



Mercedes-Benz

Mercedes-Benz S550 PLUG-IN HYBRID

Press Information

Efficiency = Performance

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The descriptions and information in this press kit apply to the international model range of Mercedes-Benz and may vary from country to country.

Efficiency = Performance

The new Mercedes-Benz S550 PLUG-IN HYBRID blends an ultramodern hybrid drive configuration with the unique innovations and the luxurious equipment and appointments of the S-Class. The luxury sedan impresses with exceptional dynamism and efficiency. Thanks to standard pre-entry climate control it also offers unique climate comfort. The first certified three-liter luxury sedan in the world is a further milestone on the road to emission-free mobility.

"The S550 PLUG-IN HYBRID is the first luxury sedan with the performance of a V8 and the fuel consumption of a compact model. The greatest challenge in this is to translate efficiency into superior performance. In this respect there is a highly interesting parallel with our successful Formula 1 racing car, which likewise has a turbocharged V6 engine and a high-tech hybrid drive," says Prof. Dr. Thomas Weber, member of the Daimler Board of Management responsible for Group Research and Mercedes-Benz Cars Development.

"The new S550 PLUG-IN HYBRID offers our customers the entire range of innovations that make our new S-Class so successful, and thanks to its intelligent operating strategy ensures outstanding driving pleasure and dynamism combined with the highest efficiency. Moreover, it allows completely emission-free driving for up to 20 miles," adds Ola Källenius, Executive Vice President Sales and Marketing Mercedes-Benz Cars.

The Mercedes-Benz S550 PLUG-IN HYBRID offers a system output of 436 hp and 479 lb-ft torque, sprints from 0 to 62 mph in just 5.2 seconds and can drive up to 20 miles purely electrically. Key elements of this impressive output are the V6 biturbo and the intelligent hybrid drive. The new high-voltage lithium-ion battery with an energy content of 8.7 kWh can be externally recharged via the charging socket in the right side of the rear bumper.

The S550 Plug-In Hybrid model has environmental certificates. These document the model's environmental performance from development through to recycling across the entire lifecycle, and the performance is certified to internationally recognized standards by independent experts. Regarding CO₂ emissions, the certificate of the S550 PLUG-IN HYBRID states: "Over the entire lifecycle encompassing manufacture, use of over 300,000 kilometres (186,000

miles) and recycling, clear advantages result when compared with the S550. External charging with the European electricity mix can cut CO₂ emissions by some 43 percent (35 tonnes). Through the use of renewably generated hydroelectricity a 56 percent reduction (46 tonnes) is possible."

The hybrid transmission is based on the 7-speed automatic transmission. The plug-in-hybrid system in the S-Class is based on the Mercedes-Benz parallel hybrid modular system. The common system-specific feature is the additional clutch integrated between combustion engine and electric motor. On the one hand, it decouples the combustion engine during purely electric operation; on the other hand, if the combustion engine is employed it affords the possibility to move off drawing on the performance of a wet start-up clutch. The clutch then substitutes for the torque converter and requires no additional space owing to its complete integration in the torque converter housing.

Haptic accelerator pedal: support for the driver

Climb in, start, drive off and, as well as exemplary efficiency, on request experience via kickdown the special acceleration of the electric motor – this is how easy hybrid driving is with the new S550 PLUG-IN HYBRID. For in everyday use it moves just as easily as any other automatic transmission car.

In the background, depending on the chosen operating mode, the intelligent operating strategy automatically selects the ideal combination of internal combustion engine and electric motor and in so doing not only adapts its strategy according to the charge status of the battery; it also foresightedly adjusts it according to the traffic or route. Anyone wanting to can also intervene manually and with the aid of four operating modes and three transmission modes regulate the hybrid interplay themselves.

What is known as the haptic accelerator pedal can signal via a double impulse when drivers should take their foot off the accelerator for sailing and recuperating. During electric operation it can supply the driver with feedback on the switch-on point of the combustion engine. The energy flow can be shown in all operating states in the instrument cluster and in the central display if this is selected by the customer.

Model	S 550 PLUG-IN HYBRID
Internal combustion engine:	
Number of cylinders/arrangement	6/V
Mixture formation	High-pressure injection, 2 turbochargers
Displacement (cc)	2996
Rated output (hp at rpm)	329 hp at 5250-6000
Rated torque	354 lb-ft at at 1600-4000
Electric motor:	
Output (kW/hp)	85 kW / 114 hp
Torque (Nm / lb-ft)	340 Nm / 251 lb-ft
System output (kW/hp)	325 kW / 436 hp
System torque (Nm/lb-ft)¹	650 Nm / 479 lb-ft
Consumption combined from (l/100 km) ²	2.8
CO ₂ emissions combined from (g/km) ²	65
Efficiency class	A+
Electric range (miles)	20
Charge time 20%-100% (400 V/16 A - 230 V/8 A) ³ (h)	2 - 4.1
Acceleration 0-62 mph (s)	5.2
Top speed (mph) ¹	130 mph
Top speed electric (mph) ¹	87

¹ Electronically limited, ² In accordance with NEDC, ³ Charge time at 230 V/8 A e.g. at a commercially available socket. Through settings on the control element of the charging cable shorter charge times can be realised (standard setting: 8 A), provided that the power supply system is designed for this. Charge time at 400 V/16 A e.g. at a wallbox. The voltage and current ratings indicated refer to the power supply infrastructure and can be limited by the car.

⁴ Sales price in Germany, incl. 19 percent VAT

Extensive standard equipment, extended pre-entry climate control

The standard equipment in the S550 PLUG-IN HYBRID is extensive and offers a world premiere: the **extended pre-entry climate control**. This is target value controlled, meaning that at the start of the journey the S-Class is air conditioned to the preset temperature if the driver has entered the departure time via the S-Class Vehicle Homepage. This is possible due to the electrically driven refrigerant compressor and electric heating elements for the heated air. In addition, when preheating it is not just the interior air but also the seats, steering wheel and armrests in the doors and center console which are heated, and when cooling the seat ventilation is also activated if the respective optional extra is on board.

Also standard on the S550 PLUG-IN HYBRID are LED High Performance headlamps and LED tail lights, leather upholstery, COMAND Online, touchpad, dual-zone AUTOMATIC CLIMATE CONTROL, Memory package for driver and front passenger, ambient lighting in seven colors and the air suspension AIRMATIC with continuously variable damping system. The basic safety equipment includes PRE-SAFE[®], COLLISION PREVENTION ASSIST PLUS (collision warning including Adaptive Brake Assist), ATTENTION ASSIST, PRE-SAFE[®] impulse, and Crosswind Assist.

The Mercedes-Benz hybrid strategy: emphasis on plug-in drives

The S550 PLUG-IN HYBRID is the first hybrid model in the U.S. for the new S-Class. The series production launch of this technology began at Mercedes-Benz in 2009. The company is among the leaders in the field of purely electric mobility, and in the years to come the main emphasis will be on plug-in hybrids.

Hybrid drives, the combination of internal combustion engine and electric drive, help cut overall fuel consumption and boost performance since the electric drive replaces or supports the combustion engine whenever the engine characteristics are unfavorable – normally in part-load operation when little power is required.

The largest potential for lowering the energy consumption of the hybrid drive systems lies in maximizing energy recovery during coasting and braking. Upon depressing the brake pedal the deceleration is initially effected by the electric motor and not by the disc brakes. The hybrid models of the new S-Class are the first to use a recuperative braking system of the second generation. It ensures an unnoticeable overlapping of the conventional mechanical brakes and the electric braking performance of the electric motor in generator mode.

Intelligent operating strategy

For efficient operation, foresighted driving, avoiding unnecessary braking and accelerating maneuvers have always been the best strategy. This gains an all new importance in a hybrid model: braking maneuvers serve not only deceleration, but can also be used to recuperate energy. In addition, the route has considerable influence on the most efficient charging and discharge of the high-voltage battery.

The intelligent operating strategy supports the driver comprehensively yet unobtrusively to achieve the most efficient driving style. The control strategy, for example, seeks to ensure that the battery, if at all possible, is flat at the end of an uphill stretch so that it can be recharged going downhill. Another key point is the requirement that urban areas be reached with a fully charged battery, if possible, so that the vehicle can be operated in stop-and-go traffic electrically – frequently and efficiently.

In the S550 PLUG-IN HYBRID the energy management system covers these three areas:

- route-based: automatically or by way of four operating modes
- driver-based: by way of three transmission modes
- traffic-based: with the aid of radar.

Charging: power from a socket

The battery of the S550 PLUG-IN HYBRID is safely fitted into the rear end of the S-Class to save space. An intelligent on-board charging system enables the battery to be charged at any conventional household power socket. The supply of electricity to the car will be made even easier in the future through inductive, cableless charging.

The S550 PLUG-IN HYBRID stores electric energy in a lithium-ion battery on lithium-iron phosphate basis. The water-cooled energy storage unit has an overall capacity of 8.7 kWh, a total weight of 251 lbs and a spatial volume of 3.4 cubic feet.

To ensure the highest levels of crash safety and dynamic handling and also maximum trunk space, the housing is made of die-cast aluminium and the high-voltage battery is located in the rear of the vehicle above the rear axle. The space available there is put to optimal use, and the S550 PLUG-IN HYBRID thus takes first place among the plug-in hybrids in terms of trunk capacity (12.2 cubic feet) and luggage compartment accessibility.

The high-voltage battery of the S550 PLUG-IN HYBRID can be charged via external electricity mains using a 3.6 kW on-board charger. The unit is permanently installed in the vehicle and charges single-phase up to 16 A. The connection for the charging cable is located under a flap of the rear bumper underneath the tail light on the right-hand side. An automatic lock ensures that

the cable cannot be separated from the vehicle by unauthorized persons. The new S-Class can be charged in two hours anywhere in the world, e.g. at a wallbox or a charging pole (400 V, 16 A). Alternatively, charging via house connection is also possible. Depending on the connection a charge of time e.g. of two hours and 45 minutes can be attained (with 230 V and 13 A)¹.

Next step: S550 PLUG-IN HYBRID – unplugged

One of the next steps on the way to the perfect electric vehicle and plug-in hybrid is cableless charging. Inductive battery charging will make the handling of electric vehicles and plug-in hybrids even more convenient. Mercedes-Benz will test this "unplugged" technology with the S550 PLUG-IN HYBRID in order to develop a genuine S-Class solution, in terms of comfort and ease of operation, for the charging of the high-voltage battery.

The history: leadership role in the premium segment

In 1982 Mercedes-Benz presented the first concept vehicle with hybrid drive – a two-cylinder horizontally opposed engine served to charge the battery. A number of other experimental vehicles followed until in 2009 the world's first standard-specification hybrid drive with a lithium-ion battery debuted at Mercedes-Benz: this S400 HYBRID was the most fuel-efficient gasoline-powered luxury sedan for a long time and the most successful hybrid in its segment with around 20,000 buyers.

The second-generation hybrid transmission evolved based on the 7-Speed automatic transmission. In 2014 the B-Class Electric Drive, already on the market in the USA, will also become available in Europe to supplement the hybrid range.

Growing range: All current hybrid and electric drive vehicles from Mercedes-Benz

- 2012: E400 HYBRID
- 2013: smart electric drive

¹ The charge time ranges between 2 hours (400 V/16 A, e.g. at a wallbox) and 4.1 hours (230 V/8 A, e.g. at a household power outlet). Through settings on the control element of the charging cable, shorter charge times can be realised even with household power outlets, provided that the power supply system is designed for this. The voltage and current ratings indicated refer to the power supply infrastructure and can be limited by the car. All charge times refer to the charging of the battery from 20% to 100%.

- 2014: B-Class Electric Drive
- 4/2015: S550 PLUG-IN HYBRID

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Mercedes-Benz S 550 PLUG-IN HYBRID

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Internal combustion engine

Number of cylinders/arrangement		V6, 4 valves per cylinder
Displacement	Cc	2996
Bore x stroke	Mm	88.0 x 82.1
Rated output	kW/hp	245/329 at 5250-6000 rpm
Rated torque	Nm/lb-ft	480 / 354 at 1600-4000 rpm
Compression ratio		10.5 : 1
Mixture formation		High-pressure injection, 2 turbochargers, EDC

Electric motor

Output	kW/hp	85 / 114
Torque	Nm/lb-ft	340 / 251
Battery		Lithium-ion
Battery energy content	kWh	8.7
Battery capacity	Ah	22

Drive

System output	kW/hp	325/436
System torque	Nm/lb-ft	650/479 (electronically limited)

Power transmission

Transmission		7-speed automatic transmission
Gear ratios	Final-drive ratio	2.82
	1st gear	4.38
	2nd gear	2.86
	3rd gear	1.92
	4th gear	1.37
	5th gear	1.00
	6th gear	0.82
	7th gear	0.73
	Reverse 1	3.42
	Reverse 2	2.23

Chassis and suspension

Front axle	Four-link front suspension with air springs, single-tube shock absorbers, anti-roll bar
Rear axle	Multi-link independent rear suspension with air springs, single-tube shock absorbers, anti-roll bar
Braking system	Internally ventilated and perforated disc brakes at front, internally ventilated disc brakes at rear, electric parking brake, ABS, Brake Assist, ESP®
Steering	Electromechanical rack-and-pinion power steering
Wheels	8.0 J x 18 (front), 9.5 J x 18 (rear)
Tires	245/50 R 18 W (front), 275/45 R 18 W (rear)

Dimensions and weights

Wheelbase	in	124.6
Track, front/rear	in	63.9 / 64.3
Length (overall)	in	206.5
Width (overall)	in	74.8
Height (overall)	in	58.8
Turning circle	M	12.3
Trunk capacity max.*	Cubic feet	12.2
Curb weight	lbs	5093
Payload	lbs	1349
Perm. gross vehicle weight	lbs	6228
Tank capacity/incl. reserve of	Gallons	16.6

Performance and fuel consumption

Acceleration 0-62 mph	sec.	5.2
Top speed	mph	130
Top speed electric	mph	87
Fuel consumption, combined**	l/100 km	2.8
CO ₂ emissions**	g/km	65
Electric range	Miles	20
Charge time 20%-100% (400 V/16 A-230 V/8 A)***	H	2 - 4.1

*acc. to VDA measuring method, **NEDC, ***Charge time at 230 V/8 A, for example at a commercially available socket. Through settings on the control element of the charging cable shorter charge times can be realized (standard setting: 8 A), provided that the power supply system is designed for this. Charge time at 400 V/16 A, for example at a wallbox. The voltage and current ratings indicated refer to the power supply infrastructure and can be limited by the car

Efficiency = Performance

The Mercedes-Benz S 550 PLUG-IN HYBRID offers a system output of 436 hp and 479 lb-ft torque, sprints from 0 to 62 mph in just 5.2 seconds and can drive up to 20 miles purely electrically. The real-life consumption is outstanding. Key elements of this impressive output are the V6 biturbo and the intelligent hybrid drive.

"The S 550 PLUG-IN HYBRID is the first luxury sedan with the performance of a V8 and the fuel consumption of a compact model. The greatest challenge in this is to translate efficiency into superior performance. In this respect there is a highly interesting parallel with our successful Formula 1 racing car, which likewise has a turbocharged V6 engine and a high-tech hybrid drive," says Prof. Dr. Thomas Weber, member of the Daimler Board of Management responsible for Group Research and Mercedes-Benz Cars Development.

Hybrid drives, the combination of internal combustion engine and electric drive, help cut overall fuel consumption and boost performance, since the electric drive replaces or supports the combustion engine whenever the engine characteristics are unfavourable - normally in part-load operation when little power is required. The experience gained with the previous vehicles from Mercedes-Benz has shown that though batteries with a higher energy content permit more frequent electric driving, they provide no added benefit from a consumption viewpoint. The capacity for braking energy recuperation determines the optimal design of the capacity and energy content of the traction battery. Recharging by the internal combustion engine cannot compensate for the additional vehicle weight resulting from an oversized battery.

For this reason, in the S550 PLUG-IN HYBRID Mercedes-Benz combines a high-energy battery with the ability to replenish the energy storage unit via the external electric mains. The advantages of emission-free electric driving are brought ideally into line with the tremendous consumption advantage of the parallel hybrid - and combined with a ride comfort and handling dynamics which meet the highest standards. As with all hybrid vehicles from Mercedes-Benz, the ultraefficient drive system is integrated in the overall vehicle in a way that creates no space restrictions. Major adjustments to the packaging of the overall vehicle are unnecessary - this is a big advantage for the production of the hybrid vehicles, for example, but it also poses a huge challenge for the

development of the electric motor and its integration in the power head of the transmission and for the development of the power electronics and the high-voltage battery.

The hybrid transmission is based on the 7-speed automatic transmission. The plug-in hybrid system in the S-Class is based on the Mercedes-Benz parallel hybrid modular system. The common system-specific feature is the additional clutch integrated between the combustion engine and electric motor. On the one hand, it decouples the combustion engine during purely electric operation; on the other hand, if the combustion engine is employed it affords the possibility to move off drawing on the performance of a wet start-up clutch. The clutch then substitutes for the torque converter and requires no additional space owing to its complete integration in the torque converter housing.

For the stop phases of the combustion engine the hybrid system has a high-voltage refrigerant compressor, and on the 12 V side an electrically assisted steering, an electric vacuum pump and an electric auxiliary oil pump for the transmission.

Completely integrated: the electric motor

The electric motor of the PLUG-IN HYBRID has been further developed from the previous hybrid vehicles. The modular design enabled longitudinal scaling from 6 to 9 rotor plate packs. Despite its compact design the electric motor delivers an output of up to 114 hp (85 kW) and torque of up to 251 lb-ft (340 Nm). The permanently excited synchronous motor is fully integrated into the hybrid transmission. Stator and rotor of the internal rotor motor are cooled by transmission oil.

Power electronics and voltage transformer

The high-voltage battery feeds the electric motor through a water-cooled DC/AC converter, the power electronics. This is a component from the Mercedes-Benz modular system and was first developed for the technology platform of the SLS AMG E-CELL, which went into production as the SLS AMG Coupé Electric Drive. The integration of the power electronics with an electric motor optimized for plug-in operation enables top performance in terms of comfort and output over the entire operating range.

The power electronics operate with a rated voltage of 325 V and supply 350 A maximum current, at the same time determining the position and status of the

electric motor by means of a rotor position sensor as well as various component temperatures. Depending on the operating situation, actuation of the electric motor is guided by the rotational speed or the torque, within the permissible limits. To optimize the effort for wiring, packaging and cooling, the DC/AC converter has been integrated into the engine space. A separate DC/DC converter at the rear of the vehicle supports the 12 V on-board power supply with an output of up to 3 kW.

With twin turbochargers: the internal combustion engine

For inherent design reasons, electric motors and combustion engines have different torque curves, which can, however, outstandingly complement each other. An electric motor makes its peak torque available as soon as it starts and can therefore compensate an internal combustion engine's weak torque in the low rev range. The electric motor and the V6 biturbo are thus ideal partners in the drive system of the S550 PLUG-IN HYBRID.

The V6 biturbo with a displacement of three litres comes from the M276 engine family and features the BlueDIRECT injection and combustion system. Cylinder heads and block are made of aluminium. To reduce friction, the cylinder barrels are coated with the aid of the innovative NANOSLIDE process. Other engine characteristics include four valves per cylinder, a particularly quiet chain drive system with silent chains and two camshaft adjusters each for the intake and exhaust sides.

The third-generation direct injection system has a fuel pressure of 200 bar and spray-guided multiple injection with piezo injection nozzles. The on-demand vane-type oil pump cools and lubricates the engine depending on engine load and engine speed. The volume control distinguishes between a low and a high pressure level and adjusts the volume flow as required. The weight of the components of the water circuit could be reduced through the systematic use of plastic. In an extended temperature range the heating supply for the interior is preferentially served. The desired temperature is thus very quickly reached during the warm-up phase. An electric heater element ensures rapid warming of the car interior also during electric driving.

The technical data at a glance:

Model	S 550 PLUG-IN HYBRID
Internal combustion engine:	
Number of cylinders/arrangement	6/V

Mixture formation	High-pressure injection, 2 turbochargers
Displacement (cc)	2996
Rated output (kW/hp at rpm)	245/329 at 5250-6000
Rated torque (Nm/lb-ft at rpm)	480/354 at 1600-4000
Electric motor:	
Output (kW/hp)	85/114
Torque (Nm/lb-ft)	340/251
System output (kW/hp)	325/436
System torque (Nm/lb-ft)¹	650/479
Consumption combined from (l/100 km) ²	2.8
CO ₂ emissions combined from (g/km) ²	65
Efficiency class	A+
Electric range (miles)	20
Charge time 20%-100% (400 V/16 A - 230 V/8 A) ³ (h)	2 - 4.1
Acceleration 0-62 mph (s)	5.2
Top speed (mph) ¹	130
Top speed electric (km/h) ¹	87

¹ Electronically limited, ² In accordance with NEDC, ³ Charge time at 230 V/8 A, for example at a commercially available socket. Through settings on the control element of the charging cable shorter charge times can be realised (standard setting: 8 A), provided that the power supply system is designed for this. Charge time at 400 V/16 A e.g. at a wallbox. The voltage and current ratings indicated refer to the power supply infrastructure and can be limited by the car,

⁴ Sales price in Germany, incl. 19 percent VAT

Depending on the power requirement and battery charge status, the S550 PLUG-IN HYBRID drives in purely electric mode. Moving off from stationary also takes place in electric mode. This "silent start" is part of the exceptional driving experience and perfects the start/stop procedure, e.g. with noiseless starting at traffic lights. In transmission mode "S" electric driving can be excluded.

If more power is required, the internal combustion engine is started by means of a process developed specifically for hybrid drives with direct-injection gasoline engines, and then is quickly and conveniently engaged by actuating the clutch, depending on operating conditions. The Mercedes-Benz starting procedure combines appropriate actuation of the starter with the ECO start/stop function of direct-injection petrol engines, in which starting is optimized by well-targeted injections and ignitions. This and the simultaneous actuation of the clutch, with its additional accelerating effect on the starting

engine, make an extremely rapid start possible compared with a conventional starting procedure, ensuring a good transition from electric driving.

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The internal combustion engine is shut off as often as possible for purely electric driving. But even so, in combination with the electric motor it delivers a total torque on the level of an eight-cylinder drive when such power is required.

Recuperative braking system: the electric motor as generator

The largest potential for lowering the energy consumption of hybrid drive systems lies in maximizing energy recovery during coasting and braking. Upon depressing the brake pedal the deceleration is initially effected by the electric motor and not by the disc brakes. The hybrid models of the new S-Class are the first to use a recuperative braking system of the second generation. It ensures an unnoticeable overlapping of the conventional mechanical brakes and the electric braking performance of the electric motor in generator mode.

The driver's desired braking power is recorded by a pedal-travel sensor. The deceleration is dependent on the driving condition and is split into a recuperative brake-force portion and a portion to be supplied by the wheel brakes. The brake pressure on the rear axle is controlled dependent on the current recuperation potential of the drive system.

In addition, the combustion engine is switched off any time the vehicle is coasting, and its drag torque when rolling is used by the electric motor as recuperation torque. However, without depressing the brake pedal no additional deceleration torque is provided for charging the battery, and the vehicle can "sail".

Intelligent operating strategy

Climb in, start, drive off and, as well as exemplary efficiency, on request experience via kickdown the special acceleration of the electric motor – this is how easy hybrid driving with the new S550 PLUG-IN HYBRID is. For in everyday use it moves just as easily as any other automatic transmission car.

In the background, the intelligent operating strategy automatically selects the ideal combination of internal combustion engine and electric motor and in so doing not only adapts its strategy according to the charge status of the battery; in transmission mode E+ it also foresightedly adjusts it according to the traffic or route. But anyone wanting to can also intervene manually and with the aid of four operating modes and three transmission modes regulate the hybrid interplay themselves. Here, what is known as the haptic accelerator pedal supplies the driver with feedback on the switch-on point of the combustion engine or signals via a double impulse when they should take their foot off the accelerator for sailing and recuperating.

For efficient operation, foresighted driving, avoiding unnecessary braking and accelerating maneuvers, has always been the best strategy. This gains an all new importance in a hybrid model: braking maneuvers serve not only deceleration, but can also be used to recuperate energy. The route has considerable influence on the most efficient charging and discharge of the high-voltage battery. The intelligent operating strategy supports the driver comprehensively yet unobtrusively to achieve the most efficient driving style. The control strategy, for example, seeks to ensure that the battery, if at all possible, is flat at the end of an uphill stretch so that it can be recharged going downhill. Another key point is the requirement that urban areas be reached with a fully charged battery, if possible, so that the vehicle can be operated in stop-and-go traffic electrically – frequently and efficiently.

In the S 550 PLUG-IN HYBRID the intelligent operating strategy covers these three areas:

- route-based: automatically or by way of four operating modes
- driver-based: by way of three transmission modes
- traffic-based: with the aid of radar.

By means of operating mode and transmission mode switches next to the Controller on the center console it is possible to switch between four operating modes. A display in the middle of the instrument cluster tells which mode is currently selected. Here an overview of all four operating modes:

- **HYBRID:** As the name indicates, this standard mode offers hybrid driving, i.e. combines the operation of electric motor and combustion engine. The extent to which the electric motor is used to optimize consumption, or with boost function for especially dynamic acceleration, depends – apart from the customer's driving style – on the battery charge status and the chosen transmission mode. Three transmission modes are available in this operating mode and can be activated using the transmission mode switch:
 - Transmission mode E (Economy) is standard; the electric motor is used for both the benefit of efficiency and for driving pleasure. A power reserve is retained for the electric motor so that maximum additional thrust can be provided.
 - In transmission mode E+ (Economy +) the objective is maximum fuel economy; all features of the intelligent operating strategy are active in E+. The greatest possible advantage is taken of the hybrid's energy efficiency. For example, the vehicle sails as much as possible during coasting, while energy is increasingly recuperated only upon approaching another vehicle travelling ahead. Transmission mode E+ additionally makes use of radar technology – for details see the section below on "traffic-based operating strategy".
 - In transmission mode S (Sport) the sporty features of the drive system dominate. The transmission selects the shift points to benefit agility. This mode does without purely electric driving. The larger amount of electrical energy available because of this is used for the electrically supported boost function.
- **E-MODE:** In this operating mode the S550 PLUG-IN HYBRID runs purely electrically as much as possible. To ensure that the driver does not inadvertently engage the combustion engine by stepping on the accelerator, the haptic accelerator pedal with pressure point is automatically activated in this mode. The combustion engine engages only when the driver overcomes the pedal's distinct pressure point.

- **E-SAVE:** Here the charge status of the battery is preserved as it was when this operating mode was activated. For example, a fully charged battery can be held available if purely electric driving in a big city is on the agenda later. Electric driving in especially favourable situations, for instance after brief stops, is still permitted, but is metered so that the charge status does not fall below the value set by pressing the button.
- **CHARGE:** Here the high-voltage battery is charged during vehicle operation with the aid of the internal combustion engine. Electric driving and boost operation are completely dispensed with. Under optimal conditions a run-down high-voltage battery can be fully charged in just about half an hour. As soon as the high-voltage battery is fully charged, the system automatically switches to E-SAVE mode.

Route-based operating strategy

The route-based operating strategy takes the decision for the optimum sequence of operating modes for a route off the driver's hands. If the exact destination is known because the relevant data has been entered into the navigation system, charge and discharge of the high-voltage battery are controlled to ensure the optimal use of energy on the overall route, for as much as 620 miles. One objective is to use the battery's energy content to drive uphill while recharging the battery through recuperation on the downhill stretch. The system uses data from the COMAND Online navigation system to calculate the recuperation potential of the road ahead. For example, the data provides information about the route profile and speed limits ahead in a one-metre grid for over 4 miles in advance.

If on the other hand the destination is not known, an assumed route is taken as a basis using likely turn-offs. In this case the system computes the probability depending on the road category. If, for example, the hybrid vehicle is travelling on a freeway, the system assumes that it will remain on the freeway for the next four miles.

Traffic-based operating strategy

In transmission mode E+, during electric operation the overrun torque is reduced to a minimum to enable sailing as often and as long as possible. However, heavy braking after a long sailing phase, or premature sailing resulting in the need to restart the engine, are counterproductive. Consequently, the system makes use of radar information in bumper-to-bumper traffic in order to get its bearings from the vehicle travelling ahead.

The distance from the vehicle ahead and the speed difference are recognized with the aid of radar sensors. At exactly the moment when releasing the accelerator pedal would lead to optimally fuel-efficient "docking" onto the vehicle ahead, the driver receives a recommendation, in the form of a noticeable double impulse in the haptic accelerator pedal, to back off the accelerator.

If the driver accepts the recommendation and electric operation is available, the combustion engine is switched off and disconnected from the drive system. The vehicle then sails. If the vehicle ahead reduces its speed or the gap becomes smaller for some other reason, radar-based overrun torque control sets in. Increased recuperation by the electric motor correspondingly changes the gap to the vehicle ahead - and recovers energy.

Extended pre-entry climate control

The S550 PLUG-IN HYBRID blends an ultramodern hybrid drive configuration with the unique innovations and the luxurious equipment and appointments of the S-Class. The luxury sedan with a long wheelbase not only displays exceptional dynamism and efficiency, it also offers unique climate comfort thanks to comprehensive, standard pre-entry climate control.

The standard equipment in the S550 PLUG-IN HYBRID offers a world premiere in the extended pre-entry climate control. Its functions are controlled by target values, meaning that at the start of the journey the S-Class is air conditioned to the preset temperature if the driver has entered the departure time via the S-Class Vehicle Homepage. This is possible due to the electrically driven refrigerant compressor and electric heating elements for the heated air. In addition to this, when preheating it is not just the interior air but also the seats, steering wheel and armrests in the doors and center console which are heated, and when cooling the seat ventilation is also activated if the respective optional extra is on board.

The standard equipment of the S550 PLUG-IN HYBRID, is indeed comprehensive. Standard features are for example LED High Performance headlamps and LED tail lights, leather upholstery, COMAND Online, touchpad, dual-zone automatic climate control, AIR-BALANCE package including ionization, improved air filtering and fragrancing, memory package for driver and front passenger, ambient lighting in seven colors and AIRMATIC air suspension with continuously variable damping system. Sophisticated safety equipment includes PRE-SAFE[®], COLLISION PREVENTION ASSIST PLUS (collision warning including Adaptive Brake Assist), ATTENTION ASSIST, PRE-SAFE[®] impulse, and Crosswind Assist Over and above this, a multitude of unique optional extras are available - here is an overview:

- **Head-up Display**
- **Driving Assistance Package** including DISTRONIC PLUS with Steering Assist, PRE-SAFE[®] Brake, BAS PLUS with Cross-Traffic Assist, Active Blind Spot Assist, Active Lane Keeping Assist and PRE-SAFE[®] PLUS, only in conjunction with Parking package including Active Parking Assist

- **Night View Assist PLUS** with early detection of people and large animals in the dark, including spotlight function
- **Premium Package**, comprising: active multicontour seats for driver and front passenger with dynamic handling function (seat side bolsters are each adjusted via an air chamber) and with ENERGIZING massage function (massage function via 14 air chambers in the seat backrest, massage heating panels in the spinal area), ventilated seats and fast-acting seat heating plus and adjustable lumbar support via three air chambers
- **Optional Rear Seat Packages that includes** rear seats electrically adjustable including Memory function comprising: three-seater bench seat with two electrically adjustable outer luxury seats, luxury head restraints with an additional cushion, front passenger seat operable from the rear, illuminated seat belt buckle extenders, PRE-SAFE[®] belt tensioners and beltbags for outer rear seats
- Armrests in the rear including double cup holder with wood trim and storage space
- **Warmth and Comfort package** comprising: heated armrest in the driver's and front passenger door as well as in the center console, heated armrest in the rear doors, heated armrest in the center armrest in the rear in conjunction with electrically adjustable rear seats, heated armrest in the business console, buttons for heating the seats and armrests in the door control panels in the doors, heated steering wheel
- **Burmester[®] high-end 3D surround sound system** with 24 loudspeakers, 24 amplifier channels and a total system output of 1540 watts
- **Individual Entertainment System in the rear** including two 25.4 cm (10") displays on the backrest of the driver's and front passenger seat, DVD player, two radio headphones and COMAND remote control

The battery of the S550 PLUG-IN HYBRID is safely fitted into the rear end of the S-Class to save space. An intelligent on-board charging system enables the battery to be charged at any conventional household power socket. The supply of electricity to the car will be made even easier in future through inductive, cableless charging.

The S550 PLUG-IN HYBRID stores electric energy in a lithium-ion battery on lithium-iron phosphate basis. A modular design with 120 serially connected VDA single cells (22 Ah/cell) supplies rated voltage of 396 V, which can vary between 270 V and 430 V depending on the operating point and consequently is optimally suited for the electric drive.

The water-cooled energy storage unit has an overall capacity of 8.7 kWh, a total weight of 251 lbs and a spatial volume of 3.4 cubic feet. An energy management system developed by Mercedes-Benz enables the best possible utilization of the installed capacity, always makes the required output available and simultaneously protects battery life and availability.

To ensure that highest levels of crash safety and dynamic handling and also maximum trunk space, the housing is made of die-cast aluminium and the high-voltage battery is located in the rear of the vehicle above the rear axle. The space available there is put to optimal use, and the S550 PLUG-IN HYBRID thus takes first place among the plug-in hybrids in terms of trunk capacity (12.2 cubic feet) and luggage compartment accessibility. Owing to the modular design of the battery components, further use of the battery system in other vehicle model series can be easily realized.

Battery charged in around two hours

The high-voltage battery of the S 550 PLUG-IN HYBRID can be charged via external electricity mains using a 3.6 kW on-board charger. The unit is permanently installed in the vehicle and charges single-phase up to 16 A. The connection for the charging cable is located under a flap in the rear bumper underneath the tail light on the right-hand side. An automatic lock ensures that the cable cannot be separated from the vehicle by unauthorized persons.

The new S-Class can be charged in two hours anywhere in the world, e.g. at a wallbox or a charging pole (400 V, 16 A). Alternatively, charging via house connection is also possible. Depending on the connection a charge time e.g. of

two hours and 45 minutes can be attained (with 230 V and 13 A)². The operating data from the charge process and the available output are continuously transmitted to the vehicle's energy management system, which then controls the charge process. The on-board charger is located near the battery to ensure the optimal length of connecting cables and cooling water lines.

With its intelligent charge management the new S-Class supports the following functions:

- optimized charging making allowances for customer input, vehicle data and charging infrastructure
- reliable automatic calculation of the purchased energy quantity
- provision and reception of charge-relevant data.

The S550 PLUG-IN HYBRID is delivered as standard with a 26 foot long charging cable for household power sockets.

Next step: S550 PLUG-IN HYBRID - unplugged

One of the next steps on the way to the perfect electric vehicle and plug-in hybrid is cableless charging. Inductive battery charging makes the handling of electric vehicles and plug-in hybrids even more convenient. Mercedes-Benz will try out this "unplugged" technology in a test fleet with the S550 PLUG-IN HYBRID in order to develop a genuine S-Class solution, in terms of comfort and ease of operation, for the charging of the high-voltage battery.

The system is comprised of two components: a secondary coil plus a floor plate with integral primary coil which is placed underneath the car, for example on the garage floor. The electric energy is transferred without contact, without a charging cable, with an output of 3.6 kW. The vehicle's high-voltage battery thus can be charged efficiently, conveniently and safely with an efficiency factor of more than 90 percent.

² The charge time ranges between 2 hours (400 V/16 A, e.g. at a wallbox) and 4.1 hours (230 V/8 A, e.g. at a household power outlet). Through settings on the control element of the charging cable, shorter charge times than 4.1 hours can be realised even with household power outlets, provided that the power supply system is designed for this. The voltage and current ratings indicated refer to the power supply infrastructure and can be limited by the car. All charge times refer to the charging of the battery from 20% to 100%.

Leadership in the electrification of the premium segment

The S550 PLUG-IN HYBRID is the first hybrid model offered in the US in the new S-class. The series production launch of this technology began at Mercedes-Benz in 2009 with the launch of the S400 HYBRID. In 2014, Mercedes-Benz will sell more hybrid automobiles than all other German manufacturers combined. The company is up there among the leaders in the field of purely electric mobility, too. In the years to come, the main emphasis will be on plug-in hybrids.

In 1982 Mercedes-Benz presented the first concept vehicle with hybrid drive – a two-cylinder horizontally opposed engine served to charge the battery. A number of other experimental vehicles followed until 2009 when the world's first standard-specification hybrid drive with a lithium-ion battery debuted at Mercedes-Benz: this S400 HYBRID was the most fuel-efficient gasoline-powered luxury sedan for a long time. Also, the most successful hybrid in its segment: some 20,000 buyers worldwide opted for the S400 HYBRID from the previous model series. In addition to the parallel hybrid transmission of the first generation, a power-split hybrid transmission was developed. The ML450 HYBRID started out on the American market with this transmission in 2009.

Based on the 7-speed automatic transmission the second-generation hybrid transmission evolved the US market never offered this car. By combining the efficiency of a diesel engine with the advantages of the hybrid drive, Mercedes-Benz set another milestone in the development of the automobile and advanced into consumption regions of 4 litres of diesel per 100 km in the luxury sedan segment.

Again in 2012, in the E400 HYBRID, Mercedes-Benz carried on the tradition of hybrids with six-cylinder direct injection gasoline engines.

In the years to come, a number of other plug-in hybrid vehicles will follow.

Pioneer also in the field of purely electric mobility

Daimler AG is a pioneer in the field of purely electric mobility. Since 2014, the B-Class Electric Drive has been on the market. Quiet, locally emission-free motoring is ensured by an electric motor generating 130 kW (174 hp).

Typically for an electric drive system, this develops its maximum torque of more than 340 newton metres (251 lb-ft) from the very first touch of the accelerator. This is approximately equivalent to the torque from a modern three-litre naturally aspirated gasoline engine. The result is noticeably powerful acceleration from stationary. For the standard sprint from zero to 62 mph, too, the electrically driven B-Class requires only 7.9 seconds. Effortlessly superior driveability and exhilarating driving pleasure with a high level of dynamism are thus guaranteed in every situation. In the interests of optimizing range, the top speed is electronically limited to 100 mph. Depending on the driving cycle, the vehicle has a range of around 85 miles.

The electric vehicles and hybrids share the electric drive components from the Mercedes-Benz modular system.

Current range of hybrids in the luxury class

With the new S-Class, Mercedes-Benz now continues its comprehensive hybrid offensive.

Research vehicles

- 1982: Mercedes-Benz concept employs a two-cylinder horizontally opposed engine
- 1993: Mercedes-Benz "Taxi Hybrid" as first parallel hybrid. A C-Class combines a 55 kW (75 hp) four-cylinder diesel engine with an electric motor delivering 130 Nm and 20 kW (27 hp)
- 2001: smart fortwo cdi. A 20 kW (27 hp) electric motor together with the 30 kW (41 hp) three-cylinder diesel engine forms a truly space-saving unit
- 2002: Mercedes-Benz Unimog "E-Drive"
- 2002: Mercedes-Benz M-Class "HyPer". ML 270 CDI with a 120 kW (163 hp) common-rail diesel engine and automated manual transmission. It features an electric motor with an output of 45 kW (61 hp) and high torque, installed between the engine and the transmission
- 2003: Mercedes-Benz F 500 Mind. The four-litre V8 diesel power plant delivers 178 kW (242 hp) and 560 Nm. The electric motor adds another 48 kW (65 hp) and 300 Nm. The company showed the same drive system in the Mercedes-Benz Vision Grand Sports Tourer vehicle study
- 2004: Mercedes-Benz Sprinter with plug-in-hybrid drive

- 2005: Mercedes-Benz S-Class "Hybrid". Eight-cylinder diesel engine developing 191 kW (260 hp) and 560 Nm, plus two electric motors with a total output of 50 kW (68 hp)
- 2005: smart crosstown. Hybrid with three-cylinder petrol engine (45 kW) and electric motor (23 kW)
- 2009: Concept BlueZERO in three versions: as electric car (E-CELL), as fuel cell-powered vehicle (F-CELL) and with range extender (E-CELL PLUS)

Production cars (hybrid and electric drive)

- 2009: S400 HYBRID (20,000 buyers worldwide)
- 2009: ML450 HYBRID
- 2012: smart electric drive
- 2012: E300 BlueTEC HYBRID
- 2012: E400 HYBRID
- 2013: SLS AMG Coupé Electric Drive
- 2013: S400 HYBRID
- 2013: S300 BlueTEC HYBRID
- 2014: C300 BlueTEC HYBRID
- 2014: B-Class Electric Drive
- 9/2014: S550 PLUG-IN HYBRID