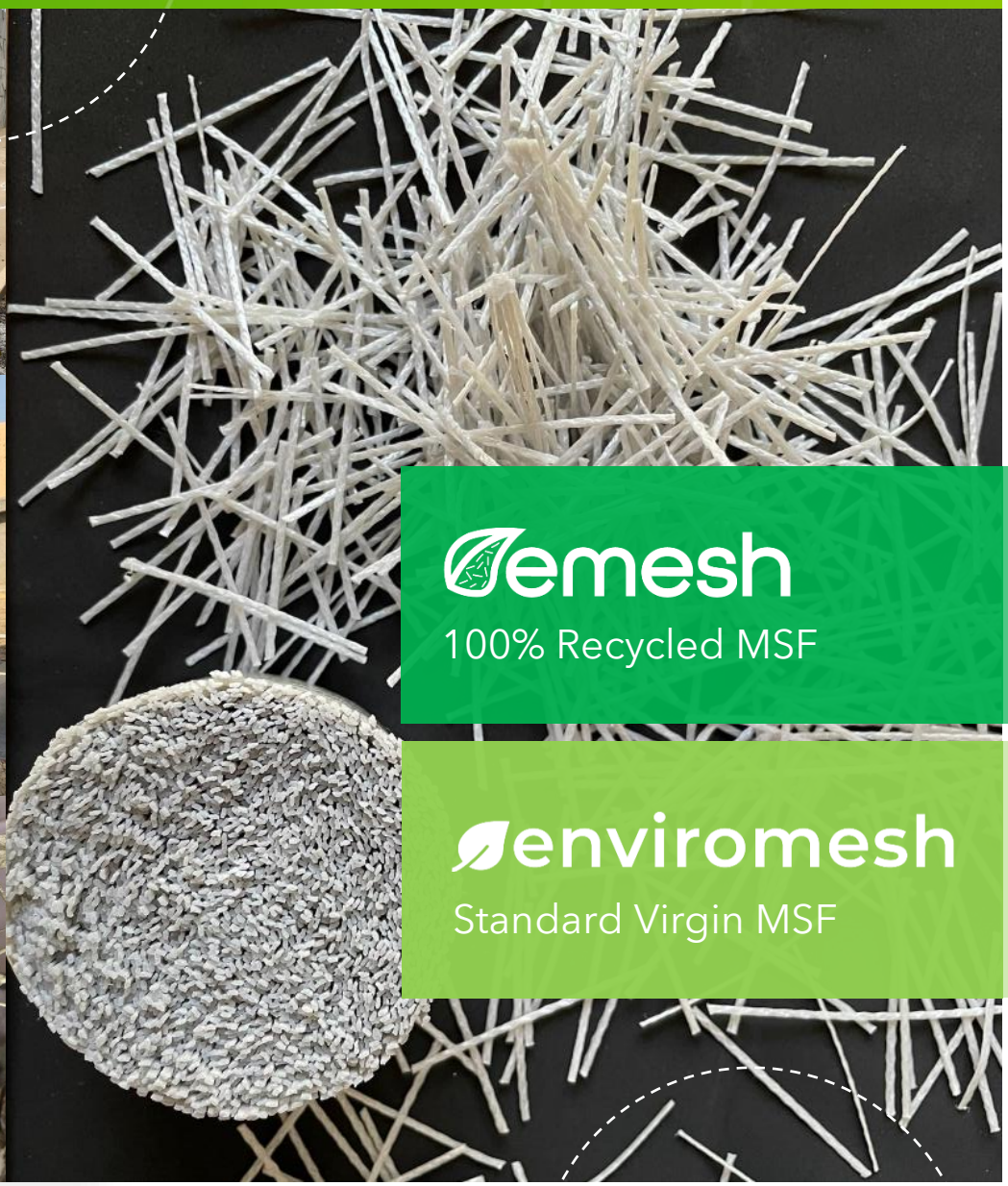
ENVIROMESH

Fibres For Concrete Reinforcement

MACRO SYNTHETIC FIBRES EPD



emesh
100% Recycled MSF

enviromesh
Standard Virgin MSF

AUSTRALASIA EPD®

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1

ECO PLATFORM EPD VERIFIED

Enviromesh EPD Version 2.0

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CONTENTS

Program Information and Verification	3
About Enviromesh	5
Macro Synthetic Fibres (MSF) Technology	6
Technical Information – EPD	8
Environmental Profile- eMesh	12
Environmental Profile – Virgin MSF	13
Additional Environmental Information	14
eMesh Benefits & Recent Projects	15
References	17

Images from year 2021
Footpaths & shared use pathways from NWPA B2M LXRP Project, VIC

Program Information and Verification

"Environmental Product Declarations (EPDs) present objective, relevant and verified environmental information about products from a life cycle perspective."

This EPD presents comprehensive environmental information about the Enviromesh range of Macro Synthetic Fibres (MSF) for concrete reinforcement products manufactured in Australia:

eMesh - Concrete fibre reinforcement product made from 100% pre-consumer recycled PP

MP47 - Macro Synthetic Fibres, 47 mm long fibres, virgin PP

SMP65 - Shotcrete Macro Synthetic Fibres, 65 mm long, virgin PP

MPP - Macro Synthetic Plus, combination of MP47 and Micro fibres, virgin PP

All our PP fibre products are classified within group 355 (man-made fibres) under the UN CPC classification system. They fall into class 3551 (Synthetic filament tow and staple fibres, not carded or combed) and class 3554 (Artificial filament tow and staple fibres, not carded or combed). ANZSIC code for our PP fibre products is 1912 - Rigid and semi-rigid polymer product mfg.

Program Information and Verification

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

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Product Category Rules (PCR) **PCR review was conducted by Chair**	PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18 The Technical Committee of the International EPD® System Massimo Marino. Contact via info@environdec.com
CEN standard EN 15804:2012 served as the core PCR	
Independent verification of the declaration and data according to ISO 14025 and EN15804	☐ EPD process certification (internal) ☑ EPD verification (external)
Procedure for follow-up of data during EPD validity involves third-party verifier:	☐ Yes ☑ No
Third party verifier  **Accredited or approved by EPD Australasia**	 **Andrew D. Moore** (Life Cycle Logic) andrew@lifecyclelogic.com.au

Version	Date and Description
1.0	16 December 2016: Original EPD of eMesh and Macro Poly, released under Fibercon brand
2.0	28 February 2022: Updated EPD of eMesh and Macro Poly (in line with 5-year validity), released under Enviromesh brand. The key changes to the EPD are an update of primary data for fibre production showing a significant reduction in electricity use, and an update of the underlying electricity grid mix in Victoria showing increased share of renewables in the grid.

About Enviromesh

Who we are?

Enviromesh prides itself in its commitment to the environment and sustainable construction. We started as Fibercon in 1994 and have been involved in engineering, designing, and supplying fibres for both MSFRC (Macro Synthetic Fibre Reinforced Concrete) and SFRC (Steel Fibre Reinforced Concrete) in the Asia Pacific region. In 2020, when the business changed hands, Fibercon became Enviromesh.

We strongly believe in inclusion and diversity. By the end of 2021 we have provided 13,000+ hours of work to NDIS supported workers at McCallum Industries in Ballarat, Victoria. We do not engage or support Modern Slavery in any form and are committed to ensuring that we comply with the legislation set out in the Australian Government Modern Slavery Act 2018.

We focus continually upon why we exist, which is to help the environment through ethical growth. So, everything that we do is a solution and service for our customers, helping customers meet their environmental objectives, help the environment in the true spirit of a win/win.

What we do?

Enviromesh aims to make the construction process simple with high value outcomes through our concrete reinforcement solutions. One of the ways we do this is by offering both standard and custom fibre types and sizes along with custom packaging.

Given our experience within the industry, especially with Local Council Projects, we are uniquely placed to provide fibre systems, support, and engineering design solutions for infrastructure projects of any size and scale.

Fibres are used for various infrastructure applications. Typically, these are what may be called the secondary application. So, while fibres may not be used in a highway or bridge, they are used in many of the ancillary applications such as footpaths, bikeways, shared use pathways, embankments, ramps, shotcrete etc.

Our Macro Synthetic fibres – eMesh, MP47, SMP65 and MPP are engineered and graded length synthetic fibres which have been specifically developed to provide a higher level of secondary concrete reinforcement. By combining the benefits and performance characteristics of polypropylene, our macro synthetic fibres provide a non-corrosive alternative to steel fibre and mesh reinforcement. Our MSFs are designed to offer resistance to cracking as well as improved toughness and energy absorption. Additional benefits include increased impact and shatter resistance as well as enhanced shear strength and fatigue endurance.

We are proud members of:

Infrastructure Sustainability Council

MSFA

ASCP AUSTRALIAN SOCIETY FOR CONCRETE PAVEMENTS

Macro Synthetic Fibres (MSF) Technology

Over the last 2 decades constant testing and trials have enabled synthetic fibres to evolve into what we have today. The current fibres can be used in a wide range of applications from secondary shrinkage reinforcement to primary reinforcing in underground shotcrete. Enviromesh has been a leading company in MSF since 2007 during which time we have developed and improved our MSF.

Reinforcement Properties

Fibre technology transforms a brittle material into a more ductile one. This replaces shrinkage reinforcing mesh, creating a much more durable concrete.

Catastrophic failure of concrete is virtually eliminated because the fibres continue supporting the load after cracking occurs. And while measured rates of improvement vary, MSF reinforced concrete exhibits higher post-crack flexural strength, better crack resistance, improved fatigue strength, higher resistance to spalling, and higher first-crack strength.

MSF are an ideal non-corrosive alternative to steel.

eMesh - 100% Recycled Macro Synthetic Fibres

eMesh Fibre Composition: 100% Recycled PP

eMesh fibres represent the next generation of innovation for standard MSF in concrete.

An Australian innovation, eMesh upcycles plastic to deliver innovative reinforced concrete. Recycled plastic macro synthetic fibres are added to concrete to replace shrinkage steel. eMesh completely replaces virgin non-recycled plastic fibres or steel reinforcing mesh.

eMesh fibres are sustainable, safer and faster to use and more cost-effective than current alternatives. eMesh completely replaces virgin plastic fibres or steel reinforcing mesh.

While many Councils and Main Road Authorities already use virgin MSF in concrete in Australia, eMesh allows them to use 100% recycled plastic to achieve the same result.

eMesh fibres are manufactured and packaged in Australia.

Macro Synthetic Fibres (MSF) Technology

Enviromesh - Virgin Macro Synthetic Fibres

Virgin Fibre Composition:
>99.9% virgin PP
<0.1% grey colouring agent

The Virgin Macro Synthetic Fibres have been embraced and readily accepted in the shotcrete and engineering industries, as the end users recognise the benefits of replacing reo-bar and mesh with synthetic fibre.

Virgin MSF can be used in a wide range of applications from secondary shrinkage reinforcement to primary reinforcing in underground shotcrete. These fibres show very defined ductile behaviour characteristics. They provide good impact, fatigue, and shrinkage control in all grade concretes. They offer excellent performance levels in general shotcrete, precast products and highly corrosive environments.

Virgin MSF are an ideal non-corrosive alternative to steel fibres with excellent post crack control (toughness) while being very economical and easy to use.

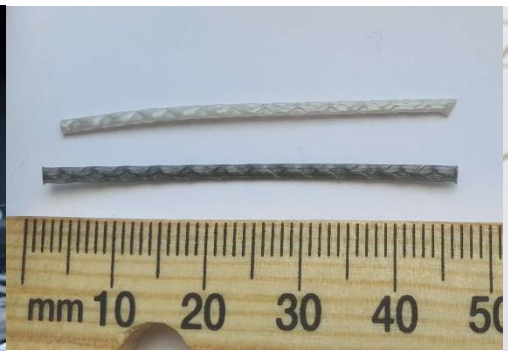
Compliance With Standards

Our concrete reinforcement fibres comply with:

- TR65 - Guidance on the Use of Macro-synthetic Fibre Reinforced Concrete (TR65 2007)
- ASTM C1116 - Standard Specification for Fibre Reinforced Concrete (ASTM 2015)
- EN 14889 - Fibres for Concrete – Part 2 – Polymer Fibres (CEN 2006)

In addition to the above, eMesh fibres also comply with:

- eMesh conforms to VicRoads 703.14
- eMesh is approved under QLD DTMR MRTS273 and is on registered products index for bridge and other structures



Technical Information - EPD

This Environmental Product Declaration (EPD) covers all of the Enviromesh macro synthetic fibre reinforcing product range. Our eMesh product provides the same high-performance as our virgin MSF products, but is made from 100% recycled plastic that is sourced from industrial off-cuts. Our virgin MSF MP47, SMP65 and MPP is a high-performance MSF.

Scope of the EPD

This is a cradle-to-gate EPD, which covers the product stage (A1- A3) of the life cycle assessment (LCA). All relevant processes from our raw materials to the manufacturing and packaging of fibres is included in the assessment.

Product stage			Construction stage		Use stage							End-of-life stage				Benefits beyond system boundary
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
			Scenario		Scenario							Scenario				
✓	✓	✓	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

✓ = module is included in this study
MND = module is not declared

Declared unit

All results in this EPD are expressed per 1 kg of packaged fibre product, ready for dispatch to the customer. This reference flow allows you to easily multiply the environmental profiles with the quantity of fibres relevant to your own specific application.

Life cycle inventory data

The life cycle inventory data have been primarily sourced from Enviromesh (formerly Fibercon) and AusLCI (AusLCI 2021). Key production data have been measured in 2021).

The fibre manufacturer produces a range of other (unrelated) products in parallel to the fibres. Production occurs in batches, which makes it virtually impossible to assess the manufacturing data based on a one-year average. Instead, data for the core process were measured at manufacturing location during a five-day production run in August 2021, when all other production equipment was turned off. The electricity use, water use and production losses (waste) were measured during this period and attributed to fibre products on a mass basis. During these production runs, the machines were only producing polypropylene fibres for Enviromesh. Although the data collection period is significantly shorter than what is typically required for EPDs (12 months of data), we believe our approach is reasonable given the constraints and lack of alternative approaches that would lead to better quality data.

Technical Information - EPD

System boundaries

The system boundaries indicate which parts of the life cycle have been included in the LCA.

eMesh - Raw material supply (A1), transport (A2) and product manufacturing (A3)

The raw materials used for eMesh fibre production consist of 100% pre-consumer (post-industrial) recycled polypropylene pellets. PP offcuts from selected manufacturing sites are collected, baled and sent to a collector for shredding and re-compounding. The production residues used to produce eMesh qualify as pre-consumer recycled content as they are offcuts from the production of a range of products that are modified (through size reduction and pelletisation) by a third-party (at a different location), before they are used for eMesh production.

The definition of pre-consumer recycled content is in line with ISO 14021. In the absence of detailed guidance from ISO 14021, the PCR (IEPDS 2020) and the GPI (IEPDS 2019), we followed the examples set out in (UL 2020).The PP offcuts are assumed to reach their end-of-waste state at the point of formation. All impacts from this point onwards have been attributed to eMesh. The resulting recycled polypropylene (rPP) pellets are transported by truck to the eMesh factory.

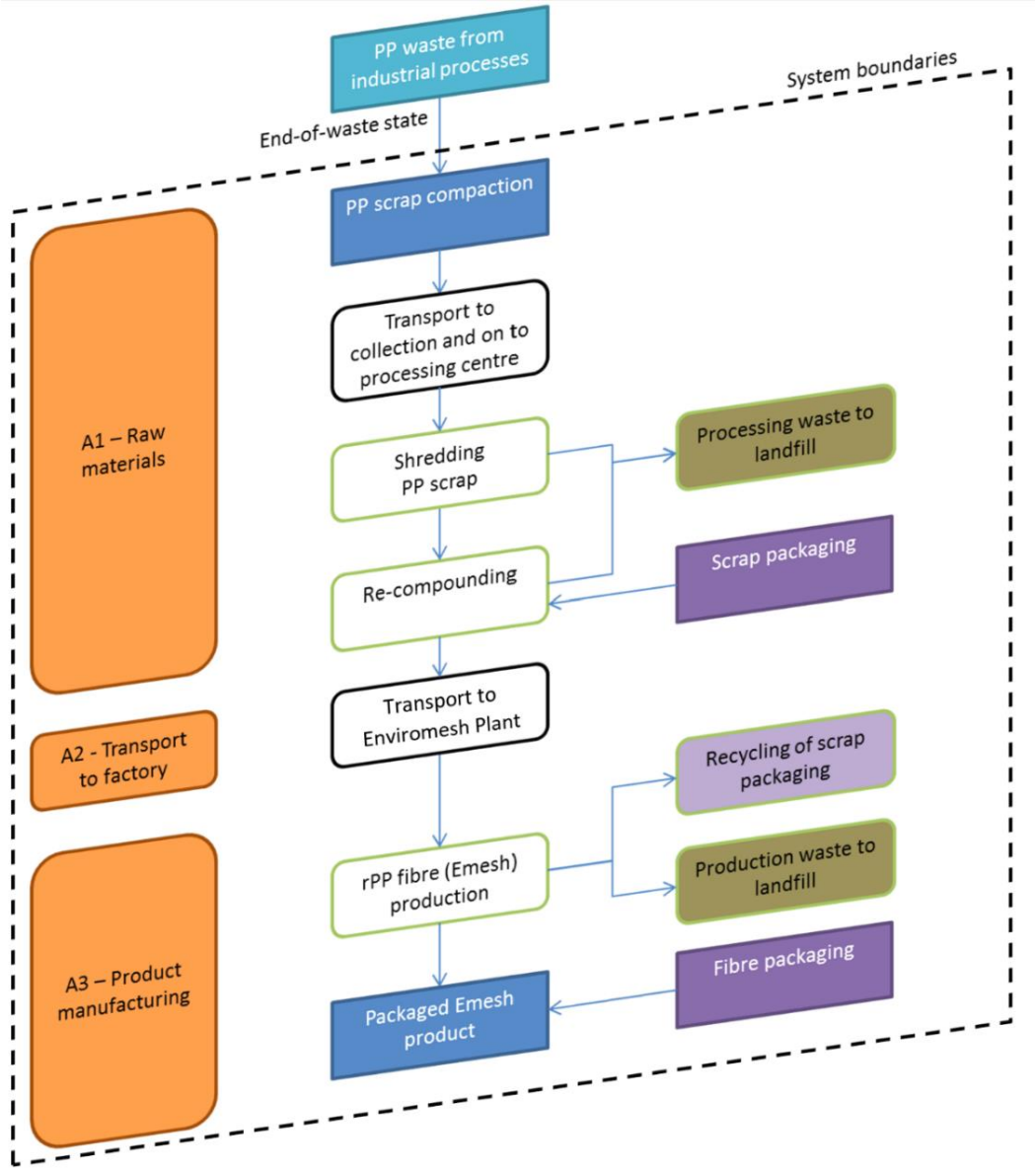


Figure 1. System boundaries for the eMesh LCA

The eMesh production involves an improved melt-spinning and hot-drawing process to produce recycled PP fibres of high mechanical properties.

Technical Information - EPD

Virgin MSF - Raw material supply (A1), transport (A2) and product manufacturing (A3)

The raw materials used for Macro Synthetic Fibre production consist almost entirely of virgin polypropylene pellets, manufactured by the plastics industry in Australia. A small amount (<1%) of additives may be added to achieve desired properties.

The polypropylene pellets are transported by truck to the Macro Synthetic Fibres factory.

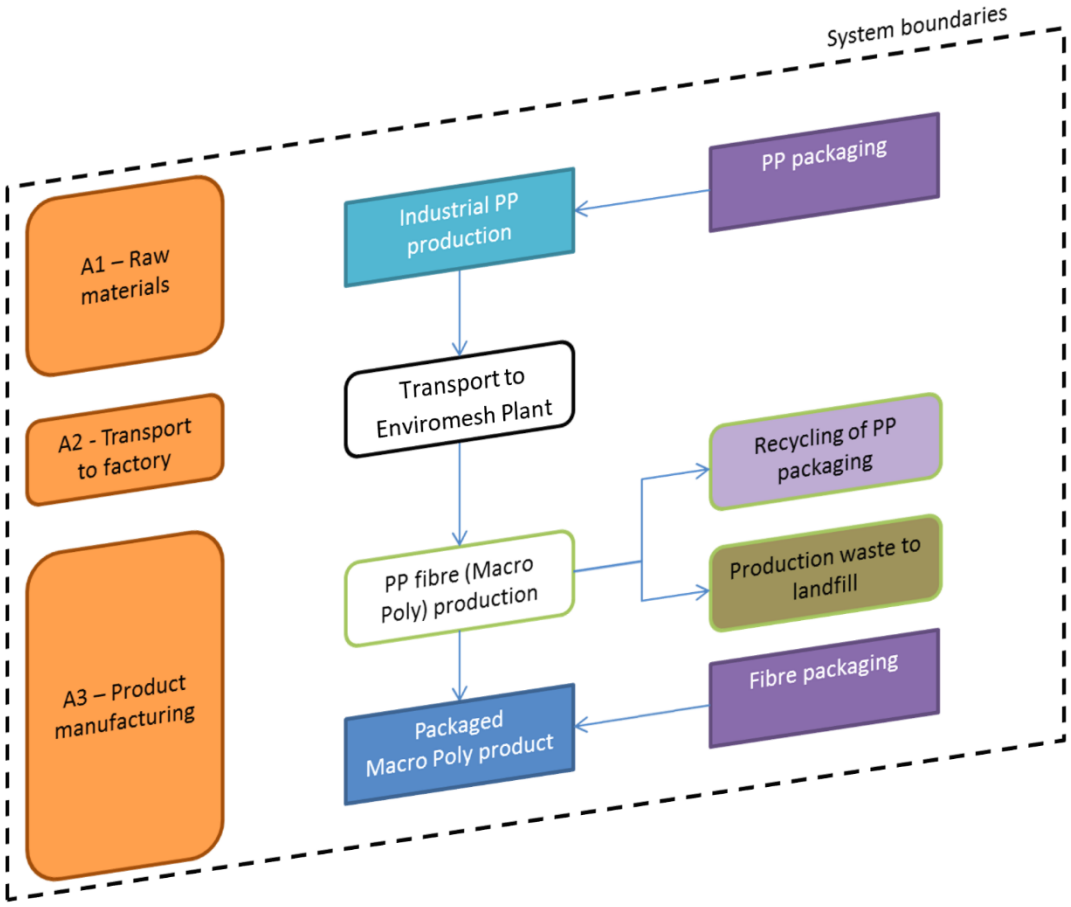


Figure 2. System boundaries for the virgin Macro Synthetic products LCA

The Macro Poly production involves a melt-spinning and hot-drawing process to produce PP fibres of high mechanical properties.

Key choices and assumptions

eMesh consists of 100% rPP. All Macro Synthetic Fibre products have been modelled as 100% virgin PP.

The LCA uses measured data (energy, water, waste) from the MSF production process and rPP re-compounding process. All transport of polymers is modelled based on actual transport modes and distances relevant to the specific supply chains of Macro Poly and eMesh fibres.

Technical Information - EPD

The weight of packaging has been determined based on the cardboard box used for the 4 kg eMesh carton. Macro Poly is packaged in smaller boxes containing 2.3 or 3 kg of fibres. Using the heaviest box to model environmental impacts is a conservative decision.

Electricity mix

Production of the Enviromesh concrete reinforcement fibres occurs in Victoria, as does the supply chain. Therefore, electricity has been modelled based on the current Victorian grid mix (71.0% brown coal, 5.8% hydro, 17.9% wind, 3.2% solar, 2% natural gas, 0.2% others) using AusLCI electricity generation process. The GHG emissions intensity is 0.934 kg CO_2e/kWh.

Source: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/data-nem/data-dashboard-nem for the twelve months until 28 January 2022. On the AEMO dashboard, select "Fuel Mix". Then select "VIC" to see the data for the Victorian grid. On the right hand side, switch from "current" to "12 months" to see the Victorian grid mix data for the last year. (Note: Rooftop solar PV is not currently included in the fuel mix data.)

Allocation

Process requirements are attributed to the different products based on their mass. This is the most appropriate basis for allocation. As a result, all fibres require the same amount of processing (e.g. energy per kg) and the size of the fibres is not a distinguishing factor. The impacts of PP production waste in landfill have been modelled based on physical causality.

Furthermore, polypropylene waste has reached the end-of-waste state at the plant where the waste is generated. All processes occurring from this point onwards have been attributed to the eMesh life cycle.

Cut-off criteria

Where possible (i.e. when data are available), all inputs and outputs to a process have been included. The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of a process.

The materials and processes that have been excluded are:

- Grey colouring agent (~0.1% m/m) added to virgin PP is substituted with virgin PP
- Greases, lubricants applied to machinery used for fibre production
- Cardboard cut-offs that might occur during packaging production
- Ink used for printing on packaging materials

The total of neglected input flows for the cradle-to-gate stages is well below 5% of energy usage and mass. (The exact percentage has not been determined.)

The environmental impacts associated with personnel, infrastructure and capital goods (buildings, plant, equipment, roads, vehicles, etc.) are excluded from the product system.

Environmental Profile - eMesh

The environmental impacts of eMesh reinforcement fibres are presented below per 1 kg of packaged product. The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding of threshold values, safety margins or risks.

Environmental profile for 1 kg eMesh, packaged, cradle-to-gate

Indicator	Unit	Stages A1-A3
Global warming	kg CO_2 eq	1.6E+00
Ozone layer depletion	kg CFC11 eq	9.8E-09
Acidification, soil and water	kg SO_2 eq	1.6E-03
Eutrophication	kg PO_4^{3-} eq	4.3E-04
Photochemical ozone creation	kg C_2H_4 eq	1.0E-04
Resource depletion – elements	kg Sb eq	5.7E-09
Resource depletion – fossil	MJ_{NCV}	1.8E+01

Environmental parameters for 1 kg eMesh, packaged, cradle-to-gate

Indicator	Unit	Stages A1-A3
Parameters describing resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ_{NCV}	2.3E+00
Use of renewable primary energy resources used as raw materials	MJ_{NCV}	0
Total use of renewable primary energy resources	MJ_{NCV}	2.3E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ_{NCV}	1.8E+01
Use of non-renewable primary energy resources used as raw materials	MJ_{NCV}	0
Total use of non-renewable primary energy resources	MJ_{NCV}	1.8E+01
Use of secondary material	kg	1.1E+00
Use of renewable secondary fuels	MJ_{NCV}	0
Use of non-renewable secondary fuels	MJ_{NCV}	0
Use of net fresh water	m^3	4.0E-03
Waste categories		
Hazardous waste disposed	kg	0
Non-Hazardous waste disposed	kg	1.1E-01
Radioactive waste disposed	kg	0
Output flows		
Components for re-use	kg	0
Materials for recycling	kg	0
Materials for energy recovery	kg	0
Exported energy	MJ	0

Environmental Profile – Virgin MSF

The environmental impacts of MP47, SMP65 and MPP Macro Synthetic Fibres (MSF) are presented below per 1 kg of packaged product. The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding of threshold values, safety margins or risks.

Environmental profile for 1 kg MSF (MP47, SMP65 and MPP), packaged, cradle-to-gate

Indicator	Unit	Stages A1-A3
Global warming	kg CO_2 eq	3.9E+00
Ozone layer depletion	kg CFC11 eq	8.9E-08
Acidification, soil and water	kg SO_2 eq	5.0E-03
Eutrophication	kg PO_4^{3-} eq	1.1E-03
Photochemical ozone creation	kg C_2H_4 eq	9.5E-04
Resource depletion – elements	kg Sb eq	1.6E-08
Resource depletion – fossil	MJ_{NCV}	1.0E+02

Environmental parameters for 1 kg MSF (MP47, SMP65 and MPP), packaged, cradle-to-gate

Indicator	Unit	Stages A1-A3
Parameters describing resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ_{NCV}	2.3E+00
Use of renewable primary energy resources used as raw materials	MJ_{NCV}	0
Total use of renewable primary energy resources	MJ_{NCV}	2.3E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ_{NCV}	1.0E+02
Use of non-renewable primary energy resources used as raw materials	MJ_{NCV}	0
Total use of non-renewable primary energy resources	MJ_{NCV}	1.0E+02
Use of secondary material	kg	0
Use of renewable secondary fuels	MJ_{NCV}	0
Use of non-renewable secondary fuels	MJ_{NCV}	0
Use of net fresh water	m^3	1.6E-02
Waste categories		
Hazardous waste disposed	kg	0
Non-Hazardous waste disposed	kg	7.4E-03
Radioactive waste disposed	kg	0
Output flows		
Components for re-use	kg	0
Materials for recycling	kg	0
Materials for energy recovery	kg	0
Exported energy	MJ	0

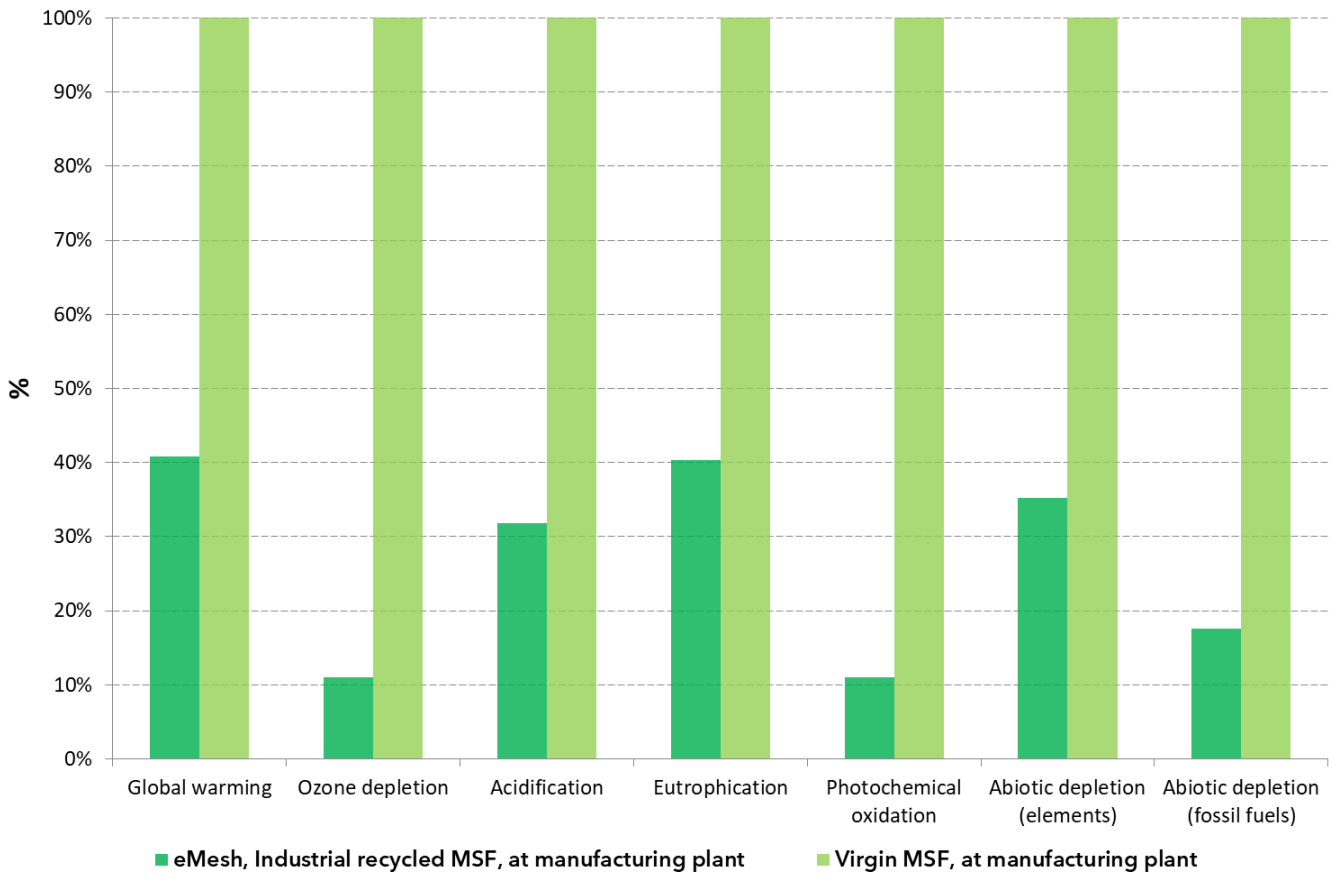
Packaging contributes less than 3% to all indicators, except for abiotic depletion (elements) to which it contributes 35%. Our conservative choice to use the heavier cardboard box as a proxy for Macro Poly packaging may lead to an overestimate of abiotic depletion (elements) larger than 10%.

Additional Environmental Information

Environmental savings of eMesh

When considering the relative environmental impacts of eMesh and Virgin Macro Synthetic Fibres, it is clear that recycled PP fibres come with a significantly lower environmental footprint than virgin PP fibres across all seven main indicators.

Compared to our virgin fibres, eMesh has 60% lower greenhouse gas emissions and eutrophication potential, 65% lower acidification potential and abiotic depletion potential (elements), 80% lower abiotic depletion potential (fossil fuels) and 90% lower ozone depletion potential and photochemical oxidation potential.



Comparing EPDs

EPDs of construction products may not be comparable if they do not comply with EN 15804. It is always important to understand the underlying details when comparing products, LCAs or EPDs. Expert analysis or interpretation can assist in avoiding unintended misrepresentations of results.

eMesh Fibres

Promotes Circular Economy

Uses 100% recycled plastic

Australian-made Innovation

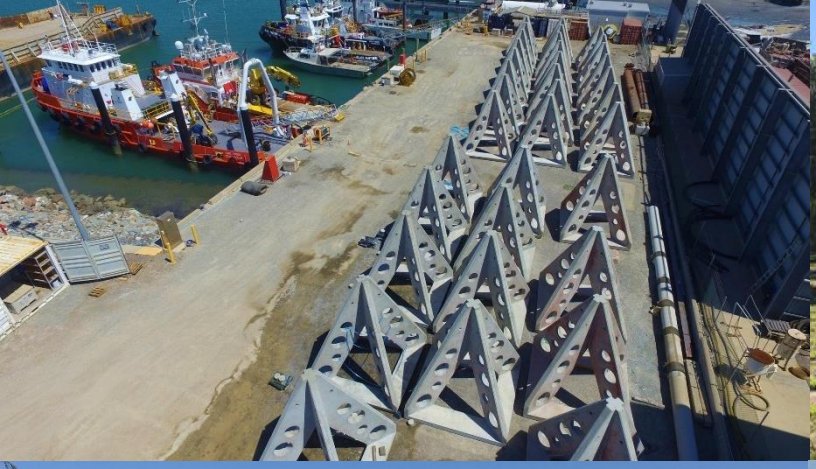
Made & packaged in Australia

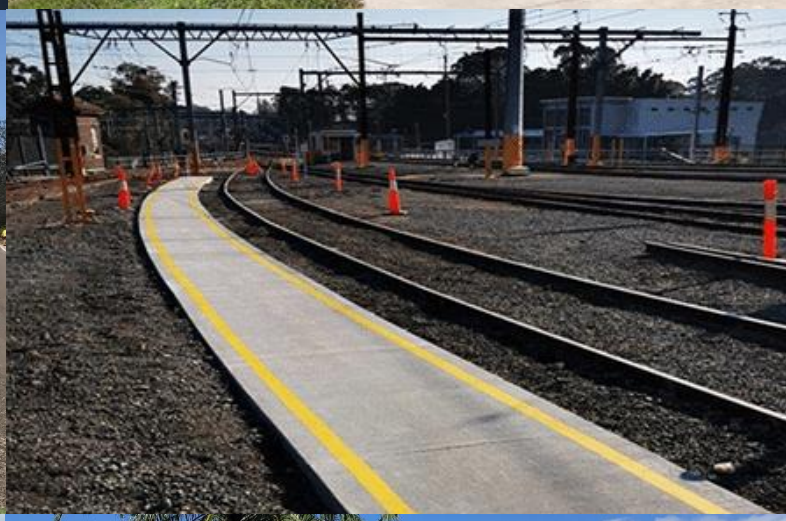
Recent Projects

100% recycled eMesh MSF have been widely used in Australia for a variety of applications.

Some recent projects include:

NWPA Bell to Moreland LXRP, VIC	SEPA Toorak Road LXRP, VIC
M80 Upgrade, VIC	NIF Rail Maintenance Facility, NSW
Mordialloc Bypass, VIC	SEPA M2M LXRP, VIC
Haughton River Floodplain Upgrade, QLD	ACT Healthy Waterways, ACT
Arrowheads Artificial Reef Units, QLD	WestConnex Rozelle Interchange, NSW
WPA Old Geelong Road LXRP, VIC	SEPA/WPA Cranbourne Line Upgrade, VIC
MTMS North & South Rail Upgrades, NSW	TAP3 TfNSW, NSW
Daintree Gateway Project, QLD	Over 30 Local Councils across Australia





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CONTACT INFORMATION

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