Nanotechnology enabling Clean and Energy Saving mobility

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Extended abstract

Electrified mobility is currently a top priority in the US, Japan, China, Korea and EU. It will introduce a radical industrial-economical-energetic change in our society, as new technologies and infrastructure are put in place over the next two decades. The driving forces behind the move to electrical mobility are:

- Reduction in hydrocarbon consumption,
  - In Europe-US-OECD countries more than **70% of all oil is consumed by transports** of which road transportation alone accounts for over 85%. "Well to wheels" energy efficiency of EVs is the key factor (up to 30% with respect to the most efficient cars based on Internal combustion engines)
- Improved safety of road transport,
- Reduction in emissions and noise produce by road transport,
  - Environmental benefits, including mitigation of climate change risks;
  - Electrical mobility eliminates noxious gas emissions in cities;
  - Public health benefits;
  - There are **1.5 million deaths a year due to road accidents**, and road accidents are the main cause of death in the under-45 age group but according to the WHO, **noxious gas emissions emitted by cars cause an even higher number of deaths that those caused by road fatalities**
- Electrification offers the opportunity to incorporate radical new safety paradigms with innovations in systems design and communications structures.

The move to the Electrical Mobility is proceeding in parallel and converging with the introduction of Renewable Energy; **both have reached a point of non return**. In EU and in the US most of new power installations are now based on Renewable Energies and essentially all new programmes on mobility address the implementation of advanced electrical power trains. 2010 will be the first year in the modern industrial era that will register:

1) An annual production of electrical transportation means (all included) higher than those based on Internal combustion engines (World)
2) The energy produced by the new installations of Renewable Sources will overcome the energy produced by the new installations based on fossils (EU-27).

On conventional cars Nanotechnology have been applied in the developments of a hundred and more components-systems and the main technology that has allowed a radical reduction of noxious and Green House Gas emissions in current cars (Gasoline, Diesel, NG or any other biofuels). In the last ten years nanotechnology has clearly contributed to the evolution

conventional cars but the benefits are hidden and perceived only by few specialists. Completely different is the case of the Full Electrical Vehicles FEVs for which the systems enabling energy efficiency, long range autonomy and safety at affordable costs have been made possible because of the advancements in nanotechnology in the last decade. FEVs developed with ten years old technologies would have a higher consume of primary energy and produce much higher GHGs than ICE vehicles.

The advent of the FEV poses a new challenge: the move from critical dependencies on oil and Natural Gas to even more critical dependencies on raw materials for energy storage, rare earth materials for efficient motors or aluminium for light weight structures. Nanotechnology **plays a crucial role** towards the design and manufacturing of new materials for energy storage, light weight structures and efficient motors thus enabling the spread of a clean and efficient mobility in an less critical economic-political context.

The presentation is organised in three sections:

1) Introduction 25-30 min
- ❑ Challenges in transportation
- ❑ Energy-power in automotive
- ❑ ICE versus Electrical Vehicles
- ❑ Convergence EV and RE
- ❑ Impact of Nanotechnologies in conventional cars

2) Full Electrical Vehicles 35-40 min: nanotechnologies enabling high performance and low cost in:

- ❑ Energy-power storage
- ❑ Tyres (low rolling resistance nanocomposites)
- ❑ Light structures (polymer based nanocomposites)
- ❑ Range extenders (catalysis)
- ❑ Lighting (printing materials)
- ❑ Solar cells
- ❑ EMF Shields and Sensors (thin film magnetic foils)
- ❑ Motors (magnetic materials)
- ❑ Heating and cooling (TE materials)
- ❑ …

3) The Full Electrical Vehicle as optimal systems integration: 15-20 min

- ❑ Design via optimal systems integration
- ❑ FEV as element of the internet of power "V2G+I"
- ❑ Evolution over the next 20 years