4. Drivetrain: Innovative Concepts Overcoming Old Barriers.

- **Six-cylinder petrol engine with magnesium crankcase and VALVETRONIC.**
- **Four-cylinder petrol engine with VALVETRONIC and bi-VANOS.**
- **Four-cylinder diesel with VNT turbocharging and intercooler.**
- **Six-speed transmission on all models.**
- **All models with more power and greater fuel economy.**

The worldwide reputation and global success of the BMW brand is attributable in particular to the Company's leadership in innovative engine technology. And throughout these years the focus has always been on BMW's straight-six power units, the absolute climax in the BMW 3 Series. Offering lots of power, supreme refinement, and optimum smoothness – and all this with weight
and engine mass kept to a minimum – the straight-six is simply perfect for this Sports Saloon.

The 3.0-litre straight-six also sets the benchmark in motoring refinement – both in its class and in engine construction in general. And not least, it has consistently won the International Engine Award for years in a row, a prize acknowledged by experts as the "Oscar" in engine construction.

A genuine revolution in engine technology: the new six-cylinder.
But is it possible at all to really improve an engine already acknowledged as perfect? The answer is clear: yes! To do this, however, you need an all-new development from the ground up, and cannot just focus on the details. So in developing the new power unit, BMW's engineers have queried everything in existence and have found many new solutions. The result is the most innovative engine currently available worldwide.

The new 3 Series is making its world debut with precisely this masterpiece in engineering: Featured in the 330i, the 3.0-litre six-cylinder petrol engine offers the absolute highlight. And with the highest output per litre, the best

power-to-weight ratio, and the lowest level of specific fuel consumption, both the engine and the car as such lead the competition far and wide.

More power and performance – greater fuel economy and cleaner emissions.

In the world of BMW, progress in engine technology naturally means more than “just” power and torque – it also means greater efficiency in the conversion of energy as well as environmental protection. And again, the six-cylinder lives up to these demands in every respect: Developing 190 kW/258 bhp at 6,650 rpm, it outperforms its predecessor by 20 kW/27 bhp or 12 per cent. Output per litre is up from 57 to 63 kW. And maximum torque of 300 Nm/221 lb-ft comes consistently from 2,500–4,000 rpm.

The world’s lightest six-cylinder in its performance class.

Despite this increase in power and torque, engine weight is down by 10 kilos or 7 per cent to just 161 kilos or 355 lb, making this the world’s lightest six-cylinder in its class. In conjunction with the increase in engine output, the power-to-weight ratio is now an even more impressive 1.18 kW/kg. And the engine also uses its fuel more efficiently, with fuel consumption down another 12 per cent from the high standard of efficiency already offered by the former model. Complying with the European EU4 and the US ULEV II emission standards, finally, the engine is an outstanding performer also in terms of environmental care.

Magnesium crankcase: lighter than aluminium.

In the interest of minimum weight, the 3.0-litre six-cylinder uses not only aluminium, but also – for the first time in volume production – magnesium another 30 per cent lighter. This revolutionary material is used for the water-cooled crankcase, the new bedplate, and the cylinder head cover.

Made of a composite magnesium/aluminium structure, the ultra-light crankcase, given its dimensions as the largest single component in the engine, makes a substantial contribution to the reduction of weight. Ultimately, indeed, this is the decisive solution in further enhancing the qualities of the Ultimate Driving Machine, considering that it is not just power and torque, but also the weight to be moved, that gives a car its agility and dynamism.

For comparison, the new crankcase weighs just 57 per cent of a comparable grey-cast iron block. This lower weight also serves to reduce fuel consumption, the weight saved on the magnesium crankcase making a 10 per cent contribution to the overall improvement of fuel economy.

Carrying over cutting-edge technology from motorsport.
So far the “bedplate” engine structure has been used almost exclusively in motorsport, providing the supreme structural and torsional stiffness as well as the durability required for the high engine speeds in racing. Now, since the
six-cylinder power unit of the 330i develops its maximum output of 190 kW at an engine speed of 6,650 rpm very high indeed on a production engine, the bedplate structure is also the best option in this case. And making the cylinder head cover out of magnesium, too, BMW has consistently continued along
the path of intelligent lightweight construction.

VALVETRONIC – now also on the six-cylinder.
VALVETRONIC, BMW’s throttle-free load management system presented for the first time in 2001, already features in BMW’s four-, 8- and 12-cylinder power units. Now making its debut in the six-cylinder 330i, this award-winning BMW patent proves its qualities in all BMW brand power units.

VALVETRONIC ensures infinite control of the opening and control times of the intake valves as a function of the gas pedal position. On a conventional engine output is controlled by the throttle butterfly quite literally “throttling” the flow of intake air and ultimately losing power in the process. By contrast, VALVETRONIC technology reduces load change resistance to a minimum, thus guaranteeing particularly efficient use of the fuel supplied and a much better engine response.

Racing-level engine speeds.
Conceived and designed for a particularly sporting style of motoring, the 3.0-litre power unit excels through a higher level of engine speed and fast-revving response. Clearly, this requires the VALVETRONIC control system
to be even stiffer and more resistant than before. Second-generation VALVETRONIC technology now featured for the first time in the 330i therefore enables the engine to run smoothly up to speeds in the region of 7,000 rpm, previously the domain of the thoroughbred sports engine. This gives the valves an acceleration speed quite comparable to that of cup tappet valve drive systems.

In the new six-cylinder BMW VALVETRONIC interacts with BMW dual-VANOS, variable camshaft adjustment for the intake and outlet valves also allowing infinite operation and adjustment flexibility. As a further improvement over dual-VANOS in the former model, the VANOS-adjusters are now

made entirely of aluminium, just as the adjuster sprocket is also made of aluminium in order to capitalise on weight benefits.

Advantage customer: even more sporting and dynamic.
The customer benefits from second-generation VALVETRONIC through an even higher level of sporting performance expressed by the greater agility
and enhanced responsiveness of the engine translating the driver's commands on the gas pedal even more precisely and directly into engine power and acceleration. In this respect BMW VALVETRONIC comes very close to the individual throttle butterfly technology used in motorsport, significantly enhancing the qualities of the Ultimate Driving Machine so typical of the 330i and reducing fuel consumption at the same time.

The electrical water pump, a fully autonomous unit.
The electrical water pump is yet another innovation in technology. Operating fully autonomously, the water pump is controlled exclusively as a function of the engine's actual cooling requirements, regardless of current engine speed. This provides a significant reduction of fuel consumption, BMW's system taking up a maximum of 200 W engine output as opposed to the power uptake of a conventional water pump of up to 2 kW.

Last but certainly not least, a new three-stage resonance intake system replacing the former two-stage unit ensures even more torque at lower engine speeds. Introduction of the third resonance pipe, the so-called vibration pipe activated by means of resonance flaps, broadens the speed range covered by the self-charging effect.

Intelligent lightweight technology for more dynamic performance.
The wide range of further innovations giving the engine huge progress in its output and efficiency confirms the many detailed improvements benefitting the latest addition to the BMW family. Two good examples are the two lightweight camshafts, each serving to reduce weight by 600 grams. Valve drive by a chain and the aluminium chain tensioner, as well as single-belt drive for all ancillaries, are further customer-friendly solutions helping to save weight and doing without even the slightest maintenance. Specifically in this area, the omission of the second belt-drive level makes the entire system even more dependable and again helps to reduce weight. And since the sound of an engine is very important to the aficionado of a sporting power unit,
the six-cylinder also offers everything it requires in this respect, the exhaust emission flap operated by engine management giving the engine
a throaty and sporting sound both under full load and part throttle.

Offering a new level of efficient performance.
The 330i sets a very high standard in terms of both performance and efficiency: Acceleration to 100 km/h comes in 6.3 seconds, 0.2 seconds faster than on the previous model. And the 330i completes the interim dash from 80–120 km/h (50–75 mph) in fifth(!) gear 0.3 seconds faster than before in just 8.5 seconds. At the same time fuel consumption is down by 12 per cent or 0.6 litres/100 km to a remarkable 8.7 litres/100 km or 32.5 mpg Imp. Top speed, finally, is cut off electronically at 250 km/h or 155 mph.

BMW 320i featuring an even more powerful four-cylinder.
BMW's engine developers have given the same detailed attention to the two-litre petrol engine entering the market in the 320i. Being based on the two-litre straight-four previously designated the 318i, the engine and the actual model designation now correspond perfectly to one another in terms of both engine size and nomenclature.

Marking the debut of the new BMW 3 Series, the four-valve power unit has been thoroughly revised and updated with an increase in both output and motoring culture, while fuel consumption and exhaust emissions have been reduced to an even lower level than before. To express this improvement in facts and figures, the new four-cylinder now offers 5 kW more power, that is 110 kW/150 bhp at 6,200 rpm. Maximum torque, in turn, is now 200 Nm/147 lb-ft at 3,600 rpm.

Power and torque of this kind accelerates the 320i to 100 km/h in just 9.2 seconds, with the car completing the interim dash from 80–120 km/h (50–75 mph) in fifth(!) gear in just 11.3 seconds. Top speed, finally, is a superior 220 km/h or 136 mph.

Best-in-class driving dynamics and impressive motoring refinement.
The actual impression you get when driving the car is even more thrilling than these outstanding facts and figures: Pulling smoothly with lots of muscle,
the four-valve power unit develops consistent performance on the road, offering a standard of driving dynamics never seen before in a four-cylinder of this size. Particularly at lower engine speeds, the driver will feel the increase
in torque by up to 23 Nm versus the previous model. And at the same time the engine is extremely smooth and refined at all speeds, the exhaust system offering acoustic progress for the aficionado of the sports engine: Thanks to the asymmetric dimensions of the front pipe cross-sections and the silencers carefully geared to the ignition frequency, the engine and

exhaust system generates a truly sporting but sophisticated sound on the road. Listening exactly, you will even hear the first and second engine order resulting from the different reflection behaviour of the advance pipes. So that ultimately
the 3 Series stands out from its competitors also through its special sound.

Exemplary fuel economy and emission management.
Compared with the former model, average fuel consumption, despite the increase in engine output, is down by approximately 2 per cent to a very low 7.4 litres/100 km or 38.2 mpg Imp in the new European driving cycle. At the same time the engine also fulfils the demanding EU4 European emission standard, making it an exceptional performer also in this respect.

The main reasons for the engine's outstanding performance are above all the fully variable VALVETRONIC valve control as well as infinitely variable
bi-VANOS camshaft management on both the intake and outlet sides. The DISA intake system comes additionally with a switching unit varying the length of the oscillating pipes as a function of engine load. In conjunction with modified engine management, this gives the 320i greater spontaneity in its response to the gas pedal, a quality previously only seen in sports engines with individual throttle butterflies.

VALVETRONIC technology used the world over.
Practical reasons alone speak clearly in favour of BMW VALVETRONIC: This technology does not necessarily require sulphur-free fuel, nor does it depend on any particular kind of catalyst. Focusing on the need for "efficient dynamics", the Company is therefore looking not only at the progress provided by VALVETRONIC in terms of performance, engine power,
and fuel consumption, but also at the possibilities of using this technology the world over as the best method to optimise engine dynamics, fuel efficiency, and emission management all in one.

The 320d continues the successful story of the BMW Sports Diesel.
BMW can rightly regard itself as the inventor of the Sports Diesel: Ever since the Company launched its first diesel engine back in 1983, the typical virtues of this self-ignition power unit – a long running life, high torque, superior fuel efficiency – have been supplemented by another substantial benefit previously provided only by the petrol engine: the joy of sheer driving pleasure.

The new 320d proves that BMW does not rest on its laurels, but rather sees the acknowledgement of existing achievements as encouragement for the future. Hence, the diesel engine in the BMW 3 Series is a true expression of pure dynamism. Featuring second-generation common-rail technology, this outstanding power unit develops equally outstanding output and torque from its four cylinders, placing the 320d right at the top in every respect: engine dynamics, drive comfort, engine output and torque are all best-in-segment.

Modified common-rail technology as the guarantee for efficient dynamics.

BMW's new diesel pushes up the benchmark significantly in terms of both refinement and efficiency. So it is not only the extra power that counts, but also – and, indeed, in particular – the elegant, quiet and efficient way the engine develops this power. This is attributable to both the engine's balance shafts and common-rail technology developed to an even higher standard of perfection. Inter alia, this common-rail system interacts with a new volume-controlled high-pressure pump atomising the diesel fuel more finely and precisely than before. The result is more power on less noise and, at the same time, a further improvement in fuel economy.

Developing up to 1,600 bar system pressure, second-generation common-rail technology provides the foundation for the extra power and performance, enhanced emission management and engine noise control meeting the requirements of BMW's engineers.

So-called MI-injectors allow multiple injection, ensure a smooth, linear injection process, and keep injection volumes within very strict tolerance limits. As a result, the combustion chambers are filled even faster than before
with exactly the right amount of fuel in a more highly atomised state, ensuring optimum combustion under the respective operating conditions. And injection of fuel up to four times per operating cycle (double-pilot, main, and after-injection) solves the old conflict of interests between engine output and noise control. Last but not least, double-pilot injection makes the entire combustion process smoother and more harmonious while after-injection improves the oxidation of particles and reduces emissions in the process.

Exhaust gas turbocharger with variable turbine geometry.

In the interest of high engine output per litre, the exhaust gas turbocharger comes with electrically variable turbine geometry. Referred to as VNT (Variable Nozzle Turbine) technology, this concept adjusts the

characteristics of the exhaust gas turbocharger perfectly to the engine's current running conditions. The electrical adjuster modifies the turbine blades instantaneously with a very high level of accuracy and minimum delay.

Blade geometry and the intercooler have also been optimised for a further improvement of turbine and compressor efficiency. The intake system, in turn, comes with a connecting duct deactivated on demand in order to optimise engine output, fuel consumption, and exhaust emissions. Variation of the combustion air swirl effect and level, finally, controls the fuel combustion process in exactly the right manner.

To suppress the second-order mass forces – that is vibrations and oscillations – typical of a four-cylinder, the engine featured electronic smoothness control as well as balance shafts. Running in the opposite direction to the crankshaft,
the balance shafts housed in the oil sump and driven by the crankshaft significantly improve the engine's high level of running smoothness with vibrations reduced to a minimum.

Sports Diesel with even more power and muscle.
Benefitting from the new four-cylinder, the driver of the BMW 320d now enjoys maximum output of 120 kW/163 bhp at 4,000 rpm, an increase by 10 kW/13 bhp. Already substantial before, maximum torque is up from 330 Nm/243 lb-ft to 340 Nm/251 lb-ft at a low 2,000 rpm, giving the car substantial boost from just above idle speed. Acceleration to 100 km/h is correspondingly impressive in just 8.4 seconds.

Thanks to its very wide and "beefy" torque curve, the diesel now also provides outstanding flexibility at all speeds, accelerating from 80–120 km/h (50–75 mph) in fifth(!) gear in just 8.5 seconds. This is almost equal to the elasticity of the top-of-the-range 330i petrol model, proving that BMW diesel engines quite rightly bear the name "Sports Diesel". Top speed is equally impressive: Achieving a top speed of 225 km/h or 140 mph, the 320d measures up with sporting petrol-engined models also in this respect.

Setting the benchmark for the leader in engine innovation.
The engine can meet every competitor particularly when it comes to fuel economy: Offering supreme fuel economy of just 5.7 litres diesel (49.6 mpg Imp) in the New European Driving Cycle, the 2.0-litre diesel is a real miracle in austerity. Benefitting from optimised exhaust gas recirculation,

the oxygen sensor positioned up front of the catalyst close up to the engine, and swirl flaps in the intake manifold, the 320d outperforms the strict EU4 emission standards, making this one of the cleanest and most economical diesel engines in the world.

Starting the engine at the touch of a button.
At normal temperatures it is virtually impossible to tell the petrol and diesel engine apart through their sound. Even at low temperatures, the diesel no longer has that typical “rattling” or “hammering” noise characteristic of a conventional diesel. And a further great advantage is that the engine starts smoothly without a noticeable delay even at 20 °C below zero.

This is because the rapid-action spark plugs supporting the start-up process in cold weather start to operate as soon as the driver opens the door and not only when he fires the engine. In addition, the system incorporates six-volt spark plugs warming up only the tip to peak temperature. And thanks to the

comfort starter, finally, all the driver has to do to start the engine is briefly press the starter button, the remaining start-up process being fully automatic until the engine is running smoothly.

Six-speed transmission on all models.
Short gearshift, superior refinement and precise gear lever control with operating forces remaining smooth and consistent – these features are typical of every BMW transmission. And now shifting gears in the new 3 Series
is even greater fun, all models coming as standard with a six-speed manual gearbox for the first time in the history of the 3 Series.

Thanks to the additional gear, the closer increments between gears, as well as the wider gear range between the lowest and the highest gear, the driver is able to adjust the gearshift process perfectly to engine and road speeds, each gear merging smoothly into the next. In everyday motoring this is a particularly benefit when setting off, the lowest gear providing even more muscle and pulling force than before. As a result, the new 3 Series drives even more dynamically than its predecessor, enabling the driver to capitalise even more on the power and performance of the engine. Acceleration is even quicker and top speed even higher – up by 9 km/h or 5 mph on the 320d.

Focusing on the petrol-engined models, BMW's engineers have sought to reduce fuel consumption to an even lower level than before, lower engine speeds cutting back fuel consumption by approximately 4 per cent. Top speed comes in fifth gear, with sixth gear serving as an economy overdrive function
to reduce both engine speed and noise. And finally, new technologies serve to keep the overall weight of the transmission at the same level as before, despite the addition of a sixth gear as well as extra power and torque. This again makes the 3 Series even more powerful and dynamic on the road.

Gearshift – now even more precise and smoother than before.
The transmission specialists have considered virtually all technical details to the practical benefit of the customer: The gearshift, for example, is a new development supplemented by an internal shift gate for even greater precision and smoothness in shifting gears. The new synchromesh, in turn, enhances gearshift comfort. The gear flanks themselves are straight and upright,
come with a particularly large helical angle and have optimised overlap for even lower transmission noise than before to the advantage of the customer.

Another example is the main bearings crucial to the smoothness and precision of the gearshift process. To avoid any change in tolerance and play caused,
for example, by differences in temperature or ongoing running conditions in the course of time, grooved ball bearings are used on both the output drive shaft and the helical ball bearing on the layshaft. Designed as clean bearings,

the main bearing units come with a special cover protecting them from dirt. This keeps the lubricant inside the bearings clean and enhances operating safety and durability in the process. And since the transmissions are filled with lifetime fluid not requiring any change in gear fluid even throughout a long running life, they are maintenance-free despite their significantly longer lifecycle.

Automatic transmission with Steptronic: shifting gears either automatically or by hand.
Automatic transmission offers motoring comfort of the highest calibre:
The additional sixth gear increases the gear range between the lowest and highest gear by 22 per cent and the gaps between gears are smaller than

before in the interest of enhanced driving dynamics and greater fuel economy.

A further forte of the automatic transmission is the very harmonious transition between gears. Top speed comes in sixth gear. And since the entire transmission is up to 10 per cent lighter, fuel consumption, depending on the overall configuration of the car, is down by up to 4 per cent.

Whenever the driver wishes to take over and shift gears himself, all he has to do is switch to Steptronic: In the Steptronic mode he merely has to briefly “flick” the selector lever to shift gears after moving the lever to the appropriate shift lane.

Saving fuel with easy-run final drive.
The easy-run final drive made of aluminium and offering a significant increase in efficiency serves in particular to reduce fuel consumption to an even lower level than before. A further technical highlight in the car, the easy-run final drive comes together with a new double-helical ball bearing concept introduced by BMW as the first manufacturer worldwide. These special ball bearings reduce operating temperatures on the final drive, thus enhancing both their function and service life.

Oil flow losses have been reduced at the same time, with the gear pattern being adjusted to the change in bearing conditions and optimised for efficiency. And last but certainly not least, torque capacity of the final drive is up by 10 per cent without the slightest increase in weight.

Tailor-made transmission for each model.
One of the secrets of the outstanding driving dynamics of the new BMW 3 Series is most certainly the transmission ratio tailored to the respective combination of engine and transmission. Indeed, this gives the entire drivetrain the final touch, offering that extra bit of driving dynamics on truly outstanding fuel economy.

Adaptation of the propeller shaft to the transmission should also be mentioned in this context, the propeller shaft itself being extra-light thanks to a new production process allowing optimum adjustment of the wall thickness of the hollow shafts to their exterior diameter. These hollow shafts save not only
up to 1 kg in weight versus the solid shafts used in the past, but also reduce unsprung masses and thus enhance roll comfort to a new standard never seen before. And to reduce gear running noise, finally, the new BMW 3

Series for the first time comes with propeller shafts connected to the final drive by
a universal disc.