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The figures for fuel consumption, CO₂ emissions, energy consumption and electric range were determined according to the European Regulation (EC) 715/2007 as amended. The figures refer to a vehicle with basic configuration in Germany and the range shown considers the different sizes of the selected wheels/tyres and the selected items of optional equipment.

All values were calculated based on the new WLTP test cycle. WLTP values are taken as the basis for determining vehicle-related taxes or other duties based (at least inter alia) on CO₂ emissions as well as eligibility for any applicable vehicle-specific subsidies. Further information on the WLTP and NEDC measurement procedures can also be found at www.bmw.de/wltp.

More information about the official fuel consumption figures and the official specific CO₂ emissions of new passenger cars can be obtained from the "Guideline on fuel consumption, CO₂ emissions and energy consumption of new passenger cars", available free of charge from all outlets, from Deutsche Automobil Treuhand GmbH (DAT), Hellmuth-Hirth-Str. 1, 73760 Ostfildern-Scharnhausen and at <https://www.dat.de/co2/>.

BMW Group Sustainability through Innovation 2022.

Introduction.



- Innovation as the key to sustainable mobility.
- Newly-developed BMW round cells optimised for NEUE KLASSE architecture.
- Costs for whole high-voltage battery up to 50 percent lower than for current generation.
- CO₂-reduced production – through green power and secondary material.
- Development head Weber: “Huge leap in technology for energy density, charging speed and range.”
- Purchasing head Post: “We will be building battery cell factories with our partners, each with an annual capacity of up to 20 GWh, at six locations in USMCA, Europe and China.”
- BMW EfficientDynamics is currently delivering practical consumption and range data, offers potential for the NEUE KLASSE from 2025.
- Sustainability in vehicle production through innovative bio-based materials to replace raw materials of animal origin.
- Replacing leather reduces CO₂e emissions by 85 percent.
- Unique recycling process creates a recycled plastic material from the maritime industry.
- CO₂ emissions are reduced by 25 percent compared to conventionally manufactured components.
- Ocean plastics used to make floor mats in the BMW iX and the BMW X1.
- The BMW Group aims to use thermoplastics made from 40 percent recycled material in its new vehicles by 2030.
- Seat design concepts for BMW and MINI: Visionary aesthetics, sustainable materials, reduced CO₂ emissions.
- Digital network for sustainable vehicle development: First applications for Catena-X.
- Generative design: Efficient and resource-saving design processes with intelligent algorithms – up to 50 percent less weight, breakthrough in the NEUE KLASSE.

- Visionary concepts and concrete solutions for intelligent traffic management and electric ecosystems in the city.
- Electric single-track vehicles: BMW CE 04, BMW Motorrad Concept CE 02, BMW Motorrad Vision AMBY and BMW i Vision AMBY.

Sustainability through Innovation.

Continuously enhancing driving pleasure and ambitious sustainability targets define the work of the BMW Group in shaping the individual mobility of the future. The company firmly believes that innovation is the key to progress in both areas. With more than 100 years of experience and extensive technological expertise, the BMW Group is rising to the challenge of developing attractive mobility solutions in harmony with climate protection, resource conservation, quality of life in urban environments and social responsibility. As part of the "Sustainability through Innovation 2022" event, the company is presenting a wide range of groundbreaking technologies, concepts and strategies that illustrate how innovative strength and visionary thinking can generate momentum for sustainable mobility.

New battery cells for the NEUE KLASSE models.

With the models of the NEUE KLASSE due to make their début in 2025, the BMW Group is poised to enter a new era in electromobility and for the first time use round battery cells, which are optimally adapted to the new architecture centred around all-electric drive systems. The innovative lithium-ion batteries for what will be the sixth generation of BMW eDrive technology will increase range by 30 percent and charging speed by around 20 percent. There will also be a reduction in CO₂ emissions in the production of the battery cells, while manufacturing costs for the entire high-voltage battery will be up to 50 percent lower compared with the current, fifth generation.

The new round cells measure 46 millimetres in diameter and will be manufactured in two different lengths. Depending on the model, they can be flexibly integrated into the available installation space in the vehicle underbody. To meet demand for battery cells for the NEUE KLASSE, the BMW Group will build two new battery cell factories with partners in Europe, China and the USMCA region.

BMW EfficientDynamics supports transformation to electromobility.

More driving pleasure, lower emissions – this is the principle behind BMW EfficientDynamics, which has been driving progress in

sustainability through continuous innovation since 2007. Along with the drive system, the technology package includes intelligent lightweight construction, reduced rolling resistance and optimised aerodynamics, all of which play a part in the transformation to electromobility. Current BMW models featuring pure electric drivetrains have been impressing media representatives in test drives, delivering outstanding energy consumption and range values and even undercutting or exceeding the official WLTP or EPA figures in some cases.

The NEUE KLASSE models will also benefit from BMW EfficientDynamics. This integrated approach to maximum efficiency influences development of the new vehicles and platforms from the very outset, not just in the drivetrain configuration, but also in the areas of design and material selection.

On the road to a circular economy and vegan interiors.

At the BMW Group, designers, material scientists and experts from other disciplines are working together on sustainable solutions for designing vehicle interiors and exteriors. The focus is on responsible procurement and processing of raw materials that is as CO₂-free as possible, continuously increasing the proportion of secondary materials with the aim of achieving a complete circular economy, new recycling processes, increased use of natural fibres and the replacement of raw materials of animal origin.

The BMW Group plans to launch its first vehicles featuring completely vegan interiors in 2023. This is being made possible primarily through the development of innovative materials with leather-like properties. Replacing leather reduces the CO₂e emissions along the value chain for the respective interior components by around 85 percent.

Recycled fishing nets as a raw material for interior and exterior components.

In a first for the automotive industry, the models of the NEUE KLASSE due to be launched from 2025 onwards will feature trim parts made of plastic whose raw material contains around 30 percent recycled fishing nets and ropes. These waste materials from the maritime industry are proactively sourced at ports all around the world to ensure that they don't end up being discarded in the sea. For numerous other materials – from steel and aluminium to plastic and glass, all the way to high-voltage batteries – new recycling processes are being developed and established in line with the principles of a circular economy. Through its work in the area of circular design, the BMW Group aims to ensure that end-of-life

vehicles are available for use as a source of raw materials for new vehicles.

Sustainable materials, new aesthetic: Visionary seat design concepts.

The BMW Group is also presenting visionary seat design concepts for future BMW and MINI models at the event. The materials used are characterised by environmentally friendly manufacturing processes, full recyclability, groundbreaking aesthetics and uncompromising premium quality with an exceptional look and feel.

Digital tools for greater sustainability.

Digitalisation and the associated innovations are also making a significant contribution to continuously increasing sustainability in the supply chain and in the construction of BMW Group vehicles. This is evident in the cross-industry data network Catena-X and in generative design with new computer-assisted methods for the development of vehicle components.

BMW AG is one of the initiators of the Catena-X partner network, which, through the establishment of a networked database, is also laying the groundwork for the creation a circular economy and the consistent reduction of CO₂ emissions in the supply chain. Around a year after its launch, the alliance for the secure exchange of data across companies in the automotive industry is now presenting its first applications ready for testing in practice.

Breakthrough in the NEUE KLASSE: Generative design.

Within the BMW Group, digitalisation in the form of generative design is playing an increasingly important role in the efficient and resource-saving design of vehicle components. Using computer algorithms, designers and engineers can create complex component geometries that enable a significant reduction in material usage and weight that would not be possible with conventional methods.

Diverse concepts for sustainable urban mobility.

To increase sustainability in the use phase of its vehicles and at the same time promote the attractiveness of cities as living spaces for their residents, the BMW Group is examining the entire urban mobility ecosystem. In addition to the development of locally emission-free vehicles, this includes diverse concepts for sustainable mobility in urban areas.



Innovative round battery cells for NEUE KLASSE from 2025.

More performance, CO₂-reduced production, significantly lower costs: BMW Group to use innovative round BMW battery cells in NEUE KLASSE from 2025.

The BMW Group is convinced that powerful, innovative, sustainably-produced battery cells will be key to the success of individual electromobility in the future. The company is set to launch a new era of e-mobility from 2025 with the models of its NEUE KLASSE – using **newly-developed round battery cells** optimised for the new architecture **for the first time.**

“The newly-developed sixth generation of our lithium-ion cells will bring a huge leap in technology that will increase energy density by more than 20 percent, improve charging speed by up to 30 percent and enhance range by up to 30 percent,” according to **Frank Weber**, member of the Board of Management of BMW AG responsible for Development. “We are also reducing CO₂ emissions from cell production by up to 60 percent. These are big steps for sustainability and customer benefits.”

“To meet our long-term needs, we will be building battery cell factories with our partners, each with an annual capacity of up to 20 GWh, at six locations in key markets for us: two in China, two in Europe and two in USMCA,” added **Joachim Post**, member of the Board of Management of BMW AG responsible for Purchasing and Supplier Network. “We have also reached agreement with our partners that they will use a percentage of secondary material for the raw materials lithium, cobalt and nickel, as well as utilising green power for production, to ensure CO₂-reduced manufacturing.”

The BMW Group has already awarded **contracts in the two-digit billion-euro range** for production of the new BMW battery cells. By leveraging the comprehensive in-house expertise of the company's own Battery Cell Competence Centre, the team from development, production and purchasing has been able to **significantly reduce costs for the high-voltage battery, thanks to the new battery cell and new integration concept for battery technology developed by BMW.** Based on current market assumptions, costs can be reduced **by up to 50 percent**, compared to the current fifth generation. The BMW Group has set itself the goal of bringing **manufacturing costs** for fully-electric models down

to the same level as vehicles with state-of-the-art combustion-engine technology.

Technological advances: new cell format and enhanced cell chemistry.

The battery cell is responsible for electric vehicles' core properties of range, driving performance and charging time. For the sixth generation of BMW eDrive technology used in the NEUE KLASSE, the company has fundamentally refined the **cell format and cell chemistry**. With the new BMW round cell specially designed for the electric architecture of the NEUE KLASSE models, it will be possible to significantly **increase** the **range** of the highest-range model **by up to 30 percent** (according to WLTP).

The new BMW round cells come with a standard diameter of 46 millimetres and two different heights. Compared to the prismatic cells of the fifth BMW battery cell generation, the nickel content in the sixth-generation BMW round cells is higher on the cathode side, while the cobalt content is reduced. On the anode side, the silicon content will be increased. As a result, the cell's volumetric energy density will improve by more than 20 percent.

The battery system plays a key role in the body structure of the NEUE KLASSE. Depending on the model, it can be flexibly integrated into the installation space to save space ("pack to open body"). The cell module level is thus eliminated.

The battery, drive train and **charging technology** in the NEUE KLASSE will also have a higher voltage of 800 volts. Among other things, this will optimise how energy is supplied to direct current high-power charging stations, which can achieve a much higher charging capacity with a current of up to 500 amperes – thus reducing the time it takes to charge the vehicle from 10 to 80 percent by up to 30 percent.

Battery cell factories in China, Europe and USMCA – each with total capacity of up to 20 GWh per year.

To supply the battery cells needed for the NEUE KLASSE, the BMW Group has already awarded contracts in the two-digit billion-euro range for construction of battery cell factories to CATL and EVE Energy. Both partners will build two gigafactories in China and Europe. Each of the battery cell factories will have a **total annual capacity of up to 20 GWh**. Plans call for two more battery cell factories to be built in the North American free trade zone, USMCA, for which the partners have not yet been nominated.

The three regions where the battery cell factories will be built will also benefit economically from the creation of new supply chains, new networks for subcontractors and new jobs.

CO₂-reduced production using green power and secondary material.

The BMW Group is particularly focused on keeping the carbon footprint and consumption of resources for production as low as possible, starting in the supply chain. Cell manufacturers will use **cobalt, lithium and nickel** that include a percentage of **secondary material**, i.e. raw materials that are not newly mined, but already in the loop, in production of battery cells. Combined with the commitment to use only green power from renewable energies for production of battery cells, the BMW Group will **reduce the carbon footprint of battery cell production by up to 60 percent**, compared to the current generation of battery cells.

Reuse of raw materials will be one of the success factors for e-mobility in the future. **Circular loops** reduce the need for new raw materials, lower the risk of infringing environmental and social standards in the supply chain and generally result in significantly lower CO₂ emissions. That is why the long-term goal of the BMW Group is to use fully **recyclable battery cells**. In China, the company is currently creating a closed loop for **reuse of the raw materials nickel, lithium and cobalt** from high-voltage batteries, thus laying the cornerstone of a ground-breaking material cycle.

The cobalt and lithium used as raw materials for the new generation of BMW battery cells will be sourced from **certified mines**. This means the company retains full **transparency over extraction methods** and, in this way, can ensure **responsible mining**. The sourcing of both raw materials from certified mines takes place either directly through the BMW Group or via the battery cell manufacturer.

The BMW Group has been actively involved for many years in initiatives to develop **standards for responsible raw material extraction** and promote compliance with environmental and social standards for raw material extraction through **certification of mines**. In this way, the company is also making itself less technologically, geographically and geopolitically dependent on individual resources and suppliers.

Development of future BMW battery cells at in-house competence centres.

The BMW Group is constantly working to further develop energy storage systems. For instance, its sixth-generation battery technology also offers

the **option** of using **cathodes made of lithium iron phosphate (LFP)** for the first time. This means the critical raw materials cobalt and nickel can then be avoided entirely in the cathode material. In parallel, the BMW Group is also pushing forward with development of **all-solid-state batteries (ASSBs)**. The company aims to have high-voltage batteries of this type ready for series introduction by the end of the decade. The BMW Group will present a demonstrator vehicle with this technology on board well before 2025.

The BMW Group has been systematically building expertise in the field of battery cell technology since 2008. Since 2019, this know-how has been concentrated at the BMW Group's Battery Cell Competence Centre (BCCC) in Munich. The BCCC spans the entire value chain – from research and development to battery cell design to manufacturability.

To ensure innovations in battery cell technology are put into practice quickly and efficiently, the BMW Group relies on a network of around 300 partners, with cooperation between established companies, startups and colleges, among others.

The knowledge gained in this way will be validated at the new Cell Manufacturing Competence Centre (CMCC) in Parsdorf, near Munich, which will begin commissioning near-standard production of samples in late 2022 for the future BMW battery cell generation to be used in the NEUE KLASSE from 2025 onwards.

The pilot line at the competence centre will make it possible to analyse and fully understand the cell production process under near-standard conditions. This will help enable future suppliers produce cells to specifications and according to their own expertise – thus further optimising battery cell production with regard to quality, output and costs.

NEUE KLASSE will make major contribution to sales volumes.

With a fast-growing product lineup and high demand, the BMW Group aims to have more than two million fully-electric vehicles on the roads by the end of 2025.

The all-electric NEUE KLASSE will make a significant contribution to BMW Group sales volumes from mid-decade. The NEUE KLASSE has the potential to further accelerate the market penetration of e-mobility: This means 50 percent of the BMW Group's global sales could already come from fully-electric vehicles before 2030.

The MINI brand will have an exclusively all-electric product range by the early 2030s, while Rolls-Royce will also be an all-electric brand from 2030. All future new models from BMW Motorrad in the field of urban mobility will likewise be fully electric.

BMW EfficientDynamics.

A new dimension in tangible efficiency.



With the introduction of its EfficientDynamics technology package back in 2007, the BMW Group presented a concept that remains unrivalled in the automotive industry to this day. It centred on consistently reducing fuel consumption – and thereby CO₂ emissions – on the one hand, while steadily increasing driving pleasure on the other.

With BMW EfficientDynamics, every aspect of vehicle development is measured in terms of how it can contribute to optimising sustainability. In addition to all aspects of the drive system, it applies to energy and heat management, aerodynamics, optimisation of rolling resistance and weight reduction through intelligent lightweight construction.

With this continuously evolving technology package, the company succeeded in reducing the CO₂ emissions of its brands' vehicle fleets by 53 percent between 1995 and 2020. The BMW Group has now set itself the target of cutting CO₂ emissions per kilometre driven for its vehicles in the use phase by a further 50 percent by 2030.

The company's meticulous efforts are now paying off, especially in the transformation to electric drivetrains.

"The real ranges that the BMW i4 and BMW iX achieve compared to their rivals show that while others focus on brochure values, BMW delivers. This clearly demonstrates the effectiveness of our EfficientDynamics strategy: maximum efficiency that is tangible for our customers," says Frank Weber, Member of the Board of Management, Development.

When determining the range and energy consumption values for the models in its electric fleet, the BMW Group focuses on realistic, customer-representative vehicle configurations and achieves impressive values through maximum efficiency.

By consistently focusing on the customer, the BMW Group – unlike many of its competitors – designs its vehicles for ranges that correspond to real-world use cases as opposed to just looking good on paper. This is also confirmed in independent tests conducted with the BMW i4 and BMW iX under real conditions by various trade publications.

Battery electric vehicles from the BMW Group perform exceptionally well in long-term tests conducted by trade media, delivering impressive ranges that in some cases even exceed the official values determined in the WLTP test cycle. In the test conducted by US trade magazine Edmunds, the BMW iX xDrive50 exceeded the official EPA range estimate by almost 100 kilometres (energy consumption (combined): 21.1 – 20.7 kWh/100 km; CO₂ emissions (combined): 0 g/km according to WLTP; NEDC values: –). It also set a new range record for electric vehicles in the Sports Activity Vehicle (SAV) segment tested by the magazine.

The BMW i4 M50 also performed well (energy consumption (combined): 22.5 – 18.0 kWh/100 km; CO₂ emissions (combined): 0 g/km according to WLTP; NEDC values: –) on the Edmunds test track, delivering a real-world range that exceeded the EPA value by more than 65 kilometres.

Everyday consumption data from realistic use cases and test vehicle configurations.

When designing new vehicle models, the developers at the BMW Group focus on the actual usage behaviour of customers. These use cases include dynamic driving situations, long-distance journeys, driving in extreme temperatures and towing a trailer.

When it comes to reducing vehicle consumption, the BMW Group places a very high focus on optimizing additional vehicle options and equipment. This not only results in small spreads with different configurations of optional equipment. It also enables vehicles with customer-representative equipment (so-called "BestFit") to stand out in the competitive environment with very good energy consumption figures.

"Efficiency is the true achievement."

Recent test reports in national and international publications confirm the effectiveness of this approach. Focus online magazine measured average energy consumption of 21.2 kWh per 100 kilometres for the BMW iX xDrive50 for urban, interurban and motorway driving with a dynamic driving style, 0.1 kWh below the official range measured in the WLTP test cycle. In its Ecotest, ADAC recorded average energy consumption of just 20.4 kWh per 100 kilometres. The range of 610 kilometres achieved by the testers also exceeded the maximum value from the WLTP test cycle. The independent experts attribute this primarily to the high efficiency of the electric motors and the intelligent energy management, which, among other things, enables adaptive

recuperation: "The enormous range achieved by the BMW iX in the ADAC Ecotest is thanks to the efficiency of the drive system."

The fact that the BMW iX xDrive50 manages the energy stored in its high-voltage battery so efficiently, even under demanding test conditions, also impressed the authors from UK consumer website Which?. They described it as "the only car we've tested since 2017 to deliver its official WLTP range" in practice. The highly integrated drive units, intelligent lightweight construction and optimised aerodynamics are decisive factors in this regard. As a result, the BMW iX xDrive50 has the lowest energy consumption of all vehicles in its segment that Which? has tested. The testers conclude: "Efficiency, not range, is BMW's true achievement."

The NEUE KLASSE will benefit from BMW EfficientDynamics.

The BMW EfficientDynamics strategy will continue to influence all aspects of new models in the future, optimising efficiency from the ground up during the use phase. This process begins in the early development stages for new vehicles or platforms such as the all-electric architecture of the NEUE KLASSE.

In addition to a new, highly efficient modular drive system from what will be the sixth generation of BMW eDrive technology, aerodynamics optimised for the battery platform will not only increase the efficiency of the NEUE KLASSE models, but also serve as an enabler for a distinctive new BMW design. Other important factors are the weight savings achieved through intelligent lightweight construction using new materials, an energy-efficient vehicle electrical system, a specific braking system for electric vehicles and the reduction of rolling resistance through improved wheel bearings, as well as close cooperation with tyre developers to achieve the best possible Class A+ tyres.



Circularity and materials.

Priority for secondary raw materials and natural fibres, BMW to offer vegan vehicle interiors for the first time in 2023.

What is a car made of? The BMW Group is finding innovative answers to this question through fundamental research, detailed development and a clear focus on sustainability. The emphasis is on raw materials that can be procured and processed as CO₂-free as possible, continuously increasing the proportion of secondary materials with the aim of achieving a complete circular economy, new recycling processes, increased use of natural fibres and the replacement of raw materials of animal origin.

At IAA Mobility 2021, the BMW Group presented the BMW i Vision Circular, a look ahead to a car that is designed according to circular economy principles across the board and defines sustainability and luxury for the year 2040. Together, designers, material scientists and experts from other disciplines are looking to the long-term future, developing innovative ideas that combine sustainability with the highest functional quality and an inspiring new aesthetic. Along with the material properties, aspects such as raw material procurement and production methods are of essential importance in the design process.

On the market from 2023: BMW and MINI models with vegan interiors.

The BMW Group plans to launch its first vehicles featuring completely vegan interiors in 2023. This is being made possible primarily through the development of innovative materials with leather-like properties. It will also be possible to use these materials for steering wheel surfaces, which must fulfil demanding criteria when it comes to feel, premium appearance and wear resistance. Fully vegan interiors will be available for both BMW and MINI models for the first time from 2023. The BMW Group is thus serving the demand for vegan and leather-free interiors, which is set to increase further in the near future, especially in the US, China and Europe.

The reduction of CO₂ emissions over the entire life cycle of a vehicle is the central goal of the BMW Group on the road to climate neutrality, which is to be achieved by 2050 at the latest. Material selection has a key role to play in achieving this goal. Replacing raw materials of animal origin makes a significant contribution to increasing sustainability in vehicle production. The introduction of a new surface material for

steering wheels will see the proportion of vehicle components that contain traces of raw materials of animal origin fall to less than one percent in the respective BMW and MINI vehicles. As a result, these materials will now only be found in areas that are not visible to the customer, for example in various waxy substances such as gelatine used in protective coatings, lanolin in paints, tallow as an additive in elastomers and beeswax as a flux for paints.

The BMW Group has for a long time been offering various fabric alternatives to leather. Now, for the first time, it is possible to offer a suitable substitute for leather for the most important interface between driver and vehicle. The steering wheel surfaces must fulfil demanding criteria when it comes to appearance, wear resistance and durability. "With a steering wheel made from a high-quality vegan surface material, we are fulfilling the wishes of our customers who do not want to make any compromises in terms of look, feel and functionality. The innovative material withstands wear and tear caused by abrasion, perspiration and moisture and has all the desirable properties of leather," says Uwe Köhler, Head of Development Body, Exterior Trim, Interior at the BMW Group. The only distinguishing feature of the new material will be a new grain effect on the steering wheel rim.

Leather-free surfaces reduce CO₂e emissions by 85 percent.

The fact that there is now a high-quality vegan surface material with equivalent properties to the real leather previously used in the production of steering wheels represents another major step towards CO₂ reduction. The new steering wheel surface material reduces CO₂e emissions along the value chain by around 85 percent compared to leather. Up to now, most of the emissions produced, around 80 percent, were in the form of methane gas from cattle rearing. The remaining 20 percent was accounted for by processing of the cowhide, which is highly energy- and water-intensive.

Climate neutrality and a circular economy are the top priorities.

To achieve the goal of climate neutrality, the BMW Group is relying on the use of green electricity in production and in the supply chain, a consistently increased proportion of secondary materials and natural raw materials, highly efficient electric motors and combustion engines and a high recycling rate in line with the principles of a circular economy.

It's all in the detail: The floor mats for various models are made from mono-material, thus avoiding material mixes that are difficult to recycle. As a result, the BMW Group saves around 23,000 tonnes of CO₂ and an

additional 1,600 tonnes of waste every year, since the recycled floor mats and waste material are also reused within the production process.

Research and development in the field of secondary raw materials and sustainable materials are a top priority. Future vehicle generations will offer other attractive alternatives to leather. The BMW Group is working with start-up companies to develop innovative bio-based materials. Compared to the synthetic leathers previously used, these result in around 45 percent lower CO₂ emissions. Mirum™, which is 100 percent bio-based and petroleum-free, has the potential to mimic all the properties of traditional leather. Another new material, Deserttux™, is made from pulverised cactus fibres with a bio-based polyurethane matrix. With these materials, replacing raw materials of animal origin can be combined with a significant reduction in CO₂.

New materials, new aesthetic: Visionary seat design concepts.

With visionary seat concepts, BMW Group Design presents ideas for concrete applications using other innovative materials and production methods that contribute to lower CO₂ emissions and increased use of secondary materials, while at the same time establishing a new, high-quality interior aesthetic for the cars of the future. Two seat concepts each for vehicles from the MINI and BMW brands are featured.

Seat surfaces are a central element in the design of a vehicle interior and are of significant importance when it comes to the customer's perception of the ambience. The design process therefore considers the look and feel, aesthetic impact and consistently high quality and tries to balance these aspects with resource-saving production and maximum recyclability of the material. Exciting colour combinations and surprising surface textures are ushering in a new lifestyle and luxury experience that is strongly influenced by an awareness of sustainability. In addition, efforts to conserve resources and reduce CO₂ emissions are driving innovation in the areas of design and material selection.

MINI is consistently focusing on vegan interiors for its next model generation. New materials and processing techniques make it possible to combine the premium character of the brand and its customers with significantly increased sustainability. With the So Soft seat concept, designers demonstrate how high-quality, colourful and comfortable a leather alternative can be. The velour used for the surfaces has a pleasant feel and offers exceptional comfort. The extremely durable material also comes in a wide range of colours, thus contributing to the interior personalisation options that MINI typically offers. Along with a

significantly reduced carbon footprint, the development goal is complete recyclability of the material used. The raw material is recycled fibres, which are processed to create a mono-material for the entire seat surface and can therefore be recycled separately.

A mono-material that is fully recyclable is also used for the surfaces of the 3D Knit seat concept. A special manufacturing process also contributes to the sustainable character of the concept. The surface material is created using a resource-saving 3D knitting method that generates almost no production waste and is less time-consuming than conventional manufacturing processes. It is also produced in one piece, lending it a high-quality appearance with no seams. The fabric created using the 3D knitting method offers a high level of comfort and a particularly modern aesthetic.

With the seat concepts created for BMW cars, BMW Group Design presents several innovative materials used side by side, which can thus be analysed together and compared. The Infinite Loop seat concept is characterised by the consistent use of recycled material. Textile waste, which is processed into a synthetic yarn, is used to produce the material for the seat surfaces. This manufacturing process uses around 98 percent less water than when using cotton and reduces CO₂ emissions by around 80 percent compared to the conventional processing of polyester.

The solid backrest elements of the Infinite Loop seat concept can be made from leftover materials from the plastics industry or, as part of a complete circular economy, from the seating foam from end-of-life vehicles. In addition, composite materials made from dust and polystyrene waste can be used for resource-saving production of the seat backrests.

The Grown Innovation seat concept combines synthetic textiles made from 100 percent recycled material with natural fibres and a new type of biomaterial obtained from bacterial nanocellulose. The biomaterial, which is created in a laboratory process over the course of several weeks, forms the basis for a plastic-free, non-animal textile material with a high-quality surface finish and long service life. Another component of the surfaces developed for the Grown Innovation seat concept consists of a synthetic textile material produced using a 3D printing process. The additive manufacturing process does not generate any production waste and offers designers almost unlimited freedom when it comes to designing shapes and colours for vehicle interiors.

The upper section of the seat backrest – a possible alternative to the wood surfaces conventionally used in cars – consists of a composite material made from fast-growing plant fibres, which are characterised by a particularly favourable carbon footprint from cultivation to processing, and a protein-based binding agent. The material can be processed efficiently and in a variety of geometries and has a high-quality grain.

Renewable raw materials and natural fibres: Reduced weight, negative carbon footprint.

The BMW Group is already using renewable raw materials, natural fibres and other bio-based materials in its vehicles – for example in door trim panels or in the substructure of the centre armrest for the new BMW 7 Series. The use of natural raw materials such as hemp, kenaf and flax minimises the use of materials and reduces weight by up to 50 percent compared to conventional materials. Natural materials also come into the CO₂ calculation with a negative value, since the plants used can absorb CO₂ and release oxygen during the growth phase.

The BMW i3, launched in 2013, demonstrated how much the use of natural materials contributes to a holistic concept for sustainability along with electromobility, intelligent lightweight construction and the use of recycled raw materials. The natural, environmentally friendly materials used in its interior also meet the highest quality standards expected for a premium car in the long term. Based on this experience, the BMW Group continues to work on the development of other possible applications for natural materials and a wide range of uses in production vehicles. The door trim panels of the BMW i3 are made from kenaf fibres harvested from malva plants, which retain their distinctive natural structure when processed. Eucalyptus wood from certified plantations in Europe is used as the raw material for parts of the instrument panel. The leather in the interior of the BMW i3 is naturally tanned using an extract of olive leaves. The natural materials also contribute to the BMW i3's excellent eco-balance, and their use in visible areas of the interior is a progressive design feature.

Components constructed from renewable plant fibres have also proven their worth in motorsport. Swiss cleantech company Bcomp produced a flax cooling shaft for the BMW iFE.20 driven in Formula E. Some carbon components in BMW M Motorsport touring cars are being replaced by reinforcement solutions made from natural fibre composites. [BMW i Ventures](#), the venture capital firm of the BMW Group, has invested in Bcomp and agreed on a development collaboration.

Revolution in the car industry: Parts made from recycled fishing nets.

In a first for the automotive industry, the models of the New Class due to be launched from 2025 onwards will feature trim parts made of plastic whose raw material contains around 30 percent recycled fishing nets and ropes. This raw material is proactively sourced at ports all around the world to ensure that it doesn't end up being discarded in the sea.

In an exclusive recycling process, waste material from the maritime industry is used to produce trim parts suitable for the exterior and interior of future vehicles. The resulting components have an approximately 25 percent lower carbon footprint than their counterparts made from conventionally manufactured plastics.

Conserving resources, reducing the carbon footprint, avoiding ocean pollution.

The BMW Group is working with different approaches to use plastic waste from the maritime industry as a raw material for vehicle components in order to conserve valuable resources and reduce CO₂ emissions. This form of recycling makes it possible to reduce the need for petroleum-based primary plastics and at the same time counteract ocean pollution.

Recycled nylon waste forms the basis for a synthetic yarn from which the floor mats in the BMW iX and the new BMW X1, for example, are made. This material, known as ECONYL, is made from used fishing nets as well as worn floor coverings and residual waste from plastics production.

Only at the BMW Group: Maritime plastic waste used to produce visible trim parts.

In a new initiative developed in cooperation with the Danish company Plastix, the BMW Group is taking the recycling of maritime plastic waste a step further. After separation, fishing nets and ropes undergo an innovative process that produces plastic granules. While recycled maritime plastic has so far only been used in the automotive industry in the form of fibres for new vehicle components, this recycled material is now also suitable for the injection moulding process for the first time. The raw material for the components manufactured in this way can consist of around 30 percent maritime plastic waste.

This creates additional application possibilities for recycled plastics. The components manufactured using the injection moulding process are trim parts that will be used in both non-visible and visible areas of the exterior and interior of the New Class models from 2025. Overall, the

BMW Group has set itself the target of increasing the proportion of secondary materials in the thermoplastics used in new vehicles from currently around 20 percent to an average of 40 percent by 2030.

Design as a starting point for CO₂ reduction and circularity.

The BMW Group currently manufactures its vehicles using almost 30 percent recycled and reusable materials. The “secondary first” approach aims to gradually increase this figure to 50 percent. In this context, it is crucial that the quality, safety and reliability of the materials comply with the same high standards as those existing for primary materials. The BMW Group takes a holistic view of sustainability and evaluates the carbon footprint of each individual material used in the interior and exterior.

The [BMW i Vision Circular](#) shows how a car can be designed with a consistent focus on the principles of the circular economy. It clearly illustrates how resource conservation begins with vehicle design. The overriding design aim for this Vision Vehicle was to optimise it for closed-loop material cycles. This involves consistently reducing the number of components, material groups and surface finishes. In addition to bio-based raw materials, the BMW i Vision Circular primarily uses materials that have already gone through a product life cycle and are 100 percent recyclable.

Closed-loop recycling: The vehicle as a source of raw materials.

Circular design aims to ensure that end-of-life vehicles are available for use as a source of raw materials for new vehicles. Recyclability is optimised primarily through a reduced variety of materials. The use of mono-materials contributes significantly to simplified recycling and improved purity of secondary raw materials. This applies to textiles as well as to plastics and metal alloys.

The BMW Group has been a pioneer in the field of vehicle dismantling and recycling processes for around two decades. The company is committed to establishing a circular economy within the automotive industry, especially for steel, aluminium, glass and plastics, and is working on concepts for automated sorting of raw materials and efficient dismantling processes. In a pilot project with chemical company BASF and recycling and environmental services provider ALBA, the BMW Group is exploring possible conditions and recycling technologies for the establishment of a material cycle for plastics that would enable an end to the use of crude oil as a raw material.

A circular economy for vehicle windows is also to be created by 2030. Consistent dismantling, sorting and reuse of automotive glass could reduce CO₂ emissions in window production by up to 30 percent compared to using new material.

Plastics: Increased use of recycled materials and bio-based raw materials.

New BMW and MINI vehicles contain around 300 kilogrammes of plastic. Around 95 percent of these plastics come from components that are sourced from suppliers and assembled at BMW Group plants.

Depending on the model, recycled material currently accounts for up to 20 percent of the thermoplastics used in a new vehicle. The BMW Group has set itself the target of increasing the proportion of recycled material to an average of 40 percent by 2030. Some plastic components are already made from 100 percent secondary material. The increased use of secondary raw materials not only leads directly to the conservation of resources, but also makes a significant contribution to reducing CO₂ emissions in the supply chain. Switching from primary to secondary materials reduces CO₂ emissions in the manufacture of thermoplastic components by 50 to 80 percent. Another way to reduce the carbon footprint in the supply chain is to use bio-based plastics and plastics reinforced with natural fibres such as cellulose, hemp, wood or bamboo.

Steel and aluminium: Low-CO₂ production, increased use of secondary raw materials.

For the manufacture of steel and aluminium components, the aim is to continuously reduce CO₂ emissions in the production of materials and make greater use of secondary materials. From 2025 onwards, the BMW Group will source steel from a Swedish manufacturer that uses hydrogen and electricity from renewable sources for production. Agreement has also been reached with another supplier for the procurement of steel from CO₂-reduced production, which means that from 2025, more than 40 percent of requirements for vehicle production at the European BMW Group plants can be covered in this way. As a result, CO₂ emissions can be reduced by around 400,000 tonnes annually. CO₂-reduced production processes are also being agreed with steel suppliers in the US and China.

At the same time, the proportion of secondary raw materials in steel components is to be gradually increased from the current average of around 25 percent. Depending on the alloy, between 50 and 80 percent

of the CO₂ emissions in the production process could be avoided in this way.

The BMW Group has been sourcing aluminium produced using electricity generated from solar energy since February 2021. The light metal produced with the help of solar power comes from the United Arab Emirates. A long-term increase in deliveries of aluminium produced using green electricity is planned, with the aim of reducing CO₂ emissions in this area by a total of around 2.5 million tonnes by 2030. From 2024 onwards, all cast aluminium wheels sourced by the BMW Group will be produced using only green electricity. Regeneratively generated energy is used both in the energy-intensive electrolysis when producing aluminium and when casting the wheels.

Some aluminium components already contain up to 50 percent secondary raw materials, with the figure set to rise to 70 percent in the cast aluminium wheels for the future generation of the MINI Countryman. The use of secondary aluminium instead of the primary raw material will lead to a reduction of 75 to 85 percent in CO₂ emissions associated with production.

CO₂-free production, second use and recycling of high-voltage batteries.

With the ramp-up of electromobility, resource-saving production of high-voltage batteries is increasingly coming into focus. The BMW Group has committed all suppliers of battery cells for the current fifth and future sixth generation of BMW eDrive technology to using 100 percent green electricity.

The second use and recycling of high-voltage batteries from electric vehicles were included in the holistic concept for sustainability at an early stage. The BMW Group has been involved in various initiator projects for the further use and recycling of high-voltage batteries since 2013. Prominent examples include the battery storage systems at the BMW Group plant in Leipzig and at the ferry terminal in Hamburg. The reusability of high-voltage batteries after a long car life as stationary power storage devices and as a means of keeping the public energy grid stable was first demonstrated with the début of the BMW i3 in 2013.

At the same time, the BMW Group is working with various partners to promote recycling and the establishment of closed-loop material cycles (circularity) for battery cells. By the time substantial numbers of end-of-life vehicles have been returned, the most suitable process will have

been industrialised. There is still no significant number of old high-voltage batteries available, since the the BMW Group designs these for the life of the vehicle and the oldest of them are only nine years old.

The proportion of secondary raw materials used in current BMW high-voltage batteries is increasing. Going forward, the mix of recycling and further use will also depend on raw material prices for battery cells. It is not yet foreseeable how the situation will evolve, which is why the BMW Group is pursuing both strands. Together with German recycling specialist Duesenfeld, the BMW Group has developed a process that aims to achieve a recycling rate of more than 95 percent – including graphite and electrolytes. In China, the BMW Brilliance Automotive joint venture (BBA) has established a closed loop for reuse of the raw materials nickel, lithium and cobalt from high-voltage batteries. The raw materials obtained in this way are used in production of new battery cells for the BMW Group. The closed-loop material cycle conserves resources and reduces CO₂ emissions by around 70 percent compared to using newly extracted primary material.

Digital tools for greater sustainability in design, development and production. Catena-X and generative design.



The cross-industry data network Catena-X and generative design with new computer-assisted method for the development of vehicle components show how digitalisation can accelerate progress towards sustainable mobility. Digital tools and the associated innovations are also making a significant contribution to continuously increasing sustainability in the supply chain and in the design of BMW Group vehicles.

BMW AG is one of the initiators of the Catena-X partner network, which, through the establishment of a networked database, is also laying the groundwork for the creation a circular economy and the consistent reduction of CO₂ emissions in the supply chain. Around a year after its launch, the alliance for the secure exchange of data across companies in the automotive industry is now presenting its first applications ready for testing in practice. Within the BMW Group, digitalisation in the form of generative design is playing an increasingly important role in the efficient and resource-saving design of vehicle components. Using computer algorithms, designers and engineers can create complex component geometries that enable a significant reduction in material usage and weight, and in some cases even deliver improved or completely new functionality that would not be possible with conventional methods.

Go-ahead for the first practical applications: Catena-X.

Catena-X enables the secure and anonymous exchange of data between automotive manufacturers, suppliers and IT companies. More than 1,000 companies and institutions are now part of the network – including automotive manufacturers, software companies, suppliers, equipment manufacturers, dealer associations, universities and research institutes. Small and medium-sized companies can also join Catena-X. All participants benefit from standardised access to information and data, which optimises efficiency in industry-specific cooperation and accelerates company processes. Digital images of vehicles that can be retrieved on the digital platform can help to develop innovative business processes and service offerings more quickly and efficiently.

In addition to the benefits of greater efficiency in the supply chain, Catena-X participants can expect more efficient quality and logistics

management as well as greater transparency in terms of sustainably reduced CO₂ emissions at all stages of the value chain. Alongside the ramp-up of electromobility, progress in reducing CO₂ emissions and conserving resources in the supply chain is the decisive factor in achieving the ambitious sustainability targets that the BMW Group has set itself. The network enables the companies involved in Catena-X to manage their carbon footprint just as precisely as conventional business figures relating to purchasing volumes, production capacities, sales data, revenue and profits. A common set of rules and standardised calculation methods coordinated with relevant NGOs lay the foundation that will allow the product carbon footprint (PCF) of each individual component to be specified with real data instead of average values in the future. This results in credible and transparent reporting on the achievement of sustainability goals in the supply chain and in vehicle production.

Catena-X also enables vehicle components to be tracked throughout their entire product life cycle – from raw material procurement to recycling. With this data, the recycling of components can be planned much more precisely. Which raw materials are required? What secondary materials are available? With Catena-X, it will be possible to answer these kinds of questions in real time in the future, thus facilitating the transformation of supply chains into material cycles. In addition to the environmental benefits, the economic benefits of a circular economy can also be precisely quantified. Along with financial savings potential, the databases will also provide information about improvements in the carbon footprint associated with the use of secondary materials.

Breakthrough in the NEUE KLASSE: Generative design.

Digital processes are increasing energy, resource and cost efficiency in the development and production of vehicle components. Generative design is rapidly gaining importance at the BMW Group as a method for the automated development of vehicle components. The design of components using computer algorithms is expected to be established as a standard method by 2025. Around 20 percent of all vehicle components could potentially be developed and designed using this digital technology. For the models of the NEUE KLASSE, generative methods will be employed for the first time to develop structural components such as the substructure of the rear seat system, for example.

Generative design enables the construction of components with complex geometries and optimal use of materials. Their weight is up to 50 percent lower than conventionally developed components.

Algorithms from the fields of quantum computing and artificial intelligence can be used for particularly demanding tasks, thereby significantly accelerating the design of components.

The BMW i8 Roadster launched in 2017 was the first production vehicle to use a component developed with the aid of generative design. The aluminium mountings for connecting the convertible top to the body of the open plug-in hybrid sports car were designed using this method and then produced in a 3D printing process.

Urban mobility. Diverse concepts for sustainable mobility in the city.



As part of its holistic approach to sustainability across the entire value chain, the BMW Group is developing not only locally emission-free vehicles, but also diverse concepts for future-oriented mobility in urban areas. To increase sustainability in the use phase and at the same time promote the attractiveness of cities as living spaces for their residents, the company is examining the entire urban mobility ecosystem. The aim is to promote acceptance of sustainable mobility solutions and to improve the transport infrastructure. This affects all areas of individual mobility and especially urban areas, where the changes in mobility originate and where they are particularly necessary.

Cities worldwide are faced with the task of counteracting the increasing densification of living and transport areas. The BMW Group is convinced that these challenges can be met with the help of innovations that offer concrete solutions against pollutant and noise emissions, traffic jams and the shortage of public space. These innovative solutions help cities to meet the mobility needs of their residents in an efficient, attractive and sustainable way, while ensuring quality of life in the urban environment.

For three decades, the BMW Group has been working with cities, universities, companies, associations, politicians and society in general on solutions for the transformation of urban mobility towards more sustainability. In cooperation with these partners, studies for the analysis of mobility needs, visions for the city of the future, concrete concepts and collaborative projects for the transformation of urban mobility area are being created. The aim is to ensure an efficient and safe flow of traffic for road users such as commuters and at the same time to guarantee a high quality of life and recreational spaces in the urban area.

Four lighthouse cities and numerous other partnerships.

In the four [lighthouse cities](#) of Munich, Rotterdam, Beijing and Los Angeles, as well as in Berlin and Hamburg, urban test laboratories for innovation in the fields of electromobility and charging infrastructure, multimodal transport, autonomous driving and digital solutions for optimising road safety and traffic flow are being created. There, concepts for locally emission-free, safe and efficient mobility come to maturity,

which are practically implemented, tested and scaled in pilot projects in order to then be transferred to other cities.

The BMW Group is also involved in intelligent traffic management initiatives to reduce CO₂ emissions. The [New Mobility Berlin](#) project initiated by the BMW Group has been developing solutions since 2016 to achieve balance between the shortage of space, changing space requirements and mobility needs in a growing city. The project, executed in cooperation with the city administration, TU Berlin and the local community, creates convenient, sustainable options for inner-city mobility and is continuously being developed.

The expansion of the digital mobility-as-a-service platform [FREE NOW](#) into a multimobility app promotes the linking of different modes of transport. FREE NOW provides access to almost 180,000 vehicles in more than 150 European cities – including eScooters, car sharing, taxis and private hire vehicles – and supports the increasing integration of local public transport.

Convenient charging solutions and digital services: Promotion of electromobility requires an attractive ecosystem.

To promote locally emission-free mobility in urban areas, the BMW Group is involved not only in the development of attractive vehicles with electrified drives, but also in the field of public infrastructure for e-mobility. Acceptance of electromobility is being actively promoted through a large number of projects intended to make this infrastructure more efficient and transparent and its use more convenient and attractive. With the public charging offering from [BMW Charging](#) and [MINI Charging](#), users register just once to gain access to more than 375,000 public charge points from around 1,000 charging infrastructure operators in Europe alone at attractive rates. Throughout Europe, all BMW Charging and MINI Charging customers charge with 100% green electricity. The BMW Group also has a stake in Digital Charging Solutions GmbH, which develops digital charging solutions for automotive manufacturers and fleet operators. The integration of these charging solutions into the vehicle's operating system makes it particularly easy and convenient to use public charging stations.

The Charge & Repark project supports the efficient use of public charging stations. The project, initiated by the BMW Group in Rotterdam, includes a digital app that notifies customers as soon as charging is complete, motivating them to move their vehicle.

The [BMW eDrive Zones](#) digital service ensures that plug-in hybrid models automatically switch to all-electric driving mode upon entering "Umweltzonen" (environment zones) and other defined areas of a city. This service also helps local authorities to achieve sustainability targets. It was created as a pilot project in Rotterdam, one of the four lighthouse cities, and after a successful test phase was continuously rolled out to other urban areas. BMW eDrive Zones are now available in 148 European and three US cities.

CO₂-free, space-saving, quiet and emotive: Electric single-track vehicles for sustainable urban mobility.

The BMW Group has more than 30 years of experience in the field of urban mobility concepts as well as outstanding development expertise in the field of electromobility.

With electric single-track vehicles, the company offers an ideal solution for locally emission-free, versatile and emotive mobility in inner cities. With significantly lower energy consumption compared to electric cars, they represent a highly efficient mobility solution. Their use reduces not only CO₂ and noise emissions, but also the need for traffic and parking spaces in urban areas.

BMW CE 04: The new electric star for the city.

The [BMW CE 04](#) has quickly become a symbol of progressive urban mobility. The purely electrically powered scooter from BMW Motorrad combines a future-oriented design with the latest drive technology and clever functionality. "The new electric star for the city," as Oliver Zipse, CEO of BMW AG, describes it, is leading a silent revolution in urban two-wheeled mobility with an emission-free drive.

With a maximum output of 31 kW/42 hp, the BMW CE 04 has a powerful motor. From a standing start, it can sprint to 50 km/h in just 2.6 seconds. Its high-quality battery and charging technology supports a range of around 130 kilometres and quick replenishment of the energy supply. This enables day-to-day emission-free riding in the city, in an urban setting and for smaller-scale fun tours after work or at the weekend – with complete peace of mind. The standard equipment of the BMW CE 04 includes a cockpit featuring a 10.25 -inch colour screen with comprehensive connectivity functions.

BMW Motorrad Concept CE 02: A breath of fresh air for urban electromobility.

Like the BMW CE 04, all new BMW Motorrad models specifically designed for urban mobility will in future be powered purely by electricity. The BMW Group is working on extremely diverse creative approaches for the urban single-track vehicles of the future. The [BMW Motorrad Concept CE 02](#) is a new and highly emotive mobility offering. With an innovative design language, new proportions and modern forms, the concept expresses a new facet of the brand character of BMW Motorrad. Thanks to the flat vehicle body, the centre of gravity of the BMW Motorrad Concept CE 02 is low and favourable when it comes to driving dynamics. At the same time, the large disc wheels and low seat height make it look inviting and confidence-inspiring.

The design and vehicle concept of the BMW Motorrad Concept CE 02 are based on the needs of a new target group: young people aged 16 and over who want to discover the joy of urban two-wheeled mobility for themselves for the first time. As a lightweight e-vehicle weighing about 120 kilogrammes, the BMW Motorrad Concept CE 02 is ideal for urban use, offering a high fun factor. The 11 kW of output and all the drive torque available directly from a standstill allow for fast acceleration at traffic lights and a top speed of 90 km/h.

Concept innovation in two forms: BMW Motorrad Vision AMBY and BMW i Vision AMBY.

Further proof of the broad range of creative solutions of the BMW Group for sustainable urban mobility is provided by a concept between bicycle and motorbike, which is presented in two versions. The [BMW Motorrad Vision AMBY](#) and [BMW i Vision AMBY](#) concepts interpret the fundamental idea of sustainable and at the same time emotive mobility in an urban setting based on two different facets. Both vehicles have an electric drive. While the BMW i Vision AMBY, a high-speed pedelec, requires constant pedalling in order to benefit from the assistance of the electric drive, the BMW Motorrad Vision AMBY is accelerated using the throttle grip and has footrests instead of pedals, as is typical of a motorcycle.

The word AMBY stands for "Adaptive Mobility". The electric drive of both vehicles supports CO₂-free riding with three speed levels for different types of roads. Its top speed is 25 km/h on cycle paths, 45 km/h on inner-city roads and 60 km/h on multi-lane roads and out of town.

Manual selection of the speed level is conceivable, as is detection of the road currently being travelled by means of geofencing technology, thereby allowing automatic adjustment of the top speed. As there is currently no legal basis for such a vehicle with an adaptive and modular speed concept, the BMW Motorrad Vision AMBY and BMW i Vision AMBY also set out to prompt the introduction of such legislation with the aim of paving the way for practical implementation of this innovative concept for sustainable urban mobility.