KPMG AECOM

BusConnects Dublin

Cover Note to Preliminary Business Case

BUS CONNECTS
SUSTAINABLE TRANSPORT FOR A BETTER CITY.

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Project Ireland 2040
Building Ireland's Future

Introduction and Purpose

The main preparatory work on the BusConnects Dublin Preliminary Business Case (PBC) was carried out during 2019. The cost estimation work was finalised in 2020, using Q4 2019 base figures, in order to allow the economic and financial analysis to be undertaken for the Preliminary Business Case.

Following its finalisation in 2020, the PBC was subsequently reviewed by the NTA, prior to its submission to the Department of Transport. In the intervening period since the PBC was prepared construction inflation has significantly increased. On this basis an updated cost estimate was prepared to reflect the impact of revised inflation parameters and provided to Government Q1 2022 as part of the PBC approval process. This cover note sets out the impact of the revised inflation parameters on the overall project costs.

How to use this cover note

This cover note provides readers with the updated information that was supplied to Government to inform its final decision for Approval in Principle, Decision Gate 1 on 8th March 2022. In line with the requirements of the Public Spending Code, the PBC is to be published. This PBC document was considered by Government in conjunction with the updated cost information set out in this note.

For clarity, these changes have not been reflected throughout the PBC document and where updates as provided in this Cover Note apply to the PBC, these are indicated with a note and/or watermark on the individual chapters/pages of the PBC document.

Updated Inflation Assumptions

In 2020, the impact of COVID related restrictions and supply chain impacts led to recorded inflation in construction of 2.2% as set out in the SCSI Tender Price Index. In 2021, the combination of material price increases and labour cost increases due to shortages in skilled labour for key trades, which pre-dated but have been exacerbated by COVID-related disruptions, have led to increased construction costs. This, coupled with strong government-supported demand, has contributed significantly to accelerated tender price increases throughout the year. For 2021, the construction inflation rate assumed in calculating the costs for BusConnects Dublin increased from 1% to 10%. Taking account of the trend in construction inflation the construction rates for 2022 and 2023 were also adjusted upwards. The updated inflation rate profiles are presented in the updated Table 8-4 below.

Updated Table 8.4 –Updated Inflation rate profiles (2020-2058)

Inflation rate	2020	2021	2022	2023	2024	2025	2026	...	2058
HICP	-1.20%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%		2.00%
Construction	2.20%	10.00%	5.00%	4.00%	4.00%	3.50%	3.50%		3.00%
Labour	-0.20%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		3.00%
PSO costs	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		3.00%

Updated Cost Projections

Taking account of the updated assumptions on construction inflation the cost projections, as presented in Table 8-1 of the PBC have been revised and are presented in the updated Table 8-1 below.

Updated Table 1.2 and Table 8.1 – Updated DoMin & BusConnects Dublin Capital Cost Estimate (2020-2032)

Period - 2020-2032 Upfront Capital costs	Do-Minimum Total *€m*	BusConnects Dublin Total Investment *€m*	BusConnects Dublin Incremental Costs *€m*
Network Redesign	0	18	18
Core Bus Corridors	0	1,090	1,090
Next Generation Ticketing	10	97	87
Bus Fleet	756	812	56
Stops & Shelters	0	22	22
Park and Ride	0	40	40
Depot	42	50	8
Base Cost	**808**	**2,130**	**1,322**
Risk & Contingency	98	632	534
Land & Property	0	182	182
Real Costs (ex-VAT)	**906**	**2,943**	**2,037**
Inflation	163	705	542
Nominal Costs (ex-VAT)	**1,069**	**3,648**	**2,579**
VAT (at 13.5%)	10	269	259
VAT (at 23%)	229	330	101
Total (incl.-VAT)	**1,308**	**4,247**	**2,939**

Sources: 'Cost Estimate Report' (October 2020) prepared by ChandlerKBS and NTA

On the basis that the inflation adjusted costs remain within the upper range presented within the PBC and assessed within the Economic Appraisal Sensitives, there were no changes to the economic and financial appraisal at this stage.

The PBC will be updated to inform the next Decision Gate on the project (Decision Gate 2 – Pre-Tender Approval) and updated costs estimates along with updated economic and financial appraisal will be included.

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BusConnects Dublin

Preliminary Business Case

February 2022

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Contents

Note to reader:

This version of the BusConnects Dublin PBC is an update of the version approved by the NTA board and released to the Department of Transport in June 2021 addressing all the comments made by the Department, JASPERS and NewERA. This document is still subject to change and modification as part of this final review process.

The cost analysis, financial and economic appraisals are based on the prevailing implementation plan as of December 2020, the submission date of the Preliminary Business Case for board approval. Dates and timelines in other sections to this document have been updated to reflect the current implementation plan as of December 2021.

BUS CONNECTS

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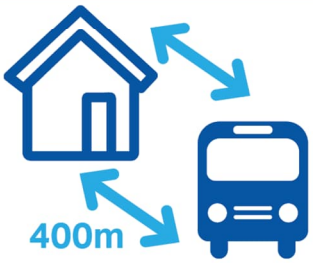
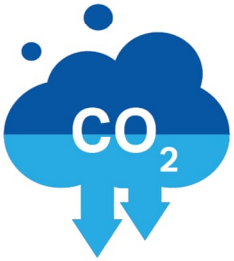
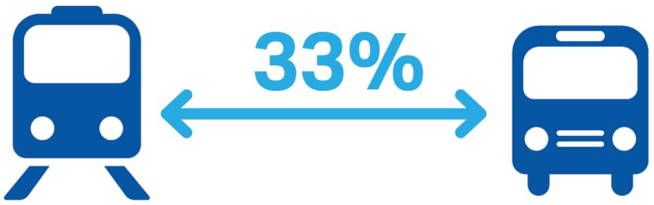
PROGRAMME IMPACTS:



16% increase in number of people within **400m** of a frequent bus service – increasing from approximately **800,000** to over **925,000**

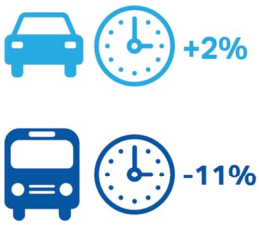


100% zero/low emission bus fleet by **2032**



Increase in number of trips involving interchange between modes

35% Increase in residents located within **400m** of a **10-minute** frequency public transport service



The policy decision to enhance bus will result in a **2%** increase in private vehicle journey times however this is outweighed by a **11%** reduction in bus journey times

2020 **62%** 2043

Minimum forecast increase in public transport patronage from **2020** to **2043** in a BusConnects scenario

Rebalancing of road space to better align with future demands for **walking, cycling, public transport** and **private vehicles**

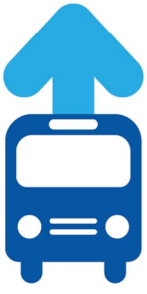
36% Bus patronage increase one year after implementation (including existing background growth trends)

25 hours

Amount of time per annum the average bus user in the Greater Dublin Area will save by **2043**

Reduction in bus journey time variability

New connections to **schools, hospitals** and **other essential services**



An overall increase of **23%** in the number of services

01

Executive summary

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.

1 Executive summary

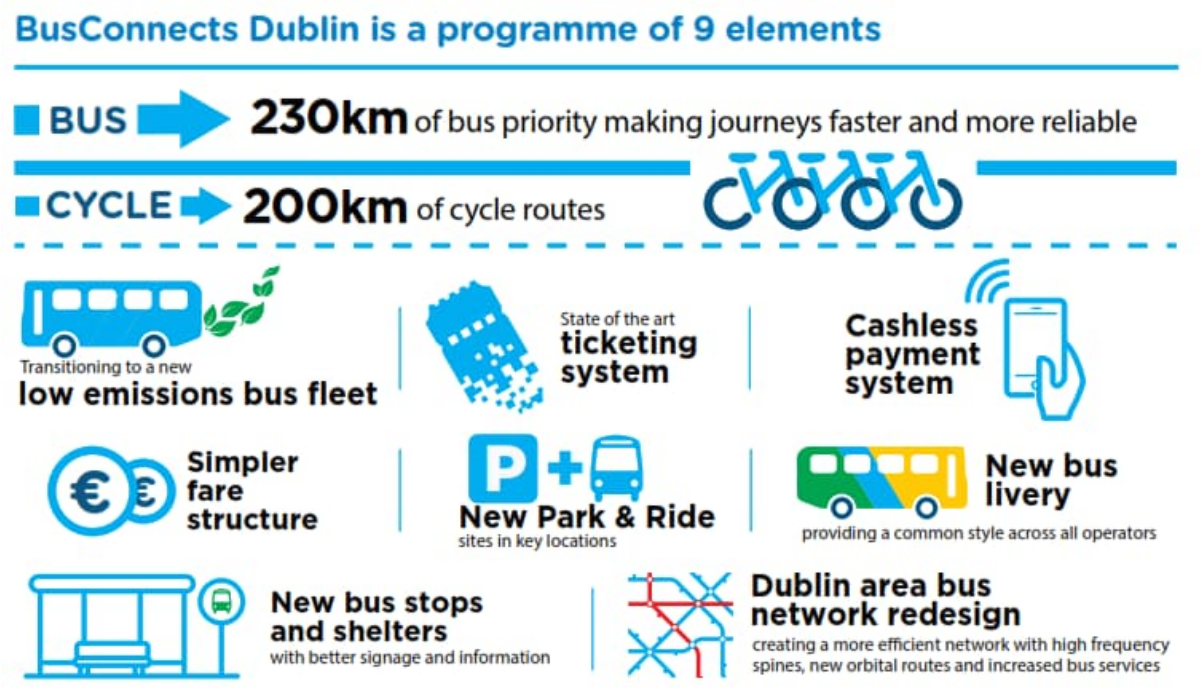
1.1 What is BusConnects Dublin?

BusConnects Dublin is a transformative programme of investment in the existing bus system providing better bus services to more people.

The BusConnects Dublin programme brings together all areas of bus investment identified in the Greater Dublin Area Transport Strategy 2016-2035 including enhanced and new bus infrastructure, investment in fleet and service enhancements such as higher frequency and new routes serving a wider catchment. It is a key part of the Government's policy to improve public transport and address climate change in Dublin and other cities. Dublin is growing and needs a bus network that works for a developing city.

Each element of the BusConnects Dublin programme contributes to transforming the bus system. By delivering BusConnects Dublin as a programme, opportunities for integration benefits will bring better overall service provision for customers and operators to ensure the programme will deliver more than the sum of its individual parts. If a programmatic approach were not taken, opportunities for integrated benefits would be missed. Risks of omission, fragmentation, delay and cost overrun would be created. This BusConnects Dublin programme therefore leverages opportunities and minimises risks.

The key elements of the BusConnects Dublin programme are as follows:



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Core Bus Corridors (including segregated cycle facilities)

Delivering 230kms of continuous bus priority measures and 200kms safe cycling facilities along 16 routes covering all radial corridors into the city centre.

The corridors will provide end to end bus priority improving bus speeds, reliability and punctuality. The priority measures include a mix of dedicated bus lanes, bus gates and bus priority at traffic signals.

Segregated cycle lanes will be provided, where possible, along the corridors providing safer cycle routing and minimising the conflict with buses and other road users.

The bus corridors will seek to enhance the urban realm at key locations along the corridors.

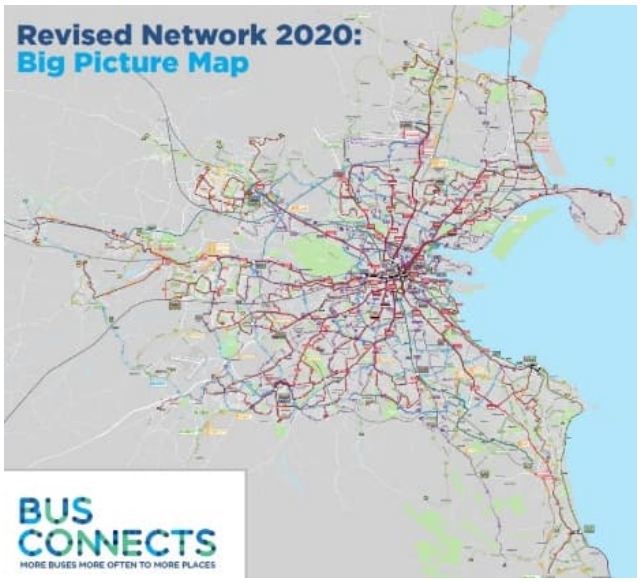
Network Redesign

The new bus network will serve existing and future passengers in a more sustainable and environmentally friendly way. Reducing the need for private cars and moving more people to public transport is a key part of tackling climate change.

Under the plan, the network will now be arranged on the basis of spines radiating from the city centre, supported by a number of other services.

Key features are:

- A 23% increase in bus services;
- A 16% increase in the population within 400m of bus services;
- 15 min frequency at evenings and weekends with additional 24-hour routes;
- Better access to a range of destinations including jobs, education, healthcare and other services.



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Low Emission Bus Fleet:

Transitioning the existing diesel only bus fleet to low emission vehicles (LEV) by 2032. The new bus fleet will use the best available technology to serve the network and will consider electric and hydrogen fuel cell technologies. From 2021, new vehicles will be low emission vehicles which produce over 30% less emissions in their use. From 2023, zero emission vehicles[1] will be brought into the fleet.

Next Generation Ticketing and Simpler Fares

A simpler fare structure that removes penalties for multiple trips and longer distance trips will be introduced. To complement the simpler fare structure the ticketing system will be upgraded to facilitate a variety of payment methods including mobile phones and debit/ credit cards, making it easier for users and reducing delays at stops associated with fare payment.

Park & Ride

To maximise the potential of the BusConnects Dublin programme, the greatest number of people need to be able to substitute private cars for the bus service. For those travelling long distances, Park and Ride facilities allow travellers to transfer to high frequency bus services at the earliest practical opportunity.

Livery, Stops and Shelters

The exterior branding of buses, known as the bus livery, will be standardised across different operators to give the bus system the feeling of a modern, effective public transport system.

A new style of bus stop across the Dublin region with standardised route and fare information across all operators and an expanded number of bus shelters, particularly at interchange locations. Newly designed timetable and route information displays will be included at each stop.

1.2 The need for BusConnects Dublin

Public Policy

Public policy at global, national and regional level is pressing for travel changes from private car to public transport, walking and cycling. Land development policy now stipulates that future development is compact and supported by high quality public transport.

Decarbonising the transport network is critical to achieving climate change targets. There is a need to convert the bus fleet to zero emission vehicles and reduce reliance on the private car through appropriate land use planning supported by provision for public transport, walking and cycling modes.

[1] *Zero emissions at the point of use.*

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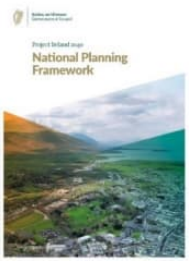
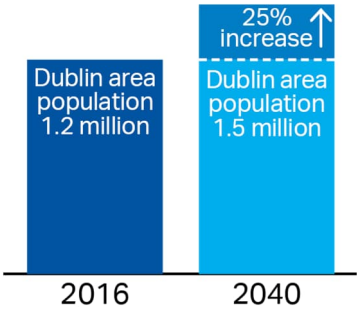


Project Ireland 2040 forecasts that, by 2040, Ireland's population will have increased by 1.1 million and there will be an additional 660,000 jobs in the country.

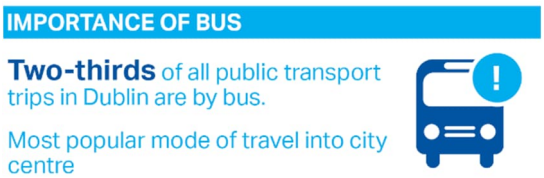
The current public transport system struggles to meet existing demand. It will not be able to address this future growth.



Public Demand

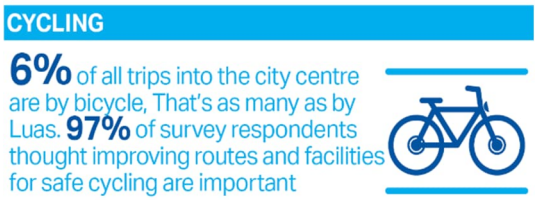
Demand for public transport has already increased significantly across Ireland. In the Dublin region, most public transport trips are by bus. That is not expected to change but demand will significantly increase.

The network serves the city centre well but does not cater well for other trips around the city. It needs to adjust to respond to where people live, work and access services, so that all citizens and visitors can realise the opportunities the Dublin area offers – a change of focus from moving people into and out of the city to all around the city, at all times of the day, seven days a week.



More people are cycling too, and they need more space and greater protection. The same applies to pedestrians. Not only are more people choosing to walk, but walking is part of every public transport trip. Better facilities are needed so that that people can walk to bus stops and cross the road safely and without delay. The bus stops too have scope for improvement: customers need more shelters, better information about services and more seating.

Transport Demand



The demand for travel in the Dublin region is not uniform. In order to be efficient and effective high quality public transport must respond to the demand. The capacities of the different modes must be matched to the existing and future demand for travel. Consideration has been given to other modes such as light rail and heavy rail as part of the wider Greater Dublin Area Transport Strategy 2016-2035. In some areas the transport demand does not warrant this scale of investment whereas in other areas demand far exceeds what could be catered for by bus. The bus network must integrate with and support other modes.

Transport efficiency

Bus speeds are slow due to buses operating within general traffic congestion and significant boarding time at stops associated with fares payment. This makes travel by bus time consuming and often unreliable. Reducing journey times, facilitated by priority measures and faster boarding and alighting, facilitated by improved methods of payment, are needed to improve efficiency.

Customer focus

Most fundamentally, travel by bus needs to be easier for all customers catering for all ages and abilities. Too many people are put off using the existing system or trying new routes because it seems too difficult or perhaps too tiring.

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This results in greater reliance on and preference for private car. The network of routes needs to be easier to understand. Services must be reliable, fast, frequent and regular. Fares needs to be simpler and not to cost more for those whose trips involve interchange between services. Information must be widely available, accurate and well communicated.

Complete overhaul

To meet the needs of a growing vibrant urban area, Dublin's bus system needs a holistic transformation that offers:

- Better coverage so that more people have access to public transport and that public transport gets them to where they need to go
- More capacity and faster services, that are more reliable and attractive to users
- Good pedestrian facilities so that they can access the system safely and efficiently
- Greater protection and facilitation of the growing numbers of cyclists
- Simpler fares, improved methods of payment and better passenger information
- Access to the network from outside Dublin (Park and Ride).

Without BusConnects Dublin, the situation facing the Dublin region is that:

- Longer journey times and increased travel stress will reduce access to opportunities and services, diminishing quality of life for residents of the Dublin region
- Transport congestion will continue to grow in a haphazard manner where road users feel unable or unprepared to switch to an increasingly outdated public transport network.
- Transport emission targets will not be met.

Manage congestion

If there is no action to prioritise bus travel and encourage bus use in the short term, the existing problems with congestion will worsen and additional buses will have to be purchased and operated to simply maintain current service frequencies. This will increase costs, but it will also reduce the appeal of bus travel which will affect patronage and fare revenue, as well as contributing to a greater number of vehicles on the road in a self-perpetuating cycle. Furthermore, declining reliability in the bus network will reduce passenger's ability to interchange between public transport services.

BusConnects Dublin will enable road users to transition to bus travel which will have a positive effect on congestion and help to avoid a tipping point in respect to traffic where it would be hard to improve sustainable travel. This will be achieved by improving the competitiveness of bus journey times, reliability, pricing and infrastructure to attract modal shift.

1.3 Impacts of BusConnects Dublin

BusConnects Dublin will deliver positive benefits overall. It will deliver significant benefits to public transport users. The benefits to public transport customers, cyclists and pedestrians will greatly exceed the cost of the scheme but will be offset to some degree by an anticipated negative impact on private motorists and goods vehicles due to the necessary and more sustainable reallocation of road space.

The benefits of BusConnects Dublin include:

- An increase in bus patronage – Upon opening BusConnects Dublin will deliver

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initial year on year growth of 79 million[2] boardings, equivalent to a 36% increase in passengers.

- BusConnects Dublin will transform the attractiveness of the public transport network. The number of people using public transport is forecast to grow from 295 million per year in 2019 to 417 million in 2028 (an increase of 42%) and 502 million in 2043 (an increase of 70%).
- The average bus user in the Greater Dublin Area will save over 25 hours[3] a year as a result of the BusConnects Dublin programme, equivalent to taking a weekly 30minute scenic walk or reading a half a dozen books like Dubliners by James Joyce
- Buses will become more reliable reducing the variability in end to end journey times by up to 49%. This will deliver significant reliability savings of around €340 million (2011 value) over a 30-year appraisal period.
- A reduction in greenhouse gas emissions from the bus fleet – in addition to the mode share benefits, once BusConnects Dublin is fully implemented in 2032, all public transport buses will be Zero or Low Emission Vehicles. A move to a zero-emission fleet in the case of electric and LEVs (in the case of hybrid vehicles during the transition of the fleet) and base case expansions will be delivered in any case since the Government decision in November 2018 to cease the purchase of diesel-only buses from July 2019.
- BusConnects Dublin includes investment in bus stop infrastructure, ticketing systems and fare structures which will create seamless interchange, reducing end to end morning peak journey times for bus passengers by 16% on average[4].
- Increased frequency and attractiveness will lead to a more dynamic public transport system resulting in a 33% increase in people interchanging between services[5].
- By improving bus services, BusConnects Dublin will generate benefits to business primarily by increasing their labour market catchment. This will help maintain the Dublin region's competitiveness as an attractive location for Foreign Direct Investment.
- In Dublin, there has been a 121% increase in cyclist numbers between 2010 and 2019. Investment in safe cycle infrastructure has not kept pace with this growth. BusConnects Dublin will create a safe and high-quality cycle network through the delivery of 200km of cycle facilities.
- Investment in cycle infrastructure will lead to significant improvements to cyclist's journey quality, travel times, safety. This will result in a larger uptake in cycling with consequent health and wellbeing benefits.
- The number of residents located within 400m of a frequent bus service will increase by 16%, from approximately 800,000 to over 925,000 (2016 census data).
- The expansion of the bus system due to BusConnects Dublin means that 14 – 20% more jobs and university places will be available to people within the same travel times as now.
- On average, 18% more places of employment could be reached by Dublin-area residents in 30 minutes of travel time.

[2] *Values presented are based on NTA Model outputs with actual 2019 patronage data used as a baseline*
[3] *An average user refers to the Eastern Regional Model data of 'all users – all travel purposes'.*
[4] *Source: AECOM via NTA Eastern Regional Model*
[5] *Source: AECOM via NTA Eastern Regional Model*

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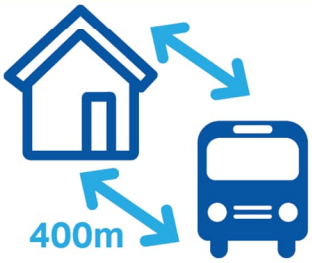

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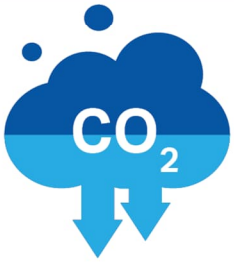
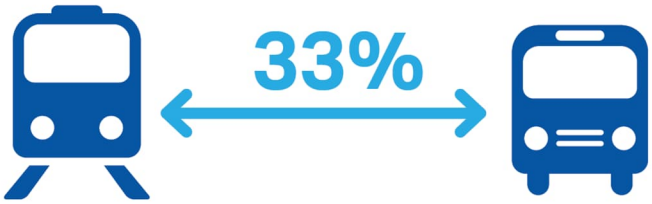


100% zero/low emission bus fleet by **2032**



Increase in number of trips involving interchange between modes

35% Increase in residents located within **400m** of a **10-minute** frequency public transport service

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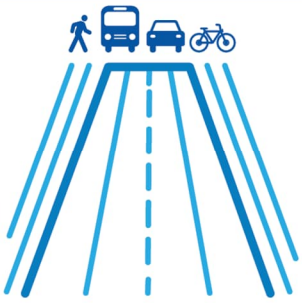

36% Bus patronage increase one year after implementation (including existing background growth trends)

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Amount of time per annum the average bus user in the Greater Dublin Area will save by **2043**

Reduction in bus journey time variability

New connections to **schools, hospitals** and **other essential services**

An overall increase of **23%** in the number of services

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1.4 Appraisal of BusConnects Dublin

Overall, the quantitative economic CBA results for BusConnects Dublin are strong with a benefit to cost ratio (BCR) of 1.6 and an NPV of €1.8 billion, given the right policy supports in place.

- Significant benefits to both new and existing public transport users – through improved services, reduced journey times and increased frequencies which outweigh negative impacts on other road traffic (car and goods vehicles)
- Public transport and active mode benefits of approximately €7.1 billion (2011 value[6]) – over a 30-year appraisal period. A proportion of this is offset by significant disbenefits to private cars and good vehicles where priority is given to buses. Overall the benefits of BusConnects Dublin over 60 years are around €4.8 billion, well in excess of the total value of the costs which are around €3.28 billion. This gives a Net Present Value of over €1.8 billion and a BCR of 1.6, indicating that BusConnects Dublin represents good value for money and will give a strong return on investment.

Table 1-1 – Quantitative CBA summary for Base Case (2011 Values)

CBA Breakdown		Impact of BusConnects Dublin compared with DoMin
		Base Case
Impacts	Sustainable Modes (PT & Cycling)	€ 7.1
	Private Vehicles	-€ 4.8
Reliability		€ 0.34
Safety		€ 0.21
Greenhouse Gases[7]		-€ 0.001
Residual Value[8]		€ 2.27
Present Value of Benefits (PVB)		**€ 5.08**
Present Value of Costs (PVC)		**€ 3.28**
Net Present Value (NPV)		**€ 1.8**
Benefit to Cost Ratio		**1.6**

- Capital expenditure on BusConnects Dublin will create a total of €1.3 billion in Gross Value Added (GVA) between 2020 and 2032
- BusConnects Dublin will generate 19,800 annual Full-Time Equivalent (FTE) jobs during construction[9].
- Negative impacts are acknowledged in aspects of BusConnects Dublin. There are many competing transport needs of different user groups and space along Dublin's transport corridors is valuable. The CBCs, for example, must cater for a wide range of transport modes and trips purposes, all competing for the relatively limited space in those corridors. Designs have been adjusted following consultation to balance these needs.

[6] 2011 is the base year specified for use on all projects in the Common Appraisal Framework (CAF) 2016
[7] This excludes the savings associated with the conversion to LEV bus fleet
[8] The residual value represents the ongoing benefits that the programme will continue to deliver at the end of the 30-year life.
[9] These are annual jobs. For example, someone employed by the programme for three years would count as three FTE.

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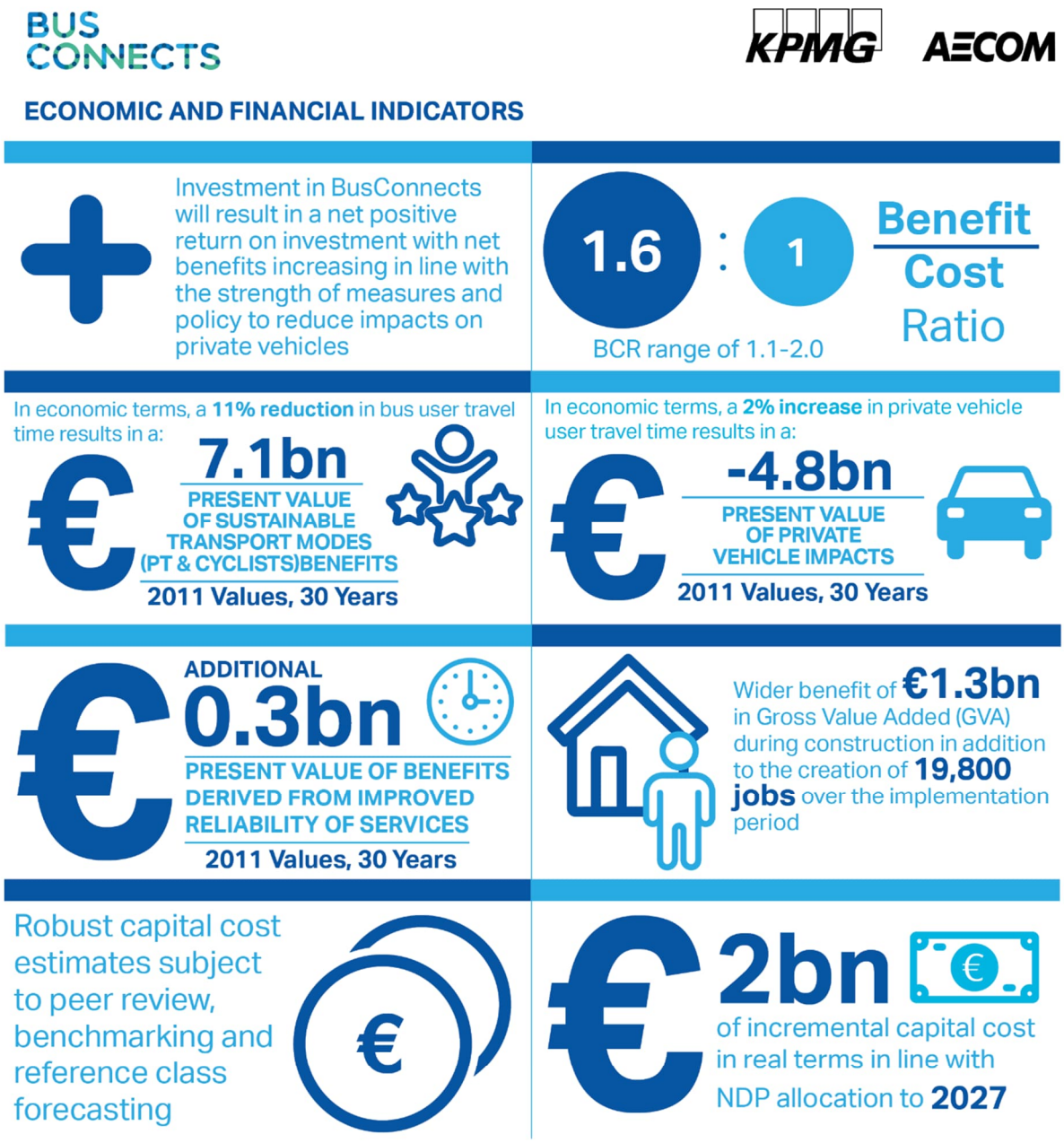
- BusConnects Dublin puts forward a case for reducing the systemic growth of congestion stemming from private vehicle trips which might otherwise be taken by sustainable modes. Highway disbenefits may eventuate in some areas of the central city, but these are also the areas that will be serviced by high quality CBCs and improved cycling facilities. Business trips and freight movements are anticipated to become more flexible over time, and their 'real world' impacts likely being less than those forecast in this PBC.

Sensitivity tests

- Sensitivity tests were undertaken to understand the effects of lower and higher than expected modal shift to public transport, and cost increases and decreases. There were also tests examining the impact of alternative future scenarios post-coronavirus.
- Under the sensitivity tests the programme remains positive from an economic standpoint.
- The outcome was an overall range of BCRs from 1.1 to 2.0 indicating that the economic case for BusConnects Dublin is robust, even if current assumptions change.
- The BCR range reflects the scale and complexity of the programme, and its radical reallocation of road space and priority to buses and active modes. The programme's success relies on careful detailed design of the infrastructure schemes, including mitigation measures, and measures to support and reinforce the programme. When all aspects come together with vigorous policy support, the benefits are significant. If this does not happen, there is the potential for the benefits to be undermined by the negative impacts on private vehicles or eroded through the likes of over-mitigation of design or decreased service provision. A strong benefits realisation and management approach to delivery is essential to ensure that the benefits materialise as planned.
- The quantified benefits assume that the design aspirations are realised to their full extent. There is potential for some of the benefits to be eroded and the costs to change as the designs evolve and it is therefore important that the business case is revisited as the programme progresses. The NPV and BCR are powerful indicators, but they do not consider information on benefits and costs that cannot be monetised.

Although an important input, the economic analysis will not be the sole basis for decision making. Other benefits, negative impacts and costs outside the economic appraisal process will be identified and addressed through the detailed planning and design stages and reflected in future updates to the Preliminary Business Case.

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.



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1.5 Financial Appraisal

The cost of implementing BusConnects Dublin considers both the capital investment in infrastructure and bus fleet and the operating expenditure required to keep buses moving.

The capital cost estimates reflect the developing maturity of the programme as design / specification moves from a concept to a preliminary design phase, informed by significant public consultation, peer reviews, benchmarking and risk analysis (including Reference Class Forecasting reviews to a 75% confidence level.)

The costs of implementation of BusConnects Dublin has been compared to the do-minimum investment required to maintain the current bus operations.

As presented in Table 1.2 the incremental capital cost of implementing BusConnects Dublin is c.€2bn in real terms (2020 prices, including risk and contingency) and €2.3bn excluding VAT when inflation over the implementation period from 2020-2032 is taken into account. This is broadly in line with the €2bn figure allocated to BusConnects Dublin in the National Development Plan to 2027.

Table 1-2 – DoMin & BusConnects Dublin Capital Cost Estimate (2020-2032)

Period - 2020-2032 Upfront Capital costs	Do-Minimum Total *€m*	BusConnects Dublin Total Investment *€m*	BusConnects Dublin Incremental Costs *€m*
Network Redesign	0	18	18
Core Bus Corridors	0	1,090	1,090
Next Generation Ticketing	10	97	87
Bus Fleet	756	81	56
Stops & Shelters	0		22
Park and Ride	0		40
Depot	42		8
Base Cost	**808**	**,130**	**1,322**
Risk & Contingency	98	632	534
Land & Property	0	182	182
Real Costs (ex-VAT)	**9**	2,943	**2,037**
Inflation	152	355	203
Nominal Costs (ex-VAT)	**1,058**	**3,298**	**2,240**
VAT (at 13.5%)	8	229	221
VAT (at 23%)	229	325	96
Total (incl.-VAT)	**1,296**	**3,852**	**2,557**

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Sources: 'Cost Estimate Report' (October 2020) prepared by ChandlerKBS and NTA

A sensitivity analysis has been carried out to provide a range of costs with an upper and lower boundary. Sensitivity has been carried out on upfront capital costs only varying the contingency and optimism bias values for CBC and NGT based on their Reference Class Forecasts studies respectively.

Table 1-3- Do Total Investment – upfront capital costs range

Upfront Capital Costs (€million)	Lower range	Base Case	Upper range
Total Real Costs (ex-VAT)	2,467	2,943	3,118

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The cost range does not vary significantly as the combined weight of CBC and NGT is below 60% of the overall upfront capital expenditure for BusConnects Dublin. The Base case is closer to the upper range value which suggests a conservative approach has been taken.

The operating costs and revenues have been calculated on an incremental basis for the purposes of understanding the long-term change in operating expenditure and future cash flow requirements. A conservative approach has also been applied to the preparation of the longer-term revenue and operating cost assumptions:

- Revenues have been based on the lower-case demand scenarios described in the economic analysis. The base case economic scenario would increase revenues by c.9%
- Operating costs include:
  - PSO costs based on existing gross PSO cost levels, adjusted for anticipated growth in vehicle kilometres to the end of the implementation period.
  - Next generation ticketing costs including all costs associated with the back office and central cost required to roll out NGT across all modes
  - No account is taken of potential longer-term efficiencies / savings in PSO costs that might be derived from the longer-term impacts of the programme

A discounted cash flow is presented in Table 1.4. This considers incremental revenue and costs over the period from 2020 to 2058. Values are presented in real and nominal terms as well as excluding and including VAT. Net Present Values are presented for two discount rate scenarios.

Table 1.4 – Discounted Cash Flows summary table – Incremental values

(EUR millions) Incremental	Cash flows	Discounted @4% Real, c. 6% Nominal	Discounted @2.5% Nominal, c. 0.5% Real
Revenue	3,831	1,653	3,421
Total inflows (Real)	**3,831**	**1,653**	**3,421**
Capex	(2,037)	(1,670)	(1,986)
Lifecycle renewal costs	(319)	(127)	(282)
Operating costs	(3,587)	(1,719)	(3,243)
Total Outflows (Real)	**(5,943)**	**(3,516)**	**(5,511)**
Total Net Cash flow (Real)	**(2,111)**	**(1,863)**	**(2,091)**
Total Net Cash flow (Nominal)	**(3,499)**	**(2,144)**	**(2,779)**
Total Net Cash flow (Nominal incl. VAT)	**(5,522)**	**(2,869)**	**(4,024)**

The NTA will continue to monitor and develop its capital cost (including renewals), operating cost and revenue projections as the programme develops and will update this analysis as Final Business Cases are prepared prior to contract award of key elements of the programme.

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1.6 How will BusConnects Dublin be delivered?

In preparing the Preliminary Business Case for investment it is not only necessary to set out the rationale for the investment and evaluate its performance. It is important to demonstrate how the project will be managed throughout the lifecycle to ensure the expected benefits and outcomes can be achieved.

In addition to setting out the strategic relevance and objectives of the scheme and measuring the financial and economic performance, as required by the Public Spending Code, the preliminary business case sets out approaches to achieving value for money throughout the project.

The procurement principles to be applied and options for procurement of the various elements of the programme are clearly set out.

The approach to risk management and the risk management strategy is set out. Details of the various risk assessment undertaken at programme and project level are described.

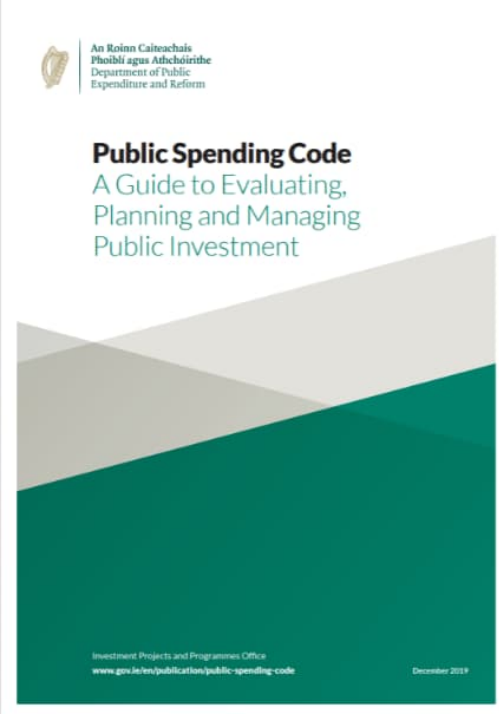
Finally, the approach to monitoring and evaluation setting out performance indicators to ensure the programme will deliver on the expected benefits and outcomes is included in the business case.

1.7 Conclusions

The Preliminary Business Case for the BusConnects Dublin Programme has clearly set out the rationale for investment in the bus network. The PBC demonstrates how alternative strategies for addressing the transport demand and issues with the existing bus network were considered.

Detailed economic and financial analysis has been conducted including a range of sensitivities which demonstrate that the BusConnects Dublin programme will deliver value for money with benefit to cost ratio of 1.6 in the central case with a range of base cases of 1.1 – 2.0, while also delivering wider benefits to society improving access to public transport for all, reducing the climate impact of transport and supporting continued economic growth and sustainable compact urban growth.

The next stages of implementation for the programme require lodgement of statutory planning applications for the Core Bus



Corridors and the commencement of the competitive tender process for the Next Generation Ticketing project. By moving to the next stage in these projects further refinement of the design will occur resulting in greater confidence in the scope and cost of the projects which can be brought forward into the final business case at the appropriate time.

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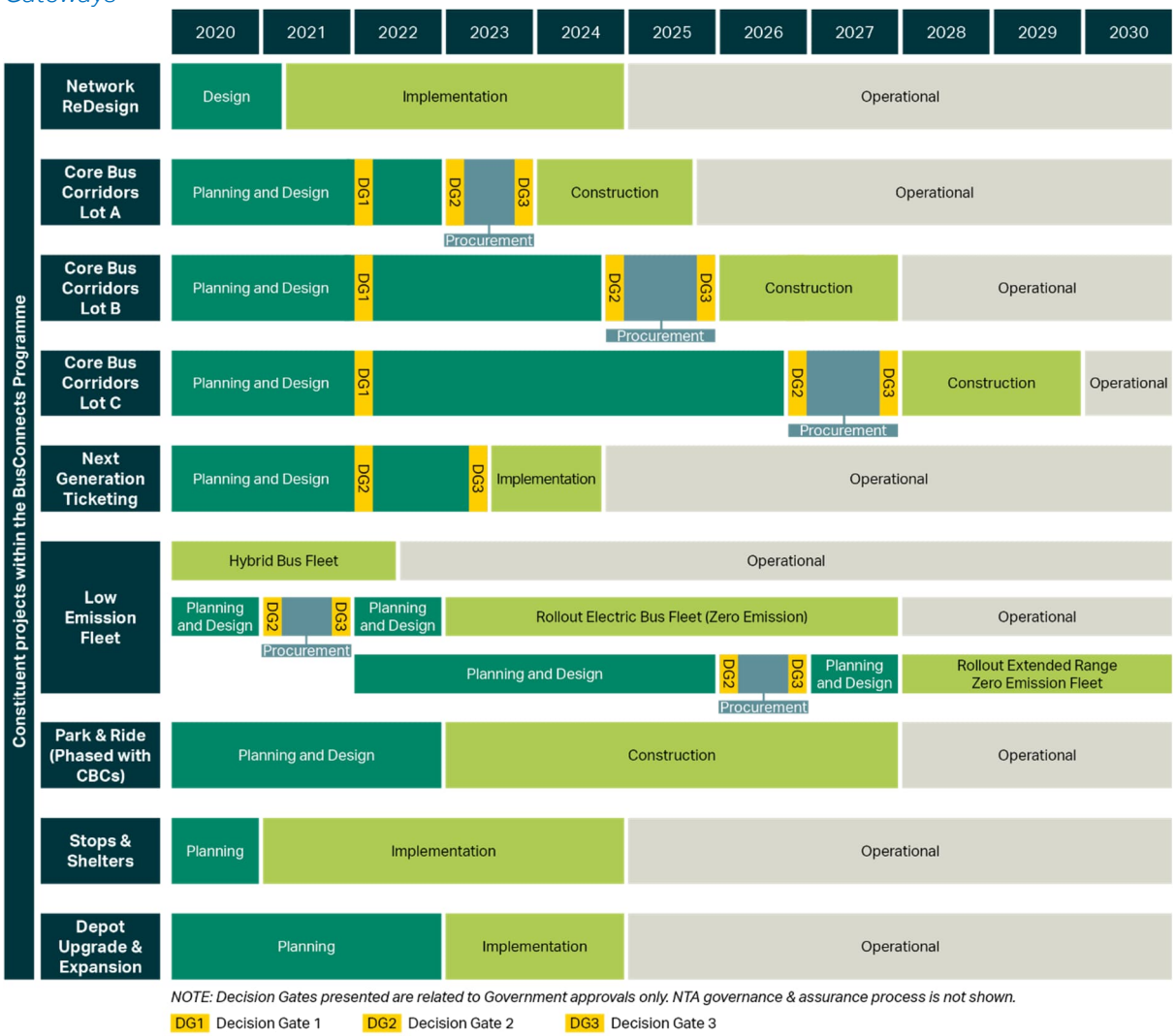
1.8 Next Steps

The figure below illustrates the overall programme for the implementation of all elements of BusConnects Dublin. Individual programme projects or components of projects will require further approvals as the programme progresses. It is envisaged that a series of updated / interim Final Business Cases will be prepared and submitted at appropriate decision points for individual programme projects or components of projects. Key Government decision gateways, in accordance with the 2019 PSC guidelines are highlighted. The current approval being sought is a PSC Gate 1 approval in principle to proceed with CBC statutory processes. Note the following figure reflects the programme of works as it stands at December 2021, submission date of the Preliminary Business Case for board approval. Updates to the programme and decision gateways will be included in further iterations of this document upon completion of the approvals process.

Figure 1.1: Constituent projects/components within the BusConnects Dublin Programme and the Decision Gateways



02

Introduction

2 Introduction

Chapter Summary

- BusConnects Dublin is a programme to transform the bus system to provide better services to more people.
- A holistic and extensive programme of network-wide changes is needed to effect such a transformation and deliver the entirety of the possible benefits.
- If a programmatic approach were not taken, opportunities for integrated benefits would be missed. Risks of omission, fragmentation, delay and cost overrun would be created.
- Carbon emissions in transport must be reduced and ultimately eliminated. The transition of the bus fleet to low emission vehicles has already begun and is therefore accounted for outside of the BusConnects Dublin programme and this PBC.
- The purpose of the business case is to confirm that BusConnects Dublin is a good use of public money by demonstrating that a clear understanding of the problem, that different options have been considered, that the proposed BusConnects Dublin interventions address stated objectives, that the forecast benefits outweigh the forecast costs, that the proposed expenditure is affordable and that there is a plan for implementation.

2.1 BusConnects Dublin

Aim: BusConnects Dublin is a programme to transform the bus system to provide better services to more people.

Most public transport in Dublin is currently provided by buses. Given the time it takes to plan and build new rail lines, bus travel is likely to remain the primary mode of public transport in Dublin for at least the next decade.

The transport system in Dublin is struggling to cope with the growth in demand and some elements of the system suffer from both real and perceived unreliability issues. BusConnects Dublin is therefore needed to make buses an effective mode of transport for existing passengers, to attract new customers and reduce the number of private car trips on the road. This programme will also help facilitate national and regional planning policy aspirations to have a compact and sustainable city which produces fewer emissions and consequently improved air quality, as the population grows. More importantly, it will enable more people to move around Dublin more easily and offer high quality services throughout the entire day.

The key elements of the BusConnects Dublin programme are:

- Next generation bus corridors – bus priority measures, bus lanes and 200km of cycle lanes along 16 routes
- A complete redesign of the bus network which responds to the projected growth in population of the Greater Dublin Area

- A state-of-the-art fares and ticketing system
- A simpler fare structure facilitating interchange between buses
- Park and ride at key locations on the National Roads network
- Modern bus livery and bus stops with better signage, information and shelters
- Cleaner bus fleet incorporating zero emission vehicles and hybrid vehicle technologies.

2.1.1 Benefits of delivering BusConnects Dublin as a programme

It will be a significant task to improve the bus network and each element of the existing system will require an overhaul to transform bus services to meet the needs of a growing, vibrant city. A programmatic approach to the enhancement of the network of bus services has been adopted because:

- The bus system is of itself an interconnected network not just a series of bus routes. Any transformation needs to be considered from the perspective of a network. Changes and outcomes by route are interdependent on each other
- A holistic and extensive programme of network-wide changes is needed to effect such a transformation and deliver the entirety of the benefits that are possible
- BusConnects Dublin is an interconnected and redesigned network, with the benefits arising from each individual bus corridor spilling over to the network as a whole.
- The enhancement of bus services on a current piecemeal basis has started taking place over a ten-year period (2018-2027). A structured programmatic approach will ensure an integrated approach is affected across the network and a continuing focus on meeting targets
- A programmatic approach will facilitate learning in relation to planning, design and implementation, in particular in relation to the Core Bus Corridor developments
- A programmatic approach will promote consideration of appropriate phasing of the individual elements to ensure a coherent approach within the overall network and one which encourages early delivery of benefits
- A programmatic approach ensures a high-quality evaluation process, in which the concept of the network transformation as a whole is appraised as well as the individual elements. The monitoring and evaluation process will drive incremental benefits realisation and facilitate continuous improvement in planning, design and implementation based on learning as the programme progresses.
- It allows for incremental approval through the Project Lifecycle and Decision Gate process of the Public Spending Code.

Delivering BusConnects Dublin as a programme will bring better overall service provision for customers and operators and will cumulatively deliver more than the sum of its elements. If a programmatic approach were not taken, opportunities for integrated benefits would be missed. Risks of omission, fragmentation, delay and cost overrun would be created. The proposed approach leverages the opportunities and minimises the risks.

Each element of BusConnects Dublin delivers unique benefits in its own right, e.g. Core Bus Corridors is an infrastructure project to enable faster, more reliable journeys, whereas Network Redesign is an operational programme to change service routes and frequencies to meet transport needs.

From a customer perspective, bus services will be improved in many ways – being able to travel on new, zero emissions buses (and transitional hybrid variants in the interim), along prioritised corridors, with an easy to understand fare and ticketing system. Such positive

transport features, initiatives and technologies will subsequently encourage use. Park and Ride facilities along with a rebranded network will deliver a new era for bus travel across the GDA.

Together the elements of BusConnects Dublin amass greater benefits across the network as a whole. Importantly, the delivery of BusConnects Dublin requires each and every element to be progressed as they are intrinsically linked and interdependent. The removal of elements, through value engineering or otherwise, is likely to result in an outcome offering diminished benefits of the programme and a network that is not properly cohesive in its service offering.

The alternative to the programmatic approach would be to appraise BusConnects Dublin as a series of discrete projects. This approach was considered and rejected as the holistic benefits could not be captured by a series of independent business cases, some costs could be overlooked and programme-level implementation and risk management matters could not be addressed.

Each element contributes towards the overall objectives of BusConnects Dublin; however, each element will deliver incremental operational benefits in its own right, albeit at a sub-optimal level until the entire programme is delivered.

In terms of assessing an incremental or 'Basic' Do-Something option to achieve the scheme objectives of BusConnects Dublin. It is considered that such an option will not achieve the primary objective of the scheme nor achieve the same level of benefits due to the interdependent nature of the various elements of BusConnects Dublin.

2.1.2 Interim programmes and interventions – Low emission vehicles and major projects

Environmental considerations and targets at both national and international levels necessitate the transition away from carbon emissions (at the point of use[10]) in transport, including public transport. There are ongoing interim improvements to Dublin's bus fleet which now incorporates hybrid technologies while progressing to a zero emissions bus fleet. The transition of the bus fleet to low emission vehicles is accounted for outside of the BusConnects Dublin programme and this PBC. Though there are obvious benefits stemming from low emission buses, their benefits and costs are outside of the scope of this PBC.

While the BusConnects Dublin PBC is being developed, other major transport projects are also planned such as DART+ and MetroLink, which means it is important that BusConnects Dublin is not considered in isolation. Therefore, a transport modelling sensitivity test was undertaken to account for the interactions with, and the complementary role of other major public transport projects. Yet, it is important to note that while other public transport infrastructure plans are included in modelling sensitivities, the benefits reported in the PBC are solely the result of the BusConnects Dublin programme to avoid double counting of benefits. For example, a passenger could take advantage of the expanded DART service to access a new suburban bus route, but only the benefits which result from the bus segment of the journey would be calculated in the PBC.

[10] *While the wider decarbonisation of electricity generation is actioned in its own right by the energy sector*

2.2 Business Case purpose

In accordance with the PSC and the CAF, the purpose of this Preliminary Business Case ("PBC") is to:

- Outline the problems that BusConnects Dublin aims to solve and the case for change
- Define the objectives of BusConnects Dublin
- Appraise the options for change
- Set out the impacts of BusConnects Dublin
- Outline next steps.

The purpose of the business case is to confirm that BusConnects Dublin is a good use of public money. It does this by demonstrating that there is a clear understanding of the problem it is intended to solve, that different options have been considered, that the interventions address stated objectives, that the forecast benefits outweigh the forecast costs, that the proposed expenditure is affordable and that there is a plan for implementation. The business case informs decisions to commit public expenditure.

This contrasts to the judgements which will be made when the proposals proceed through the planning approvals process. That will be a planning decision balancing all the benefits and disbenefits of the scheme relevant to the areas of impact such as environment and land use planning. Statutory planning approval processes will address these issues separately – including by way of further public consultation and environmental impact assessment. Planning approval allows construction to take place. It is independent of funding matters.

2.3 Business Case structure

Several steps were undertaken in the development of this BusConnects Dublin PBC, which included establishing the case for change, considering alternative solutions and assessing programme options to identify the preferred programme. It included a full assessment of the programme's impacts across the Dublin region and an economic appraisal of the benefits and costs, a financial appraisal of the programme elements, a risk analysis and outline delivery schedule.

03

The case for change

3 The case for change

Chapter Summary

- Sustainable mobility is a key element of the Government's framework to improve the quality of life for the population of Ireland supported by policy at National, Regional and local level.
- Population is expected to grow by 25% or 1.1million people by 2040.
- Bus based transport caters for most public transport trips at present. That is not expected to change but demand will significantly increase.
- The existing bus network focuses on accessing Dublin city. The network needs to adjust to meet existing and future demand responding to where people work, live and access goods and services – a shift in focus in effect to moving people around the city not just into the city.
- Decarbonising the transport network is critical to achieving climate change targets. There is a need to convert the bus fleet to zero emission vehicles and reduce reliance on the private car through appropriate land use planning supported by provision for public transport and active (e.g. walking and cycling) modes.
- Delays are commonplace on the current bus network due to buses operating within general traffic congestion and significant boarding time at stops associated with fares payment.
- Various barriers to accessing and using bus based public transport and active modes have been identified, resulting in greater reliance on and preference for private car trips.

3.1 Introduction

The case for change in the bus system forms the rationale for the BusConnects Dublin programme. This chapter describes the case for change in detail, covering:

- Public policy context
- Growth projections
- Historic growth in demand
- Problems with the existing bus system
- Conclusions on why the programme is needed.

3.2 Public policy context

3.2.1 Project Ireland 2040

Project Ireland 2040, as developed by the Department of Housing, Local Government and Heritage, and Department of Public Expenditure and Reform, outlines the Government's long-term strategy for the country. It lays out a vision for the country and a pathway to manage the high forecast population growth in a sustainable manner. A shared set of goals for every community across the country is expressed through 10 integrated National Strategic Outcomes (NSOs), presented in Figure 3.5.

NSO 4 is Sustainable Mobility. BusConnects Dublin is one of the programmes needed to deliver this NSO and it is presented as such in the *Project Ireland 2040 National Development Plan 2018 – 2027.*

Figure 3.1 - Project Ireland 2040: National Strategic Outcomes[11]

As a multi-objective programme, BusConnects Dublin aims to contribute to the *Project Ireland 2040*'s National Strategic Outcomes[12] of:

- NSO 1: Compact Growth because successful sustainable, concentrated, land use development requires high quality, high capacity public transport
- NSO 4: Sustainable Mobility because Dublin's sustained growth depends on improved public transport that is more attractive to the user and less damaging to the environment
- NSO 8: Transition to a Low Carbon and Climate Resilient Society because transport is one of the biggest contributors to Ireland's greenhouse gas emissions
- NSO 10: Access to Quality Childcare, Education and Health Services because improved transport will improve access to services

Investing in transport infrastructure is a key enabler in delivering the National Strategic Outcomes listed above. The continued growth in population and tourism numbers requires a robust, reliable and sustainable infrastructure network to bolster Ireland's growing economy, all of which are objectives that BusConnects Dublin aims to achieve.

In the *National Development Plan 2018 – 2027*, significant funding has been allocated to investment in public transport to realise these policy objectives and to solve the sustainable

[11] *Government of Ireland 2018. Project Ireland 2040: National Planning Framework. www.npf.ie*
[12] *Project Ireland 2040 Executive Summary*

mobility challenge for the growing Dublin area. As with all Exchequer investment, appraisal in line with the PSC is required before expenditure is approved, to ensure the appropriate use of funds. [13,14]

3.2.2 United Nations' Sustainable Development Goals.

Project Ireland 2040 is underpinned by and aligned with the United Nations' 17 Sustainable Development Goals. BusConnects Dublin meets Goal 11: Sustainable Cities and Communities, Goal 9: Industry, Innovation and Infrastructure and Goal 13: Climate Action.

3.2.3 Climate Action Plan 2019 and Climate Action & Low Carbon Development (Amendment) Act 2021

Greener transport in the Dublin area is expected to play a key role in the achievement of the Government's ambitions for climate action. Success depends upon both modal transfer and decarbonisation through:

- The provision of good public transport, cycling and walking infrastructure so that people are less reliant on their cars
- The conversion of private and public transport fleets to low emission vehicles

Since November 2018, the Government has committed to decarbonisation of public transport and the replacement of diesel buses with cleaner, more efficient, lower emission vehicles.

The BusConnects Dublin programme is an important aspect of the *Climate Action Plan 2019*. The *Climate Action Plan* promotes the BusConnects Dublin programme, encourages modal shift to public transport and active modes, and supports the decarbonisation of the public transport fleet. Section 10.3 of the *Climate Action Plan* specifically notes that the Government will:

> "*Implement major sustainable-mobility projects such as DART Expansion, Metro Link, and the BusConnects Dublin Programme. BusConnects Dublin targets a 50% increase in bus passenger numbers over the lifetime of the project in our major cities";* and
>
> *"We shall also expand greenways and develop over 200km of new cycling network under BusConnects Dublin".*[15]

In addition to this, Action Number 88 of the *Climate Action Plan 2019* specifically calls for: "*Increase public bus network capacity and usage (implementation of BusConnects Dublin services network"*, underpinning the importance of the BusConnects Dublin programme in the context of the *Climate Action Plan*.

The Climate Action and Low Carbon Development (Amendment) Act 2021 was signed into law by the President to establish a legally binding framework with clear targets and commitments set in law, and ensure the necessary structures and processes are embedded on a statutory

[13] *Department of Public Expenditure and Reform. 2012. The Public Spending Code.*
[14] *Department of Transport Tourism and Sport. 2017. Guidelines on a Common Appraisal Framework for Transport Projects and Programmes.*
[15] *Government of Ireland 2019. Climate Action Plan 2019. www.dccae.gov.ie*

basis to ensure Ireland achieves its national, EU and international climate goals and obligations in the near and long term.

The Act places on a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy. As such, the targets outlined in the Act supersede those outlined in the 2019 Climate Action Plan. The Act outlines that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030, compared to 2018, in line with the Programme for Government commitment and zero emissions by 2050.

The statutory recognition of a national climate objective and the requirement for sector-relevant carbon budgets will place further emphasis on the need to decarbonise the transport sector. As such, the proposals of the BusConnects Dublin will be in line with this law.

3.2.4 Regional Transport Strategies

The requirement for a bus system overhaul across the Dublin region is emphasised in the *Transport Strategy for the Greater Dublin Area 2016-2035 ("the Strategy")*. BusConnects Dublin is the result of many progressive iterations of transport demand assessments and corridor-based analyses. The *Strategy* identifies issues in the current bus network relating to frequency and reliability of services, and the complex nature of the network and fare structure. It recommends the implementation of continuous priority bus lanes in order to ensure a more efficient, reliable and effective bus system[16], supported by integration and operational measures. The strategy also calls for the replacement of the bus fleet with zero emission vehicles (at the point of use), and the implementation of safer cycling infrastructure. More detail on the role of the Strategy in the development of BusConnects Dublin is given in Section 5 of this document.

The NTA has commenced a review of the Strategy that involves assessing the degree of implementation of the existing plan and producing an updated plan that will set out the framework for investment in infrastructure and services to 2042[17]. This will be consistent with the spatial policies and objectives of *Project Ireland 2040* and the *Regional Spatial and Economic Strategy*. Consequently, it will continue to include BusConnects Dublin as key programme for implementation.

The wider BusConnects Dublin programme is also important in the context of other regional transport strategies, *Galway Transport Strategy 2016, Cork Metropolitan Area Transport Strategy 2040*, and the draft *Limerick Shannon Metropolitan Area Transport Strategy 2040.*

- The ***Galway Transport Strategy 2016*** comes to similar conclusions as the Transport Strategy for the Dublin area, claiming that long journey times and delays are by-products of the current bus network, which is in part due to lack of bus priority in the city centre. The strategy promotes continuous bus priority lanes, increased bus frequency and transport interchange, all of which are key features of BusConnects Dublin[18].
- Chapter 8 of the ***Cork Metropolitan Area Transport Strategy 2040*** is dedicated to BusConnects, which states that the bus network will *"remain the work horse of the public*

[16] National Transport Authority, 2016, Greater Dublin Area Transport Strategy 2016-2035, pg. 70
[17] An Issues Paper has been published for consultation: https://www.nationaltransport.ie/wp-content/uploads/2020/11/NTA-GDA-Transport-Strategy-2020-proof-5-FINAL-WEB.pdf
[18] Galway City Council, 2016, Galway Transport Strategy – Technical Report.

transport system in Cork". The chapter outlines the plans for BusConnects Cork and highlights the programme's importance in the context of the wider public transport network in Cork[19].

- The draft Limerick Shannon Metropolitan Area Transport Strategy 2040 also has a section on BusConnects, which sets out the objective of providing a *"reliable, high-frequency public transport service to improve connectivity of Limerick City and suburbs"*[20].

3.2.5 Active Travel Policies

The Department of Transport (DoT) is reviewing sustainable mobility policy, looking at all aspects of active travel (walking and cycling) and public transport policy. The review will result in a new 10-year sustainable mobility framework that will replace the policies published in 2009: *Smarter Travel: A Sustainable Transport Future 2009 – 2020* and *the National Cycle Policy Framework 2009 -2020*.

An extensive range of background papers were prepared by DoT looking at aspects of sustainability mobility e.g. public transport accessibility, active travel, congestion and the climate change challenge. These were the basis for a public consultation which ran until the end of February 2020.

DoT is now developing a policy, within the context of the ensuing COVID-19 pandemic, that supports a shift away from the private car to greater use of active travel and public transport; travel by cleaner and greener transport; and comfortable and affordable journeys to and from work, home, school, college, shops and leisure. BusConnects Dublin is already designed to accomplish all those objectives. Consequently, the programme is expected to feature in the forthcoming framework.

It is pivotal that cycling be considered at the fore when considering improvements to the bus system across the GDA. The NTA's *Cycle Network Plan for the Greater Dublin Area 2013* has supported key successes in the intervening period, most notably the 50% increase in cycling, (with a 130% increase recognised since 2006). BikeLife 2019, developed by the NTA and Sustrans, identified key drivers for cycling, and the barriers preventing uptake, with safety continuing to be the greatest barrier.

Substantial ongoing improvements in cycling will be delivered from:

- The setup of, and delivery from within the NTA Cycle Design Office
- A substantial boost in recent and ongoing Exchequer funding (€365 million / year)[21] to deliver cycle infrastructure and services, and separately as part of the Urban and Rural Regeneration and Development Funds.
- An accelerating and widespread rollout of cycle infrastructure and cycle-share services.

European policy[22] additionally indicates that mobility is key for the continued progression towards more sustainable societies, equitable access to services for many users and decarbonisation of transport. Progressing to 2050 three notable pillars of action are described

[19] *National Transport Authority, 2020, Cork Metropolitan Area Transport Strategy 2040*
[20] *National Transport Authority, 2020, Draft Limerick Shannon Metropolitan Area Transport Strategy 2040*
[21] *DoT, Sustainable Mobility Policy Review, Active Travel*
[22] *Sustainable and Smart Mobility Strategy – putting European transport on track for the future COM(2020) 789 final*

at the European level: to make transport more sustainable; make alternatives widely available and put in place the right incentives for change.

The positive personal outcomes (health, wellbeing and finances) and national benefits (lower burden of healthcare and reduced carbon emissions) of cycling must continue to be driven forward through dedicated cycle facilities. Ideally these facilities will be segregated from traffic, reducing the real and perceived risks to safety which burden current cyclists, as well as those who do not currently cycle.

3.2.6 Critical scrutiny of bus system operations

The bus network in Dublin is socially, economically and environmentally necessary but it is not commercially viable overall. For this reason, it is subsidised. The subsidy is managed by NTA through the Public Service Obligation (PSO) contracts that they hold with the service operators. All services used to be operated by Dublin Bus under a Direct Award PSO contract. In 2014, the NTA competitively tendered 10% of the Dublin bus services. This had the benefits of giving NTA a comparator to assess the value of the PSO to the taxpayer, of introducing competitive tension and of potentially reducing the cost of services. The outcome of the tendering process was that a new operator, Go Ahead Ireland, began operating services in 2018. A new Direct Award contract was awarded to Dublin Bus in 2019, for the remaining 90% of services. Ensuring cost efficiency in the operation of bus services remains a priority for the NTA.

The PSO payment is a large item of current expenditure for DoT and is closely scrutinised. As part of the Spending Review 2020, the Irish Government Economic and Evaluation Service (IGEES) undertook a *Review of the Governance, Efficiency and Effectiveness of Public Service Obligation (PSO) of Transport Services*. This found that, for Dublin Bus, the increase in passengers meant that the cost per passenger journey and the PSO per passenger had reduced, and so the services had become less dependent on subsidisation. It also found that that service punctuality and reliability had increased over the period 2017 – 2019. Conversely, the cost of running the services increased per seat and per vehicle kilometre over the same period, indicating a reduction in efficiency. Change is essential for bus services to become more efficient and more effective. Reducing journey times, facilitated by priority measures and faster boarding and alighting, are needed to improve efficiency. Changes to the network of bus routes is essential to make it more effective in serving the population.

3.3 Future growth projections

The Project Ireland 2040: National Planning Framework forecasts that by 2040 Ireland's population will have increased by 1.1 million and there will be an additional 660,000 jobs in the country. The Eastern and Midland Region, Ireland's economic engine, will have an additional population of between 475,000 and 500,000 people, from a population of 2.3 million people and 330,000 additional jobs, from 1.1 million jobs in the region in 2018[23].

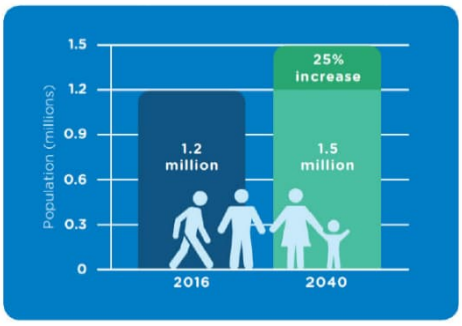


Figure 3.2 - Forecast population growth the Dublin region

[23] *CSO*

By 2040, the existing urban footprint of Dublin will contain approximately a quarter of a million additional people (between 235,000-293,000 extra). This 25% growth (Figure 3.2) will increase demand which will need to be accommodated by a high-quality public transport network.

Project Ireland 2040 outlines the need to prioritise compact urban growth and sets a target of delivering 50% of new city housing within the existing Dublin City and suburban footprint. However, the scale of projected urban development inevitably leads to some expansion of the city and suburban footprint through new greenfield developments on the outskirts, creating new origins and destinations not currently served by public transport services. Bus services will be essential to allowing these communities to access opportunities and services throughout the Dublin area.

3.4 Long term impact of Covid-19

Government restrictions to control Covid-19 have suppressed travel demand by requiring employees to work from home where possible, reducing public transport capacity, introducing remote learning and restricting travel to local areas for non-essential trips. Furthermore, people are avoiding crowded, enclosed spaces due to the risk of infection and this has reduced demand for public transport and pushed people towards greater car use. This has significantly reduced the number of people using buses to travel into the city centre or across the urban region, but it is important to acknowledge that these are temporary impacts which will shift again once the pandemic has ended.

In the long term, once restrictions are lifted, it is likely that travel demand will return to similar trends observed prior to the pandemic because demand has been artificially suppressed by Government restrictions and public health issues. Figure 3.3 shows that demand for public transport recovered quickly in June-September when Covid-19 restrictions were eased, indicating that demand for public transport remains strong. Yet, it is also important to acknowledge that some more permanent changes to travel behaviour have taken place, such as the accelerated acceptance of home working, teleconferencing for services and home delivery of retail goods which could cause fluctuation in trip volumes and peak times. This issue is explored as part of the appraisal process in the transport modelling sensitivity tests described in Section 10. While these changes may affect the demand profile across different times of day and areas of the city, it is unlikely they will substantially reduce overall demand for public transport, particularly as the Irish economy is expected to return to growth quickly after the distribution of vaccines. In any event, BusConnects Dublin will also facilitate transport in and around the city with improved orbital routes and services that can fit nicely with the new trends of home working. In light of this, continued investment in the BusConnects programme is justified to improve conditions for existing bus users, and to increase the appeal of bus travel to attract mode transfer from car users to achieve sustainability policy goals in the years following the pandemic. This will leverage the bus system's uniquely flexible ability to alter service patterns and capacity in response to changing customer needs.

Figure 3.3 Proportion of journeys made by public transport throughout 2020 - March 2020 baseline

3.5 Historic growth in demand

Public transport patronage grew nationally by 83 million over the six-year period 2013-2019 which represents a 39% increase, shown in Figure 3.4.

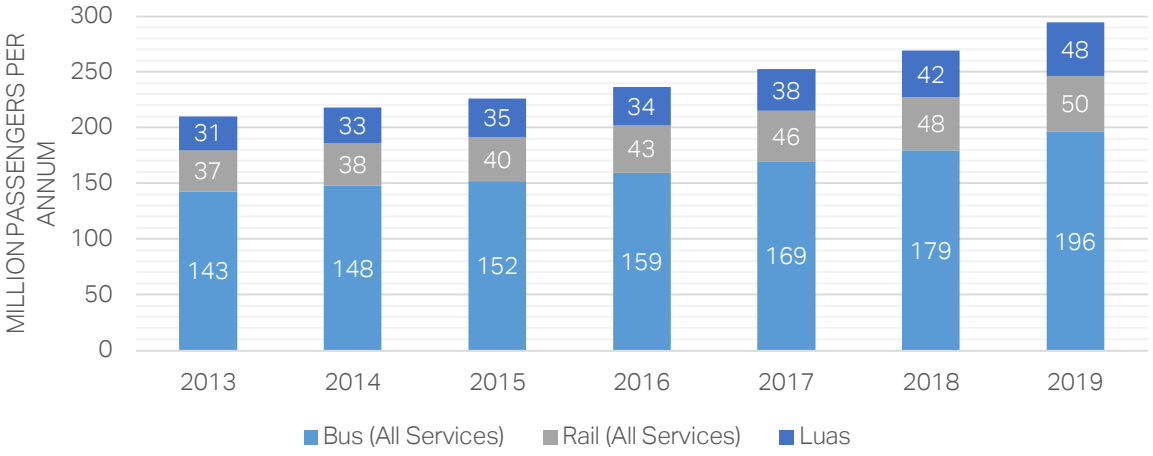


Figure 3.4 - National public transport passengers (millions) by mode (PSO Trips)[24]

In the Dublin region, buses are the backbone of the public transport system. Two-thirds of all public transport trips are made by bus. This is largely because the bus network has extensive coverage, compared with rail. Where light or heavy rail services exist, they excel at moving large volumes of people relatively quickly and can be preferable to bus transport.

[24] *National Transport Authority Bus & Rail Statistics for Ireland – State Funded Services. https://www.nationaltransport.ie/wp-content/uploads/2020/09/NTA-Bus-and-Rail-Statistics-Final-for-Web.pdf*

While the number of public transport trips is growing strongly in the Dublin area, private motorised transport remains the dominant mode of travel for work trips (53.6%) and a significant mode for other types of travel[25] (Figure 3.5).

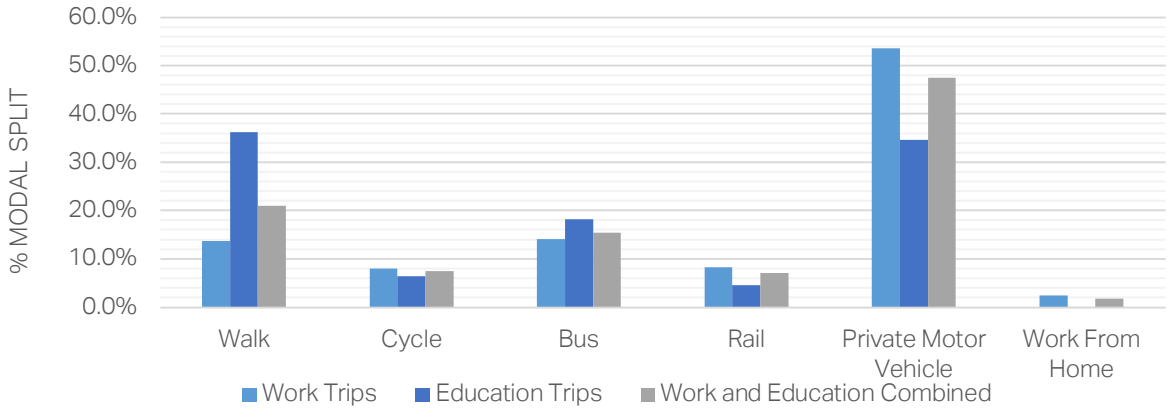


Figure 3.5 - Census 2016 – Dublin City and Suburbs Modal Split

Eastern region-wide trends show increasing car usage, by contrast the annual 'Canal Count'[26] which collects data during the AM peak period (07.00-10.00), shows the declining number of people who travel to the city centre by car. There is a steady increase in public transport, walking and cycling over the last decade (Figure 3.6), with increased demand for all public transport services into the city centre.

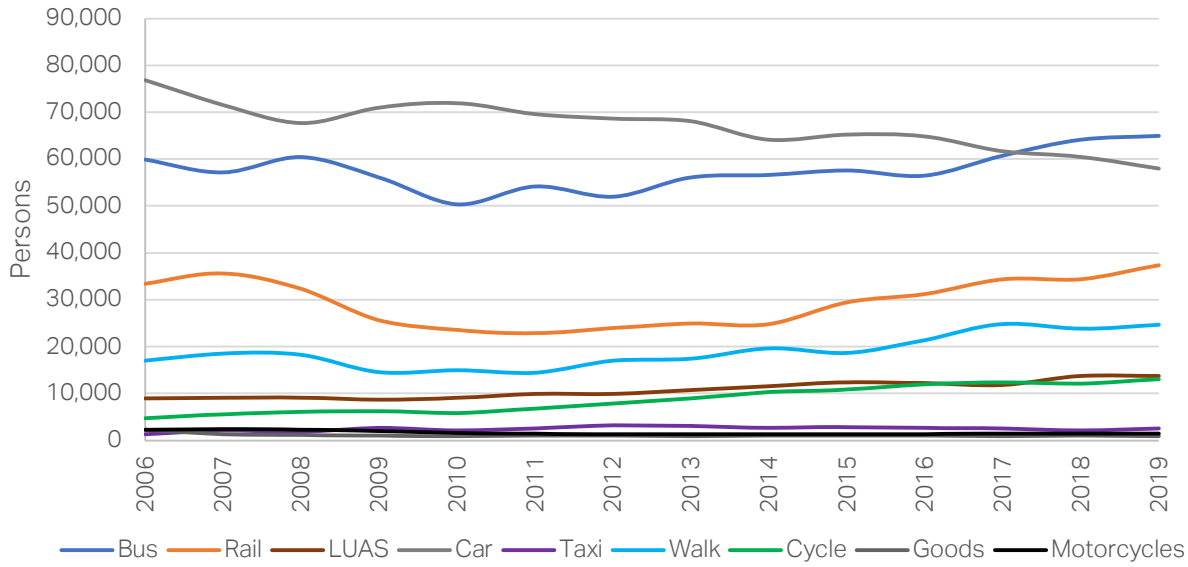


Figure 3.6 - Number of people crossing the canal cordon by mode (07:00-10:00)[27]

In 2019, more people entered the city centre by bus (31%) than any other mode, and in that year most people entered the city centre by public transport, walking and cycling (73%). There has been an enormous growth in the popularity of cycling over the last 10 years, and now 6% of people enter the city centre by bicycle, almost as many as those travelling by Luas.

[25] *Census (2016): Modal split data for the CSO Settlement: Dublin City and Suburbs*
[26] *Every November a count is undertaken of the number of people crossing a cordon around the city centre, formed by the canals. https://www.nationaltransport.ie/wp-content/uploads/2019/04/Canal_Cordon_Report_2018.pdf*
[27] *National Transport Authority, Cordon Count Report 2018 and supplementary 2019 data. This data is the latest available at the time of writing, late 2020.*

3.6 Problems with the existing bus and cycle system

The population of Dublin and its hinterland are rapidly outgrowing the current public transport system. In light of growth and expected public transport demand, and recognising the changing trends in travel, changes to the bus system are necessary to deliver an efficient, reliable and prioritised public transport system for the decades ahead.

The current system suffers from a complex, mainly radial, and fragmented network, while its fares, ticketing and scheduling are also becoming outdated. There is insufficient integration between modes and not enough prioritisation for buses and active modes.

The deficiencies in each of these areas are described in following sections.

3.6.1 Constraints of the existing bus network

More people than ever are using public transport to travel to Dublin city centre. Despite this, there are constraints on the existing public transport network that limit the effectiveness of current services and which will be compounded under forecast future population and employment growth scenarios. These constraints arise from a set of current issues, as outlined below:

Incomplete bus priority infrastructure

Bus priority measures are intended to provide bus services with the reliable journey times needed to be an attractive alternative to the private car. In Dublin, bus priority is provided by a network of bus lanes and shared bus/bike lanes. All major radial corridors (and some orbital routes) have bus lanes but there are many gaps. In locations with continuous bus lanes, competitive journey times and reliability are achieved, but it is more common to have short stretches of bus lane on routes primarily shared with general traffic. This is illustrated by AVL data provided by the NTA for bus services that currently run along the proposed CBC routes. Data shown in Figure 3.7 indicate that routes with a higher provision of bus lanes along their length tend to have shorter per kilometre journey times.

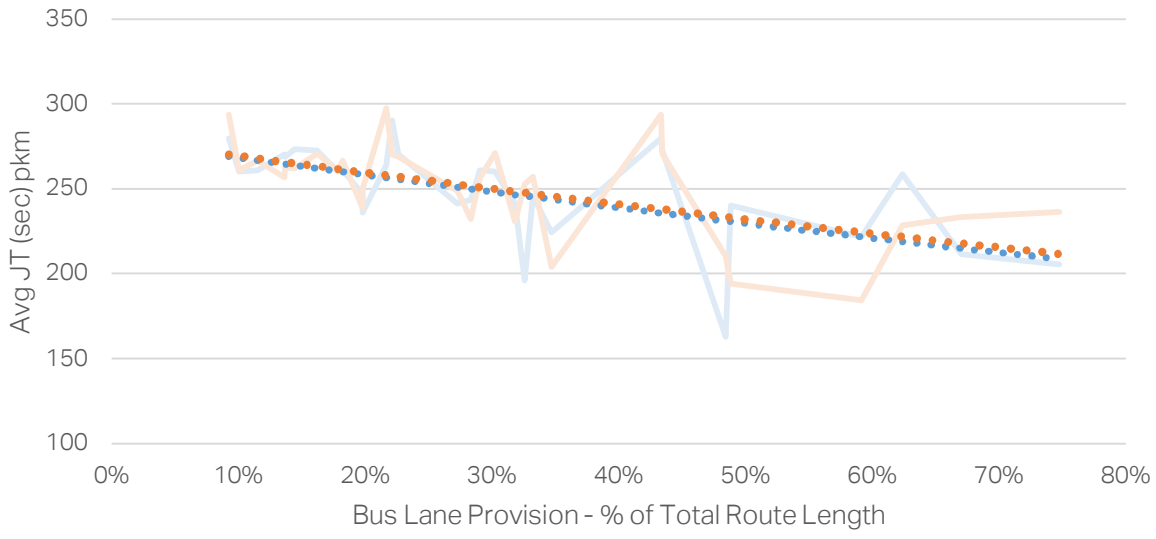


Figure 3.7 – Example peak hour journey times
Source: NTA AVL Data

The effectiveness of bus lanes in central areas is affected by sharing the space with other vehicles. This is exacerbated by the growth in traffic volumes and congestion on the wider road network. The overall result of this is a lack of journey time reliability.

A complex network

The network is very complex, which makes it hard to remember and use spontaneously. People can remember a bus route they take every day, but to feel free to move around the city, users need to be able to remember the structure of a network, just as most remember the structure of the street network.

It is not possible to produce a simple route map of the network. This complexity is compounded by a route naming system which does not emphasise the similarities between overlapping routes. Furthermore, the quality of information provided at bus stops varies considerably, ranging from bus stops with no timetable to the real time passenger information (RTPI) enabled bus stops with live information. Due to route complexity and inconsistent information, passengers often have insufficient knowledge of the network. This puts people off using the system to its full potential, or even trying it for the first time which creates a significant barrier for new users, despite some improvements in recent years.

The issues around network complexity have been identified and are set out in detail in Chapter 4 of the Bus Network Redesign Choices Report, produced by at the outset of the public consultation process[28].

Focus on peak periods

People travel for a variety of reasons, yet the bus services are focussed on the commute to work or education in the morning, and home again in the evening. The 2019 National Travel Survey indicated that work trips accounted for 2423.6% of all trips being made nationwide. While this is the largest percentage of any single trip purpose, it still means that 7676.4% of all trips are not work-related, with a significant amount of these other trips occurring outside of the traditional morning and evening peak periods.

[28] *https://busconnects.ie/media/1995/dublin-area-bus-network-redesign-choices-report-17-06-05-web.pdf*

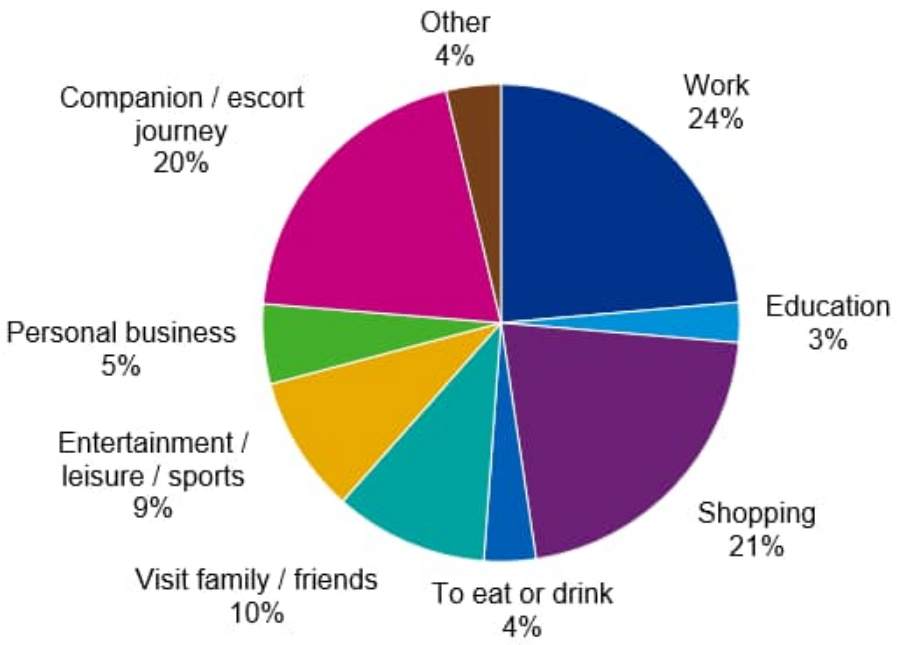


Figure 3.8 – Breakdown of daily journeys by purpose (Source: CSO National Travel Survey 20192019)

Despite this, bus services in Dublin are currently heavily orientated towards the peak periods with headways reducing significantly during off peak periods. It follows that patronage is peaked too, as shown in Figure 3.7, but these patronage figures mask the effect of people having poor travel choices outside peak periods. Many people rely on the private car for non-commuting, non-peak trips such as shopping, visiting family, attending sports activities or shift working. There is potential for improved services outside the peak period to tap into a new market, which could significantly lower car dependency.

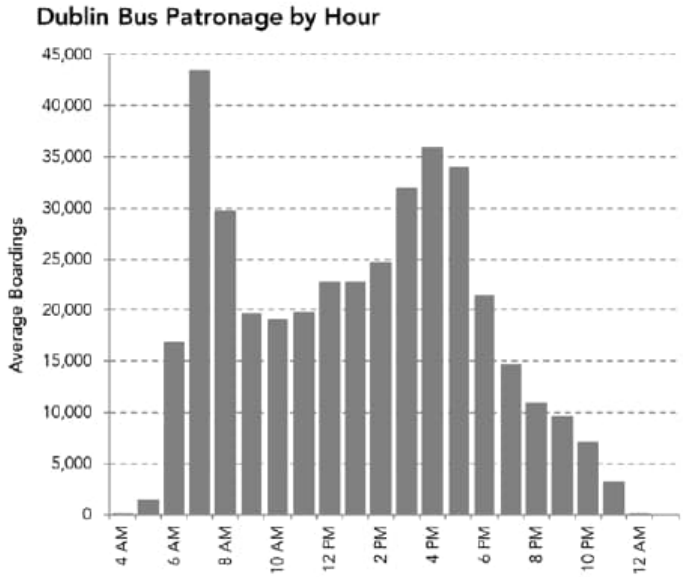


Figure 3.9 – Average daily patronage by hour for Dublin Bus (2016)29

[29] *Dublin Area Bus Network Redesign Revised Proposal (NTA, October 2019)*

Quality of cycling infrastructure

There has been significant investment in cycling infrastructure in the Dublin area in recent years however to date the investment in safe cycle infrastructure has not kept pace with the rate of growth. There has been a 105% increase in cyclist numbers between 2010 and 2019.

There is a lot to be done to provide a safe and high-quality network of cycle lanes and other facilities. The most recent strategy assessment of the cycle network, the *Greater Dublin Area Cycle Network Plan*[30], found that '*the predominant provision for cycling in the Dublin City area is by means of either on street cycle lanes (both advisory and mandatory) or bus lanes. These facilities are generally of a low Quality of Service in the city area mainly due to the lack of width for cyclists and the discomfort caused by large volumes of vehicular traffic sharing the road space. Typically, the cycle lanes achieve a QoS score of C or D'.*

More recently, BikeLife 2019 has surveyed over 1,100 people living in the GDA aged 16 years or older (all residents not only cyclists). The barriers to cycling continue to show similar trends as those of the 2013 *Greater Dublin Area Cycle Network Plan,* shown in Figure 3.10.

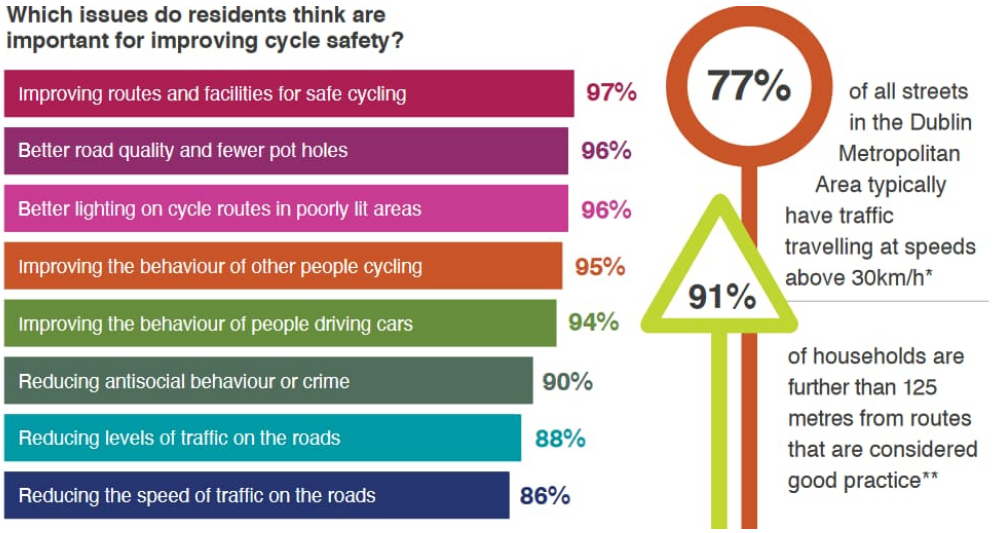


Figure 3.10 - Barriers to cycling in the GDA (surveyed June-July 2019, multiple responses allowed)

BusConnects Dublin aims to address the barriers to cycling by creating a safe and high-quality cycle network through the delivery of 200km of cycle facilities.

Mostly bus radial network

The network is good for many radial trips, taking people to and from the city centre, but not for orbital trips. For example, a trip from Ballyfermot to Castleknock, or from DCU to the Malahide Road, usually requires going into the City Centre and back out, which takes far too long and puts more buses into crowded city streets than need to be there.

In recent decades, urban centres and larger employment districts in the suburbs outside the city centre have grown, creating a more complex pattern of travel within the city. The lack of orbital services hinders people being able to travel between these locations. Generally, there is no orbital public transport option. Having to travel into the city centre and out again is usually slow by comparison with car or bicycle that bus is only used by those with no other travel choices for this sort of trip. In the rare instance where orbital bus routes do exist, they are

[30] *https://www.nationaltransport.ie/publications/strategic-planning/gda-cycle-network-plan/*

generally characterised by poor frequencies and lengthy routes e.g. route 75 from Dun Laoghaire station to The Square in Tallaght takes 90 minutes by bus. The same trip by car would take about 30 minutes via the M50 or about 40 minutes avoiding the M50.

Analysis of trips along the M50 suggests that there is a strong demand for intra-suburb trips such as between Tallaght and Sandyford, Blanchardstown and Ballymun, Tallaght and Ballyfermot, amongst others. Many of these trips between corridors are relatively short and could be potentially be a market for improved orbital public transport, walking or cycling routes, if the necessary infrastructure was provided.

Lack of integration

Rail and Luas network improvements require changes to the bus services. Buses, trams, and trains are not competitors. They are meant to work together to create an effective integrated network. Recent rail and tram upgrades (such as the Luas Green Line extension and the 10-minute DART) change the role that buses should play in the affected areas.

Even within bus services, there is a lack of integration, with various routes operating almost in isolation, with a lack of coordination hindering the potential for interchange with other routes and services.

3.6.2 Impacts of existing constraints

The constraints of the existing bus network manifest themselves in several ways, as outlined below.

Slow bus journey times

Travelling by bus takes longer than necessary. For example, a journey from Charlestown Shopping Centre, Finglas, to the City Centre is only 6.5 km, yet it takes 52 minutes in the morning peak hour. Other morning peak hour bus travel times are illustrated in Table 3.2.

Table 3-1 – Example peak hour journey times

Route	Journey	Distance	Av. AM Peak Journey Time	Ave speed
4	Monkstown Ave. to Merrion Square	8.5km	48 mins	10.6km/h
9	Charlestown Shopping Centre to O'Connell St.	6.5km	52 mins	7.5km/h
15	Clongriffin to Amiens St.	8.5km	45 mins	11.3km/h
16	Ballinteer to College Green	8.0km	59 mins	8.1km/h
83	Harristown to D'Olier St.	8.0km	63 mins	7.6km/h

Source: NTA AVL Data

Bus travel needs to be made faster by speeding up the boarding and alighting process, so buses spend less time at bus stops and by speeding up the time between stops through priority measures.

Unreliable bus journey times

Poor reliability undermines customer confidence in using a service which may already be slower than they would ideally like. Variations in journey times also has a significant impact on the ability of operators to maintain headways and can require additional buses to "fill in gaps" in the timetable caused by unreliable end-to-end journey times. Furthermore, the lack of priority measures results in bunching of buses which leads to overcrowding at stops, associated delays in boarding and imbalanced loading of buses meaning the capacity provided can be underutilised.

Investment in bus priority infrastructure will reduce interaction between buses and general traffic and reduce the likelihood of delays. The concept of standard deviation is explained visually below using a sample dataset for a road corridor in Dublin.

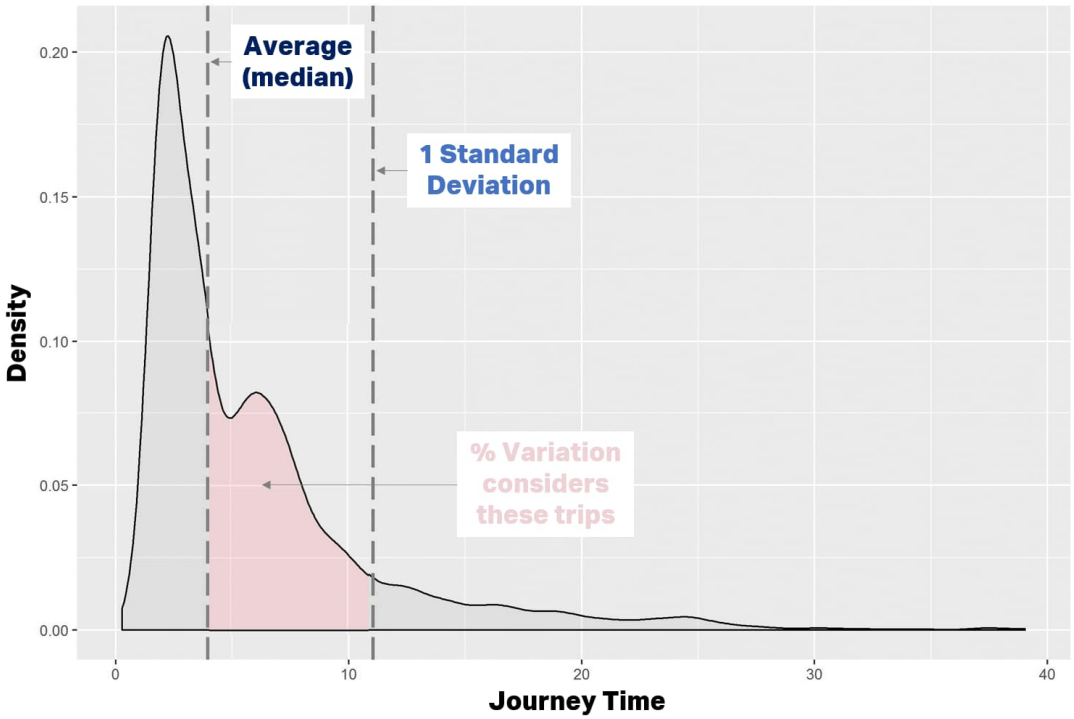


Figure 3.11 – Visual description of standard deviation based on sample dataset

Standard deviation of bus journey times has been extracted from NTA Automatic Vehicle Location (AVL) system and was used to represent the reliability on each corridor. Table 3.3 shows the end to journey time standard deviation results for both morning and evening peak, inbound and outbound direction end (i.e. journey time variance for someone travelling the entire length of each CBC).

Table 3-2 – Journey time standard deviation for Core Bus Corridors (minutes)

	AM peak Inbound	PM peak Inbound	AM peak Outbound	PM peak Outbound
CBC1 - Clongriffin to City Centre	10.42	9.85	11.02	8.76
CBC2 - Swords to City Centre	10.21	8.34	4.97	8.46
CBC3 - Ballymun to City Centre	7.48	10.17	10.16	11.09
CBC4 - Finglas to Phibsborough	9.38	7.73	7.15	8.72
CBC5 - Blanchardstown to City Centre	8.80	10.16	7.30	12.40
CBC6 - Lucan to City Centre	9.82	7.65	4.20	7.92
CBC7 - Liffey Valley to City Centre	12.06	8.91	9.26	10.72
CBC8 - Clondalkin to Drimnagh	8.44	8.04	5.56	10.21
CBC9 - Greenhills to City Centre	13.11	13.05	8.95	9.34
CBC10 - Tallaght to Terenure	11.02	8.76	10.42	9.85
CBC11 - Kimmage to City Centre	9.18	7.37	9.32	9.09
CBC12 - Rathfarnham to City Centre	11.49	8.23	13.71	10.11
CBC13 - Bray to City Centre	8.92	13.24	6.79	8.09
CBC14 - UCD Ballsbridge to City Centre	10.16	11.09	7.48	10.17
CBC15 - Blackrock to Merrion	10.16	11.09	7.48	10.17
CBC16 - Ringsend to City Centre	N/A	N/A	N/A	N/A

Source: NTA AVL Data

Table 3.3 shows that the standard deviation for the existing bus routes that serve the CBCs can vary significantly with some routes experiencing a variance in peak period journey times of up to 13 mins. Across all the CBCs, the variance in journey times is significant, ranging from 4 – 13 minutes.

Time lost to congestion

Dublin's transport system is at a critical tipping point. In a recent study, Dublin ranked the most congested city in Western Europe and the 17th most congested city in the world with people spending an extra 27 minutes commuting in rush hour per 30 minute trip in the morning, and 29 minutes extra time per 30 minute trip in the evening than they would have spent in an uncongested network.[31] The average driver in Dublin lost 8 days and 21 hours to congestion in 2019 in rush hour with congestion levels increasing by 3% from 2018. The cost of lost time due to congestion was estimated at €358 million in 2012 and forecast to rise to €2 billion per year by 2033 due to rising congestion[32]. Roads and rail systems in Dublin are close to full capacity at peak times. Congestion is hampering mobility in Dublin and congestion now spills over from peak periods into other times of the day. This has a real cost in terms of lost productivity. It also undermines transport users' quality of life and wellbeing. At present the bus routes must mix with general traffic and therefore bus users experience the effects of general traffic congestion

Rather than transport being an enabler for economic sectors, transport congestion can damage the city's competitive advantage. This undermining of Dublin's competitiveness as a city region will have an increasingly negative effect on our economy and ability to attract and retain inward investment. Workers may find it harder to get to work, many businesses will find

[31] *TomTom Index, https://www.tomtom.com/en_gb/traffic-index/dublin-traffic*
[32] *DTTAS, 2017. The Costs of Congestion. An analysis of the Greater Dublin Area. Department of Transport, Tourism and Sport, Economic and Financial Evaluation Unit*

it harder to employ the right people, goods are delayed in getting to their markets and quality of life is impacted by congestion and inadequate transport options. Congested roads place the spotlight on efficient public transport systems as a feasible travel option.

3.7 Case for change: conclusion

A Do-Nothing approach is not an option. Public policy at global, national and regional level is now insisting that travel changes from private car to public transport, walking and cycling. Policy now stipulates that future development is compact and supported by high quality public transport, and that public transport itself decarbonises.

Forecasts indicate that by 2040 Ireland's population will have increased by 1.1 million and there will be an additional 660,000 jobs in the country. The current public transport system struggles to meet existing demand, and hence will not be able to address this future growth. Without decisive intervention to improve public transport, the situation facing the Dublin region is that:

- Longer journey times and increased travel stress will reduce access to opportunities thereby diminishing quality of life for residents
- Transport congestion will continue to grow, affecting economic growth
- Transport emission targets will not be met.

The public transport system does not serve the growing transport demands of the Dublin area. The bus system caters for the majority of public transport trips at present. The network serves the city centre well but does not cater well for non-radial trips or trips between corridors. It needs to adjust to respond to where people live, work and access services, so that all citizens can realise the opportunities the Dublin area offers. To meet the needs of a growing vibrant urban area, the bus system needs a holistic transformation that offers:

- Better coverage so that more people have access to public transport
- More capacity
- Faster services, that are more reliable and attractive to users
- Good pedestrian facilities so that they can access the system safely and efficiently
- Greater protection and facilitation of the growing numbers of cyclists.

04

Programme aim and objectives

4 Programme aim and objectives

Chapter Summary

- In developing and presenting the programme aims and objectives a tiered approach is adopted. In this regard, initial high-level scheme objectives are set, with scheme specific objectives set aligned with the CAF criteria applied for transport projects.
- The overall aim of BusConnects Dublin is to deliver a public transport programme to transform the bus system, providing better services to more people. A series of grouped goals and targeted objectives are set out to achieve the overarching aim of BusConnects Dublin
- In line with the requirements of the PSC and CAF, specific objectives and SMART criteria are used in the appraisal (Section 10), monitoring and ex-poste evaluation of the scheme (Section 15.3)

4.1 High Level Scheme Objectives

The NTA's strategic vision is "*to provide high quality, accessible, sustainable transport connecting people across Ireland*". BusConnects Dublin is central to realising that vision.[33]

In order to respond to the case for change and problems defined in Section 3, a set of objectives for BusConnects Dublin have been defined.

AIM: The overall aim of BusConnects Dublin is to transform the bus system, providing better services to more people

A series of grouped goals and targeted objectives are set out to achieve the overarching aim of BusConnects Dublin.

Goal 1 – Transition to bus and active travel

Objective 1. Cater for existing and future demand for bus travel
Objective 2. Reduce reliance on private car transport for all trips
Objective 3. Simplify interchange between bus services and with other transport modes

Goal 2 – Improve the service offering

Objective 4. Increase the number and variety of destinations served by the bus system
Objective 5. Maximise the people carrying capacity of existing transport corridors
Objective 6. Integrate technology to improve the public transport system and to enhance customer experiences
Objective 7. Enhance the safety and security of the bus system.

[33] *NTA, Statement of Strategy 2018-2022, p. 17.*

Goal 3 – Improve the user experience
Objective 8. Improve bus journey times and reliability
Objective 9. Reduce barriers to using the bus system

Goal 4 – Deliver on environmental and policy targets
Objective 10. Deliver on relevant Climate Action targets
Objective 11. Enable relevant *Project Ireland 2040* strategic outcomes

This series of grouped goals and targeted objectives are used to communicate the programme rationale and are articulated throughout public and stakeholder engagement on the programme and referred to in all documents and brochures describing the programme.

Each objective also acts as a target in its own right, providing a specific instruction or direction of improvement.

4.1.1 Achieving Objectives

The PSC and CAF require objectives that are SMART (Specific, Measurable, Attributable, Realistic, Time-bound) to assist in determining whether the range of options available can deliver the project objectives and ultimately whether the scheme delivers against the objectives after it is implemented. The objectives, indicators assessing performance and data sources are set out in Table 4.1.

Table 4-1 – Goals, objective, indicators and data sources

Goal and Objectives	Performance Indicator	Source / Attribution	
		Ex Ante	Ex Post
Goal 1 – Transition to bus and active travel			
Objective 1: Cater for existing and future demand for bus travel	Number of additional public transport passengers	NTA Eastern Regional Model	Transport surveys
Objective 2: Reduce reliance on private car transport for all trips	Reduction in private car mode share	NTA Eastern Regional Model	Transport surveys
Objective 3: Simplify interchange between bus services and with other transport modes	Level of usage of multi-service ticketing	NTA Eastern Regional Model	Transport surveys and ticketing data
Goal 2 – Improve the service offering			
Objective4: Increase the number and variety of destinations served by the bus system	Number of residents within 400 metres of an all-day frequent (15 minutes or better) bus service Increase in the number of jobs and student enrolments that the average Dublin-area resident could reach in 30 minutes or less	GIS analysis of catchments using CSO population and employment and NTA projections	CSO Census data
Objective 5: Maximise the people carrying capacity of existing transport corridors	Increase in fleet passenger capacity (number of vehicles) and people throughput at corridors	NTA ERM and other transport modelling	Transport Surveys

Goal and Objectives	Performance Indicator	Source / Attribution	
		Ex Ante	Ex Post
Objective 6: Integrate technology to improve the public transport system and to enhance customer experiences	Number of bus stops with on-street Real Time Passenger Information signs and provision of bus priority at traffic signals	BusConnects Designs	Monitoring of traffic signals performance and customer surveys
Objective 7: Enhance the safety and security of the bus system	Increased provision of CCTV, lighting, shelters and improved public realm	BusConnects Designs	Customer Surveys
Goal 3 – Improve the user experience			
Objective 8: Improve bus journey times and reliability	Average bus speed / average bus speed by corridor Increase in level of bus punctuality	NTA ERM and other transport modelling Existing performance against timetable	Bus AVL data and transport surveys
Objective 9: Reduce barriers to using the bus system			
Deliver on environmental and policy targets			
Objective 10: Deliver on relevant Climate Action targets	Percentage of zero emission vehicles in bus fleet Carbon emissions reductions	Existing fleet data and planned bus fleet purchases	Future fleet data
Objective 11: Enable relevant Project Ireland 2040 strategic outcomes		Environmental modelling of carbon emissions	Transport and environmental surveys

Each objective acts as a target in its own right, providing a specific instruction or direction or improvement. Together with the associated Performance Indicators, they provide the basis of monitoring and evaluation plans, and allow monitoring of success against the goals and ultimately success of the BusConnects Dublin programme.

Based on the appraisal of options, the Monitoring and Evaluation plan presented in Section 15.3 sets out the initial targets against which the performance of the programme will be measured through the next stages of design and ultimately implementation

Section 6.4, the multi-criteria assessment of options, provides the evaluation criteria used for each of the CAF's six broad criteria for appraisal (economy, environment, accessibility and social inclusion, safety and security, integration and physical activity). Section 10, Appraisal, describes how SMART objectives and indicators are used in the programme appraisal that complies PSC and CAF requirements and applies the results of the Eastern Region Model.

All objectives will be further enhanced as the expected impacts of the BusConnects Dublin Programme become further understood as it progresses through the appraisal and planning processes, and the indicators will be refined accordingly.

The principles of SMART are applied throughout the project evaluation lifecycle with the tiered approach to objective facilitating effective communication of the programme objectives to stakeholders with a range of requirements.

4.2 Sustainability Objectives

A Draft Sustainability Plan is in preparation. It will bring together the environmental, economic and social ambitions and targets from both the PBC and environmental impact assessment processes to ensure that BusConnects Dublin delivers a positive legacy.

05

Alternative ways of addressing the problem

5 Alternative ways of addressing the problem

Chapter Summary

- This section summarises the assessments undertaken in developing the preferred option for transforming the bus system and the conclusions reached.
- The concept of providing a Quality Bus Corridor (QBC) Network in Dublin has been a feature of successive transport plans/strategies since the 1990's, most recently the *Transport Strategy for the Greater Dublin Area 2016 – 2035 ("the Strategy")*. The BusConnects Dublin programme represents the further development and refinement of the bus measures that were identified in the Strategy.
- In preparing the Strategy, NTA outlined a range of different ways to address the existing and future transport demand in the Dublin area, including alternative modes, and, through appraisal, identified the most suitable package of options to meet this demand
- The Strategy was developed iteratively and focused on identifying the most appropriate measures to address the transport shortcomings of a series of radial transport corridors in and out of central Dublin, which represents the most dominant type of trip.
- The Strategy proposed an integrated multi-modal network, with a wide suite of proposed improvements for bus, heavy rail, light rail, cycling, walking and road.
- Appraisal undertaken as part of the Strategy development indicated that, if implemented in its entirety, the measures will have significant positive benefits in terms of decreasing reliance on the private car.
- The Strategy's preferred options for bus are reflected in the BusConnects Dublin programme elements.

5.1 Introduction

The challenges facing the bus network and the case for change are very clear. The range of potential solutions to address the problem and deliver on the aims and objectives set out previously have been under consideration for some time and across a variety of different assessments and reports. It is not uncommon for the optioneering and development of major transport investment to take a long time. It is regularly the case that the early option sifting and alternative assessment happens many years before the preliminary appraisal and preliminary design phase. This section aims to summarise the assessments undertaken in developing the preferred option for transforming the bus system and the conclusions reached.

To explain the alternatives and options considered to address the problems explained in Section 3 and achieve the objectives set out in Section 4, it is necessary to step back and look at the entire transport system in the Dublin area. This section primarily outlines key considerations of the *Transport Strategy for the Greater Dublin Area 2016 – 2035 (the Strategy)*, though it is prefaced by a summary of earlier actions and assessments to improve the bus system.

In preparing the Strategy, NTA outlined a range of different ways to address the existing and future transport demand in the Dublin area, including alternative modes, and, through appraisal, identified the most suitable package of options to meet this demand.

While also considering the requirements of the Strategy, specific public transport investigation has been carried out to address the problem. The NTA delivered the *Dublin Area Bus Network Redesign Choices Report* (Choices Report) in 2017, which highlighted the need for integrated consideration of all public transport networks across the region. Subsequent and detailed investigation of the network redesign has followed.

5.2 Quality Bus Corridor Network

The introduction of a Quality Bus Corridor (QBC) Network in Dublin was one of the recommendations of the *Dublin Transportation Initiative (1994)*. Nine QBCs became operational in the period from 1996 to 2001. They were a great success: between 1997 and 2002 car flows fell by 18% and bus patronage increased by 55% across the full QBC network.

The next transport strategy for the Greater Dublin Area (*A Platform for Change, 2000 – 2016*) proposed a significant expansion of the QBC Network. Future developments were intended to have a stronger focus on orbital corridors as all existing QBCs were radial. In 2002, a Quality Bus Network Project Office was established, tasked with implementing an expanded QBC Network.

Extensive research, analysis and feasibility design was undertaken by the Quality Bus Network Project Office as they examined options to build on the proven success of the QBCs, spreading the benefits of bus priority more widely across the Dublin area. They also looked at options to move the concept of bus priority to the next level. Significant investment did not take place as a result of these efforts; however, they informed the development of the next transport strategy, the *Transport Strategy for the Greater Dublin Area 2016 – 2035 ("the Strategy").*

5.3 Strategy development

5.3.1 Purpose

The Strategy is a comprehensive, integrated, strategy that encompasses infrastructure, services and policy measures across all modes. It provides an overriding framework for the long-term planning and delivery of transport infrastructure and services in the Dublin.

The Strategy purpose is *to contribute to the economic, social and cultural progress of the Greater Dublin Area by providing for the efficient, effective and sustainable movement of people and goods.*

5.3.2 Strategy rationale

The Strategy was developed on the basis that substantial population and economic growth would need to be catered for, that the environment in the Dublin area needed to be protected and enhanced and that nobody should be excluded from society because of the design of transport infrastructure and services or by the cost of public transport. It set out to address the challenge of underinvestment in the transport systems capital stock. Where investment was already committed e.g. Luas extensions, Phoenix Park Tunnel reopening, and Kildare Line

improvements, the benefits would be substantially limited to the people travelling within those corridors. Therefore, the Strategy emphasised the need for a comprehensive package of high capacity transport network improvements covering each corridor of the metropolitan area of Dublin. It recognised that car dependency for orbital trips would need to be reduced, despite the challenges of dispersed development in the outer parts of the metropolitan region. The opportunity presented by the cycling was recognised, along with an obligation to enhance the quality and safety of cycling routes.

The problem identification process found a mismatch between public transport demand and supply which mirrors the problems articulated in Section 3.6 of this document: uncompetitive journey times, overly complex network and fare structures, poor integration, poor reliability, inadequate passenger information, congestion and sub-standard facilities for cyclists and pedestrians.

Strategy development process

The Strategy development involved significant consultation, research and the assessment of alternative modes and transport solutions. The process, which took place over several years, is summarised in Figure 5.1.

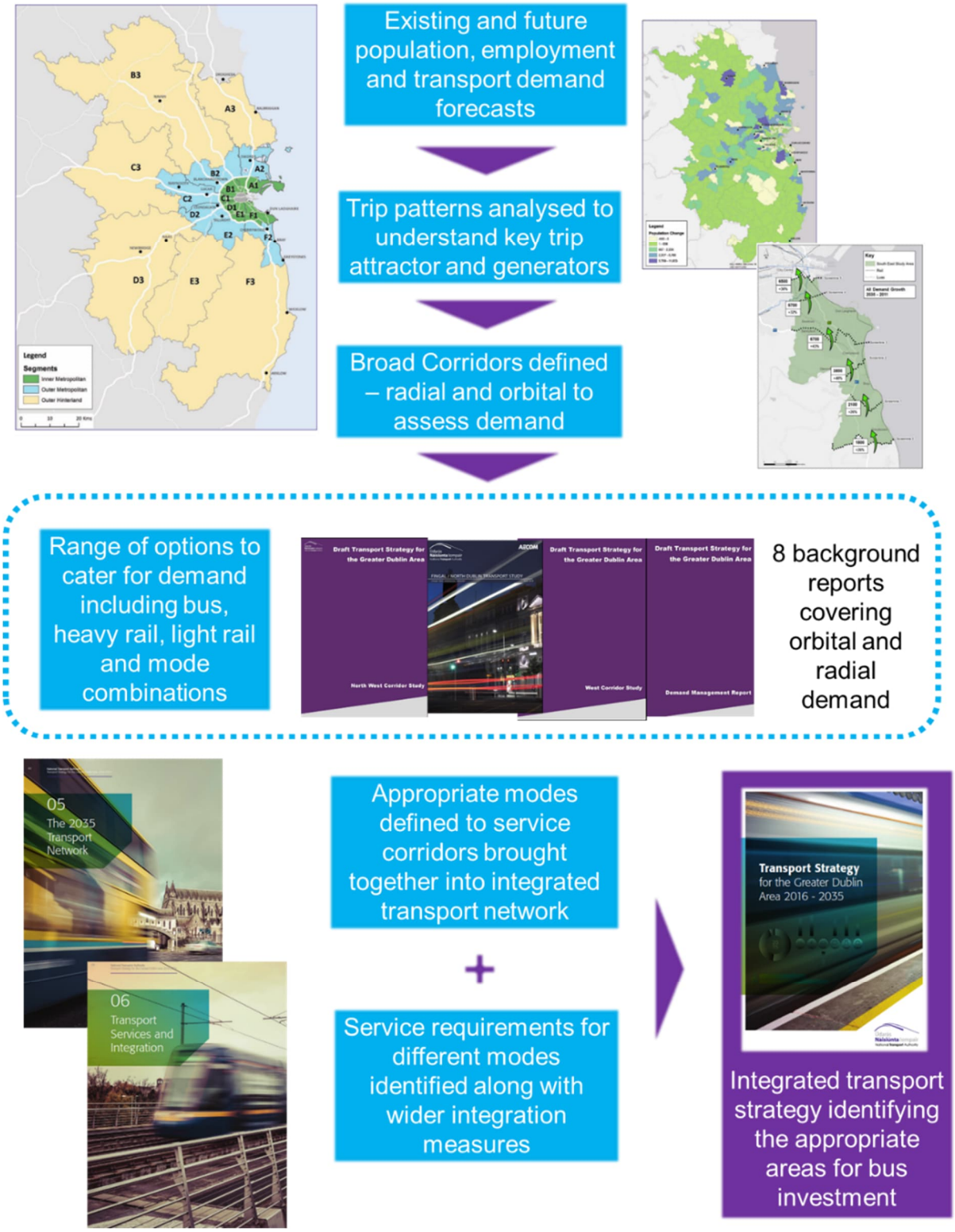


Figure 5.1 – Assessment of alternative modes and transport solutions

Section 17, Appendices contains a list of all the Strategy background papers and provides links to each.

The Strategy divided the Dublin area into corridors (Figure 5.2), based on the national and regional transport networks. The corridors primarily serve radial trips in and out of central Dublin, which represents the most dominant type of trip.

For each corridor, the existing trip patterns, including mode share and origin-destinations, and the associated issues, such as capacity constraints and a lack of existing public transport options were identified.

From this assessment, the transport shortcomings of each corridor, as well as potential options to address these, were identified. The options were appraised at a corridor level and at a local level to determine the most appropriate option or combination of options to address the identified shortcomings at the time, as well as forecasted future demand. This work determined the optimal primary mode and combination of modes in the longer term for each corridor: bus, Luas, metro or heavy rail. Options for local movement were also identified and appraised.

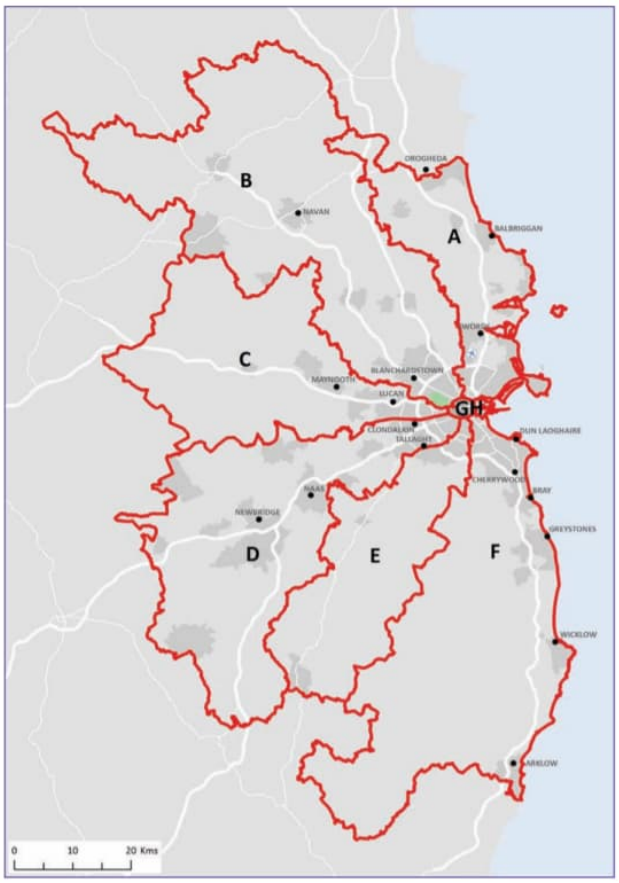


Figure 5.2 - Radial corridors of the GDA[34]

5.4 Defining the bus network within the integrated network

The Strategy proposes an integrated multi-modal network. Infrastructure proposals are presented by mode: bus, heavy rail, light rail, cycling, walking and road. Additional sections address operational, integration and management issues.

In relation to bus, specifically, the Strategy outlines the following infrastructure and investment measures:

- A Core Radial Bus Network was identified, which outlined 16 of the most important bus routes in the region, characterised by high frequency of bus services, high passenger volumes and with significant trip attractors located along them. In order to ensure an efficient, reliable and effective bus system, the Strategy outlines an intention to develop the Core Bus network to achieve, as far as practicable, continuous priority for bus movement on the portions of the Network within the Metropolitan Area[35].

[34] *Transport Strategy for the Greater Dublin Area 2016-2035, P52.*
[35] *Some of these corridors were designated as Bus Rapid Transit (BRT) routes. The BRT concept has been absorbed into the BusConnects Dublin programme, ensuring at all corridors have a similar brand and standards for high quality, high frequency service.*

- A **Core Orbital Bus Network** was identified, comprising six key orbital routes. The orbital routes will ensure that more trips within the Metropolitan area can be undertaken by public transport in a convenient and efficient manner.
- A **Core Regional Bus Network** comprising six corridors
- A **Programme of Improvements** to the bus fleet, bus facilities and stopping areas, including:
  - New bus station facilities
  - Continual replacement and upgrade of bus fleet vehicles - transition to low or zero carbon emission vehicles
  - Installation of enhanced standard bus stops
  - Provision of enhanced travel information
  - Upgrade and installation of bus shelters.

Figure 5.3 summarises the core bus network for infrastructure improvement proposed in the Strategy.

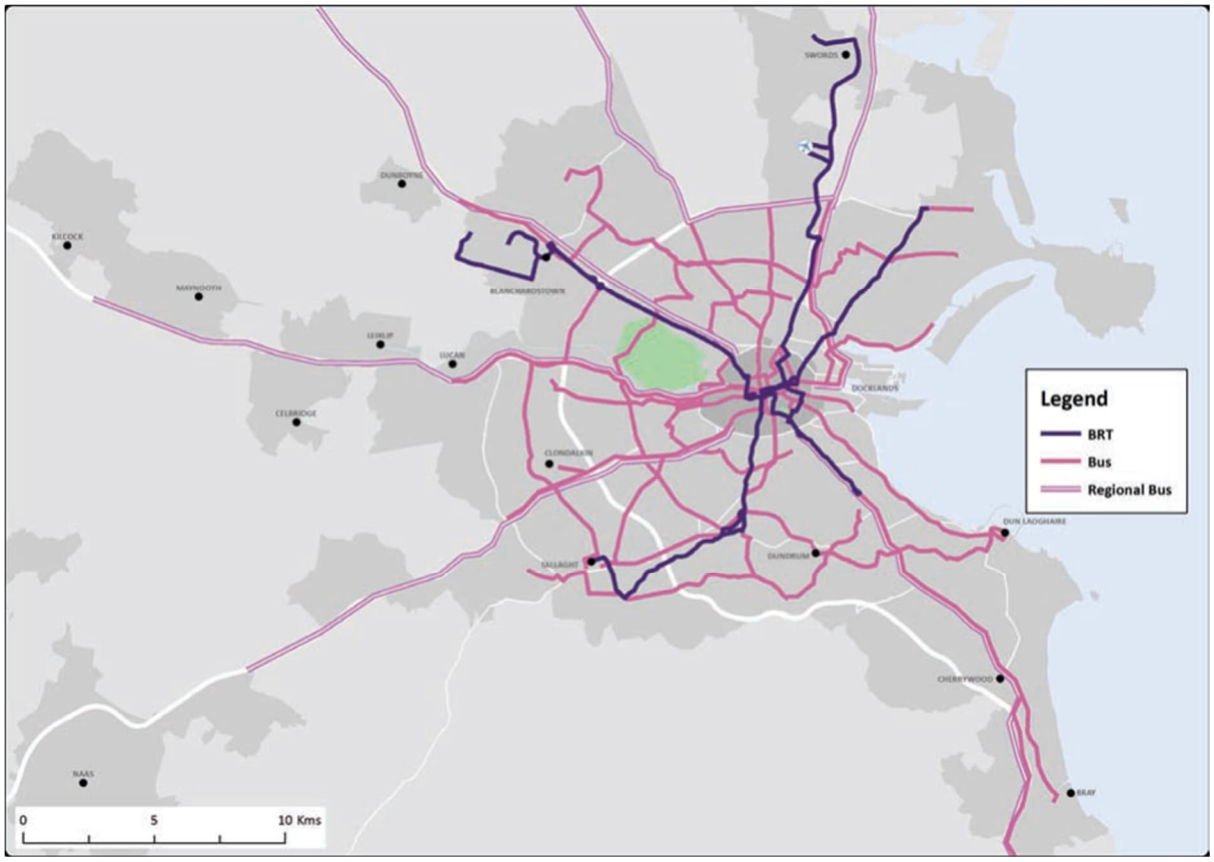


Figure 5.3 – Overall Core Bus Network

To support those areas where demand exceeds that which could be provided by bus or where existing rail modes could be upgraded, other measures are included in the strategy, including:

- An extended DART and suburban rail network, including new additional stations, as well improvements to signalling infrastructure and improved rolling stock
- Development of two Metro lines; New Metro North and Metro South (which entails upgrading existing Luas Green line to Metro standard)
- Development of new Luas lines and extension of existing lines and services

- Implementation of the proposals of the GDA Cycle Network plan, entailing the expansion of the urban cycle network to over 1,485 kilometres in length
- Upgraded pedestrian facilities across the region
- National, regional and local road improvements
- Travel demand management.

Many of these measures are complementary to the bus measures and interchange and integration have been key considerations in bringing the various measure together. Moreover, BusConnects Dublin will contribute to the development of the cycling and pedestrian facilities whilst other measures are picked up in separate programmes.

5.5 Strategy appraisal

5.5.1 Transport appraisal

The appraisal undertaken as part of the Strategy development indicated that, if implemented in its entirety, the measures will have significant positive benefits in terms of decreasing reliance on the private car, as illustrated in Figure 5.4. This is especially true for orbital trips, as illustrated in Figure 5.5.

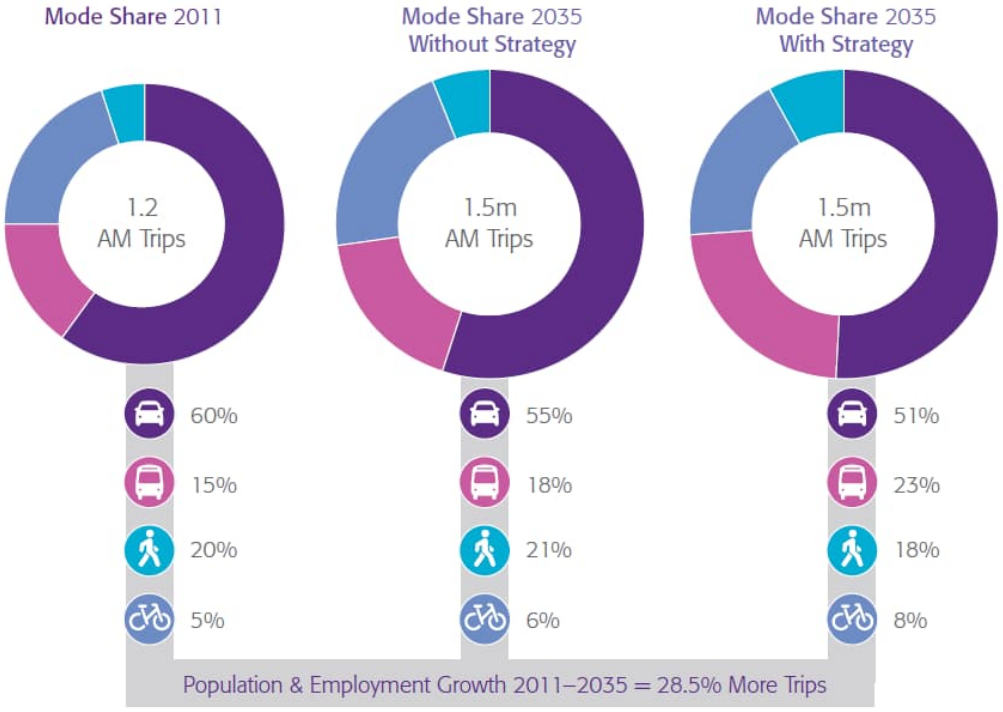


Figure 5.4 – GDA Strategy Impact Analysis – Mode Share for All Trips

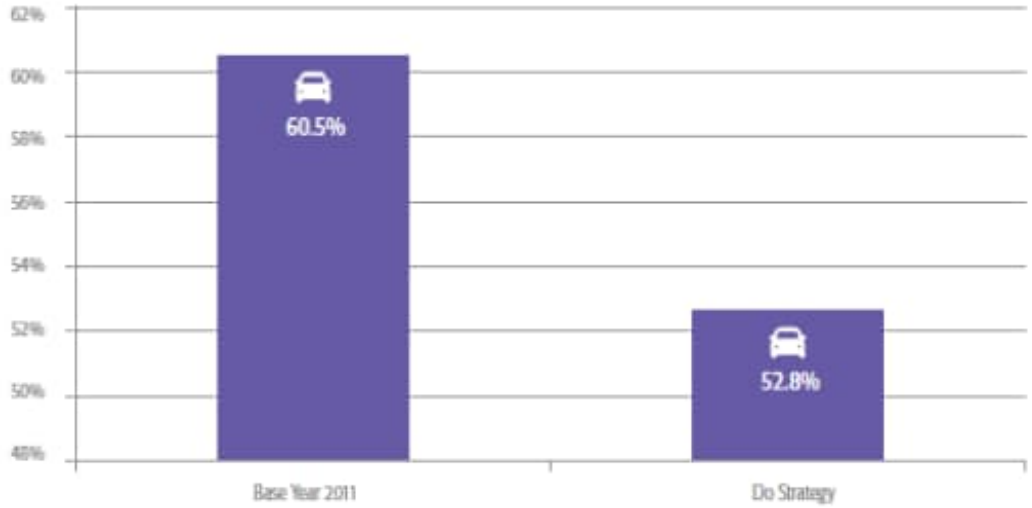


Figure 5.5 – GDA Strategy Impact Analysis – Metropolitan Orbital Car Mode Share

As well as the modal shifts highlighted above, the Strategy appraisal also indicated significant improvements in public transport journey times. Figures 5. 6 and 5.7show that the area within a one hour travel time of the city centre is far more extensive with the Strategy in place, and the areas within shorter journey times are correspondingly greater.

Figure 5.6 – GDA Strategy Impact Analysis – Travel Time by Public Transport to the City Centre 'without Strategy'

Figure 5.7 – GDA Strategy Impact Analysis – Travel Time by Public Transport to the City Centre 'with Strategy'

5.5.2 Environmental assessment

The Strategy was subject to a Strategic Environmental Assessment[36]. It included a comparative assessment of Alternative 1 – Orderly Provision of Transport (i.e. the full implementation of all elements of the strategy) with Alternative 2 – Uneven Provision of Transport and Alternative 3 – Development-led Provision of Transport. This concluded that Alternative 1 presented the best strategic approach.

5.6 The need for integration

One of the key messages emerging from the Strategy is the need to ensure any transport infrastructure delivered is accompanied by an efficient, integrated and appropriate network of transport services. The Strategy stresses that the transport network needs to:

- Provide appropriate coverage of the region
- Increase opportunities to transfer between modes and services
- Provide fast and convenient access to major travel destinations throughout the region
- Be easily understood by both local and visiting passengers
- Deliver reliable and predictable journey times
- Charge simple, affordable fares which enable transfers between services without unnecessary penalty
- Provide easy-to-use cashless payment systems
- Be accompanied by comprehensive information, both during and prior to the journey
- Provide comfortable and convenient journeys to the maximum number of passengers.

[36] *https://www.nationaltransport.ie/wp-content/uploads/2015/10/SEA_Environmental_Report.pdf*

5.7 The preferred options for bus

The Strategy outlines a series of measures that, along with the proposals identified in Section 5.4, are aimed at providing the integrated network of services identified above, as shown in Figure 5.8. The BusConnects Dublin programme represents the further development and refinement of the measures that were identified in the Strategy, considers the appropriate delivery mechanisms to optimise the impact of individuals, achieve value for money and ensure integration.

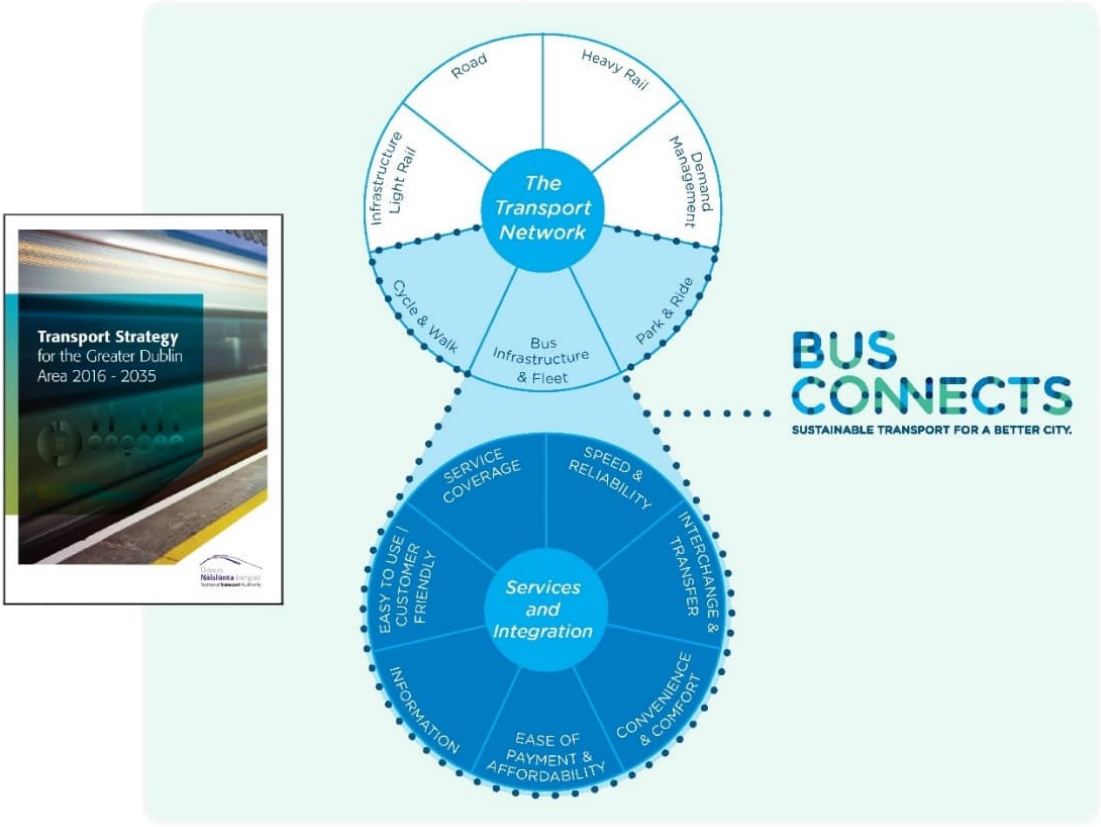


Figure 5.8 - BusConnects Dublin' programme approach delivers integrated, multi-modal transport for many

Table 5.1 maps the Strategy's preferred options for bus to the BusConnects Dublin programme elements.

Table 5-1 – Strategy Requirements and BusConnects Dublin Programme Elements

Strategy Requirements	BusConnects Dublin Programme Elements
– Core Radial Bus Network – Core Orbital Bus Network – Core Regional Bus Network	Core Bus Corridors: A network of next generation bus corridors – over 230km of bus lanes and 200km of cycle tracks/lanes to make journeys faster and more reliable.
– Express Services – Provide fast and convenient access to major travel destinations throughout the region – Increase opportunities to transfer between modes and services	Dublin Area Bus Network Redesign: A complete redesign of the bus network – to provide a more efficient network with high frequency spines, new orbital routes and increased bus services.
Bus Stops and Shelters: – Provide a standardised style of pole, flag and information panel – Increase the availability of on-street Real Time Passenger Information – Provide high quality passenger interchange points with sufficient information to enable efficient transfer between routes – Rationalise bus stop poles – Equip key bus stop locations with bus shelters, comprehensive information panels and appropriate seating	"While You're Waiting": New bus stops and shelters – with better route and fare information provided in each case and with timetable information specific to each stop.
Fares: – Introduce a simplified fare system in the Greater Dublin Area – Migrate all buses to a cashless system – Further develop the current Leap card system	"Just the Ticket": State-of-the-art ticketing system – to provide a simpler, more modern, more convenient and more integrated ticketing system. Transition to a cashless payment system – to streamline and speed up the process of paying for bus journeys.
– Continuously replace and upgrade bus fleet and transition to low or zero emission vehicles	"Cleaner Technology": Zero emission vehicles – to contribute to Ireland's climate change targets by transitioning to a lower emission bus fleet.
– Improve cycling infrastructure	"On Your Bike": Creation of a 'next generation' network of cycling facilities – delivery of 200km of cycle lanes as part of the Core Bus Corridor Project.
– Assess and determine the potential for bus-based park and ride, in particular, close to high quality road corridors	"Leave the Car": Park & Ride facilities - to enable those travelling longer distances to make part of the journey by car, then leave the car in a dedicated car park and complete the journey by bus.
	"Refreshing Bus Livery": Implement a new bus branding to integrate bus vehicles of different operators and types and provide a modern look and feel to the new bus system.

The Strategy identified corridors where enhanced bus services are appropriate and will deliver the necessary impact and benefits. Improvements to the bus system, however, are only part of a multi-modal Strategy. BusConnects Dublin is part of plans to create an integrated public transport network which when delivered will provide new opportunities for more people to travel within the region by multiple modes and will enable *Project Ireland 2040* NSO 4: Sustainable Mobility in the Dublin area.

5.8 Summary

A summary of key points from the alternative ways of addressing the problem chapter are set out below:

- The transport issues within the Greater Dublin Area cannot be solved by individual interventions or individual modes.
- The importance of bus in the transport network required the assessment of alternatives at both regional and corridor level
- The Transport Strategy for the Greater Dublin Area 2016-2035 considered in detail the transport shortcomings of each corridor in the city
- The Strategy then appraised various modes and combinations of modes to determine what elements of the integrated transport network should be served by bus
- The Strategy identified both the infrastructure investment and the need for enhanced services, ticketing, revised fares and an overall enhanced customer experience.
- Bus is identified as the preferred mode to cater for demand on various corridors, radial and orbital, and integrates with other modes such as heavy rail and light rail.
- The BusConnects Dublin Programme now brings the various infrastructure, services and integration measures together, working in tandem with other transport projects identified in the Strategy to present an integrated transport solution for the city.

06

Options development and appraisal

6 Options development and appraisal

Chapter Summary

- The Transport Strategy outlined a strategic plan to improve the bus system in the Dublin area, within an integrated transport strategy, which included investment in infrastructure and assets as well as operational change.
- The next step was to develop the individual measures, identifying and assessing options for their delivery.
- The Core Bus Corridors and the Network Redesign and other programme elements have gone through detailed option selection studies. This is evidenced in the option selection reports and network redesign reports, as well as the reports on the various rounds of public consultation. These reports are listed in Section 17, with links to the reports provided.
- This process, which resulted in the BusConnects Dublin programme being established, is described in this section which also includes an overall programme assessment

6.1 Network Redesign options development

Early appraisal of BusConnects Dublin' elements are included in the Network Redesign Choices Report. This report provided a comprehensive overview of the issues faced by the immediate population and business, along with indicative strategies to address them.

The Network Redesign was initiated to develop the Core Bus Corridor Network described in the Transport Strategy and restructure the bus network to utilise the CBC infrastructure. The redesign also responded to the need to adjust the bus network in response to Luas Cross-City and other transportation changes, to accommodate the on-going population and economic expansion of the Dublin area and to facilitate the achievement of *Project Ireland 2040* objectives.

Milestones in the Network Redesign process

- New Dublin Area Bus Network, September 2021
- Report on 2019 Consultation, July 2020
- Revised Network Report October 2019
- Revised Dublin Area Bus Network Report, June 2018
- Dublin Area Bus Network Redesign Choices Report, June 2017

6.1.1 The role of bus in the integrated transport system

The report makes the point that, 'Buses are the backbone of Dublin's public transport system'. Weekly patronage on buses is around four times that of Luas, and similarly to DART and Dublin Rail Commuter services, as shown in Figure 6.1.

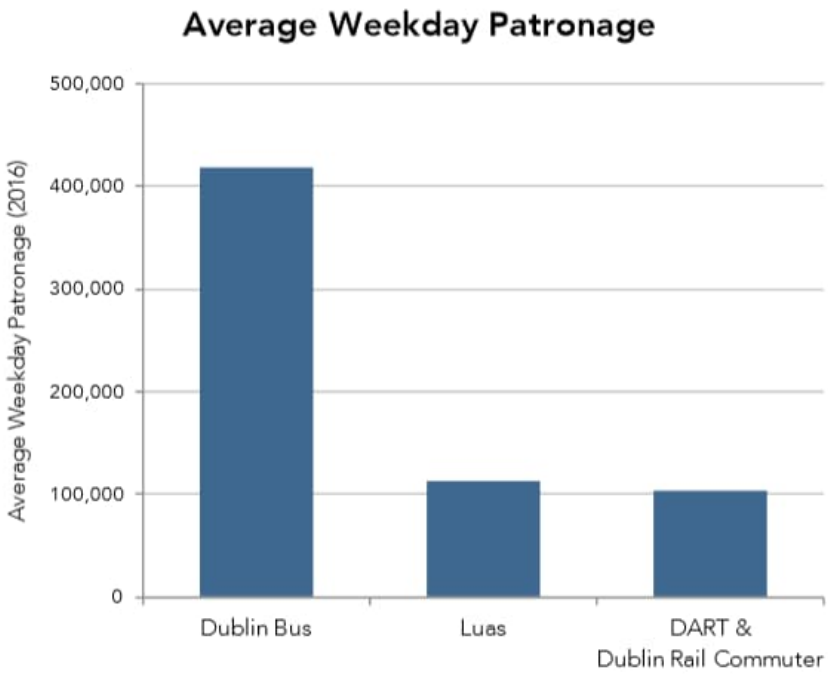


Figure 6.1 - Average weekly patronage of bus and rail

Within the context of a rapidly increasing Dublin area population (anticipated in *Project Ireland 2040*), the *Network Redesign Choices Report* acknowledges the space availability and lead-in times of differing public transport options. Dublin has expanded over recent decades such that many roads emanate from the city centre to outer suburbs – this growth pattern undoubtedly favours buses for the widespread delivery of services to most people. There is generally limited space (land) available for widespread development of light or heavy rail.

Existing railways and disused rail corridors are present for on-going use or development of rail, respectively, but such corridors are limited. The *Network Redesign Choices Report* acknowledges the provision of Luas Cross City which has had significant impact on bus operations in the city centre. Other Luas expansion projects are in development, to provide high-capacity alternatives, however, these are longer-term schemes. In the short to medium term bus remains the only practicable solution for delivering the widespread public transport accessibility improvements necessary for the anticipated growth and transition away from private car

The densification of the Dublin area has caused ever-increasing competition for road-space. Where some roads may have been able to accommodate low-occupancy private vehicles in the past, this is no longer the case. The person-capacity of corridors must be increased to allow everyone to move equitably and quickly throughout the Dublin area. Given the space constraints, population densities and growth centres, the report concludes that buses are best placed to deliver.

Finally, lead-in times for light and heavy rail are long. Depending on the political will and strategic need, rail system improvements and line extensions take many years to come to fruition.

The *Network Redesign Choices Report* ('Choices Report') emphasises that to achieve the timely transition to an efficient, effective and low-carbon public transport system, buses are necessary.

6.1.2 Issues and choices

The Network Redesign Choices Report reviewed the patterns of transport demand across the Dublin region, as well as the structure of the existing bus network. It concluded that a complete redesign of the bus network was required to respond to these issues. In particular, the network redesign process seeks to:

'*Expand the range of places that Dubliners can go in a fixed amount of time, and also to make existing trips faster... by putting people closer to more frequent services that make more effective connections*[37]

Four possible strategies were proposed in the Choices report, shown on Figure 6.2. Each is designed to deal with a specific issue in the existing network, and in combination they deliver a more useful network:

1. Standardise service categories
2. Simplify radial services to form very frequent spines
3. Build frequent orbitals by reducing duplication
4. Grow suburban feeder networks supporting the major public transport routes.

TOOL	PROBLEM ADDRESSED			
	Poor orbital service	Complexity	Low frequency	Buses in City Centre
1 STANDARDIZE SERVICE CATEGORIES	**Yes.** Categories make planning efficient services easier, releasing resources for orbital service.	**Yes.** Frequency and span are apparent from the category, without looking at timetables.	**Yes.** Service categories make frequencies predictable and consistent.	**Yes.** Categories make planning efficient services easier, reducing excess bus trips.
2 SIMPLIFY RADIAL SERVICE	**Yes.** Releases resources for orbital use.	**Yes.** Vast reduction of complexity, especially in City Centre	**Yes.** Much higher frequency for travel to, from and through the City Centre	**Yes.** Consolidating service to the centre on fewer routes means frequency can be optimized, reducing surplus trips.
3 BUILD FREQUENT ORBITALS	**Yes.**	**Yes.** The intersection of frequent orbitals and radials produce a grid pattern that is easy to grasp.	**Yes.** Increased orbital frequency.	**Yes.** Fewer passenger trips are forced through City Centre, reducing loads.
4 GROW SUBURBAN FEEDER NETWORKS	**Yes.** Improves market for both orbital and radial services to regional centres.	**Yes.** Fewer overlapping routes in suburban markets	**Yes.** Improved local frequency for travel within suburban area.	**Yes.** Feeder networks support consolidating service to City Centre on fewer routes.

Figure 2 Four strategic options for a more useful network
Sources: Network Redesign Report (2017)

[37] *BusConnects Dublin Network Redesign Report (2018), p.155*

A consultation on this report took place in 2017. 11,000 responses were received which showed broad support for the proposed strategies.

6.1.3 Options development, assessment and refinement

NTA continued with development of the network redesign based on the positive response to the strategies and objectives proposed in the Choices Report[38]. The identification and analysis of options in the network redesign process took place at local level across Dublin and a series of preferred routes which would form the draft network redesign was incrementally built up. The assessment focused on the improvements which would be achieved against the existing situation by redesigning the network in respect to the radial route structure, orbital route structure and service frequency. Further revisions, analysis and workshops led to the 'recommended plan' for the network redesign and the New Dublin Area Bus Network report was published for consultation in July 2018. It proposed fundamental changes to the existing network, designed to deliver improved services and a more integrated public transport system for the Dublin area.

A consultation on the proposals was held in 2018. The NTA received almost 50,000 submissions, petitions, emails and letters highlighting several issues including loss of direct service, need to interchange, access to schools and hospitals and possible impacts on the elderly and disabled[39]. Based on this feedback, NTA analysed the responses, identifying the areas and bus routes where concerns were raised and seeking to rectify most issues.

The proposals were amended based on the feedback received. A second draft of the network redesign was prepared which was assessed using the framework of goals and measures and with a range of detailed analytical techniques which allowed the most importance outcomes to be quantified, as shown in Table 6.1.

Table 6-1 – Measuring the usefulness of the proposed network

Goals	Measures	Key outcomes
• Expand people's ability to get more places, sooner, taking advantage of interchange on a frequent network. • Continue to serve the entire area now served, including urban, suburban and semi-rural areas. • Retain direct service to the City Centre in as many areas as practical.	• **Coverage analysis** (see Figure 6.3), showing the number of people within reach of different categories of public transport services: – The number of people within 400m of any public transport service. – The number of people within 400m of the most frequent services. – The number of people within 400m of direct service to City Centre. • **Access analysis** (see Figure 6.4), showing the change in the number of jobs and students within reach of any point in Dublin in 30,45 and 60 minutes using public transport. • **Isochrone mapping** (see Figure 6.5) showing how far a person could go in a certain amount of time (e.g. 30, 45 or	• The number of residents within 400m of any all-day local public transport service2 in Dublin would increase by 2%, from approximately 1.29 million to 1.32 million. – The number of residents within 400m of all-day frequent service would increase by 25%, from approximately 832,000 to over 1.04 million. • The number of residents within 400m of all-day direct service to City Centre would decrease by 5%, from approximately 1.19 million to 1.135 million. – The number of residents within 400m of frequent service to City Centre would increase by 16%, from approximately 800,000 to 925,000. • The average Dublin-area resident could reach 27% more jobs and student enrolments in 30 minutes or less, and 21% more jobs and student enrolments in 45 minutes or less. – The average resident living beyond the M50 could reach 26% more jobs and student enrolments in 45 minutes or less.

[38] *BusConnects Dublin Network Redesign Report (2018), p.74*
[39] *BusConnects Dublin Report on 2018 Public Consultation (2018)* https://BusConnects.ie/media/1752/consultation-report.pdf

Goals	Measures	Key outcomes
	60 minutes), starting from a given location, using public transport.	– Approximately 65% of Dublin-area residents would experience a measurable increase in job access within 45 minutes.

A consultation on the second draft of the New Dublin Area Bus Network took place in late 2019. Just over 11,000 submissions were received during this time. The main issues raised were the proposed capacity of bus service, inconveniences associated with interchange, accessibility for elderly and disabled and access to schools and colleges[40] . NTA again analysed the feedback and, taking on board the issues raised, revised the network as appropriate.

The revised bus network service plans were published by NTA in Autumn 2020[41] and form the basis for this business case. They key elements of the revised network are summarised in Table 6-2, below, and in Section 7.3.

Table 6-2 Key Elements of Revised Bus Network

Network Service	Description
Spines	Frequent bus routes made up of individual bus services timetabled to work together along a corridor. At the end of the corridor, the individual services branch off to serve different areas.
Orbitals	Services operating around the city. They provide connections between suburbs and town centres, without having to travel into the City Centre. They also provide connections to rail, Luas and other bus routes.
Other City Bound Services	Services operating into Dublin City Centre. These services are not part of any spine, but may travel along the spine, and operate on their own timetable
Local Routes	Services providing important connections within local areas, linking to local retail centres and to onward transport connections
Peak-Only Routes	Services operating during the peak travel periods, generally weekday mornings and evenings, providing additional capacity along key bus corridors
Express Routes	Direct services from outer suburbs to the City Centre at peak commute hours, operating a limited stop service to get passengers to their destinations faster

[40] *BusConnects Dublin Report on 2019 Public Consultation (2019):* https://BusConnects.ie/media/1987/2019-consulation-report-170920.pdf
[41] *https://BusConnects.ie/media/2036/BusConnects-final-summary-report-fa.pdf*

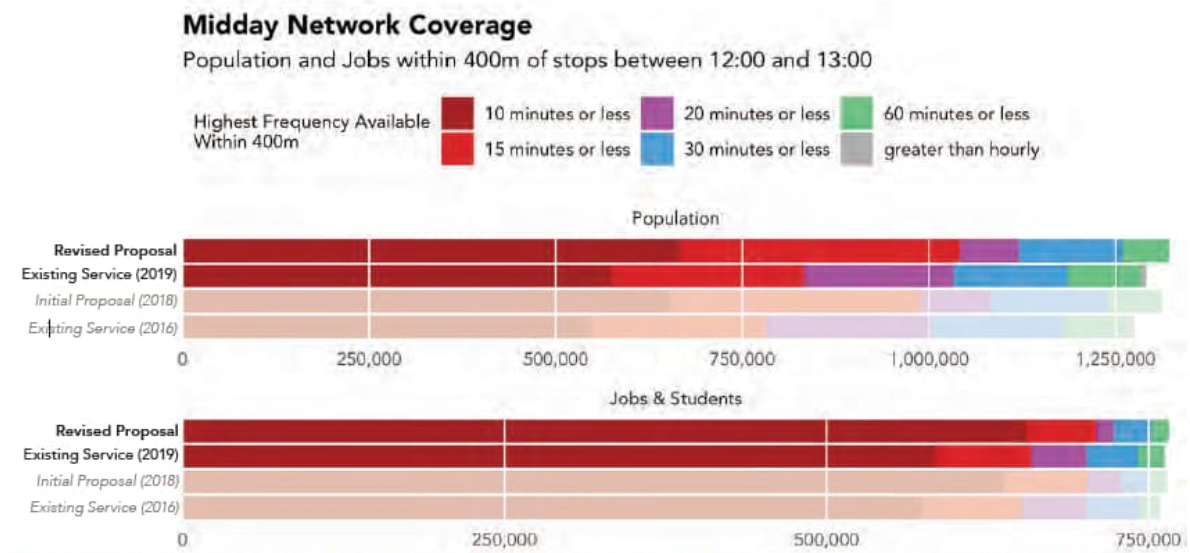


Figure 122: The chart above shows the change in the number of residents (top) and jobs and students (bottom) located within 400m as the crow flies from local public transport service at various frequencies, indicated by the colour of the bar. Overall, the revised proposed network would increase both total network coverage and coverage by frequent routes.

Figure 6.3 – Example of network coverage measurement
Source: Network Redesign Revised Proposal (October 2019)

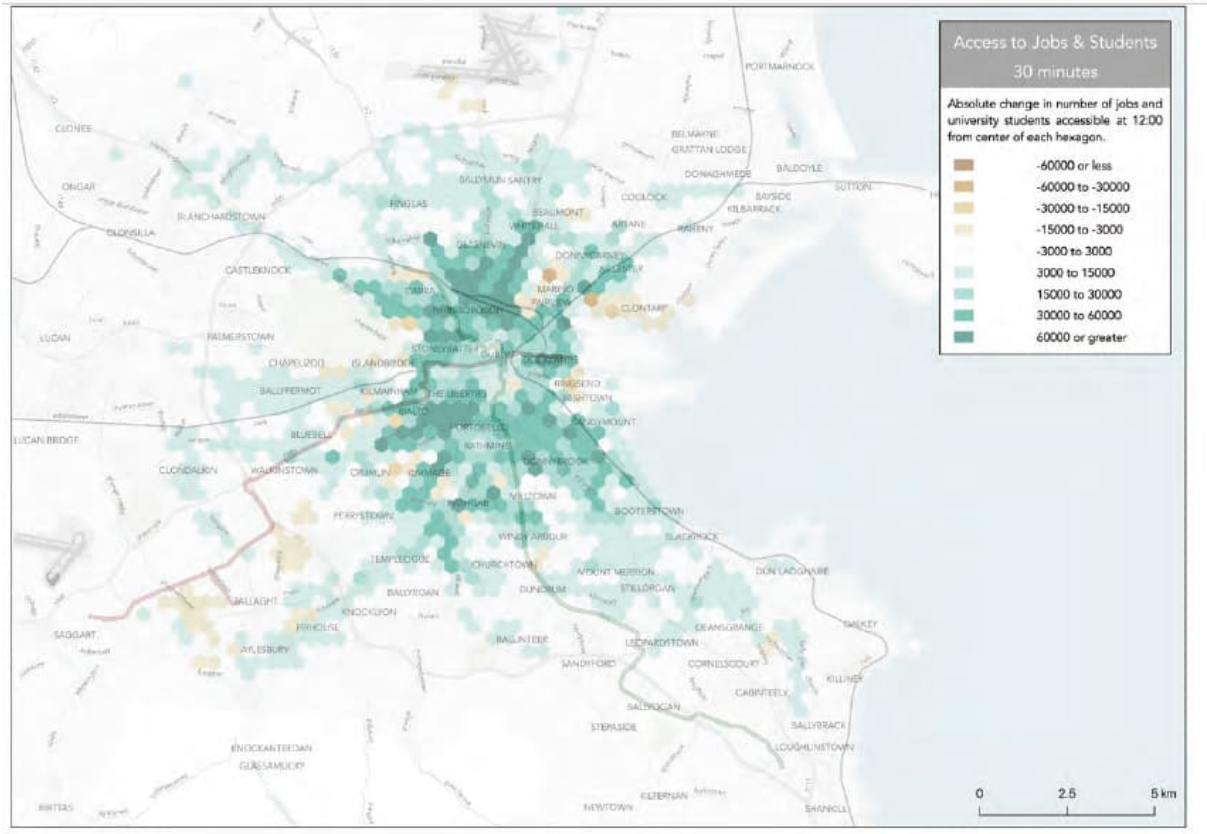


Figure 6.4 – Example of analysis of change in access to opportunity
Source: Network Redesign Revised Proposal (October 2019)

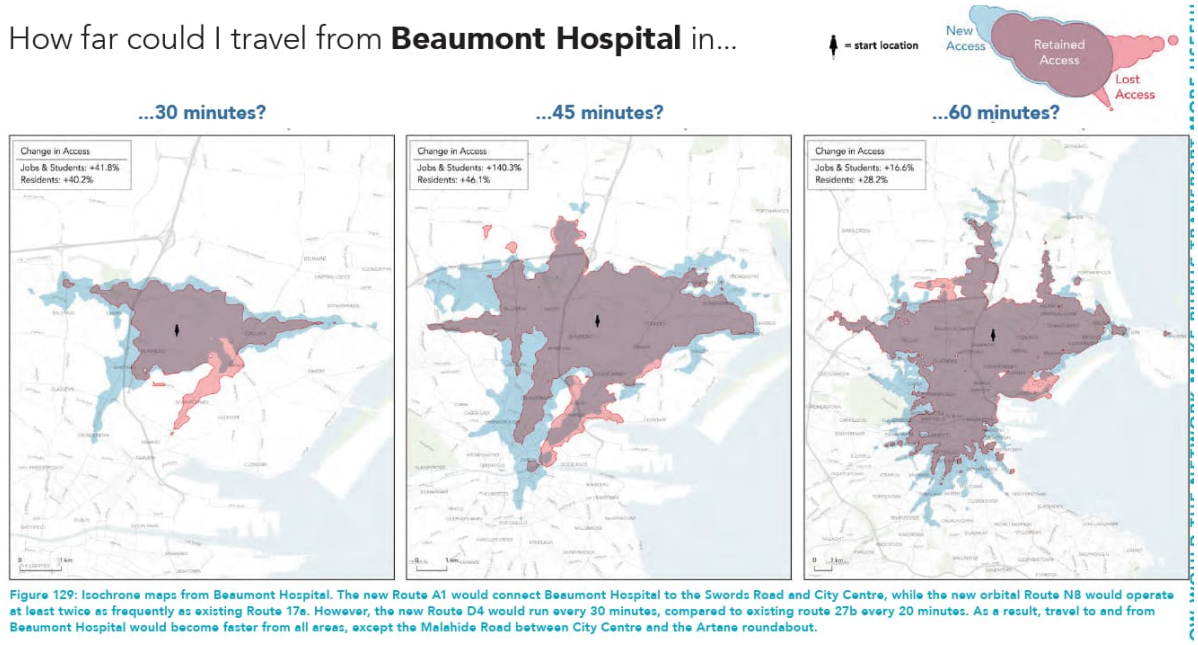


Figure 6.5 – Example of isochrone mapping
Source: Network Redesign Revised Proposal (October 2019)

6.2 Core Bus Corridor project options development

The *Transport Strategy for the GDA (2016-2035)* established the need for sixteen radial Core Bus Corridors (CBC) across Dublin, shown in Figure 6.6 These sixteen radial routes were identified through previous work by the NTA[42] to locate routes where investment in bus infrastructure should be prioritised to create high capacity, frequent and reliable services[43].

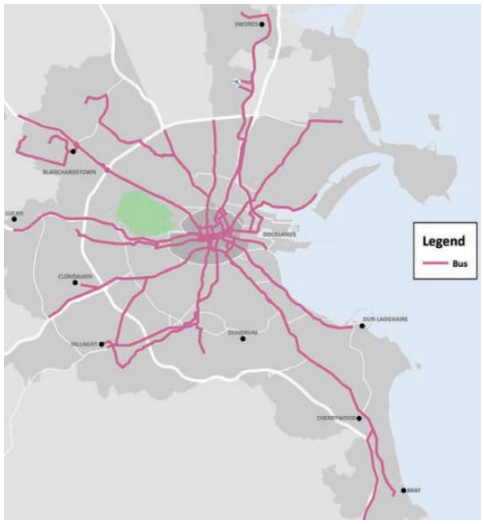


Figure 6.6 - Radial CBCs

Milestones in the CBC development process

- November 2020 Consultation reports:
  - Draft Preferred Route Option
  - Proposed Approach to Environmental Assessment
  - Draft Transport Modelling
- March 2020 Consultation- Preferred Route reports
- Emerging Preferred Route – Public Consultation Report 2018/2019
- November 2018 Consultation – Emerging Preferred Route reports, Route Option Assessment reports and Concept Designs.
- Core Bus Network Report, 2015

[42] *NTA Report 'Bus Rapid Transit – Core Bus Network' (2012):* https://www.nationaltransport.ie/wp-content/uploads/2011/12/Bus-Rapid-Transit-Core-Network-Report11.pdf
[43] *Transport Strategy for the GDA 2016-2035, p.51*

6.2.1 Aim and Objectives

The aim of the CBC project is to provide enhanced walking, cycling and bus infrastructure on key access corridors in the Dublin region, which will deliver efficient, safe and integrated transport movement along these corridors. The objectives, as shown in Figure 6.7, are to:

- Enhance the capacity and potential of the public transport system
- Support the delivery of an efficient, low carbon and climate resilient public transport system
- Improve accessibility to jobs, education and other social and economic opportunities
- Enhance the potential for cycling by providing safe infrastructure for cycling
- Enable compact growth, regeneration opportunities and more effective use of land in Dublin
- Ensure that the public realm is carefully considered.

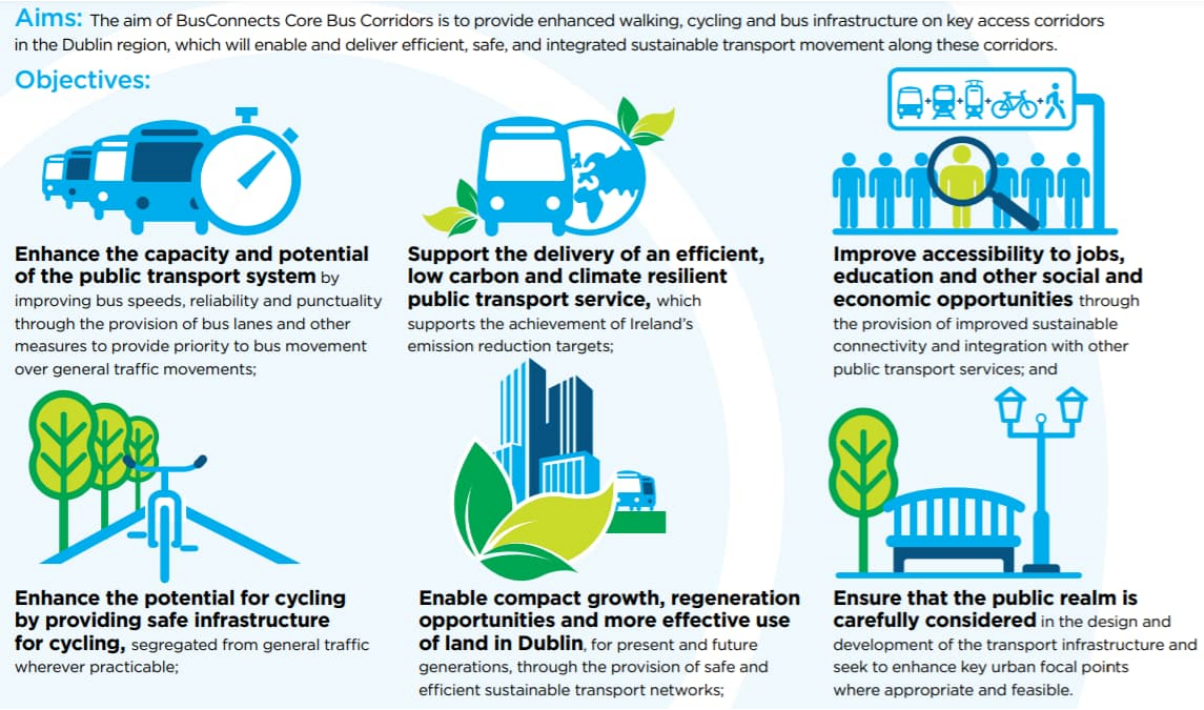


Figure 6.7 – Aim and objectives of CBC project

6.2.2 Feasibility analysis and option development

To realise the sixteen CBCs, the NTA commissioned technical reports[44] to assess the feasibility of providing continuous bus priority corridors at these locations. The key outcome of the technical reports was to establish the emerging preferred route for each CBC corridor. While each corridor assessment was unique, a typical option assessment process involved the following:

1. Identification of a study area which encompasses all feasible routes on the corridor between the two destinations under study (Figure 6.8).

[44] *Background Information, Core Bus Corridor -Corridors, Technical Documents:* https://BusConnects.ie/initiatives/core-bus-corridor-background-information/

Figure 6.8 - Example of Study Area extent in the Lucan – City Centre CBC

2. Stage 1 'sifting' assessment on all possible route options to appraise whether they could meet the practical requirements of a CBC corridor.

3. Segments which passed the first stage were amalgamated into feasible longer routes (Figure 6.9) brought forward for Stage 2 multi-criteria analysis using qualitative and quantitative data.

Figure 6.9 – Example of Feasible Routes in Lucan – City Centre CBC

4. Following this assessment, an emerging preferred CBC route was identified (Figure 6.10).

Figure 6.10 - Example of Emerging Preferred Route in Lucan – City Centre CBC

6.2.3 Public Consultation 1

Between November 2018 and May 2019, the NTA carried out the first round of public consultation regarding proposals for the Emerging Preferred Routes of 16 Core Bus Corridors across Dublin. During this first round of consultation, the NTA received 13,000 submissions in total. These submissions were reviewed and considered as part of the design process for the Preferred Route option for each corridor. Throughout the 16 CBC consultations, common

themes emerged in the feedback. Residents were most dissatisfied with the issues associated with the widening of the roads to accommodate new cycle and bus lanes as shown in the representative cross-section below (Figure 6.11).

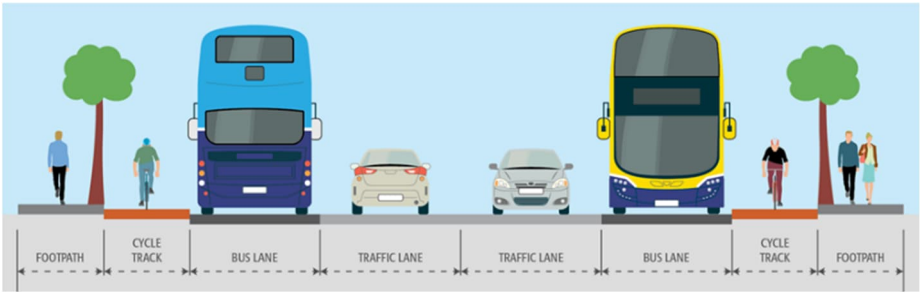


Figure 6.11 - Representative CBC cross section

The most-common issues associated with road widening were the removal of mature trees, the reduction in size of front gardens and driveways, the negative impacts on protected structures, and the more-difficult access to businesses and loading bays. Additionally, other recurring issues stated were a lack of continuously segregated cycle facilities, the safety of pedestrians and cyclists at the new proposed junctions, loss of car parking in driveways, businesses and town centres, noncompliance with design standards and the movement and/or removal of existing bus stops.

As a result of the first round of public consultation, design changes were made to each CBC. To reduce private land disruption, the right of way in many locations was adjusted to acquire more land from greenspace and public areas rather than private gardens. The width was also reduced in many locations by incorporating bus gates, one-way streets, and bus priority at intersections so that four lanes of travel are not required in all areas of the corridors. To improve cyclist and pedestrian safety, changes to new junctions were made, including removing left-turn slip lanes, adding priority signalisation for bicycles, widening footpaths and pedestrian crossings and adding signalised pedestrian/cycle crossings to roundabouts. To further reduce right of way and provide a safer cycling environment, some cycle routes were moved away from the CBCs and onto quieter streets. The number of parking spaces maintained was increased, and more public-realm improvements were included in the designs to improve the sense of community and safety along the CBCs[45].

6.2.4 Public Consultations 2 and 3

A second round of public consultation on the Preferred Route options commenced in March 2020 and continued until mid-April 2020. Due to the ongoing Covid-19 pandemic, the amount of public engagement via traditional means was lower than anticipated. As a result, public consultation was reopened in a third round that ran November 2020 through December 2020. Virtual consultation rooms allowed for review and feedback in addition to the publicly available project information on the BusConnects Dublin website. Public queries and submissions came through emails, post, phone conversations and online submissions. The report detailing the outcomes of these rounds of public consultation was not available at the time of writing this PBC.

[45] https://BusConnects.ie/initiatives/core-bus-corridor-background-information/consultation-submission-reports/

6.2.5 Basis of the business case and on-going project development

This PBC is based on the CBC designs of Autumn 2020. This project is currently at Planning stage. In parallel with the consultation process the CBC design teams continue to refine the CBC designs. The environmental and traffic impacts are being assessed and mitigated. An Environmental Impact Assessment Report (EIAR) is being prepared for submission as part of a planning application to An Bord Pleanála by the NTA under the Roads Act 1993 (as amended). Information on the Proposed Approach to Environmental Assessment (November 2020) for each of the 16 CBCs was published as part of the latest public consultation[46].

6.3 Options for fares and ticketing

Under BusConnects Dublin, the NTA will simplify and streamline the process of paying for bus journeys. The aim is to make the fare system simpler, and to make movement between different bus services seamless and easy, without financial penalty.

One of the key assumptions underlining the BusConnects Dublin plan is that a passenger's fare will not depend on whether an interchange is required. Instead, no second fare will be required upon boarding a second vehicle.

Currently customers can choose to pay for bus services either by cash, Leap Card or by using a Department of Social Protection Public Services Card. Leap Card is the flagship product and although it has been widely successful, it lacks certain functionality that would be expected in a ticketing system, ultimately impacting passenger experience. It presents challenges to the update of fares and relies heavily on driver interaction for short rides. This leads to the payment system being the second biggest source of bus delays, after traffic congestion.

To achieve the above two main transformations are required:

- A change to a simpler fare structures that allows for interchange
- A new ticketing system that supports a seamless and easy journey

6.3.1 A simple time-based fare structure

An assessment was undertaken to identify the Optimal Scenario for re-structuring of the existing fare system. The key objectives of the fare re-structuring exercise were identified as:

- Simplify the fare structures
- Align fares between modes
- Support interchange without fare penalty
- Support the efficient operation of public transport in the Dublin Area with a suitable balance of usage and cost recovery through fare collection
- Increase the number of users of Leap to reduce cash payments

The optimal scenario for the re-structuring of the fare system was identified as a two fare band structure comprising of a short distance fare and a 90 minute fare covering multiple modes.

[46] https://BusConnects.ie/initiatives/core-bus-corridor/

To arrive at this conclusion a two-stage assessment was undertaken. The initial assessment focused primarily on bus and Luas, since rail journeys generally tend to cover greater distances and are therefore more difficult to align with the other modes, in terms of fares. The initial assessment broadly compared options for a flat fare structure against various permutations of a two-stage fare offering, to identify a preferred approach to fare re-structuring. Four main scenarios were identified for testing:

Table 6-3 Fare structure Initial Assessment Options

Option	Description
1	Flat fare offering on Dublin Bus only, which covers all existing fares
2	Two stage fare offering on Dublin Bus which includes short distance fare and 90-minute fare
3	Option 1 + Flat fare offering on Luas, which would cover all existing fares
4	Option 2 + Two stage fare offering on Luas which includes short distance fares and 90 minute fare

6.3.2 A new seamless ticketing system

One of the NTA's overall objectives is to develop a state-of-the-art ticketing system that ultimately makes payments more convenient for passengers. In order to achieve this objective, the current complex fare structure needs to be redesigned in conjunction with the ticketing system, so that the full benefits can be delivered to customers. A key component to the redesign is the move to a time-based fare structure as described above. To achieve this, the ticketing system needs to be upgraded to allow for the integration this simplified passenger fare structure.

The NTA has undertaken an options assessment to identify the best way forward for ticketing on public transport in Ireland identifying Account Based Ticketing (ABT) as the preferred option. This system aims to leverage cashless technology, allowing for payments to be made using cEMV (contactless credit and debit cards), mobile phones and tokens, all linked to a payment account.

To arrive at this conclusion a thorough appraisal process has been followed. Seven options were initially shortlisted, based on a review of the NTA's strategic objectives for NGT[47]. These options were assessed using evaluation criteria in line with CAF guidelines and three options were shortlisted for more detailed appraisal. Building on the work undertaken in the Preliminary Assessment, a detailed Option Development and Assessment study was undertaken. Table 6-4 provides a summary of the options appraised.

[47] *Priority 6 in the NTA Statement of Strategy 2018-2022: https://www.nationaltransport.ie/wp-content/uploads/2018/03/NTA_Statement_of_Strategy_2018-2022_ENGLISH.pdf*

Table 6-4 - Detailed Assessment Options

Option	Description
Base Case	• Represents the least intervention from the NTA • The current Leap Card Based Ticketing (CBT) scheme will be maintained • It is assumed that the NTA will take a 'reactive' approach to developments in the ticketing market
Free Travel	• Subsidised free travel provided for all public transport users
Account Based Ticketing (ABT)	• The current Leap CBT scheme will be maintained for an assumed 5-year transition period until Account Based Ticketing is fully developed and implemented
Paper Ticketing	• The current Leap CBT scheme is discontinued with no transition to a NGT system • Public transport travel will be undertaken using physical paper tickets which could be purchased in shops, from driver etc.

6.4 Bus Fleet

There are five key factors in determining the number and type of new urban buses that need to be introduced into any bus network:

- The age profile of the fleet
- The propulsion technology, range and associated emissions profile
- Capacity and number of vehicles required to meet the projected demand for travel – if the capacity of buses is lower the number of buses required to meet demand is greater and the headway between buses is reduced
- The characteristics of the routes upon which the buses will operate, including the road layouts and bus stop layouts (and whether those characteristics can be easily modified)
- The characteristics of the depots within which the buses will be maintained and/or parked-up when not in use (and whether those characteristics can be easily modified)

Within the Dublin Metropolitan Area (DMA) the urban bus fleet currently comprises 1,145 buses, of which 1,105 are double deck and only 40 are single deck buses. This characteristic of the bus fleet is primarily due to the length of the radial bus routes serving the city centre and the desire to provide a higher proportion of seating on these longer distance bus trips, with the expectation of passengers that they will be seated for the duration of or a significant proportion of their bus journey.

In general, the current double deck buses provide a capacity of up to 95 passengers with provision of 64 seats, a dedicated wheelchair space and a dedicated buggy space. At present there are also 50 double deck tri-axle buses which have a capacity of up to 123 passengers

inclusive of 92 seats. All of the single deck buses are single door buses with the majority of them having a capacity of up to 65 passengers inclusive of 39 seats.[48]

Following a significant period of investment since 2014 the majority of buses (c.65%) in the fleet are fitted with EURO VI-compliant engines with a significantly lower exhaust emissions profile than previous generations of diesel buses. However, the remaining buses utilise older engine technology with some 2006-, 2007- and 2008-registration buses still retained within the fleet. The lifecycle replacement or steady state renewal of bus fleet generally occurs on a 12-year cycle. In this regard 2008-registration buses would fall due for steady state replacement in 2020, and 2009-registration buses in 2021, etc.

BusConnects will contribute to achieving the objectives set in the National Climate Action Plan. One of its most significant initiatives will be to transition the urban bus fleet to zero emission vehicles. The NTA has developed a detailed fleet acquisition strategy and vehicle technology roadmap, under which it will replace diesel buses currently operating in Dublin as they reach the end of their useful lives, with:

- Low emission buses – from 2019 until 2021
- Zero emission buses – from 2022 onwards

To achieve these goals in the most effective manner the NTA is keeping a technology neutral mindset, engaging closely with the market to understand the options available and with a plan to revisit decisions as technologies evolve into the future. There is a wide range of technologies at different stages of maturity that have been considered, some of which are:

- within the low emission category:
    - hybrid diesel electric
    - compressed natural gas / biogas
- and in the zero-emission category:
    - battery electric
    - green hydrogen

Along with the propulsion technologies the other consideration for bus fleet is the type of vehicle and the capacity it can provide. The following bus types are available for consideration:

- Single deck single- or multi-door buses of varying lengths up to c.12.3m
- Single deck multi-door articulated buses of varying lengths from c.18m to c.24m
- Double deck single- or multi-door buses of varying lengths from c.10.3m to c.13.8m

As a first step to inform its preferred choice of technology, the NTA undertook a preliminary market consultation with around 20 manufacturers and industry groups in 2017. In 2020 the NTA has purchased three Fuel Cell Electric Double Deck Buses (Hydrogen) and will be undertaking in service pilots in 2021. In addition, NTA has liaised with transport operators in London to understand the performance of Electric Double Deck buses. On the basis of the performance on Electric Double Deck Buses in London, a draft transition plan has been

[48] Capacity is based on the theoretical capacity permitted without exceeding the applicable maximum axle loads and Gross Vehicle Weight (GVW), whereas the actual capacity depends on the discretion of the driver and the willingness/ability of passengers to stand in close proximity to each other

developed by NTA considering the daily duties and likely future requirements for bus operations. In this regard it is considered that approximately 50% of the fleet could be in a position to be early transitioned to zero emission double deck buses. NTA will commence a pre-qualification tender process for zero emission vehicles with a view to being in a position to bringing them into service in 2023.

One of the challenges for fleet transition in Ireland is the predominance of double deck buses in the urban bus fleet. The global market for this type of bus is limited and hence there are only a small number of suppliers, and even fewer with zero emission versions of their double deck buses in service. While the Network Redesign project considers opportunities for greater interchange and shorter distance single leg bus trips, retaining direct single leg bus trips was favoured by a high proportion of respondents to the various public consultation. On this basis retaining a significant proportion of double deck buses is the fleet is a requirement.

However, in considering the transition to low and zero emission, the NTA will study all opportunities to meet the above targets and will explore the use of single deck rigid and articulated buses for those routes where these bus types might be more suitable. Zero emission options for these bus types are more readily available with proven use cases, although it should be noted that these proven use cases are generally for zero emission single deck articulated buses relate to left hand drive markets. The appetite of market to develop right hand drive may be limited.

Based on the market consultation undertaken an initial step was to procure Double Deck Plug-In Hybrid Diesel Electric buses as this was the available technology best suited to meeting the short-term requirement for low emission, 'clean' vehicles.

NTA has subsequently undertaken an assessment of double deck battery-electric buses operated in London since 2019. This study identified that, depending on the battery capacity and energy requirements for operation, existing battery-electric bus technology could be used for between 50% and 75% of the existing bus duties in the DMA. On this basis, the NTA has commenced procurement of both single deck and double deck battery-electric bus fleet.

Acknowledging the need to accommodate duties that accumulate greater mileage within a 24hr period, NTA has also commenced a trial of hydrogen fuel cell-electric double deck buses.

Other alternatives for accommodating these longer duties include the use of opportunity charging at termini or at other points along bus corridors. In this regard the specification of the battery-electric buses currently being procured includes the provision for fitment of opportunity charging equipment. To provide the necessary passenger capacity this may require articulated single deck bus types. This type of bus was used in Dublin previously, but the combination of a poor door layout, an inability to identify routes best suited to their abilities and the geometric constraints of the city centre streets resulted in them being withdrawn from service before the end of their useful economic life. It should also be noted that articulated buses longer than 18.75m would require legislative changes to permit their use on street.

On this basis the technologies being brought forward for procurement in the initial years of BusConnects include Double Deck Plug-In Hybrid Electric, Double Deck Battery-Electric and Single Deck Battery-Electric. The suitability and viability of other bus and propulsion types will be monitored over the period of investment particularly in the context of both longer duty, higher capacity routes and shorter local "feeder" type routes.

6.5 Appraisal of options for programme delivery

The overall programme has been appraised in accordance with the Common Appraisal Framework (CAF), against the standard multi-criteria appraisal headings. Considering the Case for Change within these framework criteria, the evaluation criteria of achievement, as shown in Table 6-5, were developed.

Table 6-5 – BusConnects Dublin Programme Appraisal Criteria

CAF criteria	Evaluation criteria
Economy	• Contribute to economic growth • Implement in the short to medium term • Ensure value for money • Increase public transport patronage
Environment	• Reduce reliance on the private car • Reduce growth in transport emissions, at a minimum
Accessibility and Social Inclusion	• Enhance public transport and sustainable travel access to opportunities and services • Deliver socially inclusive public transport
Safety and Security	• Improve the safety of the transport system • Protect vulnerable road users
Integration	• Enable Project Ireland 2040 • Make it easier to move between public transport services
Physical Activity	• Provide for safer and faster travel by active modes • Facilitate access to public transport by active modes

6.5.1 Do Minimum

Appraisal requires the development of a Do Minimum (DoMin), or counterfactual, which looks at the future situation without the proposed programme. As the bus system is vital to Dublin, it is assumed that it would not be allowed to degrade. Instead, there would be investment to maintain the existing system but with no additional benefit. The DoMin will include:

- Replacement of life-expired technology equipment on a like-for-like basis e.g. ticketing systems, passenger information technology and on-board Wi-Fi
- Replacement of life-expired buses
- Purchase of additional buses to maintain the existing schedule of services in the face of increased congestion which will reduce speeds and therefore reduce system capacity[49]
- In keeping with current Government policy, all replacement and additional buses purchased would be low emission vehicles (LEV).

[49] *As speeds reduce, it takes buses a longer time to meet headway targets. This means that each bus can operate fewer services in the peak periods, so NTA will need more buses if all service headways are to be maintained. It follows that the cost of operations will increase in the Do Something compare with a Do Nothing.*

6.5.2 Bus-based public transport options (Do Something)

As described in Section 5, BusConnects Dublin is a result of the GDA Transport Strategy 2016-2035 which identified and appraised options for each corridor on a multi-modal basis. Optioneering then took place, at the BusConnects Dublin project, or programme element level, as explained in Sections 6.1 to 6.4. A programmatic approach is being taken to the implementation of those projects, for the reasons set out in Section 2.1.1. Similarly, the business case is being developed at programme level as the full benefits, costs and risks across the Dublin area can only be captured and appraised in this way. The essence of the programme is that it is multi-faceted to address every aspect of the bus system. It is self-evident that only the full BusConnects programme can fully deliver the programme objectives. This presents a challenge in complying with the CAF which recommends examination of at least three 'Do Something' options at the preliminary appraisal stage. (Currently CAF provides a framework for appraisal of projects rather than multi-faceted capital programmes).

As such, when undertaking an appraisal of Bus Connects Dublin there are no alternative Do Something full programmes against which it can be assessed, rather, there are alternatives to delivery of the full programme that will ultimately not achieve the same outcomes but may deliver a level of benefit that would make them an attractive alternative for investment. These alternatives are summarised below and detailed in Table 6-6.

- A **management-based approach** focusing on improvement to the network of services and crucial ancillary elements such as fares and ticketing, as proposed in the Network Redesign initiative. As NTA plan to implement the Network Redesign before the other programme elements, the management-based approach may be better described as the first step in the incremental programme delivery, rather than a programme option.
- A **priority-based, or infrastructure-led**, approach which focuses on improvements to infrastructure on the existing network to reduce delay to buses and cyclists thereby improving journey times and reliability and changing crucial ancillary elements such as fares and ticketing.
- A **partial programme approach** which only delivers part of the programme. A partial programme could, say, comprise the Network Redesign and ancillary elements such as NGT and new bus fleet as planned and reduce the number of CBCs implemented. This is simply a partial implementation of the whole programme and, in any case, the current plan is for an incremental implementation of groups of CBCs.
- The **full programme** is designed to achieve all of the programme objectives.

Table 6-6 – Programme Elements in each option

Option	Programme Element							
	Network Redesign (NRD)	CBCs including Cycle Routes & Major PT Interchanges	NGT / Cashless Payment System	LEV Bus Fleet	Simpler Fare Structure	Bus Shelters and Stops	New Bus Livery	P&R
Do Min	No	No	No	Partial	No	Partial	Yes	No
	Some network changes to maintain an efficient bus network	Minor traffic management changes at junctions or along corridors at local pinch points	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV plus additional fleet to maintain existing headways and frequencies		Replacement of existing poles as part of national pole replacement and life expired shelters	New Livery would be rolled out as part of LEV bus renewal programme	
Management based approach	Yes	No	No	Yes	Yes	Partial	Yes	No
	Extent of Network Redesign and increases in frequencies and new routes may be impacted by availability of buses and efficiency of bus operations	Minor traffic management changes at junctions or along corridors at local pinch points	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV plus additional fleet to support new routes and frequencies – no additional buses over the full programme implementation assumed	90 min fare structure implemented across all modes	Replacement of existing poles as part of national pole replacement and life expired shelters – No new shelters at interchange or high-profile routes		
Priority Infrastructure	No	Yes	No	Partial	Yes	Yes	Yes	Partial
	Some increases in efficiency of bus operations due to reduced journey times and increased reliability which may permit limited increases in frequency or limited	12 Core Bus Corridors implemented across 16 radial routes including high-quality cycle infrastructure along the corridors	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV – Total fleet size required would be reduced from the full programme number due to reduction in routes/catchment and the increased efficiency of bus operations on CBCs		Replacement of existing poles as part of national pole replacement and life expired shelters plus shelters provided along all CBCs		P&R sites on CBC routes would be delivered

Option	Programme Element							
	Network Redesign (NRD)	CBCs including Cycle Routes & Major PT Interchanges	NGT / Cashless Payment System	LEV Bus Fleet	Simpler Fare Structure	Bus Shelters and Stops	New Bus Livery	P&R
	introduction of new routes							
Full Programme	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	All elements of NRD implemented	All CBCs, interchanges and cycle facilities implemented	NGT delivered in full	All buses renewed and additional buses to support higher frequency and new routes		Replacement of existing poles as part of national pole replacement and life expired shelters - Shelters provided along all CBCs and NRD interchange points		All P&R sites delivered
Partial Programme	Partial	Partial	Yes	Yes	Yes	Partial	Yes	Partial
	Extent of Network Redesign and increases in frequencies and new routes may be impacted by availability of buses and efficiency of bus operations	A single tranche of CBCs are delivered i.e. 4 corridors. The corridors implemented would be those that have the lowest existing level of bus priority. Only cycle infrastructure on 4 corridors implemented. Major Interchanges upgraded	NGT delivered in full	Replacement of all existing fleet with LEV plus additional fleet to support new routes and frequencies – no additional buses over the full programme implementation assumed		Replacement of existing poles as part of national pole replacement and life expired shelters - Shelters provided along all CBCs implemented and at key NRD interchange points		Relevant P&R sites on implemented CBC routes would be delivered along with other suitable locations on the redesigned network

Summary of Appraisal

The next step in the assessment compares the options against a Do-Nothing scenario using the CAF criteria, including Economy, Environment, Accessibility, Social Inclusion, Safety, Integration, and Physical Activity. Table 6.7 summarises the potential contribution of the each of the options using a 7-point scale ranging from major negative (1) to major positive (7), as outlined below. This table is a summary of the detailed appraisal set out in Appendix A of this report.

Table 6-7 - Options assessment

Option	Economy	Environment	Accessibility/ Social Inclusion	Safety	Integration	Physical Activity
Do-Minimum	• Low cost • No disruption • No additional benefits • Deterioration in bus journey times and service reliability	• Reduction in emissions with transition to zero emission fleet • No increased potential for modal shift or associated emission reductions	• No improvement to accessibility • Unchanged inclusivity	• No significant impact on safety which may worsen for vulnerable users • Cyclists remain vulnerable to buses	• Policy objectives are not achieved • Multi-modal integration, including BusConnects Dublin interchange potential, will deteriorate.	• No change
Network Redesign	• Lower cost option • Short implementation time • Better connection between people and opportunities through better coverage, frequency and ease of use • Congestion continues to undermine efficiency and reliability	• Reduction in emissions with transition to zero emission fleet • Greater coverage increases bus use • Lack of priority deters significant mode transfer • Lower potential for modal shift and associated emission reductions	• Increased orbital and suburban accessibility • Restructured fares offer greater social inclusivity	• No impact on safety • Cyclists remain vulnerable to buses	• Greater coverage supports policy goals, but they will not be achieved • Better connected service timetables but without supporting infrastructure • Financial penalty for transferring between services is removed	• Increased bus use will increase active modes to and from bus stops • Limited impact due to lack of high-quality active mode infrastructure
Priority Infrastructure	• Higher cost option • Long implementation time • Highly beneficial • Reduced journey times • Better reliability	• Reduction in emissions with transition to zero emission fleet • Priority attracts radial mode transfer to bus and cycle • Increased potential for modal shift and associated emission reductions • Construction related environmental impacts	• Quicker radial access • No improvement in suburban accessibility • Restructured fares offer greater social inclusivity	• Segregated infrastructure improves safety for cyclists • Pedestrian facilities around bus stops and at interchanges will improve safety	• Quicker bus travel supports policy goals, but they will still not be fully achieved • Financial penalty for transferring between services is removed • Physical interchange enhancements	• Segregated facilities enhance attractiveness of cycling and walking • Increased bus use will increase active modes to and from bus stops
Full Programme	• Higher cost option • Most efficient method of achieving benefits • Long implementation time • Better connection between people and opportunities through better coverage, frequency and ease of use • Reduced journey times	• Reduction in emissions with transition to zero emission fleet • Efficiency attracts radial/ orbital mode transfer to bus and cycle • Full potential for modal shift and associated emission	• Increased orbital and suburban accessibility • Quicker radial access • Restructured fares offer greater social inclusivity	• Segregated infrastructure improves safety for cyclists • Pedestrian facilities around bus stops and at interchanges will improve safety	• Greater coverage/quicker trips fully support policy goals • Improved physical and operational connectivity between bus services • Financial penalty for transferring between services is removed	• Segregated facilities enhance attractiveness of cycling and walking • Increased bus use from both the Network Redesign and priority enhancement will increase active modes to and from bus stops

Option	Economy	Environment	Accessibility/ Social Inclusion	Safety	Integration	Physical Activity
	• Better reliability	reductions realised with full programme • Construction related environmental impacts			• Physical interchange enhancements	
Partial programme	• As for full programme but only on some corridors • Congestion will undermine efficiency and reliability of network • Inequity across the network • Offers some flexibility	• As for full programme but only on some corridors • Reduced potential for modal shift and associated emission reductions • Partial delivery would also reduce the likelihood of achieving our transport emission reduction targets.	• As for full programme but only on some corridors • Inefficiencies would remain in the network leading to legibility issues given varying standards of priority infrastructure which may result in indirect routes being quickest for some journeys.	• As for full programme but only on some corridors • Cyclists remain vulnerable on untreated corridors.	• As for full programme but only on some corridors • Quicker bus travel supports policy goals, but they will still not be fully achieved	• As for full programme but only on some corridors • Gaps in the cycle and bus infrastructure network will represent perceived barriers to some new users

Key:

Major Negative	Moderate Negative	Minor Negative	No / Negligible Impact	Minor Positive	Moderate Positive	Major Positive

6.5.3 Preferred option

Table 6.6 highlights the achievements of the Do Something against the criteria. According to this assessment, the options can be ranked from most suitable to least suitable as follows:

Full Programme

- Provides the greatest achievement of all programme indicators. While more expensive than other options, the costs to the State in time and money are likely to be outweighed by the wider economic and societal benefits.

Priority Infrastructure

- Provides significant gains in respect of journey time and reliability programme indicators however it does not offer significant benefits in increasing the range of destinations that can be accessed by bus as the linking of corridors and interchange opportunities are not addressed. However, there is a very significant financial cost and retaining the existing network of services means the benefits of the expenditure cannot be fully realised. The approach of relying solely on infrastructure improvements to improve the bus system was pursued for many years prior to the Transport Strategy which concluded that a more holistic approach was required. Consequently, this is not an appropriate option for further analysis

Network Redesign

- Provides significant gains in respect to most programme indicators for limited financial cost within a short time period but journey times and reliability will continue to be a problem which will worsen over time as travel demand increases due to population and economic growth
- Fails to make cycling safer and more attractive
- Represents the first phase of the implementation of the full programme and is planned as such.

Partial Programme

- Delivers strong benefits in the corridors where the CBCs are delivered but, even in those corridors, the benefits would not be optimised as the full network effect would not come into effect for customers or efficient bus operations on trips that involved more than one CBC
- Represents phases of implementation of the CBCs after the Network Redesign in in place and the fares and ticketing project well underway.

Do Minimum

- Modal transfer will not take place and rising congestion will impact on bus services, resulting in no achievement of programme indicators, but rather dis-improvement on the already challenged status quo today.

In conclusion, the Full Programme, provides the optimal and ultimate package of measures to transform the bus system and achieve programme criteria. This preferred option is the proposed BusConnects Dublin programme.

The other approaches are options for implementation of the full programme. The management approach option represents the first increment in the programme delivery and the phased roll

out of the CBCs form the subsequent increments. There will be the opportunity to evaluate the success of each increment and adopt the lessons learned for the next. The overall implementation plan with the phased introduction of CBCs and the Network Resign. is outlined in Section.

07

Preferred BusConnects Dublin programme

7 Preferred BusConnects Dublin programme

Chapter Summary

- BusConnects Dublin is the NTA's preferred programme to transform bus services across the Dublin region.
- As it is a programme, it encompasses a series of interlinked and complementary proposals.
- This chapter provides an overview of the various programme elements, including; Core Bus Corridor (CBC) Project and "On Your Bike", redesigned bus network, restructured fares and state of the art ticketing system, Modern bus livery and bus stops with better signage, information and shelters, Cleaner bus fleet using low-emission vehicle technologies, and Park and Ride at key locations.
- The Preliminary Business Case assumes different timelines for delivery of the different programme elements, with all programme elements in place by 2032.

7.1 Overview

BusConnects Dublin is the NTA's preferred programme to transform bus services across the Dublin region. Dublin is growing and needs a bus network that works for a developing city. Its aim is to deliver an enhanced bus system that is better for the city, its people and the environment. With more buses, more often, to more places. BusConnects Dublin is designed to provide a better, more reliable and more efficient bus service for everyone.

The full programme for BusConnects Dublin includes a range of interlinked and complementary proposals including:

- *Management elements*: Redesigning the network to increase the number of homes, jobs and services with coverage, improving orbital accessibility and restructuring radial routes into spines
- *Technological elements*: Introducing new ticketing systems to improve convenience and reduce dwell time at bus stops
- *Fleet elements:* Replacing the bus fleet with low emission vehicles, introducing branding and livery to give a new "look and feel"
- *Policy elements:* Introducing a 90-minute ticket to remove the financial penalty for interchanging between buses or changing mode during trips
- *Infrastructure elements*: Creating infrastructure to separate buses and cyclists from other traffic to make sustainable travel a faster, safer and more reliable choice. Developing interchange hubs. Improving pedestrian facilities around bus stops.

Each of these elements individually brings its own benefits, but there are cumulative benefits that are dependent on the completion of the entire programme, given the network interdependencies between measures. The effectiveness of the programme is more than the sum of its parts. For example, some additional bus patronage will be attracted by simply adding new services and redesigning the network, but it will take an increase in speed and reliability to reach a wider section of the market. Addressing fares and making the system easier to use will bring another market segment on board. Bringing all these changes to people's attention so

that they can take advantage of the new opportunities would be difficult without refreshing the information system, the bus livery and the waiting environment.

There are other practical reasons for the programmatic approach as explained in Section 2.1.1. From a policy perspective, the bus-based programme is an essential component of the *Transport Strategy for the Greater Dublin Area 2016 - 2035*, which addresses specific issues that cannot be solved by other modes or by traffic demand management.

Other significant components of the *Transport Strategy for the Greater Dublin Area 2016 – 2035*, notably the major projects of DART+ and MetroLink, are acknowledged in-parallel with BusConnects Dublin. The modelling and forecasting for BusConnects Dublin avoids any double counting of benefits across the major public transport schemes in the GDA strategy.

BusConnects Dublin includes a suite of transformative changes to the bus system, intended to make it more efficient, faster, reliable and easier to use. In summary, the key elements of the BusConnects Dublin programme are shown in Figure 7.1. Each element of the BusConnects Dublin programme has gone through a rigorous selection and optioneering process by the NTA as part of the development of the *Transport Strategy for the Greater Dublin Area 2016 – 2035* and subsequent studies as outlined back in Section 6. NTA continue to develop and progress each of the elements. The status at the time of preparing this PBC is outlined in the following sections. The BusConnects Dublin website[50] is regularly updated and provides further information on the programme elements and their status.

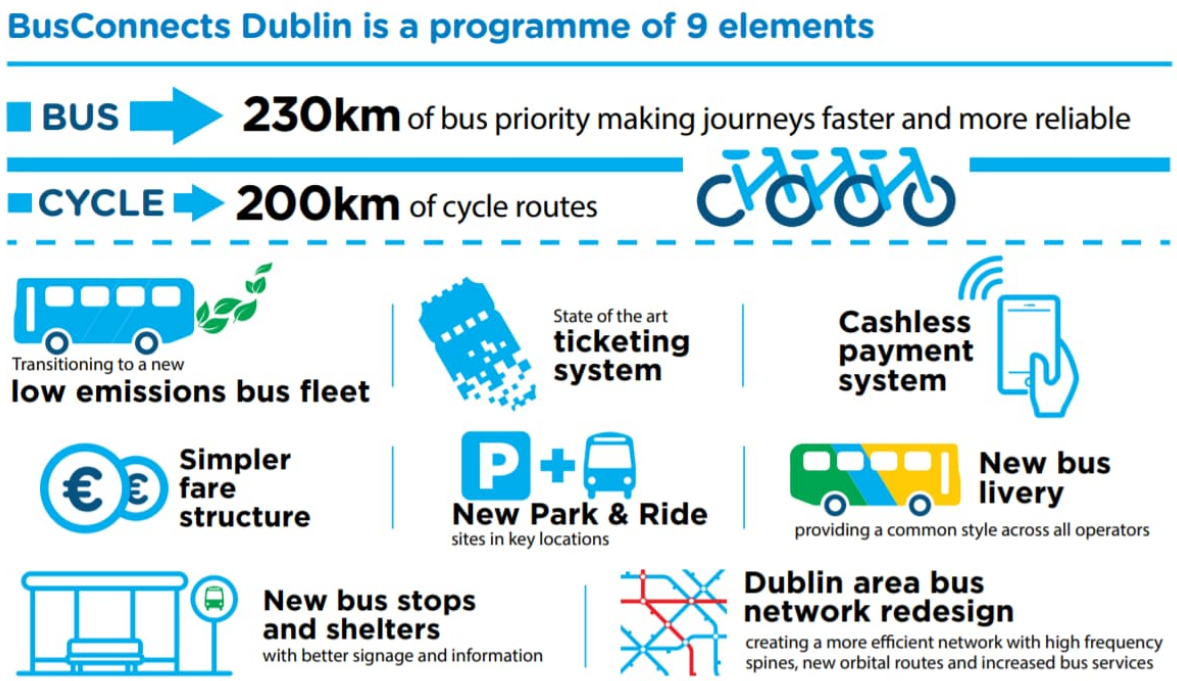


Figure 7.1 - Key Elements of BusConnects Dublin[51]

[50] *https://busconnects.ie/*
[51] *https://busconnects.ie/*

Table 7-1 – Summary of BusConnects Programme Elements and Deliverables

Programme Element	Deliverables
Core Bus Corridor (CBC) Project	• Provision of 16 core bus corridors (CBCs) including the delivery of 230km of bus priority • Urban realm improvements
On Your Bike	• Provision of 200km of cycle routes across the 16 core bus corridors
Low Emissions Bus Fleet	• Procurement of 280 low emission hybrid electric buses
Ticketing System	• Implement an Account Based Ticketing (ABT) system across the bus and other public transport networks.
Cashless Payment System	• Introduction of cashless technology, allowing for payments to be made using cEMV (contactless credit and debit cards), mobile phones and tokens, all linked to a payment account
Simpler Fare Structure	• Introduction of a short-distance fare on single leg journeys (approximately 3kms or less). • Introduction of a 90 minute fare that will allow any combination of travel on Bus, Dart/Commuter Rail and Luas services.
Park & Ride	• Provision of bus-based park & ride facilities (exact number and location TBD, pending assessment)
Modern Bus Livery	• Standardisation of the exterior and interior of buses, known as the bus livery, across different bus operators.
New Bus Stops & Shelters	• Provision of enhanced bus stops, with better route and fare information and with timetable information specific to each stop. • All operators to adopt this style of bus stop, to ensure consistency across the bus network. • Provision of additional Real Time Passenger Information (RTPI) signs along the new bus corridors and elsewhere across the region. • Provision of a large number of additional bus shelters in new locations, particularly where connecting services are being provided.
Redesigned Network	• Provision of eight high-frequency 'Spines', A to H, with buses every three to eight minutes • Provision of 26 'Branches' (A1, A2 etc.) with 10-15 minute all-day frequencies that will follow separate routes in the outer suburbs then merge together on approach to the city to form the spines. • Provision of 28 Orbital routes. • Provision of 22 'Numbered Radials' to cover main roads that are too far apart for radial service to be provided entirely through the spine-and-branch system. • Provision of 33 suburban local services that will connect suburban or semi-rural residential areas to major suburban centres and act as 'feeder' services to branches and orbitals • Provision of 38 additional 'peak-only' services, including direct and express city centre services

7.2 Core Bus Corridor (CBC) Project and "On Your Bike"

Continuous bus lanes and safe cycling facilities along 16 routes were identified through previous work undertaken by the NTA[52] to locate routes where investment in bus infrastructure should be prioritised to create high capacity frequent and reliable services. These are shown in Figure 7.2, emerging from a route feasibility and sifting process. In summary, the CBC proposal consists of:

- Sixteen CBCs focused on the bus routes with the highest patronage
- Significant journey time savings
- Up to 230km of continuous bus priority
- Up to 200km of cycle lanes

This Business Case is based on designs published in Autumn 2020.

Figure 7.2 – GDA Transport Strategy – Radia Core Bus Corridors

Introducing only some of the CBCs was not considered a viable option as it would not deliver the network benefits required. The transformative change to bus travel proposed by the NTA transport strategy for the Greater Dublin Area requires the implementation of continuous bus priority along all major radial corridors to improve journey times and reliability with the objective of increasing competitiveness with the private car. A piecemeal approach which only introduced some CBCs would not produce the network-wide benefits required to fundamentally improve bus transport in across the whole Dublin area. Furthermore, an uneven approach which benefits particular corridors and populations, at the expense of other parts of the city, is viewed as an unacceptable approach to public transport network design and successful forward planning. Instead, it was determined that the most appropriate approach was to provide a package of CBC routes which would benefit people living and working along most radial corridors in Dublin. At a local level, the design process for each of the CBCs has considered local options for the most appropriate solution.

The 16 CBCs cover the areas from the outer suburbs to the city centre, however the scope of the CBCs does not extend into the city centre. The provision for bus within the city centre forms part of the wider city centre transport plan which is being developed by DCC[53]. This wider plan considers the integration of the transport network catering for all modes of travel within the wider public and urban realm. The rationalisation of facilities for bus is complemented by the delivery of other schemes such as the Liffey Cycle Route and College Green Plaza. These schemes prioritise the delivery of high-quality walking, cycling and public transport facilities, whilst implementing traffic management measures to restrict or reduce private car movements. This is evidenced by recent schemes implemented by Dublin City Council such as the Bachelor's Walk Bus Gate.

Section 17, Appendices, contains a list of all reports relating to the CBCs, with links provided. Alternatively, the BusConnects website CBC page[54] provides current status updates along

[52] *NTA Report 'Bus Rapid Transit – Core Bus Network' (2012): https://www.nationaltransport.ie/wp-content/uploads/2011/12/Bus-Rapid-Transit-Core-Network-Report11.pdf*
[53] *https://consultation.dublincity.ie/traffic-and-transport/traffic-management-changes-north-and-south-quays/supporting_documents/Dublin%20City%20Centre%20Transport%20Study.pdf*
[54] *https://busconnects.ie/initiatives/core-bus-corridor/*

with the emerging route design proposals, environmental assessment reports and transport modelling reports.

7.3 Redesigned network

Network services, including routes, frequencies, interchange, spine and orbital routes were all considered in the redesigned network, to ensure demand for public transport can be met, in the medium and long terms. Interchange hubs proposed at Liffey Valley, Blanchardstown and UCD Belfield have been developed to an options assessment stage. Plans for interchange elsewhere will be developed as the programme progresses. This Business Case is based on bus network service plans published in Autumn 2020[55]. Under the plans, the network will be arranged on the basis of spines radiating from the city centre, supported by other services. The new routes will consist of:

- Spines - frequent routes made up of individual bus services timetabled to work together along a corridor. At the end of the corridor, the individual services branch off to serve different areas
- Orbitals – services operating around the city. They provide connections between suburbs and town centres, without having to travel into the City Centre. They also provide connections to rail, Luas and other bus routes
- Other City Bound Routes – services operating into Dublin City Centre. These services are not part of any spine and operate on their own timetable
- Local Routes – services providing important connections within local areas, linking to local retail centres and to onward transport connections.
- Peak-Only Routes – services operating during the peak travel periods, generally weekday mornings and evenings, providing additional capacity along key bus corridors.
- Express Routes - direct services from outer suburbs to the City Centre at peak commute hours, operating a limited stop service to get passengers to their destinations faster.

As summarised in Figure 7.3, the benefits of the Network Redesign include an overall increase in bus services of 23%, increased peak hour capacity, increased evening and weekend services, 24 hour operations on some routes, a 16% increase in the number of residents located within 400m of a frequent bus service to the city centre, new connections to schools, hospitals and other essential services and increased access to jobs and education.

[55] *https://BusConnects.ie/media/2036/BusConnects-final-summary-report-fa.pdf*

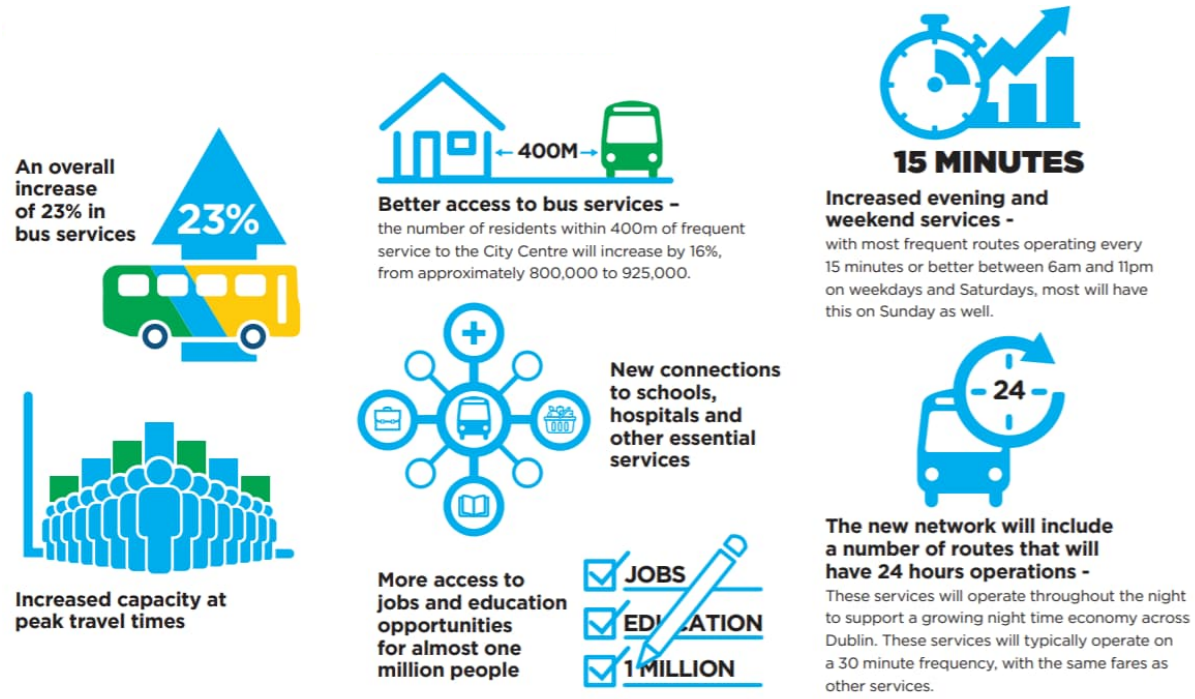


Figure 7.3 – Benefits of Network Redesign[56]

Detailed service planning will be undertaken for each of the new routes. This service planning will consider the type of vehicle required to operate the services considering aspects such as capacity and geometric constraints. For example, due to bridge clearance on the O-Route single deck vehicles will be required. Similarly, for some of the local bus routes, single deck long length or midi type buses may be appropriate. The current bus fleet is predominately double deck vehicles.

7.4 Restructured fares and state of the art ticketing system

Without changing the ticketing systems and the bus fare structure, the overall BusConnects Dublin programme would not deliver the full benefits that are possible under this transformation[57].

A transformation in the way passengers are charged for the new services is required to maximise the value obtained from the BusConnects Dublin programme. The network re-design into corridors and orbital routes calls for a new fare structure that allows for efficient interchange, not only between bus routes, but also between modes. That is why a simpler, time-based fare structure will be implemented as part of the programme. The optimal re-structuring of the fare system has been identified as a two-fare band structure comprising of a short distance fare and a 90-minute fare covering multiple modes. As opposed to the current trip-based fares, this new structure will allow passengers to make the most out of the new service.

The second biggest source of bus delays, after traffic congestion, is the payment process at bus stops. Payment of fares by cash is still commonplace, slowing down the boarding time. Even when using the Leap Card, the complexity of payment stages means a high percentage

[56] https://BusConnects.ie/media/2036/BusConnects-final-summary-report-fa.pdf
[57] https://www.BusConnects.ie/initiatives/just-the-ticket/

of passengers have to interact with the driver, resulting in delays at bus stops. At busy bus stops, these delays can occasionally be for several minutes.

To tackle this, one of the NTA's overall objectives is to develop a state-of-the-art ticketing system that ultimately makes payments more convenient for passengers. The Next Generation Ticketing element of BusConnects Dublin will implement an Account Based Ticketing (ABT) as the preferred option. This system aims to leverage cashless technology, allowing for payments to be made using cEMV (contactless credit and debit cards), mobile phones and tokens, all linked to a payment account. NGT will be implemented across Public Transport modes including metro, Luas and rail allowing for a seamless multimodal trip.

The average bus user travels a distance of 8km passing by approximately 19 stops (assuming a stop spacing of 400m[58]). The BusConnects Dublin NGT element will facilitate the boarding process and reduce dwell time at each stop. In a scenario where this reduced dwell times at stops by 5 seconds this would deliver over 13 hours in time savings for the average bus user per year.

7.5 Modern bus livery and bus stops with better signage, information and shelters

Under the BusConnects Dublin programme, the exterior and interior of buses, known as the bus livery, will be standardised across different operators to give the bus system the feeling of a modern, effective public transport system.

Roadside facilities and roadside information are essential components of a modern bus system. Across the region, the current facilities do not reflect the standard needed to make the overall system attractive and easy to use[59]. BusConnects Dublin will introduce a new style of bus stop across the Dublin region with standardised route and fare information across all operators. There will also be a greater use of Real Time Passenger Information ("RTPI") and an expanded number of bus shelters, particularly at interchange locations. The NTA has developed a standard bus stop pole for use nationwide[60] with a new flag design allowing both operators and routes to be clearly displayed. This will remove the need for multiple poles and minimise the impact on footpath space. Newly designed timetable and route information displays will be included at each stop.

Bus shelter provision will be significantly expanded as part of the BusConnects plan. New designs will create safe and secure environments, also at night with proper lighting, for passengers particularly where connecting services are being provided and dwelling times are expected.

7.6 Cleaner bus fleet using low-emission vehicle technologies

This transition to zero emission vehicle technologies will occur under the Government's renewal programme[61], this process encompasses the BusConnects Dublin programme, under which NTA targets a close to 100% conversion of its fleet into LEVs by 2030 (full conversion by 2032). The NTA is currently developing a detailed fleet acquisition strategy and vehicle

[58] *BusConnects Dublin Website. Dublin Area Bus Network Redesign Revised Proposal Report, October 2019* https://BusConnects.ie/media/1751/fullreport_full_web_version.pdf
[59] *https://busconnects.ie/initiatives/while-youre-waiting/*
[60] *https://www.nationaltransport.ie/wp-content/uploads/2020/11/Bus-Stop-Pole-Information-Note.pdf*
[61] *http://www.DTTaS.ie/press-releases/2018/ross-confirms-new-funding-transport-projects-will-significantly-support-climate*

technology roadmap, under which it will most likely replace diesel buses currently operating in Dublin as they reach the end of their useful lives, with:

- Low emission buses – from 2019 until around 2023 (approximately 500 buses)
- Zero emissions buses – from around 2023 onwards, the technology to be adopted will be subject to the monitoring of technological developments and manufacturer offerings

To inform its preferred choice of technology, the NTA undertook a preliminary market consultation with around 20 manufacturers and industry groups in 2017. In 2020 the NTA has purchased three Fuel Cell Electric Double Deck Buses (Hydrogen) and will be undertaking in service pilots in 2021. In addition, NTA has liaised with transport operators in London to understand the performance of Electric Double Deck buses. On the basis of the performance on Electric Double Deck Buses in London, a draft transition plan has been developed by NTA considering the daily duties and likely future requirements for bus operations. In this regard it is considered that approximately 50% of the fleet could be in a position to be early transitioned to zero emission double deck buses. NTA will commence a pre-qualification tender process for zero emission vehicles with a view to being in a position to bringing them into service in 2023.

As described in Section 7.3, single deck buses are more suitable for some routes. Zero emission vehicles for this type of smaller buses are more readily available and the technology is proven. On this basis NTA has begun the procurement of zero emission vehicles for this size of bus.

7.7 Park and Ride at key locations

To maximise the potential of the BusConnects Dublin programme, the greatest number of people need to be able to substitute private cars for the bus service. For those travelling long distances, Park and Ride facilities allow travellers to transfer to high frequency bus services at the earliest practical opportunity.

In November 2019, the NTA approved the *Park and Ride 5 Year Outline Strategy and Implementation Plan*. The vision for the plan is:

To support sustainable regional, urban, and rural growth through enhancing connectivity to high quality, accessible, low emission, and sustainable transport; empowering modal shift; and increasing the catchment areas of existing and future public transport by delivering a network of appropriate Park and Ride facilities.

The location of Park and Ride facilities is critical to their success. Important requirements for success include[62]:

- High capacity and frequent bus service to ensure efficient service
- Fast and reliable times to commuter destinations to be attractive
- Sited away from congested locations to enable access
- Conveniently sited for drivers on-route to major destinations
- Sufficient capacity in local road network to accommodate extra demand
- Parking controls in nearby areas to discourage illegal parking/charge avoidance
- Combined price of fare and parking charge that are attractive to drivers
- Affordable costs of site acquisition, construction and on-going operation

[62] *BusConnects Dublin Website - Park and Ride Section:* https://BusConnects.ie/initiatives/leave-the-car/

The *Transport Strategy for the Greater Dublin Area 2016 – 2035* proposes several rail-based park and ride facilities, and the BusConnects Dublin programme builds on this with a number of complementary bus-based sites. The NTA is currently assessing potential locations for the BusConnects Dublin Park and Ride facilities. At present, there are indicative locations for potential future BusConnects Dublin Park and Ride facilities, but there may be additional sites, or these locations may change after further detailed assessment. To increase attractiveness of the service, parking charges and fares will be integrated at park and ride facilities.

7.8 Timeline for delivery

The Preliminary Business Case assumes the following timelines for delivery of the different programme elements:

- Network Redesign will be implemented from 2020 to 2024.
- The Core Bus Corridors (CBCs), separated into 3 main lots, will have a staggered delivery with construction works running from 2024 to 2029.
- The conversion of the bus fleet to Low Emissions Vehicles (LEVs) will be close to a 100% by 2030 (full completion by 2032), with the implementation of LEVs from 2020 to around 2022 ahead of zero emission vehicles which will be rolled out from 2022 to 2032.
- Next Generation Ticketing (NGT) will be implemented from end of 2023 to end of 2024
- Park and Ride facilities will be constructed from 2023 to 2027 following construction of the CBCs
- New bus shelters and poles will be rolled out in Dublin from 2021 to 2024
- The new bus depot will be constructed from 2023 to 2024

The overall implementation timeline is presented in which is considered in more detail in *Section 14*. Note this reflects the implementation timeline as it stands at December 2021.

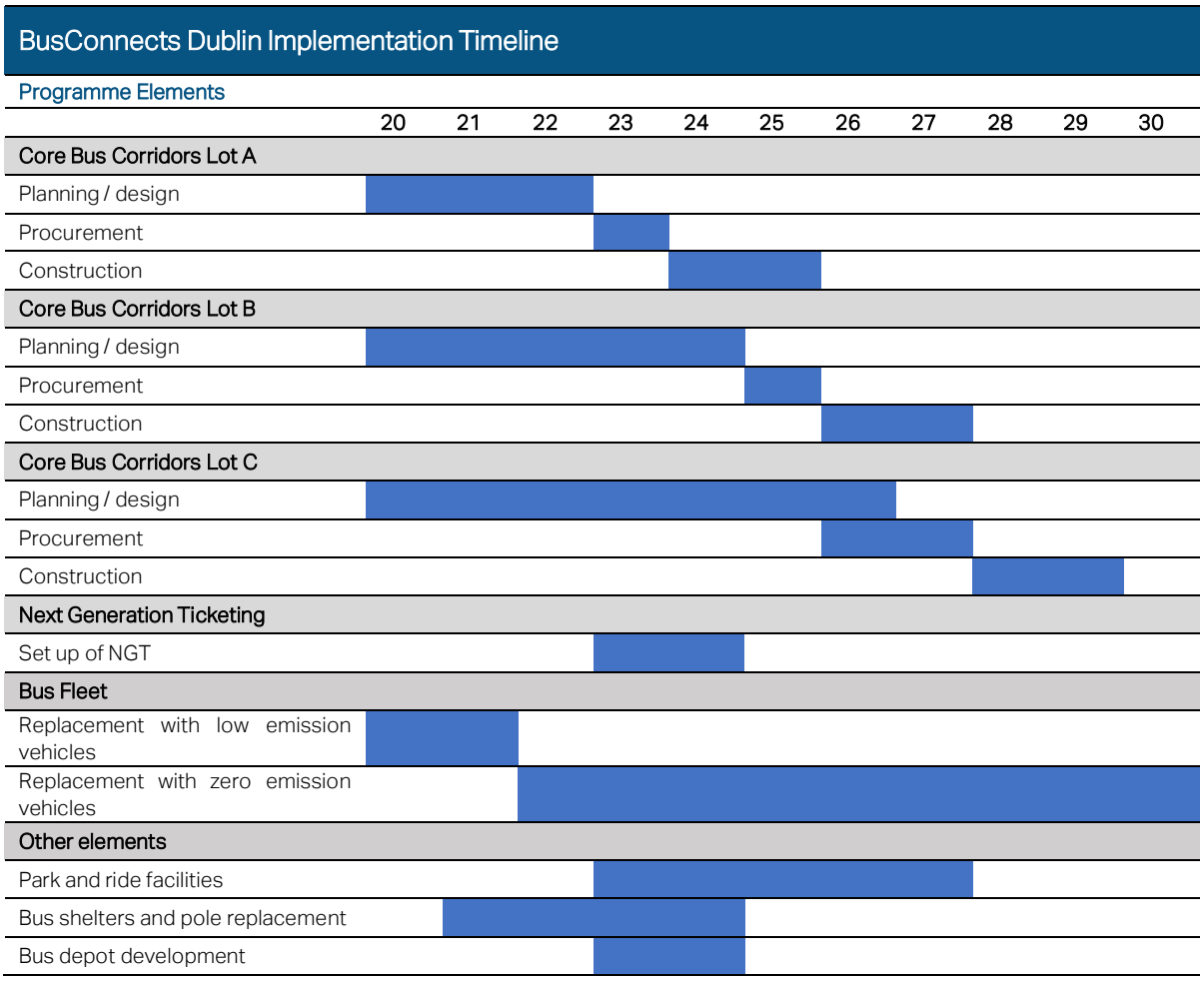


Figure 7.4 - BusConnects Dublin Implementation Timeline

The timelines presented above reflect the most current implementation plan. They are indicative and will be reviewed at the Final Business Case stage in accordance with the development stage of each programme element.

08

Cost projections

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.

8 Cost projections

Chapter Summary

- The development of robust cost estimates, including appropriate consideration of risk, is a key element in the development of the business case for the BusConnects Dublin programme.
- The cost estimates included within this chapter are based on the best information available and have been generated on a 'bottom-up' basis for each of the project elements.
- Cost estimates have been subjected to peer review, benchmarking and reference class forecasting analysis for material elements of the programme and reviewed at both at a programme and project level.
- Each of the capital cost estimates include a high-level risk and contingency allowance, as described in further detail Section 8.2 below.
- The overall risk management process adopted by NTA (at both programme and project level) is discussed in Section 13 below.

8.1 Total cost estimate

The tables in this section summarise the total costs to implement the DoMin and BusConnects Dublin. They also set out the incremental cost of implementing BusConnects Dublin as compared to the DoMin scenario. Costs have been broken down into the following categories:

- Upfront capital costs (investment costs)
- Lifecycle renewal costs
- Operational costs

Table 8-1 below sets out the estimated capital costs of BusConnects Dublin in real terms (as at 31/12/19 prices) for each project element within the overall programme. The table also includes line items for risk & contingency (including an allowance for Optimism Bias), land acquisition costs, inflation and VAT. The Public Spending Code 2019 requires certain analysis to be based on real costs (e.g. economic analysis) while other analysis requires consideration of inflation and taxes (e.g. financial appraisal). Capital costs relate to the period 2020-2032 in line with the timeline for implementation of the programme set out in section 7.8 above.

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.

Table 8-1 – DoMin & BusConnects Dublin Capital Cost Estimate (2020-2032)

Period - 2020-2032 Upfront Capital costs	Do-Minimum Total *€m*	BusConnects Dublin Total Investment *€m*	BusConnects Dublin Incremental Costs *€m*
Network Redesign	0	18	18
Core Bus Corridors	0	1,090	1,090
Next Generation Ticketing	10	97	87
Bus Fleet	756	812	56
Stops & Shelters	0	22	22
Park and Ride	0	40	40
Depot	42	50	8
Base Cost	808	30	1,322
Risk & Contingency	98	632	534
Land & Property	0	182	182
Real Costs (ex-VAT)	[illegible]	2,943	2,037
Inflation	[illegible]	355	203
Nominal Costs (ex-VAT)	1,058	3,298	2,240
VAT (at 13.5%)	8	229	221
VAT (at 23%)	229	325	96
Total (incl.-VAT)	1,296	3,852	2,557

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Sources: 'Cost Estimate Report' (October 2020) prepared by ChandlerKBS and NTA

Table 8-2 presents the estimated renewal costs of BusConnects Dublin.

Table 8-2 –DoMin & BusConnects Dublin Lifecycle Renewal Cost Estimate (2020-2058)

Period - 2020-2058 Lifecycle Renewal costs	Do-Minimum Total *€m*	BusConnects Dublin Total *€m*	BusConnects Dublin Increment *€m*
Bus Fleet	1,855	2,058	203
Next Generation Ticketing	78	137	59
Park and Ride	0	56	56
Real Costs (ex-VAT)	1,932	2,251	319
Inflation	1,374	1,609	235
Nominal Costs (ex-VAT)	3,306	3,860	554
VAT (at 13.5%)	0	16	16
VAT (at 23%)	760	861	101
Total Costs (incl.-VAT)	4,067	4,737	670

Table 8-3 presents the estimated operating costs of BusConnects Dublin PSO costs, CBCs, stops & shelters and Park & Ride are calculated in an incremental basis assuming no additional costs in the DoMin scenario are incurred for these elements.

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.

Table 8-3 –DoMin & BusConnects Dublin Operating Cost Estimate (2020-2058)

Period - 2020-2058 Operational costs	Do-Minimum Total *€m*	BusConnects Dublin Total *€m*	BusConnects Dublin Increment *€m*
PSO costs*	-	3,257	3,257
Next Generation Ticketing	459	603	144
Bus Fleet	1,484	1,625	140
CBCs, Stops & Shelters	0	39	39
Park and Ride	0	7	7
Real Costs (ex-VAT)	**1,943**	**5,529**	**3,587**
Inflation	1,143	4,470	3,327
Nominal Costs (ex-VAT)	**3,086**	**10,000**	**6,914**
VAT (at 23%)	710	2,300	1,590
Total Costs (incl. VAT)	**3,796**	**12,300**	**8,504**

**Note: PSO costs in the table above have been presented on a gross cost basis (i.e. before deducting fare revenue associated with these PSO costs). They have also been presented on an incremental basis in line with information provided by NTA. Refer to Section 11 Financial appraisal for Fare Revenue analysis.*

8.2 General assumptions

8.2.1 Inflation

Different inflation rates and annual profiles have been used for different cost items to calculate their nominal values. The inflation rates used have been set following NTA guidance, DEPR guidance and expert guidance for construction related inflation.

Table 8-4 –Inflation rate profiles (2020-2058)

Inflation rate	2020	2021	2022	2023	2024	2025	2026	...	2058
HICP	-1.20%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%		2.00%
Construction	1.20%	0.00%	1.00%	2.00%	4.00%	3.50%	3.50%		3.00%
Labour	-0.20%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		3.00%
PSO costs	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%		3.00%

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Where costs are presented in nominal terms in this report, the applicable base date is 31/12/2019. The construction related capital costs assume a rate of construction inflation of 1.2% in 2020, reducing to 0.0% by 2021 and then incrementing by 1% per annum until 2024. Between 2025 and 2027, the rate of construction inflation is assumed to be 3.5%. Thereafter, a rate of 3% is assumed until the end of the appraisal period. This inflation profile is based on estimates of the Tender Price Inflation of future tendering prices by contractors. Beyond 2024, industry averages have been used. It is important to note construction prices can be subject to significant volatility and inflation rates should be updated in a timely manner.

The rate of general inflation is assumed to be -1.2% in 2020 and thereafter it remains at 2% per annum until the end of the appraisal period. The general rate of inflation is applied to other non-

INFORMATION IN THIS CHAPTER HAS BEEN REVISED. PLEASE SEE COVER NOTE.

construction cost items. The rate of labour inflation is assumed to be -0.2% in 2020 and 3% per annum thereafter (i.e. in line with DEPR guidance of using general inflation plus 1%).

As per PSO costs, the use of a conservative 3% inflation rate has been agreed with the NTA.

8.2.2 Risk & Contingency (including Optimism Bias)

As with all capital programmes, the estimated values of costs or delivery schedules for BusConnects Dublin may not materialise as expected due to uncertainty and risk. The risks of adverse conditions and the potential uncertainty associated with each programme element has been identified and factored into the decision-making process as described further below.

Each of the cost estimates provided for the project elements includes an allowance for risk & contingency (including Optimism Bias adjustments). An optimism bias adjustment is reflected in capital cost elements to account for the tendency for transport infrastructure schemes to cost more than initially estimated. The adjustment factor was calculated to reflect the status of project development of each programme element. Risk and contingency adjustments have been applied to both upfront capital and lifecycle renewal costs.

In addition to the project level assessment, the overall adequacy risk & contingency (including Optimism Bias) has been assessed at a programme level. The table below sets out the total upfront capital costs for each element including for risk and contingency (and Optimism Bias) together with the % allowance applied at project level and at programme level for each project element. It also provides commentary around the source of the cost estimates used for this business case.

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Table 8-5 – Risk & contingency allowances applied to the different programme elements

Programme Element	capital costs incl. contingency (€m)	Contingency allowance	Comments
CBC	1,717 (58%)	40.8% (54% for land costs)	• ChandlerKBS did original project wide estimate in 2018 based on conceptual design information • NTA then appointed 4 x scheme consultants, to prepare preliminary designs and individual scheme estimates • Chandler were then reappointed to prepare an independent cost estimate across all 16 CBCs, based on the current status of design (October 2020) • NTA are satisfied that this independent cost estimate was in the same broad order of magnitude as the individual scheme consultant costs. As such it is the best source for the PBC as it has been prepared on a consistent basis across all 4 schemes. It is an independent estimate, rather than a peer review of the cost, but gives similar if not greater comfort than a peer review. • The individual schemes continue work to preliminary design stage, which will include taking on board results of third public consultation, due January / February 2021. • There is an ongoing process of cost and budget review which will track this design progression. • ChandlerKBS have included a 40.8% risk and contingency (incl. Optimism Bias (OB)) for main works and 10% contingency for land costs. • An additional 40% OB has been layered on top of the 10% contingency allowance for land costs • This has been compared to a Reference Class Forecast (RCF) prepared by Oxford Global Projects (OGP). RCF has become a standard method to appraise for large capital investment projects. OGP's conclusion was that 75% of similar projects at a similar stage (OBC/preliminary design) come in within c37% over their budget at this stage. • The OGP confidence level had reduced from a 55% level at concept design stage reflecting the design progression on the project. Cost / risk allowance is trending as would be expected as design progresses and reflects an appropriate level for preliminary design stage. • NTA therefore have independent comfort from two sources on both base cost and risk/contingency/OB. • NTA have taken a conservative approach to OB by applying 40.8% level to base costs

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Programme Element	capital costs incl. contingency (€m)	Contingency allowance	Comments
			• An overall 50% adjustment has been applied to land costs with 10% contingency to cover the specific risk of land disputes and an additional 40% to cater for OB
Bus Fleet	894 (30%)	10%	• NTA have good visibility on market pricing through recent hybrid and full hydrogen bus purchases through existing frameworks and market soundings on zero emissions vehicles. There is a reasonably transparent market in bus purchase prices. • In relation to volume NTA bus fleet team have prepared a range of fleet requirement scenarios based on both DoMin and Do BusConnects Dublin scenarios. These scenarios showed that BusConnects Dublin needed between 41-130 additional buses over the DoMin fleet. • A conservative approach has been taken at PBC stage (126 buses) • Given the above factors, NTA are comfortable with a lower level of risk / contingency / OB (10%) and do not believe an RCF is required at this stage.
Next Generation Ticketing	150 (5%)	55% (15% contingency + 40% optimism bias)	• Cost estimate developed for option comparison purposes by Systra in 2018. Systra prepared the original estimate. Concern at time of last PBC iteration was that costs were on the low side of this element • KPMG were commissioned to prepare an updated cost model. This cost model reflects further development of the project specification as it progresses to tender stage. Cost inputs have been prepared based on tender prices in similar international contracts in the UK and North America • Costs will evolve as project specification is developed through the Competitive Dialogue process • OGP have recently reported that there is a 75% confidence level that projects similar to the BusConnects Dublin elements of NGT will come in within a 35% overrun of budget at PBC stage and that there is a 75% confidence level that the Non-BusConnects Dublin elements of NGT will come in within a 73% overrun of budget at PBC stage. On a blended basis this is c55-57% which is in line with the risk/contingency/OB applied in the NGT and overall BusConnects Dublin cost models.
Stops & Shelters	31 (1%)	40%	• NTA have a rolling programme of shelter and pole instalment / replacement from a framework panel and have certainty over cost per shelter / pole. • Main risk affecting this element is volume risk (i.e. more shelters relative to poles required than forecast).

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Programme Element	capital costs incl. contingency (€m)	Contingency allowance	Comments
			• The NTA contingency calculator suggests a 23% adjustment is applied to this project given the nature of the works. To account for OB, a 40% contingency has been applied in this business case following a conservative and consistent approach with the rest of the programme elements.
Park & Ride	56 (2%)	40%	• The NTA contingency calculator suggests a 19% adjustment is applied to this project given the nature of the works. To account for OB, a 40% contingency has been applied in this business case following a conservative and consistent approach with the rest of the programme elements
Depot	71 (2%)	40%	• Estimate is based on historical construction costs incurred by the NTA on similar jobs. A 40% OB adjustment has been applied following a conservative and consistent approach.
Network Redesign	25 (1%)	40%	• limited remaining cost mainly based on professional fees. Same OB adjustment has been applied for consistency

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The levels of risk and contingency summarised in the table above have also been used to adjust lifecycle renewal costs.

No risk allowances have been applied to operating costs and revenues as they have been prepared on a conservative basis. PSO costs have been prepared with the same conservative approach based on cost / km of current PSO. It is important to note no future operating efficiencies as a result of new technology and procedures have been considered in this business case. That remains an opportunity to enhance scheme benefits further into the future.

8.2.3 Timeline

The timelines presented in this Preliminary Business Case are indicative only and will be reviewed at the Final Business Case stage, as the programme progresses, in accordance to the development of each programme element.

Capital costs will run until the full implementation of BusConnects Dublin in 2028 with Bus fleet being fully implemented by 2032. Renewal and operating costs have been calculated throughout the appraisal period to 2058.

8.3 Capital and lifecycle renewal cost assumptions

8.3.1 Core Bus Corridors

Core Bus Corridors are one of the most advanced elements. In 2018 ChandlerKBS prepared a project wide estimate based on concept designs. Since then, design consultants have been appointed to different schemes to advance designs to a preliminary stage with enough detail to initiate statutory processes. New costs estimates were prepared by the different scheme teams. In 2020 ChandlerKBS where reappointed to carry out an independent cost estimate based on the new design information and providing a consistent approach to estimation across the CBC element. The individual schemes are continuing work to preliminary design stage, which will include taking on board results of third public consultation, which is due January / February 2021. There is an ongoing process of cost and budget review which will track this design progression.

Capital costs included in this business case are based on the construction cost estimate for the latest CBC designs prepared by ChandlerKBS in October 2020. Construction costs include provisions for the following main elements:

- The improvement of bus lane facilities by providing continuous bus lanes along entire bus routes;
- The upgrade of pedestrian and cycle facilities;
- Junction improvements by widening certain junctions and replacing roundabouts with signalised junctions;
- Upgraded drainage;
- Upgraded bus stops, including the provision of new bus stops in strategic locations;
- Contractor and professional fees; and
- Tree replacements and land and compensation costs.

In addition, a contingency adjustment of 40.8% to account for the tendency for large capital projects to cost more than initially estimated has been applied to construction and

professional fees. Land acquisition costs have been treated separately with an uplift of 10% to account for the risk of land disputes. An additional 40% to account for optimism bias has been added to land acquisition costs in this business case to be consistent with the rest of the CBC costs.

The ChandlerKBS cost estimate identifies a total estimated cost of €1,665m including construction, land acquisition costs and contingency allowances. This business case identifies a total estimated cost for the CBCs element of €1,717m. The difference being the additional 40% adjustment for optimism bias applied to the land costs.

A summary of the CBC cost assumptions is presented in Table 8-6.

Table 8-6- Cost Assumptions[63]

Cost category	Assumption
Construction costs	The construction costs were primarily estimated using unit rates contained within a high-level Bill of Quantities and by using the ChandlerKBS internal Cost and Resource Estimating Database.
Contingency	A contingency allowance of 40.8% for all costs except land and compensation costs was included.
Land costs	General allowance of €25,000 per plot for land acquisition and landowner compensation costs was included.
Land contingency costs	A 10% contingency allowance, in addition to the land costs, has been included to account for the potential for dispute resolution in relation to land. An additional 40% to account for optimism bias has been included resulting in an overall c. 54% uplift.
Contractor's design fee	Allowance of 5% of the construction costs has been included for contractor design fees.
Contractor's fee	Allowance of 8% of the construction costs and contractor's design fees has been included to account for contractor overheads and profit.
Professional fees	Allowance of 12% of the total construction costs (including the contractor fees and contractor design fees) is included for professional fees.
Tree replacement	An allowance of €16,376 per tree has been included for the replacement of all trees identified. Surveys will be undertaken to determine the extent to which the trees on the existing corridors will be affected by the scheme.

An inflation adjustment has been applied to this estimate. This results in a total construction cost estimate of €2,141m (ex-VAT) for this business case.

Most of the Core Bus Corridors works will occur on existing roads and streetscape with a relative net increase of Public realm land of only 7% as a result, mainly, of private front yard land acquisitions. The incremental cost of maintaining this additional hardscape and landscape is considered negligible hence no lifecycle costs have been included for this element.

8.3.2 Next Generation Ticketing (NGT)

KPMG were commissioned to prepare an updated cost model from the original cost estimate prepared by Systra. This cost model reflects further development of the project specification

[63] *Source: 'Cost Estimate Report' (October 2020) prepared by ChandlerKBS*

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as it progresses to tender stage. Cost inputs have been prepared based on tender prices in similar contracts and market consultations. Costs will evolve as project specification is developed through the Competitive Dialogue process.

It is assumed that the next generation ticketing system will be deployed and fully operational by 2023 and will eventually replace the existing Leap Scheme. A transition phase where both NGT and Leap systems will run in parallel has been included in the cost modelling. Whilst new users will be introduced to the NGT system from 2023 onwards, a transition plan will be required for existing Leap users to move to NGT. This transition is estimated to run until 2030, the year when the Leap system will be decommissioned entirely. The cost estimates presented in this report have been developed by KPMG as of November 2020. In arriving at the cost estimates, a contingency allowance of 15% was applied to the costs, alongside an optimism bias adjustment of 40%. It has been assumed that the costs presented in this report will increase in line with the assumed rate of general inflation.

It is assumed that renewal costs of c. €26m (excl. VAT) will be incurred every six years to maintain the NGT system until the end of the appraisal period. This estimate includes the contingency and optimism bias allowances of 15% and 40% respectively.

The same approach has been followed for the DoMin scenario where a renewal cost of €10m will be incurred every six years to maintain the existing ticketing systems in place.

8.3.3 Park and Ride facilities

It is assumed that five park and ride facilities will be provided under BusConnects Dublin. It is assumed that the purchase of sites and the construction of each park and ride facility will cost €12-13 million and that the facilities will be constructed over the five-year period from 2023 to 2027[64].

As part of the Park and Ride cost estimate, it has been assumed that additional lifecycle renewal costs of 50% of the initial cost will be incurred for periodic refurbishments every 12 years from 2027 onwards.

8.3.4 Zero Emission Vehicles

In line with Government policy, it is anticipated that any new buses procured from 2021 to 2023 will be low emission vehicles, while any new fleet purchases from 2023 onwards will be zero emissions[65]. Full conversion to zero/low emission vehicles is expected to be completed by 2032 under both the DoMin and BusConnects Dublin options. The costs relating to LEVs are based on quotes received by the NTA from bus providers in response to requests for tenders. A 10% contingency allowance has been applied to the quoted bus costs as explained in section 8.2. Increased bus priority and faster journey times, which are expected with BusConnects Dublin, should reduce peak vehicle requirements. However, the BusConnects Dublin programme intends to increase patronage and provide increased frequency of services, which is likely to result in an increased peak vehicle requirement. It is estimated BusConnects Dublin will require an additional 126 buses to meet the needs of an increase in patronage as a result of implementing the programme.

[64] *Source: NTA*
[65] *Source: NTA*

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The existing bus fleet will need to be renewed every twelve years regardless of whether BusConnects Dublin progresses and it is expected that both the BusConnects and DoMin options will adopt the LEV procurement policy. Lifecycle renewal costs are therefore reflected in the cost estimates, however the incremental costs associated with LEVs only relate to the additional 126 buses that are required under the BusConnects Dublin option.

8.3.5 Bus shelters and poles

The cost estimate assumes that 5,300 bus poles in the Dublin Metropolitan Area (DMA) will be replaced and 400 bus stops will require new bus shelters between 2021 and 2024[66]. Estimates are based on existing frameworks NTA have in place for the delivery of stops and shelters. Construction inflation and a contingency allowance of 40% have been applied to these costs.

8.3.6 Network redesign

It is intended that the bus network will be redesigned, being fully implemented by 2025, with the associated capital costs being incurred throughout 2020 to 2025. Costs are primarily consisting of professional fees which vary between €3-4 million across the years. The estimated total capital cost associated with the network redesign is of approximately €27m (ex-VAT)[67], including a contingency allowance and after applying the labour related inflation rate profile.

8.3.7 Bus Depot

Due to the expected increase in peak vehicle requirement under BusConnects Dublin, and due to electric vehicle charging infrastructure taking up space in existing depots, it is anticipated that one additional bus depot will need to be constructed. It is assumed that the cost to construct the depot under BusConnects Dublin will be €50.4m[68]. Cost estimate is based on historical construction costs of similar sized bus Depots delivered in Dublin.

8.4 DoMin Assumptions

DoMin assumes that there is no network redesign, CBC project, park and ride facilities or upgrade of non-CBC bus shelters and poles and therefore no capital cost estimates are provided for these elements.

The transition to a LEV fleet is assumed in both BusConnects Dublin and DoMin options, in accordance with Government policy announced in November 2018, however the DoMin option assumes 126 less vehicles. In relation to ticketing, it is assumed that the NTA will incur costs of €15.5m every six years to maintain the current ticketing system, however it will not be upgraded to an NGT system. Finally, it is assumed that DoMin will require the construction of one additional bus depot, due to electric vehicle charging infrastructure taking up space in existing depots. The bus depot will be smaller under DoMin due to a smaller peak vehicle requirement; therefore, it is assumed that the cost will be 20% less than the BusConnects scenario.

[66] *Source: NTA*
[67] *Source: NTA*
[68] *Source: NTA*

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8.5 Operating cost assumptions

Business as usual operating and maintenance costs have been considered for each of the programme elements throughout the appraisal period. These costs have been estimated based on NTA experience of running bussing services and historical cost information. No contingency allowance has been made to operating costs.

8.5.1 Network operating costs

When the Network Redesign is fully implemented by end of 2024, the cost of the Public Service Obligation (PSO) contract incurred by NTA is forecast to go up due to the increased number of bus services provided in the redesigned network. NTA estimates that the completion of the Network Redesign in 2025 should increase the total gross PSO costs (before any offset from gross farebox revenues) by 26% (compared with 2020 costs). Accordingly, gross PSO costs are expected to increase from €345.8m in 2020 to €435.8m in 2025[69]. Given that PSO costs increase effectively pro rata with services, there remains an opportunity to drive further efficiencies into bus operations into the future once BusConnects Dublin has been fully established.

PSO costs have been estimated on a gross incremental basis, that is without accounting for revenue contribution and net of the costs associated to the Do Minimum operational scenario. In other words, PSO reflects the costs of operating BusConnects Dublin over and above the Do Minimum operational scenario. In this regard, PSO costs increase throughout the BusConnects Dublin implementation period where an increase in services and patronage will be expected as a result of an enhanced network. Beyond implementation they remain flat as the cost gap between the DoMin operation and the BusConnects Dublin is estimated to remain constant as they would both grow in a similar proportion as they cover organic demographic growth. Following the principle of conservatism, no penalties have been applied to PSO associated with an inefficient DoMin operation, for example, where increased congestion could have a negative impact on service. Similarly, no efficiencies from running the BusConnects Dublin operation have been taken into account.

8.5.2 Core Bus Corridor and non-CBC bus shelters

An incremental annual operating cost of 0.05% of the CBC project capital spend and the non-CBC bus shelter capital spend is assumed to be incurred from 2020 onwards, to account for incremental operating and maintenance costs on the new road and bus infrastructure. The assumed cost profile assumes an inflation rate of -0.2% in 2020 and 3% per annum thereafter (in line with the labour related inflation rate).

8.5.3 Ticketing

The costs derived for operating ticketing are based on the NTA project team by reference to benchmark projects of a similar nature globally, which forecasts costs out to 2040. For the purpose of the PBC, these costs have been extrapolated for the remainder of the appraisal period. The implementation of NGT is of itself a significant technology undertaking. There remains an opportunity to enhance scheme benefits further into the future through driving further efficiencies into ticketing operations once the system is fully embedded into the network.

[69] *Source: NTA*

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8.5.4 Park and Ride facilities

An annual operating and maintenance cost of 0.5% of the park and ride construction costs is assumed (i.e. €40k per annum per facility in December 2019 prices). The operating cost ramps up to €200k (in December 2019 prices) for the five park and ride facilities by 2028.

8.5.5 Zero Emission Vehicles

The operating costs, considered in the appraisal, associated with the new bus fleet relate to:

- the price of diesel and alternative fuels (hybrid, electricity)
- maintenance costs of new technology vehicles
- costs of CO_2 emissions

Operating costs are expressed in an incremental basis, that is over and above the DoMin option. Operating cost assumptions have been done based on NTA previous experience and benchmarking to forecast future values.

8.6 Cost Sensitivity Analysis

A sensitivity analysis has been carried out to provide a range of costs with an upper and lower boundary. Sensitivity has been carried out on upfront capital costs only and two parameters have been used as the basis for analysis:

- Contingency and optimism bias values for CBC and NGT
- Inflation

Both the CBC and NGT elements have bottom up cost estimates developed with Reference Class Forecasting exercises done to validate the level of contingency applied to them. The following values have been used for the sensitivity analysis, based on the RCF studies carried out for CBC and NGT respectively.

Table 8-7- Do Total Investment - cost contingency sensitivity values

Element	Lower range	Base Case	Upper range
CBC	6.0%	40.8%	55.0%
NGT	0.0%	55.0%	55.0%

The lower range value corresponds to an RCF50. This suggests 50% of the compiled reference class projects where completed within budget with a cost estimate that presented a 6% contingency at the Preliminary Business Case stage. Similarly, the upper range value corresponds to an RCF80 suggesting 80% of the compiled reference class where completed within budget having a cost estimate at Business Case stage that included a 55% contingency.

The rest of the programme elements have been kept to their base case with no sensitivity applied to their contingency values as there are no available studies currently to inform on a suitable range to be applied.

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Table 8-8- Do Total Investment – upfront capital costs range

Upfront Capital Costs (€million)	Lower range	Base Case	Upper range
Total Real Costs (ex-VAT)	2,467	2,943	3,118

The cost range does not vary significantly as the combined weight of CBC and NGT is below 60% of the overall upfront capital expenditure for BusConnects Dublin. The Base case is closer to the upper range value which suggests a conservative approach has been taken.

A sensitivity range of -1% and +1% has been applied to all the inflation profiles presented in **Table 8-4**. Applying the sensitivity range on inflation has a circa +/- 6% effect on the total nominal costs (excl. VAT). The results are presented below.

Table 8-9- Do Total Investment – Inflation sensitivity analysis

Upfront Capital Costs (€million)	Lower (-1%)	Base Case	Upper (+1%)
Total Real Costs (ex-VAT)	2,943	2,943	2,943
Inflation	162	355	561
Total Nominal Costs (ex-VAT)	3,105	3,298	3,504

8.7 Cost Control & Contingency Management

As part of the governance structures and mechanisms described in Chapter 15 the NTA will ensure the control and monitoring of capital costs as implementation progresses and the programme reaches more cost intensive phases. The NTA will have in cost control processes aligned with international best practice that will allow to track and compare actual expenditure to original project budgets and anticipate to deviations and cost overruns. It will embed capital cost control in its governance through reporting allowing for escalation to the board when necessary.

Contingency management is another key aspect that the NTA will be looking at as part of their programme governance review. Proper contingency management, potentially through the establishment of a tiered approach, will allow teams to focus in keeping within targeted project budgets and disincentivise the use of risk reserves.

8.8 Summary

The key points from the cost chapter are:

- Cost estimates have been developed for each of the programme elements to support this business case using bottom-up and benchmarking techniques.
- Each has been subject to significant analysis and challenge by a variety of difference entities.
- Costs are presented in three categories: capital costs, renewal costs and operational costs
- Different inflation rates and annual profiles have been used for different cost items to calculate their nominal values.

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- Risk and contingency allowances accounting for optimism bias have been applied to each element considering the nature of the works, the stage of development of the design and the certainty of the method used to calculate the costs.
- Those allowances have been benchmarked to actual experience on global project using Oxford Global Projects
- This section provides a summary of the costs in gross terms for the DoMin and Do BusConnects Dublin scenarios as well as in incremental terms.
- The sensitivity analysis demonstrates a conservative approach has been taken towards the estimation of upfront capital costs.
- The total real incremental capital cost of implementing BusConnects Dublin is of 2,037 €million (excluding inflation and VAT)
- The NTA will have the appropriate cost controls and contingency management mechanisms to avoid unnecessary cost overruns as implementation progresses.

09

Programme impact

9 Programme impact

Chapter Summary

- The programme impacts described within this chapter are outlined as a series of elements which improve or affect daily life. Benefactors include, but are not limited to, public transport customers, cyclists, road users, the environment, businesses and visitors.
- This chapter focuses mainly on the qualitative impacts. Quantitative economic impacts are described in Chapter 10 and align each of the benefits with their relevant CAF assessment criterion.
- The greatest benefactors of the BusConnects Dublin programme will be the passengers who use the bus system. The key passenger impacts include reduced journey times, improved journey time reliability, improved accessibility and usability and improved interchange.
- Identified benefits to businesses within the Dublin area included an extended catchment for staff and customers, Improved health and wellbeing for staff and a positive impact on private vehicle-based business trips.
- The local economic impact of Gross Value Added (GVA) and employment benefits from BusConnects Dublin are calculated using Economic Impact Assessment. An estimation of indirect and induced employment effects has been calculated through economic multiplier analysis and validated by information on the accompanying or ancillary employment that is created throughout the delivery.
- The environmental impacts at local level will be documented in the assessment process for each of the 16 CBCs, which will produce an Environmental Impact Assessment Report (EIAR) as part of the planning application to An Bord Pleanála.
- The key effects of the BusConnects Dublin programme for cyclists include travel time, safety, journey quality and ambience, and health impacts.
- As well as increasing access to more destinations around Dublin, the BusConnects Dublin programme will provide an easy-to-understand network, simpler fare structures (than the current eight different adult fare types), and easier payments that will make it easier for visitors to access and use public transport.
- The environmental benefits delivered by BusConnects Dublin are sustained over long periods as people change their behaviour to reduce reliance on the private car.
- The geographic distribution of impacts is presented graphically in Section 9.10, while gender equality impacts are examined and discussed in Section 9.11.

9.1 Introduction

BusConnects Dublin is a programme of changes to transform the bus system to provide better services to more people. This chapter focuses on the benefits that the BusConnects Dublin programme will provide differentiating between qualitative and quantitative impacts. It outlines the benefits to the Dublin region and specifically for passengers, businesses, cyclists, visitors, the environment and other road users.

To aid in the quantitative elements of the assessment the NTA's Eastern Region Model (ERM) has been used to determine the impacts (positive and negative) of the proposed programme. Specific in-depth analysis was used to calculate the positive impact that BusConnects Dublin's improved cycling infrastructure will have, given the inclusion of approximately 200km of new cycle facilities in proposals. An overview of the impacts presented in this chapter is given below.

The programme impacts described within this chapter are outlined as a series of elements which improve or affect daily life. Benefactors include, but are not limited to, public transport customers, cyclists, road users, the environment, businesses and visitors.

This chapter focuses mainly on the qualitative impacts. Quantitative economic impacts are described in Chapter 10 and align each of the benefits with their relevant CAF assessment criterion. Chapter 10 also sets out the assumptions behind the analysis.

Table 9-1 – Insight to the impact of BusConnects Dublin on daily life

Impact	Qualitative	Quantitative
Benefits for passengers (travel time and reliability)	Yes	Yes
Impact on businesses	Yes	Yes
Local economic impact	Yes	Yes
Impact on cyclists	Yes	Yes
Benefits for visitors	Yes	No
Benefits for the environment	Yes	Yes
Benefits / other impacts for other road users	Yes	Yes

9.2 Benefits for passengers

The greatest benefactors of the BusConnects Dublin programme will be the passengers who use the bus system, both current and future users. The key passenger impacts include:

- Reduced journey times – Service improvements, resulting in improved journey times, more punctual buses, new and more frequent services delivered through customer-focused design and technology. In addition, improved payment technology, both on buses and at stops, is expected to make it quicker and easier for people to board buses, reducing dwell time at stops and speeding up bus journeys, encouraging more people to use bus for more journeys. Overall, the ERM projects that BusConnects Dublin will deliver a more reliable and faster public transport option, improving journey times for bus users by up to 16% on full completion. This will benefit not only commuters at peak times but also passengers travelling for education, healthcare, retail and leisure purposes at all times of the day.

- **Journey time reliability improvements** – At present, journey times for the existing CBC bus routes can vary significantly, as described in Chapter 3.

  The CBC infrastructure will deliver segregation and priority for buses. This will reduce the variability in bus journey times along the corridors they serve by up to 49%. Knowing exactly how long a journey will take provides a greater level of confidence and assurance to passengers. Reliability benefits are separate from journey time savings. They capture the perceived benefit associated with reduced uncertainty that users experience when the variation in their bus journey times is reduced. Figure 9.1 presents a situation where improvements in the variability of a bus service do not necessarily result in journey time savings. It is therefore appropriate that the appraisal of the BusConnects Dublin programme aims to capture both the journey time savings (due to reduced headways, improved bus speeds and more direct journeys) and reliability savings (through improved bus infrastructure reducing the likelihood of blockages and congestion).

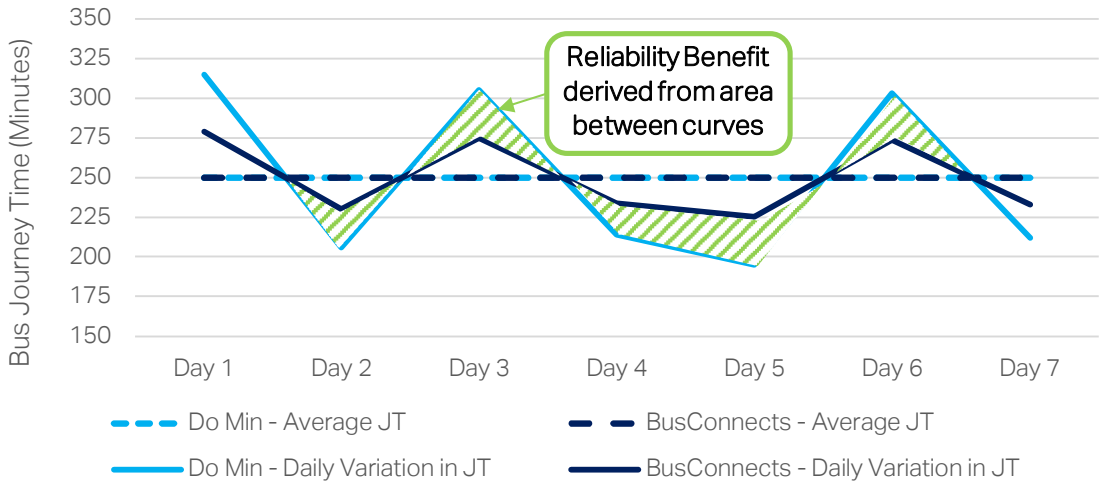


Figure 9.1 - Sample Journey Time – Average and Daily Variation

The economic appraisal of reliability benefits is a relatively new concept and whilst there are draft guidelines in place from DoT they are not yet included in the published version of CAF. A bespoke approach was used to determine reliability benefits of the scheme for the purposes of this business case, based on journey time standard deviation. The approach is in line with the draft guidance set out by DoT in relation to journey time reliability and quality and makes best use of available data. Travel time variability is expressed as the standard deviation of travel time. The 'recorded standard deviation' represents the existing variation in journey times along each section of each CBC (by hour and direction) and was quantified using AVL data and calculated in accordance with the following formula:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Where μ is the mean, N is the number of data points and x represents the value at each data point.

In terms of understanding and appraising the potential change in journey time standard deviation for each CBC, the following approach was used:

- AVL data was used to understand where hotspots currently exist, in terms of journey time variance, and identify whether the proposed Core Bus Corridor infrastructure will help mitigate the journey time variability issues
- AVL data was analysed at route level in order to understand the current traffic situation as well as to spot any potential issues with the data and validate it
- The corridor with lowest standard deviation in journey time was identified to determine if this is linked to better bus infrastructure and. if so, it was assumed that other corridors could improve to match this level of performance at a minimum. The impact of the BusConnects programme is the reduction in the journey time variability based on the differences between each CBC and the CBC which currently has the lowest variability expressed as the lowest standard deviation in journey time. This is a conservative approach as it assumes that the lowest variance possible across all the CBC's would be the same as one of the existing corridors which have comparatively limited priority, however it is based on reliable data sources (AVL data) and reduces the risk of overestimating reliability benefits
- The outputs from the NTA ERM were used to quantify the number of unique passengers travelling along each CBC route and who will therefore gain the most benefit from the reliability improvements

  The monetised value of these reliability benefits is calculated based on the formula below:

  *Benefit = Reliability Ratio * VoT * Reduction in Variability (hrs) * Demand * Correction Factor*

  Where Reduction in Variability is the difference between the sums of the variability for all journeys in the modelled area for Do Minimum and Do Something, Reliability Ratio is 0.8 based on CAF and Correction Factor used is 1.0.

- Accessibility and usability – The redesign of the bus routes will provide greater access to bus services giving considerable social inclusion benefits which is consistent with the NTA's overall equality objectives. The simplification of the routes, improved information services and fare payments, together with investment in high quality bus shelters and interchange facilities will deliver a higher quality service that can reduce the stress associated with travelling, improving health and wellbeing. The improved journey times and journey time reliability, increased frequencies and expansion of the network to serve more origins and destinations will improve access to employment, education, healthcare for all users including vulnerable groups. Furthermore, the programme will improve the quality of service provided to vulnerable users through more comfortable and accessible buses, easier payment and improved bus stops with shelters, seating and information.
- Improved interchange – The programme will be complementary to the proposed Metrolink and DART Expansion Programme both of which are currently in planning and outlined in the *Project Ireland 2040: National Development Plan.* The combination of improved waiting facilities and the simplification of the fare structure and easier payment options will facilitate more interchange across the public transport network and will reduce the existing financial penalty for interchanging. Again, this is expected to make public transport a more viable and attractive option for all types of journey destinations and purposes.
- Increased levels of physical activity - The overall improvement to bus infrastructure aims to encourage more people to take the bus which involves walking to and from the bus stop. Such physical activity has a positive impact on health and wellbeing and reduces health risk.

BusConnects Dublin will have a positive effect on the day to day life of hundreds of thousands of people across the Dublin area by making it easier to get around, meaning they have better access to all the opportunities and services on offer.

9.3 Impact on businesses

Overall, BusConnects Dublin will result in a benefit to businesses within the Dublin area however there are both positive and negative impacts.

- Extended catchment for staff and customers - The BusConnects Dublin programme will significantly reduce peak period bus journey times. This will contribute to a more inclusive society by making it easier for more people to access more opportunities and services throughout the Dublin area. Employers will benefit from the bigger employment catchment area that results from faster journeys. The catchment impact of BusConnects Dublin is estimated to result in a 14-20% increase in access to jobs and students within the same travel times on the new network. BusConnects Dublin may contribute to revitalisation of declining urban areas and improve their suitability as business locations.
- Improved health and wellbeing - The programme aims to have a positive effect on citizens' health thanks to increased physical activity both in the form of cycling and walking, which subsequently has a positive effect on productivity through reduced absence.
- Impact on private vehicle-based business trips – Goods vehicles travelling along roads where BusConnects Dublin requires the rebalancing of road space in favour of public transport is likely to experience a negative impact. This is likely to be most significant during peak periods when demand for private road-based travel is highest and congestion occurs.

  The rebalancing of road space is also likely to have a negative effect on non-freight private vehicle trips (mostly business and commuting) during the peak periods. Whilst the overall impact is negative, it varies across the network. In some areas private vehicles will experience an improvement in travel conditions as a result of modal shift onto public transport.

  During the 2028 – 2035 period the total travel time in private vehicles (cars and goods vehicles) across the Eastern region is forecast to decrease slightly due to the reduction in demand. On a per vehicle basis the average time travelled increases by between 2 – 3%. The on-going planning and design of the CBCs will seek to identify sections or areas with specific negative impacts and seek to mitigate them.

9.4 Local economic impact

The local economic impact of Gross Value Added (GVA) and employment benefits from BusConnects Dublin can be calculated using Economic Impact Assessment (Input-Output models, built on the Central Statistics Offices supply-use tables). There are also indirect and induced employment effects, an estimation of which have been calculated through economic multiplier analysis and validated by information on the accompanying or ancillary employment that is created throughout the delivery.

The economic impact of the direct investment of over €2.6 billion in BusConnects Dublin over twelve years of implementation is significant. Using the information provided on forecast costs of BusConnects Dublin and the national input-output tables from the Central Statistics Office,

local output and employment multipliers were developed to demonstrate how the planned expenditures would impact on the national economy.

Gross Value Added (GVA) – GVA refers to the value of output minus the cost of intermediate consumption. GVA is often used as a proxy for productivity in conjunction with Gross Domestic Product (which is a metric for economic activity), meaning that GVA can provide an indication of how much an activity is expected to contribute to the broader national economy. Capital expenditure on BusConnects Dublin will generate a total of **€1.3 billion in GVA** in the domestic economy between 2020 and 2032, compared to just €39 million in the DoMin Scenario. This figure is made up of **€567 million in direct GVA**, and **€716 million in indirect and induced GVA** in the wider economy.

Employment - BusConnects Dublin will generate **19,800 Full-Time Equivalent (FTE) jobs** over twelve years during the planning and construction phases of the programme. Approximately **10,800 FTE jobs will be created directly**, while another **9,000 will be supported in the wider Irish economy**. This compares to just 330 direct jobs and 270 indirect/induced jobs created in the DoMin scenario. The vast majority (17,850) of this job creation relates to the planning and construction of the CBCs and will mainly occur between 2022 and 2027 based on the planned programme. It should be noted however that the number of FTE jobs does not necessarily equal the *number of people* who will be employed, as these are counted over the entire 12-year period (i.e. if the same person is employed for 3 years on the Programme, this would be the equivalent of 3 FTE jobs).

Table 9-2 - Economic Impact by cost component (for information purposes)

Component	Total GVA (Direct, indirect and induced)	Total Employment (Direct, indirect and induced)
Network Redesign	€22m	234
Core Bus Corridors	€1,138m	17,850
Next Generation Ticketing	€8m	80
Bus Fleet	€0m	0
Stops and Shelters	€24m	328
Park and Ride	€38m	596
Depot	€48m	745
Land and Property	€4m	8
Total	**€1,283m**	**19,840**

9.5 Local environmental impact

Although air quality is generally good in Dublin, levels of air pollution are increasing and becoming a concern at some hotspots which are generally located in the city centre and around the M50. Transport emissions are one of the key contributors to this problem. BusConnects Dublin has the potential to deliver substantial environment benefits at local level by contributing to lower traffic volumes which may reduce the problems at air quality hot spots as well as traffic related noise. The environmental impacts at local level will be documented in the assessment process for each of the 16 CBCs, which will produce an Environmental Impact Assessment Report (EIAR) as part of the planning application to An Bord Pleanála. The approach to environmental assessment for each of the CBCs is detailed in the CBC page of the BusConnects Dublin website. A detailed EIAR will be completed for each CBC which

assesses the short-term impact of the preferred route during its construction phase and its longer-term impacts once the CBC is complete. Each EIAR will document potential benefits as well as highlighting potential issues at local level. The EIAR documents will consider the following potential impacts:

- Traffic and transportation: Disruption to traffic, capacity and parking
- Air quality and climate: Different types of emissions and sources
- Noise and vibrations: Construction and vehicle related noise/vibrations
- Human health: Impact on emissions, severance and physical health
- Biodiversity: Reduction in water or air quality, habitat loss and protected species
- Water, land, soils and geology: Potential contamination or disturbance
- Archaeological, architectural and cultural heritage
- Landscape and visual impact: Urban realm and streetscape changes
- Waste and resources: Impact of waste generated during construction
- Material assets: Impact on utilities during construction and operation

9.6 Impact on cyclists

The delivery of approximately 200km of offline cycle facilities will have a significantly positive impact on both existing and new cyclists on the corridors. The BusConnects Dublin programme, and the CBC project in particular, plan to provide improved facilities for cyclists on many of the key radial routes into the city. This is particularly important since the number of cyclists entering the city has more than doubled since 2006, with 6% of people now entering the city centre by bicycle[70].

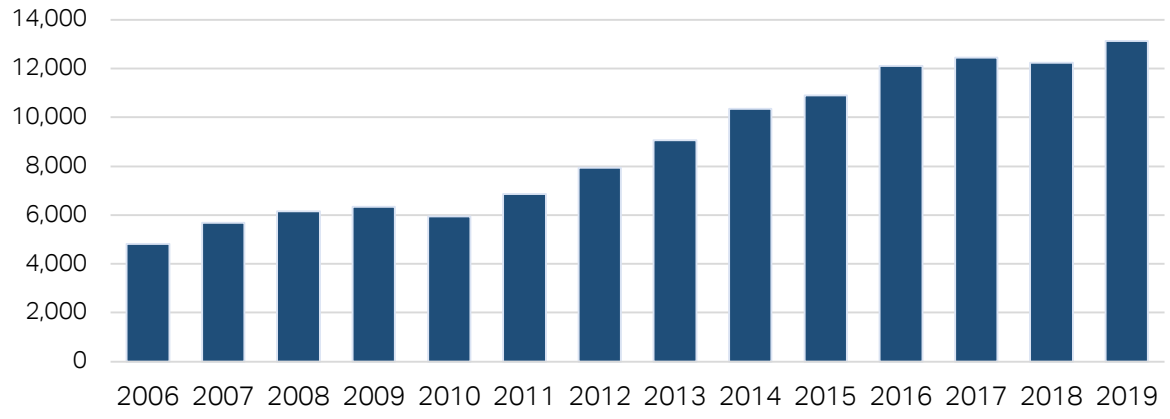


Figure 9.2 - Number of cyclists crossing cordon in AM Peak, 2006-2018[71]

Between 2010 and 2019, the total number of cyclists across the canal cordon has increased by 121% from 5,952 (representing a 3% modal share) to 13,131 (representing a 6% modal share). The compound growth rate of cyclists between 2006 to 2019 is 7.4% - that is, on

[70] *Canal Cordon Report, p. 17*
[71] *NTA Cordon Count Report 2018*

average between 2006 and 2019 an additional 7% of people cycled into the city year-on-year[72].

Sections of the BusConnects Dublin network where cyclists are currently mixing with traffic or which are shared with bus lanes will progressively gain cycle lanes or segregated cycle tracks. Cycle tracks are considered safer compared to cycle lanes, due to their physical segregation from the traffic. However, several sections of the current cycling facilities are online and interact with buses or general traffic. Combined cycle and bus lanes do not offer any physical segregation, with cyclists fully exposed to traffic and may slow public transport services. BusConnects Dublin will seek to resolve these issues of limited segregation and poor journey times, among other overdue improvements. The overall length of each cycle facility type and their percentages for all CBCs, before intervention, are presented in Table 9-3.

Table 9-3 - CBCs' existing cycle facilities length & percentages

Cycle facility type (2020)	Length (km)	Length as % of CBCs
Cycle track	30.77	23%
Cycle lane	35.06	27%
Shared bus lane	31.66	24%
No cycle facility	34.28	26%

Figure 9.3 shows as an example the existing cycle facility along the CBC 1, Clongriffin to city centre. There is an evident need to deliver route consistency and to reduce the level of exposure to live traffic for cyclists along the corridors. Each of the sixteen CBCs were assessed for their existing and proposed cycle facilities allowing benefits to be assessed for each. An example of proposed facilities for CBC1 is shown in Figure 9.4.

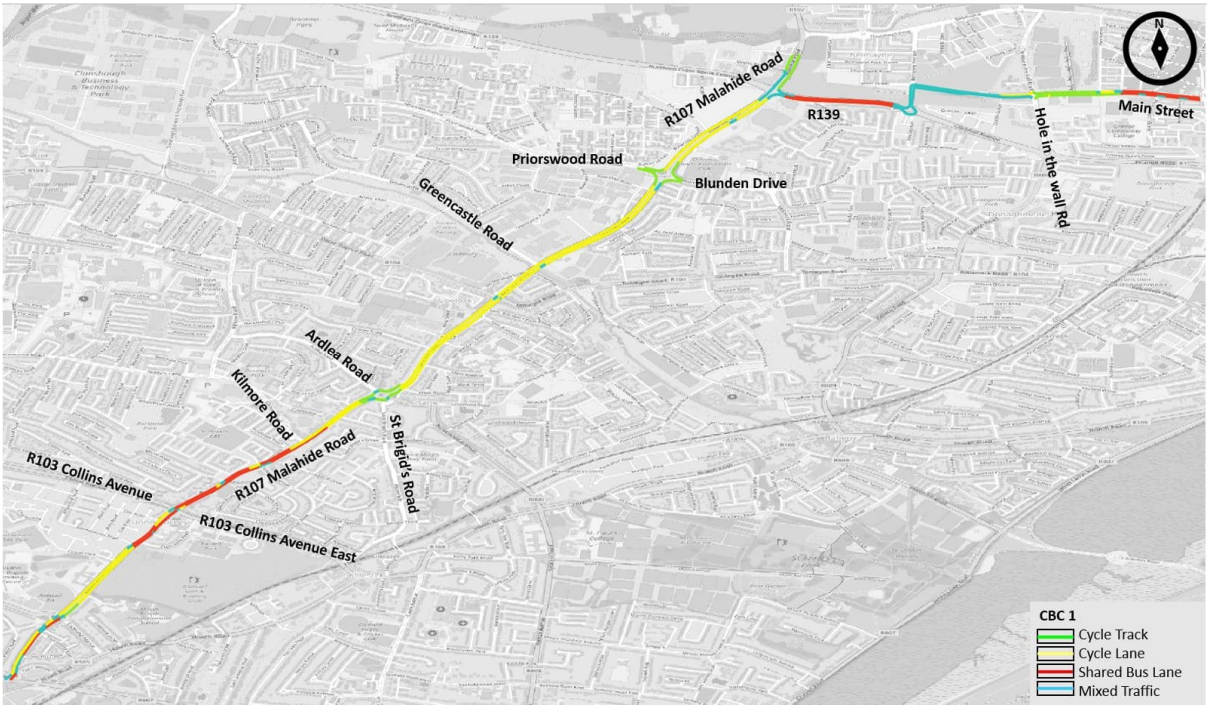


Figure 9.3 – Existing cycle facilities in Core BusConnects Dublin Corridor 1

[72] *Sourced from the Canal Cordon counts and account for differing occupancies of different modes of transport*

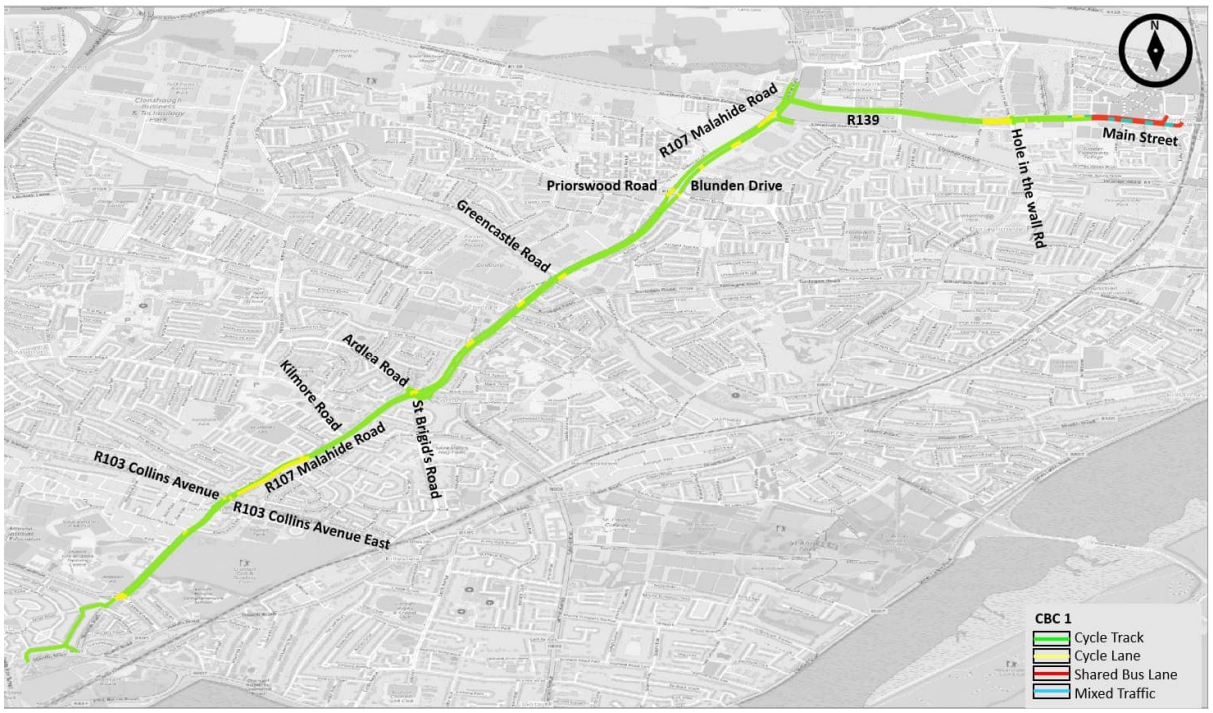


Figure 9.4 – Extent of proposed cycle facility types along CBC1

In the case of improved, increasingly segregated cycle facilities, the average speed of cycling would be expected to increase, with similar improvements in aspects such as travel time, safety, journey quality (ambience) and comfort, health and wider socio-economic impacts.

Domestic and international literature and best practice provides a framework for assessing cyclist benefits[73], while departmental values of time (Department of Transport, updated in October 2020) provide for consistent and measurable, often monetised, benefits to be assessed. These and guides and methods (for benefit assessment), ensure equitability and comparability across the CBC corridors and all other transportation schemes across the state.

The key effects of the BusConnects Dublin programme for cyclists are outlined below.

- Productivity and socio-economic impacts – Amongst wider socio-economic factors, introducing cycling into the everyday behaviours of people results in reduced absence from work due to improvements in the physical health of the users[74].
- Travel time – Cycle facilities providing increased levels of segregation offer higher average journey speeds, allowing users to spend less time in transit and allowing more productive and leisure time.
- Safety – In 2016, 591 cyclist injuries occurred in Dublin, which represented more than half (almost 61%) of all cyclist injuries in the State[75]. The number of cyclists has grown greatly since. The improved cycle infrastructure will reduce collisions and protect cyclists who are the most vulnerable road users currently. It is estimated that rate of cyclist injury incidents on the existing CBC routes will significantly reduce.

[73] *For example, where journey ambience, and its benefit monetisation are included in TII's PAG and UK's WebTAG*
[74] *TII PAG (Unit 13: Walking and Cycling Facilities)*
[75] *Road Safety Authority: 'Cyclist Injury Injuries Trends 2006-2018, with an in-depth review of 2016'Casualties', p. 25:* https://www.rsa.ie/Documents/Fatal%20Collision%20Stats/Analysis_of_road_user_groups/Cyclist%20Injury%20Trends%202006-%202016%20with%20in-depth%20review%20of%202016.pdf: http://www.rsa.ie/Documents/Fatal%20Collision%20Stats/Analysis_of_road_user_groups/Review_of_Cyclist_Injuries_2012.pdf

- Journey quality and ambience – Segregated cycle facilities reduce the perceived levels of risk and conflict between cyclists and other road users. National and international best practice in this field indicates that moderate to high benefits may result from improved journey quality, as well as encouraging more users to cycling as a viable mode of transport.
- Health impacts – Health and physical activity are highly correlated. Specifically, regular physical activity such as cycling helps to reduce the risk of various illnesses such as diabetes, cardiovascular diseases, and depression, while riding a bicycle to work every day reduces the risk of premature death by 41%[76]. Conversely, physical inactivity contributes to numerous chronic diseases and high obesity levels. By demonstrating the significant contribution of cycling to physical activity improvements as part of BusConnects Dublin, users may shift to this active mode and experience health benefits.

The benefits to cyclists due to BusConnects Dublin introduction have been monetised to aid the economic assessment of the programme, as well as outline the importance of investing in cycle facilities. Where substantial lengths of segregated cycle tracks and cycle-friendly facilities are implemented, an expected economic return of just over €1.5 billion[77] may reasonably be expected. This high benefit value represents the absolute importance and ongoing commitment that will continue to be placed on cycling improvements across Dublin.

9.7 Benefits for visitors

Dublin is a key destination for domestic and international visitors, attracting 7.6 million visitors in 2017[78]. Fáilte Ireland launched the *Dublin Visitor Orientation Strategy* in 2017, with a primary goal being to encourage more visitors to experience an extended city and county tourist offering, rather than staying confined to the city centre. For most visitors, buses and taxis are the most common mode of transport to get around Dublin[79]. As well as increasing access to more destinations around Dublin, the BusConnects Dublin programme will provide an easy-to-understand network, simpler fare structures (than the current eight different adult fare types), and easier payments that will make it easier for visitors to access and use public transport.

9.8 Benefits for the environment

BusConnects Dublin is expected to deliver environmental benefits including:

- A modal switch towards public transport and cycling and a reduction in private vehicle km travelled.
- The reduction in the growth of transport emissions from a transition to more efficient low emission vehicles. Since November 2018, the Government has committed to decarbonisation of public transport and the replacement of diesel buses with cleaner, more efficient, lower emission vehicles. A proportion of this benefit will be offset somewhat from increased emissions caused by increased congestion for non-bus road users as a result of bus priority however this impact will also reduce as the private car fleet continues

[76] *(Netherlands Institute for Transport Policy Analysis, 2018)*
[77] *Net Present Benefits*
[78] *Fáilte Ireland 2017 Visitor Research: Overview Presentation – Dublin Figures*
[79] *Fáilte Ireland 2017 Research Overview Presentation – 2017 Dublin Figures.*

to transition to low emission vehicles. Overall there will be a reduction in emissions which will further reduce as the private car fleet transitions to zero emission vehicles.

- At local level, the transition to a low emission vehicle bus fleet will improve air quality in the neighbourhoods served by buses and assist in addressing poor air quality hot spots. In the longer term, the use of zero emission vehicles instead of diesel vehicles will reduce local noise pollution for residents living along bus corridors and near depots.
- Enabling compact growth – Public transport makes more efficient use of space given over to road-based transport and therefore better supports the Project Ireland 2040 ambition for long-term concentrated development along largely established population centres. Compact growth will allow for greater efficiency in the delivery of public services for citizens into the future. BusConnects Dublin will be able to move high volumes of passengers directly between areas identified for higher-density employment and high-density residential developments, offering scope for new areas to develop along public transport corridors that can support growth into the future.

These benefits are sustained over long periods as people change their behaviour to reduce reliance on the private car.

9.9 Impacts on other road users

This section of the report focuses on the positive impact the modal shift away from private vehicles has on road safety and also a detailed discussion on the disbenefits identified in the assessment process for private road users as a result of implementing the BusConnects Dublin programme. The second sub-section discusses the cause of disbenefits, the role of disbenefits in encouraging modal shift and the efforts to mitigate the negative impacts for road users in the BusConnects Dublin design process. The third sub-section presents the analysis of disbenefits, showing the distribution of impacts on different areas, time periods and users.

9.9.1 Safety Impacts

The reduction in the number of vehicles on the roads, as a result of people transferring to bus as a result of BusConnects Dublin, will lead to a reduction in the number of collisions and associated casualties. The impact was calculated using COBALT based on outputs from the NTAs ERM. The results are set out below.

Table 9-4 – Safety impact of BusConnects Dublin

Cycle facility type (2020)	Number saved as a result of BusConnects over the 30 year appraisal period
Total Collisions Saved by Scheme	4,490
Total Casualties Saved by Scheme (Fatal)	48
Total Casualties Saved by Scheme (Serious)	237
Total Casualties Saved by Scheme (Slight)	6,129

9.9.2 Disbenefits Discussion

Balancing the Competing Needs of Different Transport Users

Dublin is a historic city with a finite amount of road space which must be shared between the competing needs of different transport users. For the policy makers who manage the

allocation of road space, the priority is to produce a solution which creates the greatest benefits for public health, the environment, local neighbourhoods, economic activity and the urban region. In the main, this is achieved by encouraging people to use sustainable travel modes such walking, cycling or public transport, as they are the most efficient means of moving large volumes of people with the lowest negative externalities. While this is the priority in personal transport, commercial activity also requires efficient supply chains and the smooth movement of goods vehicles[80] which is reliant on the road network. Improving conditions for bus travel often involves reallocating road space from private motor vehicles, but this must be achieved without unduly affecting economic activity and the movement of goods. Balancing these interlinked, but often contrasting, needs is one of the most important aspects of traffic management and a key consideration in the BusConnects Dublin design process.

Consequences of Inaction and Rising Congestion

In recent decades, it has been established that private motor vehicles are the least efficient mode of personal transport and are associated with high environmental and health costs. Earlier planning practices resulted in road-centric development which has contributed to rising congestion and increasingly inefficient bus and road networks. Traffic congestion negatively affects bus journey times, reliability and customer perception; which can contribute to modal shift away from public transport over time. This can create a self-perpetuating cycle where bus use declines due to congestion, which leads to more people deciding to drive, and a subsequent increase in traffic levels. This scenario benefits no one, but public transport providers are particularly affected as they will have to run more buses to maintain the same service frequencies on congested roads. Without intervention, this cycle is likely to continue and get progressively worse, leading to increased operator costs as well as negative impacts for the health, environment and well-being of transport users.

Shifting Attitudes, Modal Shift and Potential Disbenefits

To disrupt the cycle which produces rising congestion, it is necessary to intervene and fundamentally change traffic conditions to allow sustainable travel modes to compete with private motor vehicles. Prior to the Covid-19 pandemic, there was growing evidence of people switching to walking, cycling and public transport due to its increasing convenience and shifting attitudes to the environment. In respect to active modes, cycling and walking have grown in popularity as people seek healthier and more environmentally friendly lifestyles, a trend which has been accelerated by Covid-19. Once the pandemic ends, people will want to travel on public transport, but Dublin lacks an effective integrated public transport system which can replace the private car. This is likely to lead to a situation where there is supressed demand for public transport across the Greater Dublin Area (GDA) which cannot be realised due to the limitations of the network. In order to implement government policy, policy makers will need to capitalise on this shift in attitudes by improving public transport infrastructure to encourage the transition to sustainable travel.

The transformation of the bus network through the BusConnects Dublin programme will improve the experience of public transport users and enhance the image of bus travel in Dublin. However, reallocating road space from private motor vehicles to buses will produce substantial disbenefits for car, van, lorry and motorbike users. This is inevitable when there is a finite amount of road space and it is not possible to give equal priority to all modes of transport, particularly when national policy prioritises the movement of people by sustainable

[80] *all non-car vehicles including emergency services, light vans and trucks used by a range of people doing essential maintenance, operations and construction work and delivery vehicles, as well as freight (i.e. bulk goods transport)*

modes. When considering the issue of disbenefits for some transport users, it is important to recognise that modal choice involves individuals evaluating the positives and negatives of each mode of travel when making a decision. In order to influence this decision-making process, intervention is needed to create a push factor which makes people reconsider whether driving is absolutely necessary. It is somewhat inevitable in that process that car users will be negatively impacted, to a certain extent, so that it creates a push factor which makes people reconsider whether driving is absolutely necessary. While this is taking place, if the public transport network is enhanced then it creates the necessary pull factor which can attract car users to alternative modes of transport. Without the push factor, the pull of improving the bus network will benefit only existing public transport users, while levels of car use will likely remain the same and traffic growth over time will impact on bus operations in the long run.

CBC Design Process and Mitigating Disbenefits

The major infrastructure element of the BusConnects Dublin programme is the creation of Core Bus Corridors (CBCs) which give priority to buses, cyclists and pedestrians. The CBCs are essential to improve the journey time and reliability of bus trips as well as increasing safety for cyclists. In the original draft designs, the CBCs involved widening roads to give more space to all road users including private motor vehicles. However, public consultation in 2018 and 2019 highlighted that people were unhappy with road widening due to issues such as; the removal of mature trees, smaller front gardens, negative impacts on protected structures, reduced access to businesses/loading bays and the loss of parking spaces. Additionally, issues were raised regarding the lack of continuous segregated cycling facilities and poor provision for active modes at junctions.

The original road widening approach sought to avoid disbenefits for private motor vehicles, but the consultation process highlighted that this was not the critical issue for the public and the CBC designs were revised accordingly. The revised designs entailed less road widening, which would mean reduced space for cars and goods vehicles, resulting in higher disbenefits for drivers according to the transport modelling forecasts in the Preliminary Business Case (PBC). Furthermore, it was also necessary to reduce the amount of continuous bus priority provided as there was less road space available, which lowered the benefits for bus users as well. This highlights the complexity of designing a solution which balances the need to maintain private property boundaries, with the requirement for enhanced priority for sustainable modes, while also avoiding excessive disbenefits for private motor vehicles. While compromise and consensus are important in the design process, it is impossible to simultaneously increase space for buses and cyclists while retaining space for private cars and avoiding road widening. Essentially, some modes of transport have to be prioritised over others.

At present, the results from the latest round of consultation are being reviewed and considered. It may be necessary for further refinement of the CBC designs to respond to issues raised in the consultation prior to the finalisation of designs for planning applications. While revising the designs, the CBC engineering teams will seek to understand the local benefits and disbenefits, in order to mitigate the negative impacts where possible and produce the best possible outcome for pedestrians, cyclists and bus users. This process will be informed by the production of an Environmental Impact Assessment Report, incorporating a Traffic Impact Assessment, which will accompany the planning applications. The planning process may result in further design changes if An Bord Pleanála decide that amendments are needed. The CBC designs and mitigation measures will continue to evolve as the planning process progresses.

Potential for Improved Outcomes

The transport modelling indicates that substantial private vehicle disbenefits will occur over a thirty-year period, but it is important to recognise that these forecasts are based on the assumption that travel behaviour will remain broadly consistent over time. It is possible that the real level of disbenefits is overestimated because the forecasts do not account for the level of behavioural change happening in society or that will happen in response to the changes BC will bring about. In the medium to long term, it is possible that the following trends could reduce car demand and lessen the magnitude of disbenefits:

- Flexibility that Covid-19 has introduced: It is likely that more people will have the option of working from home and this will reduce travel demand. Long distance commuters will be particularly attracted to this option and this would reduce the number of cars on the road.
- Ongoing Shift towards Sustainable Travel: Recent trends have indicated that, where possible, people are increasingly likely to use active modes or public transport to improve their health and reduce their negative impact on the environment. In particular, it can be expected that environmental awareness will increase as the effects of climate change become more apparent and modal shift may exceed current expectations if personal preferences shift.
- Delayed car ownership: Researchers have documented how younger generations are waiting longer before they become car owners compared to their parents. This is partly due to economic issues, but it also reflects new priorities in housing and transport decisions which could have implications for travel demand e.g. younger people choose to live in urban centres, with smaller homes, in order to travel sustainability instead of prioritising a suburban house with a long-distance commute.

In addition to these reasons, there are ongoing CBC design improvements to limit the disbenefits for transport users which will also have an impact, these include:

- Adjustments to signal timings to optimise the flow of private vehicles travelling along each CBC without compromising the required sustainable mode priority at each junction.
- Implementation of a Signage Strategy along each CBC and offline, to ensure appropriate routing of traffic away from sensitive residential areas. This could also include the use of Variable Message Signage (VMS).
- Time-plating of bus gates along some CBCs to limit the general traffic displacement impacts to peak hours only.
- Cycle mode share assumptions (to support a minimum of 10% of people movement by cycling) have been factored into the design of junctions along the CBCs (e.g. appropriate green time provided for cycling) which will further strengthen a shift to sustainable modes and limit traffic redistribution.

9.9.3 Evidence and Analysis: Distribution of Disbenefits

This section provides information on the distribution of disbenefits forecast by the NTA's Eastern Regional Model (ERM) in respect to their impact on different areas, types of people and travel purposes.

9.10 Geographic Distribution of Impacts

ERM Geographic Sector Impacts – Change in Private Motor Vehicle Travel Cost[81]

The maps presented in this section show the forecast percentage change in private vehicle travel cost by ERM geographic sector. Geographic sectors are the larger scale boundary used in the ERM which allows for easy identification of strategic trends in the outputs. In these maps, a minus value represents a positive impact as costs have reduced, while a positive value represents a negative impact as costs have increased. The sector impacts are provided for 2043 across five different time periods: AM peak (7-10am), Off peak (7pm-7am), PM peak (4-7pm), school run (10am-1pm) and lunch time (1-4pm).

Figure 9.5shows the percentage change in average private vehicle costs by geographic sector in 2043 for the AM peak. Overall, this map shows that the greatest negative impact on private vehicles is primarily occurring in areas which are affected by the reallocation of road space due to the construction of CBCs. In particular, the south-central areas of Dublin experience the largest increase in private motor vehicle costs. This is likely due to the weakness of existing bus priority corridors in these areas, with the creation of dedicated CBCs causing a bigger shift in road space allocation than observed on the northside. The increase in private motor vehicle costs in the city centre is due to the implementation of bus priority measures, such as bus gates and one-way streets, which have reduced road space for private motor vehicles. It is important to note that the greatest impacts are occurring in urban areas where there are potential levers to reduce private vehicle demand by encouraging mode transfer to bus, walking and cycling modes of transport. In outer areas of the GDA, where no major infrastructure changes are taking place, there is a smaller increase in costs for private motor vehicles.

[81] *Private vehicle travel costs are calculated on the basis of the % change in private vehicle travel time based on the outputs of the NTA ERM.*

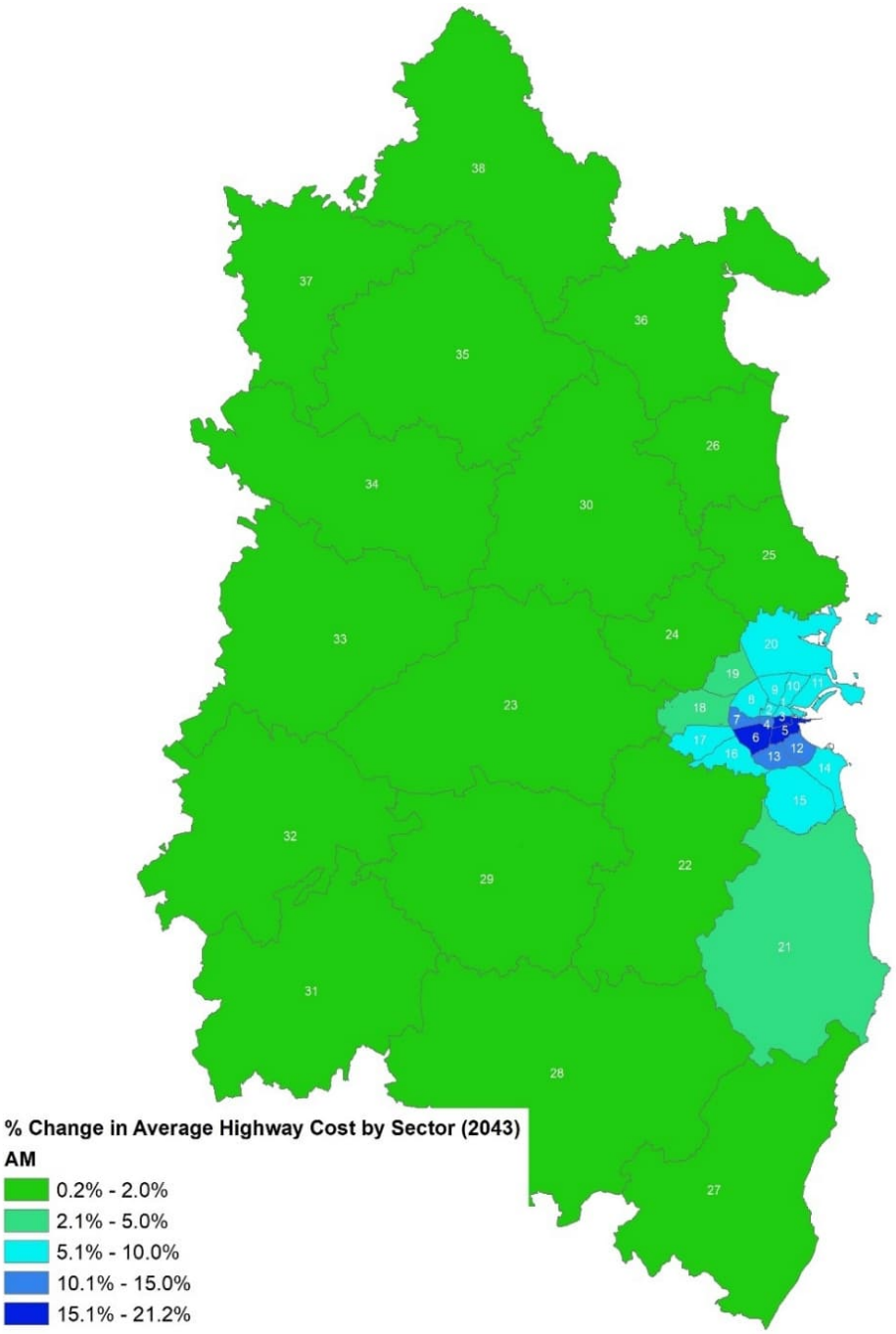


Figure 9.5 - % Change in Average Private Vehicle Travel Cost by Geographic Sector – 2043 AM

Figure 9.6 shows the percentage change in average private motor vehicle costs by geographic sector in 2043 during lunch time. This shows a similar geographic distribution of impacts as observed the AM peak, with south central areas most affected, but there are parts of west and north Dublin which are affected to a greater extent due to the implementation of CBCs and the reallocation of road space. Similar to the results observed for the AM and school run time periods, a corridor extending south of Dublin into Wicklow experiences a slightly higher increase in private motor vehicle costs compared to other outer areas and this is likely due to the Bray CBC which has reduced road capacity for private cars in these areas.

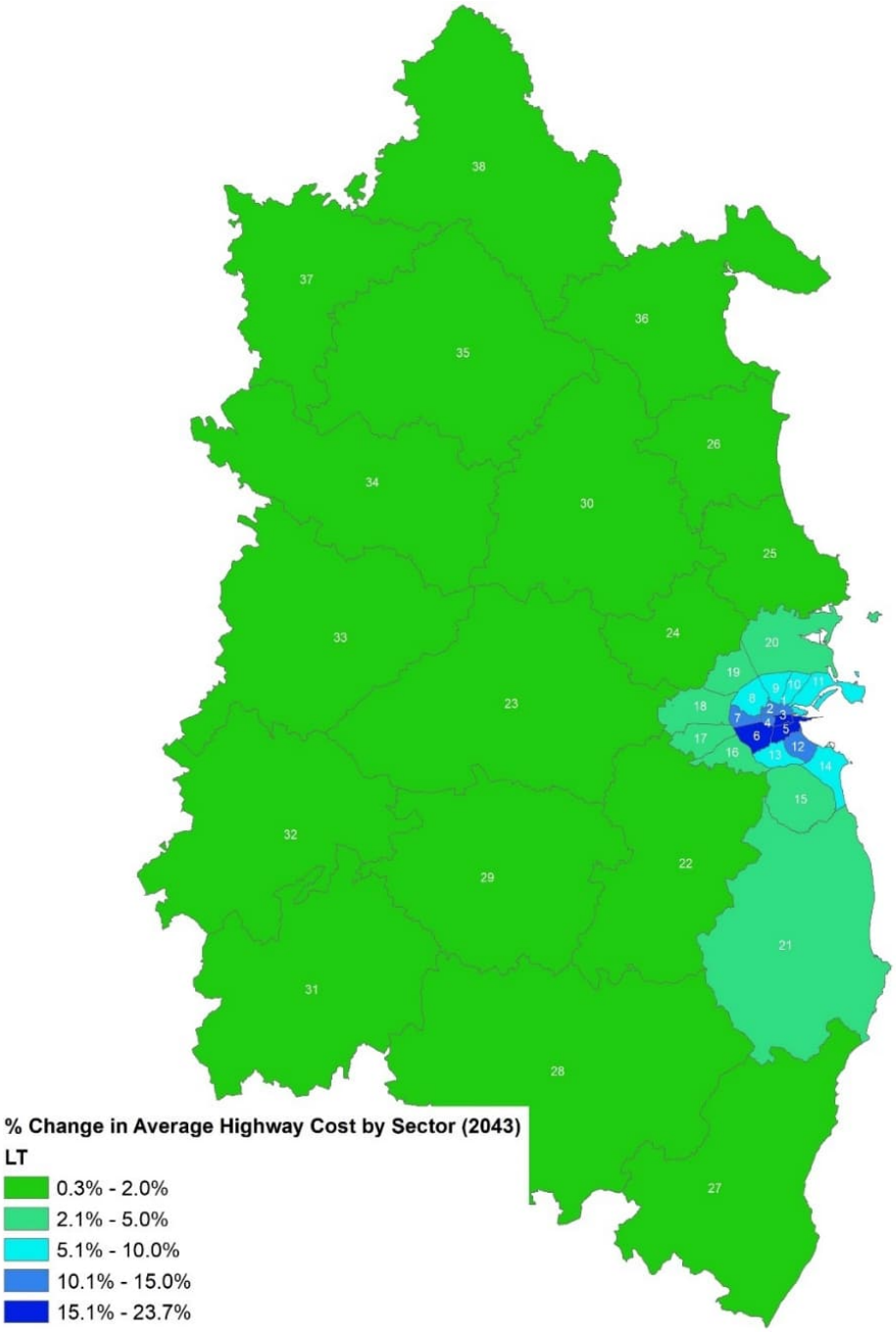


Figure 9.6 - % Change in Average Private Vehicle Cost by Geographic sector – 2043 lunch time

Figure 9.7 shows the percentage change in average private motor vehicle costs by geographic sector in 2043 for the off peak. The increase in private motor vehicle costs is much less significant in the off peak with a smaller increase in percentage costs across most areas of Dublin. Marginal changes take place in outer areas, with the worst affected places being the south-east central areas of the city and the north east near Howth. However, even in the worst affected areas, private motor vehicle costs have only increased by 5-10%, which is a much smaller impact than the changes observed at peak times. The increase in private motor vehicle costs is probably lower during this time period because the road network is not operated at peak capacity and the reallocation of road space from car to bus travel has a less significant impact on travel costs.

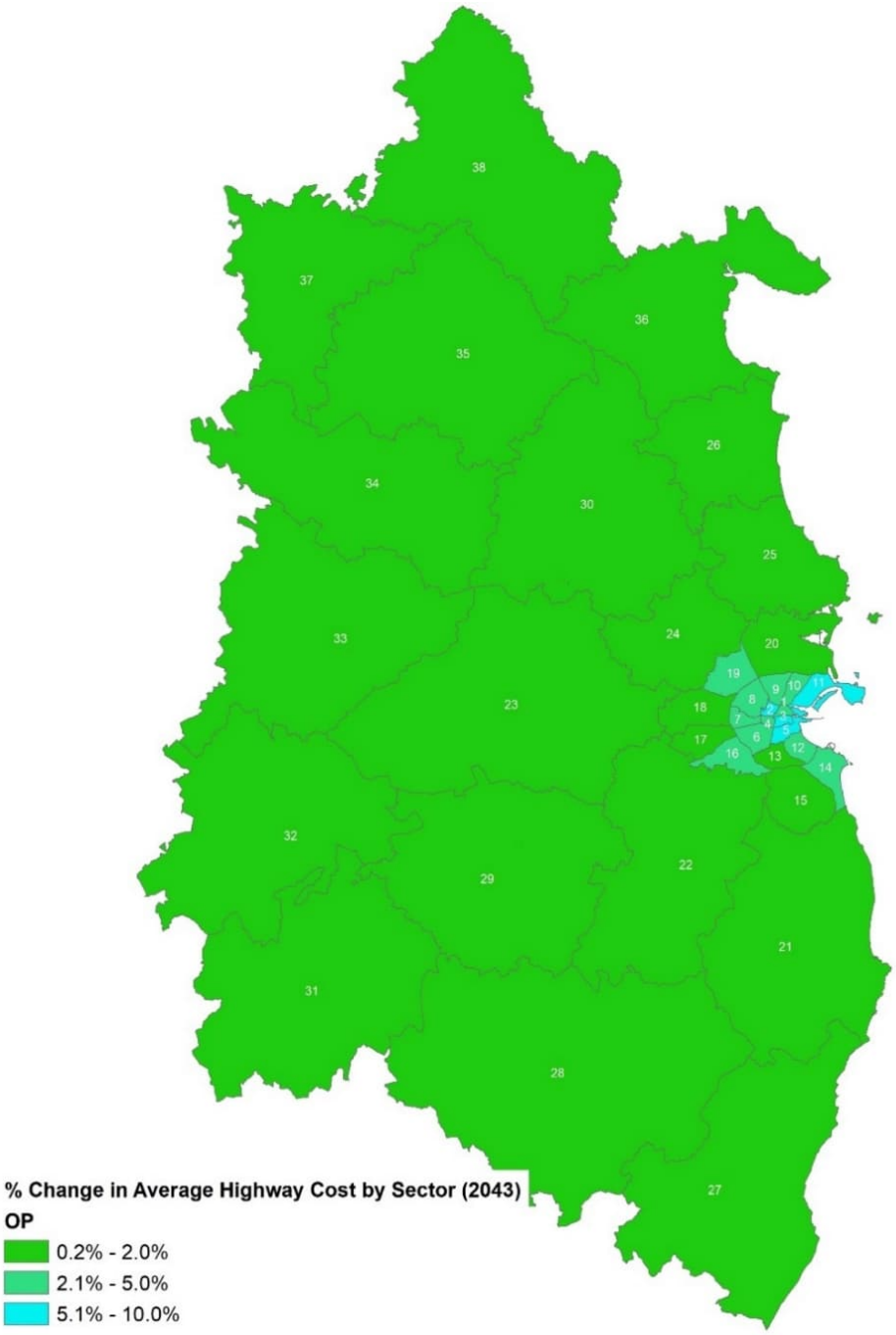


Figure 9.7 - % Change in Average Private Vehicle Cost by Geographic sector – 2043 off peak

Figure 9.8 shows the percentage change in average private motor vehicle costs by geographic sector in 2043 for the PM peak. The distribution of impacts is largely focused on the areas affected by the construction of CBCs. However, the magnitude of impacts is different to the AM peak in urban areas, with higher percentage change occurring along corridors to the north and west of the city. The greater impact on west and north Dublin, compared to the AM peak, may be due to the design of the CBCs which reallocate a greater amount of space to buses from cars in the outbound direction.

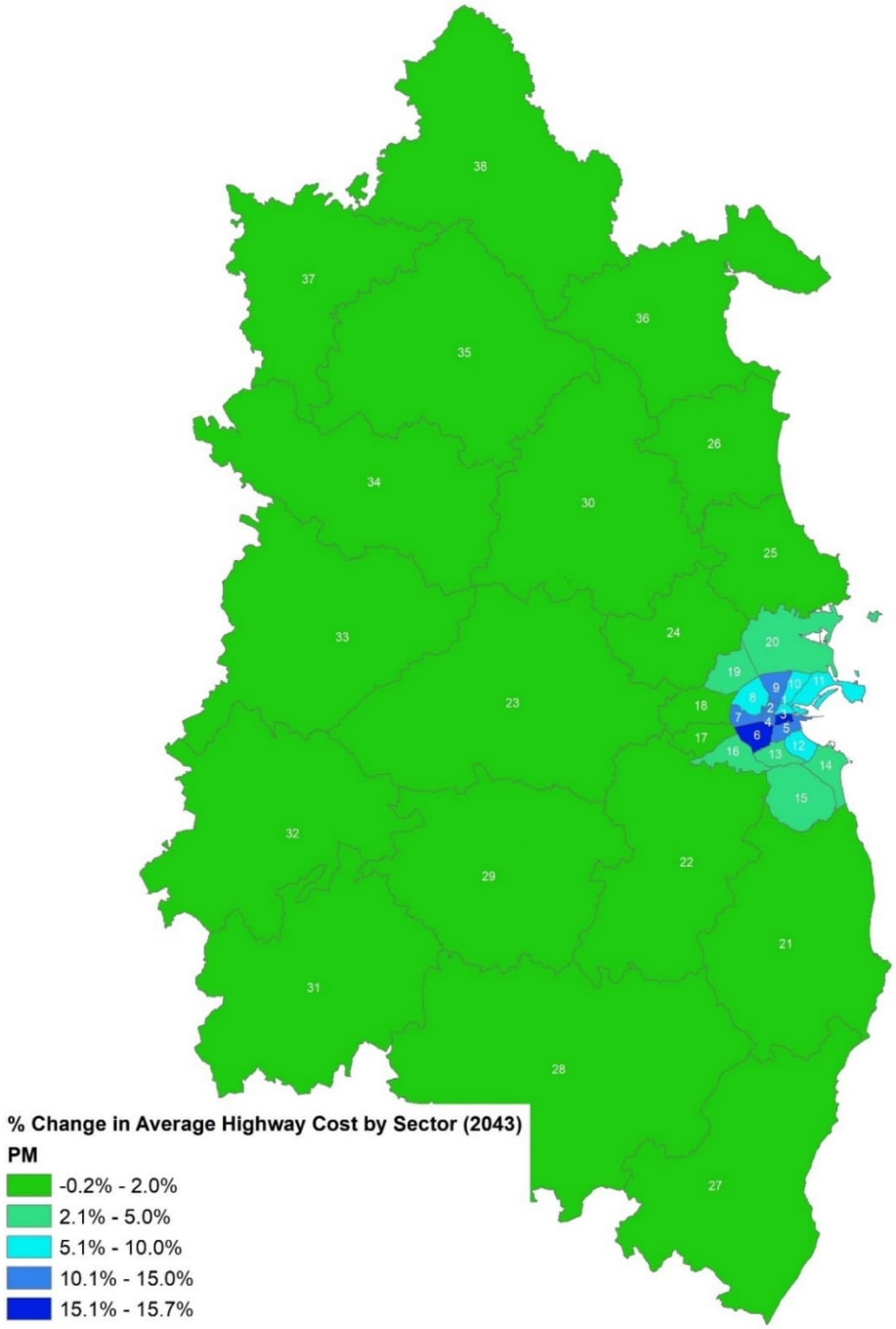


Figure 9.8 - % Change in Average Private Vehicle Cost by Geographic sector – 2043 PM Peak

Figure 9.9 shows the percentage change in average private motor vehicle costs by geographic sector in 2043 for the school run. In contrast to some other time periods, a greater increase in costs is observed on the southern corridor into Wicklow and to the north west into Meath. Like the other geographic sector maps, the greatest increase in costs are observed in the city centre and within the urban area. Both the northside and southside are equally impacted, and there is a substantial increase in costs on corridors to west Dublin. The sectors which are more impacted during this time period may contain a higher percentage of business travel trips and this could be resulting in higher costs.

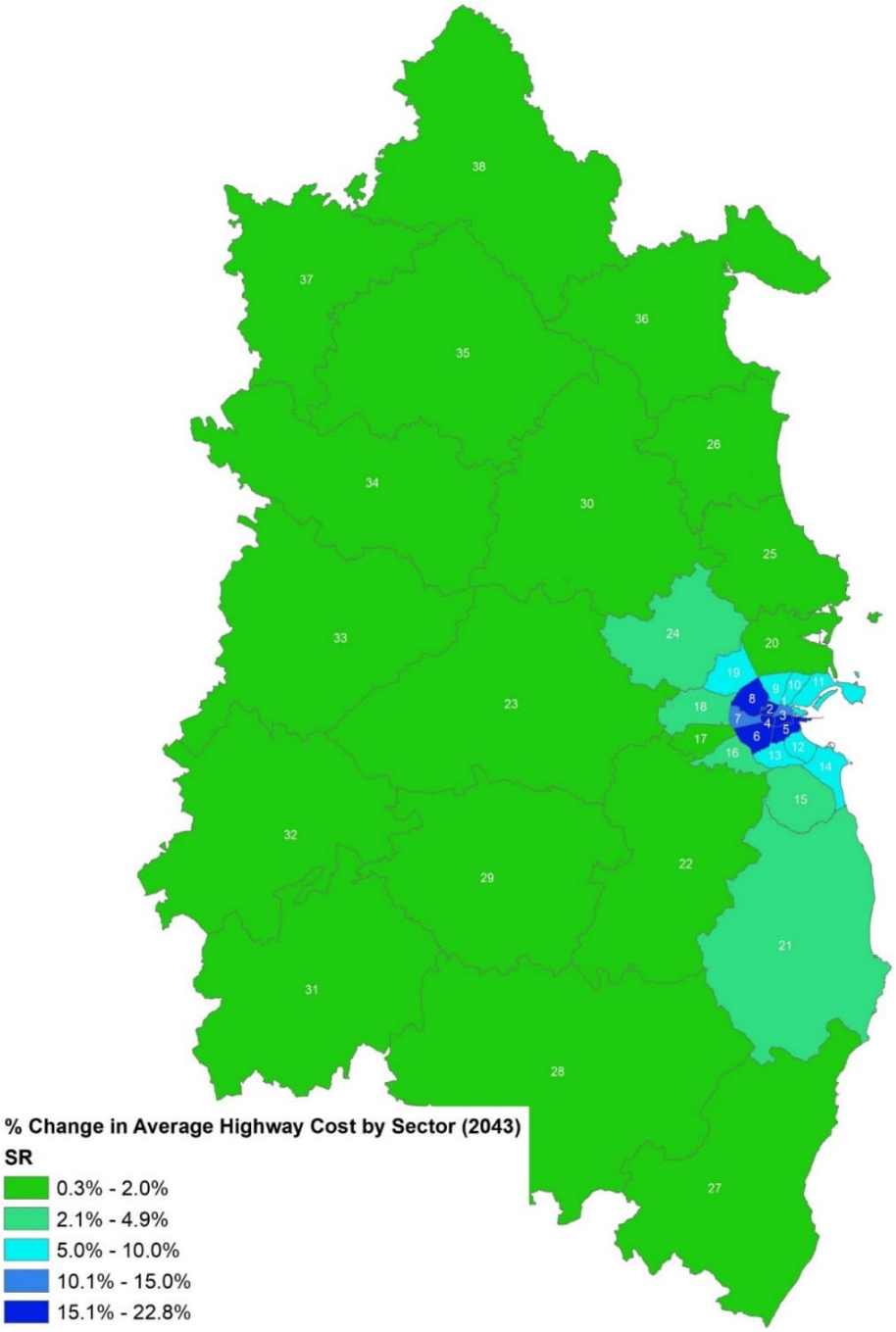


Figure 9.9 - % Change in Average Private Vehicle Cost by Geographic sector – 2043 School Run

ERM Zonal Impacts – Private motor vehicle and Public Transport Benefits

Figure 9.10 shows the distribution of private motor vehicle benefits and disbenefits at the ERM zonal level for 2043. ERM zones provide a more detailed geographic scale for assessing the

impacts than ERM geographic sectors. Essentially, these maps show the impact on access to zones for private motor vehicles. The disbenefits for private motor vehicles are largely contained to the CBC corridors in the urban area where reallocation of road space has taken space. Importantly, the distribution of disbenefits is quite uniform across the city and there is little evidence of disproportionate impacts on particular areas. In the outskirts, there is evidence of some marginal benefits for private motor vehicle traffic which has benefited from the slight reduction in traffic on the roads due to the implementation of BusConnects Dublin.

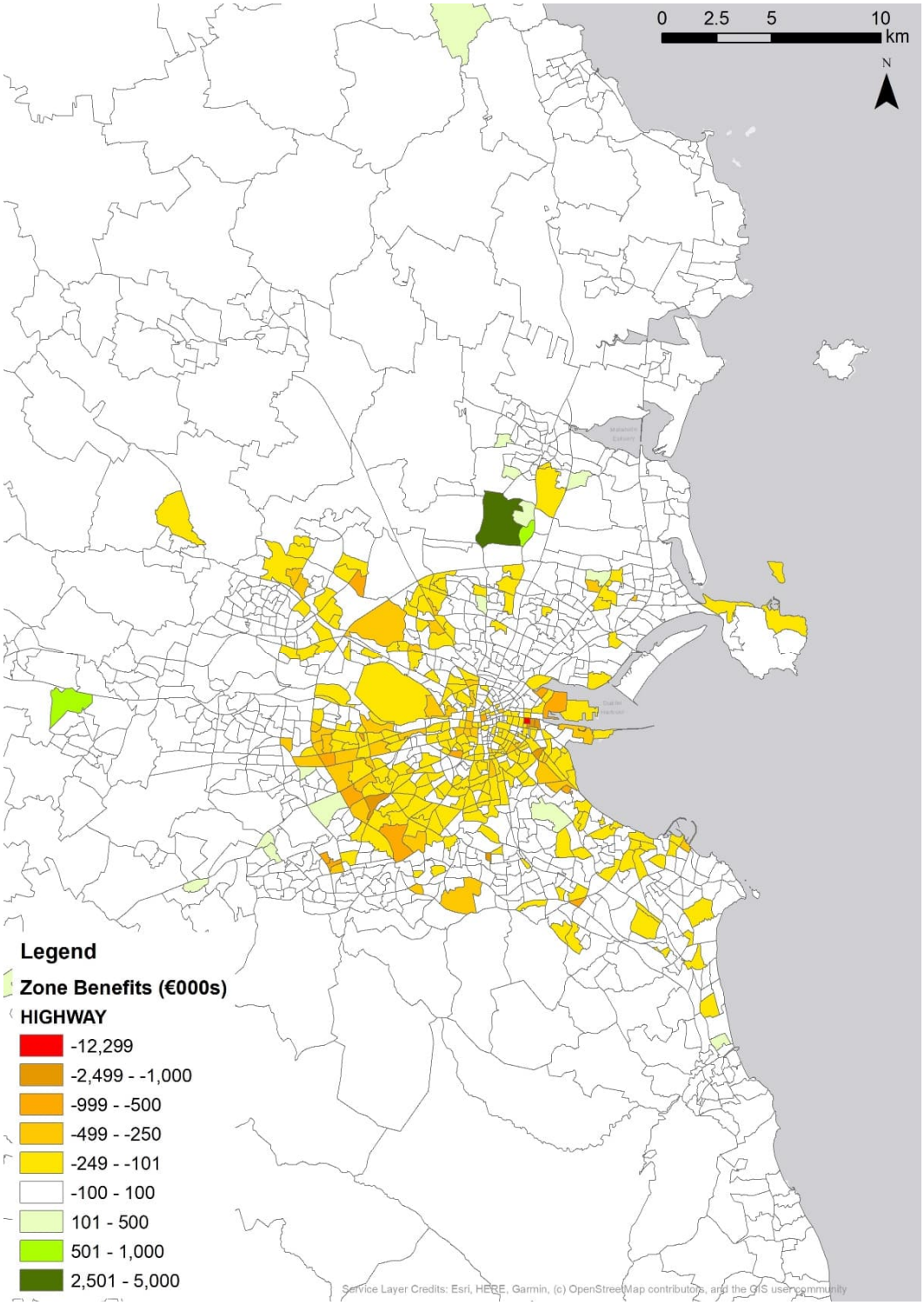


Figure 9.10 - 2043 Private Motor Vehicle Benefits and Disbenefits – ERM Zone Level

Figure 9.11 shows the distribution of public transport benefits and disbenefits at the ERM zonal level for 2043. In contrast with the private motor vehicle results, there are very few disbenefits observed and these are quite marginal in most cases. In general, there are substantial benefits to public transport users across the urban region with nearly all of the city centre experiencing a benefit. While there are gaps where only a marginal change takes place, the benefits in the suburban areas are generally focused along the main corridors where the infrastructure has been improved. In the outskirts beyond the range of CBCs, there is evidence of satellite towns such as Dunshaughlin, Ashbourne and Greystones benefiting from the revised network and other improvements.

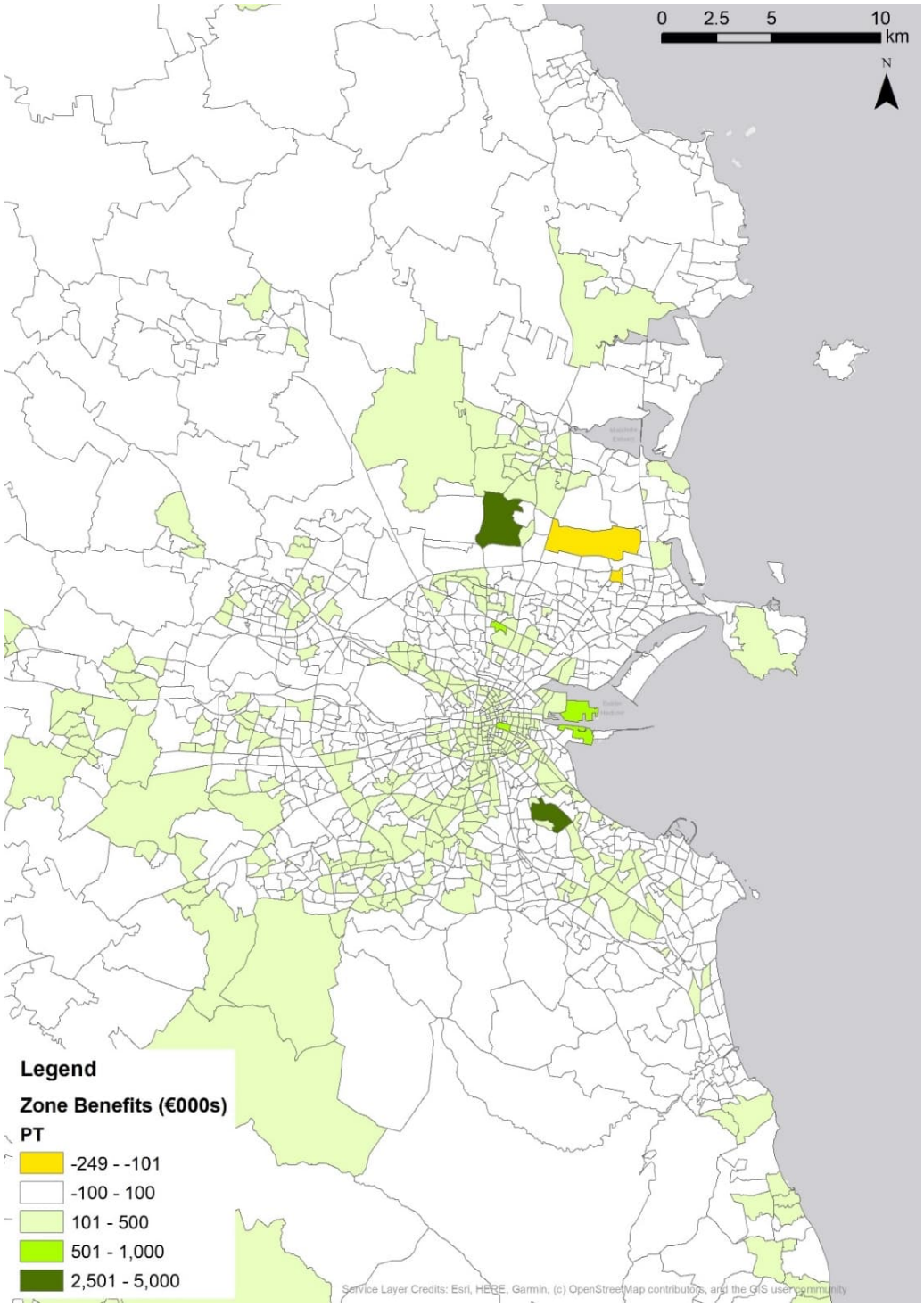
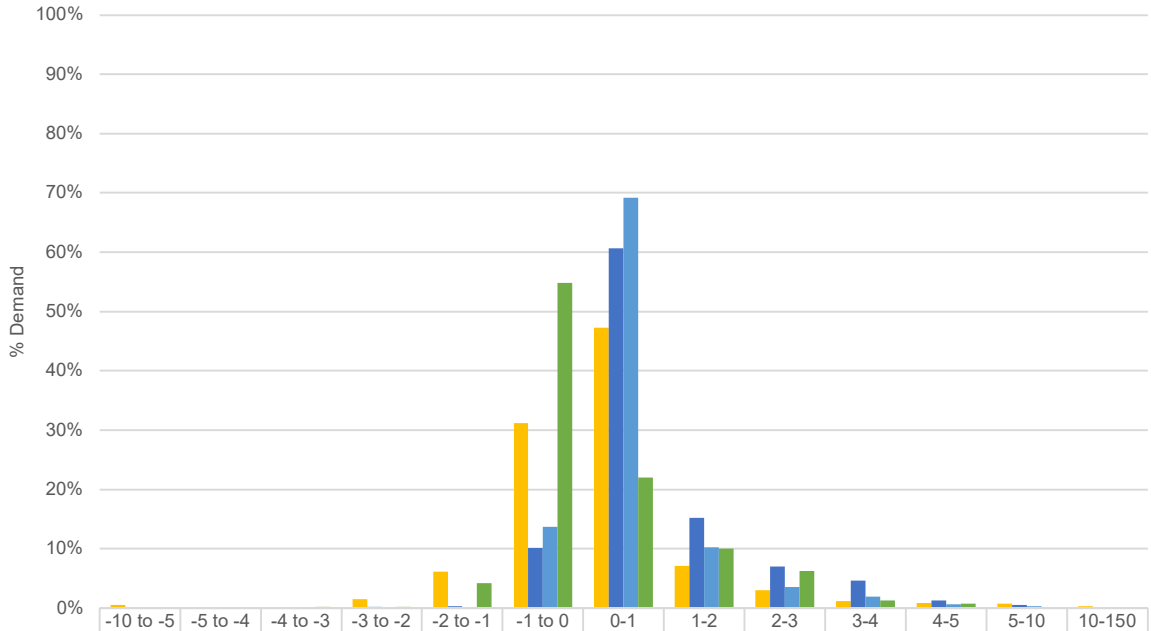


Figure 9.11 - 2043 Public Transport Benefits and Disbenefits – ERM Zone Level

9.10.1 Impact on Time Periods and User Classes

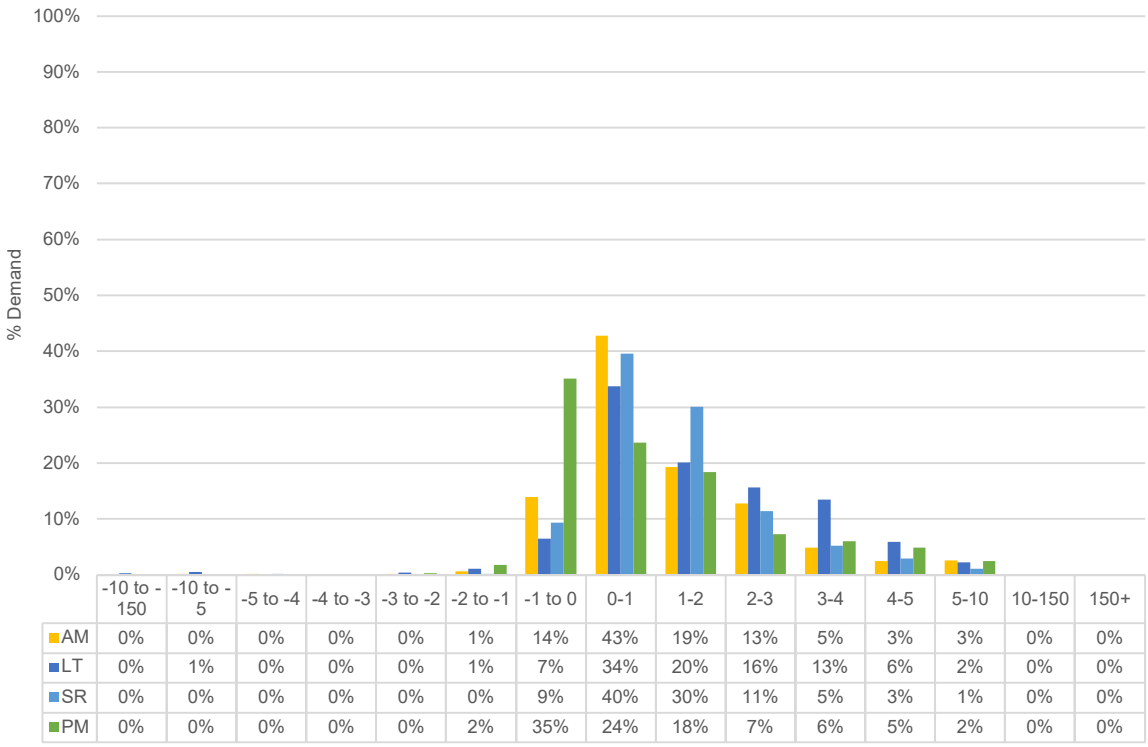
Figure 9.12 shows the average change in journey time for private motor vehicle destinations across different time periods for all user classes in 2043. The journey time results are provided in bands of minutes e.g. between 1 and 2 minutes change. The percentages represent the proportion of demand for each time period which experiences this change in journey time. This figure shows that most of the positive or negative change is quite marginal, with most results showing an increase or decrease of a minute in journey time. There are larger disbenefits for 1-2 minutes, 2-3 or 3+ minutes increase in journey time but these impacts affect a minority of overall demand. The AM and PM peaks experience greater reduction in journey time than other time periods, while the time periods most affected by an increase in travel time are lunch time and school run traffic.



	-10 to -5	-5 to -4	-4 to -3	-3 to -2	-2 to -1	-1 to 0	0-1	1-2	2-3	3-4	4-5	5-10	10-150
AM	1%	0%	0%	1%	6%	31%	47%	7%	3%	1%	1%	1%	0%
LT	0%	0%	0%	0%	0%	10%	61%	15%	7%	5%	1%	1%	0%
SR	0%	0%	0%	0%	0%	14%	69%	10%	4%	2%	1%	0%	0%
PM	0%	0%	0%	0%	4%	55%	22%	10%	6%	1%	1%	0%	0%

Figure 9.12 - Average Change in Journey Time (Minutes) for Private Vehicle Destinations across Different Time Periods for all Trip Purposes – 2043

Figure 9.13 shows the average change in journey time for private motor vehicle destinations across different time periods for business trip purposes in 2043. In contrast to the graph showing all trip purposes, it can be observed that a larger proportion of business trip demand is experiencing more substantial increases in journey times such as 1-2 minute or 2-3 minutes. The proportion of business trips experiencing increases of four minutes and above is still very small.



	-10 to -150	-10 to -5	-5 to -4	-4 to -3	-3 to -2	-2 to -1	-1 to 0	0-1	1-2	2-3	3-4	4-5	5-10	10-150	150+
AM	0%	0%	0%	0%	0%	1%	14%	43%	19%	13%	5%	3%	3%	0%	0%
LT	0%	1%	0%	0%	0%	1%	7%	34%	20%	16%	13%	6%	2%	0%	0%
SR	0%	0%	0%	0%	0%	0%	9%	40%	30%	11%	5%	3%	1%	0%	0%
PM	0%	0%	0%	0%	0%	2%	35%	24%	18%	7%	6%	5%	2%	0%	0%

Figure 9.13: Average Change in Journey Time (Minutes) for Private Vehicle Destinations across Different Time Periods for Business Trips – 2043

Table 9-5 provides the average change in journey time per private motor vehicle user by time period and trip purpose in 2028 and the equivalent data is provided for 2043 in Table 9-6. While there are some marginal improvements in travel time per user for commuting and student trips, the impact is generally negative across most time periods and user groups. However, it is important to note that all non-business trip purposes only experience a small impact with the average increase in journey time for most users being less than a minute. In contrast with other trip purposes, business users experience a larger increase in travel time of over a minute in most cases, this is because a lot of business and commercial trips take place in the city centre or central areas, which are the locations that have been most affected by the reallocation of road space to bus travel. Furthermore, business trips are four times more likely to use private vehicles than public transport, which compounds the impact on journey time for this trip purpose. However, in respect to overall demand, business trips account for only 10% of peak hour trips, and only circa 15% of trips during the afternoon, meaning that the larger increases in journey time are restricted to a minority of users. Furthermore, a large proportion of business travel may have flexibility in respect to the need to travel, may adjust or tailor the time of travel or could choose alternative transport modes. Business travel may be increasingly flexible in their journeys and behaviours, and therefore the actual impacts may be reasonable mitigated.

Table 9-5 - Average change in journey time per Private Motor Vehicle User by Class and Time Period - 2028

2028	Destination					Origin				
	Business	Commute	Others	Student	Retired	Business	Commute	Others	Student	Retired
AM	1.3	0.2	0.4	0.1	0.3	0.9	0.3	0.4	- 0.0	0.2
LT	1.4	0.7	0.6	0.4	0.4	1.4	0.6	0.5	0.0	0.5
SR	1.0	0.3	0.4	0.1	0.3	1.1	0.4	0.4	0.1	0.3
PM	1.1	0.2	0.5	0.0	0.3	1.5	0.5	0.5	0.1	0.4

Table 9-6 - Average change in journey time per Private Motor Vehicle User by Class and Time Period - 2043

2043	Destination					Origin				
	Business	Commute	Others	Student	Retired	Business	Commute	Others	Student	Retired
AM	1.2	-0.1	0.3	0.1	0.2	0.8	-0.1	0.2	-0.1	0.2
LT	1.6	0.6	0.6	0.4	0.5	1.7	0.6	0.6	0.0	0.6
SR	1.2	0.3	0.4	0.1	0.3	1.3	0.4	0.5	0.1	0.3
PM	1.0	0.0	0.5	-0.1	0.3	1.3	0.4	0.5	0.5	0.4

9.10.2 Summary of impact on private vehicles

BusConnects will have a marginal impact on the private vehicle travel time (<1minute in the vast majority of cases) however the impact is inflated due to the sheer number of private vehicle trips (approx. 56% of all daily trips in the NTA ERM) happening in the Greater Dublin Area across the day.

The *Transport Strategy for the Greater Dublin Area (2016-2035)* aims to reduce the dominance of the private car by setting a maximum mode share of 45% for car-based commuting trips across the region. The BusConnects Dublin programme results in a shift to public transport from private vehicles of up to 5% (during the morning peak period) across the city which will help to achieve this objective by transforming the bus service and improving infrastructure for walking and cycling. This is not achievable without negative impacts on those still travelling by car: that is the cost associated with the policy decision to prioritise sustainable travel.

The NTA's Eastern Region Model ('ERM') predicts increases in average travel time for private vehicles in the City which, given the demand for travel, has a significant impact in some areas. Giving increasing priority to bus transport gives decreasing priority to car transport. That of itself therefore makes the latter less attractive and is a result of measures like BusConnects Dublin being put in place to implement sustainable travel policies. However, a key component of policy implementation must be to find ways to make private car travel less attractive. So, the negative impact on car users from BusConnects Dublin is both a result of implementing policy and a means to give effect to that policy. Even though the positive impacts on new and existing public transport users far outweigh these negative impacts, consideration should be given to mitigate them where possible without undermining the concept and objectives of

BusConnects Dublin. The economic appraisal of the impacts on the various modes and trip purposes is described in Section 10.

At the CBC design level, numerous mitigation measures will be introduced to limit the disbenefits to private motor vehicles where possible. The need for mitigation measures will be identified through the Transport Impact Assessment (TIA) conducted as part of the EIAR. The TIA for each CBC will contain a comprehensive assessment of the potential transport impacts associated with construction and operation of the CBC on all modes of transport. Mitigation measures will include interventions such as; converting roundabouts to signalised junctions to allow for better management of traffic flow and bus signal priority, the provision of parallel routes, optimisation of signal times at junctions and limiting bus gates to particularly important hours of operation. Further details on the mitigation measures provided in the BusConnects programme are provided in the CBC design documents.

9.11 Gender equality impacts

Recent research[82] reported that in Dublin fewer women (66%) than men (80%) own or have access to a car, indicating that more women than men will benefit from BusConnects Dublin. The same research also found that women who own cars use them more and make more frequent trips than men, and that women's primary reason for travelling is to drop off and collect children or family members while men's primary reason is traveling for work. Again, the revised bus network and improved all-day service frequency proposed by BusConnects Dublin will increase the potential for women's trips to be made by public transport or cycling. However, the report highlighted that women are more reliant on the car, with 79% of women surveyed considering the car to be a necessity. One reason is that women are more impacted by safety issues, with 55% of women surveyed stating that they would not use public transport at night and 7% of women in Dublin reporting having experienced sexual harassment on public transport. Therefore, there is a risk that women may be disproportionately impacted by the negative impacts of Bus Connects Dublin on private car users. This is countered by the analysis that shows that the negative impacts are minimal during the night-time, and by other research[83] that suggests that urban buses are perceived as a safer form of public transport, compared with rail. This makes sense as buses are smaller, the driver has visibility and is able to intervene in the event of a problem. Overall, BusConnects Dublin's improved network of services, combined with the improvements to customer information, ticketing and the bus stop and interchange environment represent an improvement to women's travel choices.

9.12 BusConnects Dublin – overall benefits and disbenefits

The benefits and disbenefits of the overall programme, as forecast using the ERM, are summarised below.

Table 9-7 presents the forecast change in modal shares as a result of the BusConnects Dublin programme, for trips originating from areas within the M50. The modelling forecasts a 2% increase in public transport usage by 2043 with BusConnects Dublin in place. It is likely that ongoing work to identify locations for Park & Ride would further boost bus demand and reduce private car usage however this has not been modelling in this iteration of the PBC.

[82] https://www.tii.ie/technical-services/research/TII-Travelling-in-a-Womans-Shoes-Report_Issue.pdf
[83] https://rss.onlinelibrary.wiley.com/doi/abs/10.1111/rssa.12558

Table 9-7 – AM Mode Shares for trips originating from areas within the M50

Scenario	2043		
	Private Vehicles*	Public Transport*	Active modes**
DoMin	41.62%	30.53%	17.57%
BusConnects Dublin	41.08%	32.66%	19.30%
Change	-1%	2%	+10%

**Source: NTA ERM*
***Assumes 10% growth in cyclists upon opening of BusConnects alongside background growth of ~4% per annum. See Section 10.2.6.*

Table 9-8 presents the forecast change in modal shares as a result of the BusConnects Dublin programme, for trips with a destination within the M50 (where the majority of BusConnects Dublin interventions will happen). The modelling forecasts a 5% increase in public transport usage by 2043 with BusConnects Dublin in place.

Table 9-8 – AM Mode Shares for trips with a destination in areas within the M50

Scenario	2043		
	Private Vehicles*	Public Transport*	Active modes**
DoMin	41.42%	37.88%	12.43%
BusConnects Dublin	37.57%	42.66%	13.65%
Change	-4%	5%	+10%

**Source: NTA ERM*
***Assumes 10% growth in cyclists upon opening of BusConnects alongside background growth of ~4% per annum. See Section 10.2.6.*

The mode shift to public transport, outlined above, is delivered through a significant increase in bus passengers but also through an increase in some other public transport modes. As shown in Figure 9.14, compared to the DoMin scenario annual bus patronage in Dublin is predicted to increase by 36% upon opening of BusConnects Dublin (an increase of 79 million annual bus passengers including other buses). Luas will experience a slight reduction in patronage overall however investment in these modes as part of the wider Transport Strategy will balance out his impact and result in a significant increase in demand across all modes of public transport (see Figure 9.14).

On a national basis the number of public transport boardings are predicted to increase by 22% upon opening of BusConnects Dublin.

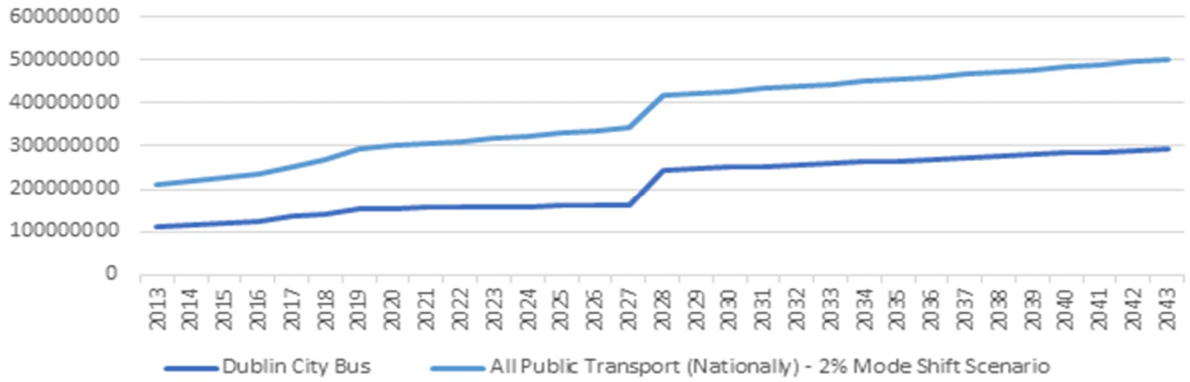


Figure 9.14 - Annual passenger boardings by public transport system

This business case takes cognisance of other schemes such as DART+ and MetroLink in its planning, and assessed these other schemes as sensitivities. Trips involving interchange between public transport and active modes are forecast to increase by 33% with BusConnects Dublin in place.

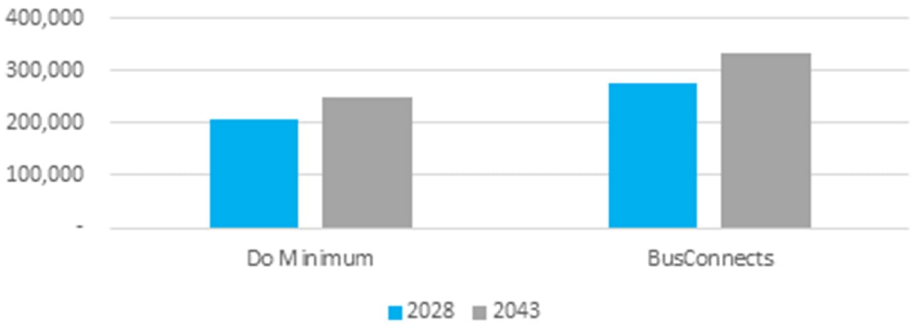
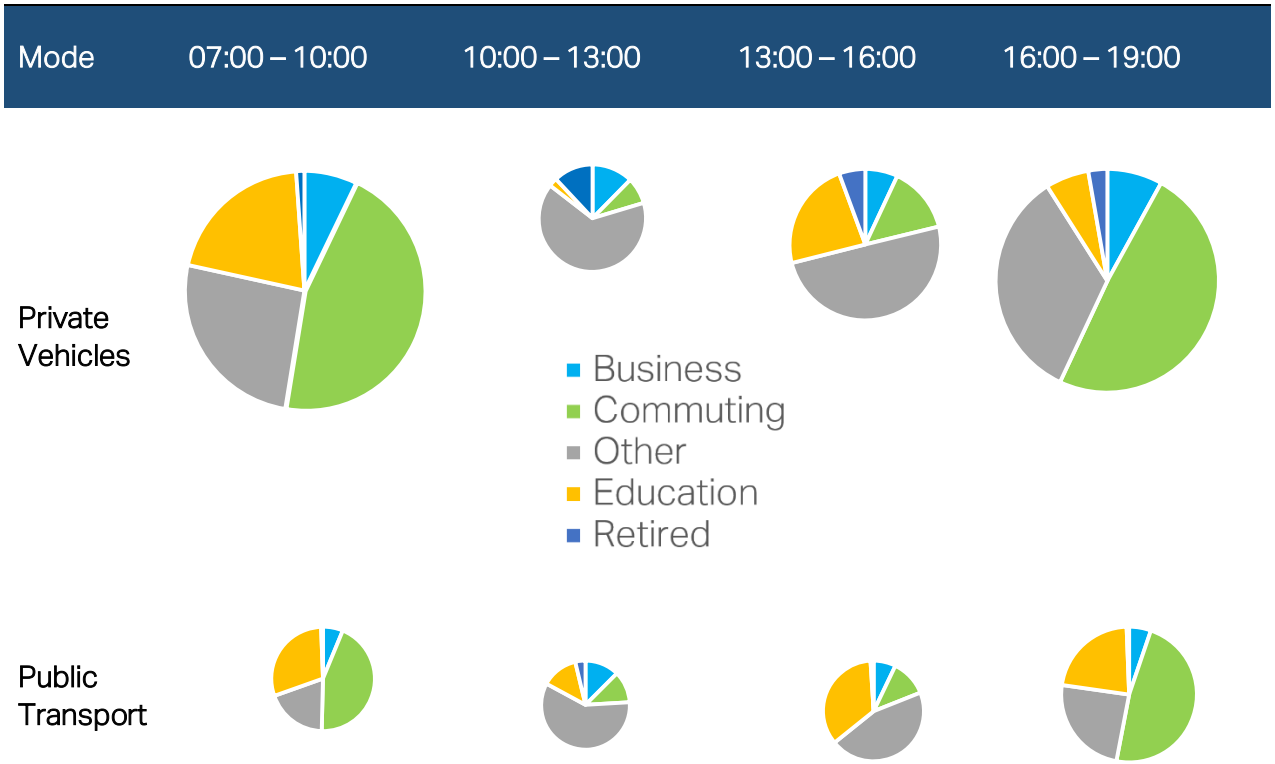


Figure 9.15 - Daily number of trips involving interchange between public transport system and active modes

The trips by mode and purpose for the entire Greater Dublin Area are summarised in Figure 9-16 to provide insight to the scale of trips by each mode, purpose and time period. The number of trips made by private vehicles is similar across all time periods while trips made by public transport are relatively higher in the AM and PM peak periods. More educational trips are made by public transport than by private car and commuting trips by all modes are higher in the AM and PM peak periods as expected.

Figure 9.16 - Total private vehicles and public transport (passenger trips) for each period and purpose – DoMin 2028



BusConnects Dublin will encourage people to use public transport and takes people off the private transport modes which will impact upon the performance of our transport networks.

During the 2028 – 2043 period the total travel time in private vehicles (cars and goods vehicles) across the Eastern region is forecast to decrease slightly due to the reduction in demand. On a per vehicle basis the average time travelled increases by 2%, as shown in Table 9.9. This masks variation because private vehicles in large proportions of the Eastern region are completely unaffected, or even experience an improvement, as a result of BusConnects Dublin and those in the BusConnects Dublin CBC areas experience small increases in travel time due to the reallocation of capacity to prioritise bus and cycling.

The improvements in network performance as a result of the BusConnects Dublin programme lead to a 11% reduction in the average travel time per bus passenger. BusConnects Dublin is expected to save the average bus commuter in the Eastern region over 25 hours per year by 2043[84].

[84] *An average user refers to the ERMs data of 'all users – all travel purposes.*

Table 9-9 – Network Performance Statistics for the Eastern Region – Weighted Daily Average

Year	Mode	DoMin	Bus Connects	Diff	Annual Impact
		Min per passenger/Veh			
2043	Private Vehicles	30.7	31.3	+1.9%	By 2043, the average bus commuter will save 25 hours a year as a result of BusConnects Dublin
	Public Transport	25.5	22.6	-11.4%	

The network statistics give a good indication of the economic impact of interventions which is analysed in detail and discussed further in Chapter 10.

9.13 Impacts on goods traffic

The efficient movement of goods is essential for the progressive, economic growth of the region and country. Two aspects of goods movements are considered – the widespread movement of goods in HGVs or bulk road cargo, and secondly to the movement of light good vehicles Dublin and other urban centres.

BusConnects Dublin will have a limited effect on HGV movements between regions or key freight hubs, given their sparseness in Dublin City (for context it should be noted that goods vehicles currently account for only 1% of all vehicles crossing the canal cordon in Dublin City). BusConnects Dublin may have a minor effect on such movement along the National Roads network which is primarily outside of Dublin City (lying 'outside' the M50 and across the state, for the most part). Indeed, BusConnects Dublin may reduce the need for personal travel on the M50 or other key arterials, and therefore freight may experience improvement.

Deliveries and other smaller-scale goods vehicle activities such as maintenance and construction vans and trucks may be impacted by BusConnects Dublin. Sharing road space with private vehicles (i.e. unprioritized), may cause them delays. Positively, deliveries are, for the most-part, not time-sensitive within a given day and it may be possible to manage and coordinate deliveries avoiding peak period commuter traffic.

9.14 Real-world impacts

This PBC has been prepared using the industry-standard methodologies and practices. Guidance from DoT's CAF, and DPER's PSC, among other technical modelling practices have been applied as required to ensure fair and reasonable forecasts are generated.

Much of the future forecasting (scenario development and testing) necessary for this BusConnects Dublin PBC, and wider transportation business cases, rely on assessment, analysis and observation of past performance and trends e.g. growth and modal changes. Additionally, policies and strategic direction are taken into account looking-ahead, such that BusConnects Dublin will deliver on the needs of the expanding city and population of Dublin, improve transport efficiency and deliver on necessary environmental change.

Modelling and forecasting have been undertaken to the highest possible standard in development of this PBC, using recent, applicable, peer-reviewed regional models (the Eastern Regional Model). While every effort is made to ensure the validity of the models, there will always be some risk that they do not precisely represent the network and performance observed some decades later. Changes to policy, changing personal transport preferences

and social norms or unforeseen events (such as Covid-19, for example), may cause some deviation between modelled and real-world network performances.

Modelling (of transport, economics and costs) remains the best tool at our disposal to understand how actions and interventions will improve the transport network, delivering on the transport needs of many users and returning positively on Exchequer (taxpayer) investment. Models are essential to guide this PBC and deliver an evidence-based approach to BusConnects Dublin delivery.

9.15 Summary

BusConnects Dublin is a transformative project for the city and region, delivering key positive impacts and improvements for a broad range of users. A summary of the key points is outlined below:

- Benefits will be delivered to new and existing public transport users, specifically by providing timely and predictable journeys.
- Cyclists will also be very positively impacted by BusConnects Dublin, where up to 200km of high-quality cycle facilities will deliver safer and prioritised journeys throughout the city and environs.
- On average, private vehicles inside the M50 area will experience a slight increase in journey time of <1minute as a result of BusConnects Dublin.
- Residents and visitors alike will be able to navigate the system more easily with increased information availability, while the increasingly sustainable fleet will delivery on Ireland's national and international environmental commitments.
- Valuably, BusConnects Dublin will provide an impetus for many private vehicle trips to be undertaken by more sustainable means, while preserving access for those with no reasonable alternative and for freight trips and delivery.

10

Appraisal

10 Appraisal

Chapter Summary

- To align with the CAF appraisal framework the proposed programme has been appraised against the best practice multi-criteria appraisal headings, namely; Economy, Environment, Accessibility & Social Inclusion, Safety & Security, Integration and Physical Activity.
- The economic appraisal is for the BusConnects Dublin programme alone. It does not include any other elements of the Transport Strategy e.g. the DART+ programme, MetroLink, demand management or any integrated complementary measures that would support behavioural change.
- The BusConnects Dublin PBC defined different scenarios for assessment in the NTA ERM. These are outlined in Section 10.2.4.
- Total costs of BusConnects Dublin include the capital cost, the cost of renewals and refurbishment of assets over their lifecycle, the cost of maintaining the assets and the cost of operating services. They are shown in Table 10 2.
- A cycling-specific assessment was undertaken based on the criteria of Safety, Accessibility and Social Inclusion, Integration and Physical Activity of the existing and new cyclists.
- Economic Appraisal concluded that the BusConnects Dublin programme is expected to have a significant positive impact for existing and new public transport users across the entire day. The benefits over the 30-year appraisal period are projected to significantly outweigh the costs.
- As outlined in Section 10.2.3, sensitivity tests were undertaken to understand the effects of reduced growth demand for services; reduced realisation of programme benefits; and/or cost increases. There were also tests examining the impact of an increase in contingency allowance and the impact of alternative future scenarios post-coronavirus.
- A safety assessment was undertaken using COBALT (Cost and Benefit to Accidents – Light Touch) which assesses the safety aspects of road schemes using detailed inputs of links that may be impacted by the scheme.
- The move to LEVs will have a significant environmental benefit. While the expanded fleet under a BusConnects Dublin scenario will enhance this benefit, the majority of the transition will occur regardless of the BusConnects Dublin programme. Therefore, the benefit has not been included in the BusConnects Dublin business case and has not been calculated.
- The various elements of the programme will likely have a positive impact on accessibility and social inclusion which is consistent with the NTA overall equality objective. The impacts of the key elements are set out in Section 10.5.

10.1 Appraisal Framework

In many ways, BusConnects Dublin is a radical programme. The redesigned network of services is quite different to the existing. The increase in service frequency, especially outside peak periods, is very substantial. The proposed sweeping reallocation of road space and traffic signal timings away from private vehicles to public transport, walking and cycling is a profound change. Significant effort has been made to understand these impacts at programme level (and also by the design teams at programme element level) but inherent biases still remain in the appraisal process when it comes to radical city-wide schemes e.g. people's willingness to change is underestimated despite the evidence of recent trends. The true impact across modes is still not being fully quantified.

To align with the CAF appraisal framework the proposed programme has been appraised against the best practice multi-criteria appraisal headings set out in Table 10-1 reproduced from Table 6-5. These focused criteria are laid out within DoT's CAF. The wider project appraisal methodology, including a CBA, ultimately aligns with DPER's PSC.

Table 10-1 – BusConnects Dublin Programme Appraisal Criteria

Criteria	Evaluation Criteria
Economy	• Contribute to economic growth • Implement in the short to medium term • Ensure value for money • Increase public transport patronage
Environment	• Reduce reliance on the private car • Reduce growth in transport emissions, at a minimum
Accessibility and Social Inclusion	• Enhance public transport and sustainable travel access to opportunities and services • Deliver socially inclusive public transport
Safety and Security	• Improve the safety of the transport system • Protect vulnerable road users
Integration	• Enable Project Ireland 2040 • Make it easier to move between public transport services
Physical Activity	• Provide for safer and faster travel by active modes • Facilitate access to public transport by active modes

10.2 Economic appraisal

10.2.1 Introduction

Economic appraisal is a type of decision method applied to a project, programme or policy that takes into account a wide range of costs and benefits, denominated in monetary terms or for which a monetary equivalent can be estimated. Economic appraisal for transport projects and programmes takes the form of a cost benefits analysis (CBA) and serves a number of functions at both the individual project/programme level and when comparing different projects/programmes:

— At the individual project/programme level, the results of the CBA indicate whether a project or programme is economically viable; i.e. whether economic benefits resulting

from the provision of a project or programme outweigh the costs to construct and maintain it. Secondly, they can provide a comparison of alternative options; and

— At the national level, the Government has finite resources to commit to infrastructure improvements. The output from economic assessments allow different projects and programmes to be compared and enable those that provide best value to be identified. If the results of the CBA are to be used to prioritise, then the assessments need to be carried out in a consistent manner.

In general terms where a scheme has a BCR of over 1:1 the scheme provides a positive return to the economy. The net present value (benefits minus costs) and BCR are relevant indicators, but do not provide information on benefits and costs that are not directly monetizable such as enhancements or negative effects on the natural or built environment. In other words, although an important input, the economic analysis should not, and will not, be used as the sole basis for decisions.

The appraisal is informed by the requirements of Department of Public Expenditure and Reform's (DPER) Public Spending Code and the Department of Transport's (DoT) Common Appraisal Framework (CAF) for Transport Projects and Programmes. The Transport Infrastructure Ireland (TII) Project Appraisal Guidelines (PAG) have been used as necessary as they represent the only technically focussed modelling and appraisal guidelines for Ireland. The PAG are consistent with the CAF and PSC but expand on the technical elements and include mode specific variables not included in CAF or PSC.

10.2.2 Economic appraisal assumptions

The economic appraisal is for the BusConnects Dublin programme alone. It does not include any other elements of the Transport Strategy e.g. the DART+ programme, MetroLink, demand management or any integrated complementary measures that would support behavioural change.

The outputs from the transport modelling and cost forecasting have provided the core inputs to the CBA process. The transport model has provided direct outputs for 2028 and 2043 and growth factors up to 2058 for this purpose. The CBA assesses the impact of each scheme on users and operators under the following headings:

- Net transport user benefits
- Journey time (in-vehicle time, transfer time, walk and wait time etc.)
- Charges (fares/tolls etc.)
- Vehicle operating costs
- Net transport operator benefits
- Impacts on Greenhouse Gas emissions
- Investment costs
- Operating and maintenance costs
- Revenue including both revenues generated by BusConnects Dublin services and abstraction from other modes. The incremental revenue is captured and categorised in TUBA as a private sector impact and thus fall under business benefits.

Additional benefits have been calculated outside of the ERM model for the following.

- Reliability as changes in reliability are not explicitly modelled within the ERM. These have been calculated separately based on real bus reliability data.

The Cost-Benefit Analysis has been undertaken using TUBA software and bespoke economic models in line with the PSC. Individual economic parameters will be based on industry-standard variables extracted from the TII Project Appraisal Guidelines and DoT guidance. This includes Values of Time, carbon and vehicle operating cost assumptions.

Core assumptions used in the appraisal are:

- A price base year and present value year of 2011 as defined in the DoT CAF
- A standard appraisal period of 30 years with a residual value period of a further 30 years. For major transport schemes, the residual value is a measure of the net present value of the infrastructure over a specified period beyond the 30-year appraisal period. This value is calculated in the same manner as the initial appraisal period using outputs from the ERM and TUBA. For all major National transport projects, a residual value period of 30 years is applied based on the guidance outlined in CAF. The residual value is included in the results table of the CBA.
- Discount rate of 4% for 30 years from current year, 3.5% for years 31-60 and 3% thereafter.
- Shadow price of public funds of 130% applied to all costs
- Shadow price of labour of 100%
- Scheme opening year of 2028 in line with capital cost profile

As outlined in the Cost Chapter, the values used in the appraisal are incremental benefits, costs and revenue of the DoSmth scheme over the DoMin. The Transport Modelling Report outlines the detail of the specific assumptions used for both the DoMin and DoSmth.

10.2.3 Exclusions from current appraisal

BusConnects Dublin will make it much more attractive to interchange between bus services due to increased frequencies, integrated timetables, the new fare system, improved waiting facilities and improved pedestrian facilities. The reduction in the "interchange penalty" is being assessed but has not been accounted for in this assessment.

The Park & Ride proposals have not been included in the current transport benefits appraisal as the locations of the sites have yet to be established; however, the capital costs and the operating costs are included.

The increase in bus services will create new opportunities for travel across all times of the day that are not yet understood and have not been captured. Ongoing work will assess the feasibility of increasing frequencies of services across the day after the opening of BusConnects Dublin.

Impact on the safety of travel by private vehicles has not been included within this iteration of the PBC.

Potential impact of a reduction in the availability of parking as a result of BusConnects Dublin has not been included at this stage due to ongoing design process.

10.2.4 Scenario based appraisal approach

Over the past decade investment in transport infrastructure has created an environment which has supported the implementation of transport orientated government policies to encourage a shift to more sustainable modes. These policies have mirrored a global shift in the attitudes to sustainability and a growing awareness of our environmental and climate impacts. Large investment programmes such as BusConnects Dublin will need to be underpinned by a continuation of strong policy to continue this shift towards sustainable modes into the future. The BusConnects Dublin CBC's have been designed for this future where a shift away from private vehicles allows a more even balance to be found between all transport modes using our roads and junctions.

The future is uncertain. In transport planning and in particular the development of major transport investment projects it is necessary to project demand for travel up to 30 years into the future. On-going changes in technology, social norms, human behaviour and public policy mean that projecting travel demand is difficult.

In general, the impact of these changes can take a long time to materialise. At a regional or national level year on year change in travel demand associated with new infrastructure or a new policy can be almost imperceptible but over the medium or long term, the aggregate impact is clearer.

One way to accommodate uncertainty and reflect potential changes in demand for travel is to use scenario planning. This involves making evidence-informed projections about changes to key variables such as:

- Strength and implementation of policy measures
- Employment composition and location
- Population composition and location
- Trip rates and frequencies
- Travel preferences and behaviours
- Mode choice

Rather than considering these changes in isolation, scenario planning varies them together to assess how changes in different variables interact and to develop an alternative future scenario for travel demand. As the NTA's ERM is based on 2016 demands and behaviours, this approach is important to ensure that the demand forecasts reflect the most recent trends. In the period since 2016 usage of public transport has increased by an average of 7% annually in the Dublin region alongside a 4% reduction in car demand across the canal cordon in Dublin on average each year. This is a faster rate of growth than was expected based on previous observed trends prior to 2016[85], reflecting the way in which mobile technology has made public transport easier to use, also a more positive attitude towards public transport combined with a growing concern for the environment and reluctance towards car ownership and travel in the city.
Forecasting the effects of BusConnects Dublin is complex because it creates space and priority for buses and cycles through a reallocation from private vehicles. This is in line with the policies set out in the NTA's Transport Strategy and Project Ireland 2040. This delivery offers both a carrot and a stick to encourage people to transfer from the car. This PBC also considers the effect of the other major projects and programmes: MetroLink and DART+. For these

[85] *Canal Cordon Report (2019), p.6: https://www.nationaltransport.ie/wp-content/uploads/2020/12/Canal-Cordon-Report-2019-V3.pdf*

reasons, the BusConnects Dublin PBC defined different scenarios for assessment in the NTA ERM:

- Stagnated movements towards sustainable modes – Scenario 1 - This represents a situation where the existing trend of people transferring to sustainable transport continues but at a reduced pace as a result of no policy or infrastructure interventions beyond those already in place. In quantitative terms this scenario represents a conservative 2% reduction in the 2043 AM peak private vehicle mode share for commuters inside the M50 area (compared to a DoMin scenario) as a result of BusConnects Dublin.
- Base Case Scenario – Scenario 2 - This represents a situation where the existing trend of people transferring to sustainable transport continue at a reasonable rate but with limited policy or infrastructure interventions beyond those already in place. In quantitative terms this scenario represents a conservative 3% reduction in the 2043 AM peak private vehicle mode share for commuters inside the M50 area (compared to a DoMin scenario) as a result of BusConnects Dublin. This scenario is consistent with the demand forecasting process used for other major transport infrastructure projects.
- Acceleration towards sustainable modes – Scenario 3 – This represents a situation where additional sustainable transport policies are developed, and implemented, to continue current trends in the growth in sustainable travel. This might include the introduction of demand management measures, the encouragement and continued support of flexible working arrangements, the constraining of parking in urban areas, the continued design of urban traffic schemes to reallocate space to sustainable modes and making permanent a large proportion of the short-term active mode measures introduced during COVID-19. In quantitative terms this scenario represents a 3.5% reduction in the 2043 AM peak private vehicle mode share for commuters inside the M50 area (compared to a DoMin scenario) as a result of BusConnects Dublin.

The future travel demand is likely to fall along between the three scenarios. The economic differential set out in this Chapter represents the cost of not implementing strong sustainable transport policies in support of BusConnects.

For context, it should be noted that the ERM covers the entire GDA, not just the area affected by BusConnects Dublin. The NTA's GDA Transport Strategy predicts a 11% reduction in the AM peak private vehicle mode share for commuters across the whole GDA, reducing the private vehicle mode share from 56% to 45%. It should be noted that while Scenario 2 achieves a 2.5% reduction in private vehicle AM commuting mode share for the entire GDA area the private vehicle share still remains high at 60%+. It is clear that to achieve the ambition of 45% mode share for the GDA the private vehicle mode shares within the M50 will need to be significantly lower than 45% to balance limited PT options elsewhere. In this context there is a long way to go to achieve the targets and the mode share assumptions associated with BusConnects are reasonable. The other elements of the GDA Strategy (policy and infrastructure) will be needed to achieve the targets. In addition to the above scenarios several sensitivity scenarios were assessed in relation to cost increases and decreases, public transport demand, and the impact of potential further design enhancements to improve conditions for private vehicles.

10.2.5 Costs for appraisal

Total costs of BusConnects Dublin include the capital cost, the cost of renewals and refurbishment of assets over their lifecycle, the cost of maintaining the assets and the cost of operating services. They are shown in Table 10-2.

Table 10-2 - Costs over 60 year appraisal period (including 30 year residual value period)

Costs	60 Year Present Value €b (2020 values and prices)	60 Year Present Value €b (2011 values and prices)
Capital Costs	€2.037	€1.506
Renewal Costs	€560	€161
Operating Costs	€6.122	€1.609
Present Value of Costs	**€ 8.719**	**€ 3.276**

10.2.6 Economic impact of cycling

BusConnects Dublin will deliver extensively on active modes, particularly cycling. A specific cycling benefits appraisal has been carried out in the development of the business case to quantify, and where reasonable, to monetise those benefits. Cycling facilities provided part of BusConnects Dublin (along each of the CBCs, or as short off-line sections), include high-quality, practical infrastructure and prioritisation measures for cycling. The economic benefit of cycling has been assessed in accordance with TII Project Appraisal Guidelines (2016)[86] and DoT's CAF. In line with international literature, cycling schemes will also attract benefits for new cyclists, i.e. those changing mode to cycling for work, leisure and recreation.

The cycling-specific assessment was based on the criteria of Safety, Accessibility and Social Inclusion, Integration and Physical Activity of the existing and new cyclists[87]. Summarised cycling benefits are developed into the streams of absenteeism, journey quality (ambience), collisions (safety), health and travel time[88] - descriptions can be reviewed in Section 9.6. The benefits across all criteria and cycling benefit streams are positive with BusConnects Dublin improvements. The outcome of cycling benefit assessment is that an expected PVB of just over €1.8 billion, for the base case scenario.

A number of sensitivity analyses were developed for assessing the change in benefits impacts of varying future demand levels, and the application of a higher discount rate on the economic viability of the programme. A growth rate of ~2% per annum was assumed for all scenarios with assumptions in relation to what % of those were new cyclists also presented. This level of growth was assumed for years 1-30 with an initial acceleration assumed upon opening of BusConnects Dublin after which the grow rate was set to zero. For context, cycle demand across the canal cordon has grown by an average of 7% per annum since 2008 despite limited investment in high quality cycle facilities. In this regard the average growth of ~2% per annum is considered conservative especially when discounting is taken into account. A further accelerated front-loaded growth would likely increase cyclist benefits.

Specifically, the scenario where 4% of all cyclists along the CBC's start cycling as a result of BusConnects indicates a PVB of €1.6 billion, a 10% scenario indicates a PVB of 1.7 billion, while the 15% scenario would anticipate €1.9 billion PVB for cycling. Table 10-3 below presents the summary results of all the CBCs combined.

[86] *TII PAG (Unit 13: Walking and Cycling Facilities) & TAG UNIT A5.1 Active Mode Appraisal – May 2020*
[87] *Noting that the CAF criteria of 'Economy' is dealt with at the comprehensively costed, BusConnects Dublin programme level.*
[88] *Residual benefits are also applicable from the cycling benefit streams for 10-years*

Table 10-3 – Summary table of cyclists' benefits

Type of benefit	Benefit values (€ billion)		
	Base Case – 10% new cyclists	4% new cyclists	15% new cyclists
Absenteeism	€ 0.003	€ 0.001	€ 0.005
Journey Quality	€ 0.288	€ 0.272	€ 0.301
Collisions	€ 0.264	€ 0.264	€ 0.264
Health	€ 0.073	€ 0.029	€ 0.110
Cyclist Travel Time Benefit	€ 0.162	€ 0.157	€ 0.166
Residual value	€ 0.942	€ 0.864	€ 1.007
Present Value of Benefits (PVB)	**€ 1.733**	**€ 1.589**	**€ 1.852**

Benefits of cycling are suited to be included within BusConnects Dublin' PVB and CBA, given the use of the DoT's CAF.

10.2.7 Economic impact for users

This covers primarily the user benefits associated with improved services to existing users and the subsequent impact on other passengers through modal shift. This also covers revenue both for public transport and highway tolls which is categorised in TUBA as a private sector impacts and thus fall under business benefits.

10.2.8 Economic appraisal results

The BusConnects Dublin programme is expected to have a significant positive impact for existing and new public transport users across the entire day. The benefits over the 30-year appraisal period (with a further 30-year residual presented separately) are projected to significantly outweigh the costs. The results of the economic appraisal are summarised below.

Table 10-4 - Base Case CBA Summary (2011 Values, €b, 60 years incl. 30 year residual)

CBA Breakdown		Impact of BusConnects Dublin compared with DoMin		
		Scenario 1	Base Case Scenario 2	Scenario 3
Impacts	Sustainable Modes (PT & Cycling)	€ 6.65	€ 7.09	€ 7.52
	Private Vehicles	-€ 5.28	-€ 4.82	-€ 4.36
Reliability		€ 0.34	€ 0.34	€ 0.34
Safety		€ 0.17	€ 0.21	€ 0.25
Greenhouse Gases[89]		-€ 0.002	-€ 0.001	-€ 0.001
Residual Value		€ 1.57	€ 2.27	€ 2.82
Present Value of Benefits (PVB)		**€ 3.44**	**€ 5.08**	**€ 6.56**
Present Value of Costs (PVC)		**€ 3.28**	**€ 3.28**	**€ 3.28**
Net Present Value (NPV)		**€ 0.17**	**€ 1.81**	**€ 3.29**
Benefit to Cost Ratio (BCR)		**1.1**	**1.6**	**2.0**

[89] *This excludes the savings associated with the conversion to LEV bus fleet*

The residual value represents the ongoing benefits that the programme will continue to deliver at the end of the 30-year life. Given it is so far into the future, the benefits beyond year 30 are discounted at the reduced discount rates as set out in CAF.

The economic appraisal of the Base Case presents a **positive case for the BusConnects Dublin programme** based on the current designs and information provided. Overall, the programme has a **Base Case BCR of 1.6 with a range of 1.1-2.0** and provides an **NPV of €1.8 billion** in the Base Case.

The BCR range reflects the scale and complexity of the programme, and its radical reallocation of road space and priority to buses, cyclists and pedestrians. The programme's success relies on careful detailed design of the infrastructure schemes, including mitigation measures, and measures to support and reinforce the programme. When all aspects come together with vigorous policy support, the benefit is significant. If this does not happen, there is the potential for the benefits to be undermined by the negative impacts on private vehicles or eroded through over-mitigation or compromise. For this reason, the benefits realisation process is a particularly important aspect of BusConnects Dublin management and delivery (see Chapter 15).

10.2.9 Sensitivity tests

Sensitivity tests were undertaken to understand the effects of reduced growth demand for services; reduced realisation of programme benefits; and/or cost increases. There were also tests examining the impact of an increase in contingency allowance and the impact of alternative future scenarios post-coronavirus. The outcome was a range of benefit cost ratios from 1.1 to 1.7 indicating that the economic case for BusConnects Dublin is robust, even if current assumptions change. Sensitivity tests have been undertaken as set out below:

1. Impact on ongoing design optimisation process
2. Demand changes due to an Alternative Plausible Future
3. Capital costs increased by 10% and 20%
4. Operating costs (majority of which is PSO payments and NGT operating costs) reduced by 10% and 20%

- 5 - Supporting infrastructure – performance of BusConnects Dublin in a network with MetroLink and DART+ in place

The results of these sensitivity tests are presented in the following sections.

1 - Design optimisation test

The BusConnects Dublin design teams are currently optimisation the design of the junctions along the CBC's to ensure the right balance between modes and where possible reduce delays predicted to be experienced by private vehicle users. The key optimisation measures are described below.

- Adjustments to signal timings to optimise the throughput of private vehicles travelling along each CBC whilst not compromising the required sustainable mode priority at each junction.

- Implementation of a Signage Strategy along each CBC and offline, to ensure appropriate routing of traffic away from sensitive residential areas. This could also include the use of Variable Message Signage (VMS).
- Time-plating of bus gates along some CBCs to limit the general traffic displacement impacts to peak hours only.
- Cycle mode share assumptions (to support a minimum of 10% of people movement by cycling) have been factored into the design of junctions along the CBCs (e.g. appropriate green time provided for cycling) which will further strengthen a shift to sustainable modes and limit traffic redistribution

Initial findings from the design teams suggest private vehicle delays could be reduced by a minimum of 6% along the CBC's. The impact of this has been tested at a zonal level with the results presented below.

Table 10-5 - CBA Summary (€b) – Design Optimisation

CBA Breakdown	Design Optimisation Test	Base Case
Present Value of Benefits (PVB)	€ 5.373	€ 5.08
Present Value of Costs (PVC)	€ 3.28	€ 3.28
Net Present Value (NPV)	€ 2.097	€ 1.81
Benefit to Cost Ratio (BCR)	1.6	1.6

2 - Alternative Plausible future sensitivity test

The scenario planning concept has been outlined in Section 10.2.4 above. The long-term impacts of COVID-19 are unknown however the scenario planning provides a framework to consider "shock waves" that occur from time to time. These "shock waves" can lead to an acceleration in the natural rate of change in society. The COVID-19 pandemic is an example of such a shockwave.

An alternative scenario for future travel demand has been developed by the NTA which considers the medium to long-term impacts associated with an accelerated transition to remote working, remote education and associated changes for a proportion of the population. In respect to employment, there is an assumption that a higher proportion of white-collar employees will utilise working from home when commuting distances are longer, while short distance commuters or blue-collar workers will be less able or inclined to work from home. For education, the greatest change is assumed in respect to university or college travel where it is assumed that a substantial shift to online learning and partial attendance will occur. Other economic assumptions regard an increase in online shopping, a reduction in business travel and an increase in freight volumes to service growing demand for online deliveries. Overall, the scenario assumes that the economy rebounds quickly and grows back with economic trends and factors, such as unemployment remaining unchanged. The full details of the travel demand assumptions used in the alternative scenario are described in a separate NTA report entitled 'Alternative Future Scenario for Travel Demand'.

The trip rates assigned with the NTA National Demand Forecasting Model have been adjusted to reflect the impact of greater working from home on different cohorts of the population considering employment type and trip type.

Overall the alternative scenario results in a significant reduction in the total number of trips on the transport network, approximately 8% lower than base projections. In the case of BusConnects Dublin these changes in demand and travel behaviour reduces the overall benefits however BusConnects Dublin still returns a robust BCR.

Table 10-6 - CBA Summary (€b) – Alternative Future

CBA Breakdown	Alternative Future Test	Base Case
Present Value of Benefits (PVB)	€ 3.580	€ 5.08
Present Value of Costs (PVC)	€ 3.28	€ 3.28
Net Present Value (NPV)	€ 0.304	€ 1.81
Benefit to Cost Ratio (BCR)	1.1	1.6

3 & 4 - Cost sensitivity test

A sensitivity test was undertaken which assessed the impact of a reduction in the operational cost of BusConnects Dublin.

Table 10-7 - CBA Summary (€b) – Operating cost reduction

CBA Breakdown	10% reduction in Opex	20% reduction in Opex	Base Case
Present Value of Benefits (PVB)	€ 5.08	€ 5.08	€ 5.08
Present Value of Costs (PVC)	€ 3.12	€ 2.95	€ 3.28
Net Present Value (NPV)	€ 1.97	€ 2.13	€ 1.81
Benefit to Cost Ratio (BCR)	1.6	1.7	1.6

Notwithstanding the inclusion of risk and optimism bias as set out in the Chapter 8: Cost projections, an increase in programme capital costs has been assessed as part of a sensitivity test to account for uncertainties in cost estimation, given that the programme is at an early stage in planning and design. The corresponding CBA results are outlined in Table 10-8. BusConnects Dublin would generate a BCR of 1.5:1 if costs increased by 10% and 1.4:1 if capital costs were increased by 20%. This still represents a positive economic return on investment.

Table 10-8 - CBA Summary (€b) – Capital cost Increases

CBA Breakdown	10% Capex Increase Test	20% Capex Increase Test	Base Case
Present Value of Benefits (PVB)	€ 5.08	€ 5.08	€ 5.08
Present Value of Costs (PVC)	€ 3.43	€ 3.58	€ 3.28
Net Present Value (NPV)	€ 1.66	€ 1.51	€ 1.81
Benefit to Cost Ratio (BCR)	1.5	1.4	1.6

5 - Infrastructure sensitivity test

Given that a number of major public transport schemes are progressing towards planning and implementation within the same timeframes a sensitivity test has been undertaken which included DART+ and Metrolink schemes. Those schemes attract passengers from buses, reducing bus demand slightly and therefore the benefits of BusConnects Dublin. The BusConnects Dublin infrastructure will always remain valuable however bus service plans in terms of frequencies and routing will be monitored as the transport network evolves. It is likely that with Metrolink and DART+ in place some of the BusConnects Dublin services on those corridors will be modified to complement and enhance access to the wider transport network.

Table 10-9 - CBA Summary (€b) – Infrastructure Test

CBA Breakdown	Infrastructure Test	Base Case
Present Value of Benefits (PVB)	€ 3.97	€ 5.08
Present Value of Costs (PVC)	€ 3.28	€ 3.28
Net Present Value (NPV)	€ 0.7	€ 1.81
Benefit to Cost Ratio (BCR)	1.2	1.6

10.2.10 Summary of Sensitivity Tests

A summary of the sensitivity tests is presented in Table 10-10 in the form of the BCR.

Table 10-10 - CBA Summary (€b) – Summary

Test Scenario	Benefit to Cost Ratio (BCR)
Base Case	1.6
Design Optimisation test	1.6
Alternative plausible future demand test	1.1
10% Capex increase test	1.5
20% Capex increase test	1.4
10% Opex reduction test	1.6
20% Opex reduction test	1.7
Infrastructure Test	1.2

Overall, the impacts of the BusConnects Dublin programme are in line with expectations given the aim to transform the bus system to provide better services to more people and to enact wider policy by prioritising sustainable travel modes.

10.2.11 Economic Appraisal Stress Test

This additional stress test is made up of a **combination** of downward assumptions and/or conditions. These have been assessed as a single scenario within the transport modelling and subsequent economic appraisal.

- **Dynamic Sensitivity –** Both DART+ Programme and Metrolink have been included in both the DoMinimum and DoSomething scenarios to understand how BusConnects Dublin performs with these schemes also in place. It is likely that with Metrolink and DART+ in place some of the BusConnects Dublin services on those corridors will be modified to complement and

enhance access to the wider transport network however no changes have been assumed in this stress test. The NTA Transport Strategy for the Greater Dublin Area 2016 – 2035 is modally balanced and designed to cater to the future needs of the Greater Dublin Area. It integrates short, medium and long-term plans for light and heavy rail, bus, cycling, walking and roads. The Strategy recognises that need for a balanced network across all public transport systems and that the achievement of the Strategy's aims requires all systems in place. In this regard the various public transport systems, i.e. heavy rail, metro, bus and light rail, are complementary to each other and in the long term each is likely to positively impact the other as the shift to public transport accelerates.

- Alternative Plausible Future - An alternative scenario for future travel demand has been developed by the NTA which considers the medium to long-term impacts associated with a potential accelerated transition to remote working, remote education and associated changes for a proportion of the population. The scenario assumes that the economy rebounds quickly and grows back with economic trends and factors, such as unemployment remaining unchanged. The trip rates assigned with the NTA National Demand Forecasting Model have been adjusted to reflect the impact of greater working from home on different cohorts of the population considering employment type and trip type. Alternative scenario analysis results in a significant reduction in the total number of trips on the transport network, approximately 8% lower than base projections. It should be acknowledged that as of September 2021 daily road-based traffic demand has already returned to pre-COVID levels. Demand for public transport still remains lower. In the case of BusConnects Dublin these changes in demand and travel behaviour reduces the overall benefits however BusConnects Dublin still returns a robust BCR.
- Cyclist Journey Quality – for the purposes of this stress test the benefits associated with improved journey quality for cyclists have been removed. Whilst unlikely, and not in alignment with the programme goals and objectives, this will assess the impact of low-quality cycle infrastructure being provided in place of the high-quality designs proposed by the NTA.
- Mode Share – Over the past decade investment in transport infrastructure has created an environment which has supported the implementation of transport orientated government policies to encourage a shift to more sustainable modes. These policies have mirrored a global shift in the attitudes to sustainability and a growing awareness of our environmental and climate impacts. Large investment programmes such as BusConnects Dublin will need to be underpinned by a continuation of strong policy to continue this shift towards sustainable modes into the future. In the period since 2016 usage of public transport has increased by an average of 7% annually in the Dublin region alongside a 4% reduction in car demand across the canal cordon in Dublin on average each year. This is a faster rate of growth than was expected based on previous observed trends prior to 2016[90], reflecting the way in which mobile technology has made public transport easier to use. It also reflects a more positive attitude towards public transport combined with a growing concern for the environment and reluctance towards car ownership and travel in the city.

  For the purposes of this 'stress test' a conservative approach towards modal shift has been assumed in the modelling process.

  This approach represents a **situation where the existing trend of people transferring to sustainable transport continues but at a reduced pace as a result of no policy (demand management, carbon charges, fare incentives etc) or infrastructure interventions beyond those already in place**. In quantitative terms this scenario represents a conservative 2% reduction in the 2043 AM peak private vehicle mode share for commuters inside the M50 area (compared to a DoMin scenario) as a result of BusConnects Dublin.

[90] *Canal Cordon Report (2019), p.6: https://www.nationaltransport.ie/wp-content/uploads/2020/12/Canal-Cordon-Report-2019-V3.pdf*

In addition, for the purposes of this stress test it is assumed that the presence of Metrolink/ DART+ in both the DoMin and DoSomething does not lead to a significant change in the modal shift linked to BusConnects. The potential impact of strong policy support has not been included which would likely lead to an upward change in passenger demand and associated economic benefits.

As expected, the 'stress test' scenario results in a significant reduction in the total number of trips on the transport network, approximately 8% lower than base projections. In addition, the demand on BusConnects Dublin reduces slightly due to some increased competition with other elements of the public transport network which, in this stress test, is not assumed to be offset by a general increase in the usage of public transport. This reduced demand combined with the limited mode shift away from private vehicles, results in less people incurring the benefits of the BusConnects Dublin Programme in this scenario. The results of this test are outlined below.

Table 10.11 –CBA Summary (2011 Values and Prices)

	60 Year PV €m
Present Value Benefits	-€ 1.5
Present Value Costs	€ 3.3
NPV	-€ 4.8
BCR	-0.45

This 'stress test' represents an unrealistic scenario however is useful to understand the importance of strong policy support in line with our sustainability, transport and climate action ambitions. In the unlikely absence of such support and the continued transition to more sustainable modes of transport there is the potential for the benefits to be undermined by the negative impacts on private vehicles or eroded through over-mitigation or compromise. For this reason, the benefits realisation process is a particularly important aspect of BusConnects Dublin management and delivery.

10.2.12 Further detail on the private vehicle economic impacts

In the economic appraisal, the change in journey time as a result of the assessed scheme is converted into monetised benefits by applying value of time (VoT) factors. The VoT costs used in the assessment are outlined in Table 10-12 showing that the VoT applied to in-work/business travel is over three times higher than the value applied to leisure or commuting trips. This means that even though business travel is a small proportion of total travel demand, the high value applied to the journey time increases for this trip type means that its impact on the overall monetised disbenefits in economic appraisal is large as a natural consequence of the variation in VoT by purpose. It is possible that a large proportion of these users will not actually perceive the impacts at this factored scale.

Table 10-12: Value of Time (VOT) Prices (Factor Costs) from the DoT CAF

Trip Purpose	Value of Time (€)
In work (business) value € per hour:	€ 26.12
In work (business) value € per minute:	€ 0.44
Leisure value € per hour:	€ 7.36
Leisure value € per minute	€ 0.12
Commuting € per hour:	€ 8.17
Commuting € per minute:	€ 0.14

To illustrate this issue, Table 10-13 provides a conversion of the average change in journey time in 2043 into costs using the value of time factors. This shows that even though non-business trip experience quite small disbenefits in time, the lower value applied to that time means that they account for less of the overall cost of disbenefits. On the other hand, business travel, which is valued far higher in respect to VoT, results in greater costs than the other trip purposes combined for both origins and destinations.

Table 10-13: Average Change in Journey Time per Private motor vehicle Users (2043) converted into Value of Time Costs

2043	Destination					Origin				
	Business	*Commute*	*Others*	*Student*	*Retired*	*Business*	*Commute*	*Others*	*Student*	*Retired*
AM	€ 0.51	-€ 0.01	€ 0.03	€ 0.01	€ 0.03	€ 0.33	-€ 0.01	€ 0.03	-€ 0.01	€ 0.02
LT	€ 0.70	€ 0.09	€ 0.08	€ 0.05	€ 0.06	€ 0.76	€ 0.09	€ 0.07	€ 0.00	€ 0.07
SR	€ 0.54	€ 0.05	€ 0.05	€ 0.01	€ 0.04	€ 0.58	€ 0.05	€ 0.06	€ 0.01	€ 0.04
PM	€ 0.42	€ 0.00	€ 0.06	-€ 0.01	€ 0.04	€ 0.56	€ 0.05	€ 0.06	€ 0.06	€ 0.05
Sum:	**€ 2.17**	**€ 0.13**	**€ 0.22**	**€ 0.06**	**€ 0.16**	**€ 2.23**	**€ 0.18**	**€ 0.22**	**€ 0.07**	**€ 0.18**

To make this point clearer, Figure 10.1 shows a proportional scale of the 2043 change in journey time (in minutes) per user for destinations. This shows that there is a mixture of positive and negative impacts, but the majority of trip purposes are affected by a change in journey time of less than a minute, with the exception of business travel.

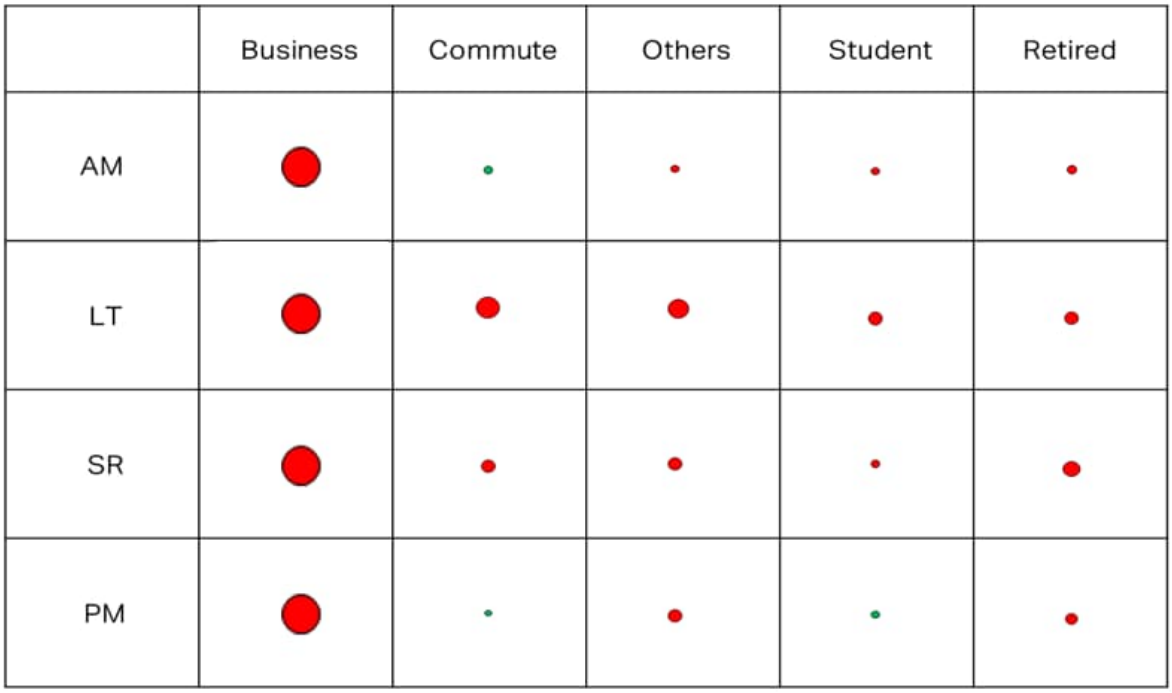


Figure 10.1: Relative Scale of Change in Journey Time (minutes) by Time Period and Purpose

In contrast with this, when the change in journey time is converted into monetised values in Figure 10.2, the negative impact on business travel is compounded by the high VoT applied to this trip purpose and results in a disproportionate impact on the calculation of overall disbenefits when compared to other trip types.

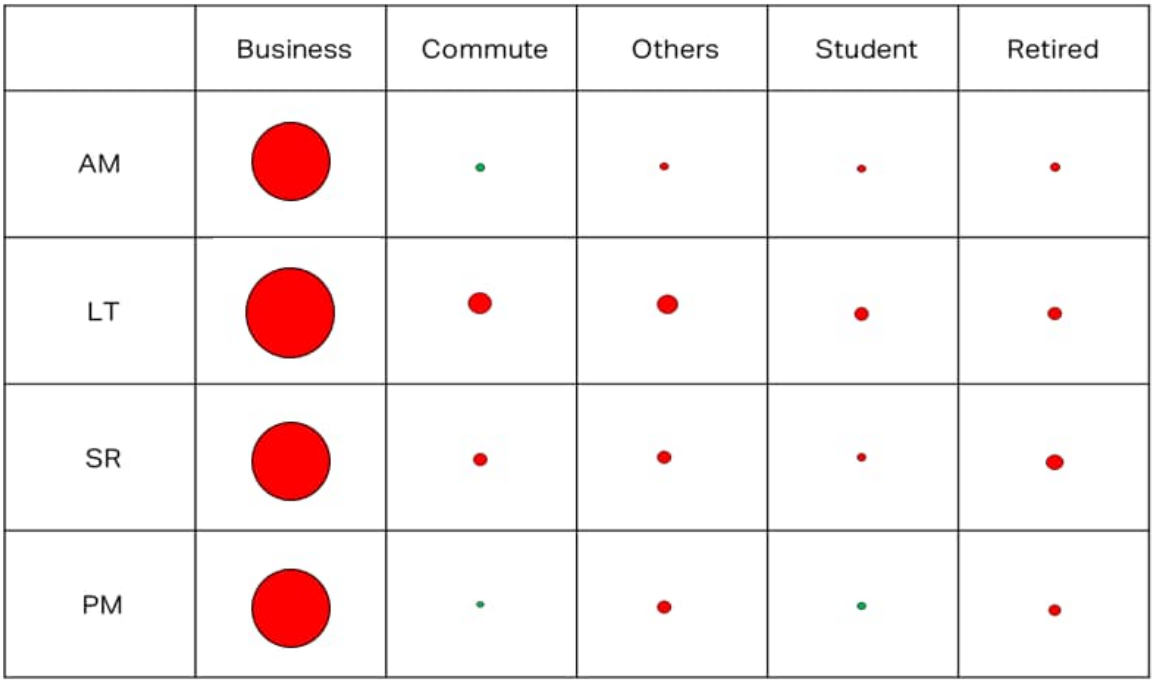


Figure 10.2: Relative Scale of Change in Journey Time in Monetised Values (€) by Time Period and Purpose

10.2.13 Economic appraisal summary

The economic appraisal of the Base Case presents a strong economic case for the BusConnects Dublin programme based on the current designs and information provided. Overall, the programme has a **Base Case BCR of 1.6 and provides an NPV of €1.8 billion** over a 30-year appraisal period (including a 30-year Residual Value period). These benefits assume that the design aspirations are realised to their full extent. There is potential for some of the benefits to be eroded as the designs evolve and/or costs to be optimised further and it is therefore important that the business case is revisited as the programme progresses.

The net present value (benefits minus costs) and BCR are powerful indicators of worth but they do not provide information on benefits and costs that are not monetizable. In other words, although an important input, the economic analysis is not used as the sole basis for decisions. Other benefits, negative impacts and costs outside the standard economic appraisal process will be identified and addressed through the detailed planning and design stages and reflected in the Final Business Case. For completeness, the benefits of the transition of the bus fleet to low emission vehicles will also be quantified outside the economic appraisal process, notwithstanding that this transition will occur both in Do-Minimum and BusConnects Dublin options. The benefits of reduced interchange penalty could also be included going forward.

Sensitivity analysis assessed the impact of including reliability impacts, varying demand levels, increased costs, the application of a higher discount rate and a reduction in interchange penalty on the economic viability of the programme.

The results of the CBA assessment demonstrate that the proposed programme is projected to provide a strong return on investment and is economically viable.

10.3 Safety Assessment

The delivery of the BusConnects Dublin programme has the potential to positively influence the safety of bus passengers, cyclists and pedestrians throughout the Dublin area.

BusConnects Dublin aims to encourage people to shift from private cars to cycling, bus and rail. This will likely decrease road traffic which, due to the lesser likelihood of injury incidents on buses, should reduce the number and severity of injury incidents overall. The safety impact of the BusConnects Dublin programme on private vehicles has not been quantified at this stage however the safety impact of the BusConnects Dublin programme on cyclists has been quantified.

The delivery of 200km of cycle facilities will have a significantly positive impact on both existing and new cyclists on the corridors. The BusConnects Dublin programme, and the Core Bus Corridor project in particular, plan to provide improved facilities for cyclists on many of the key radial routes into the city. This is particularly important since the number of cyclists entering the city has more than doubled since 2006, with 6% of people now entering the city centre by bicycle[91].

The safety issues associated with such growth but limited infrastructure improvement, are evident from the Road Safety Authority's online database of road collisions which indicates that collisions involving cyclists in Dublin increased from 219 in 2010, to 591 in 2016.

This highlights a need to ensure adequate provision of appropriate cycling infrastructure to sustain the current level of growth in a safe manner. The Core Network Project element of the BusConnects Dublin Programme provides an opportunity to deliver safe, segregated cycle facilities on the core radial routes into the City.

The safety impacts for cyclists have been taken into account as part of this appraisal as set out in Section 10.2.6.

COBALT (Cost and Benefit to Accidents – Light Touch) assesses the safety aspects of road schemes using detailed inputs of links that may be impacted by the scheme. The assessment is based on a comparison of collisions by severity and associated costs in the 'Without-Scheme' and 'With-Scheme' forecasts. Inputs to COBALT include link characteristics, relevant collision rates and costs, and forecast traffic volumes. The safety impacts are set out below.

Table 10-14 – Safety Impacts

	30-year benefits	Residual 30-year benefits	Total 60-year benefits
Total Collisions Saved by Scheme	5,107	5,247	10,354
Total Casualties Saved by Scheme (Fatal)	56	57	113
Total Casualties Saved by Scheme (Serious)	271	278	549
Total Casualties Saved by Scheme (Slight)	6,976	7168	14,144

[91] *National Transport Authority, Cordon Count Report 2018 and supplementary 2019 data. This data is the latest available at the time of writing, late 2020.*

10.4 Environmental assessment

Transition to Low Emission Vehicles (LEV)

Regardless of BusConnects Dublin the bus fleet is moving to LEV and recent trends in the car fleet suggest the move to LEV is occurring across all vehicle markets. This ongoing market trend, combined with the Government commitment that from July 2019 all future bus purchases will be low emission, will result in the existing diesel only bus fleet of 1,141 vehicles[92] being gradually replaced with LEV buses between July 2019 and around 2023 and with zero emission vehicle buses from 2023 onwards. Under this renewal plan, 50% of the bus fleet will consist of low emission vehicles by 2023, increasing to close to 100% by 2030[93] (full completion by 2032). It should be noted however that the BusConnects Dublin programme protects and enhances the attractiveness of the bus system.

Undoubtedly, the move to LEVs will have a significant environmental benefit. While the expanded fleet under a BusConnects Dublin scenario will enhance this benefit, the majority of the transition will occur regardless of the BusConnects Dublin programme. Therefore, the benefit has not been included in the BusConnects Dublin business case and has not been calculated.

LEVs aside, the picture for the environmental impact of the BusConnects Dublin programme is complex.

The ERM is based on an entirely petrol and diesel fuelled fleet for all vehicles, public and private. It calculates the environmental impact associated with a change in emissions across the Eastern Region. Emissions increase with the number of vehicles on the roads, the distance they travel (vehicle-km) and the amount of congestion, as vehicles sitting in traffic generate more emissions.

Outputs from the ERM suggest that in 2043 with BusConnects Dublin in place the average travel time of public transport users will reduce by 19% compared to a scenario without BusConnects Dublin however the average travel time for private vehicle users will increase by 3%. As private vehicles account for 78% of daily trips, in comparison to 22% on public transport, the negative impact on emissions from private vehicles outweighs the positive impacts of increased public transport use. Overall, and in the absence of decarbonisation of the fleet, the ERM outputs suggest that the programme will have a slight negative impact on air quality (see Section 10), as additional emissions generated by road users will outweigh the reduction in emissions resulting from a shift to more sustainable transport modes and improved efficiency in bus services. While the predicted modal shift as result of BusConnects Dublin is conservative, as different elements are implemented it may prove to be greater than the 3% estimate used in the base case which would eliminate the "slight negative" impact on emissions from private vehicle users.

The environmental impacts are discussed in more detail in Chapter 9. The environmental impact of BusConnects Dublin will be assessed in the usual manner for all planning applications under the EIA Directive.

[92] *See Appendix V*
[93] *Information sourced from 'BusConnects Preliminary Business Case - Options Note'*

10.5 Accessibility and social Inclusion assessment

The programme aims to improve road-based public transport at local, regional and national levels by improving bus journey time and reliability throughout the city. The scheme will achieve the objectives of the Project Ireland 2040, the Transport Strategy for the Greater Dublin Area 2016 – 2035 and the City and County Development Plans to generally improve quality of life and improve accessibility to work, education and other activities.

The various elements of the programme will likely have a positive impact on accessibility and social inclusion which is consistent with the NTA overall equality objective. However, the impacts of the key elements have been set out below.

The **core bus corridor infrastructure** is expected to significantly reduce peak period bus journey times which will improve accessibility and social inclusion by improving access to the majority of the city with journey time savings of up to 40-50% on each corridor.

The bus network redesign would have the following accessibility and social inclusion impacts:

- The number of residents located within 400m of a 10-minute frequency public transport service would increase by 35%, from approximately 480,000 today to over 650,000[94].
- The number of jobs or students located within 400m of a 10-minute frequency public transport service would increase by 19%, from approximately 540,000 today to over 640,000[95].
- Nearly 1,000,000 residents would be located within 400m of a 15-minute frequency service[96].
- On average, 18% more places of employment could be reached by Dublin-area residents in 30 minutes of travel time[97]. The bus priority measures will also assist in delivering this impact.

The main benefits of **upgrading the ticketing system** ("Next Generation Ticketing") and changing the fare structure are:

- Greater flexibility in terms of fares charged
- Greater ease-of-use, better customer service
- Reduced dwell time at bus stops, contributing significantly to faster journey times
- No financial penalty for interchange between services

Overall, the BusConnects Dublin programme is expected to have a positive impact on accessibility and social inclusion through the Dublin area.

Integration assessment

[94] *BusConnects Dublin Network Redesign Report (2018), p. 155*
[95] *BusConnects Dublin Network Redesign Report (2018), p. 155*
[96] *BusConnects Dublin Network Redesign Report (2018), p. 155*
[97] *BusConnects Dublin Network Redesign Report (2018), p. 155*

The proposed programme will integrate with Luas and rail services at interchange locations throughout the network. The proposed ticketing systems and fares structure is likely to improve interchange between modes.

The proposed programme will deliver strategic cycle routes along the CBC corridors which have been identified as part of NTA's GDA Cycle Network Study. The proposed cycle infrastructure is projected to deliver benefits of over €86 million to society over the appraisal period through health, safety and socio-economic improvements.

The scheme will be complementary to the proposed Metrolink and DART Expansion Programme, both of which are currently in planning.

10.6 Physical activity assessment

BusConnects Dublin programme aims to significantly improve facilities for existing cyclists and encourage new cyclists through improved safety and reduced journey times. Accessibility improvements to bus stops is also planned which will encourage people to walk/cycle to their local bus stops.

10.7 Summary

The Preferred Option was assessed against a range of criteria. The economic appraisal looked at the present value of benefits and costs over 60 years. It showed that BusConnects Dublin creates large benefits for the users of the public transport system, plus large health benefits for cyclists. These benefits greatly exceed the total costs of the programme i.e., capital, operating and life-cycle costs. However, the analysis also showed that BusConnects Dublin results in significant disbenefits to private vehicle users through longer journey times. The economic appraisal of the Base Case presents a positive case for the BusConnects Dublin programme based on the current designs and information provided. Overall, the programme has a Base Case BCR of up to 1.6 and provides an NPV of €1.8 billion.

The negative impact on private vehicles is a consequent of the radical change in the allocation of road space to buses, walking and cycling. It can be mitigated through the detailed design process but more importantly through complementary policy measures which continue to change travel behaviour.

Economic appraisal showed that BusConnects Dublin performs well when assessed against the other criteria of Safety, Accessibility and Social Inclusion, Integration and Physical Activity. The Environmental assessment is positive from an infrastructure provision perspective but marginally negative when the overall projected growth in demand is taken into account due to the increased travel time encountered by car users.

There will be environmental benefits arising the move to low and zero emission buses which is not included in this economic appraisal as the decarbonisation of the fleet would also occur in the DoMin situation.

11

Financial appraisal

11 Financial appraisal

Chapter Summary

In line with the PSC, the financial appraisal focuses on affordability and financial impact of the BusConnects Dublin programme. The financial appraisal:

- Is based on cashflow inputs including annualised inflows and outflows, including revenues, capital costs, renewal and maintenance costs, operating costs and taxes;
- Includes a discounted cash flow based on an incremental approach, showing inflows and outflows for BusConnects Dublin over and above those set out in the DoMin investment counterfactual, discounted at the appropriate financial discount rate; and
- An assessment of affordability in gross terms setting out the envelope of total investment required, timing of costs and ongoing operation and maintenance costs (net of revenues).

The financial appraisal is carried out over an appraisal period of 30 years beyond the capital investment period. Considering full implementation of BusConnects in 2028, the period analysed goes from 2020 to 2058.

11.1 Cashflow Inputs

11.1.1 Revenues

Revenues for BusConnects Dublin come from collecting bus fares from customers. These revenues are exempt of VAT.

Revenues for both the DoMin and Do BusConnects options are derived by applying growth factors obtained from the demand model (which uses Transport Users Benefits Appraisal (TUBA) software) to actual 2019 revenue figures[98] for Dublin Bus City services. **Base Case Scenario or "Scenario 2"** as described in section 10.2.4 has been used for the calculation of future revenues. This represents a situation where the existing trend of people transferring to sustainable transport continue at a reasonable rate but with limited policy or infrastructure interventions beyond those already in place.

Revenues are shown in an incremental basis for BusConnects Dublin over and above the DoMin scenario. The following figure represents the forecasted profile of revenues for the analysis period.

[98] *Bus & Rail Statistics for Ireland – State Funded Services Statistical Bulletin Number: 02/2020 September 2020, Table 5A: Dublin Region Annual Passenger Revenues (millions)*

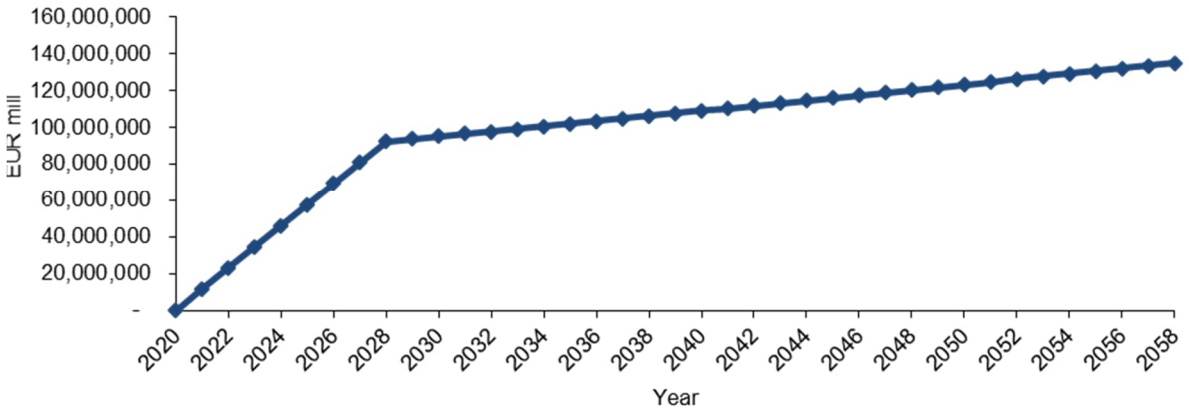


Figure 11.1 – Incremental revenue forecast for Bus connects

11.1.2 Capital, renewal and operating costs

Costs have been broken down in line with the PSC recommendations for financial appraisal analysis and by programme element:

- total upfront capital costs (or investment costs)
- total operating costs
- future renewal (or maintenance) costs

Costs have been presented on an incremental basis to carry out the DCF analysis and in a gross basis to carry out the affordability analysis (with the exception of operating costs which have been prepared on an incremental manner in line with the methodology used to calculate revenue and PSO costs).

No residual values of built assets are being considered for the purpose of this analysis.

For further detail on costs refer to section 8 Cost projections.

11.2 Discounted cash flow

11.2.1 Discount rate

The discount rates used in the Financial Appraisal are set following guidance by the Department of Public Expenditure & Reform and the National Development Finance Agency.

Two discount rate scenarios have been used in the DCF analysis:

- A test discount rate of 4% in real terms[99]; and
- A discount rate of 2.5% in nominal terms in line with DPER / NDFA guidance included in the PSC.

A 4% discount rate is being used in addition to the recommended 2.5% for sensitivity reasons as both borrowing and inflation rates can vary into the future. To convert real to nominal discount rates, a general inflation rate of 2% has been used.

[99] *https://www.gov.ie/en/policy-information/1a0dcb-project-discount-inflation-rates/*

11.2.2 Inflation rates

Different inflation rate profiles have been applied to revenues and costs. Inflation rates applied to the different cost items have been done in line with the requirements of the PSC, guidance from the Department of Public Expenditure & Reform on Project Evaluation and applicable rates as well as expert opinion on construction inflation and other specific rates. For further detail on the inflation rates applied to different cost items refer to section 8.2).

A flat 2% general inflation rate has been applied to revenues from bus fares in line with general inflation.

11.2.3 DCF summary

The table below summarises the DCF analysis on the based on incremental revenues and costs of BusConnects Dublin over and above the DoMin option. As discussed in Chapter 7, values are presented in real and nominal terms as well as excluding and including VAT. Net Present Values are presented for all discount rate options mentioned above and have been applied in real or nominal terms as appropriate to the cashflows been discounted (i.e. real cashflows at real discount rates, nominal cashflows at nominal discount rates).

Table 11-1 – Discounted Cash Flows summary table – Incremental values

(EUR millions) Incremental	Cash flows	Discounted @4% Real, c. 6% Nominal	Discounted @2.5% Nominal, c. 0.5% Real
Revenue	3,831	1,653	3,421
Total inflows (Real)	**3,831**	**1,653**	**3,421**
Capex	(2,037)	(1,670)	(1,986)
Lifecycle renewal costs	(319)	(127)	(282)
Operating costs	(3,587)	(1,719)	(3,243)
Total Outflows (Real)	**(5,943)**	**(3,516)**	**(5,511)**
Total Net Cash flow (Real)	**(2,111)**	**(1,863)**	**(2,091)**
Total Net Cash flow (Nominal)	**(3,499)**	**(2,144)**	**(2,779)**
Total Net Cash flow (Nominal incl. VAT)	**(5,522)**	**(2,869)**	**(4,024)**

The table above presents the NPV of the Programme. A financial IRR has not been presented as it is not meaningful for a net cost programme such as BusConnects Dublin.

11.3 Affordability

In addition to a DCF analysis, the PSC requires an assessment of affordability in gross terms setting out the envelope of total investment required, timing of costs and ongoing operation and maintenance costs (net of revenues).

The affordability analysis has been set out in two tables below:

- Table 11-2 sets out the capital investment costs and capital renewal costs on a gross basis; and
- Table 11-3 sets out total revenues and operating costs for BusConnects Dublin on an incremental basis over and above DoMin.

Each table shows net cashflows on an annual basis for 2020-2028 and for ten-year periods from 2029-2058. Individual project elements have been presented in real terms (2020 prices) with inflation and VAT impacts added on a total programme basis.

It has been assumed for the purposes of this PBC that the cashflow impacts illustrated below would have a consequential impact on the general government balance, noting that the VAT cost would be offset on an overall Exchequer basis.

Table 11-2 – Annual Capital and Renewal cost cash outflows expressed in gross terms – Period 2020-2058[100]

Do BusConnects Dublin (EUR millions)	2020	2021	2022	2023	2024	2025	2026	2027	2028	...	2029-2038	2039-2048	2049-2058	Totals
Capital costs														
Network Redesign Preparatory Costs	(5)	(5)	(5)	(5)	(5)	(1)	-	-	-	...	-	-	-	(25)
Non-CBC Bus Shelters and Poles Costs	-	(8)	(8)	(8)	(8)	-	-	-	-	...	-	-	-	(31)
Park and Ride Facilities - Capital Costs	-	-	-	(11)	(11)	(11)	(11)	(11)	-	...	-	-	-	(56)
CBC Infrastructure Works	(25)	(75)	(290)	(290)	(255)	(220)	(220)	(220)	(120)	...	-	-	-	(1,717)
Depot	-	-	-	(35)	(35)	-	-	-	-	...	-	-	-	(71)
Ticketing - Capital Costs	-	-	-	(150)	-	-	-	-	-	...	-	-	-	(150)
Bus Fleet - Capital Costs	-	(68)	(77)	(71)	(71)	(65)	(65)	(71)	(71)	...	(335)	-	-	(894)
Subtotal - Capital Costs	**(29)**	**(155)**	**(380)**	**(571)**	**(386)**	**(297)**	**(296)**	**(303)**	**(191)**	**...**	**(335)**	**-**	**-**	**(2,943)**
Renewal costs	-	-	-	-	-	-	-	-	-	...	-	-	-	-
Park and Ride Facilities - Renewal Costs	-	-	-	-	-	-	-	-	-	...	-	(28)	(28)	(56)
Ticketing - Renewal Costs	-	-	-	-	-	-	-	-	-	...	(59)	(52)	(26)	(137)
Bus Fleet - Renewal Costs	-	-	-	-	-	-	-	-	-	...	(458)	(806)	(794)	(2,058)
Subtotal - Renewal Costs	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**...**	**(518)**	**(886)**	**(848)**	**(2,251)**
Total Cash Outflow (Real)	**(29)**	**(155)**	**(380)**	**(571)**	**(386)**	**(297)**	**(296)**	**(303)**	**(191)**	**...**	**(853)**	**(886)**	**(848)**	**(5,195)**
Inflation	(0)	(4)	(12)	(34)	(34)	(37)	(47)	(59)	(42)	...	(278)	(560)	(857)	(1,964)
Total Cash Outflow (Nominal)	**(29)**	**(159)**	**(391)**	**(605)**	**(420)**	**(334)**	**(343)**	**(362)**	**(233)**	**...**	**(1,131)**	**(1,446)**	**(1,705)**	**(7,159)**
VAT	(7)	(31)	(53)	(97)	(61)	(54)	(55)	(59)	(40)	...	(260)	(328)	(386)	(1,431)
Total Cash Outflow (Nominal incl. VAT)	**(36)**	**(190)**	**(444)**	**(701)**	**(482)**	**(388)**	**(399)**	**(420)**	**(273)**	**...**	**(1,391)**	**(1,774)**	**(2,090)**	**(8,589)**

[100] *NOTES:*
Values beyond 2028 are grouped in to 10-year periods.
Capital and renewal costs are expressed in real terms with inflation and VAT added on a total programme basis.

Table 11-3 – Annual revenues and operations cost cash flows expressed in incremental terms– Period 2020-2058[101]

Do BusConnects Dublin (EUR millions)	2020	2021	2022	2023	2024	2025	2026	2027	2028	...	2029-2038	2039-2048	2049-2058	Totals
Total Revenue	**-**	**12**	**23**	**35**	**46**	**58**	**69**	**81**	**92**	**...**	**998**	**1,138**	**1,281**	**3,831**
Total Cash Inflow	**-**	**12**	**23**	**35**	**46**	**58**	**69**	**81**	**92**	**...**	**998**	**1,138**	**1,281**	**3,831**
Operating costs														
Core Bus Corridors/Non-CBC shelters - Operating	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	...	(10)	(10)	(10)	(39)
Park and Ride Facilities - Operating	-	-	-	-	(0)	(0)	(0)	(0)	(0)	...	(2)	(2)	(2)	(7)
PSO operating cost	-	(7)	(40)	(70)	(80)	(90)	(90)	(90)	(90)	...	(900)	(900)	(900)	(3,257)
Ticketing - Operating Costs	-	-	-	(2)	(14)	(14)	(16)	(16)	(16)	...	(50)	(8)	(8)	(144)
Bus Fleet - Operating Costs	-	(2)	(4)	(4)	(5)	(5)	(5)	(5)	(5)	...	(39)	(34)	(34)	(140)
Total Cash Outflow	**(1)**	**(10)**	**(45)**	**(78)**	**(99)**	**(110)**	**(112)**	**(112)**	**(112)**	**...**	**(1,001)**	**(954)**	**(954)**	**(3,587)**
Total Net Cash flow (Real)	**(1)**	**2**	**(22)**	**(43)**	**(53)**	**(53)**	**(43)**	**(31)**	**(20)**	**...**	**(3)**	**184**	**328**	**245**
Inflation	(0)	(0)	(3)	(7)	(10)	(13)	(14)	(14)	(14)	...	(183)	(287)	(405)	(950)
Total Net Cash flow (Nominal)	**(1)**	**1**	**(24)**	**(50)**	**(64)**	**(65)**	**(57)**	**(45)**	**(34)**	**...**	**(186)**	**(103)**	**(77)**	**(705)**
VAT	(0)	(2)	(11)	(20)	(26)	(30)	(31)	(32)	(33)	...	(350)	(450)	(603)	(1,590)
Total Cash Outflow (Nominal incl. VAT)	**(1)**	**(1)**	**(35)**	**(70)**	**(90)**	**(95)**	**(88)**	**(77)**	**(67)**	**...**	**(536)**	**(554)**	**(680)**	**(2,295)**

[101] *NOTES:*
Revenues and operating costs are expressed in incremental terms
Values are presented in real terms with inflation and VAT added on a total programme basis.
Bus fare revenues are exempt of VAT.

11.4 Conclusion

The Financial Appraisal in this PBC has followed a conservative approach to calculating capital, renewal and operating costs as well as future revenues generated throughout the 2020-2058 period.

The incremental capital cost of implementing BusConnects Dublin is c.€2bn in real terms (2020 prices, including risk and contingency) and €2.3bn when inflation over the implementation period from 2020-2032 is taken into account (see Table 8-1). The gross total investment in BusConnects Dublin to 2027 is c.€2.8bn – this figure includes over c. €0.8bn investment in bus fleet, the majority of which is also required under a DoMin scenario (i.e. the bus fleet requires replacement regardless of whether BusConnects is implemented or not). The identified gross total investment value of c.€2.8bn is inclusive of all the BusConnects elements required to implement the programme, it is based on reliable cost estimates and should be considered for inclusion in the revised National Development Plan. The capital cost estimates included in this PBC also reflect the developing maturity of the programme as design / specification moves from a concept to a preliminary design phase, informed by significant public consultation, peer reviews, benchmarking and risk analysis (including Reference Class Forecasting reviews to a 75% confidence level.) The approach to assessing and calculating allowances for risk and contingency has incorporated the best actual experience on projects internationally and thus should significantly increase the certainty that this figure will not be exceeded.

A conservative approach has also been applied to the preparation of the longer-term revenue and operating cost assumptions in the analysis above:

- Revenues have been based on the lower-case demand scenarios described in the economic analysis. The base case economic scenario would increase revenues by c.9%
- Operating costs include:
  - PSO costs based on existing gross PSO cost levels, adjusted for anticipated growth in vehicle kilometres to the end of the implementation period. This increase in PSO is then held constant in real terms through the evaluation period, i.e. no account is taken of potential longer-term efficiencies / savings in PSO costs that might be derived from the longer-term impacts of the programme
  - NGT costs have been also modelled based on operational costs from international benchmarks. The figures above include both central costs of operation of all NGT (bus, metro, light and commuter rail) and the specific costs that relate to BusConnects
  - Separate allowances have also been made for certain bus fleet and P&R costs
  - No account has been taken of the potential efficiencies/savings in costs that may be derived from a range of measures including, for example, the annual 5 year reviews that apply to spending programmes of this scale, competitive tendering of NGT, PSO bus routes and other operational services, optimisation of whole of life costing through the design process, optimisation of cost figures through removal of ticketing costs from PSO (where there may be some overlap with NGT costings).
  - It should also be noted that the operating costs are reflective of the scale of activity of BusConnects Dublin which will be a significantly larger bus network and fleet reflecting the overall modal shift to public transport of which BusConnects Dublin is a key enabler.

NTA will continue to monitor and develop its capital cost (including renewals), operating cost and revenue projections as the programme develops and will update this analysis as Final Business Cases are prepared prior to contract award of key elements of the programme.

12

Project appraisal balance sheet

12 Project appraisal balance sheet

Chapter Summary

A Project Appraisal Balance Sheet (PABS) has been prepared for the BusConnects Dublin Programme in line with the guidelines set out in PAG/CAF. The aim of the PABS is to portray and full impacts of BusConnects Dublin across all key indicators. The purpose is to set out the impacts across all indicators equally to avoid the risk of the outcome being skewed by one indicator.

12.1 PABS structure

The PABS is based on a qualitative and quantitative evaluation of a range of criteria and elements as outlined in the PAG Unit 7.1 – Project Appraisal Balance Sheet. The evaluation of the programme is based on the 6 multi-criteria appraisal headings:

- Economy
- Environment
- Accessibility and Social Inclusion
- Safety & Security
- Integration
- Physical Activity

Project Appraisal Balance Sheet

PABS Summary Table

Project Title	Reference Number		Project Description	Programme Cost (€m)	Date
BusConnects Dublin Programme	Modelling Base Year	2016	See Chapter 1	€ 3.28b	February 2021
	Opening Year	2028			

Criteria		Quantitative Statement	Summary of Keys Impacts (Qualitative Assessment)	Quantitative Assessment	Monetised (€m over 30 yrs. plus 30 yr. residual)
Environment	Air Quality and Climate	No/Negligible Impact It should be noted however that the BusConnects Dublin programme will assist in the delivery of a Significant Positive because all buses purchased in future will be low emission vehicles (LEVs)	In quantitative terms the programme will have a slight negative or negligible impact upon air quality caused by the additional emissions generated by road users outweighing the reduction in greenhouse gas emissions through the shift to more sustainable transport modes and improved efficiency in bus services. As part of the ongoing bus fleet renewal programme, NTA will replace the existing fleet with low emission vehicles. At this point it is assumed any new vehicles purchased up to 2023 will be LEV with zero emission vehicles assumed from 2024 onwards. In appraisal terms, the shift from a largely diesel fleet to zero emission vehicles is the implementation of a Government policy which will occur with or without BusConnects Dublin so there is no impact on the economic appraisal. It should be noted however that the BusConnects Dublin programme protects and enhances the attractiveness of the bus system and will maximise the environmental benefits by increasing the usage and the efficiency of the buses.	The <1% increase is insignificant in terms of Ireland's obligations under the EU 2020 Target (EU, 2017). Subject to environmental appraisal as part of the Design Stage.	Value of Change in Emissions Value of Change (€m) -€3
	Noise and vibration	Assessed at the next phase of design	The programme will result in an increase in public transport use and cycling and a reduction in car use which would reduce traffic and relatively reduce noise and vibration.		
	Waste		N/A – Subject to environmental appraisal as part of Design Stage		
	Landscape & Visual Amenity (incl. Light)		N/A – Subject to environmental appraisal as part of Design Stage		
	Biodiversity, Flora & Fauna		N/A – Subject to environmental appraisal as part of Design Stage		
	Agriculture		N/A – Subject to environmental appraisal as part of Design Stage		
	Non-Agricultural Properties		A number of residential properties will be impacted by the programme and a number of properties are proposed to be acquired as part of the CPO process.		
	Architectural Heritage		N/A – Subject to environmental appraisal as part of Design Stage		
	Archaeological and Cultural Heritage		N/A – Subject to environmental appraisal as part of Design Stage		
	Soils & Geology		N/A – Subject to environmental appraisal as part of Design Stage		
	Hydrology		N/A – Subject to environmental appraisal as part of Design Stage		

	Hydrogeology		N/A – Subject to environmental appraisal as part of Design Stage		
Safety	Collision Reduction	Highly Positive	The programme includes 200km of cycle tracks making it safer for people to cycle to and from work or for leisure. The improved cycle infrastructure will reduce collisions and protect cyclists who are the most vulnerable road users currently. The impact has been quantified and monetised as part of this business case. BusConnects Dublin will encourage people to shift from private cars to cycling, bus and rail. This will decrease road traffic which due to the lesser likelihood of injury incidents on buses will reduce the number and severity of injury incidents overall. The impact has NOT been quantified nor monetised as part of this business case.		Value of Change (€b) €0.31
	Security	Highly Positive	Improved numbers on public transport and improved accessibility to all areas will improve security by increasing passive surveillance which can reduce anti-social behavior. Increased use of electronic ticketing will reduce the possibility of theft.		
Physical Activity	Ambience	Highly Positive	The segregated cycle tracks planned make cycling safer and more enjoyable and therefore improve ambience.	**Type of benefit** / **Base Case – 10% new cyclists** Absenteeism € 0.003 Journey Quality € 0.266 Collisions € 0.242 Health € 0.067 Cyclist Travel Time Benefit € 0.150 Residual value € 1.074 Present Value of Benefits (PVB) € 1.802	Value of Change (€b) € 1.802
	Absenteeism	Highly Positive	The programme has a positive effect on citizens' health thanks to increased physical activity both in the form of cycling and walking, which subsequently has a positive effect on reducing absenteeism.		
	Reduced Health Risk	Highly Positive	The programme includes 200km of cycle tracks and therefore encourages people to cycle. The 230km of bus lanes and overall improvement to bus infrastructure will encourage more people to take the bus which involves walking to and from the bus stop. Such physical activity has a positive impact on health and wellbeing and reduces health risk.		
Economy	Transport Efficiency and Effectiveness	Highly Positive	The BusConnects Dublin programme will significantly reduce peak period bus journey times on each corridor which will improve accessibility and social inclusion by improving access to the majority of the city. The BusConnects Dublin programme will significantly improve the transport network in the Dublin area which will attract new users to public transport and result in a significant reduction in travel time for existing and new public transport users. Investment of this scale will likely lead to some wider economic impacts such as agglomeration. These have not been monetised at this point however they are likely to exist albeit not at a significant scale as the investment focusses on improving the existing network rather than bringing public transport to new, previously unserved, areas.	**Monetised Impact by Trip Purpose (€m)** **Sustainable Transport Impacts Public** €6.6b **Private Vehicle Impacts** -€4.8b Residual Value (All modes) €2.1	Value of Change (€b) €3.8b
	Wider Economic Impact	Highly Positive		BusConnects Dublin will generate a total of €1.3 billion in GVA in the domestic economy between 2020 and 2032, compared to just €39 million in the DoMin Scenario. This figure is made up of €567 million in direct GVA, and €716 million in indirect and induced GVA in the wider economy BusConnects Dublin will generate 19,800 Full-Time Equivalent (FTE) jobs over twelve years during the planning and construction phases of the programme. Approximately 10,800 FTE jobs will be created directly, while another 9,000 will be supported in the wider Irish economy	
	Funding	Neutral		**Implementation Costs - 60 Year Present Value €b (2020 values and prices)** Capital Costs €2,037 Renewal Costs €560 Operating Costs €6,122	
Accessibility and Social Inclusion	Deprived Geographic Areas	Moderately Positive	The programme will improve journey times and journey time reliability, thereby improving access to employment, education, healthcare for all users including vulnerable groups. In addition, the programme will improve the quality of service	**Impact on Deprived Areas** The number of residents located within 400m of a 10-minute frequency public transport service	

			provided to vulnerable users through improved fleet, ease of payment and improved stop infrastructure.			would increase from approximately 800,000 to over 925,000.			
	Vulnerable Groups	Highly Positive				**Impact on Access to Employment or Vital Infrastructure** On average, 18% more places of employment could be reached by Dublin-area residents in 30 minutes of travel time.[102]			
Integration	Transport Integration	Highly Positive	The programme will facilitate interchange between bus and other transport modes through new route designs, fares, passenger waiting facilities and information to increase the amount of transfer behaviour. There will be no financial penalty for transferring between bus or rail services and this will encourage interchange across the network. The improved opportunity for interchange and high quality services into the city centre will also benefit regional route passengers to move within the city. The programme will be complementary to other schemes outlined in the Project Ireland 2040: National Development Plan such as the proposed Metrolink and DART Expansion Programme both of which are currently in planning. The programme will improve road based public transport at both a local, regional and national level, by improving bus journey time and reliability throughout the city. This will benefit regional as well as local bus services. The programme will achieve the objectives of the Project Ireland 2040: National Planning Framework, the GDA Transport Strategy 2016 – 2035 and the City and County Development Plans to generally improve quality of life and improve accessibility to work, education and other activities.			Highly Positive			
	Land-Use Integration	Moderately Positive				Highly Positive			
	Geographical Integration	Highly Positive				Highly Positive			
	Integration with Other Government Policies	Highly Positive				Highly Positive			

Overall Scale of Impact								
	Environmental	Neutral	**Economy**	Moderately Positive	**Summary of Benefits (€ millions)**			
	Safety	Highly Positive	**Accessibility & Social Inclusion**	Highly Positive	**Present Value of Benefits (PVB)**	€5.1b	**Net Present Value (NPV)**	€1.8b
	Physical Activity	Highly Positive	**Integration**	Highly Positive	**Present Value of Costs (PVC)**	€3.28b	**Benefit to Cost Ratio (BCR)**	1.6:1

[102] *BusConnects Dublin Network Redesign Report (2018), p.155*

13

Risk assessment

13 Risk assessment

Chapter Summary

- Large capital projects are exposed to an inherent level of risk and uncertainty due to their complexity.
- It is therefore important that steps are taken to identify and manage risk and uncertainty for the programme.
- This chapter considers the various risks associated with BusConnects Dublin, both at an overall programme level and at an individual project level.
- This chapter also identifies mitigants that can help reduce certain risks, considers the likelihood of risks materialising and the potential impact that they may have on the programme.
- At this stage of the project, risk has been assessed at a high level at programme and project level with an ongoing exercise of risk identification and categorisation from an overall risk management stage.
- It is recognised that risk management needs to be further developed going forward with QCRA/QSRAs done for specific project elements and an approach to management of contingency at programme versus project level established. These are issues that will be addressed going forward in next steps.

13.1 Risk Management approach

BusConnects Dublin follows a programme approach separated into several project elements. The Risk Management approach is applied in a similar manner whereby an overarching Risk Management framework has been established at a programme level, and then individual Risk Management frameworks are established at project level. This is standard project management practice and provides significant benefits to managing groups of projects that are delivering on the same benefits.

Under this approach the most significant risks and those risks having an impact in more than one project element are escalated and managed at programme level. This makes for a more effective response mechanism to overall risks.

Interdependencies and interfaces are a key aspect of programme risks. In order to manage this risk effectively, NTA has set up a "overlaps committee "led by the Programme Coordinator and attended by all Project Directors, that controls risks affecting more than one project element. See also the role of the Programme Board and Programme Coordinator in Section 15 below. Individual project teams maintain risk registers for the relevant project. Key risks are escalated to the Programme Coordinator via the "overlaps committee" and reported to the BusConnects Programme Board.

13.2 Steps to evaluating risk

BusConnects Dublin follows the CAF approach to evaluating risk. This approach suggests a stepped approach to fully understand and evaluate the risks which aligns with Project Management best practices:

1 Risk identification: develop a risk register grouping risks by type

2 Assess impacts and estimate likelihood of outcomes: identify what aspects of the project are impacted (cost, schedule, quality), quantify the consequences and estimate the probability of a risk happening.

3 Derive probability distribution for the costs of the scheme: considering all identified risks, their impacts and likelihoods, a probability distribution is created which gives the probability of the scheme cost estimate being less than or equal to any specific value. Modelling software can assist on establishing the range of costs and probabilities of outcomes.

4 Risk mitigation: once risks are identified and defined the focus is on preparing mitigation plans and providing evidence of the approach to responding to risks. Responding to risks will involve accepting, eliminating or transferring risks.

5 Identify potential contingencies: Even where an evaluation of risks and their impacts is undertaken, some risks will remain unknown. As programmes progress new risks can appear. Therefore, projects should include a provision for unknown contingencies.

Individual project teams proactively manage risk by developing, controlling and monitoring risk registers with timely reporting into the specific project boards. At these boards, decisions around risks are made. There are 7 no. project boards set up for BusConnects Dublin providing an optimal amount of breakdown to the programme so that risks can be managed effectively. Requirement for risk escalation is assessed not only by the project boards but also via the overlaps committee, led by the Programme Coordinator as explained above. Escalated risks are then reported into the BusConnects Programme Board responsible for overseeing the overall delivery and acting as the approving authority. For more information on the governance structure of BusConnects Dublin refer to section 15.

13.3 Programme level risks

The key risks identified to deliver BusConnects Dublin successfully at an overall programme level are set out in Table 13-1 below. The approach to managing individual project level risks is discussed in Table 13-2 below.

Table 13-1 – Programme level risks

Risk	Description	Consequences	Impact	Likelihood	Mitigations
Programme wide approvals	There is a risk individual BusConnects Dublin elements are delayed as a result of relying on programme-wide approvals to proceed.	• delays to overall delivery programme	Very High	Low	• separate approvals processes for individual elements where possible
Cost risk	There is a risk the complexity of the BusConnects Dublin programme and the lack of certainty around designs and implementation can result in costs exceeding the initial estimates.	• increase in costs • reputational damage to the NTA	Moderate	Very High	• cost projections have been developed at project level. • account reference class forecasting in conjunction with quantified risk analyses carried out to calculate contingency levels. • detailed service cost estimates will be prepared • reviews and assurance functions must be in place • independent cost estimates should be commissioned, benchmarked to global projects of the same nature • Appropriate contract delivery models set up for the different elements • Early market engagement
Funding risk	These is a risk of lack of funding from Government to carry out the programme due to a shortfall on the allocation made in the NDP 2018-2027, of due to an economic recession where re-prioritisation of spending is required.	• poor quality of services caused by a reduction in scope • benefits of the BusConnects Dublin programme reduced	High	Moderate	• funding risk sits largely outside the control of the NTA but it can exert its influence to help secure funding • stakeholder and funder engagement following the PSC process getting approvals in time at decision gates • individual projects should progress through planning and design, ensuring that they are ready for implementation as soon as funding is made available • funding allocated shall be used as efficiently as possible • business case developed and updated at key milestones to highlight the benefits associated with all the programme elements clearly justifying the spend. • a robust Project Management and Project Controls functions shall be in place to drive delivery and avoid delays
Programme/Schedule risk	There is a risk around programme uncertainty and the duration of some of the key tasks to deliver BusConnects Dublin due to a lack of progress in works and the complex nature of major infrastructure projects.	• delays to overall delivery programme	Moderate	Very High	• a robust Project Management and Project Controls functions to monitor programme of works • have response plans to uncertain outcomes • robust risk management processes • efficient use of procurement processes
COVID-19	There is a risk COVID-19 impacts the delivery of BusConnects Dublin due to government and health restrictions as well as indirect impacts to the productivity of the construction sector	• delays to overall delivery programme • effects on cost	Moderate	Very High	• set up their staff with remote working capabilities, • having appropriate H&S measures on site • monitor closely the evolution of the pandemic, including the consideration of Alternative Future scenarios

Risk	Description	Consequences	Impact	Likelihood	Mitigations
Legal challenge risk	There is a risk BusConnects Dublin could be challenged legally due to the significant impact of the scheme on the environment. Legal challenge could come in various forms, including legal proceedings, public objections to planning and judicial review of CPO decisions.	• delays to overall delivery programme • This risk is especially impactful on the Core Bus Corridors element	Very High	Low	• legal counsel/team with experience on Major infrastructure to provide advise throughout delivery • careful reviews of legal documentation and technical notes need to be undertaken at all stages • careful archiving of information throughout the process • ensure the project documentation will hold up robustly in any legal proceedings • set up document management systems • careful assessment of risk allocation, contract delivery models and market engagement
Technology availability and compatibility	There is a risk the technology systems required to implement BusConnects Dublin will not be fit for purpose or delivered to the specification levels required due to market availability or incompatibilities amongst operators and different project elements.	• delays to overall delivery programme • poor quality services • reduced patronage and future revenues • reduced benefits of the BusConnects Dublin programme	Very High	Moderate	• specialist skill sets teamed up to oversee the implementation of new technological systems. • market consultations with suppliers and technology availability • careful thought to procurement strategy • robust specifications and requirements based on performance outputs of systems • specialised teams with demonstrated experience in implementing such technology in similar projects, • future proofing of whole life considerations in contracts
Resource risk	There is a risk the NTA will have insufficient resources internally to deliver the BusConnects Dublin programme to successful completion due to the scale of the programme.	• delays to overall delivery programme	Moderate	Moderate	• ensure appropriate level of resourcing is made available internally for each project • careful consideration to the amount of outsourcing required to resource appropriately and fill knowledge/experience gaps. • Use of external advisers
Market constraints	There is a risk the supply chain has insufficient capacity to deliver the BusConnects Dublin programme successfully due to its scale and other capital investments being undertaken.	• delays to overall delivery programme	High	High	• continuous engagement with framework contractors to ensure pipeline of works • market consultations and advertisement of works • liaison with operators on roles and responsibilities
Brexit	There is a risk NTA faces market constraints, increased costs and impediments to sourcing materials and equipment from UK suppliers due to Brexit.	• additional costs	High	High	• Early market engagement with potential alternative suppliers to the UK
Remote working	There is a risk public transport patronage and service demands are altered due to a	• reduced patronage and future revenues	High	Very High	• Monitor trends on remote work and new travel patterns by population

Risk	Description	Consequences	Impact	Likelihood	Mitigations
	sustained increase on remote working rates as seen during the pandemic.	• reduced benefits of the BusConnects Dublin programme			• Adapt the BusConnects Dublin programme to changes in travel behaviour.

13.4 Project level risks

This section sets out, by way of example, the top project level risks identified for each of the individual BusConnects Dublin elements (based on an assessment at a particular point in time). These risks are examples of how the Programme Risk Management Framework is applied at project level (which are then cascaded up to Programme level as described above).

Other project specific risks are being identified, assessed and monitored as part of the Programme Risk framework set up by the NTA. Examples of these other risks include the following categories:

- Programming and phasing of works
- Governance frameworks and processes
- Supply of specific equipment and skills
- Procurement design and specific delivery models
- New maintenance procedures and skills required for operation

A Reference Class Forecast exercise has been completed for Core Bus Corridors and Next Generation Ticketing, two of the most significant programme elements in terms of capital cost and programme risks. The RCF provides an outside view of the project, circumventing optimism and providing recommendations as to how much contingency should be considered both for the total cost and schedule of the projects. The recommendations of these studies are being incorporated to the risk management framework of BusConnects.

Table 13-2 below sets out a table of sample risks at a project level.

Table 13-2 – Project Level top risks

Project	Risk	Description	Consequences	Impacts	Likelihood	Mitigations
NRD	**Communication with bus operators**	Poor communication with bus operators will make it difficult for the new redesigned network to be implemented and mis-coordination.	• delays to the roll-out of the network, • increase in costs • inefficiencies in final bus services.	Very High	Very High	• continuous engagement with bus operators • communication plan in place • Working groups NTA/operators to be established
NRD	**System incompatibility**	Due to a change in route information and coding, and the existence of different operators, there is a risk that bus operator systems will not be compatible with the updated redesigned network initially.	• delays in the delivery if bus systems are unable to identify the new routes • poor customer satisfaction with buses not showing on real time information displays correctly.	Very High	High	• continuous engagement with bus operators • sharing of technical information • mechanisms to flag system incompatibilities early. added to the NRD Project plan for monitoring
NRD	**Understanding the new bussing service**	In moving from a system of direct bus routes to a system where interchange is required, there is a risk that customers struggle to understand the new proposed concept, which could deter them from using the network.	• customer dissatisfaction • impact on patronage and future revenue • reduce benefits of programme (reverting back to car, disrupt bus services with increased congestion)	High	High	• proactively engaged and communicated with customers to educate them • Various public consultation rounds initiated • Careful of feedback received from customers.
NRD	**Waiting times at interchanges**	There is a risk that interchanging from high frequency routes to low frequency routes could result in excessively long wait times for customers.	• customer experience • impact on patronage and future revenue • reduced benefits of programme	High	High	• timetable interactions between routes are being reviewed thoroughly to optimise schedules and guarantee connections. • safe, well-lit interchange shelters are also being designed to ensure pleasant waiting environments. • concept of late local service to address potential long waiting times at the low frequency routes is being looked at.
NRD	**Bus priority**	There is a risk that certain bus routes will not be afforded sufficient priority to ensure services can operate efficiently. This is particularly important for the O-Route, as it is a flagship route with multiple junctions and crossover points along the route.	• poor quality service • impact on patronage and future revenue	High	Very High	• examine the route and junction priorities • deploy best in class priority measures in advance of launch • test the routes for timing and delays. • Close engagement with the public to manage expectations • possibility of forming a dedicated team for flagship routes

Project	Risk	Description	Consequences	Impacts	Likelihood	Mitigations
NRD	Bus operator scheduling capacity	Bus operators may not have sufficient scheduling capacity to change in line with the proposed network redesign and therefore peak capacity requirements may not be met.	• delays on project implementation • poor quality service at peak times • long waiting times • impact on patronage and future revenue • reduced benefits of programme	Very High	Very High	• careful consideration of bus operators' requirements. • plan for spare capacity, resources and extra buses to deal with the revised network. • employing temporary resources to help operators initially • current and future data to identify when buses are being overloaded.
NRD	Insufficient capacity	There is a risk of insufficient capacity within the existing depots to provide for the requirements of the redesigned network.	• Increase in cost due to investment required in depots • Delays to fleet deployment due to lack of infrastructure	High	High	• Depot capacity currently being reviewed on a phase by phase basis • Depot strategy being developed
NRD	Technical deliveries	There is a risk the supply chain provides unfavourable fares and timelines to implement network redesign elements	• Increase in cost • Delays on implementation	High	High	• Review of full project plans to accommodate longer durations for certain activities • Decouple some elements of the NRD element and prioritise
CBC	Design uncertainties	Due to a lack of detailed site information, there is a risk that current designs are inaccurate resulting in costings suffering from optimism bias. In addition, information may be lacking in relation to existing underground infrastructure which may not be captured in current cost estimates accurately.	• delays on project implementation • cost impact specifically around interface with underground services and adjacent properties.	Very High	High	• design teams have been appointed to produce designs informing cost estimates • additional independent cost assurance function has also been commissioned. • CAF risk assessment framework being followed to capture uncertainty
CBC	Traffic management risk	The construction of the CBCs will be a complex project in congested areas and existing operational urban roads, requiring careful traffic management procedures. This risk is also associated to potential changes in traffic management legislation.	• delays on project implementation due to phasing or night works • cost impacts	High	Very High	• schemes are being delivered on a phased basis • detailed construction logistics plans to be put in place • work closely with DoT personnel to ensure it is a high priority

Project	Risk	Description	Consequences	Impacts	Likelihood	Mitigations
CBC	**Pushback on CPOs**	As part of the widening of the bus corridors, private land will need to be acquired from residents under Compulsory Purchase Orders (CPOs). There is a risk that the NTA will face pushback from residents in relation to this, which could result in legal challenge.	• reputational damages to the NTA • increased costs of land purchases • delays due to legal challenges	High	Very High	• Close communication with residents in relation to the CPOs • expert team to explain clearly and justify the CPO process to residents/stakeholders • feedback from residents appropriately managed and addressed
LEV	**Procurement processes**	There is a risk that procuring state-of-the-art LEV and electric buses may take longer than originally anticipated, particularly given that the NTA has not procured many to date.	• delays in rolling out the LEV fleet • reduced benefits of BusConnects Dublin programme.	High	High	• early initiation of procurement process • detailed planning of bus no. requirements and purchase plan.
LEV	**Equipment availability and technology readiness**	New bespoke equipment will be required for the new bus fleet, including new radio equipment, Automatic Vehicle Location equipment and other systems, which may not be available or may have lead times for procurement. There is a risk difficulty arise in procuring bespoke equipment around radio and AVL systems due to availability in the market and technology not suited for the requirements.	• delays deploying the new fleet, • poor quality service having to accept lower spec equipment • customer satisfaction reduced benefits of the BusConnects Dublin programme	Very High	High	• The response strategy to this risk is to run with the older buses in early phases until the new equipment is available and the new fleet is ready to be deployed.
LEV	**Electrical charging infrastructure**	There is a risk the roll out of LEF outpaces the deployment of charging infrastructure being deployed at depots, charging facilities.	• delays on roll out of LEF • cost impact of accelerating electrical charger's infrastructure deployment	High	Moderate	• Strategy and plan of charging infrastructure in advance of the delivery of the first electric vehicles. • Consideration has already been given into the requirement for additional depot, as space in existing depots will be reduced • close coordination between LEF roll out plan and electrical chargers plan
NGT	**Lack of internal expertise**	There is a risk the NTA internal team lacks the required technical knowledge on ticketing systems to deliver on the project.	• delays on roll out of NGT • reductions in benefits of the BusConnects Dublin programme.	Very High	High	• Dedicated team with technical expertise in NGT Training of internal resources on ticketing systems • Outsourcing and bringing expert consultants

Project	Risk	Description	Consequences	Impacts	Likelihood	Mitigations
NGT	Solution not fit for purpose	There is a risk that the solution and the provider of the solution for NGT provides a product and service that is not fit for purpose and does not meet the principles and objectives of the NTA	• delays on deployment of NGT • cost overruns • poor quality service	Very High	Medium	• undertake a robust procurement process • design a contract with the right risk/reward balance • detail a service specification and evaluation criteria through dialogue • pre-qualify candidates with appropriate resources and experience • competitive dialogue utilised to address areas of the solution that will be further defined pre contract • dedicated expert team to scope ticketing systems. robust assurance processes in place to review requirements • support from consultants with international expertise in similar projects
S&S	RTPI technology	There is a risk that Real Time Passenger Information will not be showing or will display inaccurate information due to systems incompatibility, technology availability.	• poor quality service impacting customer experience and reliability of service • impact on patronage and future revenue • reduced benefits of programme	Very High	Very High	• rigorous testing and monitoring of equipment • appropriate resourcing to manage RTPI • corrective actions plan to react to issues efficiently
S&S	Public acceptance	There is a risk customers are not satisfied with the new poles and stops look resulting in a late modification to designs.	• Increased costs	High	Medium	• Public engagement throughout design process • Booklets produced for advertising benefits
S&S	Roles & Responsibilities	Due to lack of clarity on responsibilities with regards to the S&S element, there is a risk of not delivered effectively or on time.	• delays on roll out • patronage and future revenues as customers reject interchanging at outdated S&S.	Very High	High	• clear roles within the NTA in relation to S&S • Individuals empowered to make decisions
P&R	Inadequate business case	There is a risk the business case for developing P&R will not be enough to warrant the delivery of the project.	• reduced benefits of the BusConnects Dublin programme as commuters residing in commuter towns would be unable to easily access the bus network in Dublin. • decrease in cost • patronage and future revenues	Very High	Moderate	• comprehensive case to be put forward for P&R • highlight and quantify benefits to overall programme. • development team has been put together

Project	Risk	Description	Consequences	Impacts	Likelihood	Mitigations
P&R	Cost uncertainty	There is a risk the P&R element is not well defined and costed due to assumptions not being validated, rigorously tested or challenged.	• cost increase/decrease	High	High	• cost estimate to be validated by a separate team • benchmarking to be carried out against similar projects (Luas)

13.5 Summary

A summary of the key points is provided below:

- BusConnects Dublin has a Risk Management framework established at a programme and project level following best practice Project Management allowing NTA to manage risks proactively.
- Interdependencies and interface risk are a key aspect of programme risks. In order to manage this risk effectively, NTA has set up a committee that controls programme wide risks.
- BusConnects Dublin follows the CAF stepped approach of risks evaluation whereby: risks are identified, impacts and likelihoods are assessed, mitigations are put in place and contingency plans are prepared.
- Top risks at programme and project element level is summarised in this section.
- The approach to Risk Management is evolving as the Programme develops – detailed QRSA/QRA analyses will be prepared as projects reach the required level of maturity to warrant this approach.

14

Procurement and implementation

14 Procurement and implementation

Chapter Summary

- Procurement of BusConnects Dublin is and will be carried out in accordance with NTA Procurement Policies and Procedures, which adhere to the to the National Procurement Policy Framework
- The NTA, in accordance with Irish and EU requirements, use the following procurement procedures:
  - Open Procedure
  - Restricted Procedure
  - Competitive Dialogue Procedure
  - Competitive Procedure with Negotiation
- BusConnects Dublin comprises a variety of programme elements (e.g. CBCs, fleet, etc.) each with its own unique challenges and required sectoral expertise.
- Given the diverse capabilities required for each project, the NTA's proposed strategy is to procure each of the core projects separately.
- This will allow programme elements to be developed and delivered within timelines that suit their specific requirements.
- Each project element has developed an implementation plan and programme.
- NTA will need to be appropriately resourced to deliver the programme.

14.1 Introduction

Procurement of BusConnects Dublin is and will be carried out in accordance with NTA Procurement Policies and Procedures, which adhere to the to the National Procurement Policy Framework which consists of 5 strands:

- Legislation (Directives, Regulations);
- Policy (Circulars etc.);
- Capital Works Management Framework;
- General Procurement Guidelines; and
- More detailed technical guidelines and notes issued periodically by the Policy Unit of the Office of Government Procurement.

All tender and contracting processes are carried out in accordance with NTA approved procedures and will follow existing procurement practices in the selection of suppliers. All external suppliers are procured through a competitive tendering process.

NTA's procurement policy is designed to ensure a common approach across the NTA in the procurement of goods and services including the following objectives:

Compliance with the National Procurement Policy Framework and each of the 5 strands set out above with the intention that NTA resources engaged in the procurement process adhere to such compliance;

- Delivery of a common, corporate process of strategic sourcing, supplier relationship development and contract management;

- Achievement of greater value for money by:
  - ensuring that purchasing is carried out in a coordinated and strategic manner;
  - reviewing and where possible, streamlining existing procurement processes;
  - identifying opportunities for savings, for example by utilising national frameworks or other means.
- Supporting an efficient devolved procurement process across the NTA;
- Enhancing leadership, governance, awareness and skills;
- Facilitating economic, social and environmental objectives;
- Use of transparent open processes and specifications; and
- Appropriate market soundings in advance of formal procurement.

14.2 Relevant Procedures

The NTA, in accordance with Irish and EU requirements, use the following procurement procedures:

- Open Procedure
- Restricted Procedure
- Competitive Dialogue Procedure
- Competitive Procedure with Negotiation
- Negotiated Procedure without Prior Publication (applicable in very limited circumstances)

The most commonly used procedure is the Open Procedure. The advantage of the Open Procedure is that it invites an unlimited amount of offers and, therefore, unlimited competition (unlike other procedures there is no maximum number of participants). The primary disadvantage to the NTA is the potential administrative burden of having to evaluate a large number of tender submissions. The Open Procedure is being considered in relation to the CBC packages (see 14.3.1).

The Restricted Procedure tends to be used where there is a need to pre-qualify suppliers where there is evidence that the number of potential suppliers is very large or where the NTA wishes to limit the number of suppliers who will have access to certain confidential and/or sensitive information. The procedure can be used to reduce the number of tenderers to be evaluated by the assessment panel. The disadvantage of the procedure is that it takes longer and can be a more complicated procedure.

The Competitive Dialogue Procedure and the Competitive Procedure with Negotiation may only be used for works, goods and services contracts whereby one or more of the following circumstances apply:

- the needs of the NTA cannot be met without adaption of readily available solutions;
- the contract includes design or innovative solutions;
- the technical specifications cannot be established with sufficient precision;
- a contract cannot be awarded without prior negotiation because of specific circumstances related to the nature, the complexity or the legal and financial make-up or because of risks attached to the works, goods or services; and
- in response to an Open or Restricted Procedure where only irregular or unacceptable tenders were submitted.

Either of these procedures tend to be used in the case of complex high-value projects where the above conditions are met, such as a major integrated transport infrastructure programme such as BusConnects Dublin. In relation to the difference between the two procedures, the Competitive Dialogue Procedure provides for some clarification and optimisation after the final call for tenders making it much better for highly complex outcome-based procurement. It offers a more structured procedure than the Competitive Procedure with Negotiation and arguably, therefore, offers more safeguards for the NTA. However, it offers less scope for negotiation once the NTA has identified a solution (s) for meeting its needs. The Next Generation Ticketing project is proposing to use the Competitive Dialogue procedure for the reasons stated above.

The Negotiated Procedure without Prior Publication can only be used in very limited and narrowly defined circumstances, none of which currently apply to BusConnects Dublin.

14.3 Procurement strategy

BusConnects Dublin comprises a variety of programme elements (e.g. CBCs, fleet, etc.) each with its own unique challenges and required sectoral expertise. While the outcome of BusConnects Dublin is interdependent on the various programme elements being delivered, the actual physical works required to deliver them are more separable. Given the diverse capabilities required for each project, the NTA's proposed strategy is to procure each of the core projects separately. This will allow programme elements to be developed and delivered within timelines that suit their specific requirements. The procurement and delivery strategies for each of the projects have been considered below.

14.3.1 Core Bus Corridors

The form of contract and procurement mechanism selected for construction projects of this nature is a key element in reducing risk for project delivery. The CBCs are primarily located in urban and suburban areas and this can present challenges in how the contractor can deliver. The presence of archaeology, the risk of unknown utilities and the need to construct the works in a manner which keeps business open and the transport system moving places risks and constraints on a contractor. The appropriate division of scope across contracts and work packages, along with selecting the appropriate form of contract for such work packages is fundamental to achieving successful project outcomes.

Over the last three decades there is significant experience developed within Ireland in delivery of major capital investment projects. NTA will seek to leverage the lessons learned from these projects to develop the appropriate procurement strategy for the CBCs. There are several urban transport schemes and public realm improvement schemes which provide insight into the handling of risk within the procurement and implementation stages of the project. Most recently Luas Cross City provides insight into significant construction works within in a city centre environment with high risk of unknown utilities, ground conditions and archaeology.

For the CBC project, there are 16 core bus corridors, which have been combined into 12 core bus corridor infrastructure work schemes. The procurement strategy for CBCs will consider all available contract forms starting with the suite of Public Works Contracts. The use of the UK NEC 4 contract forms and the associated options will be considered. NEC are a suite of contracts developed by the UK institute of Civil Engineers which are based on the principles of collaboration. NEC 3 (c) – Target Cost with Activity Schedule was successfully adopted on the utilities diversion project for Luas Cross City. In addition, the appropriate packaging of works will be considered (e.g. to generate economies of scale). This may vary depending on the scheme as certain corridors will have greater exposure to utility diversion or archaeological risk.

At this stage the emerging preferred contract stage is that each of the 12 work schemes will be tendered for and built individually. Each package will be procured through an open procedure, which will seek to award several design and build contracts to tenderers. In order to guide bidders in the tender process, specimen designs will be produced for each work scheme. Further packaging was considered and deemed suboptimal for these projects.

Subject to approval, the contract will be structured as an NEC contract to allow for the spirit of collaboration and to encourage a shared responsibility for delivering the projects on schedule and budget within the urban and suburban environments.

At this stage no decision has been made on whether advance work packages will also be tendered. The appropriate packaging of the 12 schemes will be developed in tandem with the design of the schemes when a greater understanding of the risks associated with archaeology and utilities has developed.

Regardless of the contract form, it is expected that the procurement process for each work scheme will take up to six months to complete, including the pre-qualification and tender phases. Assuming construction of the first work scheme begins in Q1 2024, procurement for this will kick off in Q1 2023.

14.3.2 Next Generation Ticketing and Cashless Payments

The NGT project is being procured through a Competitive Dialogue procedure, which will seek to establish a Single Party Framework Agreement for the provision of all the NGT elements. The pre-qualification phase kicked off in Q3 2020, which is seeking to bring up to five candidates forward to the Competitive Dialogue stage. The deadline for the submission of Pre-Qualification Questionnaires (PQQ) was the end of November 2020 and there is significant market interest in the project. The PQQs will need to be assessed in December 2020, therefore the Competitive Dialogue stage is unlikely to begin until Q2 2022.

It is anticipated that the NTA will provide successful candidates with access to an NGT virtual data room once the Competitive Dialogue process has launched in Q2 2022. A number of dialogue stages will then be held, where participants will be expected to submit their detailed proposed solutions. The NTA will review and assess these solutions and provide feedback, which will result in further iterations of the proposed solutions being produced. The final dialogue stage is expected to conclude Q4 2022. Once this has closed, the NTA will issue an invitation to submit formal tenders, with an expected deadline in Q4 2022. The tenders will be evaluated, and a contract will be awarded before Q3 2023.

Low/Zero Emissions Vehicles

NTA has developed as medium term fleet transition strategy which will bring the current bus fleet from a diesel only fleet using a mix of EURO IV, EURO V and EURO VI vehicles to a low emissions fleet.

In recent years the available fleet technology has continued to develop with innovation continuing to occur. The range of electric buses continues to increase, and the hydrogen fuel cell vehicles are now beginning to enter services.

The procurement strategy for the bus fleet must reflect the changing landscape of the bus market and the technology that is available to meet the demands of the future bus network. In devising the appropriate procurement strategy, it is necessary to balance the potential value for money achieved through economies of scale when placing large orders against the maintaining the flexibility to avail of new technological solutions. In this regard the procurement strategy and phasing of implementation needs to meet the steady state renewal requirements of the existing bus fleet whilst also catering for increased fleet numbers.

In addition to the fleet technology it is also necessary to consider flexibility in the make-up of the fleet between different bus sizes and types. While double deck bus is likely to remain the dominant vehicle type in the bus fleet, the nature of some of the local routes proposed under the network redesign may warrant greater numbers of single deck vehicles and midibuses.

NTA will procure a number of bus frameworks covering a range of vehicle types. These are open procurement with a commitment to an initial order and an agreed price for subsequent orders. There is no commitment to subsequent orders. In general, the lead in time for procurement of buses is generally 18 to 24 months. At present NTA currently operates frameworks for Double Deck Hybrid Buses. A tender process is currently underway for single deck electric vehicles to ensure vehicles are available by 2022.

Similarly, a pre-qualification process for Double Deck Electric vehicles will commence at the end 2020 to ensure vehicles are available for service in 2023.

Further procurements will be undertaken in line with the fleet requirements and the outcome of the fleet technology trials to be undertaken in 2021.

14.3.3 Network Redesign

A procurement strategy is not required for the network redesign component of the BusConnects Dublin programme, as this project is already underway and has been ongoing since 2017. The remaining costs relate to professional services that have already been procured.

Following a round of stakeholder and public engagement in 2017, the general objectives of the network redesign were agreed. Detailed service change ideas were developed to address the objectives, which were presented for public comment during 2018. Since then, a number of public consultation rounds have occurred, bringing on board feedback from transport users to improve the network redesign plans. At this stage, the final public consultation process is underway, and planning has commenced to decide how best to redesign the network and to introduce the new services.

14.3.4 Bus Stops and Shelters

For the locations outside of core bus corridors, the supply and installation of bus poles and bus shelters will be undertaken as part of the national programme for the delivery of bus poles and shelters. NTA currently operates framework contracts for the bus pole installation and bus shelters. The current frameworks operate on a minimum three-year period with opportunities to extend for up to a further two years. It is anticipated that during the implementation process these frameworks will be retendered.

14.3.5 Park and Ride Facilities

A procurement strategy for the provision of Park & Ride facilities has not yet been finalised. The procurement strategy will be informed by the type, locations and timing of implementation of Park & Ride sites. The models for procurement may include standard construction with subsequent operations, design, build and operate or design, build operate including bus operations.

Opportunities to build or integrate with existing park and ride operational contract will be explored with other transport operators including Transport Infrastructure Ireland and Iarnród Éireann.

14.4 Implementation plan

14.4.1 Core Bus Corridors

The core bus corridors work schemes are expected to be constructed in three groups of four. Construction of the first group of work schemes is projected to begin in 2024 and complete by the end of 2025, the second work scheme will begin in 2026 and is expected to be completed by 2027, while the final work scheme will begin in 2028 and is expected to be completed by the end of 2029. The indicative construction schedule is set out in Figure 14.1 below.

Core Bus Corridor construction schedule						
	24	25	26	27	28	29
Scheme	Lot A		Lot B		Lot C	
Clongriffin to City Centre Scheme						
Swords to City Centre Scheme						
Ballymun / Finglas to City Centre Scheme						
Blanchardstown to City Centre Scheme						
Lucan to City Centre Scheme						
Liffey Valley to City Centre Scheme						
Tallaght / Clondalkin to City Centre Scheme						
Kimmage to City Centre Scheme						
Templeogue / Rathfarnham to City Centre Scheme						
Bray to City Centre Scheme						
Belfield / Blackrock to City Centre Scheme						
Ringsend to City Centre Scheme						

Figure 14.1 – Core Bus Corridor construction schedule

The construction of the CBCs will likely result in significant traffic congestion and will cause disruption to other road users. For this reason, it is proposed that the CBCs are implemented on a phased basis in line with the schedule in Figure 14.1 above, which should help reduce the widespread disruption during the implementation period.

In advance of commencing construction of the CBCs, land will need to be acquired by local councils in certain areas to facilitate the widening of the road network. The land will be acquired by compulsory purchase orders, beginning in 2023 and concluding in early 2025. Planning consent will also need to be obtained in advance of the construction of any of the CBCs.

14.4.2 Next Generation Ticketing and Cashless Payments

The initial phase of Next Generation Ticketing is expected to be rolled-out over the course of the second half of 2023 and 2024. Procurement is currently at the early stages of a competitive dialogue process to procure a service provider who can implement and operate the ticketing system. Each of the bidders in the tendering process will be required to develop a detailed delivery and implementation methodology to meet the objectives of the project, which will include more detail on how the NGT solution will be implemented.

The NGT system is expected to be rolled-out over several work packages with a single service provider. The first work package (work package A), will involve the delivery of a fully functioning Account Based Ticketing ("ABT") back office system. This will include all necessary hosting equipment, software, services and supporting systems. All the fare collection equipment for public transport operators will be supplied, configured and installed under this work package. The equipment will be capable of accepting and validating cEMV contactless bank cards, QR codes, TFI Leap cards and free travel cards.

A Service Level Agreement will be entered into with the service provider under work package B, which will govern the management of the ABT system. This work package will comprise service delivery, system integration, asset lifecycle management, compliance with security and privacy regulations, configuration management, certifications and standards, end-to-end solution and integration maintenance and back office support services.

Numerous other work packages will be agreed with the provider in the future, as and when required. For example, it is anticipated that work package C will extend the NGT to other non-bus operators, while work package D will transition TFI Leap cards into secure tokens that may be used with the ABT system.

It should be noted that the business case approval being sought for NGT is limited to the system wide and BusConnects Dublin specific elements of the project. Irish rail, MetroLink and Luas specific elements are not within the scope of the approval being sought.

14.4.3 Low Emissions Vehicles

The transition to low emission and zero emission vehicles will consider the steady state requirements for fleet replacement, fleet expansion to accommodate new routes and higher frequencies and stated policy for vehicle technology.

In line with the Project Ireland 2040 National Development Plan 2018-2040 commitment in to "transition to low emission buses, including electric buses, for the urban bus fleet, with no diesel only buses purchased from July 2019" the transition to low emission vehicles has already commenced. In December 2019, NTA entered into a framework agreement with Alexander Dennis Limited (ADL) to supply up to 600 Double Deck Hybrid Buses. An initial order for 100 vehicles has been placed with delivery of first vehicle occurred in November 2020.

Based on analysis of existing bus routes, the current state of technology and market conditions, it is anticipated that NTA would be in a position to move towards Zero Emission Buses for renewals from start of 2023 onwards. The current technology has the potential to cover between 50% and 75% of all routes and duties. Alternative technologies or deployment plans will be required to service longer routes and duties, it is anticipated that it will be necessary to commence this transition by 2027.

The peak vehicle requirement under BusConnects Dublin is assumed to be 1,501 in 2024. This represents an increase of 126 buses above the Do-minimum scenario where new routes and frequencies are not introduced as part of Network Redesign.

Based on the current timelines for the rollout of the BusConnects Dublin network redesign, all additional buses must be in service by the end of 2024. In this regard, the purchase of additional fleet by NTA to support BusConnects Dublin network redesign will be rolled out between 2021 and 2024.

To deliver on the transition to LEV, it is anticipated that on average 150 buses will be required annually between 2021 and 2026 with this rising to 210 buses annually between 2027 and 2032.

14.4.4 Network Redesign

The NTA has decided to introduce the new network on a phased basis. The implementation will take place over a number of years commencing in 2021 with 11 phases and will be subject to Government funding

There will be overlap in rolling out the phases and as such a number of the phases will run in parallel, e.g. once planning and analysis has completed for phase one, planning and analysis for phase two will begin while phase one is being implemented.

14.4.5 Simpler Fare Structure

The simplified fare structure, which will remove penalties for interchanging and introduce a 90-minute fare, is a key element of the network redesign. As such, the simplified fare structure will be implemented in advance of completion of the network redesign, likely alongside the implementation of NGT. NGT will be capable of understanding and dealing with more complex back-office calculations, such as those required to operate the 90-minute fare. Accordingly, NGT will facilitate the implementation of the simplified fare structure.

14.4.6 Bus Livery, Bus Stops and Shelters

The implementation of the new bus livery will occur naturally over the course of new bus procurement and the existing bus repainting cycle. Every 4 years, buses are repainted to ensure that they continue to reflect a high-quality offering to the public. The new BusConnects Dublin bus livery will therefore be rolled-out over a phased basis when individual buses are due to be repainted.

As part of BusConnects Dublin, a pole replacement programme will commence in 2021 to provide refreshed poles for bus stops in the Dublin Metropolitan Area (DMA). The pole replacement programme will precede other works relating to bus shelters and CBCs, therefore all c. 5,300 stops in the DMA will be covered by the pole replacement programme. Approximately 400 shelters will also be installed as part of the programme on non-CBC routes.

It is expected that all bus poles and shelters will be completed in advance of the completion of the network redesign, therefore it has been assumed that all poles and shelters will be implemented by the end of 2024.

14.4.7 Park and Ride Facilities

At the beginning of 2020 and in line with the requirement of the Climate Action Plan 2019 the NTA established the Park & Ride Development Office. The initial tasks of Park & Ride Development Office are to develop a strategy for Park & Ride and an associated implementation plan. While the strategy will identify all opportunities, Park and Ride specific bus-based facilities have be identified for implementation as part of the BusConnects Dublin programme. At this stage it is anticipated that there will be five locations delivered to complement the implementation of the core bus corridors. Park and Ride facilities will be delivered in parallel to the CBCs works.

15

Governance, monitoring and evaluation plan

15 Governance, monitoring and evaluation plan

Chapter Summary

- This chapter sets out the high-level governance, monitoring and evaluation plan for the delivery of the BusConnects Dublin programme.
- Section 15.2 considers governance and the roles and responsibilities of the Approving Authority, Sponsoring Agency, Project Boards, the Programme Coordinator and the NTA Board
- Section 15.3 sets out key performance indicators that may be used to monitor and evaluate the Project's delivery and success.

15.1 Introduction

This chapter sets out the high-level governance, monitoring and evaluation plan for the delivery of the BusConnects Dublin programme. Section 15.2 considers governance and the roles and responsibilities of the Approving Authority, Sponsoring Agency, Project Boards, the Programme Coordinator and the NTA Board, while section 15.3 sets out key performance indicators that may be used to monitor and evaluate the Project's delivery and success.

15.2 Governance

The Public Spending Code requires there to be a Sponsoring Agency and Approving Authority for the appraisal and delivery of public investment projects. Based on the guidelines set out in the Public Spending Code, the Sponsoring Agency *"has primary responsibility for evaluating, planning and managing public investment projects"*, while the Approving Authority *"has ultimate responsibility for the project"*[103].

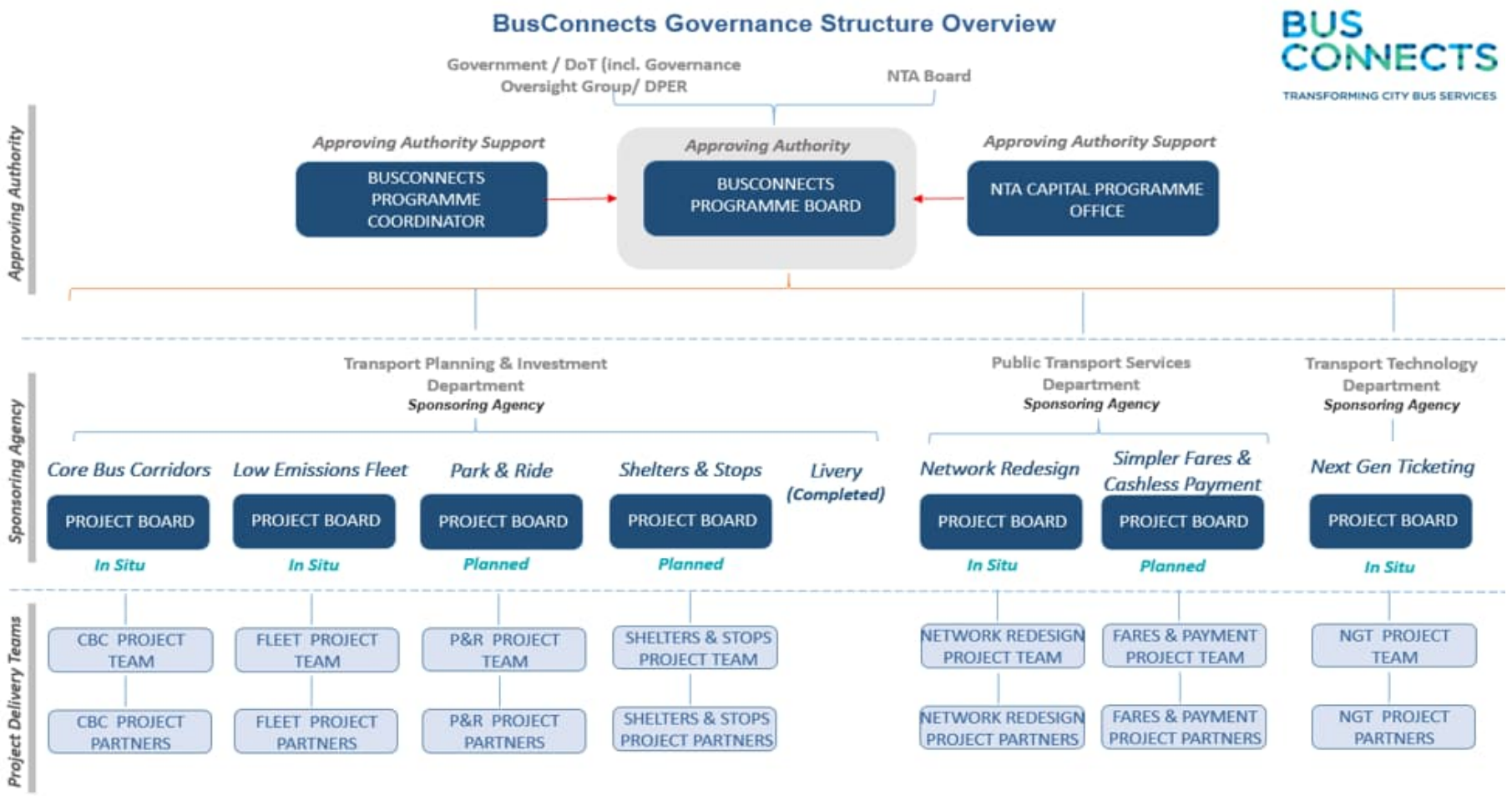
In the case of BusConnects Dublin, the NTA is acting as both the Sponsoring Agency and Approving Authority. In January 2020 Government noted that the NTA would act as both the Sponsoring Agency and Approving Authority for the BusConnects Programme, but that in doing so the NTA would ensure a clear separation of the two roles to allow for robust appraisal, scrutiny and oversight. These roles are expanded on below.

Notwithstanding the NTA's role as Approving Authority, Government approval will still be required at the key decision gates set out in the Public Spending Code, on the basis that the BusConnects Dublin programme will cost in excess of €100m.

An overview of the BusConnects Dublin governance structure is set out in Figure 15.1 below.

[103] *DPER, 2019, 'Public Spending Code', p. 14.*

Figure 15.1 – BusConnects Dublin Governance Structure Overview



15.2.1 Approving Authority

The BusConnects Dublin Programme Board is the Approving Authority for the programme. The Programme Board consists of senior NTA personnel, as well as external consultants. The Programme Board is chaired by the Chief Executive of the NTA, and the members of the Programme Board are separate to the Sponsoring Agency personnel.

The work of the BusConnects Dublin Programme Board is supported by the Capital Programme Office within the Transport Planning and Investment Directorate, who undertake the day-to-day functions associated with the Approving Authority's role, in support of the BusConnects Dublin Programme Board. The BusConnects Dublin Programme Board meets on a frequent basis and receives updates from each Project Board on the status and progress of the projects. The major decision points on each project are referred to the BusConnects Dublin Programme Board for approval.

15.2.2 Sponsoring Agencies

The BusConnects Dublin programme consists of nine individual projects as set out in Section 7. Each of the nine BusConnects Dublin projects have their own Sponsoring Agency. The relevant department within the NTA with responsibility for the particular project is the Sponsoring Agency for that project. The Sponsoring Agencies are summarised as follows:

- Core Bus Corridors –Transport Planning & Investment Department;
- Bus Network Redesign - Transport Services Department;
- Next Generation Ticketing –Transport Technology Department;
- Simplified Fares / Cashless Payments - Transport Services Department;
- Roadside Infrastructure – Stops, Shelters, RTPI - Transport Planning & Investment Department working in collaboration with Transport Technology Department;
- Low Emission Fleet - Transport Planning & Investment Department;
- Livery - Transport Planning & Investment Department (Project is completed); and
- Park and Ride – Transport Planning & Investment Department.

15.2.3 Project Boards

Seven individual Project Boards have been or will be established to govern the individual BusConnects Dublin projects. The selection of bus livery project has already been completed (rollout will occur through the bus replacement and painting elements of the programme) and therefore does not require a Project Board, while the simplified fare structure project and cashless fare project are interrelated and are therefore governed by the same Project Board. The seven individual Project Boards report into the BusConnects Dublin Programme Board.

Each Project Board is chaired by the Director of the relevant NTA department. The Project Boards provide dedicated oversight of, and challenge to, the delivery team for each project element. Project managers are also in place for each project, who manage the delivery teams in each case.

15.2.4 Programme Coordinator

In addition to the BusConnects Dublin Programme Board and Project Boards, there is a Programme Coordinator in place who monitors the status and timing of the overall programme, manages whole-of-programme risk, ensures the appropriate assurance processes are in place and facilitates cross-programme collaboration and knowledge exchange. This is a key integration function which meets frequently with Project Directors and Managers providing a forum for the management of project interdependencies. Risks, schedule dependencies and knowledge share happen at these meetings. The Programme coordinator in agreement with the Project Directors then escalates material risks and issues to the Programme Board for decision making and reporting purposes.

15.2.5 NTA Board

Where the NTA is both Sponsoring Agency and Approving Authority, the NTA Board has an important role to play in approving certain matters. Such matters include the approval of commencement of design / planning phases, Compulsory Purchase Orders, public consultations, statutory planning consents and the issuance of tender documentation. Additionally, the following contracts need to be approved by the NTA Board in advance of execution by the Chief Executive:

- Non-works contracts in excess of €2.0 million (excluding VAT);
- Works contracts in excess of €5 million (excluding VAT); and
- All public private partnership contracts.

Accordingly, a number of approvals will be required from the NTA Board at various stages throughout the BusConnects Dublin programme.

15.2.6 Government/ DoT/ DPER

DoT is the parent department to the NTA and has the responsibility to ensure that procedures are in place to ensure compliance with the Public Spending Code. It is the responsibility of the department to facilitate seeking Government approval for projects estimated to cost over €100 million. To support Government in this approval role and to ensure careful and comprehensive oversight of major projects and programmes, DoT was mandated by Government to establish two oversight groups - one of them in relation to the bus investment programme (including all BusConnects programmes).

In relation to BusConnects, DPER has the role to conduct technical reviews of Strategic Assessment Reports and Business Cases for projects estimated to cost over €100 million.

15.3 Monitoring and Evaluation

15.3.1 Introduction

This section sets out an overview of the Monitoring and Evaluation ("M+E") activities that will be required for the BusConnects Dublin programme, to ensure the project delivers against objectives and provides value for money. The Monitoring and Evaluation plan will evolve through the development of the project but at this stage it is possible to set the framework for the monitoring and evaluation framework.

15.3.2 Monitoring and Evaluation Requirements

The Public Spending Code[104] sets out the guidelines for the monitoring and evaluation of large capital investment programmes. Fundamental to this is the requirement for ongoing and routine monitoring through which to determine:

- The extent to which a programme is on track to achieve its objectives;
- The extent to which the ex-ante appraisal assumptions and forecasts were accurate;
- How results/impacts have materialised through time; and
- Lessons learnt.

With the BusConnects Dublin programme likely to have an annual value in excess of €30m and a programme of five years or more, it will be subject to regular monitoring as well as mid-point and ex-post evaluations for each five-year period of implementation. Following the PSC guidelines there will also be a requirement for a Project Completion Report. The core requirements will therefore be:

- Regular monitoring of performance indicators, covering:
    - Outturn performance
    - Management and implementation procedures
- In-depth evaluation of efficiency and effectiveness
- An independent review of programme performance, including its ongoing relevance

The monitoring and evaluation plan has therefore been designed to ensure that the relevant evidence is available to permit the above activities to be undertaken robustly, whilst also seeking to maximise learning within the BusConnects Dublin programme.

15.3.3 Programmatic Approach to Monitoring and Evaluation

Principles of Monitoring and Evaluation

The proposed BusConnects Dublin programme is, by its design and geographical coverage, very complex and extensive. The implementation schedule, and other known investment programmes in the region's transport network, will make monitoring and evaluation very challenging. However, it is recognised that establishing a robust yet proportional approach to assessing programme delivery and performance is essential.

[104] *Public Spending Code | A Guide to Evaluating, Planning and Managing Current Expenditure, Sept 2019.*

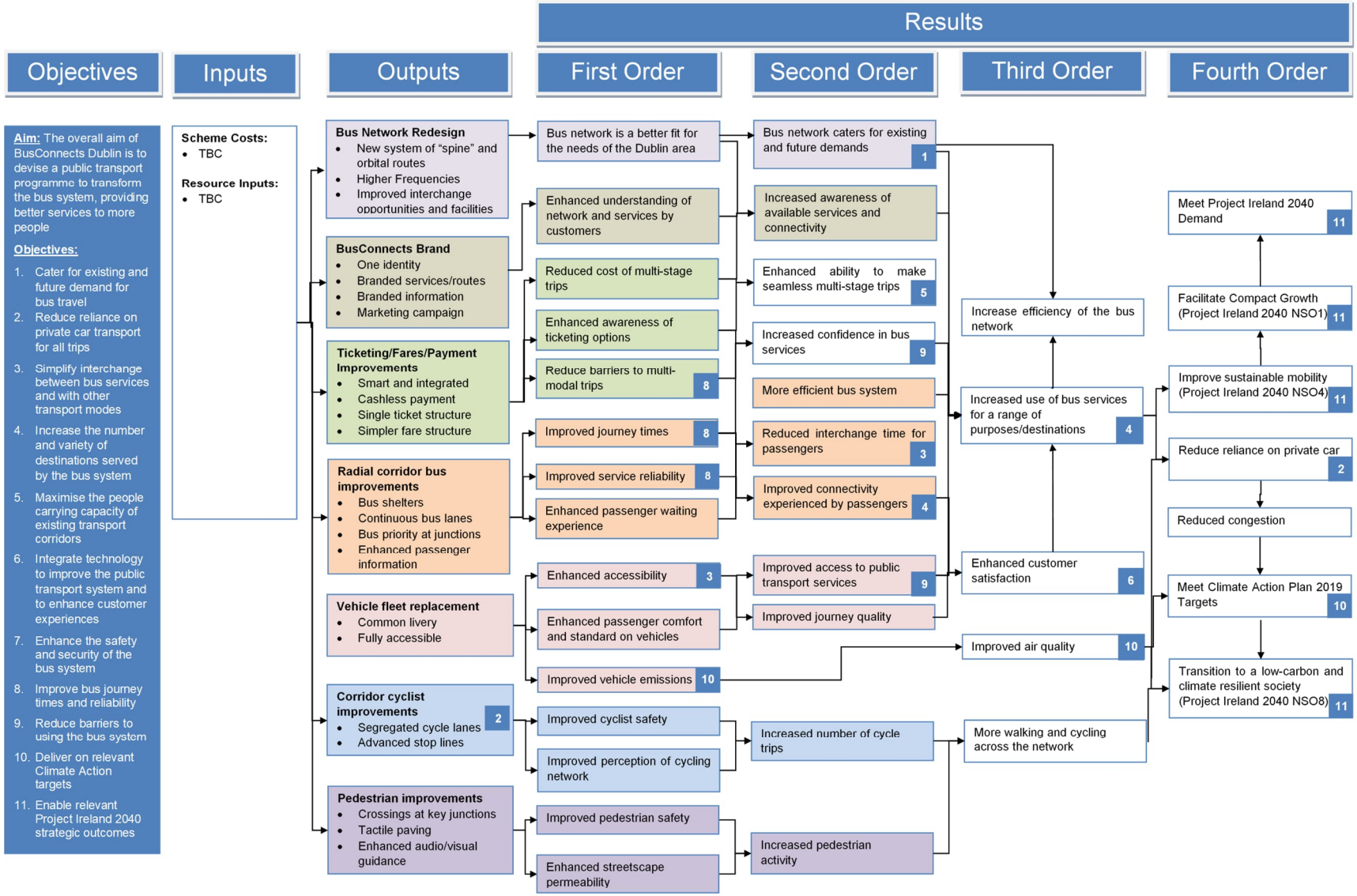
In setting out the key principles that will be followed for BusConnects Dublin, a best-practice approach has adopted:

1. Define the intervention
2. Map the intervention logic
3. Define the key indicators
4. Define the data requirements and availability
5. Establish the type of evaluation required

The proposed intervention is clearly defined in section 7 of this document. As set out in the Public Spending Code a Programme Logic Map is a useful tool for mapping the links between inputs, outputs, results and impacts of the programme. As mentioned in Section 4, scheme specific objectives and SMART criteria are used in the approach to monitoring and ex-poste evaluation of the scheme. These aspects are reflected in the Logic Models,

An initial programme-level logic map has been prepared for BusConnects Dublin and is shown in Figure 15.2. Within this figure, the blue numbered boxes demonstrate where the defined objectives are anticipated to be realised. It may be necessary in due course to prepare a series of logic maps for the programme, to reflect its complexity, and changes that may occur during phased delivery.

Figure 15.2: BusConnects Dublin Intervention Logic Map



Define Key Indicators

The key monitoring indicators should be determined by the programme objectives and results defined in the logic map and through the appraisal process. Consideration is already being given within the Preliminary Business Case to the range of results and associated indicators that are relevant for BusConnects Dublin. These indicators represent a method for measuring the success of the BusConnects Dublin Programme post implementation and allow us to assess actual performance against projected performance.

The initial focus has been on the quantifiable results that form the core of impact assessment for the programme. Establishing the indicators will ensure that robust baseline data is collected/collated and suitable resources allocated to the ongoing monitoring throughout the programme implementation period.

How the Goal and Objectives from Chapter 3 relate to the performance indicators and initial targets are outlined in Table 15-1. These initial targets can also be seen in Table 15-2 relating to programme output as programme targets.

The core indicators for programme outputs are in Table 15-2 split by programme outputs, transport outcomes and economic impacts. The economic indicators should be monitored as they provide important context to the more detailed evaluation. However, it should be noted that the ability to attribute any observed changes in data to the BusConnects Dublin programme would be very difficult.

Initial targets have been provided in Table 15-2 for the programme outputs and transport impacts based on the analysis to date.

Key aspects of the Programme are subject to statutory planning consent processes which may result in alterations and amendments to elements and parameters of the Programme. Following the planning stage, the expected outcomes from the delivery of the Programme can be finalised and specific Performance Indicators targets can be established. These specific Performance Indicator targets will be included in the Final Business Case, providing clear metrics and timelines against which the Programme can be measured and evaluated.

Table 15-1 Objectives, Indicators, Targets

Goal and Objectives	Performance Indicator	Target
Goal 1 – Transition to bus and active travel		
Objective 1: Cater for existing and future demand for bus travel	Number of additional public transport passengers	36% increase in bus patronage one year after opening and 62% increase in PT transport by 2043
Objective 2: Reduce reliance on private car transport for all trips	Reduction in car mode share	Number and percentage of public transport passengers shifting from car-based trips – 500million+ passenger trips per annum by 2043
Objective 3: Simplify interchange between bus services and with other transport modes	Level of usage of multi-service ticketing	Ticketing systems and fare structures which will create seamless interchange, reducing end to end morning peak journey times for bus passengers by 16% on average.
Goal 2 – Improve the service offering		
Objective4: Increase the number and variety of destinations served by the bus system	Number of residents within 400 metres of an all-day frequent (15 minutes or better) bus service Increase in the number of jobs and student enrolments that the average Dublin-area resident could reach in 30 minutes or less	35%+ increase in percentage of existing households within 400m of a frequent bus service. A 16% increase in the population within 400m of bus services;
Objective 5: Maximise the people carrying capacity of existing transport corridors	Increase in fleet passenger capacity (number of vehicles) and people throughput at corridors	23%+ increase in no. of buses per hour (peaks and inter-peak)
Objective 6: Integrate technology to improve the public transport system and to enhance customer experiences	Number of bus stops with on-street Real Time Passenger Information signs and provision of bus priority at traffic signals	Provision of additional Real Time Passenger Information (RTPI) signs along the new bus corridors and elsewhere across the region.
Objective 7: Enhance the safety and security of the bus system	Increased provision of CCTV, lighting, shelters and improved public realm	5,300 bus poles in the Dublin Metropolitan Area (DMA) will be replaced and 400 bus stops will require new bus shelters between 2021 and 2024.
Goal 3 – Improve the user experience		
Objective 8: Improve bus journey times and reliability	Average bus speed / average bus speed by corridor	49% improvement in bus service reliability
Objective 9: Reduce barriers to using the bus system	Increase in level of bus punctuality	230km of continuous bus priority will be delivered.
Deliver on environmental and policy targets		
Objective 10: Deliver on relevant Climate Action targets	Percentage of zero emission vehicles in bus fleet	100% Low emission fleet by 2032 with 80% of fleet Zero Emission.
Objective 11: Enable relevant Project Ireland 2040 strategic outcomes	Carbon emissions reductions	23% increase in bus services and 35% increase residents within 400m delivering on compact growth, sustainable mobility and low carbon society

Table 15-2 – Programme Targets

Programme Output	Programme Targets
Programme Outputs	
Improved bus operational efficiency	49% improvement in bus service reliability
Kilometres of CBC bus priority delivered	Delivering 230kms of continuous bus priority
Kilometres of cycle facilities delivered	200km of offline cycle facilities will be delivered
Additional bus fleet	Between 41-130 additional buses will be created accordingly to modelling.
Improved infrastructure capacity	A 23% increase in bus services.
Transport Outcomes	
Number of additional daily bus services	23%+ increase in no. of buses per hour (peaks and inter-peak)
Improved accessibility to bus network	35%+ increase in percentage of existing households within 400m of a frequent bus service
Improved accessibility to urban centres	A 16% increase in the population within 400m of bus services;
Bus journey time	Bus journey times will decrease for bus passengers by 16% on average in the morning peak.
Bus journey time variability	49% improvement in average journey time variability for services in peaks and inter-peak periods
Public transport patronage	On a national basis the number of public transport boardings are predicted to increase by 22% upon opening of BusConnects Dublin.
Public transport integration	33%+ increase in the number of public transport passengers interchanging at bus stops/hubs
Public Transport mode share	Number and percentage of public transport passengers shifting from car-based trips – 500million+ passenger trips per annum by 2043
Reduction in transport emissions	New vehicles will be low emission vehicles which produce over 30% less emissions in their use than older models. Zero emission vehicle will also be introduced in 2023.
Economic Impacts	
Economic growth	Productivity measured by Gross Value Added Percentage of working age population in employment Business growth within 800m and 1.5km of bus stops
Population growth	Number of residents in Eastern region

The monitoring of general traffic journey times will also consider generating a measure of delay per km of the network, to consider the potential disbenefits to general traffic of the largescale re-allocation of road space.

The nature of the programme also dictates that an array of wider, unquantifiable benefits is anticipated and should form part of the full evaluation. Consideration will need to be given during the preparation of the Final Business Case (s) to defining such benefits and establishing appropriate mechanisms to determine change. Enhancing and expanding the details relating to the key indicators will be a core M+E activity during the Detailed Business Case, alongside defining the programme baseline.

Data Requirements

To ensure consistency in the proposed monitoring and evaluation, whilst maintaining a proportionate and sustainable approach, datasets need to be defined for each of the core indicators. Table 15-3 sets out the current position on data availability, which will be reviewed and updated during the preparation of the Final Business Case. The emphasis has and will be placed on data that is readily available and would not require additional expenditure beyond the processing and analysis. The range of benefits that are likely to result from the BusConnects Dublin programme is considered likely to necessitate bespoke research activities to supplement these core datasets, particularly around the wider benefits. A programme for data collection will be developed to ensure all indicators that need to be monitored are supported by the correct level of evidence.

Table 15-3 – Data availability

Indicator	Dataset Description
Bus journey times	Automatic Vehicle Location (AVL) data
General traffic journey times	Data is available from open source date, such as Google Live Traffic, and the NTA's Eastern Regional Model.
Bus service reliability/punctuality	Bus performance data from operators
Bus passenger satisfaction	Bus passenger satisfaction survey
Public transport patronage	PSO operator data
Modal share	Cordon surveys on defined corridors
Road Traffic Accidents	Road Safety Authority (RSA's) accident database
Accessibility	Accessibility changes can be assessed in ArcGIS/TRACC using outputs from the NTA's Eastern Regional Model.
Cycling activity	Cycle counters

15.3.4 Monitoring and Evaluation Approach

There are three main areas of the Monitoring and Evaluation approach, namely:

(i) the schedule of activities that will be required to align with the PSC guidance and reflect the characteristics of the programme.

(ii) the potential scope for a process evaluation, required to meet the PSC guidance for the ongoing assessment of management and implementation activities; and

(iii) the evaluation approach particularly in the context of reassessing the value for money of the programme, and the consideration of the wider economic and regeneration impacts that could be influenced by the programme.

Monitoring and Evaluation Schedule

The PSC establishes that the BusConnects Dublin programme will need to undertake regular monitoring of programme implementation, alongside more detailed milestone-based evaluations at the mid-point and ex-post periods. The programme will need to be baselined as close to the point of implementation as possible, to ensure the most robust data is recorded i.e. the risks are minimised of other factors influencing travel behaviour between the baseline and start of programme implementation. Collecting/collating data at these points is key in establishing whether the objectives and results identified at the outset have been achieved and to what extent.

A core requirement of the PSC guidance is that regular monitoring of programme implementation, investment and performance is undertaken. In terms of the management, planning and implementation a light touch process evaluation is recommended, and the precise scope of this is considered further below. The proposed key result/impact indicators are predominantly based on available data and therefore should be monitored and reported on an annual basis; the precise scope and analysis will be defined within the Final Business Case. The ongoing monitoring of indicators will also support a Benefits Management approach to programme development, implementation and operation, where benefits can be tracked through time.

Process Evaluation

A process evaluation would include the assessment of inputs (resources and investment made) and outputs (the physical measures delivered). The scope of a process evaluation for the BusConnects Dublin programme will need to include:

- Schedule Management: including identifying changes in planned schedules and reasons for observed change
- Cost Management: including causes for variance in planned costs
- Risk Management: including the effectiveness of planned mitigation and the application of Quantified Risk Management procedures
- Stakeholder Engagement: including engagement methods, frequency and lessons learnt.

To ensure that lessons can be learnt throughout the implementation period it is intended to undertake review activities on an annual basis. This would include a desk-based review of key management data, supplemented by depth interviews with key delivery team members.

Evaluation Design

The final element of Monitoring and Evaluation approach is the precise evaluation design to be adopted. The reason for defining the design is to demonstrate how it is proposed to identify the results/impacts of the programme, and accounting for the influence of other factors e.g. context changes or other large-scale investment such as DART. Considering alternative explanations for observed changes in indicators is central to determining the actual contribution of the programme. There are three main types of evaluation design that are commonly adopted for large transportation interventions:

- Outcomes based design: which focuses on analysing changes in key datasets between the before and after situation, and assumes that little has changed in the wider context
- Quasi-experimental design: which uses comparator areas or corridors to consider what would have happened in the absence of the intervention i.e. the comparators are similar to the treatment corridors but will not have BusConnects Dublin investment
- Theory-based designs: which use all available qualitative and quantitative evidence to assess the assumed causal pathways between outputs and results, testing their validity and drawing conclusions on the contribution of specific interventions to the observed change.

In the context of the BusConnects Dublin Programme there are merits in adopting all approaches. The appropriate combination of evaluation approaches will be defined within the Monitoring and Evaluation Plan developed as part of the Final Business Case.

Value for Money Assessment

The ex-post evaluation of the BusConnects Dublin programme, and potentially each phase of delivery, will need to include the re-assessment of the programme's value for money. There are a range of options for completing this, including a full model update and re-run through to the assessment of observed results, and comparing with forecasts. The precise approach will be confirmed, in consultation with the NTA, as part of the Detailed Business Case.

Wider Economics and Regeneration

The impacts of the BusConnects Dublin programme on the wider economy and regeneration of the Dublin area will also be considered further. Whilst it is possible to review secondary datasets on issues such as employment and productivity, attributing any observed changes to transport investment is full of complexities and risks. A more robust and proportionate approach is to extend the Theory of Change methodology to consider the potential contribution of the programme i.e. demonstrating changes in accessibility to employment and training as a proxy for actual observed change in economic metrics. The geographical scale at which many economic datasets are available at also restricts undertaking a more detailed analytical exercise.

15.3.5 Benefits Realisation Plan

As discussed in Chapter 10, the success of BusConnects Dublin depends on the successful implementation of many different elements. One of the key arguments to having a programmatic approach to BusConnects Dublin is the successful realisation of its benefits. The NTA has the tools, capabilities and experience to measure, track and monitor the success of public transport schemes. For some of its more advanced projects such as NGT and CBC, there are clear objectives, targets and processes set to measure the benefits of the schemes. Other projects at an early feasibility stage are still in the processes of defining and aligning their benefits to the wider BusConnects Programme. A strong programme-level benefits realisation plan and management process will be put in place to make sure that all benefits are materialising as planned. The NTA is also reviewing its governance framework to ensure benefits are considered in decision-making and that robust processes are in place to monitor and control the Benefits realisation plan. This will follow from the monitoring framework discussed above.

15.3.6 Next Steps

The M+E and benefits realisation planning requirements for the programme will be developed further during the preparation of the Final Business Case, including linking the evaluation with an embedded benefits realisation philosophy, the preparation of a detailed M+E Plan, the agreement of a programme baseline period and confirmation of data availability.

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Next steps

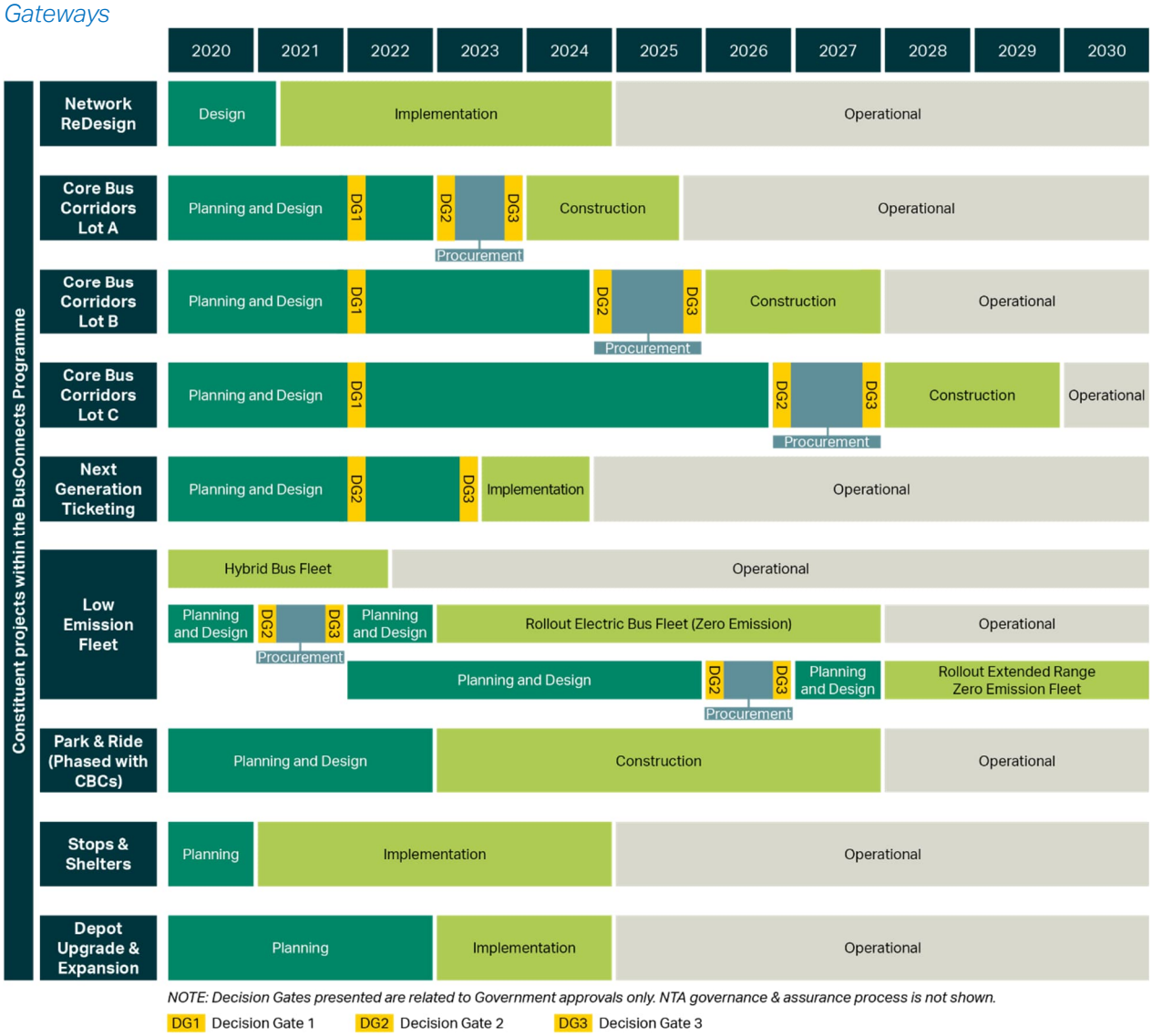
16 Next steps

Chapter Summary

- The current approval being sought is a PSC Gate 1 approval in principle to proceed with CBC statutory processes.
- Individual elements within the BusConnects Dublin programme will require further approvals as the programme progresses.
- Given the nature of the BusConnects Dublin programme, it is envisaged that a series of updated / interim Final Business Cases will be prepared and submitted at appropriate decision points for individual projects.
- Updated economic and financial appraisal will be undertaken considering both the programme wide impact and the incremental benefit of the individual element (s) or project (s) (a number of which make up the element - such as the CBA Lots A,B and C making up the CBC element of the BusConnects Dublin Programme) under consideration at each decision points.
- Each (interim) Final Business Case will be updated to reflect the current status of relevant projects within the programme at the point of preparation.
- In the short to medium term there may be an opportunity to optimise the economic and financial case for BusConnects Dublin through a variety of measures.

The figure below illustrates the overall BusConnects Dublin programme including key Government decision gateways, in accordance with the 2019 PSC guidelines. Internal NTA governance and assurance processes are not included in the figure below. Note the figure reflects the programme of works as it stands in December 2021, submission date of the Preliminary Business Case for board approval. Updates to the programme and decision gateways will be included in further iterations of this document upon completion of the approvals process.

Figure 16.1: Constituent projects/components within the BusConnects Dublin Programme and the Decision Gateways



The current approval being sought is a PSC Gate 1 approval in principle to proceed with CBC statutory processes and a PSC Gate 2 approval to commence the NGT tender process. Individual elements or projects will require further approvals as the BusConnects Dublin programme progresses. For example:

- As further projects or components of these projects (e.g. singular CBCs within a CBC Lot) within the BusConnects Dublin programme (e.g. each CBC Lot) proceed to Decision Gate 2 (Pre-Tender Approval)
- At Decision Gate 3 (Approval to Proceed) as projects or components of these projects within the BusConnects Dublin programme seek approval to proceed to contract award

Prior to seeking pre-tender approvals at Decision Gate 2 each project or components of projects within BusConnects Dublin programme will, in accordance with the PSC, confirm, reassess or further develop scope, underpinning assumptions, risk assessment and risk management strategy, delivery programme, design, costs, procurement and execution planning.

Prior to the award of major contracts at Decision Gate 3, a Final Business Case will be prepared which will update and refine the analysis of the programme-level PBC, including an update of

the project brief based on the procurement process, reappraisal of the proposal based on tendered costs (both economic and financial appraisal), detailed sensitivity and scenario testing, inclusion of a benefits realisation and integration plans and an updated risk management strategy.

Given the nature of the BusConnects Dublin programme, it is envisaged that a series of updated Final Programme-Level Business Cases will be prepared and submitted at appropriate decision points for individual projects or components of these projects as envisaged in the figure above. Each (updated) Final Business Case will be updated to reflect the current status of relevant projects or components of these projects within the programme at the point of preparation. For example, the first update may relate to a Decision Gate 3 for CBC Lot 1, bus replacement framework and / or NGT.

Examples of issues / developments and the associated analysis which would be included in subsequent updated Programme Level Final Business Cases include:

- Build on and further refine the analysis informing the economic and financial appraisal included in this PBC, this could include the outputs from NTA and wider transport policy development and studies in areas such as, for example, sustainability, alternative future scenarios, changes in travel patterns and behaviour.
- Take account of changes to the proposals including:
  - the implementation of early phases of the Network Redesign
  - Next Generation Ticketing which has become a more mature programme with improved benchmarking and a higher projected cost, is now moving into the tender phase which will provide greater scope, cost and risk certainty prior to contract award
  - Core Bus Corridor proposals which will be further developed and the planning applications, preliminary designs and EIARs will be available on each individual corridor
- Further detail on a programme-wide and project level procurement strategy, design development, cost and programme control, risk analysis, governance, monitoring and evaluation and implementation plan as these areas continue to be developed in line with the progression of the programme from business case into project procurement and implementation phases.
- Develop the economic and financial appraisal at both programme wide level and at project/component level. This approach will assess the costs and benefits of the relevant elements/projects/components of the programme for which a decision is sought. For example, the Decision Gate 2 for the CBC Lot 1 would include updated economic and financial appraisal considering only the implementation of these elements of the BusConnects Dublin programme. The updated programme business case would therefore include performance indicators for both the entire programme and the projects/components under consideration. As the programme progresses the updated business cases will build upon the economic and financial appraisal undertaken for the previous decision, in this regard the Do-Minimum will be updated to reflect parts of the programme that have been implemented or received approval to proceed
- In the short to medium term there may be an opportunity to optimise the economic and financial case for BusConnects Dublin through:
  - Confirming a range of complementary policy measures (in areas such as congestion charging, carbon taxes, parking disincentives etc.) which will bolster the policy rationale and transport benefits of the programme by encouraging modal shift from

cars to buses, offsetting disbenefits to car users that technically arise in the current approach to modelling benefits

- Efforts to mitigate the impact on private cars and good vehicles through the CBC design process
- Further enhancement of the economic case through greater analysis of the impact on demand of improved interchange as a result of the combination of BusConnects Dublin' projects
- Further development of CBC and NGT designs and specifications as these projects progress to optimise both cost of implementation and operations and enhance benefits derived from these projects
- Use procurement strategy and tender process to generate savings through competitive tension in the bidding process (noting that strong market interest has been expressed in elements of the programme)
- Further refinement of the impacts on PSO, ticketing and other operational costs as the programme as described in the Financial Analysis section above.

Appendices

17 Appendices

Appendix A – Appraisal of options for programme delivery

Overview

This Appendix describes the appraisal of options for BusConnects Dublin programme and how options were assessed in the context of the six multi-criteria appraisal headings from the Common Appraisal Framework (CAF).

Overall, five options were developed for the delivery of the BusConnects programme. These options consider the implementation of none of, or various elements of the programme, up to the implementation of the entirety of the programme. The appraisal options developed are:

- Do Minimum Option
- Network Redesign Option
- Priority Infrastructure Option
- Partial programme Option
- Full Programme Option

The overall programme has been appraised in accordance with the Department of Transport's Common Appraisal Framework (CAF), against the standard multi-criteria appraisal headings. Considering the Case for Change within these framework criteria, the evaluation criteria of achievement, as shown in Table A1, were developed.

Table A1 – BusConnects Dublin Programme Appraisal Criteria

CAF criteria	Evaluation criteria
Economy	• Contribute to economic growth • Implement in the short to medium term • Ensure value for money • Increase public transport patronage
Environment	• Reduce reliance on the private car • Reduce growth in transport emissions, at a minimum
Accessibility and Social Inclusion	• Enhance public transport and sustainable travel access to opportunities and services • Deliver socially inclusive public transport
Safety and Security	• Improve the safety of the transport system • Protect vulnerable road users
Integration	• Enable Project Ireland 2040 • Make it easier to move between public transport services
Physical Activity	• Provide for safer and faster travel by active modes • Facilitate access to public transport by active modes

Key:

Major Negative	Moderate Negative	Minor Negative	No / Negligible Impact	Minor Positive	Moderate Positive	Major Positive

Options Description

Do Minimum

Appraisal requires the development of a Do Minimum (DoMin), or counterfactual, which looks at the future situation without the proposed programme. As the bus system is vital to Dublin, it is assumed that it would not be allowed to degrade. Instead, there would be investment to maintain the existing system but with no additional benefit. The DoMin will include:

- Replacement of life-expired technology equipment on a like-for-like basis e.g. ticketing systems, passenger information technology and on-board Wi-Fi
- Replacement of life-expired buses
- Purchase of additional buses to maintain the existing schedule of services in the face of increased congestion which will reduce speeds and therefore reduce system capacity[105]
- In keeping with current Government policy, all replacement and additional buses purchased would be low emission vehicles (LEV).

Bus-based public transport options (Do Something)

BusConnects Dublin is a result of the Greater Dublin Area Transport Strategy 2016 – 2035 which identified and appraised options for each corridor on a multi-modal basis. Optioneering then took place, at the BusConnects Dublin project, or programme element level, as explained in the Preliminary Business Case (PBC) (Sections 6.1 to 6.4). A programmatic approach is being taken to the implementation of those projects, for the reasons set out in Section 2.1.1 of the PBC. Similarly, the business case is being developed at programme level as the full benefits, costs and risks across the Dublin area can only be captured and appraised in this way. The essence of the programme is that it is multi-faceted to address every aspect of the bus system. It is self-evident that only the full BusConnects programme can fully deliver the programme objectives. This presents a challenge in complying with the CAF which recommends examination of at least three 'Do Something' options at the preliminary appraisal stage.

As such, when undertaking an appraisal of Bus Connects Dublin there are no alternative Do Something full programmes against which it can be assessed, rather, there are alternatives to delivery of the full programme that will ultimately not achieve the same outcomes but may deliver a level of benefit that would make them an attractive alternative for investment. These alternatives are summarised below and detailed in Table A2.

- A **management-based approach** focusing on improvement to the network of services and crucial ancillary elements such as fares and ticketing, as proposed in the Network Redesign initiative**.** As NTA plan to implement the Network Redesign before the other programme elements, the management-based approach may be better described as the first step in the incremental programme delivery, rather than a programme option.
- A **priority-based, or infrastructure-led**, approach which focuses on improvements to infrastructure on the existing network to reduce delay to buses and cyclists thereby

[105] *As speeds reduce, it takes buses a longer time to meet headway targets. This means that each bus can operate fewer services in the peak periods, so NTA will need more buses if all service headways are to be maintained. It follows that the cost of operations will increase in the Do Something compare with a Do Nothing.*

improving journey times and reliability and changing crucial ancillary elements such as fares and ticketing.

- A **partial programme approach** which only delivers part of the programme. A partial programme could, say, comprise the Network Redesign and ancillary elements such as NGT and new bus fleet as planned and reduce the number of CBCs implemented. This is simply a partial implementation of the whole programme and, in any case, the current plan is for an incremental implementation of groups of CBCs.
- The **full programme** is designed to achieve all of the programme objectives.

Table A2 – Programme Elements in each option

Option	Programme Element							
	Network Redesign (NRD)	CBCs including Cycle Routes & Major PT Interchanges	NGT / Cashless Payment System	LEV Bus Fleet	Simpler Fare Structure	Bus Shelters and Stops	New Bus Livery	P&R
Do Min	No	No	No	Partial	No	Partial	Yes	No
	Some network changes to maintain an efficient bus network	Minor traffic management changes at junctions or along corridors at local pinch points	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV plus additional fleet to maintain existing headways and frequencies		Replacement of existing poles as part of national pole replacement and life expired shelters	New Livery would be rolled out as part of LEV bus renewal programme	
Management based approach	Yes	No	No	Yes	Yes	Partial	Yes	No
	Extent of Network Redesign and increases in frequencies and new routes may be impacted by availability of buses and efficiency of bus operations	Minor traffic management changes at junctions or along corridors at local pinch points	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV plus additional fleet to support new routes and frequencies – no additional buses over the full programme implementation assumed	90 min fare structure implemented across all modes	Replacement of existing poles as part of national pole replacement and life expired shelters – No new shelters at interchange or high-profile routes		
Priority Infrastructure	No	Yes	No	Partial	Yes	Yes	Yes	Partial
	Some increases in efficiency of bus operations due to reduced journey times and increased reliability which may permit limited increases in frequency or limited	12 Core Bus Corridors implemented across 16 radial routes including high-quality cycle infrastructure along the corridors	Replacement of life expired ticketing equipment and systems	Replacement of all existing fleet with LEV – Total fleet size required would be reduced from the full programme number due to reduction in routes/catchment and the increased efficiency of bus operations on CBCs		Replacement of existing poles as part of national pole replacement and life expired shelters plus shelters provided along all CBCs		P&R sites on CBC routes would be delivered

Option	Programme Element							
	Network Redesign (NRD)	CBCs including Cycle Routes & Major PT Interchanges	NGT / Cashless Payment System	LEV Bus Fleet	Simpler Fare Structure	Bus Shelters and Stops	New Bus Livery	P&R
	introduction of new routes							
Full Programme	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	All elements of NRD implemented	All CBCs, interchanges and cycle facilities implemented	NGT delivered in full	All buses renewed and additional buses to support higher frequency and new routes		Replacement of existing poles as part of national pole replacement and life expired shelters - Shelters provided along all CBCs and NRD interchange points		All P&R sites delivered
Partial Programme	Partial	Partial	Yes	Yes	Yes	Partial	Yes	Partial
	Extent of Network Redesign and increases in frequencies and new routes may be impacted by availability of buses and efficiency of bus operations	A single tranche of CBCs are delivered i.e. 4 corridors. The corridors implemented would be those that have the lowest existing level of bus priority. Only cycle infrastructure on 4 corridors implemented. Major Interchanges upgraded	NGT delivered in full	Replacement of all existing fleet with LEV plus additional fleet to support new routes and frequencies – no additional buses over the full programme implementation assumed		Replacement of existing poles as part of national pole replacement and life expired shelters - Shelters provided along all CBCs implemented and at key NRD interchange points		Relevant P&R sites on implemented CBC routes would be delivered along with other suitable locations on the redesigned network

Options appraisal

Taking each of the six CAF criteria in turn, the do minimum and four BusConnects do-something options were assessed, as summarised in Tables A3 – A8. Table 6-6 of the PBC provides a summary assessment of all the approaches discussed below against the criteria set out in Table 6-5 of the PBC, as well as a comparison with the other programme delivery options.

Economy

Table A3 - Options assessment – Economy

Option	Economy	Score
Do-Minimum	• **Lower cost:** a continuation of the existing Dublin Metropolitan bus network involves still incurs significant spending without any significant benefits. Full programme investment maximises return from all investment including DoMin. • **No disruption:** given there is no change to the network or infrastructure there will be no disruption to network users or general traffic along infrastructure corridors • **No additional benefits:** a continuation of the existing network with no change to services or infrastructure would not result in any benefit to existing or prospective customers. Underserved parts of the city would continue to be disadvantaged. • **Deterioration in bus journey times and service reliability:** Over time the network **users** would experience a continued deterioration in journey times and service reliability as no action will be taken to address the growing impact of congestion on the operation of bus services across the Dublin Region. From the **operator** point of view this would result in a need to increase the fleet size, and associated increases in the operating costs, to meet the current timetables as a result of growing congestion.	
Management Based Approach	• **Lower cost option:** the implementation of the redesigned network does not involve a significant financial outlay but there would be unrealised operational efficiencies without the delivery of the priority infrastructure. The likelihood of revenue outweighing operational costs within the appraisal timeframe reduces in this option. This could result in increased operating costs compared with a Do Minimum, Partial or Full Programme. • **Short implementation time:** this option does not require any planning approvals or significant construction works which would allow this option to be implemented relatively quickly. • **Better connection between people and opportunities through better coverage, frequency and ease of use:** the redesigned network improves frequency and coverage along radial and orbital corridors helping to connect people with more opportunities. The simplified design of the network should also allow for easier navigation of the network. However, interchange between bus services will not yet be 'seamless' for customers until supporting infrastructure is in place. • **Congestion continues to undermine efficiency and reliability:** the lack of improved priority on key corridors will impact on the operation of new timetable and may lead to an increasingly inefficient network.	

Option	Economy	Score
	Benefits of the network redesign will not be fully realised until the priority infrastructure is in place.	
Priority Infrastructure	• **High cost option:** the infrastructure elements of BusConnects are the costliest element of the programme representing in the region of 60% of the total capex costs. • **Long implementation time:** Individual corridors could be implemented in a 2-3 year time horizon but the full rollout may take 7-9 years including planning and construction • **Highly beneficial**: significant user benefits are realised through the provision of bus priority and support interchange infrastructure. The absence of the bus network redesign element will reduce efficiencies in the use of the CBCs and reduce the attractiveness of bus. This will result in lower modal shift leading to increase private vehicle disbenefits. • **Reduced journey times:** priority infrastructure along the core bus corridors will lead to a significant improvement in bus journey times across the Dublin Region, making the bus system more efficient and cost-effective as well as more attractive to customers • **Better reliability:** improved priority infrastructure along the bus corridors will help to make journey times across all bus services more consistent helping to make the network more reliable, making the bus system more attractive and improving customer well-being through reduced uncertainty. • **Cyclists and pedestrians** will benefit from increased priority and improved facilities along the corridors and at junctions.	
Full Programme	• **Higher cost option:** this represents the most expensive option as it entails the implementation of the entirety of the BusConnects programme. • **Efficiency:** The full benefits of the programme will be realised in the most efficient manner. • **Long implementation time:** the requirement for planning approvals, environmental consents and large-scale construction means that this option will take the longest time to implement in comparison with the other options. • **Better connections** between people and opportunities will be provided through better network coverage, frequency, and ease of use. • **Reduced journey times:** The full programme with priority infrastructure along the core bus corridors will lead to a significant improvement in bus journey times across the Dublin Region. • **Better reliability:** implementation of the improved priority infrastructure corridors and increased frequencies will help to make journey times more consistent helping to make timetables more reliable and increase the attractiveness of bus. • **Comprehensive:** the redesigned network coupled with the implementation of the priority infrastructure will deliver all the benefits of the BusConnects programme	

Option	Economy	Score
Partial programme	• **Lower cost option:** the delivery of a partial programme would result in a reduced number of CBCs being delivered but with the other programme elements in place, making this a lower cost option than the full programme. This could present an affordability advantage. • **Efficiency:** Unlikely to represent most efficient use of public funds as inefficiencies will remain in the bus system which will result in increased operating costs. Potentially may lead to a requirement for additional fleet to operate the required service frequency given that untreated corridors will incur longer and unreliable journey times in the absence of priority infrastructure. Purchase of additional fleet would increase the capital costs of this option. • **Short implementation time:** delivering a reduced number of CBCs can be implemented quicker than the delivery of all priority infrastructure elements. • **Reduced journey times:** implementing some priority infrastructure elements will help to improve journey times on some corridors. • **Better reliability:** implementation of the improved priority infrastructure corridors will help to make journey times more consistent helping to make timetables more reliable. • **Congestion may continue to undermine efficiency and reliability:** on corridors where there is no priority Infrastructure implemented congestion will remain an issue. There is also potential for traffic to divert from corridors where priority Infrastructure elements have been implemented on to corridors without priority elements compounding congestion issues on these corridors. • **Inequity:** customers using those parts of the network that benefited from the selective CBC delivery would benefit significantly more than others. • **Flexibility:** the partial programme would not prevent the delivery of the full programme at a later date once the achievement of the partial programme was evaluated. • **A reduced number of cyclists and pedestrians** will gain benefit from increased priority and improved facilities along the corridors and at junctions. • A partial approach would not bring network-wide benefits, nor was it proposed in the Transport Strategy. However, it might need to be considered in the event of financial or other impediments that delayed or prevented the full programme going ahead	

Environment

Table A4 - Options assessment – Environment

Option	Environment	Score
Do-Minimum	• **Reduction in emissions with transition to zero emission fleet:** as the existing bus fleet transitions to zero emission vehicles, the scale of emissions associated with bus travel will reduce but as congestion grows, a larger fleet will be needed to maintain the current service. This means that older buses may need to remain in services for longer, slowing the transition. • **Modal shift:** In the absence of the BusConnects programme intervention there will be no increased potential for modal shift from private vehicles to bus. • **Emissions reduction:** BusConnects is a keystone project in the NTA's GDA Strategy 2015 – 2035 and the Climate Action Plan 2019 which set out the requirements for achieving transport emission reduction targets, this option would significantly reduce the likelihood of achieving those ambitions.	
Network Redesign	• **Reduction in emissions with transition to zero emission fleet:** in the absence of priority measures, slower speeds mean that a larger fleet will be required to operate this option, compared with the full programme. This may mean that existing buses remain operational for longer, slowing the transition to a zero-emission fleet. • **Modal shift:** The delivery of the network redesign element only will not achieve the full potential for modal shift from private vehicles to bus. • **Emissions reduction:** This option would significantly reduce the likelihood of achieving emissions reduction targets s given the absence of priority infrastructure and associated improvements in journey speeds, particularly given that emissions increase significantly at low speeds in congested conditions. • **Greater coverage increases bus use:** Improved network coverage and frequencies will provide the opportunity for more trips to be made by bus however it may be difficult to attract car users due to slow speeds and poor reliability owing to lack of improved priority for buses. • **Lack of priority deters significant mode transfer:** the absence of additional priority measures along corridors will mean bus journey will remain the same or get worse due to worsening congestion conditions. Journey time reductions and journey time reliability will not be achieved under this option. This will make it difficult to encourage commuters to switch from cars limiting the ability of this option to achieve greater emissions reductions from transport.	
Priority Infrastructure	• **Reduction in emissions with transition to zero emission fleet:** priority measures with the existing network would enable an efficient transition as fleet size would not have to increase. • **Modal shift**: The delivery of the priority infrastructure element only will not achieve the full potential for modal shift from private vehicles to bus. • **Emissions reduction**: This option would lead to reduced modal shift and an associated increase in congestion given the reallocation of road space away from private vehicles. This would reduce the likelihood of achieving emission reduction targets ambitions given the absence of the service improvements associated with the network redesign. • **Priority attracts radial mode transfer to bus and cycle:** cycling upgrades delivered as part of the infrastructure programme will help to encourage greater use of cycling along radial corridors this may encourage great integration between bus and cycle and may encourage mode shift from car to bus and cycle.	

Option	Environment	Score
	• **Environmental impacts** arising from infrastructure construction associated mitigations (see Environmental Impact Assessment Report).	
Full Programme	• **Reduction in emissions with transition to zero emission fleet:** the full programme would allow for an efficient and predictable transition even allowing for additional fleet to operate the Network Redesign, because CBC would protect journey speeds. • **Mode transfer:** Improved network coverage and frequencies will help to encourage mode share particular along corridors that benefit from infrastructure works which will positively impact on journey times and reliability making bus more attractive. • **Emissions reduction:** Only the option to fully deliver the BusConnects programme is in line with plans, as set out in the NTA GDA Strategy 2015 - 2035, to achieve our transport emission reduction targets. • **Efficiency attracts radial/ orbital mode transfer to bus and cycle:** the redesigned network better provides for orbital trips and will provide more frequent radial services coupled with the infrastructure programme which should deliver better and more reliable journey times. The delivery of the full programme will encourage greater integration between cycling and bus through the provision of improved cycling facilities as part of the infrastructure works. • **Environmental impacts** arising from infrastructure construction associated mitigations (see Environmental Impact Assessment Report).	
Partial programme	• **Reduction in emissions with transition to zero emission fleet:** May lead to a requirement for additional fleet to operate the required service frequency given that untreated corridors will incur longer and unreliable journey times in the absence of priority infrastructure. This could mean that older buses must remain operational longer, slowing the reduction in fleet emissions. • **Mode transfer**: The partial delivery of the BusConnects programme will not achieve the full potential for modal shift from private vehicles to bus. • **Emissions reduction:** Partial delivery would also reduce the likelihood of achieving our transport emission reduction targets. • **Greater coverage increases bus use:** Improved network coverage and frequencies may help to encourage mode shift on to bus, in particular along corridors that benefit from infrastructure works which will have the ability to positively impact on journey times making bus a more attractive option than the private car. • **Limited CBC delivery will have reduced ability to attract mode transfer:** limited infrastructure works may not achieve the necessary journey time or reliability improvements reducing the overall attractiveness of the bus system. The limited nature of the infrastructure works with only some corridors benefiting from investment will result in an uneven distribution of positive benefits limiting the ability to drive modal shift. The full potential of modal shift related emissions reductions will not be achieved. • **Environmental impacts** arising from infrastructure construction associated mitigations (see Environmental Impact Assessment Report), but only on corridors where CBCs are implemented.	

Accessibility Social Inclusion

Table A5 - Options assessment – Accessibility Social Inclusion

Option	Accessibility/ Social Inclusion	Score
Do-Minimum	• **No improvement to accessibility:** continuation of the existing bus system will not lead to any further improvements in the provision of bus services or expand the bus network into areas that are currently not on the existing bus network. Increased journey times will likely reduce accessibility to existing and new opportunities. • **Unchanged inclusivity:** no change to inclusion as the network remains unchanged under this option.	
Network Redesign	• **Increased orbital and suburban accessibility:** implementation of the redesigned network will provide enhanced orbital and local services to areas that currently have no bus service and provide improved interchange to radial services. Improvement to network legibility will also help to make the network easier to use and navigate for new users. • **Restructured fares offer greater social inclusivity:** simplified fare structure that provides for interchange between bus, DART and Luas will result in a more affordable, efficient and integrated public transport system across the Dublin Region.	
Priority Infrastructure	• **Quicker radial access:** the provision of upgraded bus infrastructure along radial corridors will provide quicker and more reliable journey times from the outer suburbs to the city centre and vice versa, improving access. • **No improvement in suburban accessibility:** The absence of an improved network of services will result in many areas still not having access to high frequency bus services. • **Restructured fares offer greater social inclusivity**	
Full Programme	• **Increased orbital and suburban accessibility:** The full programme will build on the options above by combined both services and priority leading to a more accessible and legible bus network for all. • **Quicker radial access:** The full programme will bring efficiencies and get the most out of both the redesigned network and the priority infrastructure improving services for all users. • **Restructured fares offer greater social inclusivity**	
Partial programme	• **Increased orbital and suburban accessibility:** The delivery of a partial programme would result in inefficiencies remaining the network and would likely lead to legibility issues given varying standards of priority infrastructure which may result in indirect routes being quickest for some journeys. • **Some improvement to radial access:** improvements to priority along some radial corridors will also help to provide quicker and more reliable journey times on certain corridors from the outer lying suburbs to the city centre and vice versa. • **Restructured fares offer greater social inclusivity**	

Safety

Table A6 - Options assessment – Safety

Option	Safety	Score
Do-Minimum	• **No significant impact on safety** which may worsen for vulnerable road users as demand for private car use increases in the absence of increased public transport capacity or attractive public transport alternatives. • **Cyclists remain vulnerable to buses:** no improvement to cycling facilities along radial corridors resulting in no segregation of buses and cyclists.	
Network Redesign	• **No significant impact on safety** given limited impact on modal shift. • **Cyclists remain vulnerable to buses:** no improvement to cycling facilities along radial corridors resulting in no segregation of buses and cyclists.	
Priority Infrastructure	• **Segregated infrastructure will significantly improve** safety for cyclists • **Modal shift** may reduce on road vehicles leading to improvements for vulnerable road users such as those walking and cycling. • Pedestrian facilities around bus stops and at interchanges will improve safety	
Full Programme	• **Segregated infrastructure will significantly improve safety for cyclists** • Modal shift may reduce on road vehicles leading to improvements for vulnerable road users such as those walking and cycling. • Pedestrian facilities around bus stops and at interchanges will improve safety	
Partial programme	• **Cyclists remain vulnerable to buses on certain corridors** with remain untreated. • **Modal shift** likely lower than with the full programme however some shift likely which may reduce on road vehicles leading to improvements for vulnerable road users such as those walking and cycling. • Pedestrian facilities around bus stops and at interchanges will improve safety in corridors where CBCs are implemented.	

Integration

Table A7 - Options assessment – Integration

Option	Integration	Score
Do-Minimum	• Ambitions and objectives set out in national and regional climate action and transport **policy objectives will not be achieved**. • Multi-modal integration will not improve.	
Network Redesign	• Greater population coverage of the bus network will support policy ambitions and objectives, but they **will not be fully achieved**. • Better aligned and more attractive bus timetables but multi-modal integration, including BusConnects Dublin interchange potential, will not significantly improve without the supporting infrastructure. • Financial penalty for transferring between different public transport systems is removed	
Priority Infrastructure	• Investment in priority infrastructure is a significant step in achieving the role of the BusConnects programme in supporting our policy ambitions and objectives, but they will **still not be fully achieved**. • Financial penalty for transferring between different public transport systems is removed • Physical interchange enhancements will make it easier to operate an integrated public transport system	
Full Programme	• Ambitions and objectives set out in national and regional climate action and transport **policy objectives will be achieved**. • Financial penalty for transferring between services is removed • The supporting infrastructure including improvements to bus stops and interchange facilities will significantly improve integrated interchange between bus services and between bus and other public transport systems • Combining the integrated timetables of the Network Redesign with the interchange infrastructure of the CBCs creates physical and operational connectivity between bus services, optimising integration.	
Partial programme	• Policy ambitions and objectives will be supported by this option, but they will **still not be fully achieved** as some corridors will still have inadequate interchange facilities and unresolved bus congestion issues which will result in a less integrated bus system overall.	

Physical Activity

Table A8 - Options assessment – Physical Activity

Option	Physical Activity	Score
Do-Minimum	• **No change:** a continuation of the existing bus network and cycle facilities on the corridors will have limited to no impact on improving the attractiveness of walking or cycling	
Network Redesign	• **Increased bus use due to the improved service offering will increase the use of active modes and lead to modal shift away from private cars:** an improved network will help to encourage mode shift to bus away from private cars resulting in more active mode trips accessing bus stops. This option is limited in its ability to encourage increases in physical activity as it will not deliver any upgrades to active mode infrastructure.	
Priority Infrastructure	• **The delivery of 200km of segregated cycle facilities will significantly enhance attractiveness of cycling in particular:** infrastructure upgrades will deliver active mode upgrades along the radial corridors which will encourage greater use of cycling and walking for longer distance trips to and from bus tops and other trip attractors. • **Increased bus use due to improved bus journey times and reliability** will increase the use of active modes as a means to access bus stops and lead to modal shift away from private cars	
Full Programme	• **The delivery of 200km of segregated cycle facilities will significantly enhance attractiveness of cycling in particular** • **Increased bus use and the significant improved attractiveness of the system,** as a result of the delivery of both the network redesign and priority infrastructure. This will significantly increase the use of active modes as a means to access bus stops and as a standalone mode for travel and lead to modal shift away from private cars	
Partial programme	• **The delivery of some segregated cycle facilities will significantly enhance attractiveness of cycling** in particular however not to the same extent as the full programme. • **Gaps in the cycle and bus infrastructure network will represent perceived barriers to some new users** and will likely result in some individuals or families, making the decision to not cycle as a regular mode of transport. • **Increased bus use and the significant improved attractiveness of the system,** as a result of the delivery of both the network redesign and some of the priority infrastructure. This will significantly increase the use of active modes as a means to access bus stops and as a standalone mode for travel. This will likely lead to modal shift away from private cars but not to the same extent as the full programme.	

Summary of Appraisal

The next step in the assessment compares the options against a Do-Nothing scenario using the CAF criteria, including Economy, Environment, Accessibility, Social Inclusion, Safety, Integration, and Physical Activity. Table 6.5 summarises the potential contribution of the each of the options using a 7-point scale ranging from major negative (1) to major positive (7), as outlined below.

Table A9 - Options assessment

Option	Economy	Environment	Accessibility/ Social Inclusion	Safety	Integration	Physical Activity
Do-Minimum	• Low cost • No disruption • No additional benefits • Deterioration in bus journey times and service reliability	• Reduction in emissions with transition to zero emission fleet • No increased potential for modal shift or associated emission reductions	• No improvement to accessibility • Unchanged inclusivity	• No significant impact on safety which may worsen for vulnerable users • Cyclists remain vulnerable to buses	• Policy objectives are not achieved • Multi-modal integration, including BusConnects Dublin interchange potential, will deteriorate.	• No change
Network Redesign	• Lower cost option • Short implementation time • Better connection between people and opportunities through better coverage, frequency and ease of use • Congestion continues to undermine efficiency and reliability	• Reduction in emissions with transition to zero emission fleet • Greater coverage increases bus use • Lack of priority deters significant mode transfer • Lower potential for modal shift and associated emission reductions	• Increased orbital and suburban accessibility • Restructured fares offer greater social inclusivity	• No impact on safety • Cyclists remain vulnerable to buses	• Greater coverage supports policy goals, but they will not be achieved • Better connected service timetables but without supporting infrastructure • Financial penalty for transferring between services is removed	• Increased bus use will increase active modes to and from bus stops • Limited impact due to lack of high-quality active mode infrastructure
Priority Infrastructure	• Higher cost option • Long implementation time • Highly beneficial • Reduced journey times • Better reliability	• Reduction in emissions with transition to zero emission fleet • Priority attracts radial mode transfer to bus and cycle • Increased potential for modal shift and associated emission reductions • Construction related environmental impacts	• Quicker radial access • No improvement in suburban accessibility • Restructured fares offer greater social inclusivity	• Segregated infrastructure improves safety for cyclists • Pedestrian facilities around bus stops and at interchanges will improve safety	• Quicker bus travel supports policy goals, but they will still not be fully achieved • Financial penalty for transferring between services is removed • Physical interchange enhancements	• Segregated facilities enhance attractiveness of cycling and walking • Increased bus use will increase active modes to and from bus stops
Full Programme	• Higher cost option • Most efficient method of achieving benefits • Long implementation time • Better connection between people and opportunities through better coverage, frequency and ease of use • Reduced journey times • Better reliability	• Reduction in emissions with transition to zero emission fleet • Efficiency attracts radial/ orbital mode transfer to bus and cycle • Full potential for modal shift and associated emission reductions realised with full programme • Construction related environmental impacts	• Increased orbital and suburban accessibility • Quicker radial access • Restructured fares offer greater social inclusivity	• Segregated infrastructure improves safety for cyclists • Pedestrian facilities around bus stops and at interchanges will improve safety	• Greater coverage/quicker trips fully support policy goals • Improved physical and operational connectivity between bus services • Financial penalty for transferring between services is removed • Physical interchange enhancements	• Segregated facilities enhance attractiveness of cycling and walking • Increased bus use from both the Network Redesign and priority enhancement will increase active modes to and from bus stops
Partial programme	• As for full programme but only on some corridors • Congestion will undermine efficiency and reliability of network • Inequity across the network • Offers some flexibility	• As for full programme but only on some corridors • Reduced potential for modal shift and associated emission reductions • Partial delivery would also reduce the likelihood of achieving our transport emission reduction targets.	• As for full programme but only on some corridors • Inefficiencies would remain in the network leading to legibility issues given varying standards of priority infrastructure which may result in indirect routes being quickest for some journeys.	• As for full programme but only on some corridors • Cyclists remain vulnerable on untreated corridors.	• As for full programme but only on some corridors • Quicker bus travel supports policy goals, but they will still not be fully achieved	• As for full programme but only on some corridors • Gaps in the cycle and bus infrastructure network will represent perceived barriers to some new users

Key:

Major Negative	Moderate Negative	Minor Negative	No / Negligible Impact	Minor Positive	Moderate Positive	Major Positive

Appendix B – Background Material

17.1 Transport Strategy background papers

Title	Links	Summary
Transport Strategy for the Greater Dublin Area 2016 - 2035	https://www.nationaltransport.ie/wp-content/uploads/2016/08/Transport_Strategy_for_the_Greater_Dublin_Area_2016-2035.pdf	Main report
Core Bus Network Report 2015	https://www.nationaltransport.ie/wp-content/uploads/2015/10/Core_Bus_Network_Report1.pdf	Identified options to give high priority to buses across the core network
Radial Corridor studies	https://BusConnects.ie/media/1995/dublin-area-bus-network-redesign-choices-report-17-06-05-web.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/Navan_Corridor_Study1.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/North_West_Corridor_Study1.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/South_East_Corridor_Study1.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/South_West_Corridor_Study1.pdf	Identified and assessed options for alternative modes and combinations of modes in each corridor.

Title	Links	Summary
Modelling and appraisal	https://www.nationaltransport.ie/wp-content/uploads/2015/10/Transport_Modelling_Report1.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/Outline_Transport_User_Benefits_Assessment1.pdf	Describe the appraisal process and the assessment of options
Orbital corridor studies	https://www.nationaltransport.ie/wp-content/uploads/2015/10/Inner_Orbital_Study1.pdf https://www.nationaltransport.ie/wp-content/uploads/2015/10/Outer_Orbital_Study1.pdf	Identified and assessed options for alternative modes and combinations of modes in each corridor.
Fingal – North Dublin Transport Study	https://www.nationaltransport.ie/wp-content/uploads/2015/09/Fingal_North_Dublin_Transport_Study_Final_June_2015.pdf	Re-examined transport solutions for the North Dublin Fingal area and concluded that MetroLink was the preferred option.
Demand management study	https://www.nationaltransport.ie/wp-content/uploads/2015/10/Demand_Management_Report1.pdf	Identified and assessed options for travel demand management.
Strategic assessment report	https://www.nationaltransport.ie/wp-content/uploads/2015/10/SEA_Environmental_Report.pdf	Undertook environmental assessment of several strategic options for the GDA.

17.2 Core Bus Corridor background reports

Title	Links	Summary
CBC information for third round of public consultation (Autumn 2020)	https://BusConnects.ie/initiatives/core-bus-corridor/	For each of the 16 corridors, the draft preferred route options report and the draft transport modelling report are provided, with a general information report.
CBC information for second round of public consultation (March 2020)	https://BusConnects.ie/initiatives/core-bus-corridor-background-information/preferred-route-documents/	For each of the 16 corridors, the draft preferred route report.
CBC information for first round of public consultation (June 2018)	**https://BusConnects.ie/initiatives/core-bus-corridor-background-information/emerging-preferred-route/** https://BusConnects.ie/initiatives/core-bus-corridor-background-information/technical-documents/	For each of the 16 CBC, an information brochure setting out the emerging preferred route. Technical reports vary by CBC and include problem identification reports, route section reports, concept design drawings, feasibility and options assessment reports and Multi-criteria analysis tables.

17.3 Network Redesign background reports

Title	Links	Summary
Choices Report	https://BusConnects.ie/media/1995/dublin-area-bus-network-redesign-choices-report-17-06-05-web.pdf	Considers the alternative options and philosophies for designing a bus network to cater for existing and future demand and sets out the choices that need to be considered
Revised Network Design Report 2018	https://BusConnects.ie/media/1983/finalreport_chapter1.pdf https://BusConnects.ie/media/1984/finalreport_chapter2.pdf https://BusConnects.ie/media/1985/appendix-a1-30-minute-isochrones.pdf https://BusConnects.ie/media/1976/appendix-a2-45-minute-isochrones.pdf https://BusConnects.ie/media/1977/appendix-a3-60-minute-isochrones.pdf https://BusConnects.ie/media/1978/appendix-b1-all-day-network-a0-main.pdf https://BusConnects.ie/media/1979/appendix-b2-all-day-network-a1-north.pdf https://BusConnects.ie/media/1980/appendix-b3-all-day-network-a1-south.pdf https://BusConnects.ie/media/1981/appendix-b4-all-day-network-a1-west.pdf https://BusConnects.ie/media/1982/appendix-b5-all-day-network-a3-city-centre.pdf	Sets out the network redesign as planned in 2018 and placed on consultation reflecting the comments received on the choices report.

Title	Links	Summary
Revised Network Report 2019	https://BusConnects.ie/media/1751/fullreport_full_web_version.pdf	Sets out the final network redesign for BusConnects Dublin, the alternatives considered, strategies adopted and changes consequent upon public consultation

18 Glossary

BCR – Benefit Cost Ratio

CAF – Common Appraisal Framework for Transport Projects

CBC – Core Bus Corridor

DBC – Detailed Business Case

DoMin – DoMin Scenario

DoSmt – DoSmt Scenario

ERM – Eastern Regional Model

GDA – Greater Dublin Area

LEV – Low Emissions Vehicle

LEF – Low Emission Fleet

NDP – National Development Plan

NGT – Next Generation Ticketing

NTA – National Transport Authority

PBC – Preliminary Business Case

PSC - Public Spending Code

PSO – Public Service Obligation

PTO – Public Transport Operator

RoI – Republic of Ireland

VAT – Value Added Tax

IRR – Internal Rate of Return

QCRA – Quantitative Cost Risk Analysis

QSRA – Quantitative Schedule Risk Analysis

RCF – Reference Class Forecast

CPO – Compulsory Purchase Order

PABS – Project Appraisal Balance Sheet

DPER – Department of Public Expenditure and Reform

NDFA – National Development Finance Agency

TUBA – Transport Users Benefits Appraisal

VoT – Value of Time

CBA – Cost Benefit Analysis

S&S – Stops & Shelters

P&R – Park & Ride

GVA – Gross Value Added

OGP – Oxford Global Project

OBC – Outline Business Case

cEMV – contactless "Europay, Mastercard & Visa"

NEC – New Engineering Contracts (published by the UK Institute of Civil Engineers)

19 Disclaimer

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