Toward Sustainable Mobility by the year 2050

In Richtung zur Stützbaren Mobiliät bis zum dem jahr 2050

Hacia la Movilidad Sustentable en el año 2050

Eduardo Velasco Orosco

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Abstract

At the present time it is considered in 0.85G of vehicles in the planet, all of them in producing minor or greater degree of polluting agents. For the 2050 it is not to be surprised an increase of 2 to 2.5 times of the vehicular park and therefore a free emissions vehicle practically must be obligatory that endorses a global sustainable mobility vision.

To meet this vision, our industry is changing and will change dramatically in the next decades, the technology is advancing in each border and the propulsion system of the automobile is been re-invented itself.

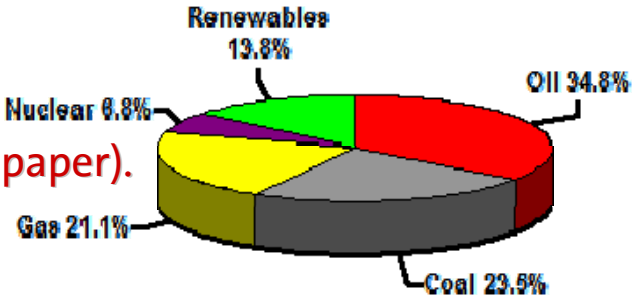
The process of evolution and transition of the present and new propulsion technologies, as well as the current and new fuels will be boarded in the present work. Having as an objective to provide answers of how to meet a global sustainable mobility, besides to conceptually establish the automobile that will be occupied the highways in 2050.

Keywords: Global sustainable mobility, Propulsion system.

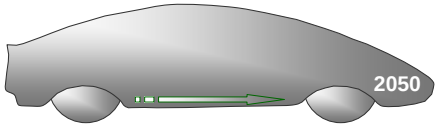
Introduction

Introduction

- World Population in our Planet:
  - Today in 2008: ~ 6.4 k M.
  - Tomorrow in the 2050: ~ 9 - 12 k M (UN).
- World Fleet / Global Vehicle Production:
  - Today in 2008: ~ 850 M / 70 M jpy (ACEA).
  - Tomorrow in the 2050: ~ 1800 - 2000 M / 400 M jpy (projection).
- Global Energy Production:
  - Today in 2008:~ 450 Exa J (450×10^{18} J).
  - Tomorrow in the 2050: ~ 1 200 Exa J (ISES White paper).

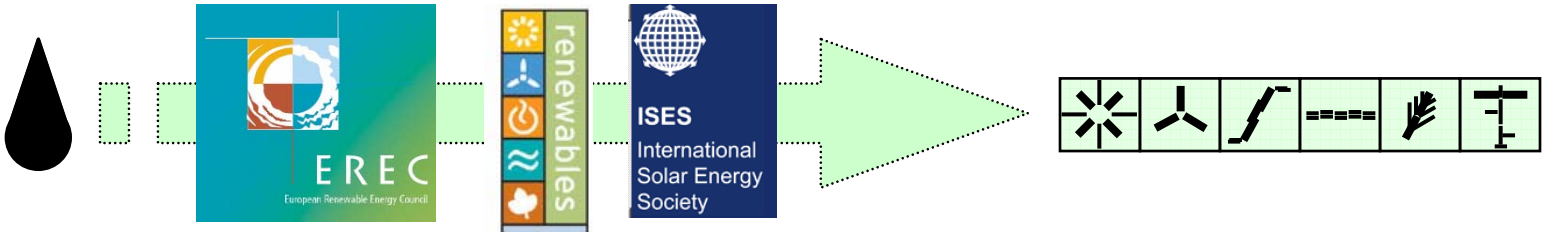


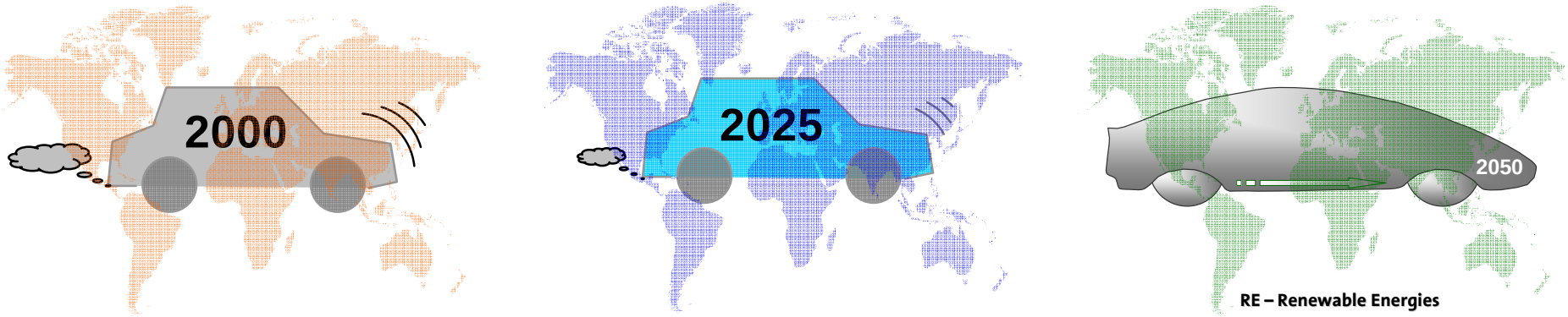
- Sustainable Mobility towards 2050:
  - Powered by energy from renewable sources.
  - Fully safety, No emissions & completely recyclable.
  - Built from intelligent materials / provide functionality to the molecular level.



Objectives

- To establish, to spread and to promote concrete goals towards the GSD & GSM by the year 2050.
- 50 % of world primary energy production by 2050 from RE.
- 80 % of world vehicle production powered by 2050 from RE.





RE – Renewable Energies

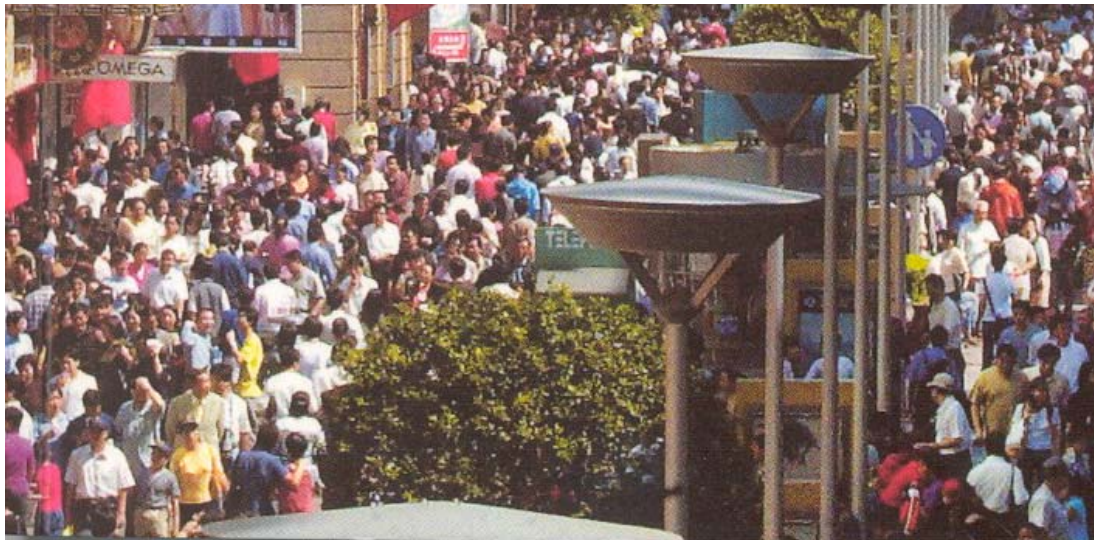
GSD – Global Sustainable Development

GSM – Global Sustainable Mobility

Global Challenges

- 1. Over population.
  - Today in 2007: 6.4 k M $^{\pm 0.25\ M}$.
  - Tomorrow in the 2050: 9 - 12 k M (UN).

5/m²



83k / km²

Global Challenges

- 2. Extreme poverty.
  - Today in 2008: ~ 1.1 k M.
  - Tomorrow in the 2050: 2 - 3 k M. / or end poverty?

Global Challenges

- 3. Severe Environment deterioration.
  - Climate change is a reality.
  - Tomorrow without actions: Diseases, Floods & droughts.

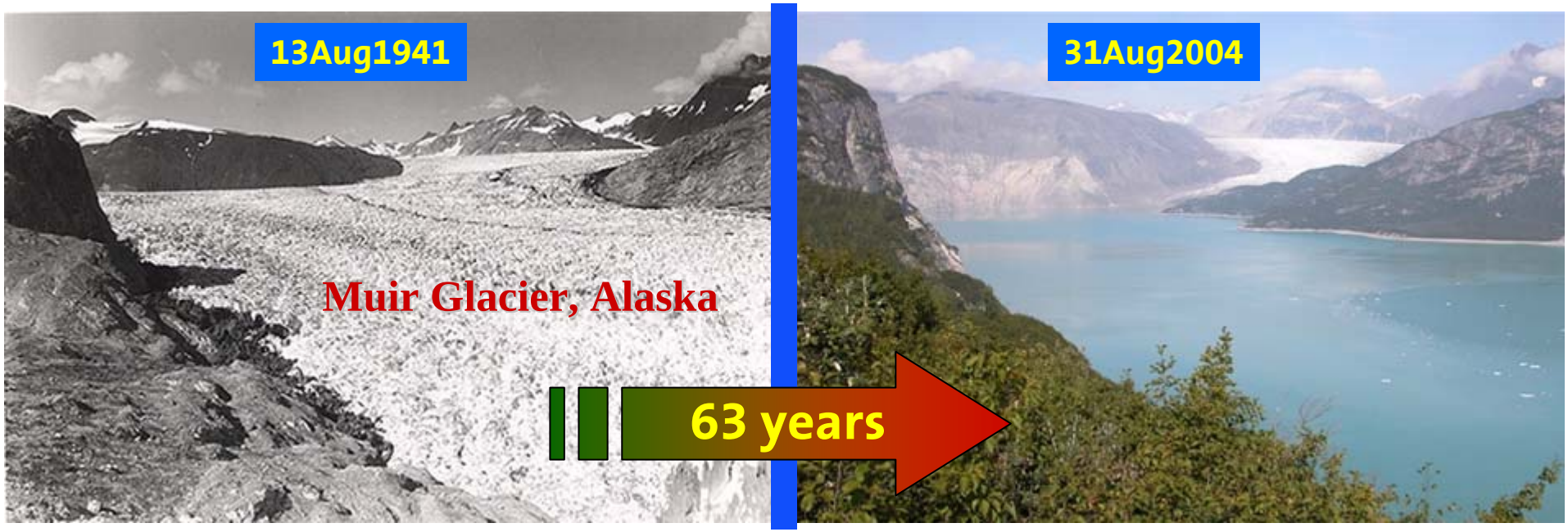
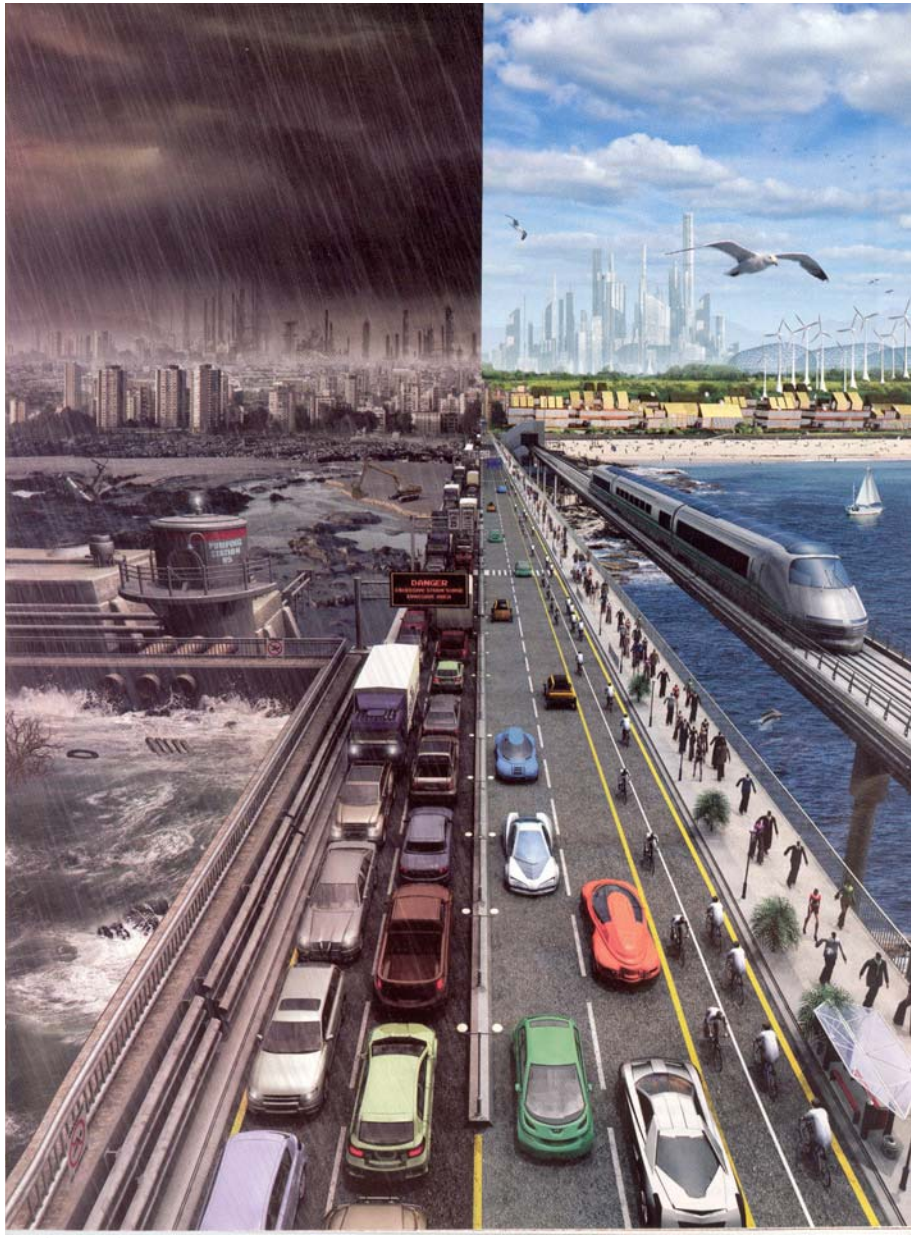


Image Credit: *National Snow and Ice Data Center, W. O. Field, B. F. Molnia*



Ref. Scientific American Sep06

GSD & GSM

GSD

Development that allows people to meet their needs of the present without compromising the ability of the future generations to meet their own needs.

GSM

Sustainable mobility definition is implicit in the above description;

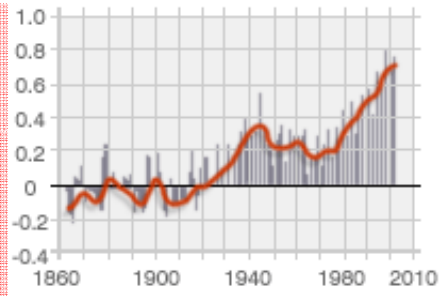
"development that allows people to meet their transportation needs of the present without compromising the ability of future generations to meet their own transportation needs".

GSD – Global Sustainable Development

GSM – Global Sustainable Mobility

GSD & GSM

- Present results:
  - Deficiencies and failures of world-wide styles of development oriented fundamentally to the economic growth.
  - Negative environmental impact caused by the human activity.
  - Untenable sociocultural phenomena that obey to opportunistic strategies of survival to short term.



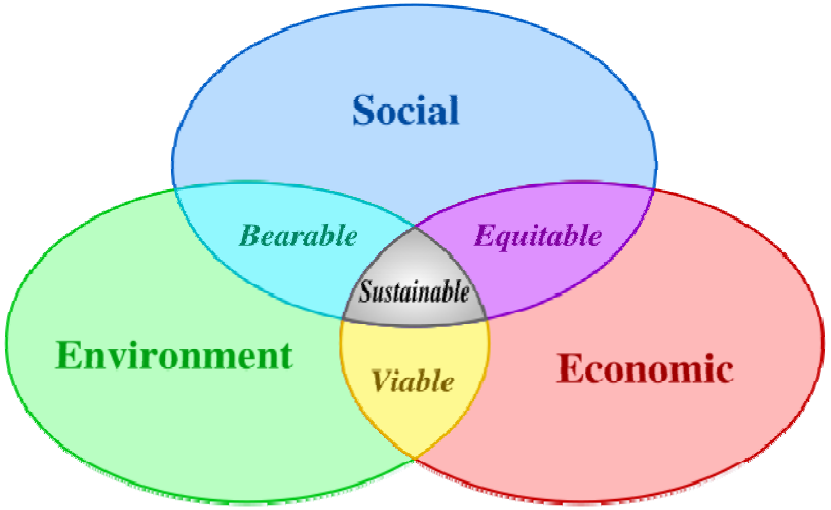
- Opportunities:
  - To consider the sociocultural dimension of each region in our planet.
  - A vision of the world on the alive beings, the relations among them and their connection with nature.
  - Transformation of political, cultural, economic, scientific, technological and human order.

GSD – Global Sustainable Development

GSM – Global Sustainable Mobility

GSD & GSM

- Economic growth based on a market decision does not guarantee the sustainable development.
  - What matters is to make money $$$; Business as usual.
- World-wide development based on a decision of positive sustainable impact guarantees future sustainability.
  - What matters is the total human development.

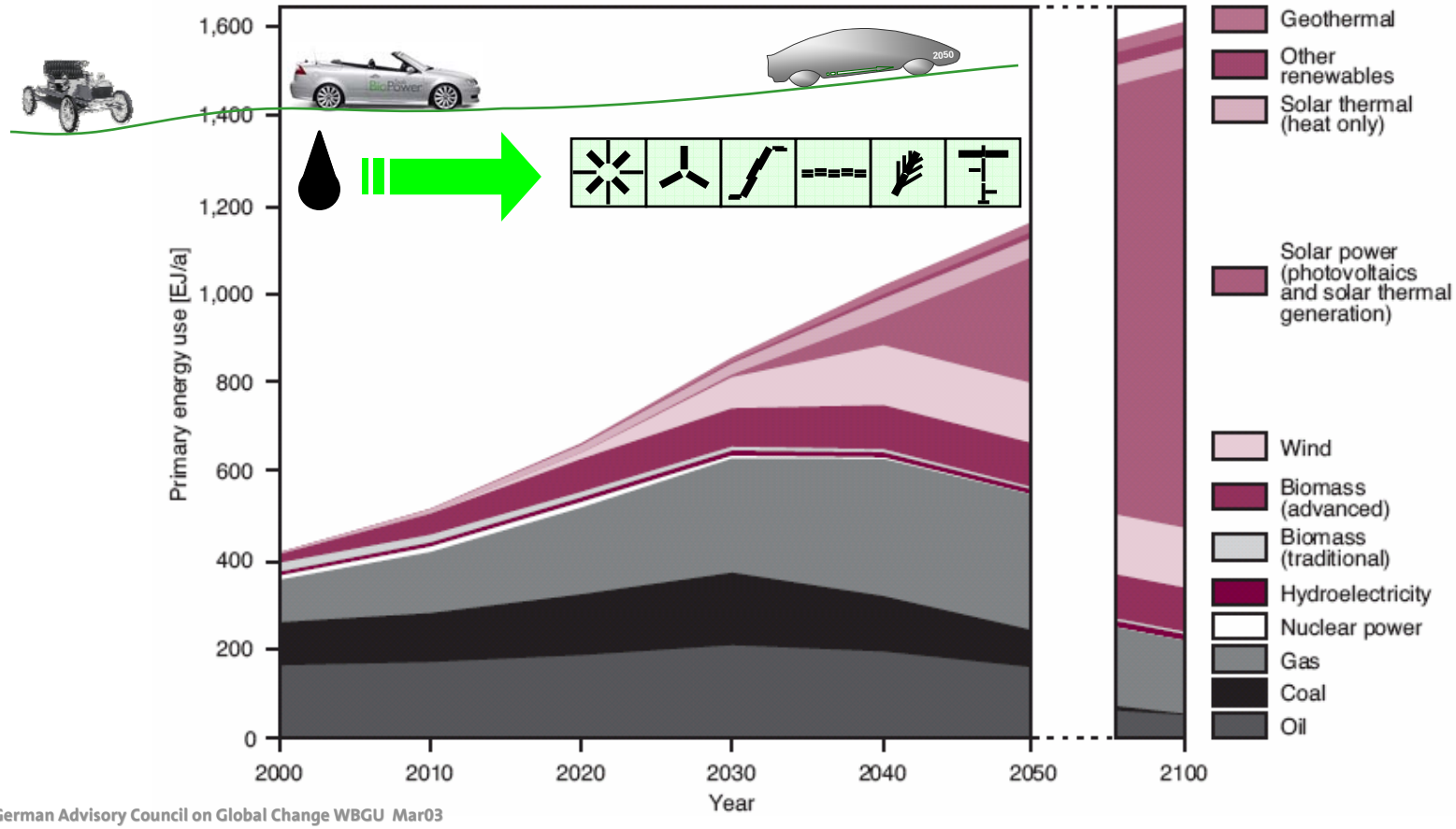


GSD – Global Sustainable Development

GSM – Global Sustainable Mobility

Renewable Energy

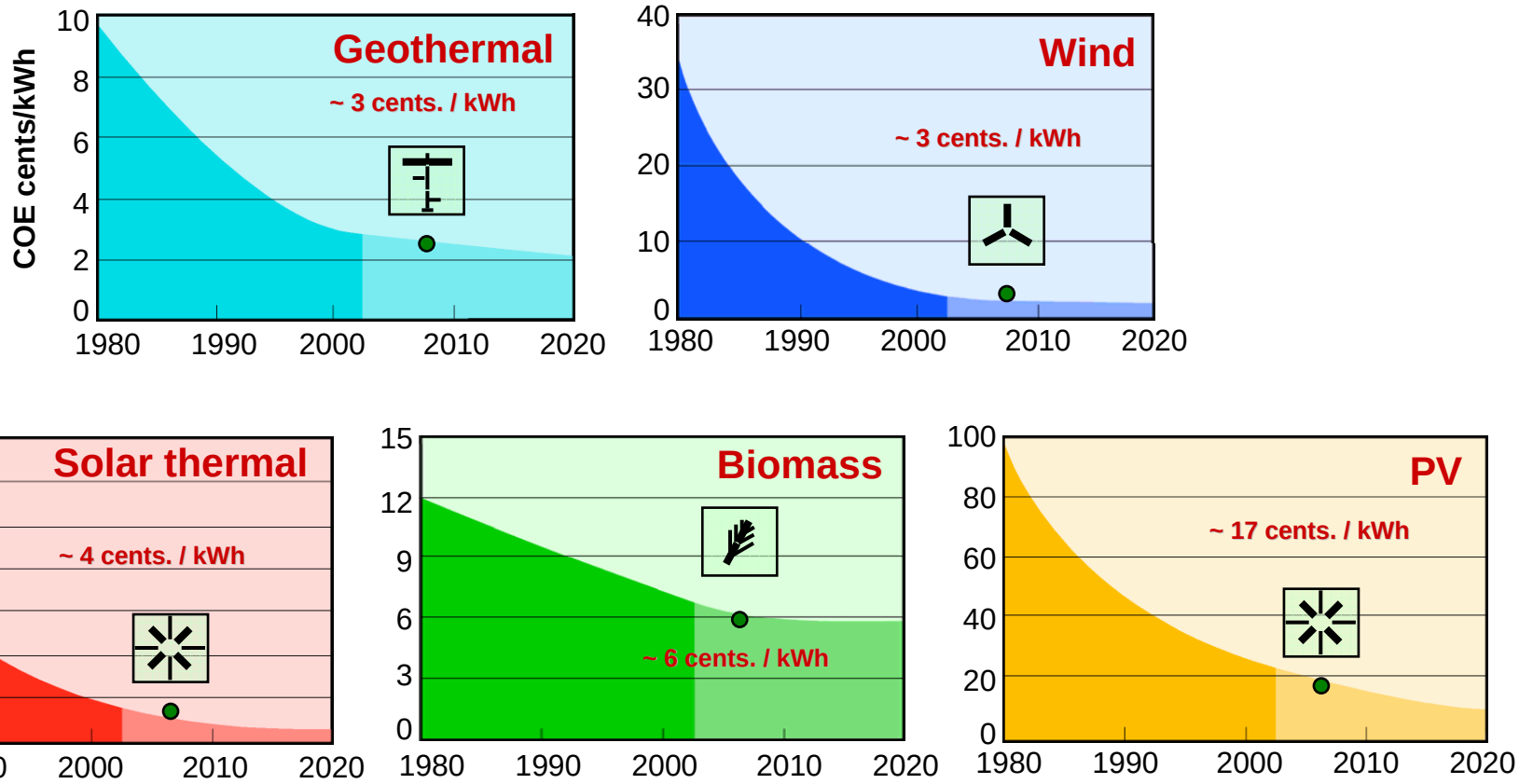
- Turning energy systems towards sustainability is feasible: The Exemplary path 2050 / 2100.



Ref. German Advisory Council on Global Change WBGU Mar03

Renewable Energy

- Renewable electricity technology cost trend.



RE's – Renewable Energies

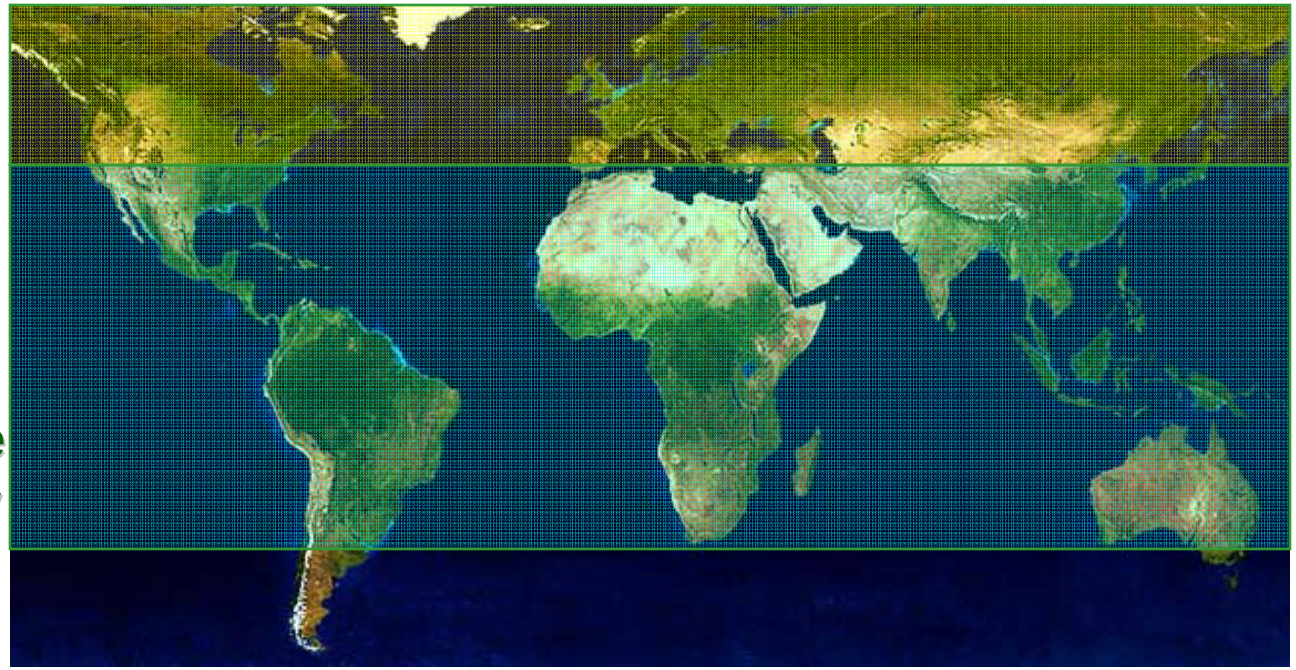
COE - Cost of Energy

Ref. NREL Energy Analysis Office Oct02

Renewable Energy

- Transcontinental grid

Global cooperation



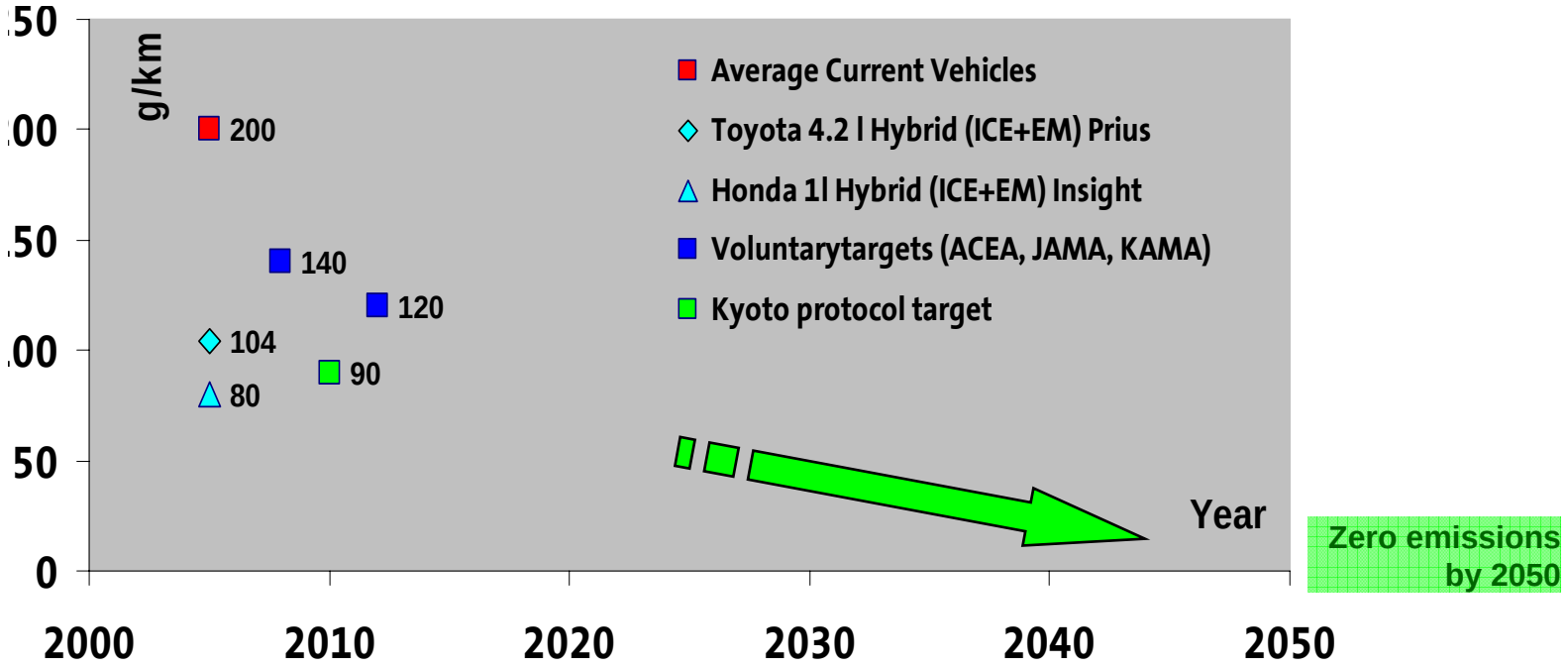
Renewable energy

Technology

Ref. NREL Energy Analysis Office Oct02

Emissions

- The dominant GHG is CO_2.
  - Responsible for 64% of the total greenhouse effect (ref. IPCC).
  - Road vehicles are responsible for about 30% del CO_2 emitted in Europe and the US.
  - Then road vehicles are responsible for ~ 20% of the GHG.



GHG – Greenhouse gas

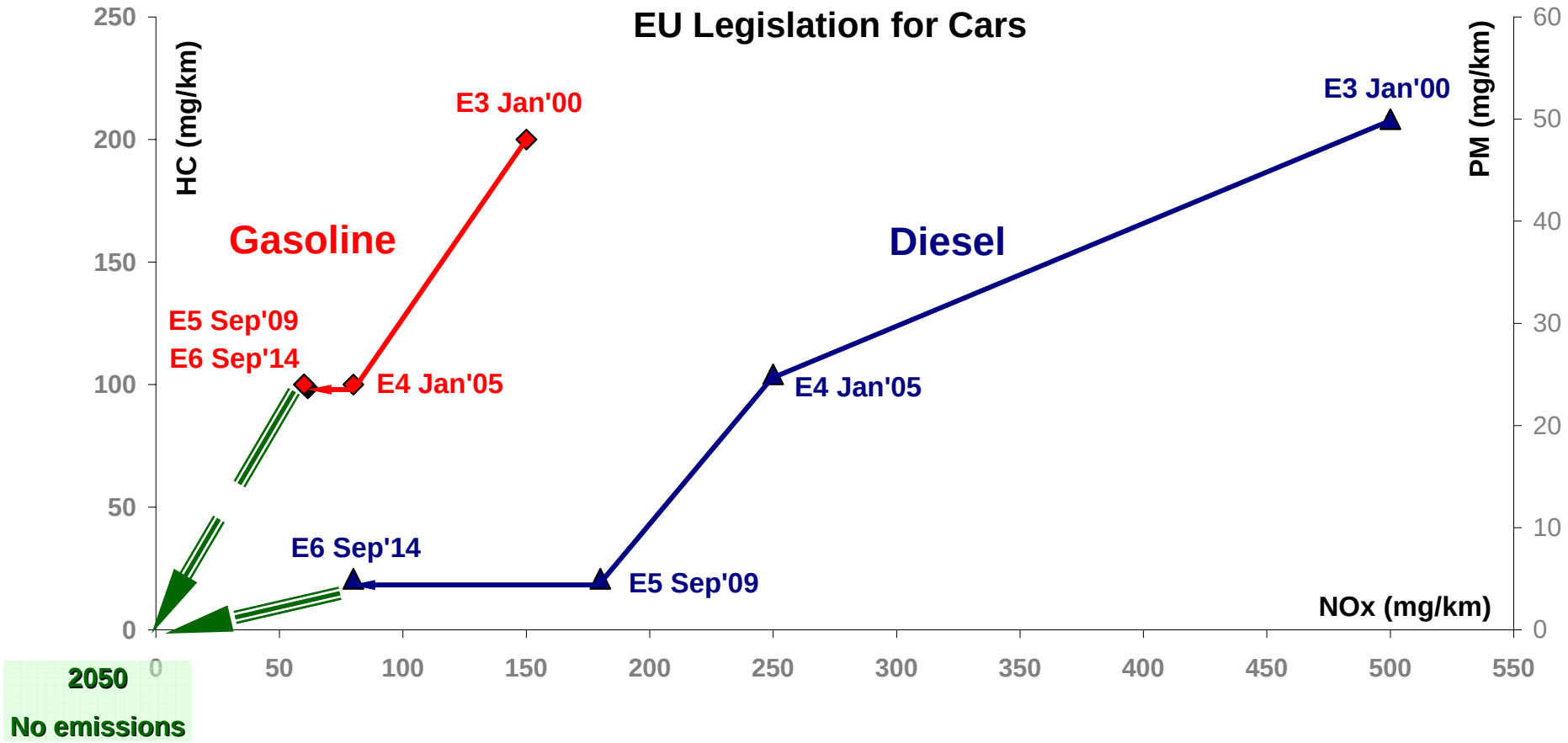
IPCC – Intergovernmental Panel on Climate Change

Emissions

- HC, PM & NO_x.

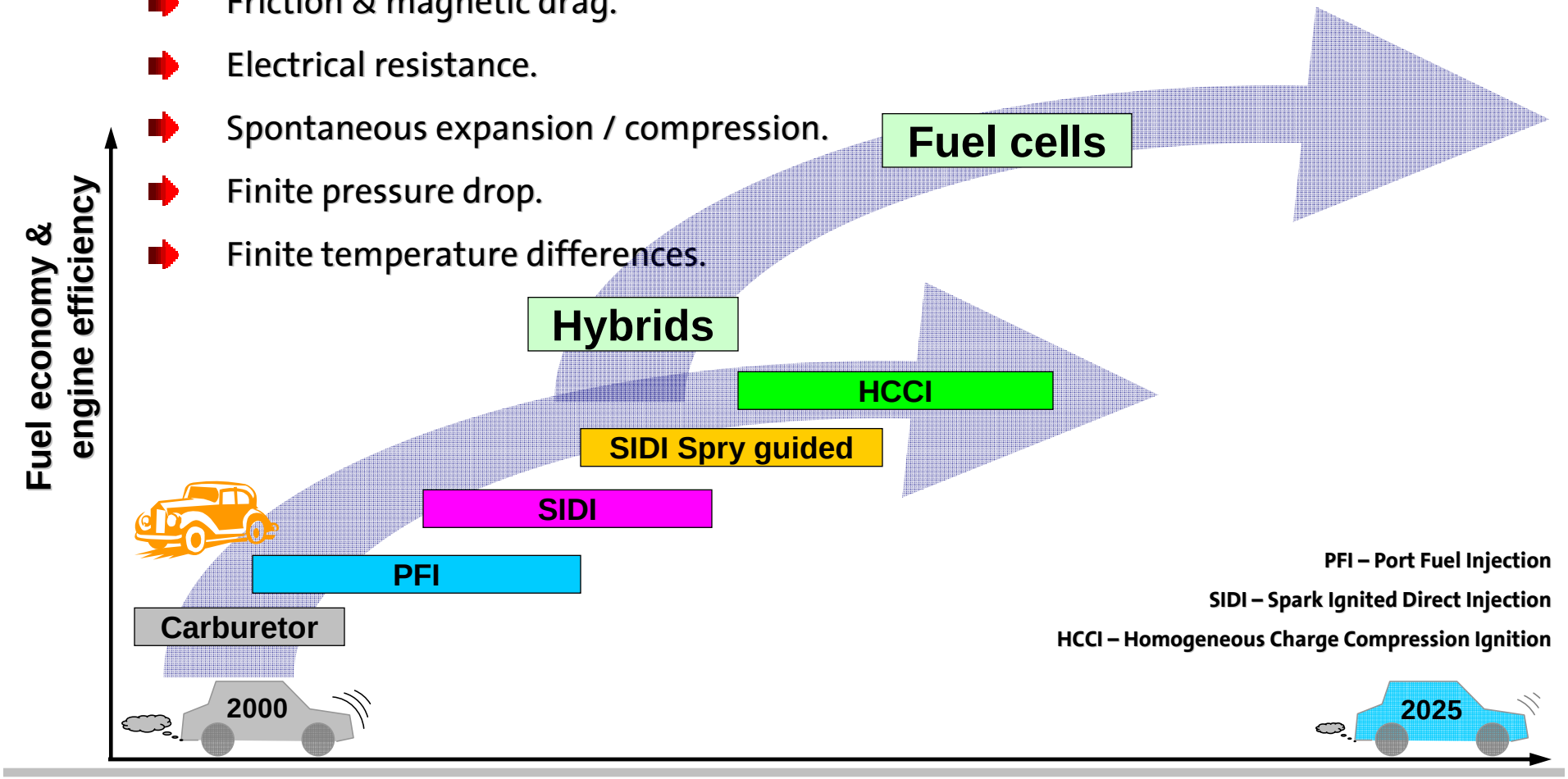
Global CO_2 legislation: 2020 ?

Global FE legislation: 2025 ?



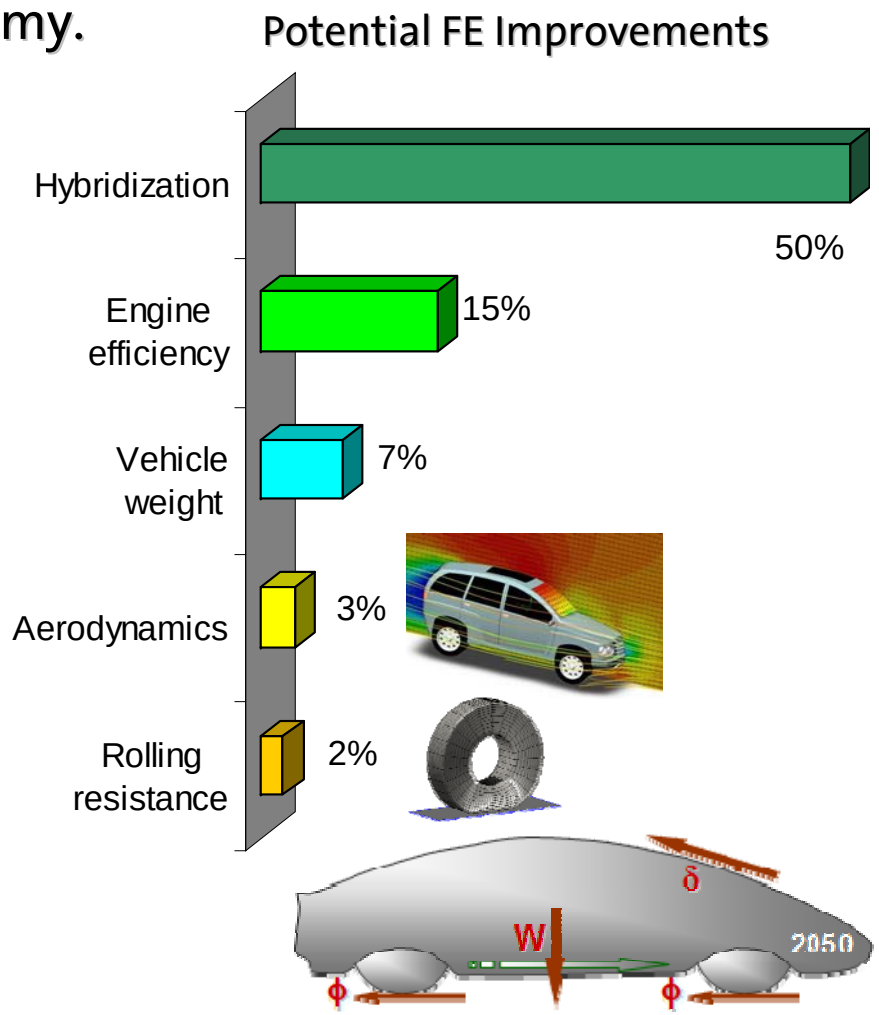
Fuel Economy

- Irreversibility mechanisms:
  - Friction & magnetic drag.
  - Electrical resistance.
  - Spontaneous expansion / compression.
  - Finite pressure drop.
  - Finite temperature differences.



Fuel Economy

- Factors affecting vehicle fuel economy.
  - Powertrain design.
    - Hybridization.
    - Engine controls.
    - Engine & Transmission.
  - Vehicle design.
    - Weight.
    - Aerodynamics.
    - Rolling resistance
  - Operational.
    - Drive & road conditions.



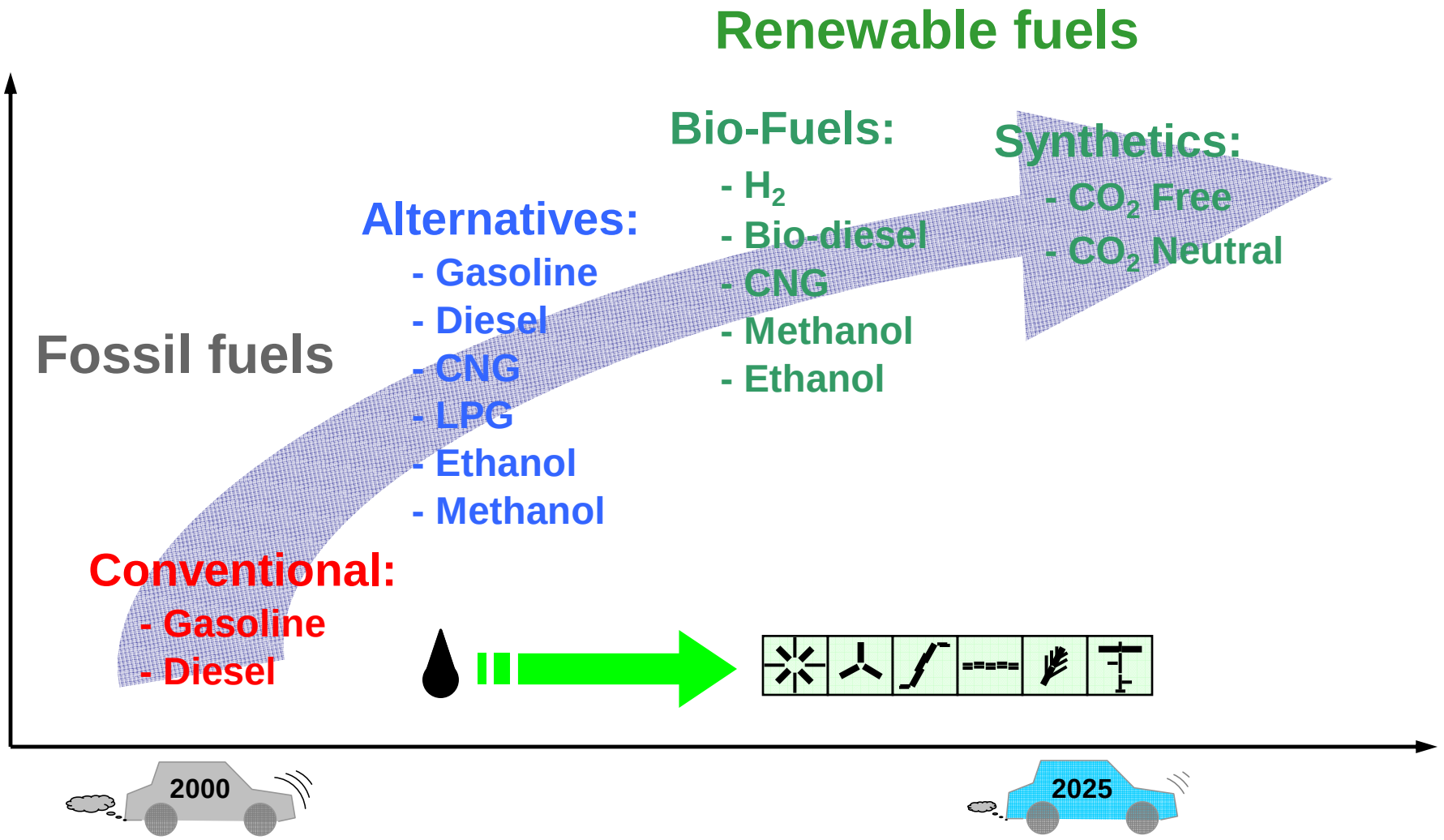
ICE Downsizing

- Developments.

Technology	Average Efficiency Increase
VVT - Variable valve timing & lift; improve engine efficiency by optimizing the flow of fuel & air into the engine for various engine speeds.	5.0%
CVT - Continuous variable transmissions; have an infinite number of "gears", providing seamless accelerations and improved fuel economy.	6.0%
AMT - Automated manual transmissions; combine the efficiency of manual transmissions with the convenience of automatics (gears shift automatically).	7.0%
CD - Cylinder deactivation; saves fuel by deactivating cylinders when they are not needed.	7.5%

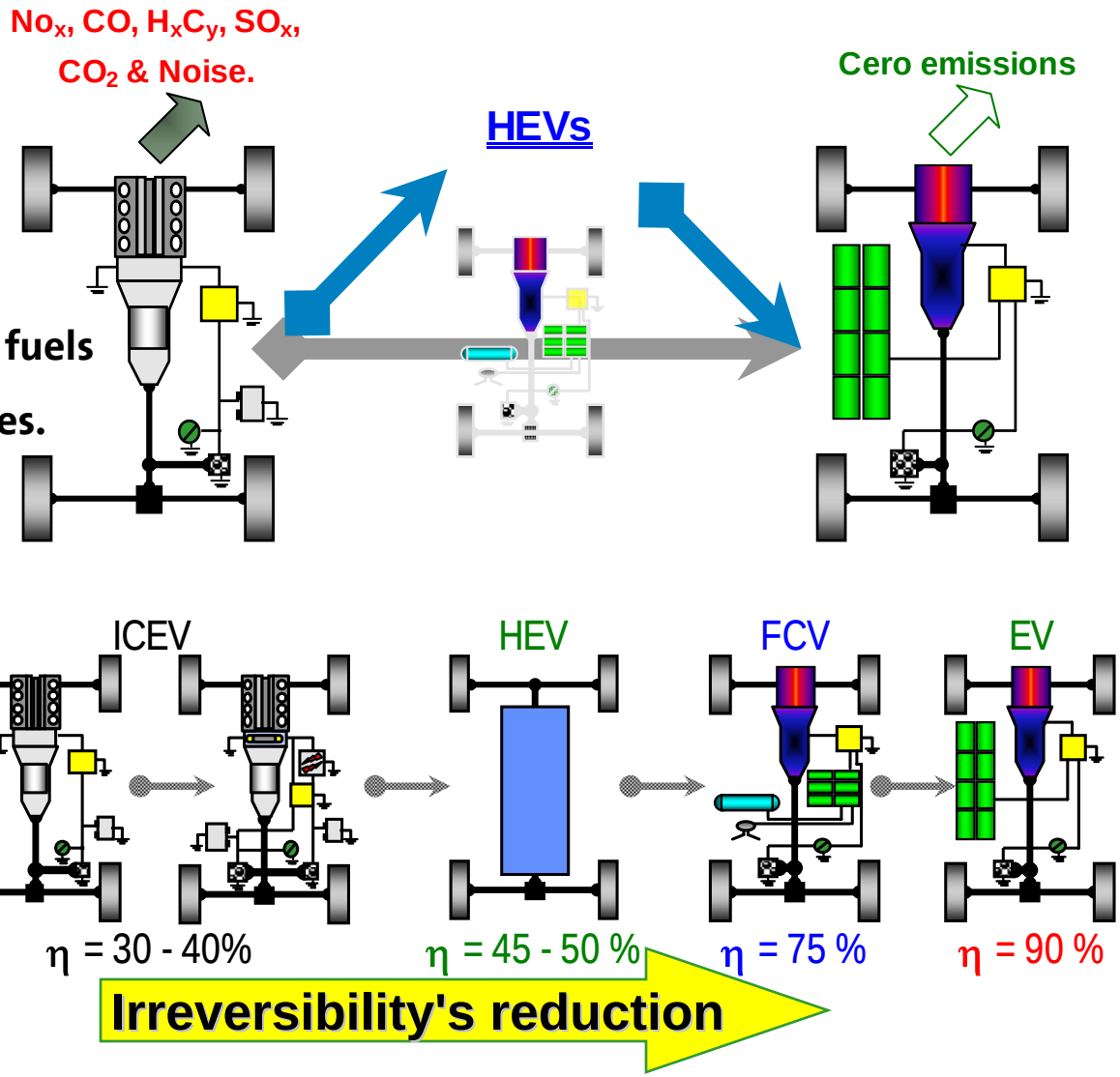
Technology	Average Efficiency Increase
Turbocharges & Superchargers - increase engine power, allowing to downsize engines without sacrificing performance or to increase performance without lowering fuel economy.	7.5%
ISG - Integrated Starter / Generator Systems; automatically turn the engine on/off when the vehicle is stopped to reduce fuel consumed during idling.	8.0%
DI - Direct injection (w / turbocharged or supercharging) delivers higher performance with lower fuel consumption.	13.0%
VCR - Variable compression ratio; Controlled crankshaft position of cylinder head by optimizing fuel power.	30% reduction of CO_2

Fuels

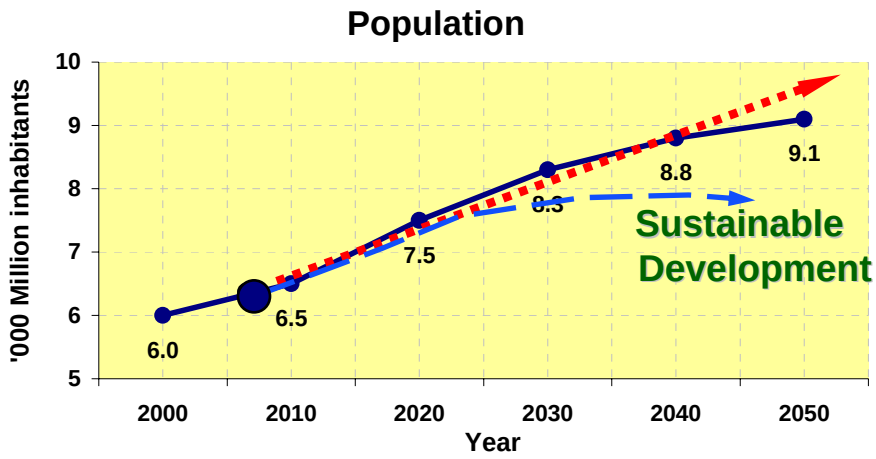

Renewable fuels
Bio-Fuels:
- H_2
- Bio-diesel
- CNG
- Methanol
- Ethanol
Synthetics:
- CO_2 Free
- CO_2 Neutral
Alternatives:
- Gasoline
- Diesel
- CNG
- LPG
- Ethanol
- Methanol
Fossil fuels
Conventional:
- Gasoline
- Diesel
2000
2025

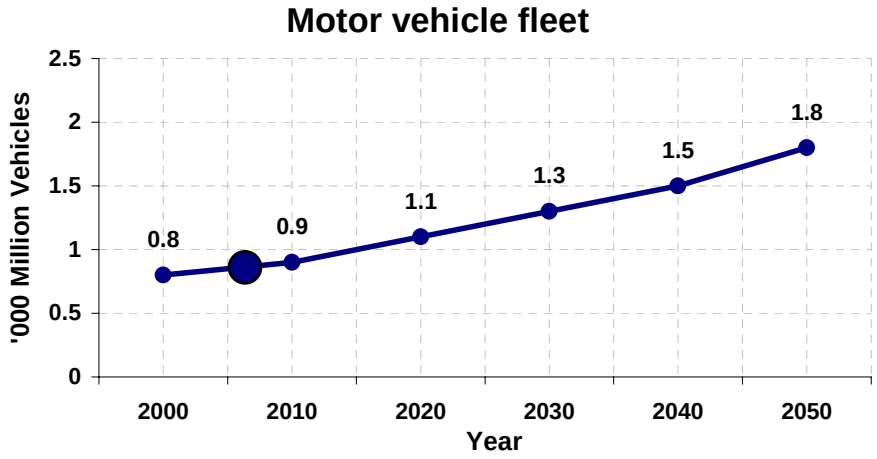
Advanced Propulsion

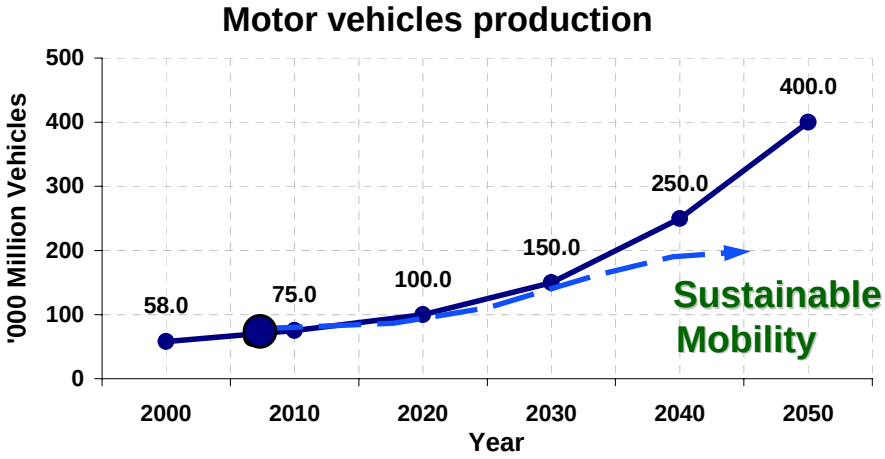
- **ICE efficiency**
  - Variable features.
- **Hybrids**
  - Advanced ICE, Bio & Flex fuels
  - Electric motors & batteries.
- **Hydrogen**
  - Fuel cells
- **Full electric**
  - Battery, Capacitor
  - Flywheel,
  - Gyros
- **Other**

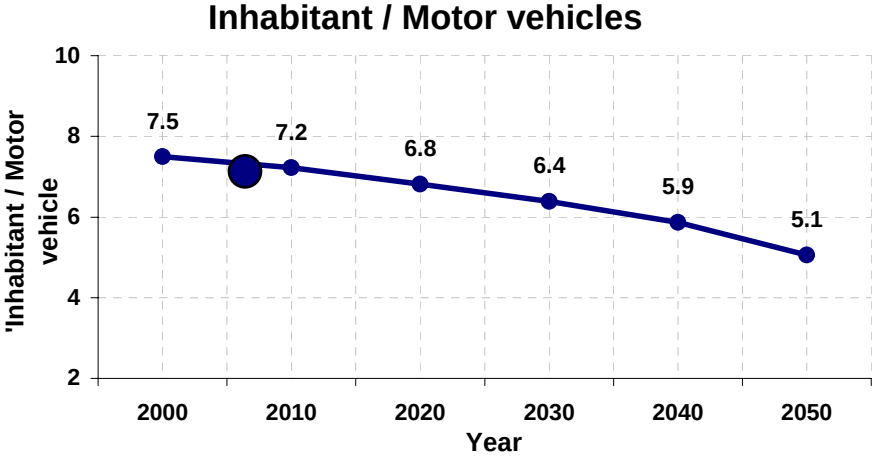


Projections





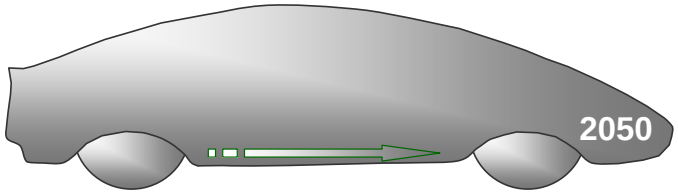




Towards the 2050 Vehicles

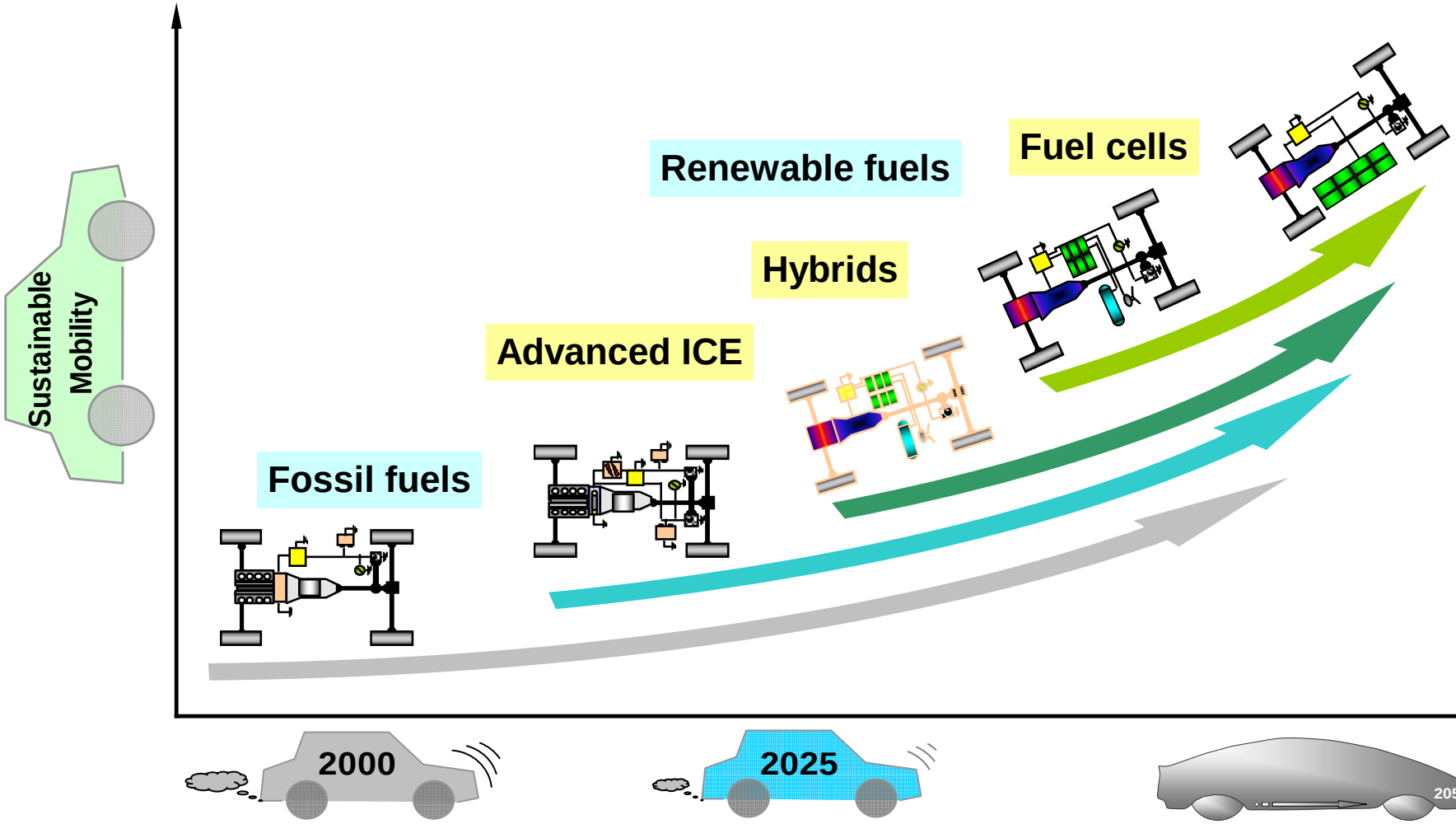
1907

2007



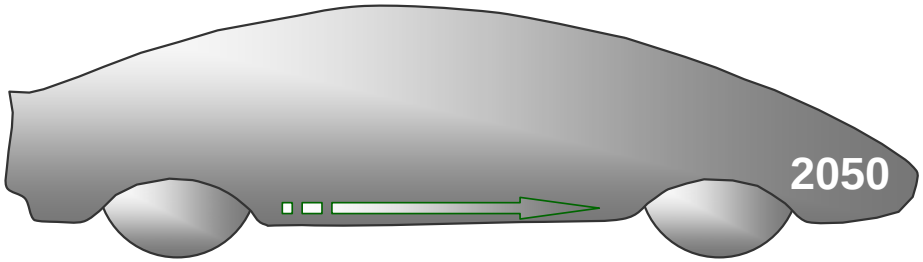
2050

Towards the 2050 Vehicles



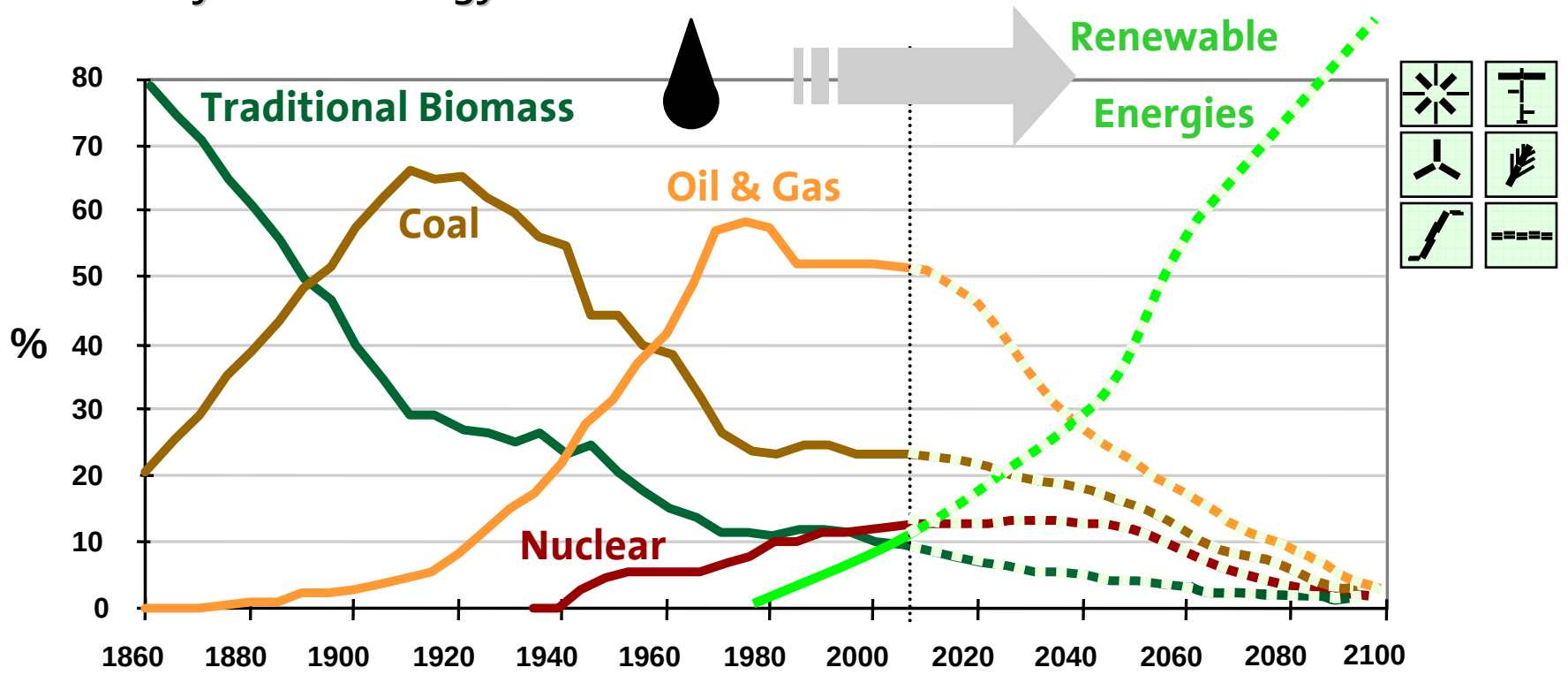
2050 Automobile

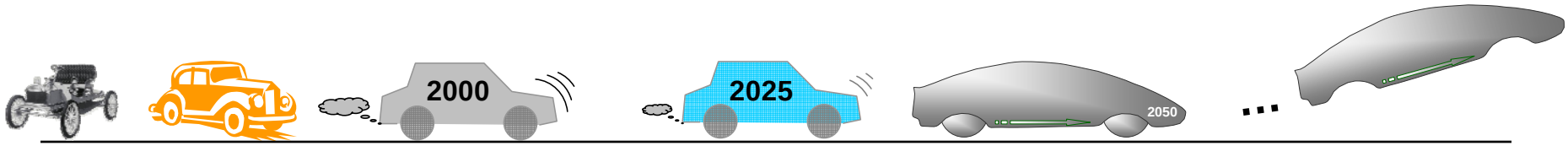
- Given the progress we have already made with technology, we can foresee what kind of automobiles will be in the roads by 2050:
  - Fully safety.
  - No emissions.
  - Completely recyclable.
  - Nature designs integrated.
  - Built from intelligent materials.
  - Connected to everything all the time.
  - Provide functionality to the molecular level.
  - Powered by energy from renewable sources.
  - Human-vehicle interface from biological sensors.



Beyond 2050

- Life cycles of energy resources.





Conclusions

Comes to a global energy policy that deals with a global sustainable mobility

- No global vision for a sustainable mobility.
- Hybrid electric vehicles have the potential to meet the short term stringent regulations (Euro 6 & SULV) as well as FE & CO2 goals.
- A change of mindset through education of our current and future generations is necessary for a global sustainable development growth.
- A positive sustainable impact instead of a positive economic growth is the right direction to setup the core design parameters of the future vehicles to meet a sustainable mobility.
- ICE developments & their major challenges may be truncated while technology is growth on batteries and fuel cells.
- Our future propulsion system will be a part of a complex development models; Our vision of anthropogenic interaction with our planet and space.

Thanks

See you at