PRESS RELEASE

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2010 ENVIRONMENT WORKSHOP

RENAULT: A DRIVING FORCE BEHIND SUSTAINABLE MOBILITY FOR ALL

Renault is taking a pioneering stance on the issue of sustainable mobility for all, as well as on ensuring that the automobile remains a means of allowing mankind to progress. Its brand signature 'Drive the Change' symbolizes the firm's ongoing bid to reduce the ecological footprint of automobiles throughout their lifecycle, from their design and production, to their use on the road and the end of their useful working life.

Acutely aware of the importance of the stakes regarding global warming, Renault has been working for many years to curb the CO_2 emissions of its models – throughout their lifecycle – in order to reduce the automobile's ecological impact. Meanwhile, as its environmentally respectful Renault eco² policy demonstrates, Renault believes it is essential to make the most effective technologies available to as many motorists as possible, at prices they can afford.

This ongoing effort enables Renault to stand out today as a real leader, thanks to a complete range of vehicles – powered by a variety of energies, from petrol and diesel, to gas and electricity – which have become increasingly ecological with each generation to emerge as the most efficient in Europe in this domain.

Renault's 2010 Environment Workshop is a chance for the brand to showcase the progress it has achieved across its vehicles' full lifecycle through the Renault eco² programme.
➔ Design – Renault is working on two fronts in its bid to become the best-placed European car manufacturer in terms of CO_2 emissions thanks to:

- **the introduction of new technologies for internal combustion engines and conventional transmissions.**
- **an unprecedented commitment to electric powertrains. Renault estimates that electric vehicles will account for 10 per cent of the world market by 2020. The Alliance is investing €4 billion in its zero emissions programme and a 2,000-strong team (1,000 at Renault, and 1,000 at Nissan) is already working on electric vehicles.**

The best of Renault's current range in terms of fuel consumption/emissions, as well as new technologies and prototype electric vehicles (Renault Fluence Z.E. and Renault Kangoo Express Z.E.), are available for road tests.
The technology these vehicles feature is very similar to that employed for the upcoming production electric cars currently under development. The sale of these electric vehicles – which represent a clean break solution aimed at putting zero emission mobility within the reach off all motorists – will begin in 2011.

➔ Production – In addition to the ISO 14 001-certification of its factories, new avenues are constantly being explored to achieve even further water and energy consumption savings, and also to cut waste.

➔ On-road use – Renault is about to launch an extensive eco-driving tuition programme for fleet operators and ordinary motorists alike.

➔ End-of-life – Renault has become a major player in France in the realms of recycling and the recoverability of plastics, metals, etc.

- Photos and pictures available on the site Media of RENAULT : www.media.renault.com
- Videos available on the site : http://thenewsmarket.com/Renault/

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RENAULT: AN ARCHITECT OF SUSTAINABLE MOBILITY FOR ALL

The key challenge today resides in the ability of a group like Renault to put vehicle technologies capable of achieving real emissions savings within the reach of all road-users and to enable people across the world to benefit from a wide range of mobility solutions.

To permit widespread access to more ecological forms of mobility, it is necessary to gain a thorough understanding of the issue. And that is the mission, for example, of the Lifecycle Management scheme which has been in place since the Megane II project, as well as of the Sustainable Mobility Institute which was founded by Renault in 2009.

LIFECYCLE MANAGEMENT

Protecting the environment calls for the impact that new services and products make, as well as the environmental and economic situations of the different markets, into account from the design stage. To arbitrate between the different environmental impacts without losing sight of other key factors (such as selling price, safety performance, comfort, cost per tonne of CO_2 avoided, etc.), Renault has for many years based its work on an approach known as Lifecycle Management. This permits the full environmental impact of a vehicle – from the mining of ores, to the sourcing of fossil fuel and the landfill treatment of waste resulting from its crushing at the end of its useful life – to be taken into consideration.

Comparisons are systematically carried out between different generations of vehicle belonging to the same segment. This global view of complete lifecycles enables Renault to focus with even greater precision on a broad spectrum of technologies (electric vehicles, hybridization, fuel cells), as well as on the potential of alternative fuels such as LPG (liquefied petroleum gas), compressed natural gas (CNG) and biofuels – both now and in the future. These alternative sources of energy are deployed taking local resources and market demand into account.

The Renault eco² and Dacia eco² signatures have permitted both brands to raise the issue of lifecycle management with their customers. This dialogue is further encouraged by the environmental measures that are being put into place.

Renault Foundation and ParisTech have joined forces in 2009 to create the Sustainable Mobility Institute to conduct research into the future of personal transportation.

The aim of the cooperation between Renault's engineers and the teacher-researchers and students from ParisTech is to promote research into the conception of innovative mobility systems and to provide future executives and scientists with the educational background they need to meet the needs of manufacturers in the transport world of tomorrow. The Sustainable Mobility Institute is more than happy to strike up partnerships with other businesses and university institutes that wish to take part in this research.

ECO-DESIGN: RENAULT'S COMPANY-WIDE COMMITMENT TO THE ENVIRONMENT

All of Renault's employees are committed to protecting the environment. Economics and ecology must come together to deliver products that can be used by as many motorists as possible.

Building the environment into the design and development process

To effectively reduce the pollutants generated at the different stages of a vehicle's life-cycle, it is essential to instigate action at the very design stage, i.e. between three to five years before the vehicle is brought to market. Some years ago, therefore, Renault adopted an approach based on eco-design, both for its products and its industrial processes. This approach covers the choice of materials, fluid extractability, dismantling operations for recycling, pollutant emissions, fuel consumption, CO_2 emissions and the environmental impact on production.

At the same time, Renault’s engineering centres are developing in-house eco-design processes. Renault aims to include 20 per cent of recycled plastic in all new vehicles by 2015.

THE VIRTUOUS CIRCLE OF RECYCLING

Renault anticipated the recycling type-approval imperatives specified in Directive 2005/64, which sets a 2015 deadline for carmakers to demonstrate that the vehicles they sell are designed to be 85 per cent recyclable. In May 2008, Megane III Hatchback became the first vehicle to obtain global homologation. This was made possible by many years' work on improving the recovery of fluids and materials at the end of a vehicle's life, while careful choice of materials plays a predominant role in eco-design with regard to end-of-life recycling. For example, Megane III Hatchback contains 23kg of recycled material (11.5%) with 16kg for Mégane II. The result is even more striking for New Scenic, which contains 34kg of recycled plastic, compared with 18kg for Scénic II (14%) ; Laguna III 33 kg (16%).

ONGOING REDUCTIONS TO THE ENVIRONMENTAL IMPACT OF PRODUCTION SITES

Since 1997, environmental management policies at production plants have cut:

- energy consumption by 30% (kW/vehicle);
- water consumption by 65% (cubic metres/vehicle), equivalent to 10 million cubic metres;
- waste by 64% (kg/vehicle);
- volatile organic compounds (VOC) by 40% (kg/vehicle);

Protecting natural resources and contributing to limiting global warming

- Cutting energy consumption

All Group sites worldwide are contributing to a strategy of making energy savings and using renewable energies. In 2009, significant variations in production brought down energy consumption. This reduction can be attributed to the efforts made over many years to optimize installations and energy supply contracts.

- Cutting greenhouse gas emissions

Renault is pursuing four main objectives in this area to:

- increase energy efficiency;
- reduce energy consumption;
- switch to alternative fuels;
- develop renewable energies.

Total direct greenhouse gas emissions fell from 755ktCO_2eq in 2003 to 508ktCO_2eq in 2009, a fall of 32% on a like-for-like basis

- Combating emissions of volatile organic compounds (VOC)

The volatile organic compounds (VOCs) released by solvents used in paint shops are the major source of atmospheric emissions generated by Renault's activities. Reducing VOC emissions is a top priority for bodywork assembly plants. In 2009, VOC emissions fell by 10 per cent over the previous year. As a result, the target of 419g/m² set for 2012 was reached in 2009.

- **Cutting production waste**, and pursuing efforts to 'Reduce, Reuse, Recycle and Recover', Renault has adopted a global approach to waste management. The '4R' approach introduced in 2008 set ambitious targets to reduce the residual impact of Renault plants and cut the quantity of waste sent to landfill by 2015. The plant waste recovery rate rose by 20 per cent in 2009 compared with 2003, largely through more extensive recycling of plastic parts.

- **Protecting water resources**

On a like-for-like basis, the Group has halved its water consumption over the past 10 years. Withdrawals totalled 10.6 million cubic metres in 2009, while residual waste (organic matter, suspended solids and metals) has also been halved in 10 years on a like-for-like basis. By gradually deploying R1, R2 and R3 best practices, and by continuing its efforts to cut residual waste, the Group is expected to reduce water withdrawals by a further 15 per cent by 2012 compared with 2007.

ALL FACTORIES ISO 14001-CERTIFIED

All the manufacturing facilities that come under Renault's responsibility are ISO 14001-certified.

The **Somaca** facility (Morocco) received ISO 14001 certification in early 2008. Renault has invested heavily in personnel and equipment to reduce the plant's environmental impact. Meanwhile, a total waste management system that meets European standards was put into place in 2007. In terms of energy consumption, action plans on the manufacturing side have yielded important savings: between 2002 and 2008, the saving per vehicle produced reached 15%.

The **AvtoFramos** facility (Russia) obtained ISO 14001 certification in April 2008, the last of the Group's industrial facilities to do so. Significant attention was paid to raising the environmental awareness of all employees in the facility.

ECO-DRIVING

➔ FOR A SUSTAINABLE 10 PER CENT REDUCTION IN REAL VEHICLE FUEL CONSUMPTION

One of the challenges facing the Renault eco² programme is adapting individual driving behaviours to the potential permitted by the latest automobile technologies. Renault has been running eco-driving awareness operations since 2008. These are aimed at the public at large and involve free tuition, tests on simulators, fun activities for the family and a family eco-driving challenge. Building on the success encountered by these operations, Renault has decided to launch a Driving eco² programme which will initially be reserved for fleet customers, before being extended to 'ordinary' motorists. Through its subsidiary Renault Environnement, Renault has joined forces with Key Driving Competences to develop on-road and simulator training programmes in Europe for drivers

of small vehicles and heavy goods vehicles alike. Local partnerships are being explored with a view to expanding this innovative approach to changing attitudes.

GIVING A SECOND LEASE OF LIFE TO END-OF-LIFE VEHICLES

In 2008, Renault's subsidiary Renault Environnement joined forces with the SITA/Suez Environnement Group to develop end-of-life vehicle recycling in France. Along with SITA, the group has taken a majority stake in Indra, a vehicle management/distribution firm, working with 350 dismantlers across France. In 2009, more than 350,000 vehicles were processed. Renault and SITA are notably developing vehicle dismantling processes aimed at the extraction and recycling of materials that will subsequently be used to produce new automotive parts. These new end-of-life recycling tools and processes are developed and tested at dismantling sites (including two centres in France's Sologne and Nord regions). The combined efforts of the three companies and their partners will contribute to meeting the vehicle end-of-life recoverability target of 95 per cent by 2015.

In 2009

➔ 31% vehicles sold by the Renault Group had CO_2 emissions lower than or equal to 120g/km

➔ 65% vehicles sold by the Renault Group had CO_2 emissions lower than or equal to 140g/km.

The Renault eco² signature is a pledge of Renault's commitment to protecting the environment and enables customers to identify those models of the Renault range that are the most respectful of the environment throughout their full lifecycle, since it indicates that they comply with the three following criteria:

PRODUCTION: Renault eco² vehicles must be manufactured in ISO 14001-certified factories. This certification testifies to a plant's ongoing efforts to reduce the impact of its activity on the environment.

ON-ROAD USE: CO_2 emissions must be equal to or less than 140g/km or the vehicle must run on agrofuels. (195g/km for light commercial vehicle)

RECYCLING: five per cent of the plastics that Renault eco² vehicles contain must be sourced from recycling. Vehicles must also be 95 per cent end-of-life recoverable.

EXAMPLES OF RENAULT eco² VEHICLES	Twingo dCi 85	Clio dCi 85	Mégane dCi 110 EDC	Scénic dCi 110 EDC	Laguna dCi 110
PRODUCTION ISO 14001-certified factory	Novo Mesto (Slovenia)	Flins (France), Bursa (Turkey)	Palencia (Spain)	Douai (France)	Sandouville (France)
ON-ROAD USE CO_2 emissions	94g/km	98g/km	114g/km	130g/km	122g/km
RECYCLING Weight of plastic sourced from recycling	15kg	15.5kg	23kg	34kg	33kg
Proportion of the vehicle's total plastic content	9%	10%	11.5%	14%	16%
End-of-life recoverability	More than 95%	More than 95%	More than 95%	More than 95%	More than 95%

RENAULT'S POWERTRAIN STRATEGY

Renault's longstanding efforts have seen the brand achieve significant, ongoing savings with regard to the CO_2 emissions of its vehicles. It currently figures among Europe's most efficient carmakers in this field.

- In 2009, **65 per cent of the vehicles sold** in Europe by the group (Renault and Dacia) had CO_2 emissions equal to or less than **140g/km** (compared with 60 per cent in 2008).
- In 2009, **31 per cent of the vehicles it sold** in Europe had CO_2 emissions equal to or less than **120g/km** (compared with 23 per cent in 2008).

Renault's ambition for the future is to be a driving force in the field of sustainable mobility for all to ensure that the automobile continues to represent a means of freedom for as many people as possible.
To achieve this, Renault has set itself the target of becoming Europe's leading carmaker in terms of CO_2 emissions thanks to the following work:

- ongoing improvements to fundamental vehicle characteristics such as weight, aerodynamic performance and friction.
- the introduction of new technologies for internal combustion engines and conventional transmissions,
- an unprecedented commitment to all-electric zero-emission* vehicles.

It is expected that nine vehicles in 10 will be powered by an internal combustion engine in 2020.
Renault is continuing to make ongoing reductions to the ecological footprint of the vehicles that make up its current and forthcoming ranges. This is being achieved through the increasingly widespread downsizing of its diesel and petrol engines thanks to the introduction of new technologies which stand to make significant contributions to reducing CO_2 emissions.
As part of its Renault eco² environmental programme, the brand believes it is vital to put the most effective technologies within the reach of as many people as possible, at affordable prices.

1. Improving fundamental vehicle characteristics

One way to reduce CO_2 emissions is to continue working vigilantly on the fundamental characteristics of all the vehicles that make up the Renault range.

➔ Vehicle weight

It has the biggest influence on CO_2 emissions. Over the past 20 years, vehicle weights have been rising gradually as a result of several factors:

- Increasingly strict standards and safety-rating procedures.
- More comprehensively equipped vehicles.
- Improvements to comfort and soundproofing performance.

Together, these three factors have led to an average increase from generation of a given car to the next of between 10 and 20 per cent, depending on model.
Yet the relationship between the CO_2 emissions of a vehicle and its weight is a factor of 1 to 10. In other words, a 10kg reduction in a vehicle's weight will result in a corresponding 1g/km decrease in CO_2 emissions (during road use). Since the turn of the century, vehicle project teams have paid particular attention to minimizing the weight of new cars. Laguna III was the first Renault model to benefit from this work and reverse the trend, with weight savings compared with Laguna II amounting to between 15kg and 65kg, depending on version.

Ways in which vehicles can be made lighter:
1/ Work on the **body structure** (optimization of the gauge of steel panels). For example: laser brazing of the body sides and the use of High Elastic Limit steels.
2/ Reducing the **weight of individual components** (e.g. thinner glass, thinner-walled exhaust pipes, etc.).
3/ The use of **lightweight materials** (e.g. aluminium bonnets, Noryl front wings, plastic composite headlights, thermoplastic tailgates).
4/ The **doubling up of functions** (minimizes the number of parts and fittings required, etc.).

Renault's range stands out today as one of the very best carmaker in Europe with regard to weight.
It is expected that it will be possible to shave between 100kg and 200kg off the weight of forthcoming generations of vehicle, which is equivalent to a potential CO_2 emissions saving of between 10 and 20g through work on weight savings alone.

➔ Enhanced vehicle dynamics

The aim here is to minimize drag in a number of different ways.

- Work on the vehicle's basic forms (frontal area, roofline, etc.).
- Exterior fitments: rear lip spoiler, profiled exterior mirror housings, flexible front bumper lips.
- Lower ride height.
- Front wheel arch liner extension flaps.
- Specific underbody and rear suspension shielding.
- Blocking of the passage of air into the engine compartment thanks to fixed or pivoting flaps.

The combination of all these techniques can improve CdA by up to 10 per cent. It is estimated that a CdA improvement of 0.02 saves 1g of CO_2/km.

➔ Reduced rolling resistance

This is essentially achieved by combating brake rub after the driver has lifted off the pedal and the fitment of low fuel consumption tyres.

2. The introduction of new technologies for conventional engines and transmissions

Renault's ongoing downsizing strategy is aimed at reducing the cubic capacity of its engines in order to bring down fuel consumption and CO_2 emissions, without detracting from performance.

➔ Widespread downsizing of internal combustion engines

Ten years' experience with diesel engines

The optimization of conventional petrol and diesel engines continues to be one of the most economical means of lowering fuel consumption and, consequently, greenhouse gas emissions. Downsizing involves reducing an engine's cubic capacity in order to bring down its fuel consumption without affecting performance. Indeed, smaller, turbocharged engines, whether petrol or diesel, are more efficient and allow significant CO_2 emissions savings to be achieved (approximately six per cent).

The downsizing of engines has two benefits. To begin with, smaller engines reduce CO_2 emissions by improving their specific performance (torque and power per litre). This can be achieved through turbocharging, a field in which Renault boasts considerable expertise. Part of the energy contained in the exhaust gases is used to compress intake air. Recovering energy in this way, plus the fact that smaller engines function efficiently across broader zones (on a given vehicle), enables fuel consumption and consequently CO_2 emissions to be reduced.

Renault benefits from more than 10 years' experience of downsizing diesel engines and, as a result, has made significant progress with successive generations of vehicle.
In the case of Laguna, for example, the 2.2 diesel engine that formerly delivered 115hp in 1996 has today been superseded by a 100hp 1.5 dCi powerplant. This has achieved a saving of almost 70g of CO_2/km, as well as a 35 per cent reduction in fuel consumption (down 2.5 litres/100km) over a period of less than 15 years.

LAGUNA	1996	2001	2007	2010	Difference 1996 → 2010
Diesel engine	2.2 dT	1.9 dCi	1.5 dCi	1.5 dCi	-
Power (hp)	115	110	110	110	-
Fuel consumption (litres/100km)	7.2	5.6	4.9	4.7	**down 35%**
Combined cycle CO_2 emissions (g/km)	190	150	130	122	**down 35%**

The benefits of dCi technology

Turbocharged diesel engines equipped with direct common-rail fuel injection represent the most energy efficient solution today. On average, diesel vehicles consume between 20 and 30 per cent less fuel than a petrol-powered vehicle of equivalent performance.

- **New-generation 1.5 dCi engines**

The 1.5 dCi (type K9K) stands apart in Renault's diesel range. It is the brand's best-selling engine with almost 900,000 units manufactured in 2009, in Valladolid (Spain) and Bursa (Turkey). It is available with several power outputs (currently from 65 to 110hp) and powers numerous Renault (from Twingo to Laguna) and Dacia models. Its simple design and low levels of friction make it **particularly competitive in terms of the performance it delivers for its price.**

Renault's engineers worked particularly hard on tuning the 85hp and 105hp dCi engines to optimize CO_2 emissions without detracting from performance.

- Taller ratios for all gears: the torque and response inherent in the dCi engine have enabled these changes to be introduced without affecting its punchy performance.
- Reduced transmission friction thanks to the use of low viscosity oils.
- Specific engine-mapping aimed at reducing fuel consumption and CO_2 emissions.

Renault is in the process of introducing significant changes to this four-cylinder 1.5-litre engine. The latest evolutions will become available in 2012 and will cut CO_2 emissions by approximately 20g/km.

- **Downsizing the engines of light commercial vehicles:**

Renault's big van range incorporates a new diesel engine: the 2.3 dCi, which is available in a choice of three power outputs – 100hp, 125hp and 150hp – for New Master. It will go on to be available for other Renault-Nissan Alliance vehicles, too.

Derived from the 2.0 dCi (M9R), which notably figures in the Laguna and Espace catalogues, this new engine supersedes the 2.5 dCi (G9U) and the four-cylinder 3.0 dCi diesel (ZD30)[1]. Under the bonnet of New Master, this 2.3 dCi diesel powerplant returns lower fuel consumption (an average saving of 1 litre/100km, and as much as 2.7 litres/100km in the case of the range's rear-wheel drive versions), as well as lower CO_2 emissions (down 10 per cent on average), higher torque (up 30Nm) and the lowest running costs in its class.

This has been achieved thanks to the new block's smaller cubic capacity and the use of a new fuel injection system incorporating latest-generation seven-hole injectors.
This new, versatile 2.3 dCi engine is available for all the different versions of New Master in either front- (transversely-mounted) or rear-wheel drive (longitudinal) form.

Technical characteristics of the 2.3 dCi engine:
- available with front- or rear-wheel drive,
- two types of transmission: manual gearbox or robotized transmission with a twin mass damping flywheel fitted between the engine and the gearbox,
- complies with two emissions standards: Euro4 (without DPF) and Euro5 (with DPF),
- three performance configurations: 75kW and 92kW (with fixed-geometry turbo), and 110kW (with variable geometry turbo).

[1]Not to be confused with the V6 dCi, which is also a three-litre diesel engine. Renault uses this six-cylinder engine for its high-end passenger cars and it will continue to be available for Laguna.

2.3 dCi – Technical Data	
Engine type	M9T
Cubic capacity (cc)	2,298
Bore x stroke (mm)	85 x 101.3
Number of cylinders / valves	4 / 16
Compression ratio	16:1
Maximum power	74kW (100hp) at 3,500rpm 92kW (125hp) at 3,500rpm 107kW (145hp) at 3,500rpm
Maximum torque	285Nm at 2,000rpm 310Nm at 2,500rpm 350Nm at 2,750rpm
Fuel injection	Multipoint, sequential
Emissions standards	Euro4 and Euro5
Transmissions	Six-speed manual Six-speed robotized
Type of drive	Front-wheel drive Rear-wheel drive

- **The future 1.6 dCi 130 engine**

When it reaches the marketplace, this all-new 1.6-litre engine will deliver a power output of 96kW (130hp). This is equivalent to a reduction in cubic capacity of 16 per cent compared with a current 1.9-litre diesel engine of equivalent power.

The downsizing process involved shortening the piston stroke by reducing the size of the crank pin and conrod assembly. The swept volume inside the cylinder is smaller, so less fuel is consumed during each cycle. Thanks to turbocharging and the use of new technologies, performance hasn't suffered at all, however. Downsizing alone results in a saving of 6 per cent compared with the engine it replaces.

The forthcoming dCi 130 (R9M) will be Euro6 ready. It is covered by 15 Renault patents and will be the core C-segment engine, in addition to playing a key role in the brand's D-segment and van ranges. It is a Renault-Nissan Alliance joint development and is due to be introduced in 2011. It will be manufactured at the Cléon plant in France. Combined with the improvements to the forthcoming vehicles themselves (weight, aerodynamics, friction), this engine will enable CO_2 emissions to be reduced by 30g/km, while fuel consumption will come down by more than 20 per cent compared with the current dCi 130.

Downsizing applied to petrol engines:

Renault was one of the first manufacturers to apply the principle of downsizing to petrol engines, and the TCe 100 – which has been available for Twingo, Clio and Modus since 2007 – stood out as a groundbreaking product in its class.

This 1,149cc block delivers outstanding driving pleasure and the fuel consumption of an engine of its size, yet it boasts the power output of a 1.4-litre powerplant and the torque of a 1.6. It is equipped with a low inertia turbocharger and was engineered to provide standard-setting performance and fuel economy for its class. The latest Euro5-compliant version was introduced at the beginning of the year under the bonnet of Clio. Clio TCe 100 emits just 129g of CO_2/km, which is a gain of 8g/km over the former version.

TCe 100 – Technical Data	
Engine type	D4Ft
Cubic capacity (cc)	1,149
Bore x stroke (mm)	69 x 76.8
Number of cylinders / valves	4 / 16
Compression ratio	9.5:1
Maximum power	74kW (100hp) at 5,500rpm
Maximum torque	152Nm at 3,500rpm
Fuel injection type	Multipoint, sequential
Emissions standards	Euro 4 / Euro 5
Transmission	Five-speed manual (JH3)
Models	Twingo, Modus, Clio

Meanwhile, the New Megane range saw the introduction of the new TCe 130 in 2009. This engine boasts the power output of a 1.8 (130hp/96kW) and the torque of a 2.0 (190 Nm), yet its downsized 1,397cc block is exceptionally fuel efficient and respectful of the environment.

TCe 130 – Technical Data	
Engine type	H4Jt
Cubic capacity (cc)	1,397
Bore x stroke (mm)	78 x 73.1
Number of cylinders / valves	4 / 16
Compression ratio	9.2:1
Maximum power	96kW (130hp) at 5,500rpm
Maximum torque	190Nm at 2,250rpm
Fuel injection type	Multipoint, sequential
Emissions standard	Euro 5
Transmission	Six-speed manual gearbox (TL4)
Models	New Megane range

Future modular TCe engines, with power outputs ranging from 90 to 115hp

With the imminent switch to Euro 5 and Euro 6 legislation, petrol engines are poised to become an increasingly attractive proposition, a trend anticipated by Renault's new **TCe** powerplant family. Scheduled for launch in 2012, it is expected to account for 85 per cent of Renault's petrol engine sales in 2015. These 'modular' engines will have a cubic capacity of between 0.9 and 1.2 litres and will be available in three- and four-cylinder form with power outputs ranging from 65 to 85kW (90 to 115hp). A number of vehicles equipped with these engines will emit less than 100g of CO_2/km.

New technologies to reduce the CO_2 emissions of internal combustion engines

Downsizing is poised to continue, and the technique is entering a new phase thanks to the advent of new petrol and diesel engine technologies that will deliver unprecedented performance in terms of low CO_2 emissions.

Six new technologies will significantly reduce the CO_2 emissions of Renault's future engines:

- Thermal management
- Low pressure EGR (exhaust gas recirculation)
- Variable swirl technology
- Variable flow oil pump
- Triple post-injection strategy
- Stop&Start technology

CO_2 savings:

TECHNOLOGY	Estimated CO_2 saving
Downsizing	-5.5%
Low pressure EGR	-3%
Stop&Start	-3%
Variable swirl	-0.5%
Variable flow oil pump	-1%
Thermal management	-1%
TOTAL	**-14%**

➔ Thermal management

The efficiency of a cold-running engine (up to 80°C) is penalized on two accounts:

- When the combustion chamber is cold (because the cooling fluid that surrounds it is itself cold), the combustion process is poor and incomplete, and produces a high quantity of hydrocarbons and carbon monoxide. Fuel consumption suffers, too.

- When a lubricant is cold, it is more viscous, which increases the energy required to pump it around the engine. Along with mechanical friction, this phenomenon has a negative impact on fuel consumption.

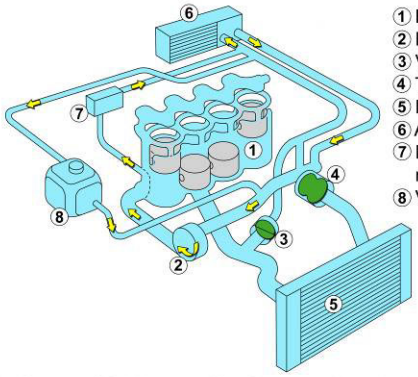
Thermal management speeds up the warming of the engine.

The system comprises a solenoid valve located in the cooling circuit upstream of the cylinder head and cylinder block. When the engine starts from cold, the valve is closed and prevents water from circulating around the combustion chambers. This causes the engine to warm up more quickly.

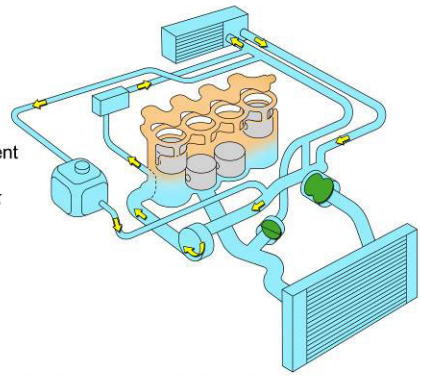
Once the optimal temperature has been reached, the valve opens and cooling reverts to the normal mode, allowing cooling fluid to flow through the cylinder block and cylinder head to control the temperature of the engine's components and ensure their reliability.

Thermal management ensures enhanced combustion and reduced friction inside the engine while it is warming up. It is estimated that this technology delivers a CO_2 emissions saving of one per cent.

Thermomanagement

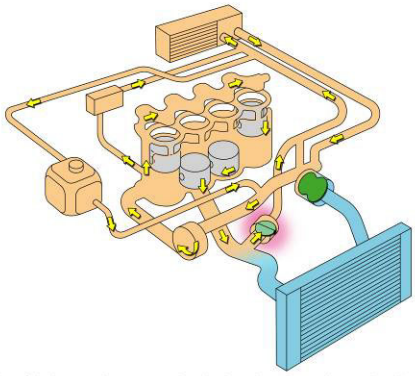


① Moteur - *Engine*
② Pompe à eau - *Water pump*
③ Vanne - *Valve*
④ Thermostat
⑤ Radiateur d'eau - *Water radiator*
⑥ Aérotherme - *Air heater*
⑦ Refroidisseur des gaz d'échappement recyclés - *EGR cooler*
⑧ Vase d'expansion - *Expansion tank*



Au démarrage à froid, la vanne (**3**) se ferme, empêchant la circulation d'eau autour des chambres de combustion.
*On cold engine start, the valve (**3**) closes to prevent the flow of water around combustion chambers.*

L'absence de circulation d'eau autour des chambres de combustion permet d'accélérer leur montée en température.
The absence of water flow around combustion chambers accelerates their temperature rise.



Une fois la tempérautre optimale des chambres de combustion atteinte, la vanne (**3**) s'ouvre et le circuit de refroidissement retrouve son mode de fonctionnement nominal.
*Once the optimum temperature of combustion chambers is reached, the valve (**3**) opens and the cooling circuit returns to its nominal operating mode.*

Montée en température rapide des chambres de combustion :
- Moins d'émissions de polluants
- Moins de frottements moteur donc moins de CO_2

Quick heating of combustion chambers:
- Less polluting emissions
- Less friction in the engine thus less CO_2

➔ Lower pressure EGR (exhaust gas recirculation)

The use of EGR cuts emissions by recycling exhaust gases and re-injecting them into the combustion chamber to bring down high combustion temperatures and minimize the production of oxygen, two factors which favour the production of nitrogen oxides.

With a conventional (high pressure) EGR, exhaust gases are recovered as they exit the combustion chamber and are still hot as they are re-injected directly into the air intake, mixed with air. Although this minimizes the production of nitrogen oxides during combustion, it raises the intake temperature and reduces turbo pressure, two factors which have a negative impact on energy efficiency.

In the case of low pressure EGR technology, the exhaust gases are recovered further downstream, once they have been through the turbine and particulate filter. They are cooled in a low pressure intercooler which enables them to be recirculated through the turbo mixed with air and thereby increase the turbo pressure. They are then cooled by air in the turbo radiator and used for combustion a second time. This cold loop enables the recirculation rate to be increased, while at the same time lowering the temperature and pressure. Emissions of nitrogen oxides are cut more efficiently than is the case with a high pressure EGR, and engine efficiency is improved. The combustion is of a higher quality and CO_2 emissions are reduced.

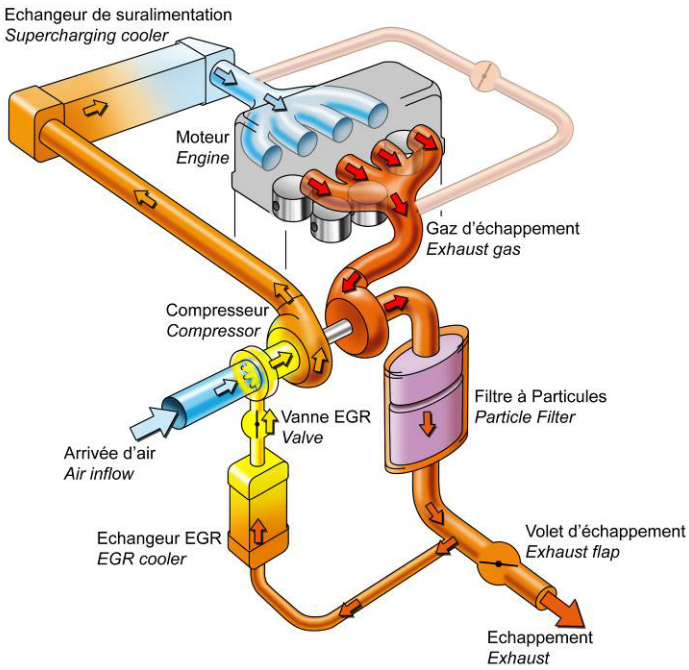
Low pressure EGR technology calls for an engine architecture that minimizes the distance between the catalytic converter/particulate filter and the air intake, an arrangement known as a post-turbo after-treatment system.

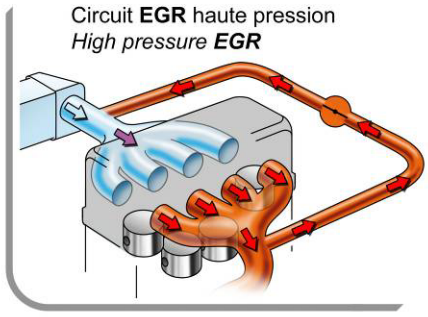
This proximity enables:

- catalytic converters and particulate filters to function at higher temperatures and therefore more efficiently,
- the fitment of a compact and efficient low pressure EGR circuit.

Use of this technology reduces CO_2 emissions by three per cent.

EGR basse pression - *Low pressure EGR*
Recirculation des gaz d'échappement par une boucle froide
Exhaust Gas Recirculation through Cold Loop





EGR basse pression : moins d'émissions polluantes, meilleur rendement de combustion donc moins de CO_2 émis.
Low pressure EGR: less polluting emissions, improved combustion, thus less CO_2.

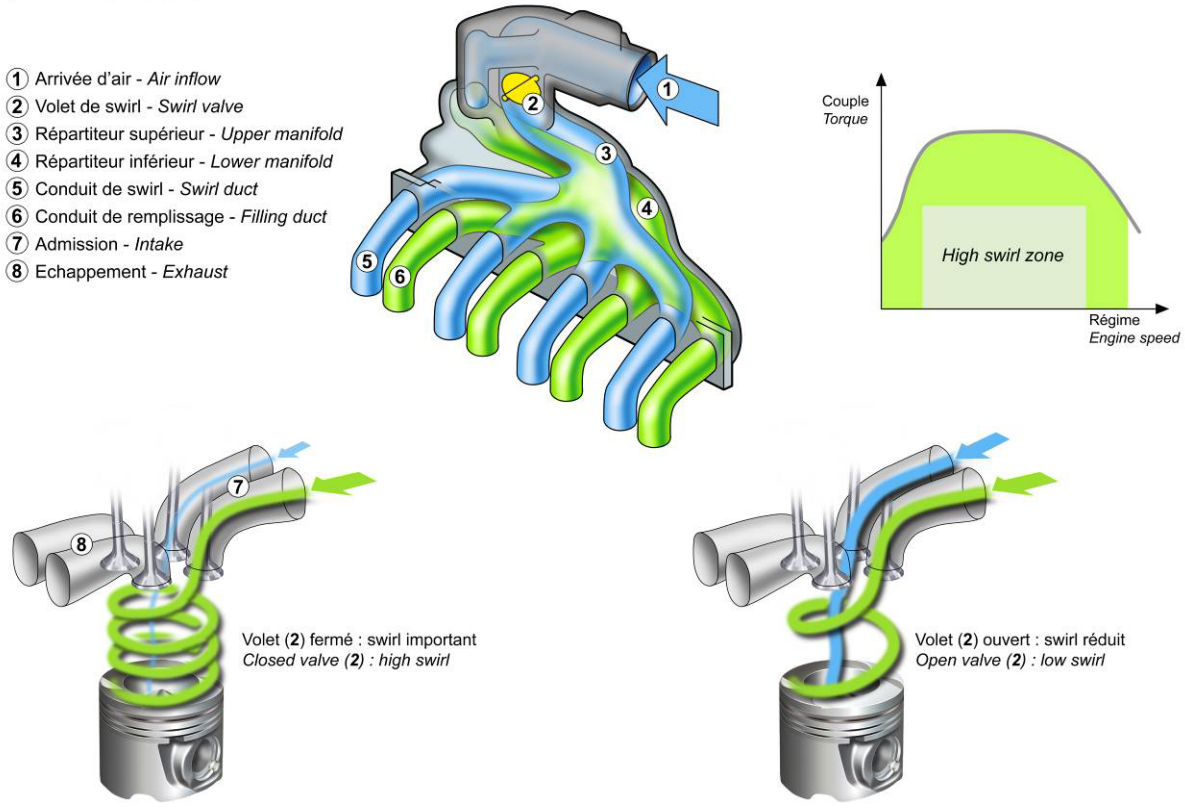
➔ Variable swirl technology

The term 'swirl' describes the phenomenon of air rotating inside the cylinder, much like a cyclone. The swirl is produced during the induction phase and is amplified during the compression phase prior to combustion. Although swirl favours efficient combustion, its properties need to be adapted as a function of engine speed and load if performance is to be optimized.

Variable swirl technology consists in controlling the amount of swirl by means of a flap situated in the upper duct of the air intake. When the flap is in the closed position, gas flows unhindered through the ports that remain open and increases turbulence.

The air-fuel mix is consequently optimised and this reduces fuel consumption, while also minimizing the emission of CO_2 and other pollutants (nitrogen oxides and particulates) at all engine speeds. This technology delivers CO_2 emissions savings of 0.5 per cent.

Swirl variable



Le pilotage du swirl permet d'optimiser le mélange air/carburant
Swirl control enables to optimize the air/fuel mix

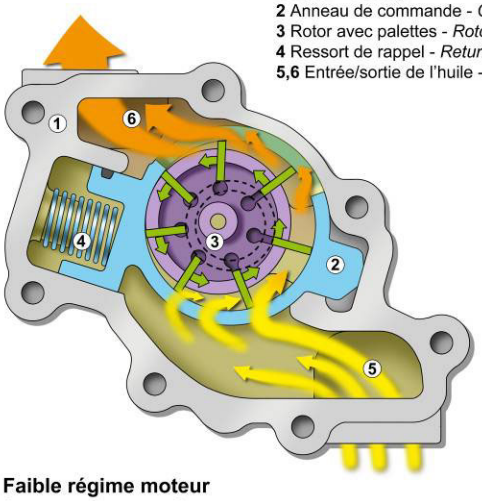
➔ Variable displacement oil pump

This technology allows the capacity of the oil pump to be adjusted as a function of the engine's needs, which notably vary as a function of engine speed, to minimize the pump's energy consumption.

The capacity of a conventional oil pump is fixed and oil pressure is capped by a relief valve. Pumping the oil the engine doesn't need through the relief valve wastes energy, however. Variable flow pumps do away with the need for a relief valve and avoid the unnecessary consumption of energy this sort of valve requires. The CO_2 emissions saving achieved in this way is approximately one per cent.

Pompe à huile à cylindrée variable
Variable displacement oil pump

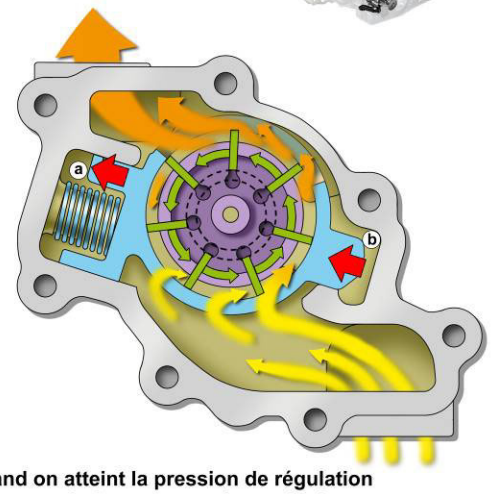
1 Carter - *Casing*
2 Anneau de commande - *Control ring*
3 Rotor avec palettes - *Rotor with vanes*
4 Ressort de rappel - *Return spring*
5,6 Entrée/sortie de l'huile - *Oil in/out*



Faible régime moteur
Low engine speed

L'anneau de commande (**2**) est totalement excentré : la cylindrée de la pompe est maximale.

*The control ring (**2**) has maximum offset: the displacement of the pump is maximum.*



Quand on atteint la pression de régulation
When regulation pressure is reached

Sous l'effet d'une différence de pression entre (**a**) et (**b**), l'anneau de commande se recentre, diminuant la cylindrée de la pompe.

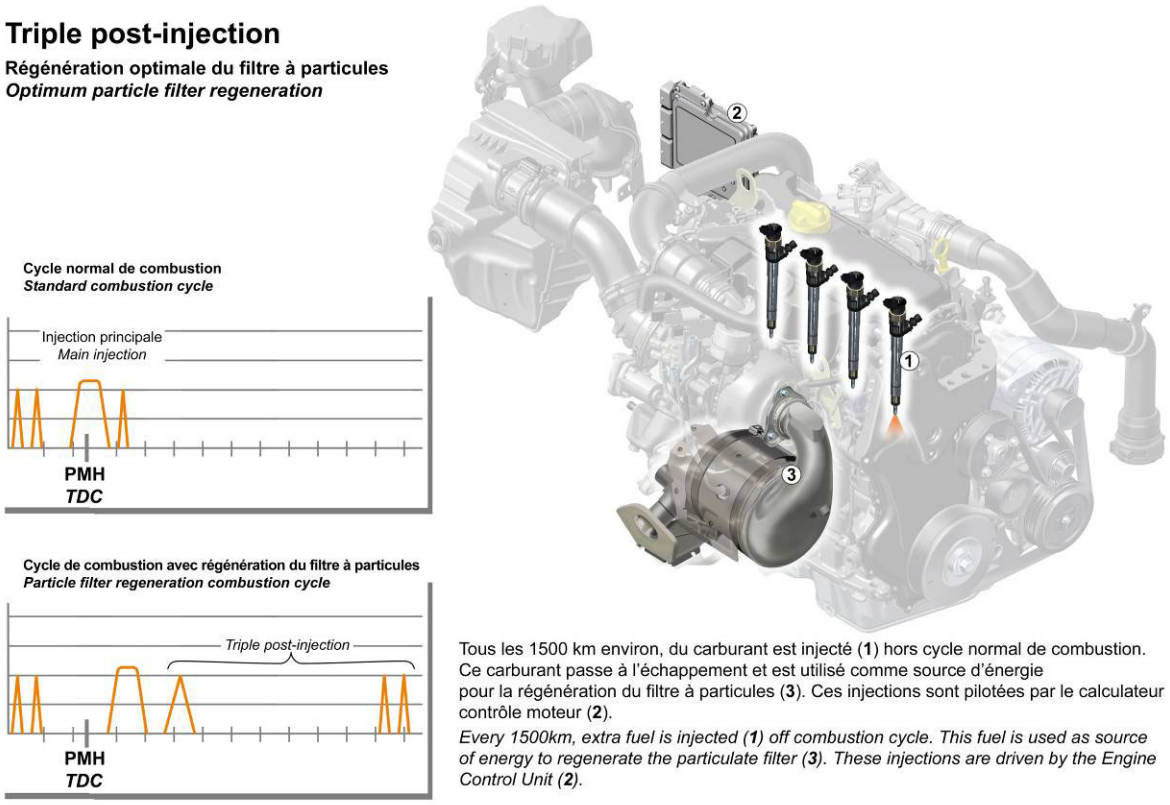
*Under a difference of pressure between (**a**) and (**b**), the control ring tends to center on rotor, reducing the displacement of the pump.*

L'énergie absorbée par la pompe est minimisée : moins de CO_2
Power needed to drive the pump is minimized: less CO_2

➔ Triple post-injection strategy

As its name implies, post-injection consists in injecting fuel during the combustion phase of the four-stroke cycle. Fuel is injected into the combustion chamber at periodic intervals in the form of three very short post-injections which are controlled by the engine's ECU. The fuel used for the last two post-injections produces a reaction in the exhaust line, inside the catalytic converter, thanks to the prior increase in the exhaust's temperature resulting from the combustion of the first post-injection. This enables the necessary temperature for regeneration of the particulate filter to be reached, however the engine is being used.

The triple post-injection strategy is employed to optimize the amount of the fuel used to regenerate the particulate filter and to limit dilution of fuel with the engine oil. It combats CO_2 emissions and permits extended oil change intervals.



Tous les 1500 km environ, du carburant est injecté (**1**) hors cycle normal de combustion. Ce carburant passe à l'échappement et est utilisé comme source d'énergie pour la régénération du filtre à particules (**3**). Ces injections sont pilotées par le calculateur contrôle moteur (**2**).

*Every 1500km, extra fuel is injected (**1**) off combustion cycle. This fuel is used as source of energy to regenerate the particulate filter (**3**). These injections are driven by the Engine Control Unit (**2**).*

➔ Stop&Start technology

As its name implies, Stop&Start technology involves automatically cutting the engine when the vehicle is at a standstill because the engine clearly doesn't emit any pollutants or CO_2.when it isn't running. This system comes into its own in built-up areas and congested traffic.

The system comprises a Stop&Start controller which instructs the ECU to cut the engine when three conditions are met: the transmission in neutral, the clutch pedal released and the car's speed close to zero kph.

When the driver presses on the clutch pedal to select first gear to pull away again, the ECU is instructed to re-start the engine, which fires up instantly, allowing the vehicle to move away. To cope with the engine's repeated starting, the specification of the starter motor is uprated.

This technology permits a CO_2 emissions saving of three per cent

EDC automatic transmission

the driving comfort associated with automatic transmission combined with the fuel efficiency and response of a manual gearbox

- **Renault has developed a new, six-speed, automatic dual-clutch transmission called EDC (Efficient Dual Clutch) which delivers a standard of fuel consumption and CO_2 emissions that marks a significant step forward compared with conventional automatic transmissions (a gain of up to 17 per cent, i.e. a saving of approximately 30g of CO_2/km).**
- **This work is based on the following solutions:**
  - **the use of a dual dry clutch combined with electric actuators – a world first.**
  - **calibration focused on minimizing fuel consumption.**
- **This EDC transmission will be introduced in the first quarter of 2010 and will initially be available for core-range versions of New Mégane (dCi 110 DPF). Thanks to their lower CO_2 emissions, these Méganes will be the brand's first automatic cars to qualify for the Renault eco² signature.**

In recent years, several new types of automatic transmission have arrived on the market, delivering a steady improvement to the overall performance/driving comfort/fuel consumption and CO_2 emissions package. Dual clutch automatic transmissions are an example of this progress.

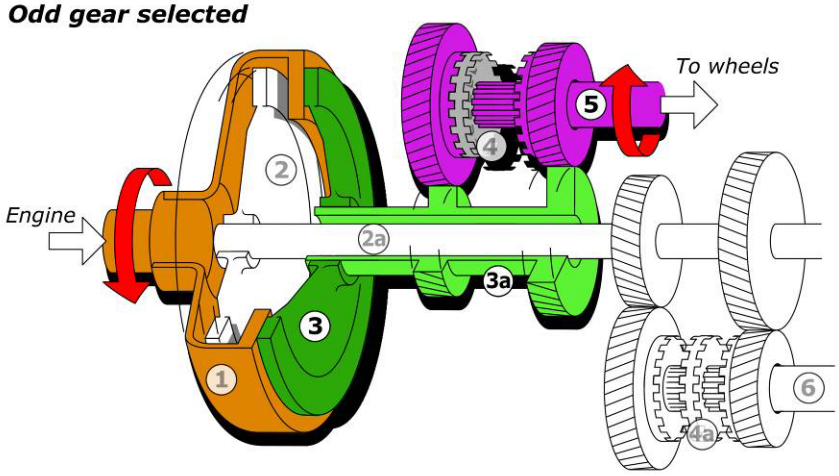
<u>The advantages of EDC automatic transmission:</u>

Renault's new EDC automatic dual clutch transmission dispenses with the need for a clutch pedal, while gearshift control is of the 'P-R-N-D' type, plus an 'up/down' shift mode. The ideal gear is selected by an electronic control unit and gearshifts are both automatic and comfortable.

To optimize efficiency and minimize fuel consumption, Renault has chosen a dual dry clutch system for its EDC transmission. The first of the two clutches looks after the odd-number gears (1st, 3rd and 5th), while the second covers the even-number gears (2nd, 4th and 6th), as well as reverse. The gears are carried by four shafts: two concentric primary shafts (each of which is connected to a clutch) and two secondary shafts. Gears are matched by means of synchronizers, as is the case with a manual gearbox. These synchronizers, like the clutches, are operated by electric actuators which are in turn controlled by a control unit.

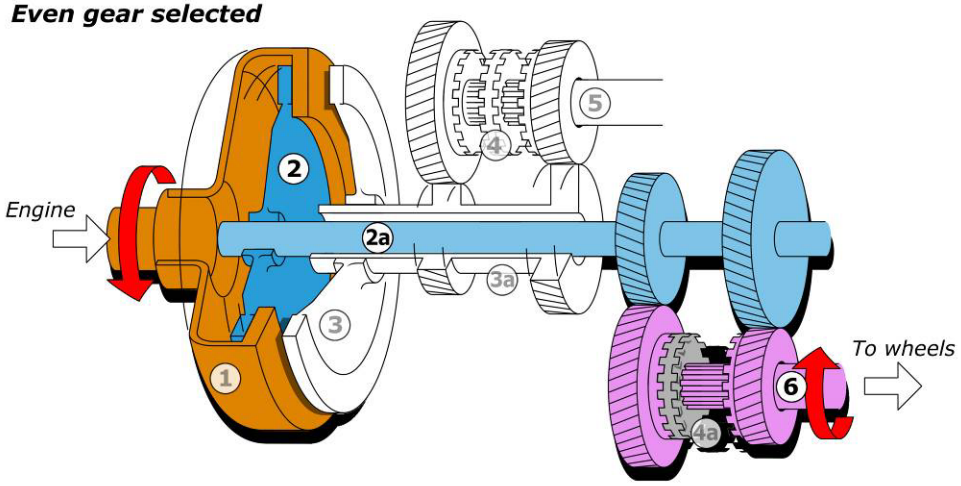
EDC : principle

Odd gear selected



*Odd clutch disc (**3**) is linked to the engine and drives input shaft (**3a**);*
*torque is transmitted to the wheels through the selected gear on output shaft (**5**).*

Even gear selected



*Even clutch disc (**2**) is now linked to the engine and drives input shaft (**2a**);*
*torque is transmitted to the wheels through the selected gear on output shaft (**6**).*

➔ **Fuel consumption and CO_2 emissions performance comparable with that of vehicles equipped with a manual gearbox**

It was this target that steered Renault's engineers in their decisions regarding the new transmission's technical specification:

- **Dual dry clutch** technology was chosen to minimize the parasitic friction associated with wet clutches and the converters of conventional automatic transmissions.
- The two clutches and synchronizers **use energy-efficient electric actuators**.

- **Gearshift calibration has been optimized to achieve low fuel consumption**: the system ensures a swift climb up through the gears in order to select the highest gear possible for a given speed, thereby minimizing fuel consumption and CO_2 emissions.
- Renault's EDC transmission delivers a level of **efficiency similar to that of a manual gearbox**.

➔ **Safe, fluid driving**

Reassuringly smooth, fast gear changes

As with any automatic transmission, gearshifts are carried out under load, i.e. the transmission of torque from the engine to the wheels is not interrupted.

When the vehicle is moving, one clutch is engaged and transmits engine torque via the selected gear, while the other clutch remains disengaged but connected to the next, pre-selected gear. At the ideal moment, the gearshift takes place by switching from one clutch to the other: the first clutch becomes disengaged at the same time as the second clutch engages, ensuring that traction is not uninterrupted during the shift (under load).

Gear changes are fast and free of jarring to ensure a reassuringly smooth ride.

Instant response to the driver's demands:

With its six speeds and ultrafast shift time (290ms), the new EDC automatic dual clutch transmission is extremely responsive and is as enjoyable to drive as a manual gearbox, whether in automatic or 'up/down' shift mode.

In automatic mode, the electronic control unit takes onboard a number of parameters to select the ideal gear. The system adapts instantaneously to the driver's demands by selecting the gear which delivers just the right amount of power the instant it is required.

The driver is free to recover control of the system thanks to the 'up/down' shift mode.

Optimized ‘creep’ control for smoother starts

As with conventional automatic transmissions, the vehicle pulls away gradually when the brake pedal is released. This feature is particularly welcome in stop/start traffic or when parking.

Hill-start assist

When starting on a slope, the system continues to apply pressure to the brakes to keep the vehicle stationary for a few seconds as the driver lifts off the brake pedal. Coupled with the creep control system, this prevents rearward movement to ensure safe hill starts.

This new EDC transmission will initially be available this spring for dCi 110 DPF diesel-engined versions of New Mégane. Equipped with this automatic transmission, **Mégane Hatchback / Coupé / Estate emit just 114g of CO_2/km** (**130g of CO_2 /km** in the case of Scénic, Grand Scénic and Mégane Cabriolet). These will be the first automatic transmission to qualify for the Renault eco² signature.

Technical data

Maximum torque	240Nm
Weight	82kg (including twin mass-damping flywheel)
Length	384mm
Primary shaft, between centres (differential)	188mm
Lubrication	1.7 litres
Gear ratio (1st gear)	15.6:1 (Mégane) 17:1 (Scenic)
Gear ratio (6th gear)	2.4:1 (Mégane) 2.6:1 (Scenic)
Gear ratio spread	6.6
Control unit	Incorporated
Rear-wheel parking brake	Mechanical
Gearshift actuators	Electro-mechanical
Clutch actuators	Electro-mechanical

3. Vehicles from Current Range available for road-test

Renault has four flagship cars from its Renault eco² range available for test drives during the 2010 Environment Workshop, including two which boast CO_2 emissions of less than 100g/km:

- **Twingo dCi 85 Renault eco²**
- **Clio dCi 85 Renault eco²**
- **Mégane Hatchback dCi 110 DPF EDC Renault eco²***
- **Laguna dCi 110 DPF Renault eco²**

** Mégane Hatchback dCi 110 EDC Renault eco² boasts the same CO_2 emissions as Mégane Hatchback dCi 110 DPF mated to a manual six-speed gearbox.*

	Twingo dCi 85 Renault eco²	Clio dCi 85 Renault eco²	Mégane dCi 110 DPF Renault eco²	Laguna dCi 110 DPF Renault eco²
CO_2 emissions (g/km)	94	98	114	122
Combined cycle fuel consumption (litres/100km)	3.6	3.7	4.4	4.7

These reductions in CO_2 emissions have been achieved thanks to a range of engine and vehicle design improvements.

POWERTRAIN: Taller ratios for all gears; reduced engine and transmission friction thanks to low-viscosity lubricants, and work on the geometry and finish of reciprocating and timing components. These developments will be extended to all Euro5-compliant 1.5 dCi engines.

VEHICLE DESIGN: Enhanced aerodynamic efficiency (flexible bib under front bumper, wheel arch extension flaps, rear underbody shielding in certain cases) and reduced rolling resistance (low fuel consumption tyres, less residual brake torque).

A COMPREHENSIVE RANGE OF ALL-ELECTRIC ZERO-EMISSION (DURING ROAD USE) VEHICLES FROM 2011

- Electric vehicles represent the clean-break solution that can put Zero-Emission mobility (during road use) within everybody's reach. In line with the brand's Renault eco² environmental policy, Renault Z.E. electric vehicles are poised to be marketed on a large scale with a view to taking a decisive stand on the environmental front.
- This clean break already enjoys significant political support around the world, notably in the form of tax incentives based on CO_2 emission savings, as well as the development of the infrastructures necessary for electricity-based mobility.
- Renault will begin selling affordable mass-production electric vehicles in 2011.
- The Renault-Nissan Alliance is aiming to be the market leader in sales of mass market Zero-Emission (during road use) vehicles.

In line with the brand's values, Renault's electric vehicles will offer customers a spacious interior, comfort, quality and safety. Renault is also working on the development of battery charging infrastructures that will be operational when the Renault Z.E. models are rolled out.

To develop these solutions, the Renault-Nissan Alliance has entered into a long list of partnerships with governments, energy companies and other organisations, such as Better Place, for example, so that mass-market electric vehicles can become a reality.

THE ALLIANCE'S COMMITMENT TO ELECTRIC VEHICLES

In the 2009 edition of its World Energy Outlook, the International Energy Agency (IEA) explains that, without the implementation of new policies, the global demand for energy is expected to rise by 40 per cent by 2030. Three-quarters of new demand will be catered for by fossil fuels which, in this benchmark scenario, will lead to a one-third increase in greenhouse gas emissions. This would double the concentration of greenhouse gases by the end of the century (equivalent to 1,000ppm) and produce an increase in average temperature of 6°C.

As far as the automobile is concerned, switching to electric vehicles stands out as a clean break solution likely to bring down CO_2 emissions, both at source (by removing the carbon factor involved in the production of electricity) and during road use. This represents a major shift and is notably highlighted in the EV/PHEV roadmap, another document published by the International Energy Agency in November 2009.

The Renault-Nissan Alliance is to market a comprehensive range of high-quality, reliable and innovative electrical vehicles at affordable prices. Renault Z.E. electric vehicles will be particularly quiet-running and generate zero emissions during road use. As such, they will mark an environmental clean-break that is within the budget of the majority of motorists.

This commitment to the electric vehicle is founded on a single, underlying principle: unlike all other technologies (internal combustion engines, hybrids), electric vehicles are genuine zero-emission vehicles regarding their use on the road. They also permit a reduction in oil-dependency.

Although the well-to-wheel emissions of greenhouse gases (expressed as equivalent CO_2) can vary significantly depending on how the electricity they use is produced in the different countries where they are driven, electric vehicles still account for a smaller quantity of greenhouse gases than equivalent internal combustion vehicles.

When the electricity is produced by nuclear or renewable sources (hydro-electric, wind-generated, photovoltaic), the well-to-wheel performance of electric vehicles is indisputably superior. With the electricity generation methods currently employed in Europe, the results are still compelling, since CO_2 emissions are halved compared to those produced by an internal combustion engine.

The carbon footprint is further improved when the car is charged at night, which promises to be the most frequently employed method. This allows customers to:

- profit from electricity when demand is low at night; such electricity often goes to waste because it is difficult to store.
- benefit from appreciable savings by profiting from off-peak tariffs offered by energy companies; in France, for example, off-peak electricity costs 40 per cent less than at peak times during the day.
- use the cleanest forms of electricity (nuclear, hydro-electric, wind power), since thermal power plants are usually on stand-by at night.

Electric vehicles represent a clean-break solution that can put sustainable mobility within everybody's reach. In line with Renault's environmental stance as promoted by its Renault eco² hallmark, Renault Z.E. electric vehicles will be a mass-produced to achieve substantial environmental savings.

SYNERGIES WITHIN THE ALLIANCE

A decade after the establishment of the Alliance, Renault and Nissan stepped up their cooperation in May 2009. This included the creation of a team dedicated to speeding up and broadening the synergies that will enable both companies to improve their performance, and more particularly in the field of electric vehicles.

The electric vehicles produced by Renault and Nissan, for example, will be equipped with batteries developed by AESC, a NISSAN-NEC joint venture. The Alliance has pooled the expertise of Renault and Nissan to strengthen synergies at every level and encourage the sharing of major electrical assemblies, such as powertrains and batteries. Renault and Nissan also share purchasing requirements and have standardized components to generate economies of scale with a view to making it possible to develop mass-market electric vehicles.

Renault and Nissan are working on shared components but, as is the case with their conventional product line-up, will offer distinct ranges of electric vehicles. Each range will be sold separately, through separate dealer networks.

RENAULT-NISSAN ALLIANCE PARTNERSHIPS

The Alliance is entering into partnerships with governments, local authorities and energy companies to drive forward the mass-distribution of electric vehicles worldwide. Up to end-May 2010, the Alliance had already signed about 60 such agreements.

Announcement date	PARTNERS
2008	Israel, **Denmark**, Kanagawa (Japan), **Portugal**, Tennessee (USA), **EDF (France),** Yokohama (Japan), Oregon (USA), **Monaco**, Sonoma County (USA), **EOS (Switzerland**)
2009	**Greentomatocars (GB), Elektromotive (GB), EWZ (Switzerland), One North East (United Kingdom)**, San Diego Gas & Electric (USA), **Electricity Supply Board (Ireland)**, Ministry of Industry and Information Technology (China), **LeasePlan (NL)**, Phoenix, Arizona (USA), Oak Ridge National Laboratory, Tennessee (USA), Hong Kong, Seattle (USA), Raleigh, North Carolina (USA), Singapore, Washington D.C. (USA), **A2A (Lombardy, Italy)**, **Netherlands**, State of Victoria (Australia), **RWE (Germany),** Vancouver (Canada), **Barcelona (Spain)**, Mexico City (Mexico), GuangDong Province (China), Saitama Prefecture (Japan), Miyazaki Prefecture (Japan), Houston (USA), Guangzhou & Dongfeng (China)
2010	**Andalusia (Spain), Reunion Island (France)**, Ryokan Association (Japan), Hertz (worldwide)**,** Christchurch City Council (New Zealand), Orlando (USA), Houston (USA), Massachusetts (USA), Avis (worldwide)**,** ChaDeMo Association (Japan), Wuhan (China), **Castilla y Leon (Spain), Acciona (Spain), ENEL (Italy), ENDESA (Spain), Madrid (Spain), Ireland,** Sao Paulo (Brazil), **Milton Keynes (United Kingdom), Mobi-e (Portugal)**

bold *= in Europe*

BATTERIES

The Renault-Nissan Alliance's battery production strategy

Battery production is poised to become **a core activity for the Renault-Nissan Alliance**. Renault and Nissan will manufacture lithium-ion batteries on three continents – America, Asia and Europe – with a view to supplying the body assembly factories where the forthcoming EVs will be produced from a local source.

This multi-locality arrangement will permit a secure supply flow and ensure logistics-related cost-savings, while at the same time enabling significant production volumes to be turned over. In the longer term, this set-up will allow the Alliance to produce more than **500,000 batteries annually**.

Latest-generation lithium-ion batteries

All Renault's electric vehicles are powered by a latest-generation lithium-ion battery.
The battery comprises 48 power modules, positioned in two rows, side by side. Modules are similar in size to a laptop computer and each one incorporates four elementary cells. It is inside these cells that the electrochemical reactions take place, enabling electrical current to be produced or energy to be stored.
The four cells of each module store 8.4V each, making a combined total of 400V for the 48 modules that make up the battery.
These compact, innovative lithium-ion batteries are produced by AESC (Automotive Electric Supply Corporation), a Nissan-NEC joint venture founded in April 2007.

The performance of these batteries compared with former-generation nickel metal hydride batteries is superior in every domain, including range, performance, reliability and safety.

- Lithium-ion batteries **do not suffer from the so-called memory effect** resulting from incomplete charge cycles which can ultimately lead to a fall-off in capacity in the case of conventional batteries
- The battery is **maintenance-free** and delivers between 80 and 100 per cent of its original capacity for an average duration of six years. It will also be possible to charge it for short cycles with no adverse effect on capacity.
- The battery is cooled by ambient airflow thanks to the heat-dissipation properties of its aluminium casing
- The energy capacity is in break with that of the previous generations: 100 Wh/kg against 25 for a Lead ion battery and 63 for a NiMh battery

Finally, **lithium-ion batteries are recyclable** and the Renault-Nissan Alliance is actively working on establishing recycling processes and infrastructures suited to automotive batteries. It is important to remember that lithium-ion batteries – which are made up of non-toxic materials (lithium, manganese oxide or iron phosphate, and graphite) – do not present any danger for the environment, unlike former nickel-cadmium batteries.

To put the demand for lithium supplies into perspective, the Alliance's AESC 250kg batteries contain just 3kg of lithium. According to the mining companies Chemetall and SQM, worldwide lithium reserves are currently estimated to be between 14 and 17 million tonnes.

RANGE OPTIMIZATION

A key consideration when it comes to electric vehicle performance

Range management is a key consideration when it comes to electric vehicles, and this is why Renault has made a point of making optimization as straightforward and efficient as possible.

A specific MMI (Man Machine Interface) has been developed to keep the driver informed about the vehicle's current state of charge and remaining range:

- a gauge alongside the speedometer displays the battery's level of charge.
- an 'econo-meter' uses a new a new colour-coded system to tell the driver how economical his or her driving is in terms of energy consumption (light blue for 'normal' vehicle use, dark blue for 'optimal' driving and red for excessive energy consumption likely to reduce the vehicle's range).
- The trip computer is adapted to the needs of electric vehicles and indicates the number of kWh remaining, average and instantaneous energy consumption and remaining range (in kilometres).

Driving an electric car can be fun, too, as the driver endeavours to accelerate as gently as possible with a view to minimizing energy consumption and maximizing range.

Three battery-charging techniques

- A standard charge using a conventional plug via the household mains supply or at the workplace (between six and eight hours).
- Fast charge: permits batteries to be charged to 80 per cent of their capacity in 30 minutes.
- Battery exchange stations: rapid battery exchange in bespoke exchange stations. In Israel, Better Place is currently putting a network of such stations into place. About 100 will be operational in 2011 and they will be compatible with Renault's first three-volume all-electric saloon car, Fluence Z.E.. Other stations will be opened progressively in other countries.

Battery exchange stations are being developed by different partners in different countries. The more electric vehicles there are on the road, the more partners there will be to put this concept into place. The Renault network is ideally qualified to develop this type of facility.

Renault's electric vehicles will be equipped with smart navigation systems that will permanently indicate the battery's remaining range, as well as the nearest charging or battery exchange station.

SAFETY: AN ABSOLUTE PRIORITY

DESIGN

As a major volume manufacturer, Renault has profited from its acclaimed knowhow in the realm of safety to produce electric vehicles that meet the same exacting standards expected of a current heat-engined vehicle. Renault's safety experts have added their own particular line of expertise to that of all those involved in the project. The advanced tools at Renault's disposal include a range of structural dimensioning calculation software, failure and crash simulators, and physical prototype evaluation.

- Battery: the incorporation of a 250kg battery in the vehicle has not been without effect and has called for specific bracing of the body structure in order to protect against impact. Given that the battery is as sensitive a component as a conventional fuel tank, it, too, has undergone bespoke strengthening with a view to ensuring that its modules are effectively protected.

- Wiring : the layout of the electrical wiring has also been optimized with a view to preventing chafing, while the power supply is immediately switched off in the case of a big impact. Batteries should not overheat during everyday use, but their temperature is constantly monitored and abnormal heating is not permitted by the battery's electronic control unit.

- Electromagnetic compatibility (EMC): all the electric, electronic and electro-mechanical equipment employed by Renault's electric vehicles (e.g. the controls for the motor, charger and battery) must meet the brand's own, exacting EMC standards which are even stricter than those dictated by European legislation. Compliance with these demands ensures that the systems of a given vehicle do not interfere with those of other vehicles, and vice-versa.

USE / MAINTENANCE

Owners of electric vehicles may carry out everyday servicing work in compliance with the instructions provided in the user's manual. Safeguards have been put into place to prevent accidents such as electrocution when working around the motor.
As is the case with all types of vehicle, the insulation and waterproofing of the vehicle's electrics have been designed to cover foreseeable driving situations in complete safety (e.g. water crossings).

In exceptional circumstances, such as flooding or immersion, the damaged caused by water will not pose any particular risks, either for people or for the environment.

At speeds of less than 30kph, electric vehicles are extremely quiet, although it should be noted that electric vehicles can be heard beyond this speed – if only because of the road-noise generated by the tyres, in addition to the sound of displaced air. In response to this apprehension, we are currently working on the artificial generation of noise that would be audible, for example, thanks to a loudspeaker located in the motor compartment. Renault's work in this domain anticipates possible forthcoming legislation.

When customers decide to buy new technology like an electric vehicle, it is absolutely essential that they feel totally reassured. The confidence inspired by a brand like Renault – which is widely acclaimed for the excellence of its work on safety, which stands out today as one of the industry's very best carmakers in terms of quality, and which benefits from one of Europe's most extensive networks – gives it a decisive edge over its competitors.

ABOUT THE CUSTOMERS

The four electric cars which make up the range of models that will begin to be introduced from mid-2011 are aimed at distinct types of customer:

- To begin with, **Twizy Z.E. Concept** is an innovative two-seater vehicle which targets city dwellers looking for a safer, more comfortable, zero-emission (during road use) alternative to a scooter.
- **Zoe Z.E. Concept** is a versatile, Clio-sized city car which covers all types of everyday use, from the daily journey to work and school runs, to trips to the shops. It is the core model of the electric vehicle range.
- The third model – **Fluence Z.E.** – targets a third type of motorist. As an electric version of the Fluence saloon car, this spacious five-seater is ideal for single-car families and packs all the appointments expected of a D-segment vehicle (status-enhancing looks, comfort, ample cabin space).
- Last but not at all least, **Kangoo Express Z.E.** is aimed at fleet operators and business customers. It combines the acclaimed strengths of Kangoo, including the same big carrying capacity, with the advantages of zero-emission motoring (during road use). Its missions include serving as a quiet, pollution-free final link in the supply chain for deliveries in built-up areas.

POTENTIAL ELECTRIC VEHICLE CUSTOMERS

Surveys reveal that 50 per cent of versatile, Clio-type hatchbacks are never used for long trips. Instead, they tend to serve essentially for short journeys, although half of owners cover 50km daily (i.e. 12,000km per year based on 240 days' use). In addition to the pleasure owners will derive from driving a Z.E. range car, they will clearly gain financially, too.

Since 2007, more than half the world's population lives in a built-up area, and the curve continues to rise.

Electric cars do not seek to replace all types of use, but they do have a natural role to play as the second car of multicar families in bigger towns and cities.

PRE-BOOKINGS FOR FLUENCE Z.E. AND KANGOO EXPRESS Z.E. OPEN SINCE APRIL 15, 2010

In the month-and-a-half since the opening of on-line pre-bookings via the Renault-ze.com website on April 15, 2010, early interest for Fluence Z.E. and Kangoo Express Z.E. already amounts to 2,500 orders. Interest has come predominantly from private motorists (87 per cent), with some 80 per cent of pre-bookings concerning Fluence Z.E..

RENAULT FLUENCE Z.E.

Prototype versions of the forthcoming Renault Fluence Z.E. available for test drives…

These prototypes represent an intermediate step between the original concept car and the production version, the objective being to demonstrate how much the Fluence Z.E. project has progressed and how easy it is to drive an electric vehicle. Renault Fluence Z.E. will be released for sale in the first half of 2011 in Israel, Denmark and Europe, and will be the C segment's first production three-volume electric vehicle, as well as the world's first car to be compatible with the Quickdrop rapid battery exchange system. It is suitable for both private and fleet use, and will appeal to customers looking for a status-enhancing vehicle that is both economical and ecological.

Renault Fluence Z.E. will be manufactured at the OYAK-Renault factory in Bursa, Turkey, using the same production line as the internal combustion engine-powered versions of Fluence. Production is due to begin in the first half of 2011.

A spacious, status-enhancing vehicle

Renault Fluence Z.E. is a large, three-volume saloon car. Although the prototypes are of the same length as the heat-engined Fluence (4.62 metres), the production electric version will be longer in order to house the batteries behind the rear seats and consequently retain the boot. Cabin space is worthy of that of a saloon car from the next segment up and boasts best-in-class front and rear kneeroom. Fluence stands out from rival three-volume saloons thanks to its sweeping, fluid lines which express sportiness and strength. The comfortable interior features a raft of useful technologies, including smart navigation, Bluetooth telephony, automatic dual-zone climate control, and automatic headlamp and windscreen-wiper activation. Renault Fluence Z.E. also innovates with the incorporation of the exclusive Quickdrop rapid battery exchange system which will enable this large saloon to overcome the range-related constraints inherent in conventional electric vehicles and thereby permit longer than average journey distances.

Renault Fluence Z.E. targets families looking for a spacious, comfortable vehicle and who seek social status through their car.

This vehicle will also figure on the shopping list of fleet operators because of its lower running costs.

MOTOR

Fluence Z.E. is powered by a synchronous electric motor with rotor coil. Peak power is 70kW at 12,000rpm and maximum torque 226Nm. The motor's weight, excluding peripherals, is 160kg. Acceleration performance is responsive and linear, with maximum torque available very early on.

BATTERY

The energy capacity of Fluence Z.E.'s lithium-ion battery is 20kW/h. On the prototype versions, it is located vertically in the boot. In the case of the production version, it will be mounted behind the rear seatbacks in order to free up minimum boot space of 300dm^3. It tips the scales at 250kg.
An energy recovery system will be used to charge the battery when decelerating.

BATTERY-CHARGING METHODS

It will be possible to charge the battery of the upcoming production version of Fluence Z.E. in one of three ways:
- via a household mains supply (10A or 16A 220V) which will fully charge the battery in between six and eight hours. This method is particularly suited to vehicles which are charged at night, since it will permit owners to benefit from the off-peak rates available in certain countries, or at the workplace.
- at quick charge stations using a 32A 400V supply which enables the battery to be charged in approximately 30 minutes.
- The Quickdrop battery exchange system will enable the Fluence Z.E.'s battery to be swapped in approximately three minutes at bespoke battery exchange stations.

CHASSIS

In order to adapt it to Fluence Z.E.'s specific specification (dimensions, weight distribution), the suspension of these prototypes has been modified compared with that of the heat-engined Fluence. The front suspension is softer since electric motors are lighter than all the internal combustion engines available for Fluence. The rear suspension has also been revised to cope with the heavier weight due to the presence of the battery.

TYRES

Renault Fluence Z.E. runs on low rolling resistance tyres. The Goodyear-developed EfficientGrip enables lower energy consumption thanks to extensive work on the tyre's casing. The tread, however, is identical to that of a conventional tyre for high performance road holding and braking, as well as long tyre life.

DIALLED-IN SAFETY

The ABS and ESC electronic driving aids have been recalibrated. On the passive safety front, the body of Renault Fluence Z.E. will be reinforced in order to deliver the same high standard of safety performance as the shorter and consequently lighter heat-engined version.

PRODUCTION

Fluence Z.E. will be manufactured at the OYAK-Renault factory in Bursa, Turkey, on the same production line as the heat-engined versions of Fluence. Production will begin in the first half of 2011. This solution will enable Renault to minimize capital outlay and get production under way quickly, while at the same time guaranteeing a very high standard of quality.

MOTOR	
Type	Electric
Transmission type	Direct drive with reducer and forward/reverse inverter
Maximum power EEC (kW)	70
Maximum torque EEC (Nm)	226
BATTERY	
Type	Lithium-ion
Range (km)	160
STEERING	
Power steering	Electric, variable rate
DIMENSIONS	
Standard wheels (inches)	21
Length (mm)	4,620
Width (mm)	1,809
Height (mm)	1,461
Wheelbase (mm)	2,702
Front/rear track (mm)	1,541 / 1,563
Front/rear overhang (mm)	908 / 1,010
Unladen weight (kg)	1,453
Standard tyres	205 / 55 R16

RENAULT KANGOO Express Z.E.

Based on Renault Kangoo Express, Renault Kangoo Express Z.E. is a zero-emissions mobility concept for business customers. The production vehicle will go on sale in the first half of 2011 in the different European markets where the internal combustion-engined Kangoo Express has established itself as a well-known and highly appreciated vehicle by fleet operators, traders and tradespeople alike. Renault Kangoo Express Z.E. will be manufactured at the firm's Maubeuge plant in France.

Renault Kangoo Express Z.E. prototype

Renault Kangoo Express Z.E. previews the upcoming electric Kangoo, a light utility vehicle aimed at business users. It will be used chiefly for city and suburban use. The length of Renault Kangoo Express Z.E. is 4.21 metres and its carrying capacity stands at three cubic metres. Its asymmetric hinged rear doors and sliding side door provide easy access to the cargo area. The batteries are located in a central position beneath the floor, enabling the electric version of Kangoo to boast the same carrying volume as the heat-engined version.

The upcoming electric production version of Renault Kangoo Express Z.E. is aimed at extremely exacting business users and has been engineered to guarantee a very high standard of reliability and durability. Its outstanding TCO rating (Total Cost of Ownership) makes it a first class solution for small businesses and fleet operators alike. It will also benefit from Renault's extensive experience of utility vehicle production. Indeed, Renault has chosen to manufacture the electric version of the Kangoo Express utility vehicle at its M.C.A. facilities (Maubeuge Carrosserie Automobile) in northern France. Production is due to begin in the first half of 2011.

Renault will manufacture this vehicle on the same line as the heat-engined versions. It will consequently benefit from the same expertise, supplier network and logistical framework as the current Kangoo. The Maubeuge plant has specialized in utility vehicle production for the past 20 years and currently manufactures Kangoo, Kangoo Express and Kangoo be bop. This factory has the capacity to adapt both to the variety of specifications associated with this type of vehicle (short and long versions, with or without windows, etc.) and to demand. The choice of Maubeuge will enable production to get under way quickly, while at the same time guaranteeing a very high standard of quality.

An all-electric vehicle

Renault Kangoo Express Z.E. is an all-electric zero-emission vehicle regarding its use on the road. It does not generate CO_2 emissions, smoke or particulates.

Renault Kangoo Express Z.E. is powered by a 44kW electric motor which boasts energy efficiency of 90 per cent, a figure which is far superior to the 25 per cent of heat engines which suffer from energy losses. This motor revs to 12,000rpm and instantly delivers peak torque, which is a constant 226Nm. Acceleration and pull-away from low speeds are particularly responsive. The electric motor is very quiet, too. The battery of the production version of the electrically powered Kangoo Express will be located beneath the boot floor and will not affect its carrying capacity.

Battery charging

Renault Kangoo Express Z.E. is charged using the socket located behind a flap at the front of the vehicle alongside the right-hand headlamp. Using the ordinary mains supply (10A or 16A 220V), the battery charges in between six and eight hours. This method is perfectly suited to vehicles which are parked up overnight or during the day at the workplace.

MOTOR	
Type	Electric
Transmission type	Direct drive, with front/rear inverter
Maximum power EEC (kW) / (hp)	44 / 60
Maximum torque EEC (Nm)	226
BATTERY	
Type	Lithium-ion
Range (km)	160
STEERING	
Power steering	Electric, variable rate
DIMENSIONS	
Standard wheels (inches)	21
Length (mm)	4,213
Width (mm)	1,829
Height (mm)	1,805
Wheelbase (mm)	2,697
Front/rear track (mm)	1,521 / 1,533
Front/rear overhang (mm)	908 / 1,010
Ground clearance, unladen (mm)	190
Unladen weight (kg)	1,425