Downer
Relationships creating success

Reconophalt™

Environmental Product Declaration in accordance with ISO 14025 and EN 15804

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AUSTRALASIA EPD®

Contents

Owner of the EPD

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Acknowledgement

Downer acknowledges the support of the South Australian Department for Infrastructure and Transport, the R2P Alliance, and Green Industries SA who co-funded this Environmental Product Declaration.

About Downer

At Downer, our customers are at the heart of everything we do.

We exist to create and sustain the modern environment, and our promise is to work closely with our customers to help them succeed, using world-leading insights and solutions.

Our business is founded on four pillars:

Safety

Zero Harm is embedded in Downer's culture and is fundamental to the company's future success

Delivery

We build trust by delivering on our promises with excellence while focusing on safety, value for money and efficiency

Relationships

We collaborate to build and sustain enduring relationships based on trust and integrity

Thought leadership

We remain at the forefront of our industry by employing the best people and having the courage to challenge the status quo

With a history dating back more than 150 years, Downer builds, manages and maintains road networks across Australia and New Zealand, and manufactures and supplies products and services to create safe, efficient and reliable journeys.

A leading manufacturer and supplier of bitumen-based products, Downer is an innovator in the sustainable asphalt industry and circular economy, using recycled products and environmentally sustainable methods to produce asphalt.

Reconophalt™ was born of Downer's rich history of identifying and understanding the evolving challenges our customers face, and working to develop innovative solutions to support our customer's continued success.

Reconophalt™ provides an avenue for our customers to realise the direct re-use of local waste streams, and further, provides for the full recovery of the high-economic and environmental value of the bitumen content within recycled asphalt pavement, which plays an important role in our various Reconophalt™ mix options.

Our research and development team continues to further develop and refine our Reconophalt™ product options to this day, with ongoing theoretical development, testing and trials to create new mixes that meet our customer's unique project challenges.

Program information

Program

EPD Australasia Limited

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Product category rules (PCR)

Asphalt Mixtures Product Category Classification v1.03 (2019-09-06): UN CPC 1533 & 3794; Appendix to Product Category Rules for Asphalt Mixtures - Australia (v2019-01-22)

PCR review

PCR review was conducted by The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com

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Independent third-party verification

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

☐ EPD process certification ☑ EPD verification

Third party verifier

Kimberly Robertson, Catalyst, PO Box 37228, Christchurch 8245, NZ
+64 3 329 6888/6880 www.catalystnz.co.nz | Verifier approved by: EPD Australasia

Procedure for follow-up

Procedure for follow-up of data during EPD validity involves third party verifier:

☑ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

Product information

Product name

Reconophalt™

Product identification

Asphalt containing high-recycled content to AS2150

Product description

Downer's Reconophalt™ is Australia's first asphalt product containing high-recycled content derived from true waste streams that would otherwise be bound for landfill. Materials are sourced through Downer's exclusive partnerships with Close the Loop, Repurpose It, Downer's own detritus repurposing facilities, and other suppliers of recycled resources.

Reconophalt™ is suitable for any application where standard C170/C320 binder is specified, for underlying base layers and non-modified wearing course asphalt. It has even been successfully used in modified-binder A15 e mixes.

Pavement construction using Reconophalt™ is as per traditional methodologies, using standard paving equipment.

Our mixes comply with AS2150 and standard state road authority specifications, while providing a marked increase in fatigue resistance for longer pavement life and superior resistance to deformation.

UN CPC code

15330

Other codes for product classification

ANZSIC Code 3101 Road and Bridge Construction

Geographical scope

South Australia

LCA information

Functional unit and Reference Service Life (RSL)

As per the PCR for Asphalt Mixtures (EPD Australasia , 2019), the functional unit for this study is one m^2 of paved Reconophalt surface which fulfils the specified quality criteria during the Reference Service Life (RSL) of 20 years.

Although the service life of asphalt is 20 years, the default service life of roads as per the Australian Appendix to PCR for Asphalt Mixtures (v2019-01-22) is 40 years. To adhere to this, the LCA is modelled such that there will be a complete replacement of asphalt at 20 years, thereby adding another 20 years to the service life of asphalt. Modules B1-C4 and D incorporate this consideration while calculating the impacts.

Databases and LCA software used

The software used was SimaPro® LCA software (v 9.0.5). The inventory data for the processes are entered in the LCA software and linked to the pre-existing background data for upstream feedstocks and services. Inventory data was selected per the standards, in the following order of preference:

1. The Australian Life Cycle Inventory Shadow Database (AusLCI shadow database) v1.27 being compiled by the Australian Life Cycle Assessment Society (ALCAS) – this data will comply with the AusLCI Data Guidelines (Australian Life Cycle Inventory Database Initiative (AusLCI), 2018). At the time of this report, the AusLCI shadow database was 2 years old.[1]
2. The Australian Life Cycle Inventory (AusLCI) v1.28 being compiled by the Australian Life Cycle Assessment Society (ALCAS) – this data will comply with the AusLCI Data Guidelines (Australian Life Cycle Inventory Database Initiative (AusLCI), 2018). At the time of this report, the AusLCI database was 2 years old.[2]
3. Australasian v2014.09 database which is the main Australasian database in SimaPro, which has been developed for use with LCA in Australia over the past 12 years. At the time of this report, the database was 6 years old.[3]
4. Ecoinvent 3.5 database (Ecoinvent Centre, 2018) for all processes taking place overseas i.e. outside Australia, using global average processes. At the time of this report, the Ecoinvent database was 2 years old.[4]

Description of system boundaries and excluded lifecycle stages

This EPD includes all life cycle stages from extraction of raw materials to disposal. The scope of this EPD is cradle to grave, while the geographic scope is the state of South Australia, wherein the construction site is within 23km radius of Downer's Wingfield asphalt plant.

All modules included in this EPD are marked as X in the table below and those excluded are marked as 'Module not declared' (MND). The system boundary for this EPD is depicted in Figure 1 overleaf.

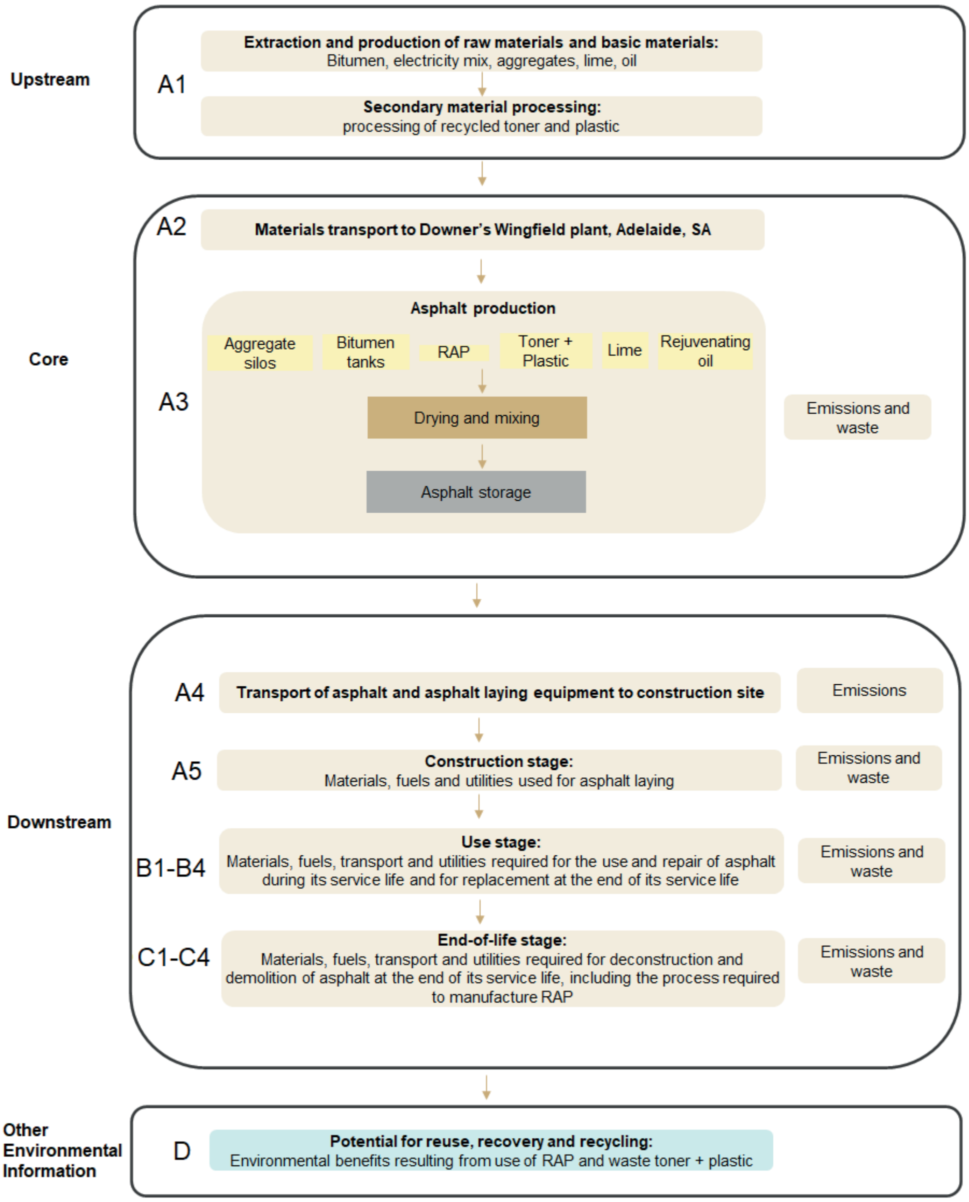
Table 1: Life Cycle of building products: stages and modules included in this EPD

GPI Module		Asset life cycle stage	Information module	Declared modules
Upstream	A1	Raw material supply	A1-3. Manufacturing stage	X
Core	A2	Transport		X
	A3	Manufacturing		X
Downstream	A4	Transport	A4-5. Construction stage	X
	A5	Construction, installation process		X
	B1	Material emissions from usage	B. Usage stage	X
	B2	Maintenance		X
	B3	Repair		X
	B4	Replacement		X
	B5	Refurbishment		MND
	B6	Operational energy use		MND
	B7	Operational water use		MND
	C1	Deconstruction and demolition	C. End of life	X
	C2	Transport		X
	C3	Waste processing		X
	C4	Disposal		X
Other environmental information	D	Reuse, recycle or recovery	D. Recyclability potentials	X

System diagram

The processes included in the LCA are presented in a process diagram in the figure below.

Figure 1: System diagram



Upstream processes

The upstream processes include those involved in Module A1 – Raw material supply. This module includes:

- Extraction, transport and manufacturing of raw materials.
- Generation of electricity from primary and secondary energy resources, also including their extraction, refining and transport for Modules A1 and A3.

Electricity inputs in foreground processes based in Australia were modelled based on the state-specific grid. The AusLCI database was used to model electricity in the foreground processes. The AusLCI dataset was updated using state specific grid data sourced from the Department of the Environment and Energy (Department of the Environment and Energy, March 2019).

Core processes

The core processes include those involved in Module A2 and Module A3, including:

- External transportation of materials to the core processes and internal transport.
- Manufacturing of the asphalt mixes.
- Treatment of external recycled materials for reuse.

Downstream processes

The downstream processes include those involved in Module A4 to C4, including:

- Transportation from the production gate to the construction site.
- Transport of waste generated from the construction site.
- Installation of the product on the site.
- Wastage of construction products (additional production processes to compensate for the loss of construction products included in module A1-A3).
- Waste processing of the waste from product wastage during the construction processes up to the end-of-waste state or disposal of final residues.
- Upstream and core processes involved in Module A1-A3 for the repair of asphalt during its useful life.
- Transport of equipment needed for repair.
- Maintenance activities necessaries during the service life of the asphalt
- Upstream and core processes involved in Module A1-A3 for the repair of asphalt during its useful life.
- Transport of equipment and use of materials for repair.
- Processes involved in Module A4-A5 for the replacement of asphalt during its useful life
- Transport of equipment and use of materials for deconstruction at the end of life.
- Transport of waste generated at the end of life for reuse.
- Treatment of waste generated at the end of life for reuse.

LCA modelling scenarios

Two scenarios were modelled to ensure a comprehensive lifecycle analysis of the product. These scenarios are currently in use and representative of one of the most likely scenario alternatives.

Scenario 1 assumes that at the end-of-life of the road i.e. 40 years, the asphalt is left as is and no deconstruction occurs. The only deconstruction occurring in this scenario is during the complete replacement of asphalt at 20 years.

Scenario 2 assumes that at the end-of-life of the road i.e. 40 years, deconstruction occurs and the asphalt removed is to be transported to Downer and Hallets for recycling into Recycled Asphalt Pavement (RAP). This means that in scenario 2, the deconstruction occurs twice i.e. once at 20 years and then at 40 years.

All environmental impacts from A1-B4 will thus be identical for scenario 1 and 2. Only the impacts from C1-C4 and benefits in D will change for scenario 2.

Data quality

Foreground data on raw material requirements, manufacture, construction, use and end of life inputs is for FY2018-2019. The data sources and their assessed quality are detailed in Table 2. Overall, the data quality for this LCA was considered High.

Table 2: Data Quality

Module	Input/output	Data source	Temporal scope	Quality
A1	Bitumen (C320 Binder)	Downer Mix Designs (Downer), Engineering Manager (Downer) and Department of the Environment and Energy	FY2018-2019	High
	Bitumen (C170 Binder)			
	Aggregates			
	Sand			
	RAP			
	Rejuvenating oil			
	Toner			
	Plastic			
A2	Transport distances from raw material suppliers to Downer's Asphalt Plant at Wingfield	Engineering Manager (Downer)	FY2018-2019	High
A3	Electricity and natural gas used for manufacturing of Reconophalt mixes	Electricity and gas bills from Downer and grid composition from the Department of the Environment and Energy	FY2018-2019	High
A4	Transport type and distances from Downer's Asphalt plant gate to construction site	Engineering Manager (Downer)	FY2018-2019	High

Module	Input/output	Data source	Temporal scope	Quality
A5	Energy water and materials required during asphalt laying	Engineering Manager (Downer)	FY2018-2019	Medium
	Waste generated during asphalt paving			Medium
B1	Use	Engineering Manager (Downer)	FY2018-2019	Medium
B2	Diesel and water consumption for road cleaning	Various local council websites and Sweeping contractor	FY2018-2019	Medium
B3	A1 - A3 inputs for 1% of asphalt	Downer Mix Designs (Downer), Engineering Manager (Downer) and Department of the Environment and Energy	FY2018-2019	High
	Equipment needed for repair (replace 1% of asphalt)	Asphalt paving methodology (Downer)	FY2018-2019	Medium
B4	A1 – A5 inputs to replace 100% of asphalt	Downer Mix Designs (Downer), Engineering Manager (Downer) and Department of the Environment and Energy	FY2018-2019	High
C1	Diesel and water consumption for deconstruction	Profiling Leading Hand (Downer)	FY2018-2019	High
C2	Transport of waste to recycling sites	Engineering Manager (Downer)	FY2018-2019	High
C3	Diesel and water used for processing at Downer's plant	Downer from Grant Wiles - Annual Diesel for RAP Processing	FY2018-2019	High
	Diesel and water used for processing at Hallets plant	Downer assuming Hallets have similar usage to Downer	FY2018-2019	Medium
C4	Materials disposed	Engineering Manager (Downer)	FY2018-2019	High
D	Materials recovered, recycled	Engineering Manager (Downer)	FY2018-2019	High

Allocation

According to the PCR 2018:04 Asphalt Mixtures (v1.03), in a process step where more than one type of product is generated, it is necessary to allocate the environmental stressors (inputs and outputs) from the process to the different products (functional outputs) to get product-based inventory data instead of process-based data. An allocation problem also occurs for multi-input processes.

The following allocation sections explain the allocations made in this EPD

Allocation of recycled content in toner, plastic (Tonerplas) and recycled asphalt paving (RAP)

Downer's Reconophalt mixes incorporate varying levels of Tonerplas and RAP. Based on the guidelines from PCR 2018:04 Asphalt Mixtures (v1.03), the transportation and processing impacts for recycled materials have been allocated to Downer. However, impacts from raw materials and extraction have been excluded as these are secondary waste materials. The waste toner and plastic are collected by Close the Loop in Melbourne and utilised to make the toner+plastic additive for asphalt. If not utilised for making the additive, these materials would otherwise have been landfilled and hence are classified as waste.

Allocation for energy used in manufacturing

Based on the guidelines of Australasian Appendix to PCR for Asphalt Mixtures (v2019-01-22), Method B is used for allocation of energy used in manufacturing of Recnonophalt, wherein energy consumption of the plant is allocated equally across all products (by mass).

Background data

The allocation approach for the generic databases utilised in this LCA is also compliant with the PCR. More specifically, the burden of primary production of materials is always allocated to the primary user of a material, while secondary (recycled) materials bear only the impacts of the recycling processes.

Compliance with standards

The LCA and EPD have been developed to comply with:

- ISO 14040:20065, ISO 14044:2006+A120186, ISO 14025:2006[5-7]
- EN15804:2012+A1:2013[8]
- The General Program Instructions (GPI) for the International EPD system v3.0[9]
- Instructions of the EPD Australasia Programme V3.0[10]
- PCR 2018:04 Asphalt mixtures (Version 1.03), 2019-09-06[11]
- Appendix to Product Category Rules for Asphalt Mixtures - Australia (v2019-01-22)[12]

Key assumptions

- All foreground data used for the manufacturing processes (up to factory gate), transportation to the asphalt plant, distribution, installation in Australia, usage, maintenance, repair, replacement, deconstruction, transport and waste processing was collected from Downer via a 'Request for Information' spreadsheet. This data was collected for the calendar year of 2018.
- For installation, the average distance of past construction jobs and tonnes of asphalt used per job by Downer was considered.
- It is assumed that 2% of the asphalt goes to waste during construction. The wasted asphalt is returned to Downer's plant for recycling This was based on data from Downer.
- According to Downer's data, minimal repair is required during the service life of asphalt. Overall, only 1% of the area (i.e. 1% of 1 m^2) will need to be the repaired and hence the materials, energy, transport associated with that are considered for repair.
- All processes required for processing of RAP are covered in waste processing (module C3) and no material is taken for landfill or energy recovery. Hence the impacts for disposal (module C4) are considered to be zero.

Content declaration

EPD Product description

Three Reconophalt mixes with varying RAP content have been included in this EPD (see Table 3).

Table 3: Reconophalt mixes included in this EPD

Product type	Mix name	RAP content
Asphalt	AC10 C320 R10	10%
	AC10 C320 R30	30%
	AC14 C170 R50	50%

The material composition for each of these mixes is shown in Table 4 and a graphical representation example of materials distribution for the AC14 mix is depicted in Figure 2

Table 4: Materials used for manufacturing for Mix AC10 C320 R10, AC10 C320 R30, Mix AC14 C170 R50 (per m^2 of asphalt)

Material	Mix AC10 C320 R10 (t)	AC10 C320 R30 (t)	Mix AC14 C170 R50 (t)
Binder	0.005	0.004	0.003
10mm Aggregate	0.015	0.012	0.010
7mm Aggregate	0.025	0.018	0.002
14mm Aggregate	0.000	0.000	0.017
Sand	0.041	0.032	0.016
RAP	0.010	0.029	0.048
Rejuvenating Oil	0.000	0.000	0.000
Tonerplas	0.001	0.001	0.001
Fine Aggregates	0.001	0.001	0.000
Utilities	Mix AC10 C320 R10	AC10 C320 R30	Mix AC14 C170 R50
Electricity (kWh)	0.260	0.260	0.260
Gas (MJ)	23.9	23.9	23.9

Table 5: Utilities used for manufacturing for Mix AC10 C320 R10, AC10 C320 R30, Mix AC14 C170 R50 (per m^2 of asphalt)

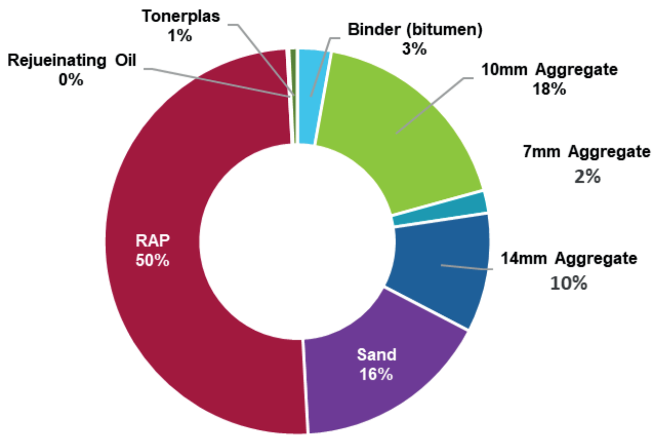
Utilities	Mix AC10 C320 R10 (t)	AC10 C320 R30 (t)	Mix AC14 C170 R50 (t)
Electricity (kWh)	0.260	0.260	0.260
Gas (MJ)	23.9	23.9	23.9

Please note that Rejuvenating oil is only used in the R30 and R50 mixes. The amount in table is zero due to rounding up. The actual amount used is 2.00E-04 t per m^2 of R30 and R50 mixes. Conversely, fine aggregates are used only in R10 and R30 mixes. All materials used in manufacturing of Reconophalt are delivered in bulk via trucks and no packaging material is involved.

Recycled material

The recycled asphalt pavement (RAP) used for manufacturing has recycled content of 100%. Tonerplas contains 50% recycled soft plastics and 50% toner waste (100% total recycled content). Since Downer makes its own RAP from the end-of-life asphalt materials, the RAP processing is included in module C4 and not A1. This has been done to align with the PCR, which states that processes which are part of the waste processing in the previous product system should not be included in A1, referring to the "polluter pays" principle.

Figure 2: Materials distribution for AC14 C170 R50 mix



Environmental performance

Environmental performance related information

The potential environmental impacts, use of resources and waste categories included in this EPD were calculated using the SimaPro v9 tool and are listed in Table 5 . All tables from this point will contain the abbreviation only.

The LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds and safety margins or risks. The impact assessment results are presented in the next sections.

Table 5: Life Cycle Impact, Resource and waste Assessment Categories, Measurements and Methods

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Potential Environmental Impacts			
Global warming potential (fossil)	GWPF	kg CO2 equivalents (GWP100)	CML (v4.1) with Land use and Biogenic carbon indicators from EF method
Global warming potential (biogenic)	GWPB	kg CO2 equivalents (GWP100)	EF method
Land use/ land transformation	GWPL	kg CO2 equivalents (GWP100)	EF method
Total global warming potential	GWPT	kg CO2 equivalents (GWP100)	Sum of the above
Acidification potential	AP	kg SO2 equivalents	CML (v4.1)
Eutrophication Potential	EP	kg PO43- equivalents	CML (v4.1)
Photochemical ozone creation potential	POCP	kg C2H2 equivalents	CML (v4.1)
Abiotic depletion potential (elements)	ADPE	kg Sb equivalents	CML (v4.1)
Abiotic depletion potential (fossil fuels)	ADPF	MJ net calorific value	CML (v4.1)
Ozone depletion potential	ODP	kg CFC 11 equivalents	CML (v4.1)
Resource use			
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value	ecoinvent version 2.0 and expanded by PRé Consultants[a & b]
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value	Manual for direct inputs[c]

[a] Method to calculate Cumulative Energy Demand (CED), based on the method published by Ecoinvent version 2.0 and expanded by PRé Consultants for raw materials available in the SimaPro database.

[b] Calculated as sum of Renewable, biomass, Renewable, wind, solar, geoth and Renewable, water.

[c] Calculated based on the lower heating value of renewable raw materials.

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value	ecoinvent version 2.0 and expanded by PRé Consultants
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value	Manual for direct inputs[d]
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value	ecoinvent version 2.0 and expanded by PRé Consultants
Total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value	ecoinvent version 2.0 and expanded by PRé Consultants[e]
Use of secondary material	SM	kg	Manual for direct inputs
Use of renewable secondary fuels	RSF	MJ, net calorific value	Manual for direct inputs
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	Manual for direct inputs
Use of net fresh water	FW	m3	ReCiPe 2016
Waste categories			
Hazardous waste disposed	HWD	kg	EDIP 2003 (v1.05)
Non-hazardous waste disposed	NHWD	kg	EDIP 2003 (v1.05) [f]
Radioactive waste disposed/ stored	RWD	kg	EDIP 2003 (v1.05)
Output flows			
Components for reuse	CRU	kg	Manual for direct inputs
Materials for recycling	MFR	kg	Manual for direct inputs
Materials for energy recovery	MFRE	kg	Manual for direct inputs
Exported energy	EE	MJ per energy carrier	Manual for direct inputs

[d] Calculated based on the higher heating value of non-renewable raw materials.

[e] Calculated as sum of Non-renewable, fossil, Non-renewable, nuclear and Non-renewable, biomass.

[f] Calculated as sum of Bulk waste and Slags/ash.

Environmental performance results – modules A1 to B4

Product stage (A1-A3) results per m^2 of asphalt

Environmental impact

Table 6: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A1-A3 per m^2 of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	6.25E+00	5.25E-03	5.86E-05	6.26E+00	3.25E-02	4.82E-03	2.01E-03	8.12E-06	2.79E+02	2.22E-06
AC10 C320 R30	5.29E+00	4.29E-03	4.63E-05	5.30E+00	2.60E-02	3.82E-03	1.62E-03	6.19E-06	2.30E+02	1.79E-06
AC14 C170 R50	4.40E+00	3.48E-03	3.40E-05	4.40E+00	1.91E-02	2.85E-03	1.22E-03	4.76E-06	1.76E+02	1.30E-06

Resource use

Table 7: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A1-A3 per m^2 of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	1.55E+00	0.00E+00	1.55E+00	2.89E+02	1.87E+02	4.76E+02	1.04E+01	0.00E+00	0.00E+00	1.59E-01
AC10 C320 R30	1.34E+00	0.00E+00	1.34E+00	2.38E+02	1.60E+02	3.98E+02	2.98E+01	0.00E+00	0.00E+00	1.24E-01
AC14 C170 R50	1.17E+00	0.00E+00	1.17E+00	1.80E+02	1.20E+02	3.00E+02	4.92E+01	0.00E+00	0.00E+00	8.87E-02

Waste categories

Table 8 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A1-A3 per m^2 of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	1.11E-04	4.47E-01	3.49E-07
AC10 C320 R30	8.79E-05	3.54E-01	2.74E-07
AC14 C170 R50	6.50E-05	2.87E-01	2.09E-07

Output flows

Table 9: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A1-A3 per m^2 of asphalt: Output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	9.60E-01	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	9.60E-01	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	9.60E-01	0.00E+00	0.00E+00

Results for transport to construction site (A4) per m² of asphalt

Environmental impact

Table 10: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A4 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	4.96E-01	2.93E-04	4.08E-06	4.96E-01	1.98E-03	4.48E-04	1.33E-04	1.78E-06	7.26E+00	6.10E-08
AC10 C320 R30	4.96E-01	2.93E-04	4.08E-06	4.96E-01	1.98E-03	4.48E-04	1.33E-04	1.78E-06	7.26E+00	6.10E-08
AC14 C170 R50	4.96E-01	2.93E-04	4.08E-06	4.96E-01	1.98E-03	4.48E-04	1.33E-04	1.78E-06	7.26E+00	6.10E-08

Resource use

Table 11: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A4 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	7.56E-02	0.00E+00	7.56E-02	7.19E+00	0.00E+00	7.19E+00	0.00E+00	0.00E+00	0.00E+00	2.50E-03
AC10 C320 R30	7.56E-02	0.00E+00	7.56E-02	7.19E+00	0.00E+00	7.19E+00	0.00E+00	0.00E+00	0.00E+00	2.50E-03
AC14 C170 R50	7.56E-02	0.00E+00	7.56E-02	7.19E+00	0.00E+00	7.19E+00	0.00E+00	0.00E+00	0.00E+00	2.50E-03

Waste categories

Table 12: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A4 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	9.29E-06	5.43E-02	3.82E-08
AC10 C320 R30	9.29E-06	5.43E-02	3.82E-08
AC14 C170 R50	9.29E-06	5.43E-02	3.82E-08

Output flows

Table 13: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A4 per m² of asphalt: Output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for asphalt mixture application (A5) per m² of asphalt

Environmental impact

Table 14: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A5 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	6.89E-01	2.66E-04	3.56E-06	6.89E-01	4.12E-03	8.51E-04	1.60E-04	3.65E-07	2.03E+01	2.26E-07
AC10 C320 R30	6.69E-01	2.47E-04	3.31E-06	6.70E-01	3.99E-03	8.32E-04	1.52E-04	3.26E-07	1.93E+01	2.18E-07
AC14 C170 R50	6.37E-01	2.28E-04	3.06E-06	6.37E-01	3.84E-03	8.11E-04	1.42E-04	2.97E-07	1.81E+01	2.07E-07

Resource use

Table 15: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A5 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	7.03E-02	1.18E-01	1.89E-01	2.14E+01	1.10E+01	3.23E+01	2.05E-01	0.00E+00	4.39E+00	5.98E-03
AC10 C320 R30	6.60E-02	1.18E-01	1.84E-01	2.04E+01	1.04E+01	3.08E+01	2.05E-01	0.00E+00	4.39E+00	5.29E-03
AC14 C170 R50	5.90E-02	1.18E-01	1.77E-01	1.92E+01	9.59E+00	2.88E+01	2.05E-01	0.00E+00	4.39E+00	4.60E-03

Waste categories

Table 16 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A5 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	5.56E-06	5.58E-02	2.96E-08
AC10 C320 R30	5.10E-06	5.39E-02	2.80E-08
AC14 C170 R50	4.64E-06	5.26E-02	2.67E-08

Output flows

Table 17 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact A5 per m² of asphalt: EPD output flows

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	1.92E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	1.92E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	1.92E+00	0.00E+00	0.00E+00

Results for use stage (B1) per m^2 of asphalt

Environmental impact

Table 18: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B1 per m^2 of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Resource use

Table 19: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B1 per m^2 of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste categories

Table 20: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B1 per m^2 of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00

Output flows

Table 21 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B1 per m^2 of asphalt: EPD Output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for maintenance (B2) per m² of asphalt

Environmental impact

Table 22: Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B2 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	2.36E-01	2.12E-04	9.60E-07	2.36E-01	1.47E-03	3.29E-04	4.98E-05	2.83E-07	3.21E+00	2.66E-08
AC10 C320 R30	2.36E-01	2.12E-04	9.60E-07	2.36E-01	1.47E-03	3.29E-04	4.98E-05	2.83E-07	3.21E+00	2.66E-08
AC14 C170 R50	2.36E-01	2.12E-04	9.60E-07	2.36E-01	1.47E-03	3.29E-04	4.98E-05	2.83E-07	3.21E+00	2.66E-08

Resource use

Table 23 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B2 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	3.38E-02	0.00E+00	3.38E-02	3.23E+00	0.00E+00	3.23E+00	0.00E+00	0.00E+00	3.66E-03	1.63E-02
AC10 C320 R30	3.38E-02	0.00E+00	3.38E-02	3.23E+00	0.00E+00	3.23E+00	0.00E+00	0.00E+00	3.66E-03	1.63E-02
AC14 C170 R50	3.38E-02	0.00E+00	3.38E-02	3.23E+00	0.00E+00	3.23E+00	0.00E+00	0.00E+00	3.66E-03	1.63E-02

Waste categories

Table 24 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B2 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	2.25E-06	1.14E-02	1.30E-08
AC10 C320 R30	2.25E-06	1.14E-02	1.30E-08
AC14 C170 R50	2.25E-06	1.14E-02	1.30E-08

Output flows

Table 25 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B2: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for repair (B3) per m² of asphalt

Environmental impact

Table 26 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B3 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	1.15E-01	8.19E-05	9.75E-07	1.15E-01	5.04E-04	8.64E-05	3.11E-05	2.34E-07	3.67E+00	3.04E-08
AC10 C320 R30	1.05E-01	7.20E-05	8.49E-07	1.05E-01	4.38E-04	7.63E-05	2.71E-05	2.14E-07	3.17E+00	2.60E-08
AC14 C170 R50	9.55E-02	6.38E-05	7.24E-07	9.56E-02	3.68E-04	6.64E-05	2.30E-05	2.00E-07	2.62E+00	2.10E-08

Resource use

Table 27 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B3 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	2.31E-02	1.18E-03	2.43E-02	3.77E+00	1.98E+00	5.76E+00	1.06E-01	0.00E+00	8.42E-01	1.92E-03
AC10 C320 R30	2.09E-02	1.18E-03	2.21E-02	3.25E+00	1.71E+00	4.96E+00	3.00E-01	0.00E+00	8.42E-01	1.56E-03
AC14 C170 R50	1.92E-02	1.18E-03	2.03E-02	2.67E+00	1.29E+00	3.96E+00	4.94E-01	0.00E+00	8.42E-01	1.20E-03

Waste categories

Table 28 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B3 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	1.99E-06	1.17E-02	7.58E-09
AC10 C320 R30	1.75E-06	1.08E-02	6.81E-09
AC14 C170 R50	1.52E-06	1.01E-02	6.15E-09

Output flows

Table 29 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B3 per m² of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for replacement of asphalt at 20 years (B4) per m² of asphalt

Environmental impact

Table 30 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B4 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	7.57E+00	5.92E-03	6.75E-05	7.58E+00	3.93E-02	6.23E-03	2.35E-03	1.04E-05	3.12E+02	2.56E-06
AC10 C320 R30	6.57E+00	4.92E-03	5.47E-05	6.58E+00	3.25E-02	5.19E-03	1.94E-03	8.41E-06	2.62E+02	2.11E-06
AC14 C170 R50	5.63E+00	4.08E-03	4.19E-05	5.63E+00	2.54E-02	4.18E-03	1.52E-03	6.92E-06	2.05E+02	1.60E-06

Resource use

Table 31 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B4 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	1.73E+00	1.21E-01	1.85E+00	3.23E+02	2.02E+02	5.26E+02	1.08E+01	0.00E+00	4.39E+00	1.71E-01
AC10 C320 R30	1.51E+00	1.21E-01	1.63E+00	2.70E+02	1.74E+02	4.44E+02	3.06E+01	0.00E+00	4.39E+00	1.35E-01
AC14 C170 R50	1.33E+00	1.21E-01	1.45E+00	2.11E+02	1.32E+02	3.42E+02	5.04E+01	0.00E+00	4.39E+00	9.77E-02

Waste categories

Table 32 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B4 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	1.28E-04	2.53E+00	4.25E-07
AC10 C320 R30	1.04E-04	2.43E+00	3.46E-07
AC14 C170 R50	8.03E-05	2.36E+00	2.78E-07

Output flows

Table 33 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact B4 per m² of asphalt: Output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	1.92E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	1.92E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	1.92E+00	0.00E+00	0.00E+00

Environmental performance results for Scenario 1 – modules C1 to D

Scenario 1 assumes that at the end-of-life of the road i.e. 40 years, the asphalt is left as is and no deconstruction occurs. The only deconstruction occurring in this scenario is during the complete replacement of asphalt at 20 years.

Results for removal of asphalt (C1) per m^2 of asphalt in scenario 1

Environmental impact

Table 34 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m^2 of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	4.79E-01	9.99E-05	1.26E-06	4.80E-01	3.53E-03	7.81E-04	8.95E-05	9.97E-08	6.44E+00	5.62E-08
AC10 C320 R30	4.79E-01	9.99E-05	1.26E-06	4.80E-01	3.53E-03	7.81E-04	8.95E-05	9.97E-08	6.44E+00	5.62E-08
AC14 C170 R50	4.79E-01	9.99E-05	1.26E-06	4.80E-01	3.53E-03	7.81E-04	8.95E-05	9.97E-08	6.44E+00	5.62E-08

Resource use

Table 35 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m^2 of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	2.04E-02	0.00E+00	2.04E-02	6.75E+00	0.00E+00	6.75E+00	0.00E+00	0.00E+00	5.13E+00	2.42E-03
AC10 C320 R30	2.04E-02	0.00E+00	2.04E-02	6.75E+00	0.00E+00	6.75E+00	0.00E+00	0.00E+00	5.13E+00	2.42E-03
AC14 C170 R50	2.04E-02	0.00E+00	2.04E-02	6.75E+00	0.00E+00	6.75E+00	0.00E+00	0.00E+00	5.13E+00	2.42E-03

Waste categories

Table 36 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m^2 of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	2.95E-06	5.97E-03	2.15E-08
AC10 C320 R30	2.95E-06	5.97E-03	2.15E-08
AC14 C170 R50	2.95E-06	5.97E-03	2.15E-08

Output flows

Table 37 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m^2 of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for transport to Downer/Hallett Resources (C2) per m² of asphalt in scenario 1

Environmental impact

Table 38 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	3.95E-01	2.34E-04	3.30E-06	3.95E-01	1.67E-03	3.82E-04	1.12E-04	1.44E-06	5.75E+00	4.79E-08
AC10 C320 R30	3.95E-01	2.34E-04	3.30E-06	3.95E-01	1.67E-03	3.82E-04	1.12E-04	1.44E-06	5.75E+00	4.79E-08
AC14 C170 R50	3.95E-01	2.34E-04	3.30E-06	3.95E-01	1.67E-03	3.82E-04	1.12E-04	1.44E-06	5.75E+00	4.79E-08

Resource use

Table 39 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	6.03E-02	0.00E+00	6.03E-02	5.69E+00	0.00E+00	5.69E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-03
AC10 C320 R30	6.03E-02	0.00E+00	6.03E-02	5.69E+00	0.00E+00	5.69E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-03
AC14 C170 R50	6.03E-02	0.00E+00	6.03E-02	5.69E+00	0.00E+00	5.69E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-03

Waste categories

Table 40 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	7.46E-06	3.94E-02	2.97E-08
AC10 C320 R30	7.46E-06	3.94E-02	2.97E-08
AC14 C170 R50	7.46E-06	3.94E-02	2.97E-08

Output flows

Table 41 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for waste processing (C3) per m² of asphalt in scenario 1

Environmental impact

Table 42 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	3.38E-01	6.28E-05	8.86E-07	3.38E-01	2.49E-03	5.51E-04	6.31E-05	6.95E-08	4.54E+00	3.96E-08
AC10 C320 R30	3.38E-01	6.28E-05	8.86E-07	3.38E-01	2.49E-03	5.51E-04	6.31E-05	6.95E-08	4.54E+00	3.96E-08
AC14 C170 R50	3.38E-01	6.28E-05	8.86E-07	3.38E-01	2.49E-03	5.51E-04	6.31E-05	6.95E-08	4.54E+00	3.96E-08

Resource use

Table 43 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	1.35E-02	0.00E+00	1.35E-02	4.76E+00	0.00E+00	4.76E+00	0.00E+00	0.00E+00	3.29E+00	8.84E-04
AC10 C320 R30	1.35E-02	0.00E+00	1.35E-02	4.76E+00	0.00E+00	4.76E+00	0.00E+00	0.00E+00	3.29E+00	8.84E-04
AC14 C170 R50	1.35E-02	0.00E+00	1.35E-02	4.76E+00	0.00E+00	4.76E+00	0.00E+00	0.00E+00	3.29E+00	8.84E-04

Waste categories

Table 44 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	2.08E-06	4.05E-03	1.51E-08
AC10 C320 R30	2.08E-06	4.05E-03	1.51E-08
AC14 C170 R50	2.08E-06	4.05E-03	1.51E-08

Output flows

Table 45 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for waste disposal (C4) per m² of asphalt in scenario 1

All waste from construction site goes to Downer/ Hallets for recycling into RAP. No waste goes to landfill or any other disposal avenue. Hence C4 impacts are zero. Waste processing impacts are covered in C3

Environmental impact

Table 46 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Resource use

Table 47 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste categories

Table 48 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00

Output flows

Table 49 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Benefits and loads beyond the system boundary (D) per m^2 of asphalt in scenario 1

The results below are for scenario 1 which assumes that at the end-of-life of the road i.e. 40 years, the asphalt is left as is and no deconstruction occurs. The only deconstruction occurring in this scenario is during the complete replacement of asphalt at 20 years.

Environmental impact

Table 50 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m^2 of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	-3.14E-01	-5.01E-04	-4.58E-06	-3.15E-01	-2.25E-03	-3.04E-04	-1.28E-04	-3.78E-07	-1.98E+01	-1.71E-07
AC10 C320 R30	-6.22E-01	-1.17E-03	-8.56E-06	-6.24E-01	-3.70E-03	-5.47E-04	-2.05E-04	-9.37E-07	-3.14E+01	-2.60E-07
AC14 C170 R50	-1.18E+00	-2.02E-03	-1.68E-05	-1.18E+00	-7.90E-03	-1.10E-03	-4.45E-04	-1.56E-06	-6.85E+01	-5.84E-07

Resource use

Table 51 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m^2 of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	-1.13E-01	0.00E+00	-1.13E-01	-2.04E+01	-1.54E+01	-3.59E+01	0.00E+00	0.00E+00	0.00E+00	-1.78E-02
AC10 C320 R30	-2.73E-01	0.00E+00	-2.73E-01	-3.17E+01	-2.32E+01	-5.48E+01	0.00E+00	0.00E+00	0.00E+00	-4.48E-02
AC14 C170 R50	-4.62E-01	0.00E+00	-4.62E-01	-7.02E+01	-5.25E+01	-1.23E+02	0.00E+00	0.00E+00	0.00E+00	-7.39E-02

Waste categories

Table 52 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m^2 of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	-7.89E-06	-4.35E-02	-3.03E-08
AC10 C320 R30	-1.41E-05	-1.12E-01	-7.19E-08
AC14 C170 R50	-2.85E-05	-1.82E-01	-1.23E-07

Output flows

Table 53 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m^2 of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Environmental performance results for Scenario 2 – modules C1 to D

Scenario 2 assumes that at the end-of-life of the road i.e. 40 years, deconstruction occurs and the asphalt removed is to be transported to Downer and Hallets for recycling into RAP. This means that in scenario 2, the deconstruction occurs twice i.e. once at 20 years and then at 40 years. All environmental impacts from A1-B4 are identical for scenario 1 and 2. Only the impacts from C1-C4 and benefits in D will change for scenario 2.

Results for removal of asphalt (C1) per m² of asphalt in scenario 2

Environmental impact

Table 54 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m² of asphalt: EPD primary impact categories

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	1.01E+00	2.29E-04	2.90E-06	1.01E+00	7.21E-03	1.60E-03	1.89E-04	3.61E-07	1.36E+01	1.19E-07
AC10 C320 R30	1.01E+00	2.29E-04	2.90E-06	1.01E+00	7.21E-03	1.60E-03	1.89E-04	3.61E-07	1.36E+01	1.19E-07
AC14 C170 R50	1.01E+00	2.29E-04	2.90E-06	1.01E+00	7.21E-03	1.60E-03	1.89E-04	3.61E-07	1.36E+01	1.19E-07

Resource use

Table 55 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m² of asphalt: EPD resource parameters

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	4.83E-02	0.00E+00	4.83E-02	1.42E+01	0.00E+00	1.42E+01	0.00E+00	0.00E+00	1.03E+01	5.12E-03
AC10 C320 R30	4.83E-02	0.00E+00	4.83E-02	1.42E+01	0.00E+00	1.42E+01	0.00E+00	0.00E+00	1.03E+01	5.12E-03
AC14 C170 R50	4.83E-02	0.00E+00	4.83E-02	1.42E+01	0.00E+00	1.42E+01	0.00E+00	0.00E+00	1.03E+01	5.12E-03

Waste categories

Table 56 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m² of asphalt: EPD waste categories

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	6.79E-06	1.92E-02	4.72E-08
AC10 C320 R30	6.79E-06	1.92E-02	4.72E-08
AC14 C170 R50	6.79E-06	1.92E-02	4.72E-08

Output flows

Table 57 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C1 per m² of asphalt: EPD output flow categories

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for transport of waste to Downer/Hallett Resources (C2) per m² of asphalt in scenario 2

Environmental impact

Table 58 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD primary impact categories – Scenario 2

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	7.90E-01	4.67E-04	6.60E-06	7.91E-01	3.34E-03	7.63E-04	2.24E-04	2.89E-06	1.15E+01	9.59E-08
AC10 C320 R30	7.90E-01	4.67E-04	6.60E-06	7.91E-01	3.34E-03	7.63E-04	2.24E-04	2.89E-06	1.15E+01	9.59E-08
AC14 C170 R50	7.90E-01	4.67E-04	6.60E-06	7.91E-01	3.34E-03	7.63E-04	2.24E-04	2.89E-06	1.15E+01	9.59E-08

Resource use

Table 59 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD resource parameters – Scenario 2

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	1.21E-01	0.00E+00	1.21E-01	1.14E+01	0.00E+00	1.14E+01	0.00E+00	0.00E+00	0.00E+00	3.86E-03
AC10 C320 R30	1.21E-01	0.00E+00	1.21E-01	1.14E+01	0.00E+00	1.14E+01	0.00E+00	0.00E+00	0.00E+00	3.86E-03
AC14 C170 R50	1.21E-01	0.00E+00	1.21E-01	1.14E+01	0.00E+00	1.14E+01	0.00E+00	0.00E+00	0.00E+00	3.86E-03

Waste categories

Table 60 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD waste categories – Scenario 2

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	1.49E-05	7.88E-02	5.94E-08
AC10 C320 R30	1.49E-05	7.88E-02	5.94E-08
AC14 C170 R50	1.49E-05	7.88E-02	5.94E-08

Output flows

Table 61 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C2 per m² of asphalt: EPD output flow categories – Scenario 2

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for waste processing (C3) per m² of asphalt in scenario 2

Environmental impact

Table 62 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD primary impact categories – Scenario 2

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	6.76E-01	1.26E-04	1.77E-06	6.76E-01	4.98E-03	1.10E-03	1.26E-04	1.39E-07	9.07E+00	7.93E-08
AC10 C320 R30	6.76E-01	1.26E-04	1.77E-06	6.76E-01	4.98E-03	1.10E-03	1.26E-04	1.39E-07	9.07E+00	7.93E-08
AC14 C170 R50	6.76E-01	1.26E-04	1.77E-06	6.76E-01	4.98E-03	1.10E-03	1.26E-04	1.39E-07	9.07E+00	7.93E-08

Resource use

Table 63 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD resource parameters – Scenario 2

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	2.70E-02	0.00E+00	2.70E-02	9.52E+00	0.00E+00	9.52E+00	0.00E+00	0.00E+00	6.59E+00	1.77E-03
AC10 C320 R30	2.70E-02	0.00E+00	2.70E-02	9.52E+00	0.00E+00	9.52E+00	0.00E+00	0.00E+00	6.59E+00	1.77E-03
AC14 C170 R50	2.70E-02	0.00E+00	2.70E-02	9.52E+00	0.00E+00	9.52E+00	0.00E+00	0.00E+00	6.59E+00	1.77E-03

Waste categories

Table 64 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD waste categories – Scenario 2

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	4.15E-06	8.10E-03	3.03E-08
AC10 C320 R30	4.15E-06	8.10E-03	3.03E-08
AC14 C170 R50	4.15E-06	8.10E-03	3.03E-08

Output flows

Table 65 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C3 per m² of asphalt: EPD output flow categories – Scenario 2

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for waste disposal (C4) per m² of asphalt in scenario 2

All waste from construction site goes to Downer/ Hallets for recycling into RAP. No waste goes to landfill or any other disposal avenue. Hence C4 impacts are zero. Waste processing impacts are covered in C3

Environmental impact

Table 66 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD primary impact categories – Scenario 2

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Resource use

Table 67 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD resource parameters – Scenario 2

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste categories

Table 68 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD waste categories – Scenario 2

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00

Output flows

Table 69 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact C4 per m² of asphalt: EPD output flow categories – Scenario 2

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Benefits and loads beyond the system boundary (D) per m² of asphalt in scenario 2

The results presented below are for scenario 2, which assumes that at the end-of-life of the road i.e. 40 years, deconstruction occurs and the asphalt removed is to be transported to Downer and Hallets for recycling into RAP. This means that in scenario 2, the deconstruction occurs twice i.e. once at 20 years and then at 40 years. Hence the benefits for scenario 2 will be higher than those in scenario 1.

Environmental impact

Table 70 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m² of asphalt: EPD primary impact categories – Scenario 2

Mix name	GWPF	GWPB	GWPL	GWPT	AP	EP	POCP	ADPE	ADPF	ODP
	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg SO2 eq	kg PO43- eq	kg C2H2 eq	kg Sb eq	MJ	kg CFC 11 eq
AC10 C320 R10	-6.29E-01	-1.00E-03	-9.17E-06	-6.30E-01	-4.51E-03	-6.08E-04	-2.56E-04	-7.55E-07	-3.95E+01	-3.42E-07
AC10 C320 R30	-1.24E+00	-2.35E-03	-1.71E-05	-1.25E+00	-7.39E-03	-1.09E-03	-4.10E-04	-1.87E-06	-6.28E+01	-5.21E-07
AC14 C170 R50	-2.36E+00	-4.03E-03	-3.37E-05	-2.37E+00	-1.58E-02	-2.20E-03	-8.90E-04	-3.12E-06	-1.37E+02	-1.17E-06

Resource use

Table 71 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m² of asphalt: EPD resource parameters – Scenario 2

Mix name	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
	MJ	MJ	MJ	MJ	MJ	MJ	kg	MJ	MJ	m3
AC10 C320 R10	-2.26E-01	0.00E+00	-2.26E-01	-4.09E+01	-3.09E+01	-7.17E+01	0.00E+00	0.00E+00	0.00E+00	-3.55E-02
AC10 C320 R30	-5.47E-01	0.00E+00	-5.47E-01	-6.33E+01	-4.63E+01	-1.10E+02	0.00E+00	0.00E+00	0.00E+00	-8.97E-02
AC14 C170 R50	-9.24E-01	0.00E+00	-9.24E-01	-1.40E+02	-1.05E+02	-2.45E+02	0.00E+00	0.00E+00	0.00E+00	-1.48E-01

Waste categories

Table 72 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m² of asphalt: EPD waste categories – Scenario 2

Mix name	HWD	NHWD	RWD
	kg	kg	kg
AC10 C320 R10	-1.58E-05	-8.69E-02	-6.07E-08
AC10 C320 R30	-2.81E-05	-2.24E-01	-1.44E-07
AC14 C170 R50	-5.69E-05	-3.65E-01	-2.46E-07

Output flows

Table 73 - Mix AC10 C320 R10, AC10 C320 R30 and AC14 C170 R50 environmental impact D per m² of asphalt: EPD output flow categories – Scenario 2

Mix name	CRU	MFR	MFER	EE
	kg	kg	kg	MJ per energy carrier
AC10 C320 R10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC10 C320 R30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AC14 C170 R50	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Interpretation of results

Across upstream, core and downstream, the replacement stage (module B4) is the most significant contributor to potential environmental impacts accounting for 44-45% of the GWPF indicator. It also accounts for 46-47%GWPB, 46-47% GWPL, 42-45%AP, 40-43% EP, 45-47%POCP, 42-45% ADPE, 47-48% ADPF and 47-48% ODP. Manufacturing (module A1-A3) is the second most significant contributor to impacts followed by road construction (module A5).

In terms of resource use and across all modules (A1-D), the largest energy use comes from non-renewable primary energy resources (PENRT). Within this, non-renewable primary energy excluding non-renewable primary energy sources used as raw materials (PENRE) account for 62-63%.

In terms of waste and across all modules, almost a 100% of the waste disposed is non- hazardous waste (NHWD).

Impacts from the replacement stage (module B4) are the highest because it includes the impacts from the production of the asphalt needed for replacement (module A1-A3), the transport to construction site (module A4) and construction impacts (module A5).

For the AC10 C320 R10 and R30 mixes, the binder i.e. bitumen is the most significant contributor to the production stage emissions (36-37%), followed by gas used for manufacturing (24-35%) and sand transport (8-15%).

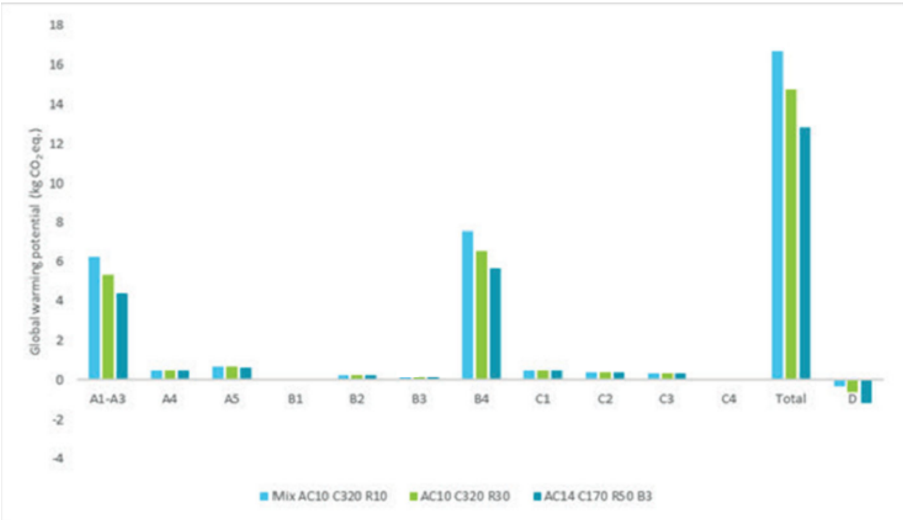
Although the amount of gas used for manufacturing is same for all mixes, it is the most significant contributor (35%) of the A1-A3 GWPF impacts for AC14 C170 R50 mix, followed by the binder (31%) and sand transport (8%). GWPF values for modules A1-D for the three Reconophalt mixes are depicted in the figure below. Polymer modified bitumen is not used in any of the mixes in this EPD, however if used, it can result in a 9% increase in GWPF for bitumen or 2% increase in GWPF emissions for the production stage (module A1-A3).

The distance from manufacturing to construction site in this EPD is calculated as 23km. However, if the construction site is further than this, it will increase the environmental impact of modules A4-A5, B2-B4 and C1-C2. For example, if the construction site is 50 km from Downer's Wingfield plant, the GWPF impacts of Mix AC 10 320 R10, AC10 320 R30 and AC 14 C170 R50 will increase by 11%, 12% and 14% respectively. Similarly, if the construction site is 100 km from Downer's Wingfield plant, the increase will be 31%, 35% and 40% respectively. There is no effect on the environmental impacts associated with the production stage i.e. modules A1-A3

Overall, the AC12 C170 R50 mix has the lowest impacts across most indicator of the three mixes except SM. This is mainly because it has the highest RAP content of the three mixes i.e. 50% compared to 10% and 30% for the AC10 mixes. Higher RAP content reduces the amount of virgin bitumen required in the mix, thereby lowering the environmental impacts.

Furthermore, the RAP also reduces the amount of aggregates, including sand and its associated transport from quarries. The avoided production of materials in mix AC14 C170 R50 represents a high percentage reduction in GWPF emissions compared to the mixes containing fewer recycled materials. GWPF values for modules A1-D for 3 Reconophalt mixes are depicted in Figure 3.

Figure 3: GWPF for modules A1-D (per m^2) for Reconophalt mixes included in this EPD



Differences vs previous version

The following changes have been made in this EPD compared to its previous version:

- Reference to PCR 2012:01 Construction Products and Services (v2.33) was deleted on page 2
- Reference to PCR 2012:01 Construction Products and Services (v2.33) in the section pertaining to Allocation on page 10 was amended to refer to PCR 2018:04 Asphalt Mixtures (v1.03)
- Reference to PCR 2012:01 Construction Products and Services (v2.33) in Compliance to Standards section on Page 11 was deleted
- Reference to PCR 2012:01 Construction Products and Services (v2.33) in References section on Page 37 was deleted
- Revision date added on the cover page

Acronyms

ADPE	Abiotic Depletion Potential (Elements)
ADPF	Abiotic Depletion Potential (Fossil fuels)
ANZSIC	Australian and New Zealand Standard Industrial Classification
AP	Acidification Potential
CED	Cumulative Energy Demand
CO2	Carbon Dioxide
CRU	Components for reuse
EE	Exported Energy
EN	European Standards
EP	Eutrophication Potential
EPD	Environmental Product Declaration
FW	Fresh Water
GPI	General Program Instructions
GWPB	Global Warming Potential (Biogenic)
GWPF	Global Warming Potential (Fossil)
GWPL	Ground Water Potential Level
GWPT	Total Global Warming Potential
HWD	Hazardous Waste Disposed
ISO	International Organisation of Standardisation
KG	Kilogram
LCA	Life Cycle Assessment
MFR	Materials For Recycling
MFRE	Materials For Energy Recovery
MND	Module Not Declared
NHWD	Non-Hazardous Waste Disposed
NRSF	Non-Renewable Secondary Fuels
ODP	Ozone Depletion Potential
PCR	Product Category Rules
PENRE	Primary Energy Non-Renewable, Energy
PENRM	Primary Energy Non-Renewable, Material

PENRT	Primary Energy Non-Renewable Total
PERE	Primary Energy Renewable, Energy
PERM	Primary Energy Renewable, Material
PERT	Primary Energy Renewable, Total
POCP	Photochemical Ozone Creation Potential
RAP	Recycled Asphalt Pavement
RSF	Renewable Secondary Fuels
RSL	Reference Service Life
RWD	Radioactive Waste Disposed
SM	Secondary Material

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