DECIBEL SOUNDSEAL ACOUSTIC INSULATION LCA

REPORT FOR INTERFLOOR LIMITED

August 2020

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Interfloor LCA Report

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1 INTRODUCTION

This document comprises the formal project report detailing an LCA of Decibel Soundseal Acoustic Insulation flooring products used in the construction industry and supplied in Europe by Interfloor Limited.

The products are specified in more detail in Section 3.1. The project was undertaken to produce an Environmental Product Declaration compliant with ISO 14025 and EN 15804; the requirements of EN 15804 have been followed in the LCA.

2 GOAL OF STUDY

The goal of the LCA reported here was to quantify environmental impacts and resource efficiency implications of Interfloor's Decibel Soundseal Acoustic Insulation products, using the impact categories and indicators specified in EN 15804+A2, for the modules A1 - A3, referred to as "Cradle-to-Gate", along with additional modules covering transport to site and installation (A4, A5) and "end of life" (modules C & D). In the EPD, indicator values for the three modules A1 - A3 are reported as aggregate values.

The LCA was conducted in order to generate one Environmental Product Declaration (EPD) for Business-to-Business (B2B) communication of the environmental credentials of Interfloor's Decibel Soundseal Acoustic Insulation products. EPD are often used in the context of the assessment of environmental performance of a building, using SKA, BREEAM, and/or LEED. In this context, compliance with EN 15804 is important to EPD users.

2.1 PRODUCT CATEGORY RULE (PCR)

There is no specific PCR for underlay-type materials but a PCR exists for "*resilient, textile and laminate floor coverings (EN 16810)*" (c-PCR-004 in the International EPD® System), which is complementary to International EPD® System's PCR 2019:14, construction products. The current version of that PCR (v 1.0, 2019-12-20 is aligned with EN 15804:2012+A2:2019).

This LCA followed PCR 2019:14 and c-PCR-004 where relevant.

2.2 PRODUCT DESCRIPTION

This LCA relates to Interfloor's Decibel Soundseal Acoustic Insulation products. These are used as sound insulation, laid under concrete sub-floors in multi-storey buildings. The products are similar in nature to sponge rubber carpet underlay and comply with BS 5808: 1991 and BS EN14499: 2015. Key technical properties from product Technical Data Sheets are included in the EPD.

2.2.1 PRODUCT RANGE

This study and the EPD derived from it concern the following products in Interfloor's Decibel Soundseal Acoustic Insulation range:

- Decibel 1
- Decibel 2
- Decibel 3
- Decibel 4
- Decibel Compact 2
- Decibel Wood

The range is shown below in Figure 1. The variation in thickness between the various products can be seen in Figure 2.

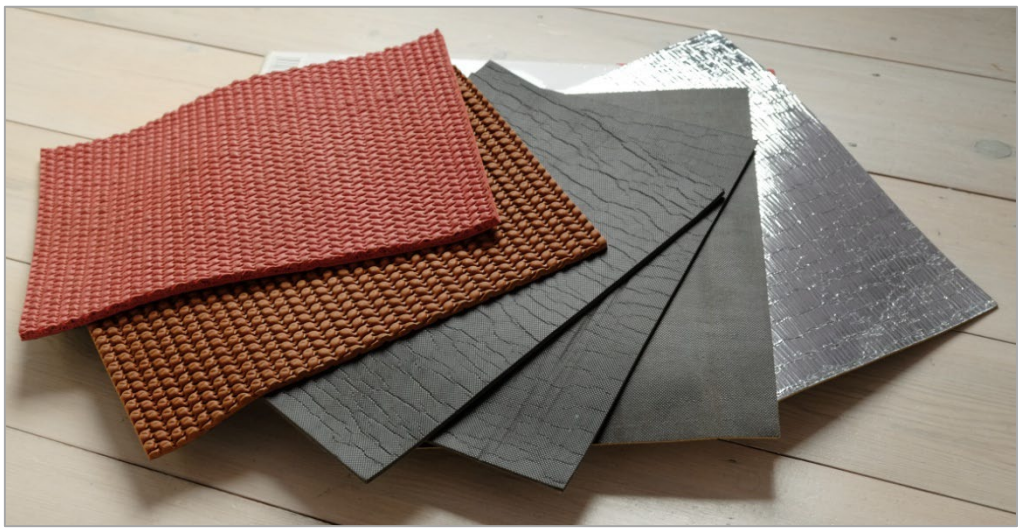


FIGURE 1: DECIBEL SOUNDSEAL ACOUSTIC INSULATION RANGE

FIGURE 2: DECIBEL SOUNDSEAL ACOUSTIC INSULATION RANGE

2.3 PRODUCT MANUFACTURE AND SUPPLY

Decibel Soundseal Acoustic Insulation products are manufactured at Interfloor's Haslingden site in the UK. The facility was visited at the outset of this project. Four types of underlay are produced at the facility: sponge rubber products, foam products, rubber crumb and a small quantity of polyurethane underlay. Each is produced by a distinct process. Utilities and some ancillary materials are shared between more than one product type. The manufacture of Decibel Soundseal and sponge rubber underlays involves the following steps:

1. batching and milling of rubber compound
2. application of rubber compound to backing material
3. calendering to ensure uniform thickness of the rubber layer
4. curing in gas-fired ovens
5. trimming and packing

Emissions to air from the curing ovens are abated in a gas-fired thermal oxidiser. Final emissions are monitored to ensure compliance with the site's environmental permit.

Decibel Soundseal products are supplied to customers as rolls formed on cardboard cores and protected by polythene bags.

Some trim from product finishing (e.g. rubber edge trim) is granulated and reused in the manufacturing process by incorporating it into the rubber compound in the first of the steps described above.

Solid wastes are sent to a material recovery facility operated by a third-party where recyclable materials are separated; residual wastes are incinerated - with energy recovered.

Although some processes at the Haslingden site use steam, the production of Decibel Soundseal products involves no process water use. Total water use across the site - including domestic use - is less than 10 m^3 per day.

2.4 FUNCTIONAL UNIT

This LCA and the EPD based on it relate to 1 square metre (m^2) of Decibel Soundseal Acoustic Insulation. The mass of the functional unit for each product is shown in Table 1

The functional units used in the LCA are also the declared units in the EPD.

Product	Thickness (mm)	Mass per m^2 ($kg.m^{-2}$)	Effective bulk density ($kg.m^{-3}$)	Biogenic carbon in packaging ($kgC.m^{-2}$)
Decibel 1	3.00	2.305	768	0.02
Decibel 2	5.30	3.017	569	0.02
Decibel 3	10.00	4.233	423	0.02
Decibel 4	11.40	4.068	357	0.02
Decibel Compact 2	2.00	2.848	1424	0.04
Decibel Wood	3.00	2.136	712	0.02

TABLE 1: PHYSICAL PROPERTIES OF DECIBEL SOUNDSEAL ACOUSTIC INSULATION PRODUCTS

The effective bulk densities shown in Table 1 are derived from the mass per square metre and thickness; these values are used in LCA calculations for life cycle modules involving product transport before or after use. The product is supplied in roll form, therefore these represent an approximation. Table 1 also includes the biogenic carbon content of the packaging in which the product is supplied, as required by EN15804+A2. This is calculated on the basis of the biogenic C content of cardboard quoted in the ecoinvent database: 44% by mass. The biogenic carbon content of each product is below 5% of the mass of the functional unit; biogenic carbon content of the product is therefore omitted from

2.5 SYSTEM BOUNDARY

This LCA and the associated EPD cover the product stage, delivery to site, installation, and 'end-of-life'management. It therefore includes the following information modules:

- A1 - raw material extraction and processing, and the processing of secondary material input
- A2 - transport of raw materials and secondary material inputs to the manufacturer
- A3 - manufacturing of the construction product and packaging
- A4 - delivery of construction products to the building site
- A5 - on-site installation
- C1 - removal from the building
- C2 - transport to waste treatment facility
- C3 - waste treatment
- C4 - final disposal
- D - benefits associated with recycling in a different product system

Modules A1, A2 and A3 comprise the product stage and are declared as one aggregated module A1 – A3. This stage includes the extraction and manufacture of raw materials, intermediate products and energy, as well as waste processing up to the end-of-waste state (i.e. no longer considered a waste material) or disposal of final residues arising during the product stage. Modules A4 & A5 are part of the

"Construction Process stage". Module C1 - C4 cover the end-of-life stage. Module D provides an estimate of the potential benefits that would accrue to a different product system were Decibel acoustic insulation to be recycled at current recycling rates and using current technologies. Because the product is not currently recycled, no potential benefits are reported in Module D in this study. Assessment of Module D excludes any third-party recycling of packaging or process wastes arising in Modules A1-A5; no specific data is available for such recycling.

All upstream resource extraction and manufacturing processes are included in the system. All energy used in manufacturing is included. Ancillary materials used in processes but not included in final products were included both in the collected data, and in the LCA where identified as significant (see Table 2). Maintenance of equipment is excluded. Figure 3 shows the modelled system and its boundaries.

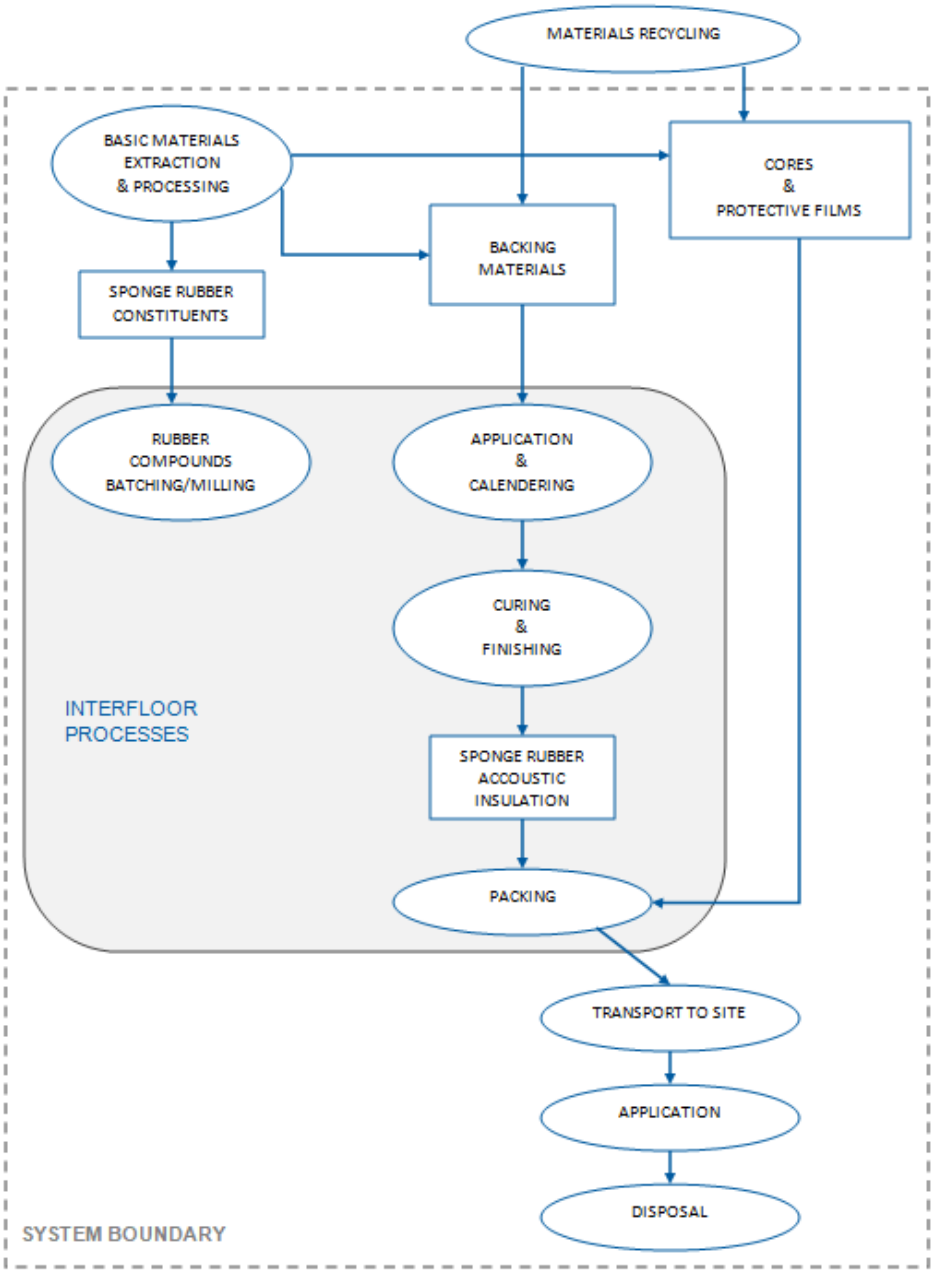


FIGURE 3: SYSTEM BOUNDARY

2.6 CUT-OFF CRITERIA

Where there are insufficient data or data gaps exist for a unit process in the LCA, these can be omitted (cut-off) up to a maximum of 1% of the total mass of input of that process. The total of input flows omitted in this way for any single module must not exceed 5% of the total energy usage and mass inputs for that module.

The following must be included in all cases, regardless of the proportion of mass or energy they represent:

- inputs giving rise to significant environmental effects or energy use in their extraction, use or disposal
- inputs or outputs classified as hazardous waste

In this study, data collected from Interfloor encompassed all raw materials used for sponge rubber, crumb and foam products, packaging materials and process aids, as well as associated transport to the manufacturing site. Process energy and water use, emissions to air and water, and direct production wastes are included within the data.

Analysis of the data provided reveals that:

- a combination of backing fabric, limestone powder, quicklime, sodium bicarbonate, styrene-butadiene rubber, mineral oil, sulphur and/or re-used process scrap account for over 99% of the finished product by mass for all of the Decibel products.
- the cardboard core and polyethylene wrap account for at least 90% of the packaging of a single roll of finished product, and over 95% for products other than Decibel Wood
- consumable items amount to approx. 75g per roll of finished product; around 2/3 of this is polythene bags and/or film.

For Decibel Soundseal products, the declared mass of a single roll of finished product ranges from 21.4kg (Decibel Wood) to 46.4kg (Decibel 3).

3 LIFE CYCLE INVENTORY (LCI)

3.1 DATA COLLECTION

Data used for this LCA were collected for Interfloor's Haslingden manufacturing site following guidance in ISO 14044:2006, using a questionnaire.

The collected data cover a 12-month period from 01/04/2018 to 30/03/2019.

3.1.1 MASS BALANCE

The factory data have been checked to ensure that sufficient materials and water are included within the inputs to account for all outputs, including products and wastes. The quantity of facing material inputs exceeds the total mass of products by approx. 5%, therefore the data are deemed credible overall[1]. Backing materials are purchased in linear metres and were not included in the overall mass balance check. LCA for individual products were compiled with reference to Bills of Materials (BoM); these BoM include ancillary materials and an allowance for wastage and the mass of returned process waste. The latter does not leave the factory site and therefore is not included as a separate input in the LCA.

3.1.2 DATA MODELLING AND DATA QUALITY

Following EN 15804, the most current available data were used to calculate the EPD.

[1] the rubber compounds include foaming and cross-linking agents which undergo chemical transformation on curing, sometimes losing mass in the process. These represent a small proportion of total inputs (c. 1-2%) and these losses have not been quantified in detail.

As described above, manufacturer-specific data cover a period of 1 year. The producer-specific data used for calculations are therefore based on 1 year averaged data and have been updated within the last 5 years.

Other (generic) data sets used for calculations have been updated within the last 10 years.

Inputs to and outputs from the system are accounted for over a 100-year time period; long-term emissions are therefore omitted from the LCIA.

For producer-specific data, the technological coverage reflects physical reality for the declared product. Comments about the plausibility of generic data, and its relevance to the declared product and producer are included in Table 2 (next page).

All packaging is included in the manufacturing activity (module A3).

Disposal of packaging waste when the product is installed is accounted for in module A5.

For most of the products, the rubber compound raw materials include sodium bicarbonate ($NaHCO_3$), which releases CO_2 during processing to contribute to foam formation. This CO_2 (0.524kg / kg $NaHCO_3$) is not included in manufacturing emissions, because it is assumed to be retained within the foam structure. The rate at which blowing agents migrate from foams has been the subject of debate. For foams exposed to the air during use, it is appropriate to assume migration of the blowing agent out of the product during any long use phase. Given that Decibel Soundseal insulation is used beneath a concrete floor, it is assumed in this study that any CO_2 released during the use phase would remain within the concrete, essentially making a small contribution to its carbonation. The significance of this assumption is discussed in Section 5.3.

3.1.3 BACKGROUND DATA SELECTION & QUALITY

Background data for raw materials and fuels were taken from the ecoinvent v 3.6 database. Transport of raw materials from the supplier to Interfloor's Haslingden facility is modelled on the basis of supplier locations provided by Interfloor. The flows from the generic database used to represent inputs are listed in Table 2 (below), which includes comments about the quality of the generic data representing inputs, any necessary adaptations made for this LCA or its use in the study. Crumb and foam products are outside the scope of this LCA, therefore raw materials used exclusively in those are not included in Table 2 or discussed further in this report.

Generic data have been taken from the ecoinvent database with "cut-off" allocation in order to comply with the requirements of EN 15804 Section 6.3.4.2 relating to secondary material inputs.

Flow nomenclature has been checked to ensure that flow names for substances with environmental significance are included in the Life Cycle Impact Assessment methods applied.

Material / substance	**Flow name in LCA**	**Generic data source and commentary**
limestone (powder)	lime	output of lime production, milled, loose. Ecoinvent dataset adapted to UK conditions (energy supply). Input quantities have been checked against primary data for similar facilities operating in the UK and found to be similar
oil (mineral oil)	base oil	generic data for base oil produced from crude oil in a refinery. Data from 2019 update of refined hydrocarbon products in ecoinvent v3.6.
rubber 1509	styrene-butadiene rubber E	product of local dataset based on styrene and butadiene data in ecoinvent. Produced by cold emulsion polymerisation c.5°C. Dataset for the polymerisation step. 23.5 w.% bound styrene content[2] based on emulsion polymerisation process for PVC. Review of polymer LCA datasets shows that monomer production from basic hydrocarbons is generally a much more significant source of environmental impacts than the polymerisation step, hence the approach followed here.

[2] https://omnexus.specialchem.com/selectors/s-versalis-eni-group/c-rubbers-sbr-styrene-butadiene-rubber?src=+sg-selector

Material / substance	Flow name in LCA	Generic data source and commentary
rubber 1205	styrene-butadiene rubber S	product of local dataset based on styrene and butadiene data in ecoinvent. Produced by solution polymerisation at up to 70°C. Dataset for the polymerisation step. 25 wt.% bound styrene content, based on suspension polymerisation process for PVC .
zinc oxide actif/haz	zinc oxide	product of local dataset, assuming production from Zn metal by the indirect (French) process, based on information from Large Volume Inorganic Chemicals BREF. Zinc source can be changed from generic market to secondary for sensitivity analysis.
santocure cbs pdr (n-cyclohexyl-2-benzothiazole sulfonamide)	sulfonyl urea	c. 0.1% of input materials per roll where used; sulfonyl urea used as a proxy
TMTD OT (tetramethyl thiuram disulfide)	[thio]carbamate-compound	<0.5% of input materials per roll. Generic [thio]carbamate-compound used as proxy. The TMTD compound and analogues are reported to be produced from thiocarbamates by oxidation
kb30 hydrated alumina	aluminium hydroxide	output of ecoinvent process “aluminium hydroxide production”
stearic acid b1805	stearic acid production	output of ecoinvent process “stearic acid production”
quicklime	quicklime, milled, loose	output of ecoinvent dataset adjusted to UK energy mix. Probably conservative even though packaging omitted; lime plants commonly burn secondary liquid fuel which is not in the data used; ≤ 0.5% of non-packaging inputs for any product
unicel oh (OBSH/OT: p-p'-oxybis(benzenesulfonylhydrazide)	benzoic compounds	blowing agent; c. 0.1% of input materials where used. Benzoic compounds used as proxy
spg powder (organic red pigment)	red pigment	c. 0.2% of input materials per roll where used. Manufacturer’s technical data sheet states that this is a blend of organic red pigment, “process oil” and $CaCO_3$. Modelled as output of a local process using cyclic N-compound as a proxy for red pigment, assuming 60% pigment, 30% lime, 10% base oil.
powder black dc (black pigment)	carbon black	< 0.1% of input materials per roll where used; assumed to be carbon black
titanium dioxide	titanium dioxide	output of ecoinvent process “market for titanium dioxide”
sodium bicarbonate	sodium bicarbonate	output of local dataset for conversion of soda-ash to bicarbonate; soda ash is a local dataset that corrects the generic data for major omissions (e.g. CO_2 released).
PEG 4000	diethylene glycol	output of ecoinvent dataset “ethylene glycol production” used as a proxy. Maximum content in any product is <0.5%
sulphur - 120 mesh	sulfur	output of ecoinvent process “sulfur production, petroleum refinery operation”

Material / substance	Flow name in LCA	Generic data source and commentary
scrim_voltex	textile, non woven polyester	PET "spunbond" non-woven textile used as backing material; two types used: 18g.m^{-2} and 60g.m^{-2} respectively. Output of a local process combining polyester fibre production and calendering, localised to Belgium where Interfloor's supplier is located[3].
foil	PET film, Al-coated	Al-coated PET film used for backing; spec. is 1.4 g.m^{-2}; assumed 0.25µ Al layer on PET (0.65g.m^{-2} Al). Product of local process based on ecoinvent data for film extrusion, PET, Al metal & sheet rolling. Used in Decibel Wood: <0.1% of content
backing_tex	n/a	polyester / recycled paper backing material; 50 gm^{-2} Not used in Decibel products
twin corona (pe thermal lamination film)	LDPE film	output of ecoinvent process "packaging film production, low density polyethylene"

TABLE 2: GENERIC DATA SELECTION AND DATA QUALITY - RAW MATERIALS

Material / substance	Flow name in LCA	Data quality / comments
grid electricity	electricity, medium voltage, residual mix	supply from "market for electricity, medium voltage, residual mix GB" process. The fuel mix in the UK high voltage supply dataset supplying this is aligned with 2018 UK residual mix as reported in the report from the Association of Issuing Bodies, Version 1.2, 2019-07-11
natural gas	heat, from natural gas	output of ecoinvent process "heat, from natural gas, at industrial furnace >100kW". Emissions of NOx and CO included in the generic process are subtracted from the direct, measured emissions reported by the factory to derive NOx and CO emissions in the unit processes characterising final production.
mains water	tap water	output of market group for tap water | tap water | cut-off, U - RER. Quality is adequate given that water use in core processes is relatively low: <1litre net use per declared unit.
wastewater	wastewater, average, RoW	assumed 90% of water input, allowing 10% for evaporation. Supplied from process: treatment of wastewater, average, capacity 1.1E10l/year, cut-off, U - RoW
general waste to sorting at MRF	municipal solid waste	output of process "market for municipal waste, GB". This represents a mix of incineration with and without energy recovery, and is used as a conservative approximation of waste treatment in a Material Recovery Facility, because the fraction segregated for recycling is not deducted.
bag 45mu 900*1470mm black	LDPE Film	output of ecoinvent process: packaging film production, low density polyethylene. Some plastic is used as bags and is MDPE; quantities are sufficiently small that MDPE vs. LDPE difference is considered insignificant.
ter_plastic	LDPE film	output of ecoinvent process: packaging film production, low density polyethylene.
ties	omitted	plastic ties used in packing; small quantity
wrap; wrap_bag; wrap_sf	LDPE film	output of ecoinvent process: packaging film production, low density polyethylene.

[3] A simplified overview of the process is at: http://www.yaolongnonwoven.com/en/technical/products-articles/What-is-spunbonded-nonwoven-fabric.html

Material / substance	Flow name in LCA	Data quality / comments
core	core, cardboard	modelled as core board; output of UK version of generic ecoinvent process. Cores used are made from 100% recycled material.
prod_bag	LDPE film	output of ecoinvent process: packaging film production, low density polyethylene.
silicon emulsion	silicone product	c. 5g per roll product as process aid; modelled as generic silicone product
nitto sewing tape	omitted	fabric tape used in process in small quantity
silicon belt paint	silicone product	very small quantities used; allowance via silicone product
twine sisal 300/100 ball	omitted	small qty used in process; estd. <1g per roll from annual use
hessian backing 6oz	omitted	small qty. used in process; estimated 3g per roll from BoM

TABLE 3: GENERIC DATA SELECTION AND DATA QUALITY - UTILITIES, PACKING & ANCILLARY MATERIALS

3.1.4 ALLOCATION

The "cut-off" version of the ecoinvent database (v3.6) is used as the source of background data, because this is the variant most closely aligned with the system boundary approach to allocation required by EN 15804; those rules essentially make the processes and the life-cycle that generates wastes responsible for their management up to the point at which they reach the "end-of-waste" state. Materials and fuels that enter the system after passing the end-of-waste state are free of environmental burdens associated with their original production.

Primary data from Interfloor's manufacturing process for raw materials, packaging and ancillary materials are assigned to products on the basis of the amounts stated in Bills of Materials[4] (BoM).

Primary data for energy and emissions[5] are allocated across all production at the facility on the basis of total mass in row 4 of the BoM. A large proportion of both energy demand and emissions are determined by the amount of facing material passing through the process. Mass is a better indicator of this quantity than area because of the varying thicknesses of the different products. Area and mass of finished rolls are taken from factory production statistics[6] and product datasheets.

3.2 PRODUCT & DECLARED UNIT COMPOSITION

Table 4 below summarises the overall composition of the declared unit.

Constituent	Decibel 1	Decibel 2	Decibel 3	Decibel 4	Decibel Compact 2	Decibel Wood
Synthetic rubber	9-11	10-12	10-12	14-16	9-10	9-11
Plasticiser	14-16	18-20	12-14	16-21	13-15	14-16
Calcium carbonate and other minerals	67 – 71	61 - 65	68 – 72	59 - 62	71 - 74	70 - 72
Polyester textiles	2 - 4	2 - 4	1 - 3	1 - 3	2 - 3	2 - 3

[4] See Excel file "Decibel BOMs"
[5] See Excel file "Interfloor LCA data collection sheet"
[6] See Excel file "rolls made"

Other polymers	<1	<1	<1	<1	<1	<1
Cardboard (packaging)	2	1.5	1.5	1.5	3	<1
Organic pigments	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 4: DECLARED UNIT COMPOSITION

Based on the specification and raw materials, the products covered by this LCA do not contain any substance listed in the 'Candidate List of Substances of Very High Concern for Authorisation' under REACH at a level above that at which declaration is required.

3.3 UNIT PROCESS DESCRIPTION

The production process is described in Section 2.3; this is modelled in openLCA software.

The unit process for Decibel 4 is shown in Figure 4 below; for each product the unit process represents production of one roll.

Inputs/Outputs: Decibel 4, acoustic insulation, at plant

Inputs

Flow	Category	Amount	Unit	Co...	Uncertainty	Av...	Provider
[sulfonyl]urea-compound	202:Manufacture of oth...	0.06640	kg		none		[sulfonyl]urea-compound production...
[thio]carbamate-compound	202:Manufacture of oth...	0.16600	kg		none		[thio]carbamate-compound producti...
base oil	192:Manufacture of refi...	7.96620	kg		none		base oil production, petroleum refine...
benzoic-compound	202:Manufacture of oth...	0.10310	kg		none		benzoic-compound production | ben...
core board	170:Manufacture of pap...	0.71000	kg		none		core board production | recycled | Cu...
diethylene glycol	201:Manufacture of basi...	0.00320	kg		none		ethylene glycol production | diethyle...
electricity, medium voltage, resi...	351:Electric power gene...	0.2131*mass_r...	kWh		none		electricity, medium voltage, residual ...
heat, district or industrial, natur...	351:Electric power gene...	0.7804*mass_r...	kWh		none		heat production, natural gas, at indus...
lime	072:Mining of non-ferro...	28.98630	kg		none		lime production, milled, loose | lime |...
packaging film, low density pol...	222:Manufacture of plas...	0.04000	kg		none		packaging film production, low densi...
packaging film, low density pol...	222:Manufacture of plas...	0.23800	kg		none		packaging film production, low densi...
quicklime, milled, loose	072:Mining of non-ferro...	0.06440	kg		none		quicklime production, milled, loose | ...
red pigment, at plant	C:Manufacturing/Interfl...	0.09660	kg		none		red pigment, at plant - RER
silicone product	201:Manufacture of basi...	0.00600	kg		none		market for silicone product | silicone ...
sodium bicarbonate	C:Manufacturing/Eugeos	0.79700	kg		none		sodium bicarbonate, for small-scale ...
Styrene-butadiene rubber E	C:Manufacturing/Interfl...	4.50900	kg		none		styrene-butadiene rubber production,...
Styrene-butadiene rubber S	C:Manufacturing/Interfl...	1.93240	kg		none		styrene-butadiene rubber production,...
sulfur	192:Manufacture of refi...	0.39850	kg		none		sulfur production, petroleum refinery ...
tap water	360:Water collection, tre...	0.0002*mass_r...	kg		none		market for tap water | tap water | Cut...
textile, non-woven polyester sp...	C:Manufacturing/Interfl...	0.76320	kg		none		textile, non-woven polyester spunbon...
titanium dioxide	201:Manufacture of basi...	0.32210	kg		none		market for titanium dioxide | titaniu...
transport, freight, lorry 16-32 m...	492:Other land transport...	0.225*mass_roll	t*km		none		transport, freight, lorry 16-32 metric t...
transport, freight, sea, container...	501:Sea and coastal wat...	0.216*mass_roll	t*km		none		transport, freight, sea, container ship |...
Zinc oxide, at plant	C:Manufacturing/Interfl...	0.06640	kg		none		zinc oxide, indirect muffle furnace, at ...

Inputs/Outputs: Decibel 4, acoustic insulation, at plant

Inputs

Outputs

Flow	Category	Amount	Unit	..	Uncertainty	A	Provider	D
Carbon disulfide	Emission to air/unspecified	3.01E-06*mass_roll	kg		none			
Carbon monoxide	Emission to air/unspecified	3.43E-04*mass_roll	kg		none			
Decibel 4, acoustic insulation, a...	**C:Manufacturing/Interfl...**	**10.96000**	**m2**		**none**			
municipal solid waste	382:Waste treatment and ...	0.085*mass_roll	kg		none		market for municipal solid waste |...	
Nitrogen oxides, GB	Emission to air/high popu...	9.63E-05*mass_roll	kg		none			
Particulates, unspecified	Emission to air/unspecified	5.88E-05*mass_roll	kg		none			
Sulfur dioxide, GB	Emission to air/unspecified	2.35E-03*mass_roll	kg		none			
VOC, volatile organic compounds	Emission to air/unspecified	3.01E-06*mass_roll	kg		none			

FIGURE 4: DECIBEL 4 PRODUCTION – MODELLING IN OPENLCA

3.4 SCENARIOS

Sweden is a major market for Decibel Soundseal Acoustic Insulation products. Therefore modules A4, C2 and C4 are modelled using scenarios representing use and end-of-life product management in Sweden. Module A5 is modelled using product-specific data provided by Decibel installers.

CONSTRUCTION STAGE

3.4.1.1 TRANSPORT TO SITE (A4)

Transport of product from the manufacturing facility to the construction site (Module A4) is modelled using a scenario based on shipment from Interfloor's factory to a distribution depot in Sosdäla, southern Sweden. The relevant parameters are shown in Table 5:

Parameter	Quantity and unit (per declared unit)
Fuel type and consumption of heavy goods vehicle used for road freight; sea freight	0.1l/km, diesel; 2.5g/tkm, HFO
Distance	567km road; 602km sea freight
Capacity utilisation (including empty returns)	36% (5.8 t average load over outward & return journeys implied in dataset); 100%
Bulk density of transported products	value from Table 1
Volume capacity utilisation factor	1

TABLE 5: SCENARIO PARAMETERS, TRANSPORT TO SITE

3.4.1.2 INSTALLATION (A5)

Decibel Soundseal Acoustic Insulation products are laid manually onto a concrete base; edges are completed with two kinds of tape: dB-Lipping and dB-Tape. dB-Lipping is a flexible tape composed of approx. 95% polyethylene, while dB-Tape is a 50µ polypropylene film with 25µ acrylic adhesive backing. Based on information from installers, 1m of the former and 1.5m of the latter are used per square metre Soundseal insulation installed. Very little waste arises when the product is installed; as well as the packaging, a loss of 1% of product is included in the LCA to allow for damage and any trimming. These wastes are assumed to be managed by incineration with energy recovery. No powered tools are required to install the product.

3.4.2 END-OF-LIFE (C1 - C4)

3.4.2.1 REMOVAL FROM SITE (C1)

Removal of Decibel Soundseal Acoustic Insulation products at the end of their lives is also a manual operation; the tape applied during installation arises as waste, and is assumed to be disposed of by incineration. No other waste apart from the product is created.

3.4.2.2 TRANSPORT TO WASTE TREATMENT (C2)

Transport of waste product from the building to the waste treatment facility (Module C2) site is modelled using a scenario. The relevant parameters are shown in Table 6 below.

Parameter	Quantity and unit (per declared unit)
Fuel type and consumption of heavy goods vehicle used for road freight	0.1l/km, diesel
Distance	50 km road
Capacity utilisation (including empty returns)	33% (3.6t t average load over outward & return journeys implied in dataset)
Bulk density of transported products	value from Table 1
Volume capacity utilisation factor	1

TABLE 6: SCENARIO PARAMETERS, TRANSPORT TO WASTE TREATMENT

3.4.2.3 WASTE TREATMENT (C3)

It is assumed that the product is segregated from other (e.g. inert) wastes when it is removed from the building, and therefore that it is subject to no other treatment prior to final disposal.

3.4.2.4 WASTE DISPOSAL (C4)

According to data on municipal waste management used to underpin the European Commission's Product Environmental Footprint method, 99% of municipal waste in Sweden is incinerated[7].Therefore disposal of the product is modelled as incineration (with energy recovery) of a mixture of inert material (waste glass used as a proxy) to represent the mineral content (set conservatively at 70 wt.%) and mixed plastics (30 wt.%) to represent backing and polymer content of the sponge. Recovered energy is reported as the Exported Energy indicator in C4.

Assuming the NCV for sponge rubber underlay of 24MJ/kg used to calculate PENRM (see Section 4.2.2), and a total energy recovery rate of 32.5% in the incinerator (ecoinvent default), exported energy is calculated as 8MJ/kg. Note that exported energy is not reported for other modules, because within the ecoinvent database, energy recovered from incineration is used in generic heat and power generation processes.

[7] http://ec.europa.eu/environment/eussd/smgp/pdf/CFF_Default_Parameters_March2018.xlsx

4 LIFE CYCLE IMPACT ASSESSMENT (LCIA)

4.1 PARAMETERS

This study investigated the environmental themes and indicators listed in the following sections, being those required by EN 15804.

4.1.1 DERIVED FROM LCA

The indicators calculated using the method specified in EN 15804+A2, were included in the study and are shown in Table 7 (below).

Parameter	Abbreviation	Units
Environmental impacts		
Climate change – GWP fossil	GWP-fossil	kg CO_2 eq
Climate change – GWP biogenic	GWP-biogenic	kg CO_2 eq
Climate change – GWP land transformation	GWP-luluc	kg CO_2 eq
Climate change – GWP total	GWP-total	kg CO_2 eq
Climate change - GWP fossil & land transformation [8]	GWP-GHG	kg CO_2 eq
Acidification potential	AP	mol H^+ eq
Eutrophication – freshwater	EP-freshwater	kg PO_4^{3-} eq
Eutrophication – marine	EP-marine	kg N eq
Eutrophication – terrestrial	EP-terrestrial	mol N eq
Photochemical ozone formation	POCP	kg NMVOC eq
Ozone depletion	ODP	kg CFC-11 eq
Depletion of abiotic resources – minerals & metals[9]	ADPMM	kg Sb eq
Depletion of abiotic resources – fossil fuels[10]	ADPFF	MJ, NCV
Water (user) deprivation potential[11]	WDP	m^3 world-eq deprived
Resource use		
Renewable primary energy as energy carrier	PERE	MJ
Renewable primary energy resources as material utilisation	PERM	MJ
Total renewable primary energy use (sum of the two parameters above)	PERT	MJ
Non-renewable primary energy as energy carrier	PENRE	MJ
Non-renewable primary energy resources as material utilisation	PENRM	MJ
Total non-renewable primary energy use (sum of the two parameters above)	PENRT	MJ
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ
Use of non-renewable secondary fuels	NRSF	MJ
Net use of fresh water	FW	m^3

[8] GWP-GHG includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN15804:2012+A1:2013
[9] The results of this environmental impact indicator shall be used with care because either the uncertainties associated with the results are high or there is limited experience with the indicator.
[10] see Footnote 9
[11] see Footnote 9

Parameter	Abbreviation	Units
Wastes		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	TRWD	kg
Output flows		
Components for re-use	CFR	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ
Other impacts		
Ecotoxicity, freshwater[12]	ETP-fw	CTUe
Human toxicity, cancer effects[13]	HTP-C	CTUh
Human toxicity, non-cancer effects[14]	HTP-NC	CTUh
Ionising radiation, HH[15]	IRP	kBq U-235 eq
Land use [16]	SQP	Pt
Particulate matter, HH	PM	disease inc.
Ecotoxicity, freshwater	ETP-fw	CTUe

TABLE 7: LCA PARAMETERS

Note that for some of the parameters - particularly the waste and water indicators - there is no single published calculation method. The decision to include or exclude specific material flows, particularly flows present in generic background data, involves an element of judgement by the practitioner.

Important details of the method used in this study are provided in Appendix 2.

Care should be taken when comparing the results obtained for these parameters with similar indicators obtained in other studies, even when reported in EPD; please refer to footnotes for important guidance relating to particular indicators.

To support comparability between EPDs based on the old version and the current version of EN 15804 (EN 15804:2012+A2:2019), a supplementary indicator for climate impact (GWP-GHG) is also reported here and in the EPD. This indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide emissions and uptake, and biogenic carbon stored in the product. it is therefore equivalent to the GWP indicator originally defined in EN 15804:2012+A1:2013.

[12] see Footnote 9
[13] see Footnote 9
[14] see Footnote 9
[15] This impact category deals mainly with the eventual impact of low-dose ionising radiation from the nuclear fuel cycle on human health. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionising radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
[16] see Footnote 9

4.2 LCA RESULTS

4.2.1 ENVIRONMENTAL IMPACT POTENTIALS

As a reminder, the declared unit is 1 square metre of product. Please refer to Table 7 (above) for full indicator names matching the abbreviations used in the tables below.

Environmental impact potentials calculated using LCIA methods are shown in Table 8 and Table 9 below for Decibel 1.

The contributions of various components to the overall indicator totals are discussed in Section 5.2.

Results for all products in the Decibel range are presented in tabular form in Appendix 1.

ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq	2.30E+00	2.31E-01	1.14E-01	2.62E-02	5.91E-02	0.00E+00	1.67E+00	0.00E+00
GWP-biogenic	kg CO_2 eq	1.36E-01	0.00E+00	7.37E-02	1.22E-06	0.00E+00	0.00E+00	3.72E-03	0.00E+00
GWP-luluc	kg CO_2 eq	1.69E-03	8.77E-05	2.02E-05	1.56E-07	3.31E-05	0.00E+00	2.10E-05	0.00E+00
GWP-total	kg CO_2 eq	2.36E+00	2.31E-01	1.14E-01	2.62E-02	5.91E-02	0.00E+00	1.67E+00	0.00E+00
GWP-GHG	kg CO_2 eq	2.30E+00	2.31E-01	1.14E-01	2.62E-02	5.91E-02	0.00E+00	1.67E+00	0.00E+00
AP	mol H^+ eq	1.72E-02	9.40E-04	1.60E-04	5.91E-06	1.50E-04	0.00E+00	5.00E-04	0.00E+00
EP-freshwater	kg PO_4^{3-} eq	4.00E-04	1.69E-05	7.81E-06	7.50E-08	6.25E-06	0.00E+00	9.61E-06	0.00E+00
EP-marine	kg N eq	1.88E-03	1.76E-04	3.89E-05	3.35E-06	2.04E-05	0.00E+00	2.50E-04	0.00E+00
EP-terrestrial	mol N eq	1.64E-02	1.93E-03	3.80E-04	2.84E-05	2.10E-04	0.00E+00	2.16E-03	0.00E+00
POCP	kg NMVOC eq	8.54E-03	6.82E-04	1.20E-04	6.83E-06	9.93E-05	0.00E+00	5.60E-04	0.00E+00
ODP	kg CFC-11 eq	5.38E-07	5.22E-08	1.47E-09	6.22E-11	1.26E-08	0.00E+00	1.10E-08	0.00E+00
ADPMM	kg Sb eq	1.60E-04	6.10E-06	3.86E-07	9.22E-09	2.91E-06	0.00E+00	1.12E-06	0.00E+00
ADPFF	MJ, ncv	6.21E+01	3.42E+00	8.48E-01	5.29E-03	8.66E-01	0.00E+00	9.06E-01	0.00E+00
WDP	m^3 world-eq deprvd	4.32E+01	3.22E+00	5.10E-01	4.20E-03	1.36E+00	0.00E+00	4.55E-01	0.00E+00

TABLE 8: DECIBEL 1 - ENVIRONMENTAL IMPACT POTENTIALS (ALL MODULES)

4.2.2 RESOURCE USE INDICATORS

Resource use indicators are shown in the Table 9 below, starting with energy indicators. PERT (total) is the sum of the PERE and PERM indicators.

PENRE indicator values include nuclear energy as well as fossil-fuel energy. The fossil fuel-derived component of PENRE is identical to the ADPF indicator value.

The "primary energy used as material" indicators (PERM; PENRM) are calculated using - as characterisation factors - published values for constituent materials which can yield energy on combustion, where available, and from published net calorific values where PE(N)RM values are not available. Tonkin (1952) reported an NCV of 32.5MJ/kg for sponge rubber carpet underlay. Based on the NCV reported for pure polymers and the fact that Soundseal underlay comprises approx.70% inert minerals, this is considered improbably high for the products assessed in this study. Calculations of PERM in this study are based on a lower NCV for sponge rubber underlay of 24MJ/kg, 16MJ/kg for

cardboard (estimate based on various sources), 48MJ/kg for polyethylene (Boustead, 1993), and 30MJ/kg for polyvinyl chloride and other polymers.

The remaining resource indicators provide information about water consumption and the use of secondary fuels and materials in the product and the product system. Outputs from the modelled system of recyclable materials, reusable components, etc. are reported as output flows (Section 4.2.4).

Contributions from the background system to these indicators are subject to a check for "reasonableness" prior to inclusion in the reported indicator. It is assumed that the secondary material indicator is intended to capture recycled material used in the product, its components and/or packaging, and/or its installation, and that the MFR indicator is intended to capture material made available for recycling in these activities. Therefore the values of SM and MFR for modules A4, and C1 - C4 are set to zero. Negative results emerging from the calculation for the resource use indicators in LCA software almost always arise because of imbalances in background systems and processes; they are reported as zero.

Examination of the LCI and contributions indicates that the output flows recorded for MER have high associated uncertainty and are from processes not directly connected to the manufacture of Decibel products or their constituent raw materials; therefore the value of this indicator is set to zero in all modules; note that waste incineration is considered as disposal rather than recovery in the conventions of EN 15804+A2, even when energy is recovered. This recovered energy from product disposal in module C4 is recorded as “Exported Energy” (EE) in Table 11.

RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	4.22E-01	4.83E-02	2.87E-02	1.80E-04	1.88E-02	0.00E+00	2.03E-02	0.00E+00
PERM	MJ	7.54E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.18E+00	4.83E-02	2.87E-02	1.80E-04	1.88E-02	0.00E+00	2.03E-02	0.00E+00
PENRE	MJ	1.13E+01	3.49E+00	5.58E-01	5.44E-03	8.93E-01	0.00E+00	9.26E-01	0.00E+00
PENRM	MJ	5.58E+01	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.70E+01	3.49E+00	8.88E-01	5.44E-03	8.93E-01	0.00E+00	9.26E-01	0.00E+00
SM	kg	5.77E-02	0.00E+00	1.70E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	3.73E-02	1.72E-03	5.10E-04	3.03E-06	6.80E-04	0.00E+00	4.00E-04	0.00E+00
NRSF	MJ	2.82E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.46E-02	2.35E-04	5.70E-04	3.81E-05	9.28E-05	0.00E+00	2.16E-03	0.00E+00

TABLE 9: DECIBEL 1 - RESOURCE USE (ALL MODULES)

NOTE: These LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

4.2.3 WASTE INDICATORS

Table 10 below presents values for the waste indicators.

These provide information on the total amounts of waste sent for disposal from the product system, separated into non-hazardous, hazardous and radioactive wastes. It is difficult to classify wastes from certain processes as hazardous or non-hazardous in a generalised manner, while available data about the amounts of waste (as mass) produced in nuclear power plants are limited. The indicator values presented here should therefore be used with caution.

WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	7.23E-02	3.60E-03	3.22E-03	4.00E-04	1.25E-03	0.00E+00	2.65E-02	0.00E+00
NHWD	kg	2.02E+00	2.36E-01	1.18E-01	1.16E-02	5.47E-02	0.00E+00	4.23E+00	0.00E+00
TRWD	kg	2.60E-04	2.38E-05	6.97E-07	1.25E-08	5.86E-06	0.00E+00	3.99E-06	0.00E+00

TABLE 10: DECIBEL 1 - WASTES (ALL MODULES)

4.2.4 OTHER OUTPUT FLOWS

Table 11 presents indicator values for other outputs that arise in the building life cycle, e.g. components for re-use or materials for recycling. For these indicators too, contributions from the background system to the output flows indicators are subject to a check for "reasonableness" prior to inclusion in the reported indicator. Values for these indicators are then only reported if the flows are outputs of principal activities in the modelled product system.

OTHER OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	6.14E-03	0.00E+00	8.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+01	0.00E+00

TABLE 11: DECIBEL 1 - OTHER OUTPUT FLOWS (ALL MODULES)

4.2.5 OTHER IMPACT CATEGORIES

EN15804+A2 requires the inclusion in the project report of indicators relating to certain additional, important environmental themes for which impact assessment methods are less well-developed or less robust than they are for the themes covered in Section 4.2.1.

The results for Decibel 1 are presented in Table 12 below. They should be treated with caution, and are not reproduced in the EPD.

OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
ETP-fw	CTUe	9.64E-01	1.12E-01	5.88E-03	2.50E-04	2.08E-02	0.00E+00	2.83E-02	0.00E+00
HTP-C	CTUh	1.46E-09	7.46E-11	1.56E-11	1.47E-12	2.50E-11	0.00E+00	1.54E-10	0.00E+00
HTP-NC	CTUh	4.95E-08	4.34E-09	3.32E-09	4.35E-10	1.46E-09	0.00E+00	3.71E-08	0.00E+00
IRP	kBq U-235 eq	4.35E-01	1.78E-02	1.70E-03	1.59E-05	4.85E-03	0.00E+00	3.39E-03	0.00E+00
SQP	Pt	2.45E+00	2.69E+00	2.13E-02	8.50E-04	4.38E-01	0.00E+00	3.64E-01	0.00E+00
PM	disease inc.	1.35E-07	1.40E-08	1.28E-09	2.81E-11	2.73E-09	0.00E+00	7.07E-09	0.00E+00

TABLE 12: DECIBEL 1 - OTHER IMPACTS (ALL MODULES)

5 INTERPRETATION

5.1 LIFE CYCLE STAGES

Figure 5 below, shows the results obtained for the main climate change indicator (GWP total) for each stage of the life cycle for all six Decibel products. The results are for 1m^2 of product, and much of the difference between the indicator values obtained arises from the different amounts of material contained in a unit area of the various products – ranging from 2.1kg for decibel Wood to 4.2kg for Decibel 3.

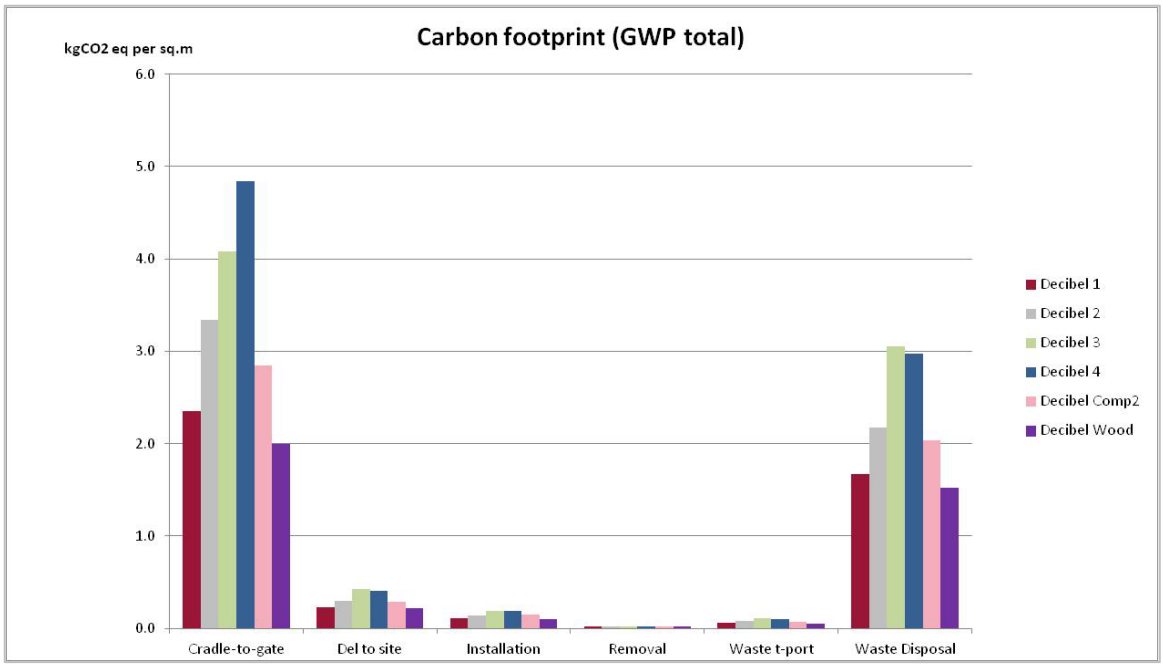


FIGURE 5: GWP AROUND THE LIFE CYCLE, DECIBEL PRODUCTS

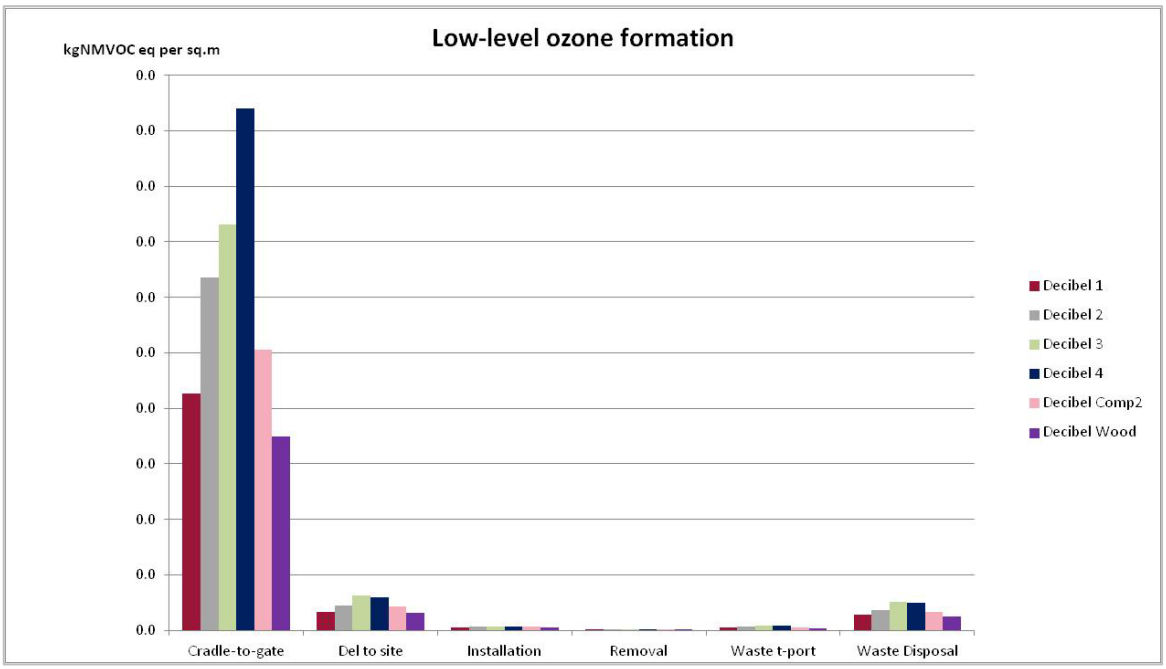


FIGURE 6: OZONE FORMATION AROUND THE LIFE CYCLE, DECIBEL PRODUCTS

The product stage and final disposal stage are clearly the most significant for this indicator. The GWP associated with final disposal results from the release as CO_2 of carbon in the polymers that comprise approx. 40% of the product in the waste management scenario considered, which is 100% incineration.

For other indicators, final waste disposal is much less significant, as exemplified by Figure 6 (above), which shows results for all products for the low-level air quality indicator “ozone formation”.

5.2 CONTRIBUTION ANALYSIS

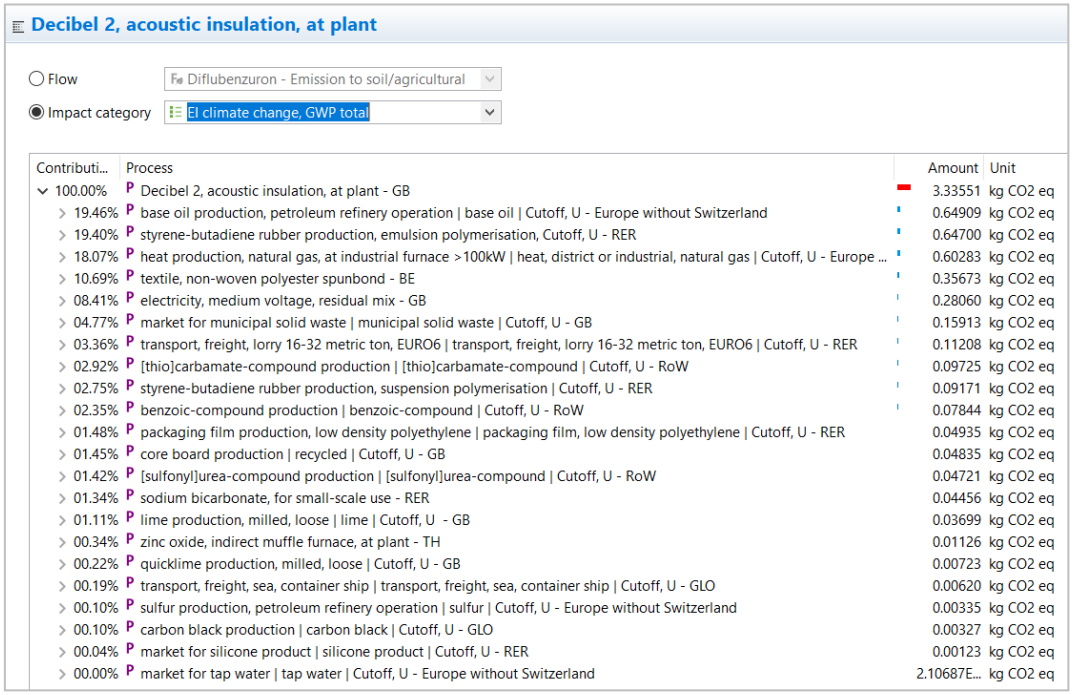
In the different sub-sections of this part of the report, contributions to selected indicators from the processes making up the product stage (modules A1-A3) are presented. This discussion is based on the LCA of Decibel 2; similarities and differences between this and other products are noted. It is important to recall that indicators are calculated for 1m^2 of product applied in the building.

For the transport stages (modules A4 and C2) vehicle operation - in particular fuel consumption - is the dominant driver of all impact categories except ODP, for which emissions present in the data representing primary fossil fuel production make the main contribution, and ADPE, for which metals assumed to be used in vehicle maintenance are very significant.

The scenario used to model product delivery (module A4) involves a mixture of sea transport and road haulage. The road transport element accounts for >90% of the GWP and fossil fuel use for that module, while the sea transport accounts for somewhat more than half of the acidification indicator, reflecting the sulphur content of the heavy fuels generally used in ships.

5.2.1 GLOBAL WARMING POTENTIAL (CLIMATE CHANGE) (GWP)

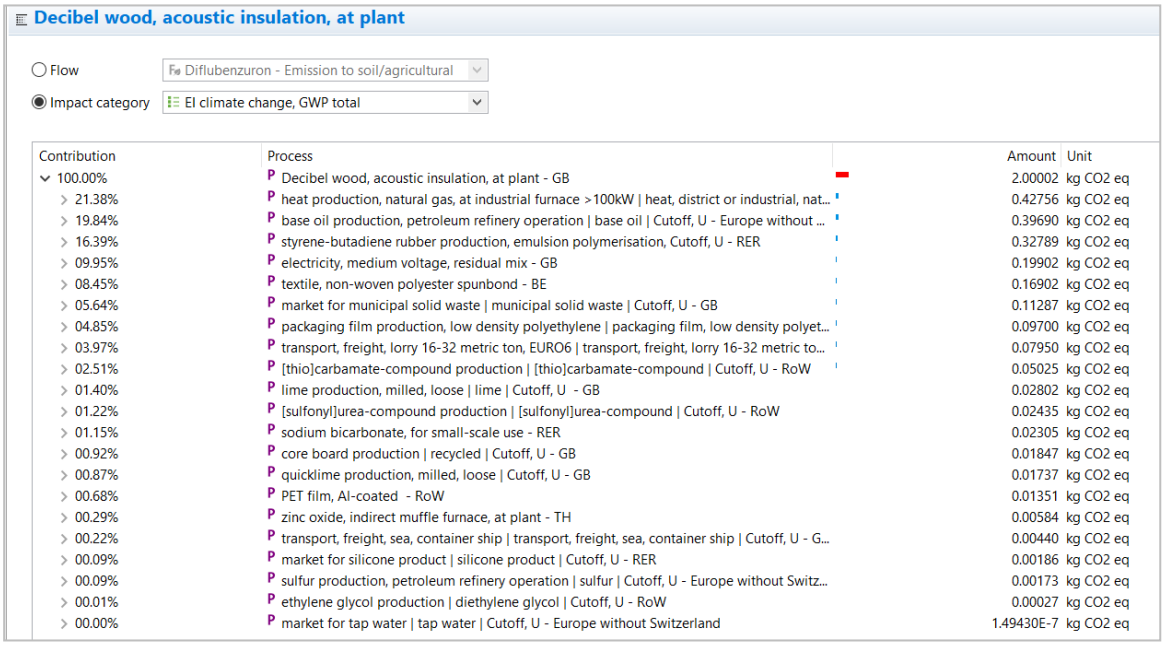
Figure 7 shows contributions from different elements to the GWP (total) indicator – the carbon footprint – for Decibel 2. Energy use at Interfloor’s facility (heat from natural gas and electricity, GB) account for approximately ¼ of the total value; production of the mineral oil and styrene-butadiene rubber raw materials – both significant ingredients – each account for approximately $^1/_5$ of that total, while the backing material accounts for around 1/10 of it. Limestone powder, despite being the largest constituent by mass, accounts for only around 1% of the carbon footprint; this is to be expected in light of the minimal processing (crushing and grinding) that this material is subject to prior to use by Interfloor. The other side of this coin is that complex chemicals used as catalysts, foaming agents and cross-linking agents, produced in multi-stage chemical processes, account for a larger proportion of the carbon footprint than they represent as a proportion of the total massof the product.



Contributi...	Process	Amount	Unit
100.00%	Decibel 2, acoustic insulation, at plant - GB	3.33551	kg CO2 eq
19.46%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without Switzerland	0.64909	kg CO2 eq
19.40%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.64700	kg CO2 eq
18.07%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | Cutoff, U - Europe ...	0.60283	kg CO2 eq
10.69%	textile, non-woven polyester spunbond - BE	0.35673	kg CO2 eq
08.41%	electricity, medium voltage, residual mix - GB	0.28060	kg CO2 eq
04.77%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.15913	kg CO2 eq
03.36%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 | Cutoff, U - RER	0.11208	kg CO2 eq
02.92%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	0.09725	kg CO2 eq
02.75%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	0.09171	kg CO2 eq
02.35%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.07844	kg CO2 eq
01.48%	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, U - RER	0.04935	kg CO2 eq
01.45%	core board production | recycled | Cutoff, U - GB	0.04835	kg CO2 eq
01.42%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.04721	kg CO2 eq
01.34%	sodium bicarbonate, for small-scale use - RER	0.04456	kg CO2 eq
01.11%	lime production, milled, loose | lime | Cutoff, U - GB	0.03699	kg CO2 eq
00.34%	zinc oxide, indirect muffle furnace, at plant - TH	0.01126	kg CO2 eq
00.22%	quicklime production, milled, loose | Cutoff, U - GB	0.00723	kg CO2 eq
00.19%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - GLO	0.00620	kg CO2 eq
00.10%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switzerland	0.00335	kg CO2 eq
00.10%	carbon black production | carbon black | Cutoff, U - GLO	0.00327	kg CO2 eq
00.04%	market for silicone product | silicone product | Cutoff, U - RER	0.00123	kg CO2 eq
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	2.10687E...	kg CO2 eq

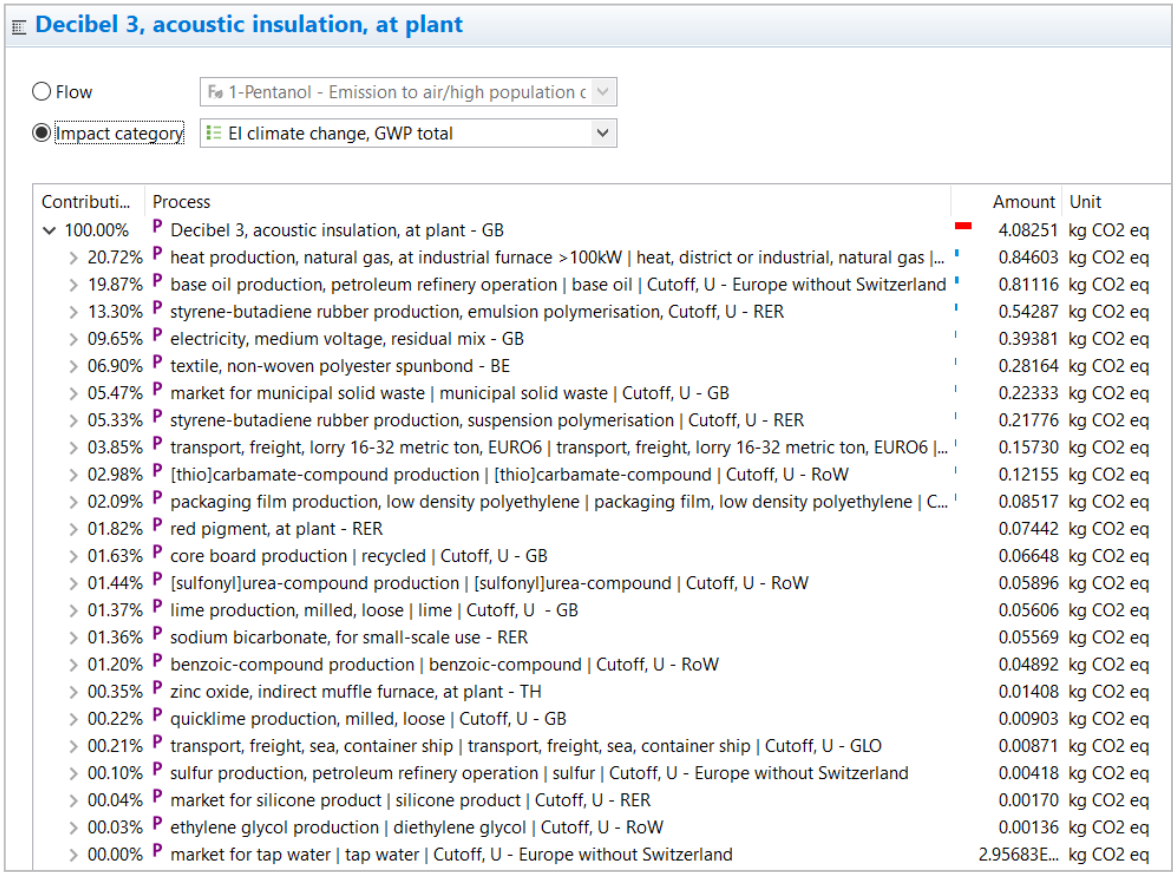
FIGURE 7: PROCESS CONTRIBUTIONS, GWP, DECIBEL 2

For Decibel Wood and Decibel 3, the overall picture is similar, although energy use at Interfloor - particularly gas consumption - makes the biggest contribution in these cases (Figure 8).



Contribution	Process	Amount	Unit
100.00%	Decibel wood, acoustic insulation, at plant - GB	2.00002	kg CO2 eq
21.38%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, nat...	0.42756	kg CO2 eq
19.84%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without ...	0.39690	kg CO2 eq
16.39%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.32789	kg CO2 eq
09.95%	electricity, medium voltage, residual mix - GB	0.19902	kg CO2 eq
08.45%	textile, non-woven polyester spunbond - BE	0.16902	kg CO2 eq
05.64%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.11287	kg CO2 eq
04.85%	packaging film production, low density polyethylene | packaging film, low density polyet...	0.09700	kg CO2 eq
03.97%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric to...	0.07950	kg CO2 eq
02.51%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	0.05025	kg CO2 eq
01.40%	lime production, milled, loose | lime | Cutoff, U - GB	0.02802	kg CO2 eq
01.22%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.02435	kg CO2 eq
01.15%	sodium bicarbonate, for small-scale use - RER	0.02305	kg CO2 eq
00.92%	core board production | recycled | Cutoff, U - GB	0.01847	kg CO2 eq
00.87%	quicklime production, milled, loose | Cutoff, U - GB	0.01737	kg CO2 eq
00.68%	PET film, Al-coated - RoW	0.01351	kg CO2 eq
00.29%	zinc oxide, indirect muffle furnace, at plant - TH	0.00584	kg CO2 eq
00.22%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - G...	0.00440	kg CO2 eq
00.09%	market for silicone product | silicone product | Cutoff, U - RER	0.00186	kg CO2 eq
00.09%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switz...	0.00173	kg CO2 eq
00.01%	ethylene glycol production | diethylene glycol | Cutoff, U - RoW	0.00027	kg CO2 eq
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	1.49430E-7	kg CO2 eq

FIGURE 8: PROCESS CONTRIBUTIONS, GWP, DECIBEL WOOD



Contributi...	Process	Amount	Unit
100.00%	Decibel 3, acoustic insulation, at plant - GB	4.08251	kg CO2 eq
20.72%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas |...	0.84603	kg CO2 eq
19.87%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without Switzerland	0.81116	kg CO2 eq
13.30%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.54287	kg CO2 eq
09.65%	electricity, medium voltage, residual mix - GB	0.39381	kg CO2 eq
06.90%	textile, non-woven polyester spunbond - BE	0.28164	kg CO2 eq
05.47%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.22333	kg CO2 eq
05.33%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	0.21776	kg CO2 eq
03.85%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 |...	0.15730	kg CO2 eq
02.98%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	0.12155	kg CO2 eq
02.09%	packaging film production, low density polyethylene | packaging film, low density polyethylene | C...	0.08517	kg CO2 eq
01.82%	red pigment, at plant - RER	0.07442	kg CO2 eq
01.63%	core board production | recycled | Cutoff, U - GB	0.06648	kg CO2 eq
01.44%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.05896	kg CO2 eq
01.37%	lime production, milled, loose | lime | Cutoff, U - GB	0.05606	kg CO2 eq
01.36%	sodium bicarbonate, for small-scale use - RER	0.05569	kg CO2 eq
01.20%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.04892	kg CO2 eq
00.35%	zinc oxide, indirect muffle furnace, at plant - TH	0.01408	kg CO2 eq
00.22%	quicklime production, milled, loose | Cutoff, U - GB	0.00903	kg CO2 eq
00.21%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - GLO	0.00871	kg CO2 eq
00.10%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switzerland	0.00418	kg CO2 eq
00.04%	market for silicone product | silicone product | Cutoff, U - RER	0.00170	kg CO2 eq
00.03%	ethylene glycol production | diethylene glycol | Cutoff, U - RoW	0.00136	kg CO2 eq
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	2.95683E...	kg CO2 eq

FIGURE 9: PROCESS CONTRIBUTIONS, GWP, DECIBEL 3

According to the PCR, a statement of the percentage of the GWP indicator that is derived from "product-specific data[17]" must be included in the EPD. In this study, product-specific data accounts for >90% of the GWP total values reported.

5.2.2 Ozone Depletion Potential (ODP)

Values for the ozone depletion potential indicator are largely driven by emissions of CFCs in data characterising upstream processes in the oil and gas sector, in which Halon-based fire extinguishing systems were installed and routinely tested, with the releases from tests reported.

The extent to which these emissions represent the current situation is unclear, and we report these values only because of the EN 15804 requirement to do so.

5.2.3 Acidification Potential (AP)

The acidification indicator is driven by emissions of nitrogen and sulphur oxides.

Direct emissions from Interfloor's operations account for around 1/3 of the indicator total, while oil refinery operations producing the mineral oil component of the rubber blend make the next-largest contribution (Figure 10).

Decibel 2, acoustic insulation, at plant

○ Flow — Diflubenzuron - Emission to soil/agricultural

◉ Impact category — EI acidification

Contributi...	Process	Amount	Unit
100.00%	Decibel 2, acoustic insulation, at plant - GB	0.02495	molc H+ eq
25.68%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without Switzerland	0.00641	molc H+ eq
10.49%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.00262	molc H+ eq
05.53%	textile, non-woven polyester spunbond - BE	0.00138	molc H+ eq
04.22%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.00105	molc H+ eq
02.73%	electricity, medium voltage, residual mix - GB	0.00068	molc H+ eq
02.48%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	0.00062	molc H+ eq
02.30%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switzerland	0.00057	molc H+ eq
01.95%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | Cutoff, U - E...	0.00049	molc H+ eq
01.64%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.00041	molc H+ eq
01.60%	core board production | recycled | Cutoff, U - GB	0.00040	molc H+ eq
01.50%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	0.00037	molc H+ eq
01.04%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 | Cutoff, U - R...	0.00026	molc H+ eq
00.92%	sodium bicarbonate, for small-scale use - RER	0.00023	molc H+ eq
00.83%	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, U - RER	0.00021	molc H+ eq
00.81%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - GLO	0.00020	molc H+ eq
00.53%	lime production, milled, loose | lime | Cutoff, U - GB	0.00013	molc H+ eq
00.34%	zinc oxide, indirect muffle furnace, at plant - TH	8.53555E...	molc H+ eq
00.28%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	7.03987E...	molc H+ eq
00.08%	quicklime production, milled, loose | Cutoff, U - GB	2.11968E...	molc H+ eq
00.08%	carbon black production | carbon black | Cutoff, U - GLO	2.09913E...	molc H+ eq
00.02%	market for silicone product | silicone product | Cutoff, U - RER	6.03262E...	molc H+ eq
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	1.13242E...	molc H+ eq

FIGURE 10: PROCESS CONTRIBUTIONS, AP, DECIBEL 2

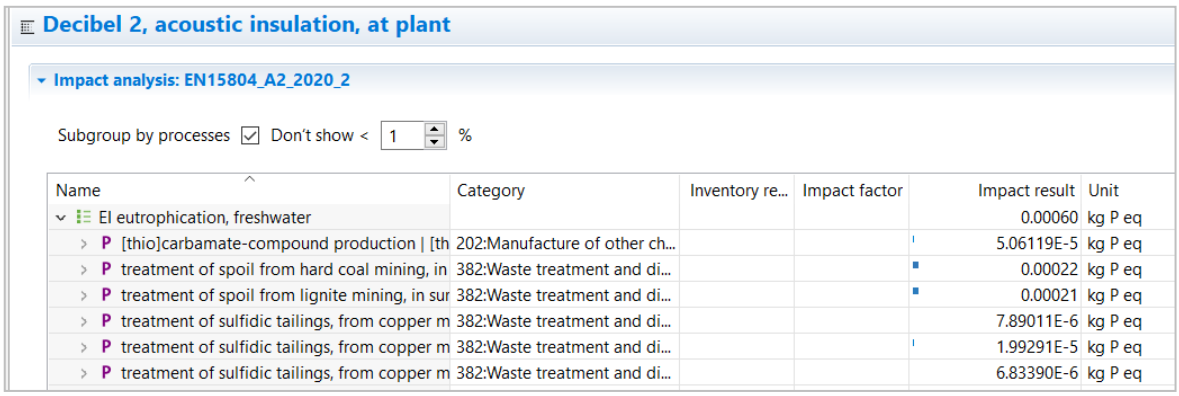
5.2.4 Eutrophication Potential (EP)

Eutrophication – the accumulation of excess nutrients in the environment is caused by nitrogen and phosphorus emissions. It is covered by three separate indicators: one for eutrophication of fresh water (where phosphorus releases are key), one for sea water and one for land (for both of which nitrogen emissions are key).

There are no phosphorus emissions from Interfloor's operations; therefore only "background" processes contribute to the freshwater eutrophication indicator. The main drivers are found to be data representing

[17] defined as "measured data, representative data or data that can be proven to be conservative"

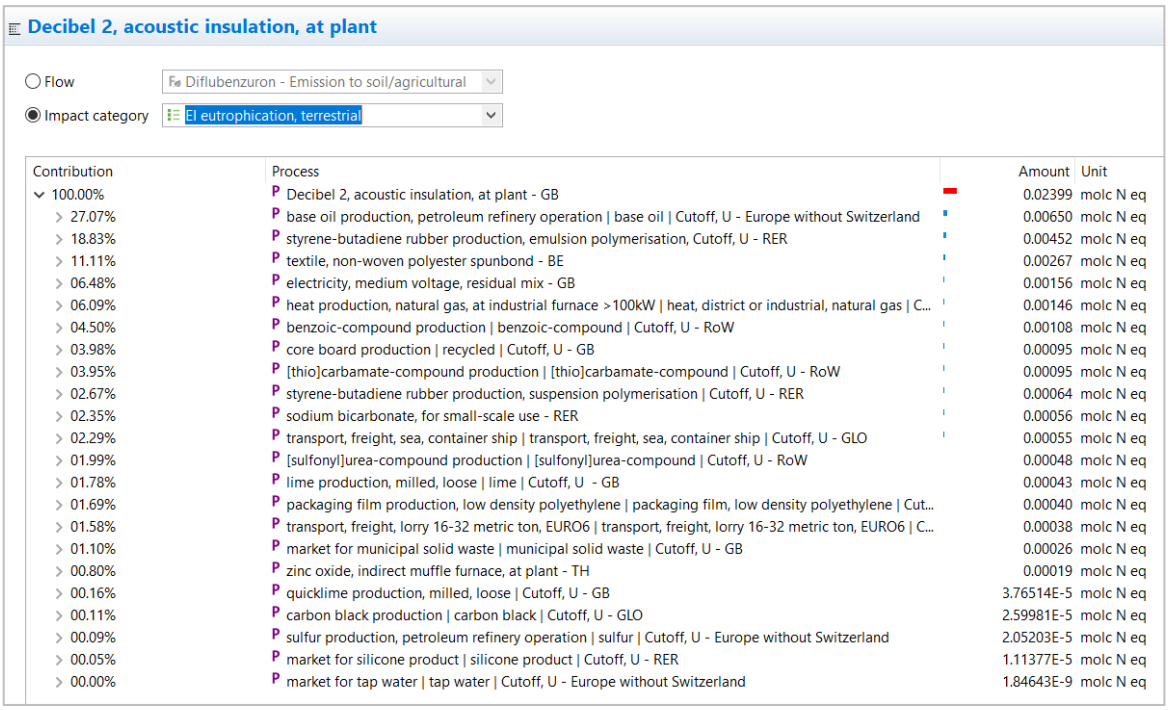
mining activities and one of the complex chemicals used in the rubber compound (Figure 11). The quality of these data is relatively low, and indeed the latter is a proxy used in the absence of actual LCA data for the production of tetramethyl thiuram disulfide. Therefore the value of this indicator is considered to have relatively high level of uncertainty.



Name	Category	Inventory re...	Impact factor	Impact result	Unit
EI eutrophication, freshwater				0.00060	kg P eq
[thio]carbamate-compound production | [th	202:Manufacture of other ch...			5.06119E-5	kg P eq
treatment of spoil from hard coal mining, in	382:Waste treatment and di...			0.00022	kg P eq
treatment of spoil from lignite mining, in sur	382:Waste treatment and di...			0.00021	kg P eq
treatment of sulfidic tailings, from copper m	382:Waste treatment and di...			7.89011E-6	kg P eq
treatment of sulfidic tailings, from copper m	382:Waste treatment and di...			1.99291E-5	kg P eq
treatment of sulfidic tailings, from copper m	382:Waste treatment and di...			6.83390E-6	kg P eq

FIGURE 11: PROCESS CONTRIBUTIONS, FRESHWATER EUTROPHICATION, DECIBEL 2

For terrestrial eutrophication, emissions of nitrogen oxides are the key driver. Therefore it is not surprising that the contributions follow a broadly similar pattern to those observed for GWP, with raw-material production chains with high energy use – notably oil refining and petrochemical processes – contributing significantly to the overall indicator total (Figure 12). For both terrestrial and marine eutrophication, emissions from Interfloor's processes account for <5% of the total.

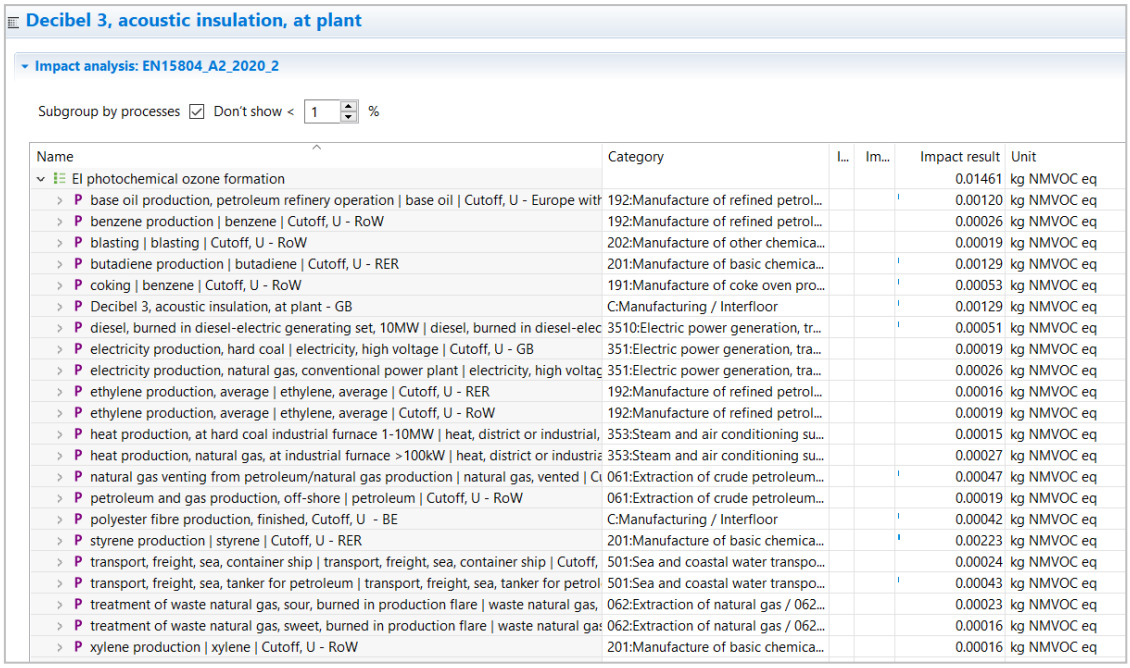


Contribution	Process	Amount	Unit
100.00%	Decibel 2, acoustic insulation, at plant - GB	0.02399	molc N eq
27.07%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without Switzerland	0.00650	molc N eq
18.83%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.00452	molc N eq
11.11%	textile, non-woven polyester spunbond - BE	0.00267	molc N eq
06.48%	electricity, medium voltage, residual mix - GB	0.00156	molc N eq
06.09%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | C...	0.00146	molc N eq
04.50%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.00108	molc N eq
03.98%	core board production | recycled | Cutoff, U - GB	0.00095	molc N eq
03.95%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	0.00095	molc N eq
02.67%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	0.00064	molc N eq
02.35%	sodium bicarbonate, for small-scale use - RER	0.00056	molc N eq
02.29%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - GLO	0.00055	molc N eq
01.99%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.00048	molc N eq
01.78%	lime production, milled, loose | lime | Cutoff, U - GB	0.00043	molc N eq
01.69%	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cut...	0.00040	molc N eq
01.58%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 | C...	0.00038	molc N eq
01.10%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.00026	molc N eq
00.80%	zinc oxide, indirect muffle furnace, at plant - TH	0.00019	molc N eq
00.16%	quicklime production, milled, loose | Cutoff, U - GB	3.76514E-5	molc N eq
00.11%	carbon black production | carbon black | Cutoff, U - GLO	2.59981E-5	molc N eq
00.09%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switzerland	2.05203E-5	molc N eq
00.05%	market for silicone product | silicone product | Cutoff, U - RER	1.11377E-5	molc N eq
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	1.84643E-9	molc N eq

FIGURE 12: PROCESS CONTRIBUTIONS, TERRESTRIAL EUTROPHICATION, DECIBEL 2

5.2.5 PHOTOCHEMICAL OZONE CREATION POTENTIAL (POCP)

Sulphur and nitrogen oxides are also important contributors to the ozone formation indicator. Direct emissions from Interfloor are more significant for this indicator than for eutrophication, accounting for approx. 10% of the total indicator; see Figure 13 (below), for Decibel 3.



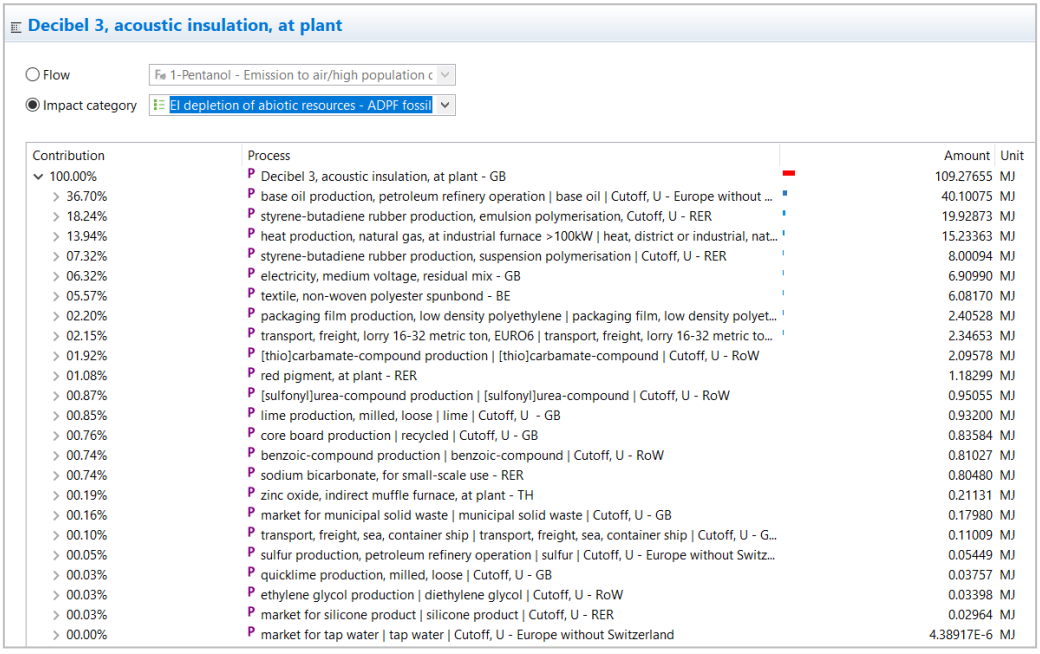
Name	Category	I...	Im...	Impact result	Unit
EI photochemical ozone formation				0.01461	kg NMVOC eq
base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe with	192:Manufacture of refined petrol...			0.00120	kg NMVOC eq
benzene production | benzene | Cutoff, U - RoW	192:Manufacture of refined petrol...			0.00026	kg NMVOC eq
blasting | blasting | Cutoff, U - RoW	202:Manufacture of other chemica...			0.00019	kg NMVOC eq
butadiene production | butadiene | Cutoff, U - RER	201:Manufacture of basic chemica...			0.00129	kg NMVOC eq
coking | benzene | Cutoff, U - RoW	191:Manufacture of coke oven pro...			0.00053	kg NMVOC eq
Decibel 3, acoustic insulation, at plant - GB	C:Manufacturing / Interfloor			0.00129	kg NMVOC eq
diesel, burned in diesel-electric generating set, 10MW | diesel, burned in diesel-elec	3510:Electric power generation, tr...			0.00051	kg NMVOC eq
electricity production, hard coal | electricity, high voltage | Cutoff, U - GB	351:Electric power generation, tra...			0.00019	kg NMVOC eq
electricity production, natural gas, conventional power plant | electricity, high voltag	351:Electric power generation, tra...			0.00026	kg NMVOC eq
ethylene production, average | ethylene, average | Cutoff, U - RER	192:Manufacture of refined petrol...			0.00016	kg NMVOC eq
ethylene production, average | ethylene, average | Cutoff, U - RoW	192:Manufacture of refined petrol...			0.00019	kg NMVOC eq
heat production, at hard coal industrial furnace 1-10MW | heat, district or industrial,	353:Steam and air conditioning su...			0.00015	kg NMVOC eq
heat production, natural gas, at industrial furnace >100kW | heat, district or industria	353:Steam and air conditioning su...			0.00027	kg NMVOC eq
natural gas venting from petroleum/natural gas production | natural gas, vented | C	061:Extraction of crude petroleum...			0.00047	kg NMVOC eq
petroleum and gas production, off-shore | petroleum | Cutoff, U - RoW	061:Extraction of crude petroleum...			0.00019	kg NMVOC eq
polyester fibre production, finished, Cutoff, U - BE	C:Manufacturing / Interfloor			0.00042	kg NMVOC eq
styrene production | styrene | Cutoff, U - RER	201:Manufacture of basic chemica...			0.00223	kg NMVOC eq
transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff,	501:Sea and coastal water transpo...			0.00024	kg NMVOC eq
transport, freight, sea, tanker for petroleum | transport, freight, sea, tanker for petrol	501:Sea and coastal water transpo...			0.00043	kg NMVOC eq
treatment of waste natural gas, sour, burned in production flare | waste natural gas,	062:Extraction of natural gas / 062...			0.00023	kg NMVOC eq
treatment of waste natural gas, sweet, burned in production flare | waste natural gas	062:Extraction of natural gas / 062...			0.00016	kg NMVOC eq
xylene production | xylene | Cutoff, U - RoW	201:Manufacture of basic chemica...			0.00016	kg NMVOC eq

FIGURE 13: PROCESS CONTRIBUTIONS, O_3 FORMATION, DECIBEL 3

5.2.6 ABIOTIC DEPLETION POTENTIAL - ELEMENTS (ADPE)

The ADPE indicator reflects the extent to which the product and the product system consume metals and other less common materials. Zinc oxide is used in many rubber compounds, including Decibel acoustic insulation. The baseline assumption in this study is that zinc oxide is made from zinc metal available on the market, some of which will be primary. This zinc use is responsible for >85% of the ADPE indicator total for all of the products; not other single constituent accounts for more than 3% of the total. The affect on the result of changing this assumption is considered in Section 5.3.

5.2.7 ABIOTIC DEPLETION POTENTIAL - FOSSIL FUELS (ADPF)



Contribution	Process	Amount	Unit
100.00%	Decibel 3, acoustic insulation, at plant - GB	109.27655	MJ
36.70%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without ...	40.10075	MJ
18.24%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	19.92873	MJ
13.94%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, nat...	15.23363	MJ
07.32%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	8.00094	MJ
06.32%	electricity, medium voltage, residual mix - GB	6.90990	MJ
05.57%	textile, non-woven polyester spunbond - BE	6.08170	MJ
02.20%	packaging film production, low density polyethylene | packaging film, low density polyet...	2.40528	MJ
02.15%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric to...	2.34653	MJ
01.92%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	2.09578	MJ
01.08%	red pigment, at plant - RER	1.18299	MJ
00.87%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.95055	MJ
00.85%	lime production, milled, loose | lime | Cutoff, U - GB	0.93200	MJ
00.76%	core board production | recycled | Cutoff, U - GB	0.83584	MJ
00.74%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.81027	MJ
00.74%	sodium bicarbonate, for small-scale use - RER	0.80480	MJ
00.19%	zinc oxide, indirect muffle furnace, at plant - TH	0.21131	MJ
00.16%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.17980	MJ
00.10%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - G...	0.11009	MJ
00.05%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switz...	0.05449	MJ
00.03%	quicklime production, milled, loose | Cutoff, U - GB	0.03757	MJ
00.03%	ethylene glycol production | diethylene glycol | Cutoff, U - RoW	0.03398	MJ
00.03%	market for silicone product | silicone product | Cutoff, U - RER	0.02964	MJ
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	4.38917E-6	MJ

FIGURE 14: PROCESS CONTRIBUTIONS, ADPF, DECIBEL 3

The relative contributions to the ADPF indicator are somewhat similar to those observed for GWP: compare Figure 14 (above) with Figure 9 (p 23), both for Decibel 3. However the ADPF indicator counts fossil hydrocarbons used both as fuel and as raw materials - hence the higher significance for the ADPF indicator of mineral oil and styrene-butadiene rubber production compared to heat production from natural gas.

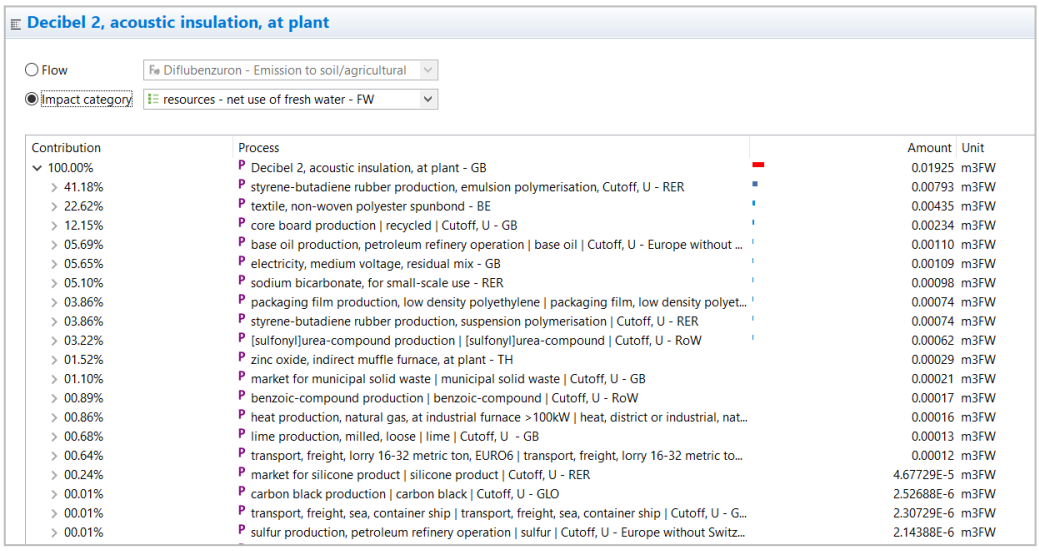
5.2.8 RESOURCE USE INDICATORS: WATER

There is no process water use in the production of Interfloor's sponge rubber products; some water is used at the facility to raise steam used in other processes, but water consumption across the whole facility is <0.25 m^3 per tonne of finished product.

The indicator values relating to the water-dependency of the product system are therefore driven by upstream activities. For both the net fresh water indicator and the water deprivation potential (WDP, a weighted measure that allows for the availability of water in locations where it is used as well as the use itself), the production of styrene-butadiene rubber makes the strongest contribution to the indicator totals.

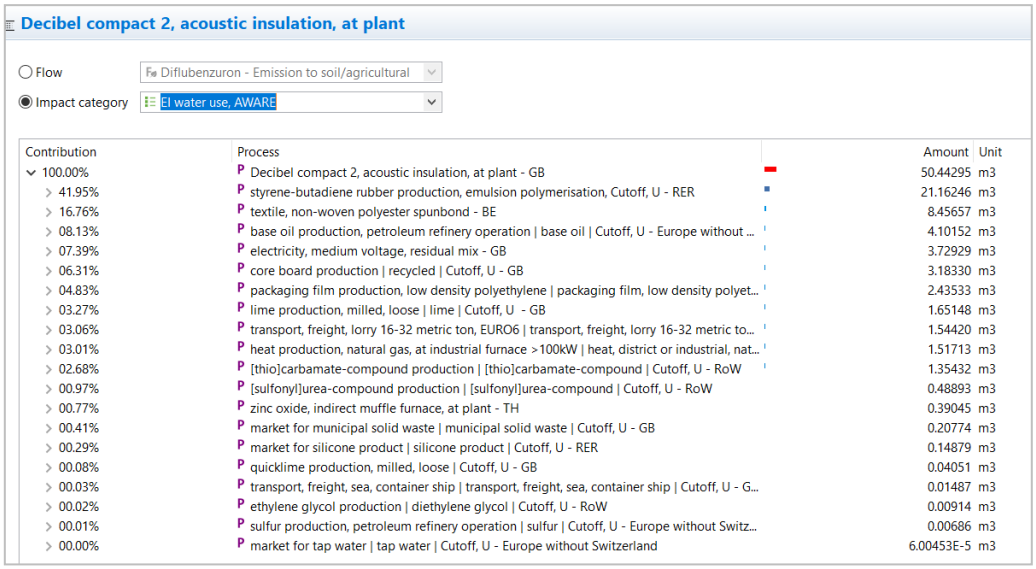
Figure 15 illustrates this for the NFW indicator for Decibel 2; Figure 16 shows contributions to the WDP indicator for Decibel Compact 2.

The quality of all generic data for water consumption is relatively low and these results should be treated with some caution.



Contribution	Process	Amount	Unit
100.00%	Decibel 2, acoustic insulation, at plant - GB	0.01925	m3FW
41.18%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	0.00793	m3FW
22.62%	textile, non-woven polyester spunbond - BE	0.00435	m3FW
12.15%	core board production | recycled | Cutoff, U - GB	0.00234	m3FW
05.69%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without ...	0.00110	m3FW
05.65%	electricity, medium voltage, residual mix - GB	0.00109	m3FW
05.10%	sodium bicarbonate, for small-scale use - RER	0.00098	m3FW
03.86%	packaging film production, low density polyethylene | packaging film, low density polyet...	0.00074	m3FW
03.86%	styrene-butadiene rubber production, suspension polymerisation | Cutoff, U - RER	0.00074	m3FW
03.22%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.00062	m3FW
01.52%	zinc oxide, indirect muffle furnace, at plant - TH	0.00029	m3FW
01.10%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.00021	m3FW
00.89%	benzoic-compound production | benzoic-compound | Cutoff, U - RoW	0.00017	m3FW
00.86%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, nat...	0.00016	m3FW
00.68%	lime production, milled, loose | lime | Cutoff, U - GB	0.00013	m3FW
00.64%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric to...	0.00012	m3FW
00.24%	market for silicone product | silicone product | Cutoff, U - RER	4.67729E-5	m3FW
00.01%	carbon black production | carbon black | Cutoff, U - GLO	2.52688E-6	m3FW
00.01%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - G...	2.30729E-6	m3FW
00.01%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switz...	2.14388E-6	m3FW

FIGURE 15: PROCESS CONTRIBUTIONS, NFW, DECIBEL 2



Contribution	Process	Amount	Unit
100.00%	Decibel compact 2, acoustic insulation, at plant - GB	50.44295	m3
41.95%	styrene-butadiene rubber production, emulsion polymerisation, Cutoff, U - RER	21.16246	m3
16.76%	textile, non-woven polyester spunbond - BE	8.45657	m3
08.13%	base oil production, petroleum refinery operation | base oil | Cutoff, U - Europe without ...	4.10152	m3
07.39%	electricity, medium voltage, residual mix - GB	3.72929	m3
06.31%	core board production | recycled | Cutoff, U - GB	3.18330	m3
04.83%	packaging film production, low density polyethylene | packaging film, low density polyet...	2.43533	m3
03.27%	lime production, milled, loose | lime | Cutoff, U - GB	1.65148	m3
03.06%	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric to...	1.54420	m3
03.01%	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, nat...	1.51713	m3
02.68%	[thio]carbamate-compound production | [thio]carbamate-compound | Cutoff, U - RoW	1.35432	m3
00.97%	[sulfonyl]urea-compound production | [sulfonyl]urea-compound | Cutoff, U - RoW	0.48893	m3
00.77%	zinc oxide, indirect muffle furnace, at plant - TH	0.39045	m3
00.41%	market for municipal solid waste | municipal solid waste | Cutoff, U - GB	0.20774	m3
00.29%	market for silicone product | silicone product | Cutoff, U - RER	0.14879	m3
00.08%	quicklime production, milled, loose | Cutoff, U - GB	0.04051	m3
00.03%	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U - G...	0.01487	m3
00.02%	ethylene glycol production | diethylene glycol | Cutoff, U - RoW	0.00914	m3
00.01%	sulfur production, petroleum refinery operation | sulfur | Cutoff, U - Europe without Switz...	0.00686	m3
00.00%	market for tap water | tap water | Cutoff, U - Europe without Switzerland	6.00453E-5	m3

FIGURE 16: PROCESS CONTRIBUTIONS, WDP, DECIBEL COMPACT 2

5.3 SENSITIVITY ANALYSIS

5.3.1 ZINC SOURCE

It was noted in Section 5.2.6 that the ADPE indicator value is dominated by zinc used to produce zinc oxide. Some sources suggest that this material is largely made form secondary zinc (scrap, refining dross, recycled metal), others that primary zinc is widely used to ensure high purity. The principal results in this study assume the default mix of primary and secondary zinc present in the ecoinvent database. Table 13 below, shows these results alongside results obtained when it is assumed that zinc oxide is made from 100% secondary zinc. There is a small, and not significant, reduction in the indicator values obtained for a number of categories, but a very large, almost tenfold, reduction in the value obtained for ADPE.

ENVIRONMENTAL IMPACTS	Unit	A1 - A3 default Zn	A1 - A3 secondary Zn
GWP-fossil	kg CO_2 eq	1.78E-01	1.77E-01
GWP-biogenic	kg CO_2 eq	3.27E+00	3.26E+00
GWP-luluc	kg CO_2 eq	2.02E-03	1.99E-03
GWP-total	kg CO_2 eq	3.34E+00	3.33E+00
GWP-GHG	kg CO_2 eq	3.27E+00	3.26E+00
AP	mol H^+ eq	2.50E-02	2.49E-02
EP-freshwater	kg PO_4^{3-} eq	6.00E-04	5.90E-04
EP-marine	kg N eq	2.75E-03	2.73E-03
EP-terrestrial	mol N eq	2.40E-02	2.38E-02
POCP	kg NMVOC eq	1.27E-02	1.27E-02
ODP	kg CFC-11 eq	9.91E-07	9.91E-07
ADPMM	kg Sb eq	2.60E-04	3.28E-05
ADPFF	MJ, ncv	9.20E+01	9.18E+01
WDP	m^3 world-eq deprvd	6.29E+01	6.26E+01

TABLE 13: SENSITIVITY ANALYSIS, ZINC SOURCE, DECIBEL 2

5.3.2 CO_2 FROM BICARBONATE

In Section 3.1.2, the assumption that any CO_2 released from the transformation of sodium bicarbonate in manufacturing remains within the foam or the concrete floor was noted. The significance of that assumption is considered here. Decibel 4 contains the highest proportion of sodium bicarbonate (c.1.7% of non-packaging raw materials in the BoM). The maximum possible amount of CO_2 that could be released from this has been calculated as 0.04kg CO_2 per m^2 of product, applying the emission factor of 0.524kgCO_2 per kg published in Annex VI of the Monitoring and Reporting Regulation[18] that supports the EU Emissions Trading Scheme. This represents approx. 1% of the total GWP for the product stage of the life cycle for Decibel 4, therefore this aspect is considered to be insignificant.

[18] European Commission Regulation (EU) No 601/2012

5.4 CONCLUSIONS & RECOMMENDATIONS

A life cycle assessment has been conducted of Decibel Soundseal Acoustic Insulation flooring products manufactured in the UK by Interfloor Limited, with the objective of producing EPD. Data characterising company's products, processes, and the background data used, have been found to be fit for purpose.

The environmental burdens associated with one square metre of Decibel product are found, as would be expected, to depend to a large degree on the mass of material in that unit area. No single ingredient or process makes the dominant contribution to the total environmental burdens, but several themes emerge:

- for almost all environmental themes, the manufacture of the product and its ingredients represents the most significant part of the life cycle. For GWP (carbon footprint) the product's end-of-life is also significant if the product is incinerated, at which point fossil hydrocarbons in the product itself are released as CO_2, even though some energy is recovered in the process. The use of this energy (as heat and power) might avoid other environmental burdens associated with heat and power production in other product systems, but assessment of such benefits from waste incineration is outside the scope of LCA compliant with EN 15804.
- styrene-butadiene rubber, mineral oil and gas combustion at Interfloor's factory make important, but not dominant, contributions to several environmental indicators
- mineral ingredients make a very small contribution to the total environmental burdens for any Decibel product, despite representing the majority of the product by mass
- raw material transport is of low significance; this is in part a consequence of the proximity to Interfloor's factory of the limestone powder supplier
- the value of the resource depletion indicator depends very strongly on whether zinc used to manufacture zinc oxide is from primary (virgin) or secondary (recycled) sources; zinc oxide production is the single main driver of this indicator
- speciality additives used in rubber compounding contribute more strongly to several environmental indicators than might be expected from the amounts used. This overall trend is expected for complex chemicals made in multi-step processes, but no specific data is available to represent the production of these materials, and the data used here is of relatively low quality.

A number of recommendations emerge from the LCA study, which are set out below. In making these points, we recognise that Interfloor produces other underlay products with very high levels of recycled content, that formulations are constrained by technical properties of products that must be achieved, and that some gas is burned to comply with regulatory requirements for emissions to air at Interfloor's factory.

We recommended that Interfloor:

- establishes a programme to review the bills of materials and factory data underpinning this LCA and the EPD on an annual basis, so that any amendments to the EPD can be made in a timely fashion and reported to the Verifier
- requests data to feed into future LCA of its sponge rubber products from its suppliers of speciality rubber compound constituents
- encourages its customers to use the Decibel product with lowest mass per unit area that meets their technical requirements
- continues to pursue energy efficiency at its Haslingden facility, and in particular efficient use of gas, which contributes significantly to the overall carbon footprint of the products
- assesses the potential for use of non-fossil derived or secondary materials within its formulations, for example as alternatives to mineral oil which makes a significant contribution to the overall environmental burdens of Decibel products in several categories
- seeks to use zinc oxide produced from secondary (recycled) zinc as far as possible.

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APPENDIX 1 -
INDICATORS: DECIBEL SOUNDSEAL ACOUSTIC INSULATION

DECIBEL 2

Environmental indicator results for all declared modules are shown in the following tables for the declared unit of 1m^2 of Decibel 2 Soundseal Acoustic Insulation; the A1 - A3 modules are shown on an aggregated basis.

DECIBEL 2	ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	GWP-fossil	kg CO_2 eq	3.27E+00	3.02E-01	1.39E-01	2.62E-02	7.70E-02	0.00E+00	2.18E+00	0.00E+00
	GWP-biogenic	kg CO_2 eq	1.78E-01	0.00E+00	7.37E-02	1.22E-06	0.00E+00	0.00E+00	4.85E-03	0.00E+00
	GWP-luluc	kg CO_2 eq	2.02E-03	1.15E-04	2.03E-05	1.56E-07	4.31E-05	0.00E+00	2.74E-05	0.00E+00
	GWP-total	kg CO_2 eq	3.34E+00	3.02E-01	1.40E-01	2.62E-02	7.71E-02	0.00E+00	2.18E+00	0.00E+00
	GWP-GHG	kg CO_2 eq	3.27E+00	3.02E-01	1.39E-01	2.62E-02	7.71E-02	0.00E+00	2.18E+00	0.00E+00
	AP	mol H^+ eq	2.50E-02	1.23E-03	1.60E-04	5.91E-06	1.96E-04	0.00E+00	6.52E-04	0.00E+00
	EP-freshwater	kg PO_4^{3-} eq	6.00E-04	2.20E-05	7.87E-06	7.50E-08	8.15E-06	0.00E+00	1.25E-05	0.00E+00
	EP-marine	kg N eq	2.75E-03	2.29E-04	4.16E-05	3.35E-06	2.66E-05	0.00E+00	3.26E-04	0.00E+00
	EP-terrestrial	mol N eq	2.40E-02	2.52E-03	4.00E-04	2.84E-05	2.74E-04	0.00E+00	2.82E-03	0.00E+00
	POCP	kg NMVOC eq	1.27E-02	8.90E-04	1.30E-04	6.83E-06	1.30E-04	0.00E+00	7.30E-04	0.00E+00
	ODP	kg CFC-11 eq	9.91E-07	6.82E-08	1.52E-09	6.22E-11	1.65E-08	0.00E+00	1.44E-08	0.00E+00
	ADPMM	kg Sb eq	2.60E-04	7.97E-06	3.93E-07	9.22E-09	3.79E-06	0.00E+00	1.46E-06	0.00E+00
	ADPFF	MJ, ncv	9.20E+01	4.47E+00	8.53E-01	5.29E-03	1.13E+00	0.00E+00	1.18E+00	0.00E+00
	WDP	m^3 world-eq deprvd	6.29E+01	4.20E+00	5.13E-01	4.20E-03	1.77E+00	0.00E+00	5.93E-01	0.00E+00

DECIBEL 2	RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	8.37E-01	6.30E-02	2.89E-02	1.80E-04	2.45E-02	0.00E+00	2.65E-02	0.00E+00
	PERM	MJ	7.54E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	1.59E+00	6.30E-02	2.89E-02	1.80E-04	2.45E-02	0.00E+00	2.65E-02	0.00E+00
	PENRE	MJ	2.56E+01	4.56E+00	5.62E-01	5.44E-03	1.16E+00	0.00E+00	1.21E+00	0.00E+00
	PENRM	MJ	7.29E+01	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	9.85E+01	4.56E+00	8.92E-01	5.44E-03	1.16E+00	0.00E+00	1.21E+00	0.00E+00
	SM	kg	5.77E-02	0.00E+00	1.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	5.51E-02	2.24E-03	5.10E-04	3.03E-06	8.87E-04	0.00E+00	5.22E-04	0.00E+00
	NRSF	MJ	2.56E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m^3	1.93E-02	3.07E-04	6.00E-04	3.81E-05	1.21E-04	0.00E+00	2.82E-03	0.00E+00

DECIBEL 2	WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	1.06E-01	4.70E-03	3.53E-03	4.00E-04	1.63E-03	0.00E+00	3.46E-02	0.00E+00
	NHWD	kg	2.96E+00	3.08E-01	1.28E-01	1.16E-02	7.14E-02	0.00E+00	5.52E+00	0.00E+00
	TRWD	kg	3.70E-04	3.11E-05	7.06E-07	1.25E-08	7.65E-06	0.00E+00	5.21E-06	0.00E+00

DECIBEL 2	OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	8.52E-03	0.00E+00	9.37E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+01	0.00E+00

DECIBEL 2	OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	ETP-fw	CTUe	2.93E+00	1.46E-01	6.18E-03	2.50E-04	2.71E-02	0.00E+00	3.69E-02	0.00E+00
	HTP-C	CTUh	2.42E-09	9.74E-11	1.67E-11	1.47E-12	3.27E-11	0.00E+00	2.01E-10	0.00E+00
	HTP-NC	CTUh	7.23E-08	5.67E-09	3.70E-09	4.35E-10	1.91E-09	0.00E+00	4.84E-08	0.00E+00
	IRP	kBq U-235 eq	5.85E-01	2.32E-02	1.71E-03	1.59E-05	6.33E-03	0.00E+00	4.42E-03	0.00E+00
	SQP	Pt	2.93E+00	3.52E+00	2.19E-02	8.50E-04	5.71E-01	0.00E+00	4.75E-01	0.00E+00
	PM	disease inc.	1.97E-07	1.82E-08	1.30E-09	2.81E-11	3.57E-09	0.00E+00	9.22E-09	0.00E+00

SOUNDSEAL ACOUSTIC INSULATION - DECIBEL 3

Environmental indicator results for all declared modules are shown in the following tables for the declared unit of 1m^2 of Decibel 3 Soundseal Acoustic Insulation; the A1 - A3 modules are shown on an aggregated basis.

DECIBEL 3

ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq	3.99E+00	4.24E-01	1.94E-01	2.62E-02	1.08E-01	0.00E+00	3.05E+00	0.00E+00
GWP-biogenic	kg CO_2 eq	2.52E-01	0.00E+00	1.02E-01	1.22E-06	0.00E+00	0.00E+00	6.79E-03	0.00E+00
GWP-luluc	kg CO_2 eq	2.51E-03	1.61E-04	2.07E-05	1.56E-07	6.04E-05	0.00E+00	3.83E-05	0.00E+00
GWP-total	kg CO_2 eq	4.08E+00	4.24E-01	1.94E-01	2.62E-02	1.08E-01	0.00E+00	3.05E+00	0.00E+00
GWP-GHG	kg CO_2 eq	3.99E+00	4.24E-01	1.94E-01	2.62E-02	1.08E-01	0.00E+00	3.05E+00	0.00E+00
AP	mol H^+ eq	3.14E-02	1.72E-03	1.70E-04	5.91E-06	2.74E-04	0.00E+00	9.13E-04	0.00E+00
EP-freshwater	kg PO_4^{3-} eq	7.20E-04	3.09E-05	8.05E-06	7.50E-08	1.14E-05	0.00E+00	1.75E-05	0.00E+00
EP-marine	kg N eq	3.42E-03	3.22E-04	4.94E-05	3.35E-06	3.73E-05	0.00E+00	4.57E-04	0.00E+00
EP-terrestrial	mol N eq	2.87E-02	3.53E-03	4.70E-04	2.84E-05	3.83E-04	0.00E+00	3.94E-03	0.00E+00
POCP	kg NMVOC eq	1.46E-02	1.25E-03	1.50E-04	6.83E-06	1.81E-04	0.00E+00	1.02E-03	0.00E+00
ODP	kg CFC-11 eq	1.16E-06	9.57E-08	1.66E-09	6.22E-11	2.31E-08	0.00E+00	2.01E-08	0.00E+00
ADPMM	kg Sb eq	3.20E-04	1.12E-05	4.15E-07	9.22E-09	5.30E-06	0.00E+00	2.05E-06	0.00E+00
ADPFF	MJ, ncv	1.09E+02	6.27E+00	8.65E-01	5.29E-03	1.58E+00	0.00E+00	1.65E+00	0.00E+00
WDP	m^3 world-eq deprvd	6.96E+01	5.90E+00	5.22E-01	4.20E-03	2.48E+00	0.00E+00	8.30E-01	0.00E+00

DECIBEL 3	RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	7.75E-01	8.85E-02	2.93E-02	1.80E-04	3.43E-02	0.00E+00	3.71E-02	0.00E+00
	PERM	MJ	1.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	1.81E+00	8.85E-02	2.93E-02	1.80E-04	3.43E-02	0.00E+00	3.71E-02	0.00E+00
	PENRE	MJ	1.48E+01	6.40E+00	5.75E-01	5.44E-03	1.63E+00	0.00E+00	1.69E+00	0.00E+00
	PENRM	MJ	1.02E+02	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	1.17E+02	6.40E+00	9.05E-01	5.44E-03	1.63E+00	0.00E+00	1.69E+00	0.00E+00
	SM	kg	5.77E-02	0.00E+00	1.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	5.91E-02	3.15E-03	5.20E-04	3.03E-06	1.24E-03	0.00E+00	7.30E-04	0.00E+00
	NRSF	MJ	1.47E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m^3	1.92E-02	4.31E-04	6.60E-04	3.81E-05	1.69E-04	0.00E+00	3.94E-03	0.00E+00

DECIBEL 3	WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	1.27E-01	6.59E-03	4.45E-03	4.00E-04	2.28E-03	0.00E+00	4.84E-02	0.00E+00
	NHWD	kg	3.52E+00	4.32E-01	1.68E-01	1.16E-02	9.99E-02	0.00E+00	7.73E+00	0.00E+00
	TRWD	kg	4.70E-04	4.37E-05	7.35E-07	1.25E-08	1.07E-05	0.00E+00	7.29E-06	0.00E+00

DECIBEL 3	OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	1.06E-02	0.00E+00	1.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.36E+01	0.00E+00

DECIBEL 3	OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	ETP-fw	CTUe	3.91E+00	2.05E-01	6.96E-03	2.50E-04	3.79E-02	0.00E+00	5.17E-02	0.00E+00
	HTP-C	CTUh	2.66E-09	1.37E-10	1.99E-11	1.47E-12	4.57E-11	0.00E+00	2.82E-10	0.00E+00
	HTP-NC	CTUh	8.67E-08	7.95E-09	4.91E-09	4.35E-10	2.67E-09	0.00E+00	6.77E-08	0.00E+00
	IRP	kBq U-235 eq	7.31E-01	3.26E-02	1.75E-03	1.59E-05	8.86E-03	0.00E+00	6.19E-03	0.00E+00
	SQP	Pt	3.89E+00	4.94E+00	2.40E-02	8.50E-04	8.00E-01	0.00E+00	6.65E-01	0.00E+00
	PM	disease inc.	2.45E-07	2.56E-08	1.39E-09	2.81E-11	4.99E-09	0.00E+00	1.29E-08	0.00E+00

SOUNDSEAL ACOUSTIC INSULATION - DECIBEL 4

Environmental indicator results for all declared modules are shown in the following tables for the declared unit of 1m^2 of Decibel 4 Soundseal Acoustic Insulation; the A1 - A3 modules are shown on an aggregated basis.

DECIBEL 4

ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq	4.75E+00	4.07E-01	1.94E-01	2.62E-02	1.05E-01	0.00E+00	2.98E+00	0.00E+00
GWP-biogenic	kg CO_2 eq	2.37E-01	0.00E+00	1.02E-01	1.22E-06	0.00E+00	0.00E+00	6.63E-03	0.00E+00
GWP-luluc	kg CO_2 eq	2.92E-03	1.55E-04	2.06E-05	1.56E-07	5.90E-05	0.00E+00	3.74E-05	0.00E+00
GWP-total	kg CO_2 eq	4.84E+00	4.08E-01	1.94E-01	2.62E-02	1.05E-01	0.00E+00	2.98E+00	0.00E+00
GWP-GHG	kg CO_2 eq	4.75E+00	4.08E-01	1.94E-01	2.62E-02	1.05E-01	0.00E+00	2.98E+00	0.00E+00
AP	mol H^+ eq	3.78E-02	1.66E-03	1.70E-04	5.91E-06	2.67E-04	0.00E+00	8.91E-04	0.00E+00
EP-freshwater	kg PO_4^{3-} eq	9.70E-04	2.97E-05	8.05E-06	7.50E-08	1.11E-05	0.00E+00	1.71E-05	0.00E+00
EP-marine	kg N eq	4.16E-03	3.10E-04	4.91E-05	3.35E-06	3.64E-05	0.00E+00	4.46E-04	0.00E+00
EP-terrestrial	mol N eq	3.54E-02	3.40E-03	4.70E-04	2.84E-05	3.74E-04	0.00E+00	3.85E-03	0.00E+00
POCP	kg NMVOC eq	1.88E-02	1.20E-03	1.50E-04	6.83E-06	1.77E-04	0.00E+00	9.98E-04	0.00E+00
ODP	kg CFC-11 eq	1.40E-06	9.20E-08	1.65E-09	6.22E-11	2.25E-08	0.00E+00	1.96E-08	0.00E+00
ADPMM	kg Sb eq	4.40E-04	1.08E-05	4.14E-07	9.22E-09	5.18E-06	0.00E+00	2.00E-06	0.00E+00
ADPFF	MJ, ncv	1.33E+02	6.03E+00	8.65E-01	5.29E-03	1.54E+00	0.00E+00	1.61E+00	0.00E+00
WDP	m^3 world-eq deprvd	9.94E+01	5.67E+00	5.21E-01	4.20E-03	2.42E+00	0.00E+00	8.11E-01	0.00E+00

DECIBEL 4	RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	1.43E+00	8.51E-02	2.92E-02	1.80E-04	3.34E-02	0.00E+00	3.62E-02	0.00E+00
	PERM	MJ	1.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	2.46E+00	8.51E-02	2.92E-02	1.80E-04	3.34E-02	0.00E+00	3.62E-02	0.00E+00
	PENRE	MJ	4.32E+01	6.15E+00	5.75E-01	5.44E-03	1.59E+00	0.00E+00	1.65E+00	0.00E+00
	PENRM	MJ	9.83E+01	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	1.41E+02	6.15E+00	9.05E-01	5.44E-03	1.59E+00	0.00E+00	1.65E+00	0.00E+00
	SM	kg	5.77E-02	0.00E+00	1.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	8.74E-02	3.03E-03	5.20E-04	3.03E-06	1.21E-03	0.00E+00	7.13E-04	0.00E+00
	NRSF	MJ	1.98E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m^3	2.90E-02	4.14E-04	6.60E-04	3.81E-05	1.65E-04	0.00E+00	3.85E-03	0.00E+00

DECIBEL 4	WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	1.95E-01	6.34E-03	4.41E-03	4.00E-04	2.23E-03	0.00E+00	4.73E-02	0.00E+00
	NHWD	kg	4.70E+00	4.16E-01	1.67E-01	1.16E-02	9.76E-02	0.00E+00	7.54E+00	0.00E+00
	TRWD	kg	5.10E-04	4.20E-05	7.34E-07	1.25E-08	1.05E-05	0.00E+00	7.12E-06	0.00E+00

DECIBEL 4	OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	1.54E-02	0.00E+00	1.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E+01	0.00E+00

DECIBEL 4	OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	ETP-fw	CTUe	6.04E+00	1.97E-01	6.99E-03	2.50E-04	3.70E-02	0.00E+00	5.05E-02	0.00E+00
	HTP-C	CTUh	4.12E-09	1.32E-10	1.98E-11	1.47E-12	4.46E-11	0.00E+00	2.75E-10	0.00E+00
	HTP-NC	CTUh	1.13E-07	7.65E-09	4.89E-09	4.35E-10	2.61E-09	0.00E+00	6.61E-08	0.00E+00
	IRP	kBq U-235 eq	7.90E-01	3.13E-02	1.75E-03	1.59E-05	8.65E-03	0.00E+00	6.04E-03	0.00E+00
	SQP	Pt	4.27E+00	4.75E+00	2.39E-02	8.50E-04	7.81E-01	0.00E+00	6.49E-01	0.00E+00
	PM	disease inc.	2.86E-07	2.46E-08	1.38E-09	2.81E-11	4.87E-09	0.00E+00	1.26E-08	0.00E+00

SOUNDSEAL ACOUSTIC INSULATION - DECIBEL COMPACT 2

Environmental indicator results for all declared modules are shown in the following tables for the declared unit of 1m^2 of Decibel Compact 2 Soundseal Acoustic Insulation; the A1 - A3 modules are shown on an aggregated basis.

DECIBEL COMPACT 2	ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	GWP-fossil	kg CO_2 eq	2.78E+00	2.88E-01	1.48E-01	2.62E-02	7.19E-02	0.00E+00	2.03E+00	0.00E+00
	GWP-biogenic	kg CO_2 eq	1.74E-01	0.00E+00	1.48E-01	1.22E-06	0.00E+00	0.00E+00	4.53E-03	0.00E+00
	GWP-luluc	kg CO_2 eq	2.84E-03	1.09E-04	2.07E-05	1.56E-07	4.03E-05	0.00E+00	2.55E-05	0.00E+00
	GWP-total	kg CO_2 eq	2.85E+00	2.88E-01	1.48E-01	2.62E-02	7.19E-02	0.00E+00	2.03E+00	0.00E+00
	GWP-GHG	kg CO_2 eq	2.79E+00	2.88E-01	1.48E-01	2.62E-02	7.19E-02	0.00E+00	2.03E+00	0.00E+00
	AP	mol H^+ eq	2.11E-02	1.17E-03	1.70E-04	5.91E-06	1.83E-04	0.00E+00	6.09E-04	0.00E+00
	EP-freshwater	kg PO_4^{3-} eq	5.50E-04	2.10E-05	8.06E-06	7.50E-08	7.61E-06	0.00E+00	1.17E-05	0.00E+00
	EP-marine	kg N eq	2.38E-03	2.19E-04	4.84E-05	3.35E-06	2.49E-05	0.00E+00	3.04E-04	0.00E+00
	EP-terrestrial	mol N eq	2.03E-02	2.40E-03	4.60E-04	2.84E-05	2.56E-04	0.00E+00	2.63E-03	0.00E+00
	POCP	kg NMVOC eq	1.01E-02	8.50E-04	1.40E-04	6.83E-06	1.21E-04	0.00E+00	6.82E-04	0.00E+00
	ODP	kg CFC-11 eq	6.52E-07	6.51E-08	1.65E-09	6.22E-11	1.54E-08	0.00E+00	1.34E-08	0.00E+00
	ADPMM	kg Sb eq	2.80E-04	7.61E-06	4.14E-07	9.22E-09	3.54E-06	0.00E+00	1.36E-06	0.00E+00
	ADPFF	MJ, ncv	7.35E+01	4.26E+00	8.65E-01	5.29E-03	1.05E+00	0.00E+00	1.10E+00	0.00E+00
	WDP	m^3 world-eq deprvd	5.04E+01	4.01E+00	5.21E-01	4.20E-03	1.65E+00	0.00E+00	5.54E-01	0.00E+00

DECIBEL COMPACT 2	RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	5.11E-02	6.02E-02	2.93E-02	1.80E-04	2.28E-02	0.00E+00	2.47E-02	0.00E+00
	PERM	MJ	1.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	1.56E+00	6.02E-02	2.93E-02	1.80E-04	2.28E-02	0.00E+00	2.47E-02	0.00E+00
	PENRE	MJ	1.02E+01	4.35E+00	5.74E-01	5.44E-03	1.09E+00	0.00E+00	1.13E+00	0.00E+00
	PENRM	MJ	6.92E+01	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	7.94E+01	4.35E+00	9.04E-01	5.44E-03	1.09E+00	0.00E+00	1.13E+00	0.00E+00
	SM	kg	5.77E-02	0.00E+00	1.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	4.26E-02	2.14E-03	5.20E-04	3.03E-06	8.28E-04	0.00E+00	4.87E-04	0.00E+00
	NRSF	MJ	2.82E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m^3	1.64E-02	2.93E-04	6.50E-04	3.81E-05	1.13E-04	0.00E+00	2.63E-03	0.00E+00

DECIBEL COMPACT 2	WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	9.13E-02	4.49E-03	4.33E-03	4.00E-04	1.52E-03	0.00E+00	3.23E-02	0.00E+00
	NHWD	kg	2.54E+00	2.94E-01	1.79E-01	1.16E-02	6.66E-02	0.00E+00	5.15E+00	0.00E+00
	TRWD	kg	3.10E-04	2.97E-05	7.35E-07	1.25E-08	7.14E-06	0.00E+00	4.86E-06	0.00E+00

DECIBEL COMPACT 2	OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	7.57E-03	0.00E+00	1.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E+01	0.00E+00

DECIBEL COMPACT 2	OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	ETP-fw	CTUe	1.65E+00	1.39E-01	6.59E-03	2.50E-04	2.53E-02	0.00E+00	3.45E-02	0.00E+00
	HTP-C	CTUh	1.73E-09	9.31E-11	1.95E-11	1.47E-12	3.05E-11	0.00E+00	1.88E-10	0.00E+00
	HTP-NC	CTUh	6.51E-08	5.41E-09	4.91E-09	4.35E-10	1.78E-09	0.00E+00	4.51E-08	0.00E+00
	IRP	kBq U-235 eq	5.23E-01	2.22E-02	1.75E-03	1.59E-05	5.90E-03	0.00E+00	4.13E-03	0.00E+00
	SQP	Pt	3.57E+00	3.36E+00	2.39E-02	8.50E-04	5.33E-01	0.00E+00	4.43E-01	0.00E+00
	PM	disease inc.	1.66E-07	1.74E-08	1.41E-09	2.81E-11	3.33E-09	0.00E+00	8.60E-09	0.00E+00

SOUNDSEAL ACOUSTIC INSULATION - DECIBEL WOOD

Environmental indicator results for all declared modules are shown in the following tables for the declared unit of 1m^2 of Decibel Wood Soundseal Acoustic Insulation; the A1 - A3 modules are shown on an aggregated basis.

DECIBEL WOOD

ENVIRONMENTAL IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq	1.95E+00	2.16E-01	1.01E-01	2.62E-02	5.39E-02	0.00E+00	1.52E+00	0.00E+00
GWP-biogenic	kg CO_2 eq	1.28E-01	0.00E+00	2.77E-02	1.22E-06	0.00E+00	0.00E+00	3.40E-03	0.00E+00
GWP-luluc	kg CO_2 eq	9.70E-04	8.21E-05	1.99E-05	1.56E-07	3.02E-05	0.00E+00	1.92E-05	0.00E+00
GWP-total	kg CO_2 eq	2.00E+00	2.16E-01	1.01E-01	2.62E-02	5.40E-02	0.00E+00	1.52E+00	0.00E+00
GWP-GHG	kg CO_2 eq	1.95E+00	2.16E-01	1.01E-01	2.62E-02	5.40E-02	0.00E+00	1.52E+00	0.00E+00
AP	mol H^+ eq	1.51E-02	8.80E-04	1.50E-04	5.91E-06	1.37E-04	0.00E+00	4.57E-04	0.00E+00
EP-freshwater	kg PO_4^{3-} eq	3.30E-04	1.58E-05	7.68E-06	7.50E-08	5.71E-06	0.00E+00	8.77E-06	0.00E+00
EP-marine	kg N eq	1.55E-03	1.64E-04	3.38E-05	3.35E-06	1.87E-05	0.00E+00	2.28E-04	0.00E+00
EP-terrestrial	mol N eq	1.36E-02	1.80E-03	3.30E-04	2.84E-05	1.92E-04	0.00E+00	1.97E-03	0.00E+00
POCP	kg NMVOC eq	7.00E-03	6.38E-04	1.10E-04	6.83E-06	9.07E-05	0.00E+00	5.11E-04	0.00E+00
ODP	kg CFC-11 eq	4.83E-07	4.89E-08	1.37E-09	6.22E-11	1.15E-08	0.00E+00	1.01E-08	0.00E+00
ADPMM	kg Sb eq	1.30E-04	5.71E-06	3.71E-07	9.22E-09	2.65E-06	0.00E+00	1.02E-06	0.00E+00
ADPFF	MJ, ncv	5.33E+01	3.20E+00	8.39E-01	5.29E-03	7.91E-01	0.00E+00	8.27E-01	0.00E+00
WDP	m^3 world-eq deprvd	3.59E+01	3.01E+00	5.04E-01	4.20E-03	1.24E+00	0.00E+00	4.15E-01	0.00E+00

DECIBEL WOOD	RESOURCE USE	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	5.70E-01	4.52E-02	2.84E-02	1.80E-04	1.71E-02	0.00E+00	1.86E-02	0.00E+00
	PERM	MJ	2.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	8.58E-01	4.52E-02	2.84E-02	1.80E-04	1.71E-02	0.00E+00	1.86E-02	0.00E+00
	PENRE	MJ	5.18E+00	3.27E+00	5.49E-01	5.44E-03	8.15E-01	0.00E+00	8.46E-01	0.00E+00
	PENRM	MJ	5.20E+01	0.00E+00	3.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	5.72E+01	3.27E+00	8.79E-01	5.44E-03	8.15E-01	0.00E+00	8.46E-01	0.00E+00
	SM	kg	2.22E-02	0.00E+00	1.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	3.00E-02	1.61E-03	5.00E-04	3.03E-06	6.21E-04	0.00E+00	3.65E-04	0.00E+00
	NRSF	MJ	9.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m^3	1.06E-02	2.20E-04	5.30E-04	3.81E-05	8.47E-05	0.00E+00	1.97E-03	0.00E+00

DECIBEL WOOD	WASTES	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	6.02E-02	3.37E-03	2.62E-03	4.00E-04	1.14E-03	0.00E+00	2.42E-02	0.00E+00
	NHWD	kg	1.68E+00	2.21E-01	8.33E-02	1.16E-02	5.00E-02	0.00E+00	3.86E+00	0.00E+00
	TRWD	kg	2.30E-04	2.23E-05	6.76E-07	1.25E-08	5.35E-06	0.00E+00	3.65E-06	0.00E+00

DECIBEL WOOD	OUTPUT FLOWS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	CFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	5.23E-03	0.00E+00	7.63E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+01	0.00E+00

DECIBEL WOOD	OTHER IMPACTS	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
	ETP-fw	CTUe	7.14E-01	1.05E-01	5.55E-03	2.50E-04	1.90E-02	0.00E+00	2.59E-02	0.00E+00
	HTP-C	CTUh	1.17E-09	6.98E-11	1.34E-11	1.47E-12	2.29E-11	0.00E+00	1.41E-10	0.00E+00
	HTP-NC	CTUh	4.17E-08	4.06E-09	2.44E-09	4.35E-10	1.34E-09	0.00E+00	3.39E-08	0.00E+00
	IRP	kBq U-235 eq	3.66E-01	1.66E-02	1.68E-03	1.59E-05	4.43E-03	0.00E+00	3.10E-03	0.00E+00
	SQP	Pt	1.74E+00	2.52E+00	1.98E-02	8.50E-04	4.00E-01	0.00E+00	3.32E-01	0.00E+00
	PM	disease inc.	1.17E-07	1.31E-08	1.21E-09	2.81E-11	2.50E-09	0.00E+00	6.45E-09	0.00E+00

APPENDIX 2 -

CALCULATION METHODS: ENVIRONMENTAL IMPACTS AND OTHER INDICATORS

The method used to calculate any indicator inevitably influences the results. Key aspects of the calculation methods used in this work are reported below. Because this assessment uses the ecoinvent database (v3.6) as its source of generic, background data, the compatibility with that database of all the methods used has been checked.

Indicators from life cycle assessment

Environmental impacts are calculated using standard methods specified in EN 15804+A2, applying the relevant characterisation factors published by the European Commission's Joint Research Centre. It is worth noting that the published version of the Abiotic Resource Depletion (Elements) LCIA method only includes characterisation factors for 90 of the 100+ elements in the periodic table, and does not include factors for rare-earth elements. Elements seldom occur in nature in the uncombined state: rather they occur as compounds in minerals. In this assessment, factors have been assigned to minerals following the method used by the ecoinvent Centre and described in Frischknecht & Jungbluth *et al*, 2007a (p.27).

Other indicators

Cumulative energy demand (CED) is used to derive PE(N)RT. The method counts all hydro-power as renewable energy, and all nuclear power as non-renewable. The primary energy in materials indicators (PERM, PENRM) are calculated from PERM values or - where those are not available - calorific values (NCV) of constituents of the product itself where these can be obtained from sources considered to be reliable.

It is important to note that although the CED method and the ADPF method produce results in the same unit (MJ-eq), they are different assessment methods. The characterisation factors for generic fossil fuels are the same in both methods used here. Other characterisation factors for these generic fuels are available and valid for CED, therefore care should be exercised when comparing energy indicators declared in different EPD. The ADPF method claims to use characterisation factors based on Net Calorific Value (NCV), but the calorific value of fossil hydrocarbon materials vary widely. For example, in the UK Greenhouse Gas National Inventory Report (2013 data as presented in the National Inventory Report to be published in 2015) NCVs of 24.4, 25.0, 27.5 and 28.1 MJ/kg are quoted for coal *used* in the UK, according to industrial sector; GCVs are 1.5MJ/kg greater in each case. On the other hand, US Energy Information Administration statistics indicate that the average GCV of coal *produced* in the USA was c.19.5GJ/tonne during 2013-14[19].

The secondary material indicator reflects the quantity of material that has passed the "end-of-waste" state used in the system.

Net use of fresh water is calculated as the difference between inflows of water resources and outflows of water returned to the water environment that are registered in the life cycle inventory (LCI). One feature of previous versions of the ecoinvent database (versions up to v2.2) was that uncontaminated water releases from processes are not all included, and many processes were not water balanced (Frischknecht & Jungbluth *et al*, 2007b (p.33). In ecoinvent v3.x, as used here, processes are water-balanced (Moreno Ruiz *et al*, 2013), so the simple difference between resource inflows and flows returning to the water environment is taken to represent net use. However, it is likely that results for this indicator when ecoinvent v3.x is used as the source of generic data will differ from those obtained where earlier versions have been used. Note that the concept of "use" in this context is not defined in EN 15804, although ISO14046:2015 provides a definition. In the approach taken here, water evaporated in processes is considered to be water "used".

[19] U.S. Energy Information Administration. December 2015 Monthly Energy Review, Table A5

Non-hazardous and hazardous wastes are not exchanged between the product system and the environment, because all wastes are assumed to be treated. The emissions from those treatment processes (which include landfill) affect the environment and feature in a normal life cycle inventory. To calculate the hazardous and non-hazardous waste indicators required by EN 15804, wastes flowing into treatment processes are classified as either non-hazardous or hazardous; these flows are then added together across the whole product system to generate the indicator values.

The classification of wastes into hazardous or non-hazardous already present in the ecoinvent database has been retained, with the European Waste Catalogue used to resolve uncertainties about highly significant flows. Clients are advised that the classification of wastes from generic processes as "hazardous" involves a considerable degree of judgement, since many wastes with similar descriptions can be either hazardous or non-hazardous. We also stress that the values of these waste indicators have very little significance as indicators of actual, or potential, environmental effects[20].

EN 15804 requires that radioactive waste arisings are quoted in mass terms. Here, this radioactive waste indicator is calculated from the life cycle inventory item "volume of final storage occupied". The densities used to convert from volumes to mass are those quoted in the ecoinvent unit process data.

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[20] See Nature, vol. 495, issue 7440 (14/03/2013) ppS5-S6 for an example

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