



## Media Information

### *Rüsselsheim TechDay*

June 2018

## **Rüsselsheim Research and Development Center Plays Key Role in Groupe PSA Global Engineering Network**

- Top Groupe PSA technologies meet the art of German engineering
- New Opel models based on two modular multi-energy platforms
- Platforms allow an individual layout according to the independent identity of each brand
- Electrification of product portfolio is at the core of PACE! strategic plan
- Responsibility for development of Groupe PSA light commercial vehicles and next generation four-cylinder petrol engines
- 15 Centers of Competence in Rüsselsheim – from hydrogen fuel cells to seat development

Rüsselsheim. With Peugeot, Citroën, DS Automobiles, Opel and Vauxhall all under the roof of Groupe PSA, a European champion has been created. The group is now pooling its strengths, creating synergies and releasing the full potential of its brands. In the process, state-of-the-art Groupe PSA technologies meet the art of German engineering. Together, this results in a new level of quality. Groupe PSA thus harbours ambitious goals, such as leadership in the reduction of CO<sub>2</sub> emissions.

The Engineering Center in Rüsselsheim takes on an important role within Group PSA. It brings typical Opel strengths to the global development network, including experience in sporty chassis designed for high speeds on the German “Autobahn”, US market federalisation and ergonomic seats certified by “Aktion Gesunder Rücken”. Opel is a tradition-rich German brand, which has always democratized cutting-edge technologies. For Opel, the Engineering Center in Rüsselsheim guarantees the combination of German engineering, precision and innovations that customers can afford.



“We want to build first-class automobiles and also excite our customers through compelling quality,” said Opel CEO Michael Lohscheller. “As we announced at the presentation of our PACE! strategic plan in November 2017, we will develop all new Opel/Vauxhall vehicles in Rüsselsheim in future. Furthermore, the Engineering Center will play a key role in the implementation of Groupe PSA’s growth strategy.”

### **Modular multi-energy platforms: For efficient variety of models**

Currently the keyword in the automobile business is efficiency. In order to manufacture efficient, economic and climate-friendly cars, the base design is key. This is why all passenger cars and most light commercial vehicles (LCVs) of Groupe PSA are currently derived from two multi-energy modular platforms – the Common Modular Platform (CMP) and the Efficient Modular Platform (EMP2). A modular platform consists primarily of the floor assembly, the chassis and various powertrains, as well as the base electric/electronic architecture. The platform is therefore the decisive factor for cost-efficient automobile manufacturing and represents 60 per cent of the material costs. The Groupe PSA platforms are complemented with modules for engines, seats, restraints, cockpits and infotainment systems that can be used in various carlines.

“Thanks to the jointly used platforms, we will – depending on the programmes – save between 20 per cent and 50 per cent of the development costs of every new Opel/Vauxhall model compared to its predecessor,” said Lohscheller.

Different variants for various segments and international markets can be developed on these modular platforms: four and five-door sedans and hatchbacks, station wagons, vans, sport utility vehicles (SUV), convertibles and coupés are possible. The Groupe PSA platform dedicated to vehicles in the B and C segments is called CMP. The new Corsa, which will make its world premiere next year, is currently being developed on this very compact platform. The Grandland X SUV and the family-friendly Combo Life leisure activity vehicle (LAV) are based on the EMP2 – which is used for the passenger car C and D segments.

In addition, EMP2 also provides each individual Groupe PSA brand with the option of personalising each car to perfectly match the respective brand character. This flexibility



ensures that an Opel model is distinctively different to the Peugeot, Citroën or DS Automobiles model based on the same platform. “Hardware, software, the choice of modules, different set-ups, calibration – all this helps us create a brand-specific character for each and every car. It also permits us to safeguard and further develop the Opel DNA and make sure that an Opel drives like an Opel,” said Christian Müller, Managing Director Engineering.

### **State-of-the-art powertrains for lowest CO<sub>2</sub> emissions**

Opel goes electric. The electrification of the Opel product portfolio is at the core of the PACE! strategic plan. One of the main goals of this plan is to meet the 95-gramme CO<sub>2</sub> limit of the EU by 2020. Groupe PSA is looking to take over a leading role on low CO<sub>2</sub> emissions – not only because it has been mandated by the authorities but also because the customers expect it. The Opel model range is therefore quickly transitioning to the efficient, flexible and electrified platforms of the Groupe PSA. By 2024, all Opel/Vauxhall passenger cars will be based on these so-called multi-energy platforms. The new CMP is the basis both for conventional propulsion systems as well as for a generation of electric vehicles (from urban to SUV). In addition, EMP2 is the basis for the next generation of plug-in hybrid vehicles (SUV, CUV, mid-range and high-end vehicles). These platforms enable a flexible adaptation to the development of the powertrain mix according to future market demands.

Opel will already have four electrified model lines on the market by 2020, including the Ampera-e, the Grandland X as a plug-in hybrid electric vehicle and the next Corsa generation with a battery electric variant. Moving forward, all European passenger car lines will be electrified, either with a battery electric or plug-in hybrid variant, alongside models powered by highly efficient combustion engines. Opel/Vauxhall will thus become a leader in emissions reduction and be a fully electrified European passenger car brand by 2024. The electrification of the light commercial vehicle portfolio will begin in 2020 to meet customer needs and future requirements of urban areas.

The engineering team in Rüsselsheim is currently making a major contribution to the development of the electric version of the new Corsa generation, a battery-powered variant. Opel can draw on a wealth of experience with its two electric cars Ampera



(premiere Geneva Motor Show 2009) and Ampera-e (Paris 2016). The Opel Ampera-e fully suitable for everyday use set standards with its range of up to 520 kilometres according to the New European Driving Cycle. Be it hardware, software, battery-pack or manufacturing, Rüsselsheim's expertise in all these areas is highly valued by Groupe PSA. The new Corsa, including the electric variant, will be built in the Spanish plant in Zaragoza.

### **Research & development for the entire Groupe PSA in Rüsselsheim**

The Opel Engineering Center is taking over a key role within Groupe PSA. It brings typical Opel strengths to the company's global research and development networks. Amongst others, this includes the experience with sporty chassis designed for the high speeds permitted on the German "Autobahn" along with US market federalisation and the AGR-certified (Aktion Gesunder Rücken e.V.) ergonomic seats. The Rüsselsheim Engineering Center will continue to ensure the connection between German engineering, precision and affordable innovations for the Opel brand. As already announced during the presentation of the PACE! plan on November 9, 2017, all new Opel/Vauxhall vehicles will be developed in Rüsselsheim. At the same time, the Rüsselsheim Engineering Center shows that it will play an integral part in supporting Groupe PSA's growth strategy.

The engineering team in Rüsselsheim also leads the development of Light Commercial Vehicles (LCVs) of Groupe PSA that are built on a dedicated LCV platform. This global responsibility includes the development of an LCV platform and modules from advanced development to production maturity. The development priorities also include the networking and electrification of light commercial vehicles along with automated driving. Leading the development in Rüsselsheim is a key component of the Opel/Vauxhall LCV offensive. The all-new Combo is already making its debut this year, the next generation Vivaro will follow in 2019.

Moreover, the Rüsselsheim Engineering Center will take on the global responsibility for the development of the next generation of high-efficiency petrol engines for all Groupe PSA brands. The next generation of four-cylinder engines will be optimised for operation in combination with electric motors and will be used in the drive train of hybrid systems. Market introduction will begin in 2022. The new generation of engines is designated for use in all Groupe PSA brands in China, Europe and North America, meeting the future



emissions standards of these markets. The power units feature state-of-the-art technologies such as direct injection, turbocharging and variable valve control. The engines are thus highly efficient and will deliver low fuel consumption and low CO<sub>2</sub> values.

Another focal point is the continuous advancement of all existing models along with the development of future vehicles and powertrains. For example, this includes the refinement of the Small Gasoline Engine (SGE) and the Mid-size Diesel Engine (MDE) families that are available in the Opel Astra and Opel Insignia and ensuring that these units meet the applicable emissions standards.

Furthermore, Groupe PSA has currently established 15 Centers of Competence in Rüsselsheim. The development teams from France and Germany defined development areas (R&D) within a short period of time in order to unleash the full potential for the entire group. The abilities of the various competence teams complement each other in a global network – to the benefit of all five group brands (Opel, Vauxhall, Peugeot, Citroën and DS Automobiles). These so-called Centers of Competence enable universal technical standards and optimal realisation within Groupe PSA around the globe.

Opel is now playing to some of the typical company strengths within Groupe PSA. Outstanding **seats** and sharp shifting of **manual transmissions**, for example, are just two of the fundamental virtues of every Opel/Vauxhall model. Furthermore, the Opel engineers have extensive experience in **fuel cell** development and in the area of **test automation**. They will also bring a wealth of knowledge in **US market federalisation** to the table and make this available to Groupe PSA. In total, 15 of these dedicated areas have now been brought together in the Centers of Competence to date:

Future technologies:

- Hydrogen & fuel cells
- Alternative fuels

Vehicle development:

- Seats
- ADAS: parking, active safety, danger alert
- Restraint systems



- Manual transmission systems
- Geometry, dimensions and tolerances
- Electromagnetic compatibility (EMC)
- Vehicle fuel function
- Vehicle material engineering (for many areas)
- US market federalisation (vehicle and powertrain)

**Methodologies:**

- Test automation
- Software industrialisation
- Automation of quality checks
- 3D print of assembly tools

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### **Modular Multi-Energy Platforms: For Efficient Variety of Models**

- New-generation Opel models based on Groupe PSA multi-energy CMP and EMP2 platforms
- High modularity and flexibility: Modular platforms offer designers greater creative freedom for vehicles with distinct personalities
- Each model will offer efficient internal combustion engine as well as electrified powertrain variants
- Lightweight design: Integration of composites, aluminium and high-strength steels

Rüsselsheim. Efficiency is the best way to protect companies in the chaotic automotive business. In order to manufacture efficient, economic and climate-friendly cars, the base design is key. This is why all passenger cars and most light commercial vehicles (LCVs) of Groupe PSA are currently derived from two modular platforms – the Common Modular Platform (CMP) and Efficient Modular Platform (EMP2). A modular platform consists primarily of the floor assembly, the chassis and various powertrains, as well as the base electric/electronic architecture. The platform is therefore the decisive factor for cost-efficient automobile manufacturing and represents 60 per cent of the material costs. Components that can be used in various vehicles are called modules. Modules for engines, seats, cockpits and infotainment systems form important parts of Groupe PSA platforms.

“Thanks to the jointly used platforms, we will – depending on the programmes – save between 20 per cent and 50 per cent of the development costs of every new Opel/Vauxhall model compared to its predecessor,” said Lohscheller.

Different variants for various segments and international markets can be developed on these modular platforms: four and five-door sedans and hatchbacks, station wagons, vans, sport utility vehicles (SUV), convertibles and coupés are possible. The Groupe PSA



platform dedicated to vehicles in the B and C segments is called CMP. The new Corsa, which will make its world premiere next year, is currently being developed on this very compact platform. The Grandland X SUV and the family-friendly Combo Life leisure activity vehicle (LAV) are based on the EMP2 – which is used for passenger car C and D segments.

Managing Director Engineering Christian Müller added: “In Rüsselsheim, we are uniting the best of two worlds – highly efficient, state-of-the-art modular platforms from Groupe PSA combined with the engineering capabilities of the R&D Center in Rüsselsheim. In future, all our cars will be developed in Rüsselsheim. This way we ensure typical Opel attributes and first-class quality – in the customer’s best interests.”

### **Modularity and flexibility for large scope of applications and brand differentiation**

Thanks to the high level of modularity combined with a variety of chassis parameters, many model variants are possible. EMP2 in particular offers a huge bandwidth that can be explored:

- four different track widths,
- five different wheelbases,
- two different cockpit architectures,
- two rear axle architectures,
- several rear vehicle modules for various versions (short, long, five or seven-seater, single seats or rear bench, combustion engine or hybrid)
- and up to six different rear vehicle assemblies, which can be produced on the same assembly line.

In addition to the possibility of combining the various elements, EMP2 also provides each individual Groupe PSA brand the option of personalising every car so that it perfectly matches the respective brand. This flexibility ensures that an Opel or a Vauxhall model is distinctively different to a sister model (Peugeot, Citroën or DS Automobiles).



### **Great deal of creative freedom for designers**

“The high variability of the Groupe PSA CMP and EMP2 platforms allows us designers a large amount of freedom. With these great fundamental proportions, we can create an exciting portfolio of vehicles that expresses the wide personality bandwidth of our brand,” said Mark Adams, Vice President Opel/Vauxhall Design.

Thanks to the variety of track widths and the large wheel arches, maximum wheel sizes of 700 millimetres – e.g. for SUVs – are possible. The platforms’ basic design also allows wheels to be pushed outwards to give the vehicles a particularly sporty appearance. In addition, the compact engine layouts enable a low bonnet. Similarly, the vehicle floor and the seating positions have been lowered by up to 20 mm compared with previous platforms. This allows the profile of the vehicle to look lower, without the need to limit space and visibility for the customers while improving the aerodynamics thanks to a reduced front surface – a classic win-win situation.

“Hardware, software, the choice of modules, different set-ups, calibration – all this helps us create a brand-specific character for each and every car. It also permits us to safeguard the Opel DNA and make sure that it is at the core of all our models,” added Müller.

### **Lightweight and multi-energy design from the ground up ensures low CO<sub>2</sub> emissions**

In the development of modular platforms, the mass reduction of future vehicles is of major importance. For instance, thanks to the use of innovative lightweight materials (aluminium, high-strength steels, floor assemblies made of composite materials), the weight of EMP2 could be reduced by 70 kilogrammes in comparison to the predecessor.

In addition, platforms are made to accommodate a greater variety of powertrain modules. Both “multi-energy platforms” can accommodate modern internal combustion engines as well as electrified propulsion systems. This allows greatest possible flexibility to answer the market’s demand for electrified vehicles in the very near future. The next-generation Opel Corsa based on CMP will therefore come onto the market with efficient downsized combustion engines as well as pure electric drive. As for EMP2, it has the additional option of hybrid drive, with which the all-wheel drive Opel Grandland X PHEV (plug-in hybrid



electric vehicle) will make its debut in 2019. Thanks to the use of these multi-energy, modular platforms, all Opel passenger car models sold in Europe will have an electrified version as early as 2024.

The concept of providing multi-energy options for each platform is a smart approach to dealing with an ambiguous outlook on the future propulsion mix. Groupe PSA brands can respond to market demand in a flexible way, by having multiple options and manufacturing the variants on the same production lines.

### **Synchronised manufacturing process in all plants**

Modular platforms for the five Groupe PSA brands (Opel, Vauxhall, Peugeot, Citroën and DS Automobiles) also facilitate the efficient manufacturing of vehicles at all production sites. They are designed to enable fully automated body assembly. Furthermore, the common parts for each site can be obtained from the nearest Groupe PSA component plant. Logistics are improved by deliveries in small consignments, unnecessary warehousing is avoided and space requirements are reduced to a minimum.

The working conditions on the assembly line were also considered during the design of the platforms. For both, great emphasis was put on easing work required on the underside of the floor, which is one of the most strenuous jobs. 80 per cent of the overhead work is prevented by preparing the parts in the component area and avoiding their attachment from below during the “wedding”.

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## State-of-the-Art Powertrains for Lowest CO<sub>2</sub> Emissions and Reduced Environmental Impact

- Electrification pillar of PACE! plan secured with PSA platform strategy
- Opel BEV offensive starting with new Opel Corsa in 2020
- Electrified Dual Clutch Transmission for mild hybrids as of 2022
- Opel ahead of regulation requirements with 79 Opel models already compliant with Euro 6d-TEMP emissions standard
- Responsibility for the development of next-generation four-cylinder petrol engines
- Best-in-class diesel engines rolled out across Opel and Vauxhall ranges
- Cutting-edge ICE technologies to lower CO<sub>2</sub> emissions rolled out across Opel and Vauxhall ranges

Rüsselsheim. In addition to electrification, highly efficient and economical combustion engines play an important role in the reduction of emissions. Groupe PSA is leading the automotive industry in the implementation of the future European Euro 6d-TEMP emissions standard, which includes Real Driving Emissions (RDE) measured on public roads. In total, 79 variants already meet the Euro 6d-TEMP emissions standard. Petrol, CNG and LPG power units complying with Euro 6d-TEMP will be available across the Opel model range – comprising ADAM, KARL and Corsa, Astra, Cascada and Insignia, Mokka X, Crossland X, Grandland X and Zafira – plus compliant diesel versions.

### **New strategic step in lowering emissions with innovative emissions reduction systems**

In general, diesel engines have low CO<sub>2</sub> emissions and are thus climate friendly. The newest generation of advanced diesel engines also features exemplary NOx treatment and is Euro 6d-TEMP compliant. The innovative combination of oxidation catalyst/NOx



adsorber and Selective Catalytic Reduction (SCR) ensures lowest levels of NOx emissions for these four-cylinder units. It is highly unlikely that owners of these high-tech engines will have to worry about potential driving bans in the future. The new units with 1.5 and 2.0-litre BlueHDi are already on sale in the Opel Grandland X.

The new, 100 per cent digitally designed, 1.5-litre, four-cylinder, turbocharged engine is more efficient than the engine it replaces. Opel offers the 96 kW/130 hp 1.5-litre diesel in the Grandland X with a six-speed manual transmission and Start/Stop (fuel consumption<sup>1</sup>: urban 4.7 l/100 km, extra-urban 3.9-3.8 l/100 km, combined 4.2-4.1 l/100 km, 110-108 g/km CO<sub>2</sub>). Maximum torque is 300 Nm at 1,750 rpm.

The cylinder head with integrated air intake manifold and the crankcase are made of lightweight aluminium, while the four valves per cylinder are activated by dual overhead camshafts. The common rail direct injection system operates at up to 2,000 bar, with fuel entering the combustion chambers through eight-hole injector nozzles. The 96 kW/130 hp engine is equipped with a turbocharger featuring variable geometry turbine vanes (VGT), which are activated electrically.

For optimum exhaust after-treatment, the emissions reduction system – consisting of a passive oxidation catalyst/NOx adsorber, AdBlue injector, SCR catalyst and Diesel Particulate Filter (DPF) – is grouped together as a compact single unit, as near as possible to the engine. The NOx adsorber acts as a cold start catalyst, reducing NOx emissions at temperatures below the SCR light-off. With this innovative technology the Opel vehicles fitted with the new 1.5-litre diesel already meet the regulatory limit of the Real Driving Emissions (RDE) compliance factor required in 2020.

The same applies to the new top-of-the-line Grandland X engine: the 2.0-litre turbo diesel (fuel consumption<sup>1</sup>: urban 5.3-5.3 l/100 km, extra-urban 4.6-4.5 l/100 km, combined 4.9-4.8 l/100 km, 128-126 g/km CO<sub>2</sub>) delivers 130 kW/177 hp at 3,750 rpm and maximum torque of 400 Nm at 2,000 rpm. This powers the Grandland X from zero to 100 km/h in 9.1 seconds and to a maximum speed of 214 km/h.

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<sup>1</sup> WLTP measurements converted to NEDC values for comparison.



Despite its feistiness, the Grandland X 2.0 diesel is very efficient with its combined consumption of less than five litres. Just like the 1.5-litre diesel, it also comes with an extremely efficient exhaust emissions after-treatment with the combination of NOx adsorber and AdBlue injection (SCR, Selective Catalytic Reduction), which removes nitrogen oxides (NOx) from the engine's exhaust gases. The watery urea solution, which contains ammonia, reacts with the nitrogen oxides in the SCR catalytic converter and creates harmless nitrogen and water vapour.

In addition to the engine itself, combining it with the new eight-speed automatic transmission plays a big role in achieving these exemplary values. After the Insignia flagship, the Grandland X is the second Opel with such a comfortable and efficient eight-speed automatic gearbox and further models will follow soon.

### **Award-winning Groupe PSA PureTech 3-cylinder petrol engines set standards**

Highly efficient petrol engines with smaller displacements (downsizing) and turbocharging are just as much part of a healthy drive mix as electric motors, hybrids and clean diesel engines. The Groupe PSA PureTech petrol engines are such state-of-the-art units. The highly efficient full-aluminium three-cylinder design has won the "Engine of the Year" award four times in a row, thus setting standards in the automotive industry. Opel uses these economical downsized units with 1.2-litre displacement in the Crossland X, Grandland X and, in the near future, in Combo and Combo Life. In order to reduce logistics, production of the engine takes place as near as possible to the vehicle plant. Due to the high demand, 2018 production capacity in the French plants Douvrin and Trémery has doubled in comparison to 2016. In addition, Groupe PSA will produce PureTech engines in Tichy (Poland) and Szentgotthárd (Hungary) as of 2019.

Most PureTech engines already comply with Euro 6d-TEMP. The direct-injection engines feature an effective exhaust after-treatment system comprising Gasoline Particulate Filter, a new-technology catalytic converter and very efficient temperature management. Internally, a new generation of oxygen sensors enables a highly precise calculation of the air-fuel mixture. This is created in the combustion chamber, into which the fuel is directly injected at up to 250 bar.



Internal friction of the three-cylinder engines has been reduced to the minimum for clean combustion in addition to saving fuel. The PureTech engines are also very compact in design and therefore require little space in the vehicle. So the designers enjoy more creative freedom, while the aerodynamics and thus the fuel consumption also benefit from this flexibility.

The base petrol engine in the **Opel Crossland X** is the 1.2-litre unit with 60 kW/81 hp (fuel consumption<sup>1</sup>: urban 6.2 l/100 km, extra-urban 4.4 l/100 km, combined 5.1 l/100 km, 117 g/km CO<sub>2</sub>). Further up the line is the 1.2 Turbo petrol direct-injection engine in two transmission versions:

- The especially economical ECOTEC variant is exclusively available with a friction-optimised six-speed gearbox (fuel consumption<sup>1</sup>: 5.4 l/100 km, extra-urban 4.3 l/100 km, combined 4.7 l/100 km, 107 g/km CO<sub>2</sub>) and produces 81 kW/110 hp.
- Equally powerful is the three-cylinder 1.2 Turbo in combination with the six-speed automatic (fuel consumption<sup>1</sup>: urban 6.5-6.3 l/100 km, extra-urban 4.8 l/100 km, combined 5.4-5.3 l/100 km, 123-121 g/km CO<sub>2</sub>).

Both engines develop 205 Nm of torque from only 1,500 rpm, 95 per cent of which is available in the frequently used range up 3,500 rpm. With such high low-end torque, the Opel Crossland X delivers superior and economical performance.

The most powerful petrol engine is the 1.2 Turbo with 96 kW/130 hp, strong torque of 230 Nm as of 1,750 rpm (fuel consumption<sup>1</sup>: urban 6.2 l/100 km, extra-urban 4.6 l/100 km, combined 5.1 l/100 km, 117 g/km CO<sub>2</sub>) plus six-speed manual gearbox. The Opel Crossland X thus sprints from zero to 100 in 9.9 seconds and reaches a maximum speed of 201 km/h.

The top-of-the-line PureTech three-cylinder unit also powers the **Opel Grandland X**. In this application the 1.2-litre direct-injection Turbo petrol engine also produces 96 kW/130 hp (fuel consumption 1.2 Turbo<sup>1</sup>: urban 6.4-6.1 l/100 km, extra-urban 4.9-4.7 l/100 km, combined 5.5-5.2 l/100 km, 127-120 g/km CO<sub>2</sub>). The lively power unit with automatic transmission accelerates the compact SUV from zero to 100 km/h in 10.9 seconds.



### **Next generation of four-cylinder petrol engines from Rüsselsheim**

The Rüsselsheim Engineering Center will take on the global responsibility for the development of the next generation of high-efficiency petrol engines for all Groupe PSA brands (Peugeot, Citroën, DS Automobiles, Opel and Vauxhall). The next generation of four-cylinder engines will be optimised for operation in combination with electric motors and will be used in the drive train of hybrid systems. Market introduction will begin in 2022.

The new generation of engines is designated for use in all Groupe PSA brands in China, Europe and North America, meeting the future emissions standards of these markets. The power units feature state-of-the-art technologies such as direct injection, turbocharging and variable valve control. The engines are thus highly efficient and will deliver low fuel consumption and low CO<sub>2</sub> values.

“Rüsselsheim already had global responsibility for engine development when we were still part of GM. With the development of the new generation of four-cylinder petrol engines, we can exploit one of our key competencies. The economical direct-injection unit, in combination with hybrid technology, will consolidate the strong position of Groupe PSA in lowering CO<sub>2</sub> emissions,” said Opel’s Managing Director Engineering, Christian Müller.



## **Opel goes electric**

Elsewhere, Opel will also go electric. The electrification of the Opel product portfolio is at the core of the PACE! strategic plan. One of the main goals of this plan is to meet the 95-gramme CO<sub>2</sub> limit of the EU by 2020 and to offer customers eco-friendly cars. Groupe PSA is looking to leverage its expertise in low emissions technologies. The platform developed by Groupe PSA will allow the Opel and Vauxhall brands to go electric quickly and efficiently. By 2024, all Opel/Vauxhall passenger cars will be based on these two multi-energy platforms. The new CMP (Common Modular Platform) is the basis both for conventional propulsion systems as well as for a generation of electric vehicles (from urban to SUV). In addition, EMP2 (Efficient Modular Platform) is the basis for the next generation of internal combustion engine and plug-in hybrid vehicles (SUV, CUV, mid-range and high-end vehicles). These platforms enable a flexible adaptation to the development of the powertrain mix, depending on future market demands.

Opel will already have four electrified model lines on the market by 2020, including the Ampera-e, the Grandland X as a plug-in hybrid electric vehicle and the next Corsa generation with a battery electric variant. Moving forward, all European passenger car lines will be electrified, either with a battery electric or plug-in hybrid variant, alongside models powered by highly efficient combustion engines. Opel/Vauxhall will thus become a leader in emissions reduction and be a fully electrified European passenger car brand by 2024. The electrification of the light commercial vehicle portfolio begins in 2020 to meet customer needs and the future requirements of urban areas.

## **New Opel Corsa also as fully electric vehicle in 2020**

The engineering team in Rüsselsheim is currently making a major contribution to the development of the electric version of the new Corsa generation, a battery-powered variant. Opel can draw on a wealth of experience with the two electric cars Ampera (premiere Geneva Motor Show 2009) and Ampera-e (Paris 2016) during this process. The Opel Ampera-e fully suitable for everyday use set standards with its range of up to 520 kilometres according to the New European Driving Cycle. Be it hardware, software, battery-pack or manufacturing, Rüsselsheim's expertise in all these areas is highly valued within



Groupe PSA. The new Corsa including the electric variant will be built in the Spanish plant in Zaragoza.

“Opel and the sister brands of Groupe PSA will have the right solutions for their customers at the right time,” said Opel CEO Michael Lohscheller. “However, offering electric vehicles will not suffice to give electric mobility a decisive boost. All stakeholders – industry and governments – must work together and act in concert while looking beyond the automobile, for example at an infrastructure for charging stations. Closing the ranks between future mobility and the power supply based on renewable energy sources is a task for society as a whole. Ultimately the customers decide what they buy. The whole package has to be convincing and work for them.”

Electric mobility is a must. For customers, an electric car should be stress-free and as easy to operate as a car with a combustion engine. Based on a comprehensive strategic electric mobility plan, Groupe PSA is developing an entire product range to meet customer needs around the globe. It includes a complete product portfolio of battery-electric (BEV) and plug-in hybrid vehicles (PHEV). By 2021, 50 per cent of the Groupe PSA model portfolio will have an electric option (BEV or PHEV). By 2023, this will be 80 per cent and by 2025 100 per cent. The introduction of mild hybrids will begin in 2022. In addition, the Engineering Center in Rüsselsheim is working intensively on the fuel cell – for electric vehicles with a driving range of around 500 kilometres and which can be refuelled in less than three minutes (Fuel Cell Electric Vehicles, FCEV).

To meet the challenges of the energy transition even more quickly, Groupe PSA announced the creation of an LEV (Low Emission Vehicles) business unit dedicated to electric vehicles on April 1, 2018. This business unit led by Alexandre Guignard – in which all Groupe PSA brands including Opel/Vauxhall are represented – will be responsible for defining and deploying the Group’s electric vehicle strategy and rolling out the related products and services worldwide. This is an important step towards the group goal of developing an electric option for the entire product portfolio by 2025. Implementation begins in 2019.

Essential elements of the electric vehicles will be developed and manufactured within Groupe PSA. This applies to electric motors and transmissions, so Groupe PSA has, for



example, entered into strategic partnerships with e-motor specialist Nidec and gearbox manufacturer AISIN AW. Furthermore, a cooperation with Punch Powertrain was recently announced that will give all Groupe PSA brands access to the patented e-DCT (electrified Dual Clutch Transmission) systems. This will enable a further drive alternative from 2022: the so-called hybrid DT2 features an integrated 48V electric motor and will equip mild hybrid vehicles in the future. The electric motor either serves as a high-torque drive or recuperates energy during coasting and braking. The DCT is especially lightweight and compact, offering outstanding performance and very low fuel consumption at competitive costs.

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## Media Information

### *Rüsselsheim TechDay*

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## Research & Development for the Entire Groupe PSA in Rüsselsheim

- German engineering: Research & development for all group brands
- Development lead: Responsibility for Groupe PSA light commercial vehicles
- Centers of Competence: 15 dedicated centers currently located in Rüsselsheim
- Typical Opel strengths: Seats and manual transmissions
- Future technologies: Hydrogen fuel cells as a key topic of electro-mobility

Rüsselsheim. The Engineering Center in Rüsselsheim is taking over a key role within Groupe PSA. It brings typical Opel strengths to the company's global research and development networks. Amongst others, this includes the experience with sporty chassis designed for the high speeds permitted on the German Autobahn along with US market federalisation and the AGR-certified (Aktion Gesunder Rücken e.V.) ergonomic seats to name but a few. The Rüsselsheim Engineering Center will continue to ensure the connection between German engineering, precision and affordable innovations for the Opel brand. As already announced with the PACE! plan on November 9, 2017 all new Opel/Vauxhall vehicles will be developed in Rüsselsheim. At the same time, the Rüsselsheim Engineering Center shows that it will play an integral part in Groupe PSA's growth strategy.

The engineering team in Rüsselsheim also leads the development of light commercial vehicles (LCVs) for the entire group. This global responsibility includes the development of an LCV platform and modules from advanced development to production maturity. The development priorities also include the networking and electrification of light commercial vehicles along with automated driving. Leading the development in Rüsselsheim is a key component of the Opel/Vauxhall LCV offensive. The all-new Combo is already making its debut this year, the next-generation Vivaro will follow in 2019. And going forward, the Rüsselsheim Engineering Center will take on the global responsibility for the development



of the next generation of high-efficiency four-cylinder petrol engines for all Groupe PSA brands.

A further focal point is the continuous advancement of all existing models along with the development of future vehicles.

Furthermore, Groupe PSA has currently established 15 Centers of Competence in Rüsselsheim. The development teams from France and Germany defined development areas (R&D) within a short period of time in order to unleash the full potential for the entire group. The abilities of the various competence teams complement each other in a global network – to the benefit of all five group brands (Opel, Vauxhall, Peugeot, Citroën and DS Automobiles). These Centers of Competence enable universal technical standards and optimal realisation within Groupe PSA around the globe.

### **Centers of Competence in Rüsselsheim: German engineering for all of Groupe PSA**

Opel is now playing to some of the typical company strengths within Groupe PSA. Outstanding **seats** and sharp shifting manual transmissions, for example, are just two of the fundamental virtues of each Opel/Vauxhall model. Furthermore, the Opel engineers have extensive experience in **fuel cell** development and in the area of **test automation**, which is especially important in view of automated driving. 15 of these dedicated areas have now been brought together in the so-called Centers of Competence:

#### Future technologies:

- Hydrogen & fuel cells
- Alternative fuels

#### Vehicle development:

- Seats
- ADAS: parking, active safety, danger alert
- Restraint systems
- Manual transmission systems
- Geometry, dimensions and tolerances
- Electromagnetic compatibility (EMC)



- Vehicle fuel function
- Vehicle material engineering (for many areas)
- US market federalisation (vehicle and powertrain)

Methodologies:

- Test automation
- Software industrialisation
- Automation of quality checks
- 3D print of assembly tools

**Center of Competence for seats: Certified by Aktion Gesunder Rücken e. V. (AGR)**

Good seats are just as much part of Opel as the “Blitz” on the grille and the company can look back on 119 years of seating heritage. Reason enough to use this competence for the entire Groupe PSA. The success story of ergonomically valuable seating began in 2003 with the first AGR (Campaign for Healthier Backs) seal of approval for the **Opel Signum**, making Opel the first manufacturer to offer back-friendly seats in the mid-size class. The offensive for healthy seating at affordable prices was rolled out across almost the entire model range. But ergonomics in the vehicle are far more than just a comfort factor. Ergonomics also mean safety. In the event of a crash, occupants have the best chance of a positive outcome when the seat keeps them in position. Seat belts and airbags are only fully effective if this is the case.

Safe and comfortable seats at affordable prices have thus been a true Opel virtue for 15 years. Today, the Rüsselsheim-based carmaker offers AGR-certified ergonomic seats in models such as the **Crossland X, Mokka X, Grandland X, Astra, Cascada, Zafira** and **Insignia**. The performance sport seat in the **Opel Insignia GSi** is the latest highlight added to the line-up. The AGR-certified Opel performance sport seat combines outstanding lateral support and best long-distance comfort and offers all comfort features familiar from the Insignia model range. The integral seat in the GSi also comes with ventilation, heating, a massage function and adjustable side bolsters. These features are complemented by the high backrest with integrated headrest in the sportiest member of the Insignia line-up. Overall the sum of sporty side support and comfort features makes the new performance



seat a unique offer – developed in the Center of Competence for healthy seating in Rüsselsheim.

The Rüsselsheim-based carmaker can also draw on a vast amount of expertise in the area of **seat structures**. The concept for the second generation of the Insignia always foresaw a modular system with the integral performance seat forming the pinnacle. This enabled all of the comfort features to be maintained in a thoroughbred sport seat.

The **base structure** of the performance seat also stems from Opel. The key steel elements are from the plant in Kaiserslautern. The unified development and production of the new bucket seat also results in significant weight savings. While the sport seat – without any of the comfort features available in the GSi – weighs 28 kilogrammes in the Corsa OPC which has been on the market for some years, the new integral seat with all its functionalities only adds 26 kilogrammes to the Opel Insignia GSi.

#### **Center of Competence for hydrogen & fuel cells: More than 20 years of experience from HydroGen1 to HydroGen4**

The new “hydrogen & fuel cells” Center of Competence in Rüsselsheim can draw on Opel’s extensive experience in this field. From 1997 to 2012, Opel maintained an Alternative Propulsion Center in Mainz-Kastel. 250 experts conducted research and development on fuel cell technology and electric propulsion systems in the vicinity of Rüsselsheim. During this time, the engineers gathered substantial knowledge in all areas of hydrogen and fuel cell technology – from system modelling and engineering, through hydrogen storage, safety and refuelling up to building vehicles and operating fleets. In cooperation with former parent company General Motors, this resulted in the **HydroGen1**, Opel’s first hydrogen fuel cell electric vehicle (FCEV) based on the first-generation **Opel Zafira** in 2000. The HydroGen1 served as a proof of concept for the company. It was presented to politicians, the media and other important stakeholders in Europe, Asia, Australia and the US in order to convey the opportunities of hydrogen and fuel cell technology to these groups. The HydroGen1 served as the pace car for the marathons during the Sydney Olympics, thus showcasing the clean, zero-emission technology to the public.



The **HydroGen3**, also based on the Opel Zafira A, was publicly presented in December 2002. Its fuel cell propulsion system was engineered as a module that could be installed in the vehicles like ordinary engines by using the same subframe. The main goal of the HydroGen3 was to compare liquid versus pressurised hydrogen storage and refuelling. For this purpose, Opel built and operated the world's first hydrogen fuel cell vehicle with a 700 bar (10,000 psi) compressed hydrogen storage system. Based on this experience, Opel eventually decided to go for 700 bar storage technology for all its future FCEVs. Today, all car manufacturers engaged in FCEVs world-wide use 700 bar systems. During the "Fuel Cell Marathon" in spring 2004, the HydroGen3 covered a nonstop distance of 9,696 kilometres from the North Cape to Europe's most western point in Portugal through 14 European countries without any noteworthy problems. One year later, former Formula One driver Heinz-Harald Frentzen won the Rally Monte Carlo for vehicles with alternative propulsion in a HydroGen3.

The next generation of FCEV at Opel was the **HydroGen4**. Its fuel cell unit (stack) with 440 cells delivered a continuous output of 93 kW. The 4.2 kilogrammes of hydrogen stored in the vehicle's 700 bar tank system offered a driving range of 420 kilometres.

As of the end of 2008, Opel participated in the world's largest market test of FCEVs of its former parent company General Motors. A total of 30 **Opel HydroGen4** were operated in Germany within the framework of the Clean Energy Partnership (CEP), a demonstration programme for hydrogen technology funded by the German government.

An FCEV is refuelled with hydrogen. At a temperature of 80 degrees Celsius, the hydrogen is converted (together with the oxygen from the ambient air) into electricity that powers the electric motor. The only product of this reaction is pure water vapour released by the exhaust pipe. It is therefore a zero-emissions electric vehicle. FCEVs can significantly reduce CO<sub>2</sub> emissions throughout the whole energy chain from the generation of the fuel to the propulsion of the car or even avoid CO<sub>2</sub> emissions completely if the hydrogen is produced from renewables like wind and solar. Hydrogen is seen to play an important role in future energy systems in terms of storing renewables when they are not in demand in order to use them at a later stage when converted back into electricity.



The main difference to a battery electric vehicle is that a fuel cell vehicle produces the electricity it requires on board the vehicle from hydrogen. The decisive advantage over pure battery electric vehicles is that the car can be refuelled with hydrogen within three minutes – just as fast as a car with a traditional petrol or diesel engine. The biggest remaining challenges for FCEVs are the cost of the system (while simultaneously meeting the durability requirements) along with a nation-wide network of hydrogen filling stations. Germany plays a leading role in Europe with a view to the latter as a clear plan exists for the creation of such a filling station network. To date, there are almost 50 hydrogen filling stations operating in Germany – all of which are open to the general public 24/7. The joint venture H<sub>2</sub>Mobility will have created 100 stations by 2020, meaning that every town in Germany can be reached with an FCEV by then. In a next step, up to 400 filling stations are planned by 2025, depending on the number of FCEVs in Germany.

Currently, close examination of which approach to choose regarding fuel cell vehicles is taking place, given the world-wide level of development both in terms of technology and infrastructure, and the situation of Groupe PSA in this environment.

### **Center of Competence for test automation: Methodologies to master complexity and increase efficiency**

Anyone in the automotive industry looking at the development of complex systems, the shortening of development times or simply the reduction of the number of prototypes built is counting on test automation. The goal is to check components for all eventualities so that when subsequently deployed, malfunctions – for example caused by software bugs – are as close as possible to zero. Therefore, the assignment for the R&D Center in Rüsselsheim is to find efficiencies as well as increase agility and quality for Groupe PSA.

This aspect can be best explained by means of an example. At Opel, Autonomous Emergency Braking (AEB) constantly monitors the environment around the vehicle, classifies complex traffic situations thanks to the combination of radar measurement and the front camera and also the driver behaviour. In critical situations, it initiates emergency braking procedures to avoid or mitigate accidents. In order to perfectly align the electronic control system with the mechatronic braking system and the sensor technology during development, a test set-up featuring all these components is undertaken. Knowing the



overall system performance early in development allows design-to-cost such that the engineers can design cost-efficient solutions. The early detection of potential software faults or system latencies in simulations long before a new vehicle reaches the prototype phase means a design can easily be optimised without having spent expensive test resources on prototype vehicles. Opel has extensive experience in test automation and achieves such precise results that the simulation outcomes are used as a reference during, for example, technical approval processes for new braking systems.

Furthermore, this cuts development time drastically. On the one hand, this is cost efficient and on the other, it supports engineers in their constant race against time. A second example is infotainment systems. Currently the development cycle spans four years. Smartphone manufacturers renew their devices within one year. The customer obviously wants both systems to be able to communicate with each other seamlessly. This time delta can only be kept to a minimum with test automation.

The term “failure rate” plays a decisive role on the way to semi-autonomous and autonomous driving. The systems of an autonomous car always need to work with the highest possible probability. In purely statistical terms the distance between two accidents with injuries on German motorways currently amounts to 12 million kilometres or 120,000 operating hours. Around ten times the aforementioned distance is required to achieve a sufficient statistical significance for motorway automation tests. That would add up to 120 million test kilometres in order to guarantee maximum statistical safety. And this effort would have to be repeated for each new functionality! For instance, this is about checking the robustness and the reliability of the sensor technology during the lifetime of a vehicle, along with the need to validate and document the way the vehicle processes the sensor data and derives decisions from it. The same applies to the so-called “fail-operational” systems, i.e. technology such as the steering system that is never allowed to fail completely, but must maintain a minimal operational status. And in the improbable event that this situation arises, the vehicle then needs to react in such a way that a so-called “safe condition” for the passengers is established.

Moreover, test automation will significantly contribute to autonomous driving validation. Traditional development methods are at their limits when it comes to reproducible and traceable testing for higher levels of automated driving – Virtual Development and Test



Automation are an efficient way to address these challenges via simulation. The Center of Competence is working in Research & Development on concepts and solutions for these new methodologies. For example, in the project PEGASUS, research on validation concepts for Level 3-4 vehicles (see explanation below) is being conducted.

**The Groupe PSA roadmap to autonomous driving includes the following four levels:**

**Level 1 – Driving Assistance:** We have already reached this phase for all Groupe PSA brands. Opel's Adaptive Cruise Control, for example, regulates speed and the distance to the preceding vehicle and can even initiate automatic emergency braking if necessary. Lane Keep Assist warns when the vehicle unintentionally veers out of lane and gently turns the steering wheel to direct it back into lane.

**Level 2 – Driving Partial Automation:** This phase is already implemented in mass production in the DS Automobiles brand with the DS Connected Pilot which combines ACC and enhanced lateral guidance. This will be further advanced from 2020 and applied to all Groupe PSA brands.

**Level 3 and 4 – Autonomous Driving:** In the third step the driver is chauffeured in traffic jams (Traffic Jam Chauffeur) and on the motorway (Highway Chauffeur) and can concentrate on other things as he does not need to dedicate his full attention to what is happening on the road.

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