ENVIRONMENTAL PRODUCT DECLARATION (EPD)

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021

SAMIBioPrime

Programme: The International EPD® System www.environdec.com
Programme operator: EPD International AB
Regional Programme: EPD Australasia www.epd-australasia.com
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Geographical scope: Australia

EPD of a single bituminous binder product as an average from multiple locations.
An EPD should provide current information and may be updated if conditions change.
The stated validity is therefore subject to the continued registration and publication at www.environdec.com

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DISCLAIMER

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

PROGRAMME INFORMATION AND VERIFICATION

An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category. These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs. This EPD provides environmental indicators for a selected bitumen binder product, manufactured at SAMI's facilities in Australia. This EPD is a "cradle-to-gate plus modules C1-C4, D" declaration covering production and end-of-life life cycle stages. This EPD is verified to be compliant with EN 15804. EPDs of construction products may not be comparable if they do not comply with EN15804. EPDs within the same product category but from different programs or utilising different PCR documents may not be comparable, see the disclaimer on the previous page. SAMI Bitumen Technologies Pty Ltd, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

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CEN standard EN 15804 served as the core PCR

PCR	PCR 2019:14 Construction Products, Version 1.3.4, 2024-04-30 (valid until 2025-06-20) (Note: this EPD also follows the Technical guidance for developing EPDs according to EN 15804+A2:2019 for Asphalt mixtures – Australia, EPD Australasia, 27 April 2022)
PCR review was conducted by	The Technical Committee of the International EPD® System. See www.environdec.com for a list of members. Most recent review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Independent verification of the declaration and data, according to ISO 14025	☒ EPD verification by individual verifier
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Procedure for follow-up of data during EPD validity involves third-party verifier:	☐ Yes ☒ No

ABOUT SAMI

Founded in 1978, SAMI Bitumen Technologies is one of the largest suppliers of bitumen in Australia. With import terminals and bulk storage facilities in all major cities, SAMI is well-equipped to meet the diverse demands of the road construction industry across the country.

We operate four production plants located in Sydney (Camellia), Melbourne (Laverton), Brisbane (Pinkenba), and Perth (Kwinana), with state-of-the-art manufacturing processes that enable us to produce a wide range of bitumen grades, including hard grades, multigrade, and EME2 binders, as well as various types and grades of polymer-modified binders, crumb rubber modified binders, bitumen emulsions, cutback bitumen, crack sealant mastics, and ready-to-use cold mixes.

Research and Development is at the core of SAMI's operations, ensuring we remain at the forefront of innovation and technology in the industry. Our proprietary products are designed to meet the rigorous requirements of various applications, including airports, ports, roads, and highways, particularly in high-traffic load conditions and extreme weather scenarios.

Sustainability is a fundamental principle at SAMI. By using lower carbon emission products and developing high-performance long-lasting solutions, we are leading the industry towards a more sustainable future. We actively promote cold and warm mix technologies to further demonstrate our commitment to environmentally responsible practices.

PRODUCT DESCRIPTION

This EPD covers SAMIBioPrime. SAMIBioPrime is a bio-based bitumen emulsion prime that is free from any petroleum solvents, designed for use as a fast-penetrating and safe prime coat.

Bitumen emulsion is a colloidal suspension of tiny bitumen droplets in water, stabilized by emulsifying agents. This product is widely used in the construction and maintenance of roads, pavements, and other infrastructure projects due to its versatility and ease of application.

SAMI produces all types and grades of modified and unmodified bitumen emulsions in all of our production facilities located in major cities across Australia.

Bitumen emulsion comes in various types, including cationic, anionic, and nonionic emulsions, each suitable for different applications depending on the specific requirements of the project. The use of bitumen emulsion allows for effective binding of aggregates, improved adhesion, and enhanced flexibility in asphalt mixtures.

One of the key advantages of bitumen emulsion is its ability to be applied at lower temperatures compared to traditional hot bitumen, which reduces energy consumption and enhances worker safety. Additionally, bitumen emulsions are environmentally friendly, as they produce fewer emissions during application and can often be used in cold and warm weather conditions.

Common applications of bitumen emulsion include sprayed seals, seal coats, microsurfacing, tack coat, prime coat and as a binder in cold mix asphalt. The product is compatible with various aggregate materials, providing a durable and resilient surface suitable for heavy traffic loads. Overall, bitumen emulsion is a crucial material for modern road construction, offering efficiency and sustainability in pavement solutions.

Bitumen emulsion offers significant sustainability and environmental benefits in comparison to traditional hot bitumen applications. One of the key advantages is its lower temperature application, which reduces energy consumption during the mixing and application processes, leading to decreased greenhouse gas emissions.

Additionally, because bitumen emulsion can be applied in cold and warm conditions, it minimizes the need for heating equipment, further lowering the carbon footprint associated with road construction and maintenance.

Furthermore, the use of bitumen emulsion can promote the recycling of materials, as it can effectively bind reclaimed asphalt and aggregates, reducing the demand for new raw materials. This not only conserves natural resources but also minimizes waste, contributing to a circular economy within the construction industry. By enhancing the durability and lifespan of pavement surfaces, bitumen emulsion ultimately supports sustainable infrastructure development while addressing environmental concerns.

CONTENT DECLARATION

SAMI Bitumen Technologies is able to design modified binders and emulsions to specific needs of the customer. The product composition of the product included in this EPD is presented in Table 1. For reasons of confidentiality, a range is provided.

Table 1: Product content per declared unit

Ingredient	Proportion (kg/tonne)	Post-consumer material, weight (%)	Renewable material, weight (%)	Renewable material, kg C/declared unit
Bitumen	200 - 680	0%	0%	0
SBS polymer	0 - 50	0%	0%	0
Caustic soda	0 - 5	0%	0%	0
Hydrochloric acid	0 - 10	0%	0%	0
Bio Oil	0 - 150	0%	0 - 15%	0 - 108
Kerosene	0 - 160	0%	0%	0
Sodium Chloride	0 - 5	0%	0%	0
Emulsifiers	0 - 20	0%	0%	0
Water	290 - 640	0%	0%	0
Total	**1 000 kg**	**0%**	**0 - 15%**	**0 - 108**

The product, as supplied, is non-hazardous. The products included in this EPD do not contain any substances of very high concern as defined by European REACH regulation* in concentrations >0.1% (m/m).

The product code for bitumen binders is UN CPC 335 (Petroleum jelly; paraffin wax, microcrystalline petroleum wax, slack wax, ozokerite, lignite wax, peat wax, other mineral waxes, and similar products; petroleum coke, petroleum bitumen and other residues of petroleum oils or of oils obtained from bituminous materials) and ANZSIC 33210 (Bitumen wholesaling).

* Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals.

TECHNICAL COMPLIANCE

SAMI Bitumen Technologies' binder products comply with relevant technical specifications as per Australian specifications and standards (e.g. Australian Standards *AS 2008: Residual Bitumen for Pavements* and *AS 1160: Bituminous emulsions for the construction and maintenance of pavements*), applicable legislation, regulations and industry standards plus project requirements.

DECLARED UNIT

"1 metric tonne (1 000 kg) of bituminous binder"

The density of this product is 940 kg/m^3.

SCOPE OF THE ENVIRONMENTAL PRODUCT DECLARATION

This EPD covers life cycle stages A1-3, C1-4 and D. This EPD covers the processes that occur in as many of the product's life cycle stages as could be effectively modelled. Stages A4, A5 and B1-7 have not been included as these are better defined at road project or structure level.

Table 2: Scope of the EPD

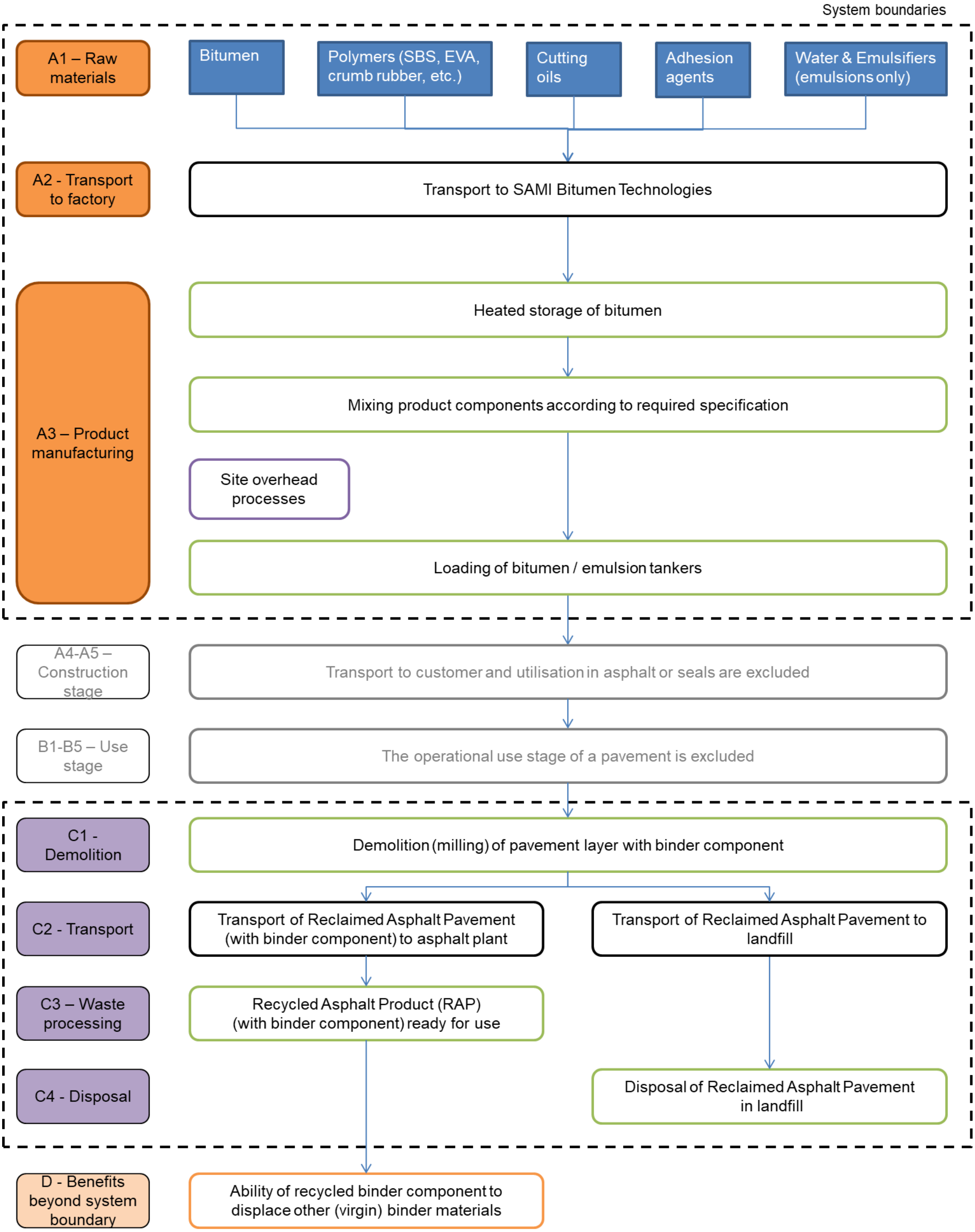
Stages	Product Stage			Construction Stage		Use Stage							End-of-life Stage				Benefits beyond system boundary
	Raw Materials	Transport	Production	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/Demolition	Transport	Waste Processing	Disposal	Reuse, recovery, recycling potential
Modules	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
				Scenario		Scenario							Scenario				Scenario
Modules Declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	GLO	AU	AU										AU	AU	AU	AU	AU
Share of specific data*	7%																
Variation products	0%																
Variation sites**	<10%																

X = module is included in this study
ND = module is not declared. When a module is not accounted for, the stage is marked with "ND" (Not Declared).
ND is used when we cannot define a typical scenario.

**The percentage specific data is relatively low, as generic data for raw materials contribute significantly more to the GWP-GHG results than SAMI's manufacturing processes.*

*** Variation across sites is due to differences in the operation of our manufacturing plants and variances in supply chain logistics.*

Figure 1. System boundary diagram



PRODUCT STAGE (A1-A3)

Raw Materials – Module A1

Extraction and processing of raw materials results in environmental impacts from the use of energy and resources, as well as from process emissions and waste.

Bitumen is produced from crude oil. Kerosene, aromatic oils, polymers and other minor ingredients are typically manufactured by the petrochemical and chemical industries. Crumb rubber (from used tyres) is used as a polymer in a large range of our products. Bio-based oils and bio-based fluxes are used as substitutes for petrochemical products in our SAMIGreen and SAMIBio range of products.

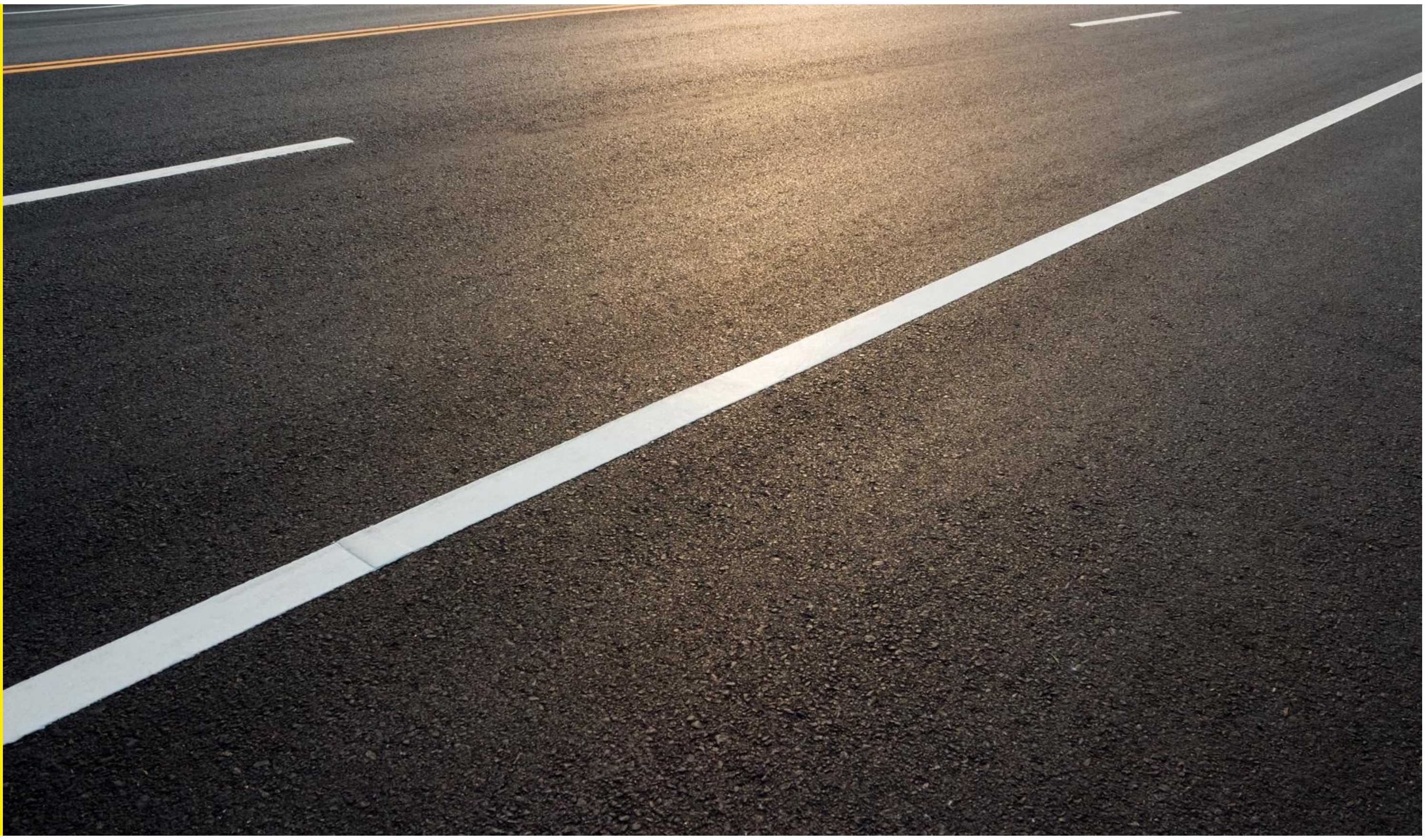
Transportation – Module A2

Hot bitumen is imported via bulk ships and stored in heated tanks at import terminals. Hot bitumen tankers transport the bitumen to our sites. Other raw materials are typically transported from suppliers (or from the receiving port if it is shipped from overseas) to our manufacturing sites via trucks. Transport of raw materials has been included in the LCA based upon estimated transport modes and distances relevant to our sites, with the exception of bitumen, for which we used the default distance (8 940 km) as per EPDA 2022.

Manufacturing – Module A3

The manufacture of bitumen emulsion involves a controlled process where bitumen is mixed with water and emulsifying agents to create a stable colloidal suspension. The process typically begins by heating the bitumen to a specific temperature to reduce its viscosity, facilitating better mixing. Once heated, the bitumen is rapidly pumped into a high-shear mixer, where it is combined with water and the emulsifying agent. This intense mixing generates a fine dispersion of bitumen droplets within the water phase, forming the emulsion.

The "**Construction process stage**" and "**Use stage**" have been excluded from the life cycle assessment, as the bitumen binder can be used for a range of different applications for which the use scenarios are unknown. The impacts of these stages are best determined at project level.



END OF LIFE STAGE (C1-C4)

Bituminous binder products reach the end-of-life as a component of a flexible pavement material (asphalt or seal). The end-of-life modules are therefore based on generic scenarios for pavement, in line with the Technical Guidance document (EPDA 2022). The scenarios included are currently in use and are representative for one of the most probable alternatives. The impacts assigned to bitumen binder products assume that the end-of-life processes can be attributed to the pavement components on a mass basis. For example, the energy required for the milling of 1 tonne of asphalt pavement (in module C1) is considered to be equal to the energy required for the milling of 1 tonne of bituminous binder product at end-of-life.

For this EPD, we applied the end-of-life scenario for pavement in regional areas. This scenario assumes 75% of asphalt is recycled into new asphalt, while the remaining 25% is downcycled into a granular subbase material.

The recycling of bituminous binder (in pavement materials) at its end-of-life leads to a reduction in the demand for virgin materials. Recycled bitumen replaces new bitumen, while recovered aggregates (both coarse and fine) substitute virgin crushed rock and sand. When downcycled, recycled asphalt is used for road base applications, leading to the replacement of virgin materials typically used in such constructions, thereby extending the usefulness of the reclaimed materials. These substitutions are beneficial as they reduce the need for processes involved in extracting and refining new materials. The benefits are reflected in the negative result values (= credits) in module D.

Note that recycling processes that may be expected in module C3, are covered by module A1-A3 to avoid double counting. This is explained in section 2.3 of the Technical Guidance document (EPDA 2022). We have listed the parameter Materials for Recycling (MFR) in module C3 to capture the amount of material collected for recycling at end-of-life, as well as the mandatory balancing (where relevant) of the GWP-biogenic indicator, PERM and PENRM parameters.

Table 3: End-of-life scenario parameters

Processes	Quantity per tonne of binder	Unit
Collection process specified by type	0 420	kg collected separately kg collected with mixed construction waste (as a component of asphalt)
Transport from demolition site to recovery / disposal sites	30	km transport
Recovery system specified by type	0 420 0	kg for re-use kg for recycling (outside the system boundaries*) kg for energy recovery
Disposal to landfill	0	kg product or material for final deposition
Assumptions for scenario development		Upon application of this product, water and kerosene evaporate. 58% of the product therefore does not reach the end-of-life. Module C1 (demolition) requires: 14.7 MJ/t diesel for milling; 5.0 MJ/t diesel for screening, and 5.4L/t of water Module C3 requires no further energy or material inputs; although 108 kg of biogenic carbon present in the recycled material is artificially released as per the PCR.

**The recycling process (crushing/screening) takes place at an asphalt plant and is an integral part of asphalt production. Therefore, it is considered outside the system boundaries as per EPDA 2022.*

RESOURCE RECOVERY STAGE (D)

Module D includes any benefits and loads from net flows leaving the product system (that have passed the end-of-waste state). Any binder material collected for recycling and processed in Module C3 is considered to go through to Module D. Recycled binder (as a component of Recycled Asphalt Pavement – the output of module C3) replaces virgin binder in module D.

Default values for the parameters in module D are taken from EPDA 2022 and presented in the following table.

Table 4: Module D scenario parameters

Parameter	Unit / effect
$M_{MR\ out}$ = 75%	amount of bituminous product exiting the system that will be recycled in a subsequent system*
$M_{MR\ in}$ = 0%	amount of recycled input material in bituminous product Note: The secondary material input of crumb rubber does not affect the net flow calculation.
Y = 100%	the material yield, between point of end-of-waste (M-EoW) in modules A4-C4 and point of substitution (M-DoS) in module D (when the material has been upgraded). Y = 100% for recycled material and Y = 1% for downcycled material*
$E_{MR\ after\ EoW\ out}$ = 0.267 L diesel/t (material reaching EoL)	specific emissions and resources consumed per unit of analysis arising from material recovery processes of a subsequent system after the end-of-waste state. This covers crushing, screening and stockpiling of recycled bituminous material. Process: *Diesel, burned in building machine*
$E_{VMSub\ out}$ = imported bitumen	specific emissions and resources consumed per unit of analysis arising from acquisition and pre-processing of the primary material, or average input material if primary material is not used, from the cradle to the point of functional equivalence where it would substitute secondary material that would be used in a subsequent system. Per tonne of binder (net flow) that makes it to module D, the avoided impacts for 1 000 kg of virgin imported bitumen are credited. 1 tonne of imported bitumen (at port) = *1 t Bitumen, at refinery/RER U/AusSD U + 8890 tkm Transport, transoceanic tanker/OCE U/AusSD U*
$Q_{R\ out}$ / Q_{Sub} = 0.42	quality ratio between outgoing recovered material and the substituted material is 0.42 (1 = equal quality) The value is determined by considering which ingredients are able to substitute bituminous products in the next life cycle. The ingredients that are considered to fulfil this function are bitumen and (aromatic) oils. Polymers are still present in the product but are assumed to lose their functionality in the next life cycle. Note that this factor is determined against the declared unit (before losses upon application are taken into consideration).
Net flow = 313 kg	The net flow expresses the amount of imported bitumen avoided in the next life cycle

** For the purpose of displaying the module D calculation formula, the recycling percentage in this table excludes the percentage of material that is downcycled, which is the remaining 25%. For downcycled material, factor Y is set at 1%, while other parameters do not change. The low Y-value means the downcycled material plays a very minor role (0.25%) in module D results.*

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

BACKGROUND DATA

SAMI has collected and supplied the primary data for its production sites based on the 2023 calendar year reporting period (1 January 2023 – 31 December 2023). Background data is predominantly sourced from ecoinvent v3.10, AusLCI and the AusLCI shadow database v1.42 (AusLCI 2023). Data for bitumen and most minor additives have been sourced from AusLCI. Data for bio-flux is based on ecoinvent data (fatty acid methyl ester) and data for cationic emulsifier has been sourced from our supplier's EN 15804+A2 compliant EPD. As a result, the vast majority of the environmental profile of our products is based on background life cycle data that have been reviewed within the last two years. Methodological choices have been applied in line with EN 15804:2012+A2; deviations have been recorded.

KEY ASSUMPTIONS

- The bituminous binder composition is provided by SAMI and has been accepted as is.
- The choice of bitumen Life Cycle Inventory (LCI) data materially impacts the results of the LCA. Default data (as per EPDA 2022) have been used, which enhances comparability of asphalt EPDs using this EPD as an input into their model.
- The choice of LCI data for polymers (SBS, EVA, crumb rubber) and other raw materials can have a significant impact on the results. Care should be taken when comparing EPDs using different background datasets.
- Allocation approaches may have a material effect on bitumen binder products and should therefore be taken into consideration when comparing results.
- The end-of-life scenario, inventory data for module C and parameters for the calculation of module D are based on default values presented in EPDA 2022.

CUT-OFF CRITERIA

- The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage, 1% of the total mass input of a process and 1% of environmental impacts.
- The total (cumulative) of neglected input flows for the cradle-to-gate stages is well below 5%.
- The contribution of capital goods (production equipment and infrastructure) and personnel is excluded, as these processes are non-attributable and reasonable data for capital goods are not readily available. A sensitivity analysis employing multiple estimates upon estimates shows a contribution of capital goods to GWP-GHG of just over 10%.

ALLOCATION

The key processes that require allocation are:

- Production of bituminous products by SAMI: All shared processes are attributed to bituminous products based on their mass. Electricity is allocated across SAMI's total bituminous product production (total PMB, emulsion, cutback tonnage across the entire range of products).
- Production of bituminous products by SAMI: Gaseous and liquid fuels used for heating within the manufacturing process are allocated to SAMI's total combined production of PMB and Cutback products at each SAMI site. No allocation of this fuel use is made to emulsion products as no gas/liquid fuel is used for heat in the preparation or storage of emulsion products.
- Upstream production of bitumen and other hydro-carbons: Prescribed AusLCI data have been used to model bitumen and kerosene, while generic AusLCI and ecoinvent data have been used to model base oil and other hydrocarbons. The allocation of refinery impacts to hydrocarbons within ecoinvent (which is also the underlying database for AusLCI) is based on exergy.
- Bio component: Not relevant for this product.
- Crumb rubber: Not relevant for this product.

ELECTRICITY

- Electricity in core processes has been modelled using adjusted AusLCI data to represent the estimated residual electricity grid mix in the Australian states where SAMI operates production plants. This is done by removing renewables from the Australian Energy Statistics 2024 data (Table O). The (SAMI production-volume) weighted average GWP-GHG of the electricity is 0.85 kg CO_2e/ kWh. The proxy residual grid mix is made up of black coal (46%), brown coal (10%), natural gas (41%), and oil products (4%).
- Electricity used in other processes is typically modelled following a location-based approach
- Given the relatively low contribution of SAMI's electricity consumption to the GWP emissions, the selection of the electricity grid mix for core processes does not have a material impact on the carbon footprint results.

LIFE CYCLE ASSESSMENT (LCA) INDICATORS

An LCA serves as the foundation for this EPD. An LCA analyses the production systems of a product. It provides comprehensive evaluations of all upstream and downstream energy inputs and outputs. The results are provided in a form which covers a range of environmental impact categories.

Table 5: Environmental indicators legend (EN 15804+A2)

Core indicators	Acronym	Unit
Climate change – total	**GWP-total**	**kg CO_2 equivalent**
Climate change – fossil	GWP-fossil	kg CO_2 equivalent
Climate change – biogenic	GWP-biogenic	kg CO_2 equivalent
Climate change – land use and land use change	GWP-luluc	kg CO_2 equivalent
Ozone layer depletion	ODP	kg CFC-11 equivalent
Acidification	AP	mol H^+ equivalent
Eutrophication aquatic freshwater	EP-freshwater	kg P equivalent
Eutrophication aquatic marine	EP-marine	kg N equivalent
Eutrophication terrestrial	EP-terrestrial	mol N equivalent
Photochemical ozone formation	POCP	kg NMVOC equivalent
Abiotic depletion potential – elements[1]	ADP minerals & metals	kg Sb equivalent
Abiotic depletion potential – fossil fuels[1]	ADP fossil	MJ, net calorific value
Water use[1]	WDP	m^3 world equivalent deprived
Additional indicators	**Acronym**	**Unit**
Global Warming Potential – Greenhouse gases	GWP-GHG	kg CO_2 equivalent
Climate change indicator in line with IPCC AR5	GWP-GHG (IPCC AR5)	kg CO_2 equivalent
Particulate matter emissions	PM	disease incidence
Ionising radiation, human health[2]	IRP	kBq U235 equivalent
Ecotoxicity (freshwater) [1]	ETP-fw	CTUe
Human toxicity, cancer effects[1]	HTP-c	CTUh
Human toxicity, non-cancer effects[1]	HTP-nc	CTUh
Land use related impacts / soil quality[1]	SQP	- (dimensionless)

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.
[2] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and some construction materials, is also not measured by this indicator.

Note regarding various GWP indicators: GWP-total is calculated using the European Union’s Joint Research Centre’s characterisation factors (CFs) based on the “EF 3.1 package” for CFs to be used in the EU’s Product Environmental Footprint (PEF) framework. CFs listed by JRC are based on the IPCC AR6 method (IPCC 2021) and include indirect radiative forcing, which results in higher numerical Global Warming Potential (GWP) values than the CFs in the internationally accepted (IPCC 2013). The GWP-GHG indicator is identical to GWP-total except that the CFs for biogenic CO_2 are set to zero. The GWP-GHG indicator in PCR 2019:14 v1.3.4 differs from the GWP-GHG in earlier (pre v1.3) PCR 2019:14 versions. The “GWP-GHG (IPCC AR5)” indicator is determined using the IPCC AR5 GWPs with a 100-year time horizon (IPCC 2013). This indicator is aligned with Australia’s greenhouse gas reporting frameworks.

Table 6: Legend for parameters describing resource use, waste and output flows

Parameter	Acronym	Unit
Parameters describing resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ_{NCV}
Use of renewable primary energy resources used as raw materials	PERM	MJ_{NCV}
Total use of renewable primary energy resources	PERT	MJ_{NCV}
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ_{NCV}
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ_{NCV}
Total use of non-renewable primary energy resources	PENRT	MJ_{NCV}
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ_{NCV}
Use of non-renewable secondary fuels	NRSF	MJ_{NCV}
Use of net fresh water	FW	m^3
Waste categories		
Hazardous waste disposed	HWD	kg
Non-Hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Output flows		
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ

Table 7: Legend for EN 15804+A1 indicators

Indicator	Acronym	Unit
Global warming potential	GWP	kg CO_2 equivalent
Ozone layer depletion potential	ODP	kg CFC-11 equivalent
Acidification potential	AP	kg SO_2 equivalent
Eutrophication potential	EP	kg PO_4^{3-} equivalent
Photochemical oxidation (Photochemical ozone creation) potential	POCP	kg ethylene equivalent
Abiotic depletion potential - elements	ADPE	kg Sb equivalent
Abiotic depletion potential - fossil fuels	ADPF	MJ_{NCV}

RESULTS: ENVIRONMENTAL PROFILES

The following section presents the results for each Life Cycle Assessment module. The results have been calculated (based on the EFv3.1 set of characterisation factors) with SimaPro software v9.6.0.1. To separate the use of primary energy into energy used as raw material and energy used as energy carrier, Option B from Annex 3 of PCR 2019:14 has been applied.

Water flows pertaining to Australian water use are disaggregated using the 36 water catchments for which characterisation factors are available for both Pfister Water Stress Index (WSI) and the Available WAter REmaining (AWARE) method. Characterisation factors are from Bontinck et al 2021.

Please consider the following mandatory statements when interpreting the results:

"The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks."

"The use of the results of modules A1-A3 (A1-A5 for services) without considering the results of module C is discouraged."

Table 8: Environmental indicators EN 15804+A2, SAMIBioPrime bituminous binder, per t

Environmental Indicator	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
Core Indicators							
GWP-total	**kg CO_2-eq.**	**-68.8**	**0.710**	**1.60**	**279**	**0**	**-134**
GWP-fossil	kg CO_2-eq.	4.32E+02	7.09E-01	1.60E+00	0.00E+00	0.00E+00	-1.34E+02
GWP-biogenic	kg CO_2-eq.	-5.14E+02	8.41E-05	9.88E-05	2.79E+02	0.00E+00	-6.54E-02
GWP-luluc	kg CO_2-eq.	1.38E+01	3.61E-07	7.55E-07	0.00E+00	0.00E+00	-5.28E-04
ODP	kg CFC11-eq.	1.65E-04	1.13E-07	2.52E-07	0.00E+00	0.00E+00	-1.75E-04
AP	mol H+ eq.	9.32E+00	7.79E-03	1.40E-02	0.00E+00	0.00E+00	-2.20E+00
EP-freshwater	kg P eq.	4.77E-02	9.52E-08	9.60E-08	0.00E+00	0.00E+00	-6.15E-05
EP-marine	kg N eq.	6.11E+00	3.39E-03	4.42E-03	0.00E+00	0.00E+00	-1.84E-01
EP-terrestrial	mol N eq.	3.17E+01	3.72E-02	4.84E-02	0.00E+00	0.00E+00	-2.03E+00
POCP	kg NMVOC eq.	2.33E+00	9.93E-03	1.18E-02	0.00E+00	0.00E+00	-6.44E-01
ADP minerals & metals[1]	kg Sb eq.	6.62E-04	8.50E-10	1.85E-09	0.00E+00	0.00E+00	-1.04E-06
ADP fossil[1]	MJ (NCV)	1.40E+04	9.91E+00	2.19E+01	0.00E+00	0.00E+00	-1.52E+04
WDP[1]	m^3 world eq. deprived	2.26E+02	1.04E-01	1.39E-01	0.00E+00	0.00E+00	-9.66E+01
Additional indicators							
GWP-GHG	kg CO_2-eq.	4.47E+02	7.10E-01	1.60E+00	0.00E+00	0.00E+00	-1.34E+02
GWP-GHG (IPCC AR5)	kg CO_2 eq	4.44E+02	7.10E-01	1.60E+00	0.00E+00	0.00E+00	-1.34E+02
PM	Disease incidence	5.25E-05	2.06E-07	7.90E-08	0.00E+00	0.00E+00	-6.50E-06
IRP[2]	kBq U235 eq.	4.63E+00	1.47E-05	3.20E-05	0.00E+00	0.00E+00	-2.05E-02
ETP-fw[1]	CTUe	5.47E+03	2.19E+00	4.85E+00	0.00E+00	0.00E+00	-3.36E+03
HTP-c[1]	CTUh	4.11E-07	2.75E-11	6.85E-12	0.00E+00	0.00E+00	-3.24E-09
HTP-nc[1]	CTUh	2.28E-05	1.46E-10	1.31E-10	0.00E+00	0.00E+00	-8.74E-08
SQP[1]	-	3.17E+04	5.01E-02	9.85E-02	0.00E+00	0.00E+00	-5.98E+01

Footnotes:

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

[2] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and some construction materials, is also not measured by this indicator.

Table 9: EN 15804+A2 parameters, SAMIBioPrime bituminous binder, per t

Parameter	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
PERE	MJ_{NCV}	1.21E+03	1.70E-02	3.15E-02	0.00E+00	0.00E+00	-2.11E+01
PERM	MJ_{NCV}	5.95E+03	0.00E+00	0.00E+00	-5.95E+03	0.00E+00	0.00E+00
PERT	MJ_{NCV}	7.15E+03	1.70E-02	3.15E-02	-5.95E+03	0.00E+00	-2.11E+01
PENRE	MJ_{NCV}	3.17E+03	9.91E+00	2.19E+01	0.00E+00	0.00E+00	-1.62E+03
PENRM	MJ_{NCV}	1.09E+04	0.00E+00	0.00E+00	-1.09E+04	0.00E+00	-1.36E+04
PENRT	MJ_{NCV}	1.41E+04	9.91E+00	2.19E+01	-1.09E+04	0.00E+00	-1.52E+04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	3.93E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	7.02E+01	3.59E-03	3.18E-03	0.00E+00	0.00E+00	-2.23E+00
HWD	kg	8.55E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	4.28E+00	4.92E-05	9.31E-05	0.00E+00	0.00E+00	-6.23E-02
RWD	kg	4.64E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	4.16E+02	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 10: EN 15804+A1 indicators*, SAMIBioPrime bituminous binder, per t

Environmental Indicator	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
GWP	kg CO_2 eq	-6.46E+01	7.08E-01	1.59E+00	0.00E+00	0.00E+00	-1.31E+02
ODP	kg CFC11 eq	1.29E-04	8.95E-08	1.99E-07	0.00E+00	0.00E+00	-1.38E-04
AP	kg SO_2 eq	5.90E+00	5.54E-03	7.78E-03	0.00E+00	0.00E+00	-1.88E+00
EP	kg PO_4^{3-} eq	1.82E+01	1.14E-03	1.49E-03	0.00E+00	0.00E+00	-6.36E-02
POCP	kg C_2H_4 eq	2.84E-01	5.43E-04	5.02E-04	0.00E+00	0.00E+00	-1.04E-01
ADPE	kg Sb eq	3.84E-04	8.62E-10	1.88E-09	0.00E+00	0.00E+00	-1.05E-06
ADPF	MJ_{NCV}	1.33E+04	9.91E+00	2.19E+01	0.00E+00	0.00E+00	-1.52E+04

* Note: the indicators and characterisation methods are from EN 15804:2012+A1:2013, but other LCA rules (system boundaries, allocation, etc.) are according to EN 15804:2012+A2:2019; i.e., the results of the "A1 indicators" shall not be claimed to be compliant with EN 15804:2012+A1:2013

Understanding biogenic carbon accounting for bituminous products with bio-based content

When we talk about carbon footprints, we are looking at the total greenhouse gas emissions caused by a product, from production to disposal. For materials like bituminous products that incorporate biogenic content—such as biobased oils and binders—how we calculate these emissions can make a big difference. This is where biogenic carbon accounting methods come into play.

Biogenic carbon refers to the carbon found in natural, renewable materials like plants. These materials absorb carbon dioxide (CO_2) from the atmosphere as they grow, temporarily storing it. When biogenic materials are used in products, this stored carbon can be locked away in the molecular structure of the material. Carbon sequestered in bio-based materials can cancel emissions occurring in other parts of the life cycle. However, not all carbon accounting methods recognise this benefit in the same way, leading to different carbon footprint outcomes for the same product.

Some accounting methods consider both the uptake (sequestration) and release (emissions) of biogenic CO_2. These methods show the full environmental effect of using bio-based materials, highlighting their potential to reduce overall carbon footprints. By including the CO_2 absorbed by plants during their growth, these methods will often show bio-based products having a reduced cradle-to-gate carbon footprint. This aligns with the efforts undertaken by the bituminous industry aimed at adopting sustainable practices and reducing our carbon emissions. In our EPD, the ***GWP-biogenic*** and ***GWP-total*** indicators follow this accounting approach.

On the other hand, certain methods ignore biogenic CO_2 uptake and emissions entirely, under the assumption that biogenic CO_2 is short-cyclic and uptake and emissions balance out to zero. This approach may make sense for biogenic fuels but overlooks the carbon absorption that occurs during the life cycle of biogenic materials that store carbon. In our view, this accounting approach makes bio-based products appear less beneficial than they actually are. If the environmental value of bio-based materials is not fully captured, it discourages their adoption despite their potential to lower carbon footprints by sequestering carbon within a material for long periods. In our EPD, the ***GWP-GHG*** indicators follow this accounting approach.

The difference between these methods matters because it affects how industries and consumers perceive the sustainability of bio-based materials. When uptake of biogenic carbon is accounted for, the benefits of using bio-based binders and oils in bituminous products become clear. These materials not only reduce reliance on fossil fuels but also contribute to a more circular carbon cycle, where emissions are balanced by natural absorption. In conclusion, choosing the right carbon accounting method is crucial to accurately reflect the environmental advantages of bio-based bituminous products. By using methods that account for biogenic CO_2 uptake, we can better understand and promote the role of these materials in building a more sustainable future.

Please note that PCR2019:14 (Annex 2) requires any embodied biogenic carbon to be artificially released when material is recycled. Therefore, module C3 (end-of-life recycling) shows an emission of biogenic CO_2 (in the ***GWP-biogenic*** and ***GWP-total*** indicators) that is required for accounting purposes but does not constitute an actual emission to the environment. If we fast forward to the next life cycle, the user of Recycled Asphalt Product (RAP) containing our bio-based bituminous material should—in theory—record the biogenic carbon in the material as a negative emission in module A1 of their life cycle. However, in practice, this information is likely lost and the biogenic carbon will not be recorded by the next life cycle. Therefore, we would caution against using the artificial GWP-biogenic emission shown in module C3.

Material Circularity Indicator (MCI)

The Material Circularity Indicator (MCI) provides a quantitative measure of how effectively a product contributes to a circular economy. Developed by the Ellen MacArthur Foundation, the MCI assesses the extent to which materials are retained in productive use over time, through strategies such as reuse, refurbishment, remanufacturing, and recycling. It is particularly relevant to sectors such as construction and infrastructure, where long material lifespans and recovery at end-of-life are critical to reducing resource consumption and waste.

While Environmental Product Declarations (EPDs) offer a comprehensive assessment of a product's environmental impacts across its full life cycle—following standardised, independently verified methodologies—they do not explicitly address circularity. The MCI complements an EPD by quantifying how well a product conserves materials and minimises waste generation, thus providing additional insight into resource efficiency and design for circularity.

The MCI evaluates both input and output flows, including the proportion of recycled and renewable content used in production, the recyclability of the product at end-of-life, and its expected lifespan and usage intensity. Results are expressed on a scale from 0 to 1, where a score of 1 represents a fully circular product and 0.1 indicates a fully linear product whose utility equals the industry average. When the utility of a product is lower than industry average, the MCI will be smaller than 0.1 and will quickly approach zero.

By including the MCI in this EPD, stakeholders gain a clearer understanding of the product's contribution to a circular economy and its potential to reduce environmental burdens through smarter material use.

Material Circularity Indicator
SAMIBioPrime MCI = 0.24
Notes:
Feedstock: SAMI's products may contain bio-based ingredients. However, these are not claimed as part of the MCI as we currently do not have enough visibility on the supply chain to ensure these are from sustained production.
Feedstock: Where a bio-based ingredient is produced from a recycled product, it is counted under "recycled material"
Feedstock: Crumb rubber ingredient is produced from end-of-life tyres. As such, it is counted under "recycled material"
Feedstock: all other ingredients are counted as virgin materials
Recycling efficiency (Feedstock) is estimated at 90%. Actual data are not available
100% of SAMI's products are assumed to go to recycling at end-of-life.
Of the product collected for recycling, the outgoing recycling efficiency reflects the percentage material expected to be recycled as Recycled Asphalt Pavement (RAP). Material that is assumed to be downcycled into pavement foundations is therefore discounted from recycling efficiency
The recycling efficiency for cutback product and emulsions is adjusted for material lost (evaporated) during application (kerosene and water)
Lifespan and functional units are assumed to be 1x industry average, as we do not have information to substantiate different values
The recycling efficiency for cutback product and emulsions is adjusted for material lost (evaporated) during application (kerosene and water)

REFERENCES

AusLCI 2023	Australian Life Cycle Inventory database v1.42 published by the Australian Life Cycle Assessment Society (ALCAS), 2023
Bontinck et al 2021	Bontinck, PA., Grant, T., Kaewmai, R. et al. Recalculating Australian water scarcity characterisation factors using the AWARE method. Int J Life Cycle Assess 26, 1687–1701 (2021)
ECHA 2024	European Chemicals Association, Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation, Helsinki | Accessed on 1 December 2024 from: https://echa.europa.eu/candidate-list-table
Environdec 2021	International EPD System, General Programme Instructions for the International EPD System, Version 4.0, 29 March 2021
EN 15804+A2	EN 15804:2012+A2:2019/AC:2021, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, August 2021
EN 15804+A1	EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, November 2013
EPDA 2022	Technical guidance for developing EPDs according to EN 15804+A2:2019 for Asphalt mixtures – Australia, EPD Australasia, 27 April 2022
EPDA 2024	Instructions of the Australasian EPD Programme; EPD Australasia Limited, v4.2 - A regional annex to the general programme instructions of the International EPD® System, 12 April 2024
IPCC 2013	Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA
IPCC 2021	Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA
ISO 14025	Environmental labels and declarations - Type III environmental declarations - Principles and procedures. International Organization for Standardization, Geneva, Switzerland, 2006
ISO 14040	Environmental management - Life cycle assessment - Principles and framework. International Organization for Standardization, Geneva, Switzerland, 2006
ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines. International Organization for Standardization, Geneva, Switzerland, 2006
PCR 2019:14	Product category rules for Construction products (EN 15804:2012+A2:2019), registration number 2019:14, version 1.3.4, published on 30 April 2024.

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