Vinidex by aliaxis

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019

StormPRO® - Polypropylene Pipes

AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

EPD registration number: S-P-00717
Version 2.0
Publication Date: 2 March 2016
Version Date: : 16 September 2022
Validity Period: 16 September 2022 - 16 September 2027
Geographical area of application of this EPD: Australia
Year taken as reference for the data: FY19/20 - 1st July 2019 to 30th Jun 2020

Table of contents

Programme:	EPD Australasia Limited, www.epd-australasia.com
Programme operator:	EPD Australasia
EPD registration number:	S-P-00717
Version 2.0:	16 September 2022
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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.epd-australasia.com.

Environmental Product Declaration details

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

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. For further information about comparability, see EN 15804 and ISO 14025.

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Accredited or approved by	EPD Australasia
CEN standard EN 15804 served as the core PCR	
PCR	Construction products, PCR 2019:14, 1.11 and UN CPC 369
PCR prepared by	**IVL Swedish Environmental Research Institute** Moderator: Martin Erlandsson, martin.erlandsson@ivl.se
Independent external verification of the declaration and data, according to ISO 14025:2010	☐ EPD process certification (Internal) ☑ EPD verification (External)
Procedure for follow-up of data during EPD validity involves third party verifier:	No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

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This version of the EPD has been updated with more recent production data. Module A5 hasn't been included in this study, because it is highly dependent on the specific installation conditions. Instead, an outline of the installation process is provided to highlight those factors that influence environmental and resource impacts.

Green Star EPD compliance

✓ The EPD conforms with ISO 14025 and EN 15804.
✓ The EPD has been verified by an independent third party.
✓ The EPD has at least a cradle-to-gate scope.
✓ The participants in the EPD are listed.

Environmental Product Declarations have been recognised as one of the initiatives that contribute to Green Star certification under the Green Building Council of Australia's (GBCA) Responsible Products Framework.

See the product specification tables to convert the product results from kilogram of installed pipe to length of pipe for individual pipe products.

About us

Vinidex is a leader in Australian manufacturing and supply of advanced pipe systems and solutions, connecting Australian people with water and energy. We provide a broad range of pipeline systems and solutions for building (plumbing, electrical), infrastructure (water, wastewater, drainage, gas, electrical, communications), irrigation and rural, mining and industrial applications.

A proud Australian manufacturer since 1960, we have a history of over 61 years in Australia with proven long-term performance and reliability. Vinidex manufactures PVC, polyethylene (PE) and polypropylene (PP) pipe and fittings systems in Australia. This is complemented by a wide range of specialised pipes and fittings from Australia and around the world to meet customer needs in diverse markets.
Vinidex 10 manufacturing locations and 12 distribution centres match Australian population centres and markets, strategically reaching across the country. Our customers are as diverse as the markets we serve, and include contractors, installers, distributors, specifiers and asset owners.

We aim to deliver quality, high-performance systems that are durable, reliable and consistently meet our customers' expectations as well as any relevant Australian and International Standards. We are passionate about creating sustainable, innovative solutions for our customers and communities. Our commitment to safety, health and environmental sustainability is integral to the way we do business.

Vinidex is committed to being a leader in sustainability.

- Vinidex is closing the loop. We will always ensure our products are engineered for long life, and then we will maximise the use of recycled material.
- Vinidex are leaders in innovation and development of sustainable products
- Vinidex is reducing the carbon footprint of products by efficient product design
- Vinidex manufactures Best Environmental Products
- Vinidex is changing our product packaging – less packaging and better environmentally

Vinidex is backed by the strength of Aliaxis, a global leader in plastic piping solutions.
This allows us to connect our customers with innovative technologies from around the world.

Vinidex Sustainability

As an industry leader, Vinidex recognises our responsibility to care for the environment.
We have ambitious goals to create a more sustainable future for Australian communities.

CLOSE THE LOOP

Our goal is to quadruple recycled content by 2025, while ensuring the long-life performance of our products.

- We are increasing take back of recycled plastic and increasing recycled content in our products
- While ensuring we make engineered products designed for long service life
- StormPRO® is 100% recyclable at end of life supporting a circular economy

INNOVATE

Vinidex led the way with development of lower carbon footprint products such as Supermain®.

Our innovation program is focused on developing systems such as StormPRO® and StormFLO® which can meet customer needs for quality, long life products, in a more sustainable way than alternatives.

BEST ENVIRONMENTAL PRODUCTS

Our products are made to stringent Australian standards and best environmental practice.

StormPRO® is manufactured to AS/NZS 5065 to ensure its long life performance.
Vinidex's quality management system is verified to the requirements of ISO 9001.

LEAD THE WAY

We undertake independently verified EPDs.

Vinidex is a partner in Operation Clean Sweep to prevent the loss of plastic pellets into our waterways – zero pellet loss is our goal.

We achieve Product Stewardship excellence.

REDUCE OUR FOOTPRINT

We have ambitious goals to reduce our carbon footprint:

- To achieve 100% renewable electricity to power our manufacturing plants by 2025
- To reduce our CO_2 per tonne of production on Vinidex sites by 75% by 2025

We aim to use less water, less waste, and changing packaging for less carbon footprint

Product information

Vinidex StormPRO® pipes are twin-wall, corrugated polypropylene pipes for non-pressure drainage applications.

Utilising modern co-extrusion techniques, StormPRO® is manufactured with a smooth bore for optimum hydraulic performance and a corrugated outside wall for high stiffness to weight ratio. By combining the strength and toughness of advanced polypropylene materials with the structured wall design, StormPRO® pipes provide an environmentally sensitive, cost-effective piping system for a multitude of drainage applications.

StormPRO® pipes are classified as SN8 with a minimum stiffness of 8000 N/m/m and are available in 6m and 3m lengths in sizes from DN 150 to DN 900. StormPRO® pipes have a black external surface and a light grey internal surface.

StormPRO® polypropylene (PP) pipes are manufactured in accordance with AS/NZS 5065: "Polyethylene and Polypropylene pipes and fittings for drainage and sewerage applications", complying with the dimensional requirements of type B pipes – ID series.

A complete range of fittings for StormPRO® pipelines are also available. Table 1 shows key characteristics of Vinidex PP pipe and Table 2 shows the content declaration.

Table 1 - Product characteristics of PP pipes

Product Characteristics	
Product names/application	StormPRO®
UN CPC Code	369 – Other plastic products
Resin density	900 kg/m3
Circumferential flexural modulus (2mm/min)	1300 MPa
Shore D hardness	60
Coefficient of linear thermal expansion	15 x 10-5/°C
Tensile yield stress (50mm/min)	31 MPa
Poisson's ratio	0.45
Ring bending stiffness	StormPRO® - 8000 N/m/m
Nominal diameter	150-900 mm

Table 2 - Content Declaration for StormPRO® pipes

Product components	Post consumer material	CAS No.
Polypropylene block copolymer	96%	9003-07-0
Polypropylene polymer masterbatch	4%	Confidential (nothing hazardous)
Total	100.00%	
Packaging materials	**Weight-% (versus the product)**	
Wood	2.5%	
Steel	0.04%	
Total	2.54%	

Product lifecycle overview

The life cycle of a building product is divided into three process modules according to the General Program Instructions (GPI) and four information modules according to ISO 21930 and EN 15804, and supplemented by an optional information module on potential loads and benefits beyond the building life cycle. Table 3 shows the system boundary and scope of the EPD. The scope of this EPD is Cradle to gate with module C1–C4, module D and optional module A4.

Table 3 - Scope of assessment and system boundary

	Product Stage			Construction Stage Process		Use Stage							End of Life Stage				Resource Recovery Stage
	Raw material supply	Transport	Manufacturing	Transport	Construction Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste Processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	X
Geography	Global/ Aus	Aus	Aus	Aus									Aus	Aus	Aus	Aus	Aus

X = module included in EPD
MND = module not declared (does not indicate zero impact result)

Life cycle of Vinidex pipes

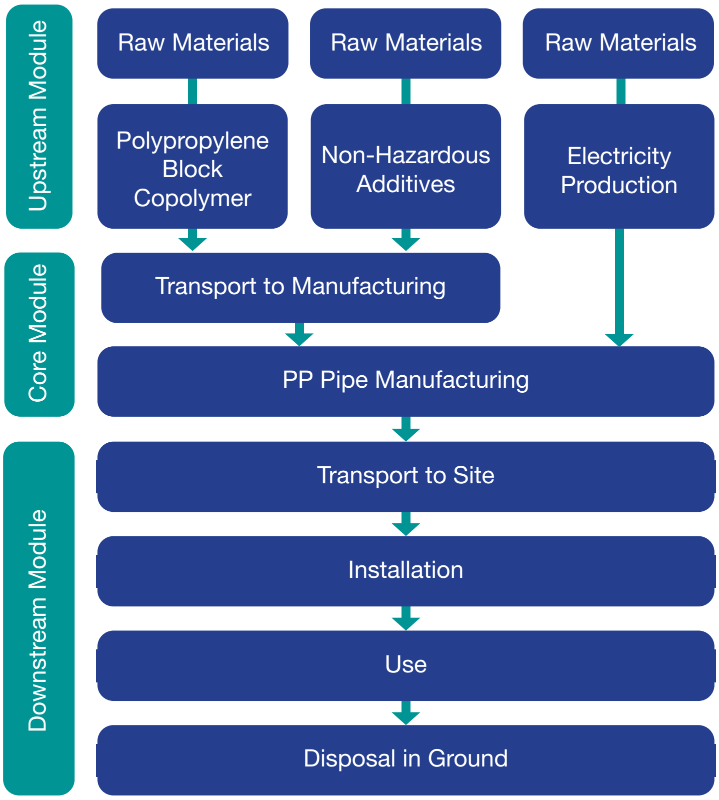


Figure 1 - Life cycle diagram of PP pipe production

Vinidex PP manufacture

Vinidex StormPRO® are structured wall pipes manufactured from a high grade polypropylene copolymer. The pipes consist of an outer corrugated layer which is bonded to an inner smooth layer. The corrugated outer layer maximises stiffness to weight ratio whilst the inner layer provides a smooth surface for optimal hydraulic performance.

Polypropylene raw material is delivered to the manufacturing facility in bulk containers where it is transferred directly into storage silos using a blower and rotary valve system.

Figure 2 - Vinidex PP pipe manufacturing sites

Masterbatch materials are added to the raw PP copolymer to add colour and to prevent degradation under sunlight.

Black is used for the outer corrugations whilst light grey is used for the inner layer. Masterbatch materials are delivered in bulk bags of approx. 750 kg. Due to the hygroscopic nature of the carbon black used in the masterbatch, these materials are dried with hot air at approximately 90˚C for 1 to 2 hours before blending. The raw materials are transferred to a batch mixer where they are blended before being transferred directly to the manufacturing line. The whole material transfer system from delivery to final production is via enclosed systems using either air pressure or vacuum transfer systems.

The main part of the manufacturing line consists of two extruders (one for each layer), feeding into an extrusion die head and a corrugator. The extruders use a combination of applied heat and internal friction to melt and pump the molten material through the extrusion die using a process similar to an Archimedean screw. The extrusion die forms the two layers of molten PP into annular rings. The inner layer is then pulled over a smooth cooling mandrel whilst the outer layer is captured by a moving train of mould blocks having the corrugation profile.

Vacuum is used to pull the outer layer into the cavity of the mould blocks whilst the controlled wall thickness and gap between the mould blocks and inner mandrel press the two layers together to form a bond at the trough of each corrugation. Chilled water is circulated continuously through the mould blocks and the inner mandrel to freeze the material in the desired form. At the designated places special blocks are automatically inserted into the mould train to form a socket or “cuff”. Only the outer layer is utilised in the formation of the cuff.

Further processes downstream of the continuous production line consist of a caterpillar style, multi-belt haul off which matches the speed of the corrugator mould blocks and helps feed the pipe into the cutter and smart trim device. The cutter cuts the pipes at the correct position in relation to the cuff and the smart trim removes part of the inner layer from the cuff to form the correct socket profile for jointing. Rubber rings are either fitted to the pipe or attached with it, to complete the requirements for the socket jointing system, before they are stacked and packaged for storage and transport. Packaging materials are timber and PET strapping. In some cases black stretch wrap is used to protect the rubber seal from sunlight. Any internal scrap, including the off-cuts from the smart trim process, is granulated on site and recycled into the outer layer of the StormPRO® product. At the time of modelling, StormPRO® PP pipes were manufactured in Wagga Wagga (NSW). Since then, manufacture has been moved to Sydney, NSW as shown in Figure 2.

Distribution stage

Vinidex has one PP pipe manufacturing facility in Australia, requiring significant distribution distances to all major Australian markets apart from Sydney and Melbourne, requiring relatively shorter distribution distances. The impact of distribution was calculated by using the distance from manufacturing to each capital city in Australia weighted by PP pipe sales volumes in each state. While some PP pipe is transported to regional areas the vast majority is sold in capital cities.

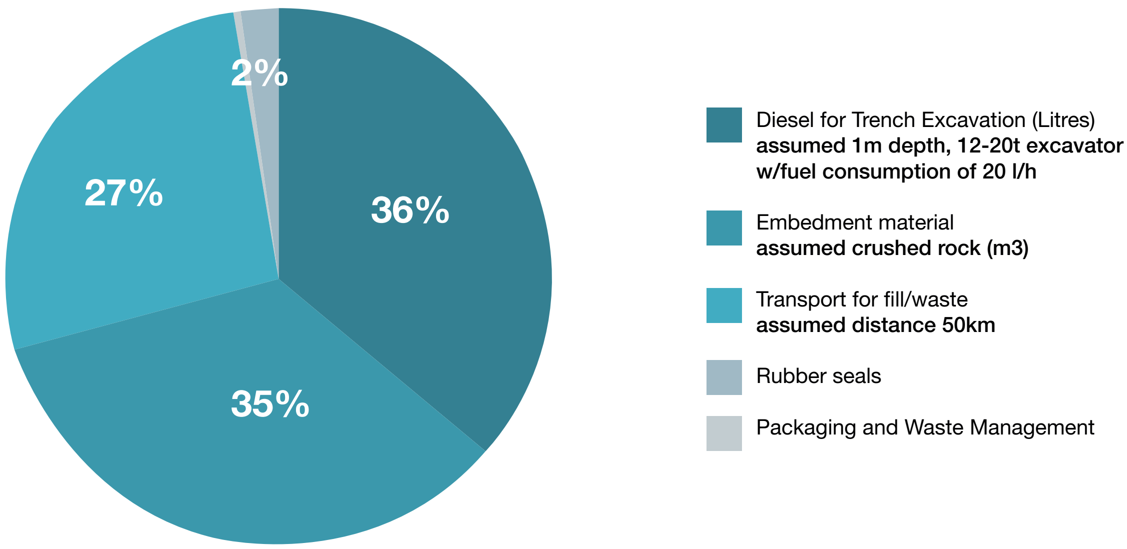
Installation

The environmental impacts and other indicators related to the installation stage of PP pipes and other flexible pipes is highly dependent on the specific details relating to a particular pipeline's design. Variables include pipe diameter(s), length of the pipeline, terrain, geology, environmental conditions, trench depth, specified fill and embedment materials and the resultant installation techniques employed by the installing contractor. Given the significant number of variables involved, attempts to define an 'average' or 'typical' pipeline installation for the purpose of calculating environmental and resource impacts will be highly inaccurate. Moreover, it would be potentially misleading for the resultant numbers to be applied across a range of pipe diameters and buried pipelines installations and for these numbers to be used for comparative purposes. The main factors which contribute to the impacts of installation of buried 'flexible' pipes apply across a range of pipe materials.
These factors, such as trench excavation and selection of embedment materials are influenced by designers, asset owners and pipeline installers. Consequently, the A5 Installation module will not be covered other than to outline the installation process and highlight those factors that influence the environmental impacts.

Vinidex PP pipe systems are usually buried as part of drainage infrastructure. The pipes are laid in an excavated trench. Uniform guidance on the correct design and installation of PP pipes and other 'flexible' pipes is given in AS/NZS 2566.2 Buried flexible pipelines – Installation. Pipe materials covered by this Standard are as follows; PVC-U, PVC-M and PVC- O, polyethylene, polypropylene, GRP, ABS, ductile iron, and steel.

The AS/NZS 2566.2 Standard covers trench excavation and design, definition of fill and embedment zones and their respective compaction requirements and field testing of the installed pipeline. Installation design is also dependent on other design factors such location, construction and traffic loadings and minimum design requirements specified by Infrastructure Agencies such as Water Authorities. In all cases the diameter of the installed pipe significantly influences installation design which in turn directly influences environmental impacts associated with buried pipeline construction. LCA modelling of one assumed scenario shows the relative contribution of key construction factors in the chart below. In many cases, the specifier and constructor can influence these factors and consequently the overall environmental impact of pipe installation. For example, in the modelled scenario, the embedment material is assumed to be crushed rock. However other embedment materials could be selected which have lower environmental impacts. This is discussed further below.

Figure 3. Relative Contribution of Construction factors to Global Warming Potential (kg CO2 eq)



A more detailed summary of the construction factors influencing environmental impacts are outlined below.

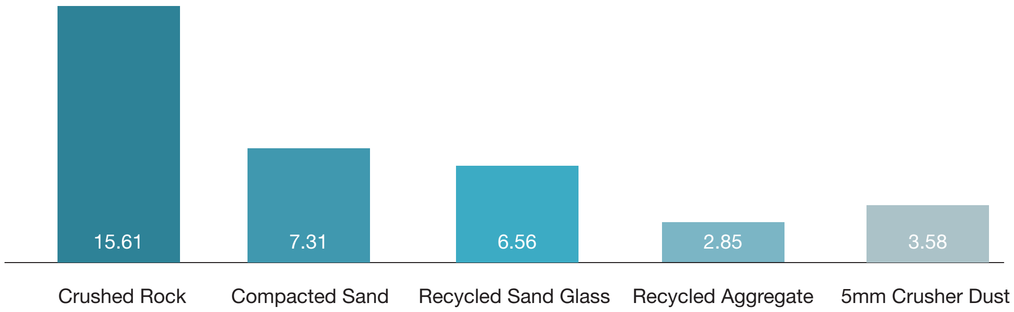
Trench Excavation

Trench excavation, in particular diesel consumption by trenching excavators governs most of the environmental and resource burden for the installation phase and is strongly correlated to the size of the trench and the type and configuration of excavator used. Additionally, there are various factors that affect efficiency of the excavator and speed of the excavation. Factors such as excavator bucket volume, bucket fill rate, cycle time, swing angle, type of excavated ground, as well as site environment and weather conditions, all influence the performance of the excavator. Equipment choice and operational efficiency is under the control of the trenching contractor.

Fill / Embedment

Type of fill / embedment materials are nominated by the pipeline designer, infrastructure owner or installer, and depend on the pipe application. LCA modelling shows that the use of screened and quarried virgin aggregate material (gravel) results in a higher environmental impact than other materials such as natural sand, recycled glass sand, crusher dust and concrete recycled into aggregate. The impact of different embedment materials is shown in Figure 4.

Figure 4. Global warming potential (kg CO2 eq) per m3 of embedment material



Transportation of fill materials that are required to be imported to site, and of excavated material from the site that cannot be used in the embedment zone will impact carbon footprint and energy consumed.

The use of equipment for backfilling and compaction will also contribute to the total environmental impact. In terms of backfilling, this can be achieved either by using machinery or may be done manually. Compaction of embedment material can be achieved using powered portable compacting machines such as surface plate vibrators or by manual means using hand tampers in some circumstances. Where single size aggregate is used the required compaction may be achieved during material dumping.

Pipe lifting equipment

In many cases small diameter PP pipes are light enough to be lifted into the trench by hand. However, this will be dependent upon trench depth. Larger diameter pipes of course will require mechanical lifting equipment, in many cases an excavator is used.

Pipe jointing

PP pipes are jointed using rubber sealed spigot and socket joints. Jointing requires the application of lubricant to reduce jointing forces. PP pipes in smaller diameters are light enough to be joined using hand tools i.e., crowbar and block of wood to lever the last pipe into the preceding socket.

Packaging materials and waste

Packaging materials include timbers and strapping used to protect the pipe during transport. In many cases, these may be reused or recycled rather than disposed of to landfill.

Wastage of pipe is minimal as short lengths are often required elsewhere and easily reused on subsequent sites or within the same site. A very rough estimate puts wastage from unusable offcuts at less than 2%. Waste pipe offcuts which cannot be reused can be recycled.

Use stage

According to AS/NZS 5065, the pipe systems are designed to outlast the building with a life expectancy in excess of 100 years (Standards Australia, 2005). The failure rate is also extremely low and is considered to be inconsequential (not relevant) in this EPD. Maintenance of these pipe systems is not planned as deterioration of the pipe in service is not an issue.

The major risk with plastics pipe systems is third party interference. However, these PP pipe systems are used primarily in drainage applications and do not share restricted footway allocations as with water and gas reticulation. Therefore, it is significantly less likely that third parties will encounter these pipe systems. Repairing a damaged PP pipe is simple using either a mechanical saddle fitting or cutting out the affected section and replacing with a new section of pipe. There is no release of dangerous substances to indoor air, soil and water during the use stage.

End of life

The PP drainage and sewerage pipes which are installed underground are assumed to remain underground at end of life. The PP pipes are inert and there is no incentive to dig them up to send for waste treatment.

Life cycle assessment methodology

This section includes the main details of the LCA study as well as assumptions and methods of the assessment. A summary of the key life cycle assessment parameters is given in Table 5.

Table 4 - Details of LCA

Declared unit	1 kg of installed pipe
Geographical coverage	Australia
LCA scope	Cradle to gate with module C1–C4, module D and optional module A4
Technical service life	100 years

Life cycle thinking is a core concept in sustainable consumption and production for policy and business. Upstream and downstream consequences of decisions must be taken into account to help avoid the shifting of burdens from one type of environmental impact to another, from one political region to another, or from one stage to another in a product's life cycle from the cradle to the grave.

LCA is the compilation of the inputs, outputs and environmental impacts of a product system throughout its life cycle. It is a technique that enables industries to identify the resource flows and environmental impacts (such as greenhouse gas emissions, water and energy use) associated with the provision of products and services.

According to EN 15804, EPDs of construction products may not be comparable if they do not comply with this standard, and EPDs might not be comparable, particularly if different functional units are used.

Core data collection

Lifecycle data has been sourced form material quantity data and production process data from Vinidex reporting systems and staff.

Core manufacturing data was collected directly from Vinidex manufacturing sites. Electricity consumption was allocated to pipe via mass of pipe produced.

Background data

Generic background data was sourced for raw materials in the upstream module, transportation and end of life waste treatment. Background data was adapted to represent Vinidex PP pipe product as accurately as possible.

Database(s) and LCA software used:

The inventory data for the process are entered into the SimaPro (v9.1.1.1) LCA software program and linked to the pre-existing data for the upstream feedstocks and services selected in order of preference from:

- For Australia, the Australian Life Cycle Inventory (AusLCI) v1.31 compiled by the Australian Life Cycle Assessment Society (AusLCI, 2019), AusLCI shadow Database v1.27, and the Australasian Unit Process LCI v2014.09. The AusLCI database at the time of this report was 2 years old, the shadow database 5 years old, while the Australasian Unit Process LCI was 6 years old. In some cases processes were up to 8 years old, however, still compliant.

- Materials sourced from outside Australia were modelled based on global averages using the ecoinvent v3.6, 2019 database. Global averages were used since the sourcing of these materials often changes from year to year. At the time of reporting, the Ecoinvent v3.6 database was 2 years old.

All background data used was less than 10 years old.

Data quality & validation

Edge Environment has used the following criteria in selecting data for modelling:

- **Relevance:** select sources, data, and methods appropriate to assessing the chosen product's LCI,
- **Completeness:** include all LCI items that provide a material's contribution to a product's life cycle emissions,
- **Consistency:** enable meaningful comparisons in life cycle impact assessment (LCIA) information,
- **Accuracy:** reduce bias and uncertainty as far as is practical,
- **Transparency:** when communicating, disclose enough information to allow third parties to make decisions,
- **Time coverage:** the data collected represents recent practice for the construction of the project, and
- **Geographical coverage:** the data collected are representative of the sourcing of materials, whether from Australia or overseas, and are in line with the goal of the study.

Cut off rules

According to the PCR 2019:14, Life cycle inventory data shall according to EN 15804 A2 include a minimum of 95% of total inflows (mass and energy) per module. Inflows not included in the LCA shall be documented in the EPD. In accordance with the PCR 2019:14, the following system boundaries are applied to manufacturing equipment and employees:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI. Capital equipment and buildings typically account for less than a few percent of nearly all LCIs and this is usually smaller than the error in the inventory data itself. For this project, it is assumed that capital equipment makes a negligible contribution to the impacts as per Frischknecht et al. (2007) with no further investigation.

- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

- Transport for raw materials accounting for less than 1% of the feedmix was excluded. This is because the impact contribution is considerably small.

Allocation

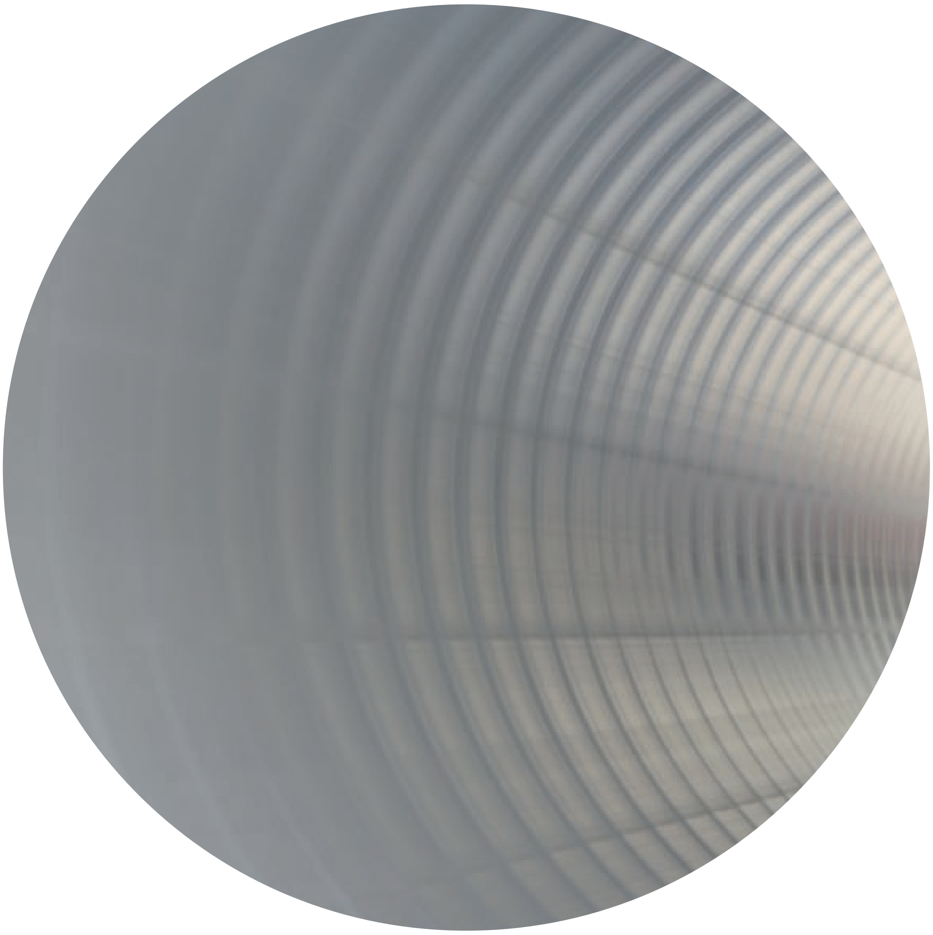
Allocation was carried out in accordance with the PCR (EPD International, 2019), section 4.5. No-allocation between co-products in the core module as there were no co-products created during manufacturing. Energy consumed in core module was allocated to pipe via mass of pipe produced.

PP environmental performance

The potential environmental impacts used in this EPD are explained in Table 5.

Table 5 - Environmental indicators used in the EPD

	Impact category	Abbreviation	Unit	Definition
Environmental impacts	Global warming potential - Fossil	GWP - F	kg CO_2 eq.	Estimates GHG warming effect for fossil, given as kgCO_2-eq.
	Global warming potential - Biogenic	GWP - B	kg CO_2 eq.	Estimates GHG warming effect for biogenic, given as kgCO_2-eq.
	Global warming potential - Land use and Land use change	GWP - Luluc	kg CO_2 eq.	Estimates GHG warming effect for land use and land use change, given as kgCO_2-eq.
	Global warming potential - Total	GWP - T	kg CO_2 eq.	Estimates the total GHG warming effect, given as kgCO_2-eq.
	Ozone depletion potential	ODP	kg CFC 11 eq.	Estimates the potential reduction of ozone in Earth's atmosphere as per CFC-11 eq effects.
	Acidification potential	AP	mol H^+ eq.	Estimates the increase of oceans acidity as per SO2 eq effects.
	Eutrophication, freshwater	EP - F	kg PO_4^{3-} eq.	Estimates the potential increment of nutrients in freshwater as kg PO_4 effects.
	Eutrophication, freshwater	EP - F2	kg P eq.	Estimates the potential increment of nutrients in freshwater as kg P equivalent effects.
	Eutrophication, marine	EP - M	kg N eq.	Estimates the potential increment of nutrients in marine water as kg N equivalent effects.
	Eutrophication, terrestrial	EP – T	mol N eq.	Estimates the potential increment of nutrients in land as mol N equivalent effects.
	Photochemical ozone formation	POCP	kg NMVOC eq.	Estimates photochemical smog (air pollution) potential as kg C2H4 eq
	Abiotic depletion potential - minerals and metals	ADP	kg Sb eq.	Estimates the impact on minerals reserves as antimony (Sb) equivalents
	Abiotic depletion potential - Fossil	ADP - F	MJ	Estimates the impact on fossil fuels reserves as MJ
	Water depletion Potential	WDP	m^3 eq.	Estimates the potential of water deprivation, to either humans or ecosystems, and serves in calculating the impact score of water consumption at midpoint in LCA or to calculate a water scarcity footprint as per ISO 14046.
Resource use	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ	Estimates the use of renewable primary energy excluding renewable primary energy resources used as raw materials
	Use of renewable primary energy resources used as raw materials	PERM	MJ	Estimates the use of renewable primary energy resources used as raw materials
	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ	Estimates the total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ	Estimates the use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
	Use of non- renewable primary energy resources used as raw materials	PENRM	MJ	Estimates the use of non- renewable primary energy resources used as raw materials
	Total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ	Estimates the total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)
	Use of secondary material	SM	kg	Estimates the use of secondary material
	Use of renewable secondary fuels	RSF	MJ	Estimates the use of renewable secondary fuels
	Use of non-renewable secondary fuels	NRSF	MJ	Estimates the use of non-renewable secondary fuels
	Use of net fresh water	FW	m^3	Estimates the use of net fresh water
Waste	Hazardous waste disposed	HWD	kg	Estimates the hazardous waste disposed
	Non-hazardous waste disposed	NHWD	kg	Estimates the non-hazardous waste disposed
	Radioactive waste disposed/stored	RWD	kg	Estimates the radioactive waste disposed/stored
	Components for re-use	CFR	kg	Estimates the components for re-use
Output flows	Material for recycling	MFR	kg	Estimates the material for recycling
	Materials for energy recovery	MFEE	kg	Estimates the materials for energy recovery
	Exported energy, electricity	EE - e	MJ	Estimates the exported energy, electricity
	Exported energy, thermal	EE - t	MJ	Estimates the exported energy, thermal
Additional environmental impact indicators	Global warming potential, excluding biogenic uptake, emissions and storage	GWP - GHG	kg CO_2 eq. (GWP100)	Estimates GHG warming effect for a change in a 100 years time, given as CO_2-eq.
	Particulate matter	PM	disease incidence	Estimates the potential incidence of disease due to PM emissions
	Ionising radiation - human health	IRP	kBq U-235 eq	Estimates the potential health damages related to the man-made routine releases of radioactive material to the environment
	Eco-toxicity, freshwater	ETP - fw	CTUe	Estimates the potential impact on fresh water ecosystems, as a result of emissions of toxic substances to air, water and soil.
	Human toxicity potential - cancer effects	HTP - c	CTUh	Estimates the potential Comparative Toxic Unit for humans - cancer
	Human toxicity potential - non cancer effects	HTP - nc	CTUh	Estimates the potential Comparative Toxic Unit for humans - non cancer
	Soil quality	SQP	dimensionless	Estimates the potential soil quality index (SQP)



Environmental information

To calculate the total environmental impact for a specific product and nominal diameter (DN), the values for each module must be added.

The total impact is the sum of the following parts:

- Value shown in A1-3
- Value of module A4
- C1-4: The four columns correspondent to module C (C1-C4)
- The value of column Module D

StormPRO® - PP pipes

Table 6 - Potential environmental impact of 1kg of PP pipe installed. Modules A1-A4, C1-4, D

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	3.55E+00	3.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-biogenic	kg CO_2 eq.	-1.03E-02	1.46E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-luluc	kg CO_2 eq.	1.13E-03	4.40E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-total	**kg CO_2 eq.**	**3.55E+00**	**3.43E-01**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
ODP	kg CFC 11 eq.	6.08E-08	4.16E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AP	mol H^+ eq.	1.82E-02	1.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-freshwater	kg PO_4^{3-} eq.	2.65E-03	1.73E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-freshwater	kg P eq.	4.26E-04	2.58E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-marine	kg N eq.	3.51E-03	4.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-terrestrial	mol N eq.	3.78E-02	5.18E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
POCP	kg NMVOC eq.	1.02E-02	1.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP-minerals&metals*	kg Sb eq.	1.53E-05	2.44E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP-fossil*	MJ	8.51E+01	4.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WDP	m^3	6.80E+00	7.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Use of resources

Table 7. Use of resources of 1kg of PP pipe installed. Modules A1-A4, C1-4, D

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.58E+00	1.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	**MJ**	1.58E+00	1.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRE	MJ	9.07E+01	4.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRM	MJ.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	**MJ**	9.07E+01	4.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.33E-02	1.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste production and output flows

Table 8. Waste production of 1kg of PP pipe installed. Modules A1-A4, C1-4, D

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1.44E-05	1.12E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	2.56E-01	1.11E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radioactive waste disposed	kg	2.65E-05	5.35E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 9. Output flows of 1kg of PP pipe installed. Modules A1-A4, C1-4, D

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Potential environmental impact - additional mandatory and voluntary indicators

Table 10. Additional environmental impacts of 1kg of PP pipe installed. Modules A1-A4, C1-4, D

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	3.37E+00	3.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results per kg of PP pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease incidence	1.26E-07	2.83E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ionising radiation - human health	kBq U-235 eq	6.12E-02	3.74E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eco-toxicity (freshwater)	CTUe	3.59E+01	7.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Human toxicity potential - cancer effects	CTUh	8.46E-10	8.01E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Human toxicity potential - non cancer effects	CTUh	2.56E-08	5.15E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil quality	dimensionless	7.41E+00	1.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Information on biogenic carbon content

Table 11. Biogenic content in 1kg of PE pipe

Results per functional or declared unit		
BIOGENIC CARBON CONTENT	Unit	QUANTITY
Biogenic carbon content in product	kg C	0.00E+00
Biogenic carbon content in packaging	kg C	2.72E-02

Note: 1kg biogenic carbon is equivalent to 44/12 kg CO_2.

Interpretation of LCA results

The majority of environmental impact lies within the PP raw material supplied to Vinidex followed by the energy used for excavation during the pipe installation phase – comparatively little impact is caused by the PP pipe manufacturing at Vinidex sites. From the feed mix ingredients, PP block copolymer resin is responsible for the majority of all environmental impacts and use of resources, although the PP polymer additive was still found to have a significant impact.

Additional environmental information

Sustainability has long been central to Vinidex's business strategies and is a fundamental part of our long term vision. Our aim is to provide the community with smart, efficient and sustainable piping solutions.

We are committed to minimising the energy used in the production of our products and have a plan to reach 100% renewable electricity use in our manufacturing by 2025. Vinidex also has a successful history of offering pipes with reduced embodied energy compared to others that perform the same function.

StormPRO® PP pipes are one example. They have a material efficient structured wall which provides strength and stiffness, with less raw material required for their manufacture.

✔ Best Environmental Products

Vinidex StormPRO® PP pipes are manufactured and certified to AS/NZS 5065. They are durable and intended for a long service life in demanding infrastructure applications. The foreword to AS/NZS 5065 states:

"By convention, plastics pipe systems are often designed on the basis of 50 year extrapolated test data. This is established international practice but is not intended to imply the service life of drainage systems is limited to 50 years. For correctly manufactured and installed systems, the actual life cannot be predicted, but can logically be expected to be well in excess of 100 years before major rehabilitation is required"

Vinidex works actively to minimise waste and to recycle post-industrial and post- consumer material into our products. Our previous achievements in this area are being expanded.

Vinidex is investing millions of dollars in more equipment at our plants to screen, handle, clean and resize recycled plastic material to allow its incorporation back into the manufacturing process for new quality pipe products.

✔ Vinidex pipe recycling

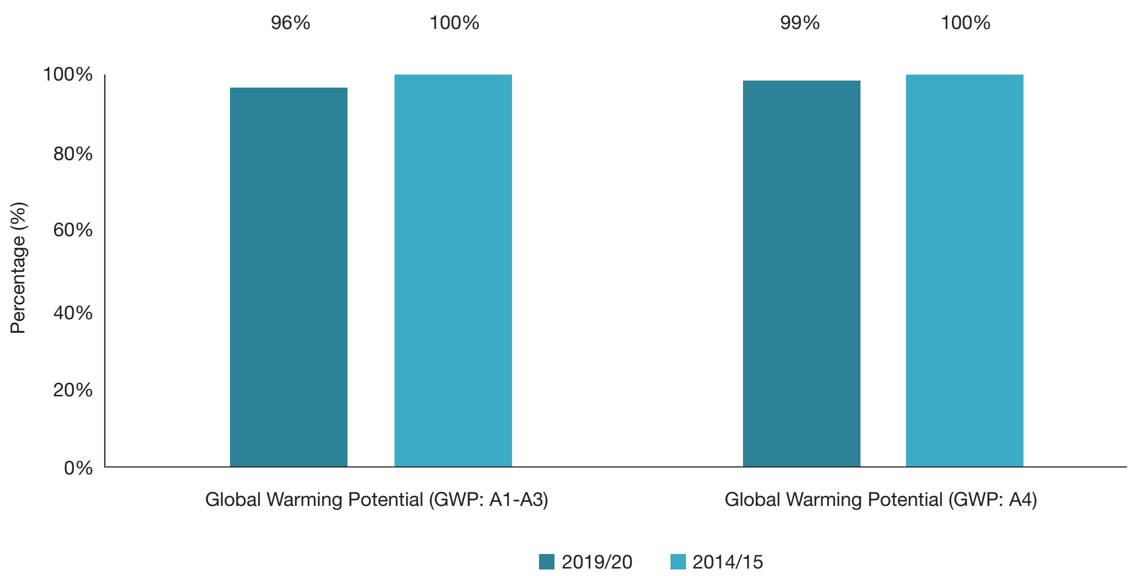
We are also working with customers, end users and material recycling companies to source greater quantities of suitable post-industrial and post-consumer recycled plastic.

We have set ambitious future targets for increasing the proportion recycled content in our pipes and fittings without compromising the long-term performance and these initiatives will allow us to achieve these targets.

Although this EPD assumes that pipes will be left in the ground at the end of their service life, it is important to know that Vinidex StormPRO® pipes can be fully recycled into new pipe products. Vinidex will take back polypropylene pipe off-cuts or pipe that has reached the end of its service life into our Sydney manufacturing operation to allow for those products to be recycled.

Differences versus previous versions of PP pipe

The GWP impact for production of PP pipes in 2019/20 is 4% lower than 2014/15. This can be attributed to reduced manufacturing waste and reduced electricity consumption during manufacturing of PP pipes. Unlike all other pipes in this LCA, the electricity and gas consumption for PP pipes has decreased in 2019/20 compared to 2015. The GWP impact for distribution of PP pipes in 2019/20 and 2014/15 is very similar.



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The International EPD System. (2015, 03 03). Product Group Classification: Multiple UN CPC Codes - Construction Products and Construction Services.

Appendix product details

Size	Application	Product Code	Stiffness Class	Effective Length (m)	Minimum Mean Outside Dia. (mm)	Pipe wieght (kg/metre)
150mm	StormPRO®	29479	SN8	6.02	169	1.5
225mm	StormPRO®	29456	SN8	5.99	259	2.9
225mm	StormPRO®	29458	SN8	5.94	343	4.7
375mm	StormPRO®	29460	SN8	5.93	428	6.8
450mm	StormPRO®	29471	SN8	5.95	514	11.0
525mm	StormPRO®	29473	SN8	5.89	600	14.4
600mm	StormPRO®	29475	SN8	5.85	682	18.8
750mm	StormPRO®	29418	SN8	5.92	835	29.1
900mm	StormPRO®	29419	SN8	5.91	999	39.6
225mm	StormPRO®	29485	SN8	2.92	259	3.3
300mm	StormPRO®	29406	SN8	2.87	343	4.8
375mm	StormPRO®	29407	SN8	2.86	428	7.9
450mm	StormPRO®	29482	SN8	2.86	514	11.3
525mm	StormPRO®	29453	SN8	2.80	600	14.3
600mm	StormPRO®	29484	SN8	2.75	682	18.1
750mm	StormPRO®	28454	SN8	2.82	835	31.6
900mm	StormPRO®	29405	SN8	2.81	999	44.9

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