Environmental Product Declaration

Program:
The International EPD® System

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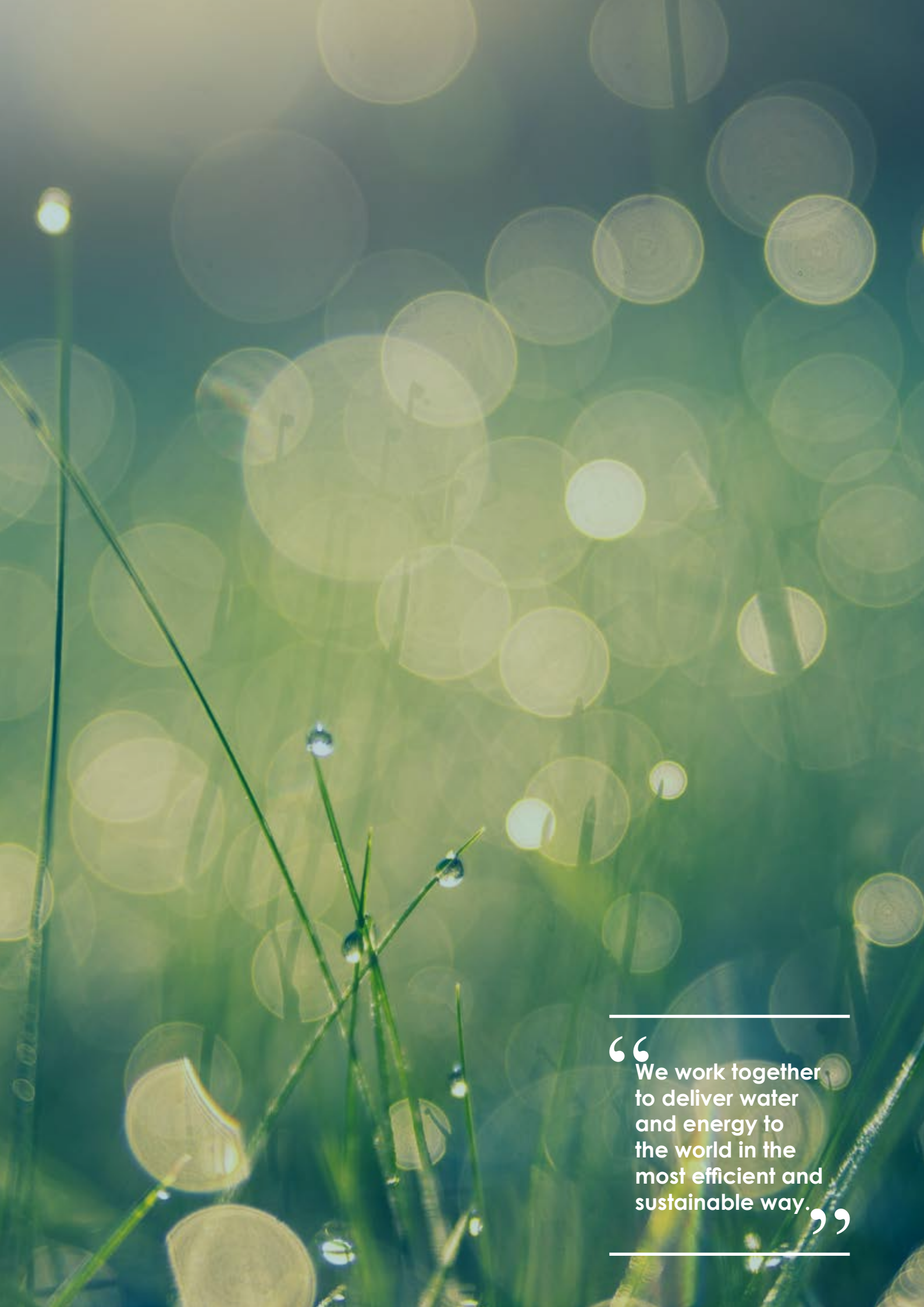
In accordance with ISO 14025 and EN 15804 for:

Glass Reinforced Plastic (GRP/GRE) Pipe and Fittings

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

FUTURE PIPE INDUSTRIES

www.futurepipe.com


“We work together to deliver water and energy to the world in the most efficient and sustainable way.”

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1. Document Information

Program:
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Product Category Rules (PCR)
PCR 2019:14 PCR 2019:14 Construction products (EN 15804:A2) (1.11)

Product Group Classification
UN CPC 53251

PCR Review Conducted by
IVL Swedish Environmental Research Institute Secretariat of the International EPD® System

Independent third-party verification of the declaration and data, according to ISO 14025:2006
☐ EPD Process Certification ☑ EPD Verification

Third party verifier
Professor Vladimír Kocí
Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier
☐ Yes ☑ No

Geographical Scope
The data and information originated from the production facility in Dubai, UAE and are distributed Globally.

2. Introduction

This report contains the environmental performance of the Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings by Future Pipe Industries LLC. This Environmental Product Declaration (EPD) has been developed using the Life Cycle Assessment (LCA) methodology. The environmental impact values calculated are expressed to 1 kg of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings.

The assessed life cycle includes all phases in the manufacturing process of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings in a "Cradle to Gate with options" scope. This LCA covers from the supply of raw material (Resin, Glass Fiber Reinforcement, Sand, Additives etc…) and all other processes up to the distribution of final product to the customer, end of life use and recovery stages.

This EPD has been conducted according to the program operator regulations and it has been verified and registered in The International EPD System. The EPD regulation is a system for the international use of Type III Environmental Declarations, according to ISO 14025:2010. Not only the system, but also its applications, is described in the Programmer's Product Category Rules (PCR). This report has been made following the specifications given in the European standard EN 15804:2012+A2:2019.

The direct and indirect emissions and the corresponding environmental impacts are calculated in the life cycle assessments and reported in this EPD includes the calculation of the environmental impacts to air, land and water, according to the selected Product Category Rules.

3. General Information

Future Pipe Industries design, manufacture and supply composite piping systems for use across the Industrial, Oil & Gas, Water and Marine & Offshore industries. Enhancing our product range, we offer a number of customized solutions including system design and engineering services, project management, technical support, field supervision and training.

Founded in 1984 in Dubai, UAE, the Future Pipe Industries have grown rapidly. Today our operations are worldwide, mobilizing over 3,300 team members across the globe. Our Head Office remains in Dubai, UAE, a country committed to sustainability through its national vision, strategies, and initiatives.

Our facilities are state of the art and create value. We are proud of our leading Technologies which include Helical Filament Winding, Continuous Filament Winding and Reinforced Thermo Plastic (RTP) Technology to deliver piping systems meeting all customer requirements.

We operate 53 production lines which serve more than 400+ customers across four core industries and have installed over 190,000 kilometers of composite pipe worldwide.

With a reputation for quality, we hold long-standing relationships with our clients and partners, delivering composite piping systems to projects which span petrochemical plants, desalination plants, sea water intake systems, brine lines, water transmission, water treatment plants, sewer and drainage and topside piping as just a few examples.

Environmental protection is one of the main pillars of FPIs corporate purpose. It is an integral part of the business strategy and ranks equally with other company objectives.

Our products can be used across a wide range of applications including but not limited to:

- Flow Gathering
- Water Injection
- Downhole Tubing and Casing
- Transmission Lines
- Battery and Header Piping
- Refineries and Plant Piping
- Petrochemicals
- Power and Desalination
- Fuel Handling
- Storage Tanks
- Water Transmission
- Water Distribution
- Irrigation
- Storm Water Systems
- Sewer and Drainage
- Ballast, Scrubber, and Bilge
- Fire Water and Sprinkler Lines
- Seawater Piping
- Offshore Chemical Injection
- Topside Piping

All Future Pipe Industries products are manufactured in accordance with international standards using the latest technology depending on the needs of project.

Environment, Health, and Safety During Manufacturing
Future Pipe Industries has a comprehensive environmental, health and safety management program and all manufacturing units are committed to the group environmental and safety policy. At group or division level specific programmes are defined to act as guidelines for the country organizations and plants. Key performance indicators (KPI's) have been selected, are reported, and are reviewed on a regular basis.

All manufacturing sites operate under a certified quality (ISO 9001), environmental (ISO 14001) and health and safety (ISO 45001) management system.

Future Pipe Industries is equally committed to reducing our environmental impact. As with safety goals, each manufacturing facility has environmental initiatives focused on responsible use of energy and water and on waste reduction.

3.1 Analyzed Product

The assessed system in this Environmental Product Declaration (EPD) comprises the full life cycle of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings by Future Pipe Industries LLC in its factory in Dubai. The assessment has been done using the production data from January 2020 to December 2020.

Future Pipe produces Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings in a wide range of sizes and capabilities. This EPD comprises the general environmental assessment of the following products:

- Glass Reinforced Plastic (GRP/GRE) Pipes;
- Glass Reinforced Plastic (GRP/GRE) Fittings

FPI GRP Technology

Future Pipe Industries GRP Pipes are made from glass fiber reinforcements that are embedded in cured thermosetting resin.

Glass Reinforced plastic (GRP) is a composite material that consists of a polymer matrix and glass Fibers. The polymer matrix is usually an epoxy, vinylester, or polyester thermosetting resin. The resin brings the environmental and chemical resistance to the product, is the binder for the fibers in the structural laminate and defines the form of a GRP part. The glass fibers add strength to the composite. The most common type of glass fiber used for GRP is E-glass (electrical resistance), ECR-glass (Electrical/ Chemical Resistance) is also typically used in applications that require particularly high protection against acidic corrosion. Additional ingredients are used in the GRP pipes such as silica sand, organic peroxides catalyst, hardeners, and accelerators.

Glass Fiber Reinforced Plastic (GRP/GRE) Pipe
Future Pipe Industries offers the largest portfolio of composite pipe systems, each designed and manufactured using the latest technology and production processes.

Continuous Filament Winding Process (Fiberstrong & Wavistrong H_2O)
Pipes are produced on a continuous filament winding machine. This machine consists continuous advancing mandrel which is composed of a continuous steel band supported by beams, which form a cylindrically shaped mandrel. As the mandrel continuously moves in a spiral path toward the end of the machine. Raw materials are fed to the mandrel from overhead. After pipe is cured a synchronized saw unit cuts the pipe to the proper length.

This process is considered continuous since it does not hold and resume at the completion of each pipe or pipe layer.

Helical Filament Winding Process (Wavistrong, Fibermar, Wellstrong, Flowstrong)
Pipes are produced using the helical (reciprocal) filament winding process by which impregnated glass fiber reinforcement with resin are applied onto a precision steel mandrel in a prescribed pattern. Repeated application of wetted fibers results in a multi-layered structural wall construction of the required thickness.

Glass Fiber Reinforced Plastic (GRP/GRE) Fittings
Fittings are manufactures by two distinct processes.

Molded Fittings
This process consists of winding of glass fiber reinforcement pre-impregnated with resin on a steel mould until the required thickness is achieved. The product is allowed to cure on the mould before releasing from it.

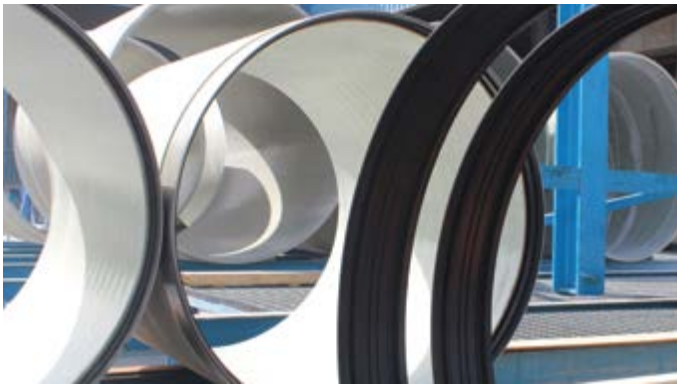
Mitered fittings
This process consists of fabrication of fittings from pipes. Cut sections of the pipes are jointed to make the required shape by lamination process.

3.2 Product Types and Ranges

By perfecting the design and manufacturing process of thermosetting resins and glass fiber reinforcements, we provide a range of products with unique performance capabilities, enabling them to be used in a variety of applications across multiple industries.

Fiberstrong GRP Non-Restrained Pipes & Fittings
Diameter Range (DN): 80 - 4000 mm
Pressure Class (PN): Up to 32 bar
Stiffness Class (SN): 2500, 5000, 10000 Pa
Standard Lengths: 6 - 12 m

Fiberstrong GRP Self-Restrained Pipes & Fittings
Diameter Range (DN): 25 - 4000 mm
Pressure Class (PN): Up to 16 bar
Stiffness Class (SN): 2500, 5000, 10000 Pa
Standard Lengths: 6 - 12 m



Fiberstrong GRP Jacking Pipes
Diameter Range (DN): 450 - 2200 mm
Pressure Class (PN): Up to 6 bar
Stiffness Class (SN): ≥ 20000 Pa
Standard Lengths: 6 m

Fiberstrong GRP Sliplining Pipes
Diameter Range (DN): 300 - 4000 mm
Pressure Class (PN): Up to 10 bar
Stiffness Class (SN): 2500, 5000, 10000 Pa
Standard Lengths: 6 - 12 m

Wavistrong H_2O GRE Non-Restrained Pipes & Fittings
Diameter Range (DN): 100 - 1200 mm
Pressure Class (PN): Up to 16 bar
Stiffness Class (SN): 5000, 10000 Pa
Standard Lengths: 6 - 12 m

Wavistrong H_2O GRE Self-Restrained Pipes & Fittings
Diameter Range (DN): 300 - 1200 mm
Pressure Class (PN): Up to 16 bar
Stiffness Class (SN): 5000, 10000 Pa
Standard Lengths: 6 - 12 m

Wavistrong GRE Pipes & Fittings
Diameter Range (DN): 25 - 1600 mm
Pressure Class (PN): Up to 120 bar
Standard Lengths: 3 - 12 m

Flowstrong GRE Pipes & Fittings
Diameter Range (DN): 3" – 16"
Pressure Class (PN): Up to 3000 psi
Standard Lengths: 6 - 12 m

Wellstrong GRE Pipes & Fitting
Diameter Range (DN): 50 – 600 mm
Pressure Class (PN): Up to 3000 psi
Standard Lengths: 6 - 12 m

Fiberbond GRP Pipes & Fittings
Diameter Range (DN): 2" - 30"
Pressure class (PN): Up to 13.8 bar
Standard Length: Up to 9 m

Any other customized product for any application could also be designed and manufactured.

Advantages of FPI GRP/ GRE Products

Composite Fiberglass Technology Advantages

Durable and Lightweight
Offers a high strength-to-weight ratio meaning lower transportation and installation costs compared to materials such as steel or concrete.

Cost Effective and Efficient
Provides a better hydraulic performance than steel, ductile iron and concrete, significantly reducing operating costs. Composite pipes are cost effective.

Environmentally Friendly and Sustainable
Low energy is required for the production of composite pipes. Composite pipes have a smooth interior surface, needing less energy for the fluids to circulate.

Longer Life Cycle
Increased durability extends the system life cycle significantly beyond what is offered by other alternative materials. Composites can last over 50 years making our pipes economical.

Versatile and Accommodating
Accommodates a variety of assembly options and complex configurations due to its versatility, capacity to withstand high pressures, temperatures and loads as well as intense chemical resistance parameters.

Anti-Corrosive and Resistant
Composites offer excellent resistance against corrosive environments including soils, saltwater, H2S and chemical applications. Composite pipes last longer.

3.3 Declared Unit

The Declared Unit of the Life Cycle Assessments is 1 kg of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings.

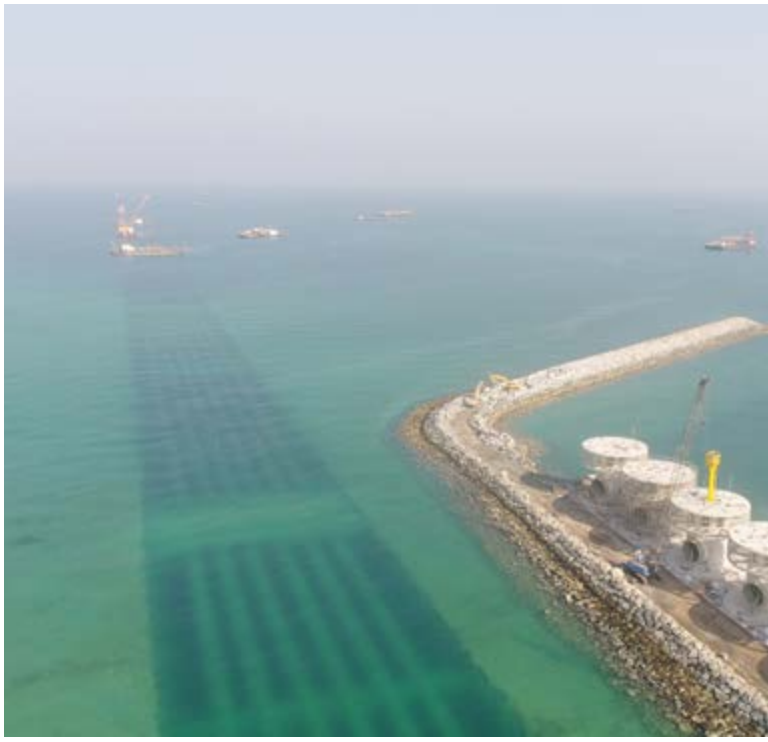
3.4 System Boundaries

This EPD covers all product stages from "Cradle to Gate with options", this means that process in the life cycle from raw materials extraction, production and transport to final customers are included. In addition to this the end of use and recovery stages is included in this LCA.

The procedures that are not controlled by the company, but are included in this environmental study, are:

- The extraction and production of fuels.
- The production of electricity.
- The production of the machinery, buildings, and vehicles.

All related direct and indirect environmental impacts related to these elements have been calculated and were included in the LCAs in this EPD.



The scope of this EPD

Possible scopes of the LCA defined in the European standard EN 15804:2012+A2:2019 are:

	Production Stage			Construction Process Stage		Use Stage						End of Life Stage					Resource Recovery Stage
	Raw Materials	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**	ND	ND	ND	ND	ND	ND	ND	ND	**X**	**X**	**X**	**X**	**X**
Geography	UAE/ GLO	UAE/ GLO	UAE	UAE/ GLO	-	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO
Specific data	GWP > %90				-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	Not Applicable				-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	Not Applicable				-	-	-	-	-	-	-	-	-	-	-	-	-

X = Included, ND=Module not declared, NR= Module not relevant

Modules from A5 to B7 are not included (X refers to considered stage; NR refers to not relevant stage and ND to not declared stage).

Upstream Processes (A1: Raw Material Supply): Production for each product starts with raw materials sourced from worldwide suppliers. 'Raw material supply' includes raw material extraction and pre-treatment processes before manufacturing.

Core Processes (A2: Transportation, A3: Manufacturing and A4: Transport): Transport is relevant for delivery of raw materials to the plant and all Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings products are distributed to customer's sites.

3.5 Product Stages

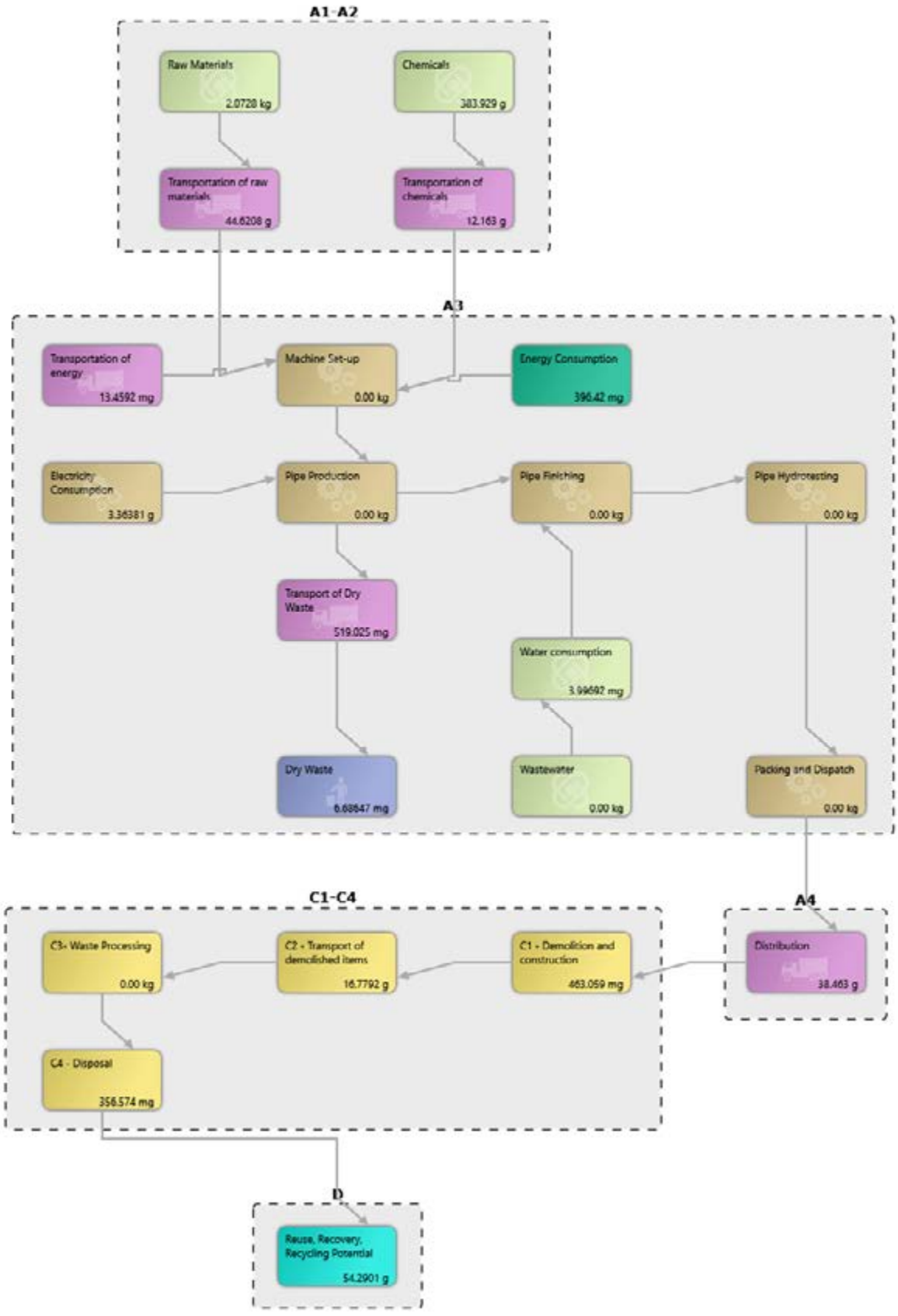
A simplified model of the manufacturing process is described in the following diagrams, enumerating the main activities included in the system boundaries. The process and facilities are also linked to the phases of the product life cycle. Future Pipe buys raw materials from worldwide suppliers (A1-A2). Pipe winding, pre-curing, extraction, calibration, post curing, finishing, and hydro testing (A3).

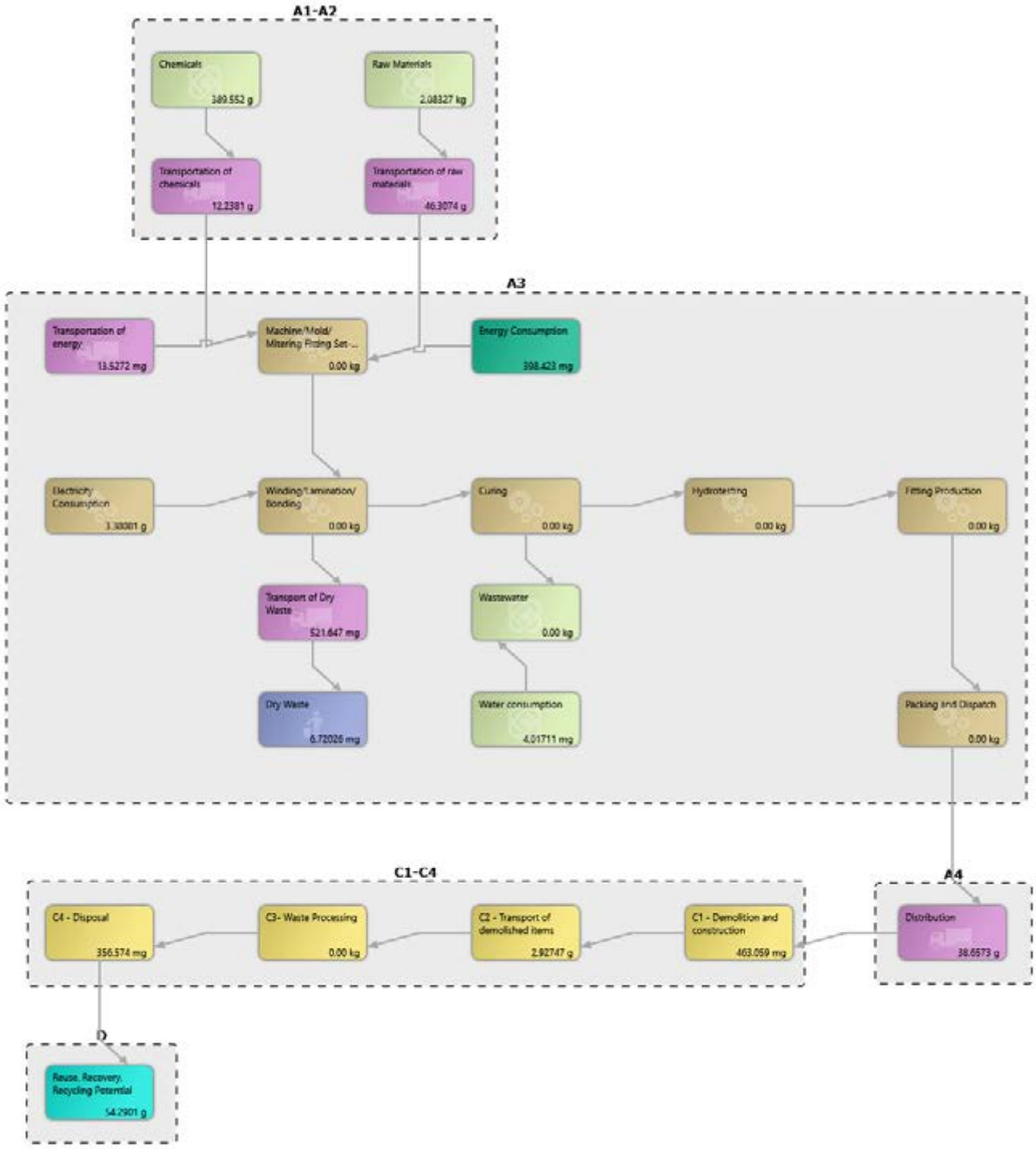
Pipes are distributed to customers all over the world (A4). Deconstruction/ demolition, transport, disposal considered in C1-C4 stage and Reuse, recovery and recycling potential considered in D stage.

Scope of this Life Cycle Assessment 'Cradle to Gate with Options'					
A1 Raw Materials Production	**A2 Transport raw materials**	**A3 Manufacture**	**A4 Distribution**	**End of use Stage (C1-C4)**	**Recovering and Recycling (D)**
					
Raw Materials and Chemicals	Transport from supplier by Road & Sea	Loading, forming, inspection, unloading, packing etc	Transport to customers by Road & Sea	Deconstruction/ demolition, transport, disposal.	Reuse, recovery and recycling potential

The following diagram designed using Air.e LCA software shows flow followed for life cycle calculation.

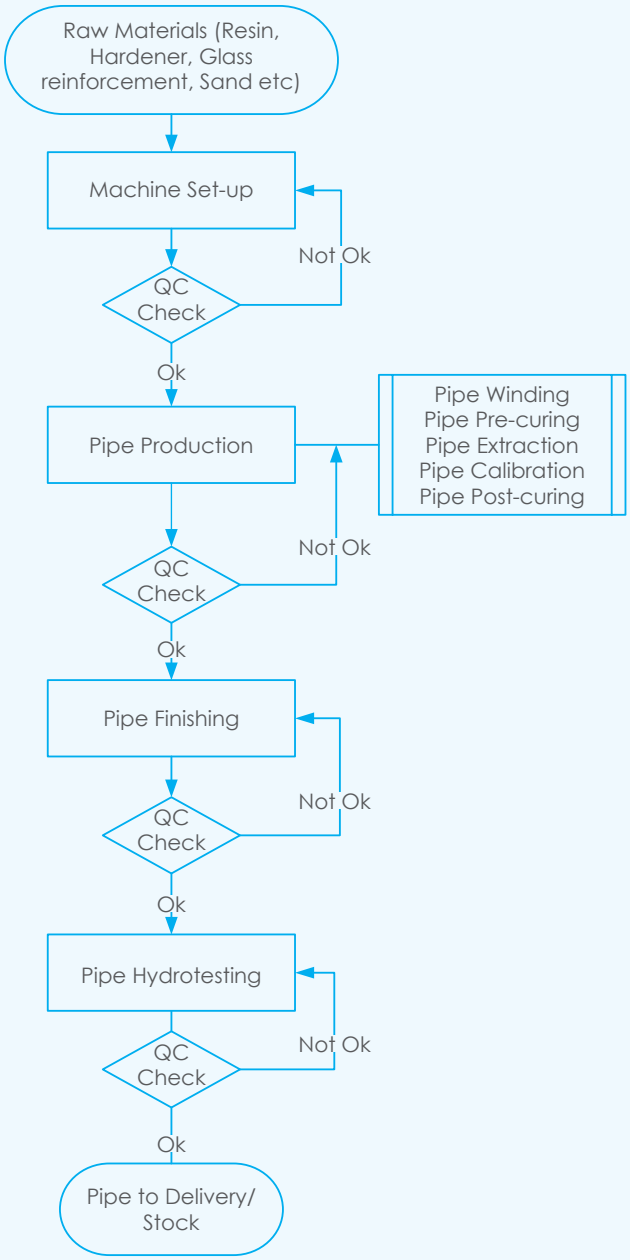
Life Cycle Assessment – GRP/GRE Pipe



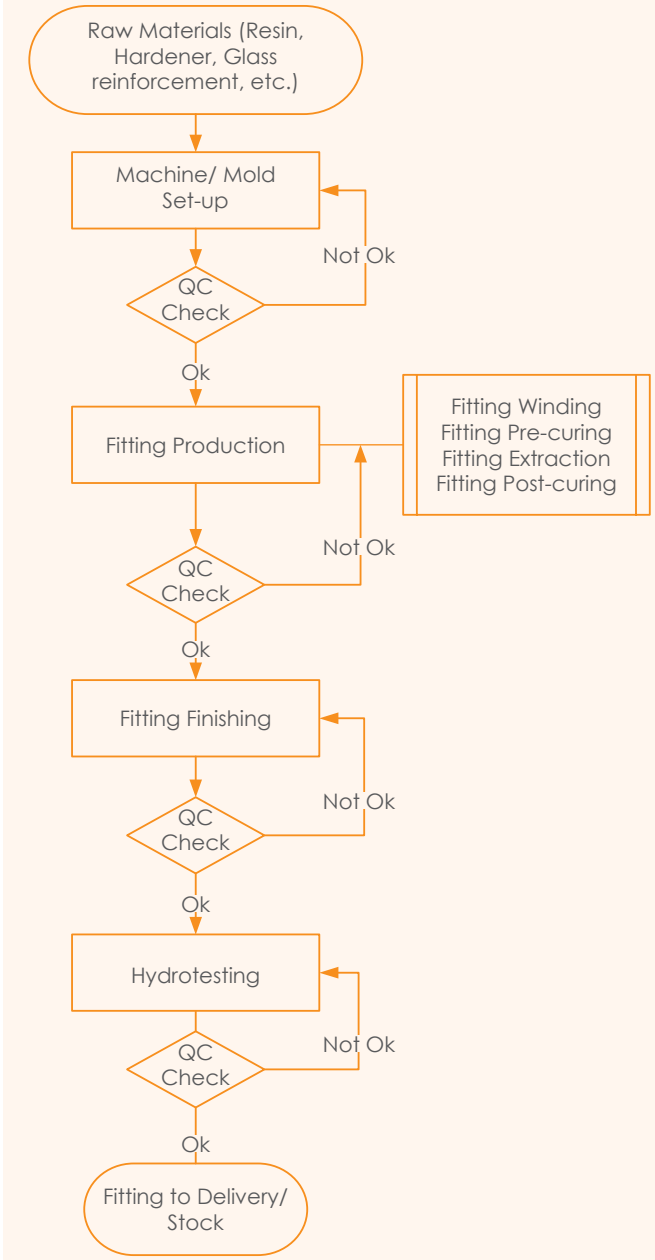

A1-A2
Chemicals
389.552 g
Raw Materials
2.08327 kg
Transportation of chemicals
12.2381 g
Transportation of raw materials
46.3074 g
A3
Transportation of energy
13.5272 mg
Machine/Mold/ Mitering Fixing Set-...
0.00 kg
Energy Consumption
398.423 mg
Electricity Consumption
3.38081 g
Winding/Lamination/ Bonding
0.00 kg
Curing
0.00 kg
Hydrotesting
0.00 kg
Fitting Production
0.00 kg
Transport of Dry Waste
521.647 mg
Wastewater
0.00 kg
Dry Waste
6.72026 mg
Water consumption
4.01711 mg
Packing and Dispatch
0.00 kg
C1-C4
A4
C4 - Disposal
356.574 mg
C3- Waste Processing
0.00 kg
C2 - Transport of demolished items
2.92747 g
C1 - Demolition and construction
463.059 mg
Distribution
38.6573 g
D
Reuse, Recovery, Recycling Potential
54.2901 g

The following diagram is a more detailed description of the A3 phase.

Manufacturing Process – GRP/GRE Pipes



Manufacturing Process – GRP/GRE Fittings



3.6 Sustainable Practices

A successful and sustainable future requires us to ensure sustainability is fundamental to the way we do business at Future Pipe Industries. We have made progress and as our business grows, we continue to align it to all we do.

Future Pipe Industries is committed working towards economic, social, and environmental sustainability. Our Corporate Purpose is rooted in the knowledge that by conducting our business operations responsibly we will create shared value for all stakeholders.

"We work together to deliver water and energy to the world in the most efficient and sustainable way."

From our Corporate Purpose through to the actions we take every day, we recognize sustainability is a business imperative which needs to take place at both a strategic and operational level.

As a company, we want to contribute to making a difference to the issues that matter most to our business and to the world. We work to reduce our environmental footprint and increase our positive social impact, while driving business growth. Doing this requires the force of collaboration and collective action from all.

Future Pipe Industries is delighted to present this EPD to help to showcase the environmental credentials of GRP (Glass Fiber Reinforced Plastic) Pipe and Fittings.

This study has been carried out to understand the environmental impacts of GRP Pipe and Fittings, including all the individual stages of life cycle (from cradle to gate only). This means the results reflect the analysis of resource acquisition, fuel use, energy use, scrap recovery, manufacturing, packing and delivery to customer. Other objectives of this study are to establish a systematic process of continuous improvement in all phases of this cycle, and to achieve the basic results to publish an Environmental Product Declaration (EPD).

Future Pipe Industries GRP/GRE Pipes and Fittings are certified according to many national and international standards. Standards developed by ASTM, AWWA and the latest ISO and EN are applied to a variety of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings applications, including conveyance of sanitary sewerage, water, and industrial waste. These are some of the sustainable practices throughout their manufacturing operations:

- ISO 9001:2015 Certification;
- ISO 14001:2015 Certification;
- ISO 45001:2018 Certification;
- The BSI Kitemark
- WRAS (Water regulation advisory scheme)
- WSAA (Water Services Association of Australia)
- ESMA (Emirates Authority for Standardization and Metrology)
- ASTM D-3262 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
- ASTM D-3517 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
- ASTM D-3754 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
- AWWA C-950 Fiberglass Pressure Pipe
- AWWA M-45 Fiberglass Pipe Design Manual
- ISO 14692 Petroleum and Natural Gas Industries – Glass Reinforced Plastic (GRP) Piping, Part 1-4.
- API 15LR Specification for Low Pressure Fiberglass Line Pipe.
- API 15HR High Pressure Fiberglass Line Pipe.
- BS EN ISO 23856:2021 Plastics Piping Systems for Pressure and Non-Pressure Water Supply, Drainage or Sewerage - Glass Reinforced Thermosetting Plastics (GRP) Systems based on Unsaturated Polyester (UP) Resin

3.7 Content Declaration

GRP/GRE Non-Restrained Pipe		GRP/GRE Self-Restrained Pipe		GRP/GRE Fittings	
Materials	**Percentage**	**Materials**	**Percentage**	**Materials**	**Percentage**
Resin	25-30%	Resin	25-35%	Resin	35-40%
Glass Fiber	20-25%	Glass Fiber	65-75%	Glass Fiber	60-65%
Silica Sand	Up to 50%	Silica Sand	-	Silica Sand	-

3.8 Substances listed in the "Candidate List of SVHC"

The following list includes all the substances used to manufacture the product that are included in the Candidate List of Substances of very high concern by European Chemicals Agency and their content exceeds 0,1% of the weight of the product.

Substance	EC number	CAS number
None	-	-

4. Technical Information

4.1 Calculation Methodology

This EPD represents a Type III Environmental Declarations according to ISO 14025:2006. The Life Cycle Assessment (LCA) has been developed following the ISO 14040 International Standard. The environmental impacts calculation method reported in this EPD follow the EF-3.0, (ILCD). The report has been done following the specifications given in the European standard EN 15804:2012+A2:2019.

4.2 Emission Factors

Emission factors and environmental impacts of elements in life cycles that are not directly controlled by Future Pipe Industries LLC have been analyzed using external studies and external emissions factors databases like Ecoinvent due to the lack of direct data. The next paragraphs describe the calculation rules and criterial applied in the calculation of the environmental performance of this type of elements in the LCA.

Raw Materials and Chemicals

Datasets from Ecoinvent 3.7.1 with emission factors raw materials for Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings has been characterized to adjust them to the characteristics of manufacturing of Future Pipe Industries LLC suppliers or countries where suppliers are located. Datasets from Ecoinvent 3.7.1 with emission factors for generic chemicals have been characterized to adjust them to the characteristics of the products manufactured by Future Pipe Industries LLC suppliers.

Electricity

A specific dataset with the Life Cycle Inventory (LCI) corresponding to the electricity mix in Dubai in 2020 has been used for this LCA.

Transport to the construction site stage – A4

The Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings is provided to customers all over the world. To create a scenario of the A4 phase, all the products sold from January 2020 - December 2020 has been analyzed as representative of the international transport. The transport means are international cargo ships and 3.5-7.5t & >32t trucks, as described in the following table.

Scenario	Parameter	Units	Value Per functional unit
A4 – Cargo Ship	Vehicle type used for transport	Transoceanic cargo ship	n/a
	Vehicle load capacity	Kg (dw)	50,000
	Fuel type and consumption	Liters of heavy fuel oil per km	0.24
	Distance to construction site	Km	See detailed table
	Capacity utilization	%	See detailed table
	Bulk density of transported products	Kg/m3	n/a
	Volume capacity utilization factor	n/a	1
A4 - Truck	Vehicle type used for transport	>32t truck,	
	3.5 - 7.5t	n/a	
	Vehicle load capacity	Tons	25
	Fuel type and consumption	Liters of diesel per km	0.38
	Distance to construction site	Km	See detailed table
	Capacity utilization	%	See detailed table
	Bulk density of transported products	Kg/m3	n/a
	Volume capacity utilization factor	n/a	1

For every destination, the total amount of products delivered to customers has been taken to account according to the following detailed table:

Means of Transport	Destination	Distance	% FU	
			Pipes	Fittings
A4-Truck	Ajman	91 kms	0.73	0.73
	Al Ain	140 kms	0.17	0.17
	Al Barsha	44 kms	10.10	10.15
	Al khobar, KSA	828 kms	0.05	0.05
	Al Lisaili	62 kms	3.81	3.83
	Al Qudra	48 kms	5.01	5.04
	Al Qusais	72 kms	0.16	0.16
	Bahrain	882 kms	0.12	0.12
	Buraidha, KSA	1320 kms	0.16	0.16
	Dammam Port, KSA	841 kms	0.11	0.11
	Dammam, KSA	834 kms	2.04	2.05
	Deira	73.6 kms	3.91	3.93
	Dhaid	111 kms	0.02	0.02
	Fujairah	156 kms	2.21	2.22
	Ghantoot	33.6 kms	1.89	1.90
	Global Village	41 kms	0.81	0.82
	Hatta	161 kms	0.01	0.01
	Jebel Ali	28.9 kms	15.84	15.92
	Jizan, KSA	2087 kms	0.26	0.26
	Jubail, KSA	860 kms	0.01	0.01
	Jumeirah	57.6 kms	0.69	0.69
	Kuwait	1287 kms	0.22	0.22
	Lahbab	65.7 kms	6.46	6.50
	Khawaneej	70.9 kms	0.02	0.02
	Khorfakan	165 kms	0.01	0.01
	Kalba	164 kms	0.09	0.09
	Madam	93.4 kms	0.50	0.51
	Margham	76.3 kms	0.95	0.95
	Mudon	33.9 kms	4.44	4.46
	Muhaisnah	72 kms	5.48	5.51
	Musaffah	101 kms	5.17	5.20
	Ras Al Khor	65.7 kms	22.07	22.18
	Rabigh, KSA	1937	0.25	0.25
	Rusayl, Oman	460 kms	2.03	2.04
	Sharjah	81.6 kms	3.69	3.71
	Sajja, Sharjah	89.2 kms	0.01	0.01
	Town Square	44.6 kms	0.01	0.01
	Umm Al Quwain	113 kms	6.32	6.35
A4-Ship	Indonesia	4278 nmi	0.02	0.02

4.3 Calculation Rules

Version 3.12.0.5 of software Air.e LCA™ with Ecoinvent™ 3.7.1 database has been used for LCA modeling and impacts calculations. Minor components are not directly related to the product, with less than 1% impact, such as office supplies, has been excluded from the assessment.

All transports of components have been included in the LCA considering real distances travelled by materials used from January – December 2020. Transport of raw materials needed to produce Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings is estimated in a global scale according to Ecoinvent™ criteria. Main means of transport have been included for materials purchases. As exact port locations are not known in detail, transport distances have been calculated from a one of the ports in the country of origin to the factory. Operation in port has also been excluded. Road distances calculated using Google Maps. Maritime distances calculated using Marine Traffic Voyage Planner.

Cut-off rules: more than 99% of the materials and energy consumption have been included. The Polluter Pays Principle and the Modularity Principle have been followed.

4.4 By Products Assignment

There are no By Products in this Environmental Product Declaration. Hence, no allocation had to be applied.

4.5 Additional Environmental Information

Dismantling/demolition (module C1)

For demolition 1 ton GRP pipe, (average length is assumed as 7 m for the pipes produced by FW method, and 12 m for the ones which produced by HW method), 20 minutes installation time is assumed by using a mobile crane which consumes 18 L of diesel per hour. The depth which pipes were installed was assumed as 3.5 m, and the required area was assumed to be digged in 1 hour by a mobile crane which consumes 15 L diesel per hour.

Transport (module C2)

This stage includes the transportation of the discarded pipes to final disposal. Average distance from demolition site to waste processing site for final disposal is assumed to be 50 km.

Type	Capacity utilization	Type of vehicle	Average distance
Truck	50%	Euro 6 >32t	50 km

Waste processing (modules C3)

As the waste is going to landfill, there is no need for any waste process.

Disposal (modules C4)

Disposal is the final stage of product life. Composite pipes may dispose with any disposal scenario after construction and demolition as their final fate and modelled as such for this EPD. It is assumed that 25% of the waste is used as inert filler, and the rest of the waste is sent to the landfill.

Recyclability potentials (module D)

In this stage, benefits from the inert filler specified in the disposal stage were calculated.

5. Environmental Performance

5.1 Potential Environment Impacts

In the following tables, the environmental performance of the declared units "1 kg of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings" are presented for the Future Pipe Industries LLC product totalized and for every sub-phase of the life cycles.

During the assessment it was not evident to distinguish the differences in the consumption of electricity, water, diesel, raw material and chemicals during the manufacturing process of the different types of Glass Reinforced Plastic (GRP/GRE) Pipes & Fittings. Hence, the calculation is based on total production vs total consumption of the product.

Environmental impacts are calculated using the EF-3.0, (ILCD).

Core Environmental Impact Indicators - GRP/GRE Pipe

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Climate change (GWP) – fossil	kg CO2e	2.51E+00	4.30E-03	3.85E-02	ND	ND	4.63E-04	1.68E-02	0	3.55E-04	-5.43E-02	2.51E+00
Climate change (GWP) – biogenic	kg CO2e	1.61E-03	6.24E-06	4.11E-09	ND	ND	3.12E-07	0.00E+00	0	6.26E-07	-8.93E-06	1.60E-03
Climate change (GWP) – LULUC	kg CO2e	-7.26E-05	-3.66E-08	9.00E-11	ND	ND	-1.04E-08	0.00E+00	0	-2.11E-07	-4.87E-07	-7.24E-05
Climate change (GWP) – total	kg CO2e	2.51E+00	4.30E-03	3.85E-02	ND	ND	4.63E-04	1.68E-02	0	3.57E-04	-5.43E-02	2.52E+00
Ozone depletion	kg CFC11e	4.78E-05	7.70E-10	3.68E-12	ND	ND	7.70E-10	0.00E+00	0	1.10E-10	-1.17E-08	4.78E-05
Acidification	mol H+e	4.74E-03	7.53E-06	1.00E-05	ND	ND	5.65E-06	5.01E-06	0	2.78E-06	-5.70E-04	4.20E-03
Eutrophication, aquatic freshwater	kg PO4e	1.82E-04	1.17E-07	6.80E-10	ND	ND	3.57E-08	0.00E+00	0	4.15E-08	-1.61E-06	1.81E-04
Eutrophication, aquatic marine	kg Ne	1.05E-03	1.76E-06	5.56E-06	ND	ND	7.22E-07	2.36E-06	0	9.87E-07	-2.51E-04	8.11E-04
Eutrophication, terrestrial	mol Ne	9.90E-03	2.00E-05	7.00E-04	ND	ND	7.90E-06	3.00E-05	0	1.00E-05	-2.75E-03	7.92E-03
Photochemical ozone formation	kg NMVOCe	3.94E-03	6.21E-06	1.65E-05	ND	ND	3.21E-06	7.01E-06	0	3.01E-06	-7.54E-04	3.22E-03
Abiotic depletion, minerals & metals	kg Sbe	9.54E-06	3.00E-09	1.40E-10	ND	ND	5.50E-10	0.00E+00	0	1.09E-09	-2.47E-08	9.52E-06
Abiotic depletion of fossil resources	MJ	1.39E+01	9.50E-02	2.32E-04	ND	ND	4.66E-02	0.00E+00	0	7.76E-03	-7.39E-01	1.33E+01
Water use	m3e depr.	5.24E-01	5.90E-04	8.50E-07	ND	ND	5.61E-05	0.00E+00	0	3.77E-04	-2.50E-03	5.23E-01

EN 15804+A2 disclaimers for Abiotic depletion and Water use indicators and all optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Additional Environmental Impact Indicators – GRP/GRE Pipe

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Particulate matter	Incidence	3.62E-08	3.72E-11	6.64E-11	ND	ND	2.87E-11	2.87E-11	0	5.02E-11	-1.50E-08	2.14E-08
Ionizing radiation, human health	kBq U235e	4.31E-02	1.74E+05	1065.5	ND	ND	2.12E+05	0	0	3.89E+04	-3.40E-03	4.26E+05
Eco-toxicity (freshwater)	CTUe	4.11E+01	6.07E-02	0.00054	ND	ND	4.94E-02	0.0001	0	1.69E-02	-8.55E-01	4.04E+01
Human toxicity, cancer effects	CTUh	5.09E-09	8.91E-13	2.25E-12	ND	ND	4.20E-13	9.76E-13	0	3.98E-13	-3.92E-11	5.06E-09
Human toxicity, non-cancer effects	CTUh	3.29E-08	1.90E-11	1.10E-10	ND	ND	1.09E-11	4.79E-11	0	8.53E-12	-6.12E-10	3.25E-08
Land use related impacts/soil quality	-	4.15E+01	9.86E-02	0.00012	ND	ND	3.30E-02	0	0	1.47E-02	-1.04E-01	4.15E+01

EN 15804+A2 disclaimer for Ionizing radiation, human health. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Use of Natural Resources – GRP/GRE Pipe

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Renewable PER used as energy	J	7.38E+05	2.40E+02	1.47E+17	ND	ND	1.13E+02	0	0	1.36E+02	-3.94E+03	1.47E+17
Renewable PER used as materials	J	1.80E+20	1.34E+17	6.28E+14	ND	ND	4.71E+16	0	0	3.38E+16	-1.56E+18	1.78E+20
Total use of renewable PER	J	1.80E+20	1.34E+17	1.48E+17	ND	ND	4.71E+16	0	0	3.38E+16	-1.56E+18	1.79E+20
Non-renew. PER used as energy	J	1.39E+07	9.50E+04	2.32E+02	ND	ND	4.66E+04	0	0	7.76E+03	-7.39E+05	1.33E+07
Non-renew. PER used as materials	J	1.28E+17	5.36E+13	3.33E+11	ND	ND	2.31E+13	0	0	4.10E+14	-8.93E+14	1.27E+17
Total use of non-renewable PER	J	1.28E+17	5.36E+13	3.33E+11	ND	ND	2.31E+13	0	0	4.10E+14	-8.93E+14	1.28E+17
Use of secondary materials	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Use of renewable secondary fuels	J	0	0	0	ND	ND	0	0	0	0	0	0
Use of non-renew. secondary fuels	J	0	0	0	ND	ND	0	0	0	0	0	0
Use of net fresh water	m3		1.94E+04		ND	ND	0	0	0	0	0	1.94E+04

End of Life – Waste – GRP/GRE Pipe

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Hazardous waste	Kg	0	1.77E+06	0	ND	ND	0	0	0	0	0	1.77E+06
Non-hazardous waste	Kg	0	2.25E+06	0	ND	ND	0	0	0	2.31E+07	0	2.54E+07
Radioactive waste	Kg	<0.01 - No nuclear energy used										

End of Life – Outflows – GRP/GRE Pipe

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Components for reuse	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Materials for recycling	Kg	0	7.76E+06	0	ND	ND	0	0	0	0	-7.68E+06	7.67E+04
Materials for energy recovery	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Exported energy - electricity	MJ	0	0	0	ND	ND	0	0	0	0	0	0
Exported energy - thermal	MJ	0	0	0	ND	ND	0	0	0	0	0	0

Biogenic Carbon Content – GRP/GRE Pipe

Details	Unit	A1-A3
Biogenic carbon content in product	Kg C	0
Biogenic carbon content in packaging	Kg C	0

Core Environmental Impact Indicators - GRP/GRE Fittings

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Climate change (GWP) – fossil	kg CO2e	2.53E+00	4.32E-03	3.87E-02	ND	ND	4.63E-04	2.93E-03	0	3.55E-04	-5.43E-02	2.52E+00
Climate change (GWP) – biogenic	kg CO2e	1.17E-03	6.27E-06	4.13E-09	ND	ND	3.12E-07	0.00E+00	0	6.26E-07	-8.93E-06	1.17E-03
Climate change (GWP) – LULUC	kg CO2e	-7.37E-05	-3.68E-08	9.00E-11	ND	ND	-1.04E-08	0.00E+00	0	-2.11E-07	-4.87E-07	-7.45E-05
Climate change (GWP) – total	kg CO2e	2.53E+00	4.33E-03	3.87E-02	ND	ND	4.63E-04	2.93E-03	0	3.57E-04	-5.43E-02	2.52E+00
Ozone depletion	kg CFC11e	4.80E-05	7.70E-10	3.70E-12	ND	ND	7.70E-10	0.00E+00	0	1.10E-10	-1.17E-08	4.80E-05
Acidification	mol H+e	4.85E-03	7.76E-06	1.00E-05	ND	ND	5.65E-06	1.02E-06	0	2.78E-06	-5.70E-04	4.31E-03
Eutrophication, aquatic freshwater	kg PO4e	1.85E-04	1.18E-07	6.80E-10	ND	ND	3.57E-08	0.00E+00	0	4.15E-08	-1.61E-06	1.83E-04
Eutrophication, aquatic marine	kg Ne	1.08E-03	1.77E-06	5.58E-06	ND	ND	7.22E-07	5.12E-07	0	9.87E-07	-2.51E-04	8.35E-04
Eutrophication, terrestrial	mol Ne	1.01E-02	2.00E-05	7.00E-05	ND	ND	7.90E-06	5.73E-06	0	1.00E-05	-2.75E-03	7.48E-03
Photochemical ozone formation	kg NMVOCe	4.01E-03	6.24E-06	1.66E-05	ND	ND	3.21E-06	1.51E-06	0	3.01E-06	-7.54E-04	3.32E-03
Abiotic depletion, minerals & metals	kg Sbe	9.83E-06	3.02E-09	1.40E-10	ND	ND	5.50E-10	0.00E+00	0	1.09E-09	-2.47E-08	9.81E-06
Abiotic depletion of fossil resources	MJ	1.41E+01	9.55E-02	2.33E-04	ND	ND	4.66E-02	0.00E+00	0	7.76E-03	-7.39E-01	1.35E+01
Water use	m3e depr.	5.31E-01	5.93E-04	8.50E-07	ND	ND	5.61E-05	0.00E+00	0	3.77E-04	-2.50E-03	5.29E-01

EN 15804+A2 disclaimers for Abiotic depletion and Water use indicators and all optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Additional Environmental Impact Indicators – GRP/GRE Fittings

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Particulate matter	Incidence	3.67E-08	3.74E-11	6.68E-11	ND	ND	2.87E-11	5.25E-12	0	5.02E-11	-1.50E-08	2.19E-08
Ionizing radiation, human health	kBq U235e	4.37E-02	1.75E+05	1.07E+03	ND	ND	2.12E+05	0.00E+00	0	3.89E+04	-3.40E-03	4.27E+05
Eco-toxicity (freshwater)	CTUe	4.20E+01	6.10E-02	1.36E-03	ND	ND	4.94E-02	1.47E-05	0	1.69E-02	-8.55E-01	4.12E+01
Human toxicity, cancer effects	CTUh	5.13E-09	8.95E-13	2.27E-12	ND	ND	4.20E-13	2.00E-13	0	3.98E-13	-3.92E-11	5.10E-09
Human toxicity, non-cancer effects	CTUh	3.37E-08	1.91E-11	1.10E-10	ND	ND	1.09E-11	9.58E-12	0	8.53E-12	-6.12E-10	3.33E-08
Land use related impacts/soil quality	-	4.19E+01	9.91E-02	1.20E-04	ND	ND	3.30E-02	0.00E+00	0	1.47E-02	-1.04E-01	4.19E+01

EN 15804+A2 disclaimer for Ionizing radiation, human health. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Use of Natural Resources – GRP/GRE Fittings

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Renewable PER used as energy	J	7.46E+05	2.41E+02	1.65E+00	ND	ND	1.13E+02	0	0	1.36E+02	-3.94E+03	7.43E+05
Renewable PER used as materials	J	1.82E+20	1.35E+17	6.31E+14	ND	ND	4.71E+16	0	0	3.38E+16	-1.56E+18	1.80E+20
Total use of renewable PER	J	1.82E+20	1.35E+17	6.31E+14	ND	ND	4.71E+16	0	0	3.38E+16	-1.56E+18	1.80E+20
Non-renew. PER used as energy	J	1.41E+07	9.55E+04	2.33E+02	ND	ND	4.66E+04	0	0	7.76E+03	-7.39E+05	1.35E+07
Non-renew. PER used as materials	J	1.29E+17	5.38E+13	3.35E+11	ND	ND	2.31E+13	0	0	4.10E+14	-8.93E+14	1.28E+17
Total use of non-renewable PER	J	1.29E+17	5.38E+13	3.35E+11	ND	ND	2.31E+13	0	0	4.10E+14	-8.93E+14	1.28E+17
Use of secondary materials	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Use of renewable secondary fuels	J	0	0	0	ND	ND	0	0	0	0	0	0
Use of non-renew. secondary fuels	J	0	0	0	ND	ND	0	0	0	0	0	0
Use of net fresh water	m3		1.14E+04		ND	ND	0	0	0	0	0	1.14E+04

End of Life – Waste – GRP/GRE Fittings

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Hazardous waste	Kg	0	8.74E+05	0	ND	ND	0	0	0	0	0	1.77E+06
Non-hazardous waste	Kg	0	1.11E+06	0	ND	ND	0	0	0	1.35E+07	0	1.46E+07
Radioactive waste	Kg	<0.01 - No nuclear energy used										

End of Life – Outflows – GRP/GRE Fittings

Impact Category	Unit	A1-A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D	Total
Components for reuse	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Materials for recycling	Kg	0	3.82E+06	0	ND	ND	0	0	0	0	-4.49E+06	-6.68E+05
Materials for energy recovery	Kg	0	0	0	ND	ND	0	0	0	0	0	0
Exported energy - electricity	MJ	0	0	0	ND	ND	0	0	0	0	0	0
Exported energy - thermal	MJ	0	0	0	ND	ND	0	0	0	0	0	0

Biogenic Carbon Content – GRP/GRE Fittings

Details	Unit	A1-A3
Biogenic carbon content in product	Kg C	0
Biogenic carbon content in packaging	Kg C	0

6. Mandatory Statements

Explanatory material can be obtained from EPD owner and/or LCA author. Contact information can be found below. The verifier and The Program Operator do not make any claim or present any responsibility about the legality of the product.

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

7. Contact Information

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8. References

LCA Report: Life Cycle Inventory of Future Pipe Industries LLC

Software: Air.e LCA rev. 3.12.0.5 www.solidforest.com

Main database: Ecoinvent 3.7.1 www.ecoinvent.org

Geographical scope of the EPD: Global

Normative: ISO 14040:2006 "Environmental management -- life cycle assessment -- principles and framework"; ISO 14044:2006 "Environmental management -- life cycle assessment -- requirements and guidelines"; ISO 14020 "Environmental Labelling: General Principles"; ISO 14025:2006 "Environmental labels and declarations -- type III environmental declarations -- principles and procedures" and EN 15804.