Vinidex
by aliaxis

Environmental Product Declaration

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

Polyethylene Pipes

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

EPD registration number: S-P-00719
Version 2.0
Publication Date: 4 August 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

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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	
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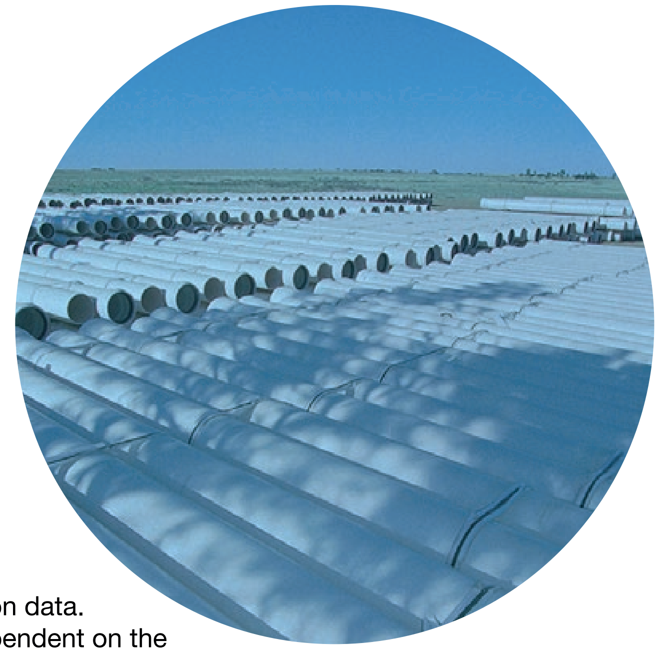
Independent external verification of the declaration and data, according to ISO 14025:2010	☐ EPD process certification (Internal) ☑ EPD verification (External)
Procedure for follow-up of data during EPD validity involves third party verifier:	No



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

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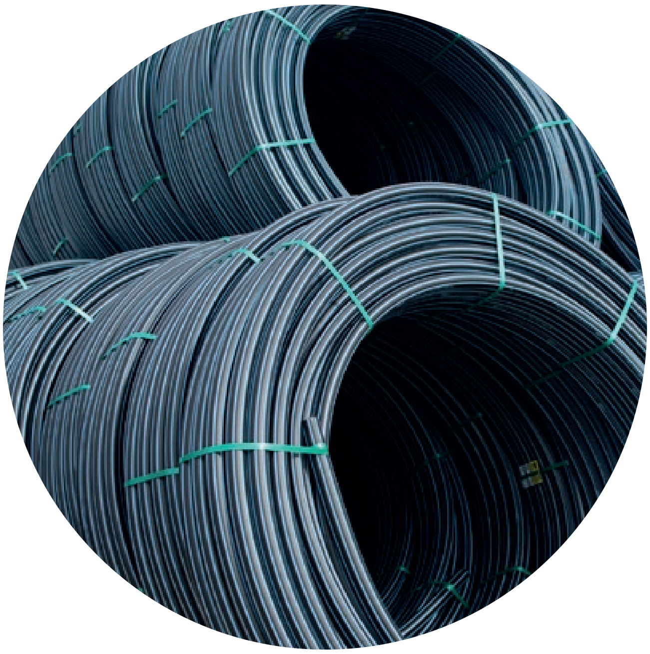
This version of the EPD has been updated with more recent production data. Module A5 hasn't been included in this study, because it is highly dependent on the specific installation conditions. Instead, an outline of the installation process is provided to highlight those factors that influence environmental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

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

Polyethylene (PE) pipe manufacture commenced in Australia in the 1950′s with small diameter pipes used for rural, irrigation and industrial applications. Since then, PE use and the number of applications for PE pipes has grown enormously, due to its versatility and the advantages it offers over iron, steel and cement systems. The flexibility of PE pipe allows cost savings in installation. Trenchless technology can avoid the need for open trenches and reduce the disturbance to the public and environment by pulling long lengths of PE pipes through holes below ground bored by mechanical moles. PE is often used in renovation of old pipelines as it can be readily inserted as a structural lining into an old pipeline.

PE pipe can be supplied in straight lengths or in coils, reducing the need for joints and fittings. PE pipes can be jointed using butt and electrofusion techniques or using mechanical fittings.

PE pressure pipes are manufactured in accordance with AS/NZS 4130 and are designated by their outside diameter or DN. For water and other general pressure applications, the maximum allowable operating pressure (MAOP) with a minimum service coefficient is designated by the pressure rating or PN. The SDR of a PE pipe refers to its 'Standard Dimension Ratio' which describes the geometry of the pipe and is the ratio of the outside diameter and the minimum wall thickness. Pipes with a higher SDR have a thinner wall than pipes with a low SDR. The SDR can be related to the MAOP using the material MRS and the service coefficient appropriate for the application.

PE pipes are available in a range of identification colours that may be either coextruded as stripes or 'jackets' that completely surround the pipe. Such colours include yellow, blue and purple for identification purposes and white jackets used minimise temperature rise in above ground applications exposed to direct sunlight. A commitment to using only the highest standard of raw materials and the latest manufacturing technology has established Vinidex with a reputation as a quality supplier of Polyethylene Pipes in sizes ranging from 13mm to 1200mm in diameter. PE pipes are used in a wide range of applications including:

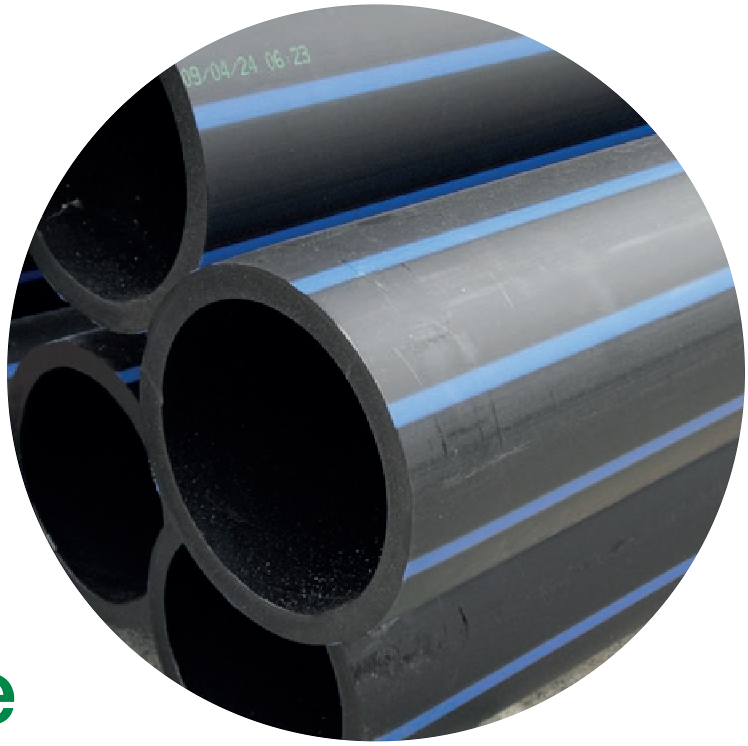
- Water supply
- Irrigation
- Mining and Slurry Lines
- Gas
- Recycled and Reclaimed Water Transfer
- Sewerage
- Drainage
- Compressed Air
- Conduits for Directional Drilling
- Conduits for telecommunication and electrical applications

Table 1 - Product characteristics of PE pipes

Product Characteristics	
Product names/application	• PE 100 • Polimax • Polymain® • Maxicoil® • Rural Plus® • Sewertech
UN CPC Code	36320 - Tubes, pipes and hoses, and fittings therefore, of plastics
Density	960 kg/m^3
Melt Flow Rate 190/5	0.3-0.5 g/10 min
Minimum Required Strength (50 year @ 20˚C)	10 MPa
Tensile Yield Strength	23 MPa
Elongation at Yield	8%
Circumferential Flexural Modulus (3 minute)	950 MPa
Circumferential Flexural Creep Modulus (50 year)	260 MPa
Poisson's ratio	0.4
Thermal Expansion Coefficient	2.4 x 10^{-4}/˚C
Thermal Conductivity	0.4 W/m.k

Table 2 - Content Declaration for PE pipes

Product components	Post consumer material	CAS No.
Polyethylene polymer	96-98%	9002-88-4
Carbon black	2-3%	1333-86-4
Non-hazardous proprietary additives	<1%	
Total	100.00%	
Packaging materials	**Weight-% (versus the product)**	
Wood	2.5%	
PET straps	0.27%	
Total	2.8%	



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 modules A4. All use stage modules were deemed not relevant.

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	Aus	Aus

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

Life cycle of Vinidex pipes

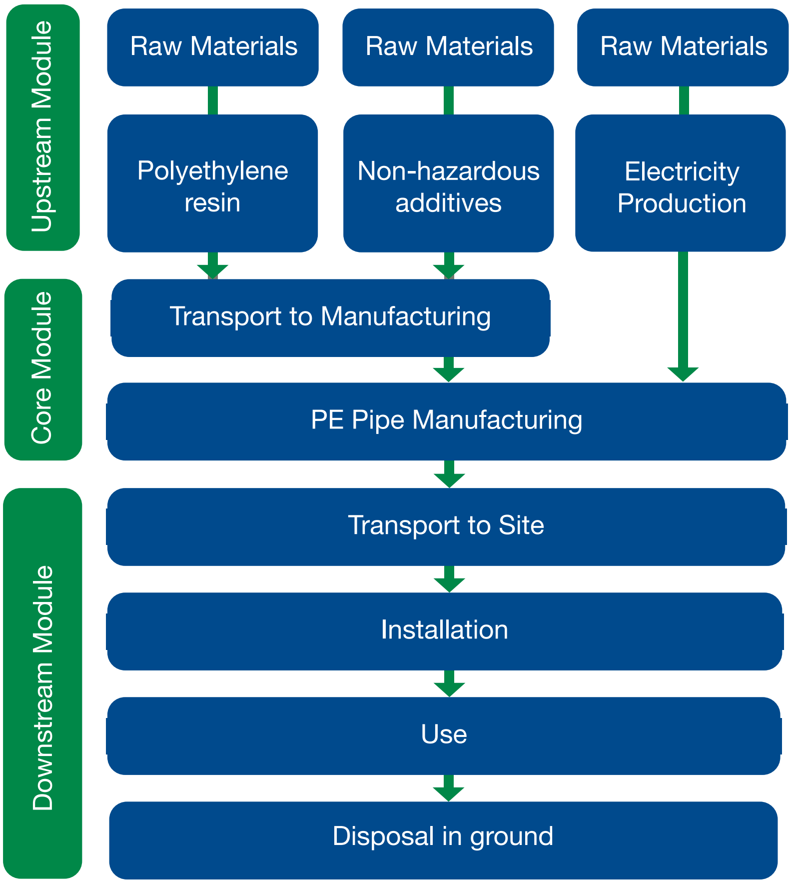


Figure 1 - Life cycle diagram of PE pipe production

Vinidex PE pipe manufacture

Vinidex PE pipes are produced using a sophisticated, highly controlled manufacturing process and extrusion technology. Materials used are precompounded in a pelletised form containing precise amounts of polymer, lubricants, stabilisers, antioxidants and pigments for the specific end product application. The PE compound is preheated to remove moisture and volatiles and is conveyed to the extruder using a controlled rate feeder. The extruder consists of a single screw configuration which melts and conveys the PE material along the length of the extruder barrel. The design of the extruder barrel/screw is complex and takes into account the properties of the various types of PE material grades used in pipe applications. Various zones exist along the length of the screw and act to melt, mix, de-gas and compress the PE compound.

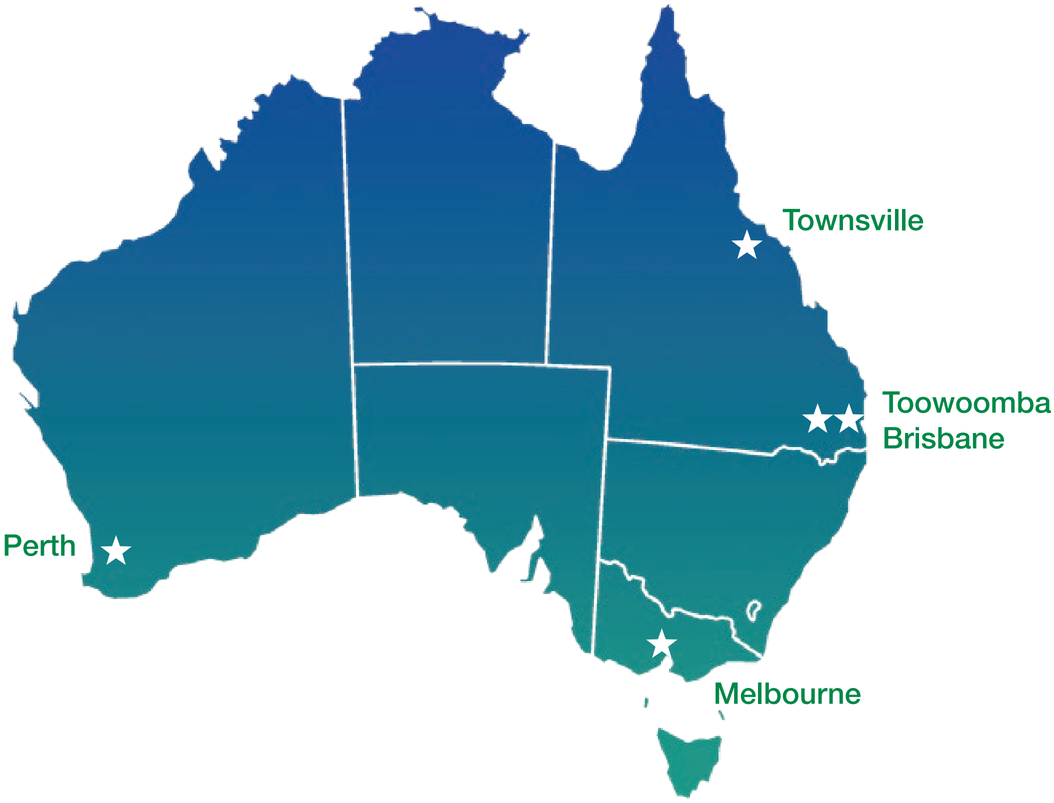


Figure 2 - Vinidex PE pipe manufacturing sites

External electrical heater bands along the barrel, together with the frictional heat generated as the PE material passes through the gaps between barrel and screw provide the energy needed to fully melt the PE compound materials. The total heat input is carefully controlled to ensure full melting of the PE without thermal degradation.

After passing through a mixing zone at the tip of the extruder, the PE melt then feeds into a head and die combination, where the melt is formed into the size of pipe required. Once the molten PE pipe form leaves the die, it enters the sizing system, where it is initially cooled to the required dimensions. This is performed using an external vacuum pressure system where the pipe surfaces are cooled with refrigerated water sprays whilst in contact with precision machined sizing sleeves. The initially cooled pipe is then progressively passed through a series of water spray cooling tanks to reduce the PE material to ambient temperature, and to finalise the pipe dimensions.

The pipe information of size, material, class, and batch data required by Australian Standards, or by specific client specification, is then marked on the pipe by an in-line printer to provide continuous branding at specified intervals. The completed pipe is then cut to standard or required length by an in-line saw. Smaller diameter pipes are either cut to standard length, or coiled, and the finished coils are strapped in standard coil sizes.
Vinidex PE pipe is manufactured in Melbourne (VIC), Perth (WA), Brisbane (QLD), Townsville (QLD) and Toowoomba (QLD) as shown in Figure 2.

Distribution stage

A significant proportion of PE pipe is sold for agriculture, industrial and gas applications, which generally require greater transportantion from manufacturing facilities than civil and plumbing applications. The impact of distribution was calculated by using the average distance from each manufacturing site to major markets, and calculating a weighted average distribution distance using market volumes.

The weighted average distance to site was estimated to be approximately 160km. A much shorter distance is required for civil and building applications in major markets close to manufacturing sites, while a longer distance was required for minor markets away from manufacturing sites, as well as agricultural and mining installation sites.

Installation

The environmental impacts and other indicators related to the installation stage of PE pressure 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, installation technique, terrain, geology, environmental conditions, 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 the wide range of PE pipe diameters and applications and for these numbers to be used for comparative purposes. 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.

Figure 3. Typical butt welding machine used for PE pipe joining.

Vinidex PE pressure pipes are available in a variety of lengths from straight lengths, typically 12 to 20m long, to coils that are hundreds of metres long (size limitations apply) and are usually installed below ground.

Coiled or butt-welded PE results in long continuous lengths of pipeline that can take advantage of trenchless installation techniques (e.g., pipe cracking, slip lining and directional drilling). Trenchless installation may be preferred in some locations, for example, for road, rail or river crossings, or to prevent disruption to above ground assets and reduce restoration in urban environments. Trenchless techniques require the use of specialist equipment and other materials, for example, drilling mud for directional drilling and grout where required.

PE pipes can also be installed using typical open trench methods. The main factors which contribute to the impacts of installation for open trench buried 'flexible' pipes apply across a range of pipe materials although, in some cases, the trench with for PE pipe may be reduced compared to other flexible pipes due to above ground jointing.

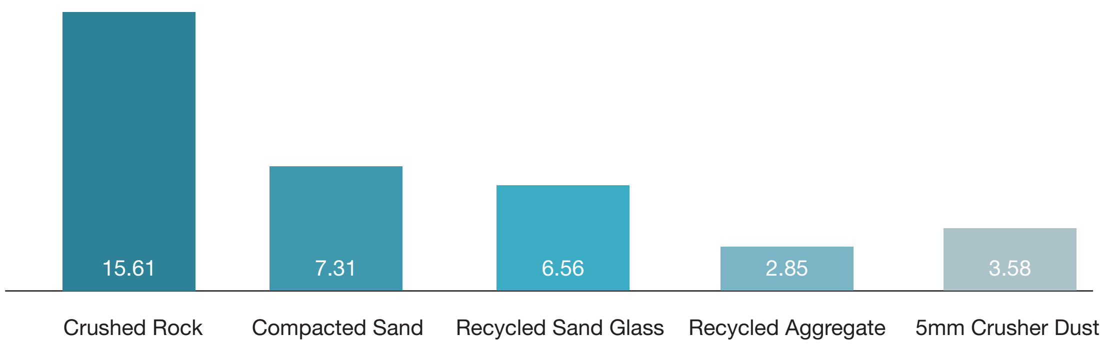
The AS/NZS 2566.2 Standard covers trench excavation and design, definition of fill and embedment zones and their respective compaction requirements and field testing of the installed pipeline.

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 open trench installations shows that trench excavation, and provision and transport imported embedment materials account for the majority (90%) of environmental impacts. In many cases, the specifier and constructor can influence these factors and consequently the overall environmental impact of pipe installation. A more detailed summary of the construction factors influencing environmental impacts for open trench installations 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

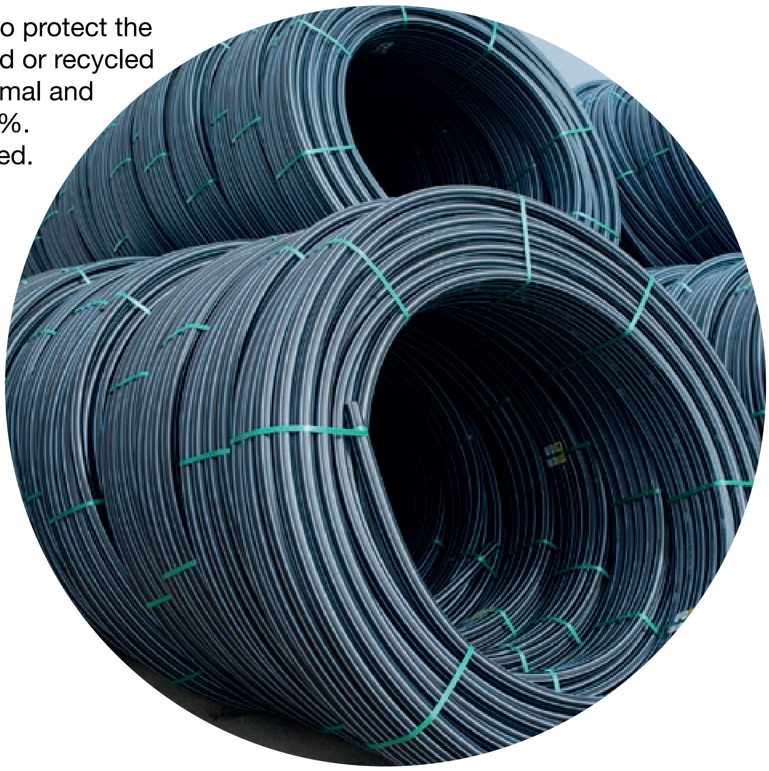
In many cases small diameter PE pipes are light enough to be lifted into the trench by hand. However, this will be dependent upon trench depth. Larger diameter pipes of course will require mechanical lifting equipment, in many cases an excavator is used.

Pipe jointing

PE pressure pipes can be joined by a variety of methods including mechanical fittings and thermal fusion processes. For smaller diameter pipes, mechanical compression fittings made from polypropylene are commonly used and joints are made with the assistance of hand operated tools only. Fusion jointing systems include butt fusion and electrofusion and have associated specialised fusion machines which require electrical power on site. Electrofusion jointing utilises moulded PE fittings containing electrical heating elements and are available in a variety of configurations including couplings, tees and saddle connections.

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 and is estimated that unusable offcuts account for less than 1%. Waste pipe offcuts which cannot be reused can be recycled.



Use stage

According to AS/NZS 4130:2009 and 4401:2006, the pipe systems can logically be expected to have a life expectancy of in excess of 100 years before major rehabilitation is required (Standards Australia, 2009: Standards Australia 2006). Maintenance of these pipe systems is not planned as deterioration of the pipe in service is not an issue.

The failure rate of the pipe itself is extremely low and is considered to be inconsequential (not relevant) in this EPD. Given the major risk with plastics pipe systems is third party interference, and that these PE pipe systems used primarily in mining and irrigation applications not sharing restricted footway allocations as with water and gas reticulation, it is significantly less likely that third parties will encounter these pipe systems. There is no release of dangerous substances to indoor air, soil and water during the use stage.

End of life

The PE pipes which are installed underground are assumed to remain underground at end of life. The PE 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 4.

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 PE 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.

Variation

Inputs for each product were allocated based on the weight of pipes produced in each site and calculated as a weighted average of the different manufacturing sites where each type of pipe is produced.

To assess whether an average of the manufacturing sites can be applied without justification, it's necessary to ensure that the variation in the GWP- GHG impact between sites isn't higher than 10% in modules A1-A3. It was found that PE pipes differ only 2% between sites.

The purpose of this EPD is to represent the average Vinidex PE pipe supplied to the Australian market. By including manufacturing sites in different states, this EPD is representative of the average production and is less susceptible to variation when production volumes alter.

PE pipe 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

PE pipes

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

Results per kg of PE pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	3.08E+00	3.92E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-biogenic	kg CO_2 eq.	-7.52E-03	2.16E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-luluc	kg CO_2 eq.	1.25E-03	1.25E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP-total	**kg CO_2 eq.**	**3.07E+00**	**3.92E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
ODP	kg CFC 11 eq.	9.77E-08	1.18E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AP	mol H^+ eq.	1.50E-02	2.09E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-freshwater	kg PO_4^{3-} eq.	2.42E-03	2.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-freshwater	kg P eq.	4.28E-04	6.92E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-marine	kg N eq.	3.09E-03	5.38E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EP-terrestrial	mol N eq.	3.31E-02	5.96E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
POCP	kg NMVOC eq.	9.07E-03	1.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP-minerals&metals*	kg Sb eq.	1.52E-05	6.83E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP-fossil*	MJ	7.63E+01	1.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WDP	m^3	8.37E+00	1.85E-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 PE pipe installed. Modules A1-A4, C1-4, D

Results per kg of PE pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.42E+00	2.36E-03	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**	**1.42E+00**	**2.36E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
PENRE	MJ	8.18E+01	1.19E-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**	**8.18E+01**	**1.19E-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	1.42E-02	4.39E-05	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 PE pipe installed. Module A1-A4, C1-4, D

Results per kg of PE pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1.58E-05	3.13E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	2.27E-01	3.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radioactive waste disposed	kg	4.67E-05	1.46E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

Results per kg of PE 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 PE pipe installed. Modules A1-A4, C1-4, D

Results per kg of PE pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	2.92E+00	3.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results per kg of PE pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease incidence	1.21E-07	3.24E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ionising radiation - human health	kBq U-235 eq	8.53E-02	1.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eco-toxicity (freshwater)	CTUe	2.85E+01	8.36E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Human toxicity potential - cancer effects	CTUh	9.32E-10	1.18E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Human toxicity potential - non cancer effects	CTUh	2.17E-08	6.38E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil quality	dimensionless	7.88E+00	4.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Information on biogenic carbon content

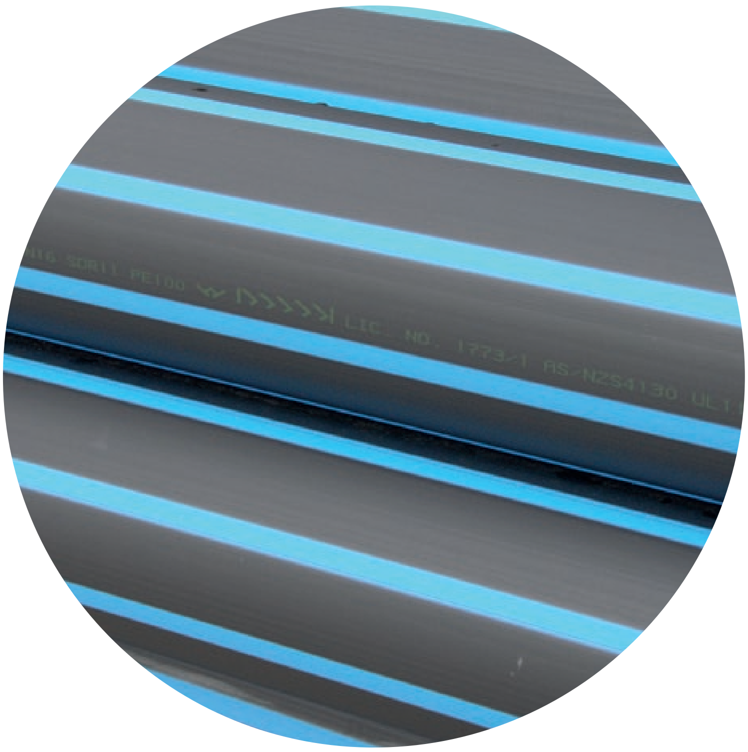
Table 11. Biogenic content in 1kg of PE pipe

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 PE raw material supplied to Vinidex and the energy used for excavation during the pipe installation phase and pipe distribution – comparatively little impact is caused by the PE pipe manufacturing at Vinidex sites. From the feed mix ingredients, PE100 resin is responsible for the majority of all environmental impacts and use of resources.



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.

✔ Best Environmental Products

Vinidex PE pressure pipes are manufactured and certified to AS/NZS 4130. They are durable and intended for a long service life in a wide range of demanding applications. The foreword to AS/NZS 4130 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 pressure pipe 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 PE pressure pipes are tested to AS/NZS 4020 and can be used safely with drinking water. PE pipes contain no heavy metals, such as lead and cadmium, no phthalates, no dioxins and no BPAs.

✔ Vinidex pipe recycling

Vinidex works actively to minimise waste. We re-process all in-house scrap material back into our manufactured pipes and fittings, preventing waste from going to landfill. External recycled content cannot be incorporated into PE pressure pipes as it is not allowed by Standards due to their stringent performance requirements.

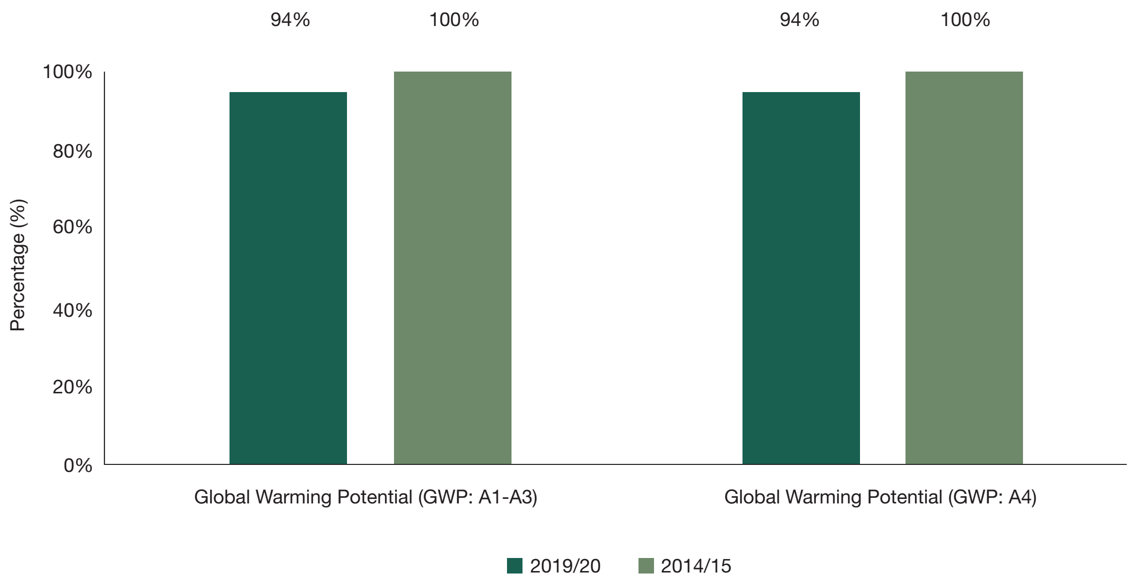
Although this EPD assumes that pipes will be left in the ground at the end of their service life, it is important to know that Vinidex PE pressure pipes can be fully recycled into new non-pressure pipe products. Vinidex will take back PE pipe off-cuts or pipe that has reached the end of its service life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

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. 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.

Differences versus previous versions of PE pipe

The GWP impact for production of PE pipes is lower (6%) in 2019/20 than in 2015. The electricity/ natural gas consumption for manufacturing in 2019/20 is higher than 2015. However, its impact is overcome by the reduced for transportation of raw materials to site (A2), due to increased local sourcing of the resin. The GWP impact from distribution is 6% lower for 2019/20 than 2014/15. This is mainly because of the change in distribution profile of PE pipes. The percentage of pipes distributed to NT and TAS in 2019/20 was lower than 2014/15. This resulted in lower weighted average distance and lower GHG emissions for distribution in 2019/20.



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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

Vinidex Capability and PE100 Polyethylene Pipe Dimensions (Based on AS/NZS 4130:2009)															
Nom. Size	SDR 41			SDR 33			SDR 26			SDR 21			SDR 17		
	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight
DN	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)
16	1.6	13	0.07	1.6	13	0.07	1.6	13	0.07	1.6	13	0.07	1.6	13	0.07
20	1.6	17	0.10	1.6	17	0.10	1.6	17	0.10	1.6	17	0.10	1.6	17	0.10
25	1.6	22	0.12	1.6	22	0.12	1.6	22	0.12	1.6	22	0.12	1.6	22	0.12
32	1.6	29	0.16	1.6	29	0.16	1.6	29	0.16	1.6	29	0.16	1.9	28	0.18
40	1.6	37	0.20	1.6	37	0.20	1.6	37	0.20	1.9	36	0.23	2.4	35	0.29
50	1.6	47	0.25	1.6	47	0.25	2	46	0.31	2.4	45	0.37	3	44	0.45
63	1.6	60	0.32	2	59	0.39	2.4	58	0.47	3	57	0.58	3.8	55	0.73
75	1.9	71	0.45	2.3	70	0.54	2.9	69	0.67	3.6	67	0.83	4.5	66	1.02
90	2.2	86	0.62	2.8	84	0.79	3.5	83	0.98	4.3	81	1.19	5.4	78	1.47
110	2.7	105	0.93	3.4	103	1.17	4.3	101	1.47	5.3	99	1.79	6.6	96	2.20
125	3.1	119	1.22	3.9	117	1.52	4.8	115	1.86	6	113	2.30	7.4	110	2.81
140	3.5	133	1.54	4.3	131	1.88	5.4	129	2.34	6.7	126	2.88	8.3	123	3.52
160	4	152	2.01	4.9	150	2.45	6.2	148	3.07	7.7	144	3.78	9.5	140	4.61
180	4.4	171	2.49	5.5	169	3.09	6.9	166	3.85	8.6	163	4.75	10.7	158	5.84
200	4.9	190	3.08	6.2	188	3.87	7.7	184	4.77	9.6	180	5.89	11.9	175	7.22
225	5.5	215	3.89	6.9	211	4.85	8.6	207	6.00	10.8	203	7.46	13.4	198	9.14
250	6.2	238	4.87	7.7	235	6.01	9.6	230	7.44	11.9	225	9.13	14.8	219	11.2
280	6.9	267	6.07	8.6	263	7.52	10.7	258	9.29	13.4	253	11.5	16.4	246	13.9
315	7.7	300	7.63	9.7	296	9.55	12.1	290	11.8	15.0	285	14.5	18.7	278	17.9
355	8.7	338	9.71	10.9	333	12.1	13.6	328	15.0	16.9	320	18.4	21.1	311	22.7
400	9.8	380	12.3	12.3	376	15.4	15.3	370	19.0	19.1	362	23.5	23.7	351	28.7
450	11	429	15.6	13.8	422	19.4	17.2	415	24.0	21.5	406	29.7	26.7	395	36.4
500	12.3	476	19.3	15.3	470	23.9	19.1	462	29.6	23.9	452	36.7	29.6	440	44.9
560	13.7	534	24.1	17.2	526	30.1	21.4	518	37.2	26.7	506	45.9	33.2	494	56.4
630	15.4	600	30.5	19.3	592	38.0	24.1	582	47.1	30	570	58.0	37.3	554	71.3
710	17.4	676	38.8	21.8	667	48.4	27.2	656	59.9	33.9	641	73.9	42.1	624	90.6
800	19.6	762	49.3	24.5	752	61.2	30.6	739	75.9	38.1	723	93.6	47.4	704	115
900	22	858	62.3	27.6	846	77.6	34.4	831	96.0	42.9	814	119	53.5	791	146
1000	24.5	953	77.0	30.6	940	95.6	38.2	924	118	47.7	904	146	59.3	880	180
1200	29.4	643	110.9	36.7	1128	137.6	45.9	1109	171	57.2	1085	211	67.9	1063	248

Vinidex Capability and PE100 Polyethylene Pipe Dimensions (Based on AS/NZS 4130:2009)												
Nom. Size DN	SDR 13.6			SDR 11			SDR 9			SDR 7.4		
	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight	Min. Wall Thickness	Mean I.D.	Approx. Weight
	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)	(mm)	(mm)	(kg/m)
16	1.6	13	0.07	1.6	13	0.07	1.8	12	0.08	2.2	11	0.10
20	1.6	17	0.10	1.9	16	0.11	2.3	15	0.13	2.8	14	0.16
25	1.9	21	0.14	2.3	20	0.17	2.8	19	0.20	3.5	18	0.24
32	2.4	27	0.23	2.9	26	0.27	3.6	24	0.33	4.4	23	0.39
40	3	34	0.36	3.7	32	0.43	4.5	31	0.52	5.5	28	0.61
50	3.7	42	0.55	4.6	40	0.67	5.6	38	0.80	6.9	35	0.96
63	4.7	53	0.88	5.8	51	1.07	7.1	48	1.28	8.6	45	1.51
75	5.5	63	1.23	6.8	61	1.50	8.4	58	1.80	10.3	53	2.15
90	6.6	76	1.78	8.2	73	2.16	10.1	69	2.60	12.3	65	3.08
110	8.1	93	2.66	10	89	3.22	12.3	84	3.88	15.1	78	4.62
125	9.2	106	3.44	11.4	101	4.18	14	96	5.01	17.1	89	5.95
140	10.3	118	4.31	12.7	114	5.21	15.7	108	6.29	19.2	99	7.48
160	11.8	136	5.64	14.6	130	6.85	17.9	123	8.20	21.9	114	9.76
180	13.3	153	7.15	16.4	145	8.65	20.1	138	10.4	24.6	128	12.3
200	14.7	170	8.78	18.2	162	10.7	22.4	154	12.8	27.3	143	15.2
225	16.6	191	11.2	20.5	183	13.5	25.1	173	16.2	30.8	161	19.3
250	18.4	212	13.7	22.7	203	16.6	27.9	192	20.0	34.2	179	23.8
280	20.6	238	17.2	25.4	228	20.9	31.3	215	25.1	38.3	200	29.9
315	23.2	268	21.8	28.6	256	26.4	35.2	242	31.8	43.0	226	37.7
355	26.1	301	27.7	32.2	289	33.5	39.6	273	40.3	48.5	255	47.9
400	29.4	340	35.1	36.3	326	42.6	44.7	307	51.2	54.6	287	60.8
450	33.1	382	44.5	40.9	366	54.0	50.2	347	64.7	61.5	322	77.1
500	36.8	424	55.0	45.4	407	66.5	55.8	385	79.9	67.6*	360	94.3
560	41.2	475	68.9	50.8	455	83.4	62.5	431	100	75.7*	403	118
630	46.3	535	87.1	57.2	512	106	70.3	485	127	85.1*	454	150
710	52.2	603	111	64.5	578	134	79.3	546	161	96.0*	512	190
800	58.8	679	141	72.5	651	170	89.3	616	205	-	-	-
900	66.2	765	178	81.7	732	216	100.0*	694	258	-	-	-
1000	72.5	852	217	90.2	815	265	111.2*	771	319	-	-	-
1200	88.2	1020	316	109.1*	976	384	133.4*	925	459	-	-	-

* = calculated using Appendix D of AS/NZS 4130

StormFLO®

Product Description	Product Code	Class	Effective Length (m)	Weight (kg/m)
225mm StormFLO® Civil	29520	SN8	5.96	3.11
300mm StormFLO® Civil	29521	SN8	5.88	4.29
375mm StormFLO® Civil	29522	SN8	5.79	7.80
450mm StormFLO® Civil	29523	SN8	5.78	12.16
500mm StormFLO® Civil	29524	SN8	5.69	16.77
600mm StormFLO® Civil	29525	SN8	5.56	19.16
225mm StormFLO® Rural	29535	SN6	5.96	3.11
300mm StormFLO® Rural	29536	SN6	5.88	4.29
375mm StormFLO® Rural	29537	SN6	5.79	7.80
450mm StormFLO® Rural	29538	SN6	5.78	12.16

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