A Renaissance lies ahead
The automotive case

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Nowadays

- >800 million vehicles
- 6.6 billion inhabitants (2 out of 5 live in China and India)
- 50% of the population is urban
- 24% of CO₂ emissions and 60% of fuel use are transport-related
2050

• \(>>1,500\) million vehicles?
• 9 billion inhabitants?
• 70% of the population is urban?
• >30% of \(\text{CO}_2\) emissions and >75% of oil uses are transport-related?
GHG emissions: transportation plays a significant role

- Road transportation: 9.80%
- Other transport: 3.30%
- Energy supply: 25.90%
- Industry: 17.40%
- Private and commercial buildings: 19.40%
- Agriculture: 13.50%
- Lumbering: 2.80%
- Waste and waste water: 17.40%
CO$_2$ emissions: transportation plays a critical role

- Road transportation: 18%
- Other transport: 6%
- Energy and heat supply: 45%
- Industry and civil engineering: 8%
- Residential: 5%
- Other: 18%
Transport CO$_2$ emissions forecast (WBCSD)
Road transport must cut CO$_2$ emissions by 50%
A conviction to share

- 2050 – Over 70% of the population is urban, predominantly Asian and emits half of the current CO$_2$: this world is significantly different from ours, particularly in terms of transportation.

- This world must be invented very soon (by 2015?); it is vital for the automotive industry…and for each of us.
Four messages to policy makers

1/ Road transport must play a leadership role to help reach the global objective of 50% less CO2 by 2050. Procrastination would be dramatic for society at large and for the automotive industry.

2/ Reducing energy consumption of cars by 50% is feasible with existing state-of-the-art technologies.

3/ Electric vehicles can be made technically and economically viable, particularly in a rapidly urbanizing environment. It is time for road transport to stop depending solely on oil.

4/ Governments and industry must “have the guts” to provoke the necessary disruptions.
Around three-quarters of the projected increase in oil demand comes from transportation, the sector least-responsive to price changes (IEA - WEO 2008)
« The cheap oil era is over »
Nobuo Tanaka, IEA Executive Director

« By design or by shock, our economy will become decarbonized »
Achim Steiner, UNEP Executive Director
Let’s be clear about it: Road mobility as we know it is NOT sustainable and the solutions contemplated so far are not commensurate with the criticality of what is at stake.

6 issues need to be addressed simultaneously:

- Road (un)safety
- Urban pollution
- GHG emissions
- Congestion
- Cost of transportation
- Oil dependency
The last edition of Challenge Bibendum has confirmed it: reducing vehicle energy consumption by 50% is achievable. Reducing CO$_2$ emissions by more than 50% is also achievable.

Good news! We are not in a dead end.
Food for thought

- 71g CO₂/km on the Shanghai roads with a modified Logan!

- Less than 30g CO₂/km in the last Monte Carlo rally with a Michelin demonstrator!
Food for thought: an integrated vision of modern, clean mobility!

- Sun rays
- Photovoltaic panels: 55m²
- Electric current
- Electrolysis + Compression
- Water
- Oxygen
- Hydrogen
- Storage up to 300 bars
- Fuel cell electric drive vehicle
- Exhaust: Water
- 20,000 km/year

Exhaust: Water

Storage up to 300 bars
Worldwide comparison of well to wheel CO₂ emissions per km driven with a battery powered car (15 kWh or 25 kWh/100 km) and ICE powered cars using oil-derived fuels.
Why so much energy consumption?

1- to overcome (often excessive) resistances
2- because engine efficiency is not terribly good (<30%) … and even pretty bad in urban conditions!
Some common sense solutions

- Optimizing aerodynamics
- Choosing the right tires
- Working on mass
- Adapting the vehicle to its purpose
- Adapting GMP to urban reality
Sub-systems for mobility (EVs / HEVs)

- Active Wheels
- Chassis control
- Auxiliary Power Solutions (batteries/supercapacitors)
- Fuel cell
- Electric motors
- Power electronics
- Gas storage
Michelin Active Wheels

- Electrical drive motor
- Electrical suspension motor
- Spring
- In-wheel active suspension
- Brake caliper
- Brake disk

Michelin Active Wheels
Would you buy or lease such an EV?

- 5 seats, L: 3.74m
- 0-100 km/h: 12s
- Autonomy: 150km to 400km
- Mass: 1000kg
- Max speed: 140km/h
- High speed internet connection: WIFI, 3G+, machine-to-machine communication
EVs should achieve cost parity with advanced ICEs well before 2020!
Venturi Volage

- 2 seats
- 4 motorized wheels
- 0-100 km/h : <5s
- Autonomy: 300km

- Max speed: 150km/h
- E-braking: 50kW
In the face of today’s challenges, procrastinating in terms of innovation will lead to price wars, consumer weariness, legal interventions!
Challenge Bibendum Rio: May 30 – June 2, 2010

It is still possible to dream about cars and tires!!!
Thank you!
Annex
In the next 25 years, the global trends are expected to be (1)

- continued dominance of ICEs and liquid hydrocarbon fuels (with enhanced combustion efficiency, exhaust gas treatment and fuel evolutions)
Reducing ICE park CO₂ emissions

- Reducing consumption:
  - Engine efficiency: from 30% to 40%
  - Cylinder reduction
  - Vehicular mass reduction
  - Aerodynamic, tire and internal friction optimization
  - (in cities) benefiting from hybrid technology,
  - Evolution of the vehicle mix,
  - Reduced use?

- Diversifying fuel sources multi-fuel technologies)
  - Bio-fuels
  - Natural gas
  - Hydrogen, synthetic fuels (GTL + CTL)
In the next 25 years, the global trends must be (2)

- dynamic market penetration of hybrid vehicles (featuring various degrees of hybridization) and electric vehicles.
- ZEV mode development
In the next 25 years, the global trends are expected to be (3)

- significant development of:
  - combined active and passive safety systems,
  - car-to-car and car-to-infrastructure communication,
  - ITS technologies

...to enable (in particular), cars to be both lighter and safer.
Energy management principles

110 kW max

Li-ion batteries → DC/DC power converter → Motor inverters → Electric motors

110 kW max
Cost? Status?

- Total cost of ownership after 5 years: better than with conventional cars
- Unrivaled comfort due to electric drive and electric suspension
- Unmatched road handling performance and safety
- Exceptional torque and acceleration
- Unprecedented interior space
- Big step into modernity