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TII Publications

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Transport Infrastructure Ireland Carbon Tool for Road, Greenway and Light Rail Projects: User Guidance Document

GE-ENV-01106
February 2024

CARBON TOOL
Transport Infrastructure Ireland

GE General

Technical

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TII Publications

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Contents

Updates to TII Publications resulting in changes to

Transport Infrastructure Ireland Carbon Tool for Road, Greenway and Light Rail Projects: User Guidance Document GE-ENV-01106

Date: February 2024

Amendment Details:

This document supersedes the December 2022 version of GE-ENV-01106, amendments have been made as per the following:

a) The carbon tool has been updated to include a calculation module for Greenways.

Contents Table

1. Introduction

The purpose of this document is to provide guidance on the use of the Transport Infrastructure Ireland (TII) Carbon Tool for assessing lifecycle carbon emissions for National road, greenway and light rail infrastructure projects in Ireland.

This document will also provide users of the TII Carbon Tool with additional background information on the development, format and content use of the TII Carbon Tool. The document is presented in two parts, as follows:

- **Part 1:** TII Carbon Tool background, including the development process and purpose, boundaries, assumptions, layout and functionality.
- **Part 2:** A step-by-step run through of each of the TII Carbon Tool's stages to ensure an understanding of the alignment with the engineering approach. To facilitate understanding, this section is best read with the Tool open. This section also includes a case study showing a worked example of the use of the Tool and describes the level of detail expected for each project phase.

The TII Carbon Tool contains embedded guidance aimed specifically at users of the Tool. This approach encourages ease of use and prevents the user from having to refer to multiple documents during completion.

Please note that in order to get access to the Carbon Tool, prospective users should email climatetools@tii.ie to be set up as an authorised user on the TII Web Application Portal.

2. Background and Rationale

The primary purpose of the TII Carbon Tool is to assist TII and its contractors in complying with the greenhouse gas (GHG) reporting requirements as per the revised Environmental Impact Assessment (EIA) Directive 2014/52/EU[1], hereafter referred to as the EIA Directive.

Where an EIA is not required, for example where the project may not be of a class or scale as to require an EIA (minor road improvement), an individual standalone assessment of GHG carbon footprint may still be required, for which the TII Carbon Tool should be used.

The TII Carbon Tool (hereafter referred to as 'Tool') is designed to be used primarily by climate practitioners, and secondarily for project designers, engineers and lead contractors as part of the early design and planning process for new road, greenway and light rail projects. The Tool is aligned to integrate with the existing planning and design cycle. The outputs from the Tool will allow TII and its contractors to compare and evaluate the lifecycle carbon impacts of multiple design options for any given road, greenway or light rail project.

Further information on carbon foot printing for TII projects can be found in:

- TII Climate Guidance for National Roads, Light Rail, and Rural Cycleways (Offline & Greenways) – Overarching Technical Document (OTD) PE-ENV-01104-01 which provides guidance on best practice methodology and processes for climate assessment for road projects, light railway and Rural Cycleways (Active Travel and Greenway projects).
- TII Climate Assessment of Proposed National Roads Projects - Standard (SD) PE-ENV-01105 which outlines the standards required for conducting and reporting climate assessment for national road projects for Project Phases 0-4.

2.1 Carbon Tool Development Process

There are already several tools in existence worldwide for measuring GHG emissions associated with the design, build, and operation of road and rail projects.

Before developing this Tool, a review of 12 existing infrastructure-relevant carbon footprinting tools was undertaken to build an understanding of existing tools, approaches, and other information sources. The review of these existing tools found that none were sufficiently specific enough to meet the requirements of TII, either in their scope and boundary of reporting, or for use in Ireland. However, certain aspects of relevant 'good practice' were identified in several of the tools reviewed, and these have been applied during the Tool's design and development. This Tool is designed to provide the specificity required for use in Ireland.

2.2 Overview

The Tool is designed to assist TII and its contractors to meet the requirement for a lifecycle carbon emissions footprint as part of the revised EIA Directive. The precise requirements of a carbon footprint are not outlined in the EIA Directive; therefore, this Tool adheres to best practice guidelines in relation to carbon footprinting within the industry, whilst also meeting the requirements of TII.

[1] The European Parliament and the Council of the European Union. (2011). EIA Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

It is customised for road, greenway and light rail projects in Ireland and will help to facilitate further, the integration of environmental issues into transport infrastructure planning, construction and operation.

It is designed to be used by contractors (project designers, consultants or lead contractors) as part of activities leading up to the design and completion of new road, greenway and light rail projects.

The Tool is designed to integrate seamlessly with the current planning and design cycle for road, greenway and light rail projects. The outputs from the Tool give TII and its contractors the information needed to understand, compare, evaluate, and reduce the lifecycle carbon impacts of multiple design options for any given road, greenway or light rail project. It uses project activity data combined with embedded emission factors and assumptions to calculate a carbon footprint for a proposed road, greenway or light rail project. The Tool allows for reporting of a project, across TII's project phases. Carbon emissions are reported in line with the project lifecycle stages outlined in Publicly Available Specification (PAS) 2080: 2016 Carbon Management in Infrastructure[2]), best practice guidance for measuring and reporting greenhouse gas emissions for infrastructure projects.

The Scope of the Tool is designed to fulfil the following criteria:

- **Include road, greenway and light rail projects:** Includes functionality to enable the assessment of road, greenway and light rail projects within one tool.
- **Lifecycle carbon emission calculation:** Enables carbon data to be presented for the different lifecycle stages in alignment with those in PAS 2080.
- **Align with TII project phases:** Useable at the different project phases, in road, greenway and light rail projects, from initial outline design and option selection through to detailed design and final implementation.
- **Model multiple projects designs and a business-as-usual baseline:** Enables modelling of ten different project designs and a baseline scenario, which reflects business as usual[3] assuming that the project is not built.
- **Flexibility in inputs and outputs:** Allows for different levels of assessment to be carried out, aligning with the project phases in TII road, greenway and light rail projects. It is also designed so that new emerging carbon emission factors data (from Environmental Product Declarations (EPDs) etc.) can be added.
- **Capture carbon mitigation measures:** Ability to capture where carbon mitigation measures are taken within each design and in later project phases capture potential carbon savings attributed to each of the measures.
- **Exportable outputs:** Provides a range of output types and outputs that can be exported.

2.3 Longevity

The Tool is designed to allow users to add emission factors for construction materials, and when more country-specific data becomes available or from EPDs.

[2] Publicly Available Specification (PAS) 2080: 2016 Carbon Management in Infrastructure, BSI, 2016
[3] Business as usual represents the existing GHG emissions from within the boundary of the proposed study area, this may include emissions from existing structures (e.g. energy consumption from a building which is scheduled for refurbishment, demolition or replacement) and existing infrastructure (e.g. current operational and use emissions of the affected road network being assessed).

The Emission Factor list can be viewed within the Tool (Emissions Factors page), and the background dataset should be updated regularly to account for updates to the source datasets.

It is recommended that the Carbon Tool undergoes an annual update during which all emission factors sources are checked for updates including new data that is more specific to Ireland.

2.4 Carbon Tool Introduction

Initially this Tool was developed and launched in 2018 using Microsoft Excel. From 2022, the Tool has been available as an online version, and operates as a web-based application using R software. The Tool has been designed to be used at the defined project phases, for road, greenway and light rail that are traditionally adhered to during TII projects (Figures 2.1, 2.2 and 2.3).

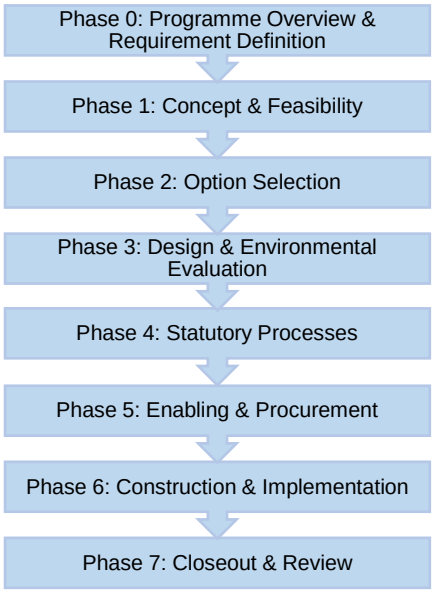


Figure 2.1 Road Project Phases (from TII Project Management Guidelines, 2023, PE-PMG-02041).

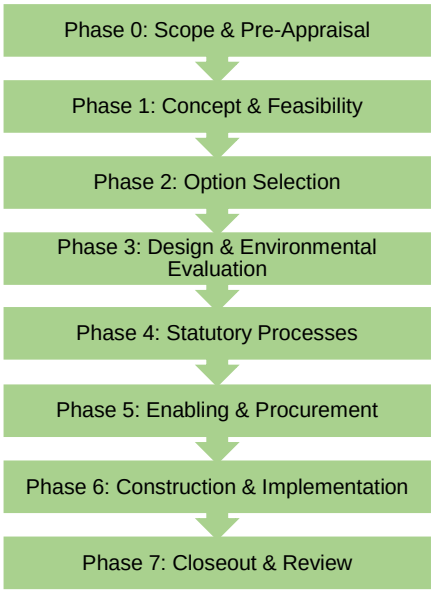


Figure 2.2 Greenway Project Phases (from TII Project Management Guidelines, 2023, PE-PMG-02041)

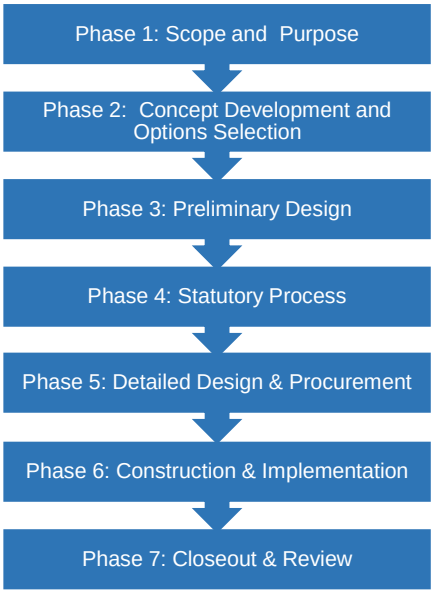


Figure 2.3 Light Rail Project Phases (from National Transport Authority (NTA) Project Approval Guidelines, 2020)

Where sufficient data is available, the Tool should be used. New available data for the project should be populated at each phase of a project, and results from the previous project phase should be copied into the new Tool for comparison purposes.

Once completed, results should be saved and downloaded as a record of the performance of the project at the particular phase.

Table 2.1 displays the level of completion required in the Tool for each project phase. Where sufficient data is available it should be entered into the Tool, with assumptions and limitations noted where relevant. For more information on data availability at each project phase, please see OTD PE-ENV-01104-01. The Tool provides a template to complete best practice information, but it cannot define the data needs for every project. The individual project boundaries will be defined as part of the EIA scope, and the information scoped in and out will depend upon the project in question.

Table 2.1 Summary of data expected for the assessment of GHG emissions and level of completion of the Tool for each phase.

<table>
<tr><th rowspan="2">TII Project Phase – Road & Greenway Projects</th><th rowspan="2">NTA Project Phase – Light Rail Projects</th><th colspan="9">Data input pages within the Tool that should be completed for each Project Phase</th></tr>
<tr><th>Project Details</th><th>Scoping</th><th>Baseline Data</th><th>High Level Design</th><th>Pre-construction</th><th>Embodied Carbon</th><th>Construction</th><th>Use</th><th>End of Life</th></tr>
<tr><td>Phase 0: Programme Overview & Requirement Definition / Scope & Pre-Appraisal</td><td>Phase 1: Scope & Purpose</td><td>Qualitative details available</td><td colspan="8">No quantitative data likely to be available for assessment of GHG emissions.</td></tr>
<tr><td>Phase 1: Project Concept & Feasibility</td><td rowspan="2">Phase 2: Concept Development & Options Selection</td><td>Qualitative details available</td><td colspan="8">No data likely to be available at this project phase and no statutory requirement for analysis.</td></tr>
<tr><td>Phase 2: Option Selection</td><td colspan="5">Qualitative and estimated quantitative details available</td><td colspan="4">Limited quantitative data might be available e.g. a partial Bill of Quantities, road user emissions (road projects), traction energy demand (light rail projects).</td></tr>
<tr><td>Phase 3: Design & Environmental Evaluation</td><td>Phase 3: Preliminary Design</td><td colspan="9">Quantitative data should be available for quantitative analysis and should be entered into the Tool for all areas that have been scoped into the EIA. Details of identified carbon savings opportunities should be completed.</td></tr>
<tr><td>Phase 4: Statutory Processes</td><td>Phase 4: Statutory Processes</td><td colspan="9">The assessments undertaken in previous phases will form the Climate Chapter of EIA Report for submission of the statutory consent documentation for the project as per the scoping report.</td></tr>
<tr><td>Phase 5: Enabling & Procurement</td><td>Phase 5: Detailed Design & Procurement</td><td colspan="9">Revised, updated and refined information should be entered into the Tool for all areas that have been scoped into the EIA. This should include all design changes. Details of identified carbon savings opportunities should be completed.</td></tr>
<tr><td>Phase 6: Construction & Implementation</td><td>Phase 6: Construction & Implementation</td><td colspan="9">Actual and detailed data from the project should be entered into the Tool for all areas that were scoped into the EIA (this is to allow for changes during the project to be tracked according to the same project boundaries). Details of implemented carbon savings opportunities should be completed.</td></tr>
<tr><td>Phase 7: Closeout & Review</td><td>Phase 7: Closeout & Review</td><td colspan="9">Final data from the project should be entered into the Tool for all areas that were scoped into the EIA. Details of final carbon savings achieved should be completed within each project phase, where information is available</td></tr>
</table>

2.4.1 Boundaries

Reporting boundaries for the Tool should align with those presented in Section 7 of PAS 2080 (Figure 2.3), which provides good practice for lifecycle carbon quantification in infrastructure projects. PAS 2080 was published by the British Standards Institution (BSI), the Construction Leadership Council and the Green Construction Board in 2016. It specifies requirements and provides guidance for the management of carbon in infrastructure (transport, energy, water, waste and communications), both in the provision of new infrastructure assets and the refurbishment of existing infrastructure. PAS 2080 has been developed to:

- Provide a specification for infrastructure carbon management which is compatible with international and sectoral norms, standards and guidance.

- Bring consistency to and encourage uptake of the practice of carbon management.
- Help the infrastructure value chain to become more efficient.
- Improve the accuracy, transparency, consistency, relevance and completeness of GHG emissions quantification.
- Support evidence-based decision making and identify opportunities for carbon reduction.

PAS 2080 guidance breaks down the project lifecycle into three stages: 1) Before use, 2) Use, and 3) End of life.

Each stage is then broken down further into subsections aligning with that for an EPD. The Tool's alignment with this approach allows for Ireland-specific EPD carbon emission factors data to be integrated into the database once it becomes more readily available.

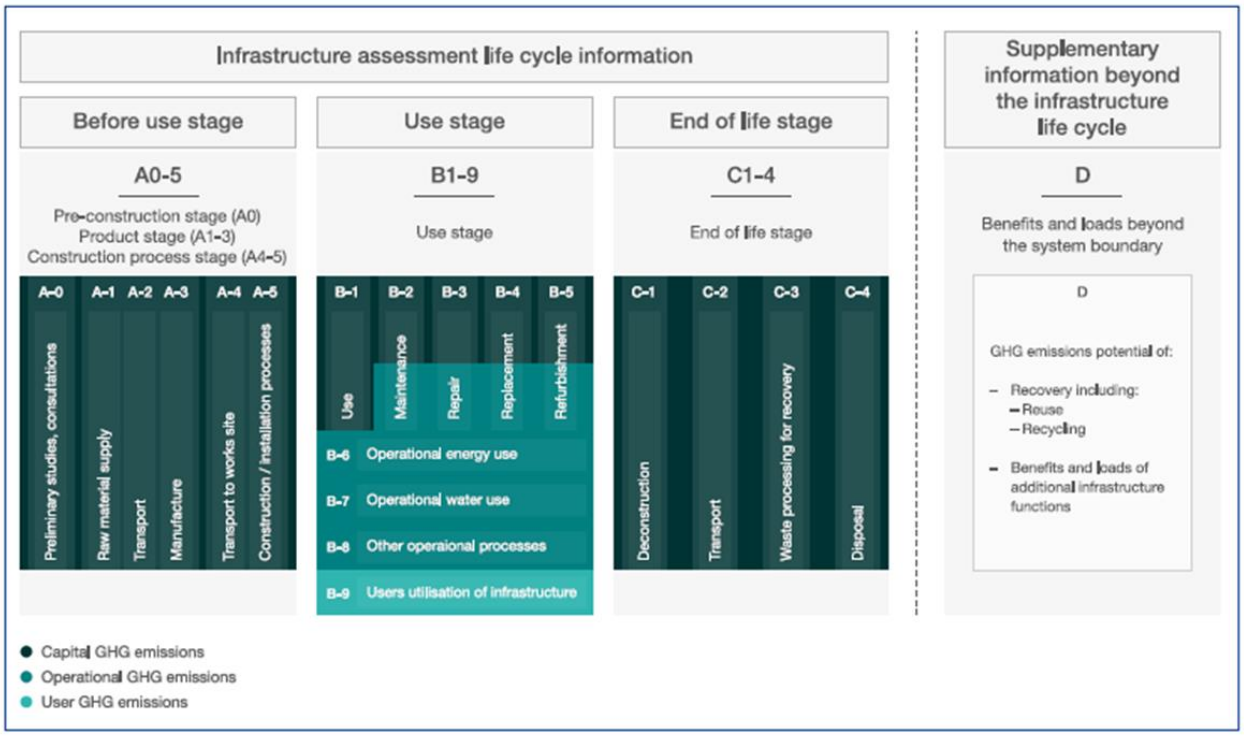


Figure 2.4 Infrastructure assessment lifecycle information from PAS 2080, displaying the Tool reporting boundaries[4]

2.4.2 Compliance with EPDs

The Tool is designed so that carbon emission factors data from Ireland-specific EPDs can be added as and when they become available. For new materials or components, this is achieved through the use of the 'Add New Material' function on the "Embodied Carbon" data input page.

2.4.3 Carbon Tool Layout and Functionality

The format of the Tool guides the user as to which cells they need to complete with raw data and when a selection from a drop-down list is required. A schematic representation of the Tool is displayed in Figure 2.4; this includes the corresponding PAS 2080 stages (in parentheses).

[4] Note that 'B-8 Other operational processes' should read 'B-8 Other operational processes'

Data entry format varies according to the information type being inputted.

Drop-down lists enable selection of materials, fuels and transport modes, while volumes and amounts are entered by the user into cells restricted to number format inputs only. Units are auto completed based on drop-down selection and all data inputted needs to be entered in these units to give an accurate result.

2.4.4 Carbon Tool Users and User Competency

The Tool is designed to be completed by personnel involved in the design for each project phase. Depending on the nature of the project, this may be a TII staff member, consultant, designer or other contractor. Although the Tool undertakes the technical calculations automatically, a certain degree of understanding of carbon footprinting processes will be advantageous to correctly evaluate the outputs; it should, be an engineer or scientist with some specialist knowledge. Expert knowledge is not expected as detailed guidance is available.

2.4.5 Overview of Tool Layout

The layout of the Tool is structured in a way which enables the user to follow the PAS2080 (Figure 2.4) lifecycle stages, as demonstrated in Figure 2.5.

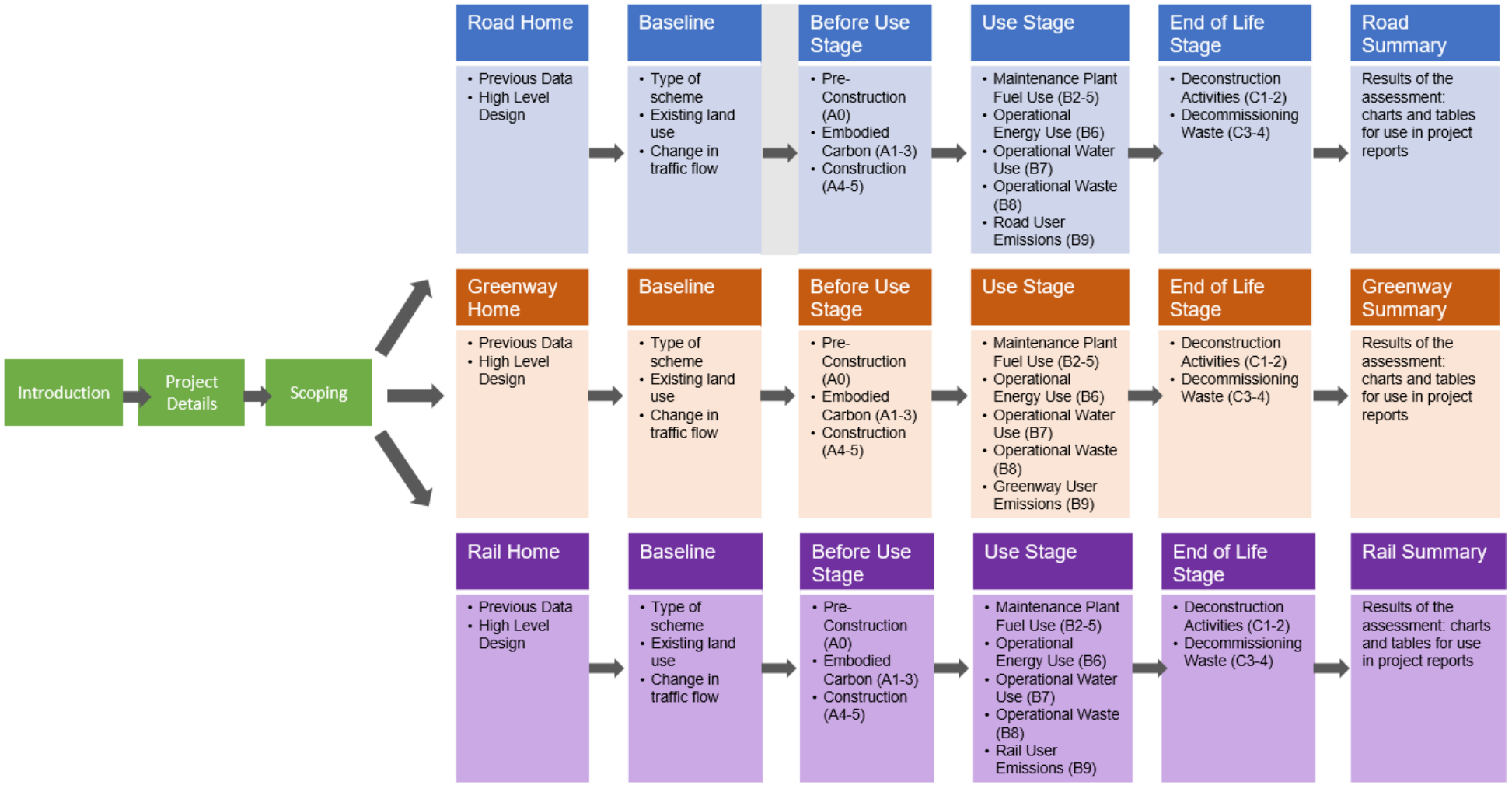


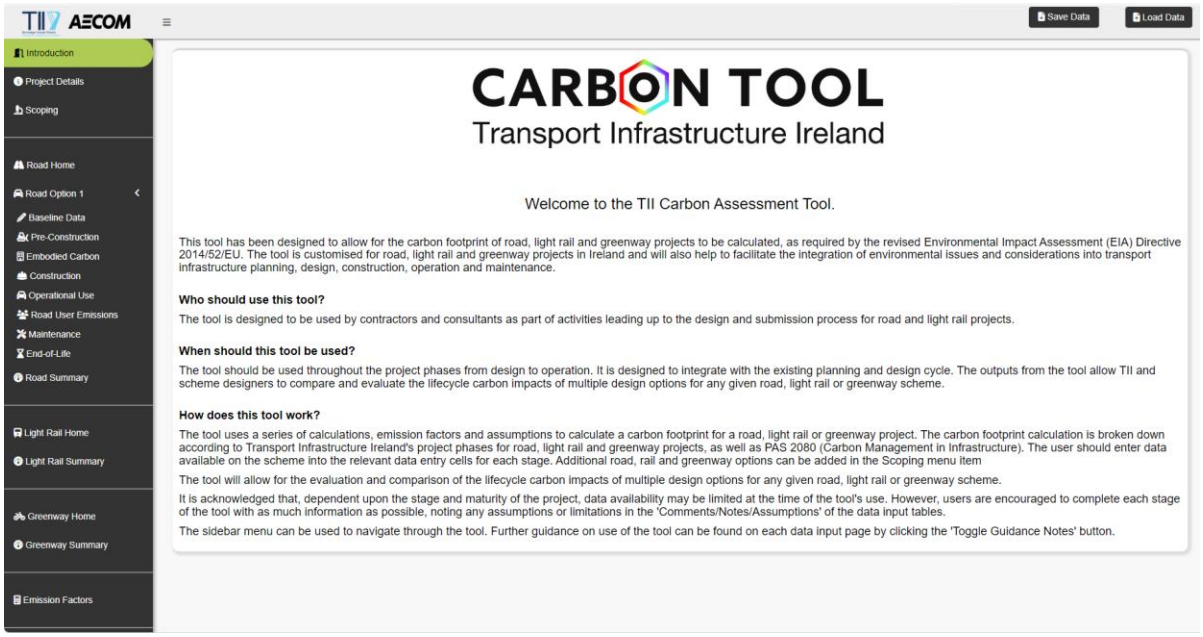
Figure 2.5 The schematic layout of the TII Carbon Tool. The references in parentheses (0, A1-3, B2-5, etc.) correspond to PAS 2080 footprint elements

3. Carbon Tool - Infrastructure Scenario Process

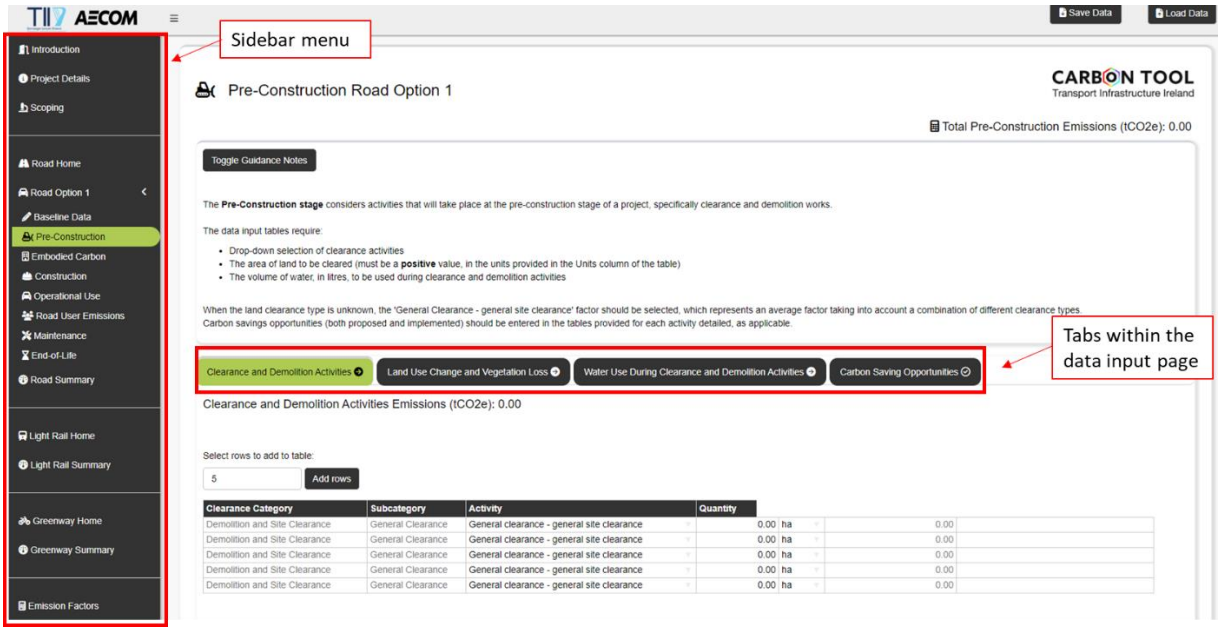
3.1 Using the Tool

3.1.1 Navigation

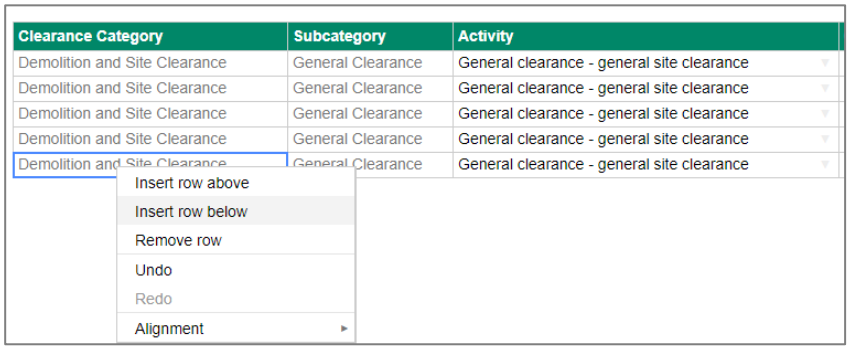
Upon opening the Tool, users will see the 'Introduction' page.



The sidebar menu can be used to navigate through the Tool. Some data input pages have multiple tabs which can be navigated by clicking on the tab title on the sidebar menu. Once selected the button on the sidebar menu with the title of the page should change colour.



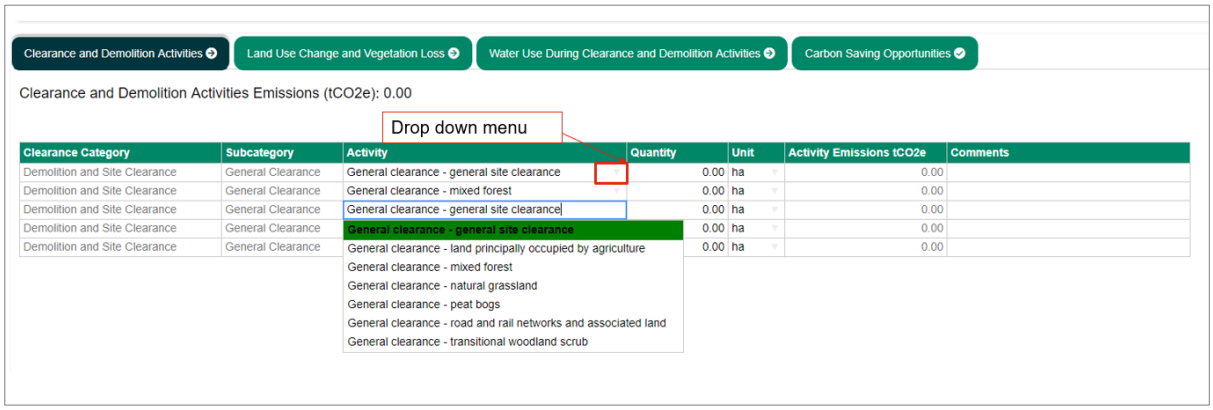
Additional rows can be added to any table throughout the Tool by right-clicking on the table.



3.1.2 Data Entry

Data entry format varies according to the information type being inputted. For some of the stages and activities, the Tool uses prepopulated data. The grey arrow symbol in the table indicates the drop-down menu is available and the user must select from the provided options.

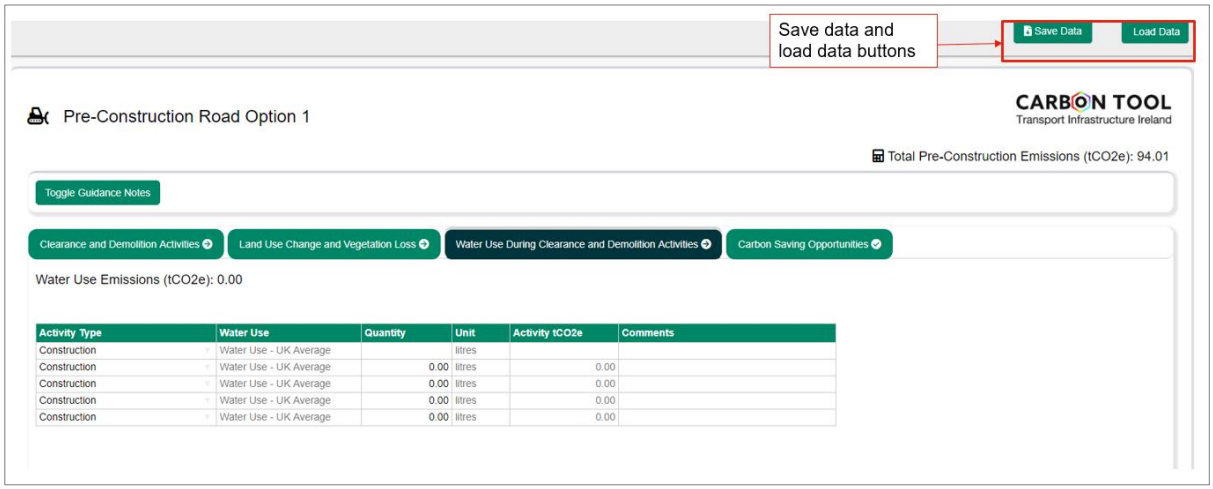
Volumes and amounts must be entered by the user into the specific cells restricted to number format inputs only. The unit type is auto populated based on drop-down selection and all data inputted needs to be entered in the units specified in the Unit column of the table. Assumptions/Notes and other comments should be entered in the column ‘Comments’.



3.1.3 Saving Data

The 'Save data’ button in the top right corner should be used at regular intervals to ensure progress is saved. Users can load previously entered data for the project by using the button ‘Load Data’ and selecting the file with the latest saved data for the project.

Users must always save the data input before closing the Tool, otherwise the data will be lost.

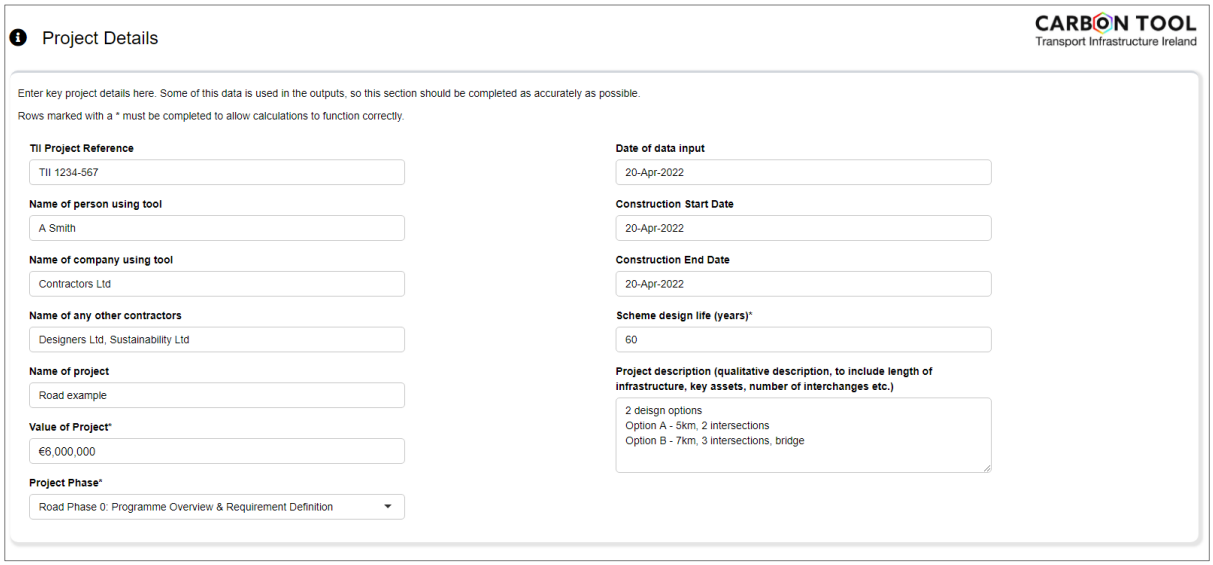


3.2 Starting a New Entry

Step 1: Enter Project Details

Purpose of this page: To collect details of the project, as listed previously, for completeness and future reference. The project value is used to calculate intensity outputs, while the project design life is used to calculate the emissions associated with the use stage of the project.

1. Click on **"Project Details"**. For this section, the user should provide:
    a) The project reference number.
    b) Project name and description.
    c) Project value (in Euro) (mandatory field that is used to calculate intensity outputs).
    d) The phase of the project for which the Tool is being run (according to Figure 2.1 or 2.2) (mandatory field that is used for submitting a copy of data from the previous project phases).
    e) The project construction period.
    f) The project design life (mandatory field that is used to calculate the emissions associated with the use stage of the project)
    g) Information about the project design features e.g. length of infrastructure, key assets and number of interchanges.



Step 2: Complete Scoping Assessment

Purpose of this page: To allow the user to record which elements are to be included or excluded from the carbon footprint assessment. This is useful for reference as the project progresses, and also for project reporting as it requests that the rationale for inclusions and exclusions are recorded.

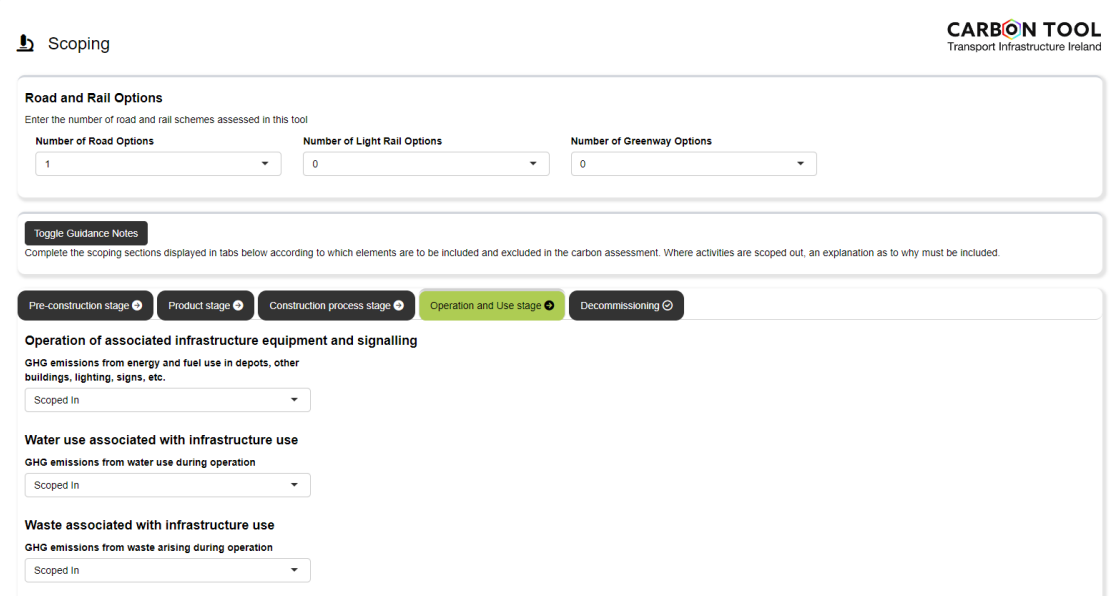
Users should then click **"Scoping"**. For this section, the user will need to identify which lifecycle stages are being included and excluded in the assessment.

Using the relevant drop-down, the user should select the number of road, greenway or light rail options to be assessed. This will create a separate tab in the left side menu, to enter project activity data for each of the options. For example, when the number of Road Options is 3, three separate tabs will be created: Road Option 1, Road Option 2, and Road Option 3.

The Tool can be used to calculate emissions for a scenario where no carbon saving methods are introduced to get the worst-case scenario. It can also be used for a scenario that calculates emissions with mitigation measures implemented and carbon savings achieved. In a scenario like this, the user should select two design options, one option would be without mitigation measures implemented and the second option would include mitigation measures.

Next, the user should complete the information under each of the lifecycle tabs on the second half of the Scoping page. Under each tab the drop-down should be completed to indicate which sources of GHG emissions are included in the scope of the assessment.

A simple one-sentence summary is also required in the Justification box where an activity is scoped out, in order to explain why the activity is being scoped out of the carbon assessment being undertaken.



Step 3: Select type of the project

Users should then use either the "Road Home", "Greenway Home" or "Light Rail Home" to proceed to the data entry tabs, depending on the project type.

3.3 Entering Project Data

3.3.1 Road Home / Greenway Home / Light Rail Home

Previous Data

Purpose of this page: To record the carbon footprint calculated as part of the previous project phase. This allows for easy comparison of the stages while this project phase is being completed and enables continuity or data transfer between project phases, especially if different contractors are being used.

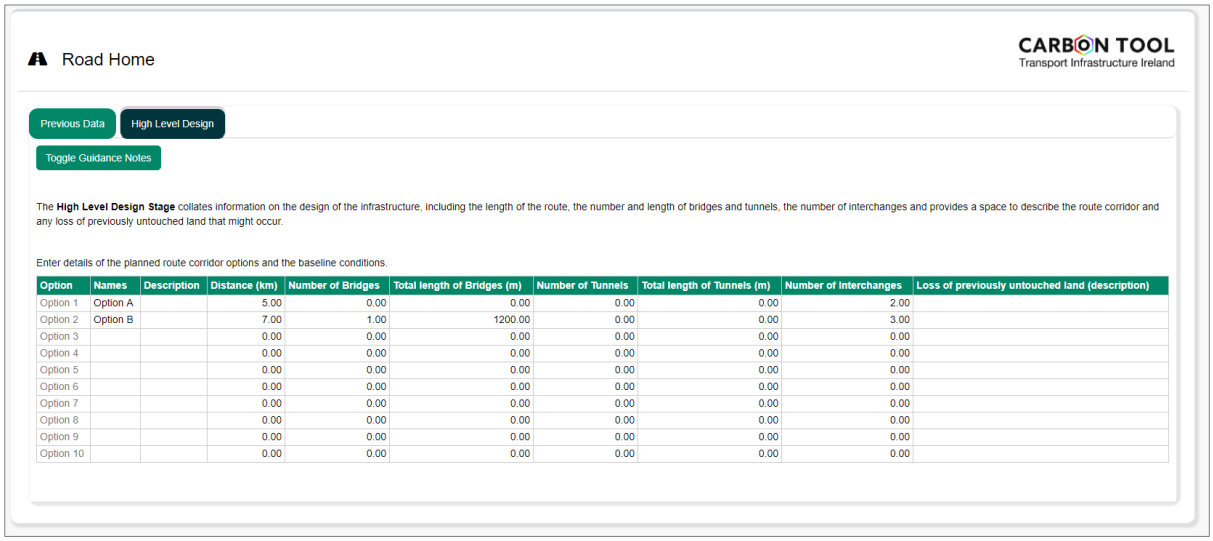
If working on Project Phase 2 onwards, users should copy the summary output from the previous tool (found in the summary tab of the Tool[5]) into the table provided (the table should be copied as Values).

High Level Design

Purpose of this page: The High-Level Design stage collates information on the design of the infrastructure, including the length of the route, the number and length of bridges and tunnels, the number of interchanges and provides a space to describe the route corridor and any loss of previously untouched land that might occur. This provides a descriptive summary of the project for reporting purposes, the information added in this is not currently used in the Tool's calculations.

Once on the **"High Level Design"** page, users need to enter high-level details on the proposed route corridor, including an estimate of the route length, number and length of bridges, roads and interchanges, as well as a summary of the loss of land.

[5] If the previous tool used for carbon assessment was MC Excel based tool, summary outputs can be found on the detailed outputs page.



Option	Names	Description	Distance (km)	Number of Bridges	Total length of Bridges (m)	Number of Tunnels	Total length of Tunnels (m)	Number of Interchanges	Loss of previously untouched land (description)
Option 1	Option A		5.00	0.00	0.00	0.00	0.00	2.00	
Option 2	Option B		7.00	1.00	1200.00	0.00	0.00	3.00	
Option 3			0.00	0.00	0.00	0.00	0.00	0.00	
Option 4			0.00	0.00	0.00	0.00	0.00	0.00	
Option 5			0.00	0.00	0.00	0.00	0.00	0.00	
Option 6			0.00	0.00	0.00	0.00	0.00	0.00	
Option 7			0.00	0.00	0.00	0.00	0.00	0.00	
Option 8			0.00	0.00	0.00	0.00	0.00	0.00	
Option 9			0.00	0.00	0.00	0.00	0.00	0.00	
Option 10			0.00	0.00	0.00	0.00	0.00	0.00	

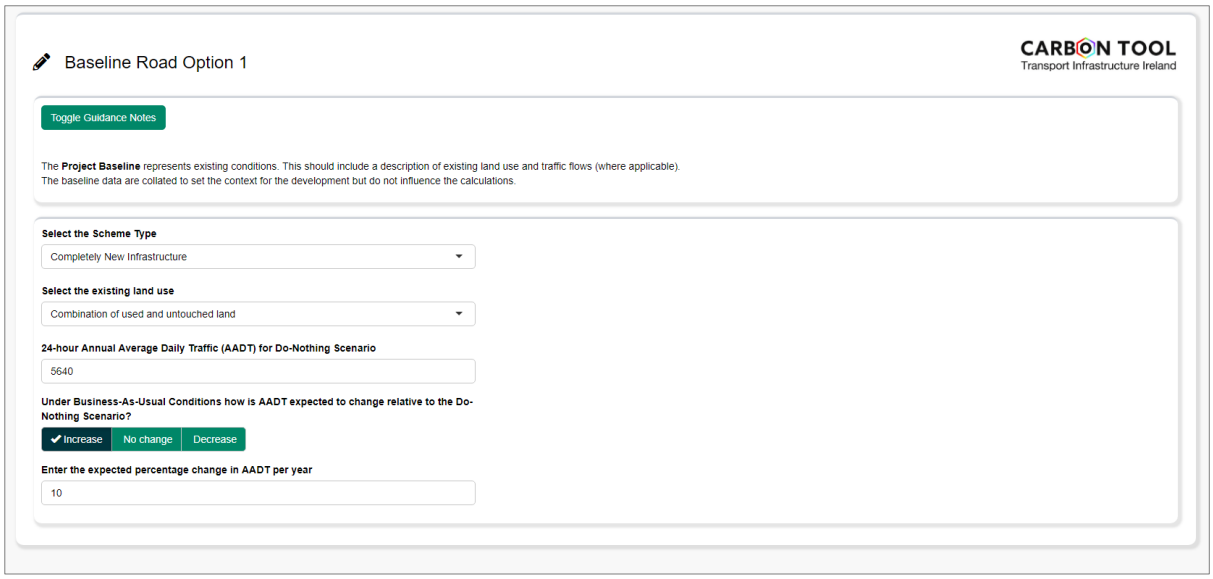
Note that the user should always complete the 'Names' column, as the text entered here for each option will be used throughout the Tool on each of the option pages. It will be displayed in the top ribbon underneath the option number for ease of identification.

3.3.2 Baseline Data

Purpose of this page: The project baseline represents the existing conditions. This includes existing land use and traffic flow (if applicable). The information added here is not currently used in the Tool's calculations.

Once on the **'Baseline Data'** page, users need to select the type of project. If the proposed project is a Completely New Infrastructure, then users will need to enter data on whether the project is being built on untouched land, land use for another purpose or combination of developed and undeveloped land.

Users are also asked to enter the current estimated annual average daily traffic (AADT) for the Do-Minimum scenario (without the proposed project), and an estimate for how much (%) this is likely to increase or decrease as a result of the proposed project.



3.3.3 Pre-Construction

Purpose of this page: The Before Use - Pre-Construction stage considers activities that will take place at the pre-construction project phase, specifically clearance and demolition works. Data entered here is collated and used in the final outputs. Carbon-saving opportunities (both proposed and implemented) should be entered in the tables provided for each activity detailed, as applicable.

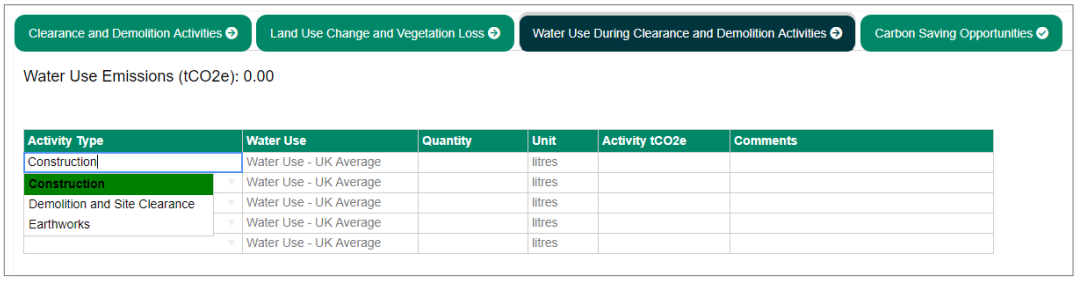
Use the side menu bar to navigate to **"Pre-Construction"**.

Here, users need to enter the following information:

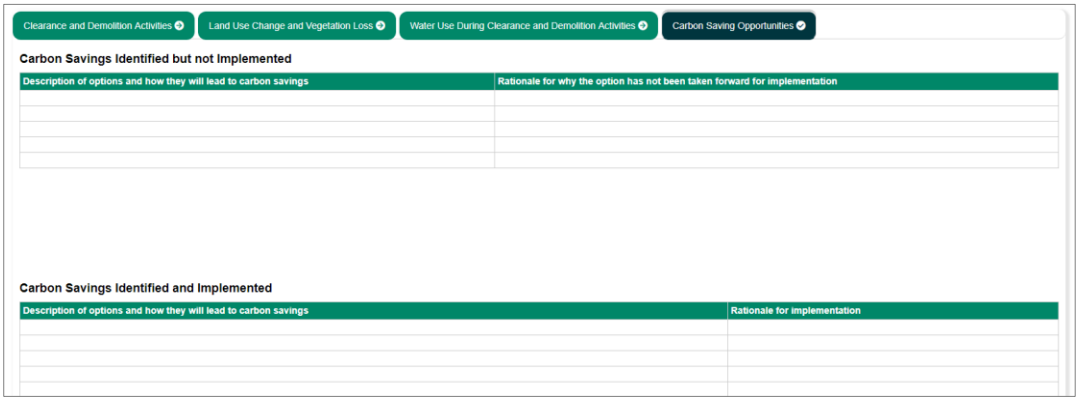
a) Clearance and Demolition Activities: use drop-down to select clearance activities and current type of land to be cleared. Then enter size of the area of land to be cleared (there must be a positive value in the units provided, in the Unit column of the table). The calculation automatically accounts for the energy requirements to undertake these activities. When the land clearance type is unknown, the 'General Clearance - general site clearance' factor should be selected, which represents an average factor taking into account a combination of different clearance types.

b) Land Use Change and Vegetation Loss: Use the drop-down menu to select the type of vegetation and planting that will be added as part of the project's development and provide quantity for each type of vegetation. The Tool automatically applies a negative value to the total to account for the carbon savings realised by planting.

c) Water Use During Clearance and Demolition Activities: Enter the volume of water, in litres, to be used during clearance and demolition activities.



d) Carbon-saving opportunities: Pre-construction activities can be entered here too. For a summary of entering carbon-saving information, refer to Section 2.3.



3.3.4 Embodied Carbon

Purpose of this page: This Embodied Carbon stage considers the product stage, including materials that will be used during the construction process and details of material transportation.

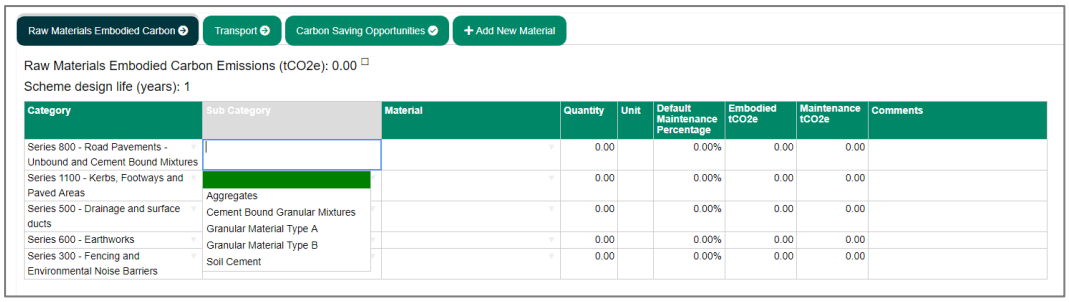
The data entered here is used to calculate the outputs and is collated, to give the embodied carbon for materials used in the construction of the project.

Use the side menu bar to navigate to the **"Embodied Carbon"** to enter details on the materials that will be used. The data to be entered here is as follows:

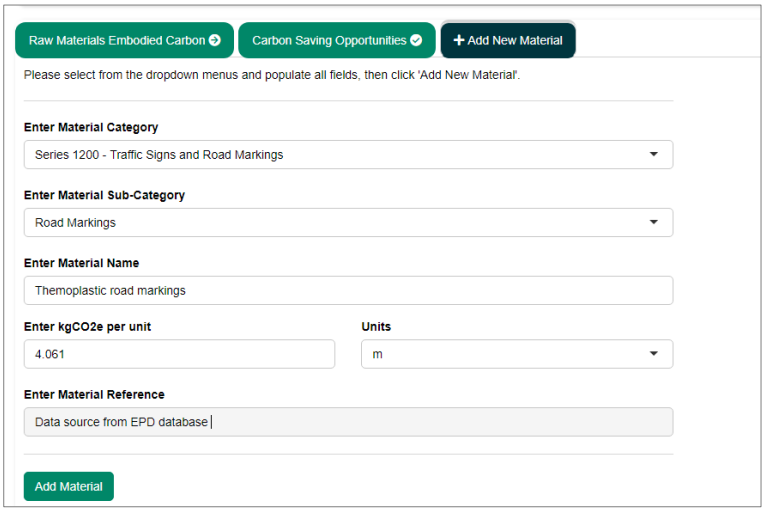
a) For TII project phases 0 and 1 (refer to Table 2.1 for details), estimates of the main construction materials to be used should be entered, with as much information that is available for transportation of materials being recorded.

b) For later TII project phases, as much detail that is available should be entered, with phases 6 and 7 completions detailing full material lists.

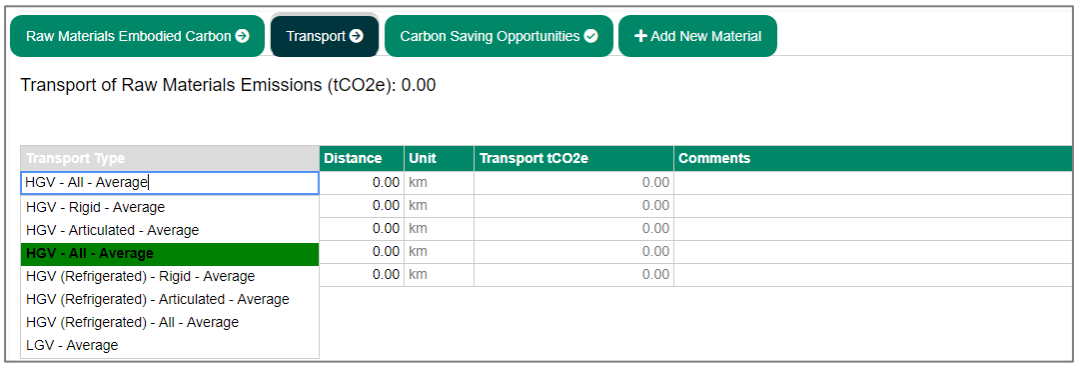
c) Use the drop-down to select category, subcategory and type of the materials used during the construction of the project and enter the quantity of each selected material. A standard industry emission factor will be applied to selected material from the embedded emission factors database.



d) Should users wish to enter a bespoke factor (e.g. carbon data from an EPD) they should click on **"Add New Material"**. The user must select the category and sub-category of material to be added, and then type in the material name, $kgCO_2e$ value per unit and units along with the source of this emission factor. Once added into the form the user must use the 'Add Material' button to submit entry before returning to the 'Raw Materials Embodied Carbon' page. The details need to be accurately recorded and will be stored in the Tool to allow TII to check the factor and sources used. When returned to the table, the user can select the newly added material using the drop-down lists by selecting the category and sub-category entered on the form; the new material will be available for selection in the materials column.



e) Maintenance material impact is calculated automatically based upon defined replacement rates of materials during the project's lifetime. The replacement rates are expressed as a percentage of the material initially used for construction. Details of these maintenance rate are contained in the **"Emissions Factors"** page in the side menu (Material (Road) and (Material (Rail) sections. Information on **transportation of the materials should** be added by selecting the mode of transport being used for transporting materials to the construction site and entering the total distance travelled to move material to the construction site.



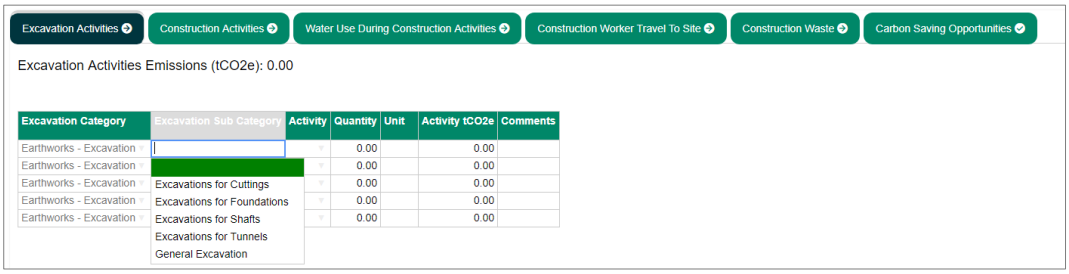
f) See below a worked-out example for transportation of 2000 tonnes of material, for a construction site located 100 km from a factory or a warehouse[6].

3.3.5 Construction

Purpose of this page: The Before Use - Construction stage considers construction activities that will take place during infrastructure development, including excavation activities, energy use of construction activities, water use and waste arising from construction activities. The data entered here is used to calculate the outputs and is collated to provide the carbon footprint for construction site activities.

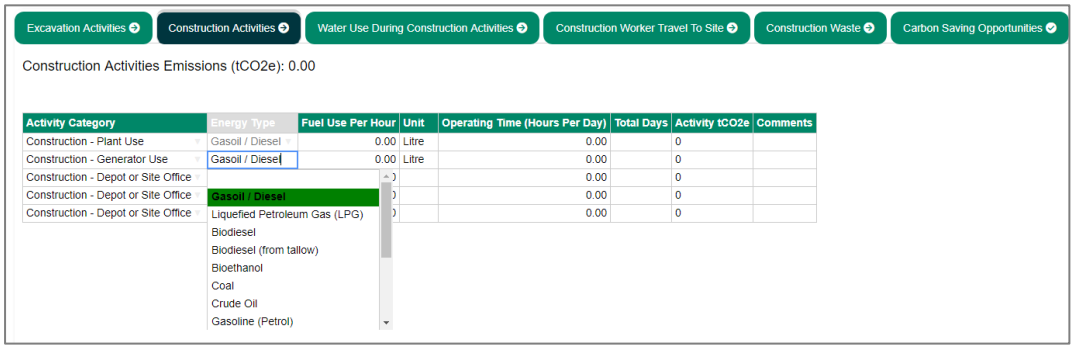
Use the side menu bar to navigate to the **"Construction"** input page. On this page, users need to enter details of the activities that will take place during construction, including:

a) Excavation Activities: Use the drop-down menu to select the type of excavation, the sub category and amount of excavated material from the site.

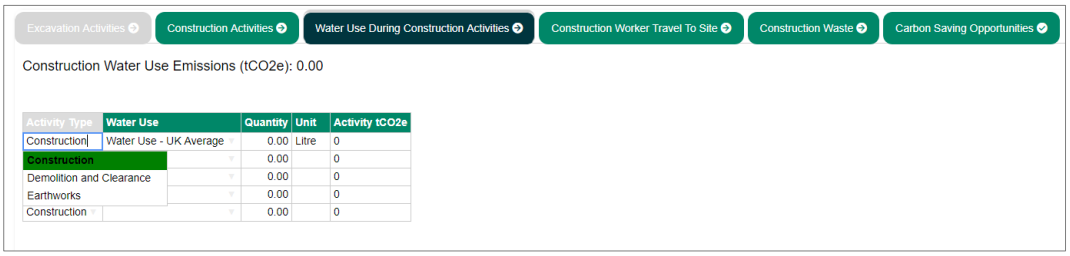


b) Construction Activities: Use the drop-down menu to select the type of energy / fuel used for each activity undertaken during the construction of the new proposed project. Provide the estimated amount of fuel/energy used per hour. Then enter the number of operating hours per day and total amount of days during which each activity will be undertaken.

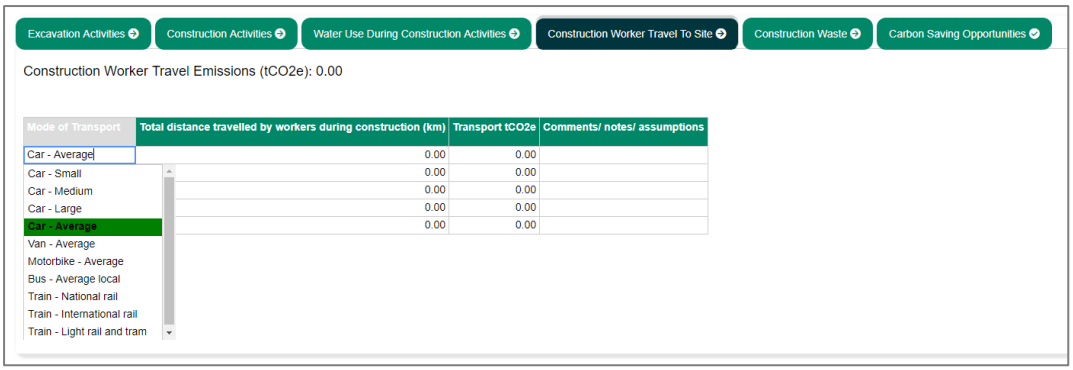
[6] Information on the maximum permitted weights and dimensions for vehicles and trailers can be found at the Road Safety Authority's website: https://www.rsa.ie/road-safety/road-users/professional-drivers/vehicle-safety-legislation/weights-and-dimensions



c) Water use during construction activities: Use the drop-down menu to select the type of activity which requires water during construction and enter the total amount of water used for each activity.



d) Construction worker travel to site: Use the drop-down menu to select the mode of transport for workers travelling to and from work, and enter the total distance travelled by workers during construction.



For each mode of transport, the estimated return journey distance between the construction workers addresses and the construction site have to be multiplied by the estimated working days; if the data is not available, assumptions on travel mode and distance should be made. See below worked out example for calculating distance travelled by employees to the construction site.

It is assumed that:

- 10 employees will travel 12 kilometres each one way to the site by average car.
- 5 employees will travel 5 kilometres each one way to the site by bus.
- The construction will take 45 working days.

For each of the transport modes data should be entered separately in the table.

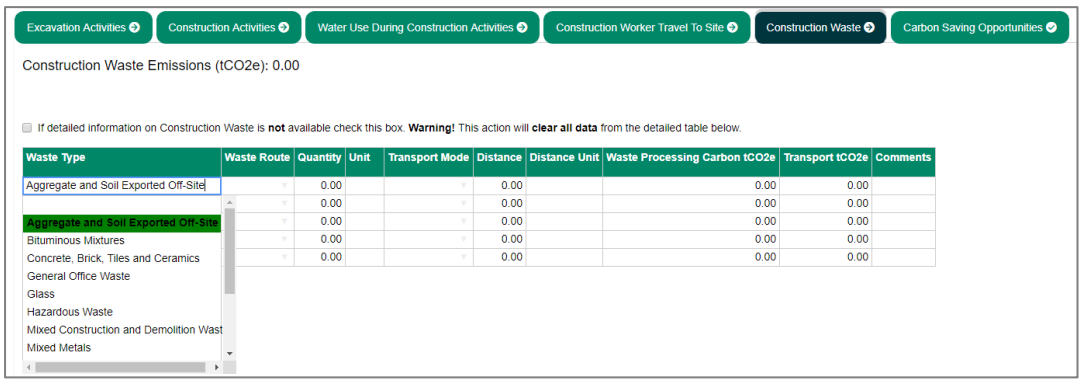
The user can add the distance travelled by each employee for the return journey, using the same mode and multiplied by working days during the construction period for each employee:

- Car journeys: 12 km x 2 (return journey) x 45 working days x 10 employees = total of 10,800 km.
- Bus journeys: 5 km x 2 (return journey) x 45 working days x 5 employees = total of 2,250 km.

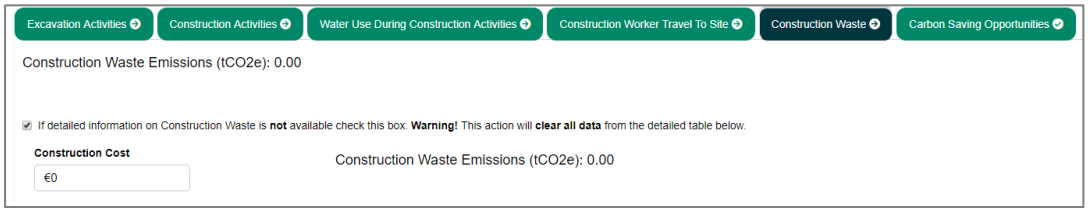
Then the total distance for 10 employees who travel using the average car should be entered for 'Car – Average', and the total distance for 5 employees travelling by bus should be entered separately using 'Bus - Average local'.

e) Construction Waste: This input page is designed to capture and account for waste materials that are taken away from site to be disposed, reused or recycled elsewhere. Excavated material that is reused on site, and therefore results in a reduction in the requirement for materials being brought to the site, is captured by the assessments conducted on the ' Pre-construction' and 'Embodied Carbon' input pages.

Use the drop-down menu to select the type of waste arising from the construction and the waste route and enter amount of waste generated. Then for each type of waste select the mode of transport used for transportation of waste to the waste centre and distance travelled for return journey.



If this information is not available, the construction cost should be provided, which will be used to estimate emissions arising from the construction waste using industry benchmark figures.



Only one of these should be completed per option.

f) Carbon Saving Opportunities: The first table should include possible opportunities that have been considered but not implemented, and the second table should include those that have been integrated to the design during this project phase.

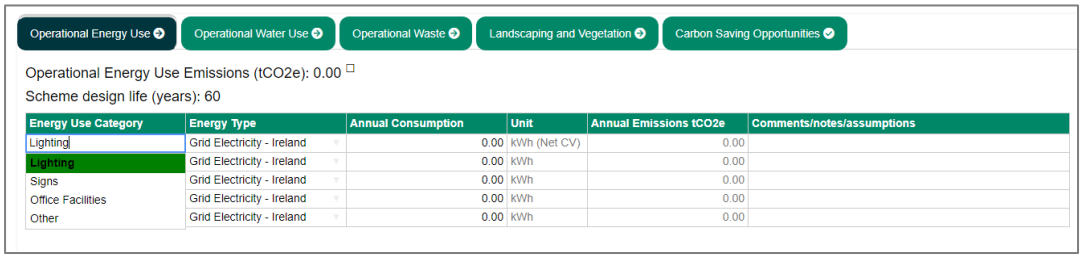
3.3.6 Operational Use

Purpose of this page: The Operational Use page calculates emissions associated with the operation of the infrastructure project such as energy, water and waste. Data recorded here is used to calculate the operational carbon footprint elements in the outputs page.

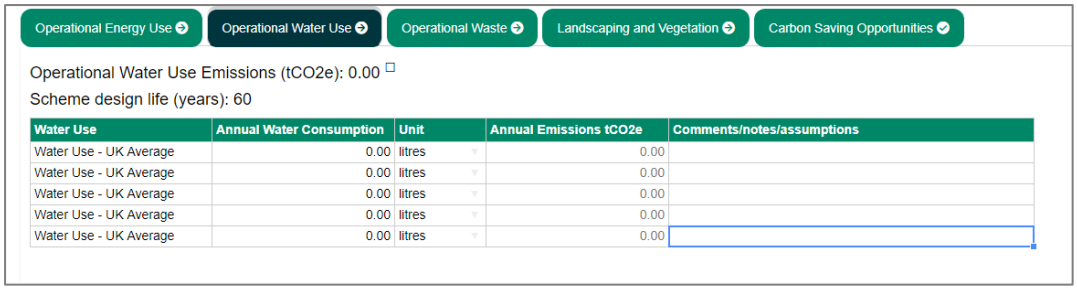
Use the side menu bar to navigate to the **"Operational Use"** input page, in which information on the operational emissions should be entered per year of operation, the Tool will calculate annual emissions and emissions over the project design life using the value provided in the 'Project Details'.

Users should include the following information:

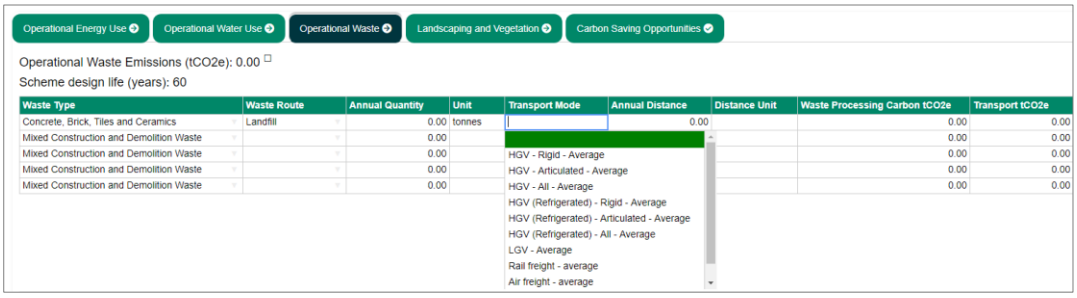
a) Operational Energy Use: Use the drop-down menu to select the energy use category, choosing from lighting, signs, office facilities or other, and for each select the energy type. Then input anticipated annual energy consumption during operation.



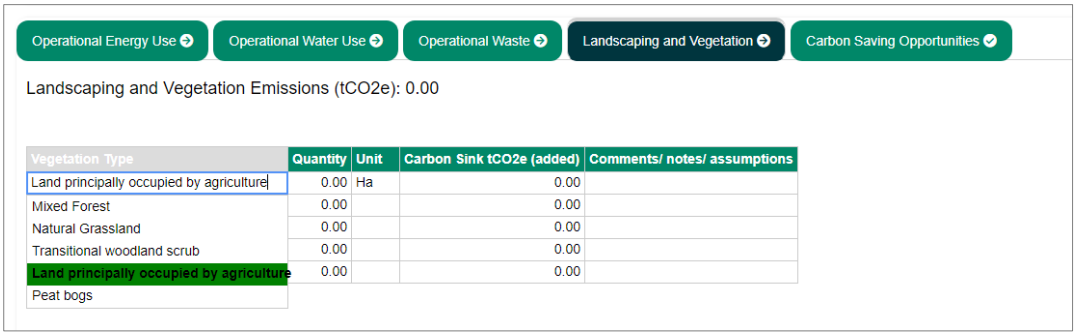
b) Operational Water Use: Enter the quantity of anticipated annual water consumption during operation of the project.



c) Operational Waste: Use the drop-down menu to select the waste type and waste route, then enter the quantity of anticipated annual waste arisings from operation. Then use the drop-down menu to select the transport mode for transporting waste to the waste processing centre and enter the distance travelled for the return journey.



d) Landscaping and Vegetation - The vegetation types and areas of planting that will be added as part of the project's development.



e) Carbon Savings Opportunities: The first table should include possible opportunities that have been considered, and the second table should include those that have been integrated to the design during this project phase.

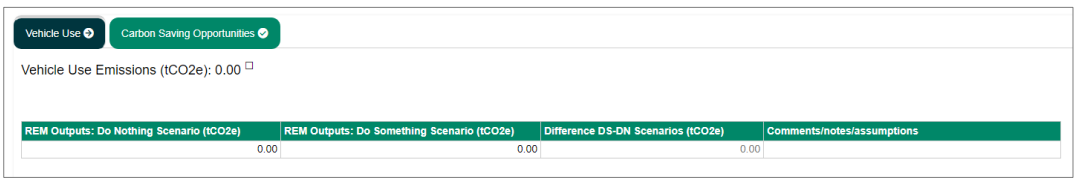
3.3.7 User Emissions

Purpose of this page: The user emissions pages calculate emissions associated with the use of the infrastructure by the users. The data inputted will vary between road, greenway and light rail infrastructure.

3.3.7.1 Road Projects

Use the side menu bar to navigate to the **"Road User Emissions"** input page, in which the following information should be entered:

a) Vehicle Use: for this input CO_2e data for the Do-minimum and Do-Something scenarios extracted from the REM tool, this should be the sum of the annual CO_2e for the duration of the development's lifetime. The Tool will differentiate between Do-Something and Do-minimum scenario.



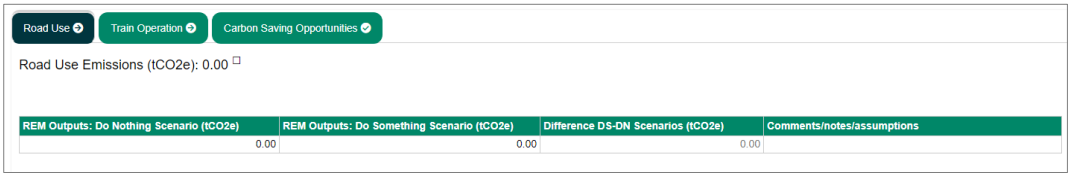
- If the difference between Do-Something and Do-minimum scenario is negative this means that the emissions arising from road users decrease when compared to Do-minimum scenario.
- If the difference between Do-Something and Do-minimum scenario is positive this means that the emissions arising from road users increase when compared to Do-minimum scenario.

3.3.7.2 Light Rail Projects

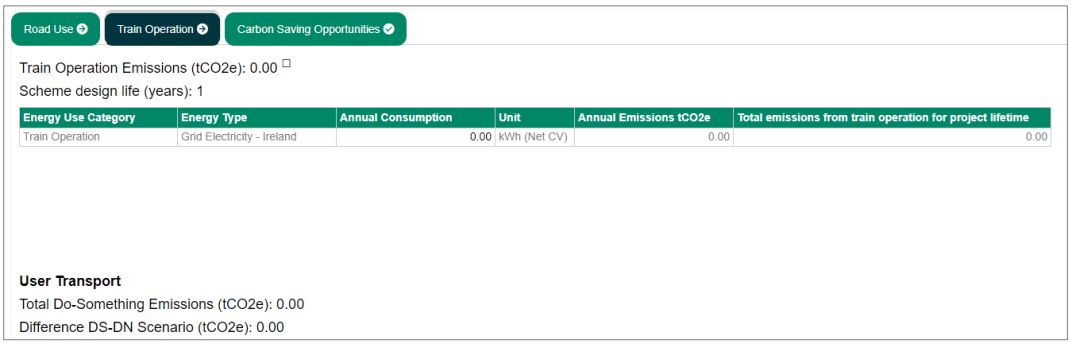
Use the side menu bar to navigate to the **"Rail User Emissions"** input page. This page calculates emissions anticipated with the use of the light rail infrastructure and change in CO_2e emissions from road users, as a result of replacing vehicle journeys with light rail journeys. To calculate this the Tool uses energy consumption required for operating trains and emissions from road users for the modelled affected network without (Do-minimum scenario) and with the light rail project (Do-Something scenario).

The following information should be entered:

a) In the 'Road Use' table input CO_2e data extracted from the REM model for the Do-minimum scenario and Do-Something scenario, this should be the sum of the annual CO_2e data for the duration of the development's lifetime.



b) Then in the 'Train Operation' table enter the anticipated annual energy consumption for operating the trains.



c) The Tool will calculate total emissions for the Do-Something scenario and the difference between the Do-Something scenario and Do-minimum scenario.

- If the difference between Do-Something scenario and Do-minimum scenario is negative this means that the emissions arising from energy used to operate trains are smaller than displaced emissions from road use, calculated for the current affected network, therefore overall User Transport emissions will be reduced when compared to Do-minimum scenario.
- If the difference between Do-Something scenario and Do-minimum scenario is positive this means that the emissions arising from energy used to operate trains are larger than displaced emissions from road use, calculated for the current affected network, therefore overall User Transport emissions will be increased when compared to Do-minimum scenario.

d) Carbon Savings Opportunities: The first table should include possible opportunities that have been considered, and the second table should include those that have been integrated to the design during this project phase.

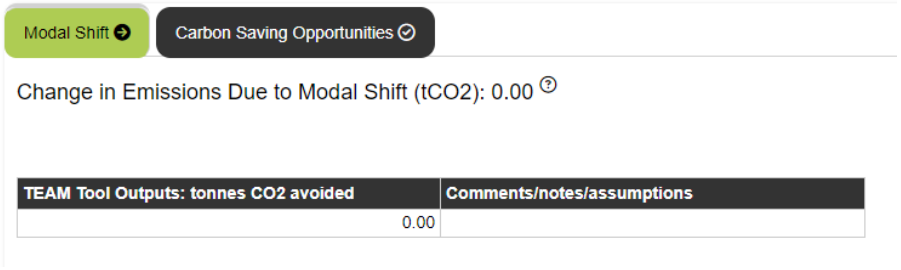
3.3.7.3 Greenway Projects

Use the side menu bar to navigate to the "Greenway User Emissions" input page.

This page calculates emissions anticipated with the use of the greenway infrastructure and change in CO_2e emissions from road users, as a result of replacing vehicle journeys with greenway journeys. To calculate this the Tool requires that use data is input direct from the TEAM Tool for the project lifetime.

The following information should be entered:

a) In the 'Greenway Use' table input CO_2e avoided data extracted directly from the TEAM Tool, this should be the total CO_2e avoided for the duration of the project's lifetime.



b) Carbon Savings Opportunities: The first table should include possible opportunities that have been considered, and the second table should include those that have been integrated to the design during this project phase.

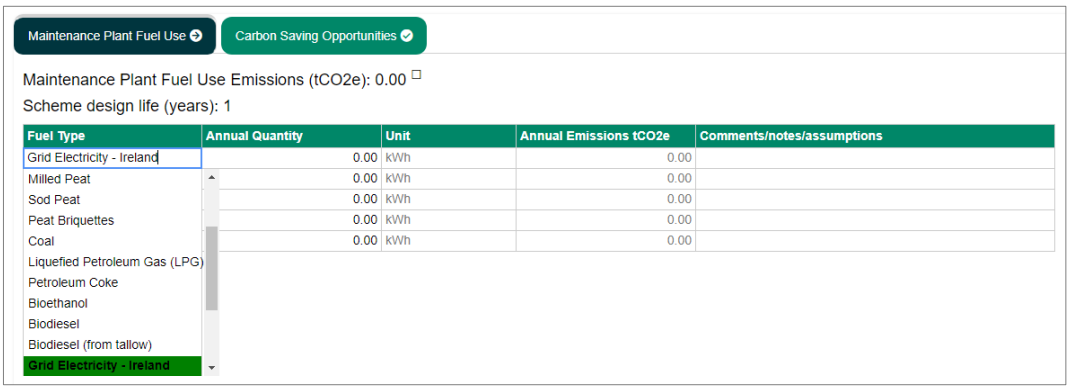
3.3.8 Maintenance

Purpose of this page: The Maintenance page calculates emissions associated with the fuel used for the maintenance of the infrastructure project during its use.

Use the side menu bar to navigate to the **"Maintenance"** input page, in which information on the operational emissions should be entered per year of operation, the Tool will calculate annual emissions and emissions over the project design life using the value provided in the 'Project Details'.

On this page, users need to enter the following information:

a) Maintenance Plan Fuel Use: Use the drop-down menu to select plant and fuel type used for maintenance, repair, replacement and refurbishment, and input anticipated annual consumption of the fuel.



b) Carbon Savings Opportunities: The first table should include possible opportunities that have been considered, and the second table should include those that have been integrated to the design during this project phase.

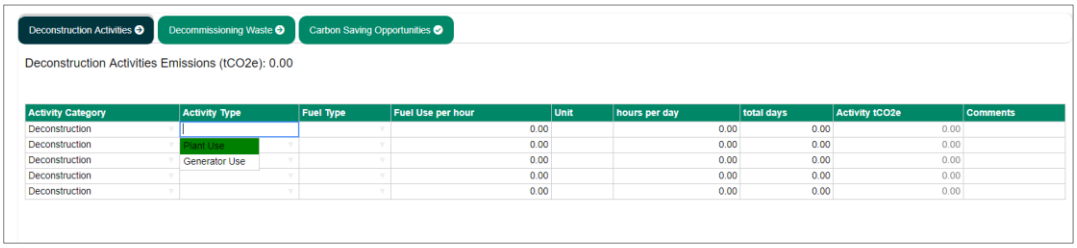
3.3.9 End of Life

Purpose of this page: The End-of-Life stage captures information relating to deconstructing and demolishing of the infrastructure that will be undertaken as part of the option; this should include waste arising. The data is used to calculate the carbon footprint for the decommissioning stage.

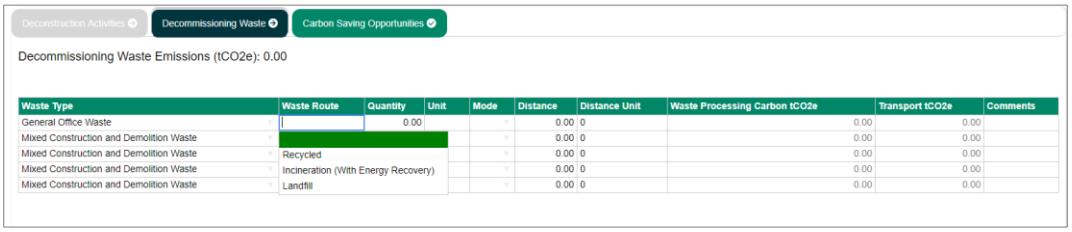
Use the side menu bar to navigate to the final data entry tab – **"End of Life"**, in which decommissioning is considered.

Here, data should be entered on deconstruction and demolition, including:

a) Deconstruction Activities: Use the drop-down menu to select the activity category , activity type and fuel/energy type used during the deconstruction/demolition. Then provide an estimated amount of fuel/energy used per hour and enter the numbers of operating hours per day and the total amount of days during which each activity will be undertaken.



b) Decommissioning Waste: Use the drop-down menu to select the material type of disposed waste and the waste route. Then enter the amount of disposed waste. For each type of waste selected, enter the mode of transport used and the distance to the disposal end point and the distance travelled for the return journey.



c) Carbon Savings Opportunities should be entered. The first table should include possible opportunities that have been considered, and the second table should include those that have been integrated into the design during this Phase.

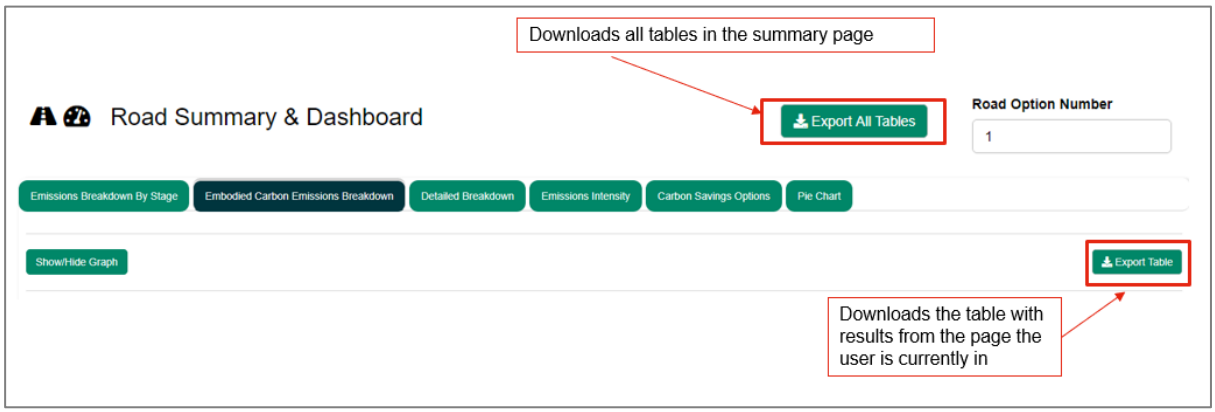
3.3.10 Results

User should use the **'Save Data'** button to save the data entered and calculations made in the Tool.

The user can view results of the assessment by selecting **'Road Summary' / 'Greenway Summary' / 'Light Rail Summary'**. Alternatively, the user can complete the details of another design option by selecting another design option in the left side menu. From here the user should begin the data entry stage again from the baseline.

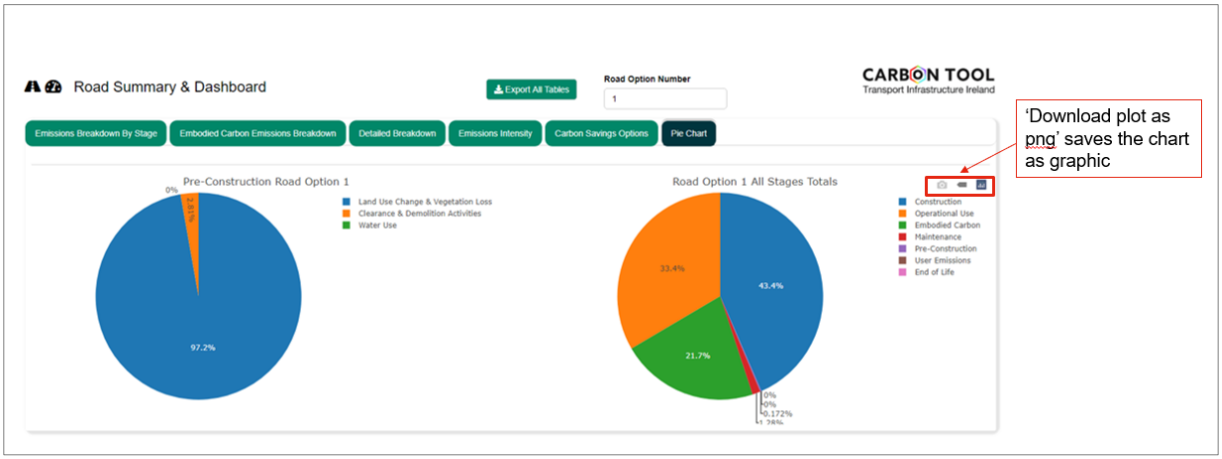
The **'Road Summary' / 'Greenway Summary' / 'Light Rail Summary'** section provides users with a summary of emissions arising during each stage of the project. Additional tabs available in this section provide detailed breakdown by source of emissions, charts, emissions intensity and carbon savings options.

The results from the Tool can be viewed incrementally as the inputs are completed in the Summary/Dashboard tabs of the Tool. The user can also download CSV files of the summary output tables and graphs.



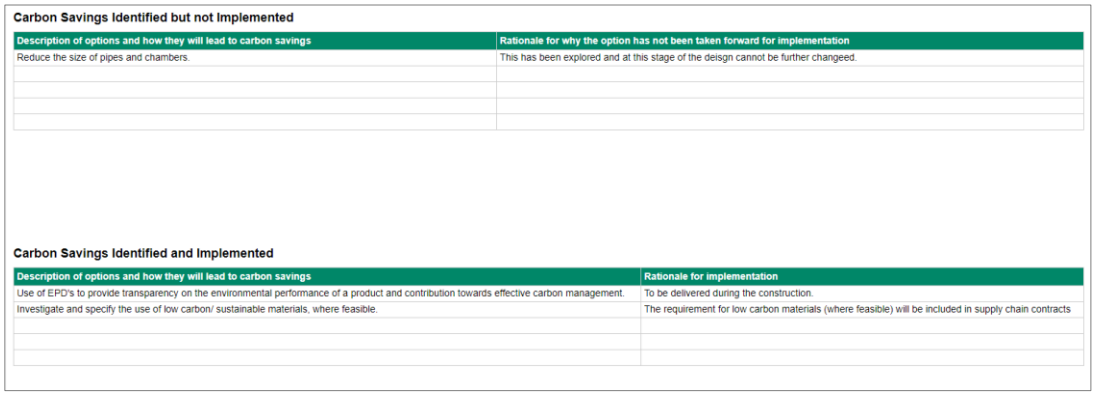
The user can download a Pie Chart page, the option for this will appear when the cursor is on the graph. When clicking at Cameron symbol the message 'Download plot as png' will appear, after clicking on this the window to save the file will appear.

3.4 Entering Carbon Saving Opportunities



For each project phase, the Tool asks users to record information on carbon savings that have been considered and/or implemented during that particular stage. This data entry section can be found within each project phase page, and consists of two tables, as follows:

- The first table requests information on options that were considered but not implemented; this is important as it provides a record of considered options that were not feasible at this stage, which could prevent duplicating assessments of the same options later in the project.
- The second table requests information on carbon-saving measures that have been implemented as part of this stage; this is important to demonstrate that low-carbon design is being considered and implemented where possible throughout the project.



Carbon Savings Identified but not Implemented

Description of options and how they will lead to carbon savings	Rationale for why the option has not been taken forward for implementation
Reduce the size of pipes and chambers.	This has been explored and at this stage of the deisgn cannot be further changeed.

Carbon Savings Identified and Implemented

Description of options and how they will lead to carbon savings	Rationale for implementation
Use of EPD's to provide transparency on the environmental performance of a product and contribution towards effective carbon management.	To be delivered during the construction.
Investigate and specify the use of low carbon/ sustainable materials, where feasible.	The requirement for low carbon materials (where feasible) will be included in supply chain contracts

Users should provide a short narrative of the options considered for that particular project phase (e.g. pre-construction) and should include estimates of the potential carbon emission savings achievable through the implementation of each option when compared to more conventional processes, material, and approaches. The rational for selection or non-section should also be recorded in this table for each option.

Emission savings are very likely to be high-level estimates at this stage. If completely unknown, please leave blank. Potential sources of emission saving values may include data from material suppliers, the conversion of energy-use savings into carbon savings as a result of more efficient processes, and indicative savings identified when inputting different project options into the Tool.

The Tool collates all options inputted into these sections as an output list of carbon-saving opportunities on the detailed outputs tool page.

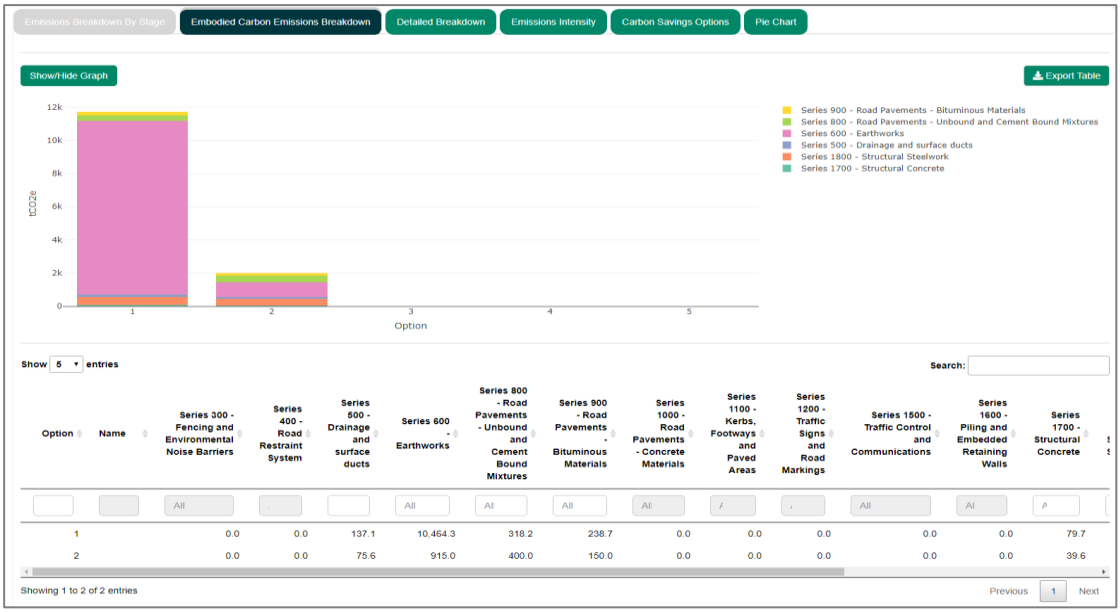
3.5 Summary Page: Extracting Results

Tables with results can be extracted in the format of MS Excel file using ‘Extract All Tables’ or ‘Export Table’ buttons. Pie charts can be extracted as pictures by clicking the camera icon in the right corner when in the section ‘Pie Chart’

Examples below show outputs for a road project with two potential design options.

Example 1: Emissions Breakdown by Stage

Example 2: Emissions Breakdown by Material



Option	Name	Series 300 - Fencing and Environmental Noise Barriers	Series 400 - Road Restraint System	Series 500 - Drainage and surface ducts	Series 600 - Earthworks	Series 800 - Road Pavements - Unbound and Cement Bound Mixtures	Series 900 - Road Pavements - Bituminous Materials	Series 1000 - Road Pavements - Concrete Materials	Series 1100 - Kerbs, Footways and Paved Areas	Series 1200 - Traffic Signs and Road Markings	Series 1500 - Traffic Control and Communications	Series 1600 - Piling and Embedded Retaining Walls	Series 1700 - Structural Concrete
1		0.0	0.0	137.1	10,464.3	318.2	238.7	0.0	0.0	0.0	0.0	0.0	79.7
2		0.0	0.0	75.6	915.0	400.0	150.0	0.0	0.0	0.0	0.0	0.0	39.6

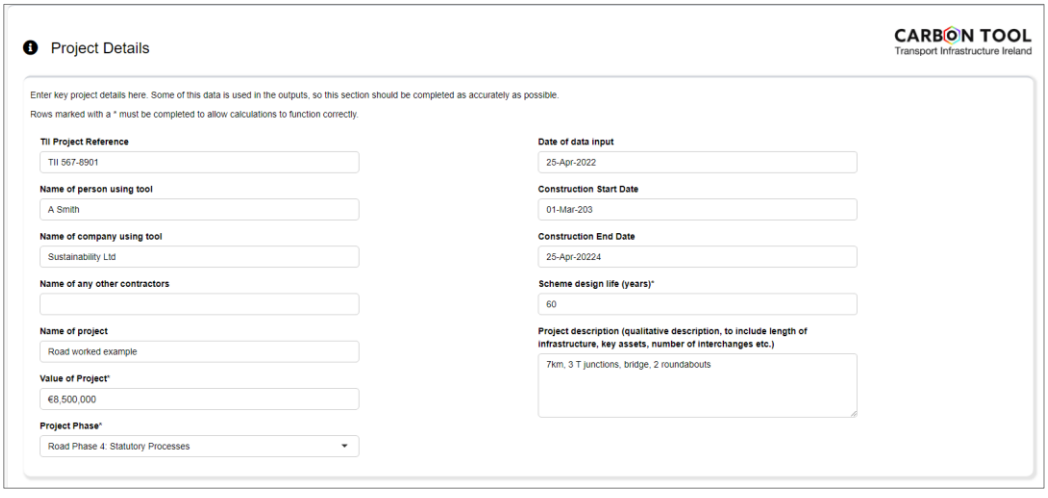
3.6 Worked Example for each Stage of the Carbon Tool

The level of detail that can be inputted to the Tool will depend on the project phase, as defined in Table 2.1 (in Part 1 of this document). This worked example shows the expected level of data for a typical Phase 4 project (the Statutory Processes Phase) and provides pointers for the detail required for further project phases within each stage of the tool. Note that the precise inclusions will be decided on a project-by-project basis by the EIA Scoping process. Once a stage, or part of a stage, within the Tool has been scoped out, it should not be included during any project phase; doing so would invalidate any comparisons made between project phases.

This example looks at a new stretch of road in Ireland, approximately 7km long. The purpose of the project is to reduce traffic flows on existing infrastructure and speed up journey times between two locations. The data used was taken from that gathered for the EIA report. Where assumptions on data had to be made, this has been indicated and pointers towards sources provided; although note that these will differ, depending on the project team.

Example: Step 1 - Enter Project Details

Enter project details, providing as much detail as possible.



The level of data entry required for this stage per project phase is as follows:

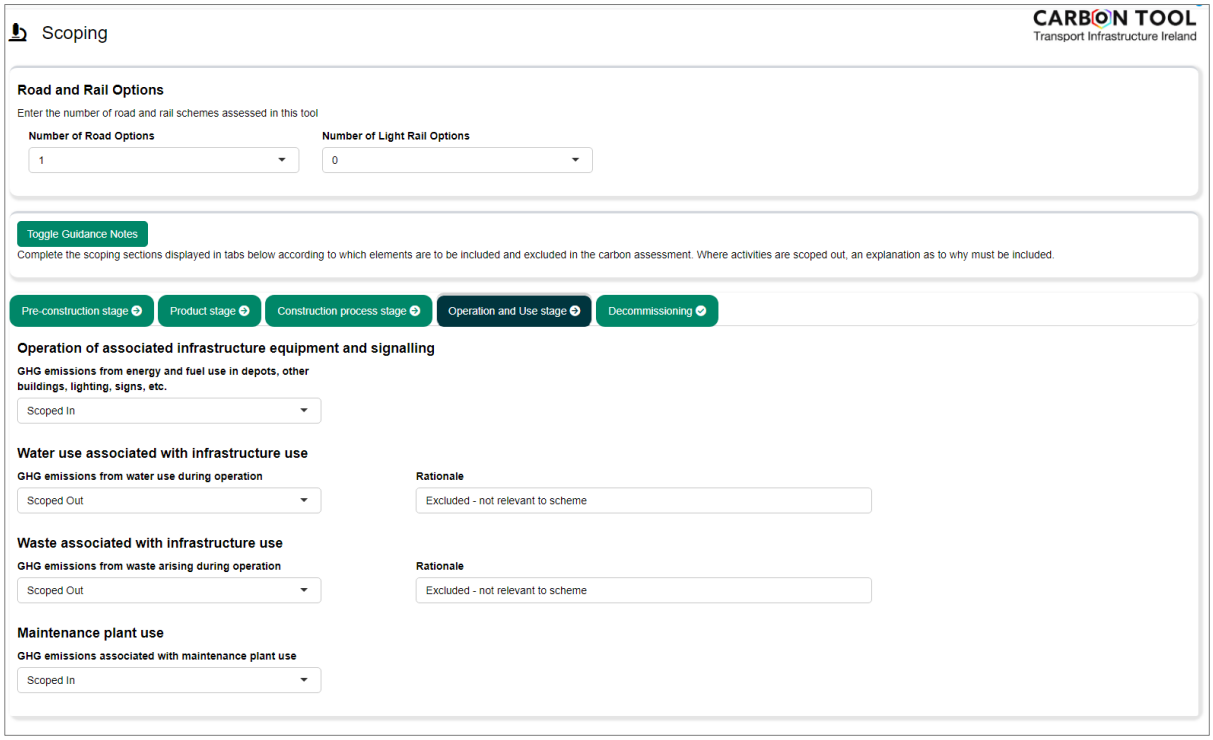
Phases 0 and 1: Qualitative details, such as the project reference and name, credentials of person and company completing the form, date of input, project phase and project description.

Phases 2 and 3: All qualitative details should be known. If there are other contractors working on the project, these should be included or if they are unknown, type "Unknown", or if there are no others, type "None". Estimates of project value and design life should now be available.

Phases 4, 5, 6 and 7: All qualitative and quantitative details should now be known, or estimates should be available. The Value of Project and Project Design Life are both particularly important and must be completed to enable the intensity outputs section to be calculated by the Tool.

Example: Step 2 - Scoping Assessment

Complete the table in Step 2 as soon as the EIA Scoping report has been submitted and accepted. The table should be completed by stating whether an activity has been "Included" or "Excluded". Where an activity is excluded, a justification of the exclusion, in line with the Scoping Report, should be provided.



The level of data entry for this stage per project phase is:

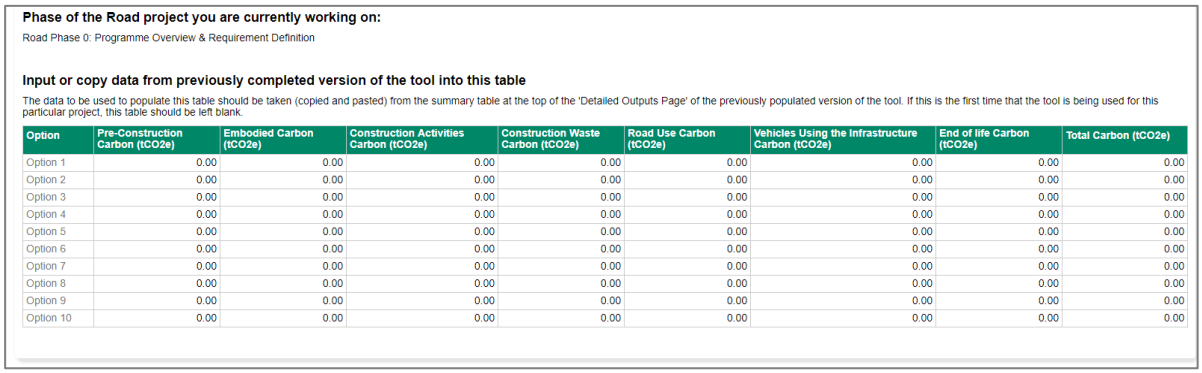
Phases 0, 1, 2 and 3: Unlikely that scoping will be done during these project phases; however, the table can be used for project planning and as a guide for early data collection, especially for a major project.

Phases 4, 5, 6 and 7: This table must be complete at Phase 4 and adhered to throughout the assessment, in accordance with the EIA Scoping Report. Only if the scope of the EIA changes, should this table be adjusted. It should be used through the last 4 phases of the project to determine which stages and sections within the Tool are completed.

Example: Step 3 – Road, Greenway or Light Rail

This is the Homepage for either a road project, greenway project or a light rail project, depending on the type of project being assessed. Copy and paste the output table from the previous phase (if applicable) into the table. Note that the table is blank in this example as no data was completed prior to Phase 4.

The level of data entry for this stage per project phase is:



Phase of the Road project you are currently working on:

Road Phase 0: Programme Overview & Requirement Definition

Input or copy data from previously completed version of the tool into this table

The data to be used to populate this table should be taken (copied and pasted) from the summary table at the top of the 'Detailed Outputs Page' of the previously populated version of the tool. If this is the first time that the tool is being used for this particular project, this table should be left blank.

Option	Pre-Construction Carbon (tCO2e)	Embodied Carbon (tCO2e)	Construction Activities Carbon (tCO2e)	Construction Waste Carbon (tCO2e)	Road Use Carbon (tCO2e)	Vehicles Using the Infrastructure Carbon (tCO2e)	End of life Carbon (tCO2e)	Total Carbon (tCO2e)
Option 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phases 0, 1, 2: It is unlikely that data will be completed before Phase 3, therefore if data is not available this table will be blank.

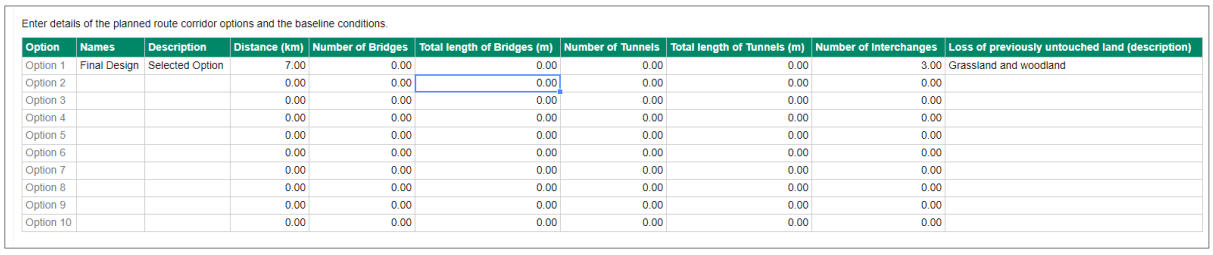
Phase 3: If the assessment has been undertaken at Phase 2 for multiple design options data should be added to the table.

Phases 4: If the assessment has been undertaken at Phase 2 for multiple design options data should be added to the table.

Phases 5, 6 and 7: Results from previously undertaken assessment should be copied and pasted into the table on the Road, Greenway or Light Rail Homepage.

Example: Projects - High Level Design

This section is not used in the output for individual projects but is important for TII as they collate data on projects for benchmarking.



Enter details of the planned route corridor options and the baseline conditions.

Option	Names	Description	Distance (km)	Number of Bridges	Total length of Bridges (m)	Number of Tunnels	Total length of Tunnels (m)	Number of Interchanges	Loss of previously untouched land (description)
Option 1	Final Design	Selected Option	7.00	0.00	0.00	0.00	0.00	3.00	Grassland and woodland
Option 2			0.00	0.00	0.00	0.00	0.00	0.00	
Option 3			0.00	0.00	0.00	0.00	0.00	0.00	
Option 4			0.00	0.00	0.00	0.00	0.00	0.00	
Option 5			0.00	0.00	0.00	0.00	0.00	0.00	
Option 6			0.00	0.00	0.00	0.00	0.00	0.00	
Option 7			0.00	0.00	0.00	0.00	0.00	0.00	
Option 8			0.00	0.00	0.00	0.00	0.00	0.00	
Option 9			0.00	0.00	0.00	0.00	0.00	0.00	
Option 10			0.00	0.00	0.00	0.00	0.00	0.00	

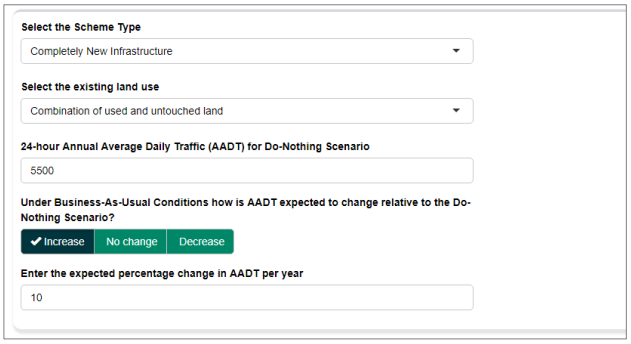
The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed. In this case, a separate row should be completed for each option considered.

Phases 4, 5, 6 and 7: This data should be available from Phase 4 and will be refined as the project phases progress; therefore, the data should be updated for each Phase.

Example: Baseline Data Entry



This stage covers the existing conditions and changes needed to build the project. The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed.

Phases 4, 5, 6 and 7: Data should be available, including estimates of land take and operational data such as annual average daily traffic (AADT) (road) and rail vehicle movements (light rail).

As in the example, the landscaping team should be able to provide data on land take and land use type, while transportation modellers are likely to hold baseline travel information. It will be refined throughout the project so should be updated for each project phase.

Example: Before Use - Pre-Construction

This stage covers land clearance and preparation before construction takes place. The following information should be provided here:

- Details of clearance and demolition activities such as type of activity and current type of land and size of the area to be cleared.

Clearance Category	Subcategory	Activity	Quantity	Unit	Activity Emissions tCO2e	Comments
Demolition and Site Clearance	General Clearance	General clearance - general site clearance	0.35	ha	0.15	
Demolition and Site Clearance	General Clearance	General clearance - land principally occupied by agriculture	2.85	ha	1.25	
Demolition and Site Clearance	General Clearance	General clearance - mixed forest	0.87	ha	1.15	
Demolition and Site Clearance	General Clearance	General clearance - natural grassland	0.21	ha	0.09	
Demolition and Site Clearance	General Clearance		0.00	ha		

- Details of Land Use Change and Vegetation such as the type and quantity of vegetation and planting that will be lost as part of the project.

Vegetation Type	Quantity	Unit	Carbon Sink tCO2e (removed)	Comments
Mixed Forest	0.87	ha	86.13	
Natural Grassland	0.21	ha	5.24	
Land principally occupied by agriculture	2.85	ha	0.00	

- Volume of water use be used during clearance and demolition activities. This is most likely to be available in the later stages of the project.

Activity Type	Water Use	Quantity	Unit	Activity tCO2e	Comments
Construction	Water Use - UK Average	83,494.00	litres	0.01	
Construction	Water Use - UK Average	0.00	litres	0.00	
Construction	Water Use - UK Average	0.00	litres	0.00	
Construction	Water Use - UK Average	0.00	litres	0.00	
Construction	Water Use - UK Average	0.00	litres	0.00	

The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options. These can be navigated to via the Road, Greenway or Rail Homepage.

Phases 4, 5, 6 and 7: This data should be available from Phase 4 and will be refined as the Phases progress; therefore, the data should be updated for each project phase. The data entered on the baseline stage related to land clearance can be used here, but note the changes in units for some aspects, required due to the nature of the calculation (the baseline Stage calculates carbon sequestration; this stage calculates the emissions arising from undertaking land clearance). In this example, the number of buildings to be demolished is required, while in the Baseline stage, the area of land take covered by buildings is required in metres squared.

From this point forward in the Tool, **carbon savings opportunities** can be recorded for each stage. These should be recorded in as much detail as possible during each project phase, to build an impression of design progress in relation to carbon-saving measures. During Phases 5, 6 and 7, quantitative data should be recorded here if available.

Carbon Savings Identified but not Implemented

Description of options and how they will lead to carbon savings	Rationale for why the option has not been taken forward for implementation

Carbon Savings Identified and Implemented

Description of options and how they will lead to carbon savings	Rationale for implementation

Example: Before Use - Embodied

This stage captures the embodied emissions (GHG emissions associated with material extraction and manufacture) material transport to the construction site.

Following information should be provided here:

- Construction materials should be selected using dropdown for category, subcategory and material, and quantities should be entered in unit provided.

Category	Sub Category	Material	Quantity	Unit	Default Maintenance Percentage	Embodied tCO2e	Maintenance tCO2e	Comments
Series 1800 - Structural Steelwork	General	Column	353.46	tonne		494.49		
Series 1700 - Structural Concrete	Concrete-Construction General	Concrete- Average	302.30	m3	0.00%	79.73	0.00	
Series 1700 - Structural Concrete	Concrete-Construction General	Ready mix concrete C32/40	82.30	m3	0.00%	0.01	0.00	
Series 800 - Road Pavements - Unbound and Cement Bound Mixtures	Aggregates	General fill/aggregate	63633.90	tonne	0.00%	318.17	0.00	
Series 500 - Drainage and surface ducts	Gullies	Gullies - Precast concrete gully pots (heavy duty)	390.00	Nr	0.00%	34.18	0.00	
Series 500 - Drainage and surface ducts	Precast concrete inspection chambers	Precast concrete inspection chambers - Average	275.00	Nr	0.00%	53.80	0.00	
Series 500 - Drainage and surface ducts	Plastic pipework	Plastic pipework (HDPE) - 600mm diameter	951.00	m	0.00%	49.08	0.00	
Series 600 - Earthworks	Fill to structures	Filling - embankments (average)	7240250.00	m3	0.00%	20612.99	0.00	
Series 900 - Road Pavements - Bituminous Materials	Miscellaneous Products and Processes	Geotextiles ground stabilising 300mm	411549.00	m2	0.00%	238.70	0.00	

Bespoke material and associated emissions factor can be added to the Tool by clicking “Add New Material to Tool” at the top of the table.

- Total distance travelled for the transportation of materials should be calculated and entered. The example below presents how to calculate total distance travelled to transport steel columns using quantity of steel in the embodied carbon page.

Assumptions made: a maximum weight laden of HGV is 44 tonnes; the distance between the factory/warehouse and the site 25km. All assumptions have been listed in the comments section.

In order to transport steel columns (353.46 tonnes as per quantity in the embodied carbon) a total of 9 return trips (353.46/44=8.03 so rounded to 9)

In the example below transport has been estimated for the key materials with highest quantities.

Transport Type	Distance	Unit	Transport tCO2e	Comments
HGV - Articulated - Average	450.00	km	0.51	Steel columns; a maximum weight laden of HGV assumed 44 tonnes; the distance between the factory/warehouse and the site 25km.
HGV - Articulated - Average	77980.00	km	88.13	Imported soil, a maximum weight laden of HGV assumed 44 tonnes; the distance assumed 10km.
HGV - Articulated - Average	28940.00	km	32.71	General fill/aggregate, a maximum weight laden of HGV assumed 44 tonnes; the distance assumed 10km.
HGV - All - Average	0.00	km	0.00	
HGV - All - Average	0.00	km	0.00	

The level of data entry for this stage per Phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

Phases 2 and 3: Some information may be gathered as part of the options assessment, key materials may only be estimated, which could be completed.

Phases 4, 5, 6 and 7: This data should be available in some form from Phase 4 and will be refined as the Phases progress; therefore, the data should be updated for each project phase. Carbon assessments from EPDs may be used and should be completed using the “Add New Material” form. As the project phases progress, it is likely that more granularity on material types is specified in the design. Carbon-saving opportunities should be recorded as they are assessed.

Example: Before Use - Construction

This stage captures the construction activities on site. There are five sections to complete, as follows:

- Details of excavation activities such as type of excavation, type and amount of excavated material. Specific excavated materials or a general factor can be selected, depending on the level of detail available.

Excavation Category	Excavation Sub Category	Activity	Quantity	Unit	Activity tCO2e	Comments
Earthworks - Excavation	Excavations for Foundations	Excavation for Foundation - Topsoil	20.00	m3	0.0219	
Earthworks - Excavation	Excavations for Foundations	Excavation for Foundation - Rock	5.00	m3	0.0236	
Earthworks - Excavation	General Excavation	General Excavation - Topsoil	5.00	m3	0.0037	
Earthworks - Excavation			0.00		0	
Earthworks - Excavation			0.00		0	

- Details of construction activities requiring energy use including the type of energy / fuel used for each activity during the construction. The estimated amount of fuel/energy used per hour and the number of operating hours per day and total amount of days during which each activity will be undertaken. A list of specific activities, such as the amount of fuel used by plant and generators, is likely to be known in the later stages of the project.

Activity Category	Energy Type	Fuel Use Per Hour	Unit	Operating Time (Hours Per Day)	Total Days	Activity tCO2e	Comments
Construction - Plant Use	Gasoil / Diesel	15180.00	Litre	5.00	90.00	18221.1296	Plant
Construction - Generator Use	Gasoil / Diesel	4631.00	Litre	5.00	90.00	5558.7649	Lighting
Construction - Depot or Site Office		0.00		0.00	1.00	0	
Construction - Depot or Site Office		0.00		0.00	1.00	0	
Construction - Depot or Site Office		0.00		0.00	1.00	0	

- Volume of water use be used during clearance and demolition activities. This is most likely to be available in the later stages of the project.

Activity Type	Water Use	Quantity	Unit	Activity tCO2e
Construction	Water Use - UK Average	37451.00	Litre	0.0056
Construction		0.00		0
Construction		0.00		0
Construction		0.00		0
Construction		0.00		0

- 'Construction Worker Travel to Site' includes the following types of transport modes and estimated total commuting distance by each mode of transport. The example below applies assumptions from example discussed in previous chapter (2.4.5).

Excavation Activities | Construction Activities | Water Use During Construction Activities | Construction Worker Travel To Site | Construction Waste | Carbon Saving Opportunities

Construction Worker Travel Emissions (tCO2e): 2.62

Mode of Transport	Total distance travelled by workers during construction (km)	Transport tCO2e	Comments/ notes/ assumptions
Car - Average	10800.00	2.3388	Return journey, 12 km one way, 45 working days, 10 employees
Bus - Average local	2250.00	0.2862	Return journey, 5km, 45 working days, 5 employees
Bus - Average local	0.00	0	
Bus - Average local	0.00	0	
Bus - Average local	0.00	0	

- Details of the waste arising from the construction activities, such as type of waste, route, quantity and distance to the waste processing unit.

Waste Type	Waste Route	Quantity	Unit	Transport Mode	Distance	Distance Unit	Waste Processing Carbon tCO2e	Transport tCO2e	Comments
Aggregate and Soil Exported Off-Site	Recycled	12607.00	tonnes	HGV - Rigid - Average	15.00	km	12.47	0.02	
Aggregate and Soil Exported Off-Site	Landfill	664.00	tonnes	HGV - Rigid - Average	10.00	km	0.82	0.01	
Mixed Construction and Demolition Waste	Landfill	11480.00	tonnes	HGV - Articulated - Average	10.00	km	1068.72	0.01	
Mixed Construction and Demolition Waste	Recycled	1120.00	tonnes	HGV - Articulated - Average	15.00	km	1.11	0.02	
Wood or Timber	Reuse Off-Site	383.00	tonnes	HGV - Articulated - Average	20.00	km	0.96	0.02	

The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

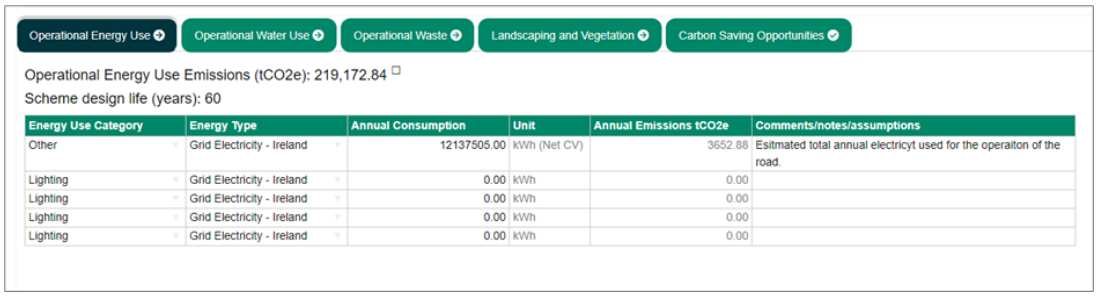
Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options. These can be navigated to via the Road, Greenway or Light Rail Homepage.

Phases 4, 5, 6 and 7: This data should be available in some form from Phase 4 and will be refined as the project phases progress; therefore, the data should be updated for each project phase. General factors and assessment, based on project size, should be used if full data is not available. This is the case, in this example and is a likely scenario for most Phase 4 projects. For Phase 5 and onwards, as the design is refined and construction planning becomes more detailed, more in-depth data on excavation and fuel use can be added to the Tool, and the specific activity types can be selected from the drop-down menu lists.

Example: Use Stage

This stage captures the operational footprint of the infrastructure project. There are three sections to complete, as follows:

- Operational Energy Data: This includes energy use by different activities such as lighting or signs as part of the project such as energy, water and waste. Where street lighting, stations or depots or offices are included in the infrastructure development, this section is likely to be included within the scoping assessment.



Energy Use Category	Energy Type	Annual Consumption	Unit	Annual Emissions tCO2e	Comments/notes/assumptions
Other	Grid Electricity - Ireland	12137505.00	kWh (Net CV)	3652.88	Esitmated total annual electricyt used for the operaiton of the road.
Lighting	Grid Electricity - Ireland	0.00	kWh	0.00	
Lighting	Grid Electricity - Ireland	0.00	kWh	0.00	
Lighting	Grid Electricity - Ireland	0.00	kWh	0.00	
Lighting	Grid Electricity - Ireland	0.00	kWh	0.00	

- Operational Water Data: This includes volume of water used during operation. It was excluded in this example as it was not relevant to the project; however, it may be included in the scope if public facilities at stations, depots or services areas are included in the project design.
- Operational Waste Data: This includes waste arising during operation. It was excluded in this example as it was not relevant to the project, however, may be included in the scope of projects if a high level of maintenance is anticipated, or a large level of refuse is likely to accumulate during operation.

The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options.

Phases 4, 5, 6 and 7: This data should be available in some form for Phase 4, especially that pertaining to vehicle use of the infrastructure. It will be refined as the Phases progress; therefore, the data should be updated for each Phase.

Example: Road User Emissions

This stage captures the use of the infrastructure by the users, as follows:

- Emissions Associated with Vehicles Using the Infrastructure - this includes road vehicles or light rail vehicles. It will usually be included in the scope as it is likely to form a significant part of the operational emissions. In this example, emissions taken directly from REM outputs have been inserted.

REM Outputs: Do Nothing Scenario (tCO2e)	REM Outputs: Do Something Scenario (tCO2e)	Difference DS-DN Scenarios (tCO2e)	Comments/notes/assumptions
261799640.40	268169794.70	6370154.30	

The level of data entry for this stage per project phase is:

- **Phases 0 and 1:** It is unlikely that data will be available; therefore, this can be left blank.
- **Phases 2 and 3:** Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options. These can be navigated to via the Road, Greenway or Light Rail Homepage.
- **Phases 4, 5, 6 and 7:** This data should be available in some form for Phase 4, especially that pertaining to vehicle use of the infrastructure. It will be refined as the Phases progress; therefore, the data should be updated for each Phase.

Example: Maintenance

This stage captures the fuel used for the maintenance of the infrastructure project during its use as follows:

- Fuel for Maintenance: This includes fuel used in the maintenance plant. It was excluded in this example as maintenance is likely to be minimal; however, it may be included in the scope of projects where a high level of maintenance is anticipated.

Fuel Type	Annual Quantity	Unit	Annual Emissions tCO2e	Comments/notes/assumptions
Grid Electricity - Ireland	35000.00	kWh (Net CV)	10.53	Evening works
Gasoline (Petrol)	3200.00	Litre	7.87	Maintenance vehicles
Grid Electricity - Ireland	860.00	kWh (Net CV)	0.26	Daily works
Grid Electricity - Ireland	0.00	kWh	0.00	
Grid Electricity - Ireland	0.00	kWh	0.00	

The level of data entry for this stage per project phase is:

- **Phases 0 and 1:** It is unlikely that data will be available; therefore, this can be left blank.
- **Phases 2 and 3:** Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options.
- **Phases 4, 5, 6 and 7:** This data should be available in some form for Phase 4, especially that pertaining to vehicle use of the infrastructure. It will be refined as the Phases progress; therefore, the data should be updated for each Phase.

Example: End of Life

This stage assesses the impact of decommissioning the project. As in this example, decommissioning can often be scoped out, as transport corridors are not always removed after they close. Decommissioning may be within the scope if there are many assets associated with the project, aside from just the transport corridors. There are two captions to complete, as follows:

- Deconstruction Activities: Includes energy use associated with dismantling of the infrastructure. Data on fuel use for plant and generators can be inputted.
- Decommissioning Waste: Includes waste arising as a result of deconstruction. Data on waste type and waste transport can be inputted.

The level of data entry for this stage per project phase is:

Phases 0 and 1: It is unlikely that data will be available; therefore, this can be left blank.

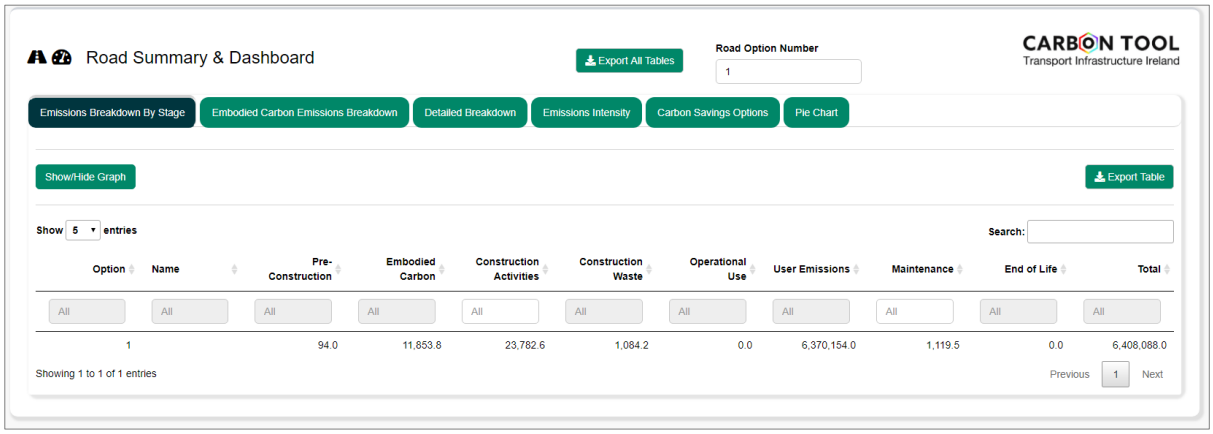
Phases 2 and 3: Some information may be gathered as part of the options assessment, which could be completed. In this case, use the extra pages provided for different options. These can be navigated to via the Road, Greenway or Light Rail Homepage.

Phases 4, 5, 6 and 7: This data may not be available for all projects as it is often scoped out of an assessment. If it is included, it should have been estimated for Phase 4. It will be refined as the project phases progress; therefore, the data should be updated for each project phase.

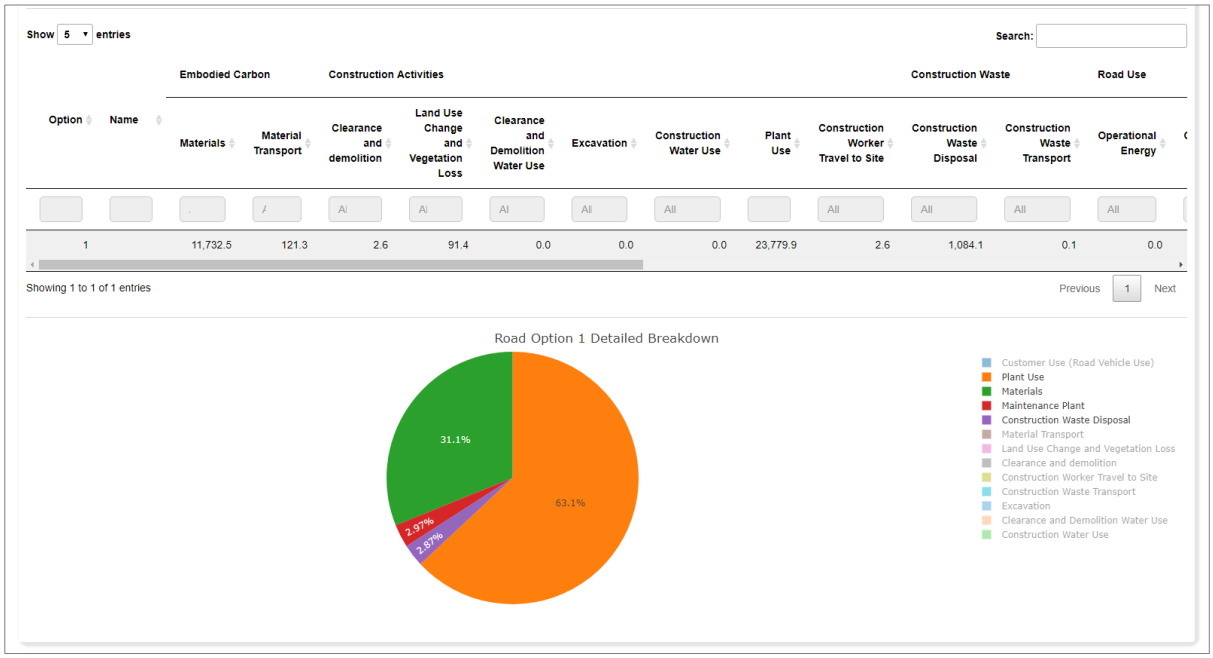
Example: Road Summary

The outputs for this example display one option only, as other options were assessed in earlier project phases. Where multiple options are assessed in the Tool, the graphs will be populated to display these, as in the outputs shown in the previous section.

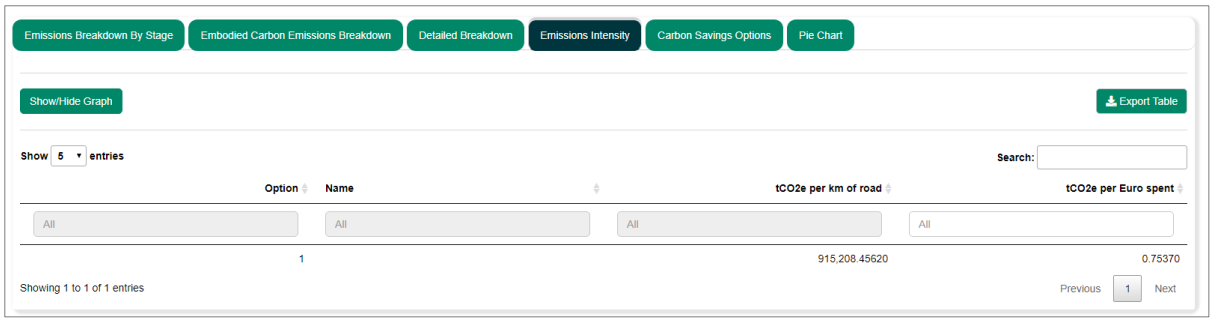
Emissions Breakdown by Stage: In this project, materials and construction activities have the main impact during the construction stages, while customer use will have a large impact during the operational phase.



Emissions Breakdown by Activity (Detailed Breakdown): Detailed breakdowns are available in the form of a table and pie charts and presents emissions by activity under each stage. In the example below the “Road User Emissions” category has been hidden in the pie chart this is because emissions over the lifetime will generally overshadow the other results being displayed, and these are the ones that can be addressed as part of the project design. Other categories with emissions below 1% have also been hidden.



Emissions Intensity Reporting: The outputs from the project can be represented by kilometre of road, and by project spend. This will allow project-by-project comparison and future benchmarking.



Appendix A:

Emission Factors Used in the Carbon Tool

Source	Description	Justification
ICE (2013), CESMM4 Carbon & Price Book 2013[7]	Construction materials Clearance and excavation activities	In the absence of Ireland specific factors, this is a comprehensive source of the embodied carbon of the most common construction materials in the UK. They are based on generic UK construction data provided to trade associations. These factors can be used until EPDs are developed.
Highways England Carbon Tool v2.4[8]	Street furniture Electrical equipment	In the absence of Ireland-specific factors, Highways England provides a source indicative carbon footprint value for typical street furniture in England.
Sustainable Energy Authority of Ireland (2019), Conversion Factors[9]	Electricity (Ireland Specific) Fuels (Ireland Specific)	The Sustainable Energy Authority of Ireland provides Ireland-specific emission and conversion factors for electricity and the most common fuels in Ireland, making these the most suitable factors for use in the Tool.
European Commission (2010), Guidelines for the calculation of land carbon stocks[10]	Land use change	In the absence of Ireland-specific factors, these values were selected from the most comprehensive list available for European land use change.
UK Government (2021), Greenhouse Gas Reporting Conversion Factors[11]	Water Supply Passenger Vehicles (except light rail) Freight vehicles (HGV only) Material disposal (reuse, recycling, landfill)	In the absence of Ireland-specific factors for vehicles and material disposal, these factors were selected as the standard used for reporting in the UK. Factors for water were derived from Water UK. Passenger Vehicle factors were calculated based on data from the UK Department for Transport and the Society for Motor Manufacturers and Traders. HGV factors were developed using UK Department for Transport data. Material disposal factors are based on figures from England's Environment Agency's WRATE tool. Further information on sources listed can be found in the Methodology Paper for Emission Factors[12].

[7] ICE CESMM4 Carbon & Price Book 2013: http://www.icevirtuallibrary.com/isbn/9780727758125
[8] Highways England Carbon Tool: https://nationalhighways.co.uk/suppliers/design-standards-and-specifications/carbon-emissions-calculation-tool
[9] Sustainable Energy Authority of Ireland (2019 and 2020), Conversion Factors: https://www.seai.ie/resources/seai-statistics/conversion-factors/
[10] European Commission (2010), Guidelines for the calculation of land carbon stocks: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:151:0019:0041:EN:PDF
[11] UK Government 2021, Greenhouse Gas Conversion Factors: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
[12] UK Government 2021, Methodology Paper for Emission Factors: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1049346/2021-ghg-conversion-factors-methodology.pdf

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