TECHNOLOGY RESPONSE TO CLIMATE CHANGE

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Long term challenges of the energy sector

- On going growth of energy demand
- Limited resources of fossil fuels
- Local/global environment
Technological responses

- Long term energy supply
- Environment protection
- Answers to global climate change
Pathways for CO₂ emissions reduction

- Improving energy efficiency
- Better use of energy
- Low carbon energy mix
- Natural gas
- Biofuels
- CO₂ capture, transport and storage
Energy Efficiency in Building, Industry

- Buildings
  - insulation
  - efficient equipments
  - new technologies

- Industry
  - efficient equipments
  - new processes
Growth of road transportation

More than 80% growth over 30 years

OCDE

Rest of the world

Vehicles (millions)

Trucks
2 wheels veh.
Utility veh.
Individual cars

+40%
+180%
Key parameters for vehicle fuel consumption reduction

- Hypothesis: 20% improvement on each parameter.
Reducing CO₂ emissions of the gasoline engine

- diesel engine
- gasoline engine
- reference
- Variable Valve Timing
- GDI stratified combust.
- CAI combustion
- Downsizing
- Hybridization

CO₂ emissions
Pathways for CO₂ emissions reduction

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Reducing energy carbon content in power generation

- Natural gas
- Nuclear power
- Renewables
Biofuels: Anticipated deployment

• Improving present processes
  EtOH, ETBE, FAME, FAEE («1st generation»)

• EtOH, Syn Diesel, DME
  from lignocellulosic biomass («2nd generation»)

• Integrated biorefining complexes

Biofuels: CO₂ balance

Source: Ademe/Direm 2002 - IFP
Passenger Cars Powertrain roadmap

1st stage
- NGV, biodiesel, ethanol
- Adv. gasoline and Diesel engines
- Gasoline hybrid

2nd stage
- Dedicated NGV
- Lignocellul. ethanol, GTL, Diesel hybrid
- "Flex-fuel" hybrid
- Plug-in hybrid

3rd stage
- BtL 2nd gen., CTL with CCS
- "Flex-fuel" hybrid plug-in hybrid

4th stage
- "Flex-fuel" hybrids, hydrogen, electric?

CO₂ emissions reduction

Increasing R&D input

2000 2010 2020 2030 années
Pathways for CO₂ emissions reduction

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CO₂ Capture and Storage

• An industrial reality already now

• An integrated approach needed: capture, transport and storage

• Large initiatives at the European and international level: ZETP, CSLF, AIE GHG etc.
Key Technological Challenges

• **Capture : reduce the costs**
  - Solvent scrubbing
  - CO2 capture by concentration
  - Oxy/pre combustion power plants

• **Underground storage : increase safety and reliability**
  - Controling CO$_2$ injection
  - Predicting long term behaviour of the reservoir
  - Monitoring CO$_2$ in place
Underground storage potential

- **5 - 150 Gt**: Unexploited coal seam
- **400 - 10,000 Gt**: Depleted oil reservoir
- **920 Gt**: Oil reservoir
- **920 Gt**: Electricity export

Diagram labels:
- Power plant
- Industrial plant
- Oil/gas plant
- CO2 Pipe
- Compression
- Injection
- Subsurface
Conclusion

• No panacea, but a bunch of solutions

• Well focused R&D programmes

• International collaboration
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