6. Examples of top down methods:
New cars

Top-down estimation of energy savings for new cars

- Indicator used to measure energy savings : specific consumption of new cars sold every year in litres/100km (test values) (or litres/100km/kW if data on car horsepower are unavailable)

- Change in specific consumption can be explained by the following variables :
  - Change in the average size of vehicles (in terms of weight, or horse power or engine size in cm3) ("hidden structure effect") (towards larger or more powerful cars, → energy savings are underestimated
  - Autonomous trend (in technical efficiency)
  - Motor fuel price
  - EU policy (ACEA/JAMA/KAMA agreement) and national energy policies (tax on motor fuels, subsidies/ tax on vehicles): after 1995/ before 1995

  →Effect of change in the size of vehicles interesting to consider but limited in practice due to data availability ; only tested for one or two countries

  →Direct rebound effect not taken into account at this stage

Modelling of the baseline specific energy consumption of new cars (1/2)

➢ Modelling of the trend in the specific consumption of cars (SC) (by country) (in litre/100km/cm^3* or litre/100km) :

- Time to capture an autonomous trend
- Average price of gasoline and diesel

➢To clean the impact of fuels substitution between gasoline and diesel, total energy savings will be calculated separately for gasoline and diesel vehicles as well for alternative fuels vehicles and then added together.

$$Ln\,(SC) = T \times \ln(t) + A \times \ln(P) + K$$

- ✓ T: trend
- ✓ A: price elasticity (<0)
- ✓ P: motor fuel price

➢ The energy savings associated to price changes will then be split into two components: energy savings linked to tax increase (policy related) and savings (>0 or <0 savings depending on the variation) linked to change in crude oil price (market related)

* or litre/100km/kW

Modelling of the baseline specific energy consumption of new cars (2/2)

- Two approaches depending on the availability of the car size data
  - Countries without data on engine size:

    Ln (SC) = T X ln (t) + A X ln (P) + K
    - ✓ SC : Specific consumption of cars in litre/100km
    - ✓ T: trend
    - ✓ A: price elasticity (<0)
    - ✓ P: motor fuel price
  - Countries with data on engine size:

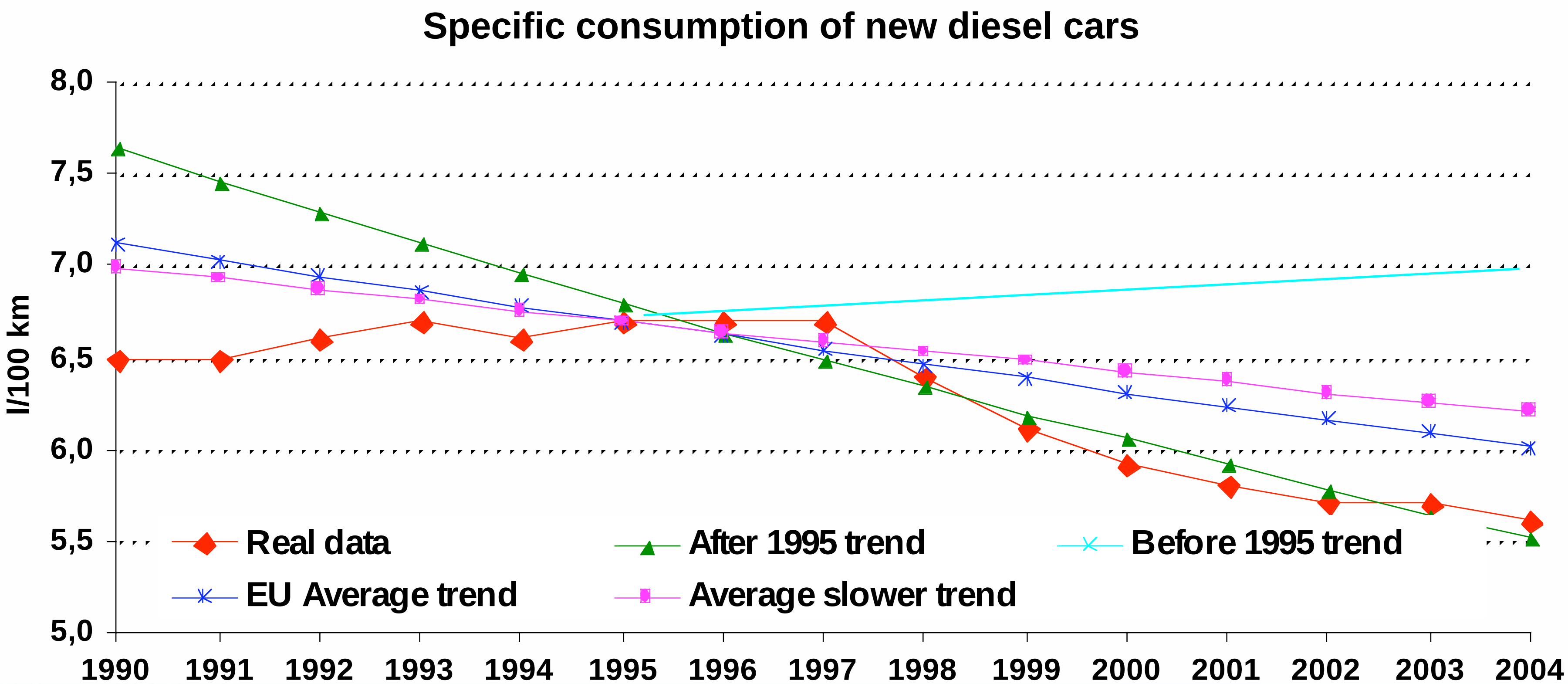
    Ln (SC) = T X ln (t) + A X ln (P) + K
    - ✓ SC : Specific consumption of cars in litre/100km/cm^3 or in litre/100km/kW
    - ✓ T: trend
    - ✓ A: price elasticity (<0)
    - ✓ P: motor fuel price

- Whatever the approach two key questions
  - What autonomous trend to be considered ?
  - Are motor fuel prices econometrically significant ?

What autonomous trends to be considered?

case of France / diesel cars

- **Trend before 1995 (ie before the ACEA/JAMA/KAMA agreement) ("before 1995 trend")**
- **Trend since 1995 ("after 1995 trend")➔ reference used in the following case studies**
- **EU average trend =** > -1.1%/year for diesel
- **Trend of the average of the 3 countries with the lowest autonomous trend ("average slower trend")**



Step 7 : Econometric analysis

Are motor fuel prices econometrically significant?

Case of Germany: gasoline cars (country without data on engine size)

- Motor fuel prices are generally not validated by statistics test (case of Germany, France, Belgium, Finland, Austria, etc).

- Example of econometric analysis for Germany for specific consumption of new gasoline cars
  - Regression with autonomous trend and motor fuel price between 1995 and 2003

    Ln (**SC**) = -0.008 X **t** – 0.02 X ln (**P**) + 2.13

    t-stat (3.1) (0.3)

    R^2 = 0.9 => Good correlation (R^2 near 1)

    F-stat = 26.8 => regression is globally significant (F-statistic is > 4.7)

    T-stat > 1.9 for time but <1.9 for prices => price effect not significant

  - Regression with autonomous trend only between 1995 and 2003

    Ln(SC) = -0.008 X **t** + 2.13

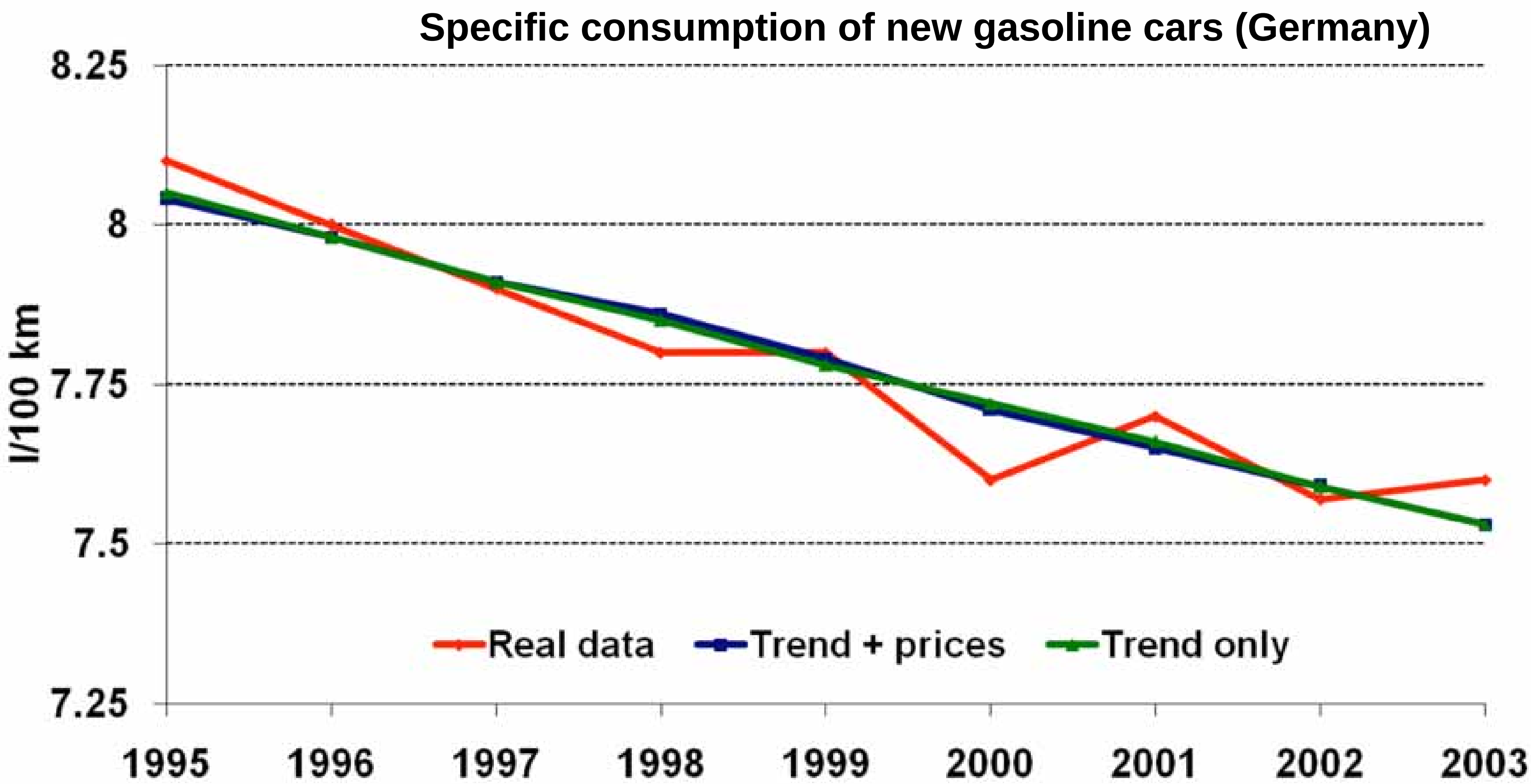
    t-stat = 7.9 , R^2 = 0.9, F-stat = 61.8

    Good correlation, regression globally significant

Econometric analysis

Are motor fuel prices econometrically significant?

Motor fuel prices are generally not validated by statistics test (case of Germany, France, Belgium, Finland, Austria, etc).



Econometric analysis

Accounting for the impact of motor fuel prices

- Although price elasticities are not econometrically significant, prices have certainly an effect and should be introduced

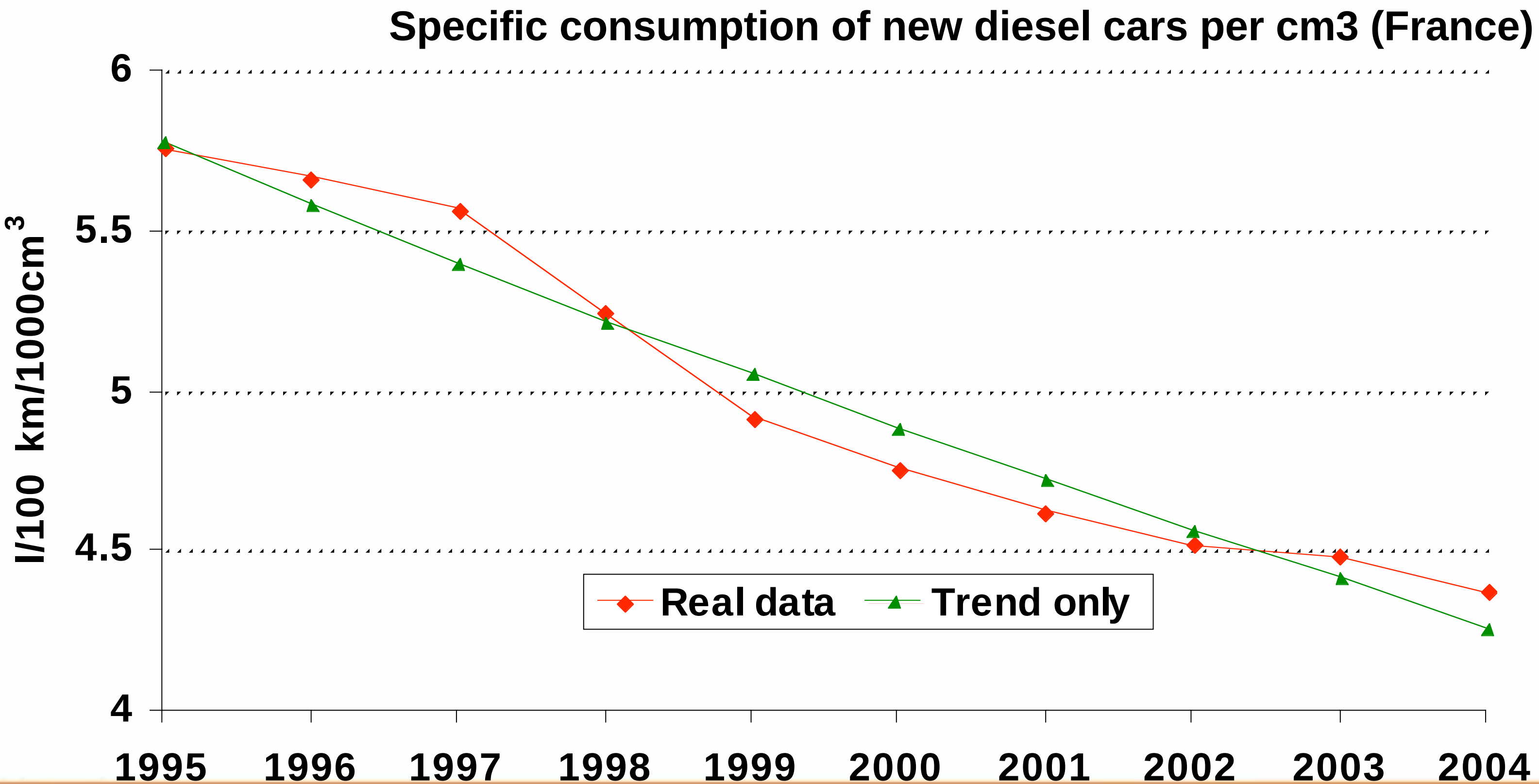
- Possibility to take into a price effect by considering a ‘default value” price-elasticity calculated with a pooling methodology or by taking an average value of EU countries with relevant data (“EU average”). In this case study the pooling methodology is not validated by econometrical tests. An EU average elasticity was used :
  - -0.35 for specific consumption of new diesel cars
  - -0.25 for specific consumption of new gasoline cars

Modeling of the baseline specific consumption of new cars:

Case of countries with data on engine size:

The impact of change in average car size can be done if data are available ➔ engine size in cm3 seems to be the most relevant indicator

- **Trend of –3,4% (close to technical trend) instead of –2.3% (technical and non technical trend)**
- **Better estimate of energy savings (underestimated if no correction of size)**
- **Engine size data available ONLY for ACEA members**



Step 8 : Calculation of ESD savings
Methodology

- **Stage 1** : Calculation of the total energy savings over the 2008-2016 period for gasoline and diesel new cars separately

- **Stage 2 :** Calculation of the energy savings induced by the technological trend and prices effects for gasoline and diesel new cars separately with the same methodology as the total energy savings, based on the estimation of specific consumption induced by trend and prices

- **Stage 3** : Total energy savings for all cars obtained by summing total energy savings for gasoline car and for diesel cars; Energy savings induced by technological trend and price effect obtained by summing what is calculated for gasoline and diesel cars.

- **Stage 4** : ESD energy savings for all cars calculated by difference for gasoline and diesel new cars separately: total savings minus trend and price-related savings

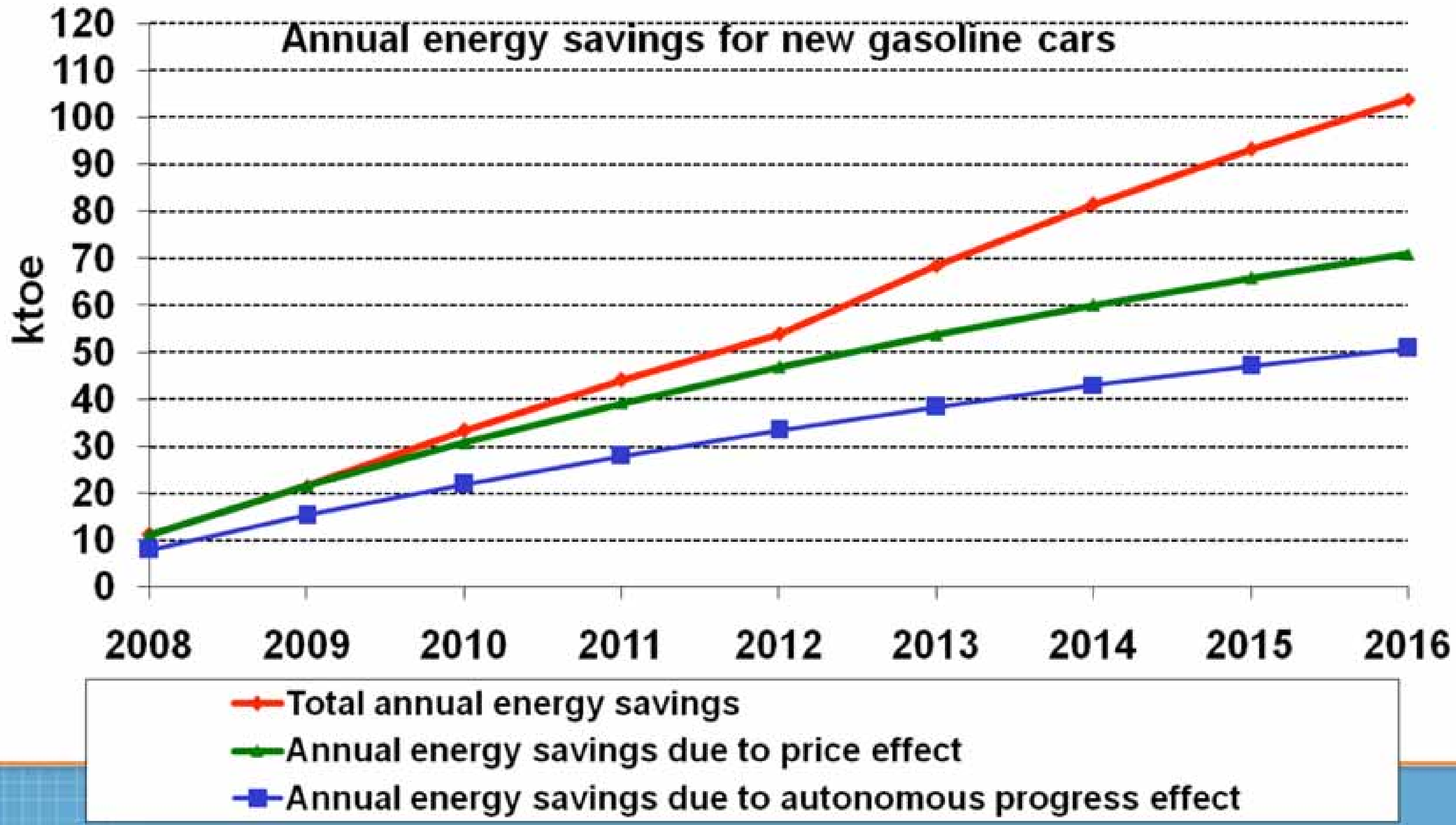
Calculation of ESD savings

Gasoline cars : stage 1 and 2 (example)

Evolution of total energy savings based on an impact of policies in 2009 and 2012 on the specific consumption of new cars

Evolution of energy savings due to technological progress effect based on a 0.8%/year trend

Evolution of energy savings due to market prices effect based on a -0.25 price elasticity

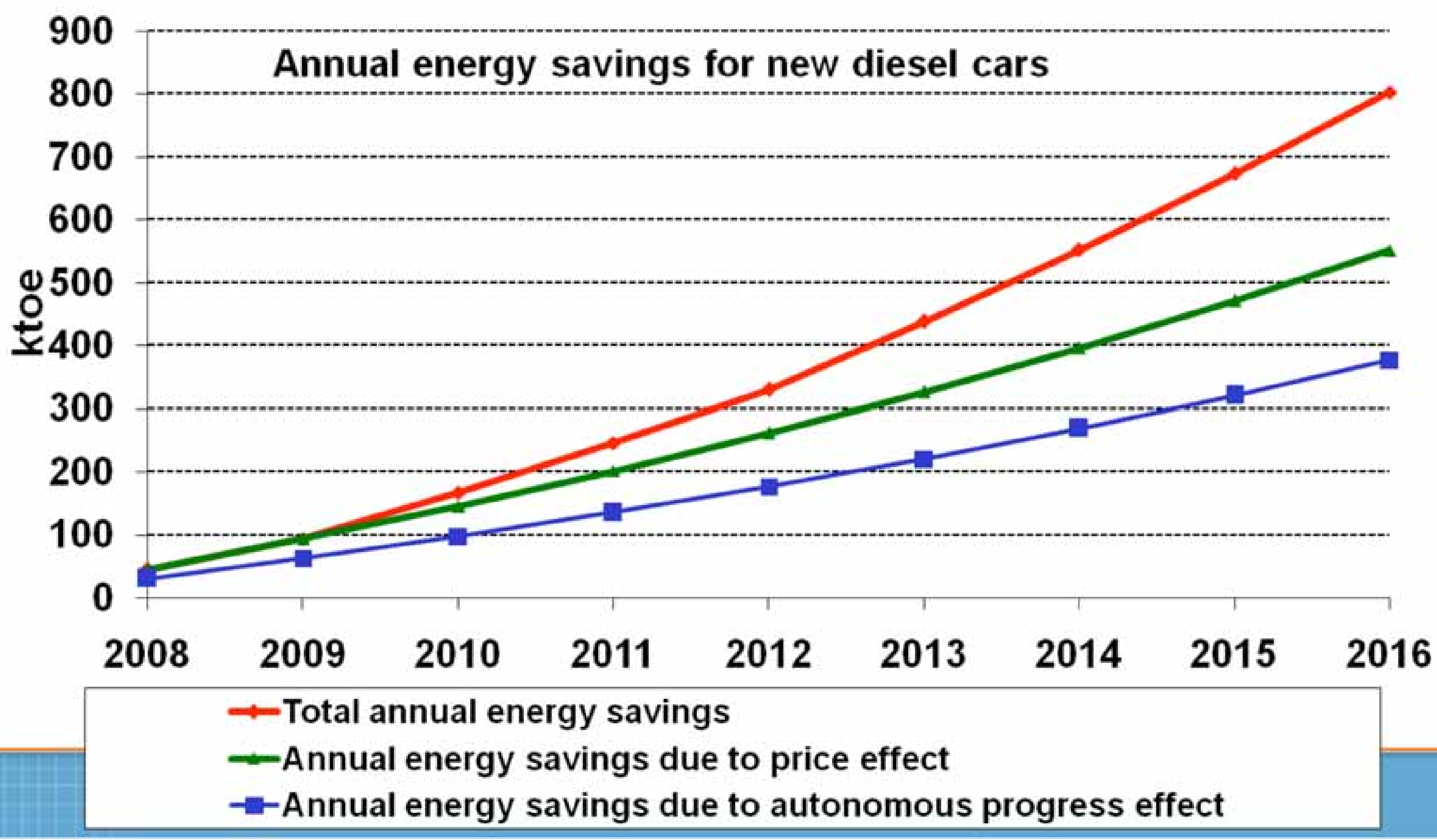


Step 8 : Calculation of ESD savings
Diesel cars : stage 1 and 2 (example)

Evolution of total energy savings based an impact of policies in 2009 and 2012 on the specific consumption of new cars

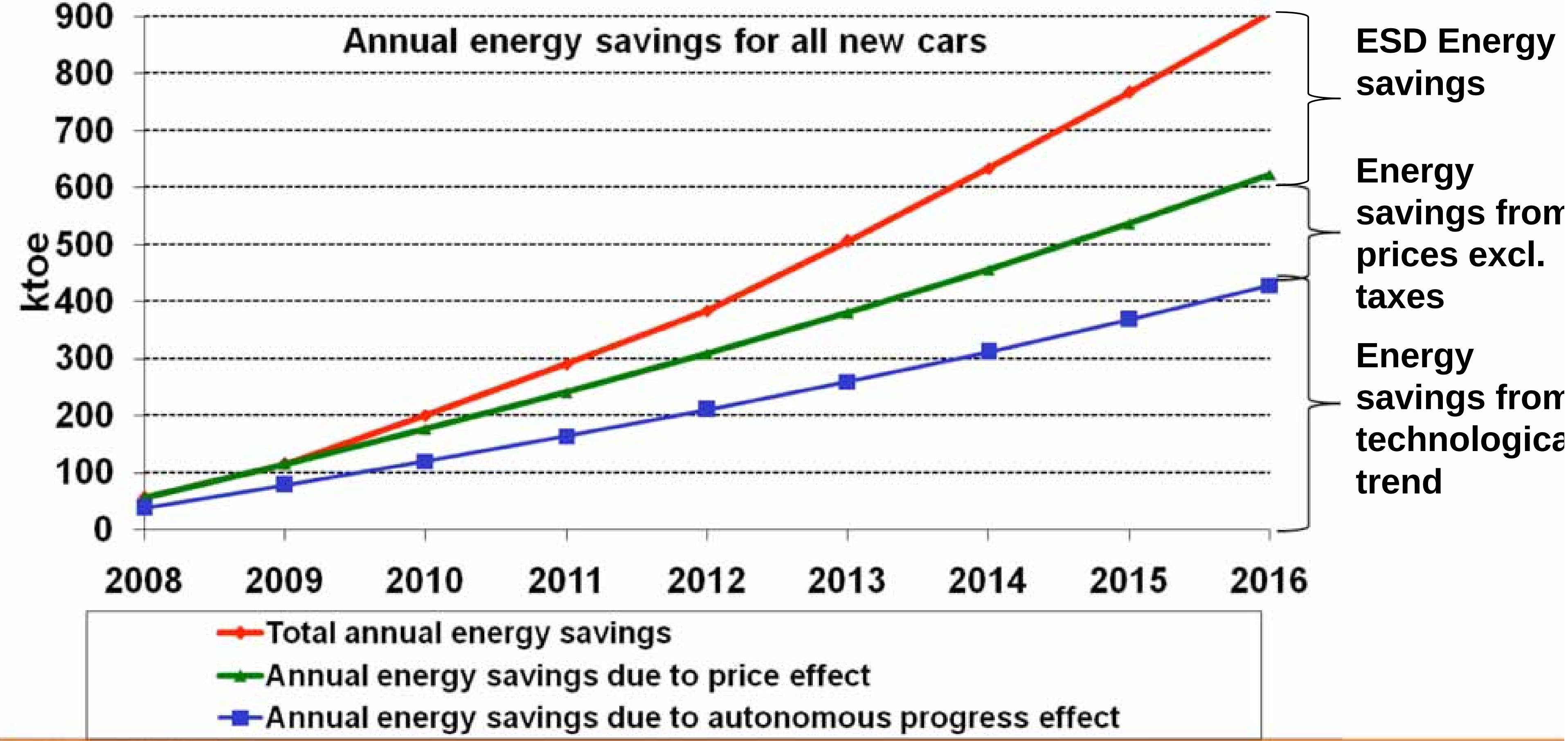
Evolution of energy savings due to technological progress effect based on a 1.2%/year trend

Evolution of energy savings due to market prices effect based on a -0.35 price elasticity



Calculation of ESD savings
All cars : Stage 3 and 4 (example)

The total energy savings over the 2008-2016 period are about **1000 ktoe/year in this example;** ESD energy savings are about **400 ktoe/year**



Step 9 : Conclusions and issues for replication on new cars

- Data limitations: no data for most EU New Member Countries (data not covered yet by the EU monitoring)
- Definition of trends or baseline to be decided :
  - A) Trend before 1995 (ie before the ACEA/JAMA/KAMA agreement) ("before 1995 trend") ***OR***
  - Trend since 1995 ("after 1995 trend")➔ reference used in the case studies
  - B) EU average trend ***OR***
  - Trend of the average of the 3 countries with the lowest autonomous trend ("average slower trend")
- Role of energy price negligible so far
- Need to define coefficient to account for difference between test values and actual values
- Similar approach seems applicable for other case studies with energy consumption indicators, although this case study may be simpler than other end-uses