

## **Mobility management and transport technologies for carbon reduction: what conclusions can we draw?**



**POWER**  
Low Carbon Economies



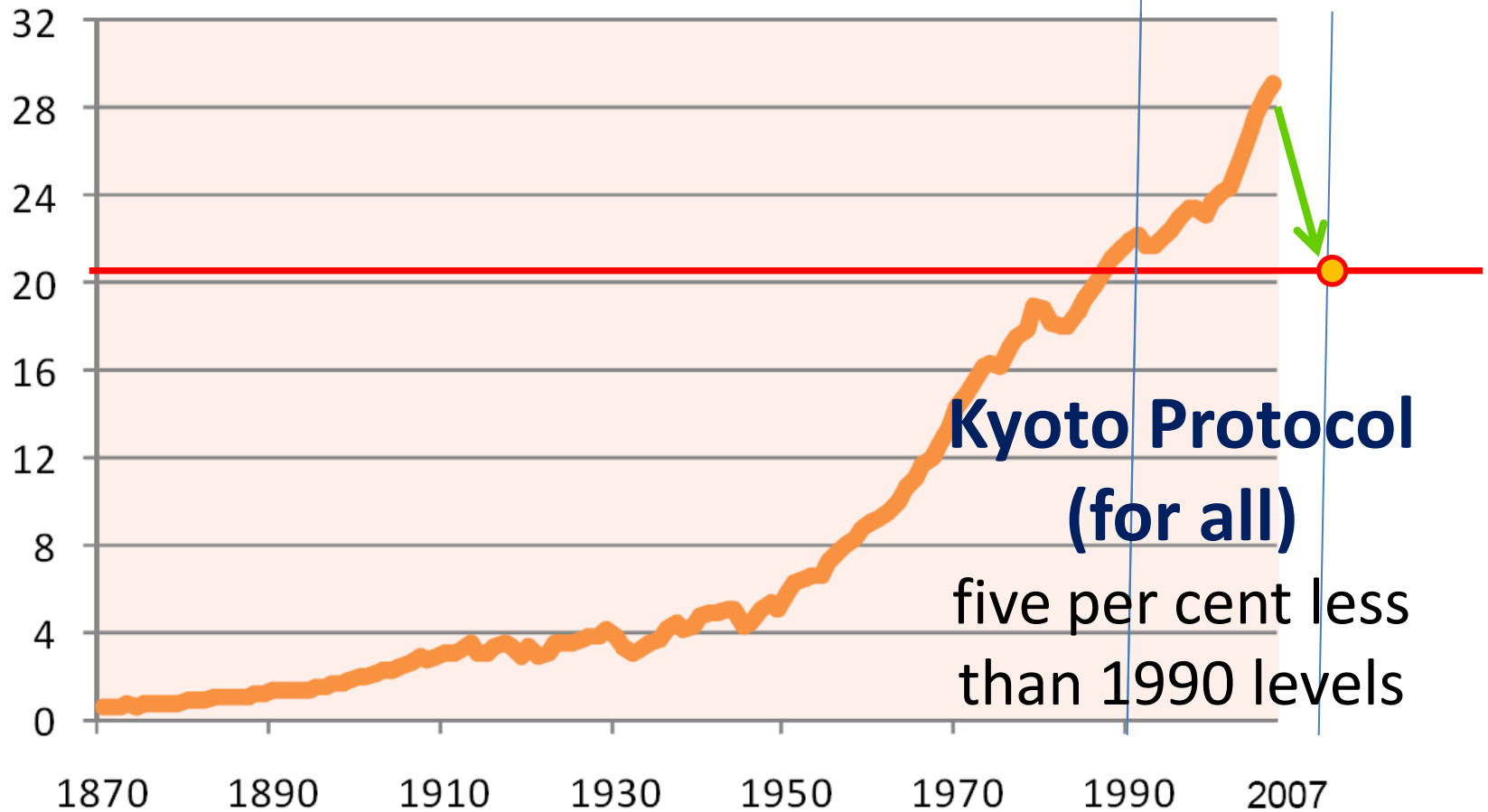
**European Union**  
European Regional Development Fund



**INTERREG IVC**  
INNOVATION & ENVIRONMENT  
REGIONS OF EUROPE SHARING SOLUTIONS

# World CO2 emissions

Gt CO<sub>2</sub>

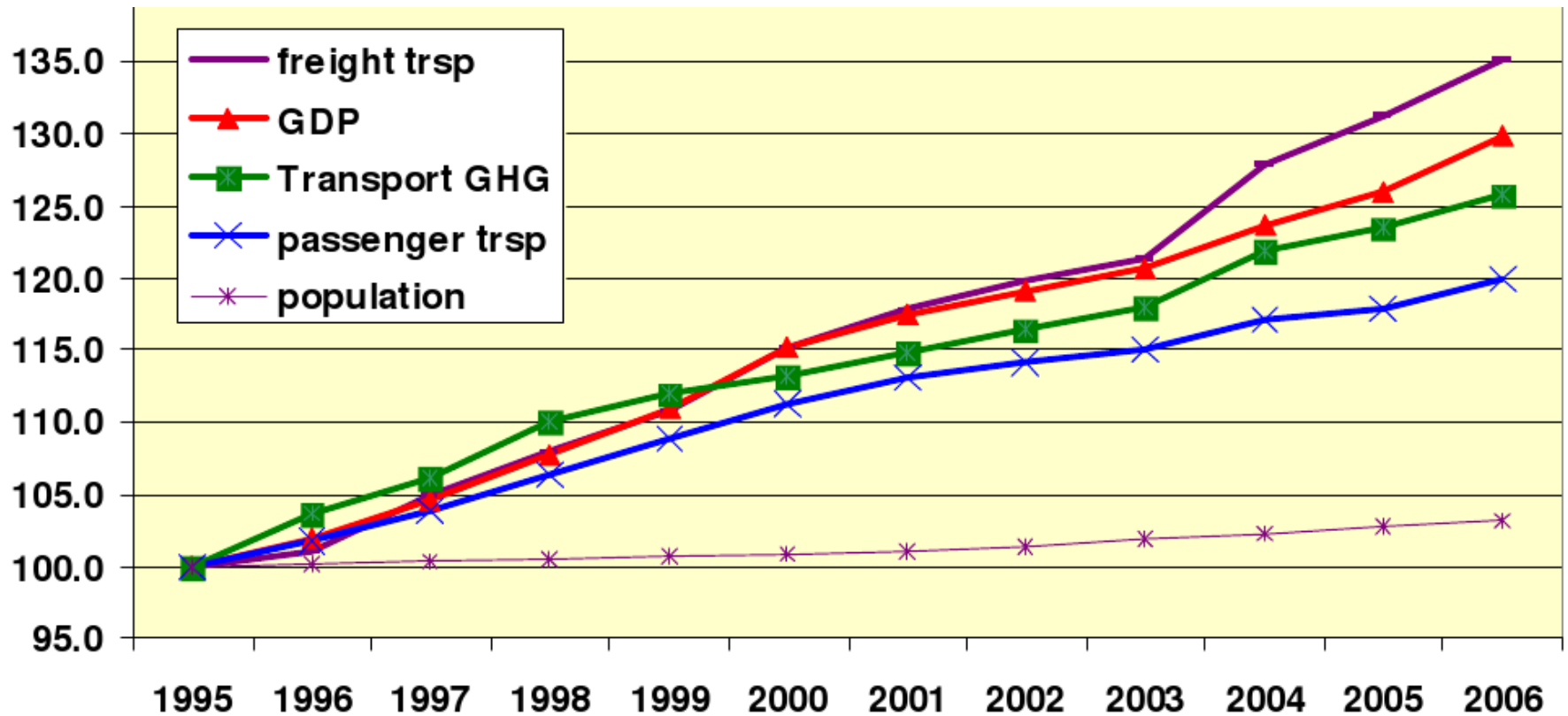


**Kyoto Protocol  
(for all)**

five per cent less  
than 1990 levels

Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, Tenn., United States.

# EU Transport and CO2 emissions

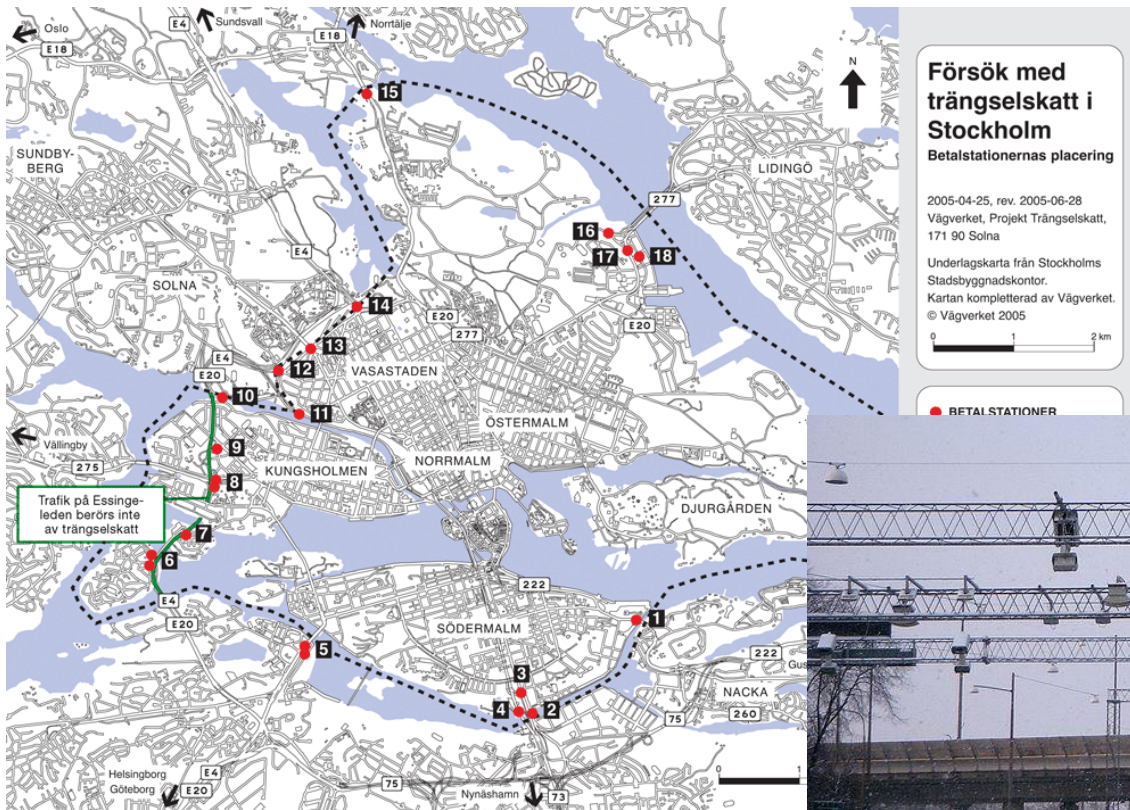


**Goal: Reduce Transport carbon emissions by 60% below 1990 levels by 2050 !!**

# Mobility management and transport technologies

- **Mobility management**
  - Direct behavioral change (Road tax, subsidies, education)
  - Land Use Planning Policies
  - Transportation Supply/Demand Management
- **Transport technologies**
  - Propulsion technologies (Electric, Hybrid, Fuel-Cells)
  - Intelligent transportation systems for CO2 reduction (Mass monitoring of traffic flows, intelligent traffic lights, fare integration systems )
  -

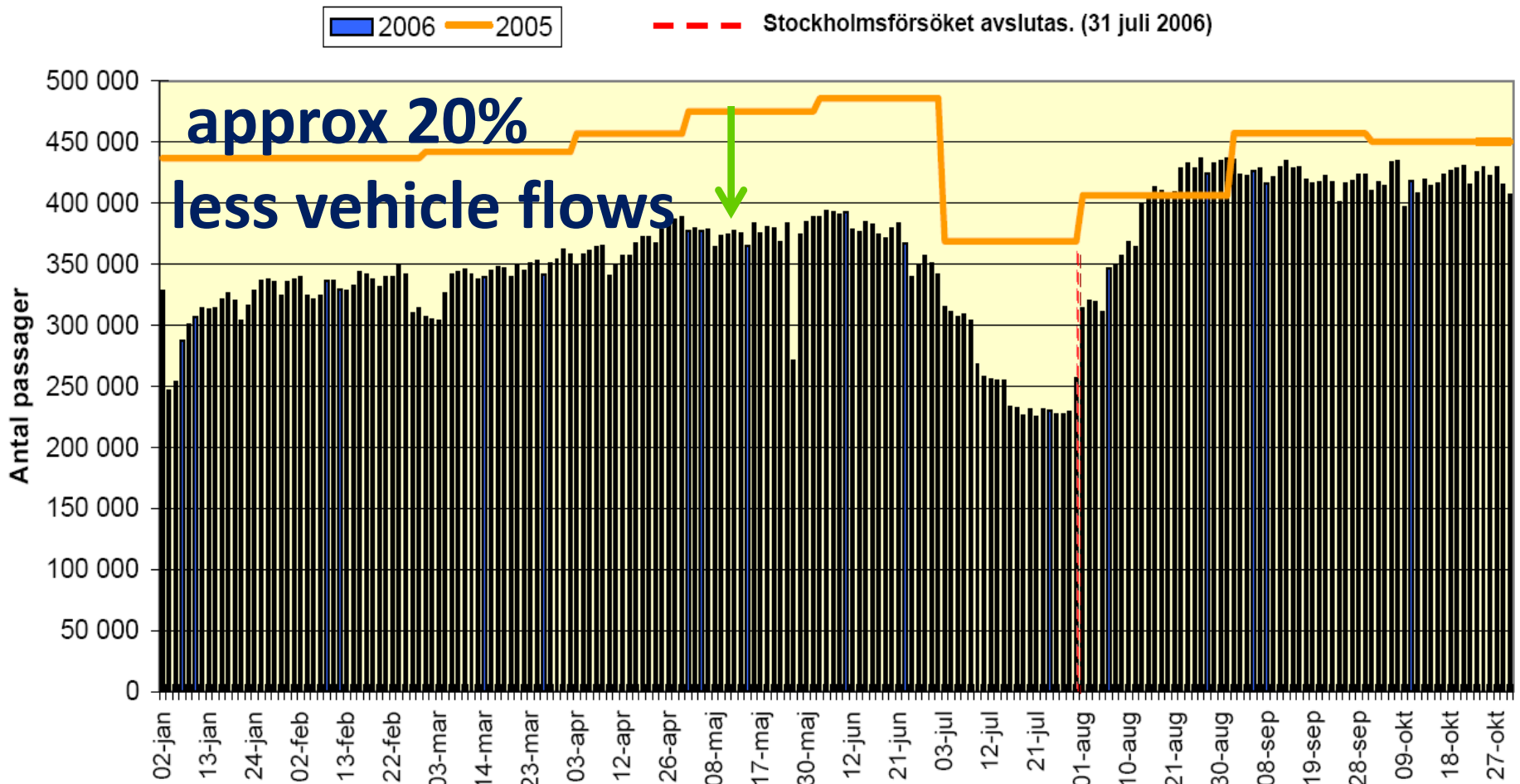
# Mobility management: Road charging scheme in Stockholm



2€-6.5€ per day



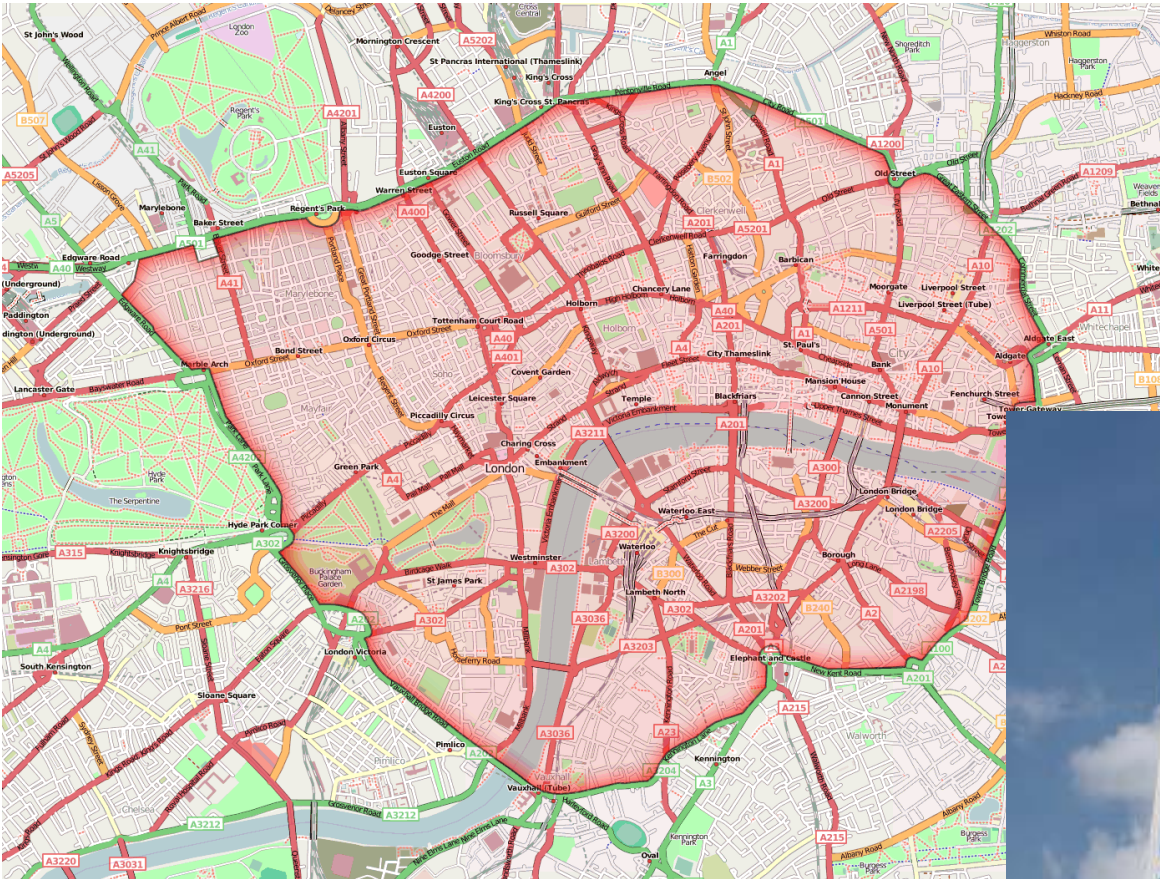
# Mobility management: Road charging scheme in Stockholm



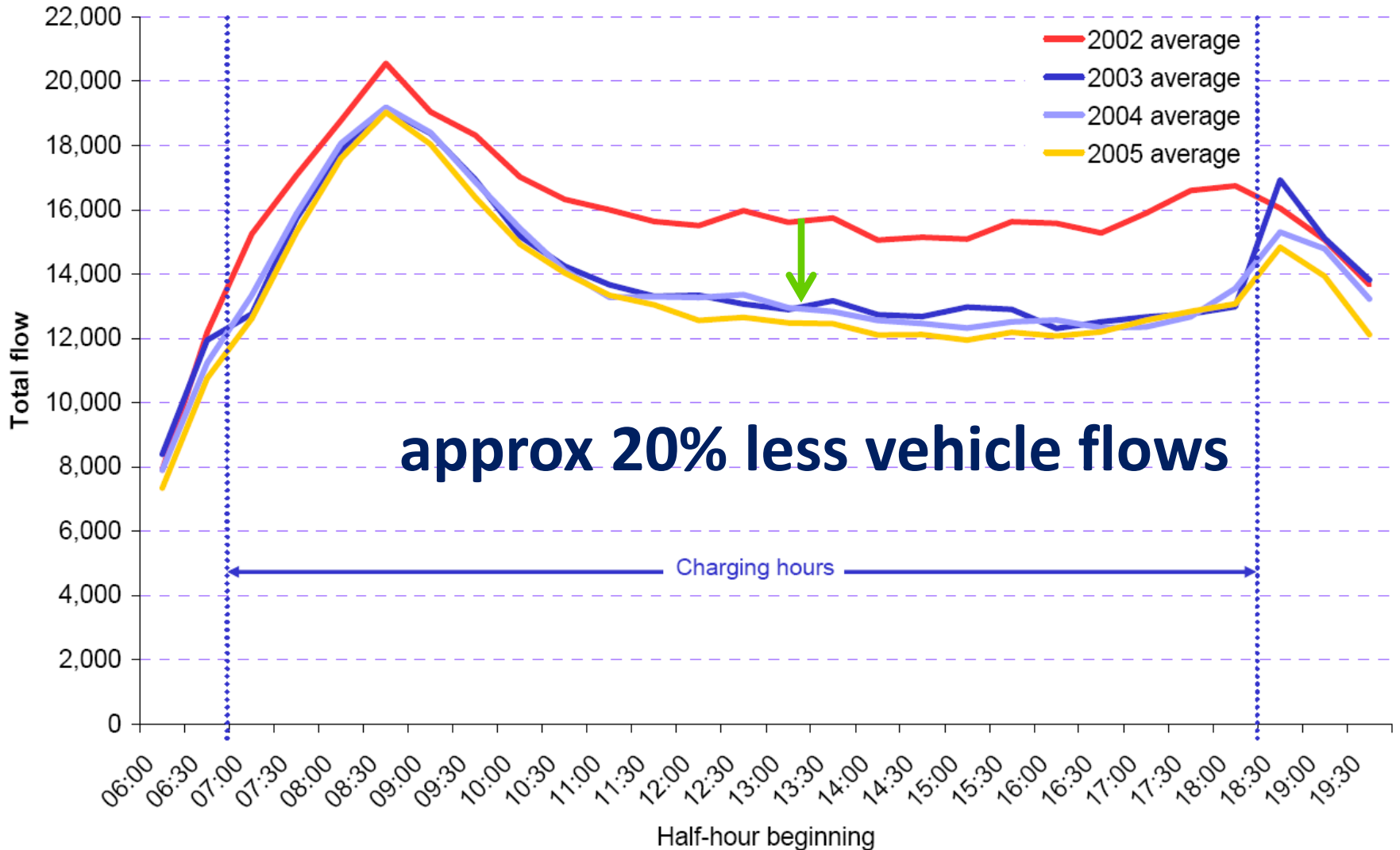
\* Data från betalstationer t o m den 31 juli. Fr o m den 1 augusti data från Trafikkontorets mätstationer. \*\* Jämförelsevärde för 2005 redovisas som ett genomsnittligt värde för resp månad.



# Mobility management: Road charging scheme in London

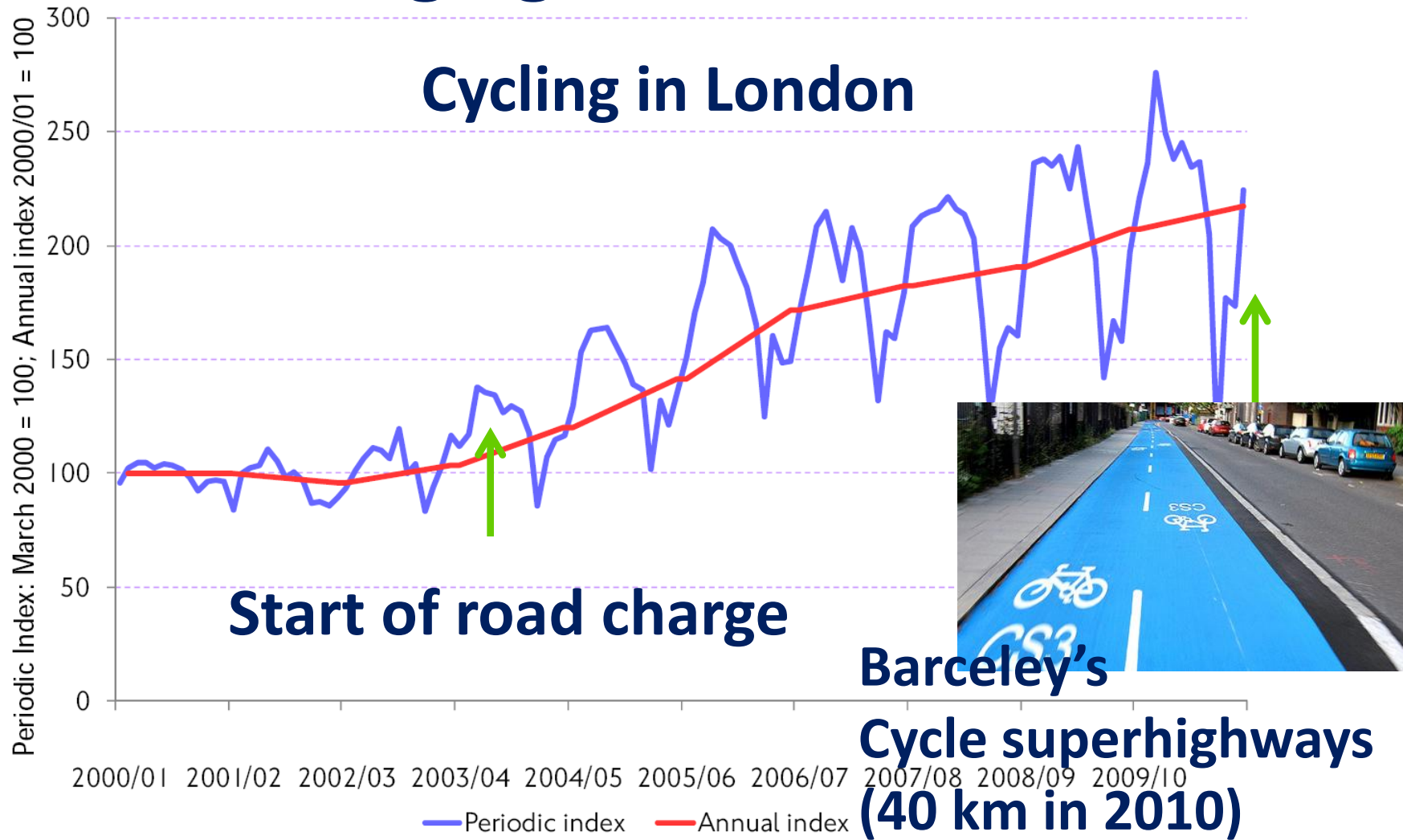


# Mobility management: Road charging scheme in London





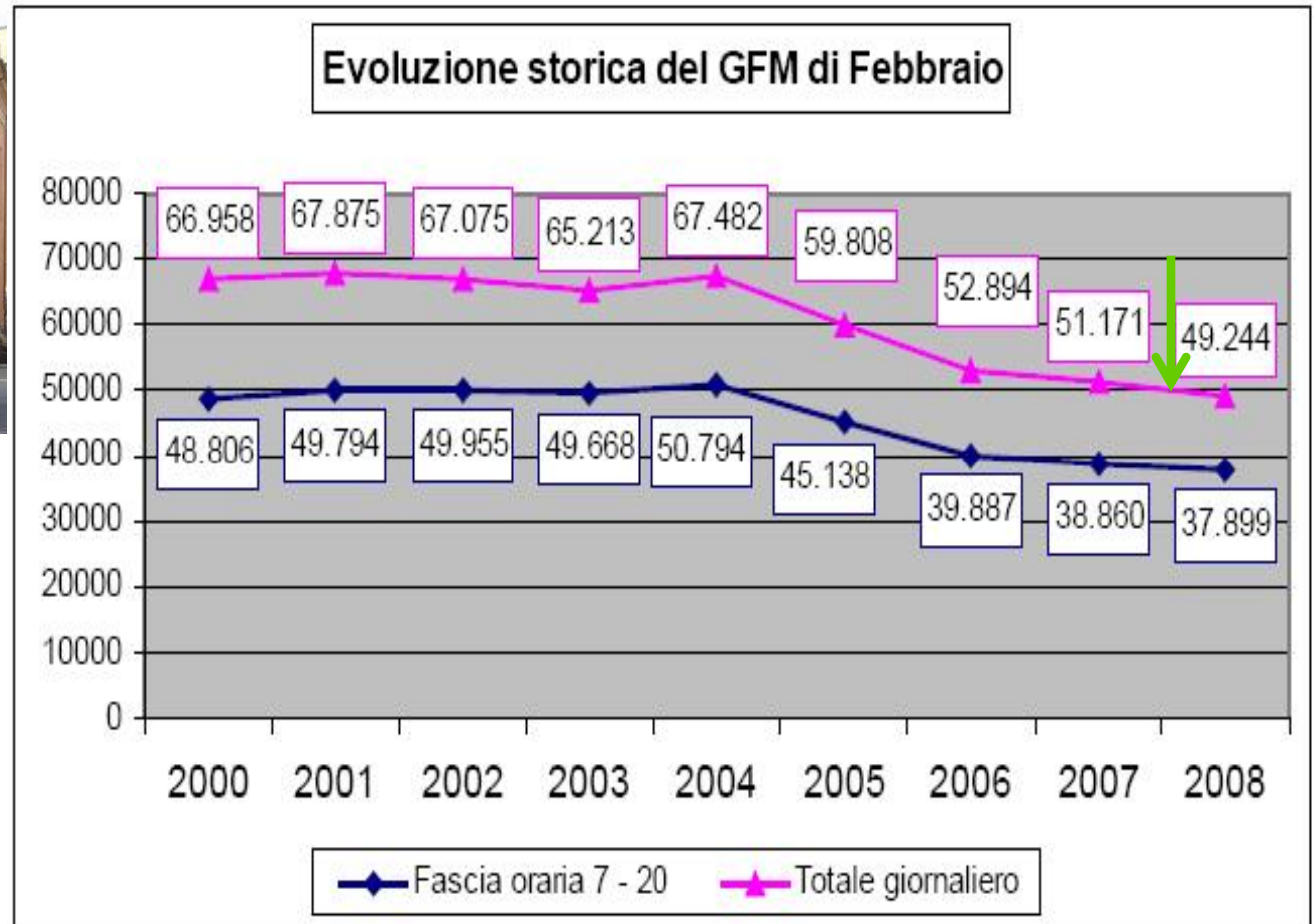
# Mobility management: Road charging scheme in London



# Mobility management: Traffic Restricted Zones in Bologna



approx 23%  
less vehicles



# Mobility management: Peak Hour Avoidance in the Netherlands



# Mobility management: Peak Hour Avoidance in the Netherlands

Observation point	Direction	Zone	No. of cars passing at peak period			No. of cars passing per day (06.00-21.00)		
			Before rewards	During rewards		Before rewards	During rewards	
Gouda	The Hague	Gouda-Zoetermeer	160	71	-56%	198	141	-29%
Zoetermeer	The Hague	Gouda-Zoetermeer	346	181	-48%	423	286	-32%
Nootdorp	The Hague	Zoetermeer-Den Haag	385	151	-61%	532	362	-32%
Nootdorp	Gouda	Opposite direction	313	243	-22%	474	378	-20%

**up to 60%  
less infrastructure**

**20%-30%  
less vehicles**

# Alternative Propulsion Technologies

- Battery electric
- Hybrid (parallel, serial)
- Fuel Cell Electric (Hydrogen powered)

**Requires new infrastructure  
and electricity from renewable energy sources!**

- Bio-fuels

**OK, but in competition with food production!**

**What is their energy consumption and CO2 emission  
in real-world application ?**

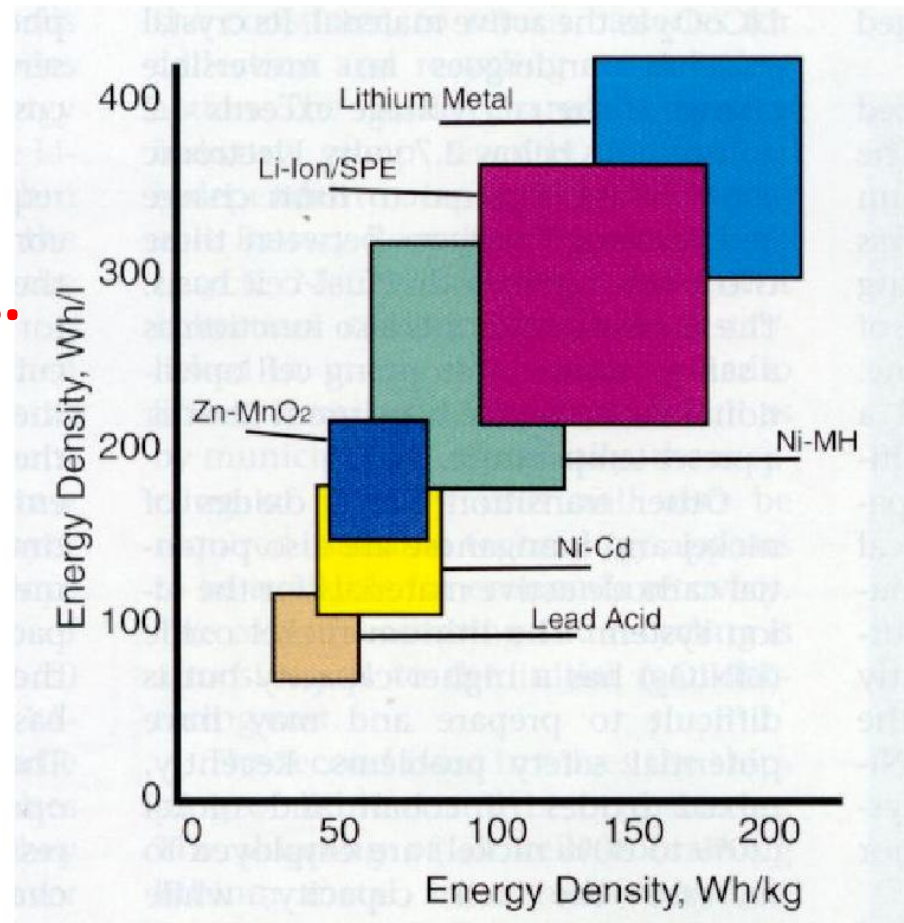


# Alternative Propulsion Technologies

## Battery electric vehicles

**Battery storage capacity is critical for range and costs!**

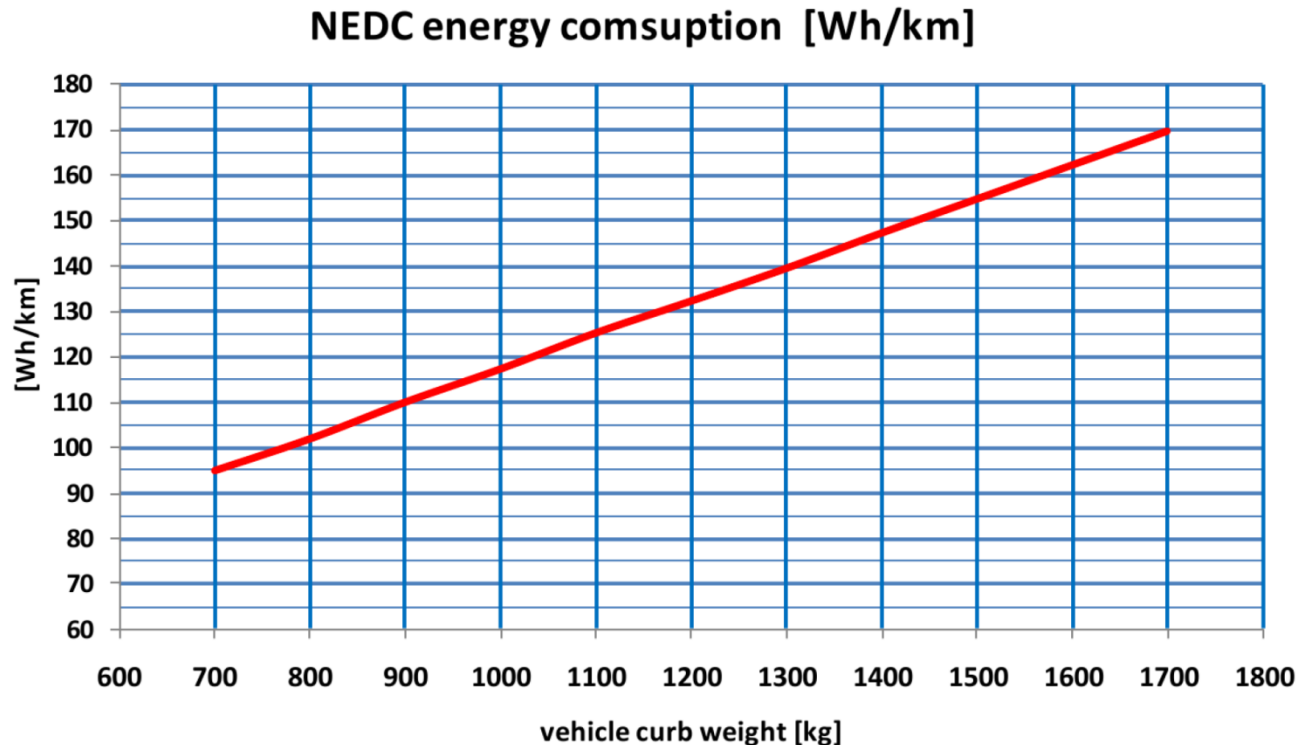
**But rapidly improving...**



# Alternative Propulsion Technologies

## Battery electric vehicles

### Energy consumption and vehicle weight



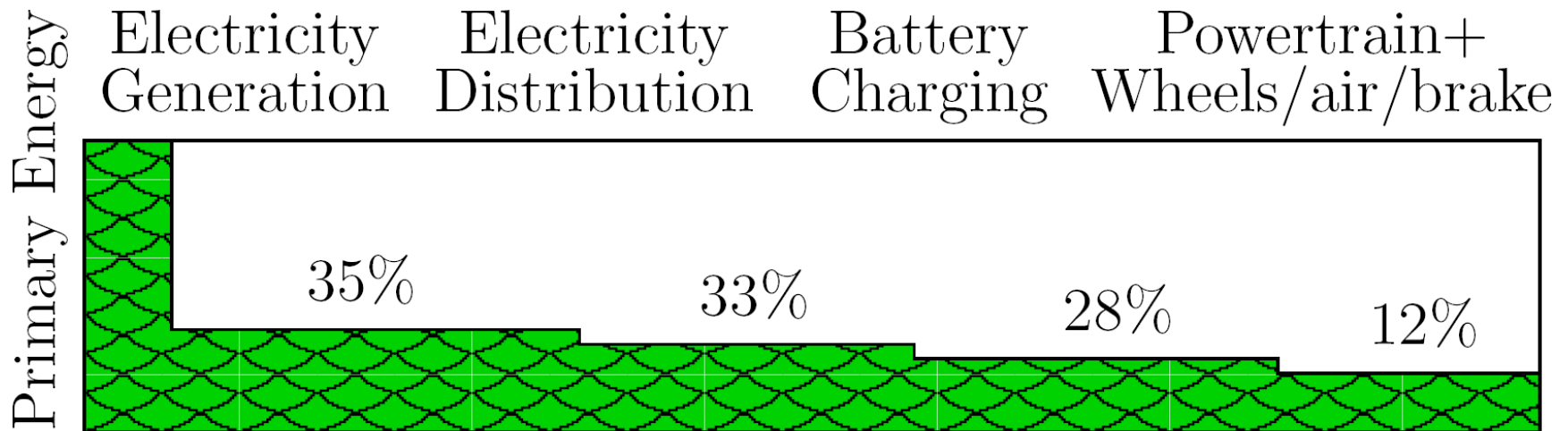
Source: C. Rossi, UNIBO-DIEM, Technical notes.

**The lighter the vehicle, the less energy the less battery!**

# Alternative Propulsion Technologies

## Battery electric vehicles

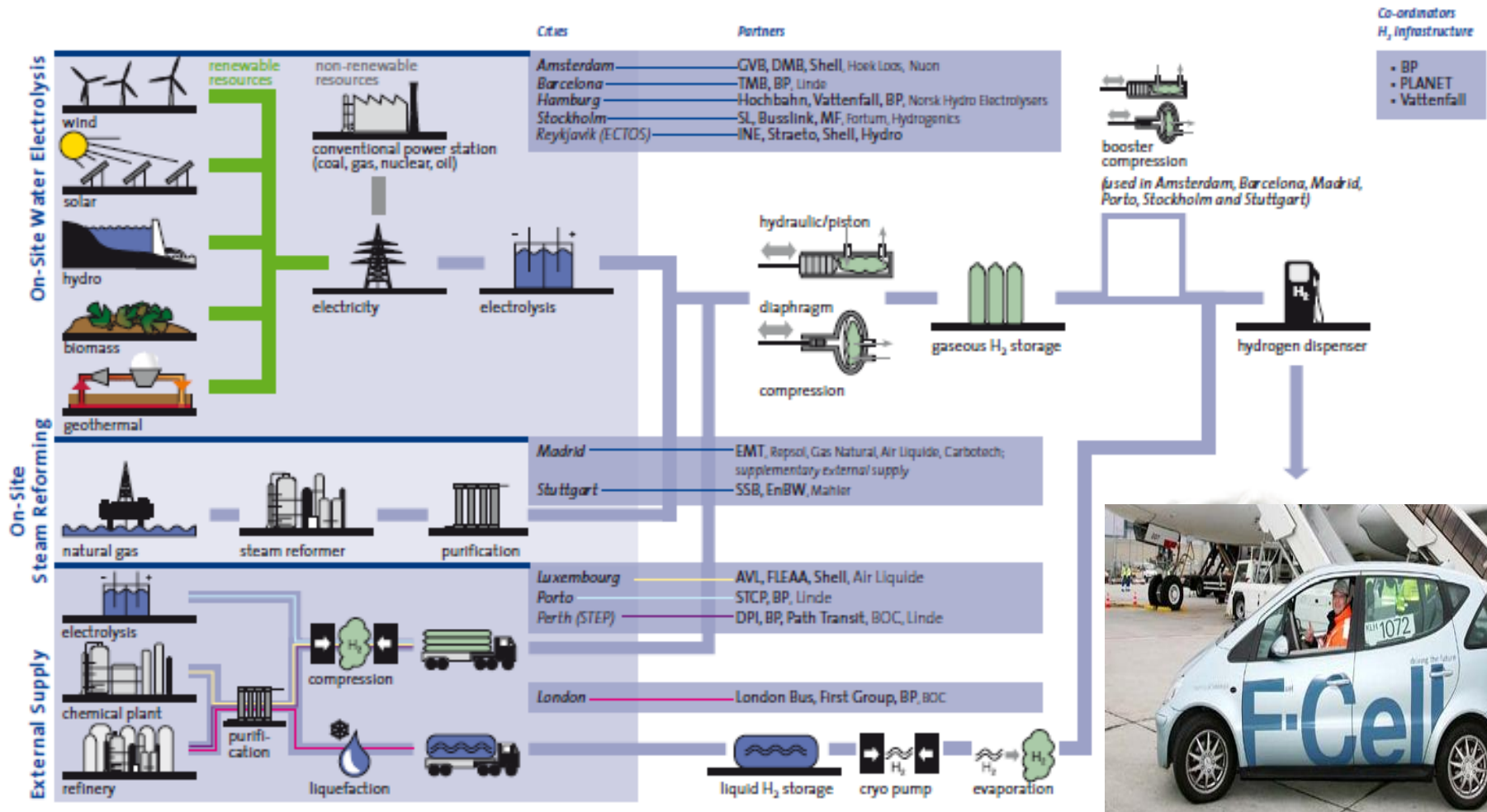
Well – to – Wheel efficiency



Example: for Nissan Leaf

# Alternative Propulsion Technologies

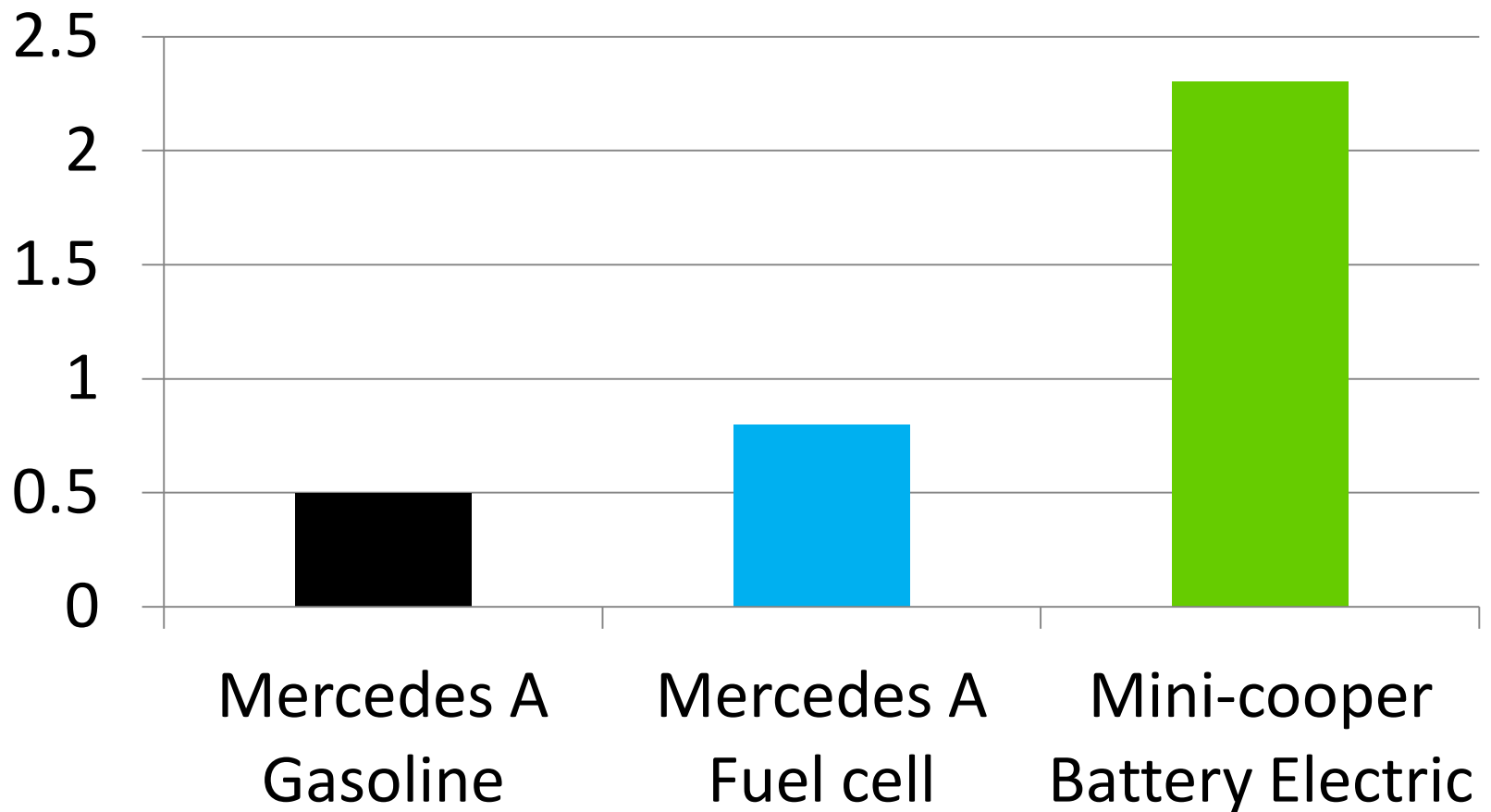
## Fuel cells and hydrogen production



# Alternative Propulsion Technologies

## Battery electric vs Fuel cell

Well – to – Wheel efficiency in km per MJ

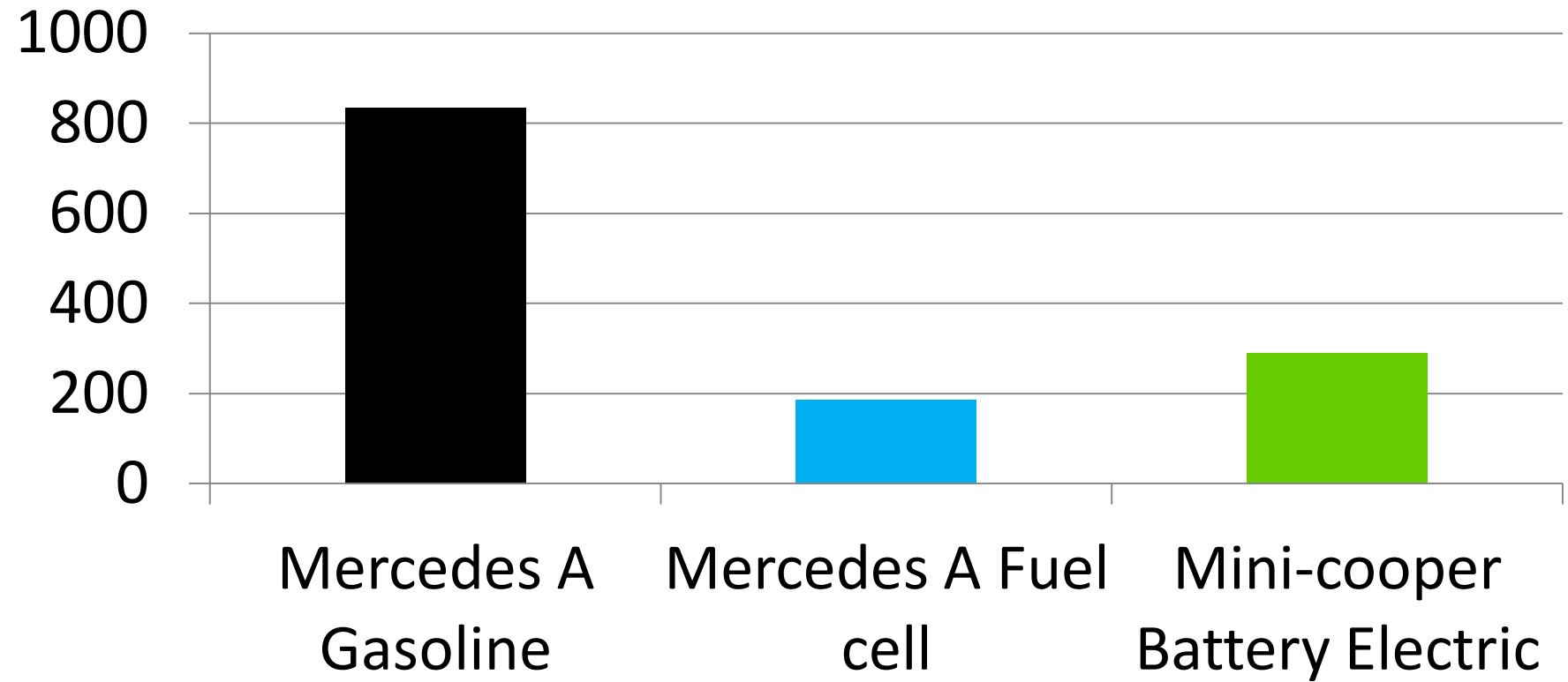




# Alternative Propulsion Technologies

## Battery electric vs Fuel cell

Range in km



Advantage of Fuel cells: long range and fast refill

# Alternative Propulsion Technologies

## Short term scenario

### Battery powered vehicles for the city:

- Light vehicles
- Low cost vehicles
- Small vehicles (parking)
- Low consumption vehicle



### Affordable, immediate effect



# Alternative Propulsion Technologies

## Medium to long term scenario

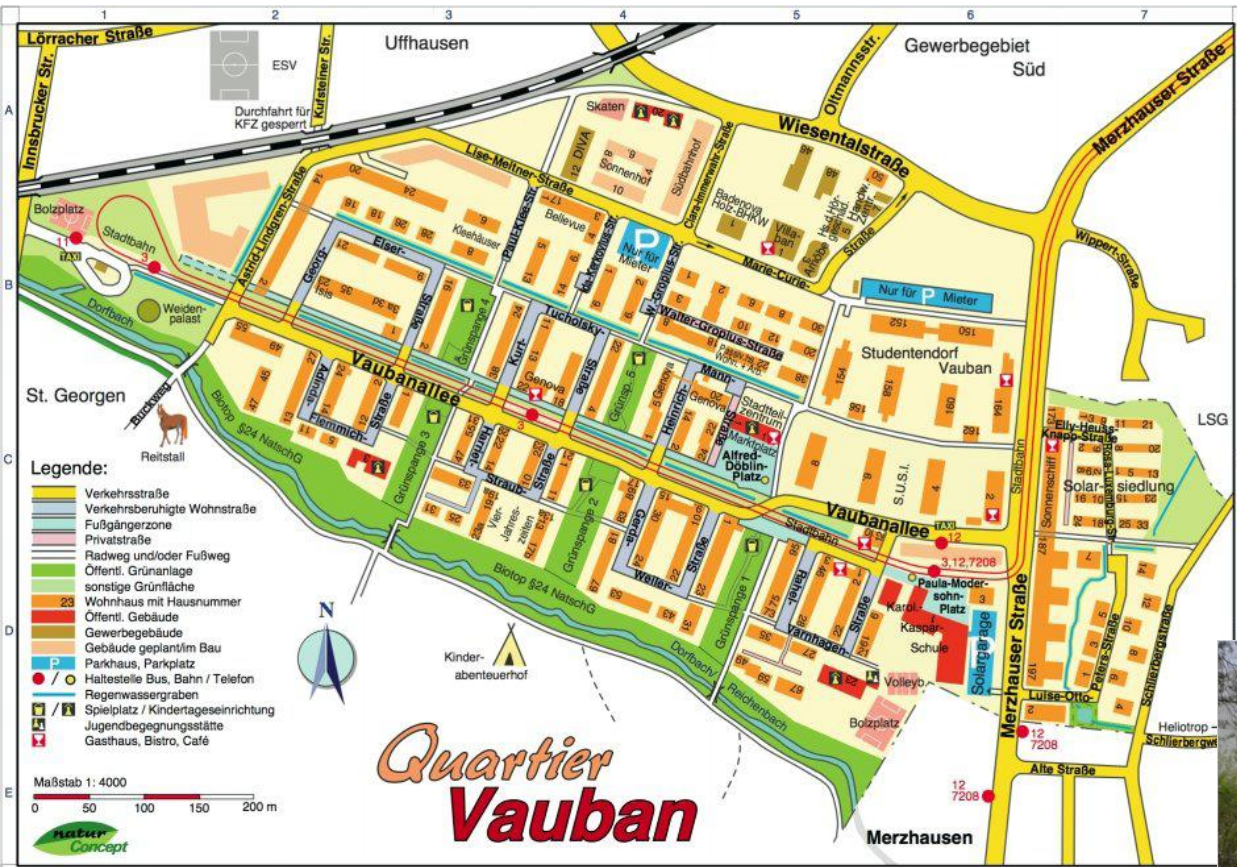
- **Battery powered electric vehicles**  
for short and medium distances
- **Battery powered electric vehicles + high speed train**  
for long distance
- **Biofuel powered Truck + rail**  
for long distance heavy trucks
- **Biofuel powered Truck + rail**  
for long distance heavy trucks

**Scenario reduces use of Biofuels,  
avoids expensive Fuelcells**

# Best practice

## Carfree Quarter Vauban, Germany

- 3300 Inhabitants
- Car-parks in periphery
- 12 cars for car pooling



- 150 cars/1000 inhabitants
- 70% sold their car

# Conclusions

- **Neither technical solutions nor demand management measures alone can eliminate carbon emission from transport**
- **Demand management can reduce carbon emissions overnight, but there are limits.**
- **Electric vehicles can eliminate carbon emissions in the long run as electricity is produced with renewable energy.**
- **Small electric vehicles are already available and in need support (preferred access, regulations)**