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# BMW Vision EfficientDynamics. Description in Brief.



## Character:

- High-performance concept study with BMW ActiveHybrid technology visualising the dynamic performance typical of a BMW against the backdrop of future demands in sustained mobility. BMW Vision EfficientDynamics as a symbol for the future of Sheer Driving Pleasure in harmony with trend-setting efficiency.
- Development aim: The performance of a BMW M Car and a highly emotional character combined with the fuel economy and emission management of a modern small car in the premium class. As a result, this unique sports car offers the most consistent rendition of the BMW EfficientDynamics development strategy.
- Innovative approach in the context of BMW EfficientDynamics: The exceedingly good balance of CO<sub>2</sub> emission management and driving pleasure results from a revolutionary vehicle concept developed all in one from the ground up, achieving a new level of efficiency combined with a unique driving experience. The overall result goes far beyond the sum total of the individual features and components in this concept car.
- BMW Vision EfficientDynamics offers a realistic impression of the unique potential of BMW ActiveHybrid technology and the great innovative thrust of BMW EfficientDynamics.

## Technology:

- Offering a full-hybrid concept, the BMW Vision EfficientDynamics concept car is powered by a three-cylinder turbodiesel and two electric motors. Overall system output is 262 kW/356 hp, maximum torque 800 Newton-metres/590 lb-ft. All-wheel drive featuring an electric motor on both the front and rear axle.
- Anticipated performance: Acceleration from a standstill to 100 km/h in 4.8 seconds, top speed 250 km/h (155 mph) (electronically limited) , fuel consumption in the EU test cycle 3.76 litres/100 km (equal to 75.1 mph imp), CO<sub>2</sub> emissions 99 grams/kilometre.

- As a plug-in hybrid, BMW Vision EfficientDynamics is able to cover the entire fuel consumption drive cycle under electric power alone. Taking the sources of energy used for generating the electric power consumed into account (EU electricity mix), this reduces the CO<sub>2</sub> emission rating to just 50 grams per kilometre.
- Electric power is generated without the slightest increase in fuel consumption through a particularly efficient concept of Brake Energy Regeneration. Energy is stored in 98 lithium polymer cells. The car is able to cover a distance of approximately 50 km/31 miles in the electric mode alone.
- Aerodynamics developed with know-how from Formula 1. C<sub>x</sub> drag coefficient optimised to just 0.22. Forward-looking energy management uses the maximum potential available in each case to minimise fuel consumption.

#### **Design:**

- Technology-oriented body design as a clear expression of consistent light-weight technology and aerodynamic quality. Design language typical of the brand, setting clear signals in terms of sporting performance and optimum efficiency.
- The 2+2-seater concept combines dynamic performance and supreme efficiency with an enhanced level of all-round function. BMW Vision EfficientDynamics symbolises BMW's commitment to offer an unprecedented driving experience for up to four occupants.
- BMW Vision EfficientDynamics comes with gullwing doors opening up to the side. Innovative, weight-optimised door kinematics makes entering the car at both front and rear convenient and very easy.
- The interior of this unique 2+2-seater intentionally demonstrates the very latest in modern technology. At the same time the use of natural materials underlines BMW's strategy of sustainability borne out through this concept car.
- The roof and door inserts made of polycarbonate glass automatically become darker as a function of incoming light.

# **BMW ActiveHybrid – a New Path to Thrilling Dynamics: BMW Vision EfficientDynamics.**



BMW sees technical innovations reducing both emissions and fuel consumption as an elementary part of the brand's product strategy, just like vehicle concepts enhancing the Sheer Driving Pleasure so typical of BMW as a lasting, sustained experience.

Now the BMW Vision EfficientDynamics concept car clearly demonstrates that these objectives expressed through the BMW EfficientDynamics development strategy are fully compatible with the most demanding reduction in fuel consumption and emissions complying in full with future requirements. Conceived as a 2+2-seater with plug-in full-hybrid technology, this unique car is able to combine the performance of a BMW M Car with a standard of fuel economy and emission management exceeding even the current level achieved by the latest small cars in the market.

This outstanding result is made possible by the consistent integration of BMW ActiveHybrid components, their combination with an extremely economical combustion engine, and the outstanding aerodynamic qualities of the BMW Vision EfficientDynamics concept car.

BMW Vision EfficientDynamics is the result of an all-inclusive development process starting from a clean sheet of paper. This ensures an improvement of both efficiency and driving pleasure far exceeding the sum total of all individual components and technologies, and is also borne out in the very emotional design of this unique concept car. BMW Vision EfficientDynamics is therefore an unprecedented sports car offering fascinating perspectives for the future of Sheer Driving Pleasure combined in full harmony with maximum efficiency.

Presenting this unique concept car, BMW is once again demonstrating the company's outstanding competence in the development of cutting-edge drive systems. Indeed, BMW Vision EfficientDynamics is the most comprehensive implementation of the BMW EfficientDynamics development strategy seen so far. The drive units provide a top speed limited electronically of 250 km/h or 155 mph, with acceleration to 100 km/h in 4.8 seconds. Average fuel consumption in the EU test cycle is 3.76 litres/100 kilometres, equal to 75.1 mpg imp, and the CO<sub>2</sub> emission rating is 99 grams per kilometre.

CO<sub>2</sub> emission management is even more outstanding when driving in the all-electric mode after charging the battery from a plug-in source: Taking all emissions in the generation of electricity into account, as prescribed by the EU mix, the car's emission rating in this case is just 50 grams per kilometre. Through this unique balance of driving pleasure and fuel economy the BMW Vision EfficientDynamics concept car clearly demonstrates the potential of BMW ActiveHybrid technology making its world debut at the 2009 Frankfurt Motor Show in the BMW ActiveHybrid X6 and BMW ActiveHybrid 7 production models.

This truly impressive power and performance is made possible by combining a particularly fuel-efficient three-cylinder turbodiesel with one electric motor each on the front and rear axle. The intelligent combination of these three power units and the energy they develop, together with precisely controlled energy management, serves to enhance both the dynamic performance and the all-round efficiency of the car, using the full potential of BMW ActiveHybrid to reduce both fuel consumption and CO<sub>2</sub> emissions to the greatest possible extent. Overall system output is 262 kW/356 hp, peak torque is 800 Newton-metres/590 lb-ft.

The special arrangement of the three power units allows all-wheel drive also available in the all-electric mode. The result is minimum power loss and at the same time harmonious transmission of the power available under all conditions.

In its design, BMW Vision EfficientDynamics for the first time conveys the dynamic look so typical of a BMW sports car to a hybrid vehicle. Developed with know-how from Formula 1, the body of this unique sports car is an expression of intelligent lightweight technology and supreme aerodynamic efficiency. And in the design of the interior, the focus was likewise on both the fascinating driving experience and, in particular, on transparent, hands-on technology and maximum reduction of weight.

#### **Turbodiesel power unit with unprecedented output per litre.**

The combustion engine is a cutting-edge turbodiesel featured for the first time in the BMW Vision EfficientDynamics concept car. Displacing 1.5 litres on three cylinders, the engine consistently follows the downsizing principle using relatively small engine capacity combined with a turbocharger to reduce fuel consumption.

Through its compact dimensions, the three-cylinder fits conveniently in front of the rear axle like in an agile mid-engined sports car, despite the two seats at the rear. Fuel is injected by the latest generation of common-rail direct injection, the turbocharger features variable intake geometry for maximum efficiency.

Engine output is 120 kW/163 hp, peak torque 290 Newton-metres/214 lb-ft. The output per litre of 80 kW/109 hp achieved in this way sets a new record in diesel technology.

The power delivered by the turbodiesel is conveyed to the rear axle by means of a double-clutch gearbox. This advanced transmission technology already offering a particularly dynamic driving experience in BMW's unusually sporting production cars, allows the driver to shift gears without the slightest interruption of power and traction.

BMW Vision EfficientDynamics comes with a newly developed, minimum consumption version of BMW's direct-clutch gearbox with six speeds for maximum efficiency and flexibility.

### **Two electric motors for full-hybrid drive.**

The combustion engine is supplemented by two electric motors. Consistently applying the BMW ActiveHybrid strategy, BMW's development engineers followed the principle of "Best of Hybrid", choosing the optimum combination of a hybrid synchronous motor on the front axle and a full-hybrid system at the rear. Through the specific configuration of the system as an advanced hybrid ideal for practical use on the road, the driver benefits from the extra efficiency of the electric motors over a far wider speed range than with a conventional hybrid car.

The rear axle comes with a second-generation full-hybrid system corresponding to the technology introduced for the first time in the BMW ActiveHybrid 7 production model. Running as an electric motor, the compact electric power unit positioned between the combustion engine and the double-clutch gearbox develops a consistent 25 kW and is able to reach a peak of up to 38 kW. Maximum torque, again, is 290 Nm or 214 lb-ft, the power developed in this way serving, depending on driving conditions, either to support the combustion engine or for all-electric motoring.

In overrun and when applying the brakes the electric motor acts as a generator feeding electric power to the lithium-polymer battery in the car. The electric energy developed in this way is therefore generated without any additional consumption of fuel, raising the principle of Brake Energy Regeneration

already featured in BMW's current models to an even higher and significantly more efficient level. Energy wasted on the brakes of a conventional car is thus saved within the new power system for subsequent use in driving the car.

A second electric motor acts on the front axle. This power unit, a hybrid synchronous motor, offers permanent output of 60 kW and peak torque of 220 Newton-metres or 162 lb-ft. Extra power of 84 kW is available for a period of up to 30 seconds and for 10 seconds the electric motor is even able to develop 104 kW. Power is transmitted through a two-stage, single-speed reduced-ratio gearbox.

BMW Vision EfficientDynamics is able to run completely under electric power, with the power of the turbodiesel engine alone, or through an infinite combination of the three power sources. Depending on driving conditions and the driver's particular requirements, the two electric motors may be used both for accelerating and for regenerating energy when applying the brakes and in overrun.

This principle ensures a high level of efficient energy management, with the charge status of the lithium-polymer battery constantly remaining within the optimum range. When accelerating the electric motors help to boost the car for even greater performance, ensuring a spontaneous and direct response and a significant reduction in fuel consumption. For a short time, for example when overtaking, the cumulative maximum output of all three power units increases to 262 kW/356 hp, with maximum torque generated by the three power units reaching 800 Newton-metres/590 lb-ft.

### **Lithium-polymer cells serving as the battery for electrical energy.**

The energy cells featured in BMW Vision EfficientDynamics are housed in a chassis element running from front to rear through the middle of the car. The front unit is the lithium-polymer complex, an ongoing development of the lithium-ion battery as the currently most efficient technology for storing a high level of electrical energy for maximum performance.

Overall, BMW Vision EfficientDynamics comes with a total of 98 lithium-polymer cells, each offering a capacity of 30 amp/hours and developing continuous output of 600 Amps at a voltage of 3.7 V. For a period of 30 seconds, each cell is even able to develop maximum output of 1,200 Amps.

Serial arrangement of the lithium-polymer cells serves to generate nominal voltage of 364 V, the gross storage capacity of the battery is 10.8 kW/h. Offering an unusually high discharge capacity of 80 per cent, the battery delivers 8.6 kW/h for driving the car.

This superior performance comes on overall weight of the entire energy storage system of just 85 kg or 187 lb. A further advantage is that through their optimum dimensions tailored to the specific qualities and features of the car, the lithium-polymer cells, together with the operating strategy chosen with a concept of energy management looking ahead at upcoming requirements, reduces the thermal load acting on the battery to such an extent that there is no need for active cooling.

**Plug-in solution: convenient charging of the electric power system on a conventional power socket.**

Brake Energy Regeneration consistently transfers electric power generated while driving without any additional fuel consumption to the battery, which may subsequently be used to supply power to both the electric motors and the on-board network. A further option is to connect the lithium-polymer cells to a conventional power socket for a simple and efficient charge process, using a plug-in connector in the front right wing of the car.

Connected to the regular domestic power mains (220 V, 16 Amps), the system requires a maximum of 2 ½ hours to fully charge the lithium-polymer cells. And wherever a power source with higher voltage and amperage (380 V, 32 Amps) is available, the charge time is an even shorter 44 minutes at the very most.

In addition to the electrical energy storage facilities, BMW Vision EfficientDynamics comes with a conventional fuel tank at the rear end of the central chassis tunnel, offering a capacity of 25 ltr or 5.5 imp gals. Running on diesel fuel alone, BMW Vision EfficientDynamics is able to cover a distance of approximately 650 km or 400 miles just with its combustion engine. Benefiting from an extra range of up to 50 kilometres or 31 miles in the all-electric mode, the car offers an overall cruising range of approximately 700 kilometres or 435 miles.

As a result, this unique concept car offers all the requirements for using energy with maximum efficiency and at the same time experiencing the dynamic performance so typical of BMW without any restriction of everyday driving qualities.



**Performance, fuel economy and emission management opening up new dimensions in hybrid motoring.**

The power delivered by the three power units gives the BMW Vision EfficientDynamics concept car a level of dynamic performance far superior to anything provided so far by any hybrid vehicle. Indeed, the performance and consumption figures determined by standardised computer simulations show an exceptionally good balance of driving pleasure and fuel economy even for a hybrid. Acceleration from a standstill to 100 km/h, for example, comes in just 4.8 seconds and the car's top speed would be over 250 km/h or 155 mph, requiring electrical limitation of top speed in accordance with BMW's corporate philosophy through electronic engine control now also on a full-hybrid sports car.

The objective to develop a vehicle offering the performance of a BMW M Car combined with supreme all-round efficiency therefore comes to bear completely and without the slightest restriction in BMW Vision EfficientDynamics.

At the same time fuel economy and emission management now reach a standard only achieved so far, if at all, by far less powerful small cars conceived primarily for city traffic and short distances. Applying the criteria of the EU test cycle currently prescribed by law, BMW Vision EfficientDynamics offers average fuel consumption of just 3.76 litres of diesel fuel per 100 kilometres, equal to 75.1 mpg imp. CO<sub>2</sub> emissions, in turn, are 99 grams per kilometre.

These consumption and emission figures are measured on a consistent internal power balance, meaning that the batteries and storage media for electrical energy maintain the same charge level throughout the entire test cycle (with the same level at the beginning and end) and are charged while driving only by the car's on-board systems.

As a plug-in hybrid, BMW Vision EfficientDynamics is able to cover the entire drive cycle for measuring fuel consumption also with its combustion engine completely switched off. Then, to subsequently charge the lithium-polymer cells to the same status as when setting off, all the driver has to do is connect the car to an external power grid. To determine the consumption of electric power, the only requirement is to compare the charge level of the battery before and after the test cycle.

Applying this measurement process, the BMW Vision EfficientDynamics concept car consumes 17.5 kWh per 100 kilometres, equal to a CO<sub>2</sub> emission rating of just 50 grams per kilometre in the EU test cycle.

To determine the total volume of CO<sub>2</sub> emissions when driving in the all-electric mode, new legal standards for measuring the level of fuel consumption are currently being prepared for hybrid and electric cars with a plug-in power supply. Applying this calculation method, the CO<sub>2</sub> emission ratings generated by BMW Vision EfficientDynamics are reduced further to just one-third of the original figure of 99 grams per kilometre. Clearly, this significant reduction of emissions opens up a new dimension in BMW's EfficientDynamics development strategy in this unique concept car.

### **Aerodynamic qualities reflecting BMW's know-how gained in Formula 1.**

BMW Vision EfficientDynamics also takes a new approach in its design and streamlining, the body and the interior clearly expressing the unique combination of supreme efficiency and the sporting performance so typical of the brand. Following the design language so characteristic of BMW, this unprecedented concept car clearly visualises both highly efficient aerodynamics and consistent lightweight construction.

In its design, BMW Vision EfficientDynamics differs significantly from the usual low-emission cars seen so far. And since the principle of "form follows function" is not reduced in this case just to the overall look of the car, but rather embraces each and every detail, BMW Vision EfficientDynamics combines unique aesthetic appeal with a highly emotional impact. Through its design alone, therefore, BMW Vision EfficientDynamics clearly proves that Sheer Driving Pleasure in typical BMW style may also be offered without restrictions in a brand-new, innovative car concept.

Measuring only 1.24 metres or 48.8" in height and boasting a sweeping, arch-like roofline, BMW Vision EfficientDynamics offers the slender silhouette of a classic Gran Turismo. With the combustion engine fitted in front of the rear axle, the designers have furthermore succeeded in giving the car a very low and sleek front end, with the flow of air depending on driving conditions being further smoothed by active louvers in the radiator closing completely whenever the need for cooling air is relatively low.

This efficient function follows in the footsteps of the active air flap control already used as a feature of BMW EfficientDynamics in many of BMW's current production models. And as a further highlight, BMW Vision EfficientDynamics guides air smoothly and exactly as required into the car through an active air intake at the front.

Numerous details in the design of the body are based on the know-how BMW has gained in Formula 1, a number of body elements serving as air deflectors and guide vanes, like on the BMW Sauber F1. Designed as ducts, for example, the A-pillars serve to channel the flow of air in the same way as the rear lights with their wing profile.

The underfloor of the car is fully covered from front to rear and from one side to the other, thus maintaining a smooth surface to avoid any air swirl liable to increase fuel consumption. Slender openings around the front air dam guide the air flowing in specifically into two closed ducts leading inside the front air dam to the wheel arches where the air comes out again through a very slim aperture at high speed, flowing just next to the outer wheel flanks. This air jet rests on the front wheels like a curtain and is therefore referred to most appropriately as the air curtain with its highly stabilising effect.

### **Overall vehicle concept for a drag coefficient of just 0.22.**

To further optimise the aerodynamic qualities of the entire vehicle and keep rolling resistance to a minimum, BMW Vision EfficientDynamics comes with tyres and rims of quite unusual size on a sports car. The tyres measure 195/55 in their width-to-height ratio, while large 21-inch rims provide a contact surface on the road otherwise offered only by a much wider tyre. In combination with the sophisticated axle kinematics, this ensures particularly agile driving behaviour.

The extra-large rim covers extending over part of the tyre flanks add to the unique, very different look of BMW Vision EfficientDynamics from the side. The blade profile integrated in the rims serves furthermore to reduce the negative effect of the turning wheels on the overall aerodynamics of the car. In all, these features optimising the aerodynamic qualities of the car give the BMW Vision EfficientDynamics concept car a very low drag factor ( $C_x$ ) of just 0.22.

### **Technological look as a strong impression of intelligent lightweight construction.**

In both its exterior and interior design, BMW Vision EfficientDynamics stands out clearly as a strong spearhead in technology. Many components of the vehicle are presented in full view expressing the “transparent” character of the car as a powerful visual feature of lightweight technology. The chassis and suspension of BMW Vision EfficientDynamics are made completely of aluminium, the roof and the outer skin on the large doors are made almost completely of a special polycarbonate glass automatically darkening as a function of the light shining on the car.

Measuring 4.60 metres (181.1") in length, 1.90 metres (74.8") in width and 1.24 metres (48.8") in height, this unique concept car offers ample space for up to four passengers and their luggage. Thanks to the consistent lightweight construction strategy applied on the car, unladen weight according to the DIN standard is limited to 1,395 kg or 3,076 lb, with the centre of gravity relevant to motoring comfort and driving dynamics remaining very low.

Considering the wide range of high-performance hybrid drive components and the high-capacity lithium-polymer battery fitted in the car, these figures clearly confirm the overall concept of BMW Vision EfficientDynamics with its great commitment to outstanding efficiency. In its power-to-weight ratio, the BMW Vision EfficientDynamics concept car is far superior to all conventional hybrid cars, achieving the same standard as extremely dynamic sports cars with a conventional combustion engine.

Carrying a maximum load of 445 kg or 981 lb, this unique 2+2-seater is fully suited for everyday traffic. Luggage capacity of 150 litres or 5.3 cu ft, in turn, allows the driver and passengers to conveniently take along, say, two golf bags. And to meet additional loading requirements the backrests of the two rear seats may be tilted down individually to provide extra storage space.

### **Emotional design through sculptural shapes and layering technology.**

Reflecting the innovative drive concept of this unique car, the design of BMW Vision EfficientDynamics likewise takes a new approach in combining functional progress with a most powerful emotional impact.

This has been achieved through the close cooperation of BMW's Design and Technical Development Divisions starting at an early point and continuing consistently throughout the entire development process. The result is a brand-new vehicle architecture with the drive components as well as the body and interior elements perfectly coordinated and matched to one another with maximum flexibility and individual style. A fully integrated design philosophy also provided new options in using harmonised design principles connecting the exterior and the interior and providing an interacting effect between the two areas.

Sculptural design language giving BMW Vision EfficientDynamics a fully harmonised, complete look ensures the proportions so typical of a BMW sports car. The front, side, rear and roof areas, for example, flow smoothly into one another. Dynamically contoured surfaces and shapes, in turn, create highly attractive light and shade effects accentuating the light and sporting character of the car in a most emotional manner.

Layering technology developed by the BMW Group Design Division acts as the fundamental guideline in designing the exterior and interior. Applied for the first time in exterior design, this technology layers one surface on top of the other, creating very smooth seams and joints to reduce the number of components and, accordingly, the weight of the car. As a result, BMW Vision EfficientDynamics meets the most demanding aerodynamic requirements without using any additional body elements, simply through the structure of the surfaces optimised for a smooth flow of air.

**Interior: innovative lightweight construction and unprecedented orientation to the driver.**

In the design of the interior, innovative layering technology provides an unprecedented symbiosis of function and stylish shapes intentionally reduced to a minimum, consistently implementing and visualising the lightweight principle also inside the car.

Specific components such as the central air vent not only serving to enhance motoring comfort but also acting as part of the cockpit, perform several functions in one. This multi-functionality is then presented visibly within the car, the use of particularly sophisticated materials providing a highly attractive combination of innovation in technology and quality clear to the eye and the touch of the surface.

This interaction of lightweight construction and individual well-being also comes out clearly in the design of the controls and switches, with a leather band, for example, running round the aluminium gear selector lever on the centre console.

Materials combining lightweight technology and all the qualities required are also to be admired all round the cockpit of BMW Vision EfficientDynamics, giving the car an unusually generous feeling of space for a 2+2-seater. The body-contoured seats, for example, are made up of a kevlar shell, a backbone structure, and seat padding with personalised fillings. Clearly, this combination alone ensures supreme comfort on minimum weight.

The driver's and front passenger's seats are connected firmly to the centre console to form a joint interior "landscape", while the rear seats anchored on the floor would appear to be hovering in space. Natural materials and light colours on the seat upholstery and all interior linings underline the light, sophisticated and sustainability-oriented atmosphere within the passenger compartment.

The instrument panel is deliberately padded only where technical components have to be appropriately covered, thus making an important contribution to passenger safety in the event of a collision. The instrument cluster played a fundamental role right from the start in the design process, serving as the starting point for all surfaces within the interior and thus creating a particularly powerful rendition of that driver orientation so typical of BMW.

**Innovative light technology: providing clear signals to the outside and offering soothing ambient illumination inside in a unique symbiosis.**

LED lights at both the front and rear end of BMW Vision EfficientDynamics provide an innovative combination of the symbols so typical of the brand and clear design language oriented towards trendsetting technology. The distinctive look of the dual round headlights characteristic of a BMW is emphasised in particular by the use of LED technology. The rear lights are integrated also in their function into the design of the entire rear section, forming part of the rear air deflector and thus merging completely into the rear contour.

Extremely flat and compact, the rear lights are made up of innovative LED units forming a smooth and consistent red surface when not in use. Only when used do the respective light chambers take on their appropriate colour such as yellow on the direction indicators.

This innovative light technology also provides an intense symbiosis of the exterior and interior, again promoting and further refining the driving experience. This is also why the ambient illumination of the interior comes with new features and qualities, the light sources within the passenger compartment being fed from the positioning lights at the side, the rear lights and the brake lights, thus changing the atmosphere created by the lights within the car as a function of driving conditions.

The optical impression conveyed by BMW Vision EfficientDynamics also results in other areas from the symbiosis of the exterior and interior, eliminating the conventional barriers between the two. The lines within the interior, for example, continue on to the innovative design of the engine compartment lid, while in its shape the third brake light positioned higher up on the car follows the structure of the glass roof and tapers to the outside where the roofline moves down gently to the rear.

### **Gullwing doors for convenient access to all seats.**

The doors on BMW Vision EfficientDynamics open up like gullwings, turning on pivots in the front roof column at the level of the side direction indicators. Since the car has no B-pillars, the large door cutouts ensure convenient entry also to the rear seats. The pivots on the doors also provide the base for the exterior mirrors, thus forming an ideal combination of function and aesthetic design.

The structure of the doors is also characterised by several layers of materials on top of one another and the optical and functional symbiosis of the interior and exterior this technology is able to offer. Made up of three layers, the overall structure comprises the outer glass surface, an interim load-bearing layer, and the interior cover with its particularly smooth shapes and flowing forms clearly visible to the passengers, layering technology again, therefore, opening up new perspectives.

The large glass surfaces extending far down on the body also provide a strong optical impression of the low seating position close to the road. And at the same time a stable sidebar ensures the body stiffness and crash safety naturally required on every vehicle. Flowing to the inside at its central point, this safety element also serves as an armrest.

This interplay of the three layers also helping to minimise the weight of the car continues on the trim bar running along the door and extending out of the armrest, finally flowing into the outer door opener on its path from inside to outside.

### **Clear focus on the essential: three-dimensional Head-Up Display.**

Layering technology is also used on the displays in the instrument cluster and in the Head-Up Display developed to an even higher standard on BMW's new concept car. The Display now creates a powerful impression of three dimensions, at the same time providing the option to present various signals more in the front or more in the background, depending on their relevance and current driving conditions.

The Head-Up Display projects information important to the driver on to the windscreen. Indeed, innovative presentation technology even allows the superimposed presentation of several views in three dimensions, keeping, say, the speedometer graphics visible in the background while the latest information on route guidance or warning signals from BMW Night Vision, for example, are shown in the foreground.



The sequence in which such signals appear depends on the driving mode chosen by the driver, the display technology, again depending on the driver's personal preference, enhancing either a particularly sporting, a more comfort-oriented, or an efficiency-based style of motoring.

Through its design alone, the BMW Vision EfficientDynamics concept car clearly shows that highly efficient individual mobility may by all means be presented in emotional style. BMW already offers models in all vehicle segments which, compared with the competition, ensure the lowest level of fuel consumption and emissions combined with superior power and performance. And now BMW Vision EfficientDynamics confirms BMW's commitment to offer a perfect combination in future of unique driving pleasure and optimum qualities in the responsible use of natural resources.

In the design process the need for sustainable management is borne out most clearly by the GINA (Geometry and Functions in N-fold Augmentation) concept developed by the BMW Group. In this case maximum creative freedom sets the foundation for innovative solutions challenging the conventional and meeting the requirements of the future.

This makes the GINA principle particularly well-suited for developing visions for the future reflecting both the wish for emotional style and individual character as well as the quest for sustainable management and efficiency. From the dimensions of its wheels through the design of the rear lights and all the way to the configuration of the cockpit, BMW Vision EfficientDynamics therefore boasts a number of details both outside and inside which, going far beyond conventional solutions, open up a new approach to maximum efficiency and that Sheer Driving Pleasure so typical of BMW.

### **Concept car serving as a spearhead in technology for BMW EfficientDynamics.**

The most obvious areas where BMW Vision EfficientDynamics points into the near future of the BMW EfficientDynamics development strategy are the drivetrain and the aerodynamics of the car. But even the individual details show highly innovative solutions, the concept car, for example, boasting not only technologies already proven for years in production models, such as Brake Energy Regeneration, Auto Start Stop and Active Air Flap Control, but also a wider range of innovative system components serving to further reduce both fuel consumption and emissions. Again, therefore, these new components are already in the final phase of development or are being tested in prototypes.



One objective of BMW's engineers was, wherever possible, to further reduce the loss of energy still quite substantial even on the most efficient combustion engines. Precisely this is why a water-cooled Thermo-Electrical Generator (TEG) is integrated in the exhaust system of BMW Vision EfficientDynamics, serving to convert a lot of the thermal energy contained in the exhaust emissions into electric power.

This technology originally developed for spacecraft uses the so-called Seebeck effect generating a certain voltage through a temperature gradient within metal-based semi-conductors.

On BMW Vision EfficientDynamics the Thermo-Electrical Generator, which has already proven its practical qualities in a BMW 5 Series test car, develops maximum output of up to 200 W. The pipes and manifolds in the exhaust system are designed in this case to maintain the full power and all the characteristics typical of the combustion engine also when using this generator system.

### **Forward-looking energy management adjusting to individual requirements.**

With the individual system components on board BMW Vision EfficientDynamics being networked with one another, conditions are perfect for implementing a forward-looking system of energy management using information gathered by the sensors of the driver assistance units fitted in the car. Data provided, for example, by the rain sensor or Active Cruise Control with its Stop & Go function as well as by the navigation system, and subsequently evaluated by the central control unit, offers an overview of current and upcoming driving conditions. Then, evaluating such data, the on-board computer is able to forecast driving conditions on the stretch of road immediately ahead, such calculations serving to prepare the car for upcoming requirements and make efficient use of the energy available through optimum operation of all systems.

Should the high-performance central computer establish, for example, that the driver is about to take the motorway, the power used for running the cooling system is reduced for a certain period in advance, on the assumption that the short increase in coolant temperature resulting from such an energy-saving measure will quickly be set off by the higher speed of the car on the motorway.

Another example of such pre-conditioning is the regeneration of energy from the air conditioning, from EPS Electronic Power Steering and the Brake Assistant.

Yet another feature of forward-looking energy management is provided by BMW ConnectedDrive through an additional innovation: Now this complex operating strategy considers not only data collected within the car, but also data coming from other vehicles (Car 2 Car) or from sensors fitted on buildings or bridges (Car 2 Infrastructure), thus enabling the driver, say, to avoid traffic congestion in good time or find parking space far more quickly.

The services already offered by BMW ConnectedDrive to avoid traffic congestion and speed up the process of finding parking space are therefore being enhanced by further components and features serving above all to provide even greater efficiency.

Further features of intelligent energy management on BMW Vision EfficientDynamics allow the driver to influence the efficiency of the car himself. By adding an Eco Mode to the existing system of Dynamic Drive Control, for example, this new concept car enables the driver to reduce fuel consumption and emissions very effectively through his individual style of motoring.

This is done by a display in the instrument cluster instructing the driver to accelerate, apply the brakes and – in the manual mode – shift gears with maximum efficiency. In the automatic mode, in turn, the electronic control unit adjusts the gearshift map on the double-clutch gearbox and the control map of the electronic gas pedal to current driving conditions also in the interest of enhanced fuel economy.

### **BMW Vision EfficientDynamics: the future of BMW EfficientDynamics.**

The BMW Vision EfficientDynamics concept car demonstrates the potential of the BMW EfficientDynamics development strategy to an extent never seen before. In this way BMW once again shows the company's unusual skill and competence in developing particularly efficient high-performance drivetrain technologies.

Applying this philosophy, BMW is able to develop vehicles meeting the need for saving natural resources and at the same time offering a new rendition of Sheer Driving Pleasure. A sports car with the dynamic performance of a BMW M Car and the fuel economy of a modern small car indeed opens up highly attractive perspectives for individual mobility in the world of tomorrow.

The new concept car offers a particularly fascinating experience through its individual character. BMW Vision EfficientDynamics is neither a mere variant of a production car built for maximum efficiency nor a purely visionary study

completely separated from series development. Rather, all the technologies contributing to the car's outstanding efficiency come from a development process conceived for regular production. Indeed, some of these technologies are already in use in current BMW models, others are approaching production standard or have already proven their functional benefits in practical tests and in prototypes.

The future qualities and the typical character of BMW ActiveHybrid technology come out particularly clearly and strikingly in BMW Vision EfficientDynamics. In conjunction with the most sophisticated energy management, the intelligent combination of the electric motor and the combustion engine ensures outstandingly good fuel economy and emission management combined with a significant improvement of driving dynamics.

BMW Vision EfficientDynamics is therefore a particularly innovative rendition of hybrid technology BMW-style and at the same time offers a fascinating outlook into the future of BMW EfficientDynamics as an overall philosophy and a significant contribution to future-proof mobility.