

PECC Seminar Perth

Clean transportation and
carbon-free electric vehicles,
short and long term vision

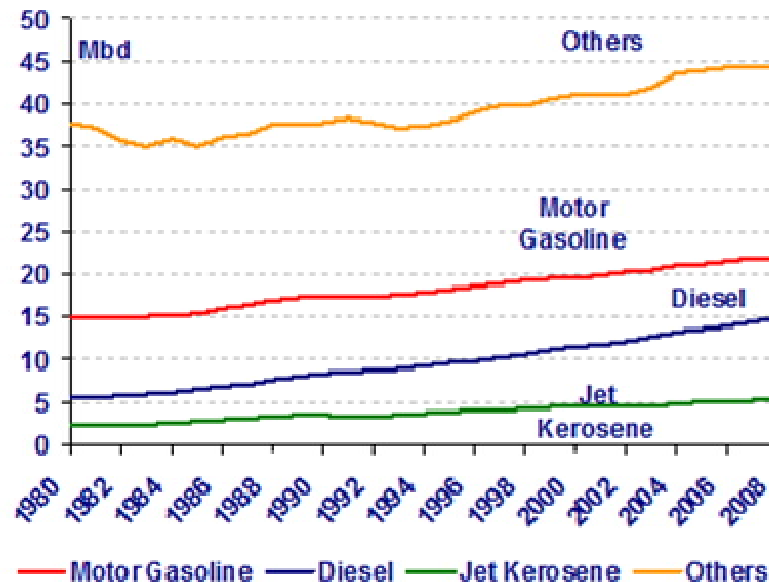
Henri Boyé,
French Ministry of Sustainable Development

Transport

- **Stakes :**
 - The most GHG emitting sector in France**
 - 26 % of national GHG emissions**
 - 32 % of final energy consumption (51 Mtoe)**
- **« Grenelle de l'Environnement » objective:
decreasing by 20 % GHG emissions to 2020**

Transportation and oil demand

Oil demand by products



Transportation : 37 Mbd
Aviation : 5 Mbd
(2008)

Trends 1980 / 2008

Share of demand

Transportation :

33 % to 42 %

Aviation : 4 to 6 %

Annual growth

Diesel : 3.6 %

Gasoline : 1.4 %

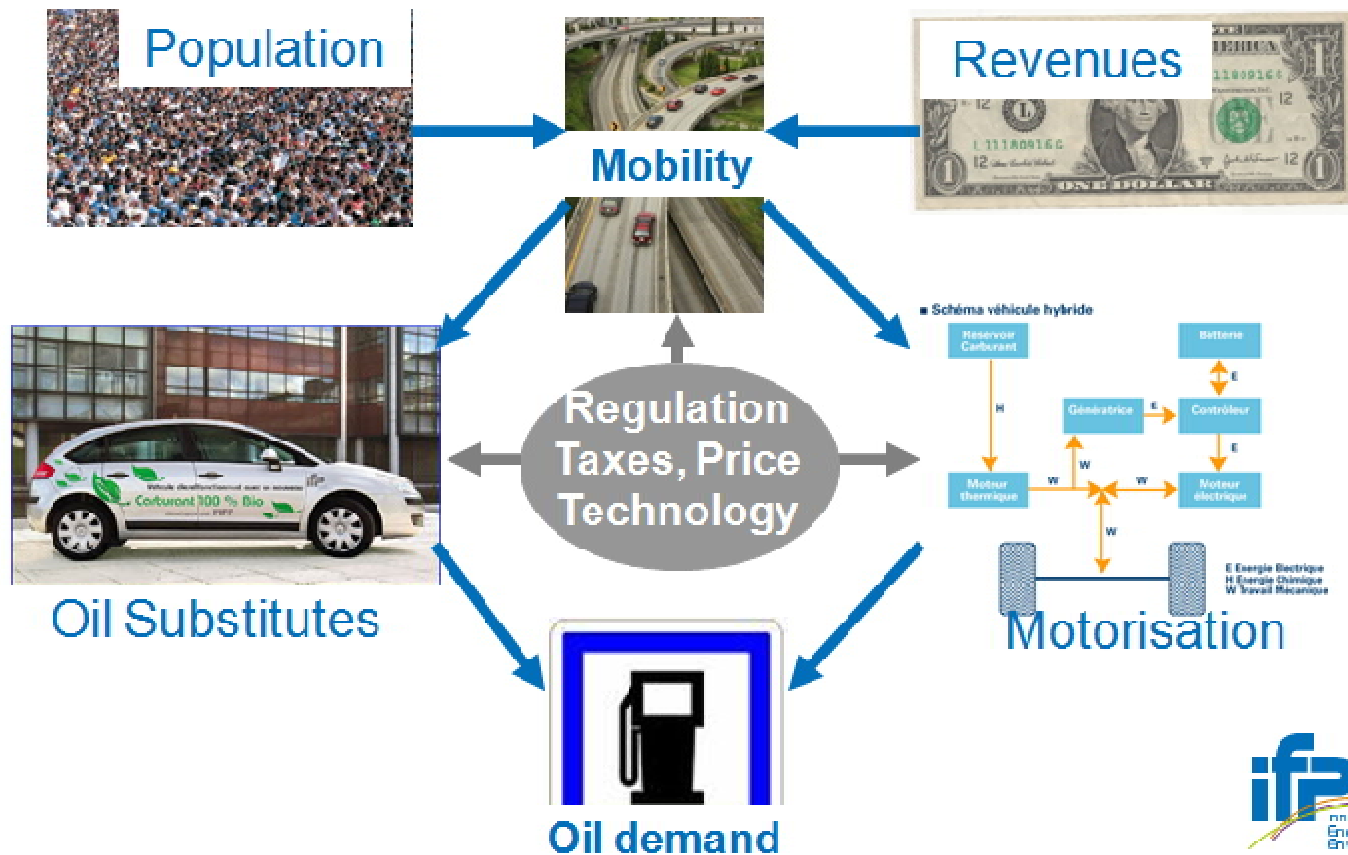
kerosene : 2.7 %

Others : 0.6 %



Oil and derived products (gasoline, jet fuel and Diesel) with the Internal Combustion Engine appeared one century ago, currently holds a virtual monopoly on the transport market, representing over 95% of the energy requirements in this sector.

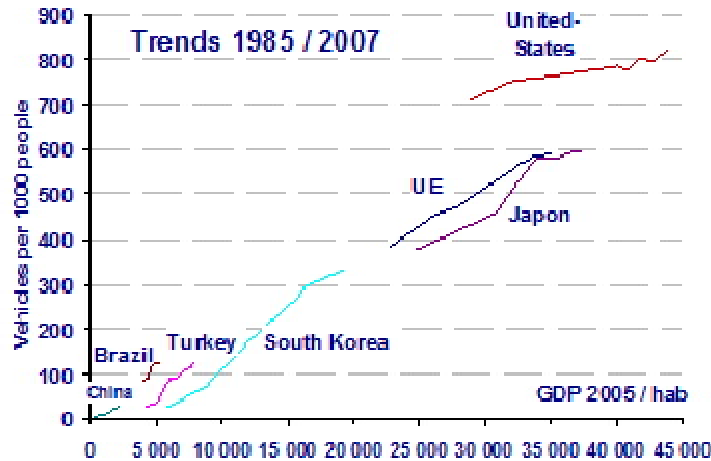
Determinants of transportation demand



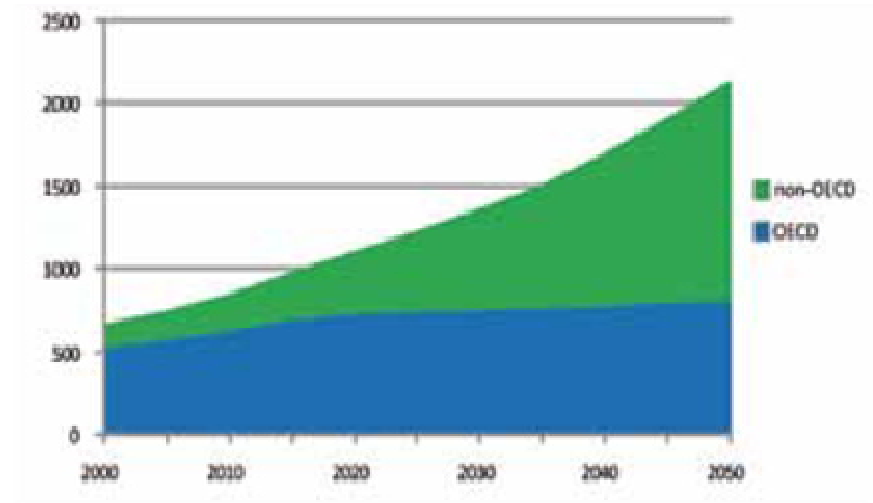
The driving forces of transport fuel demand are first related to the anticipated growth of population and revenues, mostly in emerging economies. As a result, mobility will increase. The actual impact on oil demand is depending on regulatory and fiscal policies, on the development of new types of motorisation and on the deployment of substitutes to petroleum products.

Impact on Automobile demand

Vehicles per capita and Revenues



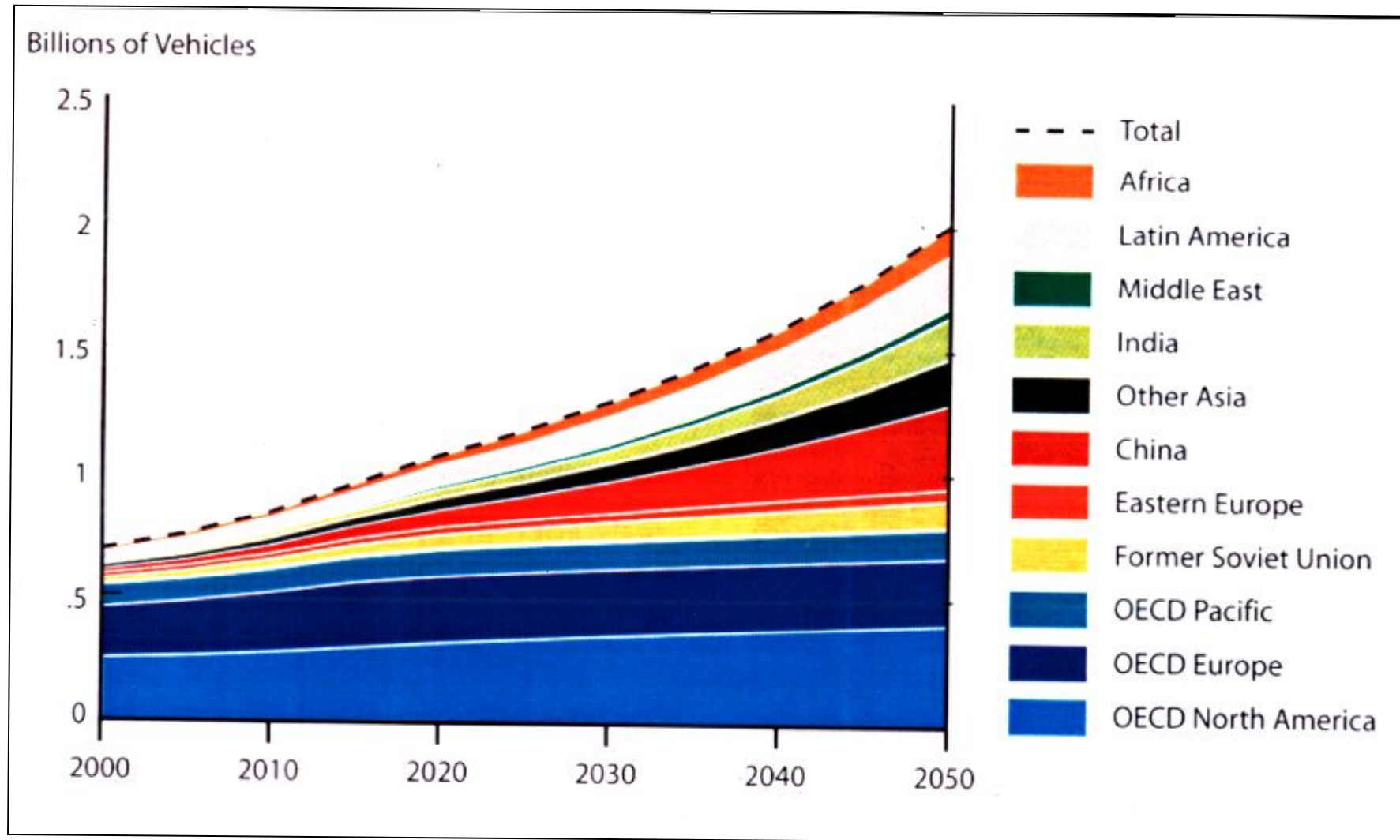
Global Growth in Light Duty Vehicles



A rapid growth of the vehicle fleets in developing and transition countries.

Vehicles per capita ownership is linked to the revenue.
In OECD countries, we may anticipate a stabilisation of car ownership.
However, there is a huge growth anticipated in emerging countries.
In 2009 more cars were sold in China than in the US.

Projected total stock of light-duty vehicles by region



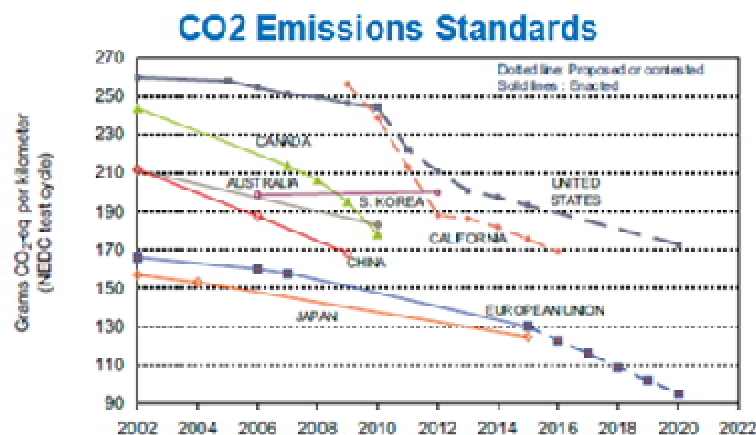
Source: Mobility 2030, World Business Council for Sustainable Development Sustainability Project, 2004

More Energy-Efficient Vehicles are on the Way

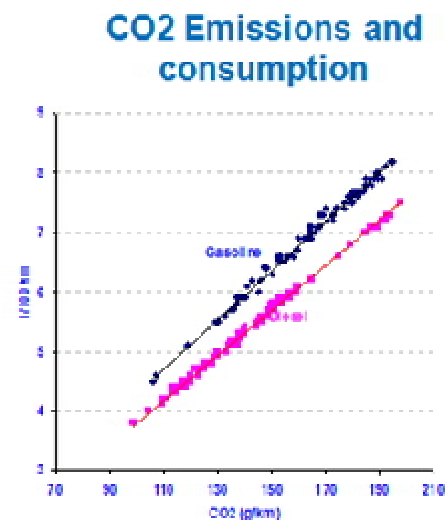
- **Superefficient and ultralight cars**
- **Gasoline-electric hybrid car**
- **Plug-in hybrid electric vehicle**
- ***Measures in transport in Europe***
 - **European agreement on cars efficiency : 120 g CO₂/Km for new cars in 2012**
 - **Car labeling Bonus Malus on cars purchasing**
 - **Car scraping subsidies (function of replacement efficiency)**
 - **Motor-fuel taxes**

Energy efficiency in transportation

Standards improvement and impact on unit consumption



Source: ICCT / 50BY50_report



US: average fuel economy standard of 35.5 mpg (6,5 l/100 km) in 2016.

Closed to the average for new car in Europe in 2006.

Europe: A real technical challenge in 2020 (95 gco2/km).

21/12

DEE - 8th Arab Energy Conference - 10 May, 2010



Energy efficiency is a major challenge. We need to remind that the efficiency of internal combustion engines averages only 20% in urban uses. **Increasing energy efficiency** standards is a first response from policy makers worldwide. Eg, the United States have set up the average fuel efficiency standard of 35.5 mpg in 2016 and the European Union has decided to reduce the CO₂ emissions of car down to 95 g/km in 2020.

New motorization

Technological responses New motorisations

Develop alternative solutions to combustion engine

Dedicated engine

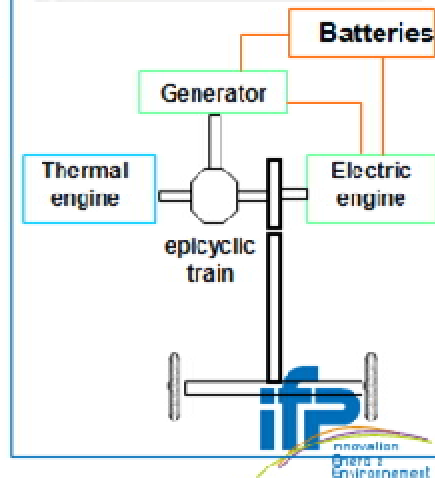
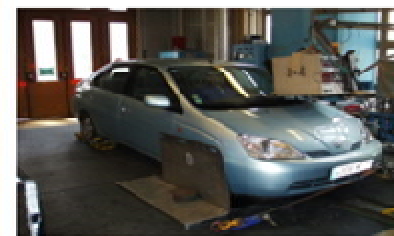
- NGV, DME
- Hydrogen

Electric vehicle

- Batteries
- Fuel cells

Hybrid vehicle thermal/electric

- System modeling
- Control strategies



Another way to reduce consumption and CO₂ emissions is to **develop alternative engines**. (using natural gas, biofuels or hydrogen on the long term). Electric vehicle is an option developed recently in some OECD countries: but it is penalized by the short range (100 to 200 km under real conditions of use) associated with today's batteries. The hybrid power pack combining electric and thermal engine looks very promising in the medium term

Why New types of motorisation

Why electric car?

One of the biggest advantages of electric cars is that they do not pollute the environment and emit less harmful to the nature gas. That's why the mass use of electric cars will bring slowing down the global warming.



Electric Vehicle today

A born-again

Once upon a time ... the golden age

Recurrent optimistic expectations through the 20th century, but never proved correct

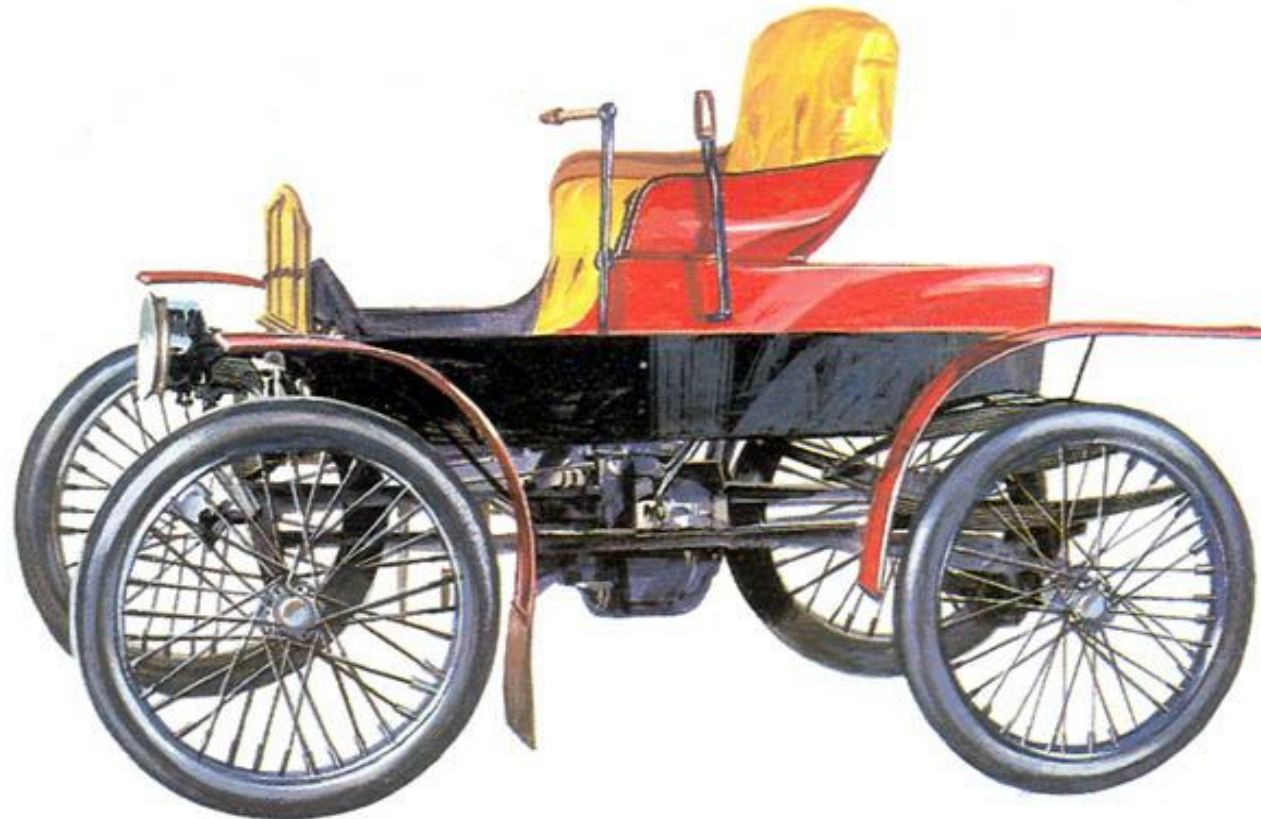
Failure of the last French attempt 15 years ago

Current renewal

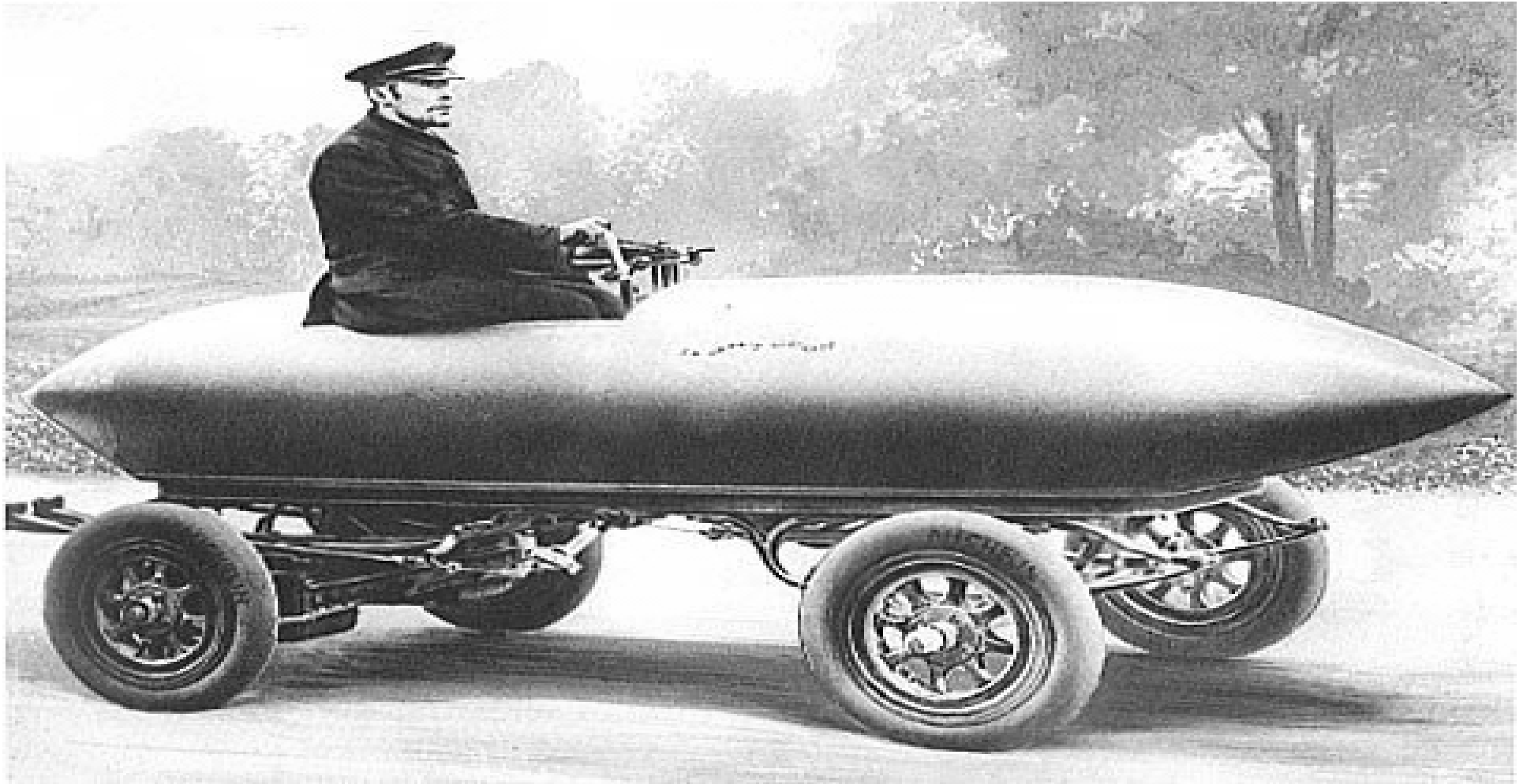
The beginning

Father of the electric car is Thomas Edison, who back in 1834 patent the first electric car driven by batteries, which can not be rechargeable.

In the late 1890s, EVs out-sold gas cars 10 to 1



La « Jamais Contente » first EV above 100 km/h



Current renewal

Technological progress of batteries Range – Power

Oil price

Environmental awareness Climate change – Air quality

Increasing and diversified offer

Future Vision

Plug In Hybrid

Plug In Hybrid – Solar

Vehicle to Grid

Which electric vehicle?

From Conventional vehicle **internal combustion engine, or (ICE)**

Battery Electric Vehicle (BEV)

Hybrid gas-electric vehicle (HEV)

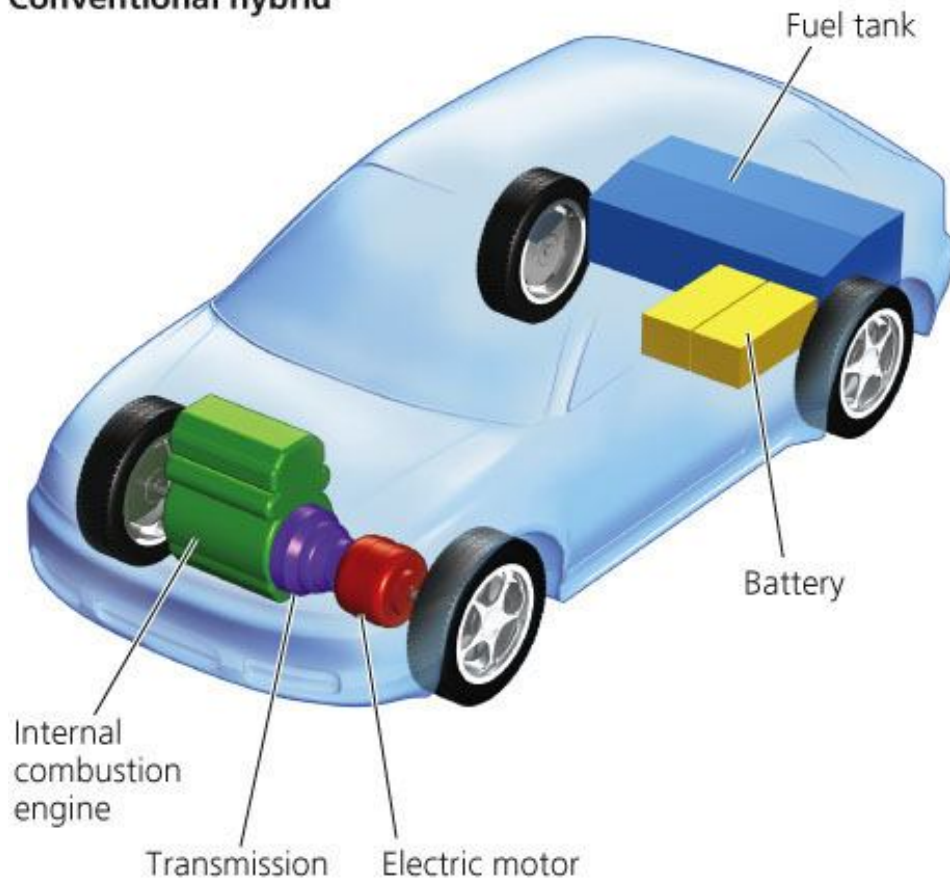
Plug-in hybrid electric vehicle (PHEV)

EREV Extended Range Electric Vehicle (ERV)

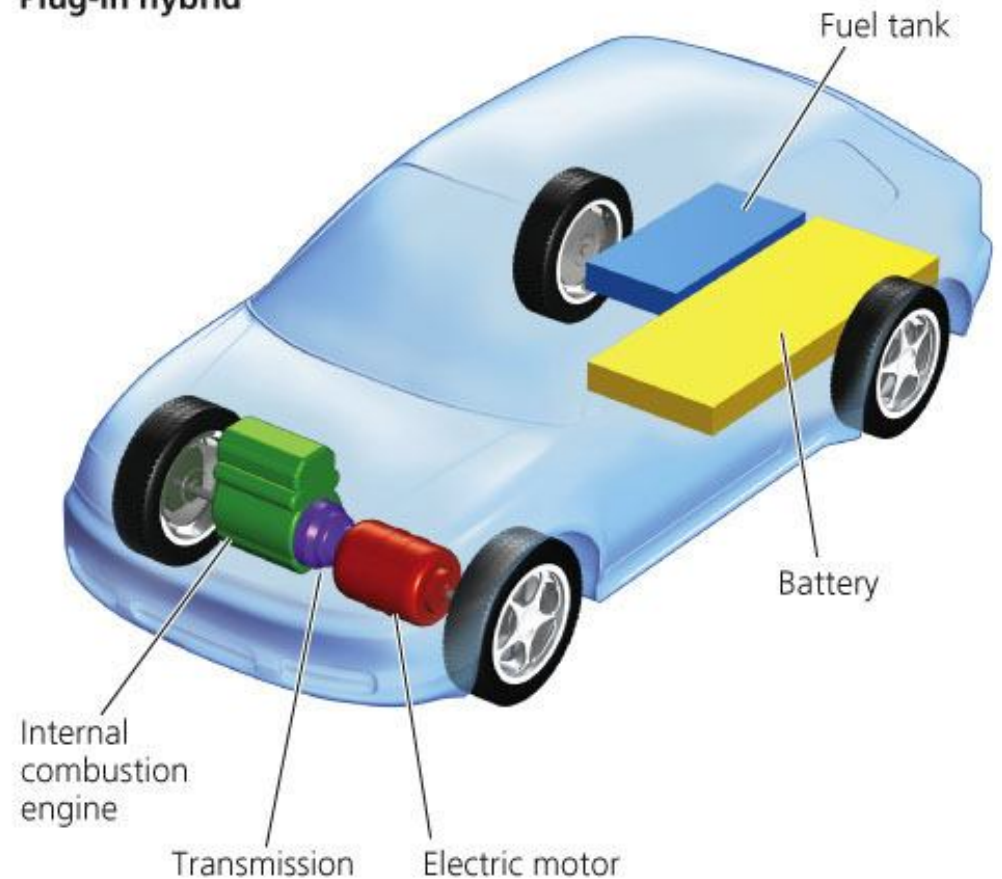
All-electric vehicle EEV

Solutions: a Hybrid-Gasoline-Electric Engine Car and a Plug-in Hybrid Car

Conventional hybrid



Plug-in hybrid



Electric bikes & scooters



« It's EV's Eve ! »

Many converging factors create a favorable environment for EVs

➔ 6 stakes

- **Geopolitic stakes**
- **Environmental stakes**
- **Sociological stakes**
- **Institutional regulation stakes**
- **Technological stakes**
- **Economical stakes**

Environmental stakes

- **Climate Change**
- **water and soil pollution**
- **air quality**

It's not only a matter of CO₂ ! :
Oil civilization is source
of several kinds of pollution...

Sociological stakes

- **pollution impact on health**
- **awareness for environment**

Institutional regulation stakes

→ Kyoto, Copenhagen , international, european, national regulations

Technological context

→ Batteries improvements. The market is mature

Economical stakes

→ Automotive industry crisis

→ EV = growth driver

→ amortized costs

→ global costs

→ EV = opportunity for another kind of mobility

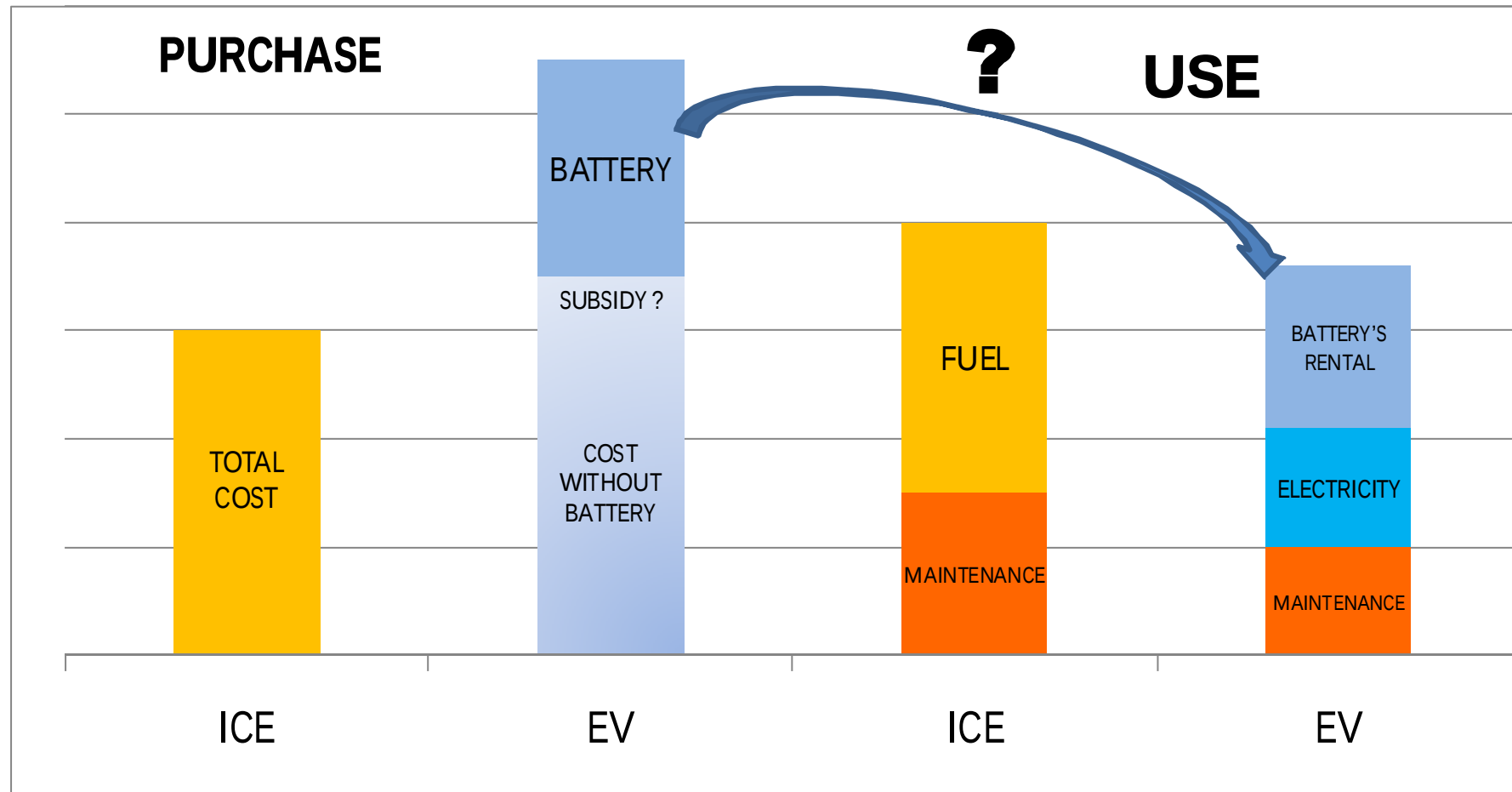
= crisis

= opportunity

Cleaner Transportation Options

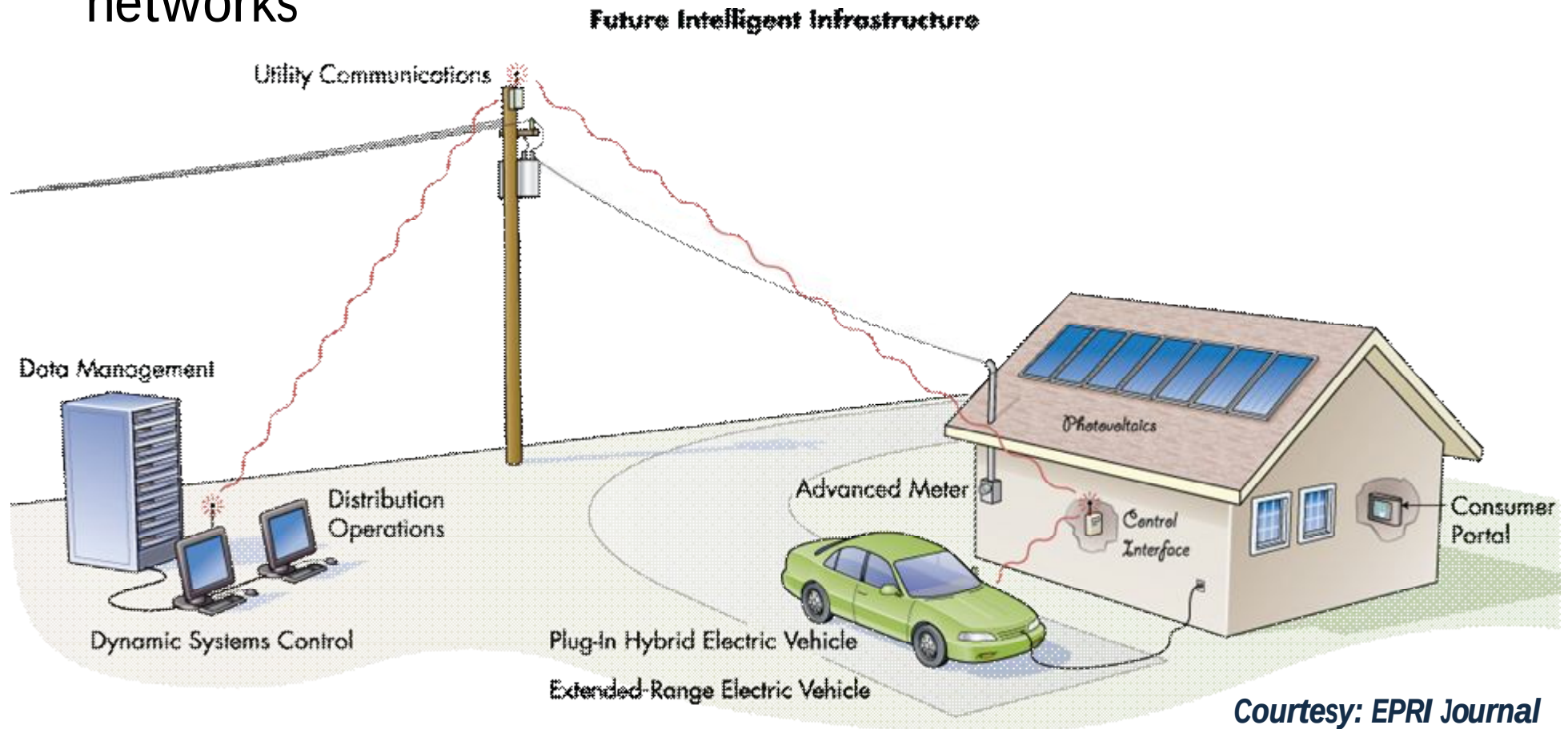
- Walk and bike more, City CarShare:
- Take public transit: lots of electric
- AVERE a European network , members including Users, NGO's, Associations, Interest groups, Public Bodies, Research & Development entities, Vehicle and Equipment Manufacturers, Electricity Utilities
<http://www.ave.org>
- Australia Aevea <http://www.aeva.asn.au>

What about the price ?



Electric Vehicles with Extended Range and Plug-in Hybrid Electric Vehicles

- Components of increasingly sophisticated local energy networks



Courtesy: EPRI Journal

EUROPEAN POLICY IN SUPPORT OF ELECTRIC VEHICLES

I DEMAND-SIDE MEASURES, incentives

II. INFRASTRUCTURE

- The recharge infrastructure for electric vehicles is, in large part, already available – in the form of domestic socket.

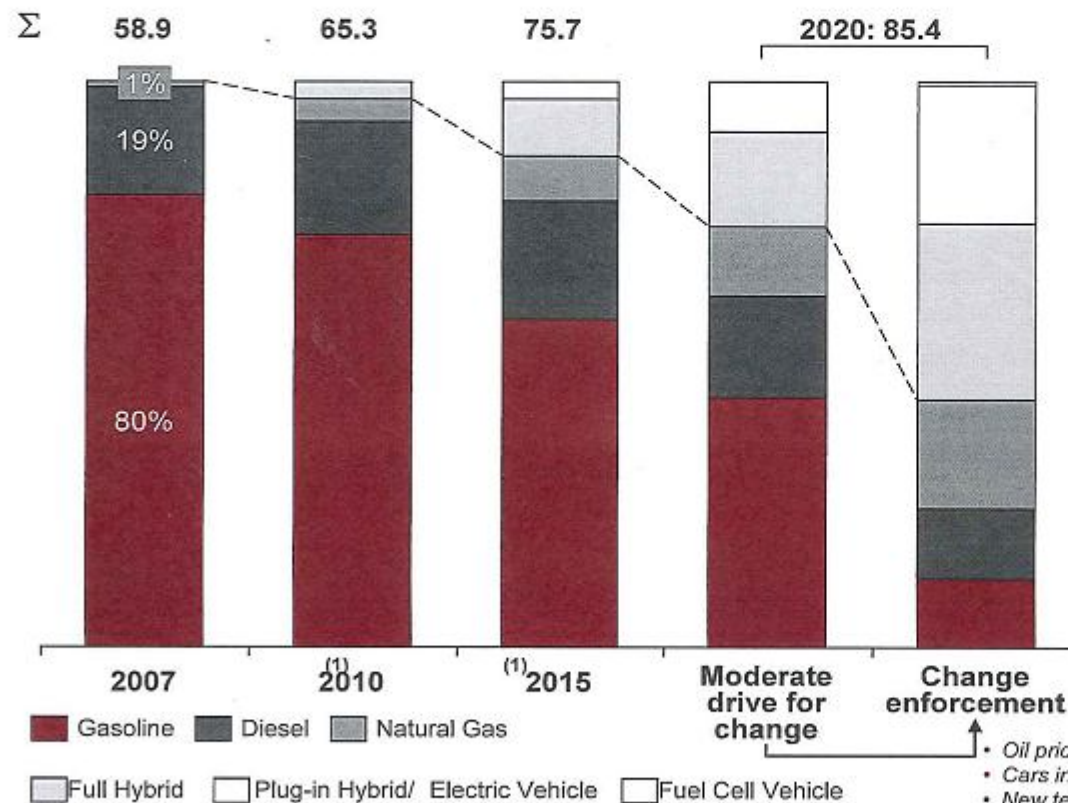
II. EDUCATION AND TRAINING

- We need skills and knowledge. Education is a long-term process and therefore in order to ensure that we have a qualified workforce in few years time, we need to take decisions on school curricula and training programmes already today.
- .

A.T. Kearney predicts that EV / PHEV will account for 25-50% of new car sales by 2020

Scenario Oct. 09

Powertrain landscape of the future - M units – New vehicles produced -



Notes: (1) "Moderate drive for change scenario" scenario
Source: A.T. Kearney analysis (Powertrain of the future, September 2008), JD Power

Challenges to EV ramp-up

- **Technological** (battery autonomy, consumption efficiency, car-to-power network communication, ICE emission improvements)
- **Cost** (economies of scale, infrastructure)
- **Charging infrastructure network** (standard, location...)
- **Regulations** (tax incentives, CO₂ emission regulations, electricity taxation for car charging)
- **Customer & driver behavior** (charging behaviors, usage)
- **Clean electric power** (nuclear + renewable power ramp-up, smart grids)

- Oil price
- Cars incentives
- New technologies costs