Alternative propulsions for clean vehicles

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Predit 3 – Clean and energy-saving vehicles

• Decrease drastically the local pollution (NOx and diesel soot)
• Decrease the global pollution by GHG and especially by CO2
• Increase the energetic efficiency – measured in Wh/km (per passenger-km or ton-km)
• Reduce the noise and the impact on populations
Predit 3 – Permanent research to obtain clean, energy-saving and silent vehicles

• Academic research for a best knowledge:
  ▪ combustion, catalyst...
  ▪ electrochemistry
  ▪ materials
  ▪ models...

• Applied developments:
  ▪ components (fuel injection, sensors, batteries, software...)
  ▪ functions (internal combustion engines, architectures,..)
  ▪ demonstrators (vehicles or part of it)

For all the vehicles: two-wheels, passenger-cars, urban trucks, buses, heavy trucks, trams, metros, trains
Predit 3 - Some evolutions for the internal combustion engines (1)

- Drastic depollution (NOx and particles): catalytic systems, additives, EGR...
- Internal aerodynamics
- Fuel injection (direct injection for spark engine, high pressure for diesel)
- New concepts for the combustion (CAI and HCCI)
- Optimization for alternative fuels (natural gas, biofuels-1st and 2nd generation, synthetic fuels...)
- Gains: 20% on the energetic needs for the same power
Predit 3 - Modifications of the internal combustion engines (2)

- Downsizing: decrease of the cubic capacity of the engine with keeping the same performance
- Variable compression engine - Camless system engine (spark and diesel)
- Optimized control of the engine in connection with the use of the vehicle
- Gains: 10 to 20%
Predit 3 - Revolution: the passage to electric motorisations

- From light to full hybrids
- Optimized architectures - depending of the vehicles and of the uses (passenger-cars, buses, urban trucks...)
- Electronic functions (efficiency, durability,..)
- Electric motors - classic and advanced (efficiency, durability, cost, weight and volume...)
- Adaptability of internal combustion engines for hybrids and energy management
- Batteries and other electric or energetic storage system (efficiency, cyclability, ageing, cost...)

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Predit 3 - Energy storage

• Applications for the electric vehicles and for the hybrid vehicles
• Analysis and experiments of batteries: Nickel-M-Hydrides, Lithium-Ion, Lithium –Iron-Phosphate, Lithium-polymer, Nickel-Chloride (Zebra)… (cycles, durability, cost… resistance to vibrations, temperature…)
• Analysis and integration of super capacitors
• Other systems (hydraulic and high-speed wheel)
• Objectives: performances, durability and decrease of the cost
Predit 3 - Auxiliaries and reduction of the weight

- Air-conditioner with high efficiency
- Optimization of the electric use in-board
- Electric auxiliaries
- Decrease of the weight for all the components
- Gains: 5 to 10% on the global energetic needs
Predit 3 - Research for the reduction of noise

- Noise from the tyre on road
- Noise and vibrations from tramways
- Analysis and decrease of noise from the braking system (road and trains)
Predit 3 - Demonstrators

• Passenger-car (PSA) :
  ▪ down-sizing with a small gasoline two cylinders engine (and controlled turbo charge)
  ▪ regenerative braking energy system (batteries and super capacitors)

• Bus (IRISBUS) :
  ▪ new architecture for the vehicle
  ▪ optimized diesel engine
  ▪ regenerative braking system (storage by hydraulic and electric systems)

• Tramway (ALSTOM) :
  ▪ optimization of the global electric architecture
  ▪ regenerative braking system (storage by high-speed wheel and electric motor)
Predit 4

- Continuation of **academic and applied researches** (combustion, materials, electrochemistry, modelisations…)

- **Development of very low-CO2 solutions** for internal combustion engines and vehicles (new engine, very low-weight vehicle…) and **optimization with alternative fuels** (bio fuels - 2nd generation and synthetic fuels)

- An important and specific program which is launched:
  - development of hybrids and all-electric vehicles
  - with ten demonstrators: passenger-cars, light trucks, buses
  - maintain of the **research on the main basic topics** (energy storage, electric motor, energy management…)

- Important points: **standardization of components** as batteries, electric motors connecting systems… (new methods for the evaluations of components, and especially for electric components and electric functions), **decrease of the costs**

- Optimization of vehicles versus real uses: new tests cycles (?)