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Project Appraisal Guidelines for National Roads Unit 13.0 - Appraisal of Active Modes

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Updates to TII Publications resulting in changes to

Project Appraisal Guidelines for National Roads Unit 13.0 - Appraisal of Active Modes PE-PAG-02036

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An updated unit that replaces the previous PAG Unit 13.0 - Pedestrian and Cyclist Facilities. This new unit provides updated guidance on the appraisal of active modes schemes. The guidance covers the appraisal of stand-alone active modes schemes or the appraisal of active mode components of wider national roads schemes. The guidance also covers the appraisal of greenway projects, in line with TII's new remit as Approving Authority for certain greenway projects. A key component of this guidance document is a new economic appraisal tool for active modes called TEAM which is available on the "Downloads" section of the TII publications website.

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1. Introduction

1.1 Purpose of the Guidelines

Investment in walking and cycling is a key policy objective of the Government. The National Development Plan (NDP) 2021-2030 recognises the importance of active travel not only in reducing carbon emissions, but also in achieving other national strategic outcomes such as compact urban growth and balanced regional development. Other national policy, such as the Climate Action Plan 2021, the Strategy for the Future Development of National and Regional Greenways, and the National Physical Activity Plan highlight the multi-faceted benefits provided by active travel investment, including carbon emission reductions, physical and mental health benefits, tourism and improvements to accessibility and social inclusion.

In recent years, there has been a step change in the pace and scale in walking and cycling investment. The 2020 Programme for Government – Our Shared Future, committed 20 per cent of the transport capital budget for cycling and pedestrian infrastructure. This was cemented in the 2021-2030 NDP alongside the development of a National Cycle Network. The Department of Transport's forthcoming National Investment Framework for Transport in Ireland (NIFTI) outlines the Department's framework for the prioritisation of future investment, and details a modal hierarchy which prioritises active travel, followed by public transport then private vehicles. To help deliver on these objectives, TII was designated the Approving Authority for specific greenway projects outside urban areas in September 2021.

In accordance with the Department of Public Expenditure and Reform's (2019) Public Spending Code (PSC), any investment project or programme is required to undergo appraisal prior to its implementation, which involves examining options and alternatives for investment, assessing the costs and benefits associated with options, and determining the most appropriate use of public funds. The Department of Transport's Common Appraisal Framework (CAF) sets out the broad appraisal requirements for transport projects, while TII's Project Appraisal Guidelines (PAG) sets out the appraisal process and requirements for National Roads and greenway schemes under its remit, including detailed guidance on the different deliverables and types of analysis required at each stage of the project lifecycle.

A requirement of the appraisal process is the assessment of the desirability of an investment proposal from the perspective of society. Rather than just looking at the financial costs of new active travel infrastructure, an active mode appraisal should attempt to capture the wider benefits provided by active travel infrastructure – such as health benefits, reduction in carbon emissions, or improved connectivity – to assess whether the project would be a worthwhile and prudent investment. There are different methods of appraisal: some types of benefits can be quantified and expressed in monetary terms, which is often referred to as 'Quantitative' appraisal; others can only be described with statements or simple scoring systems, which is referred to as 'Qualitative' appraisal.

The aim of PAG Unit 13 is to provide guidelines for the appraisal of active mode interventions within the overall project lifecycle, and to ensure that appraisers have the resources and tools to do so for both qualitative and quantitative appraisal. The guidelines are intended for those appraising TII-approved walking and cycling schemes, including greenways and road schemes with significant active travel components included. A new quantitative tool termed 'TEAM' (**T**ool for **E**conomic appraisal of **A**ctive **M**odes) accompanies the 2021 PAG Unit 13 Guidelines, which can be used for appraisal. However, these guidelines and supporting tool will prove useful to a wider range of stakeholders and contexts, including the appraisal of active travel schemes by local authorities, the evaluation of completed schemes, as well as the evaluation of policies and targets aimed at encouraging greater levels of walking and cycling.

1.2 Why have the Guidelines been Updated?

Given the changing policy context and the acceleration of active travel investment, it is important that the appraisal process for these schemes is robust enough to capture the wide range of benefits provided by walking and cycling, without placing an undue burden on those carrying out the appraisal.

These guidelines replace a previous version of PAG Unit 13, which was last updated in 2016. The updated PAG Unit 13 aims to address some of the challenges faced when carrying out active mode appraisals, and to deliver guidelines and tools that make the process easier, more comprehensive, and efficient for the appraiser. It also aims to ensure greater consistency for TII in terms of comparing and prioritising investment due to a streamlined methodology and the newly developed appraisal tool.

The main changes to PAG Unit 13 include:

- Clarification of the requirements and thresholds for qualitative and quantitative appraisal (Section 1.3);
- An expanded range of appraisal criteria for active modes, which build on international best practice and more comprehensively reflect the types of benefits provided by walking and cycling (Section 2). The results of this international review are summarised in Appendix A;
- Updated guidelines for carrying out Qualitative Appraisal for active modes (Section 3);
- Updated guidelines for carrying out Quantitative Economic Appraisal for active modes, including Cost Benefit Analysis (Section 4);
- The development of a new 'Tool for Economic appraisal of Active Modes' (TEAM), which can be used to easily carry out a Cost Benefit Analysis for active modes schemes and interventions; and
- Additional guidance for estimating walking and cycling demand (Section 5). It should be noted that TII is currently developing a tool based on the UK's 'Propensity to Cycle Tool' for Ireland, which will allow for cycle demand estimates at a route level, once published.

1.3 Appraisal Requirements and Thresholds

The complexity of an appraisal should be proportionate to the scale of the project, and as such, the PAG sets cost thresholds when different types of appraisal are required, which are consistent with the requirements of the PSC and CAF. The requirements for active mode appraisal are:

- **Qualitative Appraisal –** Qualitative appraisal must be completed for all projects, regardless of project size. Qualitative appraisal usually takes the form of Multi-Criteria Analysis (MCA) (when assessing multiple options) or a Project Appraisal Balance Sheet (when assessing only one option, or a preferred option). Both involve assessing and scoring option(s) against a set of criteria to highlight the relative benefits and costs provided. Guidelines for undertaking qualitative appraisal are contained in Section 2 and 3.
- **Quantitative Economic Appraisal –** Quantitative economic appraisal is only required for projects costing over €20 million (Major Projects), including National Road schemes costing over €20 million where active modes infrastructure is also being provided. Quantitative appraisal can take one of two forms:

- **Cost-Benefit Analysis (CBA)** involves the monetisation of benefits associated with increased levels of walking and cycling (such as health, emissions reductions etc.) and comparing these against the project/programme costs. CBA is the recommended method of quantitative economic appraisal, and TII have developed a 'Tool for Economic appraisal of Active Modes' (TEAM) to simplify the CBA process for appraisers, with additional guidance provided in Section 4. The TEAM tool can be used to complete a CBA for standalone active mode schemes, as well as for estimating active mode benefits for inclusion within the CBA of a National Roads scheme.
- **Cost-Effectiveness Analysis (CEA)** is a method of economic appraisal which compares the relative costs of options for achieving the same objective. Depending on the objectives of the project, CEA uses cost-effectiveness indicators to compare the relative costs of achieving them, such as 'cost per kilometre', 'cost per user', 'cost per tonne of CO_2 avoided'. CEA is most appropriate in instances where there is one overriding objective for all interventions, such in health, where the goal of interventions is to generally to reduce rates of illness or death. However, active mode projects have a wide range of objectives which often vary from project-to-project, meaning that it is difficult to establish a single cost-effectiveness indicator that is common to all projects and that can be used for comparison purposes. While CEA can be used to meet the economic appraisal requirements of the CAF and PSC, for this reason it is not preferred. If project teams wish to use CEA to appraise a project, the reasoning for this and the proposed cost-effectiveness indicators should be set out in the Appraisal Plan or the Strategic Assessment Report, and agreed upon with the Approving Authority.

Figure 1.1 below provides a schematic to help appraisers identify the appraisal requirements for schemes depending on their size and context. It also indicates where demand estimates are required, as well as recommended approaches to estimating demand.

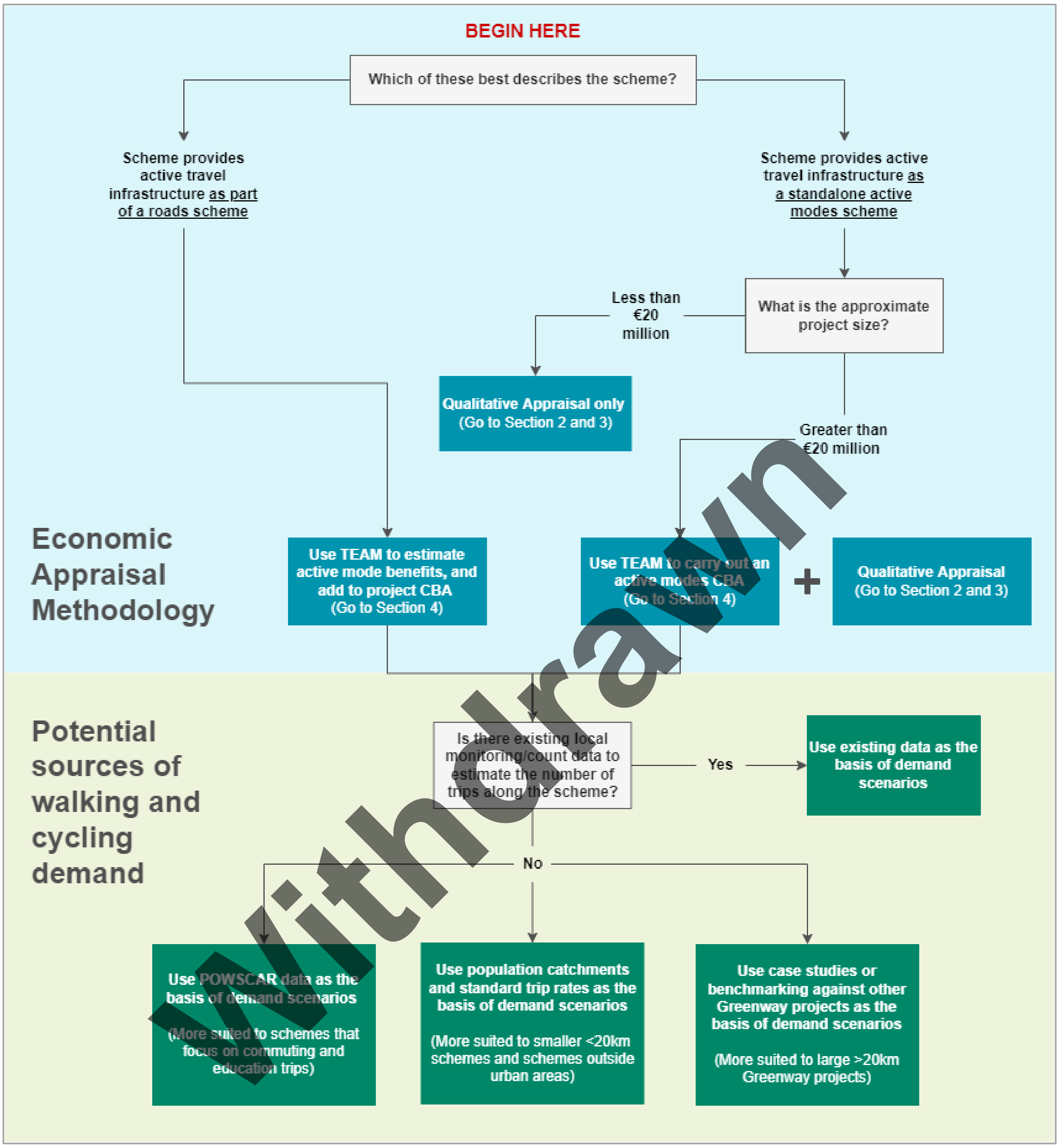

Figure 1.1 Recommended approaches to active mode appraisal

1.4 Reporting and Deliverables

Projects with an estimated cost of €10 million or more are required to develop a Strategic Assessment Report (SAR). A SAR is typically completed during Phase 0, and its purpose is to outline the strategic need for a project before time or money is spent on more in-depth design and planning. Guidance on developing a SAR is provided in *PAG Unit 2.1: Strategic Assessment Report*.

For active mode schemes with an estimated cost of **less than €100 million**, the main deliverable required is a **Project Appraisal Report (PAR).** The PAR summarises the appraisal process, and should contain the following key sections:

- **Rationale for Intervention –** This section should outline why the project is being delivered and the issues or opportunities to which it is responding (e.g. safety, climate, tourism etc.).
- **Strategic and Policy Alignment –** This section should outline how the scheme aligns with and support local, regional and national policy; including planning, transport, climate and tourism policy.
- **Objectives –** The PAR should clearly set out the project objectives; what the project aims to achieve and/or how it aims to achieve it. Objectives should be 'SMART', meaning that they are 'specific', 'measurable', 'attributable', 'realistic', and 'time-bound', and this section should outline how they align to the six CAF criteria.
- **Demand –** The PAR should include analysis of potential demand for the project, including the types of users, journey purposes and catchments the scheme is likely to serve. Where quantitative economic appraisal is required, this should also set out the demand scenarios that will be used for the CBA, with further guidance provided in Section 5 of this Unit.
- **Options –** The PAR should summarise the Option Selection process, detailing the options that were considered and the outcomes of any options selection reports. The PAR must include a 'Do Nothing / Do Minimum', which forms the base case against which options are assessed; as well as several 'Do Something' alternatives. Summarising the results of the Options Selection process, this section should conclude on the 'Preferred Option'.
- **Financial Appraisal –** The PAR should include a financial appraisal which examines the financial costs associated with the proposal. Further guidance on carrying out Financial Appraisal is contained in *PAG Unit 11: Financial Appraisal.*
- **Economic Appraisal –** The purpose of the appraisal is to compare options and to assess the wider economic, social and environmental benefits of a project. Depending on the project requirements detailed in Section 1.3, this section will include the qualitative appraisal, as well as the quantitative economic appraisal if the project has an estimated cost of greater than €20 million. It should also contain a conclusion, which summarises the main impacts and recommendations arising from the appraisal. Guidance on carrying out qualitative appraisal is contained in Sections 2 and 3, while quantitative appraisal and the use of TEAM is described in Section 4.
- **Risk Assessment –** This section should detail the main external and internal risks to the project, their likelihood of occurring, their potential impacts on the project's success (i.e. timeframes, budget, objectives etc.), as well as actions being taken to avoid or mitigate the risk. A Risk Register should be continually updated and new risks added as the project progresses. It should also reflect on lessons learned from previous projects.
- **Implementation & Procurement –** This section should consider the implementation of the project, including the project governance structure and a plan for procurement.
- **Monitoring & Evaluation Plan –** The PAR should outline a monitoring and evaluation plan; the purpose of which is to outline how the future performance and success of the scheme will be monitored. This should include Key Performance Indicators (KPI) against which success will be measured.

The PAR should be initially developed during Phase 2 of the TII project lifecycle and should be continuously updated with new information as the project progresses through the project lifecycle up to Phase 5. This is particularly true of the financial appraisal, economic appraisal, risk and implementation sections, where new information and costs are gradually obtained during the design and procurement processes.

The PAR fulfills the requirements of the Public Spending Code in relation to Preliminary Business Case and Final Business Case for active modes schemes. The complexity of the analysis and content in the PAR is somewhat streamlined in proportion with the scale and value of an active modes scheme, when compared to a major national roads scheme. Further guidance on the development of a Business Case or a PAR is available in *PAG Units 8.0 Business Case and 12.0 Minor Projects (€5m to €20m).*

For projects with an estimated cost of greater than €100 million, project teams should consult with TII regarding the required appraisal deliverables.

2. Overview of Active Mode Appraisal Criteria

Appraisal criteria are essentially a ‘check-list’ of required considerations when assessing the benefits and costs of a scheme or an option. They provide a standard structure against which appraisers can outline the main impacts of a scheme in an MCA or Project Appraisal Balance Sheet (PABS), compare the relative advantages and disadvantages of options, while also highlighting areas that might warrant further thought and consideration.

This section outlines the main appraisal criteria and sub-criteria relevant to active modes projects and programmes. CAF requires that transport projects be appraised against six key criteria: ‘Economy’, ‘Safety’, ‘Integration’, ‘Physical Activity’, ‘Environment’ and ‘Accessibility and Social Inclusion’; along with other relevant sub-criteria that reflect the nature of the project and its impacts. Based on these six CAF criteria, TII has developed a list of sub-criteria that reflect the main impacts of active modes, which can also be used as headings when undertaking qualitative appraisal.

2.1 Economy

Within transport appraisal, the ‘Economy’ criterion was traditionally dominated by user benefits associated with journey time savings, and how a new piece of infrastructure or service would affect journey times. **Transport efficiency** can be a benefit of active travel schemes in some circumstances, particularly when it relates to ‘permeability’ and reducing the distances that pedestrians and cyclists need to travel, such as providing new bridges, shortcut routes or removing barriers to permeability.

However, other economic benefits beyond transport efficiency need to be considered when it comes to active modes. One potentially significant economic benefit of walking and cycling is the **impact on the economic wellbeing of households**, where active modes reduces the costs of owning and operating vehicles. On average, Irish households spend 15% of household income on transport (90% of which relates to vehicle expenses)[1], meaning that providing alternative transport options to useful destinations can reduce costs and improve household wellbeing, particularly in areas where alternatives to private car are lacking.

Tourism can be another significant economic benefit, with several recent examples demonstrating how greenways can attract tourists and encourage increased spending on accommodation, hospitality and other services. This can lead to further investment and job creation and can be successful in spreading tourism and economic activity around the country. However, consideration also needs to be given to whether an intervention is likely to attract new tourism, or whether it will simply displace tourists and economic activity from other locations.

Investment in active modes has the potential to result in **other wider economic impacts**, depending on the objectives and location, such as reduced congestion in urban areas, greater access and growth in employment centres, and improved vibrancy of retail in town and village centres.

CAF Criteria	Sub-Criteria	Description
Economy	Transport Efficiency	User benefits associated with more efficient transport and lower journey times
	Household Impacts	Impacts on household costs associated with owning and operating vehicles
	Tourism	Potential for increased tourism and spending from domestic and overseas visitors

[1] CSO, 2016. ‘Household Budget Survey 2015-2016’.

CAF Criteria	Sub-Criteria	Description
	Wider Economic Impacts	Other wider economic impacts that may be relevant, such as reduced congestion in urban areas, access to employment centres, and improved town centre vibrancy
	Funding Impacts	Costs associated with the proposal

2.2 Safety

Pedestrians and cyclists are considered 'vulnerable' road users, a term that is used to describe those who are unprotected by an outside shield and who have a greater risk of injury in a collision with a vehicle. There are several aspects to consider when assessing the impact of an intervention in terms of safety.

Firstly, the infrastructure type and the degree to which routes/junctions are separated from traffic can have an impact on the **risk of collisions** and can also encourage new and inexperienced cyclists to take up cycling. Reducing the number of potential conflicts, such as junctions, road crossings and driveways, also has an impact on cyclist exposure to risk and journey quality.

Other attributes of **journey quality**, such as the width, gradient, surface of a route, or exposure to poor air quality, can influence users' comfort and likelihood to use the infrastructure. A facility's 'Quality of Service' as described in the NTA's *National Cycle Manual*[2] can be a useful indicator of journey quality.

Finally, the users' sense of **personal security** and factors such as lighting, remoteness and the number of entrances/exits can also influence someone's willingness to use a route. Electronic surveillance (lighting, cameras having an electronic tracking device such as a phone) may make routes more amenable, but passive surveillance and the continuous presence of other people may create a more enduring sense of safety.

It should be noted that there may also be unintended consequences of an increase in pedestrians and cyclists. In some cases, individuals who shift to active travel could increase their exposure to air pollutants and collision risks. Any design measures to mitigate these risks should be included in the appraisal, including the incorporation and use of natural capital such as plants and trees for air filtration/purification and shelter from wind and rain, where possible.

CAF Criteria	Sub-Criteria	Description
Safety	Collision Reduction	Reduced risk of collisions with traffic associated with safe and segregated walking and cycling infrastructure
	Journey Quality	Other components of journey quality, such as width, gradient, surface type or setting, that influence users' journey quality and likeliness to use infrastructure.
	Security	Sense of personal security and safety while using active travel

[2] NTA, 2011. 'National Cycle Manual. Chapter 1.4 – Quality of Service'. Available at: https://www.cyclemanual.ie/manual/thebasics/quality/

2.3 Integration

As described in Section 1, active modes are strongly supported by national, regional and local policy, meaning that it is important to outline the **integration of a scheme with government policy**. While this focuses particularly on spatial and planning policy, the appraisal should also highlight how the intervention supports and aligns with climate, transport, tourism and health policy.

In addition to policy integration, the appraisal should also consider physical integration and connectivity. As the purpose of a transport system is to bridge the gap between where people are and where they want to go, assessing the impact on integration requires consideration of how a scheme connects to a range of potential destination types. These kinds of assessments can be done at a high level or using mapping and GIS techniques to quantify the impacts on integration for larger schemes.

Integration between different land uses is one of the most important factors in the usefulness of a transport network. Routes that connect areas where people live, work or shop can cater for a large proportion of a person's daily travel and make modal shift more likely. Consideration of land use integration within the appraisal process is very much influenced by the National Planning Framework objective of 'Compact Growth', which recognises the role of active travel in connecting people to employment, services and their local communities.

The **integration of active travel routes to schools and places of education** is of particular importance. Children are generally dependent on adults for the commute to school, and as many older students do not own or have access to drive a car, a lack of access to safe and connected facilities for active travel limits their ability to travel independently. The ability to travel independently by active modes can have wider benefits for child and youth development, including ability to make decisions, to interact with their peers, independent problem solving and assessing/managing risk. It also benefits parents and caregivers, freeing up the time that is spent escorting children to school; as well as society through the avoidance of additional car trips near schools.

As people often walk or cycle to and from public transport stations, hubs and interchanges, the **integration of active mode routes with public transport interchanges** improves the sustainable mobility of people, when public transport is an available option. In urban areas, this integration will be linked to permeability and accessibility, whereas in more rural areas, this integration will be linked to the facilities for bike storage and safe routes that connect to bus, train and ferry stations.

For tourist-focused schemes, **the integration of active travel routes with tourism** destinations and services is an important consideration. A variety of 'things to see and do', such as visitor attractions, historic sites, attractive landscapes and amenities will increase the potential appeal of a route to tourists.

The **integration of active travel routes with existing local, regional and national cycling facilities** increases the level of connectivity on that network. Connection with long-distance cycle routes and greenways can improve the attractiveness of a route for recreational and cycle tourists, while connections with local network to homes, businesses and services can improve its usefulness for day-to-day users. Both type of networks should be considered when appraising an active travel scheme, particularly when utility and recreation networks overlap. A cohesive network ensures clear wayfinding and facilitates cyclists to reach their destination by the route of their choice with minimal interruption. Without this connectivity, there cannot be a cycle network; only a collection of individual cycle routes.

CAF Criteria	Sub-Criteria	Description
Integration	Policy	Integration with relevant local, regional and national policy
	Land Use	Improved connectivity between population, employment and retail centres

CAF Criteria	Sub-Criteria	Description
	Schools & Education	Improved connectivity to schools and third-level facilities
	Transport	Improved connectivity to major transport interchanges, such as rail, bus and ferry stations
	Tourism	Improved connectivity to 'things to see and do', such as tourism sites, attractions or activities.
	Cycling	Improved connectivity to other local, regional and national cycling facilities

2.4 Physical Activity

Physical inactivity is significant risk factor for chronic diseases, and while the link between physical activity and health is known and documented for over fifty years, it is only in more recent times that physical activity is given appropriate consideration in planning and infrastructure provisioning[3]. In Ireland, just one-third of people are currently meeting the National Physical Activity Guidelines, while around 10 per cent are classed as 'sedentary'[4].

Investment in active modes can encourage increased levels of physical activity, resulting in **physical health benefits** not only for the individual, but for wider society in terms of reducing healthcare costs and lower rates of absenteeism. The World Health Organisation provides guidance for the inclusion and monetisation of health benefits of active travel in its Health Economic Assessment Tool[5], based on detailed review of scientific and economic literature, and this is widely used by governments and researchers in quantifying the health benefits of walking and cycling.

Alongside these physical health benefits, being able to engage in recreational walking and cycling can benefit **mental health and wellbeing**. The recreation benefits of walking and cycling are dependent on personal preferences but can range from the enjoyment of being active in nature, the presence of social company or undertaking an activity with friends/family, sense of personal wellbeing and control over personal health.

CAF Criteria	Sub-Criteria	Description
Physical Activity	Health	Positive health outcomes due to increased levels of physical activity, including reduced risk of premature mortality, as well as lower rates and reduced costs of serious illnesses.
	Recreation	Improved wellbeing due to access to high quality facilities for outdoor recreation.

2.5 Environment

The Government's Climate Action Plan 2021 targets a 51% reduction in **greenhouse gas emissions** by 2030, and with the transport sector responsible for approximately 20% of total emissions in Ireland, investment in active modes necessary to encourage reduction in private car use.

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[3] The Lancet 2012. Special series on physical activity. Volume 380, Issue 9838.
[4] Sports Ireland, 2019. 'Irish Sports Monitor – Annual Report 2019'. Available at: https://www.sportireland.ie/sites/default/files/media/document/2020-09/irish-sports-monitor-2019-report-lower-res.pdf
[5] World Health Organisation, 2017. 'Health Economic Assessment Tool for walking and cycling'. Available at: https://www.euro.who.int/__data/assets/pdf_file/0010/352963/Heat.pdf

Project teams should consider how likely a scheme is to encourage a modal shift towards walking and cycling, particularly for short trips and regular trips to work, school and retail/services.

Air pollution from the transport sector is another important consideration, particularly in urban areas and/or in congested smaller towns which may have localised concentration of air pollution from traffic. Replacing car trips with active modes can improve local air quality by reducing the most pervasive pollutants to health and ecosystems, particularly nitrogen oxides (NOX), fine particulate matter (PM), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs).

Private cars also contribute to the **noise pollution** from roads, particularly in busy urban areas. Noise pollution cause a variety of psychological, cardiovascular and other health disorders[6]. The European Union's (EU's) Environmental Noise Directive deals with environmental noise from major transport infrastructure including roads, railways and airports and a number of state agencies including TII, Environmental Protection Agency, local authorities developed Strategic Noise Maps to show noise exposure resulting from transport noise sources. The identification and protection of quiet areas is an important component of the Environmental Noise Directive, and a mode shift to active transport modes will alleviate transport-related noise pollution.

However, the development of transport infrastructure can have other - potentially negative - environmental impacts which must be considered, particularly those from the construction phase. These include potential **impacts on landscapes, biodiversity and habitats, cultural heritage, land use and water resources.** Further guidance on evaluation of these impacts is provided in CAF and the PAG.

CAF Criteria	Sub-Criteria	Description
Environment	Carbon	Impact on carbon emissions from transport
	Air Quality	Impact on non-greenhouse gas emissions from transport that have a negative impact on human health, such as nitrous oxides and particulate matter
	Noise	Impact on local noise levels from transport
	Landscape & visual quality	Impact on local landscapes and viewpoints
	Biodiversity	Impact on biodiversity and habitats, particularly protected habitats and species.
	Cultural Heritage	Impact on areas or structures of cultural importance, including archaeological sites, historic buildings and structures, or culturally-significant landscapes
	Land Use	Impact on land uses, such as through land-take, excavation and infill, or severance.
	Water Resources	Impact on surface waters, ground waters and coastal resources.

2.6 Accessibility & Social Inclusion

Accessibility and social inclusion are fundamental considerations of infrastructure provision. Questions of who uses and benefits from an intervention are fundamental questions that should be explored in appraisal, to ensure that equity considerations are mainstreamed through the provisioning of infrastructure and identify potential unintended consequences early on in the appraisal and design process.

[6] EPA, 2020. State of the Environment. Available at: https://bit.ly/3DMgHGD

Infrastructure has the power to create opportunities for everyone, but historically the access it enables was not always equal, leaving legacy infrastructure problems, such as severed communities, limited transport options and barriers to infrastructure use due to socio-economic factors.

Disadvantaged geographic areas can be identified using the Pobal Deprivation index, which scores each small area in Ireland (defined by 50-200 households) in terms of affluence or disadvantage. The index uses 2016 Census data to calculate this score[7]. Active transport schemes that provide options for disadvantaged communities should be documented in the appraisal process, as it addresses local disadvantage and barriers to mobility from poverty (unaffordability of motor vehicles), fuel poverty or limited transport options, particularly in rural areas.

There are many **vulnerable groups** within society in the context of active modes, including people with physical disability and impaired mobility, children and older people, ethnic minorities and recent migrants and refugees. Due to physical, economic or social circumstances, these users may find it difficult to access existing transport infrastructure and services, meaning that well-designed and accessible infrastructure has the potential to open up additional opportunities and to promote social inclusion. The appraisal process should consider the impact of active mode infrastructure on access for different user groups, with any improvement of opportunities for vulnerable groups documented throughout the appraisal process.

Finally, there is a significant **gender** gap in Ireland when it comes to active travel: Census 2016 data shows than men are twice as likely to cycle to work as women, while at secondary school level, boys are nearly ten times as likely to cycle as girls. TII's *Travelling in a Woman's Shoes* report[8] highlighted many of the barriers faced by women when it comes to cycling, including a lack of safe and high quality routes, concerns over personal security, and difficulties with trip-chaining without using cars (i.e. combining trips to several destinations into one journey). The appraisal process should consider how a scheme or option is likely to contribute to reducing this divide, and how it makes transport more accessible to all users.

Social inclusion also requires consideration of the welfare of communities – how they will benefit from the proposed infrastructure, the opportunities that will arise for them and how it will facilitate participation in community life and offer a sense of belonging.

CAF Criteria	Sub-Criteria	Description
Accessibility & social inclusion	Disadvantaged Geographic Areas	Accessibility for users in disadvantaged areas, usually as identified in the *Pobal Deprivation Index*
	Vulnerable Groups	Accessibility of infrastructure for users of all ages and abilities
	Active Travel & Gender	Impact in addressing the transport needs of women and girls and reducing the gender disparity in walking and cycling
	Social Inclusion	Improving the potential for interaction and participation in community life and reducing the risk of isolation

[7] Available at: https://www.pobal.ie/research-analysis/

[8] TII, 2020. 'Travelling in a Woman's Shoes – Understanding Women's Travel Needs in Ireland to Inform the Future of Sustainable Transport Policy and Design'

3. Undertaking Qualitative Appraisal

Qualitative appraisal should be completed for all projects and is the default method of appraisal for projects and programmes costing less than €20 million. Qualitative appraisal is different from quantitative appraisal methods (such as cost benefit analysis or cost effectiveness analysis) as it ranks and scores schemes/options based on qualitative criteria and professional judgement.

3.1 Steps for Carrying out Qualitative Appraisal

At the outset of the appraisal process, an appraisal framework will need to be set up which establishes how options will be assessed and scored. The proposed appraisal framework is usually included within the Strategic Assessment Report (for projects costing more than €10 million).

The steps for carrying out qualitative appraisal are outlined below, and are adapted from *PAG Units 7.0: Multi-Criteria Analysis* and *7.1: Project Appraisal Balance Sheet*.

3.1.1 Step 1 – Establish the Decision-Making Context and Project Phase

Central to the appraisal is the decision-making context (i.e. what the project is trying to achieve). This will ultimately stem from the objectives established at the onset of the project, which will typically also align with the six key CAF criteria, as outlined above.

This also relates to the options that are under consideration at this stage of the project. Typically Multi Criteria Analysis (MCA) is used during Phase 2 Option Selection to select a preferred option, after which this will develop into a Project Appraisal Balance Sheet (PABS) in subsequent phases that summarises the main impacts of the preferred option.

3.1.2 Step 2 – Review Active Mode Appraisal Criteria and Sub-Criteria

Firstly, the criteria and sub-criteria outlined in Section 2 should be reviewed and the most relevant criterion for the scheme should be identified. While all criteria should be considered, the relevance of certain criteria will often depend on the scheme objectives. For example, if an objective of the scheme is to attract tourists to a rural area, then the 'Tourism' sub-criteria will be an important part of the appraisal. If it is determined that certain criteria are not relevant and should be excluded, an explanation should be given as to why it is not relevant to the scheme or its objectives.

The list above is not exhaustive: if there are any other relevant criteria not included here or others that might be important, they can be brought into the assessment framework as additional sub-criteria. During Option Selection this could also include more specific design criteria as appropriate.

3.1.3 Step 3 – Establish a Scoring Procedure

Once the list of relevant appraisal criteria has been identified, the next step is to determine how options/schemes should be assessed and scored. Generally, schemes should be assessed against a criterion with a short statement explaining how it will affect the criteria, and a score/rating using a pre-determined scoring scale. The PAG uses a 7-point qualitative scale for scoring options, which is used to rate the extent to which a scheme is likely to represent a positive/negative impact in each criterion. This scale is shown below.

1	2	3	4	5	6	7
Major Negative	Moderate Negative	Minor Negative	Neutral	Minor Positive	Moderate Positive	Major Positive

Where feasible, indicators should be introduced to help with scoring and to make the process more objective. This is particularly useful when trying to compare alternative schemes or routes, as it can help to distinguish which options perform better than others. There are two types of indicators:

- **Quantitative Indicators –** Depending on scheme and the data available, use quantitative indicators to help determine how to score or compare options. These indicators are particularly useful for providing objective comparisons between options: for example in the 'Schools & Education' sub-criteria, metrics like the 'number of schools within 500m of the route' can help to score options and identify the option that performs best.
- **Monetary Indicators (TEAM results) –** If a Cost-Benefit Analysis was carried out using the TEAM, monetary results can also be brought in as an indicator to help score the assessment.

3.1.4 Step 4 – Examine Results and make Recommendations & Conclusions

Based on the previous steps, the results for each scheme/option should be summarised in a performance matrix which highlights their relative strengths and weaknesses, and which can be used to guide and document the choice of a preferred option. There are two ways of summarising the results of the qualitative appraisal:

- For multiple options, this can be summarised in an MCA performance matrix. MCA is generally used during Phase 2 Option Selection, when the aim is to identify a preferred option from a short-list. Further guidance on MCA in provided in *PAG Unit 7.0*.
- Following the selection of a preferred option, the appraisal should be summarised in the form of a PABS for the preferred option. Further guidance on PABS is provided in *PAG Unit 7.1*.

The process and results of the appraisal process should be described in the required appraisal deliverables, as outlined in Section 1.4.

4. Undertaking Cost Benefit Analysis for Active Modes

As outlined in Section 1.3, Cost Benefit Analysis is the typical form of quantitative economic appraisal for transport schemes, and is required for projects costing over €20 million, including National Roads schemes where active modes infrastructure is also being provided. CBA compares the monetised active modes benefits of a proposal (such as health benefits or journey time savings) to its cost and uses this to assess where a project represents good value of money.

4.1 Introducing TEAM - CBA Tool for Active Modes

CBA for road and public transport schemes is usually carried out using dedicated models and software, which results in a streamlined and consistent appraisal process across different schemes. As part of this update to PAG Unit 13, TII have developed an Excel-based tool for undertaking a CBA of active modes schemes: the 'Tool for Economic appraisal of Active Modes' (TEAM). TEAM is a user-friendly tool that can quickly estimate the main benefits associated with increased levels of walking and cycling or improved infrastructural quality. It can be used to carry out a full CBA for an active mode scheme, as it provides a summary of the benefits and economic outputs required by the PAG and PSC. It can also be used to simply calculate the active modes benefits for inclusion in another economic appraisal (for example, to add to a CBA for a National Roads scheme).

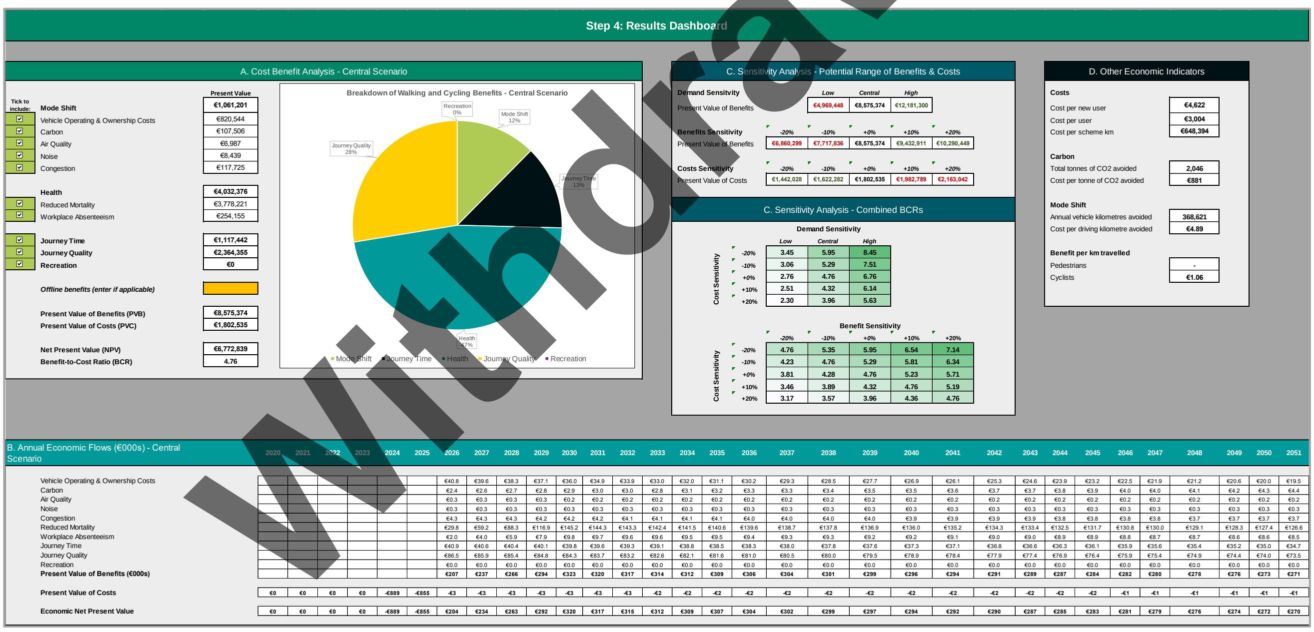
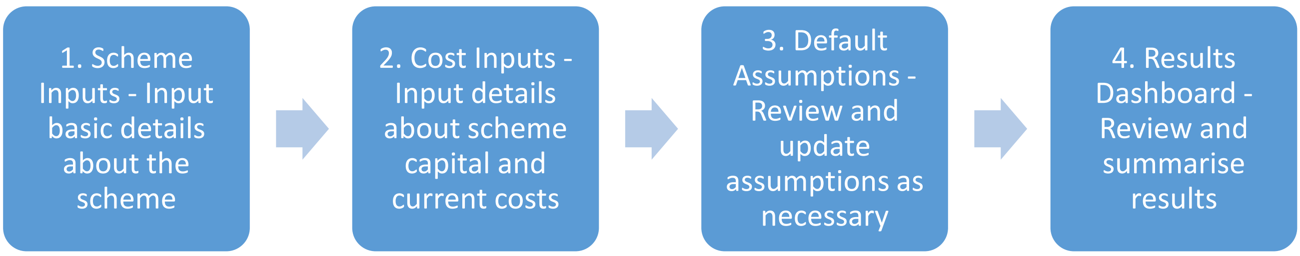


Figure 4.1 Example of the results dashboard from a TEAM appraisal

TEAM is based on a series of Excel sheets which combine simple user inputs with background calculations and assumptions to estimate the costs and benefits associated with a proposal, before summarising these results in a results dashboard. There are four main steps to carrying out a CBA using TEAM, each associated with a different Excel sheet in the tool, as follows:



TEAM is designed to be easy-to-use, with most steps explained within the tool itself. The use of standard methodologies and default assumptions reduces the data that project teams are required to gather, meaning that TEAM assessments can be carried out with relatively few user inputs. However, the following sections provide further detailed guidance for each of these steps, as well as the specific purpose and requirements of each input and assumption.

4.2 Quantitative Economic Benefits for CBA

4.2.1 Economic Benefits Included within TEAM

TEAM automatically estimates the main economic benefits associated with active modes schemes, including Health, Mode Shift, Journey Time, Journey Quality and Recreation benefits. These benefits are summarised in Table 4.1 below, along with their alignment with the Walking and Cycling Appraisal Criteria described in Section 2.

Table 4.1 Economic benefits included in TEAM

Benefit	Description of benefit	Alignment of benefit with MCA / PABS criteria (see Section 2)
Mode Shift	Benefits for individuals and society from a reduction in car use. Five benefits are included within this:	
Vehicle Operating & Ownership Costs	*Savings for households due to a reduction in vehicle operating & ownership costs, such as reduced fuel consumption, non-fuel operating costs, and the overall cost of vehicle ownership.*	Economy (Household Impacts)
Carbon	*Reduction in carbon emissions*	Environment (Carbon)
Air Quality	*Reduction in emissions of non-greenhouse gases such as nitrous oxides and particulate matter, and improved air quality and health.*	Environment (Air Quality)
Noise	*Reduction in noise from vehicles and traffic*	Environment (Noise)
Congestion	*Reduction in congestion to reduced car use, particularly in urban areas.*	Economy (Wider Economic Impacts)
Health	Benefits for users and society associated with increased levels of physical activity. Two benefits are included within this:	
Reduced Mortality	*Reduction in the risk of premature mortality.*	Physical Activity (Health)
Workplace Absenteeism	*Reduction in costs for employers associated with the number of sick days taken.*	Physical Activity (Health)
Journey Time	Benefits for users from a reduction in journey times.	Economy (Transport Efficiency)
Journey Quality[9]	Benefit for utility users from high quality cycling infrastructure.	Safety
Recreation	Benefits for recreational users of high-quality walking and cycling infrastructure.	Physical Activity (Recreation)

These benefits are estimated by TEAM using a range of sources and methodologies, most of which are hidden in background sheets to streamline the process for the appraiser. These sources include:

[9] Journey Quality was referred to as 'Ambience' in the previous PAG Unit 13

- Calculation of reduced mortality and carbon benefits is based on the methodology of the World Health Organization's Health Economic Assessment Tool (HEAT)[10] for walking and cycling. Localised parameters from CAF and PAG were used where necessary, including for vehicle emissions factors and the Shadow Price of Carbon.
- Methods and values currently contained in PAG and CAF are used to calculate air quality benefits, vehicle operating and ownership costs, and journey time savings[11].
- The methodology for 'Workplace Absenteeism' benefits has been updated from the previous PAG Unit 13, and is based on research from the WHO[12].
- The marginal external costs of noise and congestion were sourced from the UK Transport Appraisal Guidance, and value transfer techniques were used to convert these into Irish values based on relative exchange rates and real GNP[13].
- Journey quality values are an update of 'Journey Ambience' values from the previous PAG Unit 13, which were originally based on a willingness-to-pay study from the United Kingdom[14]. However, the tool now provides similar willingness-to-pay values for Irish recreational trips (referred to as 'Recreation' benefits), which are based on a literature review of willingness-to-pay for recreational walking and cycling trails from Ireland[15].

Technical methodologies for TEAM and the benefits contained therein are contained in Appendix B.

4.2.2 Additional Economic Benefits not Included within TEAM

While TEAM provides estimates of the main economic benefits associated with active mode schemes and can be used to carry out a standalone CBA, certain benefits have been excluded from current version of the tool where national-level data was not available. The most notable of these are 'Collision Reduction', for which guidance was provided in the previous version of PAG Unit 13; and 'Tourism', which is often included as a benefit for greenway schemes.

While not included within TEAM, in some circumstances, project teams/appraisers may have sufficient local-level data to estimate additional benefits. Where this is the case, these additional benefits may be calculated separately and added to the benefits calculated by TEAM, but only if supported by a strong rationale and robust local data. Any calculations and assumptions for additional benefits must be documented as part of the reporting process.

Methodologies for calculating two of these additional benefits – 'Collision Reduction' and 'Tourism' – have been provided in Appendix B. A cell has also been provided in the Results Dashboard to allow for the Net Present Value of any benefits calculated offline to then be entered into the TEAM CBA. If applicable, the NPV of these benefits should be calculated using the same assumptions as the main TEAM assessment, including the appraisal period, discount rates, demand scenarios, and future growth rates.

[10] WHO, 2017. 'Health Economic Assessment Tool (HEAT) for Walking and Cycling'. Available at: https://www.euro.who.int/__data/assets/pdf_file/0010/352963/Heat.pdf

[11] See PAG Unit 6.11 for vehicle operating costs and emissions parameters.

[12] World Health Organisation (WHO), 2003, Health and development through physical activity and sport, WHO/NMH/NPH/PAH/03.2, Geneva, Switzerland

[13] Values adapted from Department for Transport, 2019. 'TAG Data Book – Table 5.4.2. Available at: https://www.gov.uk/government/publications/tag-data-book

[14] Original research from Hopkinson & Wardman (1996) and Wardman et. al. (1997); values adapted from Department for Transport, 2019. 'TAG Data Book – Table 4.1.7'. Available at: https://www.gov.uk/government/publications/tag-data-book

[15] Values based on a 'Travel Cost method' estimate of willingness to pay for day trips on the Waterford Greenway, as estimated from AECOM, 2018. 'Waterford Greenway Intercept Survey'. Available at: https://www.waterfordcouncil.ie/media/greenway/WaterfordGreenway-BaselineSurveyReport-Jan2018.pdf.

4.3 Detailed Steps for Carrying out a CBA using the Tool for Economic Appraisal of Active Modes (TEAM)

4.3.1 Sheet 1 – Scheme Inputs

The first step of a TEAM appraisal allows the input of basic details about a scheme, as well as details of the scenarios being tested.

4.3.1.1 Section A - Scheme and Infrastructure Details

The first set of questions aims to provide basic details regarding the scheme, including:

- **Location –** Where the scheme is being delivered. Choose between five area types that best describe the location of the scheme:
- Dublin City (the area administered by Dublin City Council)
- Greater Dublin Area (counties Dublin, Kildare, Wicklow, Meath)
- Regional Cities (Cork, Limerick, Galway, Waterford)
- Other towns / urban districts (with a population greater than 1,500)
- Rural (areas with a population of less than 1,500).

The location should reflect the location where the majority of users are based. For example, if a scheme passes through a rural area but is primarily aimed at connecting two nearby towns, choose 'Other towns / urban districts'. The chosen location will affect the 'diversion rates' that are used by the tool, which refers to the modes new users are assumed to have shifted from. This is explained in greater detail in Section 4.3.3.2.

- **Scheme Opening Year –** Input the year that the scheme/intervention is expected to be complete and open to users.
- **Scheme Length –** Input the total length of the scheme / route corridor in question in kilometres. See Figure 4.2 for hypothetical example of an extension to an existing scheme.
- **Infrastructure Breakdown –** Provide a breakdown of the types of infrastructure along the route/corridor under the existing situation, and under the proposed situation/option. This should break down the total scheme length in kilometres across five potential types of infrastructure, as follows:
- Off-road segregated trails, such as greenways or off-road cycleways
- On-road cycle track with physical separation from traffic (e.g. kerbs, verges, bollards)
- On-road cycle lane without physical separation from traffic (painted lanes)
- Shared bus lanes
- No dedicated facilities / mixed traffic

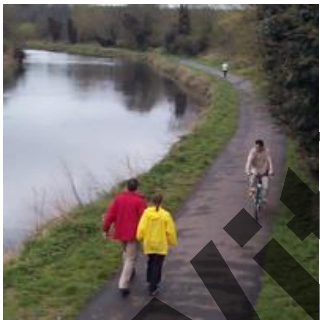
It is important to differentiate between infrastructure types, as there are different benefits that are calculated for each type. If the scheme is a new route, the 'Existing infrastructure' field should describe the infrastructure type of the nearest alternative route, which in most cases, is likely to be 'no dedicated facilities'. Examples of different types of cycling infrastructure are displayed below from the NTA's (2011) National Cycle Manual[16].

[16] Available from: https://www.cyclemanual.ie/

- **Journey Time Savings –** This should only be used in the case of interventions that remove detours or improve permeability along specific routes, such as bridges, under/overpasses, or the provision of shortcut routes. If a route does so, the user will be asked to provide an estimate of how many minutes the average pedestrian and/or cyclist will save, which will be used to calculate the journey time savings benefit.

How long is the scheme in question? (in kilometres)	**10.00**	
Break down the total scheme length into different types of infrastructure:	***Existing infrastructure***	***Proposed infrastructure***
Off-road segregated cycle trails (e.g. Greenways, Cycle Trails, Cycleways)		**7.50**
On-road cycle-track with physical separation from traffic (e.g. kerbs, verges, bollards)		**2.00**
On-road cycle lane without physical separation from traffic (e.g. painted lanes)	**1.50**	**0.50**
Shared bus lane		
No dedicated facilities	**8.50**	
	10.00	*10.00*

Figure 4.2 Example of inputting route infrastructure details

Off-road	**On-road cycle track**	**On-road cycle lane**
		
Shared Bus Lane	**No dedicated facilities / mixed traffic**	
		

Source: NTA, 2011. 'National Cycle Manual – Section 4.3 Link Types'

Figure 4.3 Example of cycling infrastructure types

4.3.1.2 Section B – Demand Scenarios

One of the most important inputs to the tool is the demand scenario, meaning the numbers of pedestrians/cyclists using a scheme before and after an intervention. This demand scenario is used to calculate the benefits associated with a change in the number of pedestrians and cyclists, and it is the most important driver of the appraisal results.

Under this field, the user is asked to input the number of daily pedestrian and/or cyclist trips in the existing situation, as well as in the future demand scenarios. There are spaces for three demand scenarios: a low, central, and high scenario. The number of trips entered should reflect the total number of trips in an area or along a route corridor, in both directions.

In many cases, it will be difficult to predict how many users are likely to use a scheme, or how an intervention (such as adding segregated facilities) will affect walking and cycling user numbers. Additional guidance has been provided in Section 5 to help estimate demand, particularly in instances where there is little existing data.

This section also asks for two additional pieces of information:

- **Annualisation –** Users are asked whether daily demand scenarios should be converted to annual values using 'working days' (i.e. 253 days per year) or using 'calendar days' (i.e. 365 days a year). While calendar days be used in most cases to annualise daily estimates, this can depend on the source of demand estimates and context. For example, if demand is likely to be dominated by cycle commuting or if estimates have been derived from a transport model, then it would be more appropriate to annualise daily demand using 'working days' so as not to overestimate benefits.
- **Recreational users –** When calculating benefits, TEAM distinguishes between 'recreational users' (i.e. people walking or cycling for exercise/fun, and with no specific destination in mind), and 'utility users' (i.e. those travelling for a specific purpose or to reach a specific destination such as work, school, shopping etc.). This split affects how benefits are calculated: while 'Mode Shift', 'Journey Quality' and 'Journey Time Savings' are only calculated for utility users, 'Recreation' benefits are limited to recreational users.

Appraisers are asked to estimate what proportion of users are likely to be 'recreational users', with the remaining users assumed to be 'utility users'. This is likely to be a high-level judgement based on the location or context of the scheme. For example, a rural greenway is likely to have a high proportion of recreational users, while an urban scheme connecting to lots of workplaces and shops is likely to be more weighted towards utility users.

This can also depend on the source of demand estimates: for example, estimates that are derived from transport models will generally exclude recreational users, while estimates that come from count or survey data include all user types.

4.3.2 Sheet 2 – Cost Inputs

The second sheet allows the appraiser to input details regarding the capital and current costs of the proposals.

4.3.2.1 Capital Costs

Capital costs are once-off costs, such as construction costs or planning/design, and are the main costs associated with projects. When inputting capital costs in the tool, the following information is requested:

- **Total Cost (excluding VAT and inflation) –** The total cost in each of the main capital cost categories (e.g. construction, design, land & property etc.) should be entered here. This total should not include Value-Added Tax (as this ultimately returns to the government); nor future inflation (as all prices are converted back to a base year). It should however include any risk associated with this particular cost category. A separate line is provided for general programme risk (sometimes also referred to as optimism bias or contingency).
- **Percentage provided by public funds –** In most cases, all of the project's budget will be supplied by public funds, and this should be kept at 100 per cent. If any private funding is being provided, reduce this value to reflect the non-public fund component for this.
- **Percentage that relates to labour –** Provide an estimate of the proportion of each cost that is spent on labour (i.e. wages, salaries etc.). This percentage is used later for calculating the Shadow Price of Labour. Default percentages have been provided for each cost category.
- **Year of the Cost estimate –** This refers to the price year in which the original cost estimates are based. The tool will then convert these costs into the base year that is being used.
- **Apportionment –** Apportionment relates to the percentage of each cost that is spent in each year. The timeframe for projects often lasts for several years, and different costs can be incurred at different times.
- **If the spending profile of the scheme is not known / not relevant:** Simply keep the yellow 'Don't Know' box checked, and the tool will automatically apportion costs to the two years before opening.
- **If the spending profile of the scheme is known:** Make sure the yellow box is unchecked, and put percentages under each year indicating what percentage of that cost will be spent. Make sure that each row adds to 100%.

The figure below provides an example of cost inputs for a project with a specific annual profile.

					How are capital costs apportioned annually? (in percentages)											
Base Capital Costs	**Total Cost (excl. VAT and inflation)**	**What percentage of this cost is provided by public funds?**	**What percentage of this cost relates to labour?**	**What is the year of this cost estimate?**	***Don't know***	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	
Main Contract Construction	**€5,000,000**	100%	30%	**2020**	☐					50%	50%					*100%*
Main Contract Supervision	**€500,000**	100%	50%	**2020**	☐					50%	50%					*100%*
Archaeology	**€250,000**	100%	50%	**2020**	☐					75%	25%					*100%*
Advance works and other contracts	**€100,000**	100%	30%	**2020**	☐					100%						*100%*
Land & Property	**€500,000**	100%	10%	**2020**	☐					100%						*100%*
Residual Network	**€0**	100%	30%	**2020**	☐						100%					*100%*
Planning & Design	**€1,500,000**	100%	60%	**2020**	☐			40%	40%	20%						*100%*
TII Programme Risk / Contingency Allowance	**€1,650,000**	100%	36%	**2020**												

Figure 4.4 Example of inputting capital costs

4.3.2.2 Operating & Maintenance Costs

The tool also asks for annual Operating & Maintenance Costs, such as those associated with staffing or day-to-day maintenance. The field also asks for some of the same information as above, including the percentage provided by public funds, the labour percentage and the price year. Once these are inputted, this annual cost is automatically apportioned for each year of the appraisal period, after the scheme opens.

Operating and Maintenance Costs				
Annual Operating and Maintenance Costs	**€5,000**	100%	50%	**2020**

Figure 4.5 Example of inputting O&M costs

4.3.2.3 Shadow Pricing

The PSC specifies two types of shadow prices[17], which have been applied by default in the tool, as follows:

- **Shadow Price of Public Funds (SPF)** – When the government raises funds through taxation, it can introduce economic distortions: taxes such as VAT or income tax raise the price paid for goods and services, which can discourage economic activity that would have otherwise occurred. The purpose of the SPF is to account for the opportunity cost of raising money through taxation, and it should be applied to all publicly-funded expenditure associated with a project or programme. As of October 2021, the SPF is set at 130% of all publicly-funded expenditure.
- **Shadow Price of Labour (SPL) –** Spending on some projects, particularly when they are located in an area with high rates unemployment, can have a stimulus effect; creating jobs and reducing the number of people claiming social welfare payments. The purpose of the SPL is to account for this impact by reducing the effective cost any labour-related spending. As of October 2021, the SPF is set at 80%, which the tool automatically applies to any schemes located in rural areas.

Both shadow prices are applied by default, as shown in the figure below.

Figure 4.6 Example of shadow pricing

4.3.3 Sheet 3 – Default Assumptions

The calculations in the tool rely on a series of default assumptions, which are listed on Sheet 3 of the Excel-based tool. These default assumptions have been developed by TII to reflect the best available data at a national level and aim to make the process of calculating benefits easier and more consistent across schemes. They also aim to reduce the data that project teams are required to gather when appraising a scheme.

The default assumptions should be reviewed and adjustments can be made if necessary. While appraisers should generally keep the pre-populated value for each assumption, there may be specific circumstances or areas where better data is available and more reflective of the local area. In these cases, this sheet provides the opportunity to replace any default assumption. For example, a scheme will mainly cater for cycling trips between two towns located 8km apart, there may be a justification for using an average journey length of 8km, rather than the default value of 5km. However, any changes to default assumptions should only be made with specific supporting evidence; evidence which should be documented in the report.

4.3.3.1 Section A – Journey Lengths and Assumptions

Most benefits increase with the length of time someone spends walking or cycling, as well as the length of car trips replaced by active travel.

[17] In economics, market prices refer to the actual cost that is paid for a good or service in the market, such as the salary that someone is paid to work on constructing an active travel scheme. However, market prices can distort the true economic costs or benefits associated with these activities, such as the fact that spending on labour can reduce unemployment and its associated economic costs. In these instances, shadow prices are used to convert market prices to a value that more closely reflects its true economic cost.

This means that assumptions around the length, speed, and direction of a journey can have a significant impact on benefits, particularly health and mode shift benefits. Default assumptions around journey length and duration are shown in the table below, along with the source/basis of the assumption.

Table 4.3 Journey lengths and assumptions

Variable	Default Assumption	Source / basis
Average non-recreational walking journey length (km)	1.4 km	*Analysis from the NTA 'National Household Travel Survey 2017'*
Average non-recreational cycling journey length (km)	5 km	
Average walking speed (km/h)	5 km/h	*Standard all-purpose walking and cycling speeds*
Average cycling speed (km/h)	16 km/h	
Average recreational walking trip length (mins)	45 mins	*CSO Quarterly National Household Survey 'Special Module on Sport' 2013*
Average recreational cycling trip length (mins)	60 mins	
Proportion of people making return journeys (%)	90%	*Analysis from the NTA 'National Household Travel Survey 2017'*

4.3.3.2 Section B – Diversion Rates

When a new pedestrian or cyclist switches to walking or cycling when making a journey, diversion rates are used to estimate what mode they are likely to have switched from. This mainly affects the mode shift benefits, but it also has an impact on other benefits.

Outside of formal transport models, there are generally two approaches that could be taken to developing diversion rates. One is to take diversion rates from published studies of substitution rates between transport modes, while the other is to base it off of the typical modal split of an area. Due to a lack of relevant studies for Ireland or for non-metropolitan areas, diversion rates in TEAM were developed using the NTA 'National Household Travel Survey 2017' and are based on the typical modal split of each area type; reweighted to exclude the mode of transport in question. These differ according to area type, not least because of the different transport options currently available in different parts of Ireland.

Default diversion rates for each area type are shown in Table 4.3 for walking and Table 4.4 for cycling. Using Table 4.3 as an example, this means that for every 100 new walking trips in a 'rural' area, 20 are assumed to be brand new trips (i.e. they did not shift from any other mode), 74 will be trips diverted from driving, 4 from bus, 1 from cycling and 1 from rail.

Table 4.3 Default walking diversion rates

New walking trips from:	Dublin City	Greater Dublin Area	Regional Cities	Other towns / urban districts	Rural
Did not previously travel / new trip	15%	15%	15%	15%	20%
Private Car	52%	68%	73%	80%	74%
Walking	0%	0%	0%	0%	0%

New walking trips from:	Dublin City	Greater Dublin Area	Regional Cities	Other towns / urban districts	Rural
Cycling	11%	5%	6%	2%	1%
Bus	20%	10%	6%	3%	4%
Rail/Luas	2%	2%	0%	0%	1%

Source: Based on NTA, 2017. 'National Household Travel Survey 2017. (Reweighted all-purpose mode shares excluding walking.)

Table 4.4 Default cycling diversion rates

New cycling trips from:	Dublin City	Greater Dublin Area	Regional Cities	Other towns / urban districts	Rural
Did not previously travel / new trip	15%	15%	15%	15%	20%
Private Car	40%	57%	56%	62%	67%
Walking	28%	18%	24%	21%	9%
Cycling	0%	0%	0%	0%	0%
Bus	15%	8%	5%	2%	3%
Rail/Luas	2%	2%	0%	0%	1%

Source: Based on NTA, 2017. 'National Household Travel Survey 2017. (Reweighted all-purpose mode shares excluding cycling.)

4.3.3.3 Section C - Other Travel Assumptions

Other miscellaneous travel assumptions have an impact on a range of benefits, such as the background journey growth rate (mainly affecting the future number of users), vehicle occupancy rates (mainly affecting mode shift benefits), and demographic data (mainly affecting health benefits, which are only calculated for adult users). These are shown in Table 4.5 below.

Table 4.5 Other travel assumptions

Variable	Default Assumption	*Source*
Annual background journey growth rate (%)	1.0%	*Based on general population growth*
Private Car Occupancy rate	1.5 passengers	*PAG Unit 6.11*
Bus occupancy rate	12.2 passengers	*HEAT (2017)*
% of trips made by adults (18-70)	75%	*Analysis of NTA 'National Household Travel Survey 2017'*
% of adult population in labour force	70%	*Analysis of 'Labour Force Survey' data*

4.3.3.4 Section D - Appraisal Assumptions

The final set of assumptions are appraisal assumptions, which are used for setting the general rules and boundaries of the economic appraisal. These are mostly based on guidance in the PSC and CAF, and should not be changed unless for a specific reason associated with a particularity of the scheme. These assumptions are shown in Table 4.6 below.

Table 4.6 Appraisal assumptions

Variable	Default Assumption	*Source*
Discount Rate	4.0%	*Public Spending Code Central Technical References 2019*
Price Base Year	2011	*Common Appraisal Framework*
Appraisal period (years)	30	
Real GNP per capital annual growth rate (2021-2025)	2.2%	
Real GNP per capital annual growth rate (2025+)	2.3%	

4.3.4 Sheet 4 – Results Dashboard

The Results Dashboard summarises the results of the TEAM assessment, based on the inputs and assumptions used in previous sheets. The Results Dashboard contains four main sections:

A. Cost Benefit Analysis

B. Annual Economic Flows

C. Sensitivity Analysis

D. Other Economic Indicators.

4.3.4.1 Section A – Cost Benefit Analysis

This section shows the main results of the CBA, including the present value of economic benefits for each benefit category. Several outputs are displayed in this section:

- **Present Value of Benefits (PVB) –** The PVB is the sum of monetised economic benefits over a project's appraisal period. This section shows the PVB for each individual benefit, as well as for the entire project. It is also accompanied by a pie chart to show how benefits compare. If undertaking an active modes CBA as part of a National Roads scheme, then the PVB from TEAM can simply be added into the overall project CBA.

A cell (highlighted in yellow) is provided where the value of any additional benefits calculated outside of TEAM be added to the overall PVB. This process in described further in Section 4.2.2.

- **Present Value of Costs (PVC) –** This is the total sum of capital and operating costs over the project's appraisal period, which have been adjusted to take the Shadow Prices (described previously) into account. An annual breakdown of the present value of costs is also calculated / provided at the bottom of the sheet.
- **Net Present Value (NPV) –** The NPV is the PVB minus the PVC, and represents the additional or net economic benefit provided by the scheme.

A positive NPV indicates that the measured economic benefits are greater than the costs, while a negative NPV indicates that the costs are greater than the benefits.

- **Benefit-to-Cost Ratio (BCR) –** The ratio of economic benefits to economic costs. A BCR of at least 1 means that the benefits outweigh the costs, while a BCR of less than 1 indicates that the costs outweigh the benefits.

These outputs and the results of the CBA should be summarised within the Appraisal section of the Project Appraisal Report. It should be noted that even if the NPV is negative or the BCR is less than one, this does not mean that the project is not worthwhile. The tool only includes benefits that are possible to monetise in Ireland, and there are many additional benefits provided by walking and cycling that are not reflected in the CBA, such as the creation of an integrated transport network or improvements in accessibility and social inclusion. These non-monetised benefits should be captured within the Qualitative Appraisal process described in Sections 2 and 3, and considered as part of any recommendations or conclusions.

A. Cost Benefit Analysis - Central Scenario

Tick to include:		Present Value
	Mode Shift	**€1,131,586**
☑	Vehicle Operating & Ownership Costs	€888,720
☑	Carbon	€104,623
☑	Air Quality	€7,445
☑	Noise	€9,127
☑	Congestion	€121,671
	Health	**€4,221,261**
☑	Reduced Mortality	€3,904,836
☑	Workplace Absenteeism	€316,425
☑	**Journey Time**	**€1,154,889**
☑	**Journey Quality**	**€5,249,196**
☑	**Recreation**	**€0**
	Other	**€0**
	Present Value of Benefits (PVB)	**€11,756,932**
	Present Value of Costs (PVC)	**€7,341,916**
	Net Present Value (NPV)	**€4,415,016**
	Benefit-to-Cost Ratio (BCR)	**1.60**

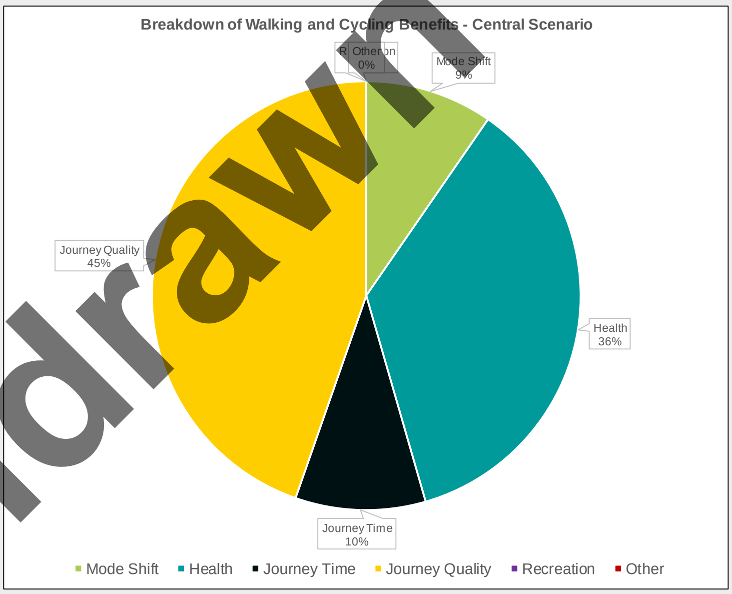


Figure 4.7 Results dashboard - example of CBA outputs

4.3.4.2 Section B – Annual Economic Flows

This section provides the annual present value of costs and benefits over the appraisal period. This will show how the costs and benefits of the project change over time.

B. Annual Economic Flows (€000s) - Central Scenario	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Vehicle Operating & Ownership Costs							€40.8	€39.6	€38.3	€37.1	€36.0	€34.9	€33.9	€33.0	€32.0	€31.1
Carbon							€2.4	€2.6	€2.7	€2.8	€2.9	€3.0	€3.0	€2.8	€3.1	€3.2
Air Quality							€0.3	€0.3	€0.3	€0.3	€0.2	€0.2	€0.2	€0.2	€0.2	€0.2
Noise							€0.3	€0.3	€0.3	€0.3	€0.3	€0.3	€0.3	€0.3	€0.3	€0.3
Congestion							€4.3	€4.3	€4.3	€4.2	€4.2	€4.2	€4.1	€4.1	€4.1	€4.1
Reduced Mortality							€29.8	€59.2	€88.3	€116.9	€145.2	€144.3	€143.3	€142.4	€141.5	€140.6
Workplace Absenteeism							€2.0	€4.0	€5.9	€7.9	€9.8	€9.7	€9.6	€9.6	€9.5	€9.5
Journey Time							€40.9	€40.6	€40.4	€40.1	€39.8	€39.6	€39.3	€39.1	€38.8	€38.5
Journey Quality							€86.5	€85.9	€85.4	€84.8	€84.3	€83.7	€83.2	€82.6	€82.1	€81.6
Recreation							€0.0	€0.0	€0.0	€0.0	€0.0	€0.0	€0.0	€0.0	€0.0	€0.0
Present Value of Benefits (€000s)							**€207**	**€237**	**€266**	**€294**	**€323**	**€320**	**€317**	**€314**	**€312**	**€309**
Present Value of Costs	**€0**	**€0**	**€0**	**€0**	**-€889**	**-€855**	**-€3**	**-€3**	**-€3**	**-€3**	**-€3**	**-€3**	**-€3**	**-€2**	**-€2**	**-€2**
Economic Net Present Value	**€0**	**€0**	**€0**	**€0**	**-€889**	**-€855**	**€204**	**€234**	**€263**	**€292**	**€320**	**€317**	**€315**	**€312**	**€309**	**€307**

Figure 4.8 Results dashboard – example of annual economic flows

4.3.4.3 Section C – Sensitivity Analysis

The PAG and PSC require sensitivity analysis to be done when carrying out CBA. The purpose of sensitivity analysis is to demonstrate how changes in demand, benefits or costs would affect the overall CBA results, and to show the potential range of values. TEAM facilitates three types of sensitivity analysis as a default:

- **Demand –** The range of the PVB under the low, central and high demand scenarios.
- **Benefits –** The range of the PVB when benefits are adjusted by ± 20%
- **Costs –** The range of the PVC when costs are adjusted by ± 20%

The combined impacts of these sensitivity tests on the BCR are also displayed in this section, showing the potential range of the BCR in a number of different scenarios. For example, the figure below shows the maximum range of the BCR between 1.03 and 3.95 when both demand and costs are varied.

C. Sensitivity Analysis - Potential Range of Benefits & Costs

Demand Sensitvity

	Low	*Central*	*High*
Present Value of Benefits	€2,510,484	€4,450,943	€6,391,401

Benefits Sensitivity

	-20%	*-10%*	*+0%*	*+10%*	*+20%*
Present Value of Benefits	€3,560,754	€4,005,849	€4,450,943	€4,896,037	€5,341,131

Costs Sensitivity

	-20%	*-10%*	*+0%*	*+10%*	*+20%*
Present Value of Costs	€1,619,919	€1,822,409	€2,024,898	€2,227,388	€2,429,878

C. Sensitivity Analysis - Combined BCRs

Demand Sensitivity

Cost Sensitivity	*Low*	*Central*	*High*
-20%	1.55	2.75	3.95
-10%	1.38	2.44	3.51
+0%	1.24	2.20	3.16
+10%	1.13	2.00	2.87
+20%	1.03	1.83	2.63

Benefit Sensitivity

Cost Sensitivity	*-20%*	*-10%*	*+0%*	+10%	+20%
-20%	2.20	2.47	2.75	3.02	3.30
-10%	1.95	2.20	2.44	2.69	2.93
+0%	1.76	1.98	2.20	2.42	2.64
+10%	1.60	1.80	2.00	2.20	2.40
+20%	1.47	1.65	1.83	2.01	2.20

Figure 4.9 Results dashboard – example of sensitivity analysis

While these three sensitivity tests should satisfy the PAG and PSC requirements, sensitivity tests on other variables can be carried out if required by saving a version of the tool, adjusting the variables of interest (for instance, variables in the default assumptions tab), and comparing the results with the original TEAM assessment.

4.3.4.4 Section D - Other Economic Indicators

This section includes some other useful economic indicators provided by the tool, including:

- **Costs –** This provides an estimate of the present value of costs per kilometre, and per user. This can be useful when trying to compare routes in terms of their cost-effectiveness.
- **Carbon –** This provides an estimate of the total tonnes of CO_2 avoided by the scheme, based on the estimated shift from private cars to walking/cycling. It also shows the 'Cost per tonne of CO_2 avoided' which is an indicator of the cost-effectiveness of the scheme in terms of reducing carbon emissions.
- **Mode Shift –** This provides an estimate of the total driving kilometres shifted to walking/cycling by the scheme. It also shows the 'Cost per driving kilometre avoided', which is an indicator of the cost-effectiveness of the scheme in terms of shifting car users to active modes.
- **Benefit per km –** The benefits for users and society for each kilometre walked or cycled.

5. Methods of Estimating Demand

A significant input to quantitative economic appraisal is the user demand scenarios (i.e. how many walking/cycling trips are expected before and after the intervention). As most benefits of walking and cycling are based on a change in the number of trips made by walking and cycling, this can have a major impact on the economic benefits estimated for the scheme. Demand is something that project appraisers often find difficult to estimate. Data for estimating the current level of walking and cycling demand is often unavailable in Ireland, and even when available, it can be difficult to forecast how walking and cycling levels might change after an intervention.

This section provides some general guidance and resources for estimating cycling demand. It summarises the potential sources of demand data, and also provides standard trip rates for situations where no local data is available to the appraiser. The appraiser could also consult the Department of Transport's 2020 Public Spending Code Lifecycle for Greenway Projects under €20m guidance, for suggested methods of demand analysis specifically for greenways under the Public Spending Code €20 million threshold.

5.1 Setting Demand Scenarios

Given the uncertainty surrounding walking and cycling demand, traditional traffic 'forecasts' are generally unsuitable for walking and cycling schemes. There are many factors that influence users' decisions to walk and cycle, including safety, infrastructure quality, levels of physical activity, settlement and commuting patterns, meaning that even using formal models, single 'forecasts' are generally not suitable for active travel projects.

Active travel scenarios can be used to explore possibilities such as 'what if the proportion of active travel doubled?' or 'what if half of all trips generated were by active modes?'. While extrapolation from historic trends tend to be linear in nature, it is impossible to forecast the future, particularly if there is envisaged step-changes in society. This change may be incremental, in response to changing attitudes or change prices of transport, or it may be sudden, brought about by an unanticipated shock (e.g. Covid). Demand scenarios enable the appraiser to explore resilience in future demand.

Economic appraisal for walking and cycling schemes should therefore be based on 'demand scenarios', which allows for uncertainty by testing the outcomes associated with a range of demand levels. Each appraisal should include a current estimated level of walking and cycling demand; as well as three scenarios, reflecting three levels of potential demand: a 'low scenario', a 'central scenario', and a 'high scenario'.

5.2 Demand Scenarios with Existing Count Data

In some cases, a scheme will be located in an area or along a route where there is existing data for walking and cycling levels from counts or surveys. Different forms of count data may be available, including continuous cycle counters which count the daily number users passing a certain location, or (more commonly) traffic surveys measuring flows over a short period. Some examples of publicly-available walking and cycling count data include:

- The annual Dublin Canal Cordon Count and Quays Count.
- Permanent cycle counters at select locations in Dublin City and Dún Laoghaire-Rathdown.

- The *IDASO* database of historic NTA traffic counts[18], which may include walking and cycling in some instances.

Count data may be for a location directly along the route, or for nearby location with similar traffic flows. Additional count and traffic survey data may be available from local authorities.

If there is existing count data for the route / location of a scheme, this is the generally the most accurate method of estimating current demand, although for longer routes, it may require count data from multiple locations. Future demand scenarios should be then estimated by applying three levels of cycling growth/uplift to represent a low, central and high scenario. The levels of cycling growth can be established by reviewing other schemes that have seen increases in cycling following an intervention, or to reflect policy targets.

5.3 Demand Scenarios without Existing Count Data

Existing count data will often not be available, and other sources must be used to estimate current and future demand. There is no one preferred source of demand scenarios, and different sources may be suitable for different locations and project contexts.

5.3.1 Case Studies and Benchmarking

Case studies of other routes that share similar characteristics can be a useful data source to estimate potential levels of demand. Benchmarking and setting demand targets can be appropriate in instances where there are no existing pedestrians or cyclists along a route (i.e. when the scheme generates the demand, such as for greenways or new off-line routes), and is commonly used for larger recreation- or tourism-focused greenway projects. For instance, a 'High' Scenario for a greenway may to be achieve the same level of walking and cycling seen by other greenway projects, with other scenarios based around this.

Studies that have been carried out for the Great Western Greenway in Mayo[19] and the Waterford Greenway[20] are the most prominent examples, although as more cycle schemes undergo ex-post evaluation in future years, this will likely in additional case studies being published.

5.3.2 POWSCAR Data

The Place of Work, School or College – Census of Anonymised Records data from the Central Statistics Office provides detailed data on commuting and educational trips between different statistical areas, including the mode of transport people take. This information can be used to estimate how many people are currently travelling between two zones for work and education by active modes, as well as the total numbers travelling by all modes to estimate the future potential for a shift to active modes. Low, central and high scenarios can be established using different targeted active mode shares, for instance.

POWSCAR only provides commuting and education data, meaning that it would only suit schemes that have a high commuting potential. A public version of POWSCAR is available online[21], in which commuting and education flows between Electoral Divisions has been combined. This does not distinguish between modes of transport, but more accurate local data can be requested from the Central Statistics Office.

[18] IDASO, 2021. Available at: https://mytrafficcounts.com/
[19] See Fitzpatricks, Failte Ireland (2011). Economic Impact of the Great Western Greenway. Department of Transport, Tourism and Sport, June 2011.
[20] See AECOM (2017). Waterford Greenway Intercept Survey 2017. Waterford City and County Council, December 2017. Available at: https://www.waterfordcouncil.ie/media/greenway/WaterfordGreenway-BaselineSurveyReport-Jan2018.pdf
[21] CSO, 2018. Available at: https://www.cso.ie/en/census/census2016reports/powscar/

5.3.3 Population Catchments and Standard Trip Rates

In situations where there is no reliable baseline data, basic population catchments can be combined with standard trip rates to estimate current demand for different area types. This is likely to be most appropriate for smaller schemes outside of large urban areas (i.e. less than <20km long). Trip rates are given below for two types of journeys: utility and recreation.

Table 5.1 below shows standard trip rates for **utility purposes** (i.e. journeys to work, school, shops etc.) across different geographical area, expressed as 'daily trips per 100 residents'. This data is based on patterns of travel observed in the NTA 'National Household Transport Survey'. For example, if a scheme serves a rural electoral division with 450 residents, these rates suggests that one could expect an average of 107 utility walking trips[22] and 12 utility cycling trips[23] to be currently made each day among that population. If the total population catchment was 1,000 residents, one could expect 238 walking trips and 27 cycling trips to be made each day in total among that population.

Table 5.1 Standard baseline trip rates for walking and cycling for utility purposes

Trips per week for utility purposes	Daily trips per 100 people		% of all trips by mode	
	Walking	Cycling	Walking	Cycling
Dublin City (Dublin City Council administrative area)	46.0	14.1	29%	9%
Greater Dublin Area (counties Dublin, Kildare, Meath and Wicklow)	38.1	8.8	20%	5%
Regional Cities (Cork, Limerick, Galway and Waterford cities)	64.7	12.8	27%	5%
Large Urban Towns (Towns with a population over 10,000)	61.7	4.2	27%	2%
Other urban districts (Towns with a population of between 1,500 and 10,000)	63.1	4.3	29%	2%
Rural (all other areas and towns with a population of less than 1,500)	23.8	2.7	11%	1%

Source: Trip rates derived from NTA, 2017. 'National Household Travel Survey 2017'.

Table 5.2 displays local walking and cycling trip rates at a national level for **recreation and exercise purposes**, based on data from the QNHS Sports Module 2013. As above, this shows how many recreational walking and cycling trips are typically each day made in a population of 100 people. For example, if the scheme serves a local population of 450 people, one might expect 167 recreational walking trips and 23 recreational cycling trips to be currently made per day among that population.

Table 5.2 Standard baseline trip rates for walking and cycling for recreational purposes

Trips per week for recreation purposes	Daily trips per 100 people	
	Walking	Cycling
National	37	5

Source: Trip rates derived from CSO, 2013. 'QNHS Sports Module 2013'.

22 (450/100) x 23.8
23 (450/100) x 2.7

It should be noted that these trip rates reflect all current walking and cycling journeys among the local population, and not necessarily just the trips along the specific scheme in question. If there are several other alternative routes within the catchment area, it may be necessary to make an additional assumption as to what proportion of walking and cycling trips in the area will take place along the scheme (i.e. 50% of local trips will use the scheme).

These standard trip rates can be used to estimate current levels of demand along a route or in an area: using the example above, the current level of cycling among a rural population of 450 is assumed to be 12 utility trips per day (equating to a 1% mode share), and 23 recreational trips per day. As above, low, central and high rates of growth or modal share targets should be used as the basis of future demand scenarios. Further guidance on setting demand scenarios may be provided in a future update to this Unit.

Appendix A:

Review of International Practice for Active Mode Appraisal

This section summarises the results of an international review of active mode appraisal practices that was carried out in advance of this update to PAG Unit 13. This review examined appraisal guidelines and practices in several locations and organisations, including the United Kingdom, Netherlands, Copenhagen, Australia, the World Health Organisation and New Zealand, and identified different types of benefits that are typically included in active mode appraisals.

Table A.1 summarises the results of this review. It shows and describes different categories of benefits that have been identified, as well as the typical significance of the benefit within Cost Benefit Analyses for active mode schemes (as indicated by examples that were reviewed). The chart shows how frequently each benefit appears across the different examples of appraisal guidance, as well as an assessment as to whether the data and methods existed in Ireland to introduce it widely into active mode appraisal guidance.

Table A.1 Review of international active mode appraisal practices and benefits

Impact		Description	Significance*	Ireland (PAG Unit 13)	UK (AMAT / TAG A5.1)	Netherlands	Copenhagen	Australia (ATAP)	WHO (HEAT)	New Zealand	Include in updated PAG Unit 13?
User	Journey Time	Impacts of reductions in journey time	+++								Yes
	Journey Quality (WTP)	Perceived safety & comfort provided by different infrastructure types	++								Yes
	Vehicle Operating Costs^	Reduced costs of vehicle ownership & operation	+								Yes
Economy	Decongestion^	Reduction in the external costs of congestion	++								Yes
	Road Maintenance^	Reduced maintenance costs on public roads	+								
	Tourism	Tourism impacts of walking & cycling	+++								Yes
	Agglomeration	Productivity benefits from increased interaction and effective density	+								
Health & Wellbeing	Collisions^ (-)	Change in collisions	++								Yes
	Reduced mortality	Benefits of physical activity in terms of reduced mortality	+++								Yes
	Cost of Illness	Benefits of physical activity in terms of lower healthcare costs	+++								
	Absenteeism	Benefits of physical activity in terms of improved workplace productivity	++								Yes
	Recreation	Wellbeing benefits associated with access to recreational infrastructure	++								Yes

Impact		**Description**	**Significance***	**Ireland (PAG Unit 13)**	**UK (AMAT / TAG A5.1)**	**Netherlands**	**Copenhagen**	**Australia (ATAP)**	**WHO (HEAT)**	**New Zealand**	**Include in updated PAG Unit 13?**
Environment	Air Pollution^ (-)	Exposure and contribution to airborne pollutants	+								Yes
	Climate Change^	Impact on greenhouse gas emissions	+								Yes
	Noise^	Impact on noise pollution	+								Yes

Appendix B:

Technical Methodology for Parameters and Benefit Calculation

This Appendix details the methodologies and sources used for calculating the benefits used in TEAM. It also provides methodologies for two benefits not currently included within TEAM, namely 'Collision Reduction' and 'Tourism'. This appendix includes:

- B.1 – Mode Shift Benefits, including Carbon, Air Quality, Noise, Congestion, and Vehicle Operating & Ownership Costs
- B.2 – Health, including Reduced Mortality and Absenteeism
- B.3 – Journey Time
- B.4. – Journey Quality and Recreation
- B.5 – Collision Reduction (not currently included in TEAM)
- B.6 – Tourism (not currently included in TEAM).

B.1 Mode Shift Benefits

As mode shift benefits are based on the shift from private vehicles to walking or cycling, the first step is to estimate this shift; or the amount of vehicle kilometres 'diverted' from private cars. This diversion can be expressed either 'per vehicle-kilometre' or 'per passenger kilometre', although most factors are expressed per vehicle kilometre.

Table B.1 Daily private car kilometres diverted

Code	Calculation	Variable	Value	Source / Basis
A		Number of new non-recreational daily trips		*Based on user estimates of the number of daily trips, and the proportion that are 'utility' trips.*
B		% of trips assumed to be diverted from private cars	Location-specific diversion factors for private cars.	*Default assumption based on location modal splits from NTA 'National Household Travel Survey' 2017 data. 15-20% of trips assumed to be new trips*
C	A x B	**Number of daily trips diverted from cars**		
D		Average length of diverted trips (km)	1.4 km (Walking) 5.0 km (Cycling)	Default assumptions estimated from *NTA 'National Household Travel Survey' 2017* data. Can be replaced with user estimates if necessary.
E	C x D	**Daily car passenger kilometres diverted (km)**		
F		Average car occupancy	1.5 people	*Default assumption based on non-commuting occupancy rates from PAG Unit 3.11.*
G	E / F	**Daily car vehicle kilometres diverted (km)**		

To estimate mode shift benefits, the diverted passenger/vehicle kilometre should be multiplied by the relevant factors for carbon, air quality, vehicle operating / ownership costs, noise and congestion. These factors are derived from a variety of sources, and are shown in the tables below.

For estimating future values, 2011 carbon emissions should be increased in line with the Shadow Price of Carbon specified in the Public Spending Code, while 2011 values of air quality, noise and congestion should be increased in line with real GNP growth per capita. As vehicle operating and ownership costs are assumed to increase in line with the general rate of inflation, future values should remain in 2011 prices in the CBA. Daily mode shift values should be converted to annual values using appropriate annualisation factors.

Table B.2 Carbon emissions

Code	Calculation	Variable	Value	Source / Basis
A		Daily car vehicle kilometres diverted (km)		
B		Daily car trips diverted		
C	A / 1.5	Daily car passenger kilometres diverted (km)		
D		Vehicle GHG operational emissions factors (g/vkm)	Grams per vehicle km by vehicle, year and area type	TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 16
E		'Cold-start' emissions factors (g/trip)	150.4 grams (Urban) 122 grams (Rural)	WHO, 2017. 'Health Economic Assessment Tool (HEAT) for walking and cycling – Methods and user guide on physical activity, air pollution, injuries and carbon impact assessment'. Tables 3, 4 and 5.
F		Energy supply factors per passenger kilometre	28.4 grams (Urban) 23 grams (Rural)	
G		Vehicle manufacturing emissions per passenger kilometre	19.9 grams	
H	(A x B) + (B x E) + C x (F+G)	Daily carbon emissions avoided (g)		
I		Shadow Price of Carbon	Annual price per tonne specified from 2019 to 2050, assumed to continue to increase by 5% each year thereafter.	DPER, 2019. 'Public Spending Code – Central Technical References and Economic Appraisal Parameters'. Table 6.
J	C x D	**Daily value of CO2 emissions avoided**		

Table B.3 Air quality

Code	Calculation	Variable	Value	Source / Basis
A		Daily car vehicle kilometres diverted (km)	Intermediate Calculation	
B		Vehicle non-GHG emissions factors (g/vkm)	Grams per km for PM and NOx by vehicle, year and area type	TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 17-18
C	A x B	Daily non-GHG emissions avoided (g)		
D		Other non-GHG costs (€)	Annual costs for non-GHG gases in 2011 values, assumed to continue to increase in line with real GNP growth per capita.	TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 14.
E	C x D	Daily value of non-GHG emissions avoided (€)		

Table B.4 Vehicle operating & ownership costs

Code	Calculation	Variable	Value	Source / Basis
A		Daily car vehicle kilometres diverted (km)	Intermediate Calculation	
B		Fuel costs (€ per litre)		TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 8.
C		Forecast fuel consumption (litres per 100km)		TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 9 & 15.
D		Non-fuel costs (€ per km)		TII, 2016. 'PAG Unit 6.11 – National Parameters Values Sheet'. Table 10.
E	D + (B x C/100)	Vehicle Operating Costs per km (€)		
F		Vehicle Ownership Costs per km	€0.103 (Urban) in 2011 prices €0.117 (Rural) in 2011 prices	Estimate based on CSO, 2016. 'National Household Budget Survey 2015-2016'.
G	A x (E + F)	**Daily value of vehicle operating & ownership costs avoided (€)**		

Table B.5 Marginal external cost of noise

Code	Calculation	Variable	Value	Source / Basis
A		Daily car vehicle kilometres diverted (km)	Intermediate Calculation	
B		Marginal external cost of noise per km (€)	€0.0022 (Urban) €0.0011 (Rural) In 2011 values and prices	Adapted from Department for Transport, 2020. 'WEBTAG Data Book v1.13.1 – Table A 5.4.2a. Values for urban and rural roads transferred to Irish values and prices.
C	A x B	**Daily value of external cost of noise avoided (€)**		

Table B.6 Marginal external cost of congestion

Code	Calculation	Variable	Value	Source / Basis
A		Daily car vehicle kilometres diverted (km)	Intermediate Calculation	
B		Marginal external cost of congestion per km (€)	€0.115 (Dublin and cities) €0.021 (Other urban) €0.014 (Rural) In 2011 values and prices	Adapted from Department for Transport, 2020. 'WEBTAG Data Book v1.13.1 – Table A 5.4.2a. Values for 'Inner and Outer Conurbations', 'Other Urban' and 'Rural' adjusted for Irish road volumes and Level of Service, and transferred to Irish prices.
C	A x C	**Daily value of external cost of congestion avoided (€)**		

B.2 Health

Improved health outcomes associated with greater levels of physical activity has many health benefits for users, society and businesses. Two benefits associated with health are included in TEAM and the PAG Unit 13 guidance: 'reduced mortality' and 'absenteeism'.

B.2.1 Reduced Mortality

'Reduced mortality' refers to the change in the relative risk of early death due to increased levels of physical activity. TEAM uses the World Health Organisation's (2017) *Health Economic Assessment Tool*[24] methodology to estimate the benefits associated with a reduction in relative mortality risk due to increased levels of walking and cycling. This methodology has been updated using Irish-specific parameters where necessary.

[24] WHO, 2017. 'Health Economic Assessment Tool (HEAT) for walking and cycling – Methods and user guide on physical activity, air pollution, injuries and carbon impact assessment'. Available at: https://www.euro.who.int/__data/assets/pdf_file/0010/352963/Heat.pdf

'Reduced mortality' benefits are based on the number of new users and the time spent walking or cycling. The steps involved are summarized in Table B.7 below, although more detailed guidance can be found in the HEAT guidance.

Table B.7 Reduced mortality benefit calculations

Code	Calculation	Variable	Value	Source / Basis
A		Risk of all-cause mortality	0.0019	DoT, 2020. 'Common Appraisal Framework'
B		Relative risk	0.886 (walking) 0.903 (cycling)	WHO, 2017 'Health Economic Assessment Tool'.
C		Reference volume of physical activity	168 minutes / week (walking) 100 minutes / week (cycling)	WHO, 2017 'Health Economic Assessment Tool'.
D		Risk reduction cap	30% (walking) 45% (cycling)	WHO, 2017 'Health Economic Assessment Tool'.
E		Weekly time spent walking / cycling per user (minutes)		Estimated based on assumptions regarding average journey lengths/speeds for recreational and non-recreational users.
F	(1–B) x (E/C)	Relative risk reduction (capped at values contained in D)		
G	A x F	Absolute risk reduction per user (i.e. no. of fatalities 'prevented per person).		
H		Value of avoided fatality	€2,310,500 in 2011 prices	DoT, 2020. 'Common Appraisal Framework'
I	G x H	Relative mortality benefit per adult user (€)		

The relative mortality benefit per user should be multiplied by the total number of *adult* users of the scheme. By default, TEAM assumes that on average 75% of trips are made by adults. It should also be noted that the number of unique users can differ from the number of trips, particularly if the same user makes a return journey on the scheme. This should be taken into account in the calculation if necessary.

Reduced mortality benefits are assumed to be phased in over five years, with 20% of the annual benefit occurring in Year 1, 40% in Year 2, 60% in Year 3, 80% in Year 4, and 100% in the years thereafter. The value of a future avoided casualty should be updated in line with real GNP growth per capita.

B.2.1 Absenteeism

Increasing physical activity increases productivity in the economy by reducing short-term sick leave. The median absenteeism rate for short terms sick leave is 4.6 days and 5.8 days for the private and public sector, respectively.

The number of employees in public sector employment is about 21% of total employment in Ireland, based on CSO employment tables. Calculating average sick leave taken in Ireland by weighting the relative proportions of private and public sector employment gives an overall estimate of 4.9 days per year.

A cycling or walking intervention of 30 minutes per day reduces absenteeism in a reduction in short-term sick leave by between 6% and 32% per annum[25].The lower bound of 6% is to be applied in appraisals to estimate the reduction in absenteeism per employee per year.

Table B.8 Absenteeism

Code	Calculation	Variable	Value	Source / Basis
A		Daily time spent walking / cycling per user (minutes)		Estimated based on assumptions regarding average journey lengths/speeds for recreational and non-recreational users.
B		Reference volume of physical activity	30 minutes per day	WHO, 2003. 'Health and development through physical activity and sport'.
C		Risk reduction cap	6%.	CAF, 2020. Based on WHO, 2003.
D	6% x (A/B)	Relative risk reduction		
E	D x 7.5 x 4.9	Average hours saved per employed user		Average of 4.9 sick days per year, and assuming 7.5 hours in a working day.
F		Value of in-work time per hour	€26.12 in 2011 prices and values	CAF, 2020.
G	E x F	Absenteeism benefit per employed user		

The relative mortality benefit per user should be multiplied by the total number of *adult* users of the scheme *who are in employment*. TEAM assumes that on average 75% of trips are made by adults, and that of those adult users, 70% are in the labour force – meaning that absenteeism benefits only apply to around half of all users.

As with reduced mortality benefits, it should also be noted that the number of unique users can differ from the number of trips, particularly if the same user makes a return journey on the scheme. This should be taken into account in the calculation.

Absenteeism benefits are also assumed to be phased in over five years, with 20% of the annual benefit occurring in Year 1, 40% in Year 2, 60% in Year 3, 80% in Year 4, and 100% in the years thereafter. The value of a future absenteeism benefits should be updated in line with real GNP growth per capita.

B.3 Journey Time

The methodology for estimating journey time savings is contained within the *Common Appraisal Framework*. Journey time savings associated with active mode schemes are typically only applied when the scheme results in a direct and visible reduction in average journey times, such as:

- Bridges and under/overpasses that provide a shorter and more direct route along a corridor;

[25] World Health Organisation, 2003. 'Health and development through physical activity and sport', WHO/NMH/NPH/PAH/03.2, Geneva, Switzerland.

- New routes or shortcuts offering a more direct route along a corridor;
- Upgrades to signal timings for pedestrians and cyclists that reduce the time they must wait.

The average minutes saved by pedestrians and cyclists should be estimated manually based on the circumstances, with journey time saving benefits estimated using the values contained in CAF. Future values should be updated in line with real GNP growth per capita. New users of the scheme are subject to the 'rule of a half', meaning that they only receive half of the benefits as existing users.

B.4 Journey Quality & Recreation

Journey quality benefits refer to the value that users perceive from improved cycling infrastructure, such as the value that they place on safety or the potential for recreation. Journey Quality benefits were previously referred to as 'ambience' in the previous version of PAG Unit 13, while this update of PAG Unit 13 also provides new 'recreation' values for recreational users of greenways.

For non-recreational users of a scheme (i.e. commuting, education, shopping trips etc.), the values for Journey Quality are based on willing-to-pay values for different types of infrastructure, as estimated research by Hopkinson & Wardman (1996)[26] and Wardman *et. al.* (1997)[27]. The total number of minutes spent on each section of the scheme should be estimated based on the section lengths, average speeds and total number of trips, and then journey quality values applied to the minutes spent on each type of infrastructure, using the rates contained in the table below.

[26] Hopkinson & Wardman, 1996. 'Evaluating demand for new cycling facilities', *Transport Policy 3(4)*, 241-249.
[27] Wardman, Hatfield & Page, 1997. 'UK national cycling strategy: Can improved facilities meet the targets?', *Transport Policy* 4(2), 123-133.

Table B.9 Journey Quality values per minute

Value of journey ambience benefit of cycle facilities relative to no facilities (2010 prices & 2010 values)				
Scheme type	**2010 Value p**	**Source**	**2011 €/min**	**Value Year**
Off-road segregated cycle track	7.03	Hopkinson & Wardman (1996)	€0.084	2011
On-road segregated cycle lane	2.99	Hopkinson & Wardman (1996)	€0.036	2011
On-road non-segregated cycle lane	2.97	Wardman et al. (1997)	€0.035	2011
Wider lane	1.81	Hopkinson & Wardman (1996)	€0.022	2011
Shared bus lane	0.77	Hopkinson & Wardman (1996)	€0.009	2011

Source: Adapted from DfT, 2020. 'TAG Data Book v1.13.1 – Table A 4.1.6'

For recreational users of walking and cycling infrastructure, similar willingness to pay values were estimated by TII based on recreational users of the Waterford Greenway[28]. This analysis used a 'Travel Cost Method' to value trips on high-quality recreational infrastructure, which assigns a value to non-market goods by estimating the cost to users of accessing it. When applied to other greenways or high quality recreational infrastructure, this provides an estimate of users' willingness to pay to use the infrastructure, and is a proxy for the benefits that they perceive in using it.

Using data from the *Waterford Greenway Intercept Survey,* recreational day-trip users (i.e. those who specifically travelled to use the Waterford Greenway for 'leisure' or 'exercise') were divided into distance bands based on their stated origin, and the average cost associated with their travel to the Greenway was estimated using operating cost parameters contained in Section B.1 and time parameters from CAF. For cyclists, the average cost of bicycle hire was also included. To avoid overestimating the benefits when applied to other greenways, only users travelling from the south-east region were included in this analysis. Users with overnight stays were also excluded, as it is not possible to definitively attribute their trips to the Greenway, and may double count with the general benefits they receive from a holiday.

These costs per user were aggregated across the different user groups, and expressed as a willingness-to-pay value per minute spent on the Greenway (based to the average time spent). As Table B.10 shows, this resulted in values per minute of approximately €0.02 for pedestrians and €0.07 for cyclists in 2011 values. These values are in a similar range to other studies of active mode willingness to pay, including the values contained in Table B.9, and a 2005 study of the economic values of trails and forest recreation in Ireland[29].

Table B.10 Recreation values per minute

	Value per minute	**Value Year**	**Reference time (hours)**
WTP Value per minute (pedestrian)	€0.0232	2011	3.5
WTP Value per minute (cyclist)	€0.0742	2011	2.6

[28] Based on AECOM, 2018. 'Waterford Greenway Intercept Survey'. Available at: https://www.waterfordcouncil.ie/media/greenway/WaterfordGreenway-BaselineSurveyReport-Jan2018.pdf
[29] Coillte and Fitzpatrick's Associates, 2011. ;Economic Value of Trails and Forest Recreation in the Republic of Ireland'. The study estimated a WTP value of between 2.1 cent and 3.2 cent per minute among visitors to several walking trails.

These values can be applied to *recreational* users using a similar methodology as journey quality. However, as these values are associated with a high-quality off-road greenway, they should only be applied to the time spent on *segregated* infrastructure.

Future values for both Journey Quality and Recreation should be updated in line with real GNP growth per capita. New users of the scheme are subject to the ‘rule of a half’, meaning that they only receive half of the benefits as existing users.

B.5 Collision Reduction

A new or upgraded facility for pedestrians and cyclists is likely to affect the rate of collisions or incidents compared to the previous situation. For existing cyclists, well-designed walking and cycling facilities are likely to reduce their risk of collisions, particularly where they remove or reduce interactions with vehicle traffic. On the other hand, a facility that attracts new users to walking or cycling may increase their exposure to the general risks of walking and cycling, and may lead to an overall increase in collisions. ‘Collision reduction’ impacts are the net impact of the two effects, and can be either positive (i.e. the scheme results in less collisions than the Do Minimum) or negative (i.e. more collisions).

Estimating collision rates requires three main data types: current count and collision data for the site in question, along with a factor to estimate the impact of the proposed intervention on collisions. Due to a lack of reliable and widespread collision data at a national level for Ireland, collision reduction benefits have not been included within the current version TEAM. However, in some instances, project teams will have access to monitoring and collision data for their scheme, meaning that it would be possible to estimate the impact of their scheme on collisions and add this to the CBA.

Estimating collision reduction impacts involves the following steps:

- **Estimate the current collision rate for the facility / route –** Collision rates are expressed as a rate per million/billion cycling kilometres, and separate rates are generally estimated for fatal, serious and minor collisions. To estimate the current collision rate, it is necessary to estimate the current annual cycling-kilometres on the route using count or other data, as well as the number of fatal, serious or minor cycling collisions using data from the Road Safety Authority[30].
- **Estimate the ‘Crash Reduction Factor’ associated with the proposed intervention –** ‘Collision Reduction Factors’ (CRF) are used to estimate the expected impact of a particular intervention on collision rates. CRF are generally expressed as percentages; for example, a 25% CRF means that the particular intervention is expected to reduce collisions by 25%. CRF vary by intervention type (i.e. segregated cycle track, junction improvements etc.), location (i.e. urban, rural etc.), and the incident type (i.e. fatal, serious, minor), and are usually obtained from studies regarding similar interventions in other locations. The ‘CMF Clearinghouse’ database[31] from the US Federal Highways Administration provides a searchable database of CRF associated with many different interventions from a wide range of studies, and is a useful source of CRF for schemes.
- **Estimate future collision rates by applying an appropriate CRF –** After applying the CRF to the current collision rates**,** apply this future collision rate to the future annual cycling kilometres (based on demand scenarios for the project) to estimate the future number of collisions per annum. This should be repeated for fatal, serious and minor collisions as data allows.

[30] See RSA, 2016. ‘Online Map of Collisions’. Available at: https://www.rsa.ie/road-safety/statistics/collisions
[31] Federal Highway Administration, 2021. Available at: http://www.cmfclearinghouse.org/index.cfm

- **Compare current and future collisions and monetise –** Comparing the current annual collisions with the future estimated number of collisions will indicate whether there is a net increase or decrease in collisions as a result of the scheme. The reduction/increase in fatal, serious and minor injuries can then be monetised using the collision values contained in the CAF.

The table below provides an example of a typical calculation for collision reduction impacts. This process should be repeated as necessary for each type of collision. Annual collision reduction values should be converted to future values using forecast real GNP growth per capita, and discounted using the social discount rate of 4% per annum.

Table B.11 Methodology for collision reduction impacts

Code	Formula	Variable	Value
Estimating current collision rates using count and collision data			
A		Route Length	5km
B		Current daily cycling count	100
C	A x B x 365 days	Current annual cycling kilometres	182,500
D		Current annual number of serious collisions along route	3
E	D / (C *.000001)	Current serious collision rate per million cycle kilometres	16.4
Estimating future collision rates using Collision Reduction Factors			
F		Estimated Crash Reduction Factor for a particular intervention type (example)	25%
G	E x (1-F)	Future serious collision rate per million cycle kilometres	12.3
Annual change in collisions			
H		Future daily cycling count from demand projections	120
I	A x H x 365	Future annual cycling kilometres	219,000
J	G x (I x .000001)	Predicted annual number of serious collisions using future collision rate	2.7
K	D - J	Annual reduction in serious collisions	0.3
Annual value of collision impacts			
L		Value of a serious collision (2011 prices & values)	€238,412
M	L x K	Annual collision reduction benefits (2011 prices & values)	€71,524

B.6 Tourism

While TEAM includes 'Recreation' benefits associated with local use of high quality Greenway infrastructure for leisure or exercise, it does not currently include the benefits associated with increased levels of spending by visitors.

Depending on the scheme, these tourism benefits can be significant, and project teams may decide to include tourism benefits in a CBA, particularly for tourism-focused greenway project. However, there are a number of caveats which should be noted when including them within a CBA to avoid overestimating the impact of the proposal:

- Firstly, only spending from overseas visitors should be included as a benefit within a CBA. While greenways can result in an economic stimulus for local businesses, there is a strong risk of 'displacement' when it comes to domestic spending: for example, a domestic visitor spending money in a café along a greenway would likely have otherwise spent that money in their home county or another part of the county, meaning that the economic benefit is simply being displaced or redistributed from one area to another.
- Secondly, only spending associated with overseas visitors *whose primary reason is to visit the greenway* should be included within the CBA. The net benefit of a greenway depends on its ability to attract visitors who *would otherwise not have visited* Ireland.

If including tourism benefits as part of the CBA, the potential annual number of overseas tourists should be estimated, along with key variables such as the proportion of overseas visitors visiting specifically for the project, the average length of stay, and the average visitor spend. Data from existing greenways is likely to be the primary source of data for tourism demand analysis, and studies from the Waterford Greenway[32] or the Great Western Greenway[33] are useful resources for this. Fáilte Ireland also publishes tourism statistics regarding visitor trends and spending[34].

[32] AECOM, 2018. 'Waterford Greenway Intercept Survey 2017'. Available at: https://www.waterfordcouncil.ie/media/greenway/WaterfordGreenway-BaselineSurveyReport-Jan2018.pdf

[33] Fitzpatricks, Failte Ireland (2011). Economic Impact of the Great Western Greenway. Department of Transport, Tourism and Sport, June 2011.

[34] See for example Fáilte Ireland, 2021. 'Key Tourism Facts 2019'. Available at: https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/KeyTourismFacts_2019.pdf?ext=.pdf

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