Environmental Product Declaration

In accordance with ISO 14025 and EN 15804+A1 for:

VFL500 SERIES

WE-EF LEUCHTEN GmbH

Programme: The International EPD® System, www.environdec.com
Programme operator: EPD International AB
EPD registration number: S-P-02405

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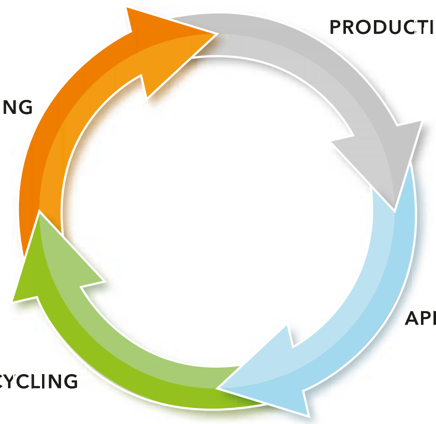
Geographical scope of EPD: Germany

Life Cycle Assessment

WE-EF was one of the first organisations in the lighting industry to provide EPDs (Environmental Product Declarations) in accordance with ISO 14025 and EN 15804 standards. These EPDs entail detailed documentation on the environmental footprint of our outdoor luminaires over all phases of their life cycle. To compile the required information, we collaborate closely with external specialists in life cycle analysis.

EPDs are product specific data sheets that contain verifiable and easily comparable information on the environmental impact of any given product. They document this impact not only for the time in which the product is actively used, but across its entire life cycle, from raw material extraction to recycling. For investors, operators and designers who care for the sustainability of their projects, this information is vital for sourcing decisions.

Prime concern of this life cycle assessment are luminaires for street and area lighting. The EPDs for these luminaires as well as detailed additional information and environmental performance statements are available online at our website.



WE-EF consider the entire process of a luminaires design life as a continous cycle. Each of the four major processes (Design and Engineering, Production, Application and Recycling) has a role in responsible environmental management, from reducing energy consumption and material inputs to controlling unnecessary light pollution. It is the Total Cost of Ownership.

Life Assessment Cycle quantifies the potential lighting in five different areas

Ozone layer

Damage to the protective ozone layer in the atmosphere

Breathing air

Smog

Global Warming

The emission of green house gas

Eco Systems

The acidification of water and soil

Non-renewable energy sources

The depletion of non-renewable energy resources

WE-EF and the environment

WE-EF recognises the importance of good environmental practices. Our entire operation from product design through to the production process and subsequent product application is based on the principle of environmental protection and the most effective use of resources. The most recent environmental legislation is strictly adhered to.

Our most significant contribution to the environment is the creation of products that are engineered to endure, essentially minimising the need to replace or recycle them for many years.

The longevity of our products is a major asset for our customers – and, at the same time, a significant contribution to the protection of our environment: Durable products need to be replaced and recycled far less often, saving energy and resources.

Penguin Parade, Phillips Island Nature Park
Victoria (AU)

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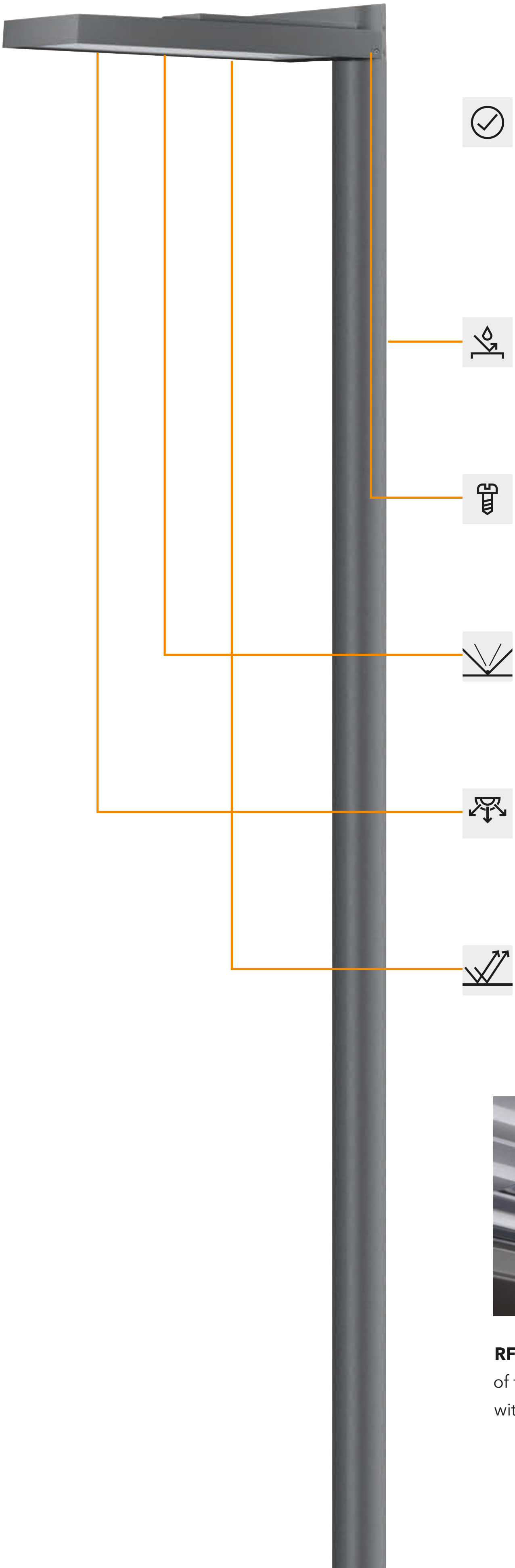


Marine-grade, all-aluminium construction
- Die-cast aluminium alloy luminaire body
- Extruded aluminium alloy pole section

FS Factory-sealed
Luminaire does not need to be opened during installation. This unique feature is found in the majority of WE-EF's LED luminaires that consequently do not need to be opened during installation. A contractor's job has never been faster, more economical and straightforward.

5CE Superior Corrosion Protection
Five Critical Elements provide outstanding and long-lasting anti-corrosion properties

PCS Hardware
- Austenitic stainless steel
- Tough, impregnated polymer coating
- Non-metallic barrier, protects against galvanic corrosion

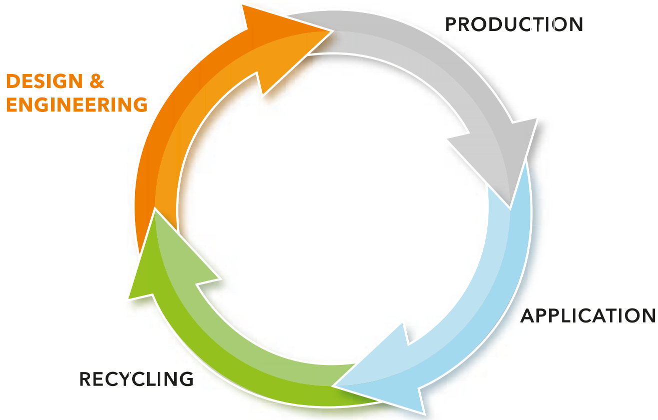
IOS® Innovative Optical System
- CAD-optimised for superior illumination and glare control
- Dark sky compliant

RFC® Main Lens
Reflection Free Contour delivers high light transmission

OLC® One LED Concept
Lens system follow the approach of the 'multi-layer' principle. These layers result in a uniform and efficient illumination

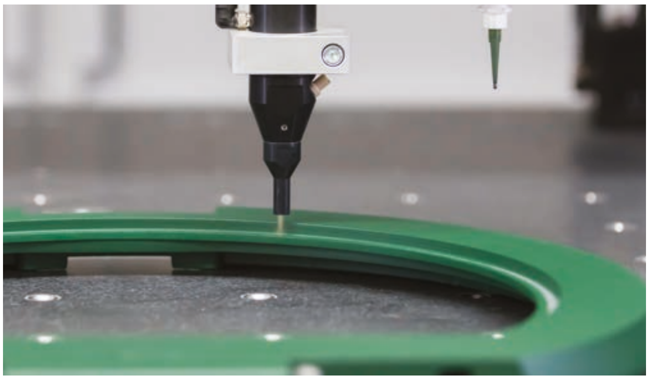
RFC® Main Lens: The contour of the main lens follows the shape of the individual LED lens, thereby minimising internal reflections within the luminaire.

DESIGN AND ENGINEERING



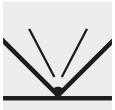
The timeless design of WE-EF luminaires is a reflection of their longevity. The way we see it, environmentally friendly engineering that accepts and masters the challenges of our times involves selecting materials and processes according to ecological criteria, high IP protection classes, efficient thermal management and IOS® Innovative Optical Systems. The development of high-quality, efficient reflector and lens technologies meeting these standards – IOS® – is one of WE-EF's core competences.

Meeting international lighting and safety standards comes as naturally to our luminaires as matching the requirements of the Dark Sky organisations. It is one of the reasons why we constantly invest in research and development.



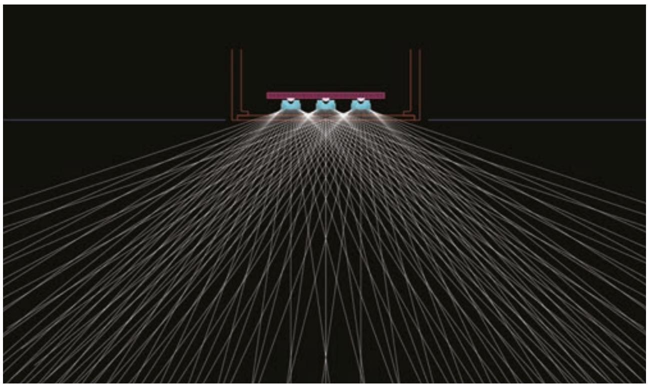
Lighting Performance

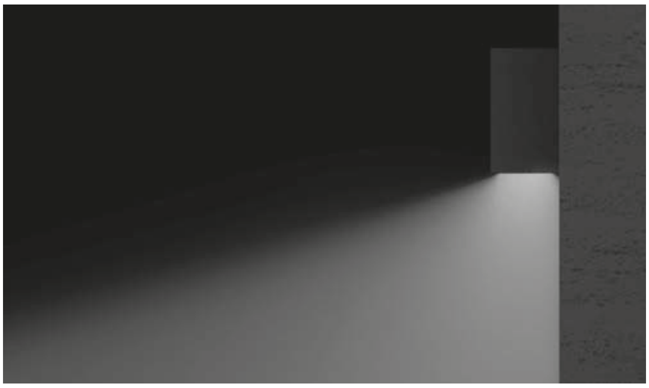
IOS® Innovative Optical System



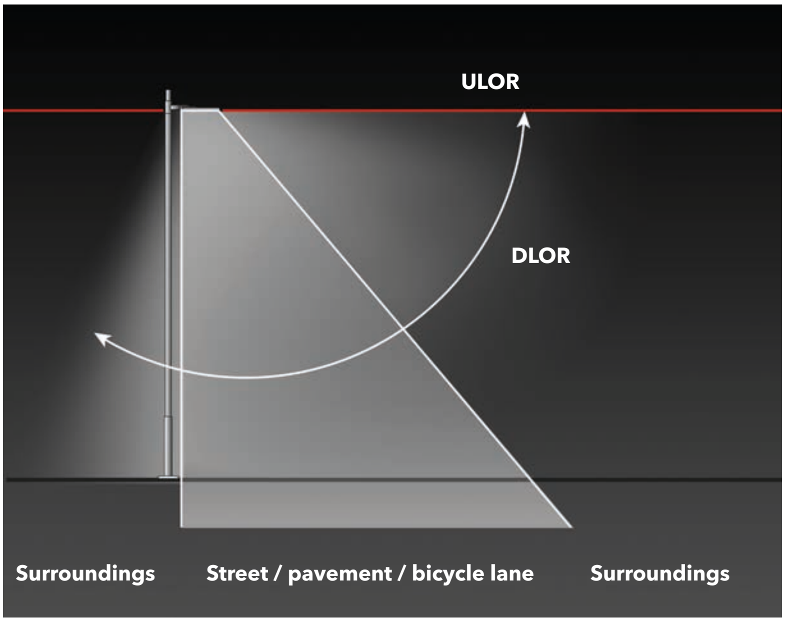
IOS® is a complete system that provides solutions. It applies across the WE-EF range of luminaires.

In-house CAD design of lenses
- Delivers tightly controlled light distribution
- High efficiency
- Minimum light spill outside the field angle





High photometric performance, beam efficiency and control
- Street and area lighting features full cut-off light distribution
- Zero light emission above 90° horizontal
- Solutions to light trespass and dark sky concerns
- Strict control in 80° – 90° zone

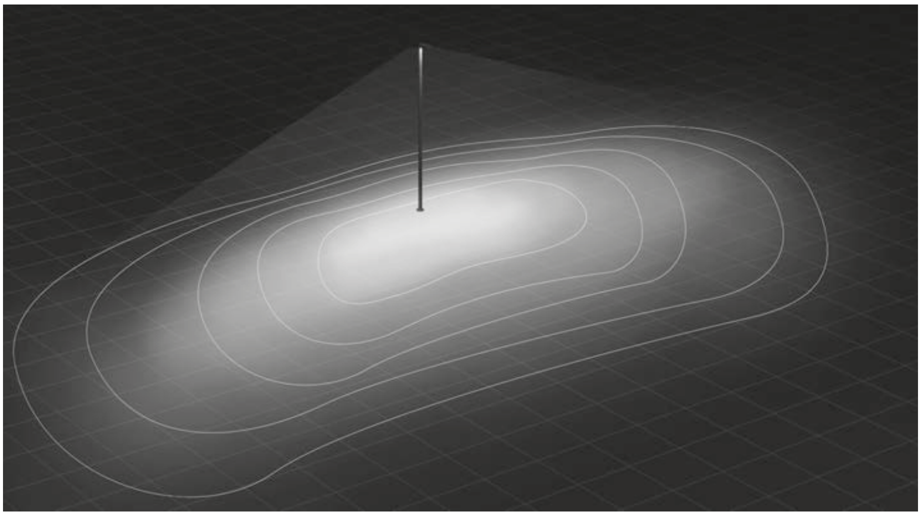


ULOR: The main purpose of an optical system is to direct light onto a specified target surface. Particularly in street lighting applications, any amount of light that is emitted above the horizontal, must be considered not merely as being wasteful, but equally so as polluting the night sky.

The Upward Light Output Ratio (ULOR) is a measure of how much light escapes from a luminaire into the sky. Obviously, a ULOR of zero percent is desirable. The better the optical system, the lower the burden on our environment.

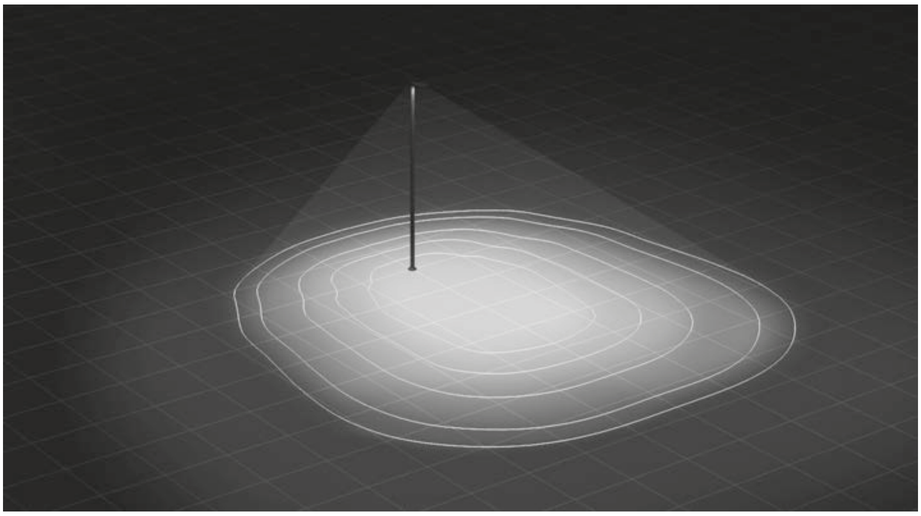
IOS® Innovative Optical System

IOS® optics for street and area lighting applications currently comprise 11 distinctly different versions for distinctly different applications and counting. Below are same of the common light distributions used in street and area lighting.



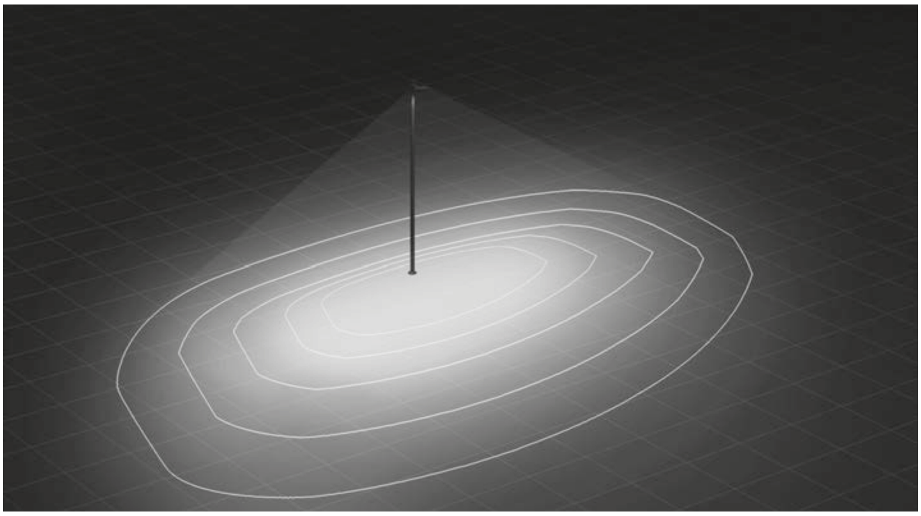
[S70] Streetlighting

Optimised for illuminance-based street lighting applications (maximum spacing between luminaires).



[A60] Asymmetric 'forward throw'

Particularly suitable for area lighting such as car parks etc.

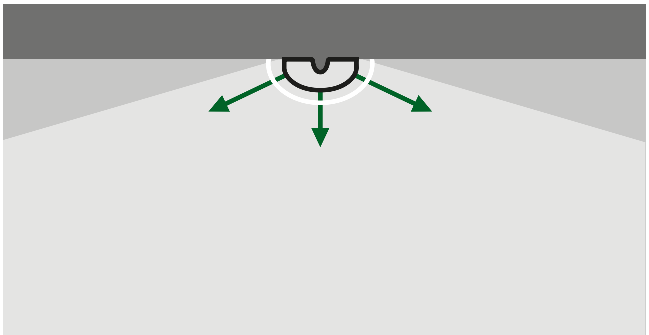


[R65] Rectangular 'side throw'

Developed for area lighting applications where a combination of side and forward throw of light is required.

RFC® Reflection Free Contour

- UV-stabilised main lens shaped to fit directional light
- Increase better light output energy saving, resulting from using less luminaires
- Improves light transmission by 20% – 30% at critical angle

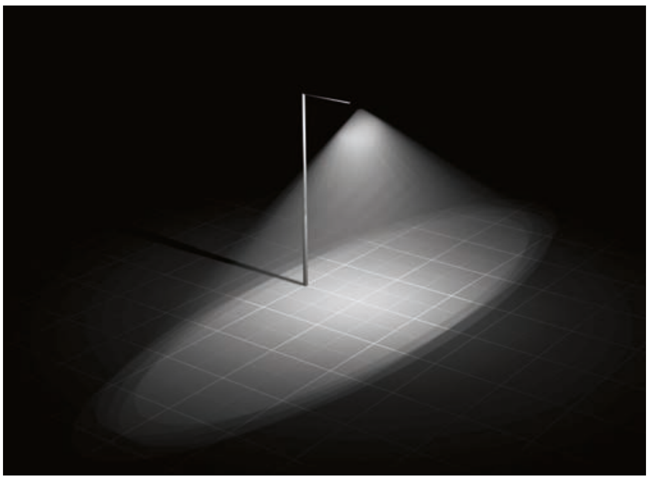


RFC® technology delivers high light transmission

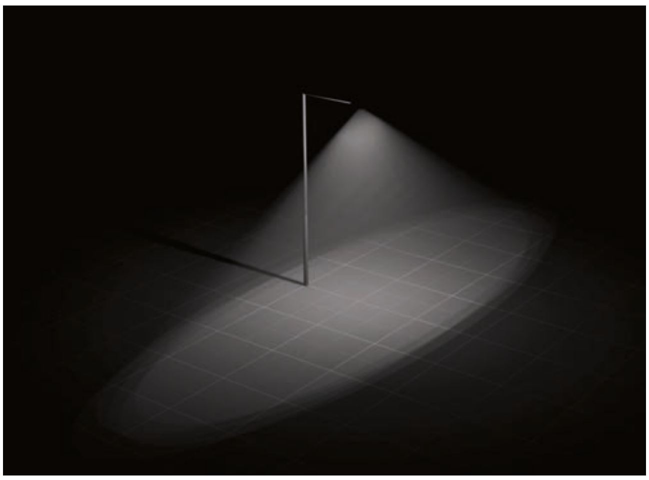
- Follow the shape of the LED
- Minimise the loss of light that occurs in the internal reflection

OLC® One LED Concept

- CAD design lenses set to aim in the same direction
- In case of LED failure, light levels drop however uniformity remains
- Replaceable LEDs and PCBs in case of failure and upgrade

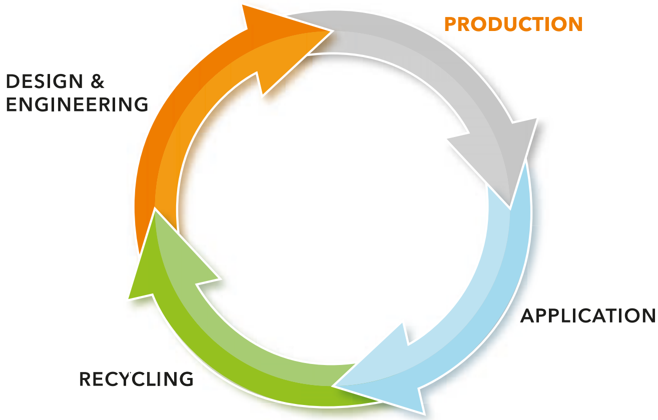


WE-EF's multi-layer technique – 100% light



WE-EF's multi-layer technique – 70%

PRODUCTION



''Made by WE-EF'' is more than just a phrase – it is the summation of the philosophy behind our high production depth. Our means of manufacturing range from tool-making for die-casting and injection moulding equipment to aluminium die-casting, CNC production, CNC sheet metal working, powder coating and pole production to pre- and end-assembly.

5CE Superior Corrosion Protection

A decisive quality feature for exterior luminaires is their resistance to corrosion. Outstanding and long-lasting anti-corrosion properties can only be achieved by a comprehensive, integrated approach. The result of many years of research and development, hands-on testing and experience,

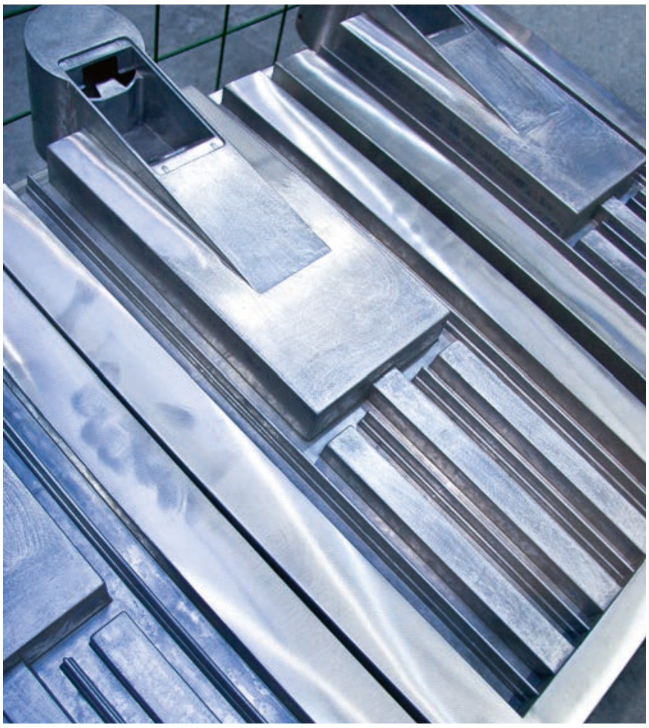
WE-EF's unique 5CE system encompasses five critical elements:

Substrate → Conversion coating → Powder → PCS hardware → Process control

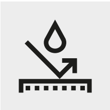
Substrate
A marine-grade, low copper content aluminium alloy is used for all WE-EF above ground luminaires.

Conversion Coating
The multi-step pre-treatment and conversion coating process includes degreasing, deoxidising, etching and depending on product, non-hazardous trivalent chromium or zirconium conversion coating. Both are considered the most effective conversion coats available for aluminium substrates.

Powder
WE-EF uses special UV-stabilised, architectural grade polyester powder, which is electrostatically bonded (60-100 µm) and oven cured at ~ 200°C. The grade of polyester powder applied is based on saturated polyester resins.



5CE Superior Corrosion Protection



For installations where corrosion protection over and above the 5CE system is required,

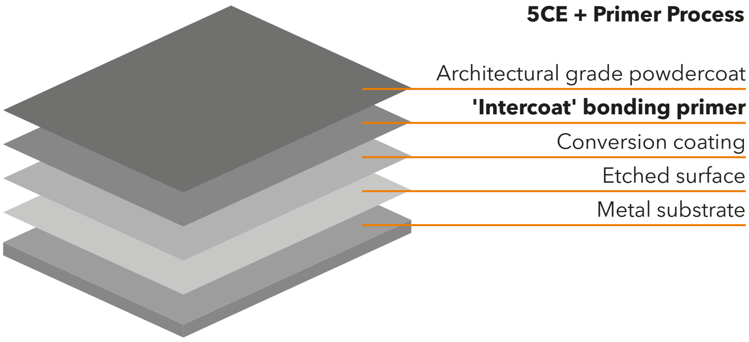
5CE + Primer introduces an additional element to the process:

Substrate → Conversion coating + Primer → Powder → PCS hardware → Process control

Primer

Immediately after conversion coating, a specially formulated 'intercoat' bonding, epoxy primer is electrostatically bonded (80-100 µm), and initially semi-cured in a 180°C oven. Following the subsequent application of the polyester powder top coat, full curing and essential 'intercoat' bond is achieved at 200°C. Top coat and primer are perfectly merged. The 5CE + Primer anti-corrosion technology is available on request for most luminaires from the WE-EF range.

5CE + Primer Process

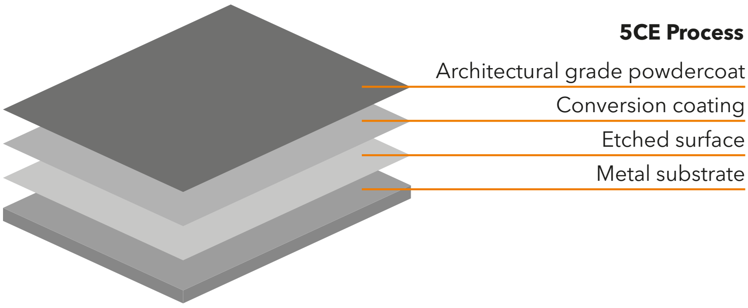


5CE tested to withstand any environment

PCS Hardware

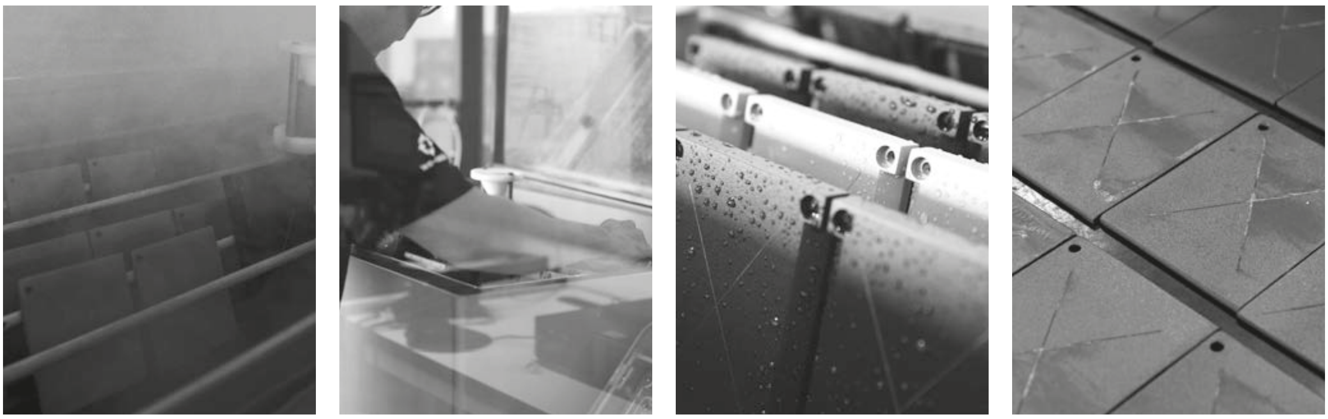
In the context of 5CE, WE-EF only uses hardware made from austenitic stainless steel, and additionally sealed with a tough, impregnated polymer coat that fulfills two functions:

- Reduced friction between male and female thread causes tighter fit between connected parts.
- Non-metallic barrier between the two metals, aluminium and steel, prevents galvanic corrosion that otherwise occurs when metals of dissimilar electro-negativities are in contact.



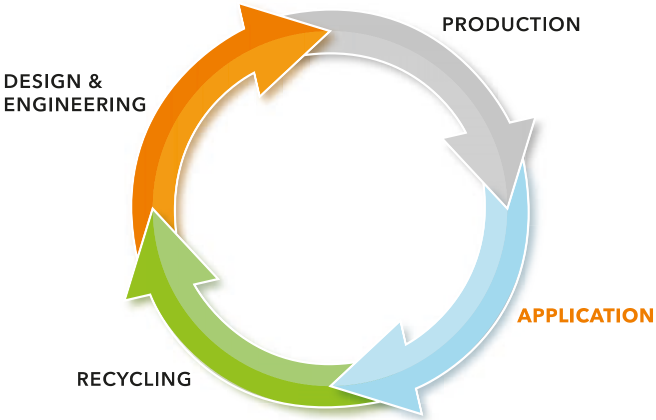
Process Control

All materials and production steps at WE-EF are part of a tightly controlled process under ISO 9001 quality assurance. It includes ongoing spectrometer analysis of aluminium alloy used, daily checks of chemical concentration in the pre-treatment phase, quality control checks on finished parts, up to 3,000 hours salt spray exposure tests etc.



Salt spray testing

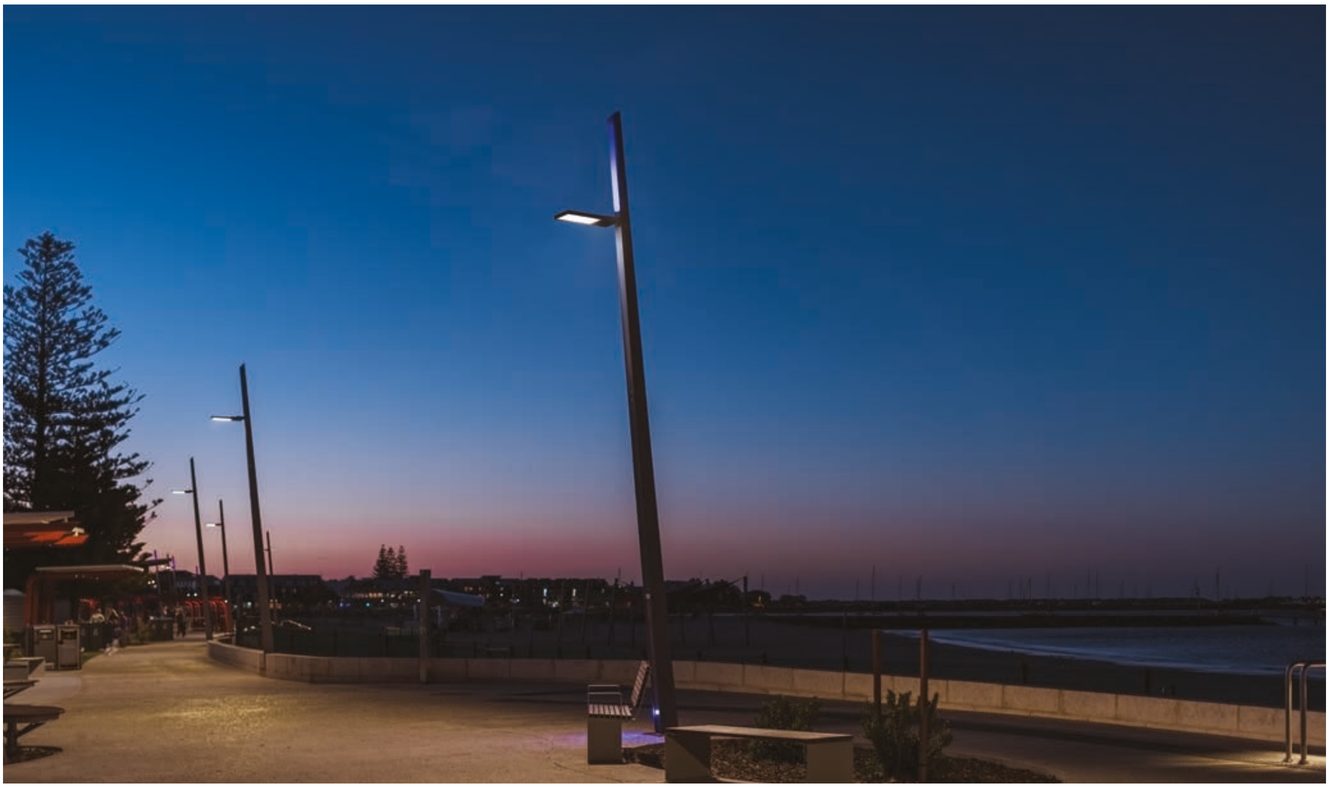
APPLICATION



Each lighting project will have its unique characteristics and accordingly its challenges. Achieving a desired outcome balanced against the demands of environmental protection, lighting standards, public health and safety, and budgets can complicate the lighting design process.

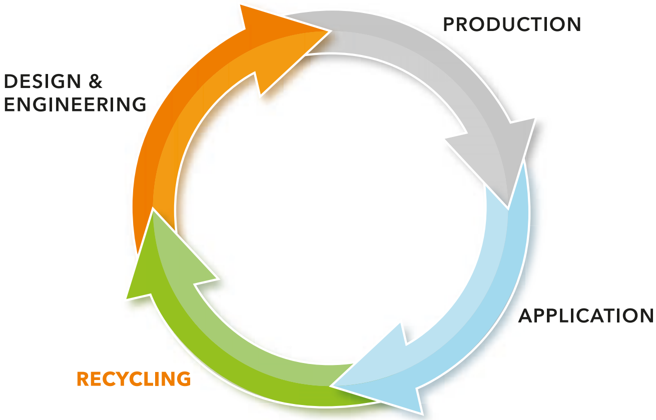
WE-EF encourages a collaborative approach on lighting projects as a way to find the solutions that work.

By using innovative light sources in combination with appropriately adapted optics, we achieve the optimum product characteristics for any given application.



Boardwalk, Koombana Bay
Bunbury (AU)

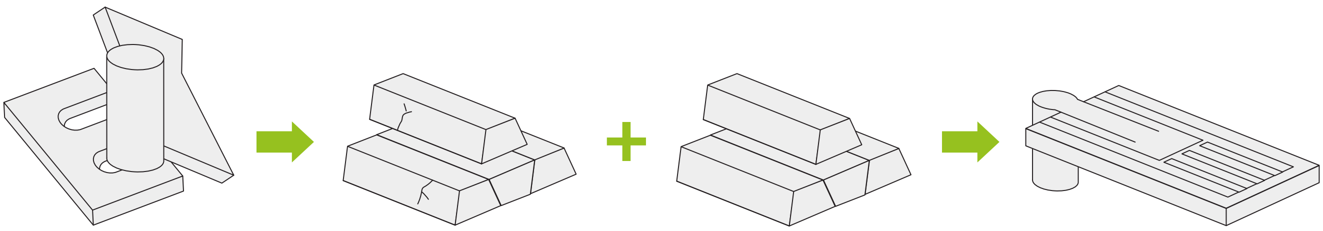
RECYCLING



We began with an aluminium substrate that was sourced from 90% authentic, refined, recycled aluminium. At end of life approximately 90% of a WE-EF luminaire is recyclable, based on weight. Materials that can be recycled from the luminaire are as follows

- Aluminium
- Plastic Material
- Galvanised Sheet Metal

Our luminaire housings are made of high-grade, recycled aluminium alloy that can be recycled repeatedly without loss of quality. All packaging material used by WE-EF are also fully recyclable and contain no dangerous chemicals. Compliance with WEEE and RHoS also ensure latest standards are adhered to. WE-EF are also members of Interseroh, who handle the recycling of all packaging material.



Products covered by EPD

This EPD is for the VFL540, VFL530 and VFL520 luminaires, which are pole mounted luminaires with street lighting distributions. The following luminaires are IP66 classification with IK08 rating.

Luminaire housing:	Marine-grade, die-cast aluminium alloy
Corrosion protection:	5CE, including PCS hardware
Driver:	Integral EC electronic converter in thermally-shielded compartment
Main lens:	RFC® Reflection Free Contour
	Polycarbonate, UV stablised
Gasketing:	Silicone CCG® Controlled Compression Gasket
Optics:	IOS® Innovative Optical System
	CAD-optimised for superior illumination and glare control
	OLC® One LED Concept
Installation:	FS Factory-sealed luminaire does not need to be opened during installation

Maximum spacing for streetlighting applications depends on wattage and light distribution: 5.5 to 9 times the mounting height.

BMW Hauptstadtrepräsentanz am Messedamm
Berlin (DE)

Table 1: Industry classification

Product	Classification	Code	Category
VFL540 VFL530 VFL520	UN CPC Ver.2.1	46539	Other electric lamps and lighting fittings (including lamps and lighting fittings of a kind used for lighting public open spaces or thoroughfares)
	EN 13201	0.0415	Main and minor road lighting, class S1-S6

Table 2: Product specifications

Product	Mass [kg]	Max Wattage [W]	Electricity Consumption [kWh/y]	Colour Temperature [K]	Luminous Efficacy [lm/W]
VFL540	9.76	139	405.88	4000	119
VFL530	8.12	81	236.52	4000	117
VFL520	6.07	43	125.56	4000	110

Declared unit & reference service life

The declared unit for the EPD is one luminaire, installed in place as a street light and operational for 20 years (73,000 hours) in Germany. The reference service life of the product is 20 years.

Rated service life LxBy (h): The number of hours after which: Requirement L90B10 – 90,000 h means that after 90,000 hours the group of LED luminaires in question must still provide 90% of the initial luminous flux, whereby 10% of the LED luminaires in question are permitted to provide less than 90% of the initial luminous flux.

Content declaration

The primary materials and components in the products are provided below. The product does not contain any harmful substances and does not produce harmful emissions in use. Packaging materials are a cardboard folding box (1.45 kg) and slotted plate (0.05 kg) with expanded polystyrene (0.05 kg) corners.

Table 3: Content declaration (kg)

Module	Component	VFL540	VFL530	VFL520
Main body	Aluminium frame	1.02	0.85	0.72
	Aluminium housing	4.69	3.82	3.06
	Aluminium cover plate	0.0506	0.0506	0.0506
	Steel chassis	0.430	0.400	0.214
	Holder plate (steel)	0.00655	0.00655	0.00655
	Silicone seal	2.00	1.80	1.10
Lamp	6 LED PWB	0.104	0.104	0.078
	9 LED PWB	0.076		
	PMMA lens	0.437	0.397	0.280
Electronics	Power control gear	0.320	0.160	0.080
	PWB housing	0.12	0.06	0.03
	Cabling	0.22	0.22	0.22
Minor components	Miscellaneous (e.g. screws, plugs, labels, stickers etc.)	0.096	0.096	0.096
Coating	Powder coating (on main body)	0.186	0.154	0.122
Packaging	Cardboard	1.50	1.50	1.50
	Expanded polystyrene (EPS)	0.05	0.05	0.05
Total	Total without packaging	9.76	8.12	6.07
	Total with packaging	11.3	9.67	7.62

Manufacturing process

WE-EF manufacturing range from tool-making for die-casting and injection moulding equipment to aluminium die-casting, CNC production, CNC sheet metal working, powder coating and pole production to pre- and end-assembly. To meet our high-quality standards, we continuously invest in tools, production facilities and the training of our staff.

SYSTEM BOUNDARIES

As shown in the table below, this EPD is of the 'cradle-to-gate' type with options . The options include the construction process stage (Modules A4-A5), use stage replacement (B4) and operational energy use (B6), end-of-life transport and processing (Modules C2-C4) and recycling potential (Module D). Other life cycle stages (Modules B1-B3, B5, B7, and C1) are dependent on particular scenarios and best modelled at the infrastructure project level.

Table 4: Modules included in the scope of the EPD

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	• Reuse • Recovery • Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	X	MND	X	MND	MND	X	X	X	X

X = included in the EPD
MND = Module not declared (such a declaration shall not be regarded as an indicator result of zero)

Production (Module A)

The production stage includes the environmental impacts associated with raw materials extraction and processing of inputs, transport to, between and within the manufacturing site, manufacturing of average product at the exit gate of the manufacturing site.

The construction process stage includes the environmental impacts associated with transport of the product to site and its installation, including disposal of associated waste. The installation materials (e.g. pole and cabling) have been excluded from this study.

Use stage (Module B)

The use stage includes the emissions and resource consumption associated with the use of construction products, equipment and services in their proper function. The replacement module (B4) is included for the electronic control gear at 50,000 hours of operation, and for LED PWBs at 90,000 hours of operation. This equates to the replacement of the electronic control gear and LED PWBs once during the Reference Service Life. The operational energy use of the luminaires is calculated based on manufacturer data.

End of life (Module C)

When an infrastructure project reaches its end-of-life, lighting products are disposed of. Waste processing includes collection of waste fractions from the deconstruction and waste processing of material flows intended for reuse, recycling and energy recovery.

This study considers the disassembly of the luminaires into components. Metal components are recycled. Plastic components are incinerated, and incineration emissions declared since the R1-value is < 0.6. Electronic components including cabling are shredded for recovery of precious metals, with the remainder incinerated. A collection rate of 75% is assumed for electronic components, with the remainder sent to landfill (C4).

Recovery and recycling potential (Module D)

The recovery and recycling potential module considers the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system e.g. as secondary materials or fuels. A credit is calculated for the net scrap sent to recycling by comparing the impacts associated with primary and secondary production.

This study includes the recovery of material (metal scrap) arising from the product stage, use stage (B4, replacement) and the end-of-life stage (C3 waste processing) that can be used in a second life cycle. Scrap metals arising through the life cycle are collected for recycling, including precious metals (copper, gold, palladium, platinum, and silver) used in the electronic components and cabling, as well as aluminium, steel, and stainless steel used in the body.

Life cycle inventory (LCI) data and assumption

This EPD is based on an original study from 2012, based on WE-EF's 2011 production year. Primary data were used for all manufacturing operations up to the factory gate, including upstream data for die-casting of aluminium house and frame parts as shown in **Figure 1**. WE-EF confirmed that the primary data for their operations sourced for the production year 2011 remained unchanged. Background data was used for input materials sourced from other suppliers.

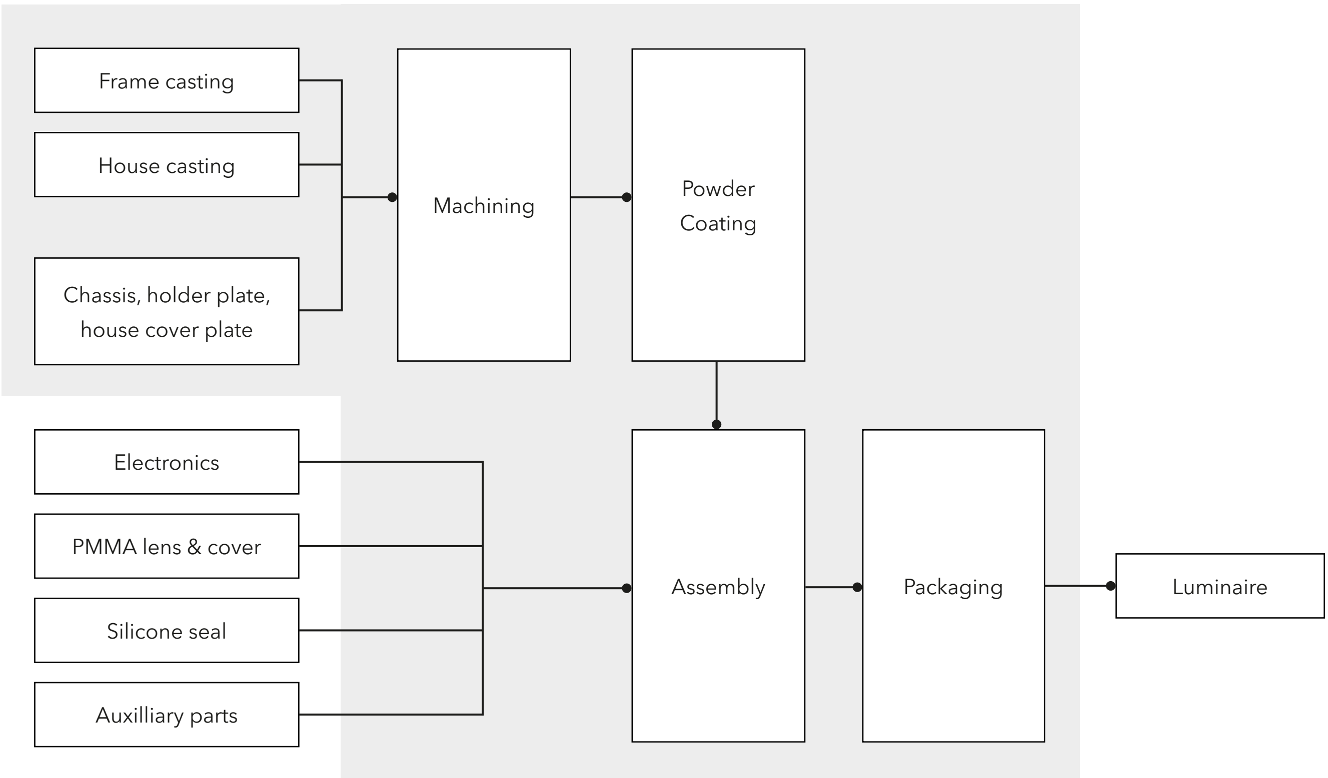


Figure 1: Product stage (cradle to gate) flowchart

All data in the background system were from the GaBi Life Cycle Inventory Database 2020 (Sphera 2020). Most datasets have a reference year between 2016 and 2019 and all fall within the 10 year limit allowable for generic data under EN 15804.

Differences to original EPD

The original EPD was published under the IBU programme. The underlying primary data for the production processes remains the same, but there are a number of changes compared to the original study. The most significant are listed here:

- The maximum wattage of the luminaires has increased, leading to increased electricity consumption across the reference service life.
- The mass of some components (steel chassis, silicone seal and PMMA lens) has been updated, affecting the upstream impacts and also the A4 and C2 transport steps.
- The aluminium input to the die-casting processes has been changed from primary to secondary, to reflect the actual production process.

This has reduced the A1-A3 impacts and the relative significance of aluminium, but note that this is an improvement in modelling and not a change in the production process. The transport of raw materials has also been improved to include the inbound transport of the aluminium to the die-casting process.

Upstream data

Raw materials used in the product are sourced from Germany. The datasets used for raw materials in the supply chain were sourced from Germany, except for operational materials used in Thailand and Taiwan, which were specific to the country of use.

Electricity

National electricity mixes were used throughout, including Thai and Taiwanese grid mixes for relevant production steps and a German grid mix for all other electricity consumption.

Recycling

It is assumed the luminaires will be decommissioned and dismantled, since they contain valuable materials. The collection rate is therefore assumed to be 100% for the luminaire assemblies. A conservative assumption is made that only 75% of precious metals are recovered from electronic components, with the remainder being sent to inert landfill.

Cut off criteria

Items that represented less than 1% and sumed to less than 5% of the total input of mandatory modules (A1-A3) were excluded.
No excluded flows were of any known particular environmental concern.

Allocation

Where subdivision of processes was not possible, allocation rules listed in PCR chapter 7.7 have been applied. No allocation has been applied to the foreground processes in this study. In the modules (A1-A3), co-product allocations have only been made in background datasets.

End-of-life allocation follows the requirements of ISO 14044 section 4.3.4.3. Open scrap inputs from the production stage are subtracted from scrap to be recycled at end of life to give the net scrap output from the product life cycle. This remaining net scrap is sent to material recycling.

LCA SCENARIO AND ADDITIONAL TECHNICAL INFORMATION

Transport to the building site (A4)

Name	Unit	Value
Transport distance	km	1,500
Capacity utilisation (including empty runs)	%	61

Installation into the building (A5)

Name	Unit	Value
EPS packaging (incinerated)	kg	0.05
Cardboard packaging (recycled)	kg	1.5

Replacement (B4)

Name	Unit	VFL540	VFL530	VFL520
Replacement of control gear PWBs (50,000 hours) [number of pieces]	Number/RSL	4	2	1
Replacement of nine LED PWBs (90,000 hours) [number of pieces]	Number/RSL	2	n/a	n/a
Replacement of six LED PWBs (90,000 hours) [number of pieces]	Number/RSL	4	4	3
Disposal of replaced components (recycling) [kg]	kg	0.500	0.264	0.158

Reference service life (RSL)

Name	Unit	Value
Reference service life	years	20

Operational energy use (B6)

Name	Unit	VFL540	VFL530	VFL520
Electricity consumption (RSL)	kWh	8,120	4,730	2,510

End of life (C1-C4)

Name	Unit	VFL540	VFL530	VFL520
Recycling	kg	6.49	5.34	4.24
Waste incineration	kg	3.23	2.76	1.81
Landfill	kg	0.0415	0.0306	0.0253

Assessment indicators
The results tables describe the different environmental indicators for each product per declared unit, for each declared module. The first section of results contains the environmental impact indicators, describing the potential environmental impacts of the product as shown in **Table 5**.

The final section shows the resource indicators, describing the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water, as shown in **Table 6** sections display.

Table 5: Indicators for life cycle impact assessment

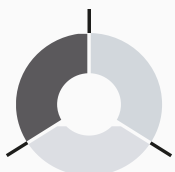
Abbreviation	Unit	Indicator
GWP	kg CO_2 eq.	Global warming potential
ODP	kg CFC 11 eq.	Ozone depletion potential
AP	kg SO_2 eq.	Acidification potential
EP	kg PO_4^{3-} eq.	Eutrophication potential
POCP	kg ethene eq.	Photochemical ozone creation potential
ADPE	kg Sb eq.	Abiotic depletion potential for non-fossil resources
ADPF	MJ	Abiotic depletion potential for fossil resources

Table 6: Life cycle inventory indicators on use of resources

Abbreviation	Unit	Indicator
PERE	MJ, net calorific value	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	MJ, net calorific value	Use of renewable primary energy resources used as raw materials
PERT	MJ, net calorific value	Total use of renewable primary energy resources
PENRE	MJ, net calorific value	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	MJ, net calorific value	Use of non-renewable primary energy resources used as raw materials
PENRT	MJ, net calorific value	Total use of non-renewable primary energy resources
SM	kg	Use of secondary material;
RSF	MJ, net calorific value	Use of renewable secondary fuels
NRSF	MJ, net calorific value	Use of non-renewable secondary fuels
FWT	m^3	Total use of net fresh water

Different stages of a product life cycle

End of life
When the luminaire has reached the end of life. We take into account the positive effect of the reuse materials



Production
We collect data from mining the raw material and transporting it to the factory

Operation
We measure the energy consumption of the luminaire installed on site as well as the impact of lamp replacement, and maintenance

Abbreviation	Unit	Indicator
HWD	kg	Hazardous waste disposed
NHWD	kg	Non-hazardous waste disposed
RWD	kg	Radioactive waste disposed
CRU	kg	Components for reuse
MER	kg	Materials for energy recovery
MFR	kg	Materials for recycling
EEE	MJ	Exported electrical energy
EET	MJ	Exported thermal energy

For WE-EF products, the following indicators are not relevant, hence result in zero values:
- Renewable primary energy resources as material utilisation (PERM)
- Use of renewable secondary fuels (RSF)
- Use of non-renewable secondary fuels (NRSF)
- Components for re-use (CRU)
- Exported electrical energy (EEE)
- Exported thermal energy (EET)

ENVIRONMENTAL PERFORMANCE – VFL540

Environmental impact	Unit	Production A1-A3	Installation A4	Installation A5	Use Stage B4	Use Stage B6	End-of-life C2	End-of-life C3	End-of-life C4	Mod D D
Global warming potential (total)	kg CO_2-eq.	64.0	0.0837	0.126	14.3	4,560	0.0722	7.35	5.66E-04	-37.1
Depletion potential of the stratospheric ozone layer	kg CFC 11-eq.	3.29E-10	2.78E-17	8.55E-17	2.94E-10	1.89E-10	2.39E-17	1.29E-14	3.11E-18	-5.31E-14
Acidification potential of land and water	kg SO_2-eq.	0.206	5.75E-05	1.40E-05	0.0764	5.40	4.97E-05	0.00115	3.60E-06	-0.166
Eutrophication potential	kg PO_4^{3-}-eq.	0.0208	1.08E-05	3.13E-06	0.00485	1.07	9.36E-06	2.60E-04	4.05E-07	-0.00866
Photochemical ozone creation potential	kg C_2H_4-eq.	0.0175	-1.95E-06	1.30E-06	0.00535	0.444	-1.69E-06	1.01E-04	2.73E-07	-0.00917
Abiotic depletion potential – elements	kg Sb-eq.	0.00173	7.06E-09	8.92E-10	0.00117	0.00176	6.09E-09	1.25E-07	5.71E-11	-0.00174
Abiotic depletion potential – fossil fuels	MJ	882	1.12	0.0534	167	45,300	0.970	5.05	0.00803	-391

Resource use

Resource use	Unit	A1-A3	A4	A5	B4	B6	C2	C3	C4	D
Renewable primary energy as energy carrier	MJ	276	0.0656	0.0153	36.4	33,000	0.0566	2.28	0.00108	-149
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	276	0.0656	0.0153	36.4	33,000	0.0566	2.28	0.00108	-149
Non-renewable primary energy as energy carrier	MJ	940	1.13	0.0589	184	57,400	0.972	5.89	0.00826	-481
Non-renewable primary energy as material utilization	MJ	19.9	0	0	3.26	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	960	1.13	0.0589	187	57,400	0.972	5.89	0.00826	-481
Use of secondary material	kg	1.91	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.303	5.88E-05	3.11E-04	0.0964	17.9	5.07E-05	0.0195	2.08E-06	-0.330

Waste categories and output flows

Waste categories and output flows	Unit	A1-A3	A4	A5	B4	B6	C2	C3	C4	D
Hazardous waste disposed	kg	1.73E-05	4.21E-08	2.25E-10	1.85E-06	3.86E-05	3.63E-08	1.54E-08	1.26E-10	-2.29E-07
Non-hazardous waste disposed	kg	4.71	1.98E-04	0.0132	1.03	44.2	1.71E-04	0.799	0.0415	-8.25
Radioactive waste disposed	kg	0.0309	1.19E-06	2.19E-06	0.00769	4.80	1.02E-06	3.29E-04	9.41E-08	-0.0355
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	1.50	0.0659	0	0	4.71	0	0
Materials for energy recovery	kg	0	0	0.0500	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0	0

ENVIRONMENTAL PERFORMANCE – VFL530

		Production	Installation		Use Stage		End-of-life			Mod D
Environmental impact	Unit	A1-A3	A4	A5	B4	B6	C2	C3	C4	D
Global warming potential (total)	kg CO_2-eq.	49.4	0.0716	0.126	7.70	2,650	0.0601	6.52	4.17E-04	-27.8
Depletion potential of the stratospheric ozone layer	kg CFC 11-eq.	1.82E-10	2.37E-17	8.55E-17	1.47E-10	1.10E-10	1.99E-17	1.22E-14	2.30E-18	-3.79E-14
Acidification potential of land and water	kg SO_2-eq.	0.109	4.92E-05	1.40E-05	0.0399	3.15	4.13E-05	0.00101	2.65E-06	-0.115
Eutrophication potential	kg PO_4^{3-}-eq.	0.0119	9.27E-06	3.13E-06	0.00261	0.621	7.79E-06	2.25E-04	2.98E-07	-0.00628
Photochemical ozone creation potential	kg C_2H_4-eq.	0.0113	-1.67E-06	1.30E-06	0.00283	0.259	-1.40E-06	8.95E-05	2.01E-07	-0.00647
Abiotic depletion potential – elements	kg Sb-eq.	0.00114	6.03E-09	8.92E-10	6.03E-04	0.00103	5.07E-09	1.18E-07	4.21E-11	-9.81E-04
Abiotic depletion potential – fossil fuels	MJ	695	0.961	0.0534	89.9	26,400	0.807	4.64	0.00592	-294

Resource use

Renewable primary energy as energy carrier	MJ	235	0.0561	0.0153	20.3	19,300	0.0471	2.16	7.98E-04	-113
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	235	0.0561	0.0153	20.3	19,300	0.0471	2.16	7.98E-04	-113
Non-renewable primary energy as energy carrier	MJ	741	0.964	0.0589	98.9	33,500	0.809	5.43	0.00610	-362
Non-renewable primary energy as material utilization	MJ	16.1	0	0	1.67	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	757	0.964	0.0589	101	33,500	0.809	5.43	0.00610	-362
Use of secondary material	kg	1.75	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.238	5.02E-05	3.11E-04	0.0523	10.4	4.22E-05	0.0170	1.54E-06	-0.249

Waste categories and output flows

Hazardous waste disposed	kg	1.62E-05	3.60E-08	2.25E-10	9.30E-07	2.25E-05	3.02E-08	1.36E-08	9.29E-11	-1.66E-07
Non-hazardous waste disposed	kg	3.92	1.69E-04	0.0132	0.554	25.8	1.42E-04	0.695	0.0306	-6.24
Radioactive waste disposed	kg	0.0244	1.01E-06	2.19E-06	0.00422	2.80	8.52E-07	3.12E-04	6.94E-08	-0.0270
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	1.50	0.0333	0	0	3.66	0	0
Materials for energy recovery	kg	0	0	0.0500	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0	0

ENVIRONMENTAL PERFORMANCE – VFL520

Environmental impact	Unit	Production A1-A3	Installation A4	Installation A5	Use Stage B4	Use Stage B6	End-of-life C2	End-of-life C3	End-of-life C4	Mod D D
Global warming potential (total)	kg CO_2-eq.	36.5	0.0564	0.126	4.86	1,410	0.0449	4.31	3.44E-04	-20.5
Depletion potential of the stratospheric ozone layer	kg CFC 11-eq.	1.08E-10	1.87E-17	8.55E-17	7.35E-11	5.83E-11	1.49E-17	1.07E-14	1.89E-18	-2.85E-14
Acidification potential of land and water	kg SO_2-eq.	0.0769	3.87E-05	1.40E-05	0.0232	1.67	3.09E-05	7.40E-04	2.19E-06	-0.0802
Eutrophication potential	kg PO_4^{3-}-eq.	0.00885	7.30E-06	3.13E-06	0.00164	0.330	5.81E-06	1.64E-04	2.46E-07	-0.00453
Photochemical ozone creation potential	kg C_2H_4-eq.	0.00830	-1.32E-06	1.30E-06	0.00170	0.137	-1.05E-06	6.50E-05	1.66E-07	-0.00457
Abiotic depletion potential – elements	kg Sb-eq.	7.96E-04	4.75E-09	8.92E-10	3.34E-04	5.45E-04	3.78E-09	1.02E-07	3.48E-11	-6.11E-04
Abiotic depletion potential – fossil fuels	MJ	524	0.757	0.0534	55.9	14,000	0.603	3.68	0.00489	-216

Resource use

Renewable primary energy as energy carrier	MJ	180	0.0442	0.0153	13.5	10,200	0.0352	1.88	6.59E-04	-84.4
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	180	0.0442	0.0153	13.5	10,200	0.0352	1.88	6.59E-04	-84.4
Non-renewable primary energy as energy carrier	MJ	558	0.759	0.0589	61.9	17,800	0.604	4.36	0.00503	-267
Non-renewable primary energy as material utilization	MJ	11.9	0	0	0.914	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	570	0.759	0.0589	62.8	17,800	0.604	4.36	0.00503	-267
Use of secondary material	kg	1.61	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.174	3.96E-05	3.11E-04	0.0337	5.53	3.15E-05	0.0114	1.27E-06	-0.185

Waste categories and output flows

Hazardous waste disposed	kg	1.52E-05	2.84E-08	2.25E-10	4.72E-07	1.20E-05	2.26E-08	9.42E-09	7.67E-11	-1.22E-07
Non-hazardous waste disposed	kg	2.80	1.33E-04	0.0132	0.350	13.7	1.06E-04	0.455	0.0253	-4.65
Radioactive waste disposed	kg	0.0180	7.99E-07	2.19E-06	0.00272	1.49	6.36E-07	2.72E-04	5.73E-08	-0.0201
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	1.50	0.0172	0	0	2.68	0	0
Materials for energy recovery	kg	0	0	0.0500	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0	0

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GENERAL INFORMATION

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

Declaration owner:

WE-EF LEUCHTEN GmbH

Web: www.we-ef.com
Email: info.germany@we-ef.com
Post: Toepinger Strasse 16, 29646 Bispingen, Germany
Reference year for data: 2019

EPD produced by:

thinkstep Pty Ltd

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Email: anz@thinkstep-anz.com
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EPD produced by:

The International EPD® System

Web: www.environdec.com
Email: info@environdec.com
Post: EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden

CEN standard EN 15804+A1 served as the core PCR

PCR:	PCR 2012:01 Construction products and construction services, version 2.33, 2020-09-18
PCR review was conducted by:	The Technical Committee of the International EPD® System
Chair:	Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ■ EPD verification (External)
Third party verifier:	Martin Erlandsson Email: martin.erlandsson@ivl.se
Verifier approved by:	The International EPD® System
Procedure for follow-up of data during EPD validity involved third-party verifier:	☐ Yes ■ No

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