Life cycle **OVERALL** DOCUMENTATION

(combined fuel consumption: 1.5-1.2 l/100 km, combined CO_2 emissions: 33.0-26.0 g/km, combined electrical consumption: 22.0-20.3 kWh/100 km)[1]

[1] Values for the saloon with long wheelbase (V 223). The stated figures are the measured "NEDC CO_2 figures" in accordance with Article 2 No. 1 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures. Electricity consumption [and range] was [were] determined on the basis of Regulation 692/2008/EC. The WLTP figure is relevant for the assessment of the motor vehicle tax.

360° Environmental Check Mercedes-Benz S 580 e Plug-in Hybrid

Mercedes-Benz

The best or nothing.

Contents

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As of: July 2021

Overview 360° Environmental Check Mercedes-Benz S 580 e

Already the fourth generation of the hybrid drive system will premiere in the S-Class in 2021. With an electric output of 110 kW/150 hp and an all-electric range of around 100 kilometres (WLTP), this S-Class will in many cases operate without using its combustion engine. The electric range has more than doubled compared with the previous model. The basis for the hybrid drive system is provided by the highly efficient M 256 six-cylinder in-line engine from the current generation of engines at Mercedes-Benz AG. Good fuel efficiency requires not only an efficient drive but also good aerodynamic qualities. The S-Class is one of the world's most aerodynamic cars, and especially so in the luxury saloon segment. Aerodynamic measures affecting the body, underbody and detachable parts allow a good showing in the wind tunnel and in real operation.

To give customers special support when switching over to the age of electric mobility, Mercedes-Benz has developed an intelligent, digital personal trainer: the Mercedes me Eco Coach. This is the latest member in the eco-system of Mercedes-Benz me apps. In an entertaining manner, the Eco Coach familiarizes drivers of electrified Mercedes-Benz models with the electric capabilities of their vehicles. Customers who follow the recommendations and hints in the app not only get to know their car with alternative drive better – they also improve their driving style and can better protect the environment.

The improvement of the environmental compatibility 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 lifecycle. This comprehensive and exhaustive Life Cycle Assessment (LCA) we call "360° environmental check". It scrutinises 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 lifecycle, we have the results checked and confirmed by independent assessors. This is how the 360° environmental check is created.

This brochure presents the results of the Life Cycle Assessment for the third generation of the S-Class in detail.

Validation

TÜV SÜD Management Service GmbH verified the following environmental declaration of **Daimler AG, Mercedesstraße 137, 70327 Stuttgart**

„360° Environmental Check Mercedes-Benz S 580 e“

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

- DIN EN ISO 14040:2021 / DIN EN ISO 14044:2021 (Environmental management - Life cycle assessment - Principles and framework / Requirements and guidelines)
- ISO/TS 14071:2014 (Environmental management - Life cycle assessment - Critical review processes and reviewer competencies
- Technical Report DIN ISO/TR 14062:2002 (Integrating environmental aspects into product design and development, 5.4 Communication strategy)
- DIN EN ISO 14020:2002 (Environmental labels and declarations - General principles) and EN ISO 14021:2016 (Environmental labels and declarations - Self-declared environmental claims)

Result:

- The environmental declaration includes a comprehensive and appropriate presentation or interpretation of the results based on reliable and traceable information.
- The LCA study on which the environmental declaration is based is in compliance with DIN EN ISO 14040:2021 and DIN EN ISO 14044:2021. The methods used and the detailed modelling of the product system are of high quality. They are suitable for fulfilling the goals stated in the LCA study. The report is comprehensive and transparently describes the survey-scope of the study.
- The assessed samples of data and environmental information included in the environmental declaration 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 study on which the environmental declaration is based included a critical review supported by an external expert and – where relevant for the environmental declaration – 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 (e.g. weights, materials and emissions) and other statements included in the environmental declaration (such as use of less resource consuming materials, recycling concept) 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 Kraftfahrt-Bundesamt 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 declaration 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, 2021-09-13

Dipl.-Ing. (FH) Fred Wenke Head of Certification Body	Dipl.-Ing. Michael Brunk Lead auditor	Dipl.-Ing. Ulrich Wegner Lead auditor

1. General environmental issues

1.1 Product information

Already the fourth generation of the hybrid drive system will premiere in the S-Class in 2021. With an electric output of 110 kW/150 hp and an all-electric range of around 100 kilometres (WLTP), this S-Class will in many cases operate without using its combustion engine. The electric range will have been more than doubled compared with the previous model. The basis for the hybrid drive system is provided by the highly efficient M 256 six-cylinder in-line engine with 270 kW/367 hp from the current generation of engines at Mercedes-Benz AG.

In the S-Class, use of the M 256 marks the first time a petrol engine from the Family of Modular Engines (FAME) has provided the basis for the plug-in hybrid. The six-cylinder unit – in conjunction with the integrated starter alternator (ISG) – is also used for the engine variants S 450 4MATIC (NEDC combined fuel consumption[1] 8.4-7.8 l/100 km, NEDC combined CO_2 emissions[1] 191-178 g/km, WLTP combined fuel consumption[2] 9.5-7.8 l/100 km, WLTP combined CO_2 emissions[2] 215-178 g/km) and S 500 4MATIC (NEDC combined fuel consumption[1] 8.4-7.8 l/100 km, NEDC combined CO_2 emissions[1] 192-179 g/km, WLTP combined fuel consumption[2] 9.5-8.0 l/100 km, WLTP combined CO_2 emissions[2] 216-181 g/km) in the Mercedes-Benz S-Class.

The new high-voltage system is more compact and more powerful, while the number of high-voltage interfaces has been significantly reduced. The integration of the power electronics into the transmission housing reduces the installation space required, while also simplifying the assembly processes at the production plant. Increasing the system voltage also increases the output, without the need for larger line cross-sections.

The high energy density of the hybrid drive unit is achieved using a permanently excited synchronous motor with an internal rotor. The 440 Nm peak torque of the electric motor is ready to go right from the start, resulting in high agility when moving off, along with dynamic driving performance. The full electric power is available up to 140 km/h, after which point it is softly reduced. This fourth-generation hybrid system lends itself to modular combination with various vehicles and combustion engines.

The high-voltage (HV) battery has been developed in-house by Mercedes-Benz AG. It is part of a fourth-generation family of batteries and represents a logical evolution of the previous generation. It consists of 108 cells in a so-called pouch configuration. The battery's total capacity amounts to 28.6 kWh, thereby bringing about a significant increase in range to around 100 kilometres. To take the high energy density into account, the HV battery has an internal cooling system. The thermal management system can therefore control the operating temperature irrespective of the climate control in the vehicle interior. As well as continuous operation in hot and cold regions, this also allows quick charging with direct current. The vehicle is equipped as standard with a 11 kW charging device for charging at home via the alternating current network.

Aerodynamic measures affecting the body, underbody and detachable parts allow a good showing in the wind tunnel and in real operation. The bodyshell of the new S-Class was designed with a particular focus on lightweight construction. The newly developed aluminium/steel hybrid bodyshell increases the aluminium content to more than 50 percent by weight. The high proportion of aluminium is achieved by using cast and extruded structural components. The Mercedes-Benz safety cell is the centrepiece of the safety system. It has a structure of hot-formed high-strength steel cross-members in the areas of the firewall and rear end. At the sides this is complemented with extremely rigid side sills of extruded aluminium sections. As well as occupant protection, compatibility with other road users was an important development objective. For this purpose, as an addition to the previous concept, the front flexural member is designed to provide an even more stable and broad impact surface for the other vehicle in an accident, for example.

[1] All NEDC values in this paragraph pertain to the saloon with long wheelbase (V 223). The stated figures are the measured "NEDC CO_2 figures" in accordance with Art. 2 No. 1 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures. The WLTP value is decisive for the assessment of motor vehicle tax.

[2] Values for the saloon with long wheelbase (V 223). The figures shown are the WLTP CO_2 figures measured according to Article 2 No. 3 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures.

With Mercedes me, Mercedes-EQ provides comprehensive services for the electric mobility of today and tomorrow. Via Mercedes me Charge, drivers of a Mercedes-EQ or plug-in hybrid model with the latest MBUX (Mercedes-Benz User Experience) infotainment generation have the possibility to get access to one of the world's largest charging networks with over 400 different operators of public charging stations in Europe alone. This convenient access to the charging stations is provided by the Mercedes me Charge charging card, the Mercedes me App or via the vehicle's media display. No separate contracts are necessary for this: apart from simple authentication, customers benefit from an integrated payment function with simple billing after they have registered their payment method once. The objective: relaxed, uncomplicated travel with transparency and planning certainty.

To give customers special support when switching over to the age of electric mobility, Mercedes-Benz has developed an intelligent, digital personal trainer: the Mercedes me Eco Coach. This is the latest member in the eco-system of Mercedes-Benz me apps. In an entertaining manner, the Eco Coach familiarizes drivers of electrified Mercedes-Benz models with the electric capabilities of their vehicles. Customers who follow the recommendations and hints in the app not only get to know their car with alternative drive better – they also improve their driving style and can better protect the environment.

Figure 1-1: Mercedes-Benz S 580 e

1.2 Production

The S-Class models with plug-in hybrid are produced at the Sindelfingen plant together with the models without plug-in hybrid. As early as 1994, the Sindelfingen plant implemented an environmental management system and one year later voluntarily had it audited in accordance with the European Eco-Management and Audit Scheme EMAS. This has created the prerequisite for continuous and effective improvement of the company's environmental performance. It is the centre of competence for vehicles in the luxury class and the lead plant for the production of the S-Class and E-Class model series. Electric vehicles of the new product and technology brand Mercedes-EQ are also produced at the site.

In 2015, the Sindelfingen site celebrated its 100th anniversary. In the same year, the Board of Daimler AG decided to make the plant fit for the future with the „Future Vision 2020+" programme.

This becomes evident in a multitude of construction measures. The new „Factory 56" building with its 220,000 m² has already been put into operation. On the roof is a photovoltaic system with around 12,000 PV modules and an output of approx. 5000 kWp (kilowatt peak), which supplies self-generated green electricity for the building. Furthermore, Factory 56 is completely paperless: thanks to digital tracking of each vehicle on the line via a tracking system, the data of a respective vehicle on the line relevant for the employees is displayed on terminals and screens in real time. All in all, this will save around 10 tonnes of paper each year. In addition to the CO_2 and energy balance considerations, Mercedes-Benz's sustainability approach also includes other ecological aspects. About 43,000 m² of the roof area (38% of the greenable area) will be greened.

Figure 1-2: Factory 56 at the Sindelfingen plant


S MB 1002

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 recovered 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 an 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 Europe-wide all the important details relating to the return of their vehicles via the free phone number +49 800 1 777 7777.


S SK 8748E

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.

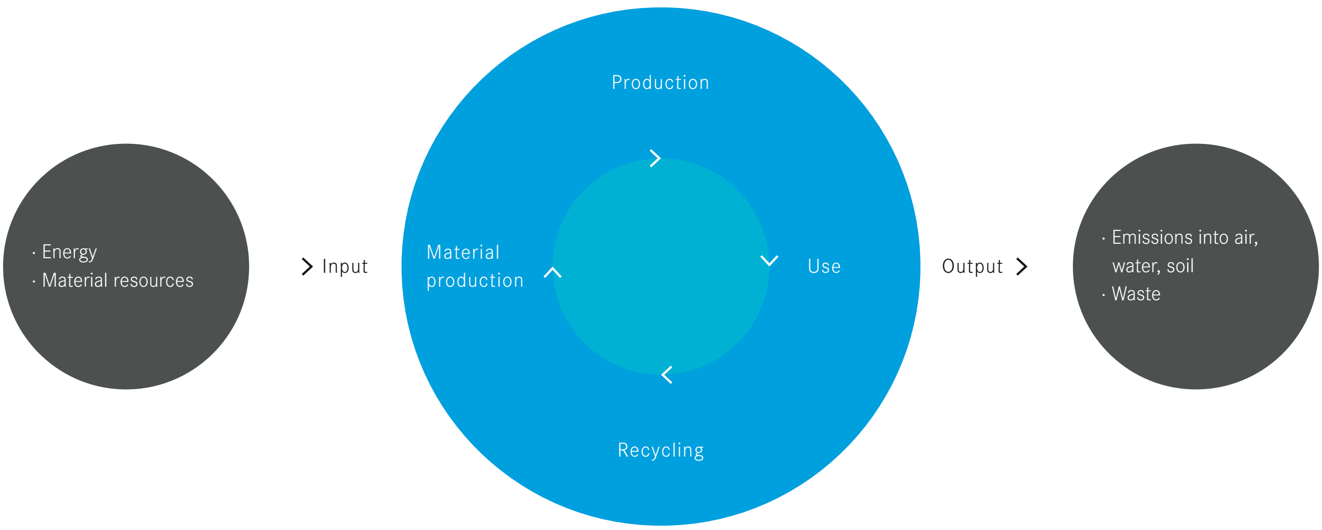
Life Cycle Assessments are used by the Mercedes-Benz passenger car development division for the evaluation and comparison of different vehicles, components, and technologies. The DIN EN ISO 14040 and DIN EN ISO 14044 standards prescribe the procedure and the required elements.

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 S-Class S 580 e are shown in the following chapters. The main parameters of the LCA are documented in the appendix. The operation phase is calculated on the basis of a mileage of 300,000 kilometres.

Figure 2-1: Overview of the Life Cycle Assessment



2.1 Material composition

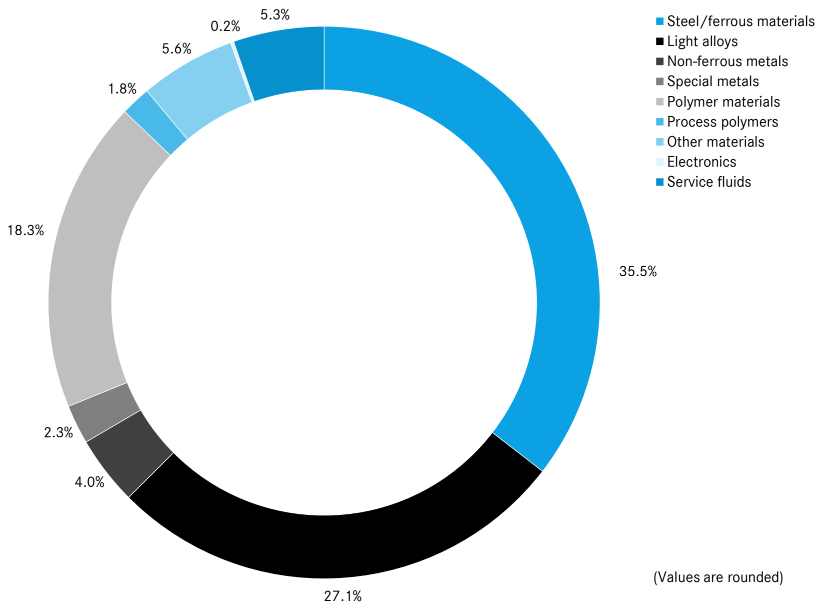
The weight and material data for the new S 580 e were determined on the basis of internal documentation of the components used in the vehicle (parts list, drawings). The “kerb weight according to DIN” (without driver and luggage, fuel tank 90 percent full) served as a basis for the recycling rate and LCA. Figure 2-2 shows the material composition in accordance with VDA 231-106.

Steel/ferrous materials account for about 35.5 percent of the vehicle weight in the new S 580 e. This is followed by light alloys with 27.1 percent and the polymer materials with 18.3 percent. Other materials (esp. glass, insulating materials, graphite) and service fluids have a share of about 5.6 and 5.3 percent respectively. The shares of non-ferrous and special metals contents are somewhat lower at around 4.0 and 2.3 percent respectively. The remaining materials – process polymers and electronics – contribute about 2.0 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 12.4 percent. Elastomers (predominantly tyres) are the second-largest group of polymers with 3.2 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 S 580 e [%]



2.2 LCA results

Over the entire lifecycle of the new S 580 e, the lifecycle inventory analysis yields e. g. a primary energy consumption of 1,001 gigajoules (corresponding to the energy content of around 31,000 litres of gasoline), an environmental input of approx. 43 tonnes of carbon dioxide (CO_2), around 31 kilograms of non-methane volatile organic compounds (NMVOC), around 82 kilograms of nitrogen oxides (NO_x) and 73 kilograms of sulphur dioxide (SO_2). If electricity generated from renewable sources such as hydropower is used, this results in a primary energy consumption of 618 gigajoules (corresponding to the energy content of around 19,000 litres of gasoline), an environmental input of approx. 20 tonnes of carbon dioxide (CO_2), around 28 kilograms of non-methane volatile organic compounds (NMVOC), around 53 kilograms of nitrogen oxides (NO_x) and about 51 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 the CO_2 emissions and also the primary energy consumption, the use phase is dominant with a share of 67 and 73 percent in the scenario with the EU electricity mix.

With electricity from hydropower, emissions from traction power generation can be significantly reduced; thereby significantly decreasing the relevance of the use phase in the CO_2 emissions, falling from 67 to 27 percent (cf. also Figure 2-3). In terms of primary energy demand, the use phase share is still dominant at approx. 56 percent, even if electricity generated from renewable sources is charged. Figure 2-4 shows the nitrogen oxide emissions.

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 (cf. Figure 2-5). The production phase must therefore be included in the analysis of ecological compatibility.

For the new S 580 e, the driving emissions (CO, HC and NO_x) as part of the life cycle assessment were 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 (especially for CO).

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

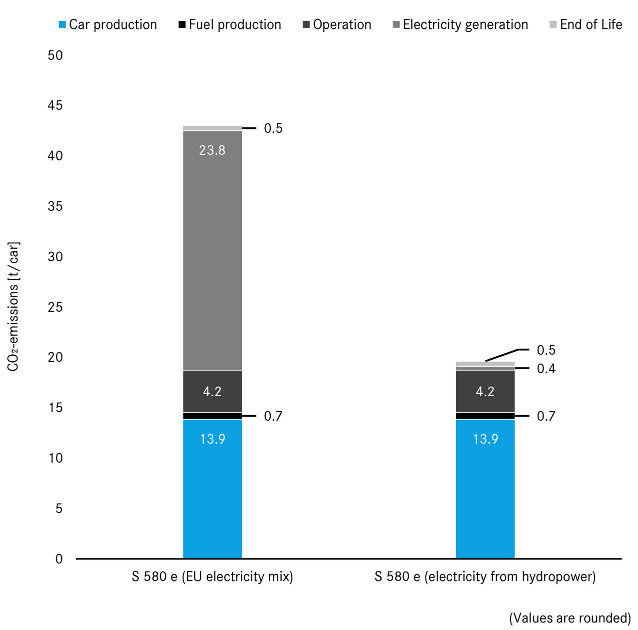
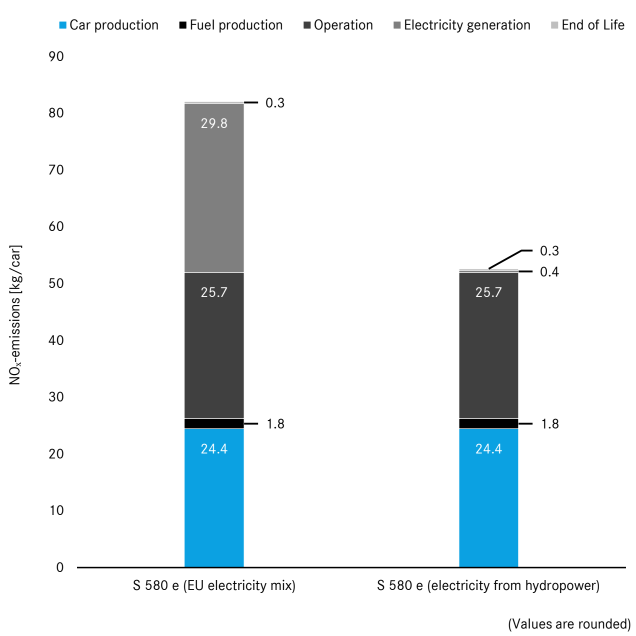


Figure 2-4: Overall nitrogen oxides emissions (NO_x)

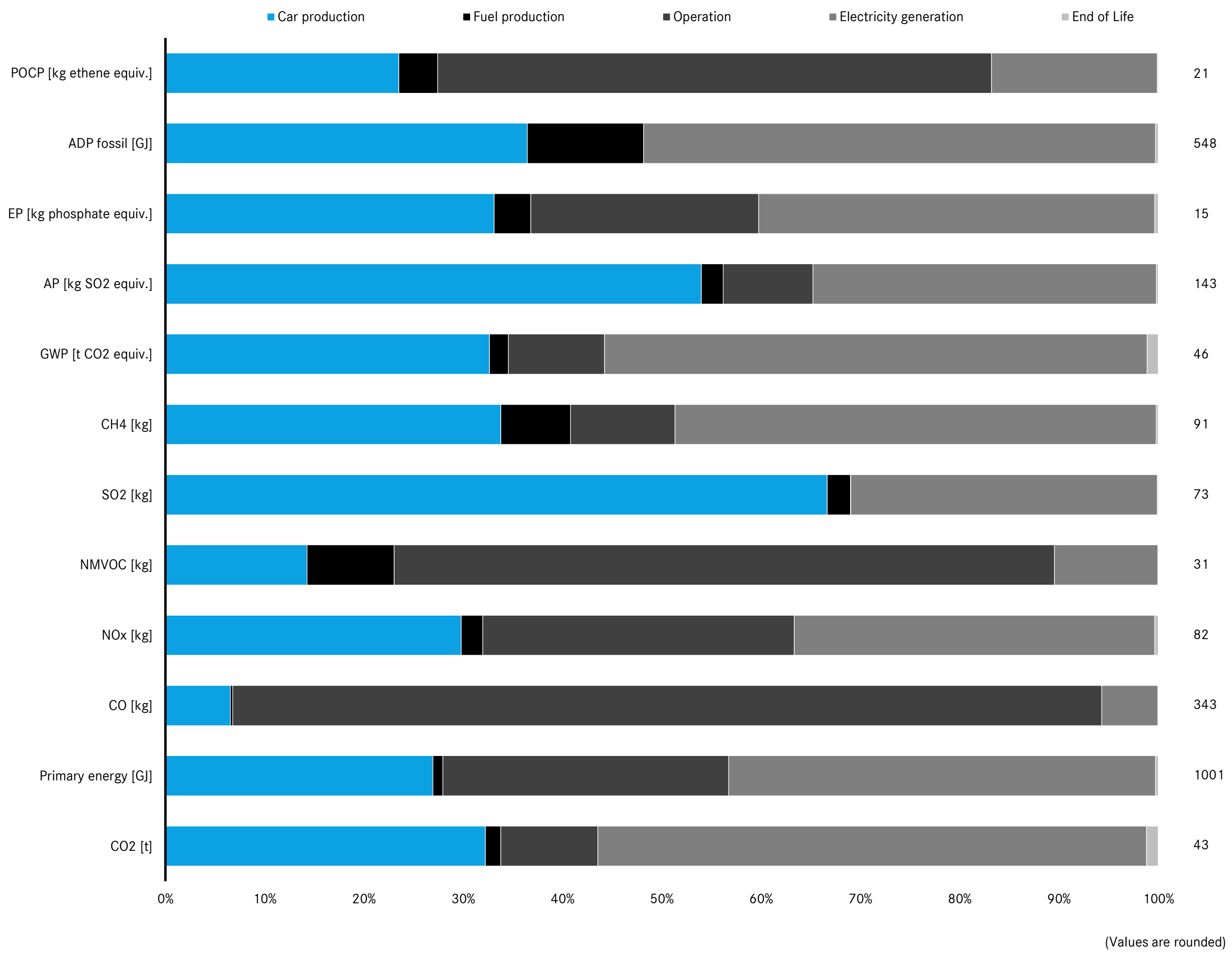


During the use phase of the vehicle, many of the emissions are dominated less by the actual operation of the vehicle and far more by the production of fuel, as for example in the case of the SO_2 emissions and CH_4 emissions. If, on the other hand, electricity generated from renewable sources such as hydropower is used for external charging of the high-voltage battery, the share of electricity generation is largely eliminated for almost all result parameters; only in the case of primary energy demand does a larger share of 8 percent remain.

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.

Figure 2-5: Share of lifecycle phases for selected parameters (EU electricity mix)



2.3 Comparison with the predecessor

In parallel with the analyses of the new S-Class plug-in hybrid an assessment of the comparable predecessor was made (S 560 e: ECE base variant 2,150 kilograms DIN weight). The parameters on which this was based are comparable to the modelling of the new S 580 e. The production process was represented on the basis of extracts from the current list of parts. The operation phase was calculated using the valid certification values. The same state-of-the-art model was used for recovery and recycling.

As Figure 2-6 shows, the production of the new S 580 e results in a higher quantity of carbon dioxide emissions than its predecessor. This is mainly due to the larger high-voltage battery and the increased proportion of light alloys in the body shell. Due to the significantly higher storage capacity of the high-voltage battery compared to its predecessor, an electric range of around 100 km (WLTP) is made possible, which is about twice as large. This can significantly increase the proportion of electric driving, while reducing the proportion of driving in combustion mode. Over the entire service life, the new S 580 e thus offers significant advantages, especially when used with electricity generated from renewable sources. The biggest saving here is in the CO_2 emissions at around 36%.

At the beginning of the lifecycle, production of the new S 580 e causes with 13.9 tonnes a higher amount of CO_2 emissions than its predecessor (12.1 tonnes). In the subsequent operation phase, the new S 580 e emits 28.7 tons (EU electricity mix) respectively 5.3 tons of CO_2 (electricity from hydro-power), depending on the type of power generation. In total, the production, use and recycling result in 43.0 resp. 19.6 tonnes of CO_2.

Production of the predecessor gives rise to 12.1 tons of CO_2. During use, it emits 37.5 (EU electricity mix) resp. 18.2 tons of CO_2 (electricity from hydropower), the contribution of the recycling is 0.5 tons of CO_2. All in all, this results in 50.1 resp. 30.8 tons of CO_2 emissions.

Taking the entire lifecycle into consideration, namely production, operation over 300,000 kilometers and recycling/disposal, the new S 580 e causes around 14.1 (EU electricity mix) resp. 36.2 percent (electricity from hydropower) lower CO_2 emissions than its predecessor.

Figure 2-7 compares the nitrogen oxide emissions of the two vehicles.

Figure 2-6: Comparison of CO_2 emissions [t/car]

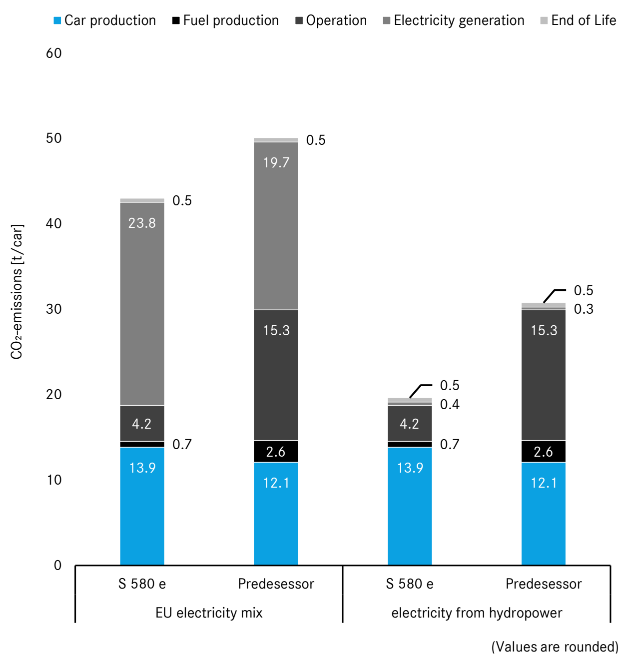


Figure 2-7: Comparison of NOx emissions [kg/car]

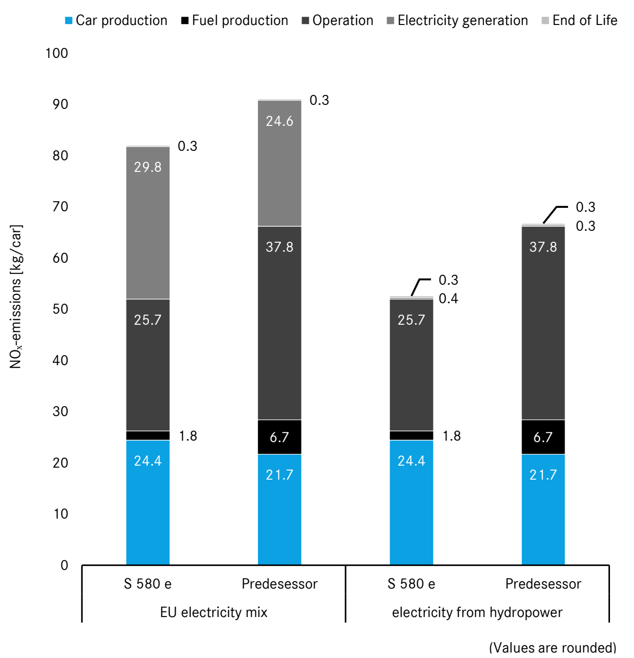


Figure 2-8 shows the examined impact categories in comparison over the various lifecycle phases. Over the entire lifecycle the new S 580e shows partly clear advantages towards the previous model in terms of global warming potential (GWP100), eutrophication (EP) and summer smog (POCP), especially when regeneratively generated electricity is used for charging. In terms of acidification potential (AP), both vehicles are at the same level.

Here, the largest contributions come from manufacturing cars and the fossil-fuel-based electricity generation. Due to the larger HV battery and the higher proportion of electric driving, the S 580 e is therefore slightly above its predecessor with the European electricity mix, while with electricity from hydropower the S 580 e is slightly more favourable.

Figure 2-8: Selected result parameters for the new S 580 e in comparison to the predecessor [unit/car]

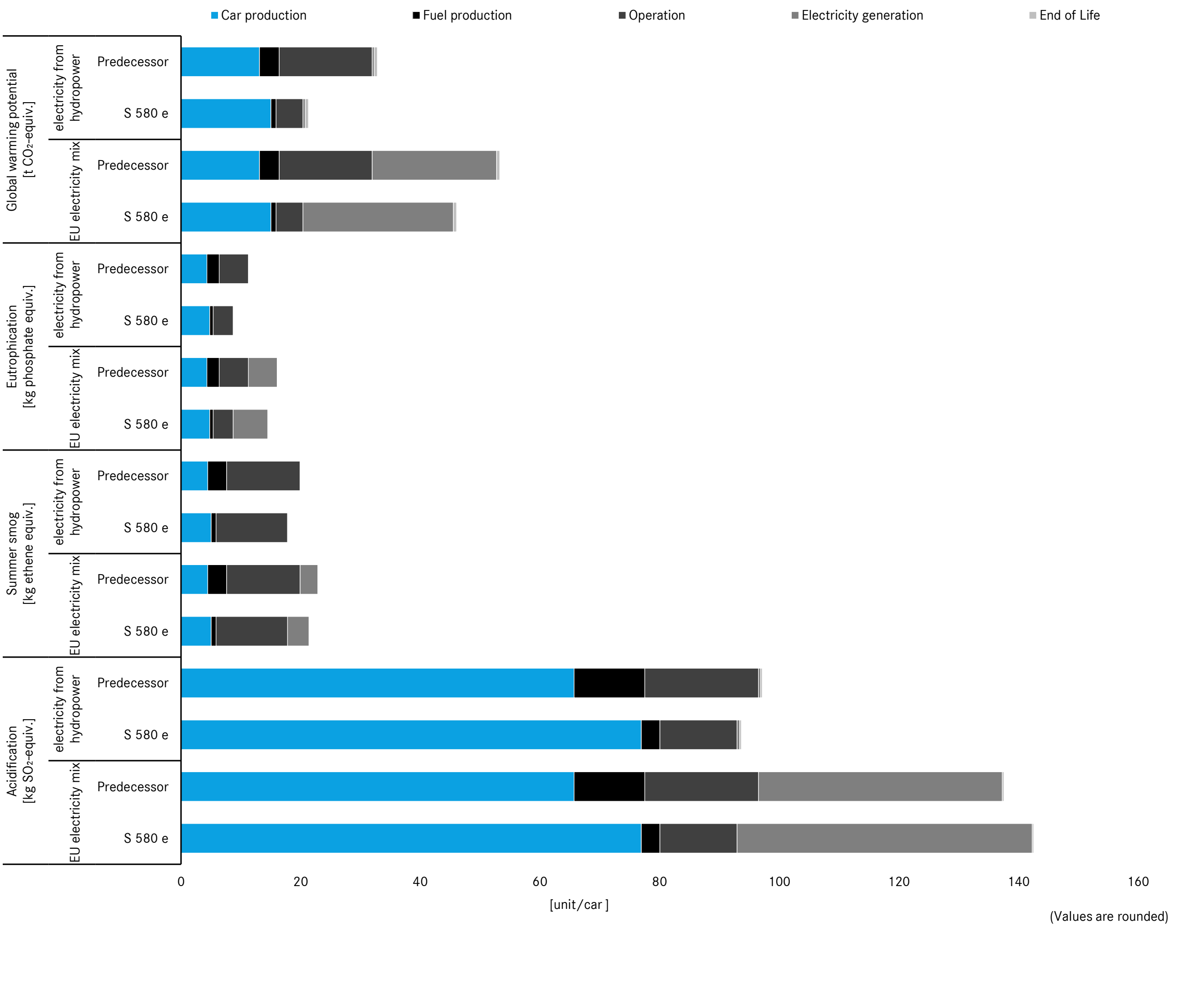
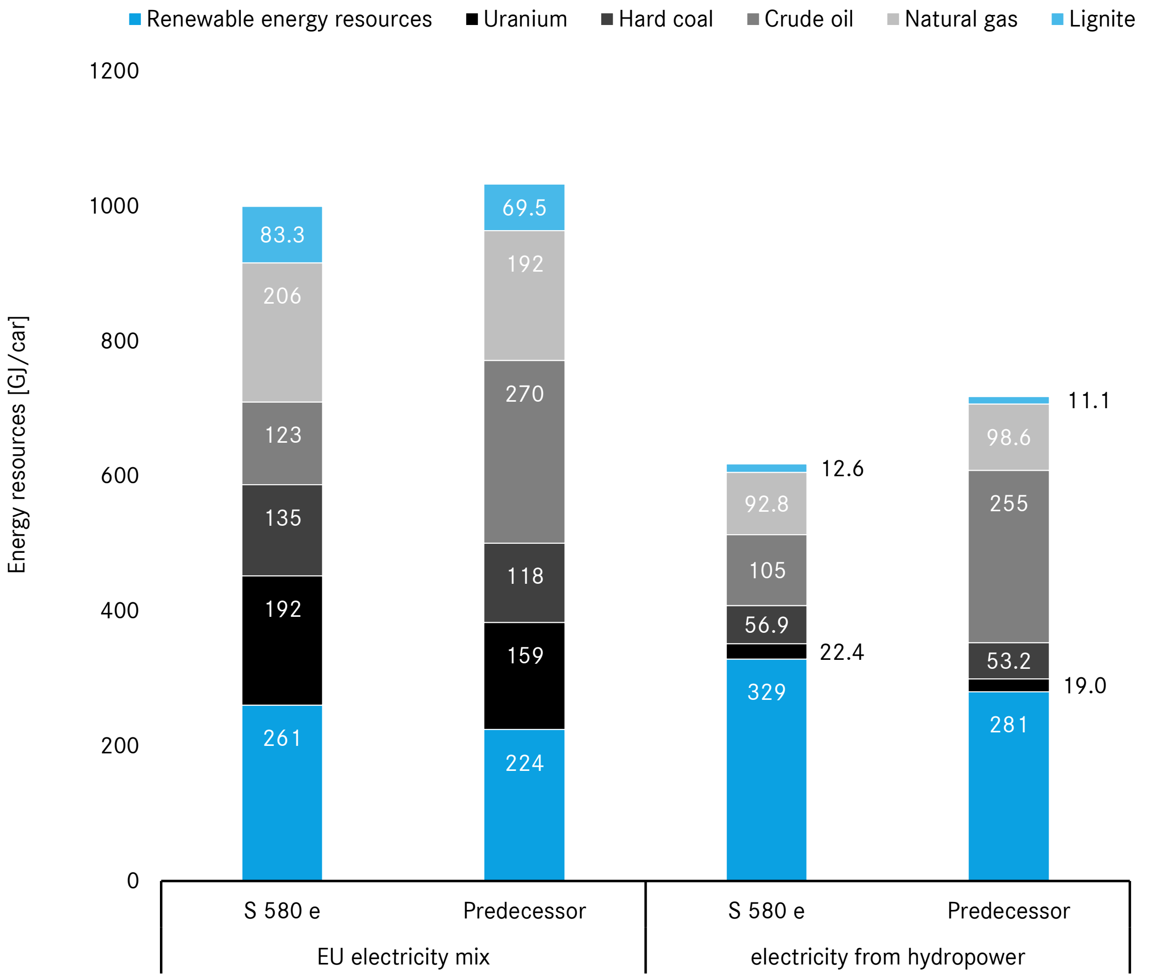


Figure 2-9: Selected energy resources new S 580 e in comparison to the predecessor [GJ/car]



(Values are rounded)

Regarding the energetic resources there are also changes compared to the previous model (cf. Figure 2-9). The consumption of energy resources such as lignite, hard coal, natural gas and uranium, which are mainly used in car production, increases in the S 580 e compared to its predecessor, mainly due to the larger HV battery and the higher aluminium content. In the use of the car, however, the electric proportion of driving can be significantly increased by the larger high-voltage battery, so that the internal combustion engine proportion of driving and thus the fuel and crude oil consumption is significantly reduced by 55 percent (electricity mix) or 59 percent (electricity from hydropower).

Due to the higher, very efficient electrical operation share of the S 580 e, fossil resource consumption (ADP fossil) can be reduced by 16 percent (electricity mix) and 59 percent (electricity from hydropower) compared to its predecessor (see also Tables 2-1).

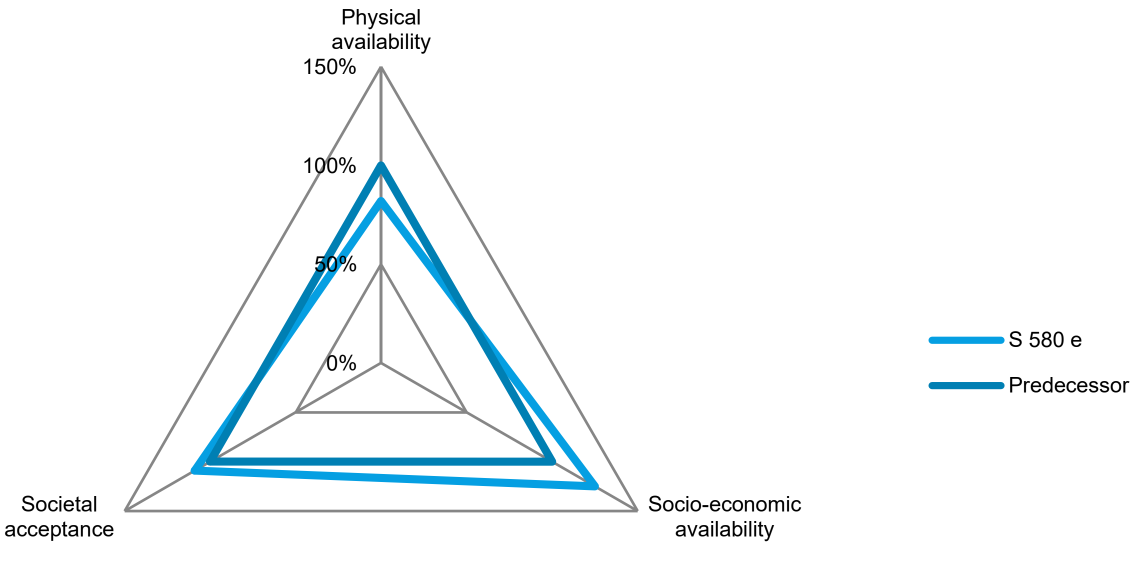
In order to comprehensively assess the use of resources in products, various aspects must also be considered in addition to pure raw material consumption. Questions pertaining to safeguarding the supply of raw materials in the medium and long term in particular as well as maintaining social and environmental standards along the supply chain play a key role. As part of the research project ESSENZ, funded by the Federal Ministry of Education and with the involvement of Daimler AG, a holistic approach was developed that brings together the different perspectives.

As an indicator of long-term supply security, the geological availability of resources is taken as an underlying basis with respect to changing needs. Medium-term effects on supply security are determined by leveraging socio-economic indicators such as country/company concentration, political stability of growing countries and price developments as well as growth in demand. Maintaining environmental and social standards are bundled in the dimension of social acceptance and provides indication of possible risks when extracting resources at the national level. In the process, indicators of working conditions and effects on the local ecosystem are taken into account.

Due to the higher proportion of electric driving in the use phase as well as the lower fuel consumption, the S 580 e with electricity from hydropower scores slightly better in the physical availability category than its predecessor scaled to 100%. In the dimensions of socio-economic availability and social acceptance, the S 580 e with electricity from hydropower is less favourable than its predecessor due to the larger high-voltage battery. With regard to socio-economic availability and social acceptance, metals in particular, which are used especially in the high-voltage components, influence the result.

Tables 2-1 and 2-2 show further LCA result parameters as an overview. The goal of bringing about improved environmental performance in the new S 580 e over its predecessor was achieved overall. Over the entire lifecycle, the new S 580 e shows partly clear advantages in the impact categories global warming potential (GWP100), eutrophication (EP) and summer smog (POCP) compared to the predecessor. In terms of acidification potential (AP), the S 580 e is at the same level as its predecessor.

Figure 2-10: Summary of resource efficiency dimensions of the ESSENZ method – S 580 e compared with predecessor (electricity from hydropower)



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

Input parameters	S 580 e (EU electricity mix)	S 580 e (electricity from hydropower)	Predecessor (EU electricity mix)	Predecessor (electricity from hydropower)	Delta to predecessor (EU electricity mix)	Delta to predecessor (electricity from hydropower)
Material resources						
Bauxite [kg]	2,830	2,821	2,025	2,017	40 %	40 %
Dolomite [kg]	316	307	319	312	-1%	-1%
Iron [kg]*	594	585	701	694	-15 %	-16 %
Non-ferrous metals (Cu, Pb, Zn) [kg]*	524	522	537	535	-2 %	-2 %
* as elementary resources						
Energy resources						
ADP fossil [GJ]**	**548**	**267**	**650**	**418**	**-16 %**	**-59 %**
Primary energy [GJ]	1,001	618	1,034	718	-3 %	-14 %
Proportionately						
Lignite [GJ]	83	13	70	11	20 %	13 %
Natural gas [GJ]	206	93	192	99	7 %	-6 %
Crude oil [GJ]	123	105	270	255	-55 %	-59 %
Hard coal [GJ]	135	57	118	53	15 %	7 %
Uranium [GJ]	192	22	159	19	21 %	18 %
Renewable energy resources [GJ]	261	329	224	281	16 %	17 %
** CML 2001, as of January 2016						

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

Output parameters	S 580 e (EU electricity mix)	S 580 e (electricity from hydropower)	Predecessor (EU electricity mix)	Predecessor (electricity from hydropower)	Delta to predecessor (EU electricity mix)	Delta to predecessor (electricity from hydropower)
Emissions in air						
GWP [t CO_2-equiv.]**	**46**	**21**	**53**	**33**	**-14 %**	**-35 %**
AP [kg SO_2-equiv.]**	**143**	**94**	**138**	**97**	**4 %**	**-4 %**
EP [kg phosphate-equiv.]**	**15**	**9**	**16**	**11**	**-10 %**	**-22 %**
POCP [kg ethene-equiv.]**	**21**	**18**	**23**	**20**	**-6 %**	**-10 %**
CO_2 [t]	43	20	50	31	-14 %	-36 %
CO [kg]	343	324	341	326	0 %	-1%
NMVOC [kg]	31	28	37	34	-17 %	-20 %
CH_4 [kg]	91	47	98	62	-7 %	-23 %
NO_x [kg]	82	53	91	67	-10 %	-21 %
SO_2 [kg]	73	51	67	48	9 %	5 %
Emissions in water						
BOD [kg]	0.16	0.14	0.20	0.18	-19 %	-22 %
Hydrocarbons [kg]	1.4	1.3	1.8	1.7	-23 %	-26 %
NO_3^- [kg]	6.8	2.2	8.2	4.4	-17 %	-50 %
PO_4^{3-} [kg]	0.42	0.24	0.50	0.35	-15 %	-31 %
SO_4^{2-} [kg]	67	19,3	63,9	24,7	5 %	-22 %

** CML 2001 as of January 2016


S MB 5004E

18:08 | 19 km
Suchen
Info
EQ
Einstellungen
AUTO
Klima-Menü
AUTO
DYNAMIC
ENGINE START / STOP
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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). 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 car cabin

The new S-Class was developed in accordance with the requirements of the quality seal of the European Centre for Allergy Research Foundation (ECARF) and has received a seal. 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 S-Class 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 measure car cabin emissions

3.3 Use of less resource consuming materials

Manufacturing vehicles requires a high degree of material usage. For this reason there is a developmental focus on further reducing the use of resources and the environmental impacts of the materials deployed. To this end, renewable raw materials and recycled plastic materials (recovered plastic) are used. Apart from the economical use of resources, reconditioning components and recycling the raw materials used also play an important role.

Recycling plastic waste and using recycled plastic materials in new products means that primary raw materials are spared and in contrast to production using crude oil, energy and CO_2 emissions are cut down on. Directive 2000/53/EC of the European Parliament on end-of-life vehicles also calls for the increased use of recycled material to thus build up and expand the markets for secondary raw material.

The use of these renewable raw 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.

At Mercedes-Benz passenger car development, the amount of less resource consuming materials is defined from the very beginning in the requirement specifications for new models. The safety, quality and functionality technical requirements placed on a component must be met both with less resource consuming materials and with comparable new materials.

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. 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.

For established and already implemented components new solutions also have to be developed time and again because the use of secondary raw material and/or natural fibre in construction is often faced with additional technical requirements, such as new safety requirements (crash relevance), further reduction in fuel consumption (lightweight construction) or a new interior concept (surface area).

In the new S-Class a total of 202 components plus small parts such as push buttons, plastic nuts and cable fasteners with a total weight of 98.9 kilogrammes can be produced partially from less resource consuming materials. Figure 3-2 shows the approved components.

The consistent use of less resource consuming materials takes place for identical parts and for parts with the same function over all model series.

To this end, established processes are applied in the S-Class: a secondary raw material comprised of reprocessed starter batteries and bumper panelling is used for the wheel arch linings, for example. The proven concept of the cardboard honeycomb structure in the boot floor is also used here. In addition, cable channels of the S-Class are produced almost entirely from recyclate.

In floor coverings, a switch was made to a new recycled yarn in tuft velour. This yarn with the brand name ECONYL® consists of regenerated nylon. It is manufactured by recovering nylon waste destined for the landfill, for example old fishing nets and fabric remnants from mills and carpets. These are collected and transformed into a new yarn having the same properties as nylon from new raw materials. The recycling process saves CO_2 compared to a virgin product. It also enables Mercedes-Benz to close material cycles.

Figure 3-2: Parts with less resource consuming materials in the new S-Class


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.

- 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.
- Evidence of compliance with the recycling rate as part of type approval.
- Take-back of all ELVs free of charge.
- 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 the S-Class

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).

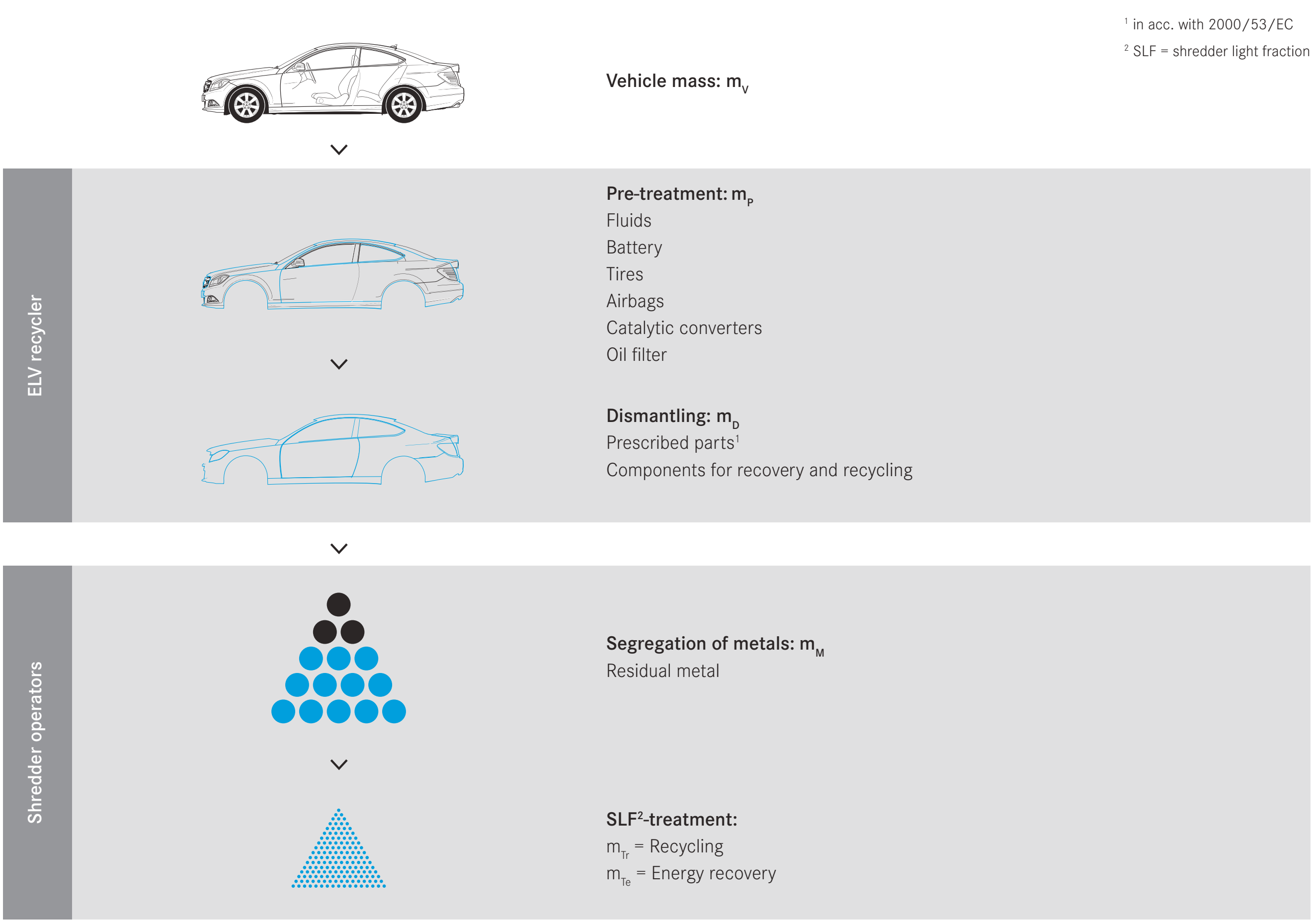
The recycling concept for the S-Class was devised in parallel with development of the vehicle; the individual components and materials were analysed for each stage of the process. The volume flow rates established for each stage together yield the recycling and recovery rates for the entire vehicle. 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 S-Class 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 S-Class, 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



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

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

4.2 Dismantling information

Dismantling information plays an important role for ELV recyclers when it comes to implementing the recycling concept. For the S-Class 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 development process, the greater the benefits in terms of reduced 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 S-Class. 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 cross-functional teams (e. g. quality management, project management etc.) are appointed in accordance with the most important automotive components and functions.

One such cross-functional 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 S-Class 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.

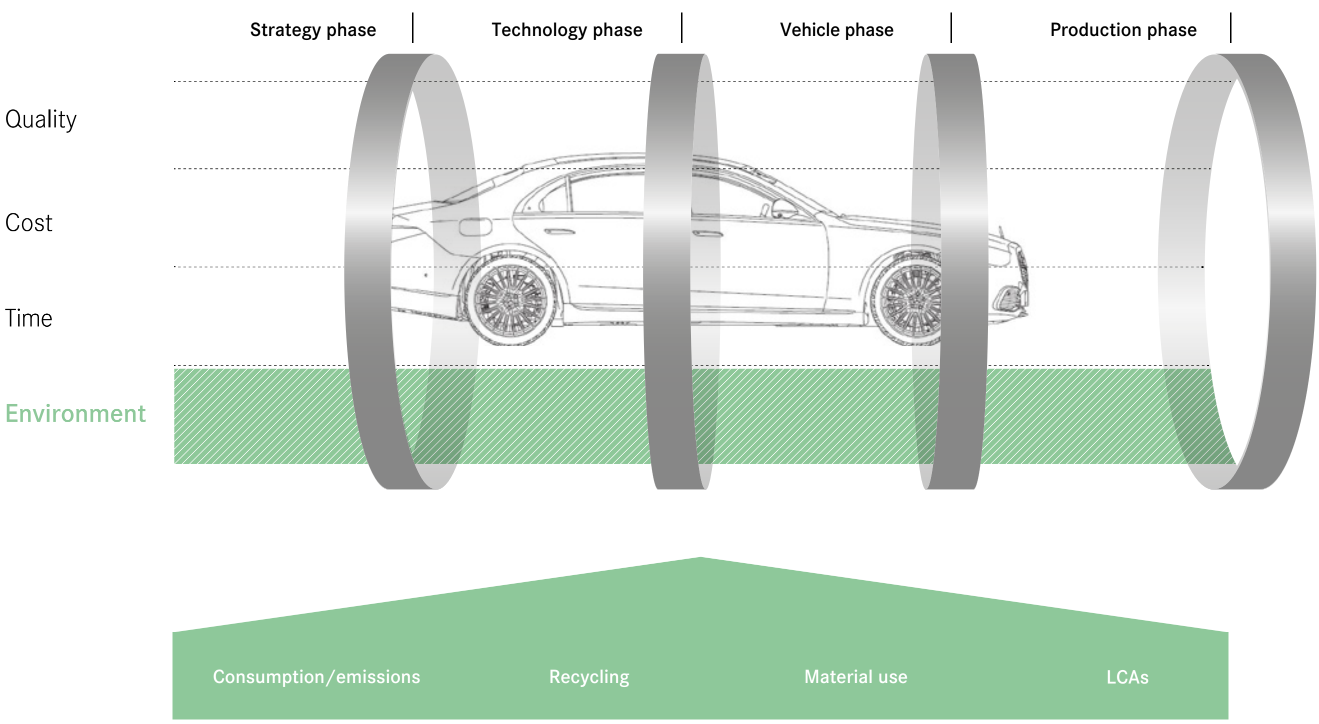
The process carried out for the S-Class meets all the criteria for the integration of environmental aspects into product development, which are described in ISO standard TR 14062.

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, Order 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 **2018-12-27** until **2021-12-06**.

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

Product Compliance Management
Munich, 2019-01-02

MS/01-03/2018

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6. Conclusion

The new Mercedes-Benz S-Class not only meets the highest demands in terms of safety, comfort, agility, and design, but also shows partly clear improvements with regard to environmental impacts over the entire lifecycle compared to its predecessor in terms of global warming potential (GWP100), eutrophication (EP) and summer smog (POCP), especially when regeneratively generated electricity is used for charging the high-voltage battery. In terms of acidification potential (AP), the S 580 e is at the same level as its predecessor. This is documented comprehensively in the underlying life cycle assessment report and was examined in an appropriate way in the context of advanced sensitivity analyses. The result was verified by environmental experts of TÜV SÜD.

With the new S 580 e, Mercedes-Benz customers benefit from an all-electric range of around 100 kilometres (WLTP). As a result, this S-Class will in many cases be on the road without the use of the combustion engine. The electric range has more than doubled compared with the previous model. The basis of the hybrid drive is the highly efficient six-cylinder in-line engine M 256, which is oriented towards the more stringent emission specifications for measurements in real driving operations (Real Driving Emissions, RDE) and also meets the strict NO_x RDE limits for real driving operations with the Euro 6d emissions standard. To conserve natural resources, a high proportion of high-quality recycled materials and renewable raw materials is also used.

Mercedes-Benz publishes since 2005 environmental product information 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. This brochure publishes the detailed environmental information already for the third S-Class generation.


S MB 5004E

Appendix

A: Product documentation

Technical data	**S 580 e**	**Predecessor (S 560 e)**
Engine type	Petrol engine in combination with a synchronous electric motor	Petrol engine in combination with a synchronous electric motor
Number of cylinders [pcs.]	6	6
Displacement (effective) [cm³]	2,999	2,996
Emission standard (fulfilled)	Euro 6d	Euro 6d-TEMP
Weight (without driver and luggage) [kg]	2,310	2,150
Fuel consumption combined [l/100 km][1]	1.0 - 0.6[2]	2.7 - 2.2[2]
CO_2 combined [g/km] [1]	23 - 14[2]	61 - 51[2]
Electrical consumption combined [kWh/100 km][1]	25.7 - 21.3[2]	18.9 - 17.6[2]

[1] The figures shown are the WLTP CO_2 figures measured according to Article 2 No. 3 Implementing Regulation (EU) 2017/1153. The fuel consumption figures were calculated based on these figures. Electricity consumption [and range] was [were] determined on the basis of Commission Regulation (EU) 2017/1151. The figures vary depending on the selected optional extras.
[2] The lifecycle assessment was calculated for the base version (lowest consumption figures).

The following table documents the used Euro limits (WLTC/RDE).

Emissions	**Euro 6d (petrol)**	**Euro 6d-TEMP (petrol)**
CO [g/km]	1 / -	1 / -
HC (NMHC) [g/km]	0.1 (0.068) / -	0.1 (0.068) / -
NO_x [g/km]	0.060 / 0.0858	0.060 / 0.126

B: LCA boundary conditions

Project objective	LCA over the lifecycle of the S 580 e (model series V223), as ECE base variant in comparison to the predecessor S 560 e (model series V222).
	Verification of attainment of the objective "environmental compatibility" and communication.
Project scope	
Functional equivalent	S-Class passenger car (base variant, weight in acc. with DIN 70020).
Technology/product comparability	With two generations of a car type, products are generally able to be compared. Due to the product comparability, the progress in development and the changing market requirements, the new S 580 e provides additional scope especially in the area of the active and passive safety. If the additional scope takes relevant influence on the balance sheet result it will get commented in the course of the evaluation.
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 (S 580 e as of 2/2021; S 560 e as of 11/2020).
	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): certification data / limits.
	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 SP2021.1 (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). These impact assessment parameters are based on internationally accepted methods. They are modelled on categories selected by the European automotive industry, with the participation of numerous stakeholders, in an EU project under the name LIRECAR. The mapping of impact potentials for human toxicity and ecotoxicity does not yet have sufficient scientific backing today, and therefore will not deliver meaningful results. The assessment of the use of resources is carried out with the ESSENCE method.
	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 10 (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 boundary conditions.

C: Glossary

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 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.
ESSENZ	Integrated method to assess resource efficiency.
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 (Kraftfahrtbundesamt).
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.
NF-Metall	Non-ferrous metal (aluminium, lead, copper, magnesium, nickel, zinc etc.).
NMVOC	Non-methane volatile organic compounds (NMHC Non-methane hydrocarbons).
POCP	Photochemical ozone creation potential, (summer smog); impact category that describes the formation of photooxidants.
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.

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