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I – China, driving Valeo’s growth strategy

At Valeo, we work tirelessly to imagine the cars of tomorrow and support automakers.

Valeo's growth strategy is built on two pillars: innovation and geographic expansion in Asia and emerging markets. In line with this strategy, the Group is focusing on China, now the world's largest automobile market and an active player in the automotive industry of tomorrow.

**Valeo, a key player in the Chinese automotive industry**

Valeo first set up operations in China more than 20 years ago, in 1994, in Hubei and Zhejiang provinces. Since then, the country has become crucial to the aim of accelerating our growth and innovation strategy. Already the largest global automotive market, China will have more vehicles on the road than the United States by 2020. For Valeo, this will mean a higher volume of original equipment business as well as promising prospects for the vehicle maintenance and spare parts businesses, generated by a fresh wave of growth.

Valeo now has 30 plants in China covering all its businesses. The Group is fully integrated into the country's industrial fabric as a result of a four-stage strategy pursued since 1994. This consists in supporting international clients, growing business with local automakers, designing products for the Chinese market locally, and developing Chinese technologies.

Valeo grew sales in China by 8% in 2015, outperforming growth in local automotive production by 4 percentage points. China now accounts for 14% of the Group's total sales and generates 20% of the overall order intake – 41% of which from local automakers – in its four business groups (Comfort & Driving Assistance, Powertrain, Thermal, Visibility) and all the technologies it produces.

This dynamic performance depends to a great extent on a human resources policy based on developing local skills and building employee loyalty. In recognition of this, the Group has been awarded Top Employers China 2016 certification. Valeo has 16,000 employees in China, including 2,300 in ten development centers and six research centers.

**Growth strategy based on steady and sustained investment**

By enhancing local teams' R&D skills, Valeo can not only provide China with market-tailored products and innovative technologies for reducing CO₂ emissions, enhancing vehicle performance and developing intuitive driving; it can also use China as a base to develop technologies for the global market.
To reach its growth targets for China, Valeo is maintaining steady and sustained investment, in particular by constantly adjusting local production capacity. Relying on these major investments and its innovative products, Valeo aims to maintain the pace of growth it has achieved in China for many years, doubling sales every four years.

**Valeo in China (by December 31, 2015)**

- 8% rise in sales, outperforming growth in Chinese auto production by 4 percentage points
- 14% of Group OEM sales
- 20% of Group order intake
- 16,000 employees – largest country in terms of headcount
- 30 plants
- 10 development centers
- 6 research centers
- 5 distribution platforms
- 7 new-build and extensions underway
**Valeo’s historical milestones in China**

**Laying the foundations**

1994: Sets up first joint ventures in Wenling, Zhejiang (Wiper Systems) and Shashi, Hubei (Climate Control).

1995: Pursues development by setting up two new joint ventures, in Wuhan, Hubei, for lighting and Shanghai for electrical systems, and, in parallel, acquires shares in another joint venture in Shanghai for wiper systems.

1997: Sets up a new joint venture for transmission systems in Nanjing, Jiangsu.

**Expanding**

2003: Increases stake in three joint ventures: 50% in electrical systems (Shanghai), 55% in wiper systems (Shanghai) and 75% in lighting systems (Wuhan).

2004: Increases stake in Nanjing joint venture for clutches.
Opens first R&D center in China at Wuhan (wiper systems) and opens 5 Axes School to provide induction programs for new employees in line with the Group’s corporate culture.

2005: Sets up new joint ventures for air-conditioning compressors in Changchun, Jilin, and for switches and detection systems in Shenzen, Guangdong.
Builds a new security systems plant in Wuxi, Jiangsu

**Being Chinese in China**

2006: Opens a second R&D center in Shanghai and a lighting plant at Foshan, Guangdong.
Acquires all the capital stock of the Wuhan lighting business.

2009: Acquire 100% of the compressors joint venture in Changchun.

2011: Inaugurates two new sites: an electronics expertise center in Shenzhen, and a plant in Wenling to boost capacity for wiper systems.

2012: Buys an 80% stake in Ruby Lighting from Chinese automaker Chery at Wuhu, Anhui. Two new sites opened: Guangzhou, Guangdong, for switches, and Wuhu, for lighting.

2013: Investment stepped up, with 4 new plants in Shenyang, Liaoning (lighting), Jingzhou, Hubei and Tianjin (thermal systems), and Wuxi (powertrain) and three plant expansions, in Wuhan and Foshan (lighting) and Nanjing (transmission).
2014: Four production sites opened in Shanghai (electrical), in Yantai, Shandong and Foshan Sanshui, Guangdong (thermal), and Shenyang (transmission).

2015: Set up two new plants in Wuhan for thermal system and in Shanghai for comfort and assistance driving systems; extends two plants, in Shenzhen and Guangzhou for comfort and assistance driving systems.
II - Innovation, Valeo’s other growth driver

At Valeo, we work tirelessly to imagine the cars of tomorrow and support automakers worldwide by designing and developing technologies to meet new needs in the automotive industry. To achieve these goals, we have developed a growth strategy based on international expansion in Asia and emerging countries, and on innovation, where our two priorities are reducing CO₂ emissions and improving intuitive driving.

In a fast-paced, highly competitive environment, Valeo has maintained its ambitious objective of increasing sales from 14.5 billion euros in 2015 to above 20 billion euros by 2020.

Valeo invests more than 10% of its original equipment sales in research and development activities. It boasts some 50 R&D centers spread throughout all of its host regions, where the Group’s 11,600 engineers are constantly innovating to improve existing technologies as well as inventing new products that anticipate the future needs and driving patterns of motorists worldwide. The Group hired over 1,200 engineers around the world in 2015, including several hundred in France, Germany, China, India and North America. Most of these new hires were in the electronics or electromechanical fields.

Valeo’s ability to continuously improve, coupled with its inventive, ground-breaking expertise, has made it a favorite among automakers. In 2015, these customers increased their orders with Valeo by 15% to a total of 20.1 billion euros. A whole 37% of these orders were for innovative products that were not on the market three years earlier. Valeo has also been singled out for its innovative spirit as well as its sound corporate strategy. In November 2015, the Harvard Business Review ranked Valeo Chief Executive Officer Jacques Aschenbroich No. 14 on its Top 100 best performing CEOs, making him the highest-ranking CEO from France. And Thomson Reuters has ranked Valeo among its Top 100 Global Innovators. Valeo has also garnered recognition for its innovation-driven strategy and performance. Euronext recently included Valeo in its new Low Carbon 100 Europe Index, ranking it among the 100 European companies with the lowest carbon intensity and the best sustainable development performance in their sectors.

R&D at Valeo
(2015 figures)

1.3 billion euros invested, or more than 10% of original equipment sales

1,406 patents filed, 27% more than in 2014

37% of the order backlog is for innovations, i.e. products that didn’t exist three years earlier

11,600 researchers

52 R&D centers worldwide
To stay at the cutting-edge of innovation, Valeo teams up with like-minded companies, industry leaders and disruptive start-ups to develop real-world solutions and market them to automakers around the world.

- In March 2015, Valeo signed a unique technology cooperation agreement with Mobileye, the global leader in front-facing-camera-based driver assistance systems.
- On March 27, Valeo showcased the innovative solutions resulting from its technology cooperation agreement with Safran.
- In August 2015, Valeo announced an investment of 22 million euros in the Cathay Capital Sino-French innovation fund, which aims to increase cooperation with innovative start-ups in France, China and the United States.
- In November 2015, Valeo joined forces with Capgemini to deploy a safe, connected mobility solution for corporate fleets and car rental companies.
- In March 2016, Valeo confirmed the acquisition of peiker – a major supplier of on-board telematics and mobile connectivity solutions – to enable the Group to widen its range of connectivity solutions. A technological cooperation agreement had been signed with the German company at the beginning of the year.
- At the end of March 2016, Valeo closed the acquisition of the German Spheros, allowing thus the Group to extend its thermal management activities in the bus market.
An innovation-driven corporate strategy

Valeo's innovation strategy seeks to respond effectively to market demands by anticipating and stimulating customer and motorist needs. Valeo's innovations, technological expertise and development methods make the Group one of the top names for technology in the automotive industry. All of Valeo's products are leaders in their markets.

Valeo is running the third annual Valeo Innovation Challenge, a contest for students worldwide that forms part of the Group's commitment to open innovation. The 2016 contest will feature a new category and be extended to students in every discipline. Students from all domains – particularly those enrolled in social sciences, design or business courses – may take part thanks to the creation of a new category, "new ways of using cars". The "technical innovation" category remains open and engineering students can still apply as usual. Over 3,300 student applicants from around the world registered for the Valeo Innovation Challenge. A total of 1,344 teams from 65 countries and 785 universities have submitted their projects or ideas in one of the two categories. In September 2016, a jury of experts and distinguished international personalities chaired by Jacques Aschenbroich will meet with the eight finalist teams and decide the winners of the two grand prizes and two second-place prizes.
Valeo InBlue®: second generation, greater connectivity

Valeo now offers a second-generation InBlue® vehicle entry/start system. With Valeo InBlue®, drivers can use their smartphone or connected watch to lock, unlock and start their car, control applications and remotely access certain vehicle data. The second-generation system features even greater connectivity, and now allows drivers to control their vehicle from any distance using either Bluetooth® or the cellular network:

- **Less than 30 meters away:** Valeo InBlue® uses Bluetooth® Smart technology to lock, unlock and start the vehicle as well as synchronize vehicle data and even control automatic parking via the Park4U® Remote and Valet Park4U® features.
- **More than 30 meters away:** Valeo InBlue® uses the cellular network, allowing drivers to remotely control a number of features such as Remote Clean4U™, the vehicle locator, the virtual key sharing device and the door locks.

In this way, Valeo gives drivers extensive and secure control of their vehicle via their smartphone, all as part of an uninterrupted, fully digital experience. The technology offers the same level of security as smartphone-based payment systems.

With Valeo InBlue®, drivers can also permanently or temporarily transmit their car key remotely at any time, wherever they may be. All they need to do is send a digital key via smartphone to the person who is borrowing the car. This person can then use his/her smartphone to unlock, lock and start the vehicle.

A study by Valeo and Capgemini Consulting has revealed a significant – and rising – level of interest in virtual keys among automotive dealers, fleet managers, car-rental and car-share professionals, etc. The car-sharing market alone represents 1 billion euros and 70,000 vehicles, and is growing by 25% a year. To meet professionals specific needs, Valeo and Capgemini have developed the InBlue Mobility solution, which allows for secure management of virtual keys via the Valeo InBlue® system, real-time collection of vehicle data, and the deployment of digital services.

Valeo InBlue® is part of the European Dependable Embedded Wireless Infrastructure (DEWI) project.
Remote Clean4U™, a remote windshield defrosting and cleaning system

Remote Clean4U™ is a revolutionary remote windshield defrosting and cleaning system that is controlled via a smartphone application. This easy-to-use system is more efficient than other methods and improves driving safety. It was designed to meet the expectations of our end-customers who are unsatisfied with the windshield cleaning methods that are currently available. The Remote Clean4U™ system has two innovative functions that the user can control remotely from a smartphone: Defrosting, which automatically defrosts a windshield in less than 90 seconds, and Debugging, which washes away insects stuck to the windshield in record time.

The Defrosting function of Remote Clean4U™ distributes an environmentally friendly defrosting fluid through Valeo’s exclusive AquaBlade® windshield wiper system, which incorporates the cleaning function into the blades themselves. The fluid is not projected onto the windshield but precisely distributed across its entire surface, cleaning it more evenly and uniformly without wasting fluid. This system is more efficient than a heated windshield and consumes 28 times less energy than an electric defrosting system. Not only is it environmentally friendly and more efficient, the system is also more convenient thanks to its remote Defrosting function, which allows the driver to defrost the windshield from the comfort
of home without having to go out to start the engine. This innovative system is useful and efficient.

Using a smartphone application, the driver can remotely start Remote Clean4U™'s Debugging function to wash away insects stuck to the windshield in record time. Thanks to its specially formulated cleaning fluid distributed through the AquaBlade® windshield wiper system, this innovative function improves visibility while using less fluid and energy.

AquaBlade® also makes the vehicle 2 kilograms lighter since only a small amount of fluid is needed to clean the windshield.

**Being in line with market expectations**

For end-users the three most important advantages of Remote Clean4U™ are: The very small time needed to defrost (60% of respondents in a Valeo survey), the comfort linked to remote control (57%) and the fact that it works without the engine running, so saving energy (by 25%).

Another interesting aspect of this innovation is that the need for Remote Clean4U™ is shared by all types of drivers, irrespective of the type of car. In an IPSOS survey, 98% of Compact owners consider Remote Clean4U™ Defrost as essential or useful, 95% for Sedans owners, 93% for SUV and 92% of small cars owners.

**Valeo solutions for optimal cabin air quality**

In order to protect the health of car users and improve their comfort and well-being, Valeo has developed new patented cabin filters that trap allergens, dust and particles (PM$_{2.5}$, PM$_1$) with almost 100% efficiency.$^1$

**A cabin filter with anti-allergen properties**

Valeo offers Europe's first patented cabin filter with anti-allergen properties. The new filter is suited to all drivers and passengers, no matter what their sensitivity to airborne allergens.

In industrialized nations, the proportion of the population suffering from pollen-related allergies has doubled over the last 30 years. According to the World Health Organization (WHO), allergy is now the fourth most serious medical problem after AIDS, cancer and cardiovascular disease. Allergy symptoms such as sneezing, watery eyes and itching are not only uncomfortable – they can also affect a driver’s concentration. In a vehicle traveling at 80 km/h, a sneezing driver has his or her eyes shut for approximately 25 meters.

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$^1$ 93% efficiency on particles of 0.3 μm.
Valeo has developed a filter that limits the risk of an allergic reaction inside the vehicle by neutralizing around 96% of allergenic pollen. This filter traps not only dust, harmful gases and odors, but also neutralizes allergens.

Designed and produced by Valeo, this filter offers all the features of a conventional device, plus anti-allergen properties thanks to a natural polyphenol-based surface treatment. Found in certain plants and fruits, polyphenol neutralizes allergenic pollen, making it possible to inhibit virtually all allergenic particles.

**Valeo’s very high efficiency PM2.5 filter**

Valeo has developed a very high efficiency PM2.5 filter that traps almost 100% of particles in order to reduce the concentration of pollutants in the cabin.

Made from close-knit, reinforced fibers, the very high efficiency PM2.5 filter reduces particle concentration inside a vehicle to levels that meet the WHO Air Quality Guidelines of 25 µg/m³ per day (despite peak levels in some Asian megacities reaching up to 900 µg/m³). To ensure the efficient operation of the air conditioning and heating systems and the well-being of passengers, Valeo recommends changing the filter regularly (at least once a year, and twice a year in very polluted areas).

**Valeo 48V e4Boost Powertrain System**

Today, Valeo is presenting its new 48V e4Boost powertrain system, which simultaneously enhances engine performance and reduces fuel consumption and CO₂ emissions.

The 48V e4Boost solution, composed of an Electric Supercharger 48V and a Belt Starter Generator iBSG 48V, recovers a maximum amount of braking energy and stores it in a 48V battery. This energy is then re-used to:

- Give the engine more torque.
- Boost engine performance during in-gear acceleration.
- Optimize vehicle energy management.

Drawing on years of experience dating back to the Stop & Start system in 2004, Valeo is extending its conventional line-up with numerous innovations that range from combustion engine optimization to electric vehicle systems.

Vehicles are becoming increasingly electric, and Valeo is the world leader in 48V solutions.

These solutions apply to all vehicle segments, whether powered by gasoline or diesel engines, and are particularly well suited to models in the high volume B and C segments.

Advantages include:
Up to 20% fewer CO$_2$ emissions* (NEDC standards).

Up to 20% better in-gear acceleration.

These advantages make Valeo's 48V e4Boost Powertrain System a solution of choice for Chinese carmakers, whose new vehicles will need to achieve an average fuel consumption target of 5 liters/100 km by 2020.

**Electric Supercharger 48V: an electric supercharger that combines lower fuel consumption and enhanced performance**

 downsizing is one of the main ways automakers cut fuel consumption in their vehicles. To maintain the same high levels of performance while reducing engine size, engine manufacturers generally opt for a turbocharger driven by the engine's exhaust gas. The drawback is a long response time, known as 'turbo lag'.

Valeo is making this problem a thing of the past with its range of electric superchargers. Part of the Valeo e4Boost 48V Powertrain System, the electric supercharger, unlike turbochargers powered by exhaust gases, is driven by an electric motor, using switch reluctance technology, resulting in almost zero lag (250 milliseconds).

Used with a 12- or 48-volt electrical architecture, the system enables to reduce fuel consumption by 10%*, thanks to further downsizing and downspeeding. Capable of replacing or supplementing turbochargers, it enhances both driving comfort and in-gear acceleration, which improves by 27% without increasing fuel consumption*.

When coupled with a Valeo energy recovery system, this electric supercharger can be used to create a cost-competitive alternative hybrid solution that delivers fuel savings from 15% to 20%*.

**The Electric Superchager 48V is a winner of the 2016 PACE Awards.**

**Belt Starter Generator “iBSG” 48 V**

iBSG includes a full range of belt starter-generators operating in a 48 V network.

* Valeo estimate, pending vehicle applications, not contractual value
Implemented on the engine front end and with a packaging equivalent to a conventional alternator, these claw pole machines with integrated electronics point out as the pragmatic, competitive and time-to-market solution allowing hybridization to spread from high end cars in low volumes to generalists and high volumes.

Thus, 48 V belt machines is the technological path privileged by Chinese car builders, China being the leading market for a 48 V implementation in term of volumes and decided OEMs.

Beyond stop-start and coasting even at high vehicle speed, iBSG operates regenerative braking and torque assist, thus enabling downsizing of the combustion engine and downspeeding of the gearbox. The belt machines deliver high torque immediately at start-up, compensating for the loss of power in smaller engines when accelerating from low speeds, and making driving more economical without compromising comfort. Attained CO2 reductions are about 15%*.

Valeo proposes a range of machines based on the same claw pole technology than conventional alternators with permanent power from 4 to 8 kW and peak power from 10 to 12 kW. With almost 2 million iBSG 48 V awarded, **Valeo is 48 V leader in China.**

* Valeo estimate, pending vehicle applications, not contractual value
IV – More Valeo’s innovations at the 2016 Beijing Autoshow

Valeo SCALA: the laser scanner, enabling automated driving

Valeo is showcasing its SCALA laser scanner, a technology which will be a key enabler for highly automated driving thanks to its extended detection range, wide field of view and accuracy.

Valeo SCALA laser device scans the area in front of the vehicle and detects vehicles, motorbikes, pedestrians and static obstacles like trees, parked vehicles and guard rails – all with an extremely high level of accuracy. It works during the day and at night, when the car is driving at both high and low speeds. Using the collected data, the scanner creates a map of the environment allowing it to analyze and anticipate events around the vehicle. This technology serves to enhance active safety by initiating measures like evasion maneuvers and emergency breaking whenever vehicles or pedestrians suddenly appear in front of the vehicle. The scanner also collects information that is essential for highly automated driving systems and automated valet parking.

Valeo SCALA laser scanner, playing a vital role in automated driving

Valeo’s technologically innovative SCALA can be used as part of the highly automated Drive4U® solution, as shown during a demonstration in real traffic conditions. When in automated mode, the system took full control of the vehicle’s steering, acceleration and the brakes.

Thanks to the Valeo SCALA, the Drive4U® innovation also includes enhanced active safety features that not only make driving safer in both manual and automated modes but also help to increase the efficiency of car travel.

In addition, Valeo SCALA laser scanner is the main technology featured in the automated valet parking prototype Valet Park4U®. With Valet Park4U®, vehicles can find a suitable space and park by themselves without a driver.

A full range of solutions for analyzing the vehicle’s surrounding environment

Valeo SCALA technology complements the existing range of multi-function front cameras, radars, ultrasonics, infrared and vision sensor systems on the market. This enables Valeo, which is already market leader in driving assistance systems, to promote innovative active safety features and automated driving.
360Vue® 3D technology: full visibility around the vehicle

The intuitive and ergonomic 360Vue® 3D system is designed to help drivers maneuver their vehicles with greater accuracy. It brings automakers one vital step closer to commercializing highly automated vehicles. 360Vue® 3D works by giving the driver a bird's eye view of the vehicle on the dashboard screen. It provides a 3D, 360 degree image of the surrounding environment which ensures full visibility around the vehicle.

With this technology, the driver can maneuver the vehicle or leave a parking space in total safety, with an excellent view of all blind spots and obstacles around the vehicle.

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The system consists of four miniature digital cameras and image processing software. The cameras are fitted into the exterior mirrors, on the front bumper and on the tailgate. The image, displayed on the multi-function center console screen, gives the driver the impression of floating above the vehicle. The system can display one or more images simultaneously on a split screen. The driver can also select and zoom in on a specific image when performing maneuvers.

The 360Vue® 3D system already equips the Volkswagen Passat and the new Volvo XC90, and 360Vue® system is also available on many Audi, BMW, Citroën, Land Rover, Mercedes and other Volkswagen models.

Ford Edge: the first BeamAtic® PremiumLED headlamp 100% made in China

The Ford Edge headlamp, supplied by Valeo, is the first Glare-Free High Beam headlamp to be produced in China.

This full-LED headlamp features Valeo's BiLED and BeamAtic® PremiumLED technologies.

BeamAtic® PremiumLED makes it possible to drive permanently in high beam mode and offers therefore perfect visibility, while never dazzling other drivers. Night driving becomes much more comfortable and safer.

This is made possible by the system's onboard camera, coupled with powerful image processing software. It detects and locates other vehicles, and adjusts the high beam pattern accordingly: the entire road is lit, except for a shadowy area around the oncoming or leading vehicles.
Interior lighting: future solutions for intuitive lighting

Advanced interior lighting is a key trend that automakers are increasingly exploiting to set themselves apart in a highly competitive market. Valeo is catering to this demand by offering a range of innovative interior lighting technologies, which are designed to optimize driver/vehicle interaction as vehicles become more autonomous. The change in focus is visible, as interior lighting becomes intuitive.

In anticipation of this change, Valeo has identified three areas of development to make driving safer, car travel more comfortable, and interior lighting more intuitive:

- **Comfort**: Comfort is essential in delivering the levels of well-being expected by the driver and passengers, who want the car to be an extension of their home. In a form of light therapy, automated variations in the interior lighting can be used to accentuate the driver's and passengers’ perceptions. A stark, cold white light, for example, prevents fatigue by stimulating the driver, whereas warm lighting creates a sense of well-being and harmony inside the vehicle.

- **Driving assistance**: Interior lighting can help enhance safety in manual driving modes. When exterior sensors detect a hazardous situation, such as a vehicle in a blind spot or a pedestrian behind the windshield pillar, light sources in a specific part of the cabin draw the driver's attention directly to the potential danger, offering optimum hazard prevention.

- **Infotainment**: Interior lighting can become part of the entertainment experience by adapting dynamically to music or videos, for example. It can also transmit data using Li-Fi technology.

In-Door Illumination: offering even greater vehicle personalization

At this year's Beijing auto show, Valeo is presenting its In-Door Illumination technology, which customizes the vehicle's interior lighting using transparent sections in the cabin. Invisible until activated, these sections light up to create patterns on the curved surfaces of the door. In-Door Illumination offers enormous potential for personalization as it draws attention to the cabin’s design, roominess and trims while allowing for more assertive branding. The In-Door Illumination lighting solution is the perfect way to create brand-specific effects when people are getting in or out of the vehicle.
F910 facing material for Dry Dual Clutch

Finalist at the 2015 PACE Awards, the F910 clutch facings for Valeo’s dry dual-clutch transmission use an innovative friction material formulated from a compressed powder rather than the twisted yarns traditionally used.

The F910 clutch facings improve driving comfort, preventing jolting when starting the vehicle and improving the quality of shifting.

This product was specifically developed for dry dual-clutch transmissions, which include one clutch for even gears and another one for odd gears. Dry Dual Clutches enable a fuel consumption and CO₂ emissions reduction of 6% to 10%* compared to a conventional automatic transmission.

Dual Mass Flywheel: significant improvements in acoustic comfort and reduced vibration

The Dual Mass Flywheel (DMF) significantly reduces perceived vibrations and engine noise.

This represents a major step forward in powertrain filtration technologies. Step necessary for new low CO2 downsized having higher torque and consequently, generate greater vibrations, especially at low speed.

The DMF absorbs torque vibrations generated by the engine to the transmission, thereby increasing the comfort of the vehicle’s occupants.

DMF is the starting point of a complete range of dampers with high dampening qualities that are becoming an essential component in tomorrow’s conventional high-performance engines as well as for hybrid powertrains, which have the strictest installation constraints.

In addition to the well-known DM, Valeo can propose DMFs with inner damper, inner long travel damper and as well with pendulum for most severe applications.

Valeo’s dual mass flywheel range offers comfort levels previously unknown on the most fuel-efficient engines. The NVH (Noise-Vibration-Harshness) level and ease of gear changes offer remarkable driving comfort for the most vibration-prone engines.

* Valeo estimate, pending vehicle applications, not contractual value
Valeo reinvents vehicle thermal management to reduce CO₂ emissions

Long-term trends in the automotive market, like autonomous driving and CO₂ emissions reduction, are forcing automakers to rethink their thermal management strategies. In a bid to make HVAC management more comprehensive and even more innovative, Valeo has included some of these new priorities in its roadmap.

Innovative technology

Thermal management has emerged as one of the keys to keeping CO₂ emissions down without compromising on passenger comfort. To this end, Valeo is now offering to equip new vehicles with a range of innovative technologies, such as:

- Multi-temperature hybrid-powertrain cooling architectures that combine various cooling functions on high- and low-temperature circuits.
- Smart engine-water circuit management, which brings the engine to the right temperature faster using heat storage and recovery systems.
  - Efficient exhaust gas recirculation (EGR), which helps reduce pollutant emissions (NOx) in diesel vehicles and optimize fuel consumption in gasoline vehicles.
  - A water-cooled charge-air cooler connected to a low-temperature water circuit to improve acceleration response time and charge-air stability.
- Active air grille shutters to regulate front-end air inlet flow, thereby reducing vehicle drag and warming the engine faster in cold weather.
- A dual-flow air conditioning system designed to increase the air change rate and reduce the need for additional electric heating inside the vehicle, without misting the windows.

These new technologies all help improve thermal management in the vehicle, significantly boosting fuel efficiency and reducing CO₂ emissions per kilometer.

**Optimal thermal management extending the range of electric vehicles**

In urban driving conditions in the winter, a vehicle in full-electric driving mode uses practically as much energy to heat the cabin as it does to drive. The thermal management challenge in this situation is to ensure the vehicle maintains an acceptable range.

In response, Valeo has invented new thermal management models for automobiles, with a particular focus on:

- Implementing cooperative thermal management to minimize energy loss, combining the internal combustion engine, electric propulsion system, battery pack and HVAC. This "smart thermal network" will be able to monitor the sub-systems' transfer, storage and recovery of energy and adapt this to the vehicle's different operating modes in order to optimize energy efficiency.

- Shifting from the notion of overall cabin comfort toward one of individualized comfort, using more localized features to reduce energy needs to the bare minimum without affecting passenger comfort. This requires a better understanding of how the human body regulates heat.

- Reducing energy needs in the winter to keep occupants at a comfortable temperature.

To this end, Valeo is offering:

- Innovative architectures for heat pumps combined with HVAC dual layer for optimizing the cabin air recirculation ratio without mist effect offering significant saving in term of electrical consumption for winter comfort.

- Air conditioning systems that maximize energy efficiency by using a very high-performance electrical compressor and compact, lightweight HVAC architectures and by identifying minimum levels of individual thermal comfort.
- Optimum Li-ion battery thermal management to guarantee unrivaled reliability and durability. Valeo offers high-performance air-, liquid- and refrigerant-based cooling systems suited to every engine architecture.

- Active air grille shutters to regulate front-end air inlet flow, thereby reducing vehicle drag.

Together, these technologies can extend an electric vehicle's range by up to 40% in winter and by 20% in summer.
Appendix

About Valeo

Valeo is a major player in the global automotive industry and ranks among the world’s top automotive suppliers. As a technology company, Valeo is fully focused on the design, production and sale of components, integrated systems and modules for the car and truck industry in both the original equipment and replacement segments.

With its intuitive driving vision, Valeo develops innovative technologies that provide optimal safety, enhanced driving comfort and greater energy efficiency. The Group offers solutions that reduce the consumption of internal combustion engines, hybrid and electric vehicles, as well as the weight and energy use of components. Major customers by alphabetical order include: BMW, BYD Auto, Chery, DAF, Daimler, Fiat/Chrysler, FAW, Ford Motor Company, Geely/Volvo Cars, General Motors, Great Wall, Honda, Hyundai/Kia, JAC, Mazda, Mitsubishi, PSA Peugeot Citroën, Renault-Nissan, SAIC, Suzuki, Tata Motors/Jaguar/Land Rover, Toyota, Volkswagen Group/Porsche/Scania/MAN and Volvo Trucks.

Key figures

- Sales of 14.5 billion euros in 2015, up 14% on 2014
- More than 10% of original equipment sales devoted to R&D
- 1,406 patents filed in 2015
- 82,800 employees
- Operations in 30 countries
- 15 distribution platforms
- 17 research centers
- 35 development centers
- 134 production sites
Valeo's four Business Groups

Powertrain Systems

The Powertrain Systems Business Group covers all activities related to the vehicle's powertrain. Powertrain Systems develops innovative powertrain solutions designed to improve fuel efficiency and reduce carbon emissions, without sacrificing driving pleasure or performance. These innovations cover a comprehensive range of products, from the optimization of internal combustion engines through to the varying levels of vehicle electrification, and from Stop-Start systems to electric vehicles.

This means that the Group's opportunities are closely linked to its technological choices, as well as to growth in the global market, especially in emerging markets. The Business Group has a clear advantage given that it operates in all regions of the world: Europe, North and South America, as well as Japan, China, South Korea and India.

Valeo's Powertrain Systems Business Group is a world leader in electrical systems and transmission systems.

2015 Facts & Figures:
- 3.8 billion euros in sales
- 19,400 employees
- 36 production facilities
- 6 research centers and 16 development centers

Thermal Systems

The Thermal Systems Business Group develops and manufactures systems, modules and components to manage powertrain, gearbox and other cooling systems, and to enable individual passenger climate control, at every phase of vehicle use.

These systems help to significantly reduce fuel consumption, CO₂ emissions and other pollutants and harmful particles from vehicles equipped with internal combustion engines. In addition, the Business Group's engineers have designed systems to improve battery performance and to extend their life span in hybrid and electric vehicle applications.

The Thermal Systems Business Group has made the most of strong growth in emerging economies.

2015 Facts & Figures:
- 4.1 billion euros in sales
- 20,100 employees
- 48 production facilities
- 3 research centers and 8 development centers
Comfort & Driving Assistance Systems

The Comfort & Driving Assistance Systems Business Group develops innovative and intuitive driver-vehicle-environment interface systems that are vital to the emergence of tomorrow's more automated and connected cars. It contributes to improving comfort and safety, while putting an emphasis on intuitive driving.

Backed by both market and technological leadership, Comfort & Driving Assistance Systems is a key player in this segment and perfectly positioned to serve emerging markets.

2015 Facts & Figures:
- 2.7 billion euros in sales
- 15,300 employees
- 26 production facilities
- 9 research centers and 8 development centers

Visibility Systems

The Visibility Systems Business Group develops and produces innovative lighting and wiper systems aimed at improving driving safety in adverse conditions. Its solutions offer perfect visibility in all weather, both day and night.

The Business Group offers a full range of wiping and lighting solutions that integrate the latest technologies.

Valeo is among the major worldwide players in this segment. The presence of Valeo's visibility systems in high-growth markets is a key factor for the success of the Business Group, which aims to strengthen its position in Asian markets.

2015 Facts & Figures:
- 4.2 billion euros in sales
- 26,300 employees
- 35 production facilities
- 5 research centers and 15 development centers