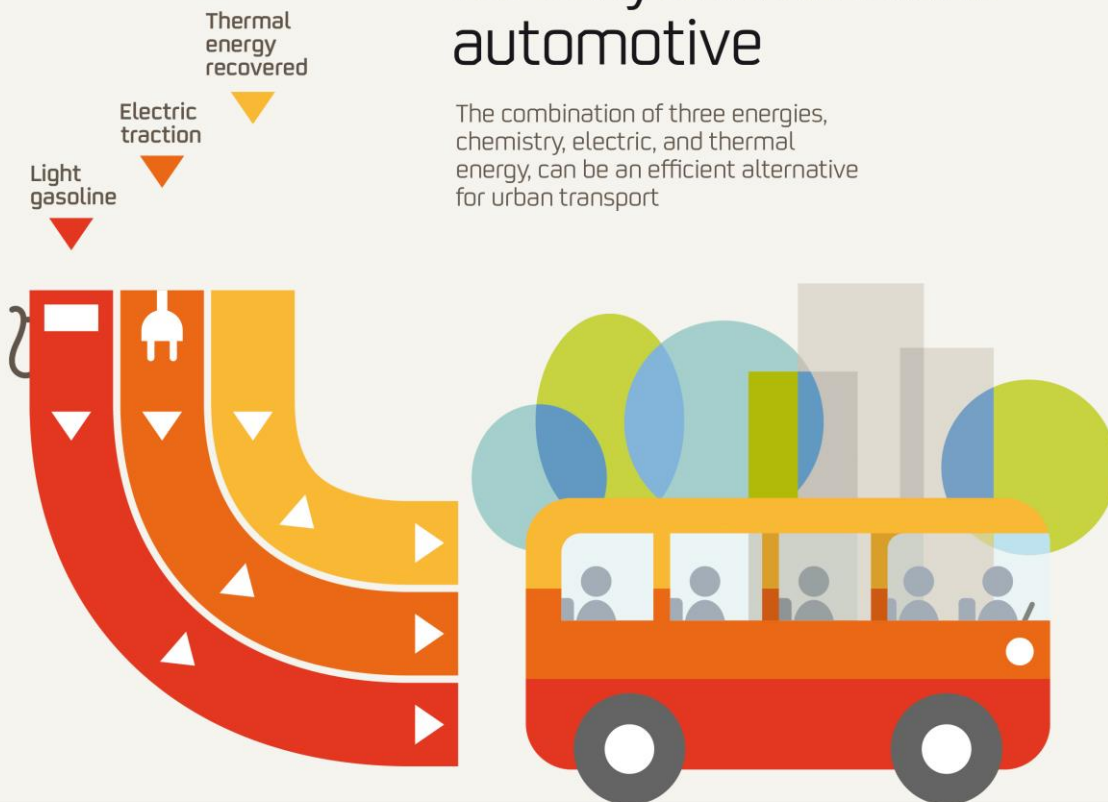


Light gasoline for a hybrid/efficient automotive

The combination of three energies, chemistry, electric, and thermal energy, can be an efficient alternative for urban transport

Particle emissions are almost non-existent, 33 times lower than those from a gasoline vehicle

33 times



The project combines the most efficient technologies: electrification, direct injection of lighter gasoline, and exhaust gas energy recovery

SPAIN 2017: Innovating in hybrid propulsion

The combination of three energies –chemistry, through a light gasoline; electricity, which drives the vehicle; and thermal, recovered from the exhaust gases– can be an efficient alternative for urban transportation. Repsol heads the technology project SPAIN 2017, a collection of Spanish companies and research centers, to develop a hybrid propulsion system that improves the competitiveness of this strategic industry.

The research looks for "an efficient propulsion system for medium-sized vehicles, both for goods and people, designed for urban environments, which is where there is a greater problem with local emissions," explains María Dolores Cárdenas, a researcher at the Engine Laboratory of the Repsol Technology Center and leader of the SPAIN 2017 project.



The result of the project will be a 19-seater demonstration minibus which will offer the same performance as a similar diesel vehicle, without a NOx or particles emissions problem.

33
times

Particle emissions are almost non-existent, 33 times lower than those from a gasoline vehicle



pure electric traction

~~NOx~~

CO₂ ↓

19 seater

INtegrated Advanced Propulsion System (SPAIN 2017)

The Advanced Integrated Propulsion System (SPAIN 2017, for its acronym in Spanish) is a hybrid series that combines the most efficient technologies in the automotive sector: electrification, direct injection, and exhaust gas energy recovery, and a sophisticated control unit capable of managing this combination.

Its traction is pure electric, but it feeds from two sources: a battery that can be recharged externally and a combustion engine that transforms the chemical energy of the gasoline into electric energy, using the crankshaft of the engine to move a generator. The electricity thus produced is either stored in the battery or used directly in the electric traction engine.

This combination allows the vehicle to be used in pure electric mode with zero emissions (of CO₂ and pollutants) from the exhaust pipe, an ideal option for use in the city, while the fuel used in the combustion engine allows for greater autonomy.

Everything adds up in SPAIN 2017, which will not only take advantage of the kinetic energy of braking to produce electricity, but also incorporates two new devices for recovering thermal energy from the combustion engine exhaust gases that will feed auxiliary elements such as windshield wipers, the radio, or air conditioning.

One of these technologies uses thermoelectric materials capable of converting the temperature difference between the inside of the exhaust pipe, which can reach 600 °C, and the outside, with an electric current. A second mechanism uses the thrust of the exhaust gases to rotate a turbine connected to another electric generator, "a system used in Formula 1 but applied to the commercial vehicle here."



Lighter gasoline and lubricant

The project was started by Repsol researchers with AutoGas liquid direct injection technology, which has proved competitive against other alternatives by reducing emissions. The new gasoline, designed specifically for this engine, has of the same advantages as LPG (liquefied petroleum gas or AutoGas): "because its greater volatility, it improves the mixing process and allows for a more complete combustion, producing less CO₂ as a whole."



Repsol researchers have developed a light gasoline that minimizes local emissions

The knowledge accumulated by Repsol in the formulation of fuels both commercial and 'tailor-made' for its competitive teams is behind this gasoline adapted to the combustion of direct injection engines. With the same philosophy, a specific lubricant is being developed in line with the fuel economy oils already marketed by the company, which reduce mechanical losses, and therefore fuel consumption, without the engine losing power.

For María Dolores Cárdenas, the weight of the combustion engine in this propulsion system combined with electrification "shows that it is a technology that will be present in mobility and that will play an important role in the coming years. An engine like this, which works with the new light gasoline, does not have a pollutant emission problem."

Sustainable urban mobility

EU regulations to reduce transport pollution are strict, and both the automotive and energy sectors "have made a great effort since the 1990s to comply with the successive Euro Standards," which have reduced the maximum emission limits for particles and NO_x by more than 90%.

Gasoline engines have risen to meet this challenge and, for this reason, SPAIN 2017 is now looking for alternatives for "a segment typically powered by a diesel engine, such as urban passenger transport or the last mile logistics," whose entry into the cities will be more and more regulated based on their emissions.

An industrial fabric focused on efficiency

Started in 2014, the project will conclude in December 2017 with the presentation of the demonstration vehicle. The five partner companies, Lancor, Infranor, Maser Microelectrónica, the CIE Group, and Repsol, invest in R+D and seek to lead innovation in the various components of the system "and to promote a research and industrial fabric linked to automotive efficiency in Spain."



Five Spanish companies are technological partners of the project, which seeks to boost innovation in the sector

For example, it works to optimize the engine and the electric generator or to lighten the weight of the protective housings of the electric machines using new materials. Also "innovation is complete" in the hardware and software of the control unit, "a determining element because it manages a very complex propulsion system."

Funded with the support of the CDTI, through the CIEN program, and with EU ERDF funds, the research also involves public research centers such as the CSIC and private universities such as the University of Mondragón, Tecnalia, and IK4.

A differentiating element of SPAIN 2017 will be its final optimization "for a typical city driving cycle," thinking about possible customers such as logistics companies, transportation services, or public administrations. Hybridization, already present in tourism vehicles, "is not yet widely applied in other heavier propulsion systems and is a niche of interest," Cardenas concludes.es.