

asPECT Software Tool

USER MANUAL



Version 2.1 – December 2014

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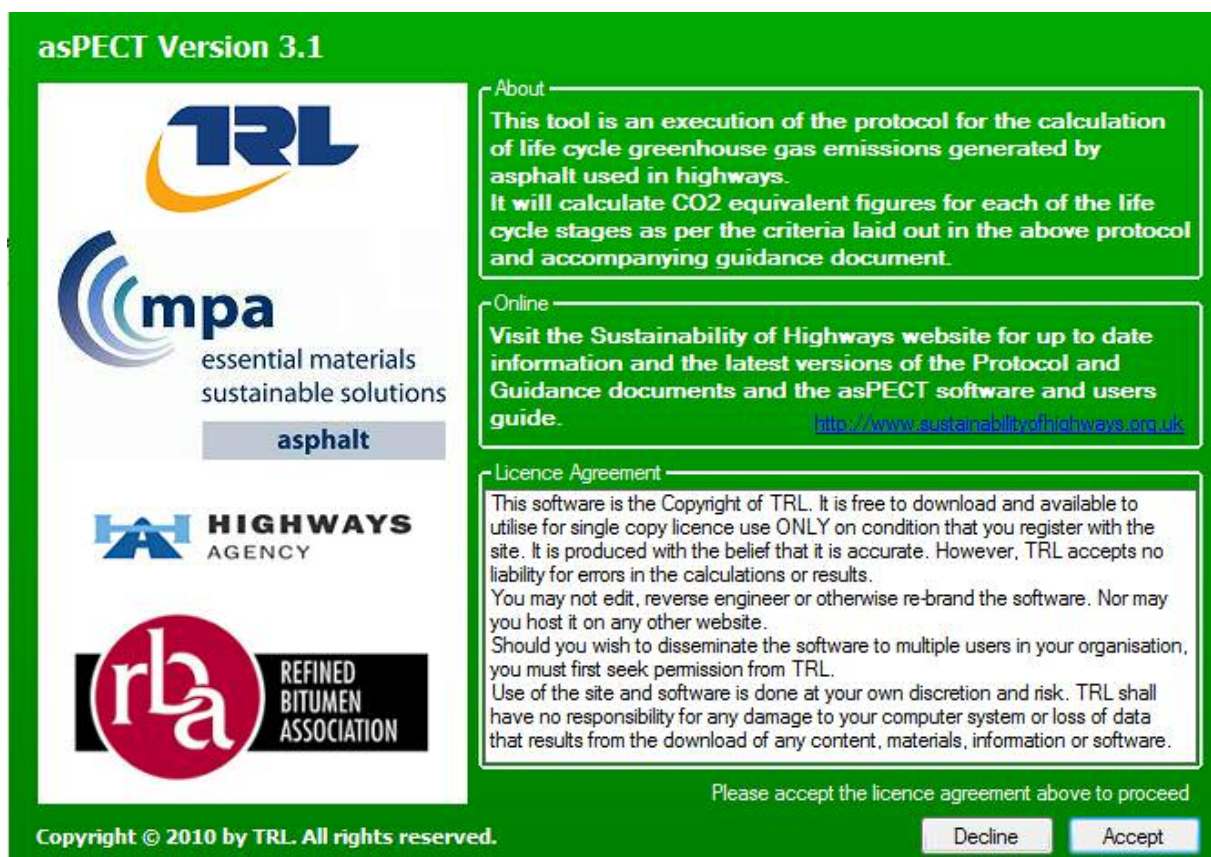


Figure 1 - Welcome screen

Foreword

The asPECT software and this user guide accompanies the protocol for calculating the life cycle greenhouse gases in asphalt¹. The suite also includes the further guidance document which is designed to provide extra interpretation and justification of the clauses within the protocol and to demonstrate how applicable sections of the *Publicly Available Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services* (PAS 2050:2011; British Standards institution, 2011) have been followed. asPECT makes comprehensive use of Defra's *Government GHG Conversion Factors for Company Reporting* (2013). The protocol, guidance document, this user guide and the software tool together constitute asPECT.

The software tool is designed to provide a framework which contains the necessary formulae, emissions factors and default data to calculate the 'cradle-to-grave' GHG emissions of asphalt products in accordance with the protocol clauses, covering the 10 steps of the asphalt life cycle indicated in Figure 2. It is designed primarily to be used by asphalt producers and contractors who have access to the detailed information that it requires to operate (which can easily be gathered through typical company accounting systems). The information generated by the

¹ **Wayman M (2014)** Protocol for the calculation of whole life cycle greenhouse gas emissions generated by asphalt. TRL Published Report. Wokingham: TRL Limited.

software is then passed onto client organisations in the pre-defined output formats which are built into the program.

Life-cycle stage		Description
1	Raw Material Acquisition	Acquiring raw materials from the natural environment with the input of energy
2	Raw Material Transport	Transporting acquired raw materials to processing
3	Raw Material Processing	Crude oil refining, rock crushing and grading, recycled and secondary material reprocessing
4	Processed Material Transport	Transporting processed raw materials to site of manufacture of bitumen bound highway components
5	Road Component Production	Production of bitumen bound mixtures
6	Material Transport to Site	Delivery of materials to site
7	Installation	Placing materials at the construction site, mobilisation of plant and labour
8	Scheme Specific Works	Installation of other specified materials direct to site (e.g. aggregates and geosystems)
9	Maintenance	Interventions to maintain the road: overlay, surface dressing works, patching, haunching etc.
10	End of Life	Excavation and material management, mobilisation of plant and labour

Figure 2- Ten step asphalt life cycle indicating scope

In 2013, a review of asPECT was commissioned. Part of the remit of this review was to update the software tool, with the following two objectives:

- a) To add additional functionality to the asPECT software, in order to facilitate the use of non-UK specific emissions factors for international users, and those requiring a more customisable approach with regards to recycling-recyclability allocation and consideration of residual binder activity.
- b) To update specific emissions factors for materials, fuels and transport in the software tool, where new and appropriate data sources have become available.

These two objectives have been met in producing the asPECT Software Tool version 3.1. Where applicable, updates have been added to this document to explain the additional functionality.

Overview of the asPECT Software Tool

Throughout this document, the latest version of the software is referred to, namely v3.1.

The tool centres around the following main elements:

- Main Screen;
- Materials Screen;
- Plants Screen; and the
- Project Screen.

All functions can be accessed through these main elements.

Also included are **six** categories of data:

- Material;
- Energy Consumption;
- Transport;
- Mixtures;
- Maintenance; and
- End of Life.

Although these data types are essentially independent entities, certain elements may contain parts of others e.g. End of Life data contains inputs from both Transport and Mixtures.

Main Screen

The Main Screen is the primary element of the tool from which all other elements are accessed. The main screen consists of a menu bar, toolbar, workspace and a status bar.

The menu bar contains 3 main menus:

- File;
- Windows; and
- Help.

For more information on the File menu, see section "Getting Started with the software tool".

The File menu contains all the basic operations for the tool, such as creating a new file or opening and saving existing files.

The Window menu allows you to arrange the windows that you currently have open to make them easier to work with.

The Help menu allows you to access the 'About' screen which contains information regarding the software version, licence agreement and contact details for technical support.

The toolbar contains 4 buttons:

- Materials
- Plants
- Projects
- Constants



The Materials button opens the Materials main screen and provides an access point to create new and edit existing materials.



The Plants button opens the Plants main screen which displays details of all the plants entered into the tool. From here you have access to create new plants and edit existing ones.



The Projects button opens the Projects main screen which displays details of all saved projects in the software. From here you have access to create new projects and edit existing ones.



The Constants button opens a number of editable forms when using the software's "open access" mode. From here you can specify your own constants for use in relation to a particular asPECT file.

Figure 3 – Toolbar icons

TRL

The status bar located along the bottom of the window contains a progress bar, to indicate the status of a file being opened or saved, and a link to the <http://www.sustainabilityofhighways.org.uk> website.

Materials Screen

Name	Category	Data Source	Source	Input Date	Input Mode	Valid Date	kg CO2e / t
Adhesion Agents	Adhesion Agents	Industry average, 2009		17/01/2012	Protocol	01/01/2010	1,200.0
Bitumen	Bitumen	Eurobitume, 2011		17/01/2012	Protocol	01/05/2011	130.0
Bitumen Emulsion (residual b...	Bitumen Emulsions	Eurobitume, 2011		17/01/2012	Protocol	01/01/2010	220.0
Cement (Portland Cement C...	Cement	SA Cement & Concrete Instit...		17/01/2012	Protocol	01/01/2010	990.0
Fibres	Fibres	Industry average, 2009		17/01/2012	Protocol	01/01/2010	0.8
Fluxes (kerosene based)	Fluxes	European Commission, 2009		17/01/2012	Protocol	01/01/2010	370.0
GGBS	Ground Granulated Blast Fu...	SA Cement & Concrete Instit...		17/01/2012	Protocol	01/01/2010	130.0
Hydrated Lime	Hydrated Lime	Hammond & Jones, 2011		17/01/2012	Protocol	01/01/2010	780.0
PFA	Pulverised Fuel Ash (PFA)	SA Cement & Concrete Instit...		17/01/2012	Protocol	01/01/2010	1.5
Polymer Modified Bitumen	Bitumen - Polymer Modified (...)	Eurobitume, 2011		17/01/2012	Protocol	01/01/2010	370.0
Polymer Modified Bitumen E...	Bitumen Emulsions - Polyme...	Data collated by the Refine...		17/01/2012	Protocol	01/01/2010	350.0
Water	Other	SA Cement & Concrete Instit...		17/01/2012	Protocol	01/01/2010	0.9
Wax (Fischer-Tropsch synth...	Waxes	Estimate from European Join...		17/01/2012	Protocol	01/01/2010	5,700.0
Wax (Crude derived parafin...	Waxes	European Commission, 2009		17/01/2012	Protocol	01/01/2010	370.0

Figure 4 - Materials main screen

The Materials screen is used to view the existing material data held in the software and to edit or add new materials.

The screen contains the following buttons: 'Create from Production Energy' and 'Create from CO₂e Figure'.

See Protocol Section 2.5

A double left click with the mouse opens the selected material for editing. **Any changes made will be reflected immediately and cannot be undone.**

A right click with the mouse brings up the option to delete the selected material. **Please note, this action cannot be undone once selected.**

Default material data cannot be edited or deleted from the software. Updates to these may be made via updates released in the future by the asPECT development team.

Plants Screen

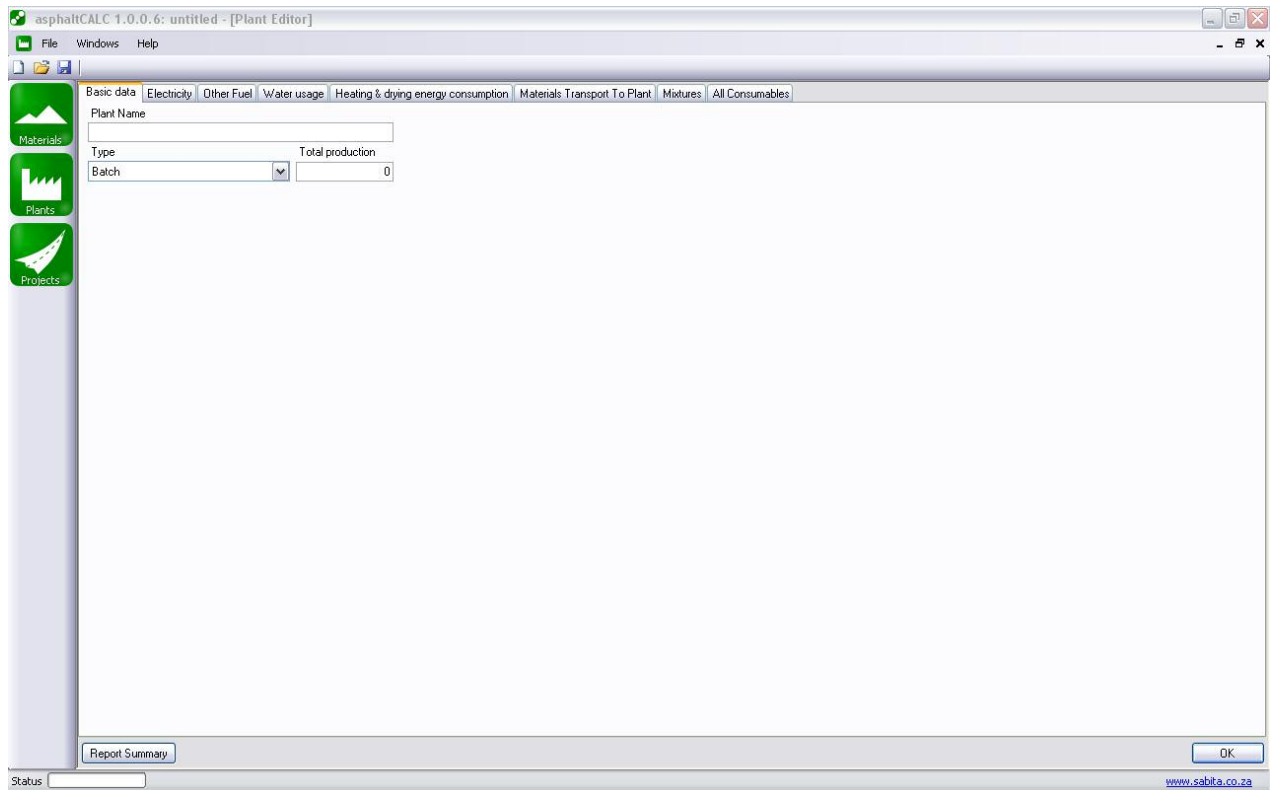


Figure 5- Plants main screen

The Plants screen is used to view the existing asphalt plants held in the software and to edit or add new asphalt plants.

The screen contains a single button: 'Add Plant'.

A double left click with the mouse opens the selected plant for editing. **Any changes made will be reflected immediately and cannot be undone.**

A right click with the mouse brings up the option to delete the selected Plant. **Please note, this action cannot be undone.**

Project Screen

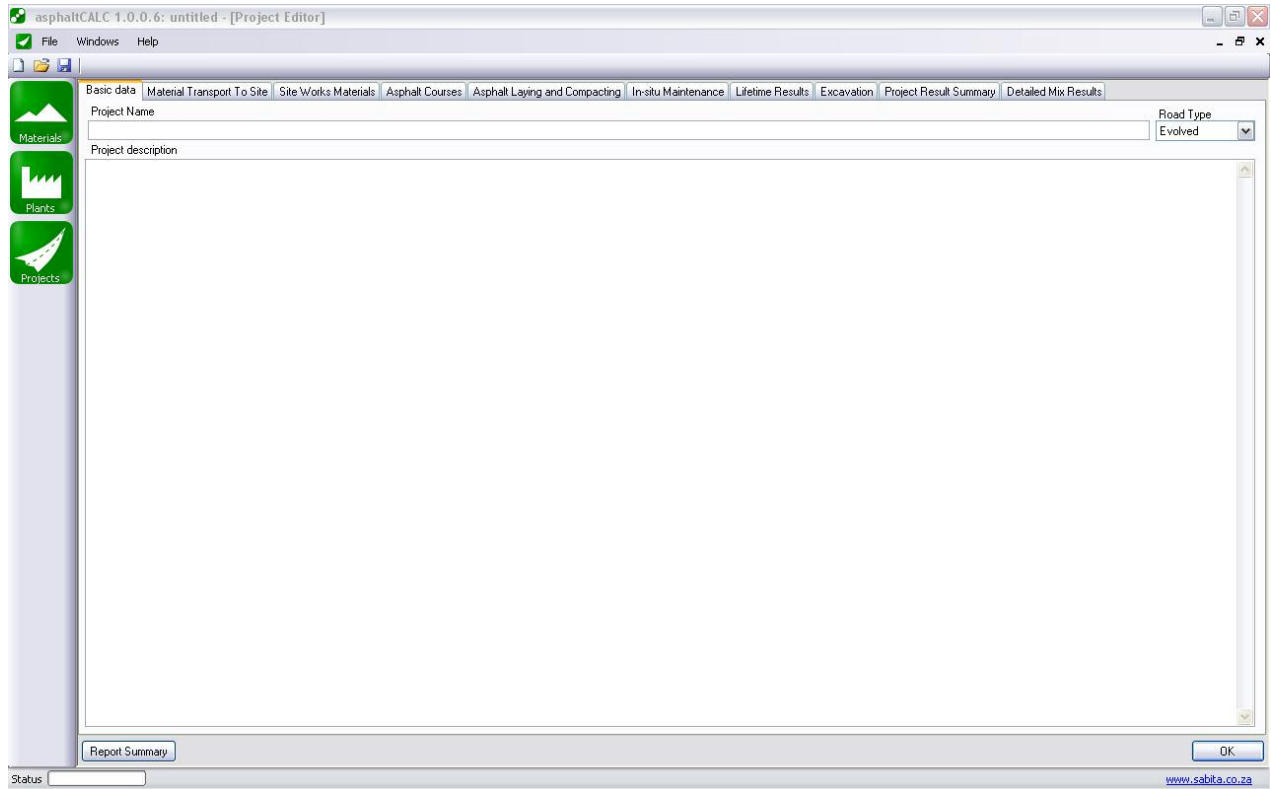


Figure 6- Projects main screen

The Projects screen is used to view the existing projects held in the software and to edit or add new projects.

The screen contains a single button: 'Add Project'.

A double left click with the mouse opens the selected Project for editing. **Any changes made will be reflected immediately and cannot be undone.**

A right click with the mouse brings up the option to delete the selected Project. **Please note, this action cannot be undone.**

Constants Screen

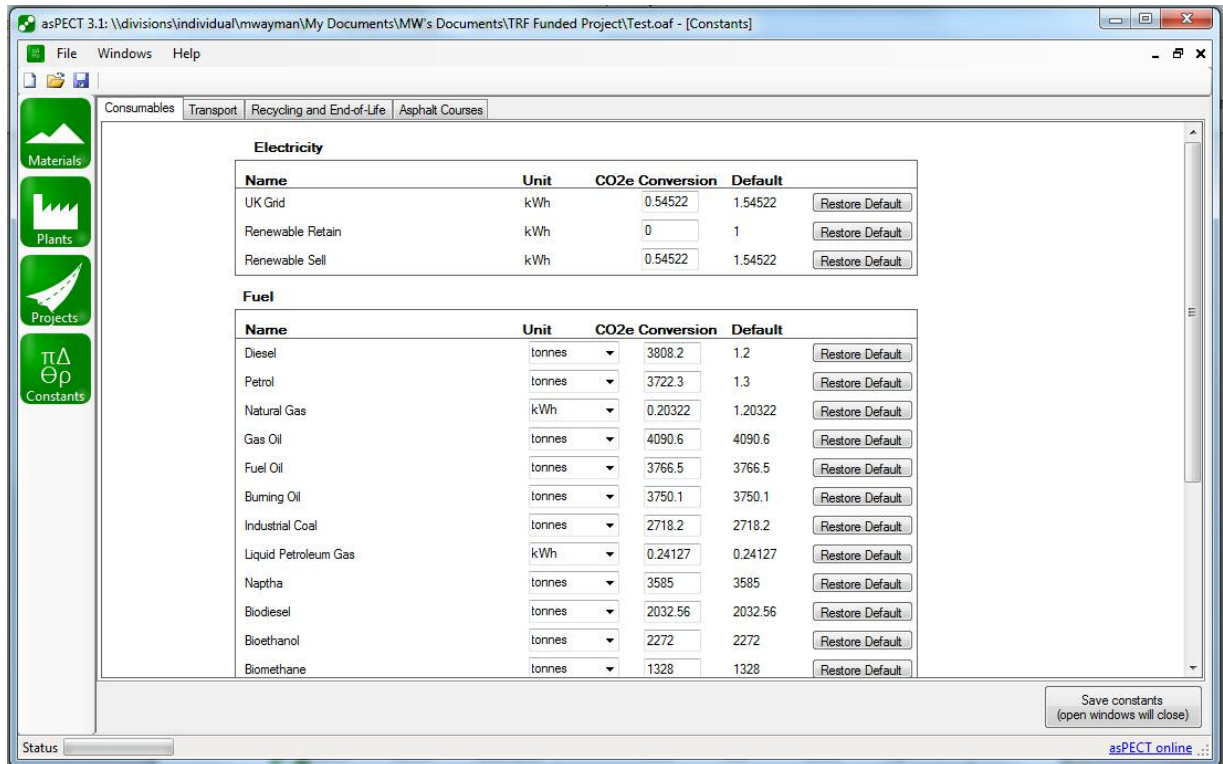


Figure 7 - Constants main screen

The constants editing screen can be accessed by clicking the Constants Icon when using the open access version of the software (when utilising .oaf files). Here the standard set of constants (or those that have been previously saved) can be overwritten and saved. The default constants can also be restored from this screen.

Getting Started with the asPECT Software Tool

Installation

The tool requires installation. To use the tool on your machine, follow the instructions on the installer, you will need administration rights to do this in Windows. This will install the software folder onto your PC.

Running the Tool

The program runs by double clicking the 'AspectDesktop.exe' file from the extracted folder.

Saving and Opening Work

Work undertaken in the tool can be saved in two types of file, with the extensions .acf and .oaf. If using .acf files then only the standard set of constants built into the tool can be used for the calculations, clicking the Constants icon from the main screen will alert the user to this. Constants can be edited if the 'open access' file type .oaf is selected when the file is saved.

To open and save your work:

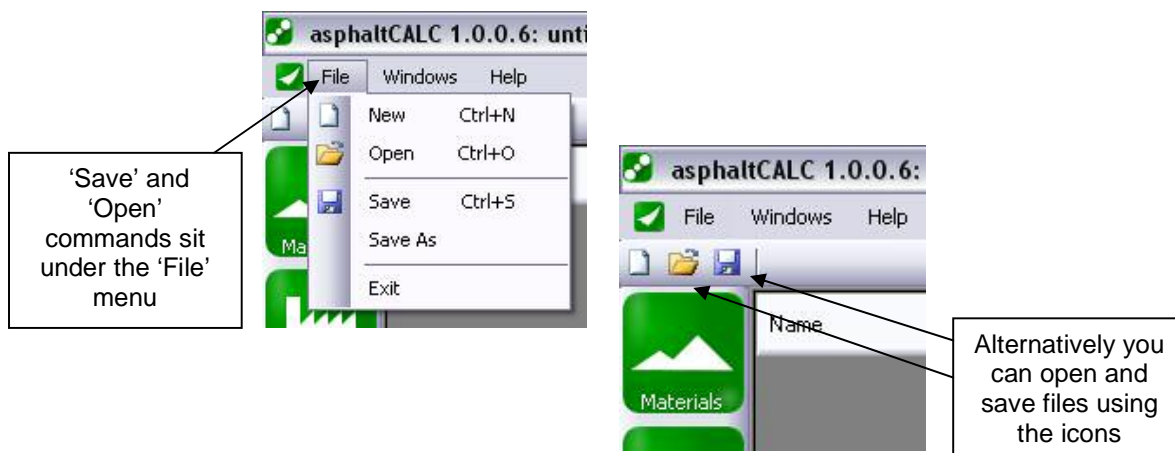


Figure 8 - Saving your work

The file can be named as you choose and does not have to be in the same folder as the software executable files.

Clients to whom asPECT data is being reported to should note the differentiation between the two file types, and consider the list of constants in addition to the final figures if .oaf files have been used in reporting.

Copy Protection

The asPECT software is free to use, subject to registration on the website. You are **not** free to distribute or to edit the software and code protection measures are taken within the software.

For further information please view the Licence Agreement (accepted on installation).

Material Screen Operations

Creating a New Material

The tool comes with preloaded default data including a range of materials (*asPECT Protocol document: Appendix D*). To complete a footprint of a mixture or a project you will need to add your own data, including raw materials. This can be done by entering the kgCO₂e/t for the material if known, or alternatively for aggregates it can be calculated from primary energy consumption from within the software.

Create from Production Energy

To add a new material to the materials list by calculating the kgCO₂e/t from the production or input energy, select the 'Create from Production Energy' button.

The 'Create from Production Energy' screen is organised as a series of tabs along the top of the window. These tabs cover each section of data which is needed for a 'cradle to gate' CO₂e footprint to be calculated.

Basic Data

This tab covers the initial information unique to the material, including the name and source. The material must be placed in a category which best describes it. The category list is provided in Table 1. Only materials that fall under the pre-existing material categories can be created from production energies, all other materials should be created from a 'CO₂ figure' (see next section).

Table 1- Material categories available when created from production energy

Crushed Rock
Ground Granulated Blast Furnace Slag (GGBS)
Incinerator Bottom Ash (IBA)
Limestone Filler
Pulverised Fuel Ash
Reclaimed Asphalt Planings (RAP)
Reclaimed Filler
Recycled Aggregate
Sand & Gravel
Slag
Waste Glass

Please ensure that the correct 'Category' for the material is selected as this determines how the material is treated by the software and where in the software it is available for use.

If Reclaimed Asphalt Planings (RAP) is specified as the category, then an additional box requiring the Soluble Binder Content (%) of the RAP is activated. This information is needed by the software when calculating the recycled content discount and the future recyclability of asphalt mixtures.

Annotations:

- A.** Enter the desired name of the material
- B.** Select the material category
- C.** Enter the source for the material
- D.** Enter the annual saleable tonnage produced at the source
- E.** Soluble Binder Content will need to be specified for Reclaimed Asphalt Planings (RAP)
- F.** Select a 'valid from date' for the material

Calculated material emissions

Figure 9 - Material Editor - Create from production energy

Electricity

This tab allows the quantification of electricity used in the production of the material. Criteria for electricity usage which should be included in the material footprint is explained in the **Protocol Section 2.5.1.1** and some further explanation of the different types of electricity is provided in **Appendix A**. After selecting the electricity source and specifying an amount, clicking 'Create' adds the energy consumption to the material. If an error has been made, the quantity of electricity used can be edited by double clicking the 'Amount' column and entering the new kWh of electricity used. Alternatively, an entry can be removed by right clicking the row and selecting delete. Please note that this action cannot be undone.

- Select the '**Source**' from the drop down list
- Enter the '**Amount**' of electricity used annually
- Click '**Add**' to associate these emissions with the material

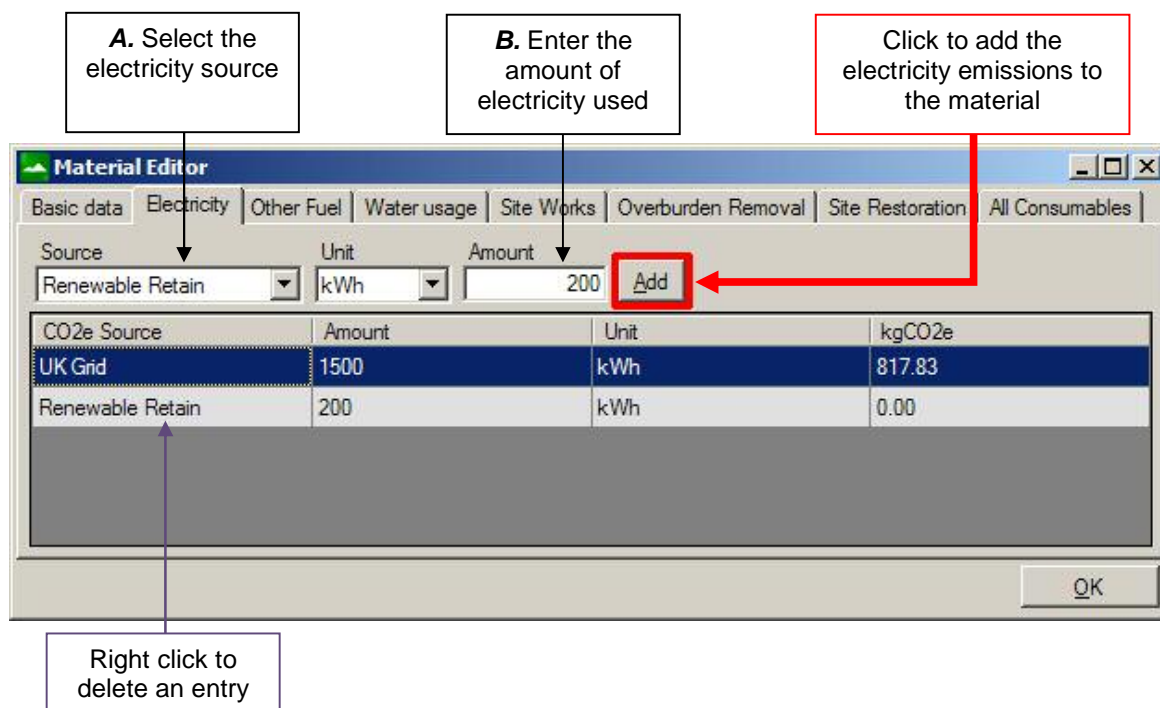


Figure 10 - Material electricity usage

Other Fuel

This tab allows other fuel use to be associated with the production of the material. The criterion for this fuel usage is again set out in **Protocol Section 2.5.1.1** and some further explanation is provided in **Appendix B**. This tab operates in a similar fashion to the previous 'Electricity' tab.

Select the fuel to be added, select an appropriate unit (most common units of the fuels are included), enter the amount of fuel used and then click 'Create'. This associates the energy consumption to the specified material. If you make an error with the entry, the quantity of fuel used can be edited by double clicking the 'Amount' column and entering the new quantity. Alternatively an entry can be completely removed by right clicking the row and selecting delete. Please note that this action cannot be undone.

- Select the fuel type from the '**Source**' drop down list
- Select the desired '**Unit**' for the fuel being used
- Enter the '**Amount**' of the fuel annually
- Click '**Add**' to associate the emissions with the material

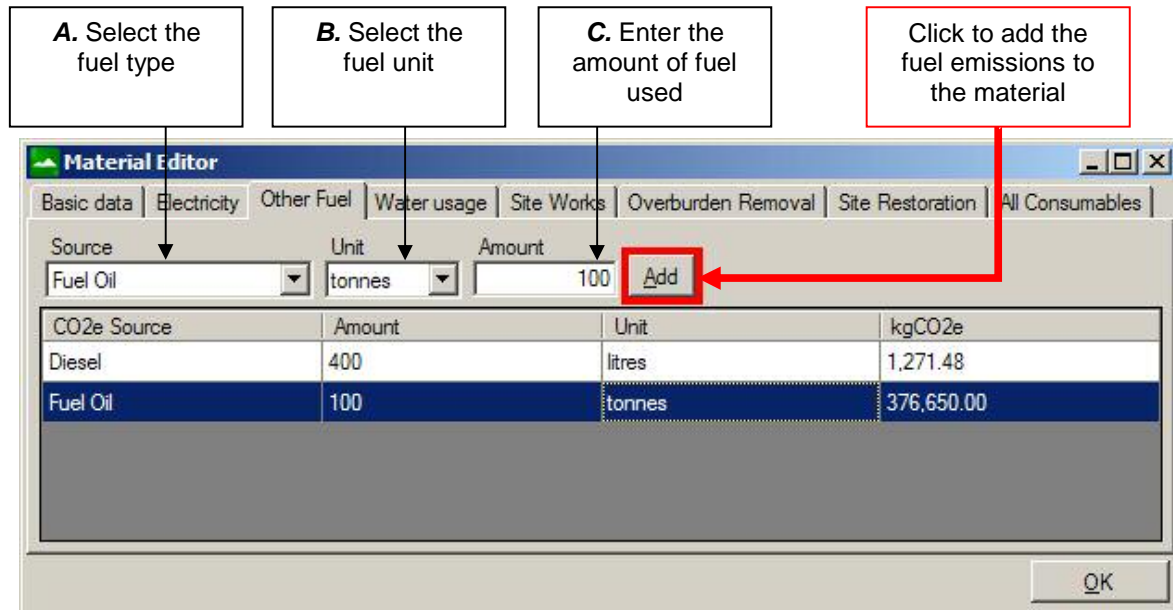


Figure 11 - Material other fuel usage

As a minimum, at least one electricity source *or* one other fuel source **must** be specified to successfully create a material.

Water usage (compulsory for primary aggregates, optional for other materials)

This tab allows the allocation of water usage in the production of the material. The criterion for this water usage is again set out in **Protocol Section 2.5.1.1**. This tab operates in a similar fashion to the previous 'Electricity' tab.

- Enter the '**Amount**' of water used annually
- Click '**Add**' to add the emissions to the material

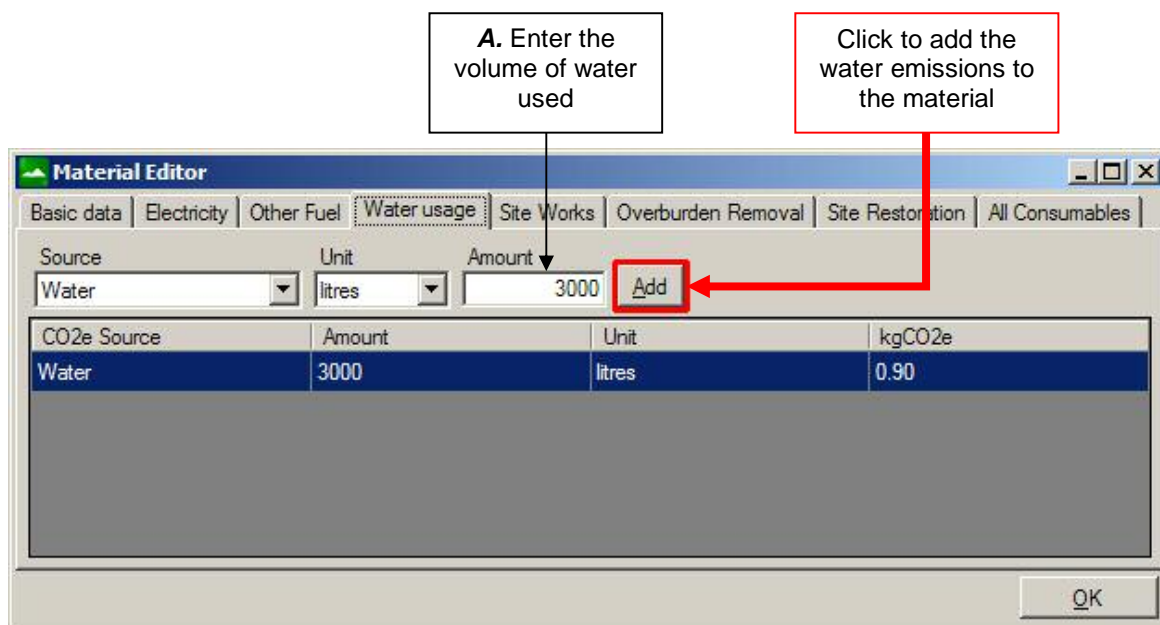


Figure 12 - Material Editor water usage

Site Works (compulsory for primary aggregates, optional for other materials)

This tab covers the usage of explosives in the quarrying of the material. Further details on explosive use are again set out in **Protocol Section 2.5.1.1**. Commonly used explosives are selected from the drop down menu and the quantity used in kg can be entered. Click 'Create' to add the explosive emissions to the material.

- Select the '**Explosive**' from the '**Source**' drop down list
- Enter the '**Amount**' of explosive used annually
- Click '**Add**' to add the emissions to the material

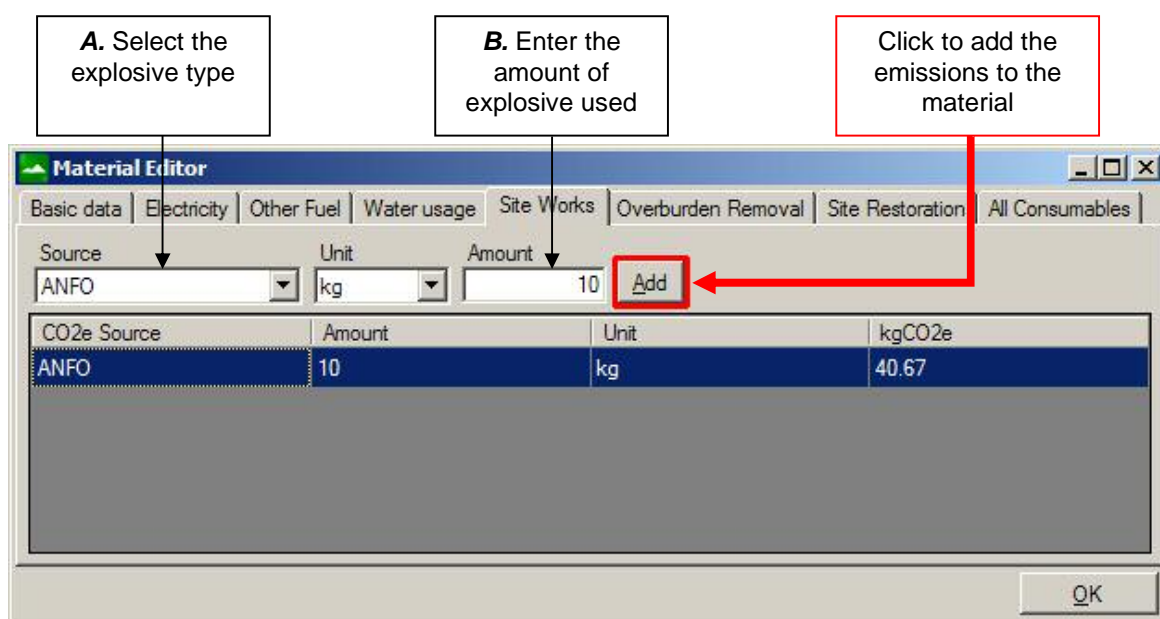


Figure 13- Material Editor site works

Overburden Removal and Site Restoration (compulsory for primary aggregates, optional for other materials)

These tabs allow the allocation of fuels used at the material production site for activities such as preparation for quarrying, excavation of overlying soil and restoration of the site at the end of operations. The requirement to quantify this fuel usage is again set out in **Protocol Section 2.5.1.1**. This tab operates in a similar fashion to the previous 'Other Fuels' tab. Select the fuel to be added, select an appropriate unit (most common units of the fuels are included), enter the amount of fuel used and then click 'Add' to save the energy consumption to the material.

- Select the '**Source**' from the drop down list
- Select the desired '**Unit**' for the fuel being used
- Enter the annualised '**Amount**' of fuel used which can be attributed to the aggregate in question
- Click '**Add**' to add the emissions to the material

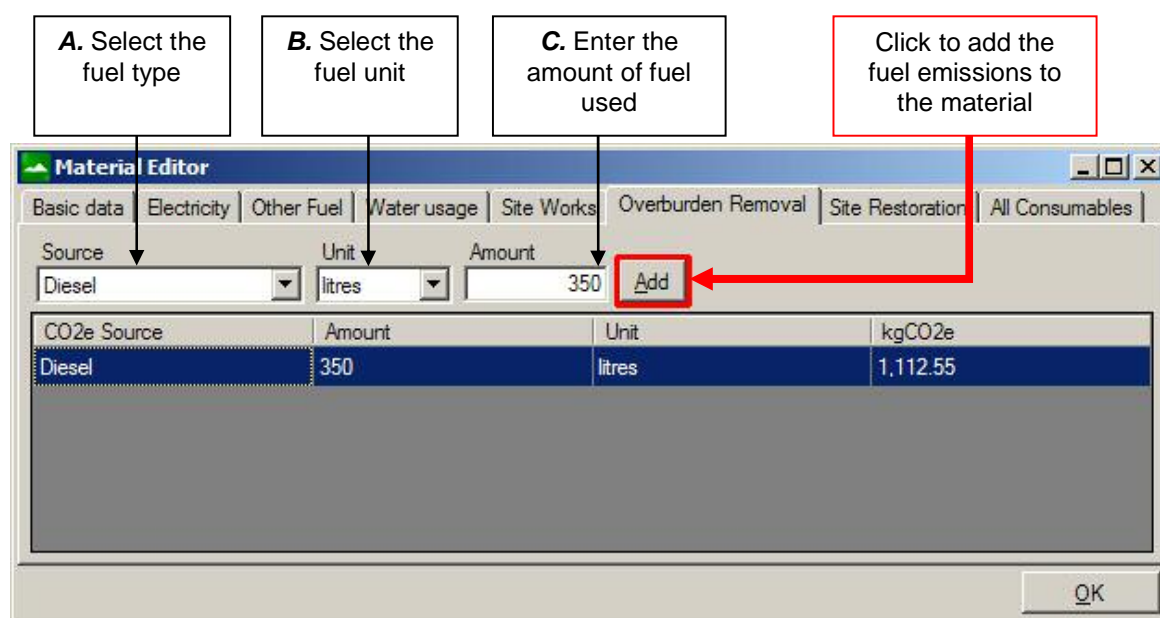


Figure 14 - Overburden removal

All Consumables

The final tab on the Material Editor is for reviewing the consumables used in the creation of the material. It provides a summary and a quick look check that the correct values are being used to calculate the kgCO₂e/t for the material being created.

- If any of the values need changing, select the appropriate tab for the entry and edit the value.
- If the emission sources are accurate, click '**OK**' to save the new material to the database.

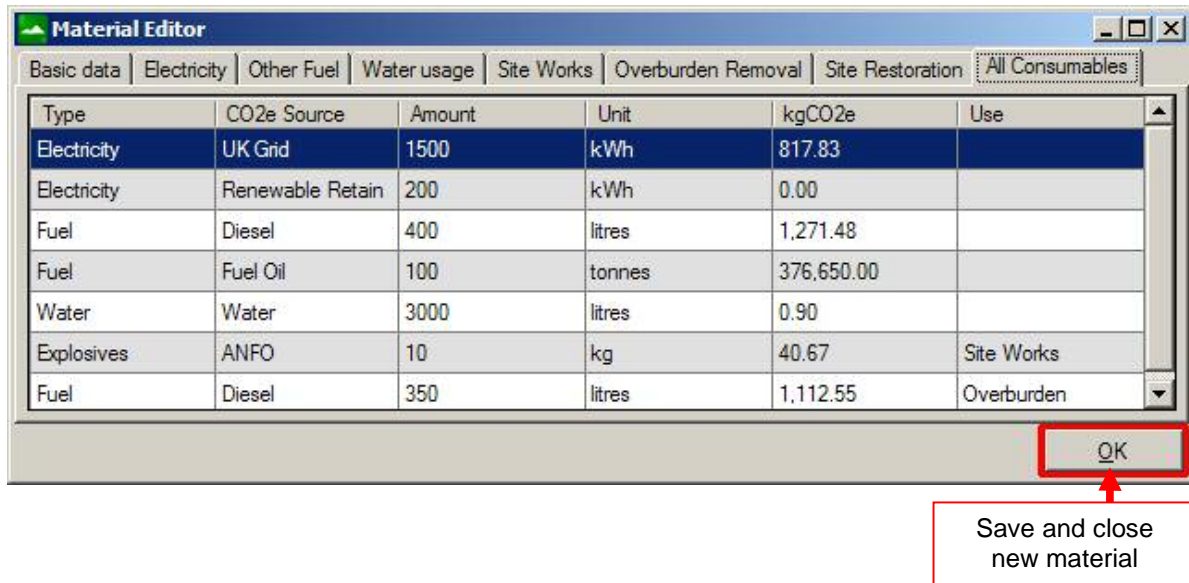


Figure 15 - Materials editor - all consumables

Create from CO₂e Figure

Table 2- Material categories available when entering a CO₂e figure

Adhesion Agents
Bitumen
Bitumen – Polymer Modified (PMB)
Bitumen Emulsions
Bitumen Emulsions – Polymer Modified (PMBE)
Cement
Crushed Rock
Fibres
Fluxes
Ground Granulated Blast Furnace Slag (GGBS)
Hydrated Lime
Hydraulic Binders
Incinerator Bottom Ash (IBA)
Limestone Filler
Natural Bitumen
Other
Pigments
Pulverised Fuel Ash (PFA)
Reclaimed Asphalt Planings
Reclaimed Filler
Recycled Aggregate
Sand & Gravel
Slag
Waste Glass
Waxes

To create a new material from a known kgCO₂e/t figure, sourced from either a published study or work conducted according to the **Protocol Section 2.5**.

- Enter a **'Name'** for the material
- Select a **'Category'** for the new material
- Enter a geographical **'Source'** for the material
- Enter the **'kg CO₂e/t'** figure
 - If **'Reclaimed Asphalt Planings (RAP)'** is selected as the material category, the additional entry box for **'Soluble binder content %'** must be completed
- Enter a description for the **'Data Source'**. This should be the details of where the material kgCO₂e/t figure being used comes from
- Select a **'Valid from Date'** for your reference
- Click **'OK'** to save the new material

A. Enter the desired name for the Material

B. Select the material Category

C. Enter the Source for the material

D. Enter the kgCO₂e/t figure for the material

E. Enter soluble binder content if the material is RAP

F. Select a 'valid from date' for the material

Material emissions value

Save and close new material

Figure 16 - Create material from known emissions figure

Plant Screen Operations

Creating a New Plant

Creating a plant involves the allocation of materials, transport, energy used in processing and energy used in heating and drying along with the definition of heating profiles and mixtures. Once you have created a plant, you will be able to see the emissions associated with each of the mixtures you produce.

Basic Data

This tab covers the initial information necessary to create a plant. It requires that you allocate a name, categorise the plant as 'Continuous' or 'Batch' and specify the total annual production of the plant in tonnes.

The screenshot shows the 'Plant Editor' window with the 'Basic data' tab selected. The 'Plant Name' field contains 'Example Plant'. The 'Type' dropdown menu is open, showing 'Continuous' and 'Batch' options. The 'Total production' field contains '100000'. Callout boxes provide instructions: A. Enter the desired name of the Plant; B. Select the Plant type; C. Enter total annual production of the asphalt plant. A red box highlights the 'Basic data' tab in the menu.

Callout A: Enter the desired name of the Plant

Callout B: Select the Plant type

Callout C: Enter total annual production of the asphalt plant

Figure 17 - Plant basic data

Electricity

Electricity used in the plant for processing the materials, in accordance with **Protocol Section 2.7 and Appendix A**. The tab operates in the same way as it does when allocating electricity usage for creating a material.

- Select the '**Source**' from the drop down list
- Enter the annual '**Amount**' of electricity used
- Click '**Add**' to add the emissions to the plant

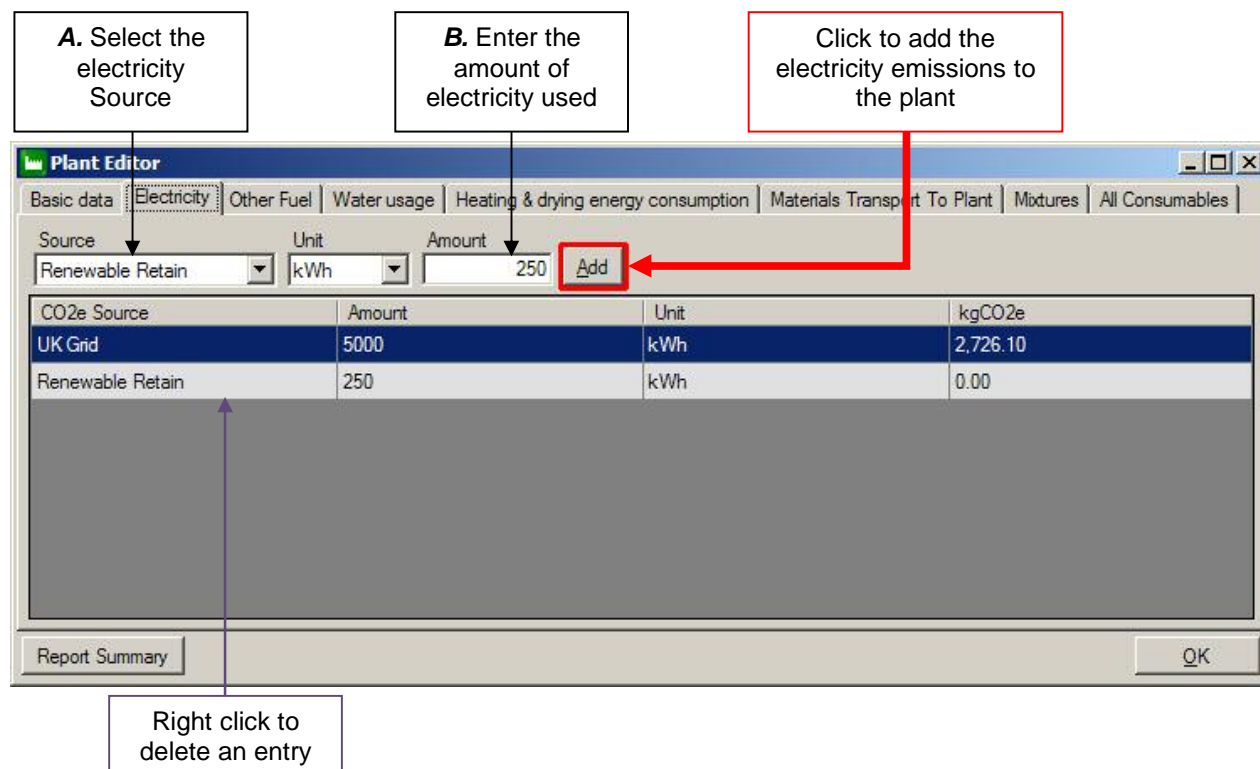


Figure 18 - Plant electricity

Other Fuel

Further energy consumption for sources other than electricity at the plant used for processing the material before heating and drying can also be added. The tab operates in the same way as it does when allocating other fuel usage for creating a material.

- Select the '**Source**' from the drop down list
- Select the desired '**Unit**' for the fuel being used
- Enter the annual '**Amount**' of fuel used
- Click '**Add**' to add the emissions to the plant

A. Select the fuel type **B. Select the fuel unit** **C. Enter the amount of fuel used** Click to add the fuel emissions to the plant

CO2e Source	Amount	Unit	kgCO2e
Natural Gas	250	m3	556.00
Fuel Oil	5	tonnes	18,832.50

Figure 19 – Other plant fuel

As a minimum, at least one electricity source *or* one other fuel source **must** be specified to successfully create a plant.

Water usage (optional)

This tab allows the allocation of water usage at the plant for the production of the asphalt. The criterion for this water usage is again set out in **Protocol Section 2.7**. This tab operates in a similar fashion to the previous 'Electricity' tab.

- Enter the annual '**Amount**' of water used
- Click '**Add**' to add the emissions to the plant

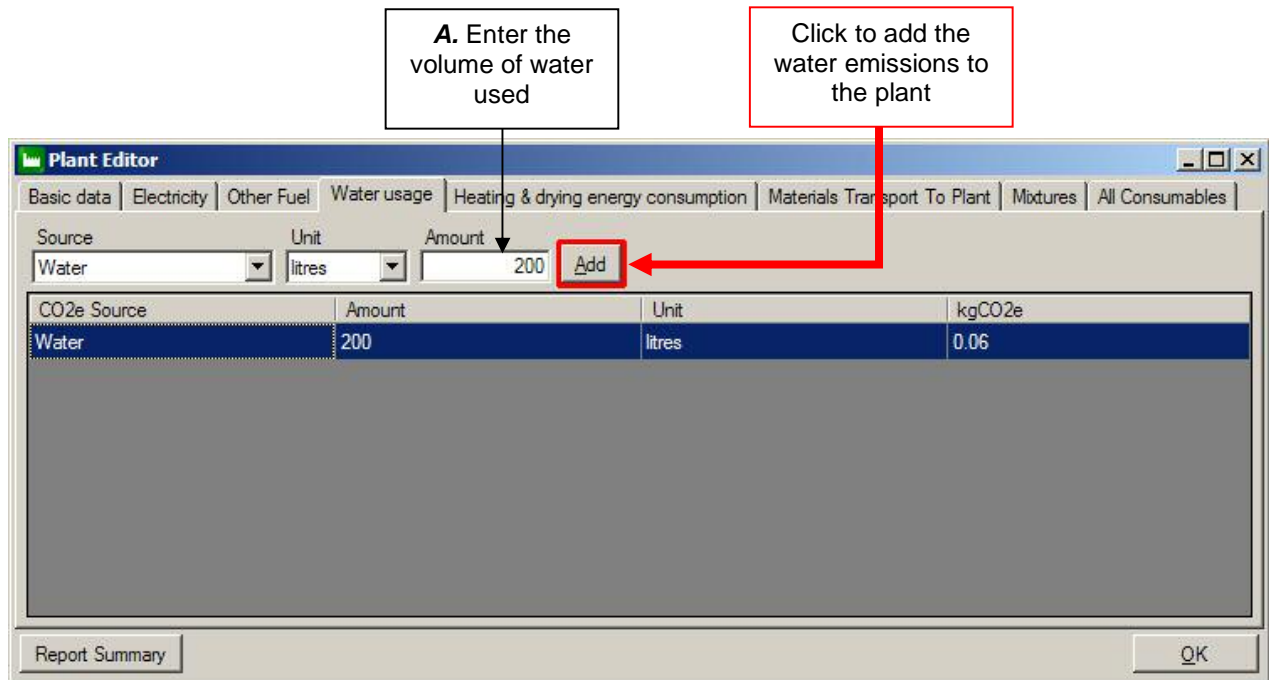


Figure 20 - Plant water usage

Heating and Drying Energy Consumption

Energy used in the plant for heating and drying the materials into asphalt is done from this tab which operates in the same way as it does when allocating other fuel usage for creating a material.

- Select the '**Source**' from the drop down list
- Select the desired '**Unit**' for the fuel being used
- Enter the annual '**Amount**' of fuel used
- Click '**Add**' to add the emissions to the heating and drying energy for the plant

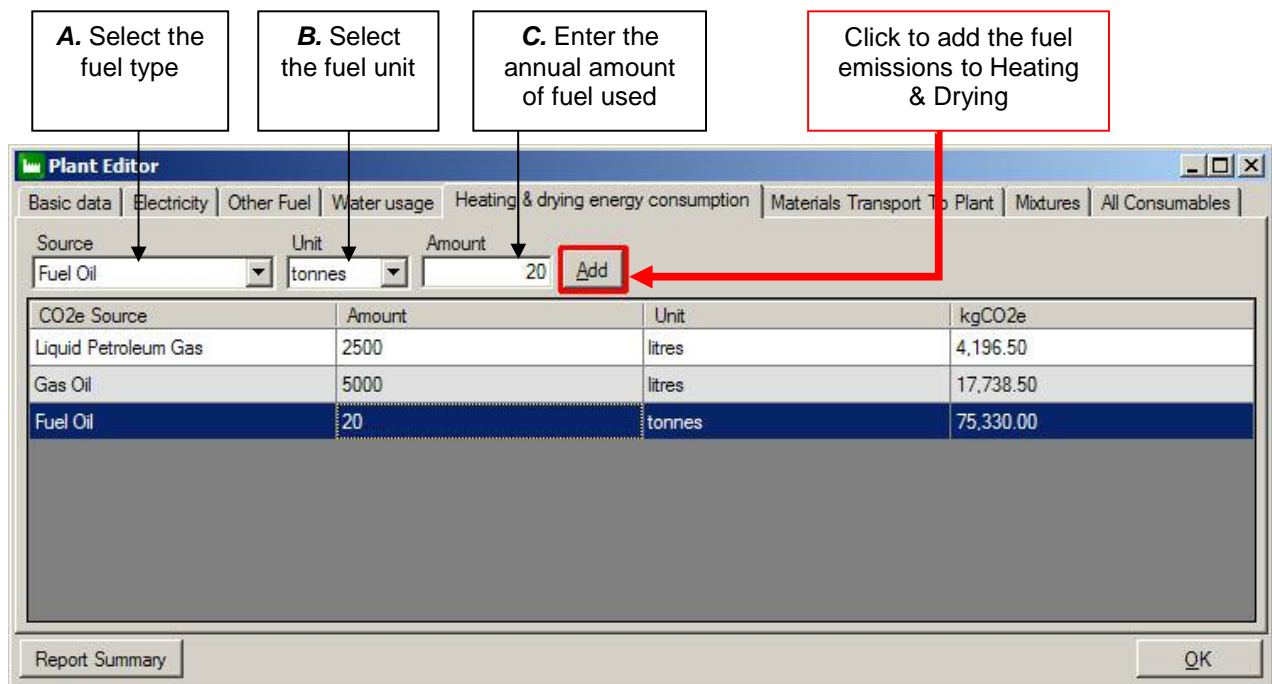


Figure 21 - Heating & drying energy consumption

As a minimum, at least one fuel source must be specified for 'Heating & Drying' to successfully create a plant.

Materials Transport to Plant

Materials used in the plant to create the mixtures need to have their transport to the plant considered. This tab allows materials and a number of transport steps to be added to the plant.

- Select the '**Material**' from the drop down list
- Click '**Add**' to associate the material into the plant
- Ensure that the correct material is highlighted on the list
- Select a '**Mode of Transport**' from the drop down list
- Adjust the '**Utilisation**' level for the mode of transport (default is 50%)
- Enter the '**Outward Journey Distance**' in kilometres
- Adjust the '**Hired Haulage**' percentage for the material (as appropriate)
- For some haulage transport modes, a return journey is not assumed. It can be selected by marking the '**2 Way**' check box
- Click '**Add**' to add the emissions for the transport leg to the material

A. Select the material

Click to add the material to the plant

B. Highlight the material row to begin adding transport

Transported Material	Material kgCO2e/t	Legs of Transport	Transport kgCO2e/t	kgCO2e/t
Example Aggregate	4.30	Rigid >17t	108.61	112.91
Bitumen	280.00	Articulated >3.5-33t, Rigid ...	147.82	427.82
Fibres	0.78	Articulated >33t	34.94	35.72
PFA	4.00	Rigid >3.5-7.5t	26.59	30.59

Mode	Utilisation	Distance	Hired Haulage	2Way	kgCO2e/t
Articulated >3.5-33t	60	60	0	-	115.10
Rigid >17t	60	15	15	-	32.73

C. Select a mode of transport

D. Adjust the utilisation if required

E. Enter the outbound journey distance

F. Enter the percentage hired haulage

Right click to delete an entry

Click to add the material to the plant

Figure 22 - Materials transport to plant

Materials classified under 'Crushed Rock' categories have the 5% loss correction automatically added during the calculation in accordance with the **Protocol Section 2.4**.

Mixtures – Normal Process

Mixtures are defined at the plant by adding materials and entering details about the heating and drying process. This is implemented in accordance with **Protocol Section 2.8**.

- Enter a **'name'** for the new mixture
- Click **'Add New Mixture'** to create
- Ensure that the correct mixture is highlighted on the list
- Enter the tonnage of **'Annual Production'** for the mixture
- Enter the **'Production Rate'** (continuous) or **'Heating Time'** (batch)
- Select a desired **'Material'** to add to the mixture from the drop down list
- Enter the **'Percentage'** of that material required in the mixture
- Click **'Add'** to add the mixture to the plant

A. Name the mixture

B. Enter the annual production of the mixture

C. Enter the production rate of the mixture

D. Select the material to be added to the mixture

E. Enter the percentage

Click to create a new mixture

Right click to delete an entry

Right click to delete an entry

Remaining plant production available for allocation is shown here

Click to add material to the mixture

Plant Editor

Basic data | Electricity | Other Fuel | Water usage | Heating & drying energy consumption | Materials Transport To Plant | Mixtures | All Consumables

Name: Mix 4

Add New Mixture

Mixture Name	Virgin Mix kg CO2e/t	RAP Saving kg CO2e/t	Transport kg CO2e/t	Heating kg CO2e/t	Non-Heatir kgCO2e/t	Total kgCO2e/t
Example ...	16.08	4.59	47.80	7.63	0.11	67.02
Mix 2	22.42	7.00	47.77	3.14	0.11	66.43
Mix 3	23.76	7.52	47.43	5.23	0.11	69.00

Mixture: Mix 2

Annual Production (t): 46000

Production Rate (t/h): 25

Calculate Production Rate from known process

Material	Percent
Example Aggregate	93.0
Fibres	0.1
PFA	0.4
Bitumen	6.5

Total Production (t): 100000

Unallocated Production (t): 6000

Materials: PFA

Percentage: 0.0

Unallocated %: 0.0

Add

Report Summary

OK

Figure 23 - Plant mixture creation

Each mixture MUST have 100% of constituent materials defined; The mixture cannot be saved if this is not the case.

The Total Production (t) of the plant MUST be allocated between the defined mixtures; the plant cannot be saved if this is not the case.

Only one bitumen component and one RAP component can be specified per mixture.

Mixtures – Special Process

To account for the potential use of novel technology and methods in the creation of mixtures, the ability to define a 'special process' is included in the software. This functions in a similar way to creating a normal mixture, but requires a number of further pieces of information to allow an equivalent production rate to be calculated. Further details can be found in **Protocol Section 2.8.3**.

- Enter a 'name' for the new mixture and
- Click 'Add New Mixture' to create
- Ensure that the correct mixture is highlighted on the list
- Enter the tonnage of 'Annual Production' for the mixture
- Check the 'Calculate Production Rate from known process' checkbox
- Enter the 'Standard Process Energy'
- Enter the 'Non-Standard Process Energy'
- Enter the 'Standard Process Production Rate'
- Select a desired 'Material' to add to the mixture from the drop down list
- Enter the 'Percentage' of that material required in the mixture
- Click 'Add' to add the Mixture to the Plant

The screenshot shows the 'Plant Editor' software interface. The 'Mixture' tab is active, displaying a table of existing mixtures and a form for adding a new mixture. The 'Add New Mixture' button is highlighted with a red box. The 'Calculate Production Rate from known process' checkbox is checked. The 'Annual Production (t)' field is set to 3000. The 'Standard Process Energy (kWh)' field is set to 3000, the 'Non-standard Process Energy (kWh)' field is set to 3500, and the 'Standard Process Production Rate (t/h)' field is set to 12. The 'Add' button is highlighted with a red box. The 'Unallocated Production (t)' field is set to 6000. The 'Special Process' section is also highlighted with a red box.

Mixture Name	Virgin Mix kg CO2e/t	RAP Saving kg CO2e/t	Transport kg CO2e/t	Heating kg CO2e/t	Non-Heating kgCO2e/t	Total kgCO2e/t
Example...	16.08	4.59	47.80	7.63	0.11	67.02
Mix 2	22.42	7.00	47.77	3.14	0.11	66.43
Mix 3	23.76	7.52	47.43	5.23	0.11	69.00

Special Process

Standard Process Energy (kWh)	3000
Non-standard Process Energy (kWh)	3500
Standard Process Production Rate (t/h)	12

Example Mixture 1

Material	Percent
Example Aggregate	93.8
PFA	2.0
Bitumen	4.2

Materials Percentage Unallocated %

PFA	1.0	0.0
-----	-----	-----

Figure 24 - Plant special mixture creation

Each mixture MUST have 100% of constituent materials defined; the mixture cannot be saved if this is not the case.

The Total Production (t) of the plant MUST be allocated between the defined mixtures; the plant cannot be saved if this is not the case.

Energy Consumption Summary

The final tab on the Plant Creator is for reviewing the consumables used at the plant. It provides a quick overview of the values that are being used to calculate the kgCO₂e/t for the mixtures being created.

- If any of the values need changing, select the appropriate tab for the entry and edit the value as required.
- If the emissions are accurate, click 'OK' to save the new material to the database.

Plant Editor

Basic data | Electricity | Other Fuel | Water usage | Heating & drying energy consumption | Materials Transport To Plant | Mixtures | All Consumables

Heating Consumption Summary

Type	CO ₂ e Source	Amount	Unit	kgCO ₂ e
Fuel	Liquid Petroleum Gas	2500	litres	4,196.50
Fuel	Gas Oil	5000	litres	17,738.50
Fuel	Diesel	100	tonnes	380,820.00

Nonheating Consumption Summary

Type	CO ₂ e Source	Amount	Unit	kgCO ₂ e
Electricity	UK Grid	5000	kWh	2,726.10
Electricity	Renewable Retain	250	kWh	0.00
Fuel	Natural Gas	250	m ³	556.00
Water	Water	200	litres	0.06
Fuel	Diesel	2	tonnes	7,616.40

Report Summary

OK

Click to view a PDF Summary of the Plant

Click to save and close the Plant


Figure 25 - Plant energy consumption summary

Plant Report Summary

Clicking the '**Report Summary**' button opens a new window with a customised report on the currently open plant. This report is in a PDF format and can be saved using the menu which appears when the mouse cursor is hovered over the bottom of the report window. The report includes a number of key features:

- Name, plant type and date
- Annual production tonnage and number of asphalt mixtures created and materials used
- Energy usage – total, processing and heating and drying breakdown
- Environmental impacts - total kg CO₂e and kg CO₂e/tonne
- Notes section – which includes important considerations and decisions made during the footprinting process. This includes:
 - Any special Processes specified for heating and drying

asphaltCALC Plant Summary Report



Name: Example Plant	Date: 12/03/2012
Plant type: Batch	

Production	Energy Usage (kWh)
Annual production (t):	Annual Consumption:
Materials available: 0	Process:
Mixtures available: 0	Heating and drying:

Environmental Impacts

Total annual kg CO₂e:	kgCO₂e / tonne:
---	-----------------------------------

Notes: None

Disclaimer: The data presented above is believed to be accurate and correct. It has however not been audited and no responsibility is held for errors resulting from misuse, misinterpretation or software failure.

This report has been produced using asphaltCALC. For more information please visit www.sabita.co.za

Figure 26 - Plant summary report

Many plant can be created by duplicating the process described above.

Project Screen Operations

Creating a Project

By creating a project it is possible to complete the full lifecycle considerations of the road. Multiple mixtures and materials can be added to a project from different sources. Additionally, transport, energy used in laying and compacting, maintenance interventions, and energy used in excavating and disposal of the materials at the end of the roads life can all be specified.

Basic Data

This tab covers the initial information necessary to create a project. It requires that you allocate a name, provide a description and categorise the road as 'Designed' or 'Evolved'. This categorisation is necessary to apply the appropriate lifetimes to asphalt courses in line with **Protocol Section 2.12**.

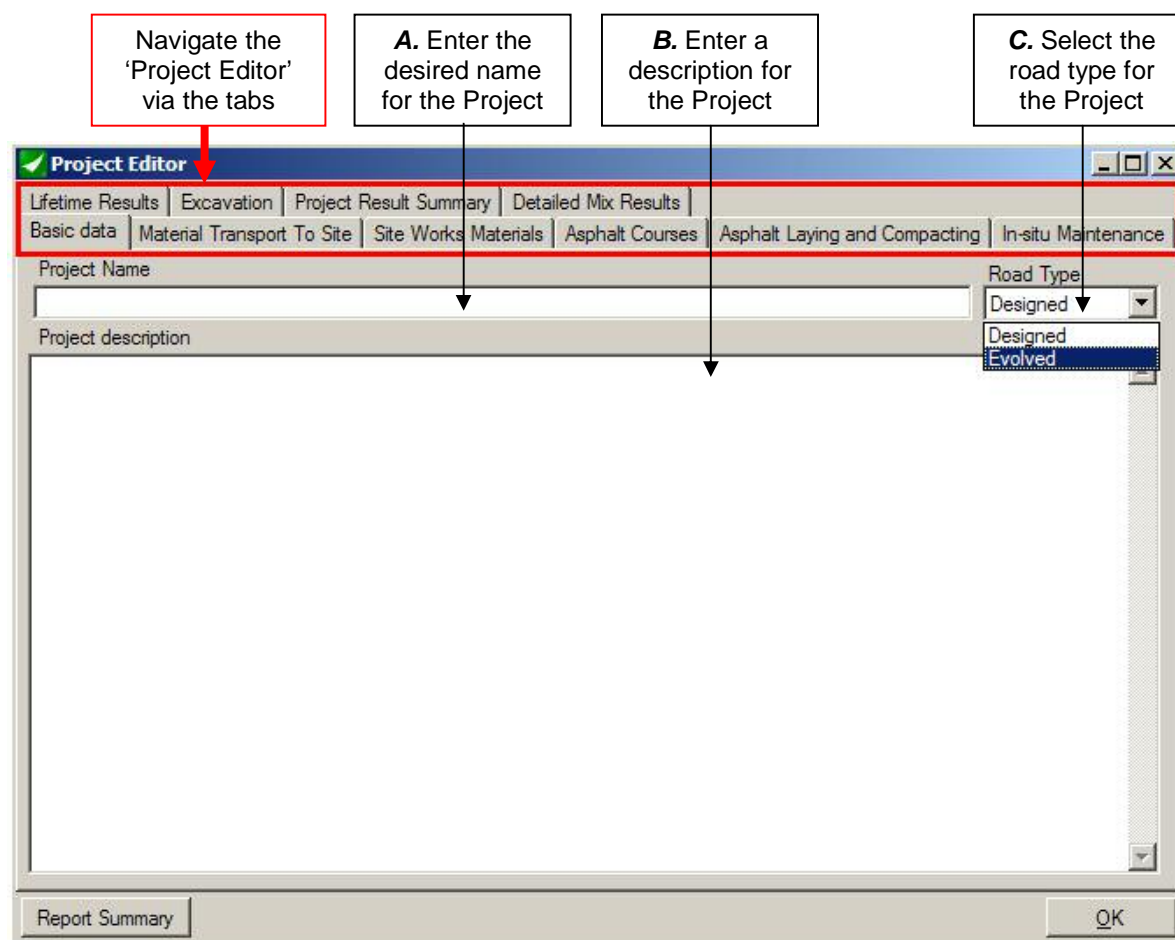


Figure 27 - Project Basic Data

Material Transport to Site

To start creating a project it is first necessary to allocate the materials and asphalt mixtures to be used.

- If choosing a material, for site specific works, such as backfill or bond/tack coats, select '(None)' from the 'Plant' list and the required material from the 'Material' list
- If choosing an asphalt mixture, select the required plant from the 'Plant' list and the asphalt mixtures produced by this plant will be available to select from the 'Material' list
- Click 'Add'

Next it is necessary to define the transport required to move the material or mixture from source to the project site. This section of the software works in the same way as the section that allows transport to be specified in the **Plant Editor**.

A. Select the Plant if choosing an asphalt mixture

B. Select the Mixture or Material

Click to add the material to the plant

B. Highlight the material row to begin adding transport

Plant	Transported Material	Material kgCO2e/t	Legs of Transport	Transport kgCO2e/t	kgCO2e/t
Exempl...	Example Mixture 1	67.02	Rigid >17t	23.46	90.48
Plant A	Test Mixture 2	212.76	Articulated >3.5-33t	28.77	241.54
	Bitumen Emulsion (...)	340.00	Articulated >33t	10.38	350.38

Mode of transport: Articulated >33t, Utilisation: 60%, Outward Journey Distance: 5 km, Hired haulage: 0%, 2 way Add

Mode	Utilisation	Distance	Hired Haulage	2 Way	kgCO2e/t
Articulated >33t	60	5	0	-	10.38

C. Select a mode of transport

D. Adjust the utilisation if required

E. Enter the outbound journey distance

F. Enter the percentage hired haulage

Right click to delete an entry

Click to add the material to the plant

Figure 28 - Project material transport

Site Works Materials

"Direct to site" materials defined on the previous tab appear here so that the quantities used in the project can be specified.

- Select each material from the '**Material**' list
- Enter the required tonnage of the selected material
- Click '**Add**'

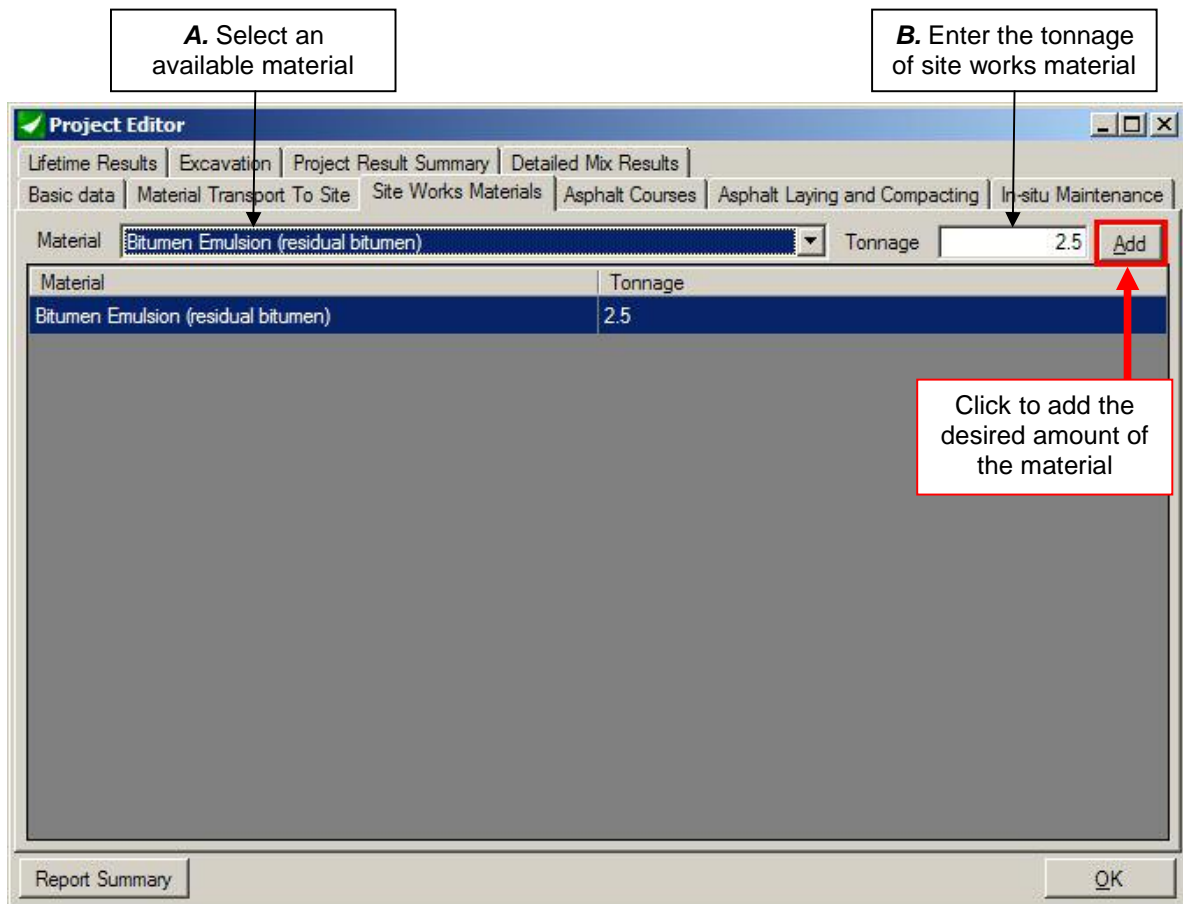


Figure 29 - Project site works

Asphalt Courses

Asphalt mixtures selected on a previous tab are here assigned to an asphalt course and the required quantity for the project is entered. The type of courses that the mixtures can be assigned to varies depending on whether an 'Evolved' or 'Designed' road was specified when creating a project.

- Choose a mixture from the '**Material**' list.
- Choose a type of course for the mixture from the '**Course**' list
- Enter the tonnage for the mixture and course defined.
- Click '**Add**'

ONLY one mixture can be specified to the surface course per project.

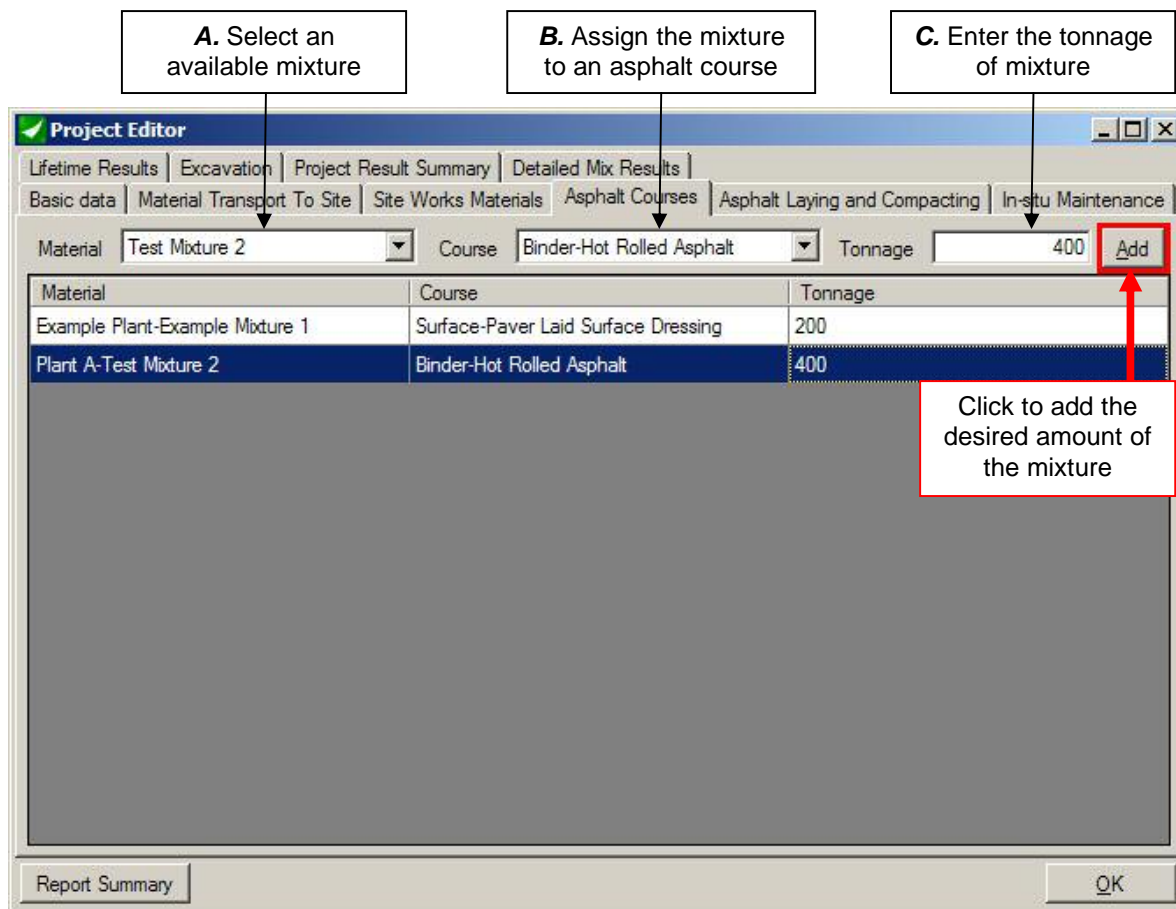


Figure 30 – Specifying asphalt courses

Laying and Compacting

Energy used in the installation of the asphalt mixtures selected on the previous tab are defined here.

- Select either the '**Default**' laying and compacting emissions or
- Select the '**Custom**' checkbox and
- Enter the custom emissions associated with laying and compacting

Custom Laying and Compacting emissions figures must be calculated in accordance with **Protocol Section 2.10**

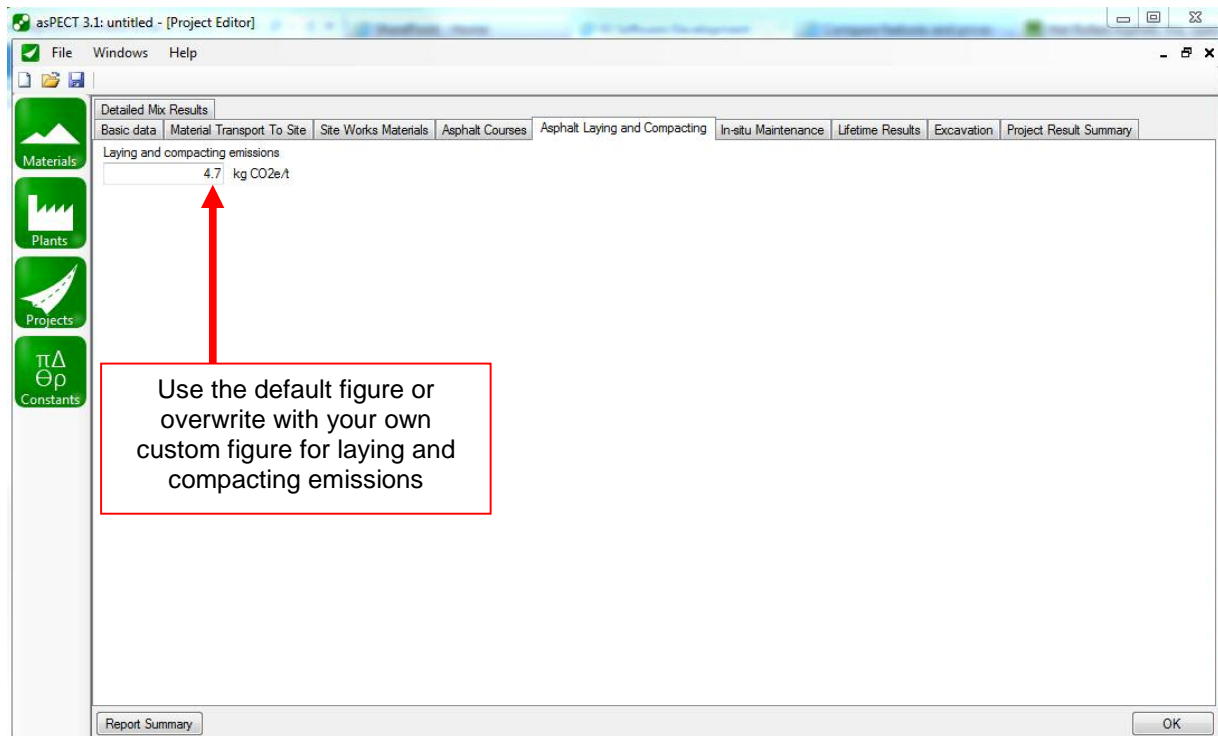


Figure 31 - Laying and compacting

In-Situ Maintenance

This tab allows you to add maintenance interventions to extend the lifetime of the surface course.

- Select the type of surface '**Treatment**' from the drop down list
- Enter the emissions for the treatment in '**kgCO₂e/t**'
- Enter the '**Tonnage**' for the treatment selected
- Enter the '**Additional Lifetime**'
- Click '**Add**' to assign the In-Situ Maintenance Treatment to the course

In-situ maintenance emissions figures must be calculated in accordance with **Protocol Section 2.12.2**

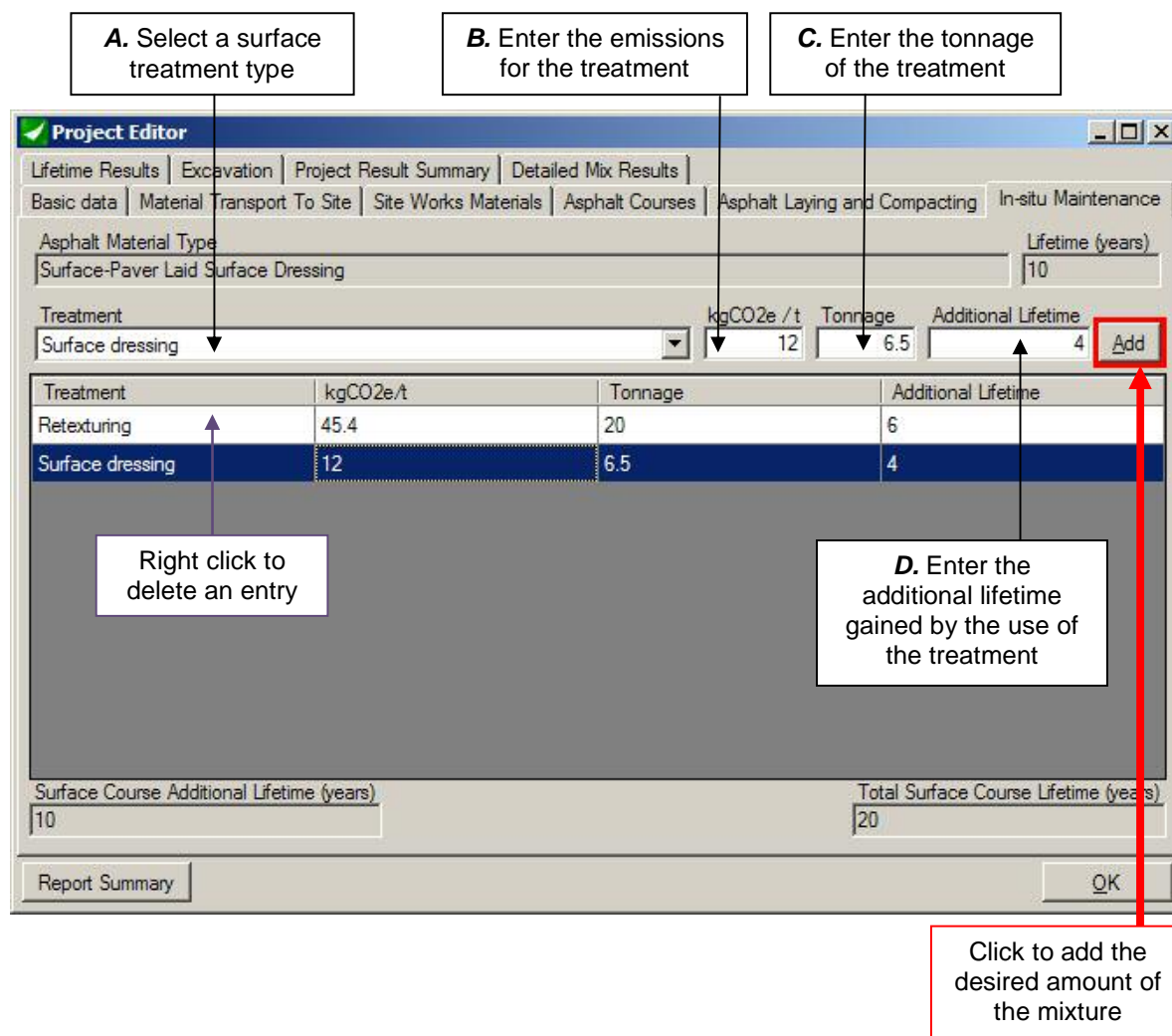


Figure 32 - In-situ maintenance

Lifetime Results

The Lifecycle Results tab presents a summary of tonnages and emissions figures by road course and gives an annualised emissions breakdown. This provides a basis to compare different mixtures on a life cycle basis.

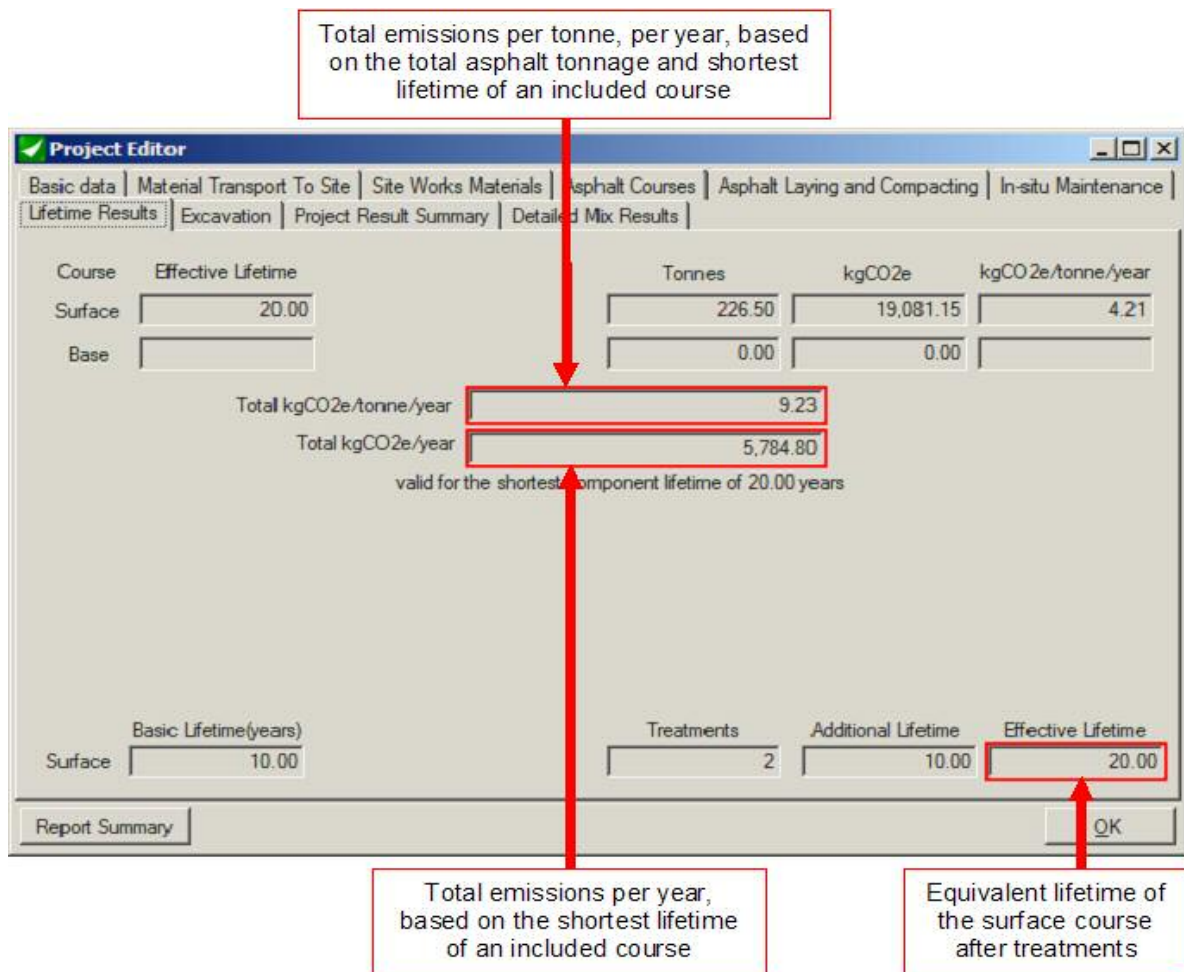


Figure 33 - Lifetime results

Excavation

Removal of the material at the end of life and the disposal/recycling of the excavated material can be either based on default values calculated from details about the planing operation or a custom figure can be used.

- Select the '**Calculate from Default**' checkbox
- Select the '**Width**' of the planing area
- Select the planing '**Depth**' OR
- Select the '**Use Custom Figure**' checkbox
- Enter the desired custom figure
- Allocate the percentage of excavated material between '**stockpiled**' and '**landfilled**'
- Complete the transport sections for both stockpiling and landfilling options in the same way as on previous transport tabs

Custom Excavation emissions figures must be calculated in accordance with **Protocol Section 2.13.2**

Select the source of the planing off energy emissions factor.

Click to add transport for material to the stockpile

The screenshot shows the 'Project Editor' interface with the following sections:

- Planing-off:** Radio buttons for 'Calculate from default' (selected) and 'Use custom figure'. Below are input fields for Width (m) 0.35, Depth (mm) 10, and a resulting value of 14.7 kg CO2e/t.
- Waste Management - Stockpiled:**
 - Stockpiled: 95 % (Tonnage: 595.175)
 - Mode of transport: Rigid >17t, Utilisation: 65 %, Outward Journey Distance: 10 km, Hired haulage: 0 %
 - Buttons: 2 way and **Add** (highlighted with a red box and arrow).
 - Table:

Mode	Utilisation	Distance	Hired Haulage	2 Way	kgCO2e/t
Rigid >17t	65	10	0	-	20.57
- Waste Management - Landfilled:**
 - Landfilled: 5 % (Tonnage: 31.325)
 - Mode of transport: Rigid >17t, Utilisation: 50 %, Outward Journey Distance: 12 km, Hired haulage: 0 %
 - Buttons: 2 way and **Add** (highlighted with a red box and arrow).
 - Table:

Mode	Utilisation	Distance	Hired Haulage	2 Way	kgCO2e/t
Rigid >17t	50	12	0	-	28.15

Figure 34 – End-of-life processes

Click to add transport for material to the landfill

Project Result Summary

The Project Result Summary tab gives a breakdown of the kgCO₂e and kgCO₂e/t emissions of every step of the lifecycle as shown in Figure 2.

Subtotal figures are also given for:

- Steps 1 to 7 – Material acquisition to asphalt installation on site
- Asphalt – Material acquisition to excavation, excluding any direct to site/site specific works materials
- Project – Grand Total for the project

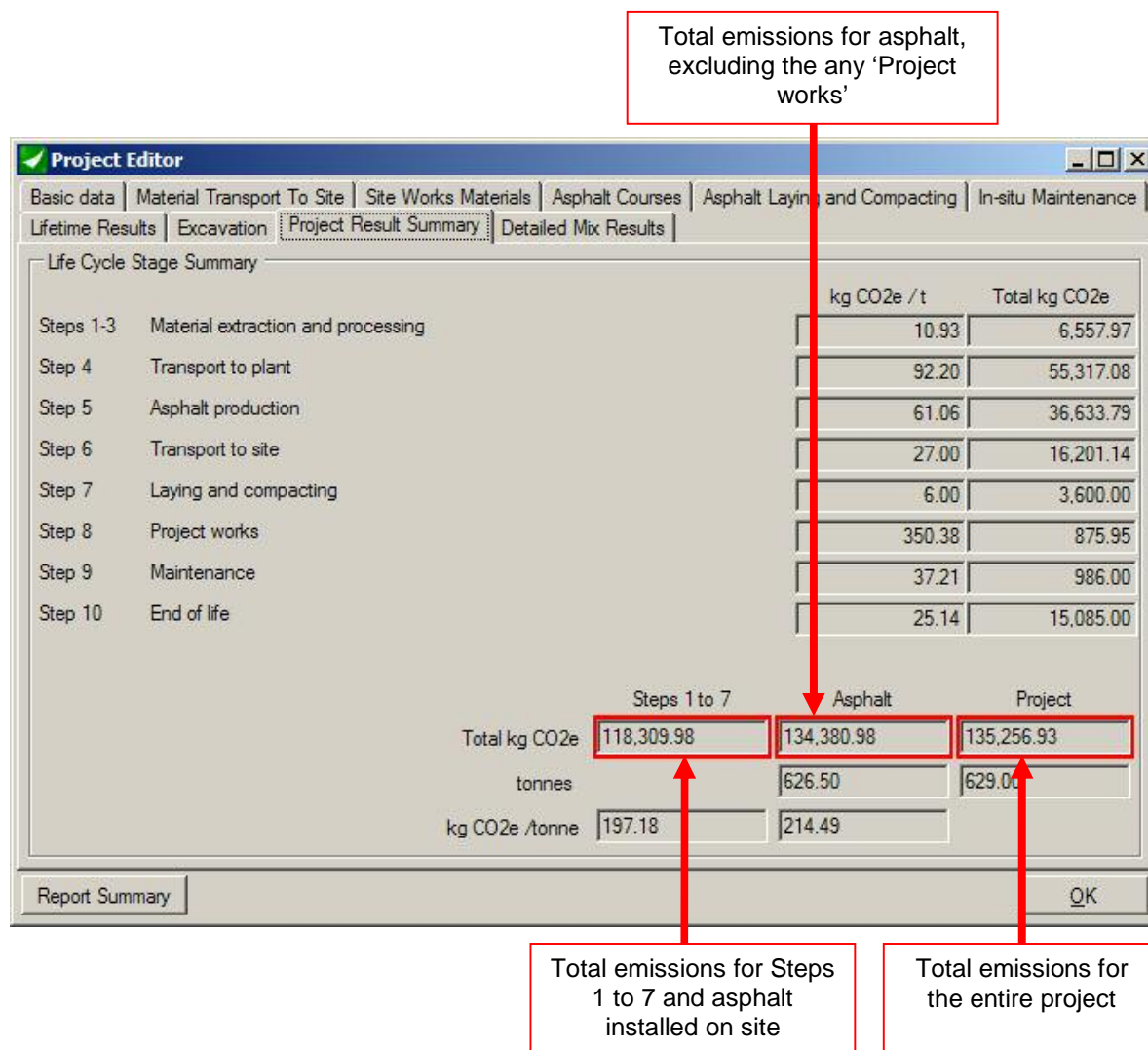


Figure 35 - Project result summary

Detailed Mix Results

The Detailed Mix Results tab gives a breakdown the kgCO₂e emissions of every asphalt mixture used in the project. The emissions associated with each mixture are given for:

TRL

- Steps 1 to 3 – Material acquisition, transport and processing
- Step 4 – Material transport to asphalt plant
- Step 5 – Asphalt production
- Step 6 – Asphalt transport to site

The total emissions and emissions per tonne of asphalt mixture are also shown.

Plant	Material	Tonnage	1 to 3	4	5	6	Total CO2e	Total CO2e/t
Example Plant	Example Mixture 1	200.00	2,296.53	9,559.22	1,547.88	4,691.52	18,095.15	90.48
Plant A	Test Mixture 2	400.00	4,261.45	45,757.86	35,085.91	11,509.62	96,614.83	241.54

Report Summary

OK

Click to view a PDF Summary of the Project

Click to save and close the Project

Figure 36 - Detailed mix results

Project Report Summary

Clicking the '**Report Summary**' button opens a new window with a customised report on the currently open project. This report is in a PDF format and can be saved using the menu which appears when the mouse cursor is hovered over the bottom of the report window. The report includes a number of key features:

- Name, description and date
- Numbers and quantities for both asphalt and site work materials
- Environmental impacts - Total kg CO₂e and asphalt kg CO₂e/t
- Notes section – which includes important considerations and decisions made during the footprinting process. This includes:
 - Use of non-default data for processes
 - Maintenance treatments specified

- Any special processes specified for heating and drying

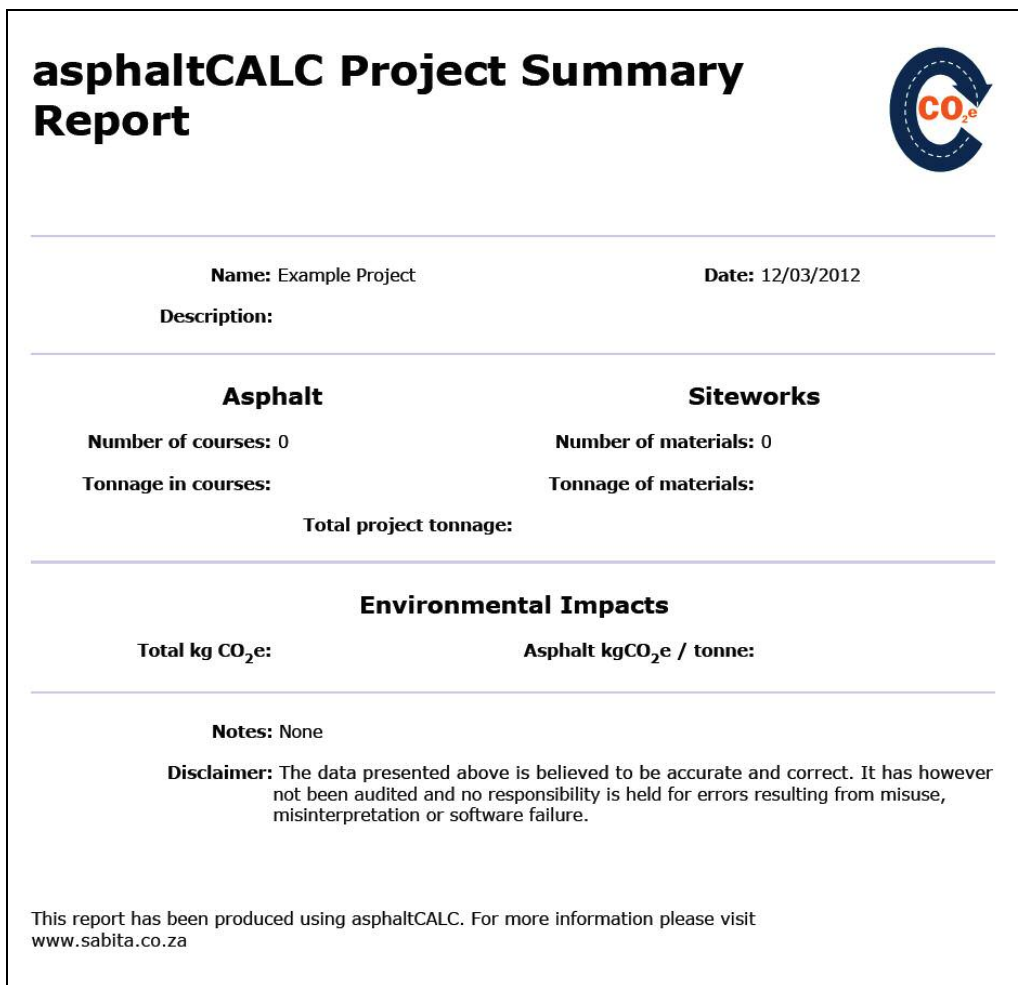


Figure 37 - Project summary report

Constants Screen Operations

Constants Forms

Constants can be edited when files with the .oaf extension are utilised. The default file extension is .acf; this can be changed by clicking save and selecting .oaf from the file type menu.

Clicking the Constants Icon from the main screen will reveal the window containing forms, as displayed in Figure 38 below.

The screenshot shows the 'asPECT 3.1' application window with the 'Constants' tab selected. The window title is 'asPECT 3.1: \\divisions\individual\mwayman\My Documents\MW's Documents\TRF Funded Project\Test.oaf - [Constants]'. The interface includes a menu bar (File, Windows, Help), a toolbar, and a sidebar with icons for Materials, Plants, Projects, and Constants. The main area displays two tables: 'Electricity' and 'Fuel'. Each table has columns for Name, Unit, CO2e Conversion, and Default, with a 'Restore Default' button for each row. A 'Save constants (open windows will close)' button is located at the bottom right.

Electricity				
Name	Unit	CO2e Conversion	Default	
UK Grid	kWh	0.54522	1.54522	Restore Default
Renewable Retain	kWh	0	1	Restore Default
Renewable Sell	kWh	0.54522	1.54522	Restore Default

Fuel				
Name	Unit	CO2e Conversion	Default	
Diesel	tonnes	3808.2	1.2	Restore Default
Petrol	tonnes	3722.3	1.3	Restore Default
Natural Gas	kWh	0.20322	1.20322	Restore Default
Gas Oil	tonnes	4090.6	4090.6	Restore Default
Fuel Oil	tonnes	3766.5	3766.5	Restore Default
Burning Oil	tonnes	3750.1	3750.1	Restore Default
Industrial Coal	tonnes	2718.2	2718.2	Restore Default
Liquid Petroleum Gas	kWh	0.24127	0.24127	Restore Default
Naptha	tonnes	3585	3585	Restore Default
Biodiesel	tonnes	2032.56	2032.56	Restore Default
Bioethanol	tonnes	2272	2272	Restore Default
Biomethane	tonnes	1328	1328	Restore Default

Figure 38 – Editable constants forms

There are four forms in total aligned to tabs. Each contains a set of constants that can be edited.

Editing Constants

Select one of the four tabs to edit a set of constants:

- Consumables – electricity, fuels, explosives and water.
- Transport – all transport modes and handling.
- Recycling and End-of-Life – the constants used in the asPECT Protocol Section 2.6 calculations and the recycled content/recyclability allocation can be modified here.
- Asphalt Courses – where aspirational design lifetimes can be altered.

TRL

Firstly locate the constant that you wish to edit. Then, moving across the screen from right to left, select the required unit and then specify the constant in the CO₂e conversion box. The default constant (as used in .acf files) is provided as a reference point. If you wish to restore the default constant then click the "Restore Default" button. Any of the constants listed in the form can be edited (and restored).

Clicking the "save constants" icon at the bottom right of the screen will close the screen. The specified constants will be utilised in all of the calculations throughout the remainder of the file, whether pre-existing or new.

If a file is opened that was created in a previous version of asPECT (pre-v3.1), then the constants file will initially display the original constants used when first opened as a .oaf file. If you choose to edit the constants file from here then the pre-2013 will be lost – clicking on "restore default" will bring up a v3.1 default constant.

Appendix A

Transport Assumptions

To allow the user to make the most accurate estimations of road transport emissions the asPECT software has been built to include the utilisation factors of vehicles in the calculations. This approach calculates the emissions for the whole journey and for the whole load carried. It is then necessary to attribute the emissions per tonne of the material/mixture conveyed.

For each category of road haulage vehicle a “maximum payload” is used to apportion emissions per tonne. For each journey, the emissions will be reported in kgCO₂e/t. The table below gives the maximum payload for each category.

Table 3 - Maximum payloads for road transport

	Max Payload (t)
Rigid	
>3.5-7.5t	2.4
>7.5-17t	10
>17t	20
Articulated	
>3.5-33t	18
>33t	30

Should the maximum payloads not be representative of the journeys undertaken in a given assessment, lower payloads can be reflected by adjusting the utilisation factor (f). These constants can also be modified in .oaf files, by selecting the transport tab via the Constants Icon.