Life cycle

Environmental Certificate for the new B-Class
Since early 2009, “Life Cycle” has presented the environmental certificate for Mercedes-Benz vehicles. This documentation series concentrates above all on providing a perfect service for the highly diverse range of stakeholders: on the one hand, the extensive and complex issue of “the automobile and the environment” is to be conveyed to the public in a readily comprehensible manner. On the other hand, specialists must also be provided with detailed information. “Life Cycle” meets these requirements with a variable concept.

Readers wishing to obtain a rapid overview can focus on the brief summaries at the beginning of each chapter, where the basic facts are listed in abridged form; a uniform system of graphics facilitates orientation.

Clearly set out tables, graphics, and informative text passages meet the requirements of readers in search of a detailed picture of Daimler AG’s environmental commitment. These elements precisely reflect the various environmental aspects down to the smallest detail.

With its attractive service-oriented documentary series “Life Cycle”, Mercedes-Benz is lending emphasis to its leadership in this important field – just as in the past, when in 2005 the S-Class became the first car to receive environmental certificate from the South German Technical Inspection Authority (TÜV Süd). Since then it has become part of the standards observed at Mercedes-Benz to document the environmental compatibility of new models by means of the environmental certificate. So far the following nine model series have received the certificate: S-Class, A-Class, B-Class, C-Class, E-Class, CLS, SLK, GLK and M-Class. The new B-Class has now received the coveted environmental certificate for the second time – and more models will follow.
Aerodynamics reduce the driving resistance. Which components help to overcome this?

Prof. Kohler: The entire drive system range is completely new: four-cylinder petrol and diesel engines with direct injection and turbocharging, dual clutch transmission and manual transmission. All engines were developed in-house.

Both diesel models (B 180 CDI BlueEFFICIENCY and B 200 CDI BlueEFFICIENCY) now run on 4.4 litres per 100 km (114 and 115 g CO₂/km respectively) – their predecessors required 5.2 litres per 100 km. The B 180 CDI BlueEFFICIENCY attains a CO₂ value of 115 g/km with automatic transmission – an improvement of 21 percent on its predecessor (146 g/km).

The petrol-engine variants have also made great strides: despite a substantial improvement in performance, the B 180 BlueEFFICIENCY and B 200 BlueEFFICIENCY now run on 5.9 litres per 100 km (137 and 138 g CO₂/km respectively), undercutting their predecessors by up to nineteen percent.

That’s a lot of significantly more efficient combustion engines, but what about alternative drive configurations?

Prof. Kohler: The modular “ENERGY SPACE” concept means that the new B-Class is already designed to accommodate versions with an alternative drive: appropriate interfaces in the body shell enable the main floor panel to be modified and a step to be produced for the versions with alternative drive. An underfloor compartment covering part of the area under the rear bench seat offers space for alternative energy accumulators.

And what specifically can we expect to see in this respect?

Prof. Kohler: We have already given a very specific insight into this area at the International Motor Show in Frankfurt. A new addition to Mercedes-Benz’s portfolio of electric cars is the near-series Concept B-Class E-CELL PLUS – a compact model that meets all the needs of daily journeys and offers its driver unrestricted mobility. This is made possible by the combination of a powerful electric drive generating a peak power output of 100 kW and a continuous output of 70 kW with a 50 kWh petrol engine. The latter performs a dual role: as low vehicle speeds it charges the battery via a generator. At higher speeds, it additionally serves as a driving engine, acting on the front wheels together with the electric motor via a newly developed automatic transmission. In all-electric, local emission-free mode the Concept B-Class E-CELL PLUS has a range of up to 100 kilometres.

What is the current status with regard to fuel cells?

Prof. Kohler: During the first circumnavigation of the world in fuel cell vehicles, three Mercedes-Benz B-Class F-CELL vehicles with local zero-emission drive systems, still based on the previous model, drove more than 30,000 kilometres as part of an expedition which lasted from January to June 2011 and crossed through some 14 countries on four continents. Based on this experience we have demonstrated that the time is ripe for electric vehicles with fuel cells. Now we need to gather pace with the issue of the infrastructure. That’s because it is only with an adequate number of hydrogen filling stations that motorists will be able to benefit from the advantages of this technology, namely high ranges, short refuelling times and zero emissions. As part of the F-CELL World Drive, the Mercedes-Benz B-Class F-CELL functioned as an ambassador for automotive mobility of the future. At the same time, Mercedes-Benz was lobbying extensively for the establishment of a comprehensive network of hydrogen filling stations – a crucial factor for the market success of this technology. So far, there are only approximately 200 filling stations worldwide at which fuel cell vehicles can be refuelled.
Product description

Heralding a new era in the compact class:
The new Mercedes-Benz B-Class

Substantially more agile and efficient, but as comfortable and spacious as ever – the new B-Class from Mercedes-Benz is a winner on all fronts.

The vehicle’s lower height and more upright seat position provide for a first impression that hints at the compact sports tourer’s dynamic credentials.

With a new four-cylinder petrol engine with direct injection and turbocharging, a new diesel engine, a new dual clutch transmission and a new manual transmission, as well as new assistance systems, the front-wheel drive vehicle heralds a new compact class era at Mercedes-Benz in technological terms too.

“No model change in the history of Mercedes-Benz has ever seen so many new developments introduced in one fell swoop,” stresses Prof. Dr Thomas Weber, Member of the Board of Management responsible for Group Research and Mercedes-Benz Cars Development. “Future B-Class customers will benefit from this quantum leap in terms of exemplary low fuel consumption and CO2 emissions combined with driving pleasure, plenty of space and the highest standard of safety that has ever been available in this class.”

Agile:
Space and dynamics abound

Fresh:
Emotional design idiom with sporty attributes

Efficient:
Drive system with new engines and dual clutch transmission

Safe:
Radar-based collision warning system as standard, PRE-SAFE® featuring for the first time

Sensational:
Outstanding aerodynamics set a new benchmark in the segment

Spacious:
Flexible vehicle concepts, equipped for alternative drive systems too

Premium:
High standards in terms of materials, image and quality
New concept:
Lower overall height but more space inside

An outstanding drag coefficient of $C_d = 0.26$ places the new B-Class at the forefront of its market segment. The most striking aspect is the reduced height: at 1557 millimetres, the new model crouches almost five centimetres lower on the road than its predecessor. In response to requests from many customers, the sitting position is more upright, however. This ergonomically expedient sitting position, in combination with a lowering of the vehicle’s floor at the rear, leads to a segment-leading degree of legroom (976 mm). The B-Class is optionally available with the EASY VARIO PLUS system. This enables simple reorganisation of the interior so as to enable the transportation of bulky items. Features of the EASY-VARIO-PLUS system include fore/aft adjustment of the rear seats.

The exterior design:
Perfect space in a most attractive guise

The new B-Class is a characteristic Mercedes sports tourer, offering plenty of space combined with impressive dynamic performance as a hatchback saloon. The new sportiness and the outstanding aerodynamics are particularly evident in the side line: the bonnet flows seamlessly into the A-pillar and the roof line descends sleekly to the striking roof spoiler. The roof features a swage line which lends the vehicle a longer appearance. The pronounced wheel arches offset by dynamic feature lines under the beltline are a sporty interpretation of the current design line from Mercedes-Benz. Refined details such as the lovingly designed headlights with the new spotlight element confirm the brand’s unmistakable premium credentials which shine through in the compact segment, too.

Outstanding aerodynamics:
Astounding $C_d$ value despite an estate car tail end

Apart from the aerodynamic exterior design, numerous optimisation measures on points of detail such as the airflow around the front wheels, the underbody design and the cooling air flow are also crucial contributory factors to this excellent aerodynamic performance.

The interior design:
Superior quality in a new dimension

High-quality materials and finely structured surfaces, stylish details, precision workmanship and a new spaciousness – the interior of the B-Class defines a whole new benchmark in the compact segment. Many features have been the reserve of higher classes of vehicle to date and embody Mercedes-Benz’s special understanding of quality and aesthetics. The dashboard is optionally available in ARTICO leather finish with stitching, for example. The three large round vents in the middle and their uniquely designed cruciform nozzles add a sporty attribute to the interior’s emotional design idiom. The display appears to hover over the vents. With its stylish design – the trim frame with galvanised finish contrasting with the piano black of the front panel – and slender lines, the colour display (TFT) is a highly attractive feature in the cockpit.

The new vehicle concept underscores the dynamic aspirations of the new B-Class.
The drive system: Designed for maximum efficiency

The new B-Class features new petrol and diesel engines as well as new manual and automatic transmissions, and all versions feature the ECO start/stop function. The new four-cylinder petrol engines mark the launch of a completely new engine series. The combustion process is completely new engine series. The combustion process is based on the third-generation Mercedes-Benz direct injection system which was introduced last year with the BlueDIRECT V6 and V8 engines. Its use in the B Class marks this technology’s debut in the compact segment. The new four-cylinder engines have been designed for both transverse and longitudinal installation. In the new B-Class they are initially available with a displacement of 1.6 litres, as the B 180 rated at 90 kW (122 hp) and the B 200 with an output of 115 kW (156 hp). Their maximum torque of 200 and 250 Nm respectively is available from an engine speed of 1250 rpm.

The new four-cylinder diesel engine is a further development of the OM651 deployed in the C to the S-Class, a common rail direct-injection engine of the third generation. With its displacement scaled down to 1.6 litres and numerous optimised points of detail, this is the first time that the compression-ignition engine has been mounted transversely in a Mercedes-Benz car. The B 180 CDI generates 80 kW (109 hp) of power, while the B 200 CDI has an output of 100 kW (136 hp). The maximum torque stands at 230 Nm from 1400 rpm for the 80 kW variant and 300 Nm from 1600 rpm for the 100 kW variant.

Another Mercedes-Benz premiere is the new 7G-DCT dual clutch transmission in the B-Class. This transmission is extremely compact, extremely variable with regard to adaptation of the engine speed thanks to seven gears, features an electric oil pump for start/stop capability, shifts gear without any interruptions in tractive power and combines the comfort of an automatic with the efficiency of a manual transmission.

The chassis and suspension: Refined sportiness now for the sports tourer, too

As a world first in the compact segment, the B-Class features a radar-based collision warning system with adaptive Brake Assist as standard, which lowers the risk of rear-end collisions.

The COLLISION PREVENTION ASSIST system gives a visual and acoustic warning to alert a possibly distracted driver to identified obstacles, and prepares Brake Assist for the most precise possible braking response. This is initiated as soon as the driver emphatically operates the brake pedal. The decentralisation of safety also encompasses an array of other assistance systems which have been adopted into the B-Class from the larger model series.

New assistance and braking system reduces the risk of rear-end collisions

The PRE-SAFE® preventive occupant protection system which features in the B-Class is available for the first time in this vehicle category. Core features of PRE-SAFE® are reversible belt tensioning, the closing of side windows and sliding sunroof in case of critical lateral dynamics and adjustment of the fully electric front passenger seat with a memory function to an ideal position for maximum effectiveness of the restraint systems. PRE-SAFE® is always activated in response to critical longitudinal and lateral dynamics and may also be triggered upon intervention by certain assistance functions.

Premiere in the compact class: PRE-SAFE® available for the first time

The instrument cluster with four analogue round dials and suspended pointers in the 6 o’clock position underscores the sporty character, as do the three large round vents in the middle and their uniquely designed cruciform nozzles. With its stylish design, the display appears to hover and makes for a highly attractive feature.

The new 7G-DCT dual-clutch transmission. Operated by means of a steering-column lever and two shift paddles behind the steering wheel, it has resulted in additional space in the centre console. Also completely new is the 6-speed manual transmission, which features easy gear shifting as well as low shift forces.

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Internet access, the convenient LINGUATRONIC voice control system, two navigation solutions tailored to different budgets, connection for mobile audio devices and an intuitive operating concept – the information and communication systems in the B-Class offer excellent user-friendliness and a superior level of functionality which has been the reserve of higher categories of vehicle to date.
1 Product documentation

This section documents significant environmentally relevant specifications of the different variants of the new B-Class referred to in the statements on general environmental topics (Chapter 2.1).

The detailed analysis of materials (Chapter 1.2), life cycle assessment (Chapter 2.2), and the recycling concept (Chapter 2.3.1) refer to the new B 180 with standard equipment.
1.1 Technical data

The weight and material data for the B 180 BlueEFFICIENCY 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, 90 percent fuel tank filling) served as a basis for the recycling rate and life cycle assessment. Figure 1-1 shows the material composition of the B 180 BlueEFFICIENCY in accordance with VDA 231-106.

1.2 Material composition

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Steel/ferrous materials account for around more than half the weight (58.4 percent) of the new B-Class. These are followed by polymer materials (19 percent) and the third-largest group, the light metals (10.3 percent). Service fluids comprise about 4.3 percent. The proportions of non-ferrous metals and of other materials (especially glass) are somewhat lower, at about 1.9 percent and about 3.8 percent, respectively.

The remaining materials – process polymers, electronics, and special metals – contribute about one percent to the weight of the vehicle. In this study, the material class of process polymers largely comprises materials for painting.

The group of polymer materials is divided into thermoplastics, elastomers, thermosets and non-specific plastics. Thermoplastics account for the largest share of polymers, at 13.6 percent. The second-largest group of polymer materials are the elastomers, at 4 percent (mainly tyres).

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.

A comparison with the previous model reveals differences with particular regard to steel, light metals and polymers. The new B-Class has an approximately 6 percent lower steel content at around 58.4 percent, while the proportion of light metals, at 10.3 percent, is around 4 percent higher than the predecessor model. The main constructional differences compared with the predecessor model are as follows:

- Aluminium bonnet and front wings
- Use of a weight-optimised aluminium/polymer cockpit cross member
- Increased use of aluminium in the axles
- New petrol engines featuring full aluminium construction

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### Table: Technical Data

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>B 180 BlueEFFICIENCY</th>
<th>B 200 BlueEFFICIENCY</th>
<th>B 180 CDI BlueEFFICIENCY</th>
<th>B 200 CDI BlueEFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine type</td>
<td>Petrol</td>
<td>Petrol</td>
<td>Diesel</td>
<td>Diesel</td>
</tr>
<tr>
<td>No. of cylinders</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Displacement (effective [cc])</td>
<td>1595</td>
<td>1595</td>
<td>1796</td>
<td>1796</td>
</tr>
<tr>
<td>Emission standard (fulfilled)</td>
<td>EU 5</td>
<td>EU 5</td>
<td>EU 5</td>
<td>EU 5</td>
</tr>
<tr>
<td>Weight (w/o driver and luggage) [kg]</td>
<td>1320</td>
<td>1320</td>
<td>1400</td>
<td>1400</td>
</tr>
<tr>
<td>Exhaust emissions [g/km]</td>
<td>1350**</td>
<td>1350**</td>
<td>1430**</td>
<td>1430**</td>
</tr>
<tr>
<td>CO₂ (eff)</td>
<td>137 – 144</td>
<td>137 – 144</td>
<td>115 – 121</td>
<td>116 – 122</td>
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<tr>
<td>NOₓ</td>
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<td>0.013</td>
<td>0.150</td>
<td>0.150</td>
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<tr>
<td>CO</td>
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<td>0.101</td>
<td>0.348</td>
<td>0.348</td>
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<tr>
<td>HC (petrol version)</td>
<td>0.044</td>
<td>0.044</td>
<td>-</td>
<td>-</td>
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<tr>
<td>HC + NOₓ(diesel version)</td>
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<td>-</td>
<td>0.175</td>
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<tr>
<td>PM</td>
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<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
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<tr>
<td>Overall NEDC consumption [l/100 km]</td>
<td>5.9 – 6.2</td>
<td>5.9 – 6.2</td>
<td>4.4 – 4.6</td>
<td>4.4 – 4.6</td>
</tr>
<tr>
<td>Driving noise [dB(A)]</td>
<td>72</td>
<td>74</td>
<td>72</td>
<td>74</td>
</tr>
</tbody>
</table>

* NEDC consumption for base variant B 180 with dual clutch transmission and standard tyres: 5.9 l/100 km
** Values with dual clutch transmission
2 Environmental profile

The environmental profile documents the general environmental features of the new B-Class with regard to such matters as fuel efficiency, emissions, and environmental management systems, as well as providing specific analyses of the environmental performance, such as the cycle assessment, the recycling concept, and the use of secondary and renewable raw materials.
The new B-Class makes for significantly improved fuel efficiency. In the B 180 BlueEFFICIENCY with dual clutch transmission, consumption has now decreased from the previous levels of 7.1 – 7.3 l/100 km (on market entry in 2005) and 7.3 – 7.5 l/100 km (on market exit in 2011) to 5.9 – 6.2 l/100 km, depending on the tyres used. Compared with the time of launch of its predecessor, this represents a reduction in fuel consumption of up to 17 percent; and compared with the market exit of the predecessor model, the reductions amount to as much as 19 percent.

The fuel efficiency benefits are ensured by an intelligent package of measures, the BlueEFFICIENCY technologies. These extend to optimisation measures in the drive system, energy management, and aerodynamics, and to tyres with optimised rolling resistance, weight reduction through a lightweight design, and driver information on energy-efficient driving.

The most important measures include:

- The ECO start/stop function fitted as standard on all available engines.
- Aerodynamic optimisation measures such as lowered chassis, optimised underbody and rear-axle panelling, radiator shutters and aerodynamic wheel trim.
- Tyres with low rolling resistance offer a reduced rolling resistance coefficient.
- Wheel bearings with significantly reduced wheel bearing friction.
- Weight optimisation with lightweight materials.
- Regulated fuel and oil pumps can adjust pump performance depending on the required load.

Figure 2-1: Measures designed to reduce consumption in the new B-Class
Furthermore, Mercedes-Benz offers its customers “Eco Driver Training”; the findings from this training course show that a car’s fuel efficiency can be increased by up to 15 percent by means of economical and energy-conscious driving.

The new B-Class is also fit for the future in terms of fuels. The EU’s plans provide for an increasing share of biofuels. This requirement is of course fulfilled by the B-Class since a biodiesel content of 10 percent (E10) is permissible for petrol engines. A 10 percent share of biofuels is also allowed for diesel engines, in the form of 7 percent biodiesel (B7 FAME) and 3 percent of high-quality hydrogenated vegetable oil.

Significant improvements have also been achieved in terms of exhaust emissions. Mercedes-Benz is the world’s first automobile manufacturer to install maintenance and additive-free diesel particulate filters in all diesel passenger cars, from the A to the S-Class¹. This of course also applies to the diesel variants of the B-Class. With the new B-Class, Mercedes-Benz is ensuring a high degree of emission control efficiency not only in terms of particulates. The B 180 BlueEFFICIENCY with dual clutch transmission control efficiency not only in terms of particulates.

The B-Class is produced at the Mercedes production plant in Rastatt, which has operated an environmental management system certified in accordance with the EU’s Eco-Management and Audit Scheme (EMAS) and the ISO 14001 standard for many years now. The paint technologies used for the B-Class, for example, are not only the technological state of the art but also stand out by virtue of their high levels of environmental friendliness, efficiency and quality, which are achieved thanks to consistent use of water-based paints with less than 10 percent of solvents. This painting process makes it possible to reduce the use of solvents and cut paint consumption by 20 percent by means of electrostatic application.

Considerable success has also been achieved in terms of energy savings in Rastatt. The plant’s own highly efficient combined heat and power facility uses clean natural gas to supply electricity and heating. Equally important are wheel heat exchangers. Such rotation heat exchangers are used anywhere that large volumes of air are exchanged – for example when ventilating plant halls and paint booths. The energy needed to heat areas where wheel heat exchangers are used can be reduced by as much as 50 percent. CO₂ emissions are reduced even further by using a solar facility to heat the industrial water for the plant. A geothermal facility has been installed to provide both heating in the winter and cooling in the summer for the new body shop, as well as to cool the welding plant. For this, groundwater is drawn from five extraction wells and fed back via six infiltration wells. No fossil fuels are therefore required. To provide visitors and employees at the Rastatt plant with an insight into the everyday practices designed to protect the environment, an “environmental information path” has been set up. The specific measures used in and around the plant to ensure environmentally friendly production are explained there.

Rastatt is the central plant for production of the Mercedes-Benz compact class. For the new B-Class (W 246 models series), a new production hall housing the new body shop (right in the picture) has been added to the existing buildings, to the left of where the first new model rolls off the production line. A new geothermal facility cuts down on CO₂ – this picture shows the hydraulic unit.

In sales and after-sales too, high ecological standards are secured in Mercedes-Benz’s own environmental management systems. At the dealerships, Mercedes-Benz fulfills its product responsibility with the MeRSy recycling system for workshop waste and for vehicle, used, and warranty parts and packaging materials. With the take-back system introduced in 1993, Mercedes-Benz has also enjoyed the position of role model within the automotive industry in workshop disposal and recycling. This exemplary performance in automotive manufacturing is consistently applied throughout the process, right up to the customer. The waste that accumulates at the workshops resulting from the maintenance and repair of our products is collected via a nationally organised network, processed, and made available for reuse. The “classics” 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 parts, the GTC is an integral element of service and parts operations for the Mercedes-Benz brand.

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 environment-friendly manner and free of charge. For convenient disposal, 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 06800 1 777 777.

¹ A standard feature in Germany, Austria, Switzerland, and the Netherlands; optional in all other countries with a fuel sulphur content of less than 50 ppm.
2.2 Life cycle assessment (LCA)

Decisive for the environmental compatibility of a vehicle is the environmental impact of its emissions and consumption of resources throughout its life cycle (see Figure 2-2).

The standardised tool for assessing a vehicle’s environmental impact is life cycle assessment (LCA). This shows the total environmental impact of a vehicle from the cradle to the grave, in other words from raw material extraction through production and usage up to recycling.

In the development of Mercedes-Benz passenger cars, life cycle assessments are used in 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 humans and the environment, such as global warming potential, summer smog potential, acidification potential, and eutrophication potential.

4. **Interpretation**
   - draws conclusions and makes recommendations.

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**Down to the smallest detail**

- With life cycle assessment, Mercedes-Benz registers all of the effects of a vehicle on the environment - from development via production and operation through to disposal.
- For a comprehensive assessment, all environmental inputs are accounted for within each phase of the life cycle.
- Many emissions arise not so much during driving, but in the course of fuel production - for example non-methane hydrocarbon (NMVOC) and sulphur dioxide emissions.*
- The detailed analysis also includes the consumption and processing of bauxite (aluminium production), iron and copper ore.

* NMVOC = non-methane volatile organic compounds

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**Life Cycle Assessment**

![Figure 2-2: Overview of life cycle assessment](image-url)

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**Figure 2-2: Overview of life cycle assessment**
2.2.1 Data basis

To be able to ensure the comparability of the vehicles, as a rule the ECE base variant was investigated. The B 180 BlueEFFICIENCY with dual clutch transmission (90 kW) at the time of launch served as the basis for the new B-Class; the corresponding predecessor (at the time of market exit and market entry) served as a basis of comparison.

A comparison with these two variants allows the steps in development already completed in the predecessor up to the time of market exit to be determined. These document the ongoing improvement of environmental performance over the lifetime of a model generation. In the following section, the essential basic conditions for the LCA are presented in a table.

<table>
<thead>
<tr>
<th>Project objective</th>
<th>LCA for the new B-Class as ECE base variant with the B 180 BlueEFFICIENCY engine compared with its predecessor (B 180 BlueEFFICIENCY at market exit and B 170 at market entry, respectively)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional equivalent</td>
<td>B-Class passenger car (base variant; weight in acc. with DIN 70020)</td>
</tr>
<tr>
<td>Technological/product</td>
<td>With two generations of one vehicle model, the products are fundamentally comparable. Due to continuing developments and changing market requirements, the new B-Class provides additional features, above all in passive and active safety and in terms of a higher output (&gt;5 kW). In cases where these additional features have an influence on the analysis, a comment is provided in the course of evaluation.</td>
</tr>
<tr>
<td>System bounds</td>
<td>Life cycle assessment for car manufacturing, usage, and recycling. The scope of assessment is only to be extended in the case of elementary flows (resources, emissions, non-recyclable materials).</td>
</tr>
<tr>
<td>Allocations</td>
<td>For material production, energy supply, manufacturing processes, and transport, reference is made to GaBi databases and the allocation methods they employ. No further specific allocations.</td>
</tr>
</tbody>
</table>

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 criterion. All available weight data are processed. Noise and land use are not currently available in LCA data and are therefore not taken into account. Particulate matters and emissions are not considered. Major sources of particulate matter (above all from tyres and brakes) are independent of vehicle model and are thus not relevant to the vehicle comparison. Vehicle care and maintenance are not relevant to the comparison. |

Assessment | Life cycle, in acc. with ISO 14040 and 14044 (product LCA). Vehicle care and maintenance are not relevant to the comparison. Particulate matter and emissions are not considered. Major sources of particulate matter (above all from tyres and brakes) are independent of vehicle model and are thus not relevant to the vehicle comparison. No explicit cut-off criterion. All available weight data are processed. Noise and land use are not currently available in LCA data and are therefore not taken into account. Particulate matters and emissions are not considered. Major sources of particulate matter (above all from tyres and brakes) are independent of vehicle model and are thus not relevant to the vehicle comparison. |

Assessment parameters | Material composition in acc. with VDA 231-106. Life cycle inventory: consumption of resources as primary energy, emissions, e.g. CO₂, CO, NOₓ, SO₂, NMVOC, CH₄, 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 recognised methods. They are based on the categories selected by the European automotive industry, with the participation of numerous stakeholders, as part of the EU's LIRECAR project. Representation of toxicity potential for humans and the environment would be imprecise according to the current state of the art and is therefore not expedient. Interpretation: sensitivity studies of car module structure, dominance analysis of life cycle. |

Software support | MB DfE tool. This tool presents a passenger car on the basis of the typical structure and components, including their production, and is adapted by means of vehicle specific data on materials and weight. It is based on the assessment software GaBi 4.4 (http://www.pe-international.com/gabi). |

Evaluation | Analysis of the life cycle results according to phases (dominance). The manufacturing phase is evaluated on the basis of the underlying passenger car module structure. Contributions relevant to the analysis are discussed. |

Documentation | Final report with all basic conditions. |

The fuel has a sulphur content taken to be 10 ppm. Combustion of one kilogram of fuel thus yields 0.02 grams of sulphur dioxide emissions. The usage phase is calculated on the basis of a mileage of 160,000 kilometres. The LCA includes the environmental impact of the recovery phase on the basis of the standard processes of drying, shredding, and recovery of energy from the light shredder fraction (LSF). Environmental credits are not granted.
Over the entire life cycle of the B 180 BlueEFFICIENCY, the life cycle inventory analysis yields for example a primary energy consumption of 468 gigajoules (corresponding to the energy content of around 14,300 litres of petrol), an environmental input of approx. 33 tonnes of carbon dioxide (CO₂), around 15 kilograms of non-methane volatile organic compounds (NMVOC), around 18 kilograms of nitrogen oxides (NOₓ) and 29 kilograms of sulphur dioxide (SO₂). In addition to an analysis of the overall results, the distribution of individual environmental factors on the various phases of the life cycle is investigated. The relevance of the respective life cycle phases depends on the particular environmental impact under consideration. For CO₂ emissions, and likewise for primary energy consumption, the use phase dominates with a share of 80 percent (see Figure 2-3).

However, the use of a vehicle is not alone decisive for its environmental impact. A number of environmental emissions arise to a significant extent in manufacturing, e.g. SO₂ and NOₓ emissions (see Figure 2-4).

The production phase must therefore be included in the analysis of ecological compatibility. It is not the actual operation, but rather fuel production which is now the dominant factor for a variety of emissions, such as hydrocarbon (NMVOC) and NOₓ, and for closely associated environmental effects such as photochemical ozone creation potential (POCP, summer smog) and acidification potential (AP).

For comprehensive and thus sustainable improvement of the environmental impacts associated with a vehicle, the end-of-life phase must also be considered. The use or initiation of recycling systems is worthwhile from an energetic point of view. For a comprehensive assessment, all environmental inputs are taken into consideration within each phase of the life cycle. In addition to the results shown above, it was determined for example that municipal waste and stockpile goods (especially ore processing residues and tailings) largely arise in the manufacturing phase, while special waste is created mainly through the production of petrol in the usage phase.

Environmental burden in the form of emissions into water is a result of vehicle manufacturing; this especially applies to heavy metals, NO₃⁻ and SO₄²⁻-ions, and the factors AOX, BOD and COD.

In order to assess the relevance of environmental factors, the impact categories abiotic depletion potential (ADP), eutrophication potential (EP), photochemical ozone creation potential (POCP, summer smog), global warming potential (GWP), and acidification potential (AP) are shown in normalised form for the life cycle of the B 180 BlueEFFICIENCY.

In normalisation the life cycle is evaluated against a superordinate reference system for improved understanding of the significance of each indicator value. The frame of reference chosen was Europe (EU 25 +3). Normalisation was based on the overall European yearly values, and the life cycle of the B 180 was itemised for one year. In terms of European yearly values, fossil ADP accounts for the largest share in the B 180, followed by GWP (see Figure 2-5).

The relevance of these two impact categories on the basis of EU 25 +3 is therefore greater than that of the remaining impact categories examined. The proportion is the lowest in eutrophication.

2.2.2 LCA results for the B 180 BlueEFFICIENCY

Figure 2-3: Overall carbon dioxide (CO₂) emissions in tonnes

Figure 2-4: Share of life cycle stages for selected parameters
In addition to the analysis of overall results, the distribution of selected environmental effects on the production of individual modules is investigated. Figure 2-6 shows by way of example the percentage distribution of carbon dioxide and sulphur dioxide emissions for different modules. While bodyshell manufacturing features predominantly in terms of carbon dioxide emissions, due to the mass share, when it comes to sulphur dioxide it is modules with precious and nonferrous metals and glass that are of greater relevance, since these give rise to high emissions of sulphur dioxide in material production.
2.2.3 Comparison with the predecessor model

In parallel with the analysis of the new B-Class, an assessment of the ECE base version of the predecessor model was made (1285 kg DIN weight on market entry and 1295 kg on market exit, respectively). The underlying conditions were similar to those for the new B-Class. The production process was represented on the basis of an excerpt from the current list of parts. Use of the predecessor vehicle with a comparable engine was calculated on the basis of applicable certification values. The same state-of-the-art model was used for recovery and recycling.

As Figure 2-7 shows, production of the new B-Class results in a quantity of carbon dioxide emissions which is comparable to the predecessor. However, assessment of the entire life cycle yields clear advantages for the new B-Class.

At the beginning of the life cycle, production of the new B-Class gives rise to a quantity of CO₂ emissions which is approximately comparable to the predecessor (5.9 tonnes of CO₂ overall). In the subsequent usage phase, the new B-Class emits around 26 tonnes of CO₂; the total emissions during production, use, and recycling thus amount to 33 tonnes of CO₂.

Production of the previous model at the time of market exit (= predecessor from 2011) gives rise to 5.5 tonnes of CO₂. The figure for the predecessor from 2005 is almost identical at 5.7 tonnes. Due to the higher fuel consumption, the predecessor emits 33 tonnes (2011) and 32 tonnes (2005) of CO₂. The overall figures for both predecessor models are therefore around 39 tonnes of CO₂ emissions.

Over its entire life cycle, comprising production, use over 160,000 kilometres, and recovery, the new model gives rise to 16 percent (6 tonnes) less CO₂ emissions than its predecessor.

Figure 2-8: Selected result parameters of the new B-Class compared with the 2011 predecessor [units/car]
Figure 2-8 shows further emissions into the atmosphere and the corresponding impact categories in comparison over the various phases. Over the entire life cycle, the new B-Class shows clear advantages in terms of CO₂, NOₓ, SO₂, and CH₄ as well as in the impact categories of global warming potential, acidification and eutrophication. In terms of carbon monoxide and NMVOC operation emissions, the predecessor model already significantly undercut the EU 5 limits at the time of market exit, therefore it was not possible to achieve any further improvement in this respect.

Figure 2-9 shows consumption of relevant material and energy resources. The shifts in the material mix also lead to changes in demand for material resources in production. For example, iron ore consumption in the new B-Class is lower due to the lower amount of steel used, while bauxite requirements, on the other hand, is higher due to the increased use of primary aluminium. The significant fall in requirements for energy resources (natural gas and oil) is mainly due to the significantly enhanced fuel economy during the usage phase.

Compared with the predecessor, primary energy savings of 14 percent (2011) and 12 percent (2005) are achieved over the entire life cycle. The fall in primary energy demand by 77 GJ (2011) and 66 GJ (2005) corresponds to the energy content of about 2400 and 2000 litres of petrol respectively.
### Input parameters

<table>
<thead>
<tr>
<th>Resources, ore</th>
<th>New B-Class</th>
<th>2011 predecessor</th>
<th>Delta vs. 2011 predecessor</th>
<th>2005 predecessor</th>
<th>Delta vs. 2005 predecessor</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauxite [kg]</td>
<td>238</td>
<td>61</td>
<td>-51 %</td>
<td>70</td>
<td>-36 %</td>
<td>Aluminum production, higher primary share</td>
</tr>
<tr>
<td>Dolomite [kg]</td>
<td>78</td>
<td>5.5</td>
<td>42 %</td>
<td>5.3</td>
<td>46 %</td>
<td>Magnesium production, higher magnesium mass</td>
</tr>
<tr>
<td>Iron ore [kg]**</td>
<td>661</td>
<td>929</td>
<td>-5 %</td>
<td>930</td>
<td>-7 %</td>
<td>Steel production, lower steel mass</td>
</tr>
<tr>
<td>Mixed ores (esp. Cu, Pb, Zn) [kg]**</td>
<td>84</td>
<td>56</td>
<td>44 %</td>
<td>58</td>
<td>44 %</td>
<td>Primarily electrics (cable harnesses, battery)</td>
</tr>
<tr>
<td>Rare earth ore/precious metal ore [kg]**</td>
<td>1.8</td>
<td>1.6</td>
<td>16 %</td>
<td>1.6</td>
<td>0 %</td>
<td>Engine/transmission periphery (exhaust system)</td>
</tr>
</tbody>
</table>

** In the form of ore concentrate

<table>
<thead>
<tr>
<th>Energy sources</th>
<th>New B-Class</th>
<th>2011 predecessor</th>
<th>Delta vs. 2011 predecessor</th>
<th>2005 predecessor</th>
<th>Delta vs. 2005 predecessor</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADP fossil [GJ]</td>
<td>432</td>
<td>509</td>
<td>-15 %</td>
<td>496</td>
<td>-13 %</td>
<td>Primarily fuel consumption</td>
</tr>
<tr>
<td>Primary energy [GJ]</td>
<td>468</td>
<td>545</td>
<td>-14 %</td>
<td>534</td>
<td>-12 %</td>
<td>Consumption of energy resources. Significantly lower than for the predecessor, due to the increased fuel efficiency of the new B-Class</td>
</tr>
</tbody>
</table>

** Share from

| Lignite [GJ] | 9.5         | 10.2            | -6 %                      | 10.2            | -7 %                      | ca. 62% from car manufacturing |
| Natural gas [GJ] | 53          | 56              | -6 %                      | 56              | -5 %                      | ca. 54% from usage |
| Crude oil [GJ] | 330         | 424             | -17 %                     | 413             | -15 %                     | Significant reduction due to lower fuel consumption |
| Hard coal [GJ] (GJ) | 31          | 31              | 2 %                       | 32              | -2 %                      | ca. 96% from car manufacturing |
| Renewable energy resources [GJ] | 14           | 16              | -1 %                      | 16              | -2 %                      | ca. 96% from car manufacturing |
| CML 2001, as at: November 2009 |

### Output parameters

<table>
<thead>
<tr>
<th>Atmospheric emissions</th>
<th>New B-Class</th>
<th>2011</th>
<th>Delta vs. 2011 predecessor</th>
<th>2005 predecessor</th>
<th>Delta vs. 2005 predecessor</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2 [t CO2-equiv.]</td>
<td>34</td>
<td>40</td>
<td>-16 %</td>
<td>40</td>
<td>-15 %</td>
<td>Primarily due to CO2-emissions</td>
</tr>
<tr>
<td>AP [kg SO2-equiv.]</td>
<td>45</td>
<td>47</td>
<td>-4 %</td>
<td>46</td>
<td>-1 %</td>
<td>Primarily due to SO2-emissions</td>
</tr>
<tr>
<td>EP [kg phosphate equiv.]</td>
<td>3.6</td>
<td>4.1</td>
<td>-13 %</td>
<td>3.7</td>
<td>-4 %</td>
<td>Primarily due to NOX-emissions</td>
</tr>
<tr>
<td>POCP [kg ethylene equiv.]</td>
<td>8.4</td>
<td>7.7</td>
<td>10 %</td>
<td>10</td>
<td>-16 %</td>
<td>Primarily due to NMVOC-emissions</td>
</tr>
<tr>
<td>CO2 [t]</td>
<td>39</td>
<td>39</td>
<td>-16 %</td>
<td>39</td>
<td>-16 %</td>
<td>Primarily due to operation. CO2 reduction is a direct consequence of lower fuel consumption.</td>
</tr>
<tr>
<td>CO [kg]</td>
<td>59</td>
<td>54</td>
<td>8 %</td>
<td>77</td>
<td>-24 %</td>
<td>Due to car manufacturing and usage in approx. equal amounts.</td>
</tr>
<tr>
<td>NMVOC [kg]</td>
<td>18</td>
<td>21</td>
<td>-12 %</td>
<td>18</td>
<td>-18 %</td>
<td>Approx. 75% due to usage, of which approx. 75% is due to driving operation.</td>
</tr>
<tr>
<td>CH4 [kg]</td>
<td>18</td>
<td>45</td>
<td>-13 %</td>
<td>46</td>
<td>-16 %</td>
<td>More than 70% due to car manufacturing. Operation accounts for only 2%.</td>
</tr>
<tr>
<td>NOX [kg]</td>
<td>15</td>
<td>21</td>
<td>-12 %</td>
<td>18</td>
<td>-18 %</td>
<td>Approx. 50% due to car manufacturing and usage. Driving operation accounts for approx. 17% of total nitrogen oxide emissions.</td>
</tr>
<tr>
<td>SO2 [kg]</td>
<td>29</td>
<td>29</td>
<td>-2 %</td>
<td>29</td>
<td>-2 %</td>
<td>Due to car manufacturing and usage in equal amounts.</td>
</tr>
</tbody>
</table>

### Emissions in water

<table>
<thead>
<tr>
<th>New B-Class</th>
<th>2011</th>
<th>Delta vs. 2011 predecessor</th>
<th>2005 predecessor</th>
<th>Delta vs. 2005 predecessor</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSB [kg]</td>
<td>0.3</td>
<td>0.3</td>
<td>-12 %</td>
<td>0.3</td>
<td>-15 %</td>
</tr>
<tr>
<td>Hydrosolvents [kg]</td>
<td>0.3</td>
<td>0.3</td>
<td>-13 %</td>
<td>0.3</td>
<td>-10 %</td>
</tr>
<tr>
<td>NO3- [g]</td>
<td>1080</td>
<td>1104</td>
<td>-1 %</td>
<td>1080</td>
<td>-8 %</td>
</tr>
<tr>
<td>PO4 3- [g]</td>
<td>24</td>
<td>24</td>
<td>-1 %</td>
<td>24</td>
<td>1 %</td>
</tr>
<tr>
<td>SO4 2- [kg]</td>
<td>14</td>
<td>15</td>
<td>-9 %</td>
<td>15</td>
<td>-8 %</td>
</tr>
</tbody>
</table>

* CML 2001, as at: November 2009

Tables 2-2 and 2-3 present an overview of some further LCA parameters. The lines with grey shading indicate superordinate impact categories; they group together emissions with the same effects and quantify their contribution to the respective impacts over a characterisation factor, e.g., contribution to global warming potential in tonnes of CO2 equivalent.

In Table 3-3 the superordinate impact categories are also indicated first. The new B-Class shows significant advantages over its predecessors in the impact categories GWP, AP and EP, while in terms of POCP it performs better than the predecessor at the time of market entry. The goal of bringing about improved environmental performance in the new model over its predecessor was achieved overall.
2.2.4 Component life cycle assessments

The enhancement of environmental compatibility at an overall vehicle level is an integral part of the Daimler passenger car development process. The necessary basis for this is created at component level. Similar to the overall vehicle life cycle assessment, the component life cycle assessment is determined via the environmental profile of the materials and processing methods used. Representation of the usage phase is based on fuel consumption, which in the case of component comparisons is calculated by means of what is known as the fuel reduction value. This takes into account the fact that the fuel consumption of a passenger car changes with an increase or reduction in weight.

By studying the entire life cycle it can be observed that there is no shift in the problem. The aim is to achieve the break-even point (intersection between conventional and alternative component variants) as early as possible in the usage phase.

Figure 2-10 is a schematic depiction of the two extremes of “maximum lightweight design” and “optimum lightweight design” in relation to the “conventional design”. In the case of maximum lightweight design, the additional costs incurred in component production can be so high that these variants come out worse than the conventional component when measured over the life cycle. Despite the lower component weight and the resulting reduction in consumption, the significantly higher production costs can no longer be compensated for during vehicle use. The “optimum lightweight design” variant lies somewhere between the conventional and the maximum design in terms of production. The fuel savings here are not as great as with the “maximum lightweight design” variant. Overall however, this variant is the most economical over the entire life cycle. The break-even point – the point from which the higher production costs are calculated – comes at around 100,000 kilometres in the case of the fictional example depicted here.

In the case of the new B-Class too, component designs were assessed in parallel with development. One example is the cockpit cross member beneath the dashboard. The alternatives examined included a sheet steel variant, a welded aluminium variant and an aluminium/polymer variant produced using a combined IHF/IM (Internal High-pressure forming/injection moulding) process at the Mercedes-Benz plant in Hamburg.

Figure 2-11 shows the material composition of the designs which were tested. By using aluminium, it is possible to reduce the weight significantly compared with the steel variant. The welded aluminium variant and the aluminium/polymer variant produced using the IHF process have comparable weights.

Figure 2-12 shows the determined global warming potential for component production and use to be an important parameter. Overall, the aluminium/polymer variant of the new B-Class is the most ecological. Compared with the conventional steel variant, the new IHF design reduces the global warming potential by around ten percent over the entire life cycle.

The safety structure of the B-Class offers significant reserves. In the Euro NCAP crash test, it achieved the best results in its segment and was awarded five stars.
2.3 Design for recovery

With the adoption of the European ELV Directive (2000/53/EC) on 18 September 2000, the conditions for recovery of end-of-life vehicles were revised.

The objective of this directive is the prevention of vehicle waste and the promotion of the return, reuse, and recycling of vehicles and their components. This results in the following requirements on the automotive industry:

- 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 1 January 2015 at the latest.
- Evidence of compliance with the recycling rate in 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 from the manufacturer to the ELV recyclers within six months of market introduction.
- Prohibition of the heavy metals lead, hexavalent chromium, mercury, and cadmium, taking into account the exceptions in Annex II.

With the adoption of the European ELV Directive (2000/53/EC) on 18 September 2000, the conditions for recovery of end-of-life vehicles were revised.

- End-of-life vehicles have been taken back free of charge since January 2007.
- Heavy metals such as lead, hexavalent chromium, mercury or cadmium have been eliminated in accordance with the requirements of the ELV Directive.
- Mercedes-Benz already currently has a highly efficient take-back and recycling network.
- By reselling certified used parts, the Mercedes Used Parts Center makes an important contribution to the recycling concept.
- Even during development of the B-Class, attention was paid to separation and ease of dismantling of relevant thermoplastic components.
- Detailed information is provided in electronic form for all ELV recyclers: the International Dismantling Information System (IDIS).
2.3.1 Recycling concept for the new B-Class

The calculation model reflects the real ELV recycling process and is divided into four stages:

1. Pre-treatment (extraction of all service fluids, removal of tyres, battery, and catalytic converter, triggering of airbags).
2. Dismantling (removal of replacement parts and/or components for material recycling).
3. Segregation of metals in the shredder process.
4. Treatment of non-metallic residue fraction (shredder light fraction, SLF).

The recycling concept for the new B-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.

At the ELV recycler's premises, the fluids, battery, oil filter, tyres, and catalytic converters are removed as part of the pre-treatment process. The airbags are triggered with a device that is standardised among 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.

The reuse of parts 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 Mercedes-Benz brand's service and parts business and makes an important contribution to the appropriately priced repair of vehicles. The reuse of parts 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 Mercedes-Benz brand's service and parts business and makes an important contribution to the appropriately priced repair of vehicles.

In addition to used parts, materials are selectively removed in the vehicle dismantling process that can be recycled using economically appropriate procedures. These include components of aluminium and copper as well as selected large plastic components.

During the development of the new B-Class, these components were specifically prepared for subsequent recycling. Along with the segregated separation of materials, attention was also given 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.

The calculation procedure is regulated in ISO standard 22628, “Road vehicles – Recyclability and recoverability – calculation method”.

![Diagram of recycling concept](image)

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. With the described process chain, a material recyclability rate of 85 percent and a recoverability rate of 95 percent overall were verified on the basis of the ISO 22628 calculation model for the new B-Class as part of the vehicle type approval process (see Figure 2-13).
2.3.2 Dismantling information

For the new B-Class too, all necessary information is provided in electronic form via the International Dismantling Information System (IDIS). The IDIS software provides the ELV recyclers with information, on the basis of which vehicles can be subjected to environment-friendly pre-treatment and disposal at the end of their service life.

The system presents model-specific data both graphically and in text form. In pre-treatment, specific information is provided on service fluids and pyrotechnic components. In the other areas, material-specific information is provided for the identification of non-metallic components. The current version (June 2011) covers 1758 different models and variants from 61 car brands. The IDIS data are made available to ELV recyclers and incorporated into the software half a year after the respective market launch.

2.3.3 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 that may be present in materials or components of Mercedes-Benz passenger cars have been listed in an 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.

The heavy metals lead, cadmium, mercury, and hexavalent chromium, which are prohibited by the ELV Directive of the EU, are also taken into consideration. To ensure compliance with the ban on heavy metals in accordance with the legal requirements, Mercedes-Benz has modified and adapted numerous processes and requirements both internally and with suppliers.

The new B-Class complies with valid regulations. For example, lead-free elastomers are used in the drive system, along with lead-free pyrotechnic initiators, cadmium-free thick film pastes, and surfaces free of hexavalent chromium in the interior, exterior, and assemblies.

Materials used for components in the passenger compartment and boot are also subject to emission limits that are likewise laid down in the DBL 8585 standard as well as in delivery conditions for the various components. The continual reduction of interior emissions is a major aspect of component and material development for Mercedes-Benz vehicles.

In the case of the new B-Class, it has been possible to reduce the total amount of organic compounds in the air inside the vehicle (measured as an FID value) by 48% compared with the predecessor.
In addition to the requirements for attainment of recycling rates, the 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 meet these requirements, the technical specifications for new Mercedes models prescribe a constant increase in the recycled content of passenger cars.

The studies relating to the use of recycled material, which accompany the development process, focus on thermoplastics. Unlike steel and ferrous materials, which already include a proportion of secondary materials from the outset, the use of plastics requires a separate procedure for the testing and release of the recycled material for each component. For this reason, the data on the use of recycled material in passenger cars are documented only for thermoplastic components, as this is the only factor that can be influenced in the course of development.

The quality and functionality requirements placed on a component must be met both with recyclates and with comparable new materials. To secure passenger car production even when shortages are encountered on the recycled materials market, new materials may also be used as an option.

In the new B-Class, a total of 75 components with an overall weight of 39.2 kg can be manufactured partly from high-quality recycled plastics. The mass of the approved components made from recycled material has thus been increased by 13 percent compared with the predecessor model. Typical applications include wheel arch linings, cable ducts and boot linings, and underbody panelling, which are largely made from polypropylene.

In the B-Class, 75 components with an overall weight of 39.2 kg can be produced partly from high-quality recycled plastics:

- These include wheel arch linings, cable ducts, and underbody panelling.
- The mass of recyclate components has risen by 13 percent compared with the predecessor model.
- Wherever possible, recyclate materials are derived from vehicle-related waste streams; the front wheel arch linings are made from recovered vehicle components.

Figure 2-15: Use of recycled materials

Figure 2-16: Use of secondary raw materials in the new B-Class

<table>
<thead>
<tr>
<th>Component</th>
<th>New B-Class</th>
<th>Predecessor</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight in kg</td>
<td>39.2</td>
<td>34.6</td>
</tr>
</tbody>
</table>

Figure 2-16 shows the components approved for the use of recycled materials.

A further objective is to derive the recycled materials as far as possible from automotive waste streams, thereby closing process loops. For the front wheel arch linings of the B-Class, for example, a recyclate composed of reprocessed vehicle components is used (see Figure 2-15); these comprise starter battery casings, bumper covers from the Mercedes-Benz recycling system MeRSy, and process waste from cockpit production.
2.5 Use of renewable raw material

In automotive production, the use of renewable resources concentrates on the vehicle interior. In the new B-Class, the natural fibres largely comprise coconut and wood fibres as well as honeycomb cardboard, which are used in combination with various polymer materials for series production. The use of natural products in automotive manufacturing has a number of advantages:

- Compared with glass fibre, natural fibres normally result in a reduced component weight.
- Renewable resources help 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.
- In energy recovery they exhibit an almost neutral CO₂ balance, since only the same amount of CO₂ is released as was absorbed by the plant during growth.

The types of renewable raw materials and their applications are listed in Table 2.4.

In the new B-Class, a total of 21 components with a combined weight of 19.8 kg are produced using natural materials. The total weight of components manufactured with the use of renewable raw materials has thus increased by 29 percent compared with the predecessor.

Figure 2-17 shows the components in the new B-Class produced using renewable raw materials.

For the tank ventilation the Mercedes engineers have also drawn on a raw material from nature: wood-based coke is used in the activated charcoal filter. This porous material adsorbs the hydrocarbon emissions, and the filter is constantly regenerated during operation.

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>A variety of filters</td>
</tr>
<tr>
<td>Wood</td>
<td>Moulded wood-fibre material, mountings for door paneling</td>
</tr>
<tr>
<td>Coconut/natural rubber</td>
<td>Rubberised backrest padding</td>
</tr>
<tr>
<td>Wood</td>
<td>Activated charcoal filter</td>
</tr>
<tr>
<td>Honeycomb cardboard</td>
<td>Luggage compartment floor</td>
</tr>
</tbody>
</table>

Table 2-4: Application of renewable raw materials

<table>
<thead>
<tr>
<th>Component</th>
<th>New B-Class</th>
<th>Predecessor</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight in kg</td>
<td>19.8</td>
<td>15.3</td>
<td>+ 29%</td>
</tr>
</tbody>
</table>
Reducing the environmental impact of a vehicle’s emissions and resource consumption throughout its life cycle 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 realised at great expense. The earlier sustainable product development (“Design for Environment”) is integrated into the development 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. Environmental burden can often only be reduced at a later date by means of downstream “end-of-pipe” measures.

“We strive to develop products which 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 this is the task of environment-friendly product development. Comprehensive vehicle concepts are devised in accordance with the “Design for Environment” (DfE) principle. The aim is to improve environmental performance in objectively measurable terms, while at the same time meeting 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 environment-friendly materials.

3 Process documentation

Focus on “Design for Environment”

- Sustainable product development (“Design for Environment”, DfE), was integrated into the development process for the B-Class from the outset. This minimises environmental impact and costs.
- In development, a “DfE” team ensures compliance with the secured environmental objectives.
- The “DfE” team comprises specialists from a wide range of fields, e.g. life cycle assessment, dismantling and recycling planning, materials and process engineering, and design and production.
- Integration of “DfE” into the development process has ensured that environmental aspects were included in all stages of development.
Integration of Design for Environment into the operational structure of the development project for the new B Class ensured that environmental aspects were not sought only at the time of launch, but were included in 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 new B-Class meets all the criteria described in the international ISO TR 14062 standard for the integration of environmental aspects into product development.

In organisational terms, responsibility toward improving environmental performance was an integral part of the development project for the B-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, powertrain, interior) and cross-functional teams (e.g. quality management, project management) are appointed in accordance with the most important automotive components and functions.

One such cross-functional group is known as the DfE team, consisting of experts from the fields of life cycle assessment, dismantling and recycling planning, materials and process engineering, and design and production. Members of the DfE team are also incorporated 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 deriving improvement measures where necessary.
The new Mercedes-Benz B-Class not only meets the highest demands in terms of safety, comfort, agility, and design, but also fulfils all current requirements regarding environmental compatibility.

Mercedes-Benz is the world’s first automotive manufacturer to have held the environmental certificate in accordance with the ISO TR 14062 standard since 2005.

The environmental certificate for the new B-Class documents the significant improvements that have been achieved compared with the previous model.

5 Conclusion

Both the process of environmentally compatible product development and the product information contained herein have been certified by independent experts in accordance with internationally recognised standards. In the new B-Class, Mercedes customers benefit for example from significantly enhanced fuel economy, lower emissions and a comprehensive recycling concept. In addition, it employs a greater proportion of high-quality secondary and renewable raw materials. The new B-Class is thus characterised by environmental performance that has been significantly improved compared with its predecessor.
## 6 Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
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</thead>
<tbody>
<tr>
<td>ADP</td>
<td>Abiotic depletion potential (abiotic = non-living); impact category describing the reduction of the global inventory of raw materials as a result of the exploitation of non-renewable resources.</td>
</tr>
<tr>
<td>Allocation</td>
<td>Distribution of material and energy flows in processes with multiple inputs and outputs, and assignment of the input and output flows of a process to the product system under investigation.</td>
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<tr>
<td>AOX</td>
<td>Adsorbable organically bound halogens; a sum parameter in chemical analysis primarily used in the assessment of water and sewage sludge, whereby the sum of the organic halogens adsorbable on activated carbon is determined. These comprise chlorine, bromine, and iodine compounds.</td>
</tr>
<tr>
<td>AP</td>
<td>Acidification potential; an impact category expressing the potential for changes in the milieu of ecosystems due to the introduction of acids.</td>
</tr>
<tr>
<td>Base variant</td>
<td>Base vehicle model without optional extras, usually Classic line and with a small engine.</td>
</tr>
<tr>
<td>BOD</td>
<td>Biological oxygen demand; used in the assessment of water quality as a measure of the pollution of waste water and waters with organic substances.</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical oxygen demand; used in the assessment of water quality as a measure of the pollution of waste water and waters with organic substances.</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsches Institut für Normung e.V.</td>
</tr>
<tr>
<td>ECE</td>
<td>Economic Commission for Europe; the UN organisation in which standardised technical regulations are developed.</td>
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<tr>
<td>EP</td>
<td>Eutrophication potential; impact category that expresses the potential for oversaturation of a biological system with essential nutrients.</td>
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<tr>
<td>FID value</td>
<td>The flame ionisation detector – or FID for short – is a cumulative detector for organic compounds (= hydrocarbons). The operating principle is based on the measurement of the conductivity of an oxyhydrogen flame (the fuel gas is hydrogen) between two electrodes. This enables measurement of the total quantity of organic substances in an air sample.</td>
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<tr>
<td>GWP100</td>
<td>Global warming potential, time horizon 100 years; impact category that describes potential contribution to the anthropogenic greenhouse effect (caused by mankind).</td>
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<tr>
<td>HC</td>
<td>Hydrocarbons</td>
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<tr>
<td>IDIS</td>
<td>International Dismantling Information System</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>IMDS</td>
<td>International Material Data System</td>
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<tr>
<td>Impact categories</td>
<td>Classes of effects on the environment in which resource consumptions and various emissions with the same environmental effect (such as global warming, acidification, etc.) are grouped together.</td>
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<tr>
<td>KBA</td>
<td>Federal Motor Transport Authority (Kraftfahrtbundesamt)</td>
</tr>
<tr>
<td>Life cycle assessment (LCA)</td>
<td>Compilation and evaluation of input and output flows and the potential environmental impacts of a product system throughout its life.</td>
</tr>
<tr>
<td>MB</td>
<td>Mercedes-Benz</td>
</tr>
<tr>
<td>NEFZ</td>
<td>New European Driving Cycle; a standardised cycle prescribed by legislation, in use in Europe since 1996 for determining emission and consumption values for motor vehicles.</td>
</tr>
<tr>
<td>Nonferrous metal</td>
<td>A metal other than iron or an alloy with a significant iron content (aluminium, lead, copper, magnesium, brass, nickel, zinc, tin etc.).</td>
</tr>
<tr>
<td>POCP</td>
<td>Photochemical ozone creation potential; impact category that describes the formation of photo-oxidants (&quot;summer smog&quot;).</td>
</tr>
<tr>
<td>Primary energy</td>
<td>Energy that has not been subjected to anthropogenic conversion.</td>
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<tr>
<td>Process polymers</td>
<td>A term from VDA material data sheet 231-106; the material group of process polymers includes lacquers, adhesives, sealants, and underbody protection media.</td>
</tr>
<tr>
<td>SLF</td>
<td>Shredder Light Fraction; non-metallic substances remaining after shredding as part of a process of separation and cleaning.</td>
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