Valeo presents five major innovations at the Frankfurt Motor Show

Frankfurt, Germany, September 13, 2011 – Valeo is recognized as a world leader in innovation, channeling 6% of sales into R&D and filing over 600 patents every year. The Frankfurt Motor Show provides an opportunity to present the innovations that will fuel the Group's development in the coming years, including:

- **Park4U® Remote**: First shown to the public at IAA, this fully automatic parking assistance system maneuvers the vehicle into a parking space without any input from the driver. It can be activated either from inside the vehicle or remotely, using a smartphone.

- **Key Bridge**: a smartphone-compatible key that allows the driver to connect the vehicle to a mobile phone. This interface presents information pre-configured by the automaker and allows certain settings to be modified. Drivers can, for example, adjust their seat to a preprogrammed position or activate air-conditioning, all from the comfort of their own kitchen.

- **BeamAtic® PremiumLED**: smart LED lighting system. Headlamps equipped with BeamAtic® PremiumLED provide maximum visibility, similar to high beam, without blinding oncoming or overtaking motorists.

- **Affordable Hybrid**: an electrification solution for the powertrain. The Affordable Hybrid architecture consists of a motor-generator and low-voltage electronics (48V). By combining the Stop-Start function, regenerative braking and engine assistance, this system offers the advantages of a hybrid for a very low cost.

- **Air Intake Module**: a new air intake architecture for charged combustion engines. The air intake module, integrating a water cooled charge air cooler, contributes to an increase in energy efficiency and enables more compact charged combustion engines with lower emission levels.

Valeo's innovations have three main goals: to improve efficiency in both combustion engines and electrical drivetrains, to recover and re-use the vehicle's kinetic energy, and to combine innovative technologies in order to make vehicles safer and more comfortable. These new features also increase road safety while maintaining the pleasure of driving.
Valeo is confirming its status as a global partner for automakers, capable of producing concrete, accessible innovations that were scarcely imaginable just a few years ago.

The result is a new relationship with the car: Valeo is making driving safer, more economical, easier, more comfortable, and more enjoyable. Because they are better integrated into tomorrow's environment, Valeo's innovations help to create a more responsible automobile.

**Valeo stand: Hall 8 Stand D02**

Valeo is an independent industrial Group fully focused on the design, production and sale of components, integrated systems and modules for the automotive industry, mainly for CO₂ emissions reduction. Valeo ranks among the world's top automotive suppliers. The Group has 124 plants, 21 research centers, 39 development centers, 10 distribution platforms and employs 61,400 people in 28 countries worldwide.

**Press contacts:**
**Michelle Pierson**
Phone: +33 1.40.55.21.75  
Mobile: +33 6.70.75.84.44

**Aurélie Wayser-Langevin**
Phone: +33 1.40.55.37.18  
Mobile: +33 6.22.74.19.82

For more information about the Group and its activities, please visit our Web site [www.valeo.com](http://www.valeo.com) and join us on Facebook
I Valeo's five new technologies at the IAA
- Park4U® Remote
- Key Bridge
- BeamAtic® PremiumLED
- The Affordable Hybrid
- Air Intake Module

II Valeo's strategic priorities

III Valeo technology serving the environment

IV A range of innovative technologies supporting Valeo's global development
- Power electronics for electric vehicles
- Low-pressure exhaust gas recirculation: two new concepts
- Dry double clutch: compact, robust, rapid and energy-efficient
- Stop-Start systems
- Thermal Management of Lithium-Ion batteries in electrified vehicles
- High efficient air conditioning
- 360Vue® system: all-round vehicle vision
- Multifunction control panel
- Smart wiper systems

V Transversal expertise
I - Valeo's five new technologies at the IAA

Park4U® Remote

Park4U® Remote offers automatic parking that requires no input from the driver. The system can be activated from inside the vehicle or remotely using a smartphone.

Parking assistance has become one of the most popular innovations in recent years. Valeo was the first supplier to market this feature; it appeared on mid-range vehicles in 2007. The second generation is even more advanced, assisting the driver through any number of forward-reverse maneuvers until the vehicle is properly parked, requiring only 40cm on either side of the vehicle. It also helps drivers with perpendicular parking and in maneuvering out of a parking space. The system automatically calculates the maneuvers required to exit the space.

The second-generation Park4U® system is already available on the Volkswagen Touran and Sharan, the Audi A7 and A6 and the Seat Alhambra. By the end of 2011, it will equip 38 models for a dozen brands on three continents.

The IAA provides the opportunity to demonstrate a future generation of Park4U®, Park4U® Remote, which is fully automatic, requiring no driver input. The driver may remain inside the vehicle, without touching the pedals or the wheel, or stand outside the car and start the maneuver using a smartphone. Park4U® Remote is synchronized with the smartphone using software compatible with Apple-OS and Android. The maneuver can be activated and deactivated at any time.

The presentation of the Park4U® Remote demonstration vehicle, in the outside area opposite Hall 8, confirms Valeo's leadership position in parking assistance.

Park4U® Remote is a unique system operable using a smartphone. It presents an advanced technology, improving safety and driving comfort.

Key Bridge

Key Bridge is a smartphone-compatible key that connects the vehicle to a mobile phone. It allows users to consult remotely information supplied by the vehicle using their smartphone. Similarly, the phone can control some functions remotely, such as air conditioning and vehicle locking.

Valeo's aim is to link the vehicle to its environment with a secure, scalable connection. The key guarantees the secure and exclusive transmission of information to its owner, and the Bluetooth link adapts the connection to new hardware bought by the user.

After leaving the vehicle, the driver can consult information on the key at any time by opening an application downloaded onto the phone. So, using a smartphone or tablet computer, he or
she can obtain information, such as the car’s GPS position, mileage and how much fuel is in the car’s tank (functions pre-configured by the automaker).

When the vehicle is within range, the application can also refresh the information stored on the key in order to obtain real-time data such as cabin temperature or, in the case of an electric vehicle, battery state-of-charge.

The smartphone-compatible key uses low energy Bluetooth technology so as to reduce the key’s energy consumption. Bluetooth technology requires no additional telematics system. RF (Radio Frequency) technology between the key and the vehicle needs no special installation. The system’s modular design allows automakers to configure the desired level of functionality.

This latest Valeo innovation is now on the market.

**BeamAtic® PremiumLED**

BeamAtic® PremiumLED headlamps allow high-beam lamps to be used at all times, in all circumstances. The shape of the beam is adjusted to avoid blinding oncoming motorists, leaving the road fully lit, apart from the portion occupied by the vehicles detected by the system.

Powerful data-processing software and a BeamAtic® camera located at the top of the windshield are used to detect oncoming and overtaking vehicles.

The system also anticipates variations in altitude (going over the top of or down a hill) and adjusts the vertical direction of the beam, so that the headlamps can always stay on high beam without blinding other drivers.

BeamAtic® PremiumLED technology is twice as efficient as Xenon and five times as efficient as halogen headlamps. LEDs have a lifespan significantly exceeding that of the vehicle itself. In addition, the color of the light - equivalent to daylight - provides greater visual comfort. LED lighting systems also offer greater style differentiation, giving designers considerably more freedom in the styling and customization of the vehicle’s front end.

The BeamAtic® PremiumLED system will be equipping a mass-market vehicle by 2013.

**The Affordable Hybrid**

A hybrid vehicle combines an internal combustion engine (ICE) with an electric motor, enabling the “downsizing” of the ICE while achieving similar performance levels to current engine designs and optimizing the use of the vehicle’s electrical energy. The Affordable Hybrid architecture is based on a compact motor-generator which uses a low voltage electrical system (48V). Costs are thereby reduced, making this solution acceptable for the mass market.
In the proposed architecture, the electric motor, which assists the ICE, can be installed in different positions: in front of the ICE (on the accessory drive), after of the gear-box or between the two.

This solution integrates Valeo’s Stop-Start (see p.12), regenerative braking and torque assist functions, thereby offering fuel savings of 15 to 20% on an average gasoline-engine vehicle.

Its original electro-technical architecture means that the motor-generator provides a high level of power (up to 15kW) and takes up no more room than a conventional alternator. The specific feature of this technology is that it delivers high torque immediately on start-up, and can therefore make up for the loss of power in smaller engines when accelerating from low speed, making driving more economical, without compromising comfort.

Valeo’s system for “Affordable Hybrid” vehicles is compatible with diesel and gasoline engines, and the system enables automakers to meet future European CO₂ targets for 2020.

**Air Intake Module: a new air intake architecture for increased efficiency in charged combustion engines**

Valeo’s innovative compact air intake module comprises a water cooled charge air cooler (WCAC), a throttle body, a high-pressure Exhaust Gas Recirculation (EGR) valve, one or two temperature sensor(s) and a high pressure EGR distribution rail integrated into the outlet flange of the manifold.

The water cooled charge air cooler (WCAC) replaces the air to air charge cooler (ACAC) used for conventional charged combustion engines. Water, as coolant fluid, has a significantly higher coolant capacity than air and for that reason a very compact system can be designed. Furthermore the WCAC architecture allows for a reduction in the length of the charge air hoses (compared to those used for a conventional system with ACAC) or even to eliminate them completely.

In the EGR system, exhaust gases are recovered in the exhaust manifold and re-injected through a distribution rail fitted into the air intake’s outlet manifold. The EGR gases are mixed with the cooled charge air after the WCAC and then directed to each inlet valve of the cylinder-head. Valeo’s Air Intake Module enables a reduced charge air volume between the turbo charger’s compressor outlet and the inlet valves of the engine cylinder-head and thus contributes to an improvement of the transient engine behavior. Furthermore the charge air cooling power can be adapted to the required level by regulating the coolant flow of the water charge air cooler. This function is required to fulfill the continually increasing emission reduction requirements.

Valeo has developed an innovative actuator which contributes to the reduction of NOx emission after an engine cold start or which contributes to an improved regeneration of the particle filter system. The actuator integrates both the functions of the throttle-body and the shut-off and a charge air by-pass valve. One DC motor actuates both the throttle flap and the charge air by-pass flap. The cost optimized actuator is 20% lighter when compared to two separate components.
Valeo’s Air Intake Module has also been developed to suit low pressure EGR engine applications in order to achieve lower engine emission levels in the future.
II - Valeo’s strategic priorities

A strategy focused on curbing CO2 emissions

Valeo is a world leader in almost all its product lines. It is organized into four Business Groups: Powertrain Systems, Thermal Systems, Comfort & Driving Assistance Systems and Visibility Systems.

Valeo’s ambition is to be the partner of choice of automakers for CO₂ emissions reduction in all market segments. Innovations developed by the four Business Groups include solutions for fuel, electric, and hybrid vehicles.

Powertrain Systems

The Powertrain Systems Business Group covers all activities relating to the vehicle’s powertrain. Its mission is to develop solutions that reduce fuel consumption while maintaining driving pleasure. Innovations target conventional engines (see Stop-Start, p.12, dry double clutch, p.11) and systems designed for hybrid and electric vehicles (for example the electric motor and inverter for hybrid and electric vehicles).

Thermal Systems

The Thermal Systems Business Group develops energy management solutions for propulsion systems and comfort solutions for the passenger compartment. A/C compressors and innovative front end module solutions complete the product portfolio. These solutions contribute significantly in reducing consumption (e.g. variable displacement compressors, see p.14) and the emission of polluting gases and harmful particles from thermal engine vehicles.

In addition, the Business Group engineers systems designed to improve the range and maximize the lifespan of batteries for hybrid and electrical vehicles (Valeo’s thermal management of Lithium-Ion battery, see p.13).

Comfort & Driving Assistance Systems

The Comfort & Driving Assistance Systems Business Group designs systems relating to the driver’s interface with his or her environment and the vehicle. These smart driving systems create a bridge between the vehicle and smartphone or tablet computer (see Key Bridge, p.1). Other products automate certain maneuvers (see Park4U®, Park4U® Remote p.1). Sensors (radar, ultrasound, cameras) have also been developed that allow the driver to survey the driving environment (see 360Vue®, p.15).
Visibility Systems

The Visibility Systems Business Group develops lighting and wiper systems that support the driver in all driving situations. The mission of this Business Group is to produce systems that weigh less (see the direct drive synchronized wiper motors, p.16) and are more energy efficient, while improving safety and comfort (see LED lighting systems, p.9, and the AquaBlade® wiper system, p.16). The entire range of systems is designed for all market segments.

All the Business Groups contribute to Valeo's growth. Their activities break down as follows:

<table>
<thead>
<tr>
<th>BG</th>
<th>Powertrain Systems</th>
<th>Thermal Systems</th>
<th>Comfort &amp; Driving Assistance Systems</th>
<th>Visibility Systems</th>
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<tbody>
<tr>
<td>2010 sales (€ bn)</td>
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<tr>
<td>Patents filed</td>
<td>122</td>
<td>191</td>
<td>186</td>
<td>116</td>
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The Group is also looking to boost its position in high-growth markets such as emerging countries and Asia. It plans to generate 30% of sales in Asia by 2015. As the world's largest automobile market with 17 million vehicles produced in 2010, Valeo should be able to double its sales in the Chinese market by 2015 (48% growth registered between 2009 and 2010). The Group has also strengthened its business in India (up 81%) and Korea (up 38%).

In order to ensure “above average” organic growth in every region, Valeo's R&D is supporting the Group's growth all over the world. Valeo invests 6% of its sales in Research and Development and plans to recruit over 1000 engineers in 2011.

Technical solutions designed to cut CO₂ emissions and promote growth in emerging countries lie at the heart of Valeo's strategy. Valeo's ambition is to outperform global automotive production by 3% a year from 2011 to 2015 and to post €14 billion sales by 2015. In the first half of 2011, the Group recorded net income of €218 million, up 30% - its best growth for 13 years.
III - Valeo technology serving the environment

Valeo designs new technologies to help deal with today’s major environmental challenges while improving driving comfort, performance and safety.

80% of Valeo’s product portfolio is linked to reducing CO₂ emissions, for all types of vehicles.

Reducing fuel consumption

There are several areas where improvements can lead to reduced CO₂ emissions in internal combustion engines, starting with fuel consumption. Valeo offers opportunities to optimize powertrain systems in three areas:

- **Improved thermo-dynamics in internal combustion engines through:**
  - Downsizing the engine, reducing engine displacement while maintaining overall performance. In order to maintain the same power as the original engine, downsized engines need to be charged by a turbocharger. Valeo provides cooling systems for the intake air that allows for higher charge pressures and direct fuel injection systems to improve combustion and avoid engine knock.
  - Optimizing the engine’s compression ratio. Valeo’s innovative cooled EGR solution for gasoline engines enables significantly increased compression ratios (and therefore performance) without negative effects on the engine (such as engine knock). The system is adapted from diesel engine EGR systems and allows real-time optimal combustion control in gasoline engines, thereby providing a fuel saving of 4 to 7%.
  - Optimizing distribution. Valeo’s e-Valve provides infinitely variable valve timing, which considerably reduces "pumping" losses.
  - Engine thermal management, with real-time, precision control of the cylinder-head temperature thanks to the Themis™ electronic control valve.
• **Low speed engine optimization**

Optimizing engines at low RPM, or "down speeding", can be achieved using longer gear ratios. To maintain driving comfort, vibrations need to be filtered out at low engine speeds, and more torque supplied. Valeo has three solutions that contribute to this goal:

  o High performance long travel dampers to dampen torsional vibrations.

  o Dual clutch transmissions. This continuously optimizes gear ratios for optimum energy efficiency. Valeo has opted for a dry clutch solution with electro-mechanical actuators as the best energy-saving solution. The reduction in CO₂ emissions is approximately 2% on a manual transmission and 8% on a hydraulic automatic transmission.

  o Air intake modules. These improve response time for turbochargers by up to 500 ms, thus enabling faster acceleration rates at low RPM.

• **Electrification / hybridization of powertrains**

The addition of an electric motor allows the internal combustion engine to be used more efficiently, thereby using less fuel for the same workload. Different hybrid systems exist depending on the power of the electric motor. They start with Stop-Start (see p.12), which shuts off the combustion engine temporarily during short stops. The next step in electrification, called "Affordable Hybrid", recovers energy during deceleration and re-uses it during acceleration (regenerative braking), assisting the combustion engine. Valeo’s "Affordable Hybrid" is a low voltage system (48V) with a new compact motor-generator. This is a much cheaper solution than current high-voltage hybrid systems.
Energy efficiency

Reducing CO₂ emissions also means improving the overall energy equation of an average automobile. LED lighting is one part of the solution. Its light output makes it the most efficient source of light for automotive vehicles. For an equivalent quantity of light, LEDs will consume 12W in low beam by 2013, whereas halogen bulbs need 65W. A vehicle using LEDs instead of traditional bulbs for all lighting and signaling functions would save 2.8 grams of CO₂ per kilometer.

Valeo offers LED systems for all front and rear lighting applications. The Volkswagen Passat, Peugeot 508 and Citroën C5, for example, all have LED daytime running lights. The BMW 6 series GT and Land Rover Evoque both have Valeo LED fog lamps, and the first mass-market electric car, the Nissan Leaf, features LED low beams developed by Valeo and its partner Ichikoh, a product that received the Nissan Global Innovation Award in July 2011.

Smart driving

One of the Group's priorities is to reconcile CO₂ emissions reduction with improved driving quality. Smart driving has three objectives: facilitating urban maneuvers (see Park4U®, p.1, the 360Vue® system, p.15), enhancing the Human Machine Interface (see multifunction control panel, p.16), the development of remote interaction between the driver and the vehicle (see the Key Bridge – smartphone-compatible key, p.1).
IV - A range of innovative technologies supporting Valeo’s global development

Several Valeo technologies that are already available on the market are likely to see significant up-take in the years to come. They include the power electronics unit for electric vehicles, low-pressure exhaust gas recirculation, the dry double clutch, Stop-Start systems, thermal management of lithium-ion batteries for electric vehicles, high-performance air-conditioning systems, 360° vehicle vision and the multifunction control panel.

Power electronics for electric vehicles

To be competitive, the electric vehicle needs to reduce its production costs and extend its range. Valeo’s response focuses on optimizing the power electronics associated with the electric motor. With this unique architecture, both cost and weight are reduced.

The power electronics unit drives the electric motor, and includes three elements: the inverter, charger and the DC/DC converter. The inverter supplies current to the electric motor, according to the torque required by the driver. The charger enables the re-filling of the battery from the grid and the DC/DC converter turns the battery’s high voltage into 14V to power the car’s various comfort and driving systems.

The main innovation of this architecture is that it integrates the charger and inverter functions within the same electronic unit, which uses the motor’s inverter and windings when recharging the battery. The system is able to charge the battery (to be used in reverse mode) due to the "triple H-bridge" configuration of the inverter. Such a topology, allows the system to be connected to the end and to the central points of the motor phases. The motor windings provide the needed inductance (one per phase) to charge the battery, with both weight and volume thereby reduced. The use of a high-efficiency inverter increases the vehicle’s range in all electric mode and the fast charger (enabled by this architecture) decreases the charge time.

Valeo’s solution improves performance while at the same time limiting energy loss. By raising the operating voltage, it is possible to reduce the current passing through the components. The maximum current is reduced from 550A to 70A, and the heat loss in the inverter is thereby limited, with intrinsic heat loss in the electric drivetrain cut by 20%.

The overall cost of the inverter/charger is also reduced, thanks to a 40% decrease in the amount of silicon in the inverter.

By integrating the inverter with the charger, it is also possible to share the same heat exchanger with the DC/DC converter, and thereby limit the cost of assembling the power electronics.

The key success factor lies in the use of a specific power module, which Valeo has designed from a technology using bare-die assembly on copper lead-frames. Electronic reliability is...
also improved thanks to the inverter’s unique structure, which allows the electric motor to function in degraded mode, if one of the phases becomes inoperative.

**Low-pressure exhaust gas recirculation: two new concepts**

Valeo has developed two systems for improved recirculation of exhaust gases on a diesel engine, using Exhaust Gas Recirculation (EGR) in a low-pressure circuit. These solutions offer a 20% weight reduction.

Exhaust Gas Recirculation (EGR) is a system for reducing nitrogen oxide (NO\textsubscript{x}) emissions. The high-pressure EGR loop recovers part of the exhaust gases at the cylinder head outlet and re-injects them into the air intake. This system's advantage is that it limits the amount of oxides formed in the combustion process, with nitrogen oxide production reduced at source. Consequently, the combustion process is cleaner.

Adapting the system to a low-pressure circuit has made it possible to increase the exhaust gas recirculation rate, by recovering the gases after they have passed through the turbocharger: the gases are cooled in a water-cooled heat exchanger and then re-introduced into the turbocharger compressor inlet.

Valeo is offering two new solutions, which feature the two valves combined in a single unit, eliminating one of the electric motors.

The first solution is known as the Cold Side EGR, because the unit is located in the intake pipe between the air filter and the compressor, and is therefore protected from the heat, enabling the use of less costly parts. Two valves are required: one for the EGR circuit and another for the intake circuit. The innovation lies in the two valves being controlled by a single motor. The EGR valve is rotated directly, while the intake valve remains open until the EGR is partially open, and then closes progressively until completely shut.

The second, Hot Side EGR solution maximizes the exhaust gas recirculation rate. A three-way valve, positioned in the exhaust pipe after the after-treatment, routes almost all the exhaust gases towards the intake. The mass of air is not reduced, and the fact that it is stable optimizes the operation of the turbocharger and maximizes the recirculation rate. Hot Side EGR allows engine manufacturers greater freedom for cutting fuel consumption, for the recirculation of the gases is no longer limited by the EGR system, but by the characteristics of the combustion process.

These systems offer 20% weight reduction and help optimize leaks and charge losses.

**Dry double clutch: compact, robust, rapid and energy-efficient**

The automation of transmissions continues to evolve, with various technologies offering the user the same function: automatic transmissions, automated manual transmissions and dual clutch transmissions.
The dry double clutch cuts CO\(_2\) emissions by between 6 and 10% compared to conventional automatic transmissions. There are two dual clutch technologies: wet or dry, Valeo has designed a dry double clutch module. It consumes less fuel and emits less CO\(_2\) than a dual wet clutch, and its design features fewer components, which makes it more reliable.

Dry double clutch transmissions have two clutches and three clutch plates whose rotation is linked to the engine’s flywheel. The clutch on the engine side is for start-up and odd gears, while the clutch on the gearbox side is for even gears and reverse. Each of the two parts alternately transmits torque to one of the two axial transmission input shafts.

The Valeo module is associated with energy-efficient electro-mechanical actuators, resulting in a reduction of fuel consumption and CO\(_2\) emissions by 8 to 10% compared to automatic transmissions with the same number of gears, and by 4% compared to dual wet clutches. The electro-mechanical actuators, which include an assisting spring that reduces electrical consumption, enable the slipping of the two clutch plates to be controlled in a precise and synchronized manner. Thanks to this feature, the Valeo module offers better performance than that of conventional automatic transmissions, together with smooth acceleration when changing gears as there is no torque interruption. The result is enhanced comfort and performance compared to an automated manual transmission.

When stationary, the clutches are disengaged (actively closed by the command system), for greater safety.

The complete module, comprising a dual dry clutch, controls and a command system, was entirely designed by Valeo’s engineers.

Valeo’s dual dry clutch is extremely compact, and can be easily adapted to a large number of transmissions.

**Stop-Start systems**

**A comprehensive Stop-Start range: i-StARS starter-alternator, ReStart reinforced starter**

The Stop-Start function cuts off the engine automatically when the vehicle is stationary. Two Valeo systems, the i-StARS starter-alternator and the ReStart reinforced starter, make this possible by allowing the engine to restart immediately and silently. They can be adapted to different transmissions.

In the city, cars are at a standstill for almost 35% of the time, with their engines idling needlessly. Automating engine cut-off and restart has therefore become a significant technology in efforts to reduce CO\(_2\) emissions. The automated Stop-Start function provides fuel savings of around 6% in European standard mixed cycle use, and up to 15% in congested city driving.
The first system, the i-StARS starter-alternator, replaces the alternator. The engine is started immediately and silently via the belt drive that permanently links the system to the crankshaft. In alternator mode, the power electronics improve the system's electrical efficiency making it also the most efficient alternator on the market. The integration of control and power electronics in the unit makes it easier to install in the engine compartment and reduces the system cost. The i-StARS starter alternator can be adapted to any engine Stop-Start strategy specified by the automaker. i-StARS shuts off the vehicle's engine when vehicle speed drops below 8 km/h for automated transmissions, and below 20 km/h for manual transmissions. Engine restart is immediate (400 msec), noise and vibration-free, even if the driver unexpectedly changes his or her mind while stopping. The system adapts to all manual and automatic transmissions.

Valeo also proposes a second system, the ReStart. It is a reinforced starter that offers extra durability for repeated stopping and starting. ReStart adapts to all types of engine, and all displacements, and can also start the engine at extremely low temperatures. The system does not require the vehicle's architecture to be modified, and can therefore be fitted very quickly. The system operates when the vehicle is at a complete stop. Valeo is currently working on developing a reinforced starter capable of restarting an engine while still rotating, allowing for increased functionality.

In vehicles equipped with the Start-Stop function, Valeo’s Stop-Stay-Cool system keeps the air conditioning running when the compressor is shut off.

StopStayCool represents an air conditioning technology specifically developed for vehicles with the stop-start function and ensures passenger comfort during the motor stop phases. The core component is a new type of storage evaporator that works exactly like every state-of-the-art evaporator, but can as well “store cold”. This stored cooling power allows the air conditioning to remain running in the passenger compartment even during the periods in which the stopped combustion engine cannot power the mechanical climate compressor any more.

The storage function is enabled by a specific phase change material (PCM) that is embedded in the evaporator. This material is charged during the engine-on phases with cooling power, stores this power and releases the stored cooling power during the engine-off periods.

The storage capacity is sized to cover nearly 95% of all expectable stop phases.

Over 50 vehicle models will be fitted with Valeo Stop-Start systems by 2015.

**Thermal Management of Lithium-Ion batteries in electrified vehicles**

Valeo, already working on battery conditioning, for the past 10 years, is developing additional products addressing the specific needs of lithium-ion batteries.

The Valeo product portfolio contains systems based on air-, fluid- and refrigerant-cooling.

Electric vehicles require more extensive and more complex thermal management than vehicles with internal combustion engines. Beside the battery conditioning already mentioned the cooling of the electric motor and the related power electronics is necessary to ensure both the vehicle range and the lifespan of the battery pack.
Electrical traction depends on the operating temperature and the aging behavior of the battery pack. The operating temperature of the battery should always be in the rather narrow range between 20°C and 40°C, independent of the state of charge and the ambient temperature.

Valeo’s answer to the problem is to propose both products and complete systems that manage the operating temperature of the battery pack. The battery temperature is adjusted by a cooling media, which either circulates across the battery pack or takes away heat from single battery cells by use of contact heat exchangers. The energy necessary for heating the battery is drawn from the thermal management loop of the propulsion system for hybrid vehicles and from a dedicated electric heater for electric vehicles. The re-cooling of the cooling media is in most cases performed using the air conditioning cooling loop. In coolant based architectures, re-cooling is carried out by a chiller, where heat is extracted from the coolant. In case of direct refrigerant cooling the battery cells are in physical contact with a dedicated battery evaporator.

These architectures ensure not only the correct temperature of the entire battery pack but also a homogenous temperature across and in between each single battery cell, thus promoting optimal durability of the battery pack.

**High efficient air conditioning**

Valeo develops air conditioning systems that guarantee both high comfort and high energy efficiency at the same time, including “low-cost” modules as well as fully automatic multi-zone modules. From an extensive overall package of solutions, three are described in detail: the variable displacement compressor, the internal heat exchanger and the fine particle filter.

- **Variable displacement compressor: high performance compressor**

In this new generation of internally/externally controlled variable displacement compressors special importance was given to stability control, energy efficiency and reduced NVH (noise, vibrations and harshness). This new compressor is based on technology used in mechanical compressors, featuring continuously adjustable displacement that is independent of the rotation of the combustion engine. It guarantees energy efficiency and low noise, by integrating innovative valve technology and active oil separation solutions. Depending on the type of A/C architectures (see internal heat exchangers) the compressor could be downsized while maintaining the same power output. The compressor is available as clutch or clutch less. Market introduction with variants of 125cc, 140cc and 160cc will take place during the coming months; additional sizes are under development.
• Internal Heat-Exchanger: more power, less CO₂

Internal Heat Exchangers are developed to exchange heat between cold and hot refrigerants. Their application permits a reduction in compressor size and therefore a more efficient A/C system, allowing for reduced fuel consumption and CO₂ emissions. The Valeo IHX offers a high level of compactness and performance, achieved by the use of deep-drawn aluminum sheet-metal and a specific refrigerant circuit. In addition to high performance, it dampens pressure variations and is compatible with the refrigerant R134a and R1234yf. It is available in different sizes and can be adapted with modular connection fittings to vehicle specific packaging needs.

• Cabin fine particle filter: blocking particles with size smaller than 0.5 µm

The fine particle cabin filter prevents cabin air from ambient pollutants. It cleans the air breathed in by the passengers and eliminates odors and particles such as dust and pollen. The Valeo filter has an efficiency of around 85%. Even particles with less than 0.5 µm are retained by the filter media. This outstanding performance is kept during the lifetime of the filter. The new cabin fine particle filter improves in a significant way the air quality for the driver and the passengers. It is easily adaptable to different car models.

360Vue® system: all-round vehicle vision

360Vue® gives the driver an aerial view of the vehicle on the dashboard's central display, offering complete visibility of the vehicle's immediate environment. The driver can carry out maneuvers in complete safety, around low obstacles, near blind corners and exiting parking spaces.

The system consists of four miniature digital cameras and image-processing software. The cameras are embedded in the external rearview mirrors, the front bumper and the tailgate, providing the driver with a consistent wide-angle image on the multifunction screen located on the center console and offering a real bird's-eye view of the car. The system can either display a single image or several views simultaneously on a split screen, and the driver can also select images on the screen, by choosing the wide-angle rear view, for example, during parking maneuvers. This technology is intuitive and user-friendly: it was designed for the greatest possible precision during maneuvers, using a dynamic grid overlaid on the image.

By the end of 2011, 17 models representing five different brands will be equipped with Valeo's multi-camera all-round vision solution. Vehicles already offering the system include the BMW 5 Series and 7 Series, the Volkswagen Touareg and the Range Rover Sport.
Multifunction control panel: optimization of the electronic architecture and design flexibility

The multifunction control panel controls the heating, air conditioning, audio system and any other function, according to the specifications of the automaker. Additional controls may be added, such as hazard lights, central locking, satellite navigation and smartphone connectivity, etc. The inclusion of a touch screen also allows information to be displayed and controls to be activated.

Valeo also offers alternative solutions such as short-travel switches, and resistive or capacitive touch-sensitive surfaces and gesture recognition. All help to heighten perceived quality while offering innovative ergonomics. A more compact design offers greater styling freedom. These technologies eliminate all difficulties involved in the alignment and sizing of the different switches.

The multifunction control panel is based on a modular electric architecture, which has the advantage of using standard technological bricks, thereby reducing development costs. This approach offers considerable latitude in managing product variations and the physical separation of the control unit from the control panel simplifies integration into the dashboard. The use of latest generation LED lighting technologies, moreover, and a single screen help to reduce electrical consumption.

Smart wiper systems: Dual Direct Drive Motor, Aquablade®

Dual Direct Drive Motors

The Dual Direct Drive Motor is a new wiper motor concept, which is lighter and more energy efficient. Each arm has its own motor instead of the usual, bulkier mechanical system, and the motors are synchronized electronically to maintain constant wiper speed. This system requires none of the linkage normally used to connect the two arms of a conventional wiper system, and the motors used for the two arms are lighter than the conventional mechanical system. This new generation of lightweight motors offers enhanced efficiency and greater torque. It also offers a weight saving of 30%, or 1.7kg, and reduces CO₂ emissions by 0.17 grams per kilometer.

Aquablade®

Aquablade® wipers are equipped with a system of small outlets that apply the cleaning fluid directly in front of the wiper blade. Traditional nozzles, which usually spray the fluid onto the windshield (obstructing the driver’s vision), are removed. The blade’s tubes distribute just enough fluid through tiny holes along its entire length. The system's precision limits excessive waste of water inherent in traditional nozzle systems. Due to this increased precision, the need for wiper fluid is divided by two thus reducing the system weight by 2kg and its CO₂ emissions by 0.2g. Aquablade® is frost-proof and uses standard cleaning fluids. It maintains constant cleaning performance regardless of the speed of the vehicle and the strength of the wind.
V - Transversal expertise

Valeo is presenting a unique work of art on its stand at the Frankfurt Motor Show, entitled *Art Shadow*.

It uses Valeo-technology products, including electric motors, wiper blades, headlamps, sensor-camera units and a sophisticated light play to display the shadow of a vehicle on a white canvas. Using products cleverly positioned to project a particular shadow is highly symbolic of Valeo's expertise, illustrating “the combined skills of Valeo’s engineers brought together in one car.”

For this work, Valeo chose Benoit Pailley, well-known for his artistry in staging objects in an original way. He has received a number of awards for his work, and has regular exhibitions all over the world.

In order to involve people online who may not be attending the Frankfurt Motor Show, the Group will also present a behind-the-scenes documentary on its website and Facebook page, describing the creation of the installation and the artistic route taken by Benoit Pailley in its conception.

There will also be a Facebook game based on the shadow play principle, in which participants have to recreate the shadow of a car using the Valeo products available. By involving people online, Valeo's intention is to share its passion for motor vehicles with the general public.