to assign scores based on the logic above. The Do-Minimum is considered to result in broadly negative impacts to reflect the missed opportunity that arises from continuing the status quo.

When considered in relation to the Do Minimum scenario, all Do Something packages are expected to be have a neutral or positive impact in terms of decarbonisation.

3.1.2 Objective 1.2

For **Objective 1.2** metrics were obtained from the project solutions development team which identified either that packages would result in large improvements in journey time and increased services across all identified routes (achieving the maximum score) or that only some increase against current provision would be seen (which provides a lesser positive impact). As above, the Do-Minimum is considered to result in broadly negative impacts to reflect the missed opportunity that arises from continuing the status quo.

When considered in relation to the Do Minimum scenario, all Do Something packages are expected to be have a neutral or positive impact in terms of decarbonisation.

3.2 Goal 2 – Improve All-Island Connectivity between Major Cities

Relevant policies and plans summarised under the Work Package 1 – Context and Policy Paper identify the importance of investment in north-south connectivity, as well as enhancing links between major cities including consideration of the potential for high/higher speed rail. The key policy drivers include meeting transport demand, compact growth, quality of life.

3.2.1 Objective 2.1

Achieving Objective 2.1 to increase the attractiveness of rail as a public transport choice for travel between the seven major cities of Belfast, Derry~Londonderry, Dublin, Waterford, Cork, Limerick and Galway would require improvements focusing on intercity travel, with fewer intermediate stops and reduced need for interchange on longer distance routes. The scores for **Objective 2.1** were assessed based on two criteria:

- By comparing scales of potential reductions in journey times across to/from the major cities for package scenarios, greater reductions in journey times across the network is treated as a proxy indicator for higher potential mode shift to rail.
- By comparing potential changes in resident population catchments accessible within indicative 60-90 minute travel times to/from each of the seven city centres, greater increases in populations catchments for the seven cities are considered to represent more positive improvements in rail accessibility; and

The catchment analysis and journey time assessments are made using GIS data software and Podaris multi-modal planning tool. These are discussed further in **Section 4.1** below.

When considered in relation to the Do Minimum scenario, all Do Something packages are expected to be have a neutral or positive impact in terms of improving connectivity between major cities. Packages 2A and 2B are expected to provide transformative cross island connectivity and large improvements in journey time which is why they have scored as Positive compared to Package 2C.

3.3 Goal 3 – Enhance Regional & Rural Accessibility

Regional accessibility is also a key focus of national and regional strategic policies, including a focus on improved connectivity to and from the North West. Improving regional access means better economic and social connections for people who do not live in the seven major cities, increasing access to opportunity and supporting balanced regional development. Ireland's National Planning Framework, part of Project Ireland 2040, aims to improve accessibility between centres of scale separate from Dublin.

3.3.1 Objective 3.1

Achieving Objective 3.1 to give people in rural and regional areas better access to economic opportunities, health, education, and civic services would require improvements to the existing rail infrastructure and services with potential infilling with new lines to serve settlements that lack rail services. The scores for Objective 3.1 are assessed by comparing potential changes in employment catchments accessible within indicative 60-90 minute travel times to/from all the seven city centres and large settlements across the island. **Table 7** summarises the large settlements considered in the high-level catchment analysis.

Table 7: Large settlements considered in the catchment analysis

Large settlements considered in the catchment analysis					
Arklow	Banbridge	Craigavon	Enniskillen	Mallow	Sligo
Armagh	Carlow	Downpatrick	Kilkenny	Mullingar	Strabane
Athlone	Castlebar	Drogheda	Killarney	Navan	Tralee
Balbriggan	Cavan	Dundalk	Larne	Newbridge	Tullamore
Ballina	Clonmel	Dungannon	Laytown-Bettystown-Mornington-Donacarney	Newry	Wexford
Ballymena	Coleraine	Ennis	Letterkenny	Omagh	Wicklow
Ballymoney	Cookstown	Enniscorthy	Limavady	Portlaoise	

The scales of increase in numbers of jobs accessible by rail are considered to degrees of positive impacts in regional and rural rail accessibility.

3.3.2 Objective 3.2

To improve inter-regional accessibility would also require improvements to the existing rail network with potential infilling with upgraded or new links to replacement indirect links and reduce interchange times. Similar to the scoring for Object 2.1, the scores for this objective are assessed by comparing potential reductions in journey times across a sample of city pairs, together with qualitative consideration of the potential for rail service improvements from track capacity released as a result of any new and upgraded intercity lines. And similarly, greater reductions in journey times are treated as a proxy indicator for improving inter-regional accessibility.

The catchment analysis and journey time assessments are made using GIS data software and Podaris multi-modal planning tool. These are discussed further in **Section 4.1** below.

3.4 Goal 4 – Encourage Sustainable Mobility

Policies at every level of Government support sustainable mobility aims, with a focus on providing alternative travel options to reduce travel by private motor vehicle, integration of public transport services with each other and with active travel infrastructure, and managing travel demand, including through integrating transport and land use planning through strategies like compact

growth. Note that **Objective 4.1** and **4.2**, namely, to help manage demand through compact growth and better integration of public transport with land use, to enhance the integration of rail with other transport modes will not be part of the Sift 2 assessment as the six proposed packages are high-level in nature and therefore the proposed objective will not be compatible for assessment at this sift.

3.4.1 Objective 4.3

It should be noted that as Objectives 4.1 and 4.2 are not assessed at a package level, the environment assessment captured in Objective 4.3 is presented below the main MCAF table in order to not unduly skew a presentation of assessment against the overall Goal.

For WP2 Sift 2 we have undertaken a qualitative assessment of the six packages against one set of environmental metrics, focusing on minimising the negative impact on the environment.

For **Objective 4.3** the aim was to assess the impacts on the environment against seven criteria, which were Noise, Air Quality, Landscape, Townscape, Biodiversity, Historic Environment and Water Environment. The receptors and datasets for each of these criteria was reviewed to determine if it intersected or overlapped with the 20km corridor for segregated packages, or were within close proximity to the proposed packages to upgrade the existing network. Further details on the scoring results can be found in Error! Reference source not found..

The scoring used a five-point qualitative scale as outlined in Section 2 above, for each of the seven environmental criteria. Once these had been scored, a summary qualitative score was given, based on individual scores for each of the seven categories.

At this early stage of strategy development, where there are no confirmed engineering interventions or alignment options, there was no identification of any 'showstoppers'. Any future stages of strategy development and subsequent scheme optioneering would seek to implement the mitigation hierarchy and to avoid, minimise, and mitigate any impacts that has been identified at Sift 2.

A quantitative assessment is not possible due to the packages being based on 20km wide corridors for segregated new lines considered.

The GIS datasets that have been compiled as part of the environmental aspects of Sift 2 are shown in **Table 8** below.

Table 8: GIS Datasets used in Ireland and NI as part of the assessment of the captioned objective.

Environmental Topic	Northern Ireland datasets	Republic of Ireland datasets
Noise	Environmental Noise Directive – Noise Mapping (Rounds I to III)	Noise (National Noise Maps Rounds I to III)
Air Quality	NI Air Quality NI Air Quality Management Areas (AQMA)	AIR monitoring stations Air Quality Index for Health Air European Monitoring and Evaluation Programme (EMEP) monitoring stations Exceedance of EU air quality limit values
Landscape	National Parks Areas of Outstanding Natural Beauty (AONB) UNESCO World Heritage Sites NI Regional Landscape Character Assessment	National Parks UNESCO World Heritage Sites Landscape Character Areas Protected Views and Prospects Scenic Routes

Environmental Topic	Northern Ireland datasets	Republic of Ireland datasets
	Landscape Character Areas	
Townscape	Ordnance Survey mapping Conservation Areas	Ordnance Survey mapping Architectural Conservation Areas
Historic Environment	Sites and Monuments Record Scheduled Historic Monument Areas Listed Buildings Historic Parks and Gardens UNESCO World Heritage Sites	Sites and Monuments Record Sites and Monuments Record - Zones of notification Record of Monuments and Places National Inventory of Architectural Heritage (NIAH)
Biodiversity	Natura 2000 sites (SAC and SPA) Areas of Special Scientific Interest (ASSI) Ramsar Sites National Nature Reserves Priority Habitats Ancient Tree Inventory	Natura 2000 sites (SAC and SPA) Natural Heritage Area (NHA) Proposed Natural Heritage Area (pNHA) Ramsar Sites Nature Reserves Ancient and Long-Established Woodland Survey
Water Environment	Indicative Flood Maps and Flood Hazard / Flood Risk Maps Designated watercourses under the Water Framework Directive.	CFRAM Flood Extents Maps & Predictive Flood Risk Areas Surface Watercourses and Groundwater Designated watercourses under the Water Framework Directive.

3.5 Goal 5 – Foster Economic Activity

The Trans-European Transport Network (TEN-T) articulates the aim to better connect major cities with ports and airports, and the new opportunities that may be achieved. At a regional level, the three regional assemblies in Ireland identify the existing rail corridors and potential corridors as new economic corridors, with the potential to improve freight movements, workforces, and tourism. In Northern Ireland rail is seen as a method to support the growth of the economy and potential new industrial opportunities through developing the economic corridors. As such, 3 objectives have been defined as an indicator to how well the packages score against this goal.

3.5.1 Objective 5.1

To contribute to balanced economic growth between urban and regional areas can be illustrated based on wider economic impacts on productivity and distribution of jobs and measured based on the population and employment accessible morning commute of the jobs growth areas. The changes in the sizes of populations and/or numbers of jobs within station catchment areas indicate scales of potential demand or mode shift and assessed based on the relative change against a defined base case using the GIS and Podaris planning tool (**Section 4.1**); and the scoring considers the degree to with the assessed potential changes in population and employment catchments are shared between the seven major cities and the remaining samples of large settlements. If the potential impacts tend to be biased in favour of either the major cities or the larger sample of other settlements across the island, the package would be considered to score negatively; and any

packages that present a more equal distribution of catchment effects between major cities and other settlements would be considered to score positively.

3.5.2 Objective 5.2

For WP2 Sift 2 freight analysis undertaken for Sift 1, where we developed a detailed Origin and Destination freight demand matrix between NUTS 3 Regions, has been built upon. This allowed consideration of the potential tonnage that could be lifted and the distance between these points. This has allowed identification of the key ODs for international gateways and key conurbations. To assess the potential scale of mode shift to rail a 5% modal share and 10% modal share have been assessed.

These modal shares are dependent on a number of wider constraints being addressed including changes to the track access charges to reduce them and help improve the competitiveness of rail freight.

The assessment of this metric is based on the potential number of freight paths that would become available across the network between centres and gateways. Where building new segregated high speed rail is proposed it has been assumed that this will free up existing rail infrastructure for more freight, regional and suburban services and the bigger the scale of new high speed rail the more potential freight paths on the network. In addition, Package 3 will upgrade the existing lines and create new connections which will free capacity on the network and potentially bring new customer to rail freight across Ireland.

3.5.3 Objective 5.3

The goal to support the efficient movement of people between economic centres and international gateways considers the potential scales of change in both populations and jobs catchments across the following gateways.

- Dublin Airport
- Shannon Airport
- Cork Airport
- Belfast International Airport
- George Best Belfast City Airport
- Ireland West Airport Knock
- City of Derry Airport
- Kerry Airport

Larger potential changes in the total resident populations and jobs catchments accessible within indicative 60-90 minute travel times to/from each of the gateway centres are considered to represent more positive impacts in terms of more transport economic efficiency between economic centres and gateways.

The catchment analysis uses GIS data software and Podaris multi-modal planning tool. These are discussed further in **Section 4.1** below.

3.6 Goal 6 – Achieve Economic & Financial Feasibility

With significant plans for investment in transport infrastructure, delivering greater value of money is key. Ireland's Public Spending Code requires that for a project to proceed it must be the 'best means to a particular policy goal', while Northern Ireland's Better Business Cases NI Supplementary Guidance aims to ensure that public expenditure is 'put to use in a way that delivers the maximum value'.

Ireland's new National Development Plan sets out significant spending on transport infrastructure, while previous funding announcements note the need to meet steady state investment levels. Northern Ireland's Investment Strategy acknowledges the potential need for alternative funding when budgets are limited. In addition, there may be opportunities to better align investment strategies with broader funding sources, such as EU programmes, or explore potential additional sources.

The key policy drivers include: Steady state investment, funding capital and operating needs, efficiency, meeting demand, maximising benefit, accountability.

Note that **Objective 6.2** and **6.3**, namely, to help manage demand through compact growth and better integration of public transport with land use, to enhance the integration of rail with other transport modes will not be part of the Sift 2 assessment as the six proposed packages are high-level in nature and the assessment is largely qualitative.

3.6.1 Objective 6.1

To plan investment in rail that is financially feasible, a high-level costs assessment is based on benchmark 'costs per km' by typology, considering up-front capital expenditure for implementation and high-level assumptions about the potential net increases in ongoing annual operating costs.

It should be noted that the cost captured in Sift 2 includes illustrative values for part-capex and opex. Broad, high-level benchmarked costs on a 'per track-km' basis only have been considered, not including all infrastructure items, full add-ons or risk. Therefore, these values do not represent a comprehensive estimate of capex or opex, but are considered adequate for high-level differentiation purposes at this stage.

3.7 Other considerations

In addition to the strategic goals, considerations were also given to concerns about feasibility, risk, and stakeholder consensus.

3.7.1 Feasibility & Risk

Qualitative scoring of the operational feasibility and deliverability considers high-level reviews of the potential engineering and operational constraints and challenges, as well as the potential risks and their severities.

3.7.2 Stakeholder Consensus

Critical to the success of the project is ensuring there is public engagement and a level of support across the aims of the Review. Moreover, the ability to incorporate views and insights from the public and stakeholders will add significant value to options development and to gain a baseline of sentiment on rail on the island of Ireland.

The project team delivered an 8-week public and stakeholder consultation across the island of Ireland as part of Work Package 1. The benefit of carrying out the consultation at an early-stage was to open the Review to suggestions, ideas and to learn from the experiences of people on the island of Ireland when it comes to rail as a mode of travel. In addition, engaging with influential and vocal stakeholders to share their ambitions for the future of rail, increases the prospect of stakeholder buy-in and acceptability as the project progresses through subsequent stages and potential implementation.

The public consultation submissions were analysed against 11 key themes, shown on **Figure 7**. A detailed summary can be found under the Context and Policy Report under Work Package 1. The relative engagement across themes have been considered during the formulation of the 6 proposed package in Work Package 2 and the level of engagements on the key themes will be considered when assigning the relative weightings towards a particular theme.

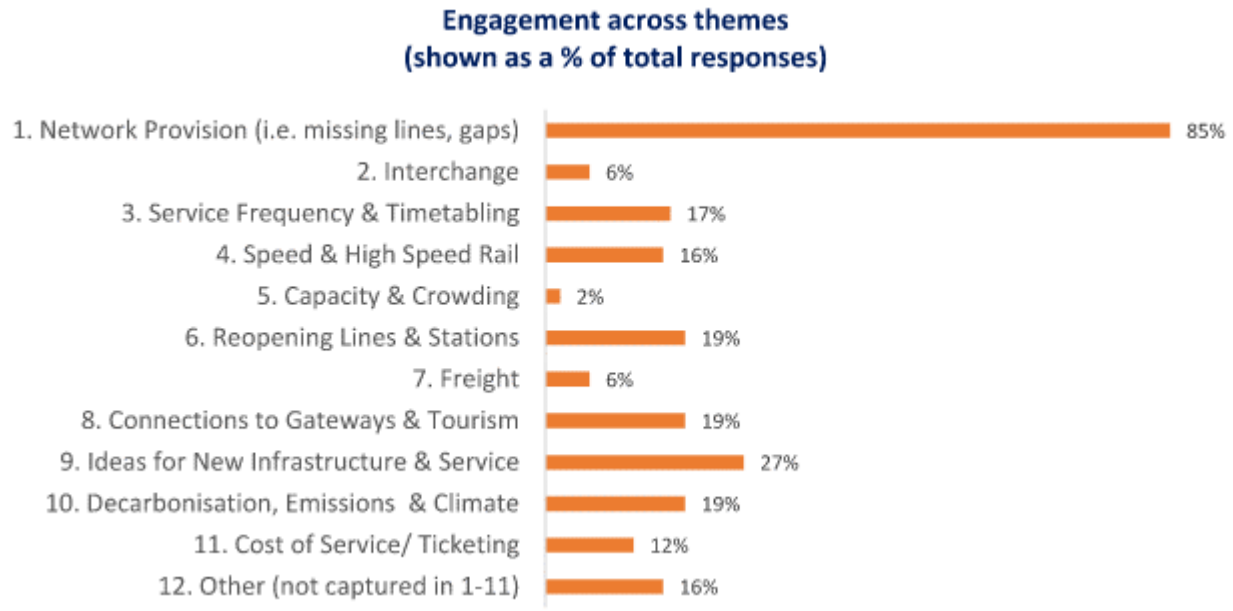


Figure 7: Summary of public engagement towards 11 key themes

Journey Time Assessment

For WP2 Sift 2 of the AIRS, journey time assessment has been conducted using a combination of Podaris (generating potential routes and associated timetables) and GIS (creating a network and calculating journey times between a series of origins and destinations.

The analysis and assessment for the remaining Goals and associated metrics will be undertaken from the interrogation of the Podaris model and GIS data and the process is described in this section.

4.1 Podaris

4.1.1 Background

The tool Podaris was utilised to develop high-level outputs for prioritisation and sifting. Several assumptions have been made and applied across scenarios, to ensure that consistent results can be extracted which are realistic enough for comparisons, but will facilitate further refinement in later sifts.

4.1.2 New High Speed and Higher-Speed lines

New high speed and higher-speed lines were drawn both between city pairings (city pairs which passed Sift 1) and city pairings with selected regional stations (**Table 9**).

- It was assumed the infrastructure would be entirely double-track.
- The most direct line between stations was drawn, avoiding water bodies. In all cases, further consideration of appropriate alignments (avoiding gradients, settlements, known constraints) would be required to fully assess the likely feasibility, costs and benefits. For Sift 2, the direct, straight-line approach was applied to all high speed links, ensuring consistency.
- Two speeds for lines were tested: 200km/h (higher-speed) and 300km/h (high speed), in line with speeds used on high speed and higher-speed lines internationally.
- It was assumed that high speed lines to/through Belfast would also include a new stop at Belfast International Airport, and high speed lines to/through Dublin would include a new stop at Dublin Airport.
- It was assumed that all high speed stations would have a 90 second dwell time

Table 9: Modelled routes for New High Speed and Higher-Speed lines

Route	Stops	Speeds tested
High Speed Belfast – Dublin (Direct)	Belfast, Dublin	200km/h, 300km/h
High Speed 5 Cities Derry~Londonderry-Cork	Derry~Londonderry, Belfast Int'l Airport, Belfast, Dublin Airport, Dublin, Limerick, Cork	200km/h, 300km/h
High Speed 4 Cities Belfast-Cork	Belfast, Dublin Airport, Dublin, Limerick, Cork	200km/h, 300km/h
High Speed 6 Cities	Derry~Londonderry, Belfast Int' Airport, Belfast, Dublin Airport, Dublin, Waterford, Cork, Limerick, Galway	200km/h, 300km/h
High Speed 6 Cities (South)	Belfast, Dublin Airport, Dublin, Waterford, Cork, Limerick, Galway	200km/h, 300km/h
High Speed 7 Cities (Direct)	Derry~Londonderry, Belfast Int' Airport, Belfast, Dublin Airport, Dublin, Waterford, Cork, Limerick, Galway, Wexford	200km/h, 300km/h
High Speed 7 Cities (Direct)	Derry~Londonderry, Belfast Int' Airport, Belfast, Dublin Airport, Dublin, Waterford, Cork, Limerick, Galway, Wexford	200km/h, 300km/h
Regional High Speed 6 Cities (Limerick T)	Derry~Londonderry, Belfast Int' Airport, Belfast, Dundalk, Dublin Airport, Dublin, Portlaoise, Galway, Limerick, Cork	200km/h, 300km/h
Regional High Speed 7 Cities (via Athlone)	Derry~Londonderry, Belfast Int' Airport, Belfast, Dundalk, Dublin Airport, Dublin, Portlaoise, Athlone, Galway, Limerick, Cork	200km/h, 300km/h

4.1.3 New conventional speed lines

New conventional speed lines were drawn to fill gaps in the network, with the particular aims of connecting towns with populations of over 10,000 to the network. Straight, direct lines between stations were also modelled as with the new high speed routes. A speed of 120km/h was assumed for all lines, although in reality, this may be higher for certain routes. A speed of 120km/h is taken as the minimum desirable speed for the future AIR network. A 45 second dwell time at each station was assumed.

These were modelled as end-to-end routes, even though some sections of some routes already exist. Other routes (e.g. Sligo-Galway) would be completely new routes.

The following routes were modelled (**Table 10**):

Table 10: Modelled routes for New conventional speed lines

Route	Stops	Speeds tested
New conventional Sligo-Galway	Sligo, Coollney, Charlestown, Knock Airport, Claremorris, Tuam, Athenry, Galway	120km/h
New conventional Derry~Londonderry-Sligo	Derry~Londonderry, Letterkenny, Ballybofey, Ballyshannon, Bundoran, Sligo	120km/h
New conventional Derry~Londonderry-Portadown	Derry~Londonderry, Strabane, Omagh, Dungannon, Portadown	120km/h
New conventional Sligo-Omagh	Sligo, Enniskillen, Omagh	120km/h
New conventional Antrim-Lisburn	Antrim, Belfast Int' Airport, Lisburn	120km/h
New conventional Cork-Waterford	Cork, Midleton, Youghal, Dungarvan, Waterford	120km/h
New conventional Drogheda-Dublin	Drogheda, Swords, Dublin Airport, Dublin	120km/h
New conventional Sligo-Belfast	Sligo, Enniskillen, Monaghan, Armagh, Belfast	120km/h
New conventional Derry~Londonderry-Dublin (via Navan)	Derry~Londonderry, Strabane, Clones, Navan, Dublin	120km/h
New conventional Belfast-Galway	Belfast, Portadown, Monaghan, Cavan, Mullingar, Athlone, Galway	120km/h

Total = 1,588km of new conventional track estimated

4.1.4 Enhanced existing lines

Existing lines were modelled as 'enhanced' through several changes:

- Assuming all are double-track
- Assuming the same track alignment and station locations as present
- Increasing average speeds to 120km/h for routes where existing speeds are lower than 120km/h
- Increasing average speeds to 160km/h for routes where existing speeds are already greater than 120km/h
- 45 seconds dwell time at stations

Total = 2,511km of track to enhance (most of the network besides short branch lines)

4.2 GIS

The Geographic Information System (GIS) package ArcGIS Pro was used to calculate journey times for key origin-destination pairs using the outputs from the Podaris workflow together with timetable information for the existing rail network. The pairs of origins and destinations were:

- The two most significant major cities, based on population and distance, for each large town with a population greater than 10,000;
- The three most significant airports for each large town, consisting of Dublin Airport (as the main international gateway for the island), and the two closest other airports.

The analysis process in ArcGIS Pro has made use of the Network Analyst extension. A network dataset, consisting of both the street and public transport networks for the island of Ireland, was built, allowing for movements through the network to be modelled both spatially and temporally. The street network was created using OpenStreetMap data while the public transport network was created using GTFS timetable data. The existing public transport data was derived from datasets published by Transport for Ireland and from data generated from printed timetables on the Translink website, while GTFS data for proposed routes was exported with Podaris and then combined with the existing datasets using Python prior to being imported to ArcGIS Pro.in

Once the network dataset was built, Route analysis using Network Analyst was conducted by importing the list of origins and destinations described above. The journey times for all pairs of origins and destinations was calculated for each scenario by configuring the active public transport to exclude the rail routes that did not form part of each scenario. The difference in journey times for each pair of locations versus the base case was then calculated, and the aggregate saving in journey time for each package was calculated based on a weighting of the importance of each origin-destination pair as described in Section 4.5.3.

4.3 High-level infrastructure costs

At this point, high-level infrastructure costs have been estimated based on the track infrastructure required. Costs have been derived on a per-kilometre basis from the following resources:

- PWC's 2016 report: 'High speed rail international benchmarking study – HS2 Phase Two'[2]. This is a study to examine the UK's HS2 Phase Two budget and delivery planning within an international context, and the study considered 32 international comparator high speed rail schemes as part of a cost benchmarking exercise. **The key findings from this report relevant to All-Island Rail are the averaged, normalised comparator costs per route km for delivering high speed rail at different times, in different currencies, in different global contexts.**
- The European Commission's 2018 report: 'Assessment of unit costs (standard prices) of rail projects (CAPital Expenditure)'[3]. This is an extensive benchmarking report, collating costs from across rail projects in the European Union. **The key findings from this report relevant to All-Island Rail are the averaged, normalised comparator costs per route km for delivering new or upgraded rail infrastructure (other than high speed rail) in Europe.**
- The UK's Office of Road and Rail (ORR), industry finance reports[4], for High Speed 1 and for Northern Ireland Railways. Rail industry finance reports are published annually; and **the key inputs relevant to All-Island Rail are the actual annual operating costs for high speed rail in the UK and for conventional rail in Northern Ireland.**

The bases for the Sift 2 costs from these resources are summarised in **Table 11**.

Table 11: Assumed benchmark unit costs for Sift 2

Assumed unit costs (EUR, millions/km, 2021 prices)	CAPEX /KM	Source	OPEX /KM	Source
New high speed	€ 45	£32m per route km (GBP 2011 prices, adjusted to EUR 2021 prices)	€ 2.4	Adjusted to EUR 2021 prices, based on ORR Table 7250: High Speed 1 finances (2015/15-2020/21)
Enhancements	€ 7		€ 0.25	

[2] High speed rail international benchmarking study (publishing.service.gov.uk)

[3] https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/assess_unit_cost_rail_en.pdf

[4] https://dataportal.orr.gov.uk/statistics/finance/rail-industry-finance

New conventional	€ 9	EU commission report Figure 4, mean values adjusted to 2021 prices	€ 0.25	Adjusted to EUR 2021 prices, based on ORR Table 7260: Northern Ireland Railways finances (2015/15-2020/21)
New higher speed	€ 11		€ 0.25	

4.4 Generalised Journey Times (GJTs)

4.4.1 Background

This is a short technical note to outline the methodology used to calculate the current Generalised Journey Times (GJTs) for the city pairings made up of two of the seven major cities as outlined in goal 2 of the strategic rail review (https://strategicrailreview.com/goals-and-objectives/) and the revised GJT's for those city pairings after the implementation of several high speed rail options.

GJT for rail is made up of three components

- In-vehicle time (IVT): The amount of time spent inside the train itself from origin to destination
- Frequency penalties: The lower frequency a train service has, the longer passengers have to wait at the station for and the less closely they can time their arrival at or departure from the station to their preferred time. Therefore, to take account of this, a frequency penalty is applied increasing the less frequent service. Standard values for frequency penalties in the UK can be found in the Passenger Demand Forecast Handbook (PDFH) and these are the values we have used for calculating GJT for this piece of work.
- Interchange penalties: The addition of an interchange as part of a train journey represents an inconvenience to the passenger. This is accounted for by adding both the time required to make the interchange to the overall GJT but by also adding an interchange penalty the value of which varies depending upon the overall journey distance, on the assumption that an interchange on a long journey is likely to represent more of an overall inconvenience than an interchange on a shorter journey. Standard values or interchange penalties can also be found in the PDFH and we have used these values for calculating GJT for this piece of work.

The overall calculation for GJT is as follows

GJT = IVT + Frequency Penalties + Interchange Time + Interchange Penalties

4.5 GJT Methodology

4.5.1 Calculating Existing GJTs

As a first step, we started by calculating the existing GJTs, using the formula listed above, for the city pairings made up of two of the seven major cities that were taken forward from the first sift. These can be found in **Table 12** below:

Table 12: O-D City pairs

Origin	Destination
Belfast	Derry~Londonderry
Dublin	Cork
Belfast	Dublin

Origin	Destination
Dublin	Galway
Dublin	Limerick
Dublin	Waterford
Galway	Limerick
Cork	Limerick
Cork	Waterford
Limerick	Waterford
Belfast	Galway
Cork	Galway
Derry~Londonderry	Galway
Dublin	Derry~Londonderry

The IVTs for each of the above city pairings was calculated through an analysis of the existing timetables across the Island of Ireland

Frequencies for each of the above city pairings were sourced by performing timetable analysis on the existing timetables across the Island of Ireland . The frequencies were then translated into frequency penalties by applying the corresponding frequency penalty as found in the PDFH.

The number of interchanges and average interchange time for each interchange were sourced by performing timetable analysis on the existing timetables across the Island of Ireland. These were then translated into interchange penalties by applying the corresponding interchange penalty as found in the PDFH using route distances.

Following all of these steps, we were able to produce existing GJTs for each of the city pairs broken down by IVT, Frequency Penalties and Interchange Penalties. These were then inputted into our journey time matrix model.

4.5.2 Calculating High Speed Package GJTs

As part of the optioneering work we then produced several possible high speed networks that could potentially be implemented as part of this project. We then used Podaris to produce as the crow flies (but avoiding water/ inland water bodies) IVTs for each of the connections on the proposed high speed networks at both 200kmh and 300kmh.

For each of the high speed options, we assumed that this would result in a standard 1tph frequency for all of the city pairings listed above. In cases where this is a change in the existing frequency, which would result in a different frequency penalty, this was applied.

For each of the high speed options, we assumed that for each of the city pairings passengers would choose the quickest route available to them. In cases where this route was a different route to the existing route that passengers would use on the existing railway network this results in either removing the need for interchange or changing the overall distance of the journey. Where this is the case we have used the values from the PDFH to revise the interchange penalties in accordingly. In the absence of a new timetable for each of the high speed options, we have assumed that the average interchange time remains constant in cases where a journey requires an interchange.

Following all of these steps, we were able to produce indicative GJTs for each of the city pairs under each of the proposed high speed rail infrastructure options broken down by IVT, Frequency Penalties and Interchange penalties.

4.5.3 GJT Changes and Outputs

Following on from calculating both existing GJTs and Indicative GJTs we were then able to calculate the GJT changes associated with each option. For this section, we produced the following outputs

We produced GJT changes for each city pairing for each of the proposed high speed options compared to existing GJTs. These changes were also broken down by IVT, interchange penalty and frequency penalty changes as well as the overall GJT change.

We produced the cumulative GJT change for each of the proposed high speed options compared with the existing GJTs for all of the city pairings. For this number, each of the city pairings was considered to have the same importance and was not weighted in any way.

We also produced a separate Cumulative GJT change for each of the proposed high speed options compared with the existing GJTs for all of the city pairings that were weighted by the relative importance of each route. In terms of strategic importance to the wider economy and the population of the Island of Ireland, journey time savings are more important between some city pairings than others. Each city pairing was given a weighting based on its origin-destination cumulative population as a percentage of the overall cumulative origin-destination population of all of the city pairings assessed. It is important to note that cumulative population is being used as an initial starting point to determine the relative strategic importance of the city pairings. We recognise that other parameters are important in determining relative strategic importance and we intend to explore these in later sifts. This weight was then applied to the unweighted GJT saving for the city pairing to come up with a weighted GJT saving for each city pairing. These figures were then added together to produce a cumulative weighted GJT change. It is important to note that the weighted GJT numbers are intended to be used as a comparison between different high speed options as a way of assessing their GJT benefits relative to one another. **They should not be considered in isolation and be taken as achievable GJT savings.**

Finally, we produced the total person minutes saved based on 2019 end to end demand figures and 2040 end to end demand figures. These were combined with the weighted and unweighted GJT savings to produce the following outputs

- Unweighted total person minutes saved using 2019 demand
- Weighted total person minutes saved using 2019 demand
- Unweighted total person minutes saved using 2040 demand
- Weighted total person minutes saved using 2040 demand

4.6 Overall GJT Assessment Summary

To conclude, this technical note has

- Outlined the theoretical background of GJTs
- Outlined how existing GJTs were calculated for the relevant city pairings
- Outlined how indicative GJTs were calculated for the relevant city pairings under several high speed infrastructure options

- Outlined the GJT outputs produced to compare the relative benefits of each of the proposed high speed options

Residential and Employment Population Catchment Analysis

To quantify the increase in accessibility offered by each proposed package, the catchment area of each major city, large town with a population of over 10,000, and airport has been calculated for the base case and for each proposed package. This process used the same process in Podaris and ArcGIS Pro Network Analyst as described in Section 3.6 to create a network dataset.

Once the network dataset was created, Service Area analysis within Network Analyst was used to calculate the catchment area for different time thresholds (30, 60, 90, and 120 minutes) for each location. These catchment areas, represented as polygons, were then exported for post-processing in Python. Each polygon was used to overlay population and employment statistics at the smallest geographical output level in both jurisdictions to calculate the total residential and employment catchment for each package. By comparing the increase in catchment population for each package for each location, the relative benefit of each option can be determined and the results are then aggregated for reporting.

Sift 2 Assessment Results

Table 13 presents an overall summary of the multi-criteria assessment scores, by goal and by package. A detailed explanation can be found in Appendix A.

Table 13 - GIS Datasets used in Ireland and NI as part of the assessment of the captioned objective.

Goal		Objective		Package 2A: All 7 cities HSR	Package 2B: Large 5 cities HSR	Package 2C: Capital cities HSR	Package 3: Regional connectivity	Package 4: Rural connectivity
1	Contribute to Decarbonisation	1.1	To reduce the carbon emissions associated with rail's construction, operation, and maintenance	Slight Positive	Slight Positive	Positive	Neutral	Positive
		1.2	To reduce the carbon emissions from motor vehicle travel	Positive	Positive	Positive	Positive	Slight Positive
2	Improve All Island Connectivity between Major Cities	2.1	To provide an attractive public transport choice for travel between the seven major cities of Belfast, Derry/Londonderry, Dublin, Waterford, Cork, Limerick, Galway.	Positive	Positive	Slight Positive	Slight Positive	Neutral
				Slight Positive	Slight Positive	Slight Positive	Positive	Neutral
3	Enhance Regional & Rural Accessibility	3.1	To give people in rural and regional areas better access to economic opportunities, and health, education, and civic services	Neutral	Neutral	Slight Positive	Positive	Neutral
		3.2	To improve inter-regional accessibility	Neutral	Neutral	Slight Positive	Positive	Slight Positive
4	Encourage Sustainable Mobility	4.1	To help manage demand through compact growth and better integration of public transport with land use	To be assessed in Sift 3				
		4.2	To enhance the integration of rail with other transport modes					
		4.3	To minimise the negative impact on the environment	Qualitative assessment reported separately below in Sift 2				

Goal		Objective		Package 2A: All 7 cities HSR	Package 2B: Large 5 cities HSR	Package 2C: Capital cities HSR	Package 3: Regional connectivity	Package 4: Rural connectivity
5	Foster Economic Activity	5.1	To contribute to balanced economic growth between urban and regional areas	Slight Negative	Neutral	Slight Positive	Positive	Slight Positive
		5.2	To support the efficient movement of goods to and from economic centres and international gateways	Positive	Slight Positive	Neutral	Slight Positive	Neutral
		5.3	To support the efficient movement of people between economic centres and international gateways	Slight Positive	Slight Positive	Positive	Positive	Neutral
6	Achieve Economic and Financial Feasibility	6.1	To plan investment in rail that is financially feasible	Negative	Negative	Slight Negative	Negative	Slight Negative
		6.2	To access potential funding	To be assessed in Sift 3				
		6.3	To ensure the benefit cost ratio of investment in the railway network is considered alongside meeting objectives					

Environmental impacts	To minimise the negative impact on the environment	Slight Negative	Slight Negative	Slight Negative-Neutral	Slight Negative	Slight Negative-Neutral

Key
Showstopper
Negative
Slight Negative
Neutral
Slight Positive
Positive
N/A

Conclusion

7.1 Conclusions

In Sift 2 five discrete Packages have been assessed qualitatively against the All-Island Rail Strategy's Goals and Objectives. The first three Packages focussed on different configurations of a potential high speed rail network, the fourth focussed on boosting Regional connectivity, and the fifth explored opportunities to develop the rail network to better serve rural communities.

This sift has demonstrated that the high speed rail packages would support the Strategy's decarbonisation, connectivity, and economic goals, while the regional and rural packages would enhance regional and rural accessibility. This suggests that a combination of intercity (high speed or other form of improved connectivity), regional, and rural interventions will be needed to deliver all the Goals and Objectives of this study.

This sift also found that an All-Island high speed rail network focussed on a “spine” from Belfast to Dublin to South West Ireland would achieve the same goals and objectives as alternative, more costly networks, such as one based on multiple high speed railways radiating from Dublin. This has enabled us to objectively rule out Package 2A, because:

- The most viable corridors for high speed rail are those that carry highest demand between Ireland’s key cities, over long distances. These flows are Belfast – Dublin and Dublin – South West (serving Galway, Limerick, and Cork). If this corridor could be connected to Derry~Londonderry via a link to Antrim and/or a new railway from Portadown to Derry~Londonderry, then this would also deliver direct Dublin – Derry~Londonderry services.
- While new high speed rail between Belfast and Derry~Londonderry would deliver transformational journey time savings between these cities, it would not deliver benefits for other towns and communities along this corridor. We believe there is a stronger case for a regular new railway between Belfast/Portadown and Derry~Londonderry as this line could also serve towns such as Dungannon, Omagh, and Strabane.
- There would be insufficient demand between Galway and Dublin to justify new high speed rail between these two cities (alone) – but this corridor could be linked to a core Dublin – South West high speed rail. Similarly, high speed rail between Waterford and Dublin (alone) would not attract sufficient demand.
- In summary, a single “spine” high speed line running from the South West of Ireland to Belfast via Dublin would deliver transformational connectivity improvements for all the Island’s key cities, at a fraction of the cost of building 3-4 new lines.

In Sift 3 (Stage G) we will assess the components of the Packages at an intervention level and refine our proposed packages for modelling in Stage H.

Appendix A

Emerging Rail Freight Strategy

Introduction

The purpose of this Technical Note is to set out a broad high level qualitative assessment of potential future service scenarios for rail freight in Ireland. It is informed by a review of and conforms to the options outlined in the *Rail Freight 2040 Strategy*, alongside the outputs from the baseline O-D matrix and the BAU forecast, and our extensive knowledge of the freight market.

Rail Freight 2040 Strategy

This is a strategy document published by *Iarnrod Eireann* in 2021. While it only covers the Republic of Ireland, its implementation will impact on the viability of rail freight across the island of Ireland. The document sets out a strategy to deliver growth in both rail freight volumes and market share, while also contributing towards Ireland meeting its environment and sustainability goals.

The aim of the strategy is to increase rail's market share so that it is broadly comparable to other European countries, while at the same time reducing CO_2 emissions associated with freight transport and delivering regional economic development. It notes that rail freight volumes have fallen from just under 4 million tonnes in 1981 to around 0.3 million tonnes currently.

The strategy recognises that future rail freight growth will need to be generated from 'modal shift' from the road haulage sector. An analysis of current road freight traffics within the Republic of Ireland was therefore conducted to support the strategy development. It subsequently established that demand for future rail freight services is likely to be focused at the Tier 1 ports (Dublin, Cork and Foynes) and along the following region-to-region pairs (this being where current road freight flows are the largest):

- Greater Dublin area – South West (Cork);
- Greater Dublin area – Mid West (Limerick);
- Greater Dublin area – West (Galway);
- Greater Dublin area – Border (Sligo).

Unsurprisingly, Dublin is identified as a key source of demand, both domestically and at the busiest port in the country. Given that the strategy only covers the Republic of Ireland, flows between the greater Dublin area and the wider Belfast conurbation are not considered, albeit it would not be surprising if demand was also identified along this corridor (see below). To support and facilitate rail freight growth (at the locations and corridors identified above), the strategy outlines actions in the following key areas:

- Investment in infrastructure, both on the track network and in terminals;
- Investment in modern rolling stock;
- Lowering track access charges; and
- Various other policy initiatives.

Infrastructure investments include the development of new 'Strategic Rail Freight Interchanges' or 'SRFIs' at Dublin and Limerick. These will be similar to developments elsewhere in Europe, combining large-scale warehousing, intermodal terminal facilities and access to the main road network at one location. Smaller-scale 'Tactical Rail Freight Terminals' or 'TRFTs' are proposed for Cork, Galway and Sligo to enable sustainable intermodal rail freight services to/from their respective regions. TRFTs are intended to be smaller than SRFIs, being stand-alone intermodal terminals located close to existing and planned industrial areas. Other terminal developments include a more modern and efficient facility within the Dublin port estate and new connections to the ports of Cork and Foynes. The existing active intermodal terminal within Waterford port is also noted.

The strategy notes that investment will be made in a fleet of new intermodal wagons. They will be capable of conveying 45ft pallet-wide shipping containers and reefer boxes. Alongside this, a fleet of new bi-mode electric-diesel locomotives is also promised to replace the existing but ageing traction (Class 071).

In order to support a growth in rail freight volumes, the strategy outlines the rail network developments that will be required. This includes:

- Development of passing loops – it acknowledges that growing passenger volumes on a predominantly single-track network will be increasingly difficult. More extensive double-tracking and new passing loops will therefore be developed at key points on the network; and
- Dedicated freight paths will be developed within the working timetable to support intermodal freight services.

The strategy notes that Ireland has some of the highest track access charges in Europe. It states that a review of track access charges will be undertaken, including identifying the funding required to lower charges for freight services. It states that funding will be sought from domestic Government budgets to meet the cost of capital investments. This will be supported by contributions from the European Commission and private sector funding will also be secured for new facilities and rolling stock.

Origin-Destination Matrix and Forecast Traffics

To support this all-Ireland rail freight assessment, traffic flows (current and forecast) across the island of Ireland have been established my MDST. The Technical Note *'Generating an O-D Matrix for freight movements in Ireland'* reports on the methodology and outputs from this task. In summary, it quantifies current road and rail freight volumes moving within the island of Ireland by origin and destination region, alongside a 'business as usual' (BAU) forecast for 2040 for road flows (again by origin and destination region). The purpose of the exercise was to extend the Rail Freight 2040 Strategy traffic analysis to the whole island of Ireland and to produce projections of future road freight demand on a BAU basis.

For rail freight, the Technical Note identified the following current services and overall demand (just over 0.3 million tonnes-lifted). In contrast, surface freight in Ireland is dominated by the road haulage sector, which is estimated to currently lift around 229 million tonnes per annum. This is expected to grow to 267 million tonnes by 2040 on a BAU basis.

A summary of the key existing rail freight services on the island of Ireland is provided in Table A-1, and the volumes the commodities transported by rail freight are presented in Table A-2.

Table A-1: Current Rail Freight Services

Type	Service	Train Type	Operates Between
IWT (International Warehousing and Transport)	6 trains per week Monday to Friday	Intermodal	Ballina and Dublin Port
DFDS	2 trains per week	Intermodal	Ballina and Belview Port (near Waterford City)
Coillte	3 trains from both Ballina and Westport to Waterford on a weekly basis	Pulpwood	Ballina / Westport and Waterford
Boliden/Tara Mines	3 trains per day from Tara Mines to Dublin Port 5 days per week	Mineral Ore	Tara Mines (near Navan) and Dublin Port

Table A-2: Current Rail Freight Volumes

Commodity	000s tonnes-lifted	Assumed service
Products of agriculture, hunting, and forestry; fish and other fishing products	49	Coillte. Pulpwood: Ballina / Westport and Waterford
Metal ores and other mining and quarrying products; peat; uranium and thorium	139	Boliden/Tara Mines. Mineral Ore: Tara Mines (near Navan) and Dublin Port
Food products, beverages and tobacco	158	DFDS. Intermodal: Ballina and Belview Port (near Waterford City)
Total	**346**	

From Technical Note *'Generating an O-D Matrix for freight movements in Ireland'*

One of the conclusions that emerges from the O-D Matrix assessment is that it supports the key message stated in the *Rail Freight Strategy 2040*, namely that future rail freight growth will need to be generated predominantly from 'modal shift' from the road haulage sector (rather than organic market growth).

However, future rail freight services in Ireland are only likely to be viable where there is a sufficient critical mass of cargo moving (in terms of tonnes-lifted) on a region-to-region basis. In order to identify future potential service scenarios for rail freight in Ireland, the current and BAU forecast road freight O-D matrices were interrogated (as rail freight growth will need to be generated from 'modal shift') to establish the region-to-region pairs which have (or will have) the necessary critical mass. Region-to-region pairs meeting the following criteria were deemed to be those likely to support viable rail freight services:

- Minimum of 1 million tonnes per annum of road freight moving in at least one direction; and
- Each region-to-region pair being at least 160km apart (100 miles).

A daily train service conveying around 400 tonnes of cargo per train would equate to just over 100,000 tonnes-lifted per annum. One million tonnes per annum therefore appears to be the minimum level of region-region cargo flows that could support a daily train service given other factors being beneficial to rail e.g. economics and service quality. The road haulage market's inherent flexibility also means that rail freight generally is unable to provide a competitive service offer over distances less than around 160km.

Table A-3 below shows the region-to-region pairs which meet the criteria outlined, including both the current and projected volumes for 2040. The *Dublin* and *Mid East* regions have been grouped together to form a 'Greater Dublin' zone (there are a number of surrounding settlements that are considered to be part of the wider Dublin area that fall into the Mid East region). Due to their geographic size and spread across the wider Belfast conurbation, a 'Greater Belfast area' has also been created formed from the Belfast region itself and its surrounding zones (similar to Dublin, a number of surrounding settlements are considered to be part of the wider Belfast conurbation). Dublin, Belfast and South East totals also include the road traffics passing through the ports in those regions.

Table A-3: Current and Forecast Road Freight – Region-to-Region Flows >1 million tonnes-lifted and >160km

2019					
Origin	**Destination**	**000s Tonnes**	**Origin**	**Destination**	**000s Tonnes**
Greater Dublin	Border	3,277	Border	Greater Dublin	2,786
Greater Dublin	West	1,818	West	Greater Dublin	1,225
Greater Dublin	Mid West	1,829	Mid West	Greater Dublin	1,230
Greater Dublin	South West	2,528	South West	Greater Dublin	1,283
Greater Dublin	South East	3,061	South East	Greater Dublin	2,087
Greater Dublin	Greater Belfast	1,883	Greater Belfast	Greater Dublin	1,859

2040					
Origin	**Destination**	**000s Tonnes**	**Origin**	**Destination**	**000s Tonnes**
Greater Dublin	Border	3,754	Border	Greater Dublin	3,255
Greater Dublin	West	2,090	West	Greater Dublin	1,480
Greater Dublin	Mid West	2,128	Mid West	Greater Dublin	1,442
Greater Dublin	South West	2,956	South West	Greater Dublin	1,554
Greater Dublin	South East	3,496	South East	Greater Dublin	2,488
Greater Dublin	Greater Belfast	2,199	Greater Belfast	Greater Dublin	2,486

From Technical Note *'Generating an O-D Matrix for freight movements in Ireland'.* Greater Dublin includes port traffic to/from Dublin Port. South East includes port traffic to/from Rosslare and Waterford. Greater Belfast includes port traffic to/from Belfast Port.

These identified region-to-region flows are similar to the traffic assessment outputs reported in the *Rail Freight Strategy 2040* (see above), but with the addition of flows Greater Dublin – South East (Rosslare and Waterford) and Greater Dublin – Greater Belfast. It is over these region-to-region pairs that future intermodal rail freight should be established, as they demonstrate the most potential to generate modal shift from road haulage.

To these, Greater Belfast – South East should possibly be added. Direct connectivity between the island of Ireland and the EU post-Brexit has taken on greater importance. The additional administrative costs (Customs) and delays associated with the landbridge route via Great Britain has generated a switch of traffic to direct ferry sailings to mainland Europe. At present, this is concentrated on the driver-accompanied and unaccompanied trailer market, both from Dublin and Rosslare.

Waterford Port already handles an intermodal service connecting with lift-on lift-off shipping services to the rest of the EU (containers lifted to/from vessel hold using cranes). Roll-on roll-off (RoRo) ferry services can also convey containers; they can be double-stacked on special port-to-port trailers (sometimes called Mafi trailers after the manufacturer) which are then hauled to/from the ferries using port yard tractors.

Rosslare Harbour is rail-served and owned by Iarnród Éireann, though at present its RoRo services only convey driver-accompanied and unaccompanied road trailers. Consequently, there may be potential for an intermodal rail service to/from the port, focused on EU trade, connecting with the port's RoRo ferry services to the EU. Therefore, in addition to a Dublin service, intermodal rail could also serve the other key origin/destination of traffic on the east coast, namely the greater Belfast area.

Transport Costs

We have considered likely rail freight costs for the seven corridors identified where both the current and future (business as usual forecast) freight flows suggests there could be sufficient volume to attract viable intermodal rail freight services. These have then been compared with estimated road haulage costs (using current diesel-powered HGVs) for the same flows. All costs have been estimated using a modelling-based approach.

The fixed operating costs of a modern diesel locomotive are around £3,800/€4,522 per day[5] (covering leasing costs or interest/depreciation plus insurance, maintenance and train crew). Running costs are around £4.05/€4.82 per km (based on diesel fuel at March 2022 prices). Leasing costs for intermodal platform wagons would typically be around £106/€126 per day for an *Ecofret* or similar wagon design (as used on the GB network, a fixed formation twin wagon comprising 2 x platforms each capable of conveying a 40ft shipping container). An internodal train comprised of a single diesel locomotive and 20 wagons would therefore have a fixed operating cost of around £5,920/€7,045 per day. Such a train would therefore be able to convey 40 x 40ft shipping containers in each direction, though in this case an average load factor of 34 x 40ft containers (85%) has been assumed.

[5] Exchange rate of £1 = €1.19, as at end of March 2022

Iarnrod Eireann currently quotes track access charges of €0.0088 per gross tonne-km for the 'Intercity' track network. A train of 40 wagons (tare weight of 42 tonnes per wagon) and conveying 34 shipping containers with an average gross weight of 15 tonnes would therefore have a total weight of 1,440 tonnes (including 90 tonnes for the locomotive with fuel). The effective track access charge is therefore £10.65/€12.67 per train-km. Table A-4 below shows the distances for the six corridors identified.

Table A-5: Corridor DIstances

Distances	One-way	Round trip	
Dublin - Cork	270	540	km
Dublin - Rosslare	180	360	km
Dublin - Galway	220	440	km
Dublin - Belfast	180	360	km
Belfast - Rosslare	355	710	km
Dublin - Sligo	220	440	Km
Dublin - Limerick	220	440	Km

In the first instance, we have estimated transport rates under the following circumstances:

- Each train set is capable of undertaking one round-trip per 24 hour period i.e. it offers a daily (Monday to Friday) service in both directions; and
- One end of the journey is rail-served i.e. the start or end of the trip is located at the rail-head, which could be a port e.g. Dublin or Rosslare, or warehouse. The other end of the journey is remote from the rail-head, thereby necessitating a local road haul.

This position could be considered the 'baseline', as they reflect track network and land-use conditions as they exist today.

Intermodal terminal lifts (one lift at each end of the journey) are estimated to be around £25/€29 per lift. A local internal 'shunt' within the rail-head (one per journey) using yard tractors e.g. within a port from quay to rail terminal, is estimated to be £20/€24 per shunt. A local road haul (over 50km round-trip and 3.5 hours including loading and waiting time) is estimated to be £138/€164.

Table A-5 below shows the estimated transport rates based on the above costs. The comparator HGV rates assume fixed costs of £32/€38 per hour and running costs at £0.52/€0.62 per km. In addition to drive time, three hours has been factored into the journey to allow for loading, waiting and drivers statutory breaks.

Table A-5: Estimated Intermodal Rail and HGV Costs

	£ per unit			€ per unit		
	Rail	HGV	+/- Rail	Rail	HGV	+/- Rail
Dublin - Cork	£412	£380	£31	€ 490	€ 453	€ 37
Dublin - Rosslare	£373	£286	£87	€ 444	€ 340	€ 104
Dublin - Galway	£390	£338	£52	€ 464	€ 403	€ 62
Dublin - Belfast	£373	£286	£87	€ 444	€ 340	€ 104
Belfast - Rosslare	£449	£473	-£24	€ 534	€ 562	-€ 29
Dublin - Sligo	£390	£338	£52	€ 464	€ 403	€ 62
Dublin - Limerick	£390	£338	£52	€ 464	€ 403	€ 62

MDST cost models. Assumes train set undertakes one round-trip per 24 hour period and one end of trip is rail-served.

Note that other than the Belfast – Rosslare corridor, road haulage is currently able to provide a more cost competitive offer to the logistics market. A local road haul at each end (i.e. neither end rail-served) would be even less cost competitive by rail. This analysis partly explains the current dominant position of the road haulage sector in Ireland; the distances over the key trade corridors are too short and logistics activity is generally located away from rail-heads, thereby necessitating the extra costs of a local road haul for the final delivery, for rail to provide a cost competitive solution.

The above assessment has been re-run, albeit with a number of efficiency enhancements that could be expected as part of a long-term rail freight strategy for Ireland (as reflected in the *Rail Freight Strategy 2040*), as follows:

- Each train set is capable of undertaking one and half round-trips per 24 hour period i.e. two train-sets could offer a twice daily (Monday to Friday) service in both directions;
- Both ends of the journey are rail-served. This could be between a port and a rail-served warehouse e.g. Dublin port to Cork, or between two rail-served warehouses located near Belfast and Dublin. In this case, the cost of the local road haul is removed from the supply chain (and replaced by the cheaper internal shunt within the rail-head);
- Track access charges are reduced substantially to €0.004 per gross tonne-km. The effective track access charge would therefore be £4.84/€5.76 per train-km.

The additional trip per train-set in a 24 hour period would result from network enhancements, such as passing loops, additional double-tracking and dedicated intermodal paths in the working timetable (quicker transit times between terminals, thereby allowing an additional trip). The development of SRFIs and TRFIs would result in a greater level of logistics activity locating at a rail-served site.

Table A-6 below shows the estimated transport rates based on the above costs. The comparator HGV road haulage costs are also shown again (using the same costs and assumptions).

Table A-6: Estimated Intermodal Rail Costs with Efficiency Enhancements

	£ per unit			€ per unit		
	Rail	**HGV**	**+/- Rail**	**Rail**	**HGV**	**+/- Rail**
Dublin - Cork	£219	£380	-£162	€ 260	€ 453	-€ 192
Dublin - Rosslare	£195	£286	-£90	€ 232	€ 340	-€ 108
Dublin - Galway	£206	£338	-£133	€ 245	€ 403	-€ 158
Dublin – Belfast*	£195	£286	-£90	€ 232	€ 340	-€ 108
Belfast - Rosslare	£241	£473	-£232	€ 287	€ 562	-€ 276
Dublin - Sligo	£206	£338	-£133	€ 245	€ 403	-€ 158
Dublin - Limerick	£206	£338	-£133	€ 245	€ 403	-€ 158

MDST cost models. Assumes train set undertakes 1.5 round-trips per 24 hour period and both ends of trip are rail-served

** In practice one and half round-trips per 24 hour period unlikely to be feasible given the distance involved.*

Under these efficiency-enhanced operating conditions, intermodal rail is able to offer a cost competitive solution when compared with road haulage. Rail is cheaper over all of the seven identified corridors. The key factors are:

1. Asset utilisation – a high proportion of rail freight operating costs are fixed (between 40-50%). Therefore, by working assets to a higher level of utilisation (i.e. 'sweating the assets'), per unit delivery costs begin to fall. In this case, by moving from one round-trip to one and a half round trips per 24 hour period, the train set is able to move 102 containers per day (rather than 68 boxes) for the same locomotive and wagon fixed costs.

2. Rail-served logistics activity – locating logistics activity e.g. distribution centres, on the same sites as rail terminals eliminates the need to use a local road haul for the final delivery to the end-user. In this case, a £138/€164 local road haul (using road legal HGV equipment and duty-paid diesel) can be replaced by a £20/€24 internal shunting move using yard tractors. The development of major distribution floor space capacity on rail-served sites in the English Midlands (e.g. DIRFT) partly explains the recent growth rates in Great Britain, over distances not too dis-similar to those within the six corridors within Ireland.

Conclusions and Next Steps

This appendix has outlined the potential for rail freight to grow on the island of Ireland to potentially achieve mode share comparable to similar European rail systems.

In the next stage of the development of the All-Island Strategic Rail Review, the following opportunities should be considered as options for encouraging the growth of rail freight on the island of Ireland:

- Reducing Track Access Charges for freight services to stimulate demand for rail freight.
- Strengthening rail connectivity to the island's busiest ports where links are feasible and improve access to ports that currently are underserved by rail freight.
- Developing a network of inland terminals close to major cities on the rail network, especially where there is good access to major roads/motorways, limited impact on communities and passenger traffic, and good access to industrial clusters.
- Developing a sustainable solution for first-mile-last-mile rail freight access for key ports – especially Dublin Port, as the busiest port on the island.