

MEDIA KIT INNOVATIONS@RENAULT

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INNOVATIONS@RENAULT 2014 BEHIND-THE-SCENES OF INNOVATION AT RENAULT



Innovation lies at the heart of Renault's brand identity. The latest vehicles to have been unveiled, as well as those due to be revealed in the coming months, all carry new techniques and technologies which are focused on the needs and expectations of motorists. These innovations contribute directly to the affordable mobility that Renault is striving day after day to deliver to its customers.

Several weeks after the unveiling of the new Espace and its new, ultra-low fuel consumption EOLAB prototype, Renault lifts the lid on two innovations scheduled to appear in 2015. These includes an avant-premier glimpse at **Renault's new more efficient and more compact electric motor** as well as a **modern turbocharged petrol engine adapted for LPG use**, aimed at reducing customer's fuel bills.

Innovations@Renault similarly represents an opportunity to **map out longer-term avenues for innovation by exploring new approaches** to mobility. Renault is taking you inside with three prototypes that have been developed with its partners as research projects: a **mild-hybrid diesel LCV prototype** (HYDIVU project), a **very small exploratory two-stroke diesel engine concept** (POWERFUL project) and a **small electric delivery vehicle prototype** based upon the Twizy (VELUD project).

This year, **Renault is taking you behind-the-scenes of its innovations** introducing you with the **Cooperative Innovation Laboratory** (LCI) which is a 'think tank' that acts like a start-up by bringing together engineers, designers and customer survey specialists. You will also have an opportunity to discover **Renault Creative people**, an original means of emulation aiming at stimulating **the creativity inside of Renault**.

"Being open to other cultures and fields, learning to think differently and preparing people's minds for ground-breaking innovations that will form the backbone of the world of tomorrow – that is the Renault philosophy. This journey behind-the-scenes of innovation offers an insight into the inner workings of the originality and specific features of Renault innovation. The key idea is to stimulate creativity to benefit from everyone's ideas." **Rémi Bastien, Engineering Innovation Director.**



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SOON TO HIT PRODUCTION Pushing the boundaries even further in the realm of electric vehicles and alternative energies:

While maintaining its commitment towards sustainable mobility, Renault is continuing to pursue the development of electric vehicles. To this end, Renault is unveiling a completely new electric motor, designed by its powerplant engineers and manufactured in France. More compact but just as efficient, it benefits from the knowledge and expertise acquired by Renault in the domain of electric vehicles. Renault similarly has a presence on the alternative energy front, in proposing a dual-fuel petrol/LPG option in a latest-generation combustion engine, which reduces fuel bills by 25 per cent in comparison with a modern petrol engine.

"The future of mobility calls for the same command of electric motor technology as it does of internal combustion engines. We are consequently active on every front, from internal combustion engines to electric motors and alternative energies." **Rémi Bastien, Director of Innovation Engineering**

1. A new Renault electric motor : compact and efficient, designed and manufactured by Renault

With this completely new electric motor, Renault reaffirms its electric vehicle strategy and its desire to develop a comprehensive level of expertise in this field.

Three key words: compactness, performance, efficiency:

The objective was first and foremost to work on the integration of components for a more compact motor. **Volumes have been reduced by 10 per cent for the same level of performance,** which opens up new opportunities to use it for smaller vehicles.

The electronic management and charging systems have been refined to optimise charging time at low power and electricity consumption while on the move.



HOW IT WORKS

Entirely designed and manufactured by Renault

- Designed by Renault's motor engineers in France,
- Manufactured in France at Renault's Cléon plant, which specialises in advanced powerplants,
- Innovative in its design and architecture: this motor was subjected to 95 specific tests, taking advantage of the electric vehicle experience Renault has acquired.

A motor designed to be more compact:

This is a synchronous electric motor with wound rotor developing 65kW and peak torque of 220Nm, complete with an integrated Chameleon charger.

Integration, miniaturisation and simplification are the three objectives that guided the designers of this motor.

- Integration: switching from macro-module stacking to fully integrated modules
- Miniaturisation: the design of smaller modules, assembled closely (minimisation of space between the modules, doing away with external power supply cables)

'Three in one': the junction box, power electronics and Chameleon charger are all contained within a single system entitled Power Electronic Controller, enabling a 25 percent reduction in the size of this group of functions.

• Simplification: switch to air cooling for the electric motor (removal of inter-module ducting). Only the Power Electronic Controller continues to be cooled by water, adapted to its specific needs.

Refinement of the charging system at low power:

The designers have improved the electronic management of the charging process in order to reduce charging times using low-power infrastructure (flexi-charger cable for domestic networks, 3kW and 11kW electric charging points).

Enhanced efficiency: thanks to the comprehensive redesign of the inverter system, the designers have been able to improve efficiency, thereby reducing the consumption of electric energy.

2. Turbocharged dual-fuel petrol/LPG engine: a modern powerplant adapted for LPG

The objective is to transfer the advantages of using LPG across to a modern engine in order to improve both its running costs (25 per cent cheaper fuel bills) and environmental performance (10 percent fewer CO₂ emissions).

HOW IT WORKS:

- It is a latest-generation three-cylinder petrol engine with LPG dual-fuel capability, integrating modern technologies (turbo, Stop&Start, energy recovery under braking, eco-mode) and compliant with Euro 6b emissions legislation. The gains achieved in terms of fuel consumption in comparison with an LPG engine of the previous generation are around 20 percent.
- The technical challenge came in striking the right balance between turbo boost and LPG pressure and in optimising the engine management strategy to permit maximum use of the LPG mode with no need for input for the driver.
- In the same vein, the entire powertrain will be fitted at the factory complete with its LPG kit.



02 RESEARCH PROTOTYPES Reducing customers' energy bills and exploring new mobility solutions

Renault is presenting three research prototypes developed in tandem with its partners as cooperative projects. The objective is to curb the energy bills of customers by reducing their vehicles' fuel consumption, in addition to conceiving new logistical solutions for the 'final kilometres' to improve the quality of air in towns and cities.

1. HYDIVU: a Mild-Hybrid Diesel solution to bring down consumption and emissions in LCVs.

The objective of this research prototype – produced as part of the HYDIVU (Hybrid Diesel for LCVs) project – is above all to reduce the consumption of LCVs for business customers who travel long distances. Developed on the base of the Renault Master, this prototype is fitted with a powertrain that integrates an electric motor (mild hybridisation), Twin-turbo technology and a downspeeding design. The combination of these three technologies results in a **in a fuel consumption saving of up to 10 percent when used over long distances**.



HOW IT WORKS:

This powertrain is derived from the Energy dCi 165 Twin Turbo engine, to which the engineers have applied the following evolutions:

- A 48-Volt (10-12kW) starter motor/alternator-type electric motor mounted on the gearbox: this delivers additional torque, thereby reducing the load on the internal combustion engine. With an advantageous position in the powertrain as close as possible to the wheel, it is able to benefit from greater mechanical efficiency, allowing it to recover more energy during periods of deceleration and braking. This 'free energy' is stored inside the 48V battery and can be-used in the form of additional torque, which in turn reduces to a similar degree the load on the internal combustion engine.

- **'Downspeeding'**: this reduces the running speed of the internal combustion engine by lengthening the gear ratios. This reduction in engine revs results in less friction which is directly beneficial to consumption.

An improvement in the engine's thermo-mechanical efficiency has been achieved through:

- The employment of a Twin-Turbo concept with variable geometry adapted to downspeeding. The objective is to strike a balance between sufficient torque available from the very lowest revs (from 1,000rpm) and consistent driveability across the entire operating range,

- A reduction in friction thanks to downspeeding and the use of innovative technologies such as steel pistons,

- Fuel-injection pressure increased to 2,500 bar (compared with 2,000 bar) for a reduction in polluting emissions while at the same time ensuring the necessary power output.

PARTNERS: LMS, IFPEN, Valeo, Continental.

2. POWERFUL: a very small two-stroke diesel engine that is economical both to purchase and to run

The pressure to reduce fuel consumption and CO_2 emissions demands major breakthroughs in the realm of efficiency. The most efficient engines – which are widespread in large ocean vessels such as container ships – are two-stroke diesels. Their efficiency is close to 50 percent, while four-stroke automotive diesels struggle to achieve 35 percent. Until now, making these two-stroke engines small enough to adapt to the automotive world was impossible, but the POWERFUL (POWERtrain for FUture Light-duty vehicles) project sets itself the goal of investigating solutions for road vehicle applications.

The efficiency gains of the two-stroke cycle offer other benefits: compactness and a reduction in weight, given that it involves halving the engine size and number of cylinders (here a twin-cylinder). The engine is 40kg lighter and more compact, thereby making it ideally suited to small vehicle platforms.

This makes it an additional means of achieving downsizing, the objective being to produce a very small diesel engine for road vehicles that is even more economical, both to purchase and run (improved fuel consumption and lower CO_2 emissions). Initial results are promising, even if we are still naturally at the research phase. It must be noted that performance is not yet sufficiently strong, since it is merely an exploratory study at this juncture.

HOW IT WORKS:

- A two-cylinder turbo diesel engine: switch from four to two cylinders while retaining the same bore and stroke.
- A 50 percent reduction in engine size in comparison with a 1.5-litre diesel.

Engine Size:	730cc
Maximum Power:	35-50kW
Maximum Torque:	112-145Nm, available from 1,500rpm
Stroke x Bore:	76mm x 80.5mm
Maximum Engine Speed:	4,000rpm
Boost:	Mechanical supercharger and turbocharger



The advantages of two-stroke technology

- Lower fuel consumption / CO₂ emissions thanks to improved cycle efficiency and the effects of downsizing.
- De-pollution: enhanced efficiency of the de-pollution systems, particulate filters and NOx-Trap to comply with current and forthcoming legislation.
- Cost price: the reduction in the number of components means the cost price is brought closer to that of a petrol engine.
- Sound: a two-stroke, two-cylinder engine produces the same sound as a four-stroke, four-cylinder unit.

PARTNERS: 18 industrial, scientific and academic partners within France and across Europe.Delphi, IFPEN, University of Valencia, Czech Technical University in Prague, Le Moteur ModerneFINANCE: European Commission

3. Exploring new solutions for urban deliveries

Re-evaluating urban logistics:

Twizy Delivery Concept is a research prototype that forms part of the du VELUD (Electric Vehicle for Sustainable Urban Logistics) project. The VELUD initiative aims to run a pilot delivery scheme in Paris with an electric LCV in order to reduce the impact of urban deliveries on air quality. Based on the Renault Twizy, this prototype explores an alternative for deliveries in built up areas.

The central focuses of this project are the following:

- Experimenting in the sphere of new uses for 'final kilometres' logistics.
- Testing the adaptive potential of **modular cargo zones** in accordance with the goods on-board.
- Defining an **intelligent management of the fleet** to achieve optimum activity and an efficient delivery service.

This project should make it possible to establish the blueprint for a future system of urban logistics, incorporating the criteria of the towns and cities with the changing demands of transport linked to the development of e-commerce (home shopping deliveries...).

HOW IT WORKS:

The prototype innovates through its specification – a small electric-powered vehicle to which is attached a trailer, which is capable of holding up to 15 adjustable containers depending upon the load in a total space of one cubic metre.



PARTNERS:

Industrial Systems Engineering School (EIGSI, La Rochelle), AIRPARIF, La Petite Reine Groupe Stars Service, City of Paris

FINANCE: ADEME

03 BEHIND-THE-SCENES OF INNOVATION Identifying trends and drawing inspiration

This year, Renault is opening its doors to provide a behind-the-scenes glimpse of its innovations through both the discoveries of the Cooperative Innovation Laboratory as well as its original methods which make it possible to identify trends and stimulate creativity within the company. These initiatives dedicated to innovation illustrate Renault's bold approach and are based upon the key idea that innovation at Renault is everybody's business.

1. Cooperative Innovation Laboratory (LCI): a start-up inside the company

The Cooperative Innovation Laboratory (LCI) is an independent structure right at the heart of Renault. Its mission is to conceive ground-breaking innovations and bring them to life in realistic prototypes, delivering appreciable value to customers.



A place of creative freedom established by senior management, the LCI brings together Engineering, Product and Design specialists in the same workspace. The result of this original organisation is a dynamism and ability to create and react which make it an extraordinary melting pot of ideas.



It is spearheaded by three men: Gilles Lallement, Director of the LCI and in charge of Engineering, Patrick Lecharpy for Design and Serge Mouangue for Product Strategy. These three people guide and coordinate the LCI's projects in a collaborative manner.

The quest for ground-breaking solutions

"The LCI resembles a start-up composed of around 40 people, but integrated within a large company," explains Gilles Lallement. "It provides us with an ideal situation in which to formulate ground-breaking innovations and concepts. Our objective is to take a project or major innovation right up to the development stage every two years." The projects developed within LCI are extremely varied, with a large margin for manoeuvre and a willingness to open up to the outside world: one third of the projects are the result of discussions with external players such as parts suppliers and specialist schools.



The objective is to step outside the framework of conventional programmes and create a fertile breeding ground for completely original ideas, by taking advantage of the group's combined engineering experience. Examples include the Renault Twizy, the NEXT TWO autonomous and connected electric vehicle prototype, EOLAB and many more besides.

Collaborative working, similar to a start-up



Each project has four key ingredients: design, technology, economic constraints and customer surveys. Patrick Lecharpy reveals: "Our organisation is based upon removing the barriers between the different professions. Product, Design and Engineering work together in collaborative fashion. Each one has the right to monitor and contribute in the others' specialist domains. We have a single motto: propose solutions to make rapid advances together."

Serge Mouangue adds: "Our approach is characterised by our forward-looking vision, based upon the identification of customers' needs and the markets of tomorrow. The LCI stands out through the way it tackles issues. In deliberately researching opposing views to commonly held beliefs, we open the door to new ideas for developing product strategies of the future."



From an idea to a physical model: prototypes to assist decision-makers

By virtue of being a flexible and dynamic organisation, the LCI is able to progress within a matter of days – sometimes just hours – from the idea stage to physical realisation (design model, prototype, etc.), which enables decisions to be made rapidly on a concrete basis. This entity represents a real strength for the company and demonstrates the distinctive character of the way Renault goes about innovation.



2. The tools of creativity: innovation is everybody's business!

1. Stimulating internal creativity

INNOVATION ROOM: an open-minded place for topical exhibitions that is open to all and a source of inspiration

Available to all Renault staff members, this room contributes to the development of their potential to innovate and create within a philosophy of '**serendipity'** (the act of finding a solution by chance, like Archimedes did in his bath).



Topical exhibitions are held in the Innovation Room twice a year. They offer the opportunity to present innovative objects from every sector of the industry – excluding the car itself – in an engaging manner aimed at **generating fresh ideas**.

The way the Innovation Room operates is founded on organised visits, themed conferences and creative meetings. The topics discussed alternate between business-related issues and ground-breaking themes (current technological evolutions and major societal trends).

Examples of exhibition topics:

- Company-related themes: save the materials, Emotion, Perceived Quality.

- Ground-breaking themes: Play the Game (gamification), Maker generation (when the consumer becomes the actor/creator).

More specifically, the current exhibition, 'Maker Generation' is based upon the do-it-yourself culture: in a world in which digital platforms and electronic components enable everybody to make, adjust, manipulate and create objects, consumers are increasingly eager to go further than before. They will want to acquire the manufacturers' technical data to be able to share them and enhance them to their own tastes.



RENAULT CREATIVE PEOPLE: innovation is everyone's business at Renault

Renault Creative People is an internal creativity initiative dedicated to innovation that is based upon the company's information technologies: intranet, shared spaces, etc. The objective is to allow all Renault Group staff – wherever they are in the world – to put forward ideas for innovations, work through them and play an active role in their implementation.



Renault Creative People consists of three main pillars:

- A forum that invites ideas on the intranet, which periodically calls upon all staff to suggest ideas for innovation on a precise theme. Two calls for ideas were made in 2014.

Requests for ideas can be made following topical exhibitions in the Innovation Room: Emotion, Connected vehicles, CO_2 / environment and universal design (taking into account the issue of disability) are some of the themes that have been covered in recent years.

We can similarly raise calls for ideas on topics specific to the business, such as reducing vehicles' fuel consumption and CO₂ emissions, connected lifestyles, new services, social business, biomimicry, etc.

The ideas hosted on the forum are reviewed by a jury that filters, evaluates and redirects the best of them towards incubators where they are worked upon in sharing zones. Each call generates on average 200 eligible ideas.

- **Incubators** delve deeper into the best ideas arising from the forum by allowing interested parties to get together where they can bring their contribution to a specific idea in a shared working zone called "Creative lab".

- **The ideas workshop** is the place where the subjects worked upon in the incubator are reviewed each week. The ideas workshop acts as a place for free exchange, where constructive criticism and encouragement are the key words, without any taboos and in a good-humoured environment.

CREATIVE LAB: giving form to ideas

An idea can sometimes look good on paper but not necessarily translate so successfully across to real life. The Creative Lab is a place that is open to everybody and where staff come together to physically shape their ideas and exchange views with potential contributors.







As an example, discussions within the Creative Lab enabled Renault to launch a smartphone application that evaluates how suitable it would be for a driver to switch from an internal combustion-powered vehicle to an electric vehicle.

2. Opening up to the outside world for inspiration and to reinforce the company's vision

A COMMUNITY OF INNOVATION: focusing the mind on ground-breaking innovations

"Understanding and sharing what works, providing a catalyst for fresh encounters, creating new knowledge: Through our Innovation Community, we share with our partners and peers best practice in innovation management, in a context that extends beyond the automotive sphere. The objective is to build a vision of the future together and prepare our ecosystem for ground-breaking innovations." **Dominique Levent, Director of Strategy and Creativity.**



The innovation community is composed of Renault experts, automotive partners (Michelin, Valeo, Visteon) and specialists in other domains (SNCF, EDF, CEA, Safran, La Poste), as well as consultants and academics (Ecole des Mines, Ecole Polytechnique, CNAM, Strate Collège, Les Ateliers ENSCI and even HEC Montréal).

First achievement: a shared vision of electric eco-mobility through the study of energy consumption at an underground station running with electric vehicles connected to the station grid.

RENAULT AT THE HEART OF SILICON VALLEY:

Renault has established a watch group which follows the major trends at the heart of Silicon Valley, composed of around 15 people. Indeed, this eminent hub of global innovation is an unparalleled source of inspiration for Renault, as the company closely monitors technological developments, working in collaboration with the area's key players. Drawing fully upon the technological trends of the moment, the first innovation projects emerging from this satellite will nurture and enrich Renault's innovation agenda throughout the years to come.

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