Deriving Least-Cost Policy Strategies for Meeting CO_2-Reduction Targets in Passenger Car Transport in the EU-15

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  - AEOLIKI Ltd, Cyprus
  - Black Sea Energy Center, Bulgaria
  - Association Rhônalpénergie-Environnement, France
  - Centre for Renewable Energy Sources, Greece
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  - Chalmers Tekniska Högskola Aktiebolag, Sweden
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  - Sociedade Por Quotas CEEETA-ECO, Portugal
  - Det Økologisk Råd (EcoCouncil), Denmark

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2. Recent developments in passenger road transport
3. CO_2 emissions in passenger car transport
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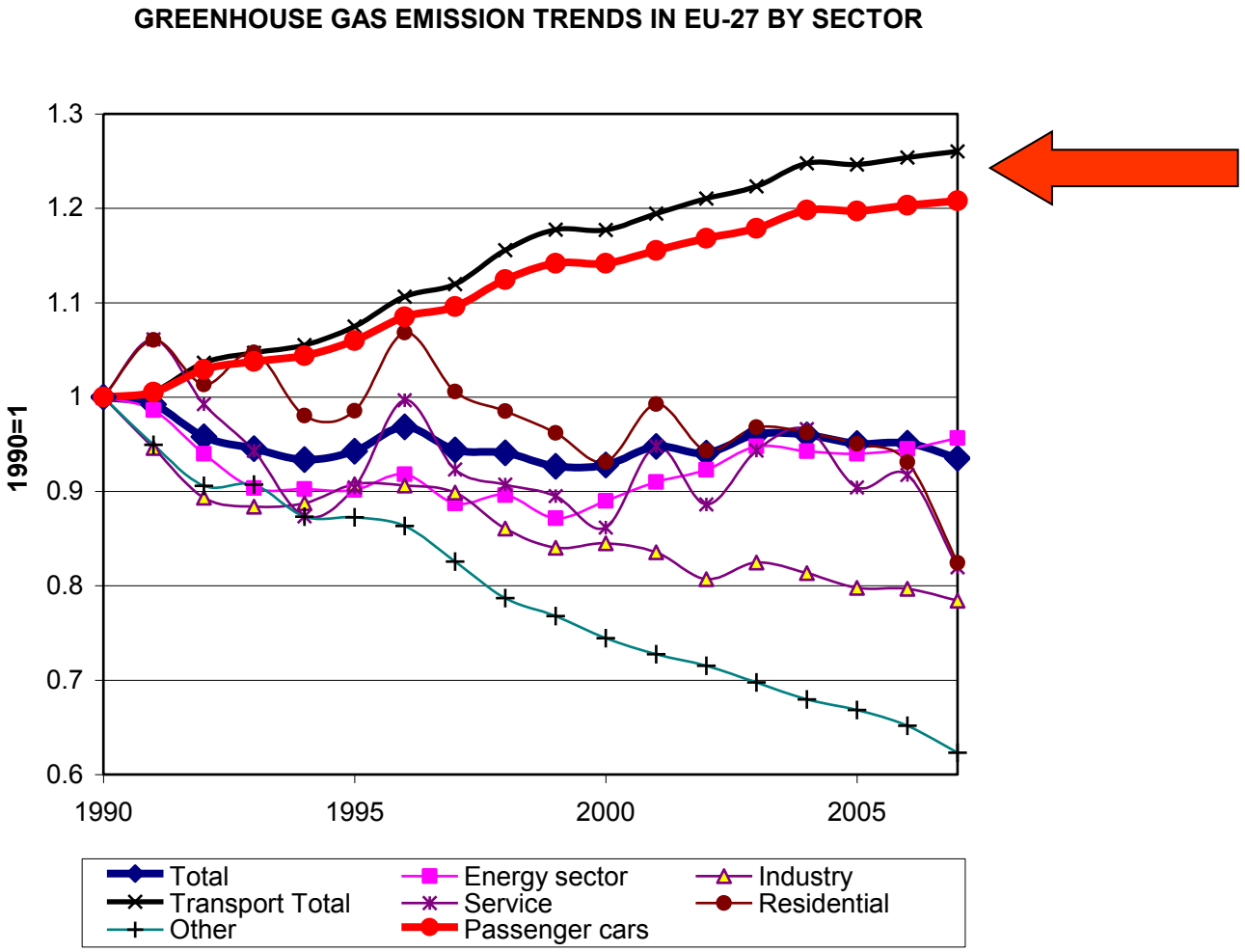
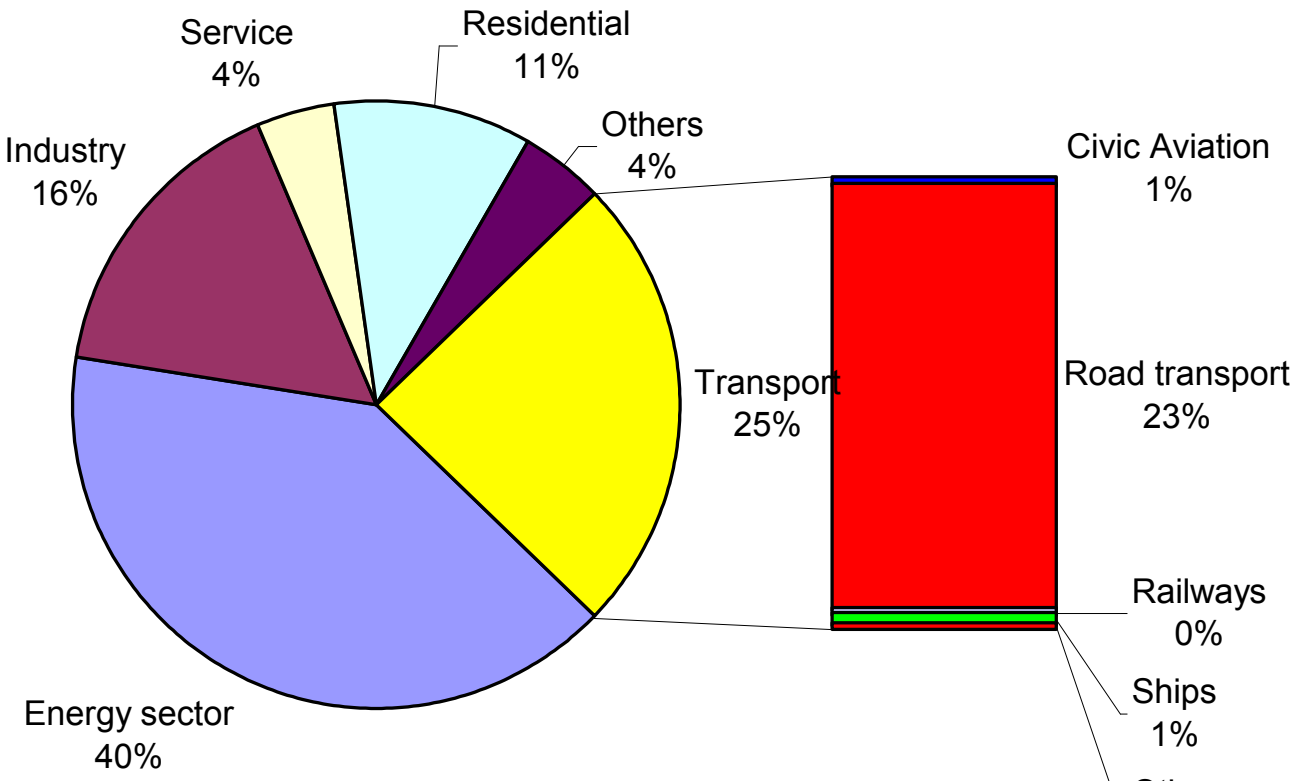
Introduction



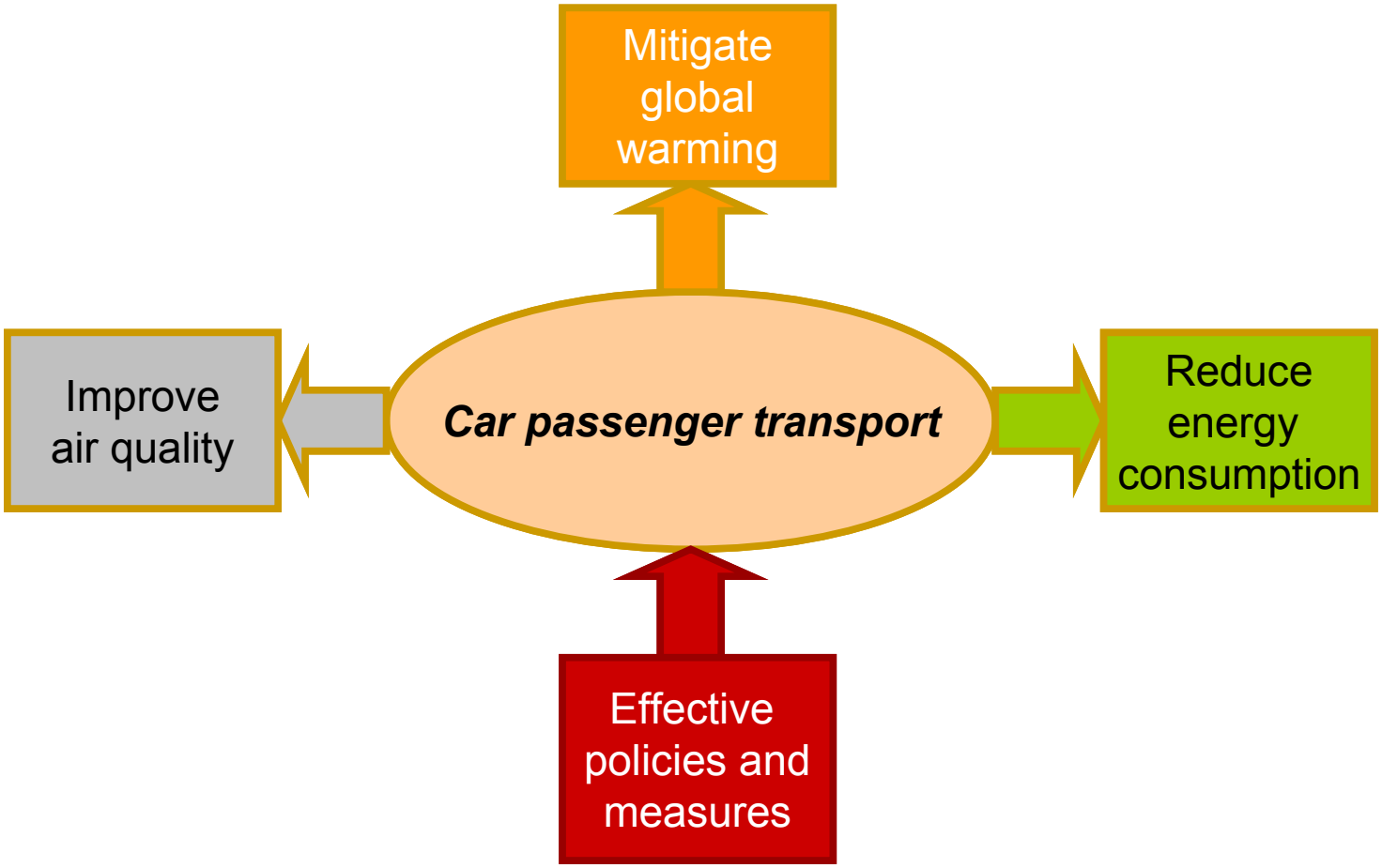
Introduction

GREENHOUSE GAS EMISSIONS EU-27



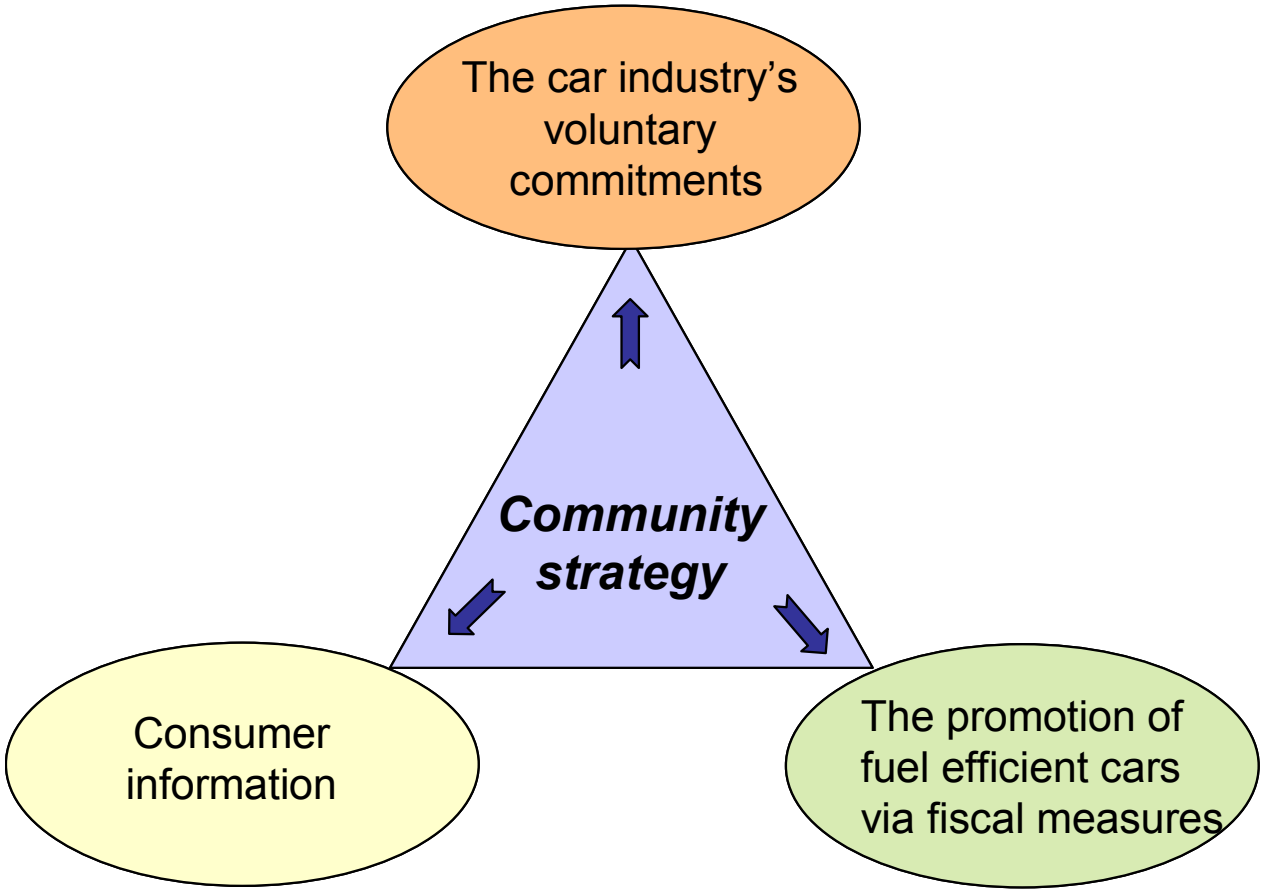
TOTAL ENERGY 2007:
4000 Mio tons CO2_equ

Introduction



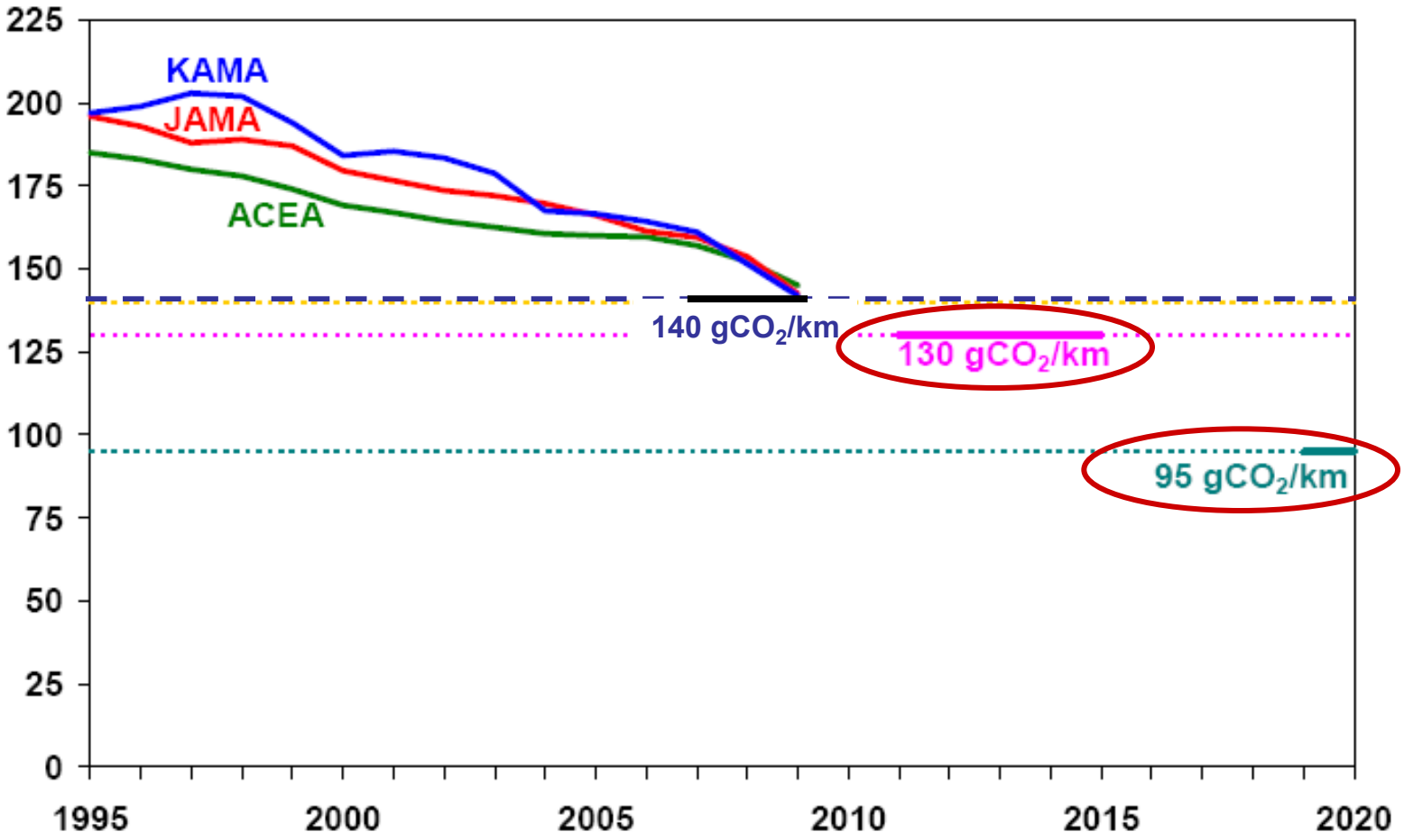
The challenges for EU climate and energy policies

Introduction



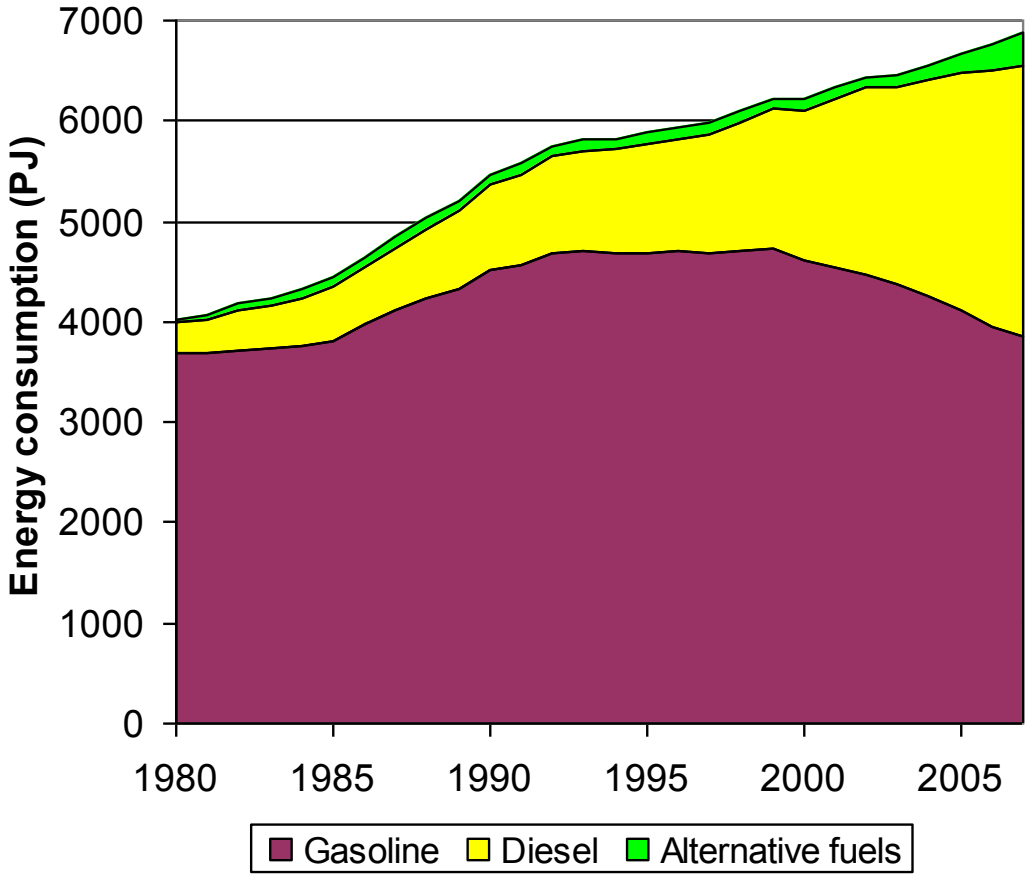
The three pillars of the Community strategy

Introduction



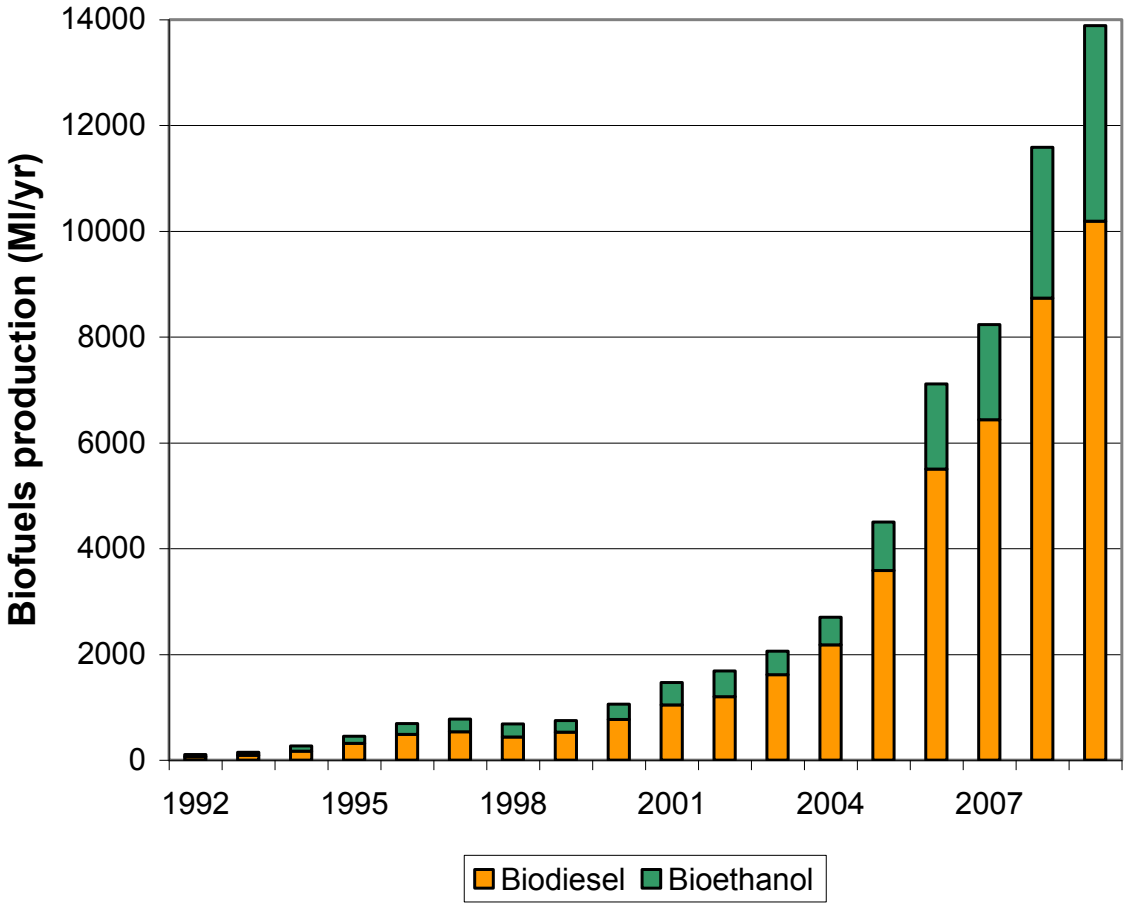
Evolution of CO2 emissions from new passenger cars by the European (ACEA), Japanese (JAMA) and Korean (KAMA) car manufacturer associations

Recent developments in passenger road transport



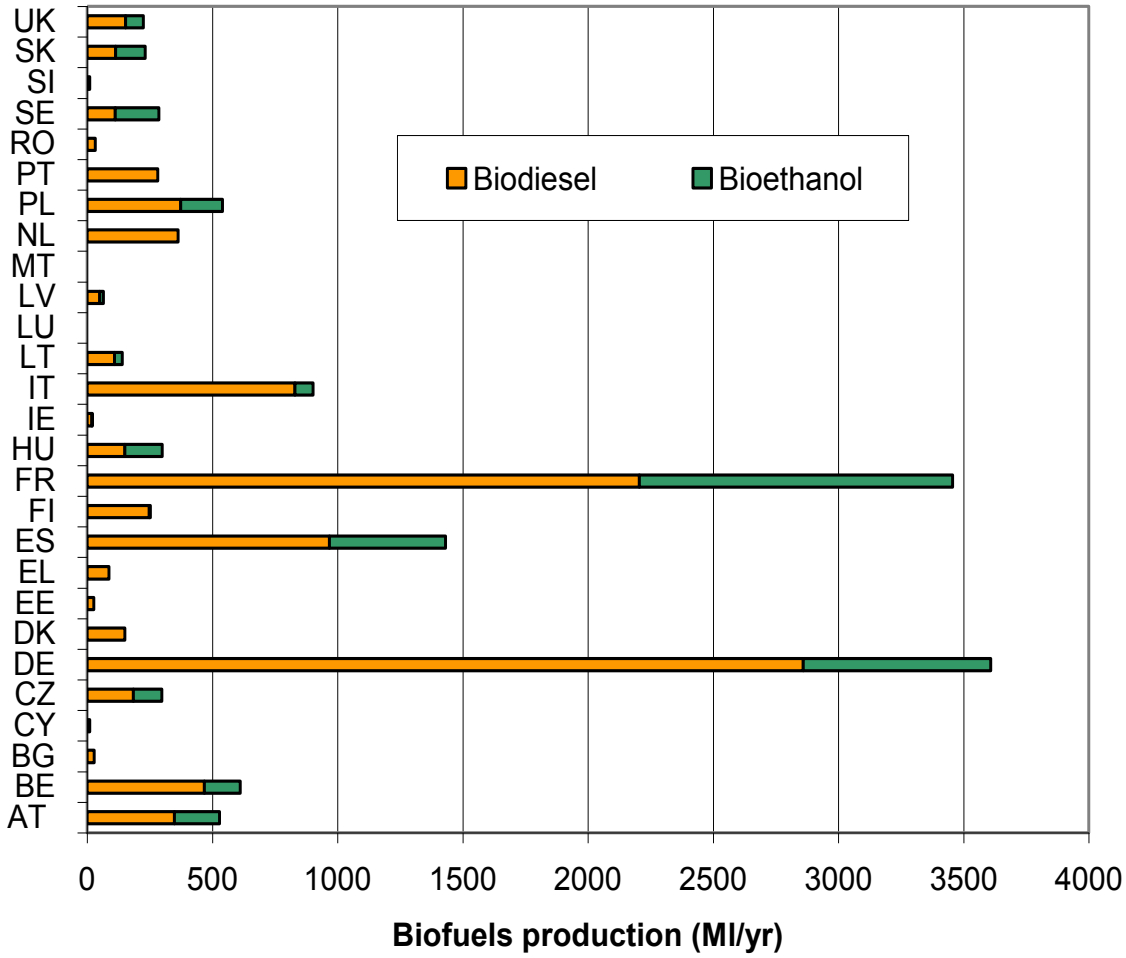
Energy consumption in car passenger transport in EU-15 by fuel, 1980 – 2007

Biofuels production



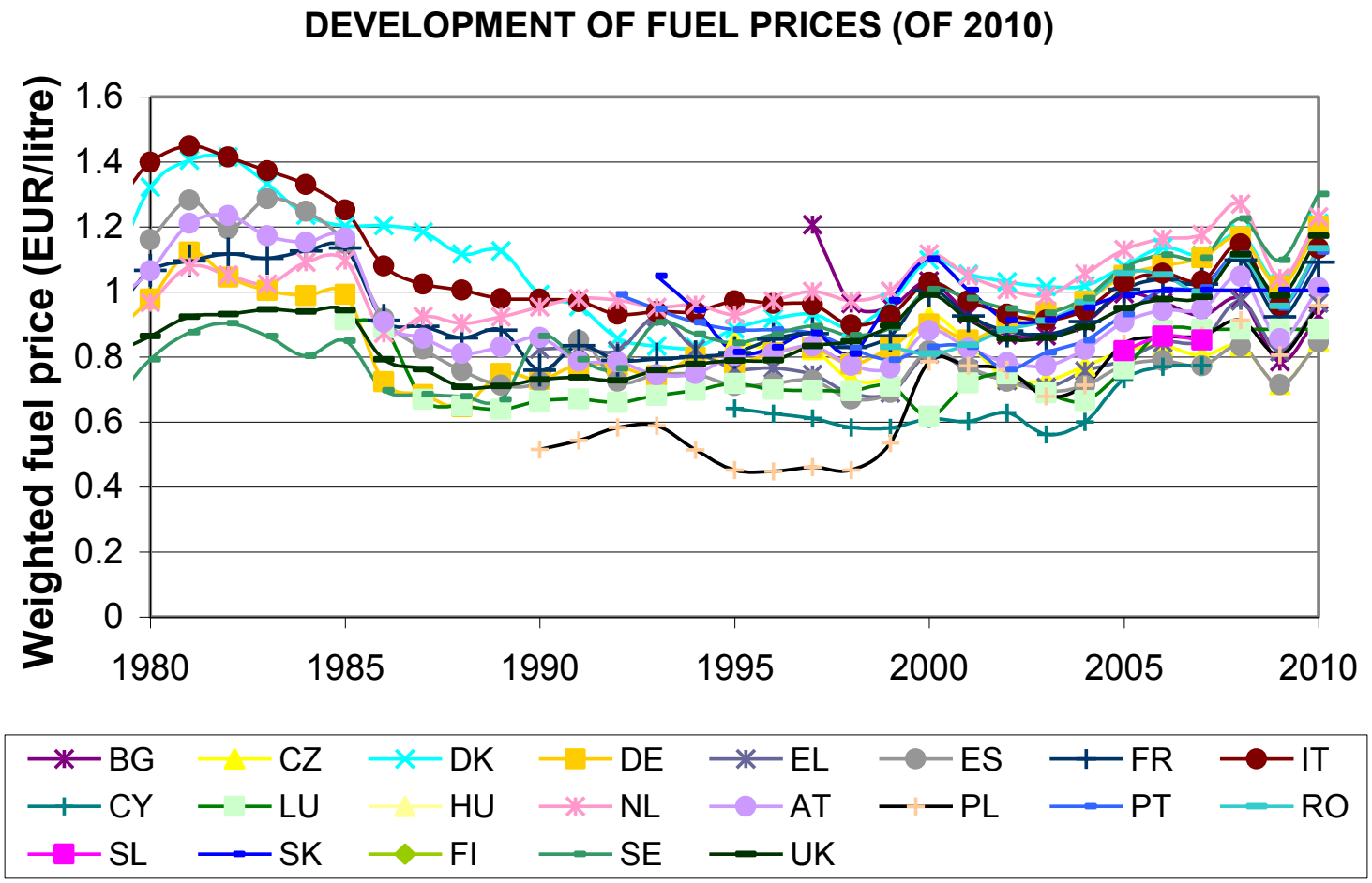
Recent trends in biofuels production in EU-27 (Data source: EBTP, 2011)

Biofuels production



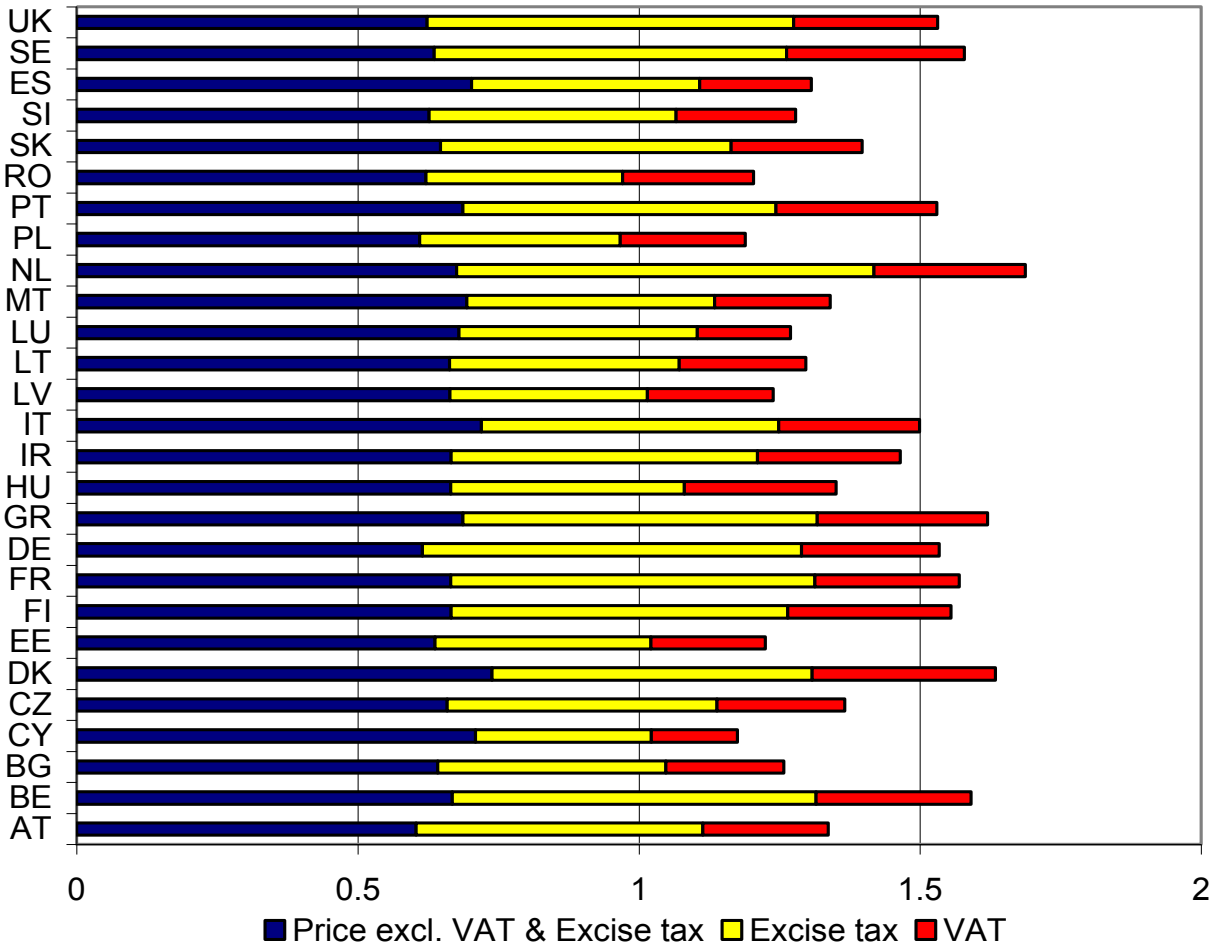
Comparison of biofuel production in 2009 in EU-27 countries (Data source: EBTP, 2011)

Development of fuel prices



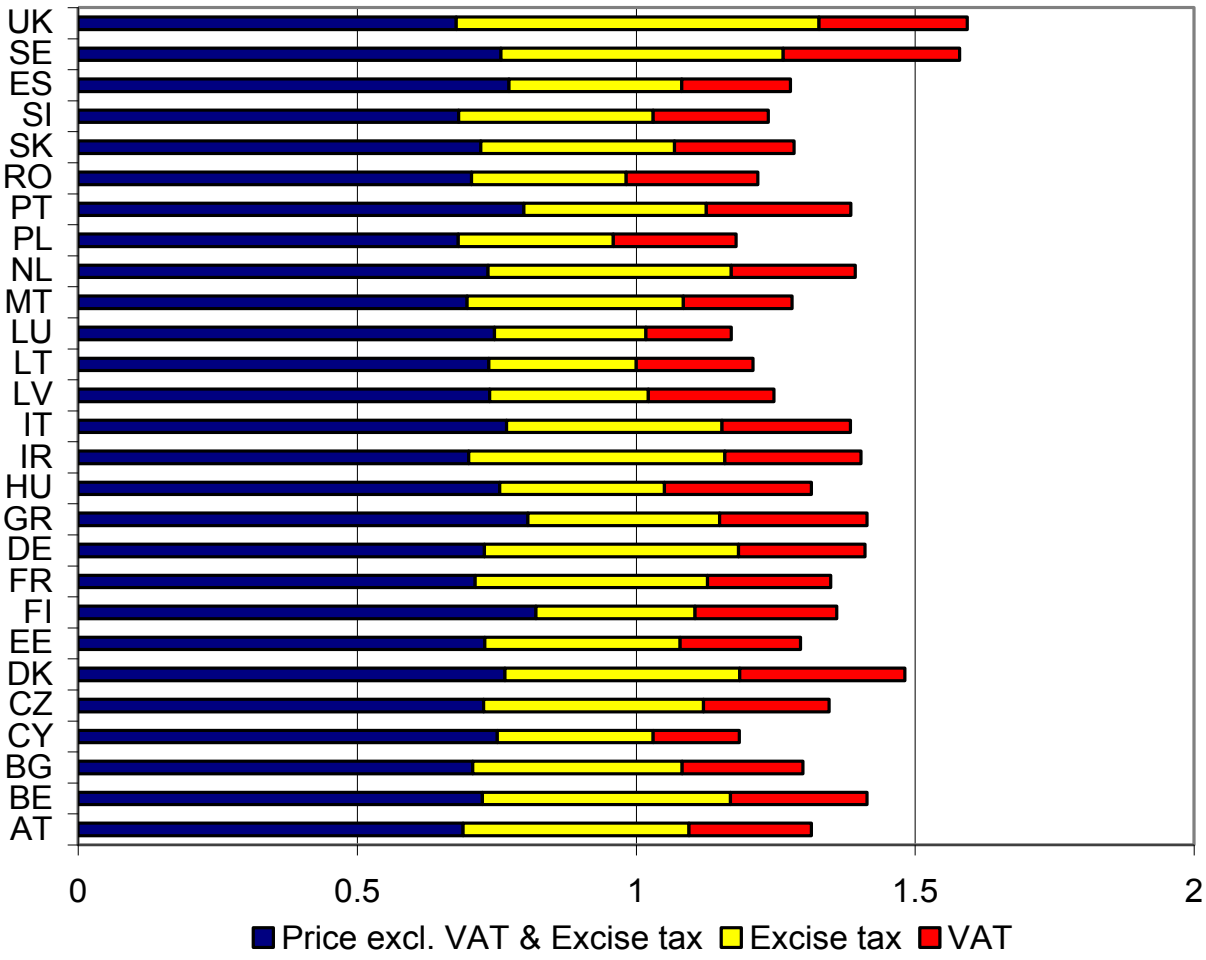
Weighted fuel prices (including all taxes) for EU countries 1980 – 2010
(in prices of 2010, numbers for 2010 preliminary) (Source: EEP; IEA, 2010)

Development of fuel prices



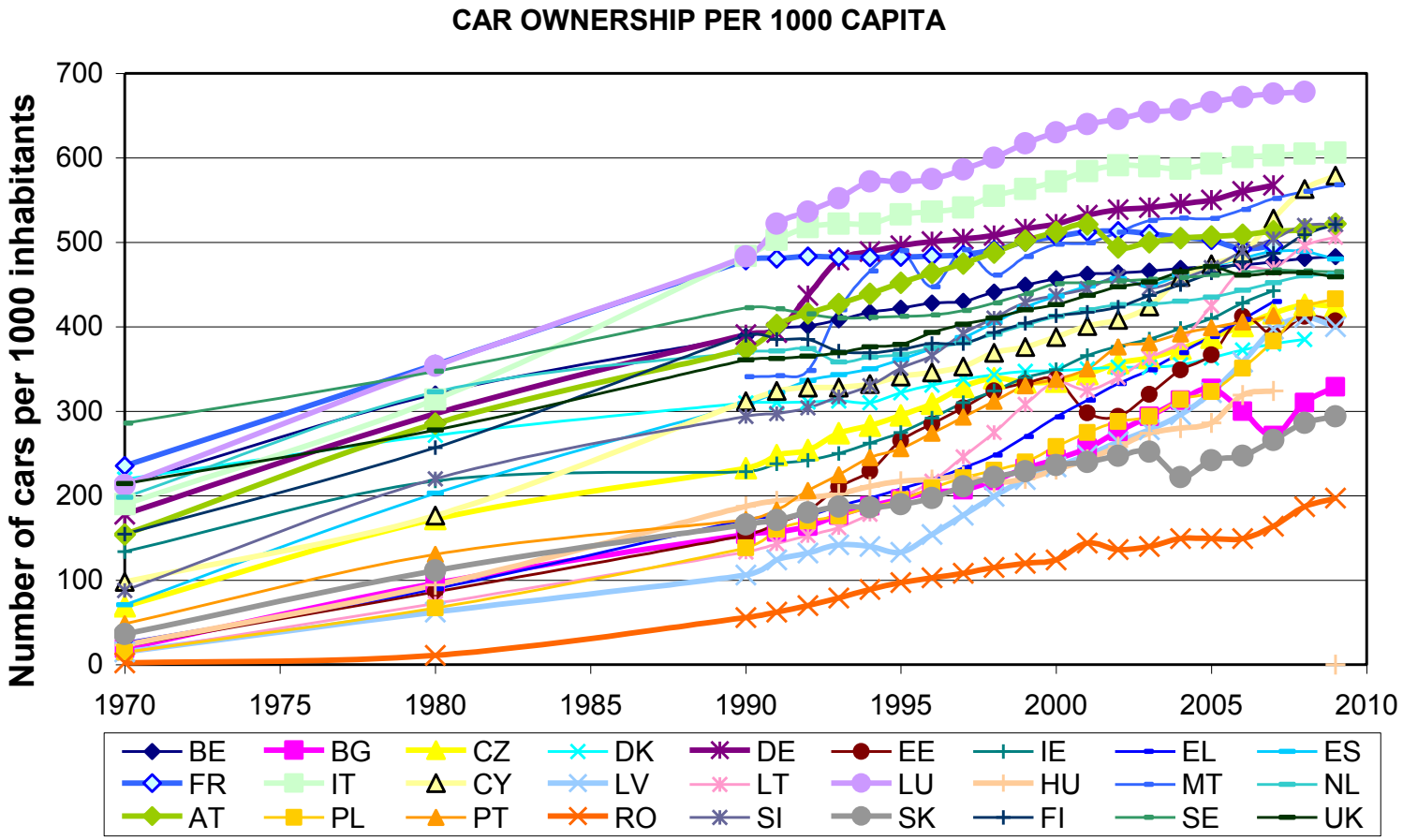
Price structure of gasoline in EU-27 (data source: EEP, 2011 - effective March 2, 2011)

Development of fuel prices



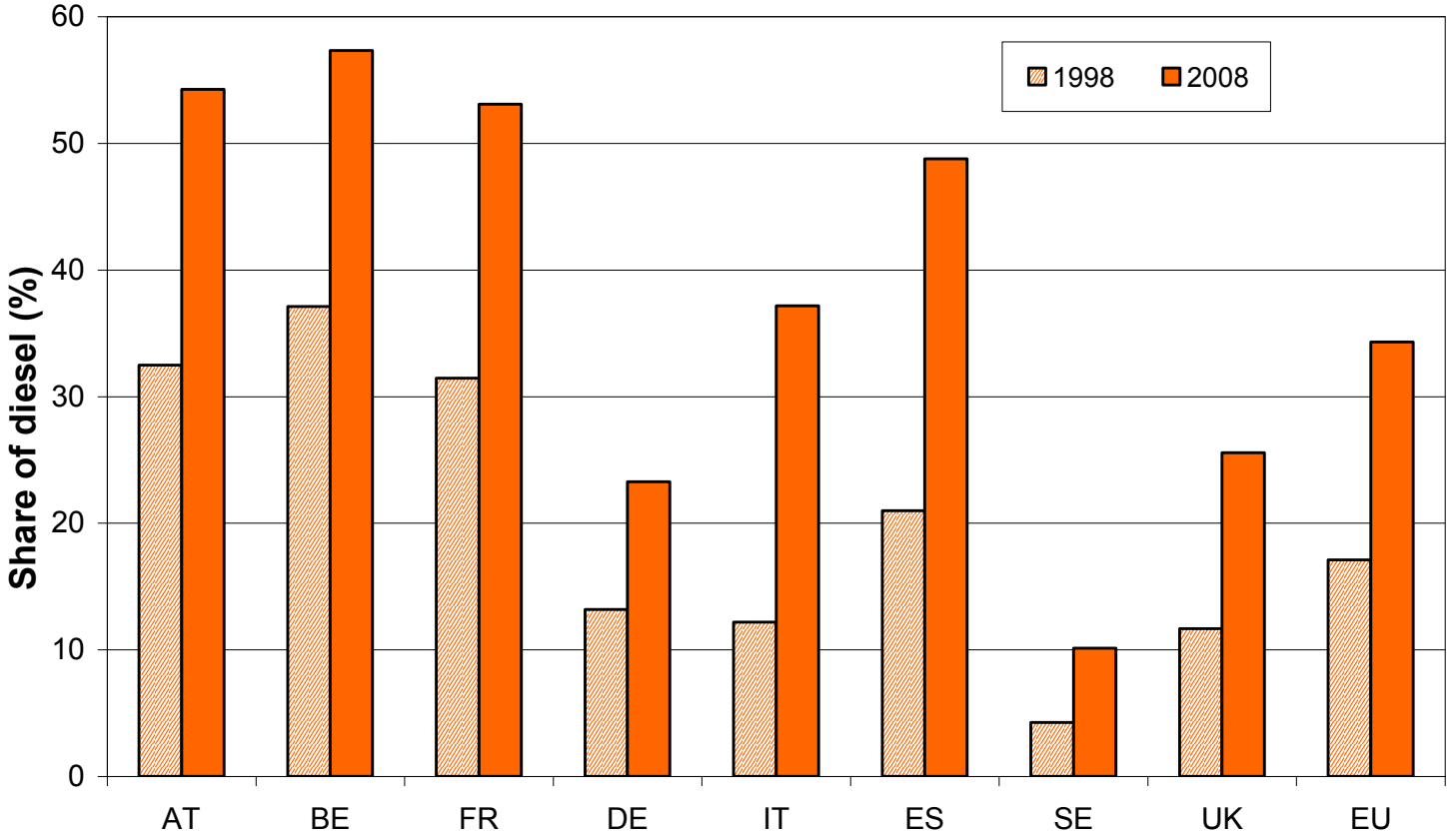
Diesel prices in 2011 for EU-27 (data source: EEP, 2011 - effective March 2, 2011)

Development of car stock



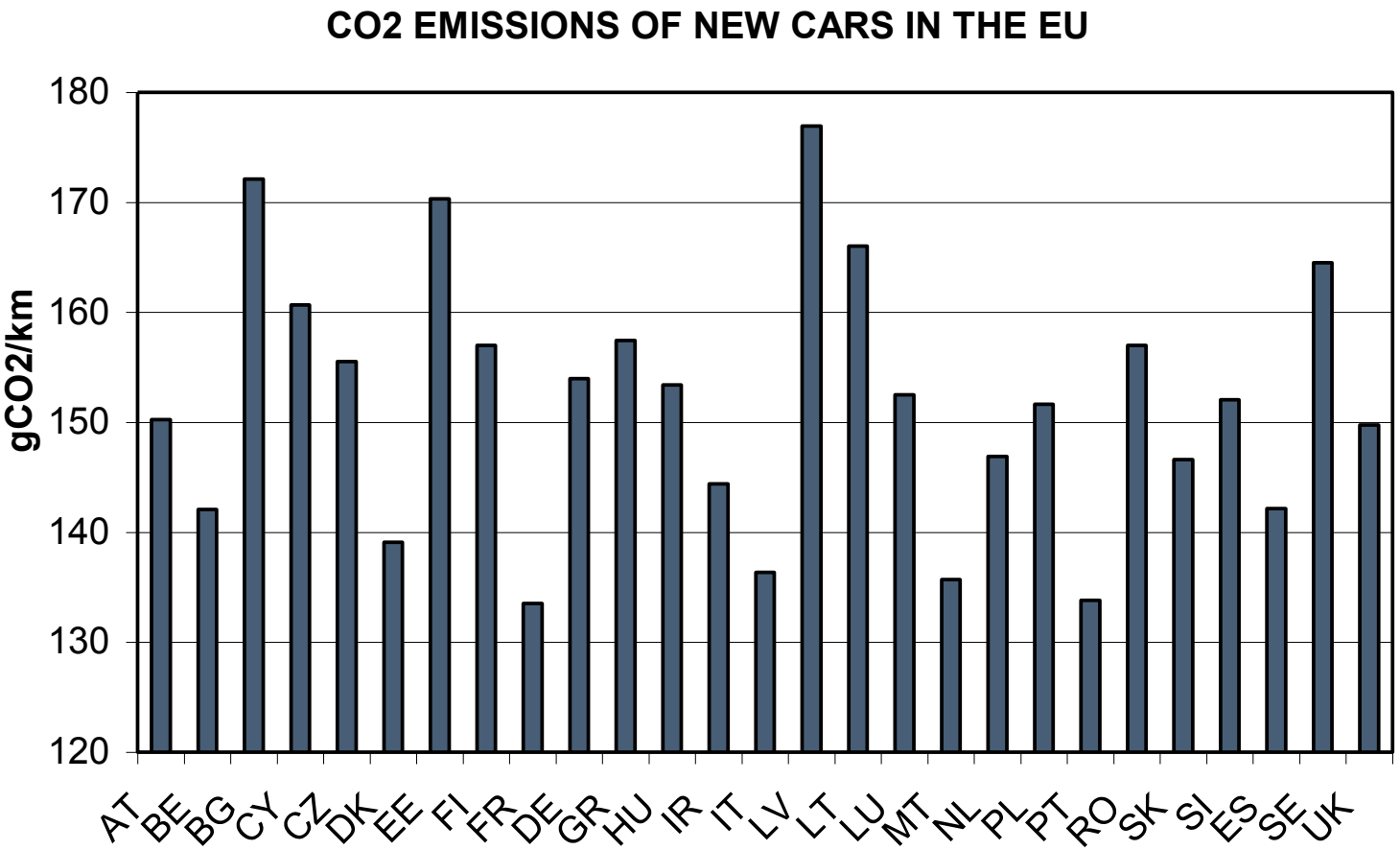
Car ownership per 1000 capita in EU-27 countries 1970 – 2009
(Source: EUROSTAT; ALTER-MOTIVE database)

Development of car stock



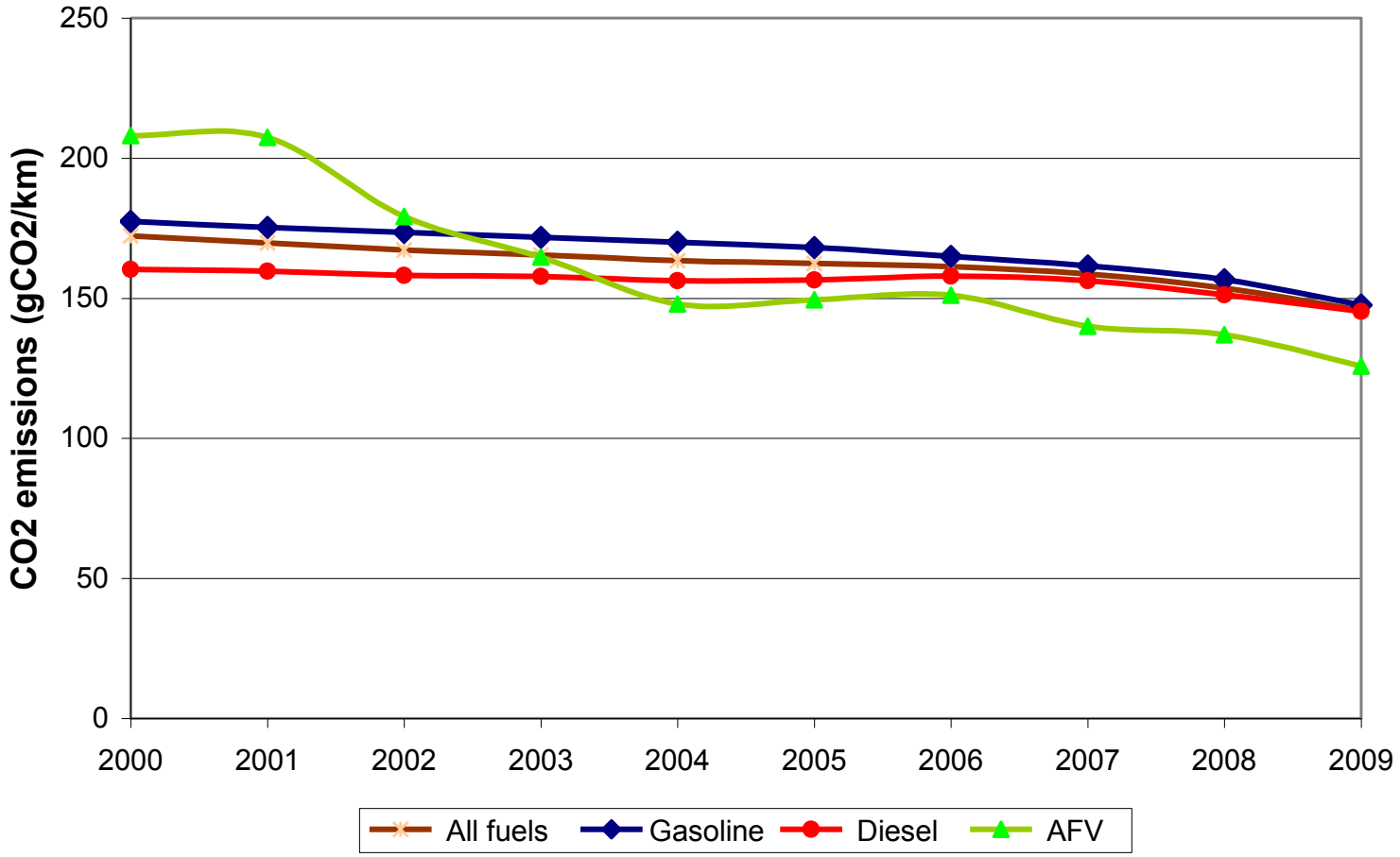
Share of the stock of diesel cars in total fossil fuel consumption, selected EU countries 1998 vs 2008 (data source: ODYSSEE database; ALTER-MOTIVE database)

Performance of new registered cars



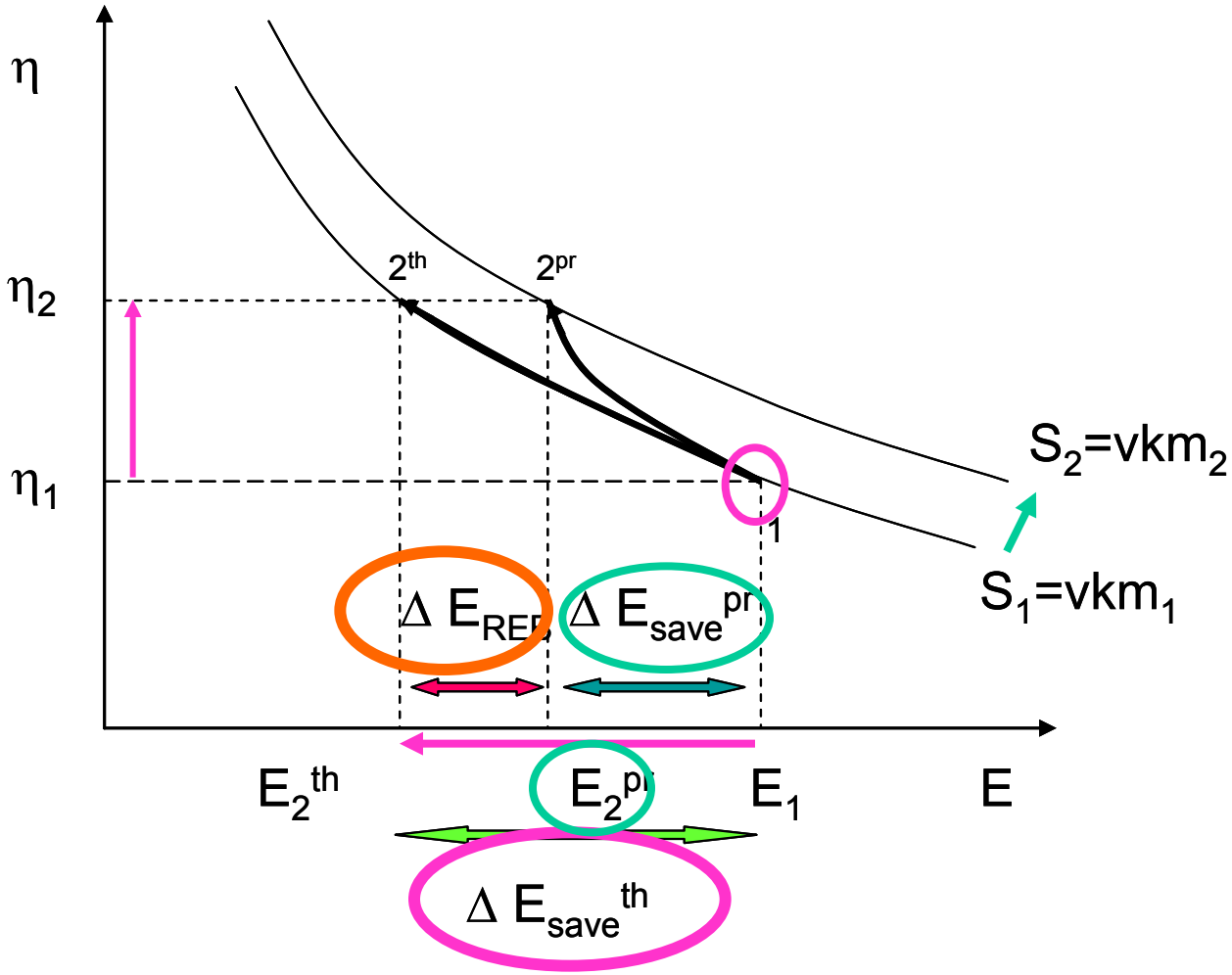
CO2 emissions of new cars in EU-countries in 2009 (data source: DB, 2009)

Performance of new registered cars



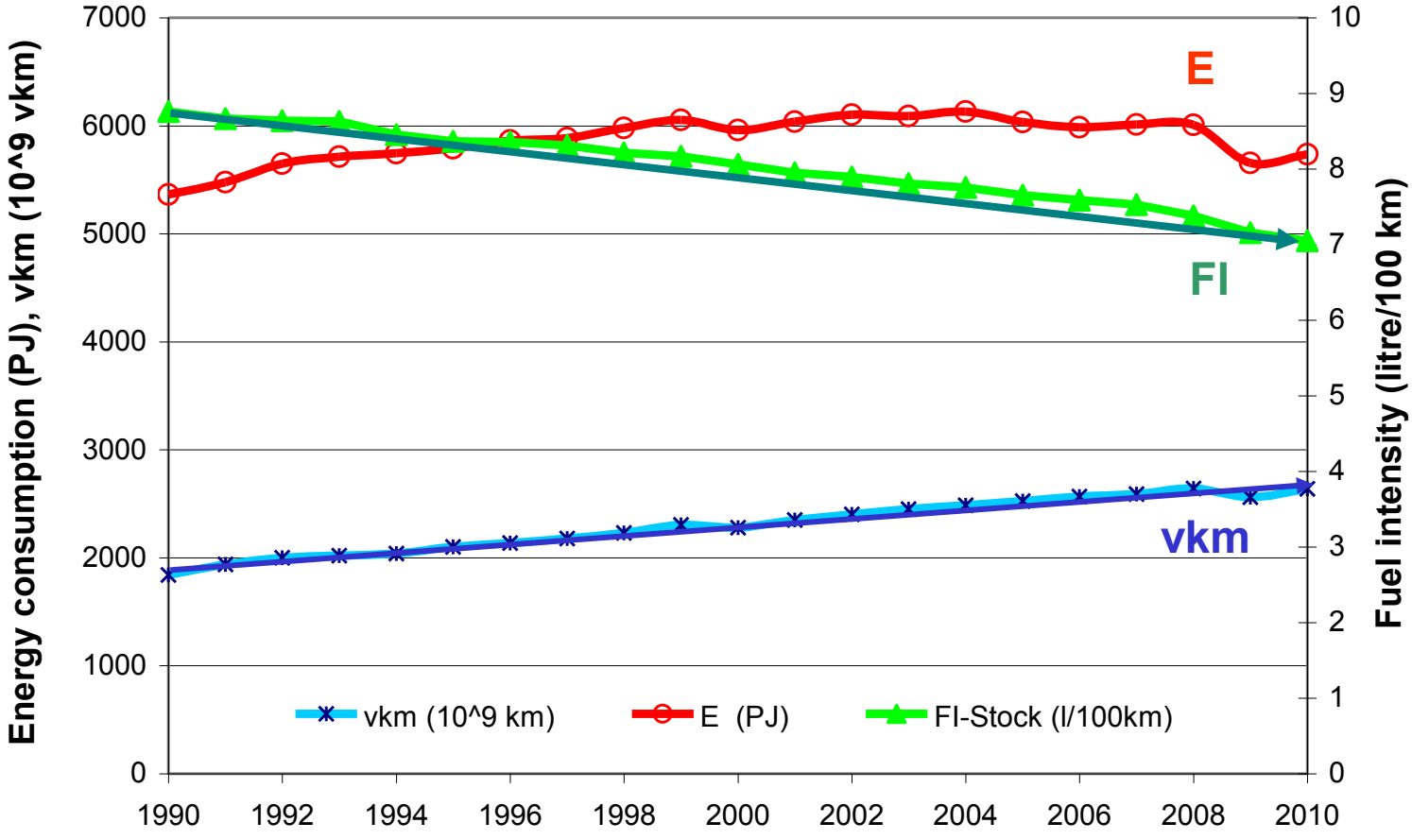
Development of average CO2 emissions from new passenger cars by fuel in EU-27 countries from 2000 to 2009 (data source: EC, 2010)

Rebound-effect



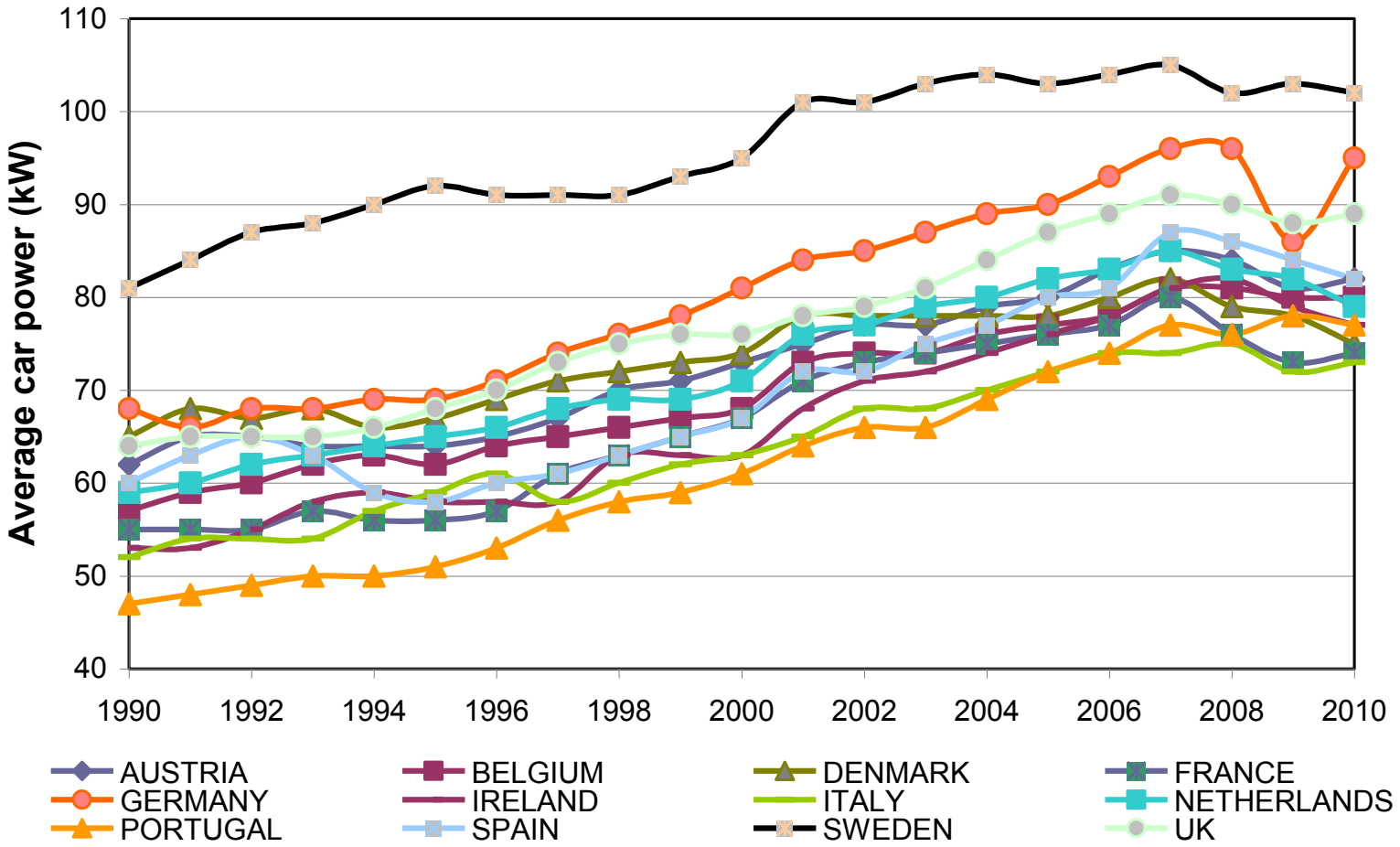
The rebound effect

Rebound due km driven



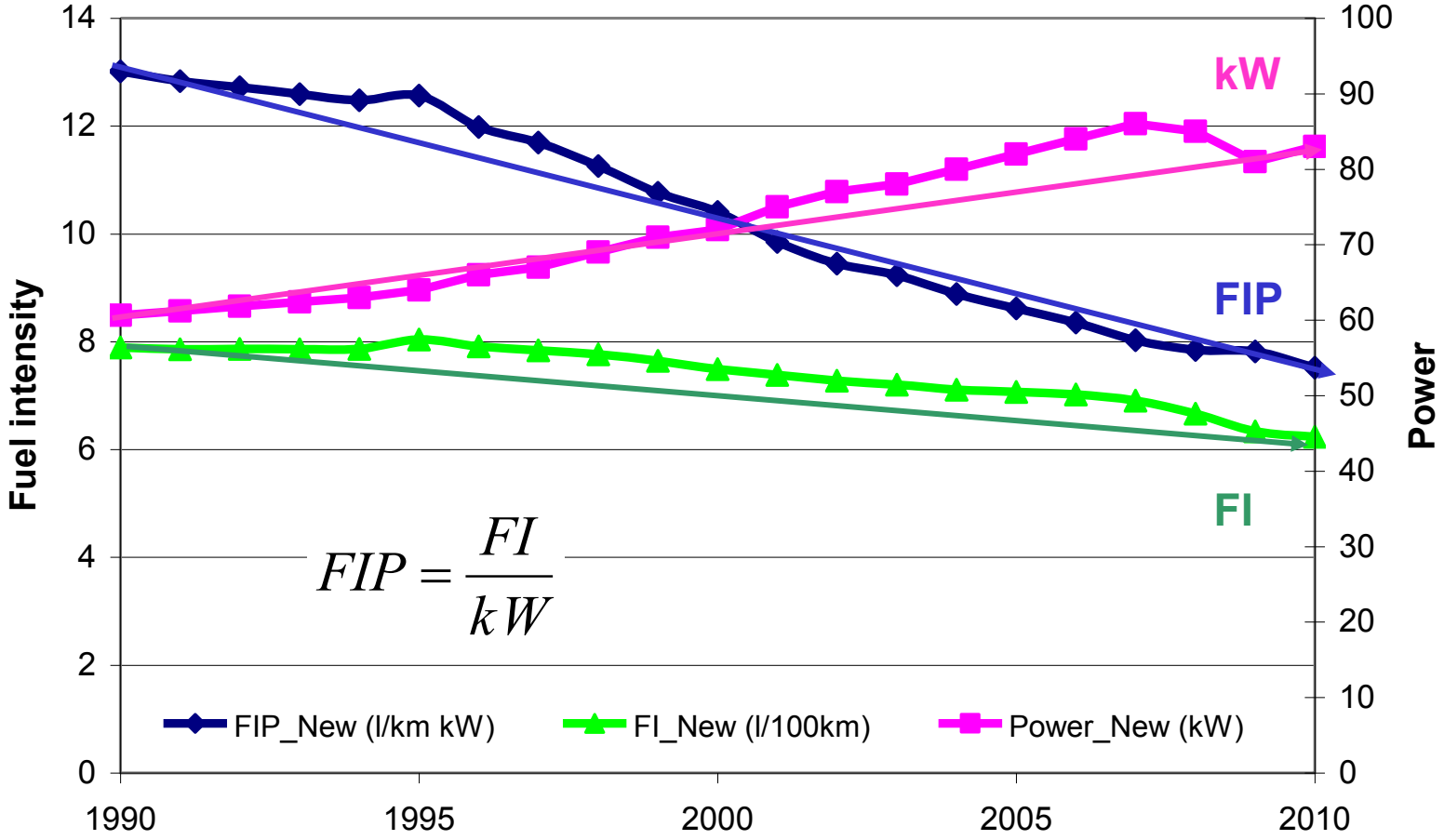
Development of vehicle km driven (vkm), energy consumption and the fuel intensity of the stock of vehicles in EU-15 from 1990 to 2010

Rebound due car size



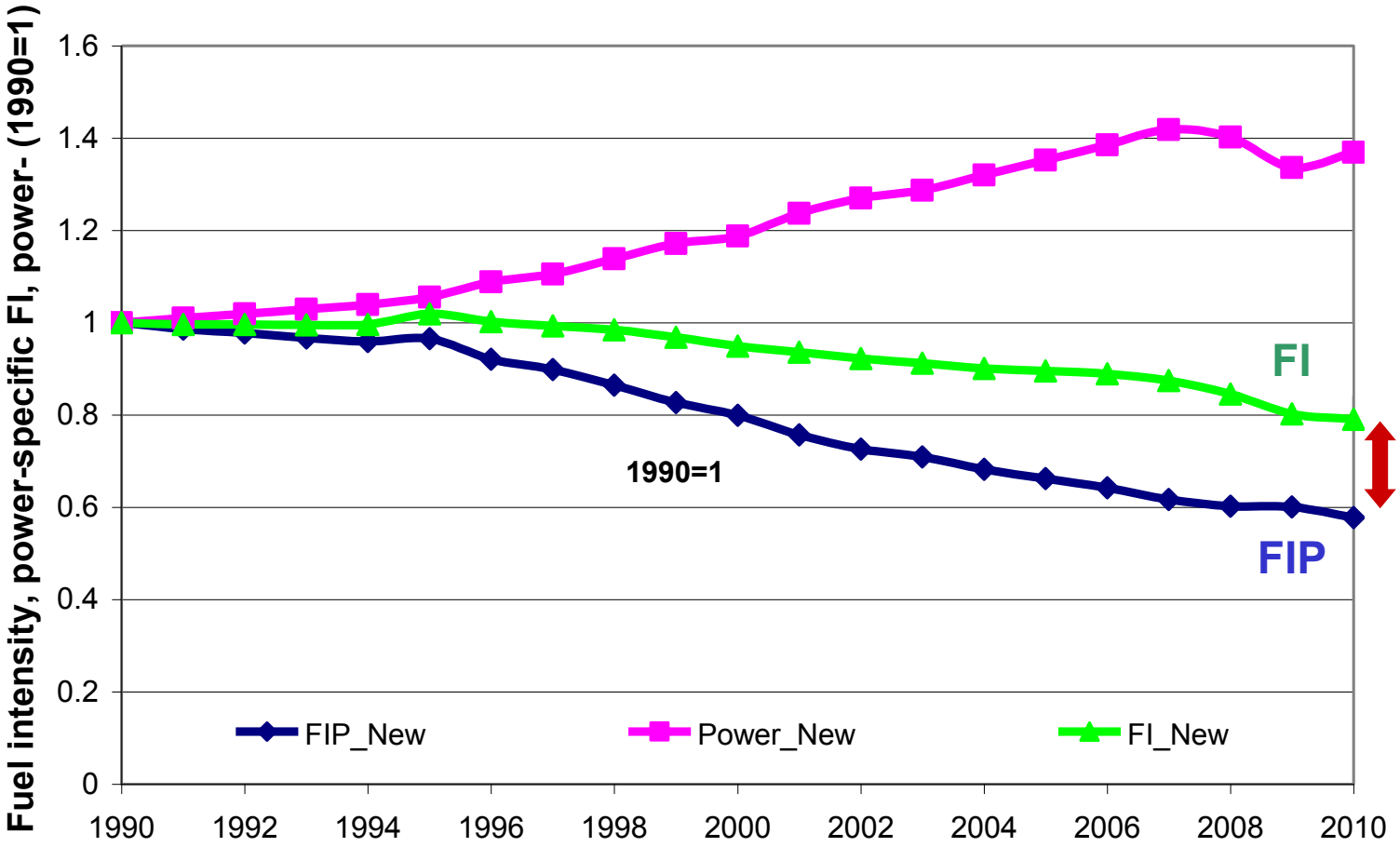
Average developments of car power (kW) in various EU-15 countries from 1990 to 2010

Rebound due car size



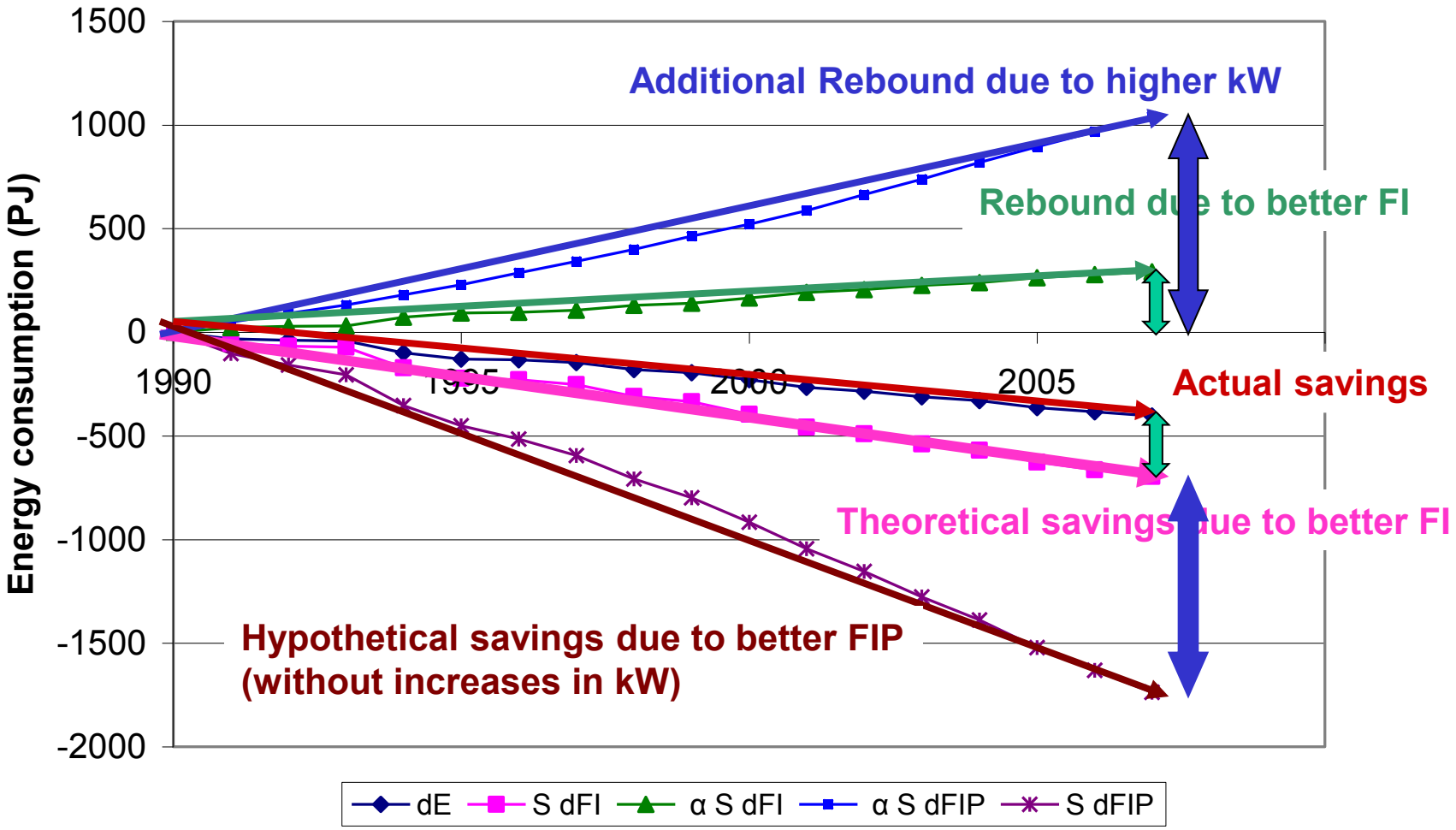
Development of fuel intensity, power-specific fuel intensity and power (kW) of new vehicles in EU-15 from 1990 to 2009

Rebound due car size



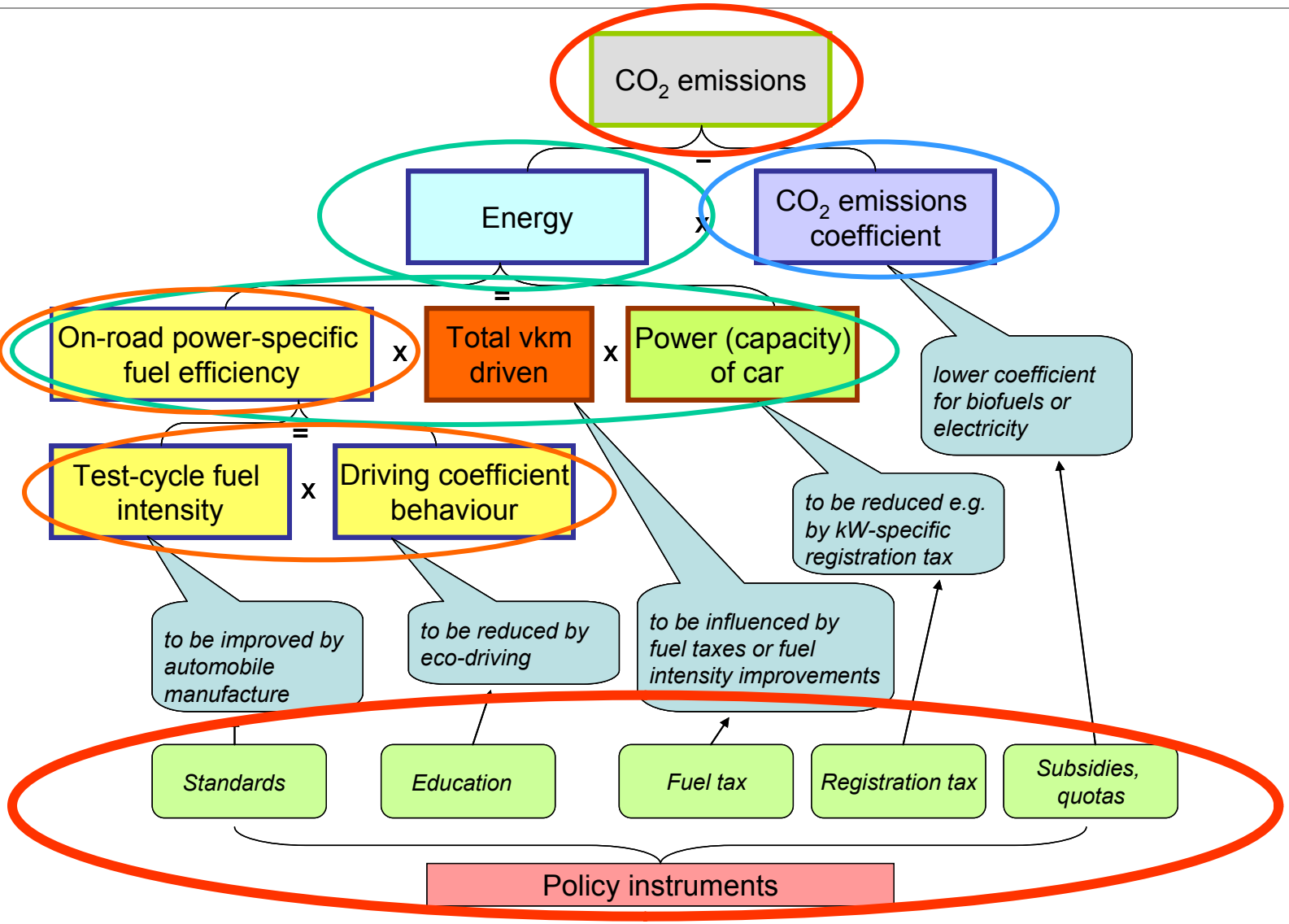
Normalised development (1990=1) of fuel intensity, power-specific fuel intensity and power (kW) of new vehicles in EU-15 from 1990 to 2009

Rebound-effect



The impact of better FI and switch to larger cars on total passenger car energy consumption

CO_2 emissions in passenger car transport



Impact factors on CO2 emissions in the car passenger transport sector

CO_2 emissions

So we can reduce CO_2 emissions by influencing :

- **vkm** (by increasing the price by taxes) or
- **FI** (by introducing various measures for technical efficiency improvement) or
- $\mathbf{f_{CO2}}$ (by using fuels with less carbon, e.g. biofuels, or electricity).

CO_2 emissions

The method of approach is finally based on calculation of total costs for society and resulting CO_2 reductions:

- For taxes these costs are the welfare losses for society;
- For the technologies we consider the additional investment costs of the technology and the energy cost reduction respectively the increased producer surplus if the technology is produced in the region;
- For alternative fuels we have to consider the additional production costs minus the increased producer surplus if the technology is produced in the region.

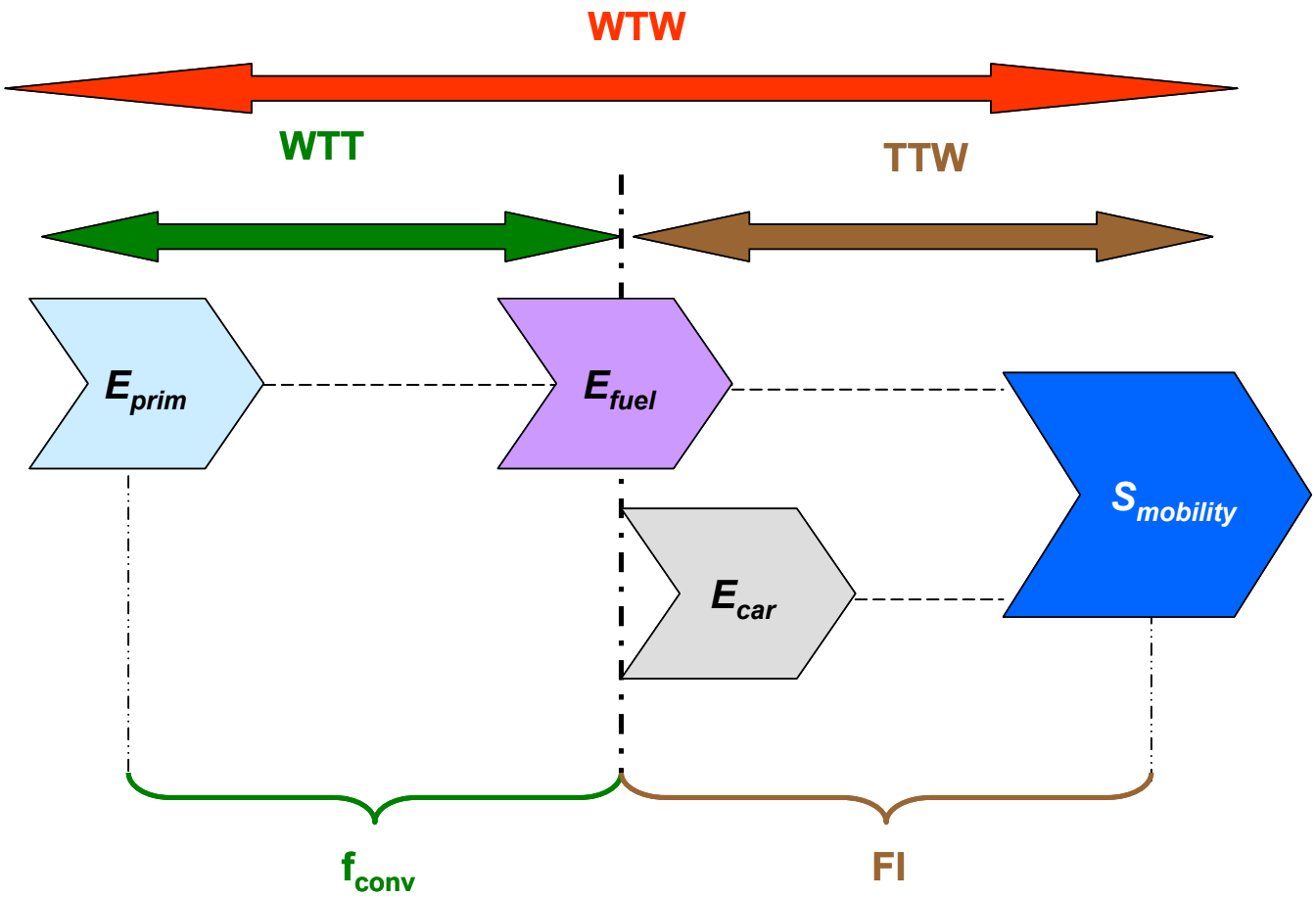
For the last two categories it is furthermore important to consider the technological learning effect.

CO_2 emissions

Policy measures implemented in transport sector could be put in three main categories:

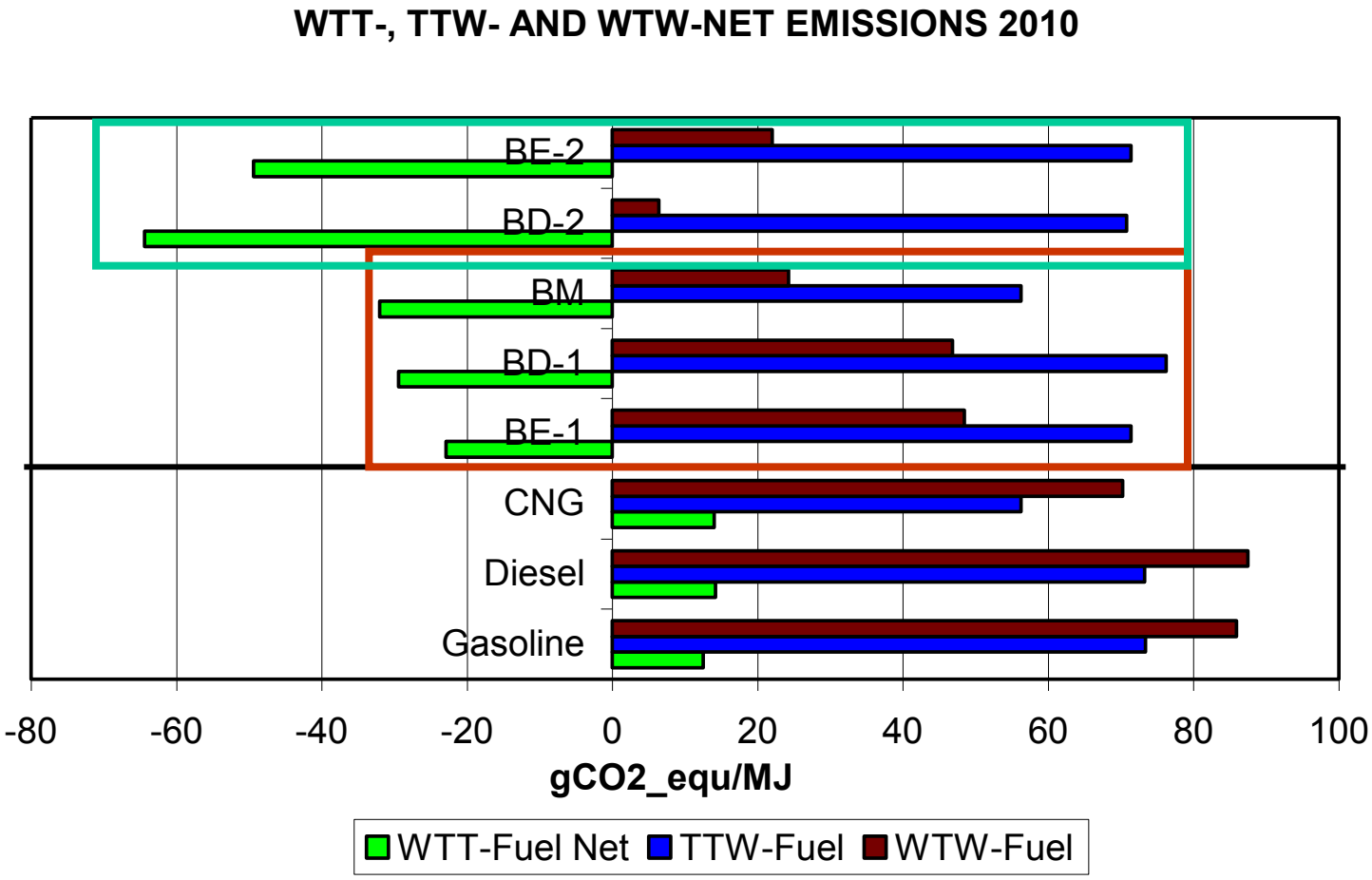
- **Switch** from fossil fuels to alternative fuels, in the first line to biofuels;
- **Improve** efficiency of cars including switch to alternative and more efficient powertrains;
- **Reduce** energy consumption with taxes and standards.

Switch – Energy chain



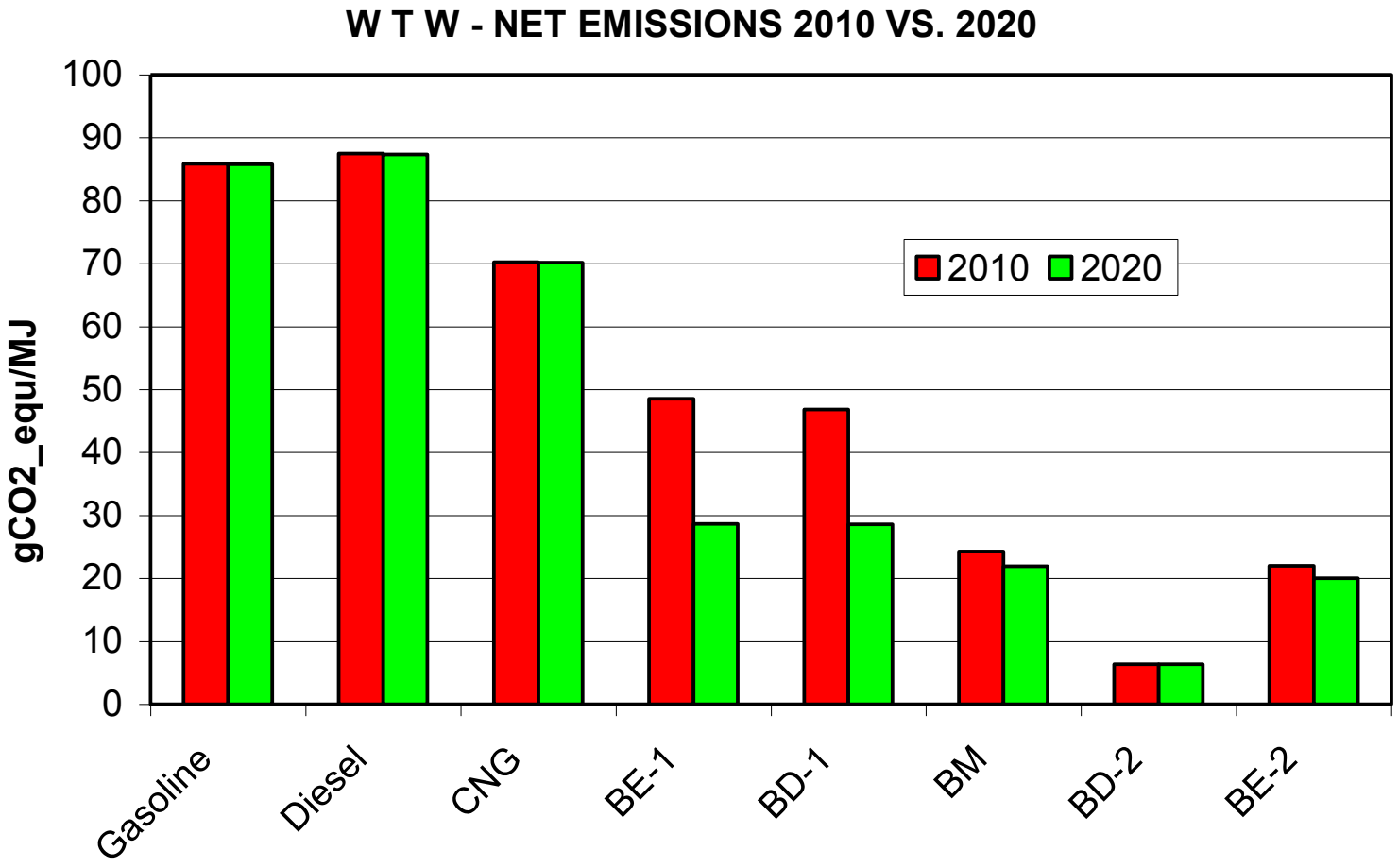
WTT and TTW - conversion in the energy service providing chain

Switch - Biofuels



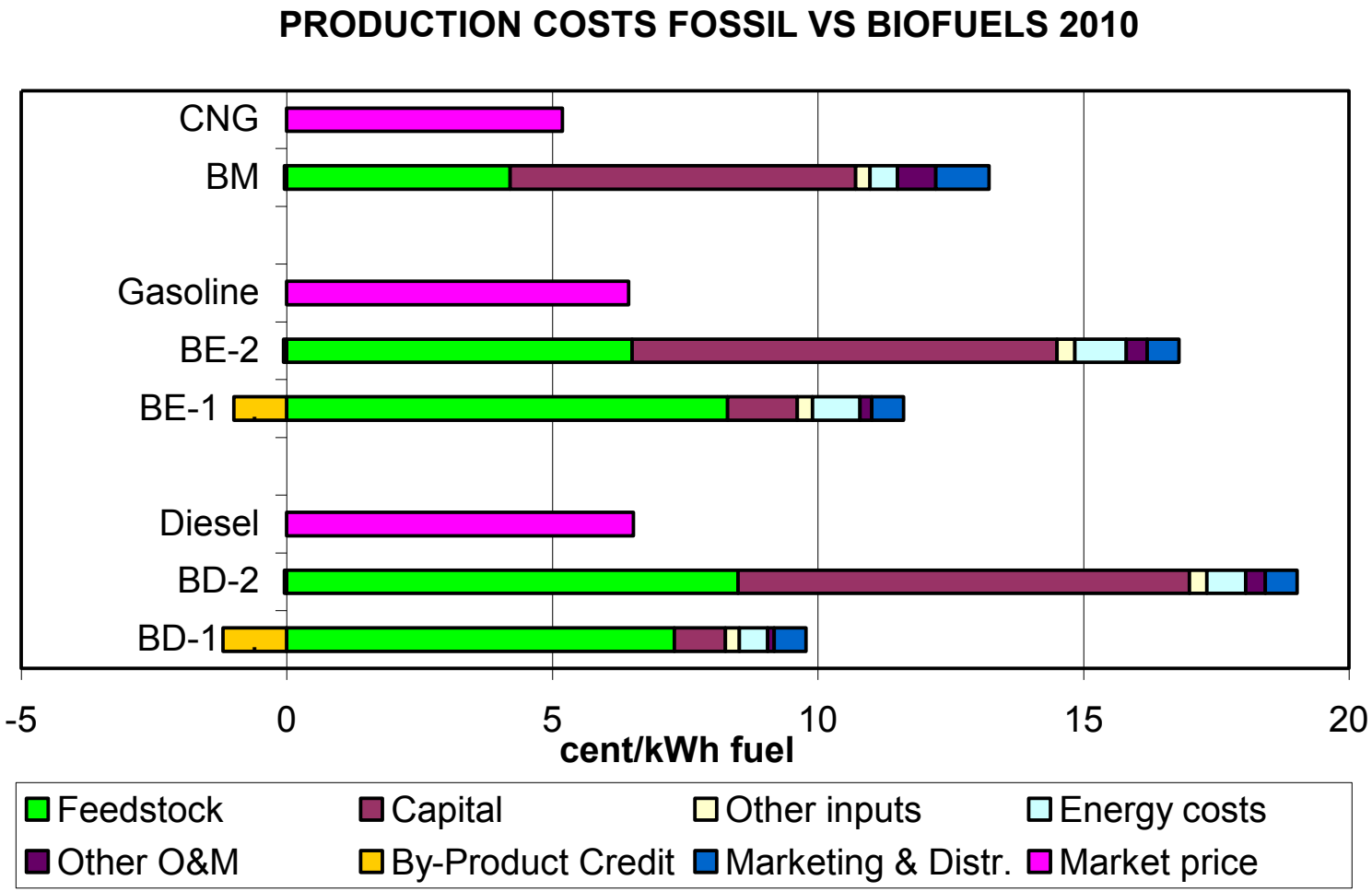
WTT-, TTW- and WTW net CO2 emissions of fossil fuels vs biofuels in 2010 for the average of EU-countries on a WTW basis

Switch - Biofuels



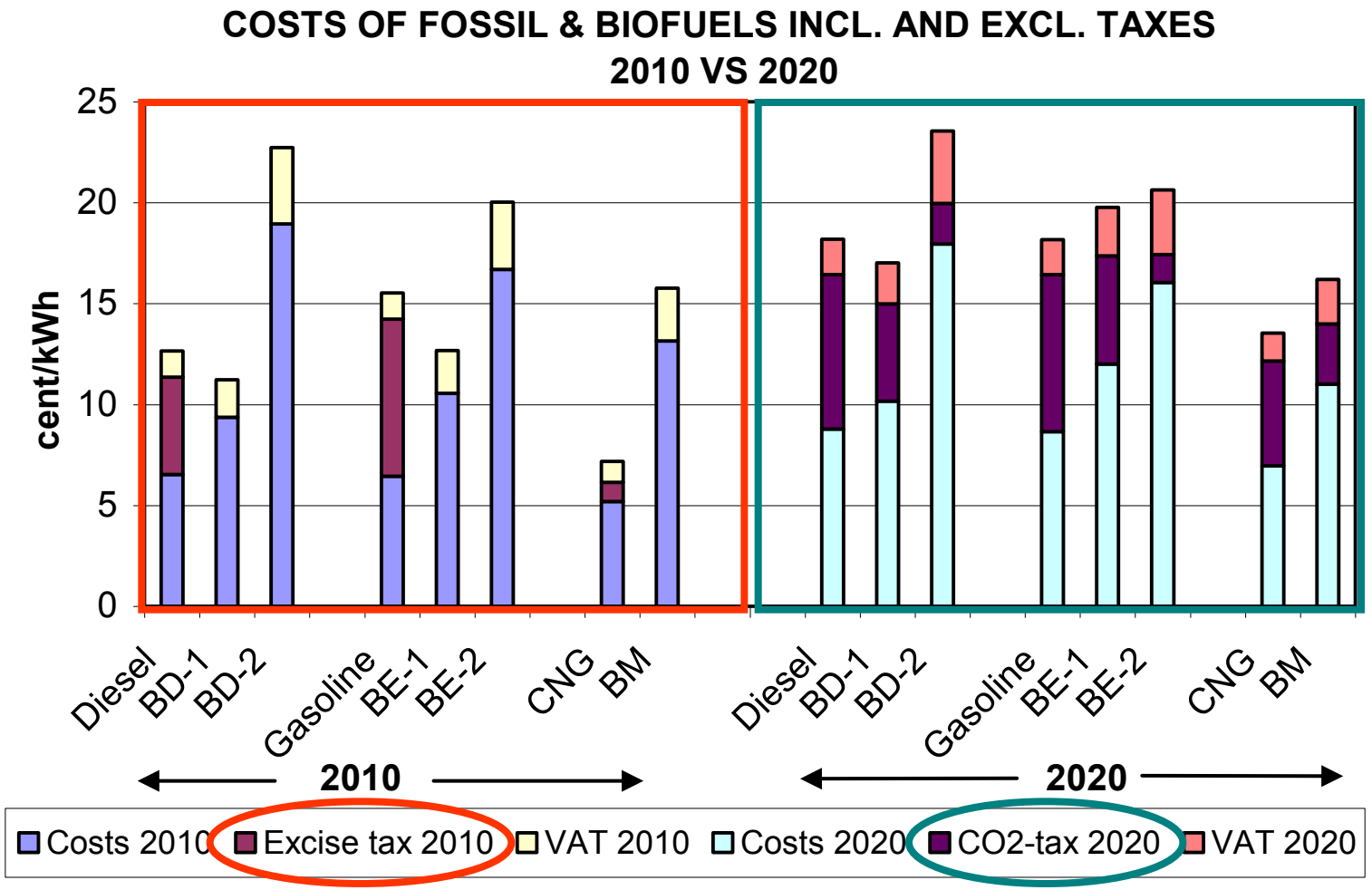
CO2 emissions of fossil fuels versus biofuels in 2010 and 2020 for the average of EU countries on a WTW basis

Switch - Biofuels



Production costs of fossil fuels versus biofuels excl. taxes in 2010 for the average of EU countries (Source: Toro et al, 2010)

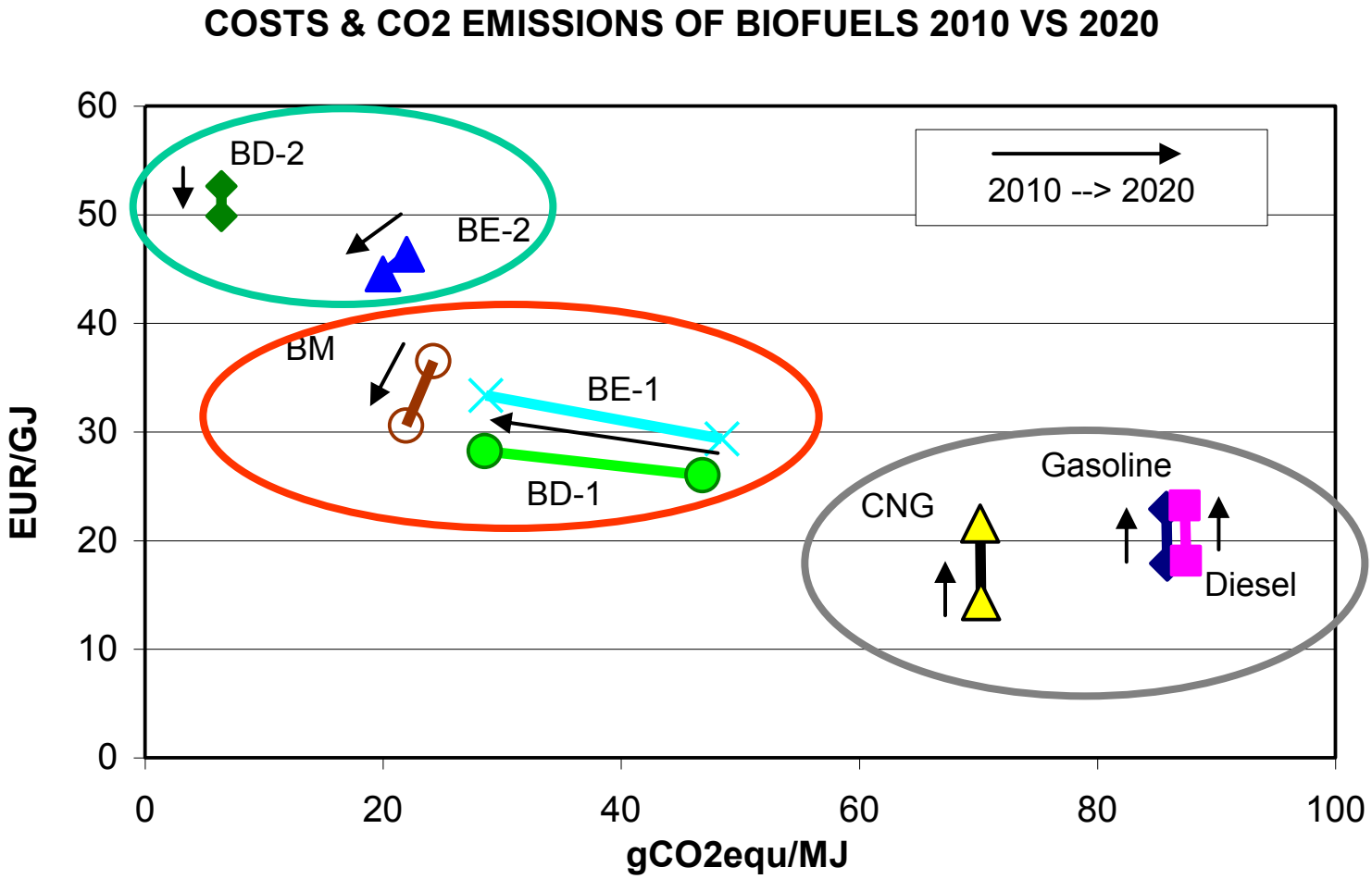
Switch - Biofuels



Cost of fossil fuels vs. biofuels incl. and excl. taxes in 2010 vs 2020 for the average of EU-countries

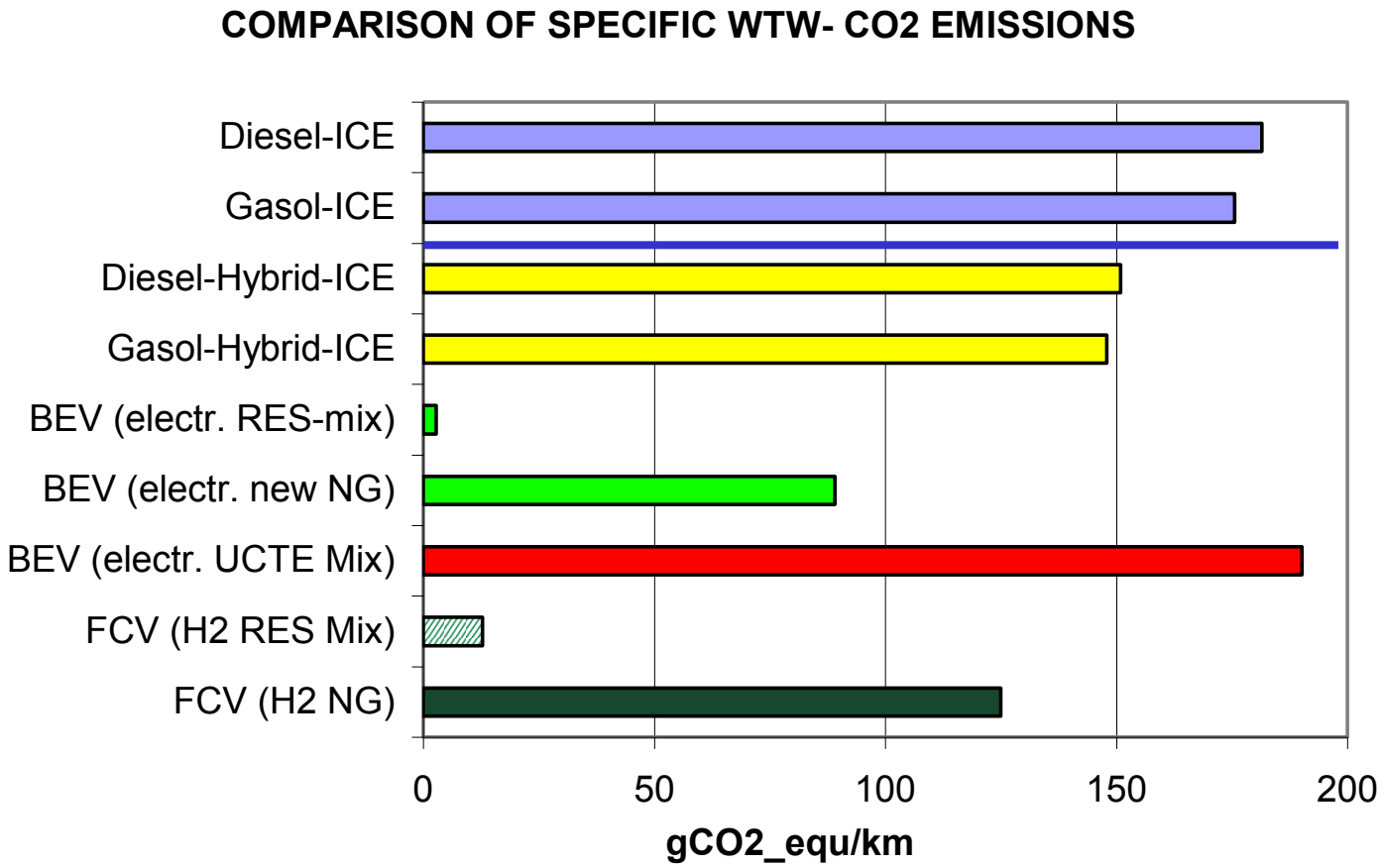
Switch - Biofuels

Switch



Fossil fuels vs. biofuels production costs (exclusive taxes) and WTW CO2 emissions, 2010 and 2020

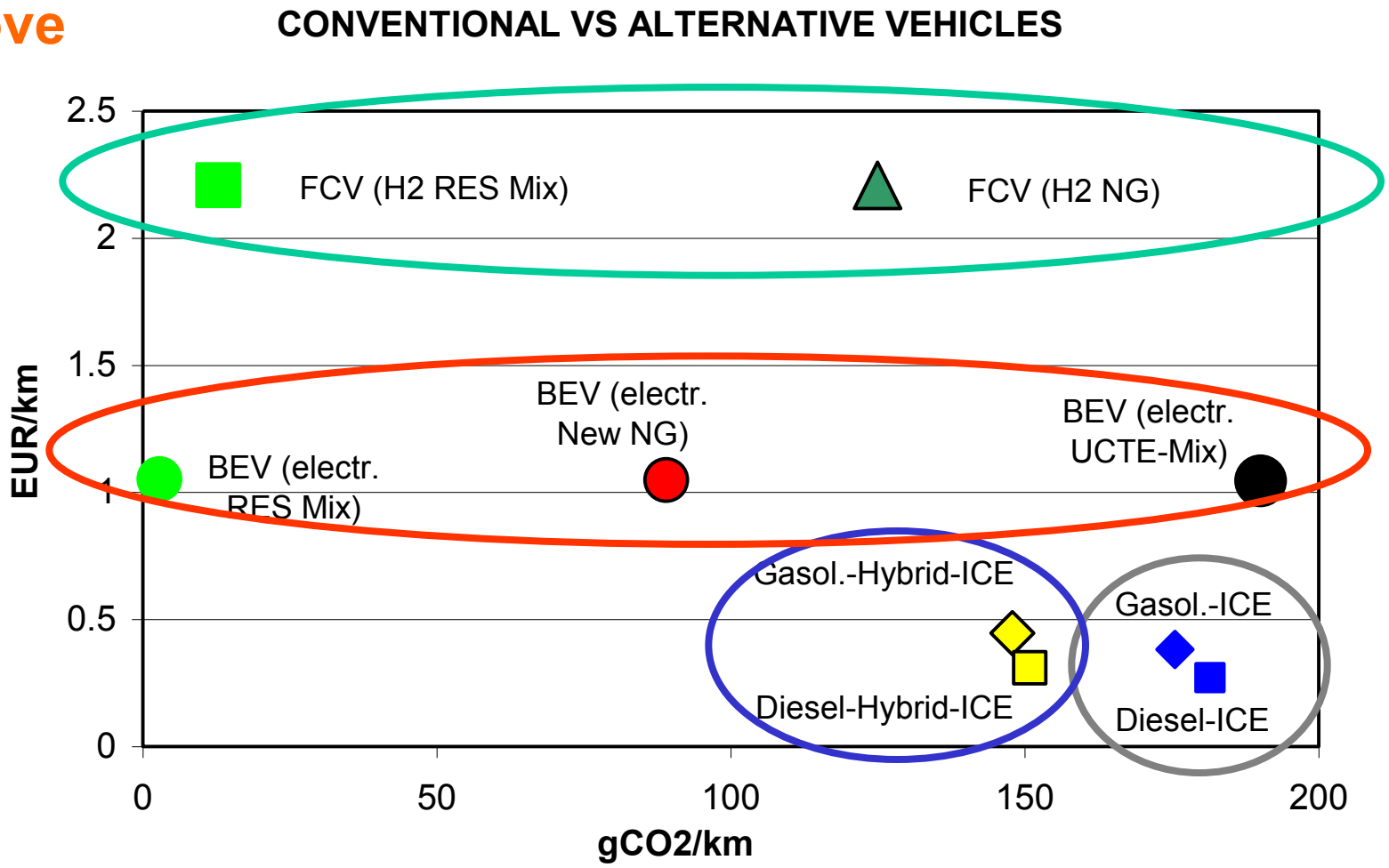
Improve - Efficiency



Comparison of specific CO2 emissions of conventional and hybrid gasoline and diesel vehicles with pure BEV based on different electricity generation mixes and FCV with hydrogen

Improve - Efficiency

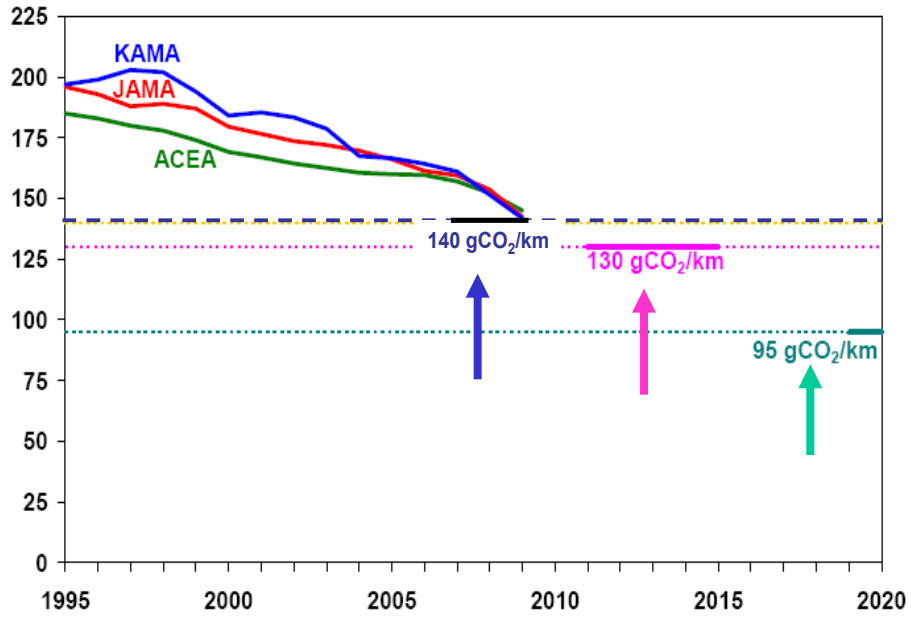
Improve



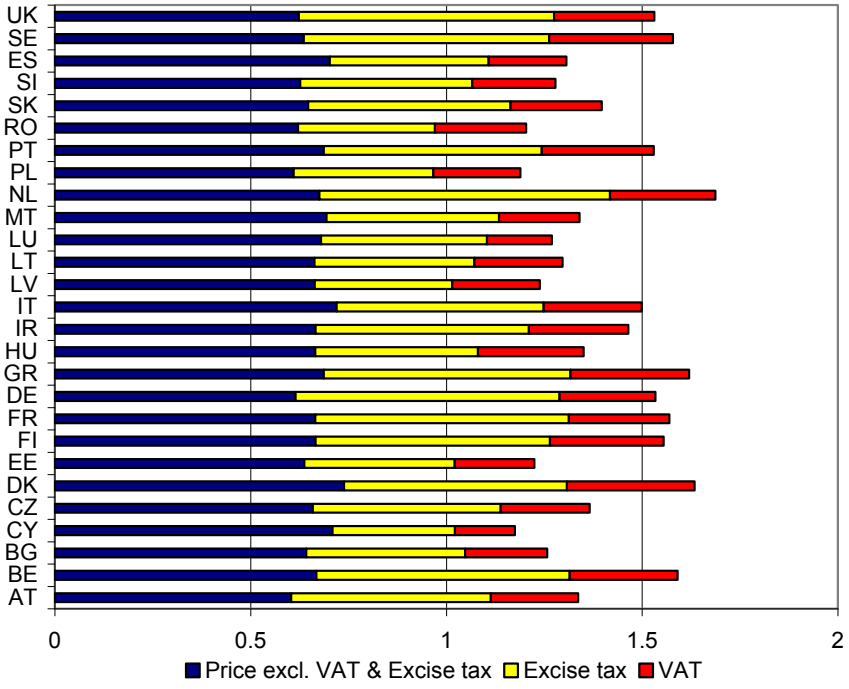
Comparison of specific CO2 emissions and driving costs

Reduce – Standards & taxes

Reduce



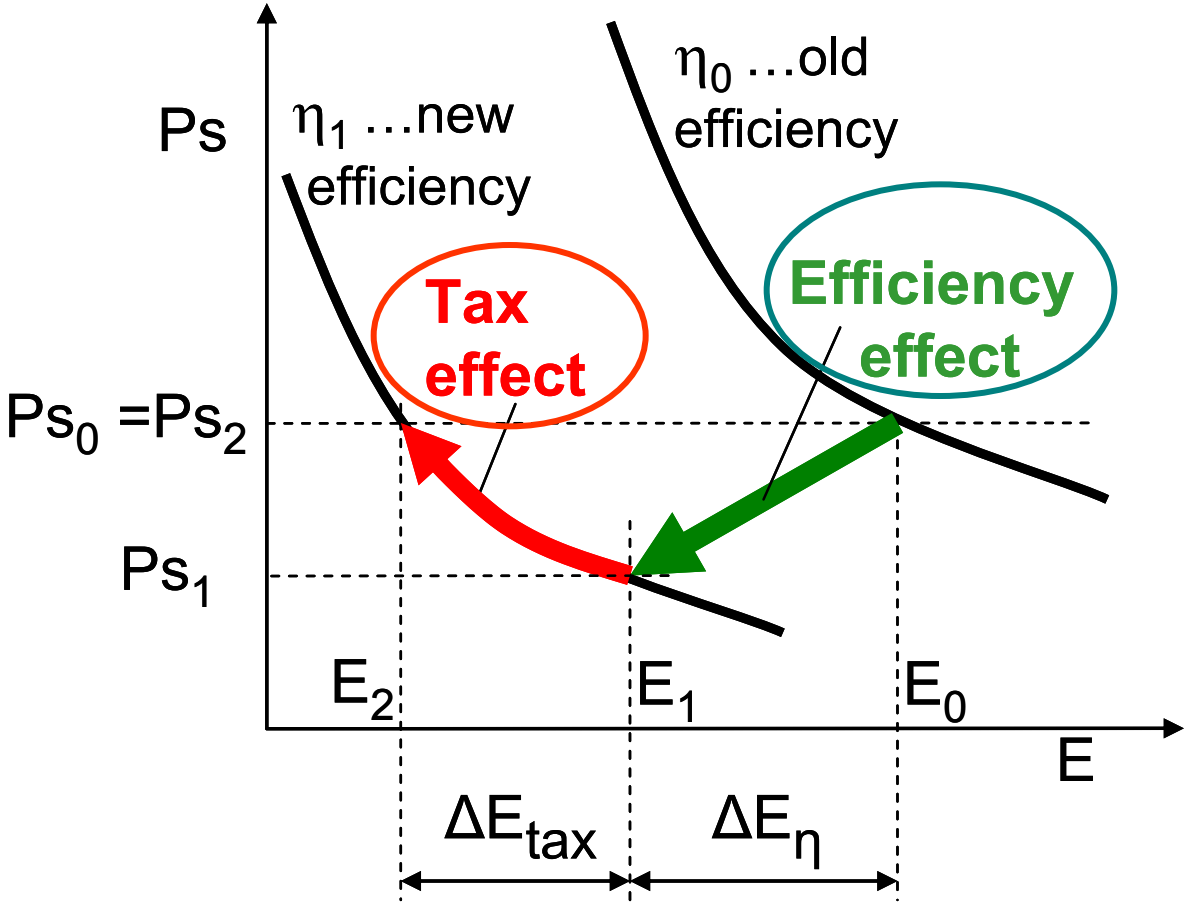
Evolution of CO2 emissions from new passenger cars by manufacturer associations (EC, 2010)



Price structure of gasoline in EU-27

(data source: EEP, 2011 - effective March 2, 2011)

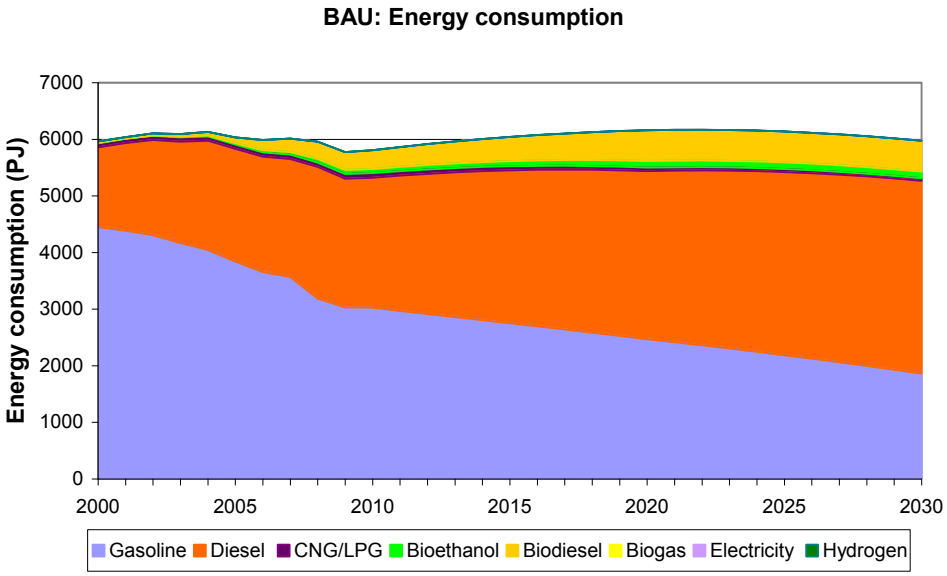
Reduce – Standards & taxes

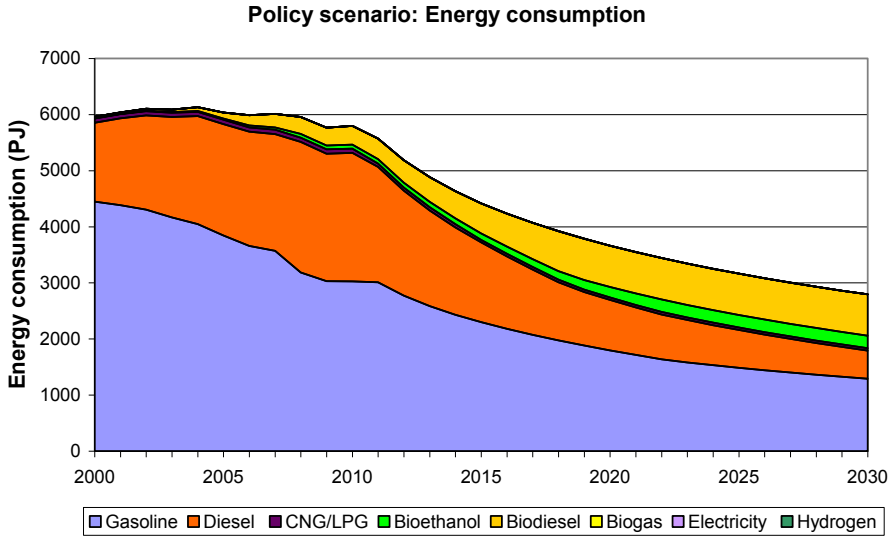


How taxes and standards interact and how they can be implemented in a combined optimal way for society

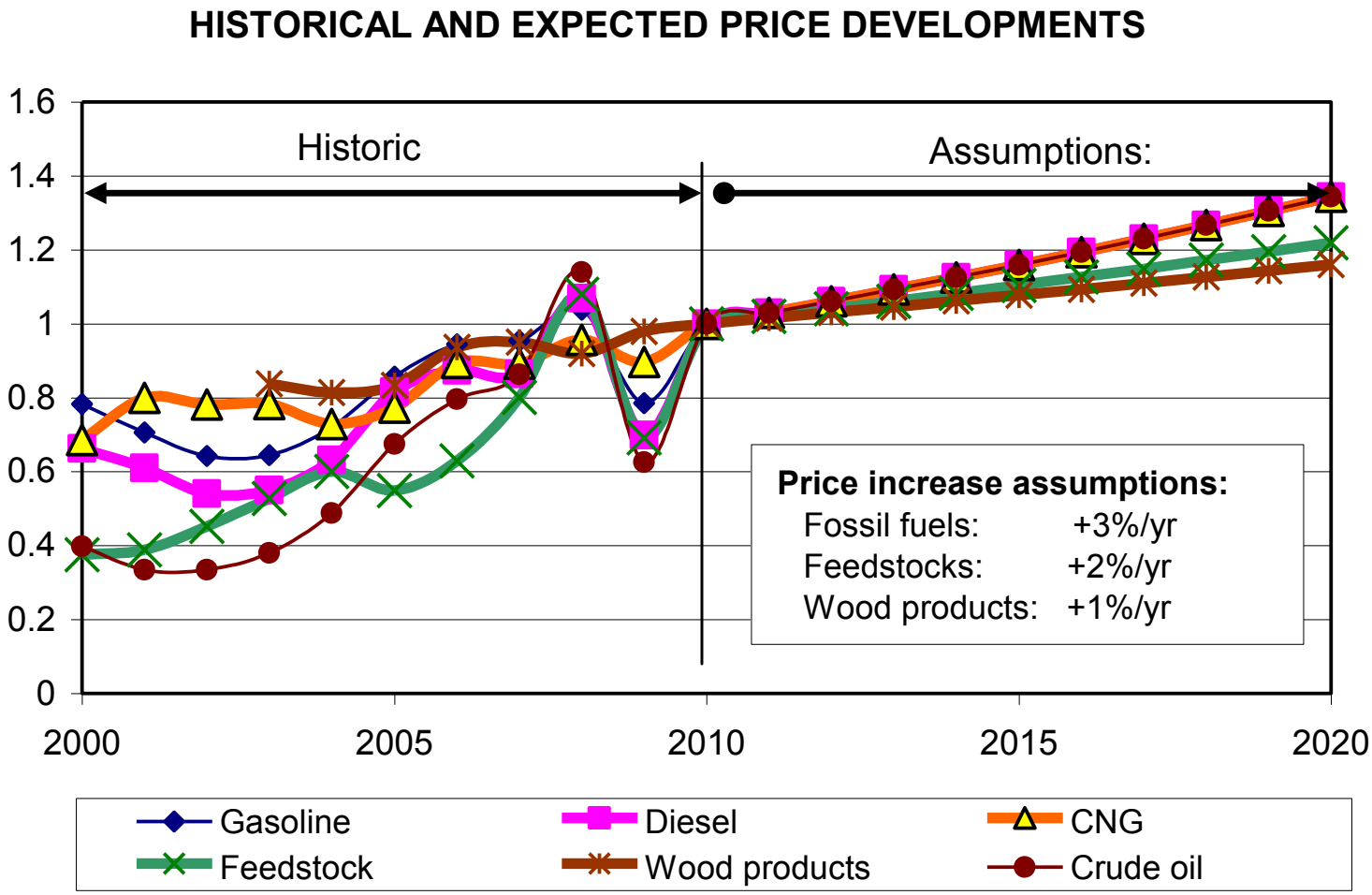
Scenarios

- Business as Usual Scenario
- Ambitious Policy Scenario



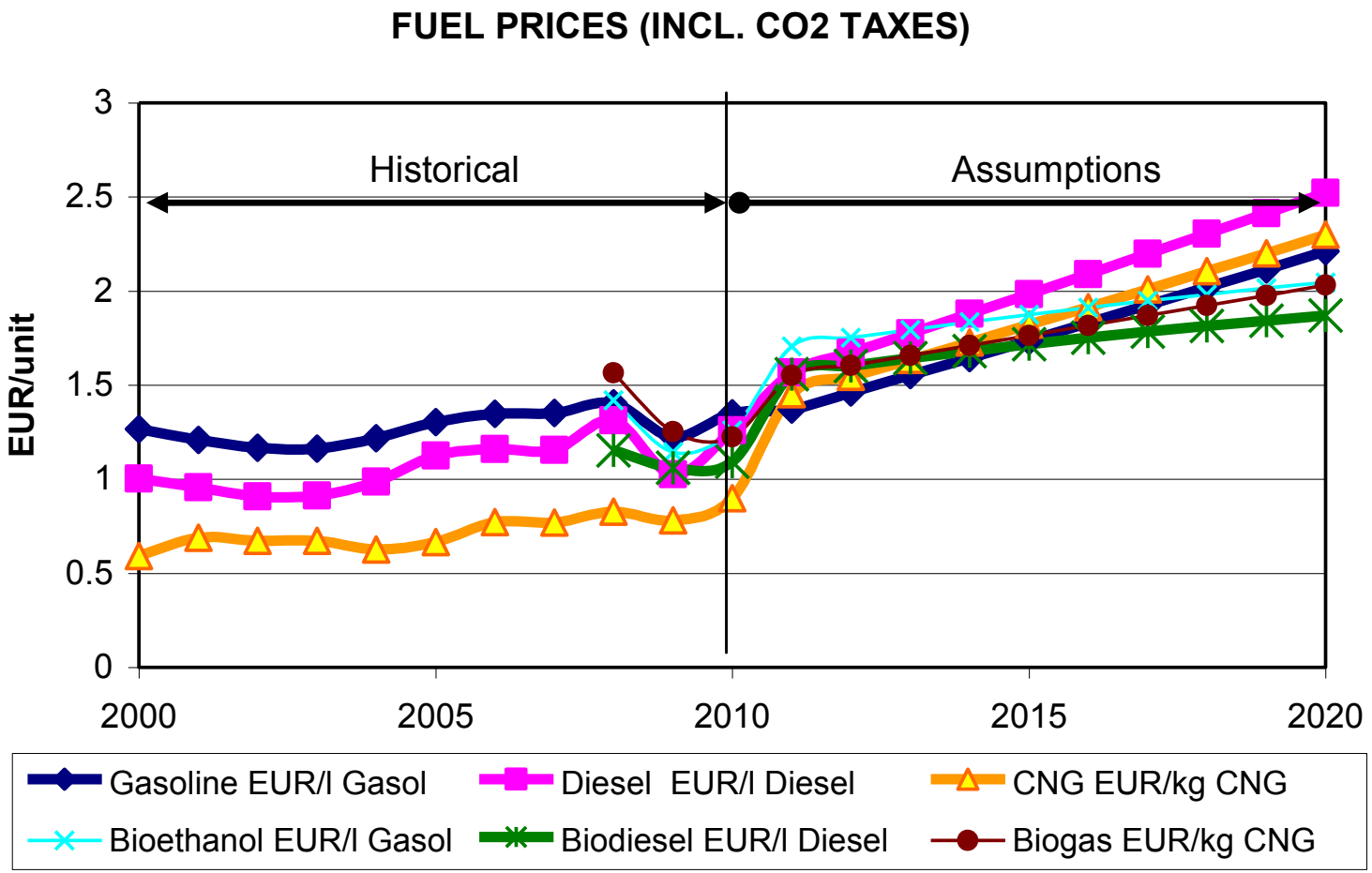


Scenarios



Historical price developments and assumptions for price development in the scenarios up to 2020

Scenarios

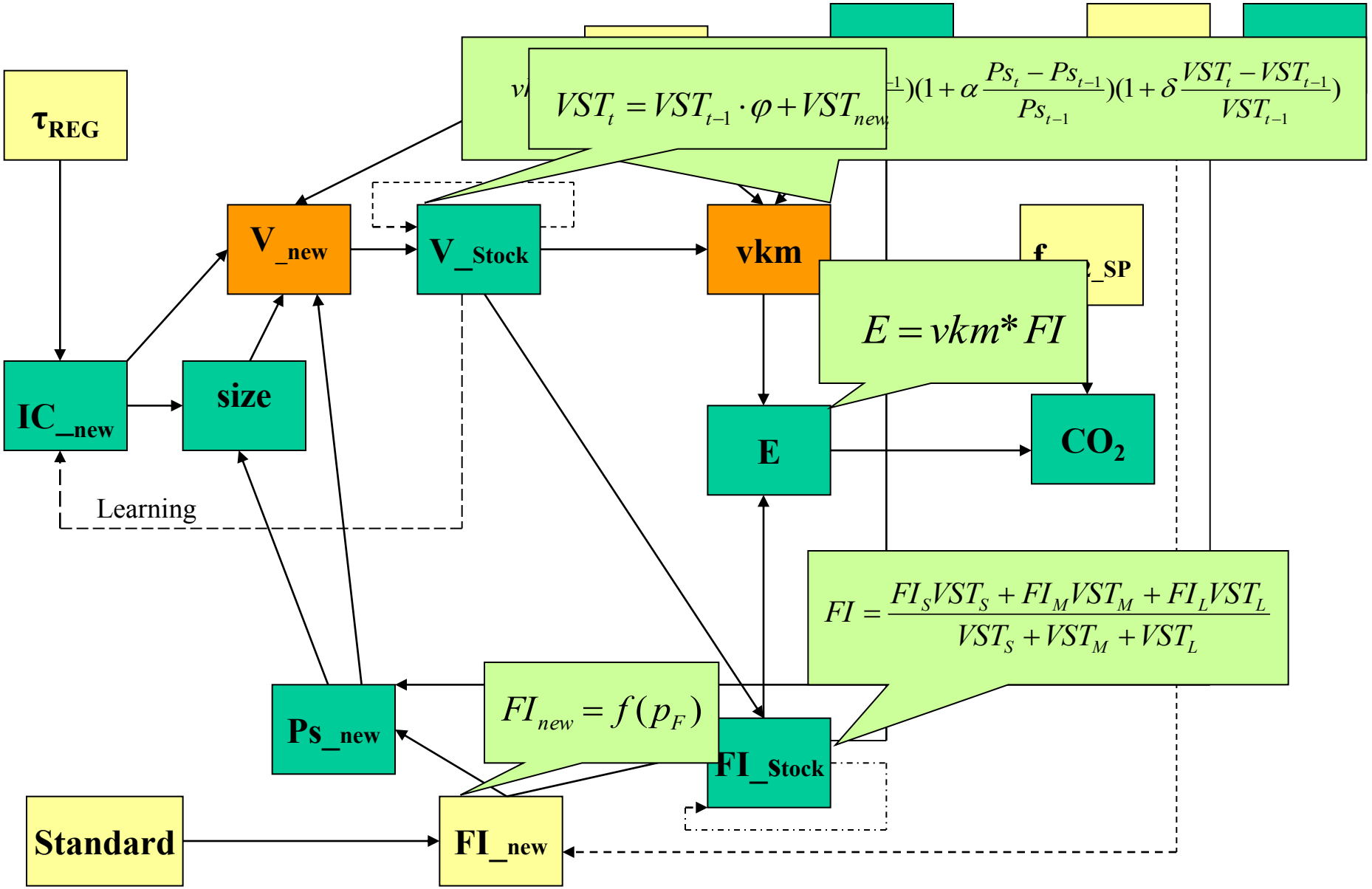


Historical developments of prices incl. and excl. taxes and development in the fiscal policy scenarios up to 2020

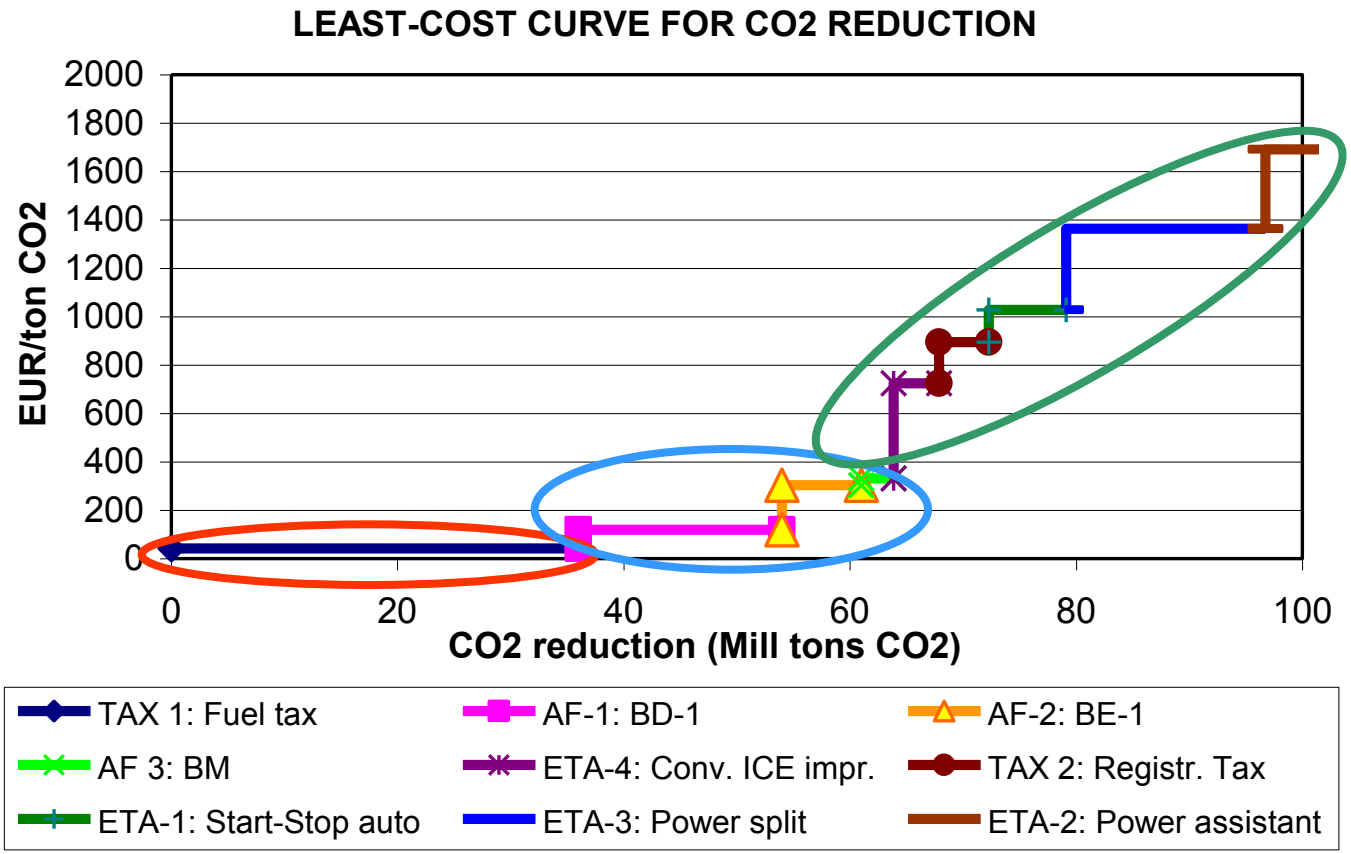
The ALTER-MOTIVE model

0. Historical development
1. Assumptions about future development of income and fuel price
2. Energy consumption
3. Travel distance (vkm)
4. Fuel intensity
5. Number of cars (stock)
6. New registered cars (1000/yr)
7. Fuel price (w and w/o tax)
8. Costs of cars (w and w/o tax)
    - Registration tax
    - Ownership tax
    - Procurement of BEV
9. Service price (EUR/km)
10. Size of cars / share of small, medium and large cars

The ALTER-MOTIVE model



Which measures contribute to CO2 reduction …
… and at which costs?



Least-cost curve for CO_2 reduction in passenger car transport in the EU-15

Priorities of actions today, up to 2020 and beyond

Actions that should be implemented immediately are:

- Introduce a green bonus scheme for CO_2 reduction in passenger transport

It is to introduce a green bonus/malus system for every citizen that provides monetary incentives for car sharing, turning-in or not owning a car (incl. scrapping scheme), using low-emission highly efficient vehicles and including (plus and minus) links to an ownership tax and to the use of public transport.

This system will work like an annual tax declaration and can be seen as a forerunner for a personal carbon allowances system.

- Convert fuel taxes to CO_2 based tax and adapt at a 5% higher level per year

Priorities of actions today, up to 2020 and beyond

- New vehicles: tighten requirements to the car manufacturing industry

  Standards for the aggregate of all segments of sold vehicles in every country should be enforced by 6% per year.

  The major effect could mainly come about from a switch to smaller cars. In this context it is important that car producers are further committed to market a higher share of smart cars with less kW and lower CO_2 emissions.

- Implement a size-dependent registration fee for cars

  A size-dependent registration fee for cars would provide a monetary incentive for customers to purchase smaller cars.

- Continue to procure case studies

Priorities of actions today, up to 2020 and beyond

Actions that should be implemented up to 2020 are:

- Develop infrastructure for "emission free" vehicles
- Biofuels first generation: tighten standards – ensure better ecological performance

Actions that focus on the long run, after 2020 are:

- Emphasize efficient R&D for second generation biofuels and hydrogen

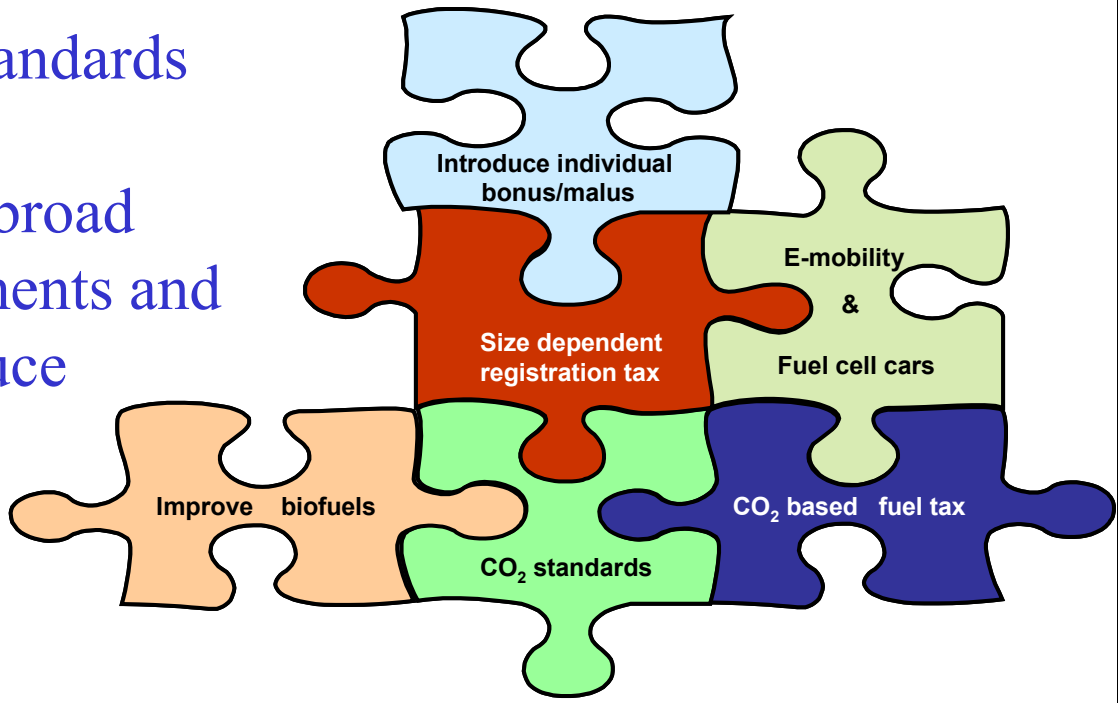
Conclusions

- **Technological solutions** alone are a very expensive strategy for reducing CO_2 emissions.

- Regarding **BEV and fuel cell cars** up to 2020 no CO_2 savings at reasonable costs for society will be achieved.

• **Short-term:** focus on standards and taxes

•**Long-term:** only a very broad portfolio of policy instruments and new technologies can reduce energy consumption and straightforward CO_2 emissions significantly.



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