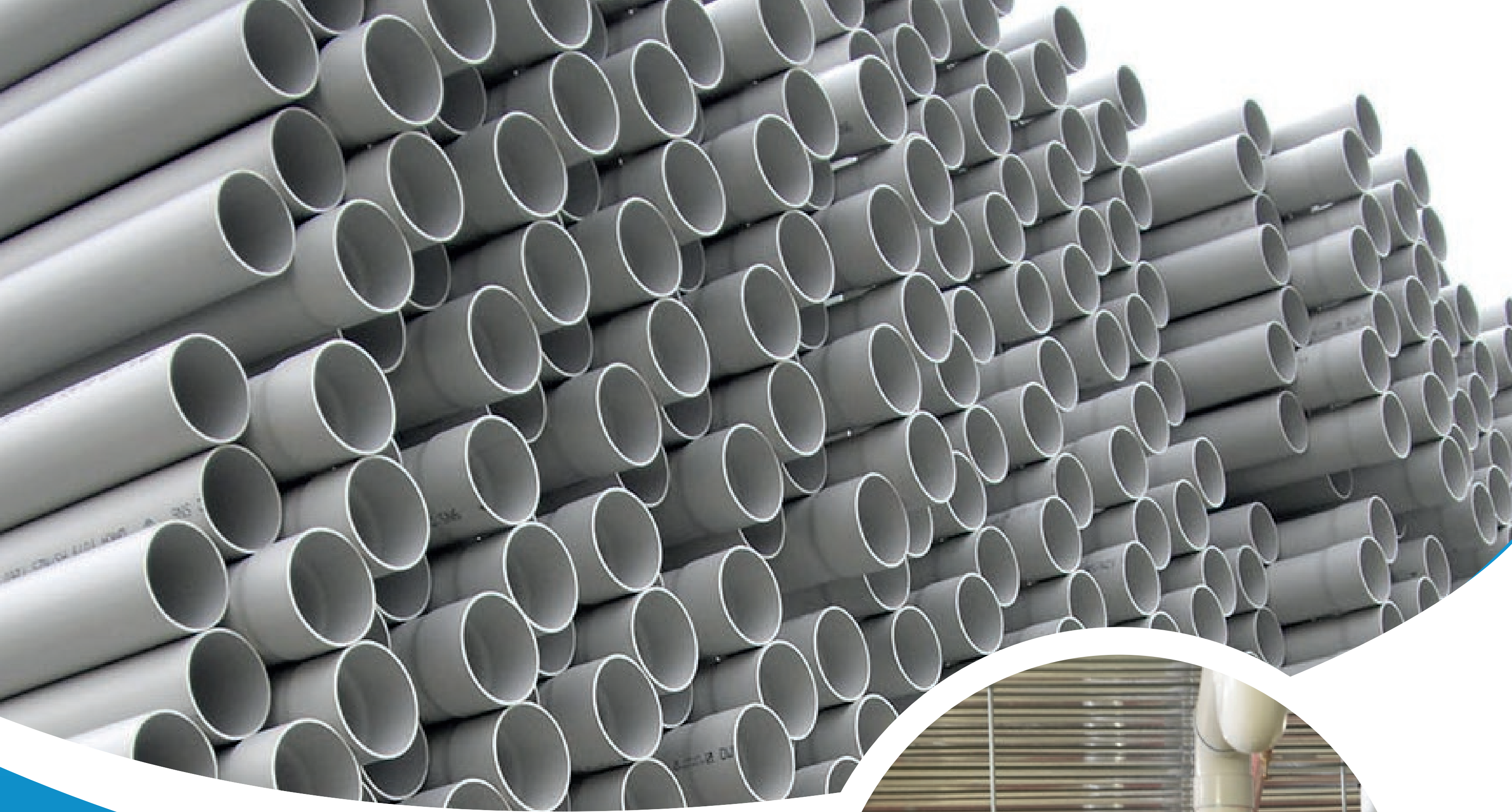

Vinidex by aliaxis

Environmental Product Declaration

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

PVC Non-Pressure Pipes and Conduits

AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

EPD registration number: S-P-00716
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

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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).

Environmental product declarations within the same product category from different programmes may not be comparable. EPD of construction products may not be comparable if they do not comply with EN 15804.

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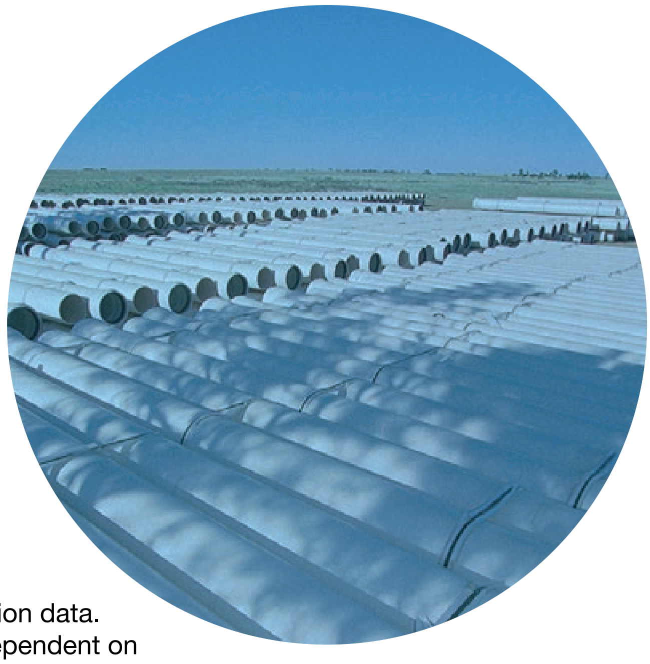
Accredited or approved by	EPD Australasia
CEN standard EN 15804 served as the core PCR	
PCR	Construction products, PCR 2019:14, 1.11 and UN CPC 369
PCR prepared by	**IVL Swedish Environmental Research Institute** Moderator: Martin Erlandsson, martin.erlandsson@ivl.se
Independent external verification 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.

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.

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.
✓ The EPD has product specific results.
✓ All Vinidex PVC pipes meet Best Environmental Practice polyvinyl chloride (PVC) Green Building Council of Australia (GBCA) requirements

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. At the time of publication, this product specific EPD and Vinidex's Best Environmental Practice (BEP) PVC certification combine to give a Responsible Product Value (RPV) of ≥ 6 for Responsible Systems in Green Star Projects.

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.

Product-related or management system-related certifications:
- AS/NZS 2053 - Conduits and fittings for electrical installations.
- AS/NZS 1260 - PVC-U pipes and fittings for drain, waste and vent application.
- AS/NZS 1254 - PVC-U pipes and fittings for stormwater and surface water applications.

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
- Vinidex PVC pipes 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.

- Vinidex PVC Non Pressure pipes are manufactured to the following standards to ensure its long life performance:
  - AS/NZS 2053 - Conduits and fittings for electrical installations.
  - AS/NZS 1260 - PVC-U pipes and fittings for drain, waste and vent application.
  - AS/NZS 1254 - PVC-U pipes and fittings for stormwater and surface water applications.
- Vinidex's quality management system is verified to the requirements of ISO 9001.
- Vinidex PVC pipes are accredited to Best Environmental PVC (BEP) Standards.

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

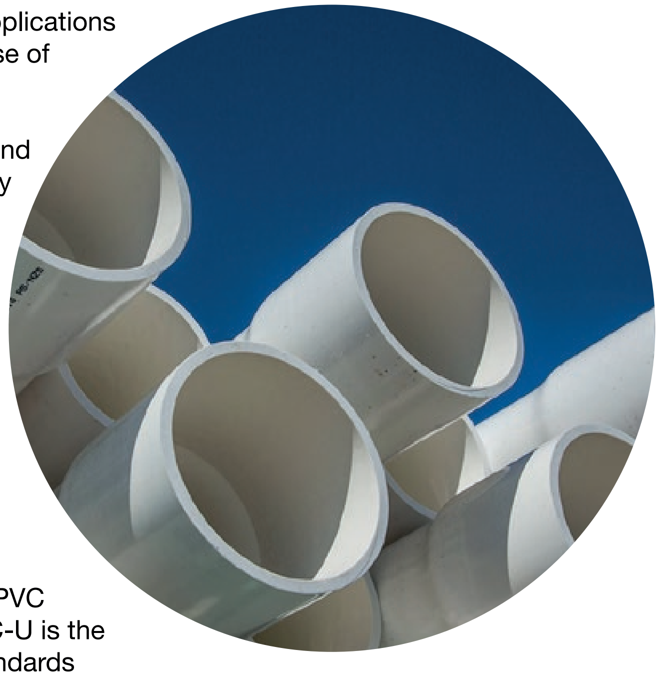
We have ambitious goals to reduce our carbon footprint:

- 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

PVC is the material of choice for non-pressure systems. It is used for plumbing, sewerage and drainage applications as well as for electrical and communications conduits. The material is ideally suited to these applications and is used in all types of buildings and infrastructure due to its ease of installation, light weight, non-conductive properties and long life.



The material is very stable retaining its properties in the long term and does not corrode at all in wet conditions or environments commonly encountered that are aggressive towards metals or concrete. PVC pipes and conduits are used above ground, behind the wall, in fully exposed and buried installations.
Vinidex produces a complete range of PVC non-pressure pipe and conduit products conforming to relevant Australian Standards in sizes from 16 mm to 375 mm. Pipes have StandardsMark product certification and products intended for plumbing applications also have WaterMark certification permitting their use in plumbing applications in accordance Volume 3 of the National Construction Code of Australia.

Pipes and conduits are all produced from PVC-U although they are commonly referred to as being manufactured from PVC. PVC-U is PVC Unplasticised and contains no phthalates or other plasticisers. PVC-U is the technical description of the material used in specifications and Standards documentation. Specific product characteristics are shown in Table 1 and the content declaration in Table 2.

Table 1 - Product characteristics of PVC non-pressure pipes

Product Characteristics	
Product names/application	Polyvinylchloride (PVC) pipes covered in this EPD are: • **PVC solid wall:** DWV, Stormwater, Electrical & Communications Conduit • **PVC form core:** DWV, Stormwater & Communications Electrical Conduit • **PVC Corflo®:** Electrical Conduit See Table 9 for individual product codes.
UN CPC Code	369 – Other plastic products
Density	1420-1480 kg/m^3
Ultimate tensile strength	52 MPa
Compressive strength	66 MPa
Shore D hardness	80
Coefficient of linear thermal expansion	7 x 10^{-5}/°C
Vicat softening temperature	80-84°C
Elongation at yield	5.5%
Poisson's ratio	0.40
Ring bending modulus	3200 MPa

Table 2 - Content Declaration for Solid Wall and Corflo®

Product components	Post-consumer material, weight-%	CAS No.
PVC resin	81%	9002-86-2
Filler	15%	1317-65-3
Stabilizer	2%	Confidential (nothing hazardous)
Titanium white (pigment)	1%	13463-67-7
Oxidised polyethylene wax	0.2%	9010-79-1
Polyethylene wax	0.3%	8002-74-2
Other pigments	0.3%	Confidential (nothing hazardous)
Total	100.00%	
Packaging materials	**Weight-% (versus the product)**	
Wood	2.5%	
Steel	0.04%	
Total	2.54%	

Table 3 - Content Declaration for Foam Core

Product components	Percentage Content - Core	Percentage Content - Skin	CAS No.
PVC resin	84%	82.9%	9002-86-2
Filler	13%	8.7%	1317-65-3
Stabilizer	3%	2.5%	Confidential (nothing hazardous)
Titanium white (pigment)	0%	0.6%	13463-67-7
Azodicarbonamide	1%		9010-79-1
Polyethylene wax	0.4%	0.8%	8002-74-2
Calcium Stearate	0.2%		9002-86-2
CPE (Chlorinated Polyethylene)		4.1%	64754-90-1
Oxidised polyethylene wax		0.2%	9010-79-1
Pigment		0.2%	Confidential (nothing hazardous)
Total	100%	100%	
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	
Wood	0.025	2.5%	
Steel	0.0004	0.04%	
TOTAL	0.0254	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 4 shows the system boundary and scope of the EPD. The scope of this EPD Cradle to gate with module C1–C4, module D and optional module A4. Due to the durability of PVC pressure pipes, and lack of planned or required maintenance throughout the service life, modules B1-B7 were also deemed not relevant (of negligible impact).

Table 4 - 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

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

Life cycle of Vinidex pipes

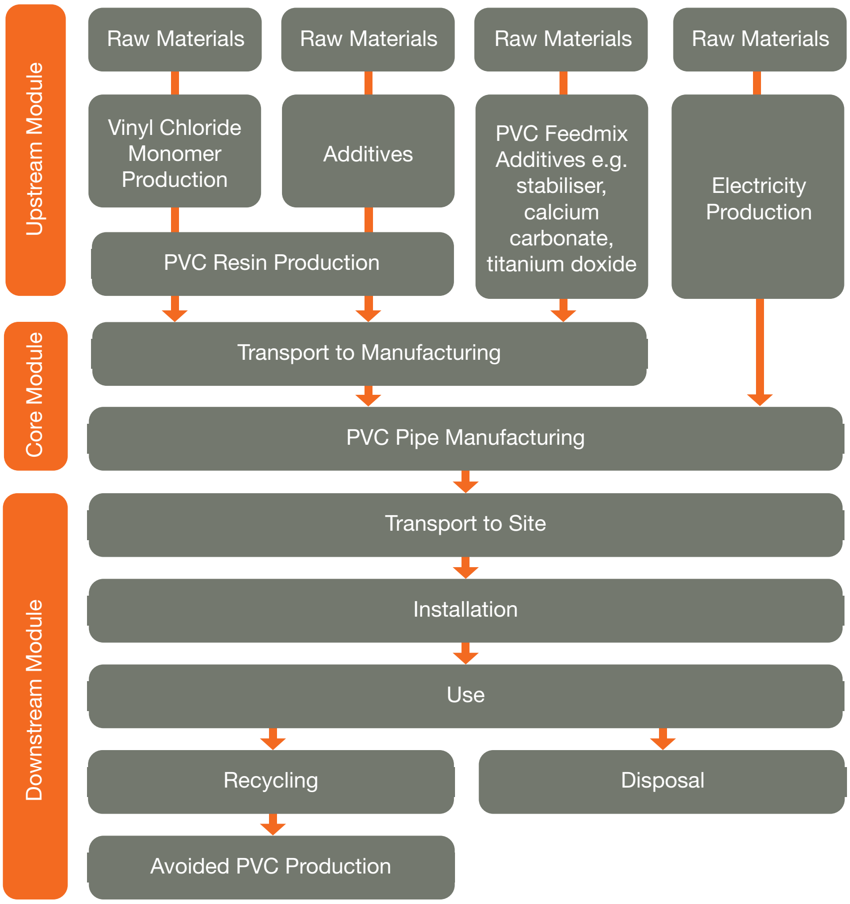


Figure 1 - Life cycle diagram of PVC pipe production

Vinidex PVC non-pressure pipe manufacture

Vinidex non-pressure PVC-U pipes are manufactured primarily from PVC resin along with additives, including: calcium carbonate, titanium dioxide, calcium based stabiliser, lubricants and pigments. In the case of foam core PVC-U pipe, azodicarbonamide is also used as a blowing agent. The PVC resin is the main ingredient in the PVC-U pipe feed mix. Internal PVC-U pipe scrap from production is fed back into the feed mix and utilised as the internal structure of foam core pipes also included in this EPD. The feed mix is heated and mixed prior to extrusion and then cooled with water to form the pipe structure. One end of the pipe is then re-heated after cutting and expanded to form a socket to allow for pipe joining.

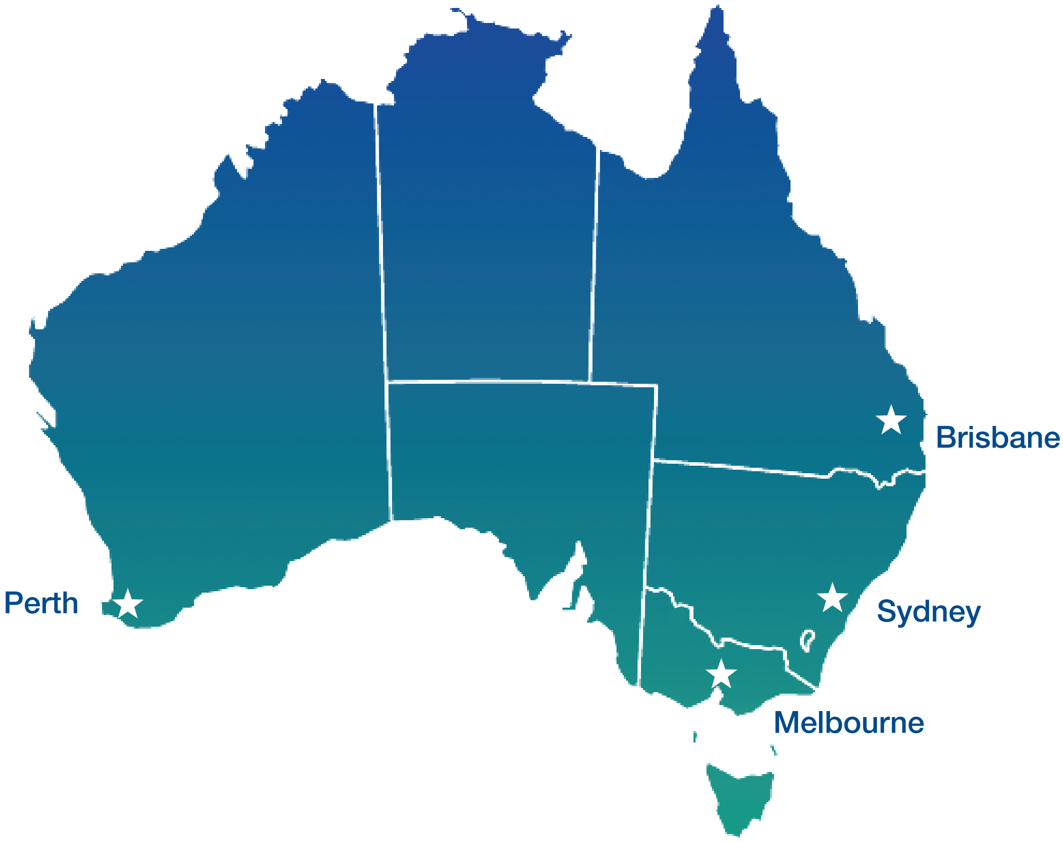


Figure 2 - Vinidex PVC non-pressure pipe manufacturing sites

Finally the lengths of pipe are palletised, packaged with a softwood timber frame, steel and PET strapping. Vinidex PVC-U manufacturing sites for PVC non-pressure pipe are shown above in Figure 2.

The results shown in this EPD are representative of the weighted average PVC-U pipe production, incorporating PVC-U pipe of both solid wall and foam core construction.

Distribution stage

Vinidex has PVC-U pipe manufacturing facilities in Australia's major markets, and the vast majority of pipe distribution is over short distances within Sydney, Melbourne, Brisbane and Perth metropolitan areas. While some pipe will be transported a long distance, either into rural areas or interstate to Adelaide, Hobart and Darwin, the weighted average distance to site is estimated to be between 50 and 70 km.

Installation

The environmental impacts and other indicators related to the installation stage of PVC non-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 non-pressure PVC 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.

PVC non-pressure pipes are typically available in 3 – 6m straight lengths and are installed in both above ground attached to the outside of buildings or inside buildings and also buried below ground. Applications include drain, waste and vent (DWV) plumbing, stormwater plumbing, electrical and communications conduits.

PVC non-pressure pipe and conduit of nominal diameter 90 mm and below are predominantly installed above ground, either on inside or outside of buildings – in residential construction they are typically located in wall and floor cavities. In the case of commercial, industrial, and high-rise residential installations pipe diameters up to nominal diameter 150mm are also used and are typically suspended from floor and ceiling surfaces. Pipes are light enough to be carried by person, cut by handsaw, and positioned into place by hand. Installation requirements for plumbing applications are defined by the various parts of AS/NZS 3500 Plumbing and Drainage standards and volume three of the National Construction Code.

PVC pipe diameters 100 mm and larger are predominantly buried, with DN100 and 150 mm pipes typically being used to connect building services to larger diameter PVC sewer or stormwater drainage infrastructure provided by water and council agencies. This scenario also applies in the case of PVC conduits used to house and protect electrical and communications cables.

Buried installations use 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. 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.

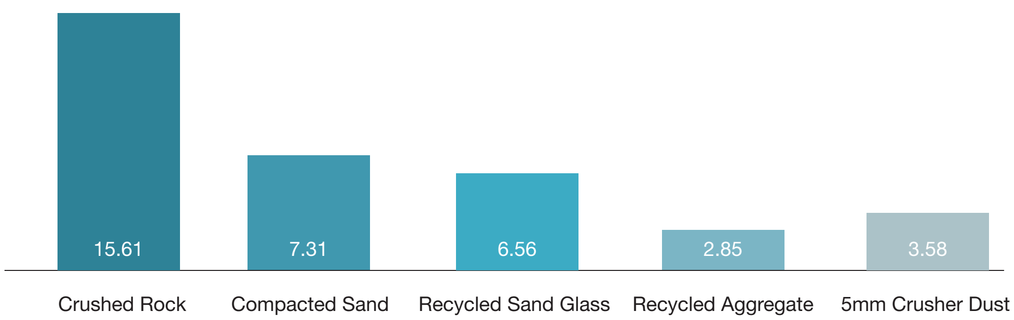
Trench Excavation

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 3.

Figure 3 - 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 PVC non-pressure pipes are light enough to be lifted into the trench by hand. However, this will be dependent upon trench depth. Larger diameter pipes, greater than DN150 of course will require mechanical lifting equipment, in many cases an excavator is used.

Pipe jointing

PVC non-pressure pipes are commonly joined by either of the following methods:

i) Solvent weld jointing (SWJ) - pipe or fitting socket and spigot ends are joined by initial application of a primer to the jointing surfaces, followed by application of solvent cement and subsequent insertion of the spigot end into the socket.

The solvent softens the PVC and the close fit of the socket and spigot joint results in chemical welding of the spigot to the socket. This method of jointing is predominantly used for DWV and Stormwater pipe diameters 100mm and below and for all diameters of electrical and communications conduit.

ii) Rubber ring jointing (RRJ) – in this case an elastomeric seal ring installed in the ring groove of the pipe socket provides a seal with the inserted pipe spigot. Rubber ring jointed systems are typically for DWV PVC pipes larger than DN150, especially those used in water and council agency sewer infrastructure.

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

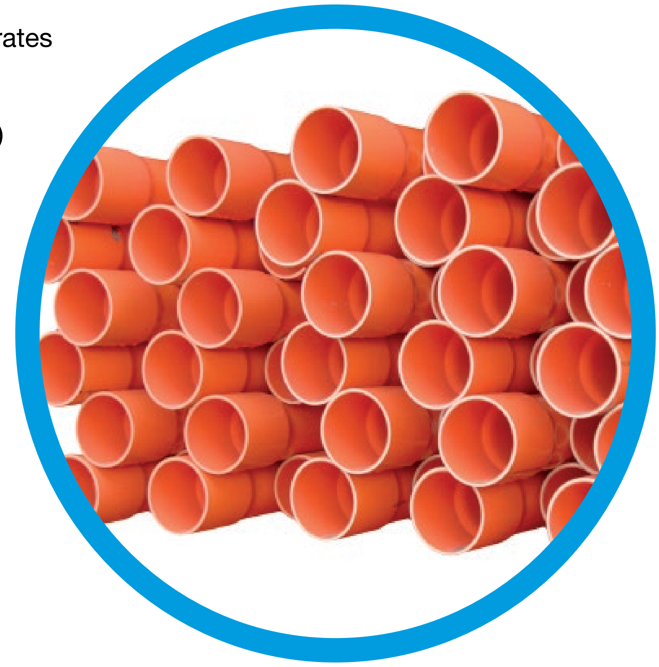
Maintenance of the pipe systems is not required and not planned. These systems are designed with this in mind as access to these systems in a finished building is often limited given their location in floor slabs or behind finished walls and ceilings. The pipe systems are designed to outlast the building with a life expectancy of in excess of 100 years. The failure rate is also extremely low and is considered to be inconsequential (not relevant) in this EPD. Post installation problems, if any, tend to be linked to 3rd party damage such as inadvertently drilling through pipes behind ceiling and wall finishes. Apart from PVC pipes containing lead stabilisers, there are no significant emissions from leaching of chemicals during the use stage for PVC pipes (European Commission, 2004). In the case that pipe is damaged, repair is simple using either a mechanical clamp or cutting out a small section (typically only 100mm in the case of a drilled hole or misdirected fastener type of incident) and replacing with a new section of pipe or simply a repair sleeve fitting – accessing the pipe to effect the work will generally be the most challenging aspect of a repair. There is no release of dangerous substances to indoor air, soil and water during the use stage.

End of life

PVC plastics pipe systems are readily recyclable and are currently recycled in all capital cities in Australia. Practically all pre-consumer pipe waste is recycled at manufacturing locations and post-consumer pipe waste recycling is on the rise. Due to fact that plastic pipes are a relatively new product with a very long service life, most plastic pipe that has been installed in Australia is still in its first life time.

Plastic pipe therefore represents a very small proportion of waste going to landfill – a fact confirmed by an audit of construction and demolition waste in NSW from 2011 (DSEWPC, 2011). PVC-U pipe can be recycled 6-7 times without significant reduction in pipe material quality requirements. Assuming a pipe life time of 100 years, the PVC material in PVC pipes may have a life time in excess of 600 years.

Due to a lack of national data on PVC pipe recycling, recycling rates were calculated by using best estimates for PVC pipe waste generation and recycling in NSW. Based on estimates by the former Department of Environment and Climate Change (DECC) and subsequent discussions with PIPA, it was estimated that there is approximately 1,300 tonnes of PVC pipe entering the waste stream each year in NSW. The current amount of PVC pipe recycled in NSW is approximately 350 tonnes, giving a recycling rate of 26.9%. This recycled PVC material is used in an innovative product range where the recyclate is used to manufacture new pipe with the same life and performance expectations as pipe made solely from virgin material. It is good to know that even when that long service life has been achieved that it can be recycled again back into pipe with exactly the same performance and life expectancy as the original pipe. So not only does plastic pipe connect Australia, it is also very much in the loop as far as recycling is concerned.



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 5 - 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 - While the design life of the PVC-U pipe is in excess of 100 years, the duration of the pipe use in buildings will be less for buildings with a shorter lifetime

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 PVC-U pipe product as accurately as possible.

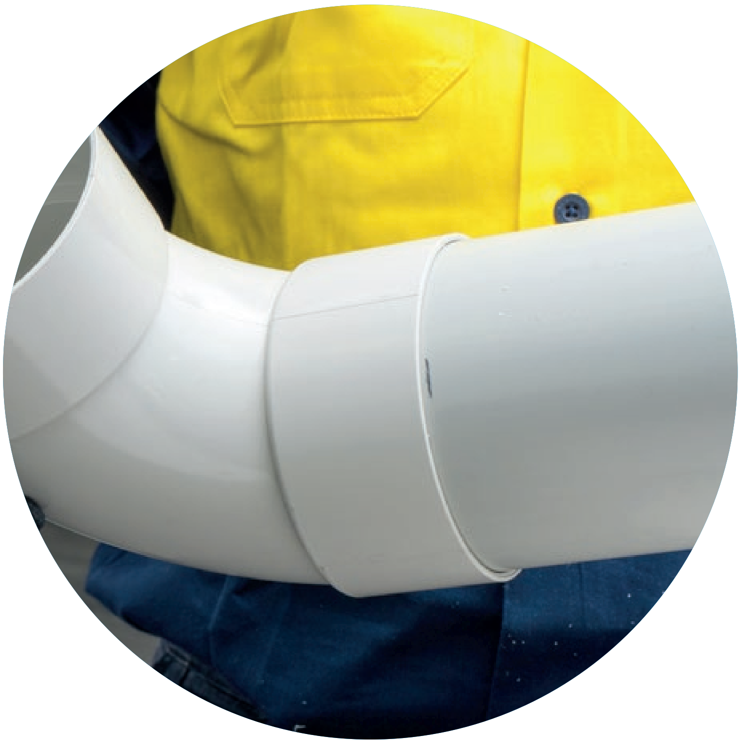
Database(s) and LCA software used:

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

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 PVC foam core pipes differ only 6% between sites. PVC solid wall pipes however, differ 18% between sites.

The justification behind applying an average despite this variation, is that given that Vinidex distributes across Australia, a customer buying a Vinidex product won't be able to identify the specific manufacturing site the product is coming from. By including manufacturing sites in all different states, this EPD is representative of the average production and is less susceptible to variation when production volumes alter.

PVC non-pressure environmental performance

The potential environmental impacts used in this EPD are explained in Table 6.

Table 6 - 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

PVC non-pressure pipe Solid Wall

Table 7 - Potential environmental impact of 1kg of Solid Wall pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC solid wall pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	3.26E+00	2.84E-02	5.24E-05	9.17E-03	5.43E-02	1.49E-02	-5.48E-01
GWP-biogenic	kg CO_2 eq.	-9.97E-03	1.18E-06	1.78E-09	5.83E-07	1.09E-04	2.26E-06	-1.03E-03
GWP-luluc	kg CO_2 eq.	2.03E-03	3.65E-08	7.24E-13	7.49E-08	1.25E-08	1.07E-07	-4.12E-04
GWP-total	**kg CO_2 eq.**	**3.25E+00**	**2.84E-02**	**5.24E-05**	**9.17E-03**	**5.44E-02**	**1.49E-02**	**-5.49E-01**
ODP	kg CFC 11 eq.	9.73E-07	3.45E-10	7.67E-15	1.38E-09	1.66E-10	1.50E-09	-2.44E-07
AP	mol H^+ eq.	1.84E-02	1.47E-04	4.64E-07	7.23E-05	3.79E-04	1.17E-04	-2.64E-03
EP-freshwater	kg PO_4^{3-} eq.	3.45E-03	1.43E-05	6.82E-08	8.68E-06	2.53E-05	1.41E-05	-7.43E-04
EP-freshwater	kg P eq.	6.43E-04	2.13E-07	3.91E-11	3.14E-07	1.71E-06	4.92E-07	-1.71E-04
EP-marine	kg N eq.	3.92E-03	3.86E-05	2.02E-07	2.05E-05	5.38E-05	3.44E-05	-5.29E-04
EP-terrestrial	mol N eq.	4.08E-02	4.28E-04	2.20E-06	2.25E-04	5.80E-04	3.77E-04	-5.46E-03
POCP	kg NMVOC eq.	1.10E-02	1.30E-04	5.75E-07	7.16E-05	1.58E-04	1.11E-04	-1.72E-03
ADP-minerals&metals*	kg Sb eq.	3.37E-05	2.02E-08	1.19E-12	3.28E-08	5.27E-08	5.98E-08	-1.21E-05
ADP-fossil*	MJ	5.36E+01	3.90E-02	1.93E-05	1.22E-01	2.84E-01	1.48E-01	-1.15E+01
WDP	m^3	1.41E+01	6.23E-02	2.70E-05	7.70E-02	1.60E+00	1.54E-01	-3.66E-01

* 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 8. Use of resources of 1kg of Solid Wall pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC solid wall pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	2.47E+00	8.27E-04	4.54E-07	1.37E-03	2.66E-02	2.38E-03	-4.21E-01
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**	**2.47E+00**	**8.27E-04**	**4.54E-07**	**1.37E-03**	**2.66E-02**	**2.38E-03**	**-4.21E-01**
PENRE	MJ	5.71E+01	4.05E-02	1.94E-05	1.29E-01	2.87E-01	1.56E-01	-1.23E+01
PENRM	MJ.	3.27E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	**MJ**	**8.98E+01**	**4.05E-02**	**1.94E-05**	**1.29E-01**	**2.87E-01**	**1.56E-01**	**-1.23E+01**
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	1.87E-02	1.39E-05	3.59E-09	1.53E-05	8.83E-04	2.62E-05	-4.27E-03

Waste production and output flows

Table 9. Waste production of 1kg of Solid Wall pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC solid wall pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	3.46E-05	9.26E-08	5.29E-12	1.69E-07	9.79E-08	2.25E-07	-7.68E-06
Non-hazardous waste disposed	kg	3.68E-01	9.19E-04	7.31E-08	8.95E-04	7.06E-02	6.95E-01	-7.59E-02
Radioactive waste disposed	kg	5.69E-05	4.43E-10	5.91E-14	6.75E-10	1.27E-09	8.99E-10	-1.52E-05

Table 10. Output flows of 1kg of Solid Wall pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC solid wall 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	2.69E-01	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 11. Additional environmental impacts of 1kg of Solid Wall pipe installed. Modules A1-3, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC solid wall pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	3.14E+00	2.81E-02	5.18E-05	8.98E-03	5.35E-02	1.46E-02	-5.24E-01

A1-A4, C1-C4, D Results per kg of PVC solid wall pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease incidence	1.32E-07	2.34E-09	1.31E-12	4.59E-10	2.90E-09	7.34E-10	-2.18E-08
Ionising radiation - human health	kBq U-235 eq	1.43E-01	3.09E-06	4.09E-10	4.88E-06	8.77E-06	6.39E-06	-3.74E-02
Eco-toxicity (freshwater)	CTUe	5.26E+01	6.46E-01	1.27E-03	7.11E-02	1.76E-01	1.48E-01	-1.10E+01
Human toxicity potential - cancer effects	CTUh	1.70E-09	6.62E-12	1.03E-14	2.40E-12	1.24E-11	4.42E-12	-3.10E-10
Human toxicity potential - non cancer effects	CTUh	4.82E-08	4.26E-10	7.02E-13	9.78E-11	1.67E-10	1.60E-10	-9.17E-09
Soil quality	dimensionless	1.13E+01	1.39E-02	3.21E-06	3.12E-02	1.35E-01	6.61E-02	-1.63E+00

Information on biogenic carbon content

Table 12. Biogenic content in 1kg of Solid Wall 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.

PVC non-pressure pipe Foam Core

Table 13. Potential environmental impact of 1kg of Foam Core pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC foam core pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	3.29E+00	2.84E-02	5.24E-05	9.17E-03	5.43E-02	1.49E-02	-5.48E-01
GWP-biogenic	kg CO_2 eq.	-1.02E-02	1.18E-06	1.78E-09	5.83E-07	1.09E-04	2.26E-06	-1.03E-03
GWP-luluc	kg CO_2 eq.	2.07E-03	3.65E-08	7.24E-13	7.49E-08	1.25E-08	1.07E-07	-4.12E-04
GWP-total	**kg CO_2 eq.**	**3.28E+00**	**2.84E-02**	**5.24E-05**	**9.17E-03**	**5.44E-02**	**1.49E-02**	**-5.49E-01**
ODP	kg CFC 11 eq.	1.03E-06	3.45E-10	7.67E-15	1.38E-09	1.66E-10	1.50E-09	-2.44E-07
AP	mol H^+ eq.	1.83E-02	1.47E-04	4.64E-07	7.23E-05	3.79E-04	1.17E-04	-2.64E-03
EP-freshwater	kg PO_4^{3-} eq.	3.44E-03	1.43E-05	6.82E-08	8.68E-06	2.53E-05	1.41E-05	-7.43E-04
EP-freshwater	kg P eq.	6.51E-04	2.13E-07	3.91E-11	3.14E-07	1.71E-06	4.92E-07	-1.71E-04
EP-marine	kg N eq.	3.83E-03	3.86E-05	2.02E-07	2.05E-05	5.38E-05	3.44E-05	-5.29E-04
EP-terrestrial	mol N eq.	3.99E-02	4.28E-04	2.20E-06	2.25E-04	5.80E-04	3.77E-04	-5.46E-03
POCP	kg NMVOC eq.	1.08E-02	1.30E-04	5.75E-07	7.16E-05	1.58E-04	1.11E-04	-1.72E-03
ADP-minerals&metals*	kg Sb eq.	3.42E-05	2.02E-08	1.19E-12	3.28E-08	5.27E-08	5.98E-08	-1.21E-05
ADP-fossil*	MJ	5.48E+01	3.90E-02	1.93E-05	1.22E-01	2.84E-01	1.48E-01	-1.15E+01
WDP	m^3	1.42E+01	6.23E-02	2.70E-05	7.70E-02	1.60E+00	1.54E-01	-3.66E-01

* 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 14. Use of resources of 1kg of Foam Core pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC foam core pipe								
Indicator	**Unit**	**A1-A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	2.48E+00	8.27E-04	4.54E-07	1.37E-03	2.66E-02	2.38E-03	-4.21E-01
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**	**2.48E+00**	**8.27E-04**	**4.54E-07**	**1.37E-03**	**2.66E-02**	**2.38E-03**	**-4.21E-01**
PENRE	MJ	5.85E+01	4.05E-02	1.94E-05	1.29E-01	2.87E-01	1.56E-01	-1.23E+01
PENRM	MJ.	3.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	**MJ**	**9.33E+01**	**4.05E-02**	**1.94E-05**	**1.29E-01**	**2.87E-01**	**1.56E-01**	**-1.23E+01**
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	2.22E-02	1.39E-05	3.59E-09	1.53E-05	8.83E-04	2.62E-05	-4.27E-03

* 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.

Waste production and output flows

Table 15. Waste of 1kg of Foam Core pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC foam core pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	3.55E-05	9.26E-08	5.29E-12	1.69E-07	9.79E-08	2.25E-07	-7.68E-06
Non-hazardous waste disposed	kg	3.47E-01	9.19E-04	7.31E-08	8.95E-04	7.06E-02	6.95E-01	-7.59E-02
Radioactive waste disposed	kg	5.72E-05	4.43E-10	5.91E-14	6.75E-10	1.27E-09	8.99E-10	-1.52E-05

Table 16. Output flows of 1kg of Foam Core pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC foam core 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	2.69E-01	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 17. Additional environmental impacts of 1kg of Foam Core pipe installed. Modules A1-3, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC foam core pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	3.17E+00	2.81E-02	5.18E-05	8.98E-03	5.35E-02	1.46E-02	-5.24E-01

A1-A4, C1-C4, D Results per kg of PVC foam core pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease incidence	1.36E-07	2.34E-09	1.31E-12	4.59E-10	2.90E-09	7.34E-10	-2.18E-08
Ionising radiation - human health	kBq U-235 eq	1.45E-01	3.09E-06	4.09E-10	4.88E-06	8.77E-06	6.39E-06	-3.74E-02
Eco-toxicity (freshwater)	CTUe	5.17E+01	6.46E-01	1.27E-03	7.11E-02	1.76E-01	1.48E-01	-1.10E+01
Human toxicity potential - cancer effects	CTUh	1.64E-09	6.62E-12	1.03E-14	2.40E-12	1.24E-11	4.42E-12	-3.10E-10
Human toxicity potential - non cancer effects	CTUh	4.68E-08	4.26E-10	7.02E-13	9.78E-11	1.67E-10	1.60E-10	-9.17E-09
Soil quality	dimensionless	1.09E+01	1.39E-02	3.21E-06	3.12E-02	1.35E-01	6.61E-02	-1.63E+00

Information on biogenic carbon content

Table 18. Biogenic content in 1kg of Foam Core 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

PVC non-pressure pipe Corflo®

Potential environmental impact – mandatory indicators according to EN 15804

Table 19. Potential environmental impact of 1kg of Corflo® pipe installed. Modules A1-A4, C1-4, D

A1-A$, C1-C4, D Results per kg of PVC Corflo® pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	3.20E+00	2.84E-02	5.24E-05	9.17E-03	5.43E-02	1.49E-02	-5.48E-01
GWP-biogenic	kg CO_2 eq.	-9.66E-03	1.18E-06	1.78E-09	5.83E-07	1.09E-04	2.26E-06	-1.03E-03
GWP-luluc	kg CO_2 eq.	2.03E-03	3.65E-08	7.24E-13	7.49E-08	1.25E-08	1.07E-07	-4.12E-04
GWP-total	**kg CO_2 eq.**	**3.19E+00**	**2.84E-02**	**5.24E-05**	**9.17E-03**	**5.44E-02**	**1.49E-02**	**-5.49E-01**
ODP	kg CFC 11 eq.	9.73E-07	3.45E-10	7.67E-15	1.38E-09	1.66E-10	1.50E-09	-2.44E-07
AP	mol H^+ eq.	1.78E-02	1.47E-04	4.64E-07	7.23E-05	3.79E-04	1.17E-04	-2.64E-03
EP-freshwater	kg PO_4^{3-} eq.	3.31E-03	1.43E-05	6.82E-08	8.68E-06	2.53E-05	1.41E-05	-7.43E-04
EP-freshwater	kg P eq.	6.43E-04	2.13E-07	3.91E-11	3.14E-07	1.71E-06	4.92E-07	-1.71E-04
EP-marine	kg N eq.	3.50E-03	3.86E-05	2.02E-07	2.05E-05	5.38E-05	3.44E-05	-5.29E-04
EP-terrestrial	mol N eq.	3.62E-02	4.28E-04	2.20E-06	2.25E-04	5.80E-04	3.77E-04	-5.46E-03
POCP	kg NMVOC eq.	9.88E-03	1.30E-04	5.75E-07	7.16E-05	1.58E-04	1.11E-04	-1.72E-03
ADP-minerals&metals*	kg Sb eq.	3.36E-05	2.02E-08	1.19E-12	3.28E-08	5.27E-08	5.98E-08	-1.21E-05
ADP-fossil*	MJ	5.54E+01	3.90E-02	1.93E-05	1.22E-01	2.84E-01	1.48E-01	-1.15E+01
WDP	m^3	1.36E+01	6.23E-02	2.70E-05	7.70E-02	1.60E+00	1.54E-01	-3.66E-01

* 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 20. Use of resources of 1kg of Corflo® pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC Corflo® pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	2.52E+00	8.27E-04	4.54E-07	1.37E-03	2.66E-02	2.38E-03	-4.21E-01
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**	**2.52E+00**	**8.27E-04**	**4.54E-07**	**1.37E-03**	**2.66E-02**	**2.38E-03**	**-4.21E-01**
PENRE	MJ	5.89E+01	4.05E-02	1.94E-05	1.29E-01	2.87E-01	1.56E-01	-1.23E+01
PENRM	MJ.	3.27E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	**MJ**	**9.16E+01**	**4.05E-02**	**1.94E-05**	**1.29E-01**	**2.87E-01**	**1.56E-01**	**-1.23E+01**
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	m3	1.87E-02	1.39E-05	3.59E-09	1.53E-05	8.83E-04	2.62E-05	-4.27E-03

Waste production and output flows

Table 21. Waste of 1kg of Corflo® pipe installed. Modules A1-A4, C1-4, D

A1-A4, C1-C4, D Results per kg of PVC Corflo® pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	3.45E-05	9.26E-08	5.29E-12	1.69E-07	9.79E-08	2.25E-07	-7.68E-06
Non-hazardous waste disposed	kg	3.79E-01	9.19E-04	7.31E-08	8.95E-04	7.06E-02	6.95E-01	-7.59E-02
Radioactive waste disposed	**kg**	**5.69E-05**	**4.43E-10**	**5.91E-14**	**6.75E-10**	**1.27E-09**	**8.99E-10**	**-1.52E-05**

Table 22. Output flows of 1kg of Corflo® pipe installed. Modules A1-3, C1-4, D

A1-A3, C1-C4, D Results per kg of PVC Corflo® 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	2.69E-01	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 23. Additional environmental impacts of 1kg of Corflo® pipe installed. Modules A1-A4, C1-4, D

Results per kg of PVC Corflo® pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	3.08E+00	2.81E-02	5.18E-05	8.98E-03	5.35E-02	1.46E-02	-5.24E-01

Results per kg of PVC Corflo® pipe								
Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particulate matter	disease incidence	1.27E-07	2.34E-09	1.31E-12	4.59E-10	2.90E-09	7.34E-10	-2.18E-08
Ionising radiation - human health	kBq U-235 eq	1.42E-01	3.09E-06	4.09E-10	4.88E-06	8.77E-06	6.39E-06	-3.74E-02
Eco-toxicity (freshwater)	CTUe	5.14E+01	6.46E-01	1.27E-03	7.11E-02	1.76E-01	1.48E-01	-1.10E+01
Human toxicity potential - cancer effects	CTUh	1.66E-09	6.62E-12	1.03E-14	2.40E-12	1.24E-11	4.42E-12	-3.10E-10
Human toxicity potential - non cancer effects	CTUh	4.70E-08	4.26E-10	7.02E-13	9.78E-11	1.67E-10	1.60E-10	-9.17E-09
Soil quality	dimensionless	1.16E+01	1.39E-02	3.21E-06	3.12E-02	1.35E-01	6.61E-02	-1.63E+00

Information on biogenic carbon content

Table 24. Biogenic content in 1kg of Corflo® 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.

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.

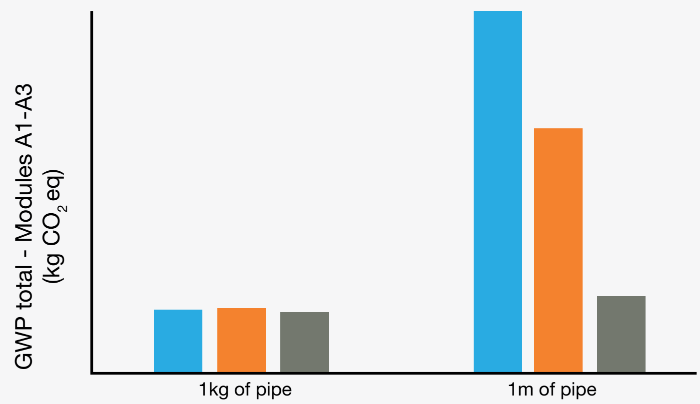
✔ Best Environmental Practice PVC

Vinidex PVC pipes are accredited to Best Environmental Practice (BEP) PVC Standards. BEP criteria include strict minimum compliance requirements for PVC supply chain constituents, PVC resin production, PVC product manufacture and end of life management and are verified by an independent third party certifier.

In 2002, the Vinyl Council of Australia launched a voluntary product stewardship initiative to recognise and address all environmental issues facing the Australian PVC industry. Vinidex has been a signatory to the Product Stewardship Program since its foundation. Recently, Vinidex was awarded the PVC Stewardship Excellence Award for 2020-2021. This award certifies that Vinidex met 100% of the Australian PVC industry's Product Stewardship commitments in 2020.

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. Sandwich construction pipes with a foam or recycled PVC core and Corflo® are examples of structured wall pipes which use less raw material for their manufacture. Although the declared unit for this EPD is 1kg of pipe, the environmental benefits of material efficient pipes can be more clearly seen when comparing a given length of pipe. The figure below shows the Global Warming Potential (total) results for the cradle-to-gate modules A1-A3 for 1 kg and 1 m length of Vinidex DN125 conduits.

Figure 4 - Comparison of DN125 HD Electrical Conduit



	1kg of pipe	1m of pipe
DN125 Conduit Solid Wall	3.25	16.09
DN125 Conduit foam core	3.28	9.12
DN125 Corflo®	3.19	3.77

✔
PVC
pipe
recycling

Vinidex PVC pipes are rigid and contain no plasticisers or phthlates. Vinidex PVC pipes do not contain any heavy metals such as lead, cadmium or mercury.

Vinidex PVC non-pressure pipes are manufactured and certified to a number of application specific Australian Standards:

- AS/NZS 1260 – PVC-U pipes and fittings for drain, waste and vent applications
- AS/NZS 1254 – PVC-U pipes and fittings for stormwater and surface water applications
- AS/NZS 2053 – Conduits and fittings for electrical installations

PVC-U pipes are durable and intended for a long service life in demanding infrastructure applications. The foreword to AS/NZS 1260 states:

"It should be noted that, by convention, plastics pipe systems are often designed on the basis of 50 years extrapolated test data. This is established international practice but is not intended to imply the service life of drainage pipes 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. 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.

Recycled content can be readily incorporated into PVC non-pressure pipes. Recycled PVC is most appropriately used in the core of sandwich construction pipes. These pipes have the same performance characteristics and life-expectancy of pipes manufactured from a solid wal
of PVC.

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 PVC non-pressure pipes can be fully recycled into new pipe products. Vinidex will take back PVC pipe off-cuts or pipe that has reached the end of its service life into our Brisbane, Sydney, Melbourne and Perth manufacturing operations to allow for those products to be recycled.

Interpretation of LCA results

The majority of environmental impact lies within the raw material supplied to Vinidex manufacturing sites – comparatively little impact is caused by the PVC-U pipe manufacturing at Vinidex sites.

From the feed mix ingredients, PVC resin is responsible for the majority of all environmental impacts and use of resources, although additives were still found to have a significant impact.

Sensitivity analysis

MANUFACTURING LOCATION

As the pipes covered in this study are manufactured in different locations with varying electricity intensities and water consumption, the maximum differences between sites was assessed for each product. However a weigther average was deemed appropriate as the purpose of this EPD is to represent the average Vinidex PVC- non pressure pipe product supplied to the Australian market.

END OF LIFE RECYCLING RATE

The assumption for end of life recycling rate was tested using low and high rates based on estimation ranges for PVC pipe in construction and demolition waste stream and current PVC pipe recycling rates. The amount of PVC pipe entering the waste stream is difficult to calculate due to low volumes and only recent targeted separation and collection.

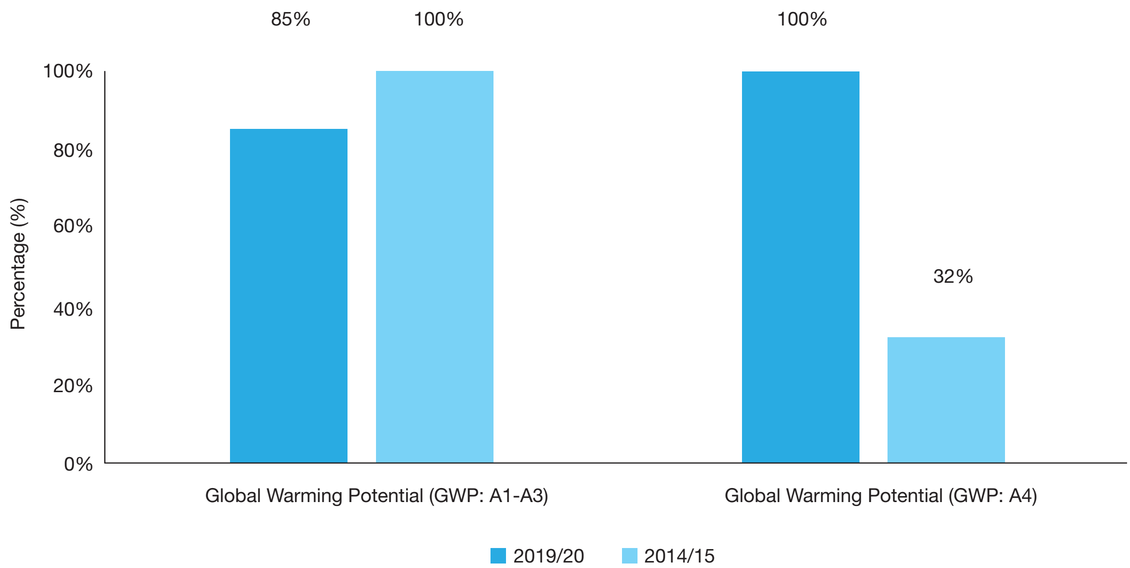
Estimates were made from PIPA PVC pipe recycling data and PVC waste data estimated by PIPA in collaboration with the former Department of Environment and Climate Change. A case study into PVC pipe recycling was published by the Department of Sustainability, Environment, Water, Pollution and Communities (DSEWPC, 2012).

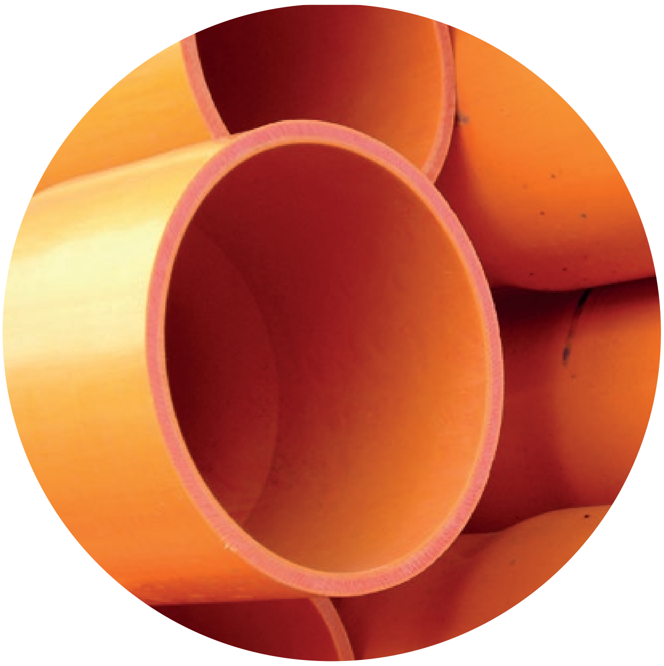
Using extremes of both PVC pipe waste and recycling rates gave a low recycling rate of 15.4% and a high of 61.5%. While there is a significant difference in Module D when varying the EOL recycling rate, results are only slightly altered when looking at modules A1-C4.

Differences versus previous versions PVC solid pipe

The GWP impact for production of PVC solid pipes in 2019/20 is less (15%) than the 2015. This is despite an increase in the electricity required to produce the pipes compared to 2014/15. The reduction in GHG emissions is driven by the change in PVC processes given a change in the PVC supplier and by reduced manufacturing waste (1% in 2019/20 vs 2% in 2014/15), which results in less raw material being used.

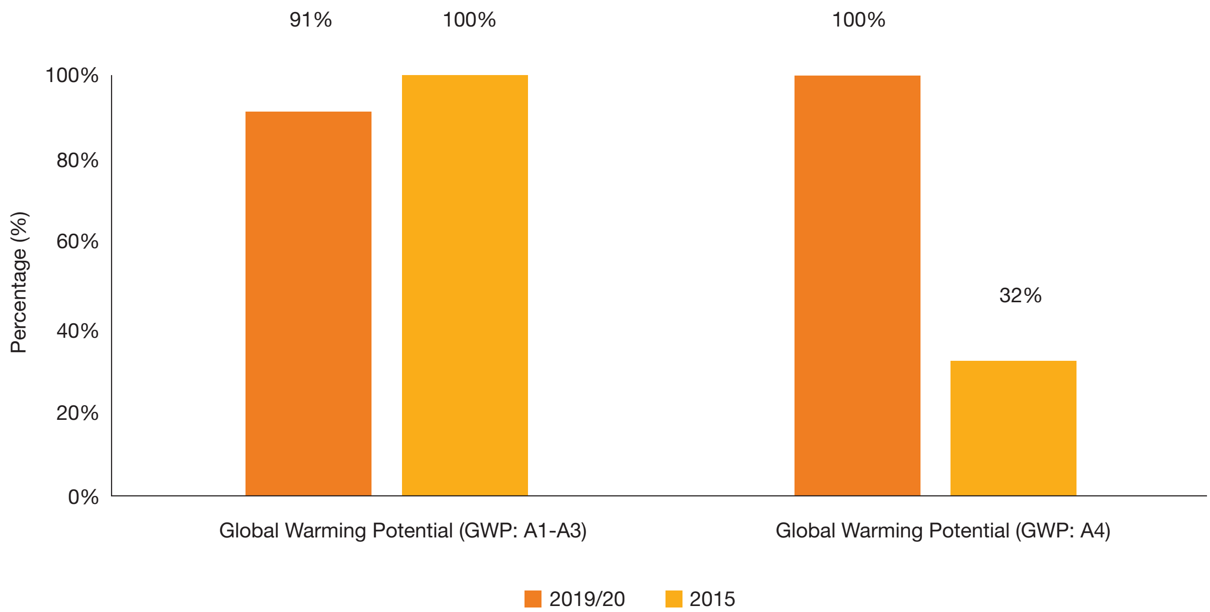
In case of the PVC solid pipe, the reduced wastage is able to compensate for the increase in GHG emissions due to higher electricity usage, however this may not be the case for other pipes. The GWP impact from distribution is 68% higher for 2019/20 than 2014/15. However, since distribution contributes to less than 1% of total environmental impacts, its influence is minimal.





PVC foam core pipe

The GWP impact for production PVC foam core pipes in 2019/20 is 9% lower than 2014/15. Despite the higher electricity/ natural gas consumption for manufacturing the main drivers are the change in the processes used given a change in the PVC supplier and the different feedmix for 2019/20 pipes. The GHG emissions from distribution are 68% higher for 2019/20 compared to 2014/15. However, since distribution contributes to less than 1% of total environmental impacts, its influence is minimal.



PVC Corflo® pipe

Corflo was not included in 2014/15.

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Appendix product details

Table 25 - DWV PVC non-pressure (solid wall) product details

Product Description	Product Code	Class	Effective Length (m)	Foam (kg/m)	Solid (kg/m)
40mm DWV Pipe	20230		6	N/A	0.38
50mm DWV Pipe	20260		6	N/A	0.58
65mm DWV Pipe	20280		6	N/A	0.85
80mm DWV Pipe	20310		6	N/A	1.10
100mm DWV Pipe SCJ SN6	18000	SN6	6	1.08	1.51
100mm DWV Pipe SCJ SN10	18005	SN10	6	1.23	1.77
100mm DWV Pipe SCJ SN10	19002	SN10	6	1.08	1.50
100mm DWV Pipe SCJ SN10	19007	SN10	6	1.77	N/A
100mm DWV Pipe RRJ SN10	19530	SN10	6	N/A	1.89 (V)
150mm DWV Pipe SCJ SN4	19070	SN4	6	2.09	2.81
150mm DWV Pipe SCJ SN8	19111	SN8	6	N/A	3.01
150mm DWV Pipe SCJ SN8	18110	SN8	6	2.50	3.49
150mm DWV Pipe SCJ SN8	18120	SN8	3	2.51	3.54
150mm DWV Pipe RRJ SN8	19601	SN8	3	N/A	3.51
225mm DWV Pipe SCJ SN4	19140	SN4	6	5.00	6.85
225mm DWV Pipe SCJ SN8	19180	SN8	6	6.04	8.52
225mm DWV Pipe SCJ SN8	19200	SN8	3	6.06	8.55
225mm DWV Pipe CRJ SN8	19680	SN8	3	N/A	7.23
225mm DWV Pipe RRJ SN8	19680	SN8	3	6.01	8.48 (V)
225mm DWV Pipe RRJ SN8	19682	SN8	3	N/A	8.49
300mm DWV Pipe SCJ SN4	19210	SN4	6	9.14	10.85
300mm DWV Pipe SCJ SN8	19250	SN8	6	N/A	13.53
300mm DWV Pipe SCJ SN8	19255	SN8	6	N/A	13.53
300mm DWV Pipe RRJ SN8	19730	SN8	3	9.54	N/A
300mm DWV Pipe RRJ SN8	19731	SN8	3	N/A	13.58
375mm DWV Pipe CRJ SN8	19820	SN8	3	N/A	23.83

(v) also in Vinitite

Table 26 - Stormwater PVC non-pressure (solid wall) product details

Product Description	Product Code	Class	Effective Length (m)	Foam (kg/m)	Solid (kg/m)
75mm Stormwater Pipe	20500	SN2	6	N/A	0.57
90mm Stormwater Pipe	20510	SN2	6	0.54	0.71
90mm Stormwater Pipe	20501	SN2	6	N/A	0.71
90mm Stormwater Pipe	20512	SN2	6	N/A	0.93
150mm Stormwater Pipe	20530	SN2	6	1.70	2.25
225mm Stormwater Pipe	20540	SN2	6	3.89	5.49
300mm Stormwater Pipe	20550	SN2	6	6.14	8.72
375mm Stormwater Pipe	20580	SN2	6	N/A	12.82

Table 27 - PVC non-pressure (solid wall) Electrical product details

Product Description	Product Code	Class	Overall Length (m)	Weight (kg/m)
20mm HD Electrical PVC Pipe SCJ	10700	HD	4	0.19
25mm HD Electrical PVC Pipe SCJ	10720	HD	4	0.27
32mm HD Electrical PVC Pipe SCJ	10740	HD	4	0.38
40mm HD Electrical PVC Pipe SCJ	10760	HD	4	0.55
50mm HD Electrical PVC Pipe SCJ	10780	HD	4	0.76
63mm HD Electrical PVC Pipe SCJ	21020	HD	4	1.18
63mm HD Electrical PVC Pipe SCJ	10800	HD	4	1.19
80mm HD Electrical PVC Pipe SCJ	21030	HD	4	2.28
80mm HD Electrical PVC Pipe SCJ	10820	HD	4	2.68
100mm HD Electrical PVC Pipe SCJ	10840	HD	4	3.32
100mm HD Electrical PVC Pipe SCJ	21045	HD	6	3.27
100mm HD Electrical PVC Pipe SCJ	21040	HD	4	3.2
125mm HD Electrical PVC Pipe SCJ	21050	HD	4	4.64
125mm HD Electrical PVC Pipe SCJ	10860	HD	4	4.76
150mm HD Electrical PVC Pipe SCJ	10880	HD	4	6.55
150mm HD Electrical PVC Pipe SCJ	21060	HD	4	6.15
200mm HD Electrical PVC Pipe SCJ	21065	HD	6	11.21
200mm HD Electrical PVC Pipe SCJ	21070	HD	4	11.21
250mm HD Electrical PVC Pipe SCJ	21072	HD	4	17.85
16mm MD Electrical PVC Pipe SCJ	10000	MD	4	0.11
20mm MD Electrical PVC Pipe SCJ	10020	MD	4	0.16
25mm MD Electrical PVC Pipe SCJ	10040	MD	4	0.2
32mm MD Electrical PVC Pipe SCJ	10060	MD	4	0.31
40mm MD Electrical PVC Pipe SCJ	10080	MD	4	0.44
50mm MD Electrical PVC Pipe SCJ	10100	MD	5	0.54
80mm LD Electrical PVC Pipe SCJ	10864	LD	4.5	1.2
80mm LD Electrical PVC Pipe SCJ	11040	LD	6	1.07
100mm LD Electrical PVC Pipe SCJ	10863	LD	4.5	1.76
100mm LD Electrical PVC Pipe SCJ	11100	LD	6	1.72
125mm LD Electrical PVC Pipe SCJ	10861	LD	4.5	2.68
125mm LD Electrical PVC Pipe SCJ	11200	LD	6	2.62
150mm LD Electrical PVC Pipe SCJ	11320	LD	6	3.38
200mm LD Electrical PVC Pipe SCJ	11330	LD	6	6.17

Table 28 - PVC non-pressure (Corrugated) Electrical product details

Product Description	Product Code	Class	Overall Length (m)	Weight (kg/m)
100mm HD CORFLO Electrical PVC Pipe	21135	HD	6	1.16
125mm HD CORFLO Electrical PVC Pipe	21153	HD	6	1.22
150mm HD CORFLO Electrical PVC Pipe	21139	HD	6	2.08

Table 29 - PVC non-pressure (solid wall) Communications product details

Product Description	Product Code	Overall Length (m)	Weight (kg/m)
50mm Communications PVC Pipe	10791	5	0.78
100mm Communications PVC Pipe	10841	5	2.33
100mm Communications PVC Pipe	10844	5	2.26
20mm AUSTEL Communications PVC Pipe SCJ	11640	4	0.16
25mm AUSTEL Communications PVC Pipe SCJ	11650	4	0.2
32mm AUSTEL Communications PVC Pipe SCJ	11660	4	0.3
50mm AUSTEL Communications PVC Pipe SCJ	11680	4	0.68
80mm AUSTEL Communications PVC Pipe SCJ	11690	6	1.49
20mm TELSTRA 73/91 PVC Pipe SCJ	11710	5	0.19
20mm Communications PVC Pipe SCJ	11715	5	0.19
50mm TELSTRA 73/95 PVC Pipe SCJ	11730	5	0.76
50mm OPTUS Communications PVC Pipe SCJ	11731	5	0.76
100mm Communications PVC Pipe SCJ	11750	6	2.39
100mm TELSTRA 73/207 PVC Pipe SCJ	11760	5	2.39
100mm HD SC Communications PVC Pipe SCJ	11755	6	3.19

Table 30 - PVC non-pressure (foam core) Electrical product details

Product Description	Product Code	Class	Overall Length (m)	Weight (kg/m)
80mm HD SC Electrical PVC Pipe SCJ	21030	HD	4	1.34
100mm HD SC Electrical PVC Pipe SCJ	21045	HD	6	2.24
100mm HD SC Electrical PVC Pipe SCJ	21040	HD	4	2.24
125mm HD SC Electrical PVC Pipe SCJ	21050	HD	4	3.16
150mm HD SC Electrical PVC Pipe SCJ	21060	HD	4	4.34
200mm HD SC Electrical PVC Pipe SCJ	21065	HD	6	7.22
100mm LD SC Electrical PVC Pipe SCJ	10863	LD	5	1.18
125mm LD SC Electrical PVC Pipe SCJ	10861	LD	5	1.94
150mm LD SC Electrical PVC Pipe SCJ	11320	LD	6	2.48
200mm LD SC Electrical PVC Pipe SCJ	11330	LD	6	4.11

Table 31 - PVC non-pressure (foam core) Communications product details

Product Description	Product Code	Overall Length (m)	Weight (kg/m)
100mm Communications PVC Pipe SCJ	10844	5	1.63
100mm Communications PVC Pipe SCJ	11750	6	1.63
100mm TELSTRA 73/207 PVC Pipe SCJ	11760	5	1.63
100mm HD SC Communications PVC Pipe SCJ	11755	6	2.11

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