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BMW Group Innovation Workshop 2021. Highlights.

- The new BMW iDrive: Latest-generation display and operating system focuses on touch and voice control. BMW Curved Display as a fully digital display cluster. BMW Intelligent Personal Assistant with expanded capabilities. Individual driving experience with PERSONAL, SPORT and EFFICIENT My Modes. New BMW iDrive and BMW Operating System 8 enable innovative digital services, including BMW Digital Key Plus, BMW Maps with Augmented Reality and Remote Software Upgrade.
- BMW Concept iX5 Hydrogen Protection VR6: Unique combination of maximum protection and locally emission-free driving pleasure. World's first certified security vehicle with hydrogen fuel cell drive train. Armoured vehicle underbody with innovative layer structure protects hydrogen tanks from hand-grenade attacks. Protection to VR6 resistance class criteria, similar to passenger compartment, confirmed by government test centre for firearms.
- CUBE Concept DYNAMIC CARGO inspired by BMW and SoFlow
Concept CLEVER COMMUTE inspired by BMW: BMW Group issuing licences for two new micromobility concepts. Innovative "pick-up trike" and e-scooter variants with potential to make urban traffic more sustainable.
- New BMW Group Driving Simulation Centre: New facility at Research and Innovation Centre (FIZ) soon to be completed. 14 simulators and usability labs enable uniquely realistic mapping of the driving process for development and testing purposes. Most advanced, most versatile system of its kind worldwide includes a High-Fidelity Simulator for testing automated driving systems and a High-Dynamic Simulator.
- BMW Startup Garage: Venture client programme for young tech companies presented for first time at IAA Mobility 2021. Highlight: Live pitch event for six finalists of Open Call 360° Sustainability Challenge. Outstanding sustainability innovations will be brought to market-readiness in conjunction with the BMW Group.

BMW Group Innovation Workshop 2021. Introduction.



Sustainable mobility, the circular economy, digitalisation and automated driving – these future areas of activity will shape the BMW Group's transformation process. They are also the focal point of the BMW Group Innovation Workshop 2021. The BMW Group will present a wide variety of different concepts, technologies and initiatives underlining the company's leading position in areas that will be crucial to shaping the individual mobility of tomorrow. In addition to combating climate change, the innovations presented focus primarily on the diverse mobility needs of people in different regions of the world and on delivering an emotionally engaging driving experience through digitalisation and intelligent connectivity.

With its renewed ambition to reduce CO₂ emissions, the BMW Group is committed to a course that meets the 1.5-degree goal for limiting global warming. The aim is to reduce CO₂ emissions per vehicle and per kilometre by at least half from 2019 levels by 2030. Throughout the vehicle lifecycle, spanning production and the upstream supply chain, the plan is to reduce CO₂ emissions per vehicle by at least 40 percent. Increased use of secondary materials and the creation of a circular economy will also contribute to this. The "Secondary First" approach seeks to gradually increase the percentage of recycled and reused materials in new vehicles from the current average of 30 percent to 50 percent.

The new BMW iDrive: Natural interaction between driver and vehicle.

The new BMW iDrive represents a rethinking of the entire operating, information and experience concept for BMW vehicles, specifically designed for touch and voice control. The new BMW Curved Display serves as a fully digital display cluster with modern graphic displays and an intuitive menu structure. The BMW Intelligent Personal Assistant also has expanded capabilities. The new My Modes enable an emotionally rich driving experience combined with a world of digital discovery. The new BMW iDrive also creates an integrated system for digital products and services that connect the vehicle with the customer's everyday digital life.

BMW Concept iX5 Hydrogen Protection VR6: Maximum protection, zero emissions.

With its BMW Concept iX5 Hydrogen Protection VR6, the BMW Group underlines both the importance of hydrogen fuel cell technology for the locally CO₂-free mobility of tomorrow and its ability to master completely new challenges in the development of security vehicles – while still pursuing sustainable solutions. The first certified security vehicle with a hydrogen fuel cell drive train has an underbody specially developed to protect against hand grenade-attacks and certified in accordance with the criteria of the VR6 resistance class, similar to the armoured passenger compartment.

**CUBE Concept DYNAMIC CARGO inspired by BMW and SoFlow
Concept CLEVER COMMUTE inspired by BMW: More sustainability in urban traffic.**

With two innovative micromobility concepts, the BMW Group is showcasing new ways to make urban traffic more sustainable. Licences for both vehicles have now been issued to partner companies. The CUBE Concept DYNAMIC CARGO inspired by BMW is an electrified “pick-up trike” that combines agility with particularly safe driving characteristics and flexible usage options. As a re-imagining of the e-scooter, the SoFlow Concept CLEVER COMMUTE inspired by BMW is ideal for short trips and for the so-called “last mile”.

New BMW Group Driving Simulation Centre: Next-level testing in realistic conditions.

The new BMW Group Driving Simulation Centre will soon be completed. With 14 simulators and usability labs covering an area of 11,400 square metres, it is the most advanced, most versatile facility of its kind in the automotive industry worldwide. It enables highly detailed mapping of the real-life driving process and therefore offers further optimised development possibilities – including for automated driving systems.

BMW Startup Garage: Live pitch event at IAA Mobility 2021.

Since 2015, the BMW Startup Garage has been seeking out young tech companies whose innovations can deliver real benefits for the BMW Group's products, services, systems and processes. Sustainability is the focus of the current selection programme. Six selected startups will present their innovations at a live pitch event at the IAA Mobility 2021.

The new BMW iDrive.

Intelligent, intuitive, interactive.



At BMW Group, the customer is the measure of all things – and that is the standard the new BMW iDrive aspires to. It represents a rethinking of the entire operating, information and experience concept for BMW vehicles. The latest generation of the BMW iDrive is based on the also new BMW Operating System 8, with a significantly expanded range of software and features.

Embedded in a puristic interior: The display and operating system.

The high-quality, puristic interior embodies the philosophy of the new BMW iDrive. Creating a clearly structured system that is easy and intuitive to use was a priority. This is achieved through optimal combination of voice and touch control, with functions available at the push of a button. Digital technologies and features create a new level of human-centred interaction between the driver and the vehicle.

In addition to setting new standards for intuitive and convenient operation, the new BMW iDrive also helps make every drive a mobility experience, thanks to a wide range of helpful features and new display concepts.

The following core elements characterise the new generation of the BMW iDrive display and operating system:

- Up to 50-percent reduction in the number of haptic buttons and switches, compared to the previous generation based on BMW Operating System 7.
- Operation optimised for voice and touch control.
- “Floating” BMW Curved Display as a fully digital display cluster. Driver-oriented design and customisable display content.
- All displays consistently oriented towards the driver. All information can be grasped at a glance, without distraction – ensuring a high level of safety.
- My Modes (PERSONAL, SPORT and EFFICIENT), available at the push of a button; up to ten different control levers can be adjusted at the same

time to create an emotional driving experience combined with a world of digital discovery.

- BMW Intelligent Personal Assistant with new capabilities. This personal voice assistant is always available, attentive and ready to help. Serves as a digital companion that makes driving safer and more enjoyable.

Connecting the vehicle to the customer's digital ecosystem.

The new BMW iDrive system integrates many digital products and services that intelligently connect the vehicle with the customer's everyday digital life.

As our technology flagship, the BMW iX offers the widest range of innovations in the field of digital services and features:

- BMW Digital Key Plus is now safer and more convenient than ever, thanks to ultra-wideband (UWB) technology: The car can be unlocked and started without having to take out your Apple iPhone.
- More ways to personalise your vehicle with BMW ID: Personal settings for seat and steering-wheel position, side mirrors, navigation, driver assistance functions, display layouts, short cuts, favourites and infotainment-system settings with associated key or digital key are immediately available and can be transferred between compatible BMW vehicles with Operating System 7 and Operating System 8.
- First production vehicle to offer 5G connectivity and personal eSIM – transforming the car into a fully-connected device like a smartwatch. Customers benefit from significantly improved telephone service and high-speed internet through their own mobile phone plan, as well as a WiFi hotspot for all passengers (expected to be available by the end of 2021. Availability may vary, depending on the customer's market and mobile network operator).
- BMW Maps: Cloud-based learning navigation system with ultra-precise, charging-optimised route guidance for electric vehicles, including availability of charging stations and range visualisation, as well as over 120 million points of interest.
- BMW Maps integrates navigation guidance with augmented reality: The live image from the front camera shown in the control display is enriched with turn-by-turn and lane navigation, as well as POI information.

- Interior camera with features that deliver value for customers: Did you leave your wallet, mobile phone or other important items in the car? The My BMW app lets you take a quick peak inside the vehicle. Push notification via My BMW app sends a picture from the inside if the vehicle is broken into; snapshot feature for taking pictures of passengers in special moments.
- Seamless integration of third-party apps, such as Spotify and Alexa. Deep integration of Apple CarPlay and Android Auto into the overall display cluster.
- Greater variety and flexibility for activating functions on demand over the air: Buy permanently, book for three years, 12 months or even just for a month: BMW iX customers will be able to choose from a wide range of optional equipment in the areas of driver assistance, convenience and infotainment.
- Remote Software Upgrade has been standard in BMW vehicles since Operating System 7 was introduced in 2018. New, improved and expanded functions can be transferred to the vehicle quickly and conveniently over the air; in June 2021, functions were transferred to a total of 1.3 million vehicles in this way.

The BMW Group's new BMW iDrive sets the benchmark for display and operating systems, vehicle connectivity and comprehensive digital products and services.

The new BMW iDrive can be experienced in the BMW Group's technology flagship, the BMW iX, which will be available soon. Other models with the new BMW iDrive and BMW Operating System 8 will follow, including the BMW i4.



The BMW Concept iX5 Hydrogen Protection VR6.

World's first certified security vehicle with hydrogen fuel cell drive train.

Maximum protection and zero emissions: The BMW Group is unveiling the first certified security vehicle powered by a hydrogen fuel cell drive train – for pure-electric, locally emission-free driving. The BMW Concept iX5 Hydrogen Protection VR6 meets the needs of private individuals and those who require special protection, while setting new standards for sustainability in its vehicle segment. With this concept car, the BMW Group underlines both the importance of hydrogen fuel cell technology for the locally CO₂-free mobility of tomorrow and its ability to master completely new challenges in the development of safety vehicles – while still pursuing sustainable solutions.

The BMW Group has a more than 40-year tradition of developing and building security vehicles with different levels of protection. The basic vehicle for the new concept is the BMW X5 Protection VR6 [fuel consumption combined: 14.4 l/100 km (WLTP), 12.8 l/100 km (NEDC); CO₂ emissions combined: 329 g/km (WLTP), 295 g/km (NEDC)], the world's best-selling security vehicle in the luxury class segment for Sports Activity Vehicles.

With its integrated safety concept, it meets the requirements of the VR6 resistance class, in accordance with the internationally recognised official test criteria of the Association of Test Centres for Attack-Resistant Materials and Structures (VPAM). Its armoured passenger compartment provides protection against attacks with firearms or explosive charges. BMW's hallmark superior dynamic performance, which facilitates escape from potentially critical situations, and its discreet appearance are further key factors in ensuring a particularly high level of safety.

With an armoured passenger compartment featuring moulded parts made of high-strength steel, protective glass that is around 30 millimetres thick and tight protective sealing of gaps in sensitive areas, such as doors and the body, as well as an armoured luggage compartment partition, the vehicle can withstand fire from the world's most widely used weapon, the AK-47, and prevent penetration of splinters from attacks involving HG 85 hand grenades. The armoured passenger compartment can also withstand lateral blasts with up to 15 kilograms of TNT equivalent from a distance of four metres. So-called post-blast protection technology for the protective glass is particularly effective at protecting against secondary attacks. Even after a blast, all windows remain in their construction position, so no openings can occur between the glass and the body.

The BMW Concept iX5 Hydrogen Protection VR6 implements a holistic safety concept that combines proven occupant protection with the special requirements of a sustainable hydrogen fuel cell drive train. A new vehicle underbody was developed specifically to protect against hand-grenade attacks. The focus was on shielding the hydrogen tanks, including their valve systems, by means of a non-magnetic underbody protection, which weighs as little as possible and ensures maximum ground clearance. Armouring was developed for this purpose with an innovative layer structure that guarantees protection from blasts, while maintaining high bending rigidity.

A blast impact test was conducted under the supervision of the government test centre for firearms and the deformation of the underbody protection measured and compared with the results of previous simulations. Computer tomography was then used to examine the tanks and underbody protection plate for cracks, delamination, hidden breaks or any splinters that might have penetrated the structures. The hydrogen tanks also underwent burst and leakage tests. Certification took place after a second blast impact test, which was also conducted under official supervision. This officially confirms the effectiveness of all aspects of the safety measures for the model-specific underbody protection, similar to those in the passenger compartment.

With certification of the safety measures in accordance with uniform criteria, the BMW Concept iX5 Hydrogen Protection VR6 is proof that comprehensive safety for people with increased protection needs is compatible with locally emission-free hydrogen fuel cell technology. The concept car is therefore the world's first locally emission-free security vehicle produced by an OEM with certification in the VR6 protection class.



CUBE Concept DYNAMIC CARGO **inspired by BMW and SoFlow Concept** **CLEVER COMMUTE inspired by BMW.** **New micromobility concepts for enhanced** **sustainability in urban traffic.**

The CUBE Concept DYNAMIC CARGO inspired by BMW is an electrified “pick-up trike” combining agility with particularly safe driving characteristics and flexible usage options. As a re-imagining of the e-scooter, the SoFlow Concept CLEVER COMMUTE inspired by BMW is ideal for short trips and for the so-called “last mile”. Both micromobility concepts have the potential to make urban traffic more sustainable in an innovative way. As the next step in this direction, the BMW Group is issuing licences to partner companies CUBE and SoFlow.

The CUBE Concept DYNAMIC CARGO inspired by BMW: Ideal combination of driving pleasure, versatility and safety.

The CUBE Concept DYNAMIC CARGO inspired by BMW is an entirely new way of thinking about cargo bikes for use in city centres. The innovative design principle combines driving pleasure with high versatility and maximum safety.

The base of the three-wheeler is formed by the front main frame, which leans into corners and is connected to the rear end via a pivoting axle. This pivoting axle connection keeps the rear end stable, without tilting, even when going round corners. The vehicle is powered by the two rear wheels using an electrified drive train that is solely controlled by how hard the rider is pedalling. This combination of design and drive concept ensures the vehicle rides like a normal bicycle. In addition to significantly increasing riding stability in all weather conditions, compared to two-wheeler concepts, the two non-tilting wheels of the CUBE Concept DYNAMIC CARGO inspired by BMW are rigidly mounted on the rear axle, enabling a versatile, pick-up-like loading platform, which can be fitted with different attachments to suit requirements.

Another advantage of the non-tilting loading platform concept is that the rider barely notices any additional weight and all loads can be transported safely and reliably.

The SoFlow Concept CLEVER COMMUTE inspired by BMW: Flexible e-scooter for multimodal mobility.

The BMW Group is rethinking the idea of the privately-owned e-scooter with the SoFlow Concept CLEVER COMMUTE inspired by BMW. This innovative new concept enables zero-emission multimodal mobility in urban settings, as

well as for the so-called “last mile”. The concept impresses with its compact size, without compromising robustness or riding stability. A clever folding mechanism means the SoFlow Concept CLEVER COMMUTE inspired by BMW can easily be transported in a car’s luggage compartment or carried on public transport.

In so-called “public transport mode”, the footboard of the SoFlow Concept CLEVER COMMUTE inspired by BMW folds up at the sides and the rear wheel pivots into the resulting opening from below. This mechanism shortens the wheelbase of the e-scooter substantially, so it can even be carried on an escalator without difficulty. It can also be rolled along on both wheels, like a carry-on suitcase. The front wheel’s integral hub motor provides an electric impulse that makes it easier to push the e-scooter up ramps in this mode.

The SoFlow Concept CLEVER COMMUTE inspired by BMW can be folded up to a size that easily fits into a car’s luggage compartment. Without having to fold down the rear backrest, it can be carried crossways in a MINI luggage compartment or lengthways in a BMW 3 Series Sedan, for instance. This also means larger vehicles are able to accommodate several SoFlow Concept CLEVER COMMUTE inspired by BMW e-scooters at once for family outings.



New BMW Group Driving Simulation Centre.

Most advanced, most versatile facility of its kind in the automotive industry.

The new BMW Group Driving Simulation Centre is currently being built on the grounds of the Research and Innovation Centre (FIZ) north of Munich. With 14 simulators and usability labs covering an area of 11,400 square metres, it is the most advanced, most versatile facility of its kind in the automotive industry worldwide. Construction began in mid-August 2018. Despite massive worldwide restrictions due to the COVID-19 pandemic, the building was completed on schedule in May 2020. Since then, installation of the simulators has been in full swing. Commissioning will take place by the end of the year.

Individual simulators, such as the Vega Vector dynamic simulator, are already operational and undergoing final testing. This dynamic simulator uses an LED wall with a 220-degree field of view and around 13,000,000 LED units.

“This is one of five simulators with an LED wall for visualising the virtual world. During the planning phase, we studied this LED technology very closely, enabled it for simulation and are now the first automotive manufacturer to use it. The LED walls produce a very bright image that is rich in colour and contrast and therefore offer significantly better immersion than the usual projection systems. They also enable realistic night and dazzle scenarios,” according to Martin Peller, head of the Driving Simulation Centre.

The two impressive High-Fidelity Simulator Sapphire Space and High-Dynamic Simulator Diamond Space simulators are already undergoing final testing.

The real-life driving process is mapped in unique detail in the High-Fidelity Simulator: Braking and acceleration in corners, driving around roundabouts or a rapid succession of turns can be simulated with a high degree of precision on the system's almost 400-square-metre field of motion. Complex inner-city traffic situations, which pose a particularly diverse set of challenges for automated driving systems, can also be recreated under laboratory conditions for the first time.

The High-Fidelity Simulator Sapphire Space in detail:

- Development focus: Functionality of systems in demanding situations, such as inner-city driving.

- Simultaneous longitudinal, lateral and rotary movements possible.
- Acceleration of up to 0.65 g – almost comparable with the acceleration of a BMW M3 Sedan (353 kW/480 hp, fuel consumption combined: 10.2-10.0 l/100 km; CO₂ emissions combined: 231-227 g/km WLTP); from zero to 100 km/h in 4.2 seconds.
- Movement area of almost 400 square metres.
- System height of over 10 metres.
- Around 83 tonnes of moving mass.
- Required peak electrical power: up to 6.5 MW.

The new High-Dynamic Simulator is able to generate longitudinal and lateral acceleration of up to 1.0 g. In testing new systems and functions, it is used to map highly dynamic evasive manoeuvres, full braking and intensive acceleration.

The High-Dynamic Simulator Diamond Space in detail:

- Development focus: Functionality of systems in highly dynamic driving situations.
- Highly dynamic longitudinal and lateral acceleration of up to 1.0 g – almost comparable with the acceleration of a BMW iFE.20 in Formula E: from zero to 100 km/h in 2.8 seconds.
- Slide length of 21 metres.
- System height of over 9 metres.
- Around 23 tonnes of moving mass.
- Required peak electrical power: up to 3.0 MW.

“This allows us to focus on the virtual world in a development phase that still has about two years to go until the series launch of a new model and which only used real prototypes in the past. We are relying on a smart combination of test benches, simulation, real-vehicle testing and driving simulators,” explains Martin Wahle, head of Virtualisation and Driving Simulator.



BMW Startup Garage recognises innovations to enhance sustainability.

Live at IAA Mobility 2021: The Sustainability Challenge final.

Together with young tech companies from all over the world, the BMW Group is stepping up development of innovative solutions for enhanced sustainability. The BMW Startup Garage, founded in 2015 as the world's first venture client unit, plays a key role in this. Since then, more than 100 young companies have gone through its programme. The BMW Startup Garage will present its activities to a broad audience for the first time at the IAA Mobility 2021. At the IAA Summit on the Munich exhibition grounds from 7-12 September 2021, visitors will be able to learn more about startups from the venture client programme that are already helping enhance sustainability.

This year, with the Open Call 360° Sustainability Challenge, the BMW Startup Garage has focused specifically on technologies for building the sustainable mobility of tomorrow. Young companies from around the world were invited to submit innovations in the areas of recyclable materials, sustainable supply chain, energy-efficient production, mobile intelligence, intelligent building management, customer-centric mobility and future-oriented technologies as part of their application to the BMW Group's venture client programme. More than 250 startups from almost 50 countries took part in the Open Call 360° Sustainability Challenge.

Six finalists in live pitch event.

Following a multi-stage selection process, a live pitch event marking the end of the Challenge will be held for finalists at the BMW Startup Garage Hub at the IAA Summit on 9 September 2021. During a one-hour show, the startups selected will present their outstanding technologies for sustainability. The BMW Group will honour six winners, whose innovations range from energy-saving technologies for green batteries and cooling systems to sustainable materials made from recycled or natural resources, to solutions for material circularity and traceability throughout the supply chain. The presentation begins at 5:00 p.m. and can be followed on site at the IAA Summit or via livestream at www.bmwstartupgarage.com/opencall-sustainability.

Long-term collaboration, extensive network.

The BMW Startup Garage shares ideas with more than 1,000 startups in about 30 countries every year, seeking out innovations that deliver real benefits for the BMW Group's products, services, systems and processes. This secures the company early access to innovations that can be customised

before they are ready to market. The startups gain valuable insights into the processes of a premium automotive manufacturer and are able to build a network within the company. They also receive assistance in refining their business plan. The aim of the programme is to evaluate and enable startups as suppliers and long-term partners for the BMW Group.

The BMW Startup Garage is one of four pillars on which the BMW Group has built its collaboration with startups around the world. Through its BMW i Ventures unit, the BMW Group invests in fast-growing technology startups – with a focus on digital vehicle technologies, autonomous driving and on-demand mobility. Startups that operate sustainably also receive support from the BMW Foundation Herbert Quandt. In conjunction with the UnternehmerTUM platform founded at the Technical University of Munich, the foundation has launched the accelerator programme RESPOND, which promotes responsible leadership and sustainable business models. Since 2016, the startup accelerator URBAN-X launched by MINI has also focused specifically on urban living. In the meantime, more than 70 startups from numerous countries have already completed the URBAN-X programme, with innovations in the areas of mobility, infrastructure, energy and recycling.

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