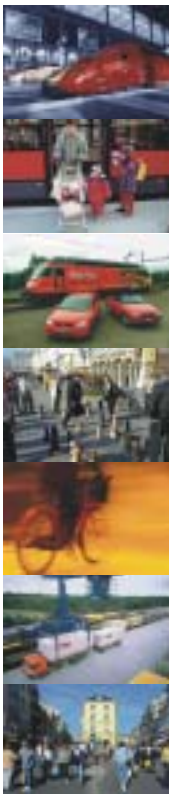




## Environmentally Sustainable Transport (EST) Systems for CO<sub>2</sub> Emission Reductions

*est!*



### EST Mobility in 2030

### Concepts, Strategies and Practical Solutions

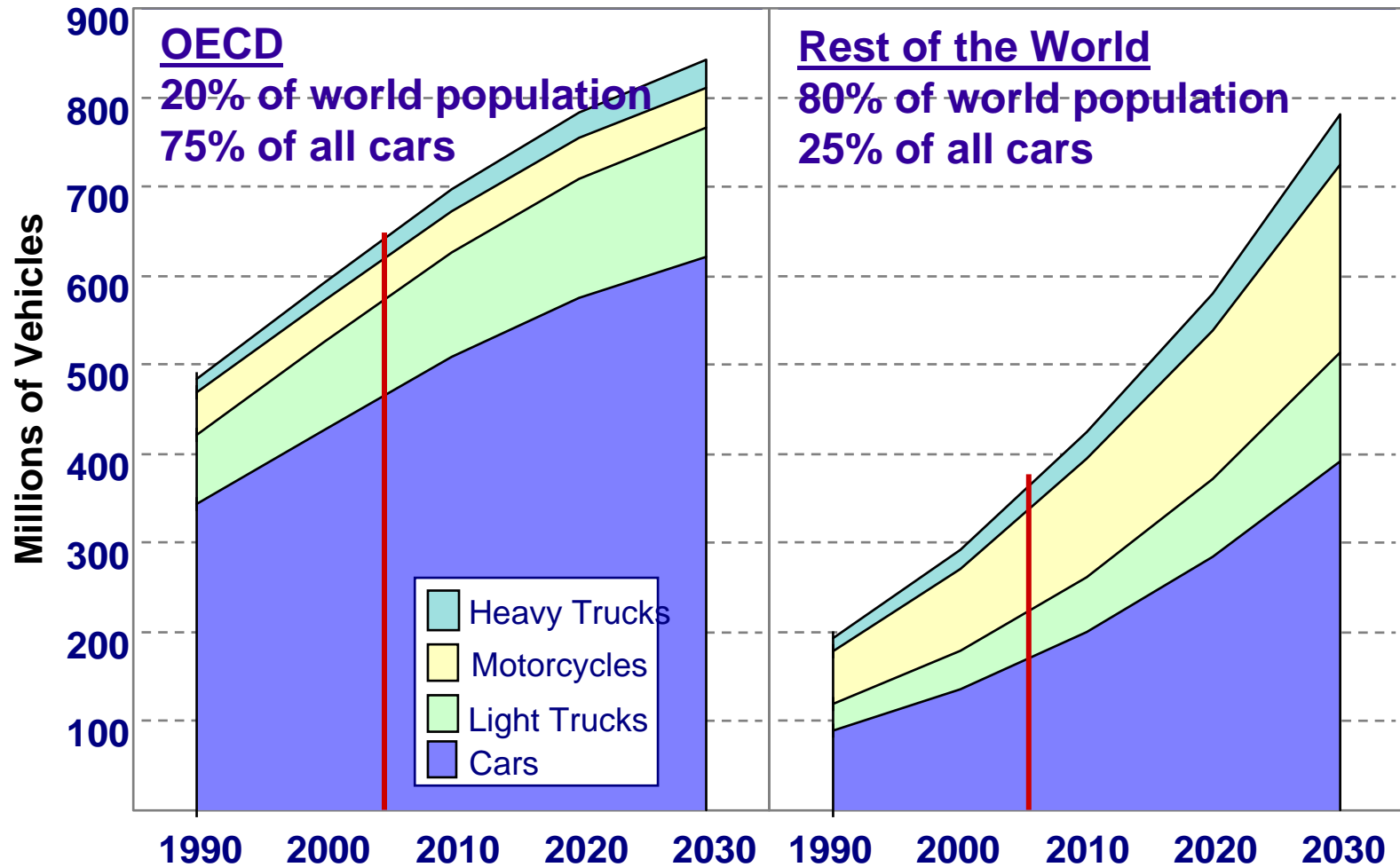
presented by

**Dr. Peter Wiederkehr**

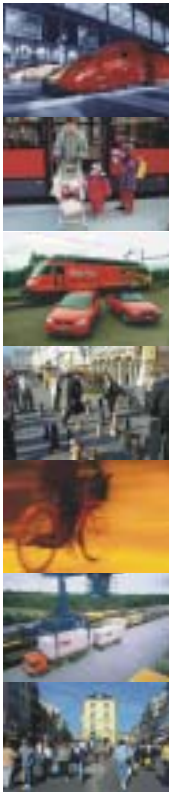
**Transport and Mobility, EST**

**BMLFUW, Vienna, Austria**

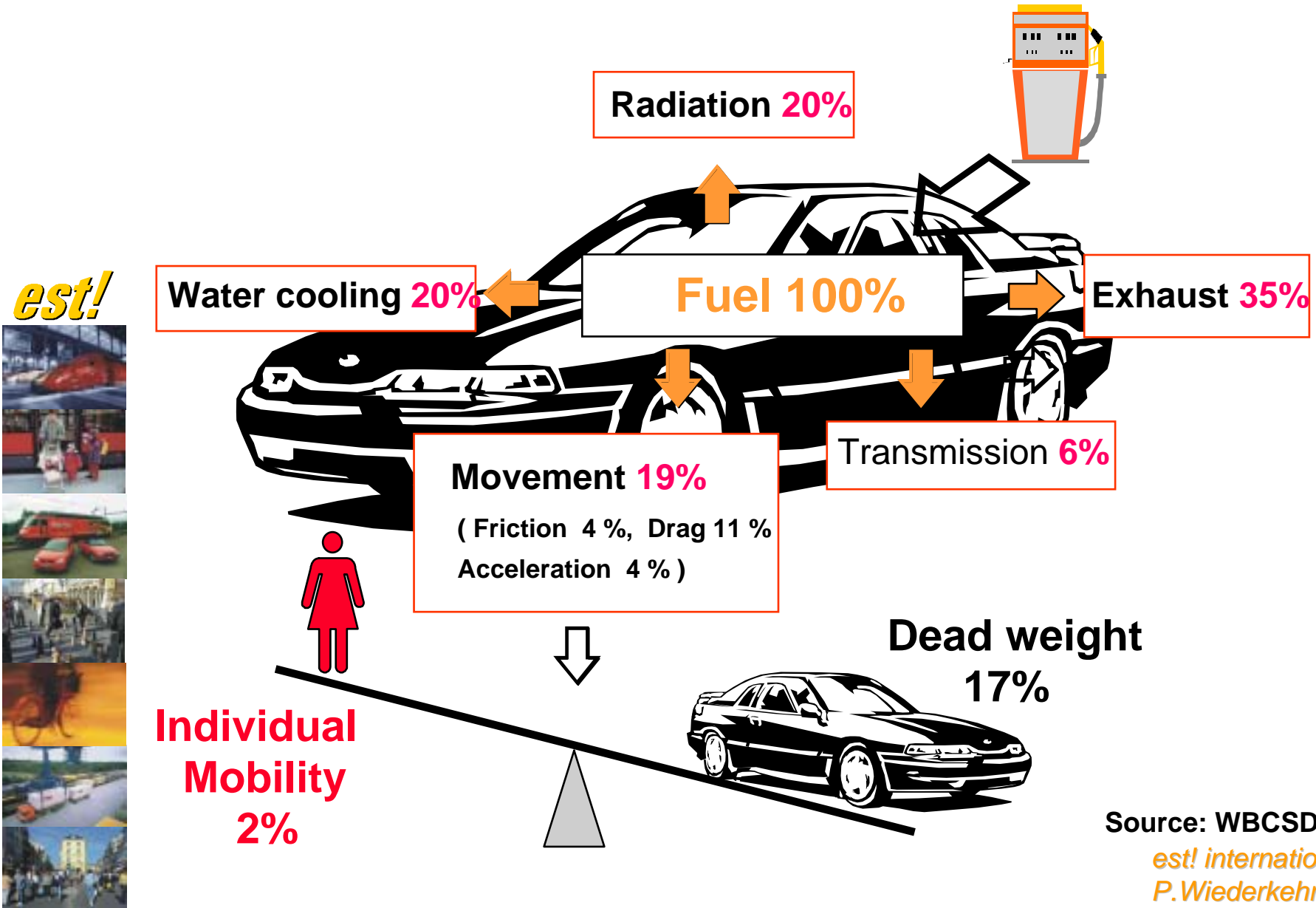
# Motor Vehicle Stock Projections 1990 - 2030



*est!*



# Car Energy Efficiency and Mobility

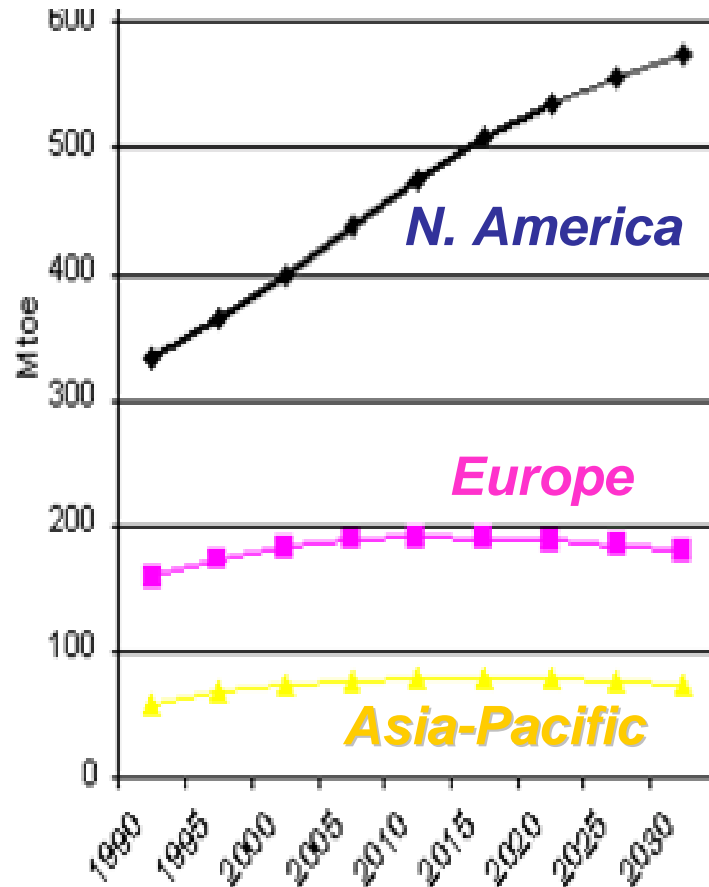


# Motor Vehicle Fuel Use – Current and projected trends up to 2030

## OECD

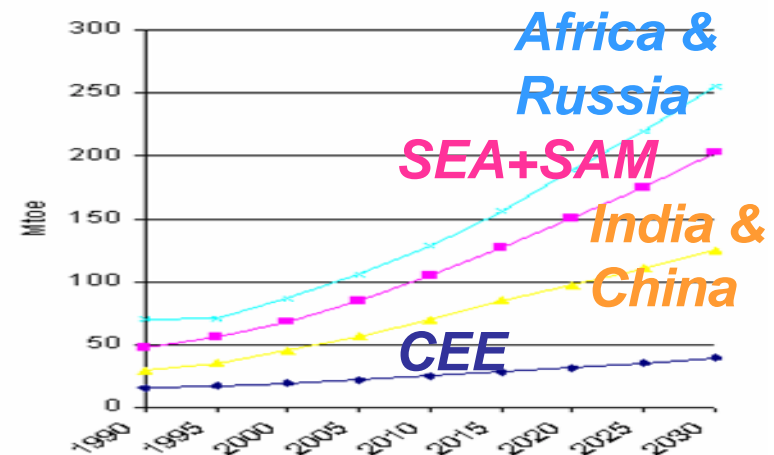
## Petrol Use

2005 to 2030: +40%

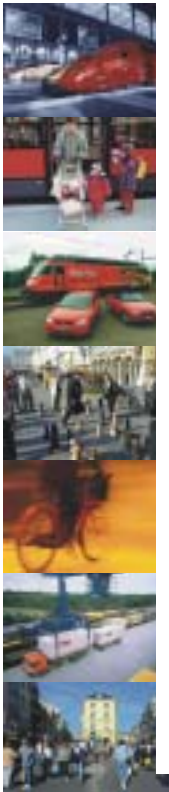


## Non-OECD

2005 to 2030: +200%



*est!*

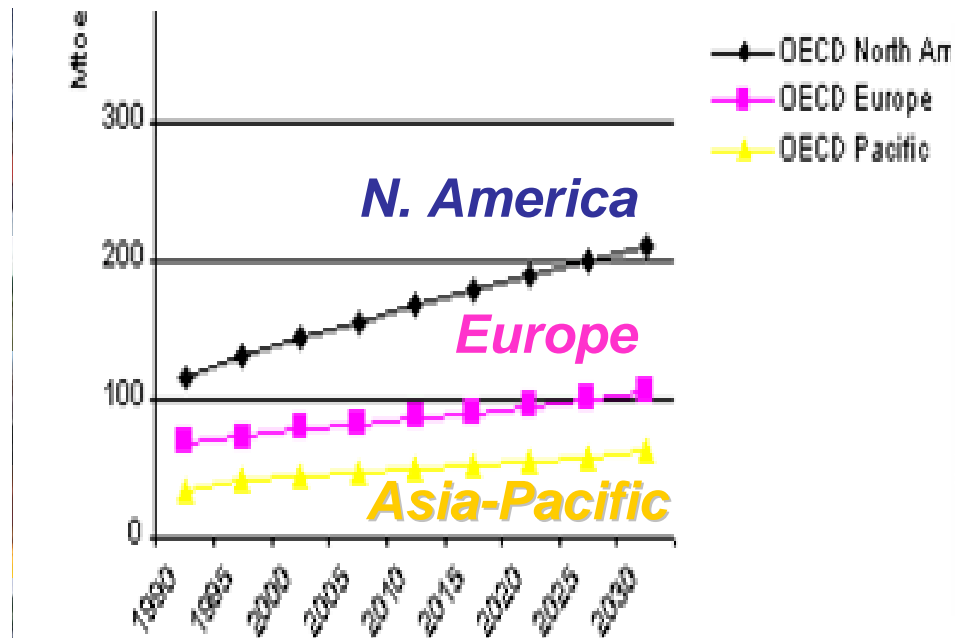


# Motor Vehicle Fuel Use – Current and projected trends up to 2030

## Diesel Use

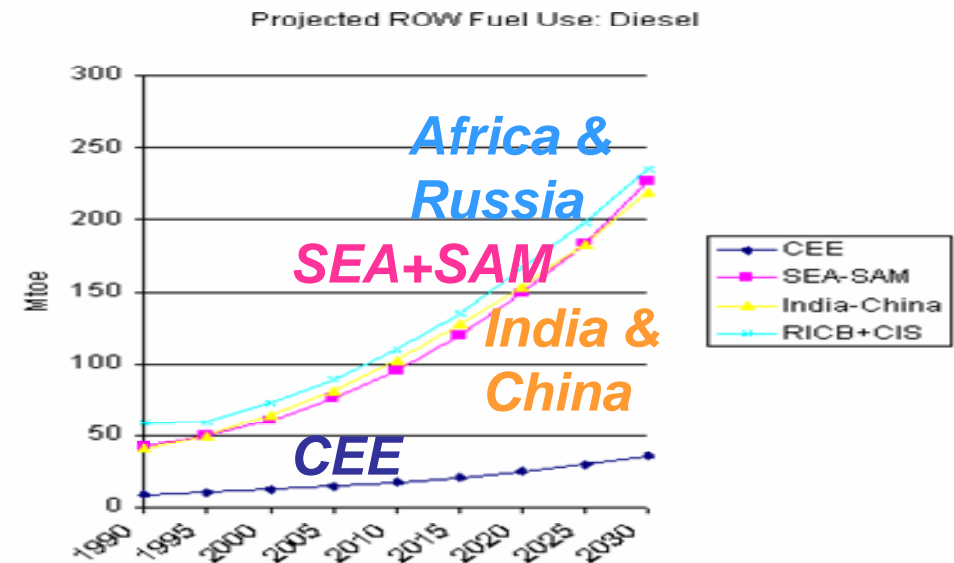
### OECD

2005 to 2030: +37%



### Non-OECD

2005 to 2030: +180%



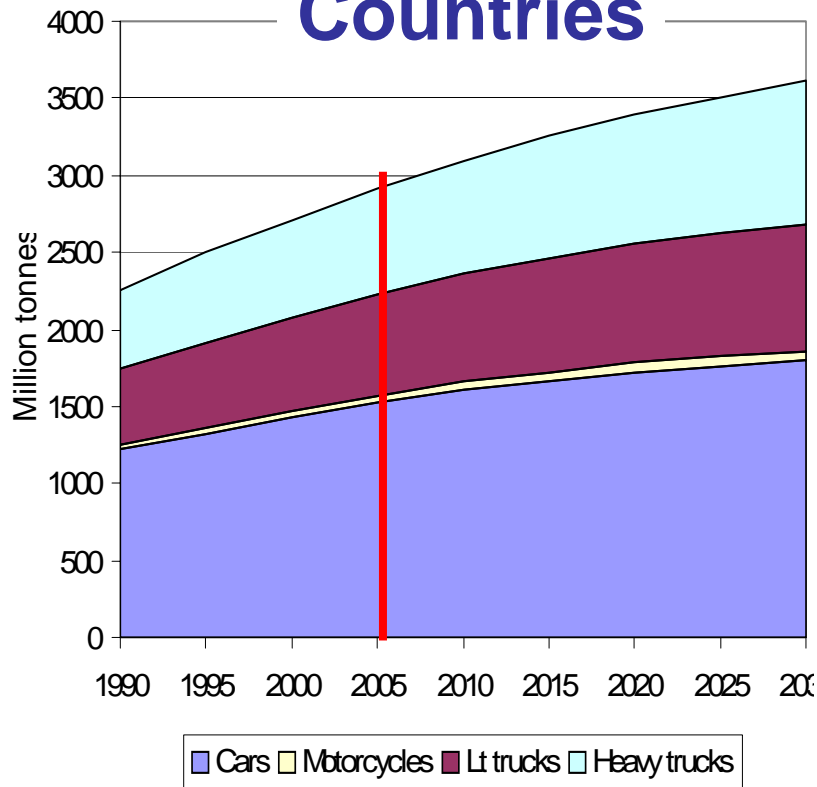
# Global CO<sub>2</sub> Emissions by Motor Vehicles

Projections 1990-2030

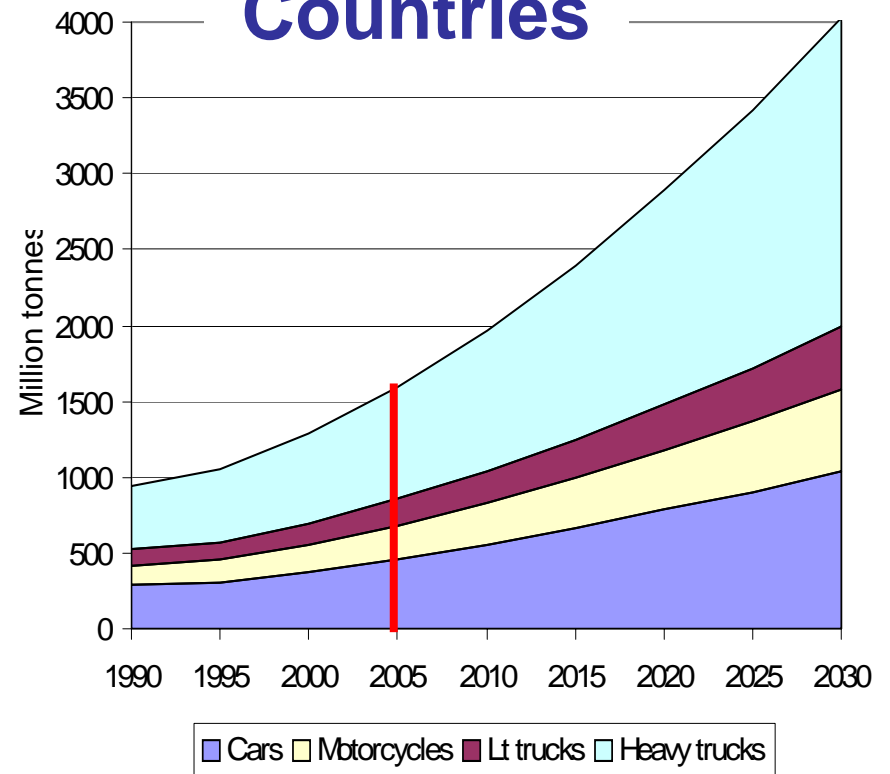
*est!*



## OECD Countries

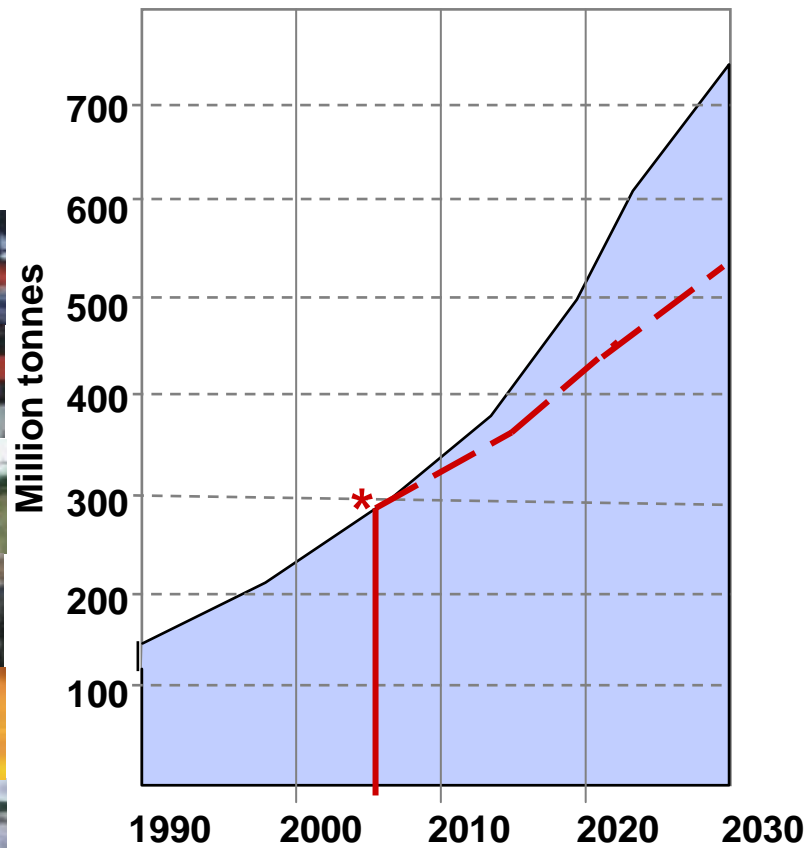


## Non-OECD Countries



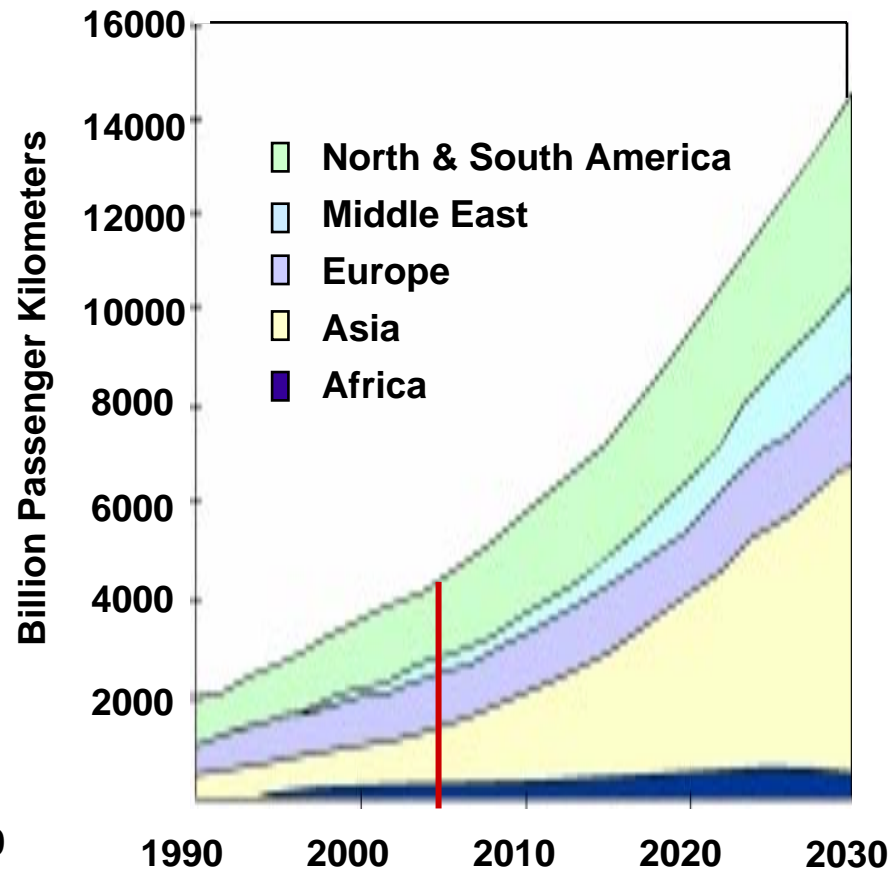
# Global Trends in Aviation: 1990 - 2030

## Kerosene use



\* equiv. of 2% of global fuel use  
 - . - aggressive F.E.

## Passenger travel



Source: ICAO

est! international  
 P. Wiederkehr 7

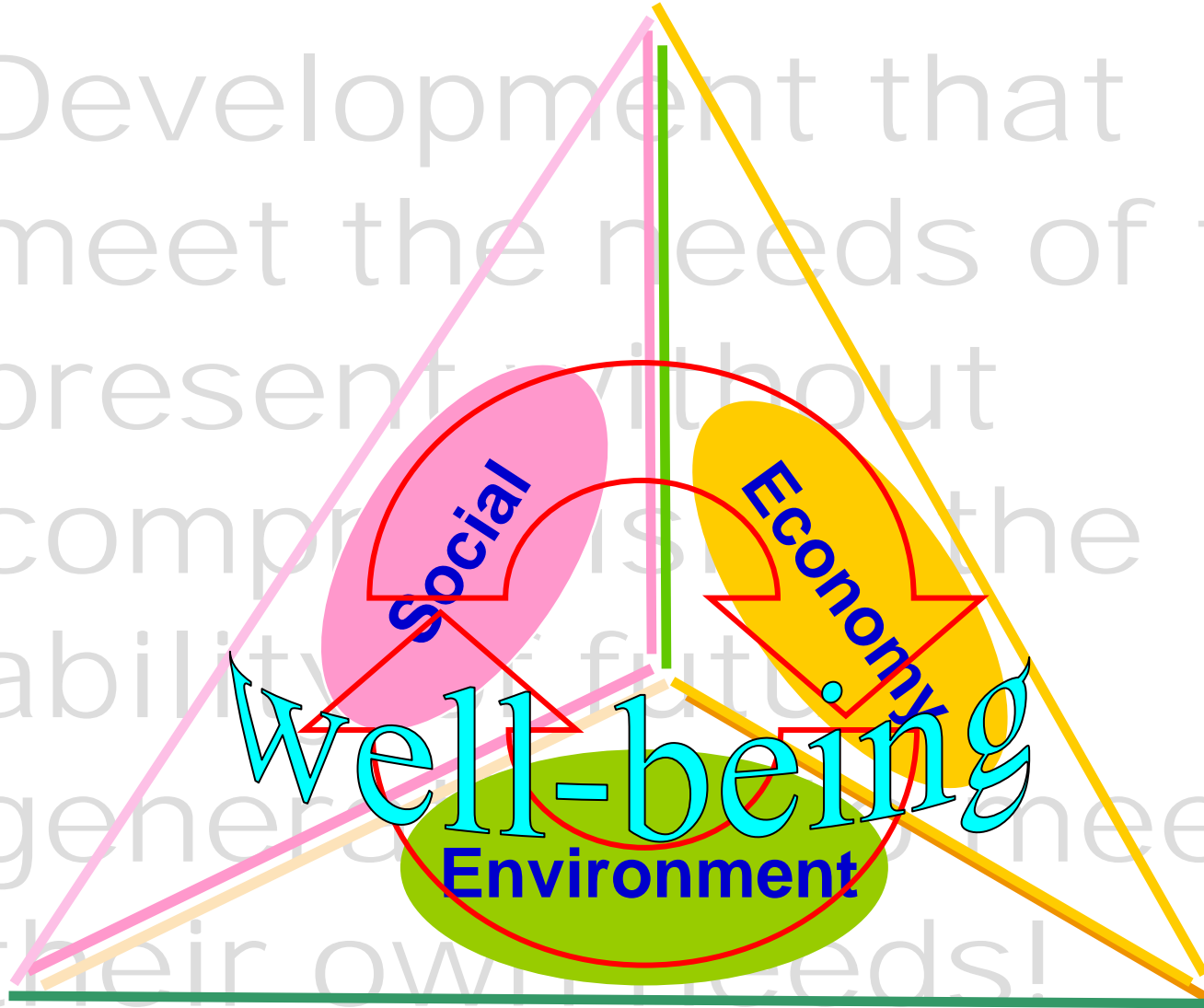


# Sustainable Development

- the three linked constituents -

Development that meet the needs of the present without compromising the ability of future generations to meet their own needs!

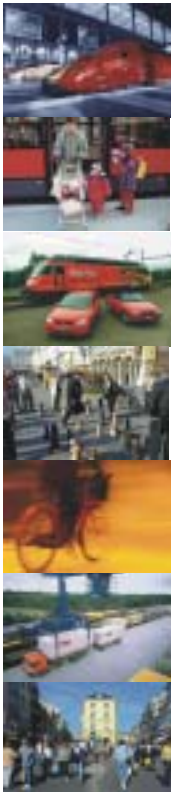
*est!*



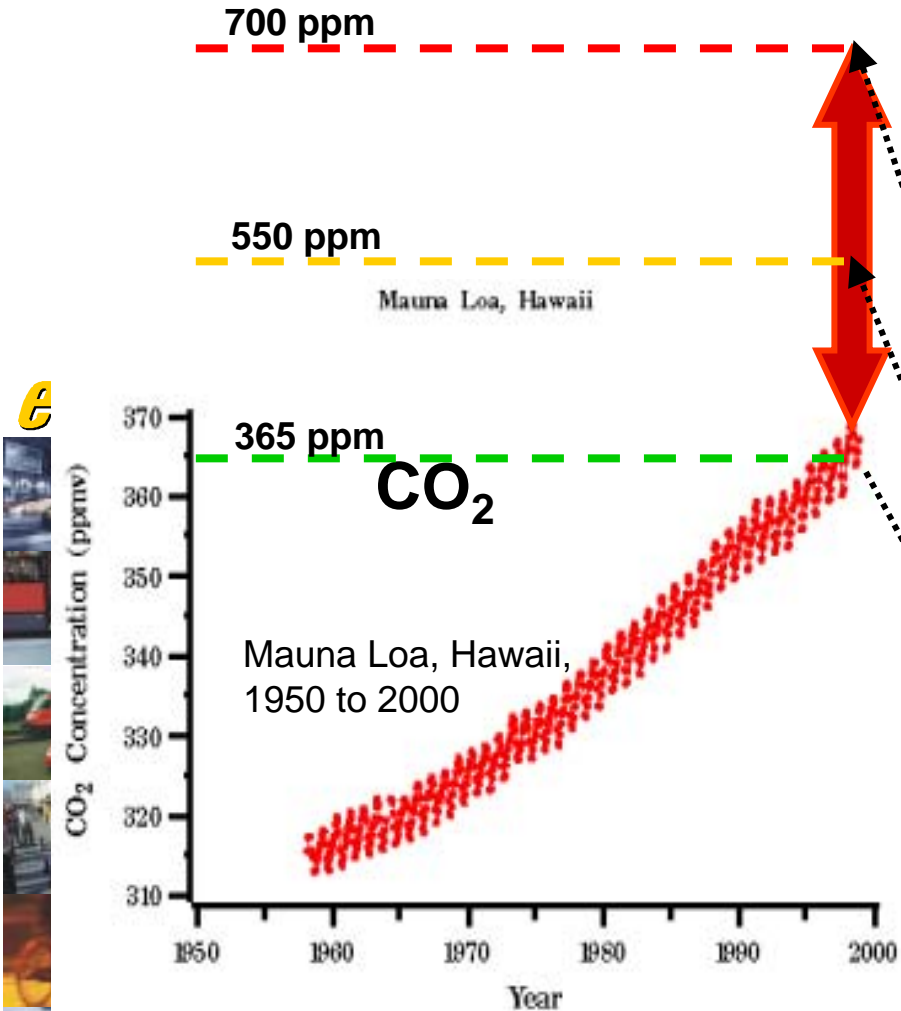
# Environmental Sustainability Principles

- ◆ **Regeneration**: rate of use of **renewable resources** below rate of their regeneration
- ◆ **Substitutability**: rate of use of **non-renewable resources** below rate of their replacement by renewable resources
- ◆ **Assimilation**: releases to the environment should not exceed **critical thresholds** or **critical limits**
- ◆ **Avoiding irreversibility**: avoidance of **irreversible effects**

*est!*

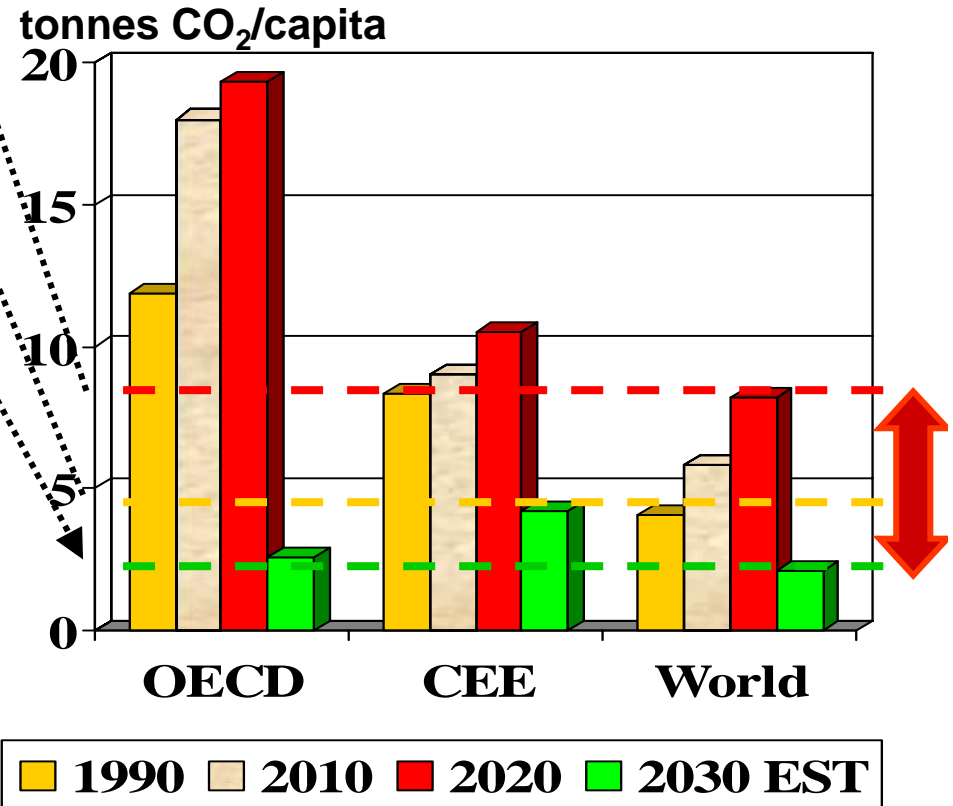


# Impact of CO<sub>2</sub> Emission Trends on Atmospheric Concentration levels



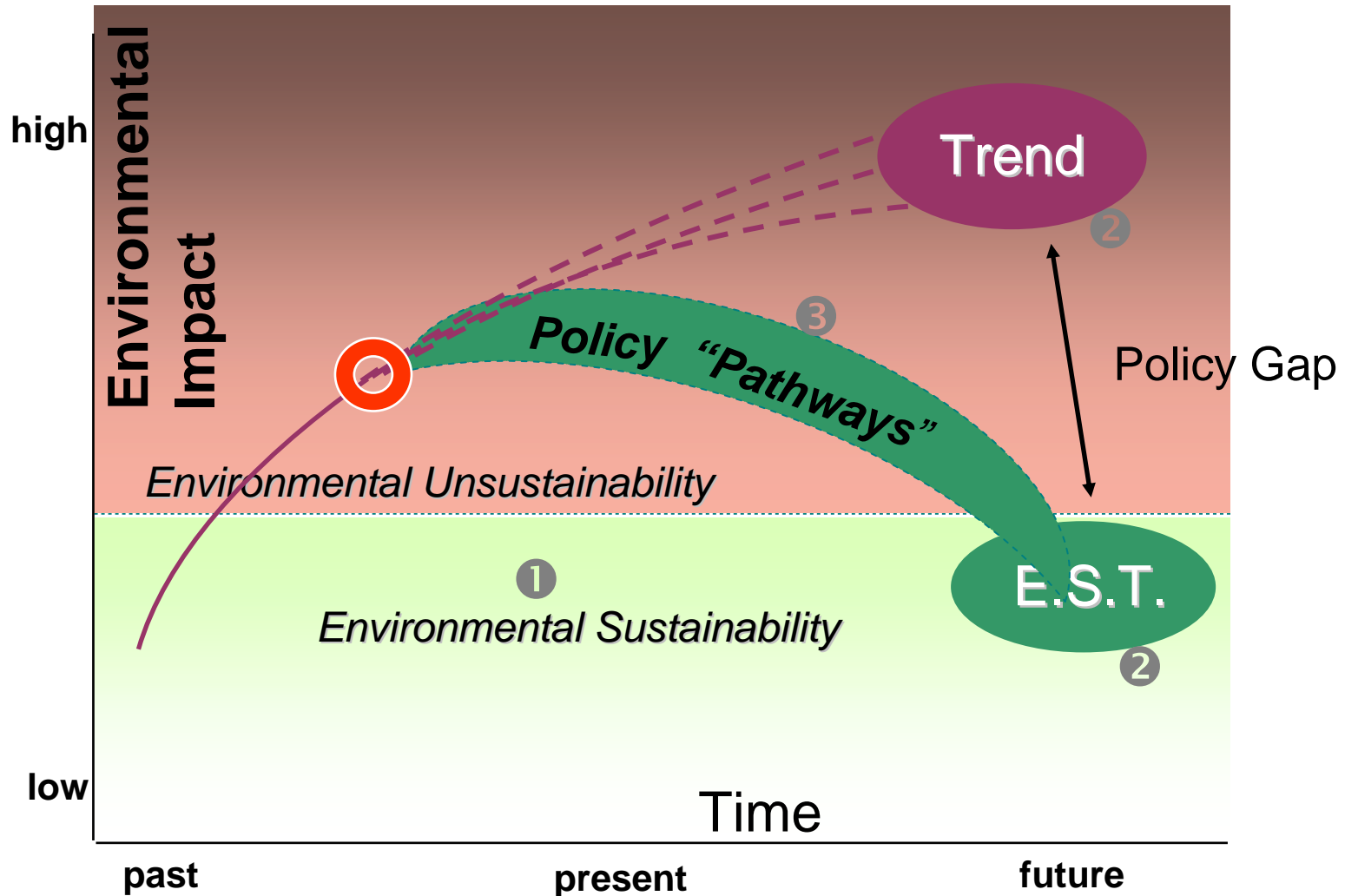
Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)

## CO<sub>2</sub> Emissions projections to 2020

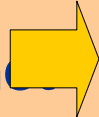






# The EST Concept and Approach

## - The role for proactive policy



# Quantified, Sector-specific Action Targets

EST Criteria	Targets by 2030	EU by 2010
<b><u>Noise</u></b> WHO Guidelines met 	<b><u>Noise sources</u></b> - 50% to - 70%	(---)
<i>est!</i> <b><u>Air quality (NO<sub>2</sub>, PM)</u></b> WHO Guidelines met 	<b><u>Air emissions</u></b> - 50% NO <sub>x</sub> ; - 99% PM	- 51% NO <sub>x</sub>
Critical ozone levels attained 	- 90% NO <sub>x</sub> , VOC	- 54% VOC
<b><u>Acidification / Eutrophication</u></b> Critical Loads met 	<b><u>SO<sub>x</sub>, NO<sub>x</sub> emissions</u></b> - 75% to - 90%, - 50% NH <sub>3</sub>	- 77% SO <sub>x</sub> - 14% NH <sub>3</sub>
<b><u>Climate protection</u></b> Stabilising CO <sub>2</sub> concentrations 	<b><u>GHG / CO<sub>2</sub> emissions</u></b> OECD: - 80%, global: - 50%	- 8% CO <sub>2</sub>

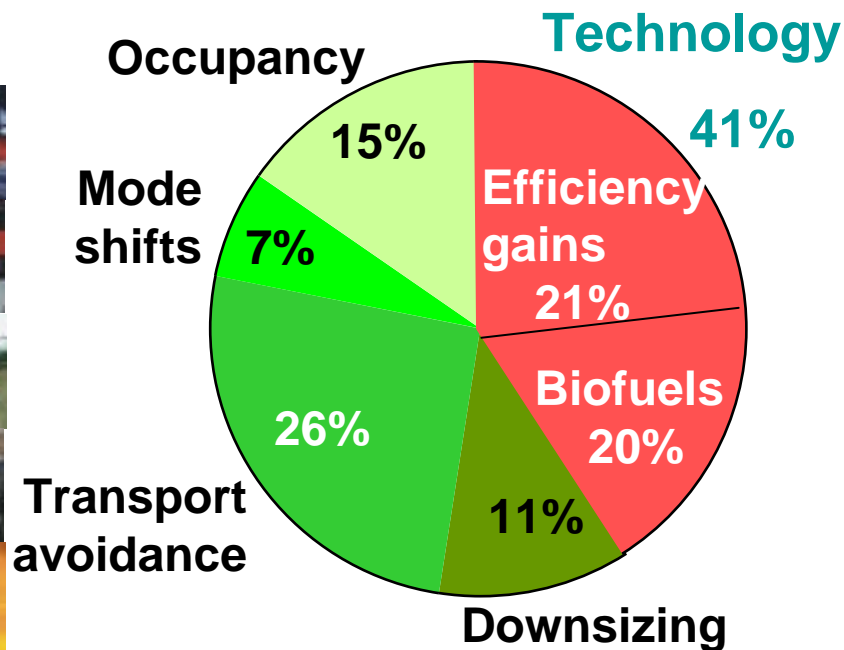
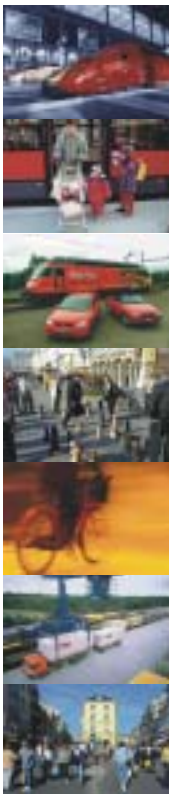
# Measures to achieve EST:

## Passenger Transport

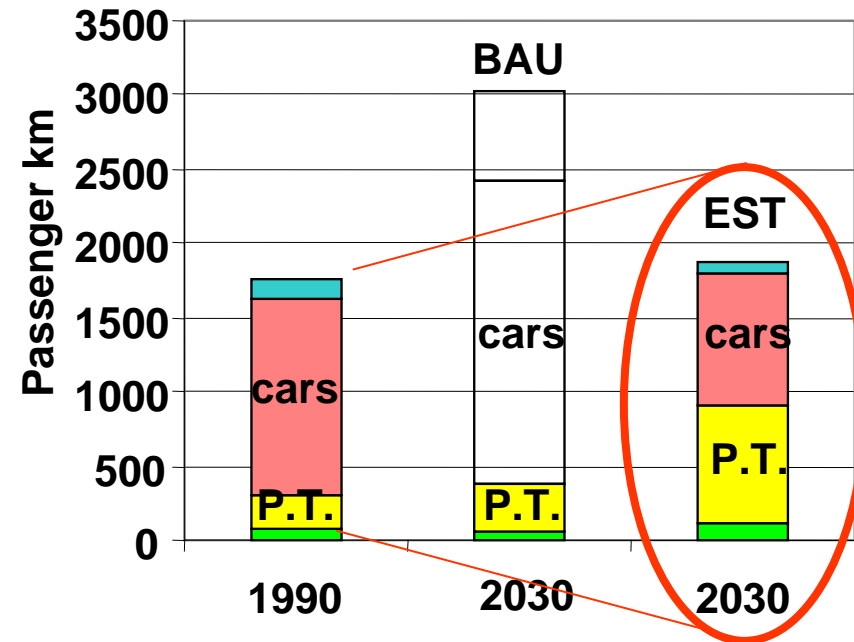
Demand Management

59%

*est!*



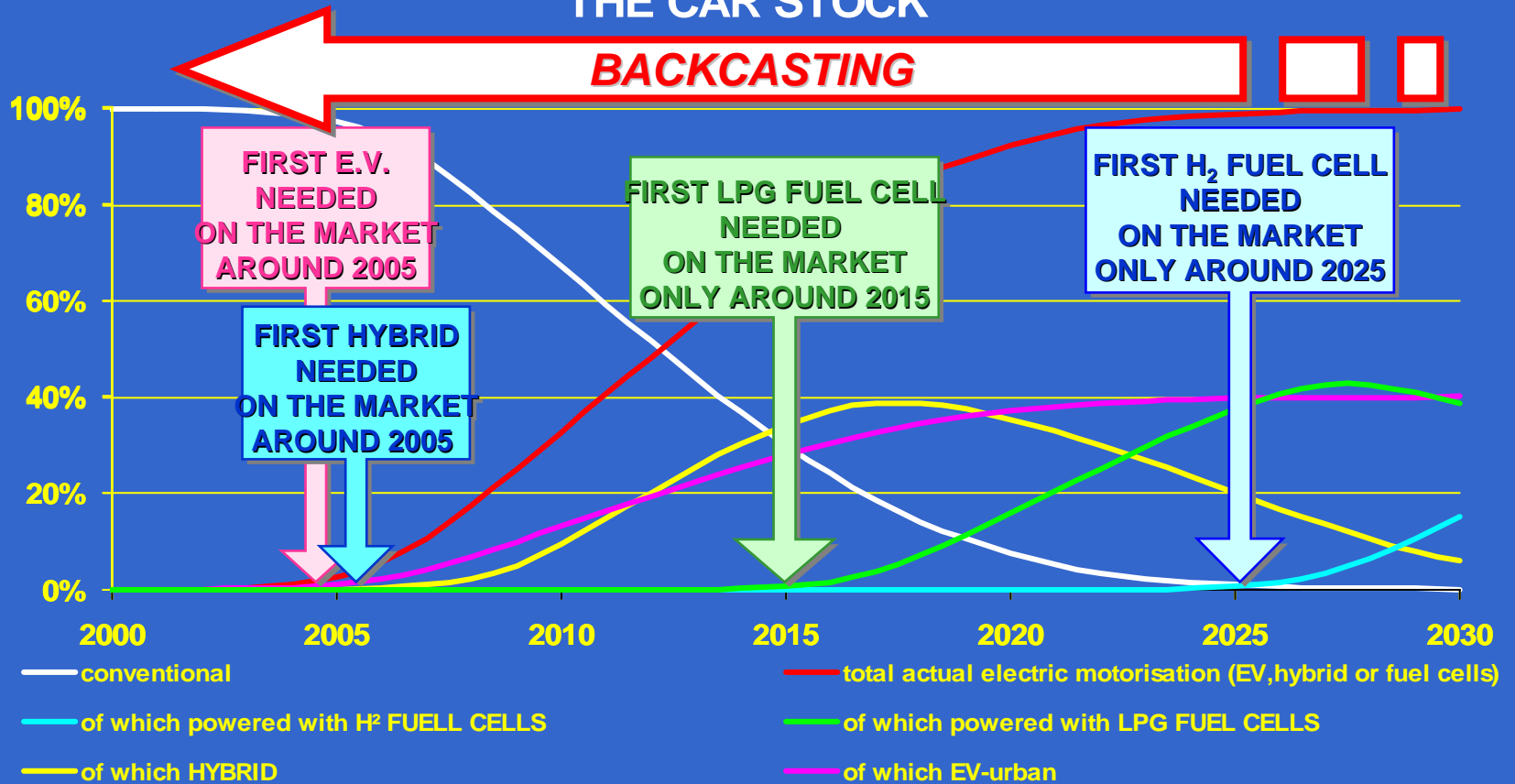
## Modal Split



- Aircraft
- Passenger cars
- Public transport +
- non-motorised

# Backcasting for Introducing Technology

RELATIVE SHARES OF THE NEW TECHNOLOGIES IN THE CAR STOCK



Source: A. Morechoine,  
ADEME, EST 1999.

# ***EST Technology Innovation by 2030: zero emission for “passenger cars”***

## **Biofuel for conventional/ hybrid fuel/electric vehicles**

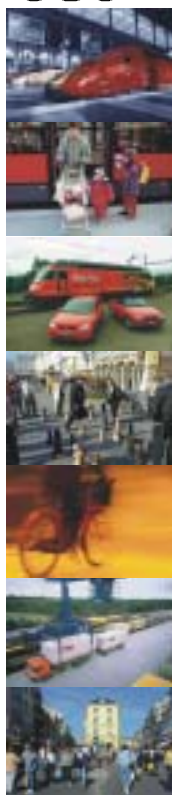
<b><i>Market share</i></b>	<b><i>2015</i></b>	<b><i>2020</i></b>	<b><i>2030</i></b>
Hybrid veh.	15%	20%	10%
Biofuel ICE	10%	20%	40%
(High F.E. ICE	70%	40%	20%)

<b><i>Emissions:</i></b>	<b><i>NOx</i></b>	<b><i>PM</i></b>	<b><i>CO<sub>2</sub></i></b>
Hybrid	- 50%	- 80%	- 50%
Biofuel	- 6%	- 25%	- 90%
CNG/diesel	- 75%	- 95%	- 20%

## **Natural gas and hydrogen fuel cell passenger vehicles**

<b><i>Market share</i></b>	<b><i>2015</i></b>	<b><i>2020</i></b>	<b><i>2030</i></b>
CNG FC:	start	15%	20%
LH <sub>2</sub> FC:	---	start	5%

***est!***

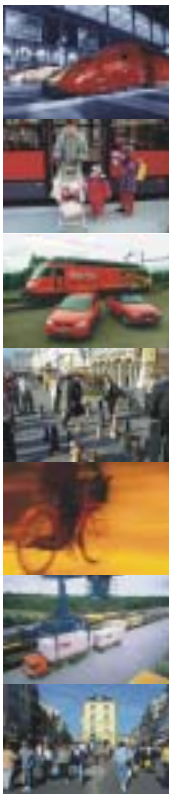


# ***EU Alternative Fuels Targets on Market Share***

***3 options with a potential of more than 5% fuel consumption***

***Development scenario to attain 20% market share by 2020***

***est!***



	Biofuel	Natural Gas	Hydrogen	Total
2005	2	-	-	2
2010	<b>5.75</b>	2	-	8
2015	(7)	5	2	14
2020	(8)	10	5	(23)
<b>GHG</b>	<b>-75% - 95%</b>	<b>-15%</b>	<b>-&lt;100%</b>	

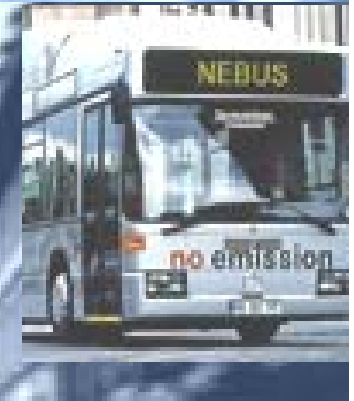
Source: EC, 2004

**➔ Saving of 10% of EU transport CO<sub>2</sub> emissions**

# EST in 2030: Individual and Mass-Transit

New forms of flexible use for individual mobility (soft/active and motorised) and integrated mobility services: e.g. multi-modal links for car-rail-bus-tram and on-demand services.

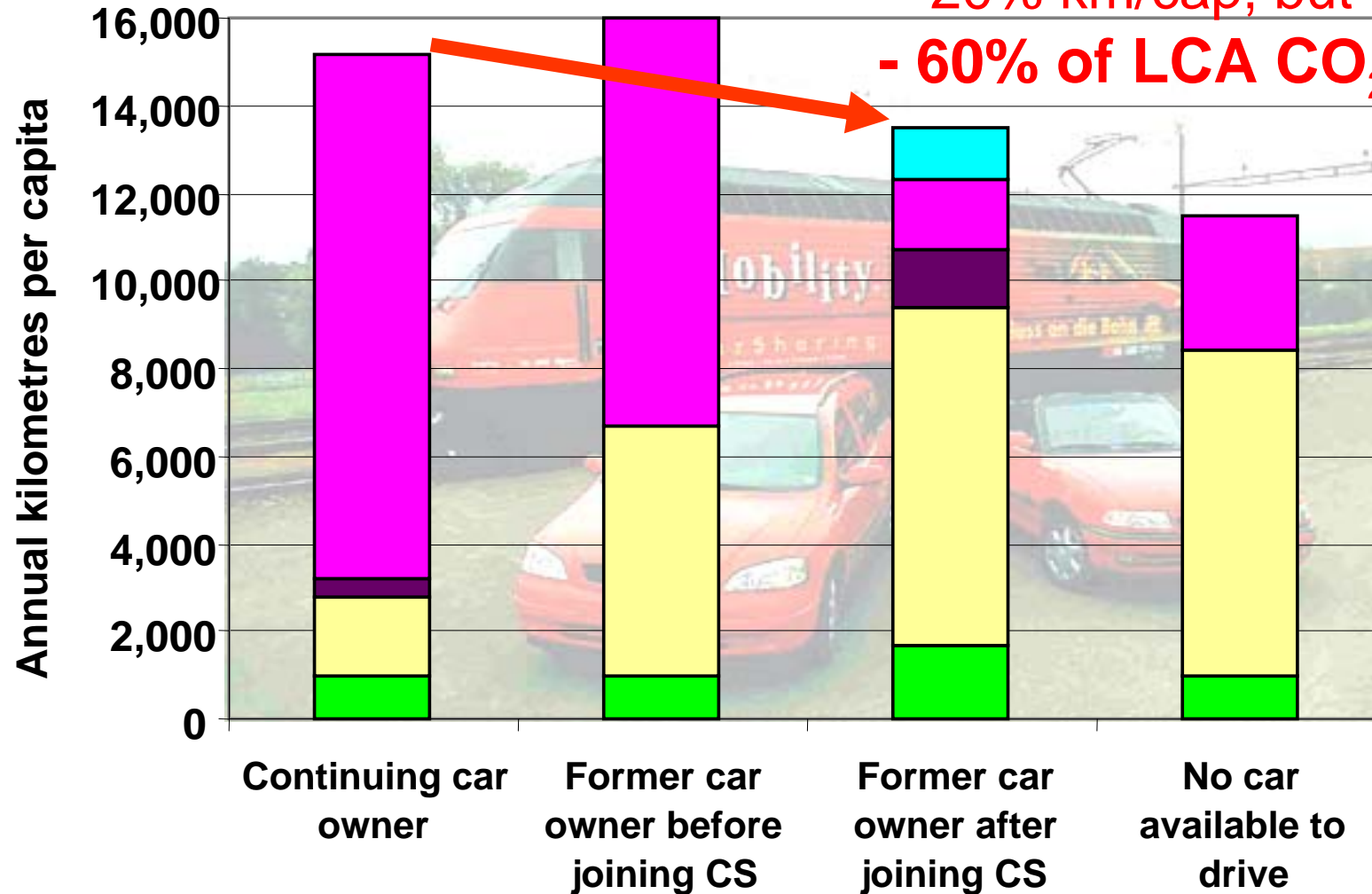
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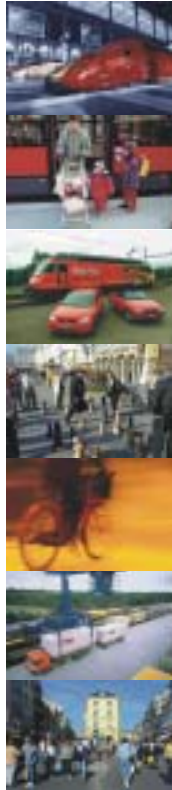
# EST in 2030: Integrated Mobility Services

- Example: MobilityCarsharing Switzerland\*

- 20% km/cap, but  
- 60% of LCA CO<sub>2</sub>



*est!*



■ Walking/bicycling  
 ■ Public transport  
 ■ Motorcycle  
 ■ Private car  
 ■ Carsharing

\* car mobility of 60'000 members served by 1700 vehicles

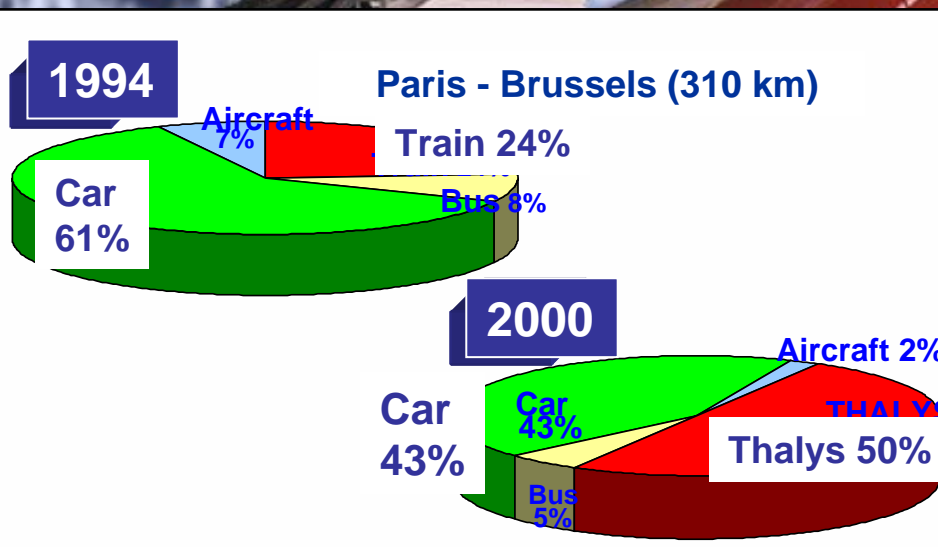
*est! international*

*P. Wiederkehr 18*

# EST in 2030: High-Speed Rail and Air Links

Rail is mainly electric, with increases in high speed modes, efficiency and capacity, replacing short-haul by airplane. Rail-air links greatly developed (leisure travel!).

*est!*



# Measures to achieve EST:

## Freight Transport

Demand Management

54%

Load-factor

Technology 46%

Zero Emission Technology 25%

Bio-, Synfuels 21%

Mode shifts 24%

11%

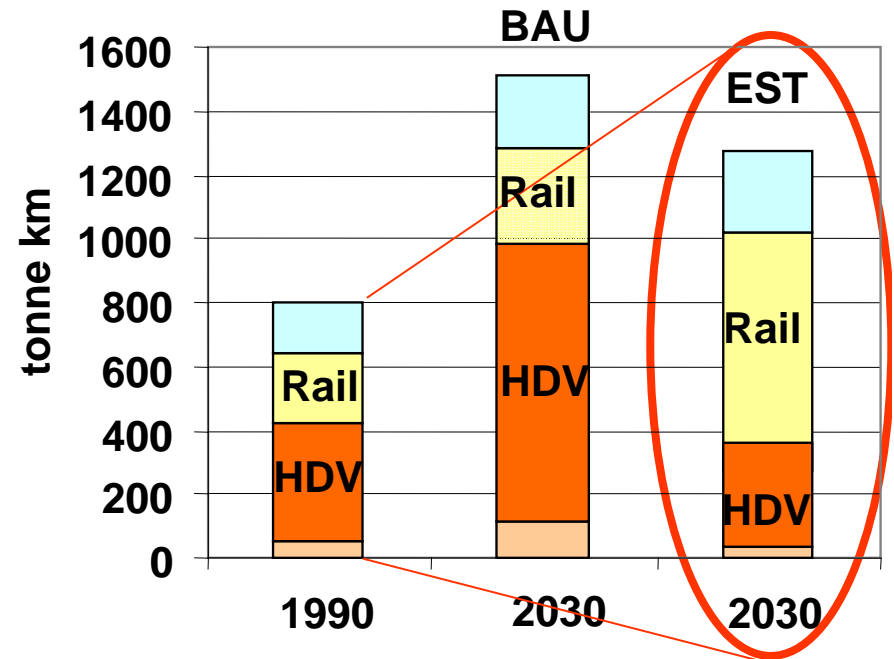
24%

19%

Transport avoidance



## Modal split

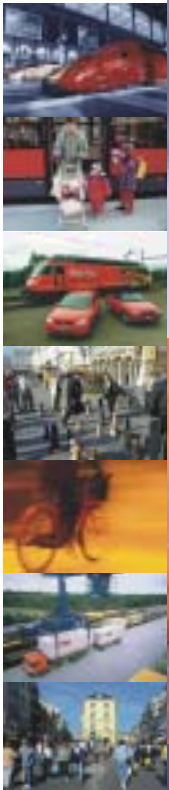


- Waterways
- Rail freight
- Heavy trucks
- Light duty vehicles

# ***EST in 2030: Freight and Combined Transport***

**Low carbon fuels and hydrogen are used directly or in fuel cells. Reduced empty trips (30% in Europe) by much improved multi-modal freight logistics. Longer-distance freight transport (>500km) mainly by rail or combined transport.**

***est!***



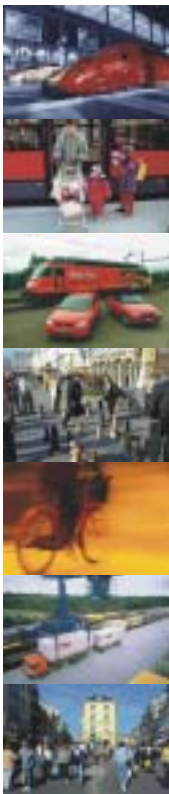
# Modal shift : from road to rail freight - CO<sub>2</sub> savings

Example: GreenCargo vs. truck transport in Sweden

GreenCargo



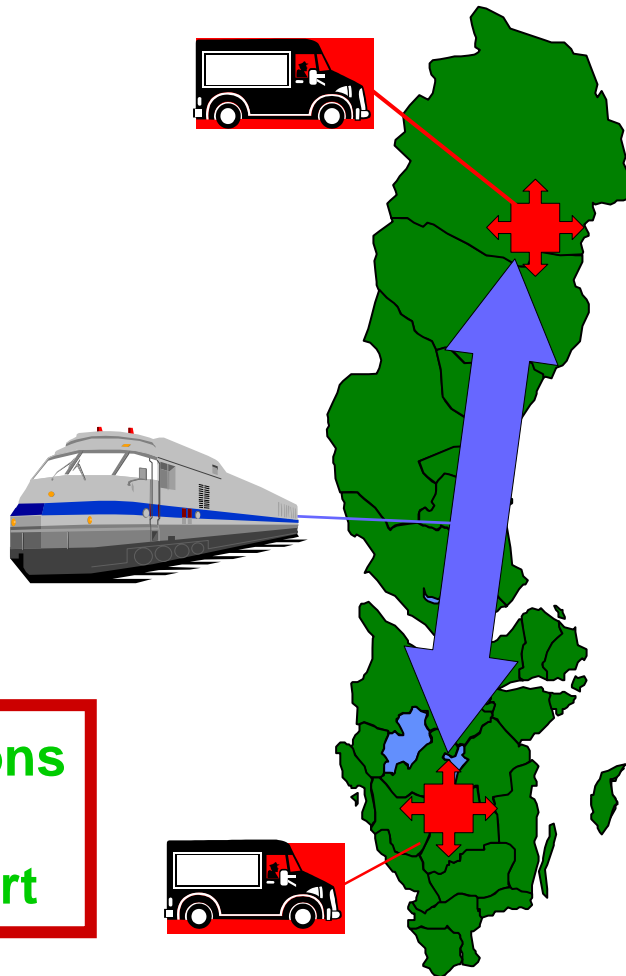
*est!*



One client:

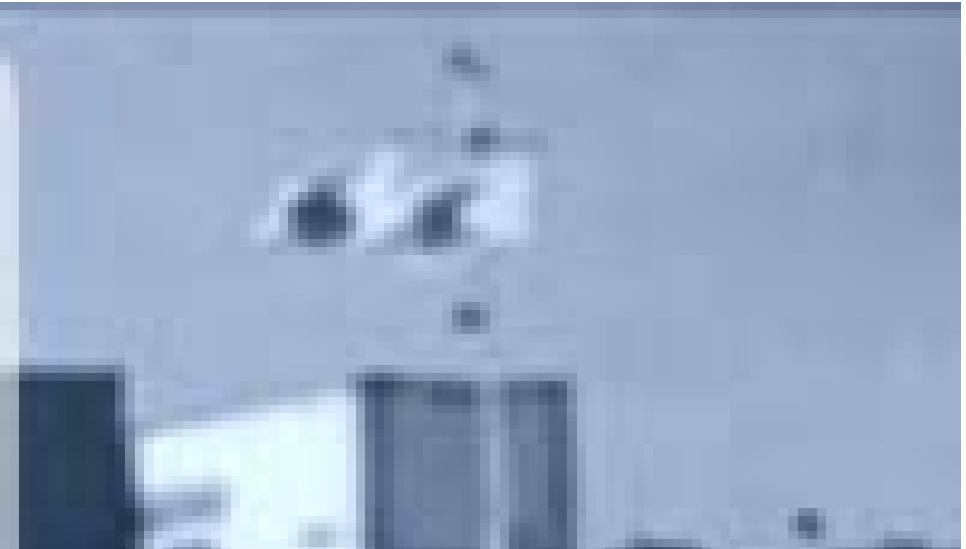
- 200 days /year
- 1500 km distance
- electric train with diesel truck distribution on both ends

**95% avoided CO<sub>2</sub> emissions  
by rail freight  
compared to road transport**



# ***EST in 2030: inland water and maritime transport***

**More fuel efficient (less CO<sub>2</sub> emissions!) and low-polluting fuels (e.g. biofuels) for maritime and inland-water shipping vessels will be used. Hydrogen may also be used as a fuel.**

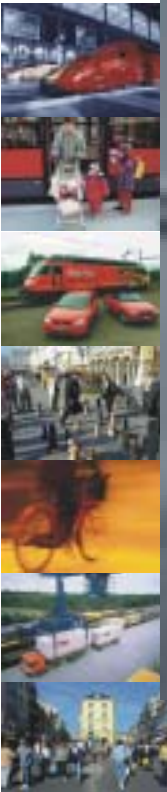


## ***EST in 2030: aviation***

**Air planes will be much cleaner and more fuel efficient\* and of higher capacity. Many long-haul business trips will be replaced by telecommunication.**

**Bio-kerosene (and hydrogen) for jet turbines, and bio-ethanol for piston aircraft may be used.**

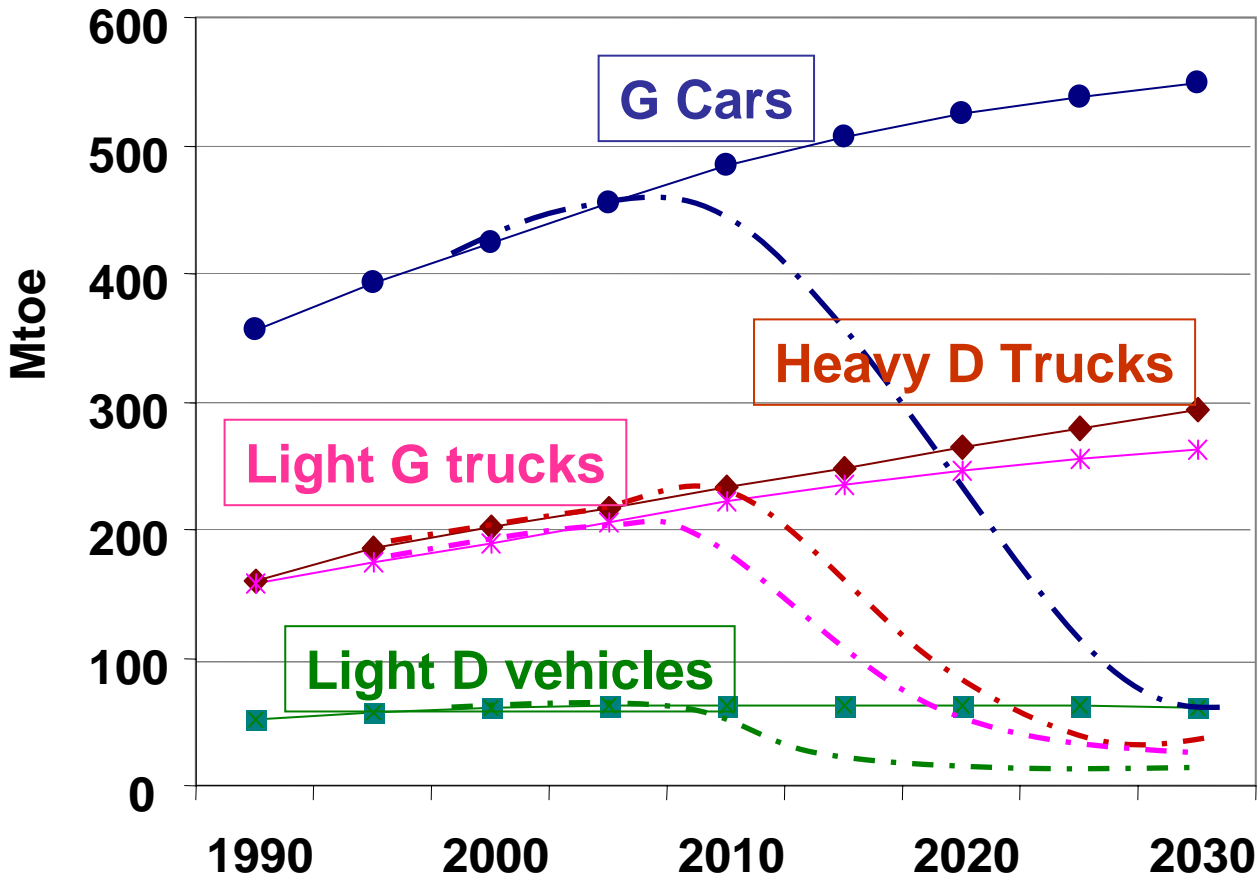
***est!***



**\* Aircraft improvements by 2020:**

- 50% fuel/ pkm
- 80% NOx/pkm

# Road Fuel Use Projections and EST Scenarios in the OECD Area



**BAU trends**

**EST trajectories**

## “ *Winning the Oil Endgame* “

“ .....It is entirely possible to cut projected U.S. oil consumption ***in half by 2025,*** and ***eliminate it completely by 2050,*** without compromising rapid economic growth. ....

.....  
Once the U.S. has saved half of its oil, it can cost-effectively replace an additional ***20% with advanced biofuels*** and the ***rest (30%) with natural gas.***”

Amory B. Lovins,

\* *Winning the oil endgame,*  
2004

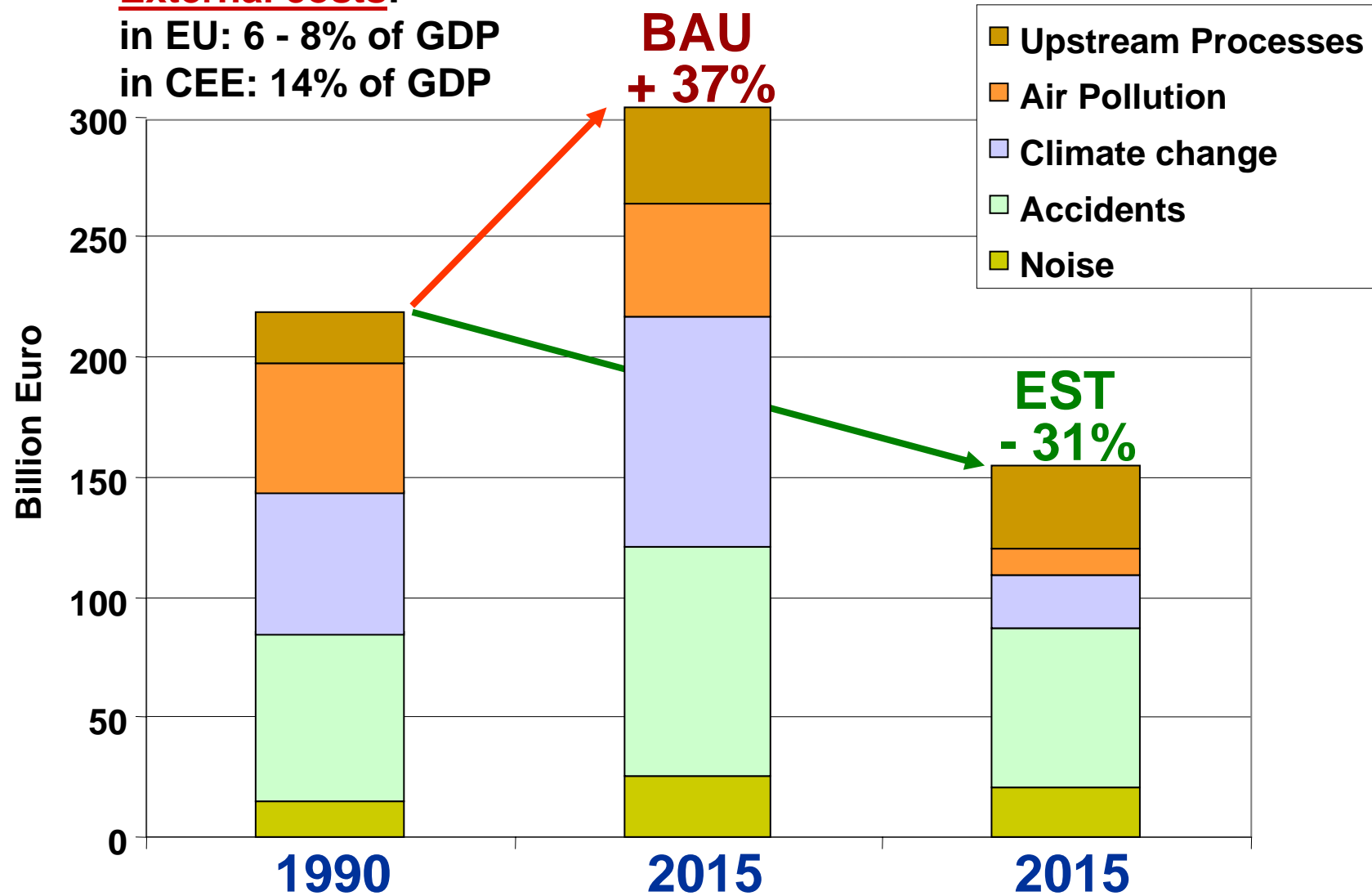
Rocky Mountain Institute,  
Colorado, USA.

*est!*

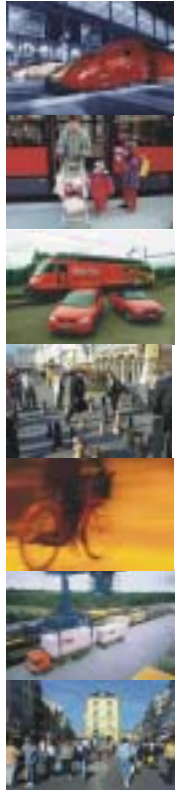


# Economic Benefits of EST – Reduced Externalities

**External costs:**  
 in EU: 6 - 8% of GDP  
 in CEE: 14% of GDP



*est!*



# General conclusions

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## regarding motor vehicle CO<sub>2</sub> emissions

- ❖ *Motor vehicle emissions trends are unsustainable - mainly due to projected increase of CO<sub>2</sub> and other greenhouse gas emissions in the long-term*
- ❖ *Growth of diesel fuel demand faster than for gasoline raising concerns about climate effects also due to black carbon (PM) that cause 50% of climate effect.*
- ❖ *Alternative fuels (CNG, biofuels, synfuels) could replace some oil (20% of market share in 2020 in the EU) reducing 10% or more of transport CO<sub>2</sub> emissions –*  
*it is just a start, but with high potential for CO<sub>2</sub> savings.*

*est!*



# Backcasting towards EST - Results

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Key features to meet long-term sustainability goals, notably preventing climate change:

- *Aggressive introduction of **zero-emission vehicles** (standards) and **low-carbon fuels** (FE requirements, biofuels)*

*and*

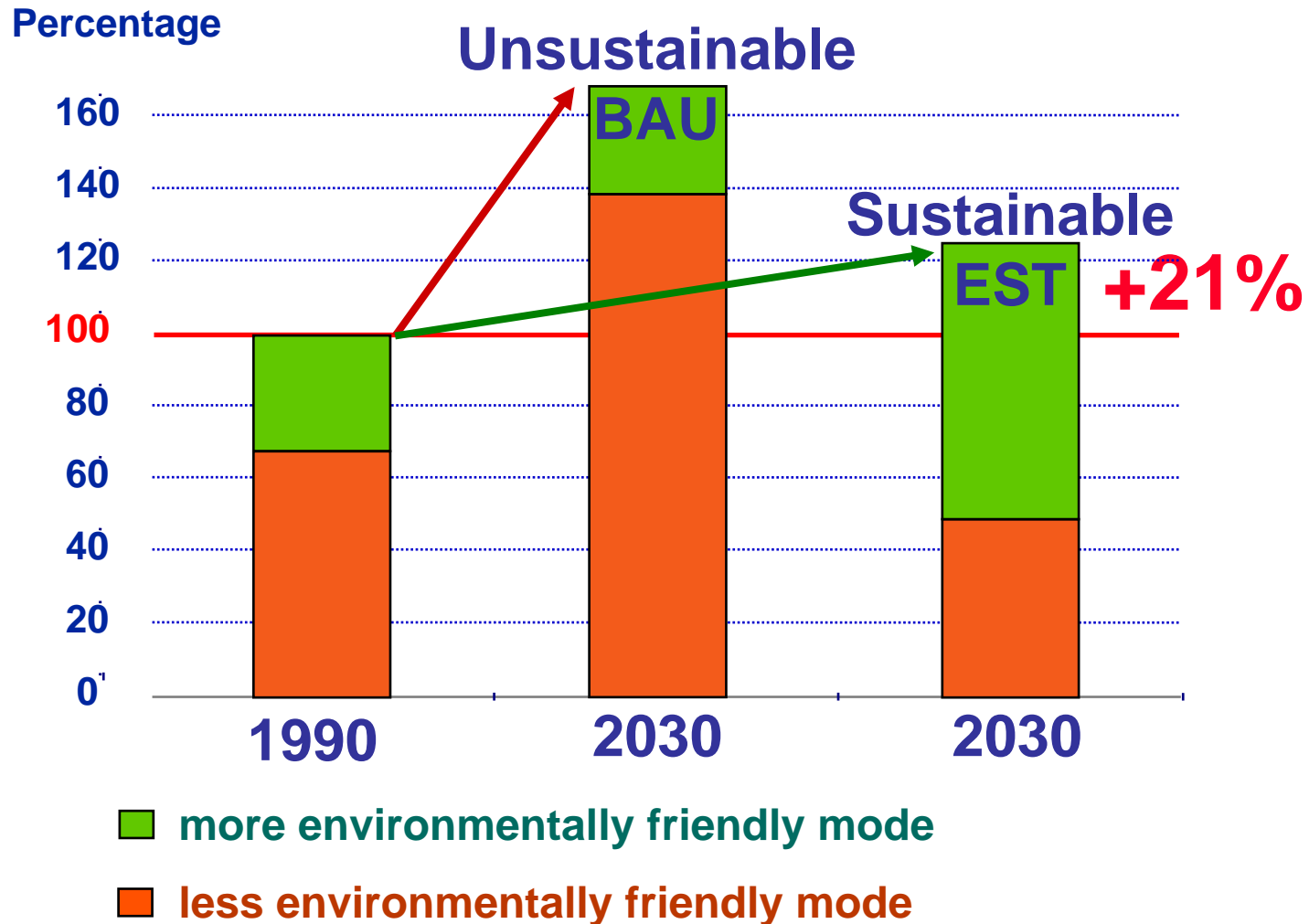
- *Comprehensive policies for **demand-side management** both for passenger and freight:*
  - Integrated **new mobility services** for passenger transport and multi-modal logistics for freight
  - Changing **modal share** of passenger and freight transport through transport **infrastructure investment**, **welfare-increasing pricing and fiscal policies**
  - Information, education and awareness raising of the public towards a sustainable future of transport

*est!*



# Transport Modal Split in 2030

EST versus business-as-usual trends



*est!*

