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## Opel Environmental Protection Technology Milestones and Innovations

- 1972 Opel GT sets diesel world record**  
A modified Opel GT with a 95 hp, 2.1-liter turbo-diesel engine sets a number of **diesel world records** at Opel's test center in Dudenhofen, and reaches a top speed of 197.5 km/h. Shortly thereafter, the Opel Rekord 2.1D became the first Opel diesel passenger car on the market.
- 1981 Water-based lacquer reduces environmental impact**  
Opel becomes the first automaker to use **water-based lacquer** in series production at its Russelsheim paint shop. These lacquers are largely free of organic solvents and considerably reduce the impact on the environment.
- 1984 Kadett with top  $C_d$  value**  
Sales of Kadett E begin. The GSI version is the **most aerodynamic** car in its class in the world, with a  $C_d$  of 0.30.
- 1989  $C_d$  world record for Calibra**  
Opel sets a further **aerodynamic** record with the new Calibra. The coupé variant has a sensational  $C_d$  of 0.26.
- 1989 Catalytic converter as standard**  
Opel becomes the first European automaker to fit all its cars with a

**catalytic converter as standard**, from the smallest to the largest model. And it becomes the first car manufacturer to realize a recycling loop for plastics.

- 1995**            **Lower consumption thanks to less weight**  
Opel presents the **Corsa ECO 3**, the first “three-liter” car in the world. Its diesel consumption of just 3.4 liters per 100 km was primarily achieved by radically reducing the car’s weight, such as by using carbon-fiber-reinforced composite materials instead of sheet-metal panels on the hood, doors and fenders.
- 1996**            **World first in the Vectra**  
Opel presents the world’s first **turbo-diesel engine with direct injection and four-valve technology** in the Vectra.
- 1997**            **One less cylinder**  
Opel becomes the only European automaker to offer an economical **three-cylinder engine**, in the Corsa 1.0 12V.
- 1999**            **Fifty percent lower power station emissions**  
A **state-of-the-art power station** is built in Rüsselsheim, initiated by Opel. It operates at an exemplary efficiency level: 89 percent of the energy (from natural gas) is converted into heat/electricity, and CO<sub>2</sub> emissions are more than 50 percent lower than the previous power station.
- 2000**            **Fuel cells on the march**  
GM/Opel presents the **HydroGen 1, a fully serviceable fuel cell-powered Zafira** with hydrogen propulsion, to the public for the first time at the Geneva Motor Show. It is powered by a 55 kW/75 hp three-phase engine, whose electrical power is supplied by a pure hydrogen-operated fuel cell unit. The HydroGen1 has a top speed of 140 km/h, a range of around 400 km and thanks to its revolutionary engine, it produces no emissions.

**2000**

**Just 4.4 liters per 100 km**

Opel launches the **Astra ECO 4**, the **first “four-liter” car** in the compact class that is **suitable for everyday use**. Powered by a 1.7-liter, 55 kW/75 hp turbo-diesel direct injection engine with four-valve technology and intercooling, the Astra ECO 4 consumes just 4.4 liters per 100 km (MVEG mix). In contrast to the other Astra variants of the time, the ECO 4 has a subtle rear spoiler and smaller front intake openings. Together with the underbody trim, these features reduced the car’s wind resistance by five percent to  $C_d = 0.28$ .

**2000**

**Natural gas premiere**

Opel unveils a **Zafira concept car with natural gas propulsion** at the AAA car show in Berlin at the end of October. The Zafira 1.6 CNG (Compressed Natural Gas) features a monovalent propulsion unit optimized for natural gas operation. The technological basis is provided by the Zafira 1.6 16V with a gasoline engine. Designed by Opel Special Vehicles GmbH (OSV) in Rüsselsheim, the concept car produces 74 kW/100 hp and has a top speed of 172 km/h.

**2000**

**Fifty-percent lower fuel costs**

**Zafira CNG series production** begins. The natural-gas powered Zafira and its innovative **monovalent<sup>plus</sup> concept** make Opel a pioneer in this field in Germany and a market leader right from the start. The Zafira CNG’s greatest strength is its high economy: compared to a similarly sized gasoline engine variant, the Zafira CNG’s fuel costs are around 50 percent lower, and around 30 percent lower than a similar diesel variant. The CNG engines also produce fewer CO<sub>2</sub> emissions. The 1.6-liter engine is based on the 1.6-liter ECOTEC gasoline engine and produces 71 kW/97 hp.

**2001**

**3.8 liters of diesel at an average of 90 km/h**

During the Michelin Challenge Bibendum, an environmentally compatible

vehicle rally, the Zafira-based, fuel cell-powered **Hydrogen1** prototype and a production model **Opel Astra ECO 4** show off their performance capabilities. Pitted against many competing vehicles from other automakers, the HydroGen1 was the only fuel cell-powered vehicle to successfully complete the 350-kilometer course through high temperatures and altitudes from Los Angeles to Las Vegas. The Astra ECO 4 with a 1.7-liter turbo-diesel engine demonstrated its superb economy on the California Speedway, where it achieved a fuel consumption of less than 3.8 liters per 100 kilometers at an average speed of over 90 km/h.

**2002**

**Three-cylinder gasoline model breaks “five-liter” barrier**

**Opel Corsa ECO** is the first car in its class with a gasoline engine to break the **five-liter consumption barrier** (4.99 liters per 100 km; MVEG combined). Its CO<sub>2</sub> emissions were just 120 g/km. A highly efficient 1.0-liter ECOTEC engine (43 kW/58 hp) was combined with an innovative automated Easytronic five-speed manual transmission. The automatic mode in the Corsa ECO was programmed so that the engine was always operating in the most economic range. The aerodynamic enhancements were also decisive in the car's fuel consumption and CO<sub>2</sub> emissions, which were more than ten percent less than the Corsa 1.0. Various optimizations lowered the wind resistance to C<sub>d</sub> = 0.29 – a remarkable value for a supermini.

**2002**

**Natural gas engine with turbocharger**

Opel presents the Concept M at the Geneva Motor Show, a sporty **van with a natural gas turbo engine**. The turbo-charged 1.6-liter engine (110 kW/150 hp) has a top speed of over 200 km/h.

**2002**

**Astra Station Wagon is second CNG model**

Opel unveils the **Astra station wagon 1.6 CNG** at the IAA for commercial vehicles in Hanover. This is Opel's second CNG model with monovalent natural gas propulsion after the Zafira 1.6 CNG. It boasts the same

advantages as the Zafira CNG: high economy, low CO<sub>2</sub> emissions and no reduction in cabin space.

**2002 Top speed over 250 km/h with 112 hp**

Opel presents the **ECO Speedster concept car** at the Paris Motor Show. Based on the mid-engine Speedster sports car, it has a carbon fiber body with considerably improved aerodynamics ( $C_d = 0.20$ ) and weighs only around 660 kg. It's powered by a 1.3 CDTI ECOTEC engine with 82 kW/112 hp, which propels the concept car to over 250 km/h during test drives, but consumes only 2.5 liters of diesel per 100 km (MVEG cycle).

**2002 TWINPORT reduces consumption**

Opel introduces **TWINPORT technology**, which reduces fuel consumption in small, four-valve gasoline engines with up to 1.6-liter displacement. The concept makes its premiere in a 1.6 ECOTEC engine. Known for its efficiency, the engine uses six percent less fuel thanks to variable intake control and high rates of exhaust gas recirculation.

**2002 Astra ECO consumes just 4.4 liters of diesel**

More power, improved refinement and considerably lower harmful exhaust emissions: these are the plus-points of the new Opel Astra 1.7 CDTI, the world's **first series production diesel vehicle** to meet all the **Euro 4 exhaust standards**, valid from 2005. The newly developed four-cylinder ECOTEC turbo-diesel has common-rail direct injection, produces 59 kW/80 hp and propels the Astra to a top speed of 173 km/h. Its fuel consumption is just 4.6 liters per 100 km (MVEG cycle). The **Astra ECO** is even more economical: with its optimized air and rolling resistance, the Astra ECO's engine needs only 4.4 liters of diesel per 100 km, and thanks to the aerodynamic improvements has a top speed of 178 km/h.

**2003 Five stars for Corsa ECO**

**Opel Corsa ECO** is the only car to achieve the **maximum five stars** for its environmental compatibility in the "ADAC Eco Test". ADAC conducted

the ECO test on behalf of the International Automobile Federation FIA, and assessed the cars' exhaust and CO<sub>2</sub> emissions.

**2003            ECO Speedster sets 17 records**

During 24 hours of endurance **record drives** on the high-speed loop at Opel's test center in Dudenhofen, the 82 kW/112 hp **ECO Speedster** prototype sets 17 new international records for special automobiles with turbocharged engines in the 1100 - 1499 cm<sup>3</sup> displacement class. The car's average speed during the 24-hour marathon was 225.079 km/h, and its top speed was 256.739 km/h.

**2003            Particulate filter needs no maintenance**

Opel presents a newly developed, **maintenance-free Diesel Particulate Filter system** (DPF) at the IAA in Frankfurt. Thanks to its innovative regeneration process, there is almost no impact on fuel consumption, CO<sub>2</sub> emissions or output. The filtration is designed so that all exhaust emissions, such as soot particulates, hydrocarbons and carbon monoxide, are effectively reduced. DPF technology made its production start in early 2004 in the Vectra and Signum model lines.

**2004            New diesel sets standards**

Opel expands its Vectra and Signum model lines' engine range with a **new generation of 1.9-liter common-rail turbo-diesels**. Initially, two variants are available, one 88 kW/120 hp and one 110 kW/150 hp. Thanks to its variable multiple injection, the new four-cylinder diesel generation is ahead of the competition: its output and torque range, fuel consumption, emission levels and refinement all set standards. All 1.9-liter CDTI engines in the Vectra and Signum model lines in Germany come with a maintenance-free diesel particulate filter as standard.

**2004           Praise for gasoline direct injection**

The Opel **Signum 2.2 DIRECT** is named “**most environmentally friendly gasoline car**” in the ADAC Eco Test. The 2.2 DIRECT ECOTEC is the first Opel engine with adjustable high-pressure **gasoline direct injection**. The 114 kW/155 hp engine consumes just 8.2 liters of gasoline per 100 km (MVEG combined) – around six percent less than would be possible with a conventional layout.

**2004           World record for specific power output**

Opel presents the Vectra OPC concept car with the first 1.9-liter CDTI **TWINTURBO engine** with 156 kW/212 hp at the Essen Motor Show. The specific power output of 82 kW/112 hp per displacement liter is a **world record for a diesel passenger car**. Despite this power, the TWINTURBO engine requires just 6.0 liters of diesel per 100 km in the European test cycle. The key to TWINTURBO technology is the engine’s turbocharging with two exhaust-gas turbochargers, which work in series and not in parallel like Biturbo technology. The Opel concept car is the world’s first diesel passenger car with sequential turbocharging.

**2004           Fuel cell Zafira in operation at IKEA**

After a more than 9696 kilometer endurance drive through 14 European countries, GM/Opel’s enhanced **HydroGen3** fuel-cell vehicle arrives at its destination as scheduled. It is first used as a customer service delivery van at the IKEA furniture shop in Berlin-Spandau.

**2004           More TWINPORT engines**

Opel expands its ECOTEC engine range with the innovative fuel-saving TWINPORT technology. A **newly developed 1.2 TWINPORT engine** with 59 kW/80 hp is available for the Corsa and Agila models, and consumes up to around 12 percent less fuel than the 75 hp unit it replaces. The 1.4-liter, 66 kW/90 hp TWINPORT engine replaces the 1.6-liter two-valve unit with 64 kW/87 hp in the Meriva, improving fuel economy by almost 15 percent.

- 2004**            **Combo now also with natural gas engine**  
The series-production version of the **Combo 1.6 CNG** with monovalent 1.6-liter natural gas engine (71 kW/97 hp) makes its world premiere. With this third CNG model, Opel strengthens its **leading role in the natural gas series production vehicle** market in Germany even further, and increases its market share from a stable 60 percent in the previous years to around 80 percent.
- 2004**            **Praise for CNG engagement**  
The **German Federal Government honors Opel's special contribution** as a manufacturer of natural gas vehicles. In the current progress report "Perspectives for Germany – Our Strategy for Sustainable Development", GM and Opel's commitment to the use of alternative fuels in road traffic is explicitly highlighted. The report states, "Opel/GM is a pioneer in the production of natural gas production vehicles."
- 2005**            **Lower consumption in spite of higher performance**  
The advantages the new **103 kW/140 hp 1.8-liter gasoline ECOTEC engine** offers compared to its same-displacement predecessor include up to 14 percent higher performance with around four percent lower consumption, improved elasticity and refinement. The new four-cylinder gasoline unit debuts in the Zafira and will also be offered in the Vectra and Signum as well as other models lines.
- 2005**            **Specialist press distinguishes 1.3 CDTI**  
The **1.3 CDTI** common-rail turbo-diesel ECOTEC from Opel is "**Engine of the Year 2005**" in the 1.0 – 1.4-liter displacement category. The "International Engine of the Year Award" jury, consisting of specialist journalists from

26 countries, named the compact powerhouse, developed by GM Powertrain, top in this class.

**2006 Zafira is favorite among natural gas taxis**

Natural gas pioneer Opel is by far the strongest brand in the natural gas initiative “**Thousand environment taxis for Berlin**”, supported by the Federal Ministry for Environment. With around 520 Zafira 1.6 CNGs, Opel supplies around 75 percent of the natural gas taxis being used in this project. The 1.6-liter natural gas engine emits 32 g less CO<sub>2</sub> per km than a comparable gasoline engine. With average annual mileage of 80,000 km – normal for Berlin taxis – this means a reduction of CO<sub>2</sub> emissions of 2.5 tons per vehicle.

**2007 Astra with more economical engines**

The new Opel Astra can be ordered with two innovative **1.7 CDTI engines**. The relatively compact common-rail turbo-diesel boasts **high power output per liter coupled with exemplary economy**. The 1.7 CDTI ECOTEC with 81 kW/110 hp produces just 140 g/CO<sub>2</sub> per km. Gasoline engines achieve similar figures, with the new 85 kW/115 hp, 1.6 ECOTEC producing up to 10 percent higher output at around three percent lower consumption than the 77 kW/105 hp unit. The new four-valve engine features **Cam-Phase** technology and the further improved TWINPORT concept. With improved driving performance, the new 132 kW/180 hp 1.6 turbo that replaces the 2.0-liter turbo requires just 7.7 liters per 100 km, 13 percent less than before.

**2007 Lowest CO<sub>2</sub> emissions for a seven-seater**

The second-generation Zafira in production since October 2006 has already sold 5200 units throughout Europe. Both the Combo 1.6 CNG and the Zafira 1.6 CNG belong to the most environmentally friendly cars in their class. The Zafira boasts the **lowest CO<sub>2</sub> emissions** of any seven-seater.

**2007**

**Retrofitting with LPG or particulate filter**

In addition to the natural gas vehicles Zafira CNG and Combo CNG, Opel Service Partners offer **retrofitting** of the current Astra, Corsa, Meriva, Vectra and Zafira model lines with selected engines to **LPG**. Advantages include up to 40 percent lower fuel costs compared to gasoline engines and reduced emissions. Opel offers diesel car owners a **particulate filter** as a **retrofit solution**. Thanks to a special regeneration process, consumption, CO<sub>2</sub> emissions and performance remain at practically unchanged levels.

*Text and photos can be downloaded from the Internet at <http://media.opel.com>.*