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Electric Vehicles for urban logistics improvement

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Abstract

The use of EVs for distribution of goods and public transportation together with the legislation that allows only to the logistic vehicles and public vehicles to access in the city center will have a large positive environmental effect on both noise level and pollution. With the progress of alternative powertrains that reduce local emissions to zero, urban buses can now throw in to decarbonising road transport. Without a doubt, a number of cities are already paying attention on cleaner public transport, while many bus operators are renewing their fleet or deploying low-emission vehicles. About goods trucks, they can drive directly into centrally placed distribution hubs where the last mile delivery to the shops is made with smaller EVs driving predefined routes. This approach can potentially increase the utilization of the last-mile delivery vehicles and thereby reduce their number causing lowering distribution costs.

Within the i-NEXT project (Innovation for Green Energy and eXchange in Transportation) CNR TAE Institute is involved in infrastructure, logistic and vehicle development with the aim to reduce the impact of transportation on the cities and touristic areas. The proposed project, according to the European Union action plan on urban mobility, aims to support innovation in transport, by promoting a system based on sustainable mobility and RES (Renewable Energy Sources), and by acting simultaneously on improving logistics and distribution channels. The goal of the project is to create next practice solutions, offer promising opportunities for urban logistics operations, in order to become both more efficient and more environmentally sustainable.

Keywords: Fuel cell vehicles, Hybrid power train, Range extender, Urban mobility

1 Introduction

The project will involve two different areas in which both actions on touristic mobility and private, public and commercial transportation initiatives focused will be supported. The experimental phase will be carried out in Sicily (Italy) and, specifically in *Bagheria* and *Palermo* Municipalities and in the *Temples Valley* (Agrigento). Within these sites, it will be possible to test, demonstrate and validate the obtained results coming from the research activities concerning with the interaction among energy, mobility and building data. The intervention in the touristic area (*Temples Valley*) aims to preserve the environment by reducing pollutant emissions. The high number of visitors who attend this area, in fact, involves the use of many conventional vehicles responsible for high emissions of greenhouse gases and noise. In parallel, through the coordination of different types of transport, will bring benefits to decongest traffic and better accessibility to the city center (Bagheria and Palermo) with a positive impact on quality of life in terms of environment and reduction of energy consumption.

2 Infrastructures

The interaction among building energy demand, energy production from renewable energy source (RES), energy saving and energy storage will be developed. An integrated system concerning with electric mobility/energy production from RES/energy saving/energy storage will be implemented. The latter will act in the same way on the improvement of the goods distribution in the last-mile both in terms of smart mobility and renewable energy and smart grid as well. These actions will allow to guarantee an energy supply safety and a consequent knockoff of energy prices. The experimentation fields are addressed to the integration of alternative sustainable mobility (Intelligent Transport Systems - ITS) through the use of an ICT platform oriented on services, infrastructures and vehicles with electric/hybrid propulsion. About the development of sustainable infrastructure based on the use of RES, a controlled power conversion system will allow the management of the recharge of the batteries on board of vehicles. The electricity produced from renewable energy will be fed into the main grid, from which the energy needed to the electrolyzer, the compressor and electric charging stations, will be taken (Fig.1). In order to make this balance equal to zero and to achieve a zero environmental impact, an energy management system integrated in the ICT platform will ensure control and management. The integrated system will be made available to the community by optimizing exchange nodes, access to the city, the realization of technological supports and computerization of logistics platforms. This means to improve the quality of life and facilitate the administrations in their tasks by a simple and organized. system. At the same time the project will address the development of production plants from renewable energy sources with advanced electrochemical storage systems and hydrogen production/storage able to interface the electric/hybrid vehicles and ICT platform.

3 Electric Vehicles

With regard to the technologies installed on the vehicles, research will be strongly oriented towards the application of Fuel Cells (FC), innovative storage systems (Ni-$NaCl_2$/Li-Ion), and hybrid powertrain architecture able to guarantee long autonomy. One of the challenges facing fuel-cell and hydrogen technologies is to move from development to providing practical low-carbon solutions in combination with other energy and transport products.

Hybrid electric vehicles (HEVs) based on batteries and fuel cell give the possibility to merge the advantages of both technologies and avoid some disadvantages. If the cost of FCs remains high, hybridization can reduce the life-cycle cost of fuel cell vehicles, increasing thus their growth option value and their combination with other technologies creates better scenario for their market introduction [3]. This explains the growing orientation of car manufacturers towards HEV based on batteries and FCs [4-8]. Recently, several prototypes in which the range extender function is performed by FCs have been developed. Such a hybrid concept, overcoming the limits of batteries, makes the growth of FCs in the automotive sector, easier since they use lower power and lower cost FCs. Furthermore in this type of systems the quantity of hydrogen carried on board the vehicle remains quite low facilitating refueling and a low weight for the hydrogen tanks. A small FC used as on board batteries charger in a range extender approach allows to reduce costs, weight and recharge time of batteries and, at the same time, to increase the range with respect to the equivalent electric vehicle. In the proposed configuration FC system works as batteries recharge that provides, following an identified strategy, the necessary power to the driving cycle to increase the autonomy of the vehicle. The storage system (traction batteries) provides, however, the energy required to satisfy the peak power demand (Fig.2).

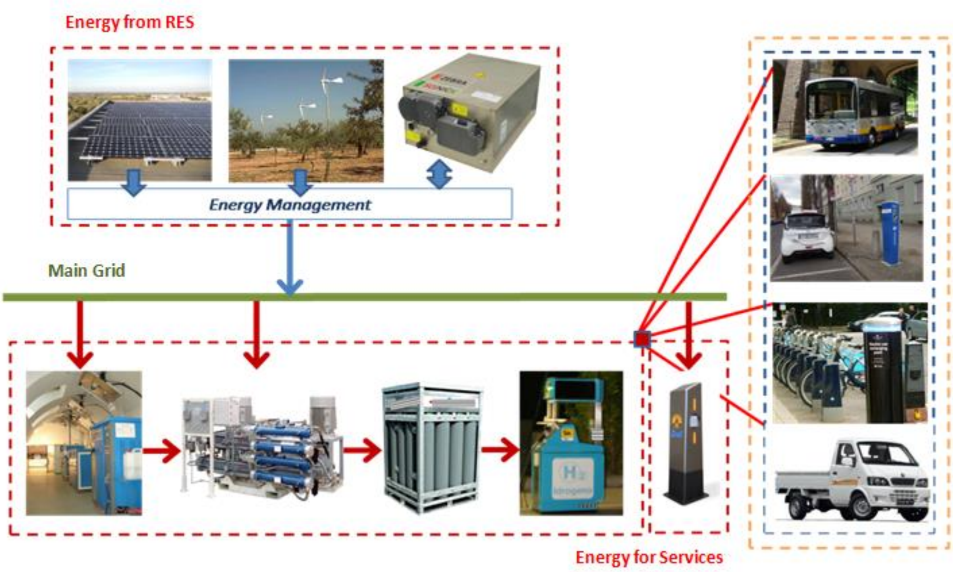

Figure 1: Energy Balance. Energy from RES - Energy for Services = 0

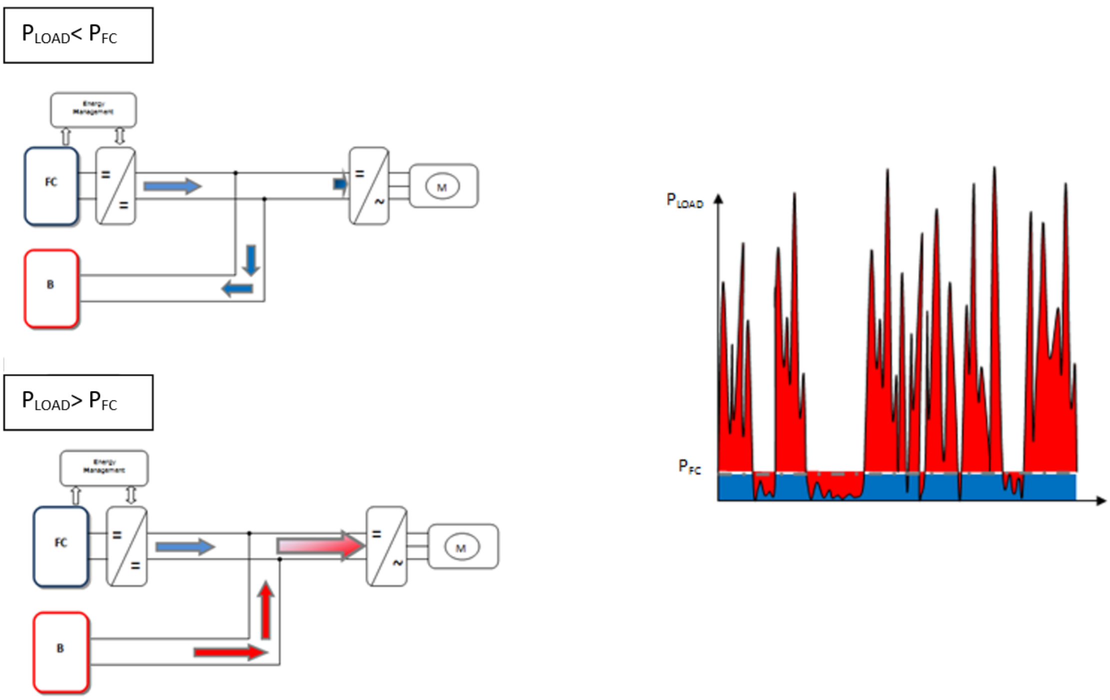

Figure 2: Block diagram of the powertrain based on Range Extender approach and representation of energy flows.

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