Life cycle OVERALL DOCUMENTATION

Environmental Certificate Mercedes-Benz CLS

Mercedes-Benz
The best or nothing.

Index

Prepared by:

Daimler AG, Untertürkheim
Department: Group Environmental Protection, RD/RSE

As of: April 2018

Editorial

Dear readers,

The new CLS is the first Mercedes-Benz to be certified in accordance with the new WLTP test method (Euro 6d-TEMP). Customers benefit from the WLTP because it provides a more realistic standard of comparison for the consumption and emission figures of different vehicle models, and takes optional extras into account. However, the real consumption has always been decisive for Mercedes-Benz. An example: across the model range, our vehicles are leading in terms of aerodynamics.

Furthermore, environmental protection at Mercedes-Benz means much more than fuel consumption. Because the earlier this “Design for Environment” approach is integrated into the development process, the greater are the benefits in terms of minimized environmental impacts and costs.

It is likewise crucial to reduce the environmental impact caused by emissions and consumption of resources during the entire life cycle. This comprehensive and exhaustive Life Cycle Assessment (LCA) we call ‘360° environmental check‘. It scrutinizes all environmentally relevant aspects of a car‘s life: from manufacture of the raw materials to production, vehicle operation and then recycling at the end of the vehicle‘s life – a long way off in the case of a new Mercedes-Benz.

As well as documenting every last detail of this LCA in-house throughout the entire life cycle, we have the results checked and confirmed by independent assessors from the TÜV Süd inspection authority. Only then does a car receive its Environmental Certificate.

This brochure summarises the results of the LCA for you.

I hope you enjoy the informative and certainly entertaining article LifeCycle. By the way: this brochure is like all previously published LifeCycle brochures available for download from http://www.mercedes-benz.com.

Kind regards,

Dr. Sabine Lutz
Vice President Group Research, Sustainability & RD Functions

Validation

TÜV SÜD Management Service GmbH, supported by an external expert in the critical review, verified the Life Cycle Assessment study (LCA) of the following product-related environmental information of
Daimler AG, *Mercedesstraße 137, 70327 Stuttgart*, for the passenger car

„Environmental Certificate Mercedes-Benz CLS“

Verification was based on the requirements of the following standards and guidance documents in as far as applicable:

- EN ISO 14040/14044:2006 regarding the statements on the LCA of CLS 350 d 4MATIC and CLS 450 4MATIC (Principles and general requirements, definition of objective and scope of the LCA, life cycle inventory analysis, life cycle impact assessment, interpretation, critical review)
- ISO/TS 14071:2014 Environmental management - Life cycle assessment - Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006
- Technical Report DIN ISO/TR 14062 (Integration of environmental aspects into product design and development)
- EN ISO 14020 (Environmental labels and declarations. General principles) and EN ISO 14021 (Self-declared environmental claims)

Result:

1. The environmental certificate includes a comprehensive and appropriate presentation or interpretation of the results based on reliable and traceable information.
2. The LCA study on which the environmental certificate is based is in compliance with ISO 14040 and ISO 14044. The methods used and the modelling of the product system correspond to the state of the art. They are suitable for fulfilling the goals stated in the LCA study.
3. The assessed samples of data and environmental information included in the environmental certificate were traceable and plausible. Verification did not reveal any issues within the defined scope that compromised the validation in any way.

Verification process:
Verification of the LCA included a critical review of the methodology applied and – where relevant for the environmental certificate – a data-oriented audit of the LCA results and their interpretation in the form of interviews, inspections of technical documents and selective checks of the data entered in the LCA database (GaBi). LCA input data (including weights, materials and emissions) and other statements included in the environmental certificate (such as use of renewable raw materials und recyclates, recycling concept etc.) were traced back on random sample basis where possible to documents including official type approval documents, parts lists, supplier information, measurement results etc..
The input data fuel consumption and CO_2-emissions had been investigated by Daimler AG according to a procedure under surveillance of the German KBA and were not included in the data verification.

Independence of verifier:
Daimler AG has not placed any contracts for consultancy concerning product-related environmental aspects with TÜV SÜD, either in the past or at present. There are no areas of financial dependence or conflicts of interest between
TÜV SÜD Management Service GmbH and Daimler AG.

Responsibilities:
Sole liability for the content of the environmental certificate rests with Daimler AG. TÜV SÜD Management Service GmbH was commissioned to review said LCA study for compliance with the methodical requirements, and to verify and validate the correctness and credibility of the information included therein.

TÜV SÜD Management Service GmbH

Munich, 2018-04-23

Dipl.-Ing. Ulrich Wegner
Head of Certification Body

Michael Brunk
Lead auditor

1. General environmental issues

1.1 Product information

The third generation of the Mercedes-Benz CLS is powered by completely new engines: in-line six-cylinder and in-line four-cylinder units as diesel and petrol versions. Three six-cylinder models will be available on market launch.

The new, systematically electrified in-line six-cylinder with EQ Boost (integrated starter/generator) and a 48 volt onboard electrical system powers the CLS 450 4MATIC (combined fuel consumption[1] 7.8 - 7.5 l/100 km, CO_2 emissions combined[1] 184 - 178 g/km). The integrated electric motor known as EQ Boost assists the combustion engine e.g. when accelerating, makes driving without the combustion engine possible („sailing“) and supplies the battery with power by means of high-efficiency recuperation. By doing so it makes fuel savings possible that were previously the exclusive domain of high-voltage hybrid technology. All in all, the new in-line six-cylinder engine delivers the performance of an eight-cylinder engine with significantly lower consumption. The CLS 450 4MATIC is equipped with a particulate filter as standard.

The special traits of the top-of-the-line engine in the diesel family include the stepped-bowl combustion process, two-stage turbocharging and, for the first time, the use of CAMTRONIC variable valve-lift control. Its design features a combination of an aluminium engine block and steel pistons as well as further improved NANOSLIDE® coating of the cylinder walls. All components relevant to efficient emissions reduction have been installed directly on the engine. The six-cylinder diesel engine is used in the CLS 350 d 4MATIC (combined fuel consumption[1] 5,8-5,6 l/100km, CO_2-emissions combined[1] 156-148 g/km) and CLS 400 d 4MATIC (combined fuel consumption[1] 5,8-5,6 l/100 km, CO_2 emissions combined[1] 156-148 g/km) models.

The new CLS is the first model series from Daimler to be certified to the Euro 6d-TEMP emissions standard as planned and thereby using the new „WLTP“ test method.
Since 1 September 2017, a new method has been prescribed in the EU for measuring the fuel consumption and emissions of new passenger car models to be newly certified – the WLTP (Worldwide Harmonized Light Vehicles Test Procedure). This test will become mandatory for all newly registered passenger cars at the end of the year and will thereby gradually replace the New European Driving Cycle (NEDC).
In addition to the new WLTP driving cycle on the test bench, there will be an additional measurement on the road for compliance with the new Euro 6d-TEMP emissions standard. The additional procedure goes by the name „Real Driving Emissions“ (RDE) and is used to validate the emissions figures determined on the test bench also in real-life operations. The „road emission figure“ for nitrogen oxides including measuring tolerance may not exceed 2.1 times the laboratory limit.

In addition to the improvements to the vehicle, the driver also has a decisive influence on fuel consumption. So that the driver can check his driving style for efficiency and adapt it if necessary, the ECO display shows situation-specific an evaluation of his driving style in the instrument cluster by color-highlighted icons. Thanks to the new ECO display, the driver can learn to immediately implement the highest level of efficient driving and thus drive more efficiently. The CLS owner's manual also includes additional tips for an economical and environmentally friendly driving style. Furthermore, Mercedes-Benz offers its customers “Eco Driver Training”. The results of this training course have shown that adopting an efficient and energy-conscious style of driving can help to further reduce a car's fuel consumption.

The new CLS is also fit for the future when it comes to its fuels. The EU's plans make provision for an increasing proportion of biofuels to be used. It goes without saying that the CLS meets these requirements: in the case of petrol engines, a bioethanol content of 10 percent (E 10) is permitted.
A 10 percent biofuel component is also permitted for diesel engines in the form of 7 percent biodiesel (B 7 FAME) and 3 percent high-quality, hydrogenated vegetable oil.

---

[1] The stated figures were determined in accordance with the prescribed measuring method. These are the „NEDC CO_2 figures“according to Art. 2 No. 1 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures. The figures vary depending on the selected optional extras. The lifecycle assessment was calculated for the base versions (lowest consumption figures in each case).

1.2 Production

The CLS is built at the Mercedes plant in Sindelfingen. An environmental management system certified in accordance with EU eco-audit regulations and ISO standard 14001 has been in place at the Sindelfingen plant since 1995. The painting technology used at the Sindelfingen plant, for example, boasts a high standard not only in technological terms but also with regard to environmental protection and workplace safety. Service life and value retention are further increased through the use of a clear coat, whose state-of-the-art nanotechnology ensures much greater scratch-resistance than conventional paint. Through the use of water-based paints and fillers, solvent emissions have been drastically reduced.

Electricity and steam at the Sindelfingen factory are produced in the Daimler-own combined heat and power plant. The co-generation of electricity and heat requires 25% less fuel than separate generation. Continuous process optimisation also helps to save energy. For example, the optimisation of the energy requirements of the ventilation systems in assembly and the replacement of the control systems enabled savings of 1005 t of CO_2 per year.

1.3 After Sales

High environmental standards are also firmly established in the environmental management systems in the sales and after-sales sectors at Mercedes-Benz. At dealer level, Mercedes-Benz meets its product responsibility with the MeRSy recycling system for workshop waste, used parts and warranty parts and packaging materials. This exemplary service by an automotive manufacturer is implemented right down to customer level. The waste materials produced in our outlets during servicing and repairs are collected, reprocessed and recycled via a network operating throughout Germany. Classic components include bumpers, side panels, electronic scrap, glass and tyres.

The reuse of used parts also has a long tradition at Mercedes-Benz. The Mercedes-Benz Used Parts Center (GTC) was established back in 1996. With its quality-tested used parts, the GTC is an integral part of the service and parts operations for the Mercedes-Benz brand and makes an important contribution to the appropriately priced repair of Mercedes-Benz vehicles.

Although the reuse of Mercedes passenger cars lies in the distant future in view of their long service life, Mercedes-Benz offers a new, innovative procedure for the rapid disposal of vehicles in an environmentally friendly manner and free of charge. For convenient recycling, a comprehensive network of collection points and dismantling facilities is available to Mercedes customers. Owners of used cars can find out all the important details relating to the return of their vehicles via the free phone number 00800 1 777 7777.


S MB 1551

2. Life Cycle Assessment (LCA)

The environmental compatibility of a vehicle is determined by the environmental burden caused by emissions and the consumption of resources throughout the vehicle's lifecycle (cf. Figure 2-1). The standardised tool for evaluating a vehicle's environmental compatibility is the LCA. It comprises the total environmental impact of a vehicle from the cradle to the grave, in other words from raw material extraction through production and use up to recycling.

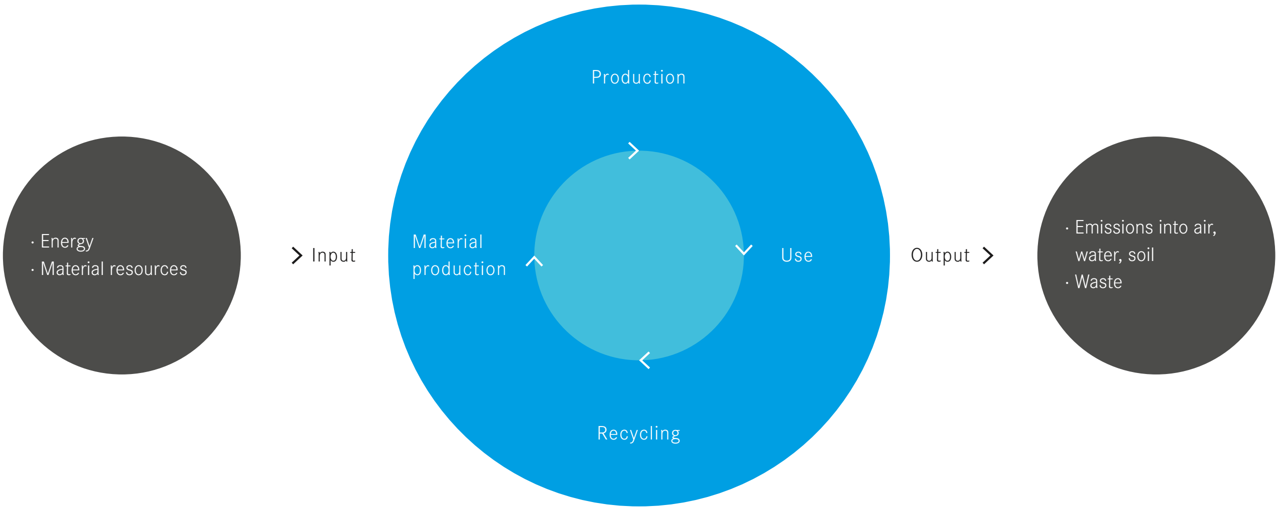
Life Cycle Assessments are used by the Mercedes-Benz passenger car development division for the evaluation and comparison of different vehicles, components, and technologies. The DIN EN ISO 14040 and DIN EN ISO 14044 standards prescribe the procedure and the required elements.

The elements of a Life Cycle Assessment are:

1. Goal and scope definition: define the objective and scope of an LCA.
2. Inventory analysis: encompasses the material and energy flows throughout all stages of a vehicle's life: how many kilograms of raw material are used, how much energy is consumed, what wastes and emissions are produced etc.
3. Impact assessment: gauges the potential effects of the product on the environment, such as global warming potential, summer smog potential, acidification potential, and eutrophication potential.
4. Interpretation: draws conclusions and makes recommendations.

The LCA results of the new CLS are shown in the following chapters. The main parameters of the LCA are documented in the glossary. The operation phase is calculated on the basis of a mileage of 250,000 kilometres.

Figure 2-1: Overview of the Life Cycle Assessment



2.1 Material composition new CLS 350 d 4MATIC

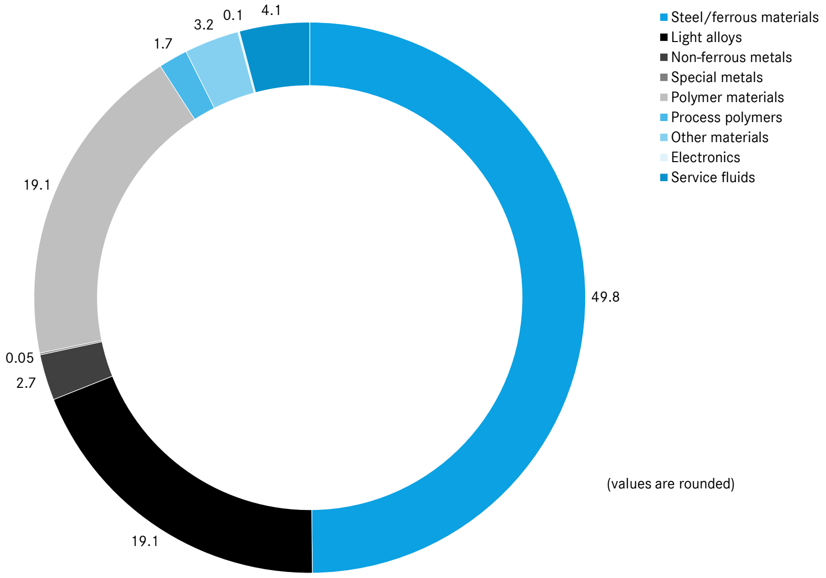
The weight and material data for the new CLS 350 d 4MATIC were determined on the basis of internal documentation of the components used in the vehicle (parts list, drawings). The “kerb weight according to DIN” (without driver and luggage, fuel tank 90 percent full) served as a basis for the recycling rate and LCA. Figure 2-2 shows the material composition of the new CLS 350 d 4MATIC in accordance with VDA 231-106.

Steel/ferrous materials account for slightly the half of the vehicle weight (49.8 percent) in the new CLS 350 d 4MATIC. These are followed by polymer materials at 19.1 percent and light alloys as third-largest group. Service fluids comprise around 4.1 percent. The proportions of other materials (e.g. glass) and non-ferrous metals are somewhat lower, at about 3.2 and 2.7 percent respectively. The remaining materials – process polymers, electronics, and special metals – contribute about 1.9 percent to the weight of the vehicle. In this study, the material class of process polymers largely comprises materials for the paint finish.

The polymers are divided into thermoplastics, elastomers, duromers and non-specific plastics, with the thermoplastics accounting for the largest proportion at 12.3 percent. Elastomers (predominantly tyres) are the second-largest group of polymers with 4.5 percent.

The service fluids include oils, fuels, coolants, refrigerants, brake fluid, and washer fluid. The electronics group only comprises circuit boards and their components. Cables and batteries have been allocated according to their material composition in each particular case.

Figure 2-2: Material composition of the new CLS 350 d 4MATIC [%]



(values are rounded)

2.2 LCA results for the new CLS 350 d 4MATIC

Over the entire lifecycle of the new CLS 350 d 4MATIC, the lifecycle inventory analysis yields a primary energy consumption of 782 gigajoules (corresponding to the energy content of around 21,700 litres of diesel), an environmental input of approx. 50 tonnes of carbon dioxide (CO_2), around 32 kilograms of non-methane volatile organic compounds (NMVOC), around 75 kilograms of nitrogen oxides (NO_X) and 37 kilograms of sulphur dioxide (SO_2). In addition to the analysis of the overall results, the distribution of individual environmental impacts over the various phases of the lifecycle is investigated. The relevance of the respective lifecycle phases depends on the particular environmental impact under consideration. For CO_2-emissions, and likewise for primary energy demand, the operating phase dominates with a share of 81 and 77 percent respectively (see Figure 2-3).

However, it is not the use of the vehicle alone which determines its environmental compatibility. Some environmentally relevant emissions are caused principally by manufacturing, for example SO_2 emissions (see Figure 2-5). The production phase must therefore be included in the analysis of ecological compatibility.

For the new CLS, the driving emissions (CO, HC and NO_X) as part of the lifecycle assessment were for the first time modelled based on limits; while for nitrogen oxides the RDE limits (Real Driving Emissions) applicable in normal driving were used. Compared to earlier studies, the proportion of these emissions in driving therefore increases over the entire lifecycle.

During the use phase of the vehicle, many of the emissions these days are dominated less by the actual operation of the vehicle and far more by the production of fuel, as for example in the case of the NMVOC and SO_2 emissions and the inherently associated environmental impacts such as the summer smog (POCP) and acidification potential (AP).

Figure 2-3: Overall carbon dioxide emissions (CO_2) in tons

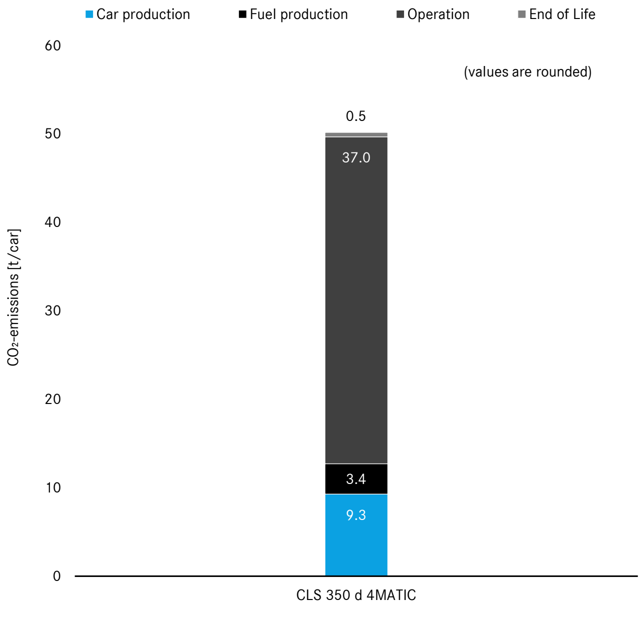
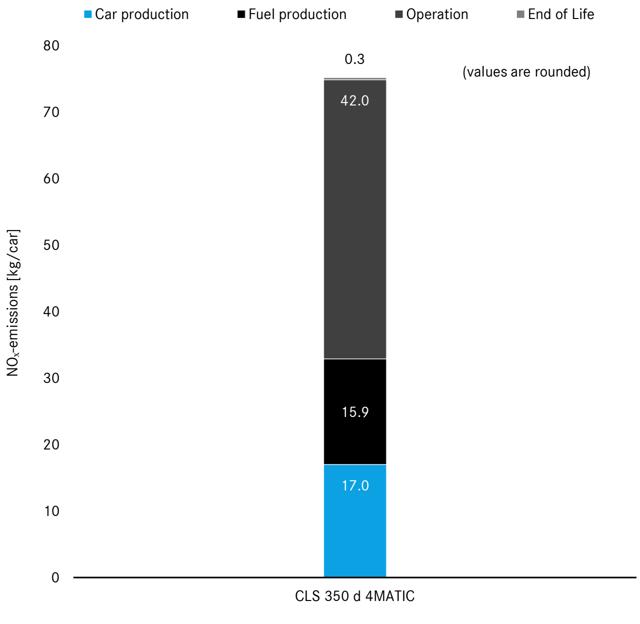


Figure 2-4: Overall Nitrogen oxides emissions (NO_X) in kilograms

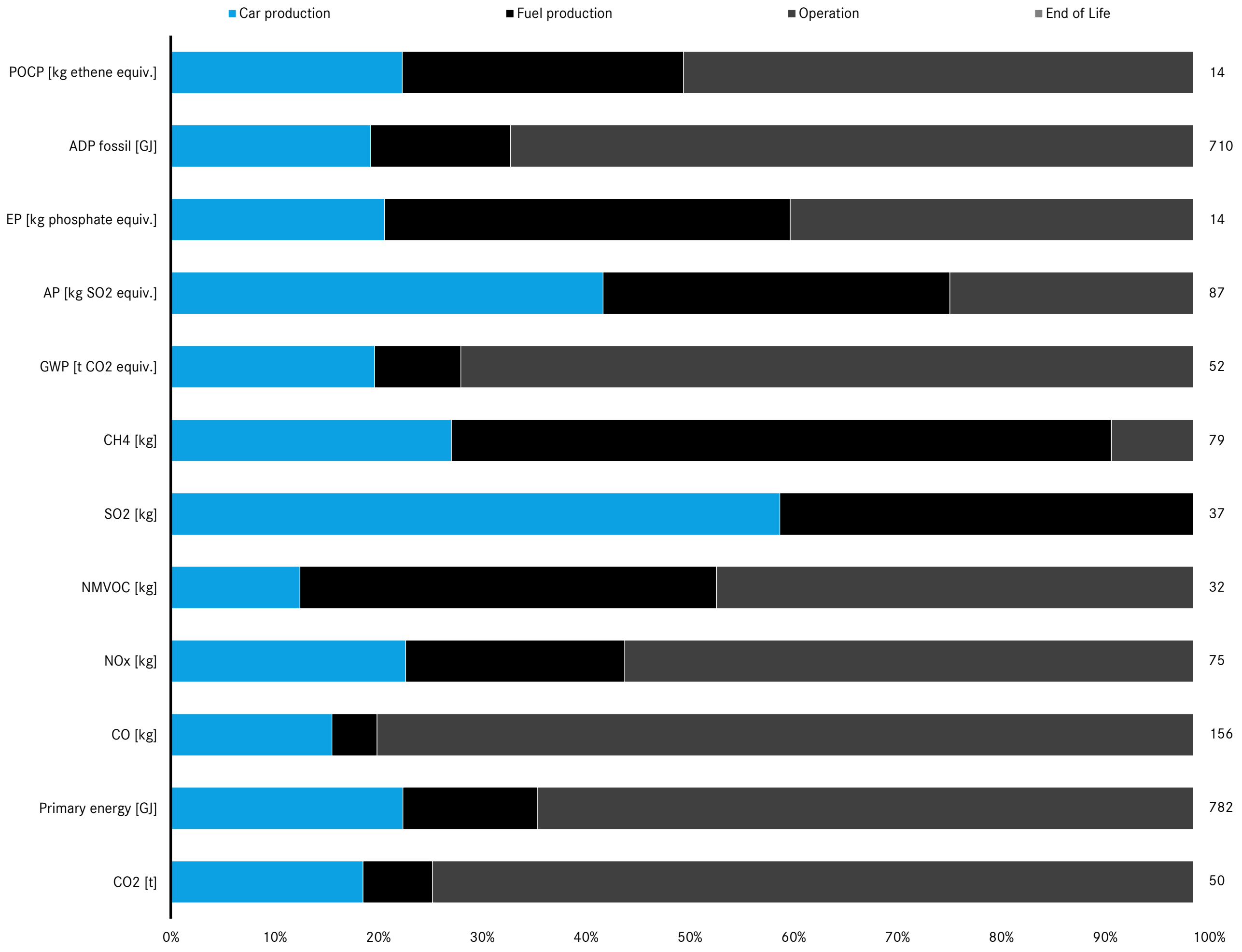


For comprehensive and thus sustainable improvement of the environmental impacts associated with a vehicle, it is essential that the end-of-life phase is also considered. In terms of energy, the use or initiation of recycling cycles is worthwhile. For a complete assessment, all environmental inputs within each lifecycle phase are taken into consideration.

Environmental burdens in the form of emissions into water result from vehicle manufacturing, in particular owing to the output of inorganic substances (heavy metals, NO_3^-- and SO_4^{2-}-ions) as well as organic substances, measured according to the factors AOX, BOD and COD.

Tables 2-1 and 2-2 show further LCA result parameters of the new CLS 350 d 4MATIC as an overview.

Figure 2-5: Share of lifecycle phases for selected parameters




S MB 1551

Table 2-1: Overview of LCA parameters (I)

Input parameters	CLS 350 d 4MATIC	Comments
Material resources		
Bauxite [kg]	1,411	Aluminium production.
Dolomite [kg]	304	Magnesium production.
Iron [kg]*	1,038	Steel production.
Non-ferrous metals (Cu, Pb, Zn) [kg]*	221	Mainly electric (wiring harness/battery) and zinc.
* as elementary resources		
Energy resources		
ADP fossil** [GJ]	710	81 % from use phase.
Primary energy [GJ]	782	
Proportionately		
Lignite [GJ]	10	81 % from car production.
Natural gas [GJ]	103	53 % from car production.
Crude oil [GJ]	550	94 % from use phase.
Hard coal [GJ]	47	93 % from car production.
Uranium [GJ]	18	81 % from car production.
Renewable energy resources [GJ]	53	55 % from use phase.
** CML 2001, as of January 2016		

Table 2-2: Overview of LCA parameters (II)

Output parameters	CLS 350 d 4MATIC	Comments
Emissions in air		
GWP** [t CO_2-equiv.]	52	Mainly due to CO_2-emissions.
AP** [kg SO_2-equiv.]	87	Mainly due to SO_2-emissions.
EP** [kg phosphate-equiv.]	14	Mainly due to NO_x-emissions.
POCP** [kg ethene-equiv.]	14	Mainly due to NMVOC and CO-emissions.
CO_2 [t]	50	19 % from car production.
CO [kg]	156	16 % from car production.
NMVOC [kg]	32	87 % from use phase.
CH_4 [kg]	79	73 % from use phase.
NO_x [kg]	75	77 % from use phase.
SO_2 [kg]	37	41 % from use phase.
Emissions in water		
BOD [kg]	0.17	46 % from use phase.
Hydrocarbons [kg]	4.6	84 % from use phase.
NO_3^- [kg]	4.9	94 % from use phase.
PO_4^{3-} [kg]	0.64	88 % from use phase.
SO_4^{2-} [kg]	22	52 % from use phase.
** CML 2001, as of January 2016		

2.3 LCA results for the new CLS 450 4MATIC

In addition to the diesel variant, the petrol model CLS 450 4MATIC with EQ Boost (integrated starter generator) and 48-volt on-board power supply was examined. Over the entire lifecycle, the lifecycle inventory analysis yields a primary energy consumption of 935 gigajoules (corresponding to the energy content of around 28,700 litres of petrol), an environmental input of approx. 63 tonnes of carbon dioxide (CO_2), around 50 kilograms of non-methane volatile organic compounds (NMVOC), around 69 kilograms of nitrogen oxides (NO_X) and 47 kilograms of sulphur dioxide (SO_2). For CO_2-emissions, and likewise for primary energy demand, the operating phase dominates with a share of 84 and 80 percent respectively (cf. Figure 2-6).

Figure 2-7 shows the nitrogen oxide emissions over the entire lifecycle in detail. The most important phase is the driving operation modeled on the basis of the RDE limit. Then the shares of fuel and vehicle production follow. Figure 2-8 shows the lifecycle shares of all examined parameters as an overview.

Figure 2-6: Overall carbon dioxide emissions (CO_2) in tons

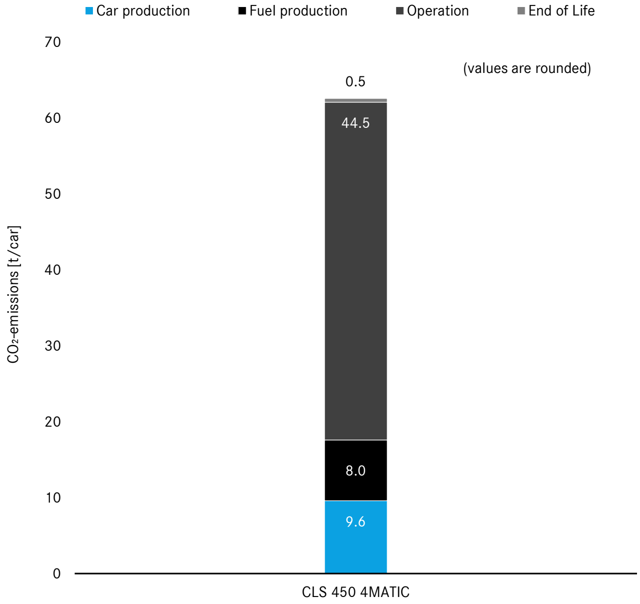
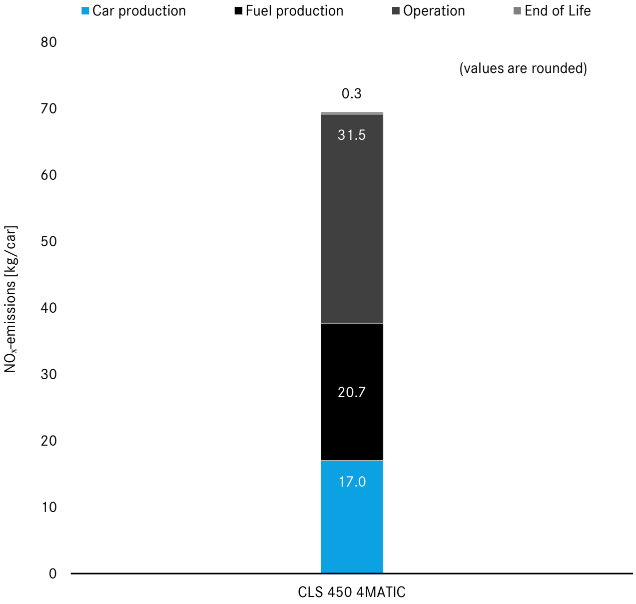


Figure 2-7: Overall Nitrogen oxides emissions (NO_X) in kilograms



Tables 2-3 and 2-4 show further LCA result parameters of the new CLS 450 4MATIC as an overview.

Figure 2-8: Share of lifecycle phases for selected parameters

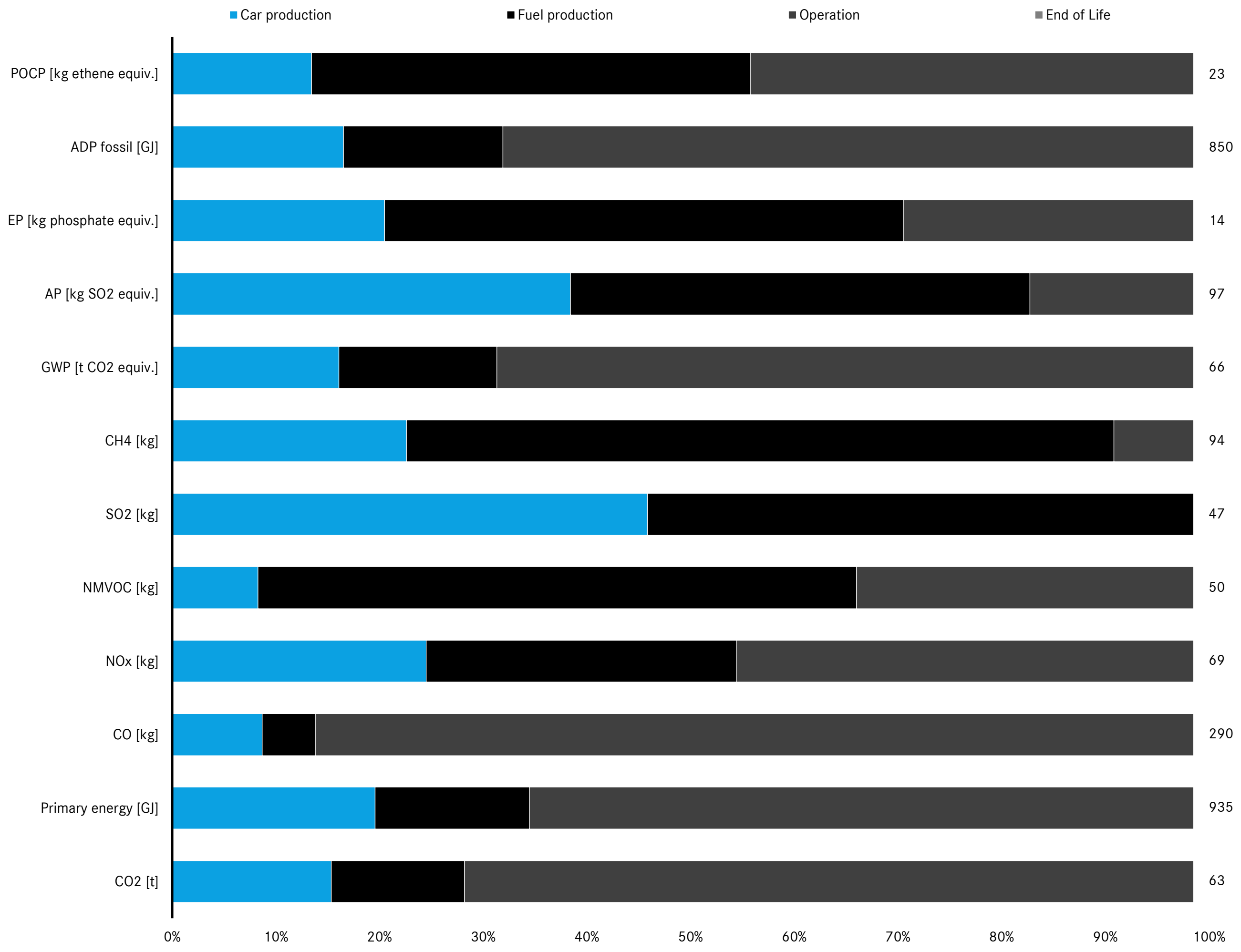


Table 2-3: Overview of LCA result parameters (I)

Input parameters	CLS 450 4MATIC	Comments
Material resources		
Bauxite [kg]	1,434	Aluminium production.
Dolomite [kg]	305	Magnesium production.
Iron [kg]*	1,059	Steel production.
Non-ferrous metals (Cu, Pb, Zn) [kg]*	256	Mainly electric (wiring harness/battery) and zinc.
* as elementary resources		
Energy resources		
ADP fossil** [GJ]	850	83 % from use phase.
Primary energy [GJ]	935	
Proportionately		
Lignite [GJ]	12	78 % from car production.
Natural gas [GJ]	133	41 % from car production.
Crude oil [GJ]	657	95 % from use phase.
Hard coal [GJ]	48	92 % from car production.
Uranium [GJ]	21	75 % from car production.
Renewable energy resources [GJ]	64	59 % from use phase.
** CML 2001, as of January 2016		

Tabelle 2-4: Overview of LCA result parameters (II)

Output parameters	CLS 450 4MATIC	Comments
Emissions in air		
GWP** [t CO_2-equiv.]	66	Mainly due to CO_2-emissions.
AP** [kg SO_2-equiv.]	97	Mainly due to SO_2-emissions.
EP** [kg phosphate-equiv.]	14	Mainly due to NO_x-emissions.
POCP** [kg ethene-equiv.]	23	Mainly due to NMVOC and CO-emissions.
CO_2 [t]	63	15 % from car production.
CO [kg]	290	9 % from car production.
NMVOC [kg]	50	92 % from use phase.
CH_4 [kg]	94	77 % from use phase.
NO_x [kg]	69	75 % from use phase.
SO_2 [kg]	47	54 % from use phase.
Emissions in water		
BOD [kg]	0.22	57 % from use phase.
Hydrocarbons [kg]	3.3	76 % from use phase.
NO_3^- [kg]	17	97 % from use phase.
PO_4^{3-} [kg]	0.62	87 % from use phase.
SO_4^{2-} [kg]	29	59 % from use phase.
** CML 2001, as of January 2016		

3. Material selection

3.1 Avoidance of potentially hazardous materials

The avoidance of hazardous substances is a matter of top priority in the development, manufacturing, use and recycling of Mercedes-Benz vehicles. For the protection of humans and the environment, substances and substance classes whose presence is not permitted in materials or components of Mercedes-Benz passenger cars have been listed in the internal standard (DBL 8585) since 1996. This standard is already made available to the designers and materials experts at the advanced development stage for both the selection of materials and the definition of manufacturing processes.

Materials used for components with contact to air of the passenger compartment are also subject to emission limits that are laid down in the vehicle specifications book and in part specific supplier specification DBL 5430. The reduction of interior emissions is a key aspect in the development of components and materials for Mercedes-Benz vehicles.

3.2 Allergy tested interior

The CLS too was developed in accordance with the requirements of the quality seal of the European Centre for Allergy Research Foundation (ECARF). The ECARF Seal of Quality is used by ECARF to designate products that have been scientifically tested and proven to be suitable for allergy sufferers. The conditions involved are extensive: numerous components from each equipment variant of a vehicle have to be tested for inhaled allergens, for example. Furthermore, the function of the pollen filter must be tested in both new and used condition. In addition, tests are undertaken with human “guinea pigs”. Driving tests are conducted in the CLS with people suffering from severe asthma, for example, with lung function tests providing information about the impact on the bronchial system. In addition, all materials that might come in contact with the skin are dermatologically tested. So-called epicutaneous skin tests were undertaken with test subjects suffering from contact allergies in order to test the tolerance levels for known contact allergens. To this end, substances from the interior are adhered to the skin as potential allergens, using plasters. The air-conditioning filters also have to meet the stringent criteria of the ECARF Seal in both new and used condition: amongst other things the tests measure their retention efficiency with regard to dust and pollen.

Figure 3-1: Test chamber to messure car cabin emissions

3.3 Use of secondary raw materials

In addition to the requirements for attainment of recycling rates, manufacturers are obliged by Article 4, Paragraph 1 c) of the European ELV Directive 2000/53/EC to make increased use of recycled materials in vehicle production and thereby to establish or extend the markets for recycled materials. To comply with these stipulations, the specifications books for new Mercedes models prescribe continuous increases in the share of the secondary raw materials used in car models.

The studies relating to the use of recycled material, which accompany the development process, focus on thermoplastics. In contrast to steel and ferrous materials, to which secondary materials are already added at the raw material stage, recycled plastics must be subjected to a separate testing and approval process for the relevant component. Accordingly, details of the use of secondary raw materials in passenger cars are only documented for thermoplastic components, as only this aspect can be influenced during development. The quality and functionality requirements placed on a component must be met both with secondary raw materials and with comparable new materials. To ensure passenger car production is maintained even when shortages are encountered on the recycled materials market, new materials may also be used as an alternative.

In the base variant of the CLS, a total of 132 components with an overall weight of 53.5 kilograms can be manufactured partly from high-quality recycled plastics. Typical areas of use are wheel arch linings, cable ducts and underbody panels, which consist for the most part of polypropylene.

With the material Dinamica® a high-quality secondary raw material is now also used in the interior of the new CLS. Dinamica® is a microfiber made of recycled polyester and water-borne polyurethane. The recycled polyester contained in Dinamica® derives e.g. from textiles and PET bottles. Dinamica® has a suede leather optic and haptic and is used in the interior e.g. as seat cover, roof and pillar liner.

A further objective is to obtain secondary raw materials wherever possible from vehicle-related waste flows, so as to achieve closed cycles. To this end, established processes are also applied for the CLS: a secondary raw material comprised of reprocessed starter batteries and bumper panel-ling is used for the wheel arch linings, for example.

Figure 3-2: Use of secondary raw materials in the CLS

3.4 Use of renewable raw materials

In automotive production, the use of renewable raw materials is concentrated primarily in the vehicle interior. Established natural materials such as flax and cellulose fibres, wool, cotton and natural rubber are also used, of course, in series production of the CLS.

The use of these natural materials gives rise to a whole range of advantages in automotive production:

- Compared with glass fibre, natural fibres normally result in a reduced component weight.
- Renewable raw materials help to reduce the consumption of fossil resources such as coal, natural gas and crude oil.
- They can be processed by means of conventional technologies. The resulting products are generally readily recyclable.
- If recycled in the form of energy they have an almost neutral CO_2-balance, as only as much CO_2 is released as the plant absorbed during its growth.

In the base variant of the new CLS, a total of 86 components with an overall weight of 32.2 kilograms are made using natural materials. Figure 3-3 shows the components in the new CLS which are produced using renewable raw materials.

Figure 3-3: Components in the CLS produced using renewable materials


Feld
2

4. Design for recovery

With the adoption of the European ELV Directive (2000/53/EC), the conditions for recovery of end-of-life vehicles were revised. The aims of this directive are to avoid vehicle-related waste and encourage the take-back, reuse and recycling of vehicles and their components. The resulting requirements for the automotive industry are as follows:

- Establishment of systems for collection of end-of-life vehicles (ELVs) and used parts from repairs.
- Achievement of an overall recovery rate of 95 percent by weight by 01.01.2015 at the latest.
- Evidence of compliance with the recycling rate as part of type approval for new passenger cars as of December 2008.
- Take-back of all ELVs free of charge from January 2007.
- Provision of dismantling information to ELV recyclers within six months of market launch.
- Prohibition of lead, hexavalent chromium, mercury and cadmium, taking into account the exceptions in Annex II.

4.1 Recycling concept for new CLS

The calculation procedure is regulated in ISO standard 22628, "Road vehicles – Recyclability and recoverability – Calculation method." The calculation model reflects the real ELV recycling process and is divided into four stages:

1. Pretreatment (removal of all service fluids, tyres, the battery and catalytic converters, ignition of airbags).
2. Dismantling (removal of replacement parts and/or components for material recycling).
3. Separation of metals in the shredder process.
4. Treatment of non-metallic residual fraction (shredder light fraction – SLF).

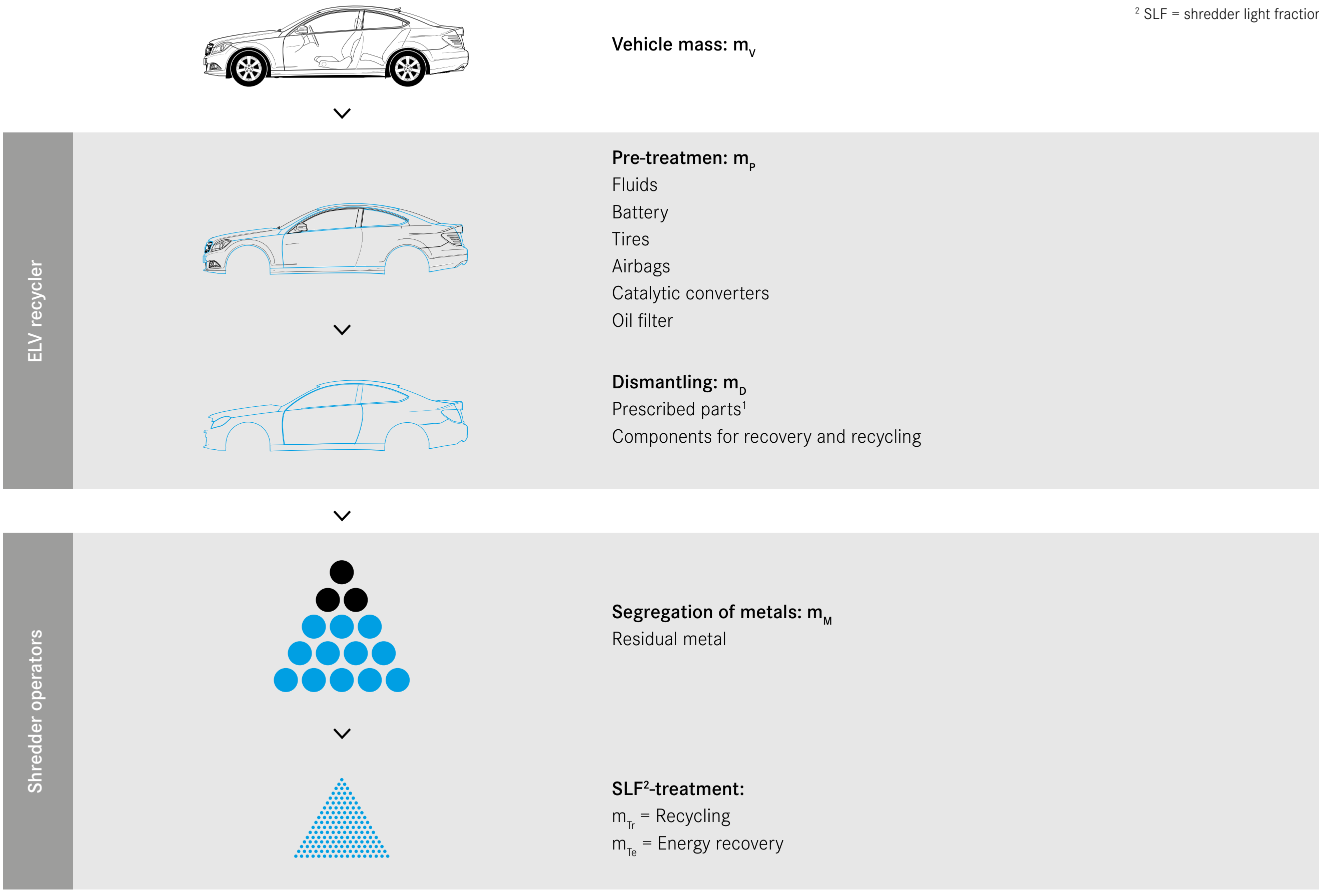
The recycling concept for the CLS was devised in parallel with development of the vehicle; the individual components and materials were analysed for each stage of the process. The volume flow rates established for each stage together yield the recycling and recovery rates for the entire vehicle. With the process chain described below, an overall material recyclability rate of 85 percent and a recoverability rate of 95 percent were verified on the basis of the ISO 22628 calculation model for the CLS as part of the vehicle type approval process (see Figure 4-1).

At the ELV recycler's premises, the fluids, battery, oil filter, tyres, and catalytic converters are removed as part of the pretreatment process. The airbags are able to get triggered with a device that is standardized amongst all European car manufacturers. During dismantling, the prescribed parts are first removed according to the European ELV Directive. To improve recycling, numerous components and assemblies are then removed and are sold directly as used spare parts or serve as a basis for the manufacturing of replacement parts. In addition to used parts, materials that can be recycled using economically appropriate procedures are selectively removed in the vehicle dismantling process. These include components of aluminium and copper as well as selected large plastic components.

During the development of the CLS, these components were specifically prepared with a view to their subsequent recycling. Along with the segregated separation of materials, attention was also paid to ease of dismantling of relevant thermoplastic components such as bumpers, wheel arch linings, outer sills, underfloor panelling and engine compartment coverings.

In addition, all plastic parts are marked in accordance with international nomenclature. In the subsequent shredding of the residual body, the metals are first separated for reuse in the raw material production processes. The largely organic remaining portion is separated into different fractions for environment-friendly reuse in raw material or energy recovery processes.

Figure 4-1: Material flows in the recycling concept



[1] in acc. with 2000/53/EC

[2] SLF = shredder light fractior

$$R_{cyc} = (m_P + m_D + m_M + m_{Tr}) / m_V * 100 > 85 \text{ percent}$$

$$R_{cov} = R_{cyc} + m_{Te} / m_V * 100 > 95 \text{ percent}$$

4.2 Dismantling information

Dismantling information plays an important role for ELV recyclers when it comes to implementing the recycling concept. For the CLS too, all necessary information is provided in electronic form via the International Dismantling Information System (IDIS). This IDIS software provides vehicle information for ELV recyclers, on the basis of which vehicles can be subjected to environmentally friendly pretreatment and recycling techniques at the end of their operating lives.

The IDIS data are made available to ELV recyclers and incorporated into the software six months after the respective market launch.

Figure 4-2: Screenshot of the IDIS-Software

5. Process – Design for Environment

Reducing the environmental impact of a vehicle's emissions and resource consumption throughout its lifecycle is crucial to improving its environmental performance. The environmental burden of a product is already largely determined in the early development phase; subsequent corrections to product design can only be implemented at great expense. The earlier environmentally compatible product development ("Design for Environment") is integrated into the develop-ment process, the greater the benefits in terms of minimised environmental impact and cost. Process and product-integrated environmental protection must be realised in the development phase of a product. The environmental burden can often only be reduced at a later date by means of downstream "end of pipe" measures.

We strive to develop products that are highly responsible to the environment in their respective market segments – this is the second Environmental Guideline of the Daimler Group. Its realisation requires incorporating environmental protection into products from the very start. Ensuring that this happens is the task of environmentally compatible product development. It follows the principle "Design for Environment" (DfE) to develop comprehensive vehicle concepts. The aim is to improve environmental performance in objectively measurable terms and, at the same time, to meet the demands of the growing number of customers with an eye for environmental issues such as fuel economy and reduced emissions or the use of environmentally friendly materials.

In organisational terms, responsibility for improving environmental performance was an integral part of the development project for the CLS. Under the overall level of project management, employees are appointed with responsibility for development, production, purchasing, sales, and further fields of activity. Development teams (e. g. body, drive system, interior etc.) and crossfunctional teams (e.g. quality management, project management etc.) are appointed in accordance with the most important automotive components and functions.

One such crossfunctional group is known as the DfE team. It consists of experts from the fields of lifecycle assessment, dismantling and recycling planning, materials and process engineering, and design and production. Members of the DfE team are also represented in a development team, in which they are responsible for all environmental issues and tasks. This ensures complete integration of the DfE process into the vehicle development project. The members have the task of defining and monitoring the environmental objectives in the technical specifications for the various vehicle modules at an early stage, and of deriving improvement measures where necessary.

Integration of Design for Environment into the operational structure of the development project for the CLS ensured that environmental aspects were not sought only at the time of launch, but were given consideration from the earliest stages of development. The targets were coordinated in good time and reviewed in the development process in accordance with the quality gates. Requirements for further action up to the next quality gate are determined by the interim results, and the measures are implemented in the development team.

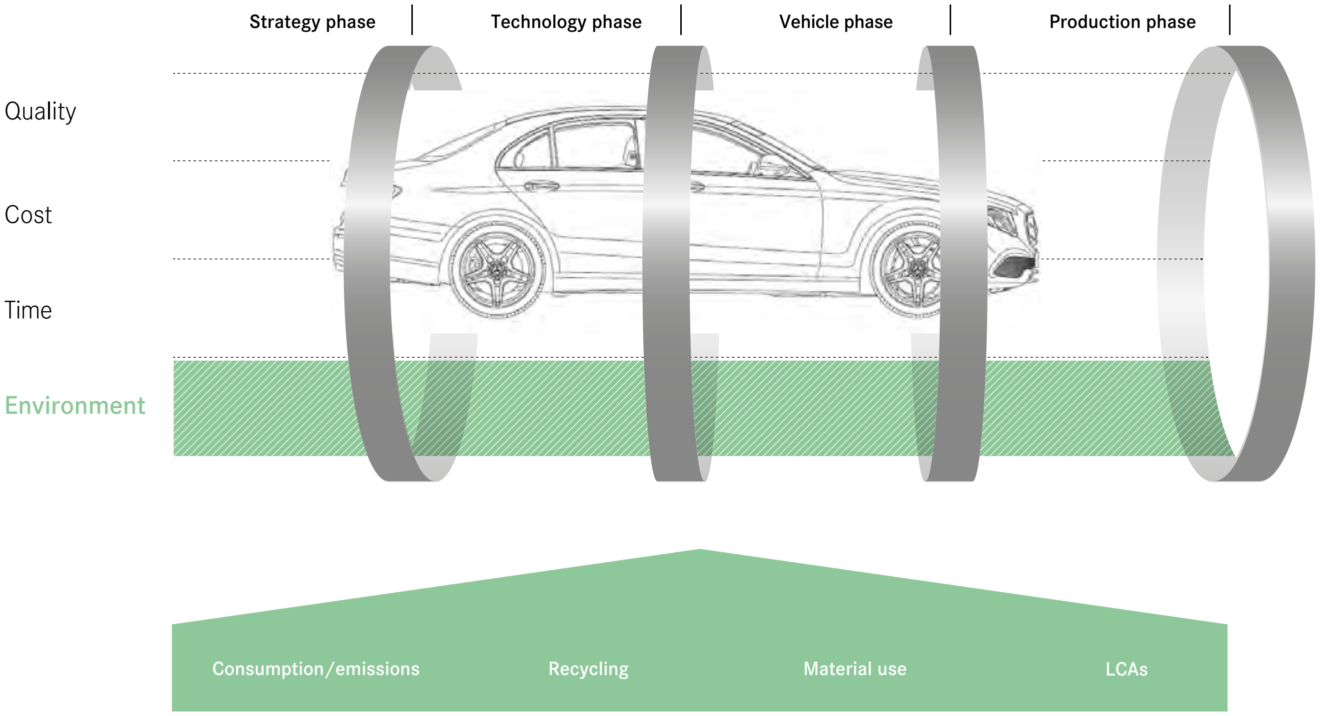
The process carried out for the CLS meets all the criteria for the integration of environmental aspects into product development, which are described in ISO standard TR 14062.

Over and above this, in order to implement environmentally compatible product development in a systematic and controllable manner, integration into the higher-level ISO 14001 and ISO 9001 environmental and quality management systems is also necessary.

The international ISO 14006 standard published in 2011 describes the prerequisite processes and correlations.

Mercedes-Benz meets the requirements of the ISO 14006 in full. This was confirmed for the first time by the independent appraisers from the South German Technical Inspection Authority (TÜV SÜD Management Service GmbH) in 2012.

Figure 5-1: „Design for Environment“ activities at Mercedes-Benz



ZERTIFIKAT ■ CERTIFICATE ■ 認證證書 ■ СЕРТИФИКАТ ■ CERTIFICADO ■ CERTIFICAT

TÜV SÜD Management Service

CERTIFICATE

The Certification Body
of TÜV SÜD Management Service GmbH

certifies that

Daimler AG
Mercedes-Benz Sindelfingen
Béla-Barényi-Straße 1
71063 Sindelfingen
Germany

has established and applies
an Environmental Management System
with particular focus on eco design for

Development of passenger vehicles.

A specific audit, Report No. **70014947**,
revealed, that the entire product life cycle is considered
in a multidisciplinary approach when integrating environmental aspects
in product design and development
and that the results are verified by means of Life Cycle Assessments.

Thereby the requirements according to

ISO 14006:2011
ISO/TR 14062:2002

are fulfilled.

This certificate is valid only in combination with the
ISO 14001 certificate, registration no.: 12 104 13407 TMS
from **2017-12-20** to **2018-12-06**.

Certificate Registration No.: **12 771 13407 TMS**.

Product Compliance Management
Munich, 2017-12-21

TÜV SÜD Management Service GmbH • Zertifizierungsstelle • Ridlerstraße 65 • 80339 München • Germany
www.tuev-sued.de/certificate-validity-check

TÜV®


S MB 1505
AMG

6. Conclusion

The new Mercedes-Benz CLS meets the highest standards with regard to safety, comfort, agility, and design, and was also analysed comprehensively in terms of its environmental impact over the entire lifecycle. This is documented in the underlying report on the lifecycle assessment study and examined appropriately as part of expanded sensitivity analyses. The result was verified by environmental experts of TÜV SÜD.

With the new CLS, Mercedes-Benz customers benefit from the completely newly developed engine family, which is geared to the stricter emissions provisions for measurements in real driving operations (Real Driving Emissions, RDE). The new diesel engine generation with Euro 6d-TEMP emissions standard complies with the strict NO_X RDE limits also in real driving. In addition, it employs a great proportion of high-quality secondary and renewable raw materials.

Mercedes-Benz publishes since 2005 as the world's first automotive manufacturer environmental product information referred to as "Environmental Certificate" as a result of the process of environmentally compatible product development in accordance with the ISO TR 14062 and ISO 14040/14044. Over and above this, since 2012 the requirements of the ISO 14006 standard relating to the integration of environmentally compatible product development into the higher-level environmental and quality management systems have been met, as also confirmed by TÜV SÜD Management Service GmbH.


S MB 1505

Glossary

A: Product documentation

The following table documents essential technical data of the examined CLS-models.

Technical data	CLS 450 4MATIC	CLS 350 d 4MATIC
Engine type	Petrol engine	Diesel engine
Number of cylinders	6	6
Displacement (effectice) [cc]	2,999	2,925
Output [kW]	270	210
Emission standard (fulfilled)	EU6	EU6
Weight (without driver and luggage) [kg]	1,865	1,860
Fuel consumption [l/100km][1]	7.8 - 7.5[2]	5.8 - 5.6[2]
CO_2 [g/km] [1]	184 - 178[2]	156 - 148[2]

[1] The stated figures were determined in accordance with the prescribed measuring method. These are the „NEDC CO_2 figures“ according to Art. 2 No. 1 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures. The figures vary depending on the selected optional extras.
[2] The lifecycle assessment was calculated for the base versions (lowest consumption figures in each case).

The table below shows the limits EURO 6d-TEMP (WLTC/RDE).

Emissions	Petrol engine	Diesel engine
CO [g/km]	1/-	0.5/-
(HC+NO_x) [g/km]	-/-	0.170/-
HC (NMHC) [g/km]	0.1 (0.068)/-	-/-
NO_x [g/km]	0.060/0.126	0.080/0.168
PM [g/km]	0.00045/-	0.00045/-
PN [1/km]	6E11/9E11	6E11/9E11

B: LCA basic conditions

Project objective	
Project objective	LCA over the lifecycle of the CLS 350 d 4MATIC and the CLS 450 4MATIC as ECE base version.
	Verification of attainment of the objective “environmental compatibility” and communication.
Project scope	
Functional equivalent	CLS passenger car (base variant, weight in acc. with DIN 70020).
System boundaries	LCA for car production, use and recycling. The LCA limits must only be exceeded in the case of elementary flows (resources, emissions, non-recyclable materials).
Data basis	Weight data of car: MB parts list (CLS 350 d 4MATIC and CLS 450 4MATIC as of: 10/2017).
	Materials information for model-relevant, vehicle-specific parts: MB parts list, MB internal documentation systems, IMDS, technical literature.
	Vehicle-specific model parameters (bodyshell, paintwork, catalytic converter etc.): MB specialist departments.
	Location-specific energy supply: MB database.
	Materials information for standard components: MB database.
	Use (fuel consumption, emissions): type approval/certification data.
	Use (mileage): MB specification.
	Recycling model: state of the art (see also Chapter 4.1).
	Material production, energy supply, manufacturing processes and transport: LCA database as of SP28 (http://documentation.gabi-software.com); MB database.
Allocations	For material production, energy supply, manufacturing processes and transport, reference is made to GaBi databases and the allocation methods which they employ.
	No further specific allocations.
Cut-off criteria	For material production, energy supply, manufacturing processes and transport, reference is made to GaBi databases and the cut-off criteria they employ.
	No explicit cut-off criteria. All available weight information is processed.
	Noise and land use are currently not available as lifecycle inventory data and are therefore not taken into account.
	Fine dust” or particulate emissions are not analysed. Major sources of particulate matter (mainly tyre and brake abrasion) are not dependent on vehicle type and consequently of no relevance to the result of the vehicle comparison.
	Vehicle maintenance and care are not relevant to the result.
Assessment	Lifecycle, in conformity with ISO 14040 and 14044 (LCA).
Analysis parameters	Material composition according to VDA 231-106.
	Lifecycle inventory: consumption of resources as primary energy, emissions such as CO_2, CO, NO_x, SO_2, NMVOC, CH_4 etc.
	Impact assessment: abiotic depletion potential (ADP), global warming potential (GWP), photochemical ozone creation potential (POCP), eutrophication potential (EP), acidification potential (AP).
	Interpretation: sensitivity analyses of car module structure; dominance analysis over lifecycle.
Software support	MB DfE tool. This tool models a car with its typical structure and typical components, including their manufacture, and is adapted with vehicle-specific data on materials and weights. It is based on the LCA software GaBi 8 (http://www.gabi-software.com).
Evaluation	Analysis of lifecycle results according to phases (dominance). The manufacturing phase is evaluated based on the underlying car module structure. Contributions of relevance to the results are discussed.
Documentation	Final report with all basic conditions.

Term	Explanation
ADP	Abiotic depletion potential (abiotic = non-living); impact category describing the reduction of the global stock of raw materials resulting from the extraction of non-renewable resources.
Allocation	Distribution of material and energy flows in processes with several inputs and outputs, and assignment of the input and output flows of a process to the investigated product system.
AOX	Adsorbable organic halogens; sum parameter used in chemical analysis mainly to assess water and sewage sludge. Used to determine the sum of the organic halogens which can be adsorbed by activated charcoal; these include chlorine, bromine and iodine compounds.
AP	Acidification potential; impact category expressing the potential for milieu changes in ecosystems due to the input of acids.
Base variant	Base vehicle model without optional extras, usually Classic line and with a small engine.
BOD	Biological oxygen demand; taken as measure of the pollution of waste water, waters with organic substances (to assess water quality).
COD	Chemical oxygen demand; used in the assessment of water quality as a measure of the pollution of waste water and waters with organic substances.
DIN	German Institute for Standardisation (Deutsches Institut für Normung e.V.).
ECE	Economic Commission for Europe; the UN organisation in which standardised technical regulations are developed.
EP	Eutrophication potential (overfertilisation potential); impact category expressing the potential for oversaturation of a biological system with essential nutrients.
GWP100	Global warming potential, time horizon 100 years; impact category that describes potential contribution to the anthropogenic greenhouse effect (caused by mankind).
HC	Hydrocarbons
IDIS	International Dismantling Information System
IMDS	International Material Data System
Impact categories	Classes of effects on the environment in which resource consumptions and various emissions with the same environmental effect are grouped together (e. g. global warming, acidification etc.).
ISO	International Organisation for Standardisation
KBA	Federal Motor Transport Authority
LCA	Life Cycle Assessment Compilation and assessment of the input and output flows and the potential environmental impacts of a product in the course of its life.
MB	Mercedes-Benz
NEDC	New European Driving Cycle; cycle used to establish the emissions and consumption of motor vehicles since 1996 in Europe; prescribed by law.
NF-metal	Non-ferrous metal (aluminium, lead, copper, magnesium, nickel, zinc etc.)
NMVOC	Non-methane volatile organic compounds (NMHC Non-methane hydro-carbons)
POCP	Photochemical ozone creation potential, (summer smog); impact category that describes the formation of photo-oxidants (summer smog).
Primary energy	Energy not yet subjected to anthropogenic conversion.
Process polymers	Term from the VDA materials data sheet 231-106; the material group “process polymers” comprises paints, adhesives, sealants, protective undercoats.
RDE	Real Driving Emissions
SLF	Shredder Light Fraction; non-metallic substances remaining after shredding as part of a process of separation and cleaning.
WLTC	Worldwide Harmonized Light Vehicles Test Cycle; a cycle prescribed by law used to determine the emission and consumption figures of motor vehicles in Europe since 09/2017.
WLTP	Worldwide Harmonized Light Vehicles Test Procedure; a procedure prescribed by law used to determine the emission and consumption figures of motor vehicles in Europe since 09/2017.

Daimler AG
Mercedesstr. 137
70327 Stuttgart