Ouverture de 'Innovation Management in Global Markets – 2'

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Abstract

With globalisation, since the early 80's, the companies compete in open markets with articulated, widespread and highly interconnected organisations (business networks).

The competitive upgrading imposed by global markets determines particular organisational and strategic priorities for corporations.

In the automotive industry, characterized by an intense global competition, the economic instability and the stagnation in sales have stimulated all manufacturers to create competitive alliances and enable global innovation and imitation processes.

To align with the growing attention towards pollution and, more generally, environmental issues, the big automotive corporations have invested substantial financial resources and capabilities in re-engineering power systems; on the one hand focusing R&D towards new power systems (i. e. Full Hybrid and Mild Hybrid), on the other one, developing imitation processes to obtain less emissions and better performance by traditional engines.

Keywords: Innovation Management; Imitation Management; R&D Policies; Business Networks; Global Competitive Advantage; Automotive Industry

1. Overture

With globalisation, since the early 80's, the companies compete in open markets with articulated, widespread and highly interconnected organisations (business networks). These complex structures privilege management capabilities and outsourcing relations with co-makers and competitors (competitive alliances).

> □ *Sharp's history of making one-of-a-kind products is based on its founder's - Tokuji Hayakawa - dream to 'Make products that other companies want to imitate'.*

In global markets, corporate culture evolves towards a cross cultural management, oriented to overcome the physical limits of competition (market-

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space management) and the local roots of the companies. In global markets, corporate culture of the global network makes it possible to create organisations with a constructive uniformity, stimulated and controlled by communication network (Internet, Intranet, Extranet). In addition, a global business culture presupposes multilevel performance assessments that envisage an evaluation of the strategic consistency of organisations' results and processes, complementarity (chairman leadership) and operating harmony (inter-dependence of structures, shared responsibilities, management leadership).

> □ "*In open markets, there is clear evidence of the crucial importance of a competitive approach to the market (market-driven management) and 'cross cultural management', i.e. company management that is strongly profit-focused locally and globally, and not turned inward into the organisation (as is the case in closed, uncompetitive markets) but exploiting the opportunities offered by open markets, i.e. variable demand and the instability generated by competition"* (Brondoni 2010).

> □ "*Increasingly, firms are confronted with innovation competition… The effect of creative destruction, in the Schumpeter sense (1949) is well known. What is new is its acceleration and geographical generalisation"* (Lambin 2000).

2. Business Network, R&D and Global Competition

In open markets, not protected by geographical and administrative boundaries, business networks adopt very flexible management behaviour, drawing on intangible resources, designed to exploit global economies of scale (Doyle 2000; Jaworski et al. 2000; Day 1994). In business networks the search for global economies of scale aimed at obtaining a pro tempore competitive total cost, requires: 1. complex outsourcing functions; 2. dynamic localisation of plants; 3. and finally, a large-scale commercialisation, to tackle local demand that is poorly motivated to purchase, volatile in its choices and non-loyal in its repurchasing habits. (i.e., the typical conditions of oversupply, now exacerbated by rising inflationary pressures and recession).

Globalisation requires corporations to maintain high growth rates, manage the value and develop high profitability, with a faster and faster performance time shrinking. In addition, a growing importance of 'global finance capitalism', requires: a continuous comparison between big players, with common global competitive horizons; the development of managerial skills of flexible adaptation to change; a narrow focus on the 'core business', with an increasing specialisation of management to the problems of globalisation; outsourcing of non-core processes; offshoring of operations; and disposal of marginal business to profitability.

The competitive upgrading imposed by global markets determines particular organisational and strategic priorities for corporations, which include: a continuous reduction of management, with career progression within the networks; the focus of internal and external R&D departments on objects of research and development

very specialized, delimited and characterized by of very low spending and investment return periods.

As a result of competitive pressures in global markets, also the structures of R&D are in fact asked to create alternative value lines to propose research projects and operational plans with distinctive content, but strongly oriented to competition (market-driven management).

Therefore, they develop R&D projects and plans characterized by increasing investments and by corporate policies of open innovation (dominated by global competition and global financial capitalism), which should minimize the risk of failure by crossing the traditional policy of 'supply innovation' (production breakthrough, Schumpeter 1934) with modern imitation policies developed by global firms.

3. Product Innovation and Imitation in the Automotive Industry: Power Systems and Global Competitive Advantage

In the automotive industry, manufacturers have to face a market characterized by an intense and ever-changing global competition.

The automotive industry, in its rapid development since World War II, has experienced several periods of crisis that have influenced its evolution: first one, the oil crisis in 1973 and 1979 with drastic price increases of crude oil (which led manufacturers, especially the Japanese ones, to launch new smaller car models with more efficient engines); secondly the economic and political instability, from 2001 to 2003; and more recently, the violent world economic and financial crisis, which, starting from beginning of 2008, resulted in a drastic reduction in sales volumes and revenues in all segments of the automotive industry.

In recent years, global economic instability and severe stagnation in sales in major markets has stimulated all automotive manufacturers to create competitive alliances and enable innovation and imitation processes in order to mitigate the effects of a global over-supply and to revitalize a product already in mature life-cycle phase.

For these purposes, the big automotive corporations have invested substantial financial resources and capabilities in design and production of new power systems, to align with the growing attention of buyers from the most advanced Nations towards pollution and, more generally, environmental issues.

Experiences of Toyota, Honda, Renault, Mercedes-Benz, BMW and Fiat are examined below.

These case studies represent a large share of global manufacturers in the automotive sector and show an area of activity with close interrelations, where imitation and innovation are key factors for the firm's profitability and for the growth of a global mature market with falling sales and prices.

3.1 The Toyota Motor Corporation Case

The continuous increase of vehicles in circulation and the strict emission standards issued in recent decades by the governments of industrialized countries

have led many automotive manufacturers to invest in R&D to design eco-friendly cars with low emissions.

In recent years, many car manufacturers have focused their research and development of engines with alternative fuels, while some of them have focused on plug-in electric vehicles (PEV), or on projects of hybrid electric vehicle (HEV), characterized by the presence of an electric motor and a conventional internal combustion engine (ICE) powered by gasoline (or diesel). Hybrid electric vehicles performance are quite similar to those of conventional cars, but at the same time they reduce fuel consumption and motor vehicle emission. Furthermore, they don't require the provision of new charging stations because the batteries are recharged by the movement of the vehicle and by the energy produced by the combustion engine.

The results of the research conducted by the end of the 90's by all automotive firms had actually been intuited 40 years earlier by Toyota that, well ahead of competitors, has invested for many years significant resources in research and development of hybrid technology.

Toyota in fact, was the first company in the world, imitated by its direct competitor Honda to enter the Hybrid Car segment, strategic to its potential, taking advantage of experiences, skills and resources to anticipate market trends and meet the needs of consumers (market-driven management). Toyota consolidated management experience in competition orientation have enabled to transform a period of global financial crisis and stagnation of sales in the real chance to establish itself as a first mover and gain a global competitive advantage (*'before and better than competitors*').

The Toyota Motor Corporation was founded in August 1937 by a branch of the Toyoda Automatic Loom Works (founded in 1890), one of the most important textile industries in the world. In November 1938 the first factory opened in Honshu, while the first plant outside of Japan opened in Brazil in 1959. Today the Group controls 14 companies, some of which operate in fields not related to the automotive one, for a total of over 300,000 employees, of which 70,000 employed by Toyota Motor Corporation.

The organisation and rationalisation of the production chain have configured the main 'historic' competitive advantages of TPS-Toyota Production System, which can be summarized in pursuit of the objectives of: costs reduction (in growth, an increase in volume results in the reduction of the variable unit cost, while in stagnation and crisis it is needed to affect fixed costs, for example by using outsourcing and co-makership); elimination of waste, to minimize the excesses of production (over-supply); elimination of stocks by: just-in-time, an effective communication system and the elimination of conflicts; organizational innovation (lean production and global economies of scale).

Within a wide variety of alternative energy sources for automotive, Toyota has developed a dual-fuel cars (HEV), therefore preserving the traditional internal combustion engine joined to a system of electric power, non-polluting.

These innovations have resulted in high investment and risk of default but the Japanese corporation has always considered that the development of hybrid technology would strengthen its corporate social responsibility, with a positive impact on its image globally.

□ *"In recent years, the situation surrounding corporations has changed dramatically. One of the greatest changes is the increasing demand for corporate social responsibility to take on global environmental issues such as global warming, resource depletion and atmospheric pollution. In order to make tangible progress in initiatives that contribute to sustainable development of the environment and society in the future, Toyota is putting forward the "sustainability in three areas" concept, which encompasses research and development, manufacturing, and social contribution. Based on this theme, we are advocating activities that target harmony between people, society, and the earth" (Toyota Vision by Katsuaki Watanabe, Toyota Chairman).*

The first steps were made in 1965, when Toyota began to study the use of a gas turbine combined with an electric motor as an alternative propulsion system. In 1967 the first vehicle with a petrol engine mated to an electric motor was produced (a small bus to transport tourists). Finally, in January 1997, Toyota Motor Corporation introduced the Prius, the first mass-produced car equipped with the THS-Toyota Hybrid System.

Product innovations developed by Toyota in the years, together with imitations and innovation processes implemented with partners and co-makers, led to the full hybrid Prius, which clearly indicated the strategic orientation of the Japanese corporation towards the goal of a fully electric car. In fact, in 2007, Toyota has launched the Prius Plug-in HV, i.e. a Prius with larger batteries for greater autonomy with only electric use. Fundamental aspect of this prototype is that Plug-in hybrid (electric) vehicle are designed so as to allow the charging of the battery also from a conventional 120-volt outlet, in contrast to the normal hybrid that can be charged only by the vehicle's kinetic energy.

Global product innovation related to the development of hybrid and plug-in HV however, must be examined in their complex relationships of R&D to be fully understood. For example, with regard to the global process imitation made by Toyota with the 'by-wire', developed by imitation of the aerospace industry. This system replaces the traditional hydraulic and mechanical connections with electrical connections, providing advantages in weight and space as well as shorter reaction times.

In addition, hybrid engine introduction on a global scale must be compared to global reverse imitation and global reverse innovation on the environmental impact that an 'ecological' car can generate during its life cycle. In this sense, to reduce pollution, Toyota has investigated the possibility of recycling of automobile components, extending the study from design to vehicle scrapping. The key problem in the life cycle of hybrid vehicles is still disposing of batteries, essential components of the HSD. They are processed through Toyota dealers network that act as collection points, from where they are subsequently shipped to certified recycling companies.

3.2 The Honda Case

While Toyota, on the one hand, concentrates its R&D investments exclusively on the hybrid and the electric car, Honda, on the other hand, has two different strategic orientations: one in the long term and one in the short term.

Honda short-term policies are in fact focused on global product imitation, namely hybrid vehicles production to take advantage of Toyota global success, with Civic Hybrid, Accord Hybrid and more recently with the low cost sedan Insight. Civic, Accord and Insight are the first models of a range of modern eco-friendly vehicles. Finally, at the Tokyo Motor Show 2008 Honda unveiled the hybrid compact coupe CR-Z -Compact Renaissance Zero, to dispel customers prejudices towards the design of hybrid cars.

The entry of Honda in hybrid cars industry is therefore not a policy of me-too product against Toyota (market leader, with a share of about 90 per cent), but rather identifies a company policy of growth based on imitation and product innovation.

In fact, the technical choices of Honda differ significantly from those of Toyota: the latter has developed a full hybrid (where two motors can exchange energy flows), while Honda has adopted a mild hybrid system called Integrated Motor Assist (IMA), in which the electric motor supports the internal combustion engine.

Honda short-term development policies, based on the global product imitation of hybrid engines, support long-term corporate policies, guided by the objectives of global product innovation, which provide for the production of zero-emission car exclusively powered by hydrogen (FCX Clarity project). In fact, Honda is the world leader in hydrogen powered engine technology, as shown by the project FCX Fuel Cell-Xperimental.

The fuel cell enables the conversion of hydrogen and oxygen in electrochemical energy and heat without any internal combustion process. The two main advantages of this technology are the inexhaustibility of hydrogen and the absence of harmful emissions. The Honda FCX Clarity is the first car powered by hydrogen fuel cells deriving from the FCX prototype. The vehicle is driven by an electric motor of 100 kW (136 hp) powered by fuel cell, where hydrogen combined with oxygen generates electricity used to power the vehicle. The project has been under development since 1999 and have made three different prototypes so far. The final version, unveiled at Los Angeles Auto Show 2007, was launched in California and in Japan (only for government agencies and other institutions) in 2008. A global scale production should start by 2018, although fuel cells technology complain considerable difficulties with effective diffusion because of the lack of an extensive hydrogen stations network.

However, the innovation and imitation are a constant reality in Honda's development policies. In fact, the company's founder, Soichiro Honda started the business in 1937 as a manufacturer of pistons and soon became one of the suppliers of Toyota. Later, at the beginning of the 50's the company had an ingenious intuition: mount a small-displacement engine on a bicycle thereby creating a simple and economical means of transport. The invention was a success and the company began to produce different models of mopeds and motorcycles, which conquered the Western markets since the 60's. Honda applied numerous innovations in motorcycles and mopeds, surpassing the technology of the most quoted English and

Italian manufacturing companies and in the 70's became the world's largest manufacturer of two-wheeled vehicles.

Honda's unconventional, both product and process, innovation and imitation, led the corporation to diversify the business, starting the car production in 1960, initially only for Japan. Then, sales were extended successfully to the United States and Europe. In fact, a sudden increase in oil prices, caused by the first oil crisis, made appreciate the small Japanese cars for their exceptional operating cost-effectiveness. Since then, the presence of Honda has strengthened to become one of the leading car manufacturers worldwide, thanks to its ability to seize emerging market opportunities.

3.3 The BMW Case

BMW, for many years, led the energy development strategy towards an overall improvement of its car efficiency, finalising the R&D activities to an improvement of traditional technologies and to development of cutting edge solutions for sustainable mobility. In this sense, with the project called 'Efficient Dynamics', the consumption and emissions have been reduced by: the introduction of a new and efficient generation of engines (with a direct injection), the adoption of the *Auto Start Stop* (stop & go); the recovery of the kinetic energy of braking to power the battery, the adoption of the gear indicator, in order to reduce the fuel consumption; the use of tires with low inertia; the insertion of electrically operated fins to optimize the entry of air to the radiator and to minimize the aerodynamic resistance; the design of new airfoils; the use of lightweight materials.

In the long term, however, BMW research activities on engines seem to support hydrogen technology applied to traditional combustion engines (Clean Energy Strategy). In this perspective, in recent years the 'Hydrogen 7', the first luxury car in the world both hydrogen and gasoline powered, based on the "760i" long wheelbase, has been unveiled. The presence of two tanks (one with a capacity of 74 liters of gasoline and the other of 8 Kg of liquid hydrogen maintained at a temperature of - 250° C) ensures to travel about 700 Km (of which more than 200 viable in hydrogen mode). The dual power 'Hydrogen 7' then summarizes the research strategy of BMW: to embed hydrogen power into reliable and tested traditional engines.

3.4 The Mercedes-Benz Case

Even for Mercedes-Benz, the research activities are aimed at ensuring sustainable mobility on high levels, involving the entire production process, from raw materials to propulsion systems with low emission and recycling of materials (True Blue Solutions). In particular, *BlueEFFICIENCY* project encompasses numerous technologies to optimize fuel consumption and to reduce harmful emissions. For this reason, the innovation and imitation processes are mainly focused on the development of engines, as in the case of BMW, and mainly concern: efficient energy management, with the recovery of braking energy; the *ECO start / stop*, turning off engine at traffic lights or in a jam, which reduces emissions and fuel consumption; the use of tires with low rolling resistance; the introduction of direct

injection, the use of lightweight materials to reduce the weight of vehicles; the development of aerodynamics.

Further development activities are concentrated on BlueTEC project, aiming to reduce the environmental impact of diesel engine, given its leading role in the European market. The project was started in 2007, with the E 300 BlueTEC, and in 2008 were introduced *Sports Utility Vehicle (SUV)* Class R, ML and GL 320 BlueTEC, prepared for the American standard BIN and Euro 6 standards, scheduled for 2015.

Mercedes-Benz R&D, as well as the development of conventional engines, in the long term is oriented to alternative fuels engines design. In this context, an important project concerns the *NGT-Natural Gas Technology* which provides bivalent petrol and CNG engines whose main benefits are: low fuel consumption, low operating costs and ease of use.

The long-term strategy for research and development also provides for the project 'modular propulsion technology' (*BlueHYBRID*) with hybrid engine of both a gasoline engine and the electric one. The compact hybrid module is constituted by an electric disc-shaped motor, which performs the functions of alternator and starter. During deceleration of the vehicle, the electric motor generates energy and accumulates the energy of braking. Unlike Toyota and Honda (which have focused R&D on hybrid petrol-electric engines), Mercedes-Benz, with the *BluetecHYBRID* project develops the combination of an electric motor and one diesel Bluetech.

Finally, in the context of long-term policy of product innovation, Mercedes-Benz is continuing its research on hydrogen powered engines (fuel cell), aimed at eliminating the use of oil and the resulting pollution. The research in the field of fuel cell technology began in 1994, and Mercedes has continually invested in product innovation of hydrogen propulsion. Today, Mercedes-Benz claims to have experience of nearly 4 million kilometers with more than 100 test vehicles, which is the largest fleet of fuel cell vehicles.

3.5 The Renault Case

In 2007 Renault introduced the *eco2 project*, establishing the basic criteria that car production must comply with to reduce environmental impact: CO2 emissions below the limits set by the EU authorities in 2010 (140 g / km), or ethanol or biodiesel power; manufacturing establishments with certified international standards for safety and environment (for example, reduction of water consumption, harmful emissions, use of chemicals and waste and scrap); high recyclability of vehicle components and reuse of plastic and other materials in the manufacturing phase.

Renault short term research and development activities are addressed 'to leave fewer pollutants traces', while in the long term are aimed at designing new technologies for the production of a 'clean car'. As part of this goal, in March 1999 Renault entered into an agreement (competitive alliance) with Nissan, to achieve a 'clean car', not linked to hybrid or diesel. According to this agreement, Renault would have dealt with the diesel engine and ethanol, while Nissan, thanks to its extensive know-how, would have dedicated to fuel cell and hybrid engines.

> □ *"The Nissan Green Plan 2010 sets out in a transparent way the future commitment to eco-friendly management. The Environmental Action Plan is divided into many tasks and objectives, going from the production of environmentally friendly cars to the establishment of less polluting factories. It has been designed to provide answers to immediate challenges, but also to give life for a sustainable business model in the long term. The project, in particular, aims at developing a Nissan hybrid car, at the energy efficiency of the gasoline engine improvement, at new cleaner diesel engines development, but also at the use of engines based on fuel cell, ethanol and especially electric propulsion" (Toshiyuki Shiga, Chairman Nissan, December 2006).*

For Renault the global product innovation is still represented by the electric car, which is the real long-term solution to air pollution.

> □ *"All the pieces of the puzzle are in place for making a mass-production vehicle in the near future: battery range, optimyzed energy consumption, performances and driving pleasure" (Carlos Goshn, CEO Renault-Nissan, May 2009).*

The electric car in fact has obvious advantages such as: a sale price equivalent to that of diesel cars (batteries are leased); usage costs lower than those of the cars with a combustion engine, for the cost of electricity significantly lower than oil; high performance engines, with low maintenance costs. Given these advantages, however, there is still the problem of a limited battery life. In order to overcome this limitation, the Renault Group devotes considerable annual investments in R&D for a new lithium-ion battery and for the study of an innovative charging mode, more practical and fast, like the 'quick drop' (i.e. a machine that removes the battery and replace it in about three minutes with a charged one).

3.6 The General Motors Case

General Motors, one of the largest car manufacturers in the world, in recent years has accumulated significant losses and since 2008 has lost the leadership of the first carmaker in the world for sales, surpassed by Toyota.

Innovation and ecology, as indicated by President Obama, are the guidelines for the development of the company to regain world leadership. To achieve this, GM has oriented short term R&D strategy towards the development of engines fueled with gaseous fuels, especially LPG. In fact, since 2005, with the acquisition of the automotive division of Daewoo (renamed under the Chevrolet brand) and the equity alliance with Fiat, on the European market, where it is a leader in the production of LPG powered cars, it offers the possibility of double power across the entire range.

In the long term, however, GM has adopted a policy of product innovation regarding the electric motor. With this in mind, at the 2007 Detroit Auto Show was unveiled the prototype of the Volt, which Chevrolet has been producing and selling since 2010.

With the Volt a new phase of development of electric cars begins, which derives from the design of an innovative class of vehicle with extended range called *E-REV*

(Extended-Range Electric Vehicle). The Volt is a car with an electric motor, with a range of about 60 km, also equipped with an internal combustion engine that can run on both petrol or bioethanol.

Volt is a 'lonely' experience among the great North American car manufacturers (GM, Ford, Chrysler) that are still involved in the construction of large cars with impressive fuel consumption. In other words, Volt expresses only a symbol of the socio-environmental responsibility of GM, while representing a major global product innovation focused on solving the global energy and environmental issues.

3.7 The Fiat Case

Fiat has launched several years ago, in collaboration with Fiat Powertrain Technologies and Magneti Marelli, intensive research on various engineering solutions aimed at developing new power systems. Among these, it is important the design of an engine aimed at downsizing (i.e. the design of high-performance engines with reduced displacement). In this context, it was made a 2-cylinder turbo petrol engine 900cc (with power up to 105 hp), with MultiAir technology (i.e. a system of control of the intake valves that increases performance and at the same time reduces fuel consumption and emissions).

On selected models, the Multiair engine technology is associated with dual petrol-methane and hydrogen-methane power. It also includes: the 'Start & Stop' device; recyclable or of natural origin materials, for the interior and for the body; tires with low rolling resistance; and finally the eco-drive system, which allows to record consumption on a USB memory, analyses the driver's style and provides recommendations for environment careful driving.

FIAT then directs the research and development activities on technologies that are already known and available, but that however aim to protect the environment and to reduce the operation costs of the car. In particular, the FIAT R&D is oriented towards engines that utilize gaseous hydrocarbons (and specifically CNG[1] and LPG[2]), as a less polluting alternative than conventional automobiles fuels.

In effect, the use of methane in Italy begins during the autarchic policy of fascism in the 30's. Later, methane-powered cars experienced a major growth with the first oil crisis of 1973, for the exceptional increase in the price of oil, and then, natural gas and LPG powered car has increased rapidly since the late 90s thanks to governments tax relief (eco-incentives) in favor of less polluting fuels.

The CNG powered engines are environmentally friendly, reliable and economical, thanks to tax relief and a gas cost much lower than that of gasoline. Benefits which does not conflict with a safe use because, according to the *EPA-US Environmental Protection Agency*, methane is the safest fuel after diesel.

The priority assigned by FIAT at the CNG engine is detected by the fact that FIAT is the only manufacturer that offers five models in its range with the methane-petrol dual power. In Europe, currently only four manufacturers (Fiat, GM-Opel, Mercedes and Volkswagen) offer at least one model with methane-petrol, complemented by only natural gas powered cars (called 'monovalent', such as the Passat and the Volkswagen Touran EcoFuel and GM-Opel Zafira CNG ecoFLEX), or with a small gas tank for mobility even in areas with limited CNG distribution networks.

FIAT R&D is also active in the study of bioethanol powered engines, i.e. powered with biofuels derived from natural resources biomass. In this sense, an example is the FlexFuel technology, already available in vehicles manufactured and sold in Brazil, capable of using four different types of fuels: bioethanol[3], gasoline, petrol and natural gas. The flex technology was studied in the 90's and had a great success, especially in Brazil (because of its vast cultivated with sugarcane), where in 2003 Volkswagen introduced a vehicle with engine flex, immediately followed by Chevrolet and Fiat. Then, in 2006, Honda launched the flex versions of the Civic and Fit, as well as Toyota that introduced the Corolla in biofuel in 2007. Since then, all manufacturers selling cars in Latin America had to bring flex engines. In Europe, the flex technology has been less successful: first, Ford introduced the Taurus flex in 2004, only sold in Sweden, and in 2005 also Saab and Volvo launched cars with flex engines, but always getting poor sales results. More generally, in fact, some manufacturers have focused the R&D on biofuels, while other global players, such as TATA and GM, have focused on the study of electric motors, as this innovation does not involve the creation of new distribution facilities.

Finally, like other major manufacturers, Fiat allocates part of its R&D investments in the development of hydrogen powered car, the more ecological existing fuel. Experimentation was started in 2001 with the development of fuel cell technology and the creation of the first working prototype, but with a contained maximum speed limits and limited autonomy. In this research field, in fact, projects and prototypes are very numerous, but often do not satisfy technical constraints of autonomy and reliability, remaining a simple study and design experiment.

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Notes

[1] CNG-Compressed Natural Gas, is a mixture of methane and other light hydrocarbons like butan and propane.

[2] LPG-Liquefied Petroleum Gas, is formed from a mixture of different paraffinic hydrocarbons with low molecular weight, which at ambient temperature and atmospheric pressure, are in gaseous form, but are liquefied to make cheaper transport them.

[3] Bioethanol is a fuel of vegetable origin, obtained through a process of fermentation and distillation of biomass, i.e. agricultural products rich in sugars such as cereals. The main advantage of bioethanol consists in the significant reduction of emissions of carbon dioxide, that is, however opposed to the disadvantage of a reduced thermodynamic efficiency.