Training Seminar

Evaluation of energy efficiency trends and potentials

Grenoble, 30 January – 10 February 2006

Energy efficiency in the household and service sector: policy measures and indicators

Bruno Lapillonne

Enerdata

Content

Enerdata

Policy measures in the household and service sector

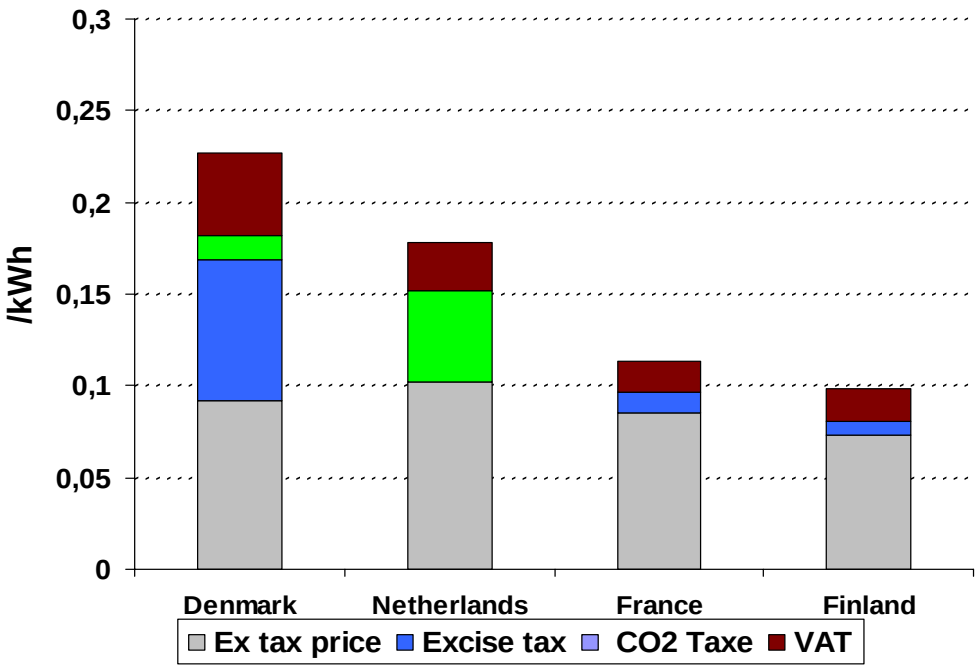
Enerdata

Policies and measures

1. **Taxes**
2. **Regulations**
3. **Economic incentives** (subsidies)
4. **Information of consumers**
5. **Voluntary agreement**

Enerdata

Taxation: electricity prices for households



Enerdata

Regulations

Efficiency standards

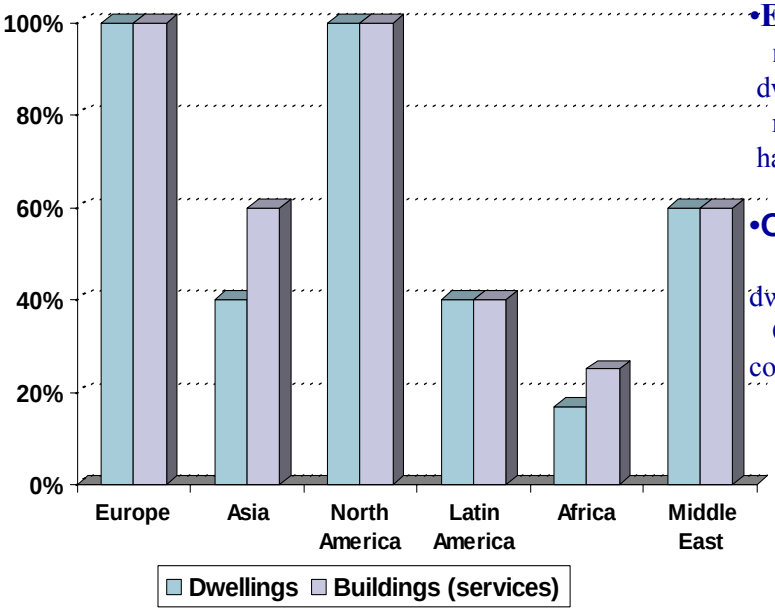
Obligation of information : labelling of appliances, buildings certificates on energy performances of dwellings

Regulation on energy companies : energy savings obligations (white certificates)

Other regulations (maintenance)

Enerdata

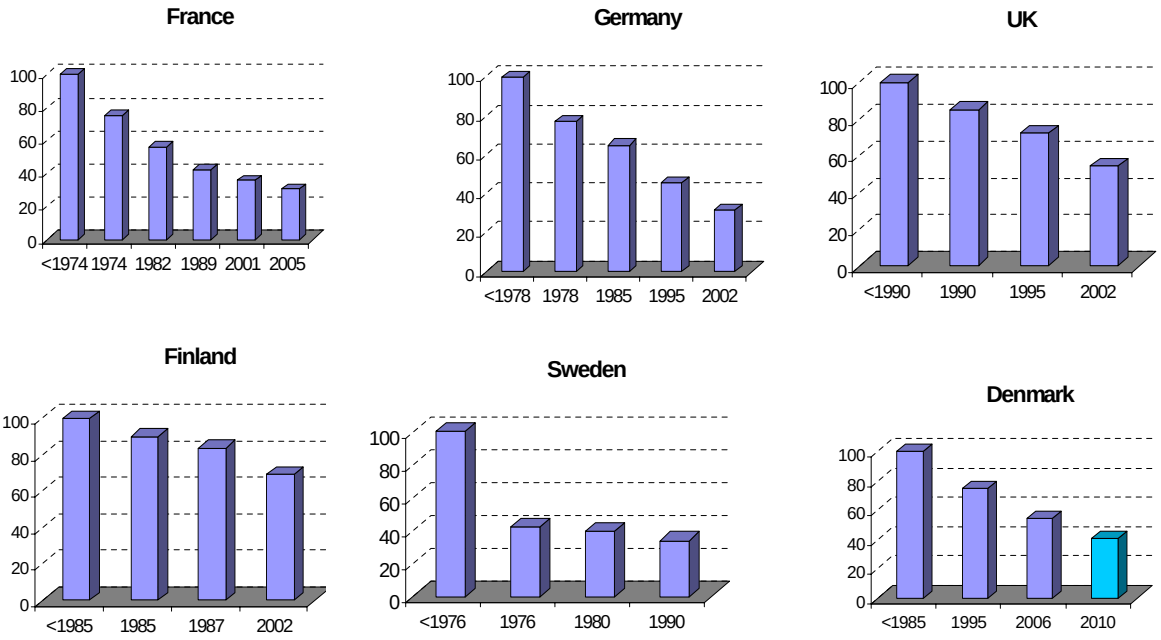
WEC survey : Regulations
Building regulations



- **Europe**
  mandatory efficiency standards for new dwellings or buildings**) in all** countries
  regular and recent revisions in more than half of the countries
- **Other regions**
  few countries with standards for new dwellings; slightly more frequent in services
  Often voluntary standards (60% of countries with mandatory or voluntary standards in service sector

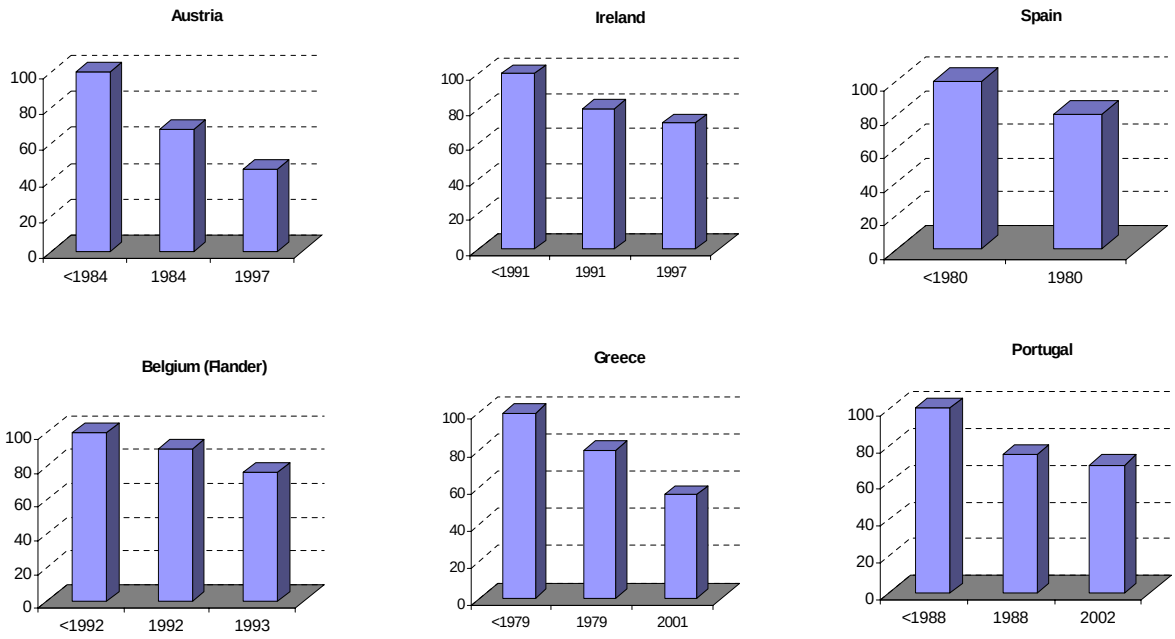
Enerdata

Regulation on building codes in EU countries



Enerdata

Regulation on building codes in EU countries



Enerdata

EU Directive on the energy performance of buildings (2002/91) (**Decembre 2002)**

- **Implementation of an harmonised procedure of calculation of energy performance of buildings**
- **Minimum efficiency standards**
- **Mandatory reinforcement every 5 years**
- **Minimum efficiency standards for large existing buildings under renovation (>100m2)**
- **Obligation of certificates of energy performance for the sale or rent of dwellings or buildings**
- **Obligation of inspection of boilers and air conditioners**
- **Transcription by January 2006: few countries have done it**

Enerdata

EU Directive on the energy performance of buildings

Enerdata

Energy requirements for new and existing buildings in Denmark

Requirement in the Building Regulation regarding maximum heat loss:

BR 82: a new building may use 10 litres oil/m2.

BR 95: a new building may use 7.5 litres oil/m2.

New energy requirement 2006: a new building may use 5.5 litres oil/m2.

New energy requirement 2010: a new building may use 4.2 litres oil/m2 (milestone).

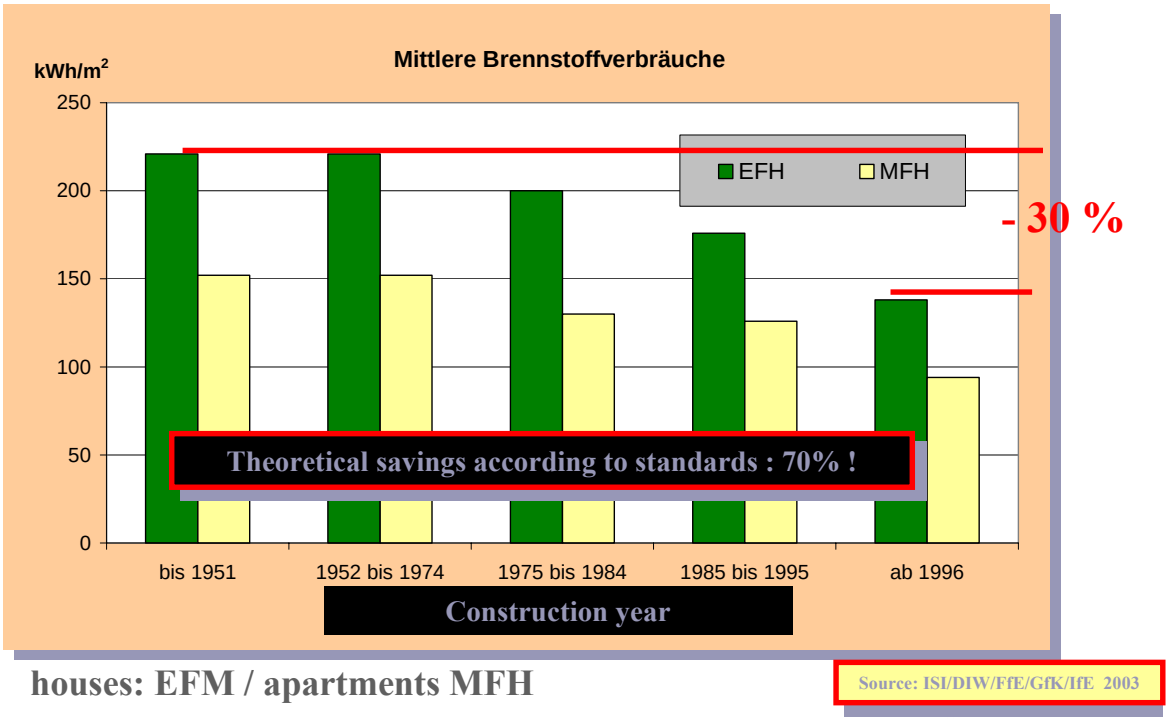
New energy requirement 2015: a new building may use 3 litres oil/m2 (milestone).

Average net heat consumption in existing buildings today: 14 litres oil/m2.

continue

DANISH ENERGY AUTHORITY

Impact of new standards: problem of control and behaviours: specific consumption of dwellings in Germany (2003)



Energy Efficiency Commitment in UK 2002 - 2005

Obligation on electricity suppliers to to improve energy efficiency of households

Mandatory savings of 62 TWh of energy from households over 2002 – 2005 (saving of 1% of households CO2 emissions)

At least 50% of the total energy savings had to come from the “Priority Group” (1/3 of households) (low income households receiving social benefits)

Overall target was set in fuel-standardised, lifetime discounted energy savings.

Suppliers not restricted to their own customer base

Suppliers had flexibility over the types of measures used to meet their targets

Suppliers were not required to spend a fixed amount of money

Savings included business as usual activities

EEC (Energy Efficiency Commitment) : role of OFGEM

Will set the individual company targets

Will need to approve all of the suppliers schemes

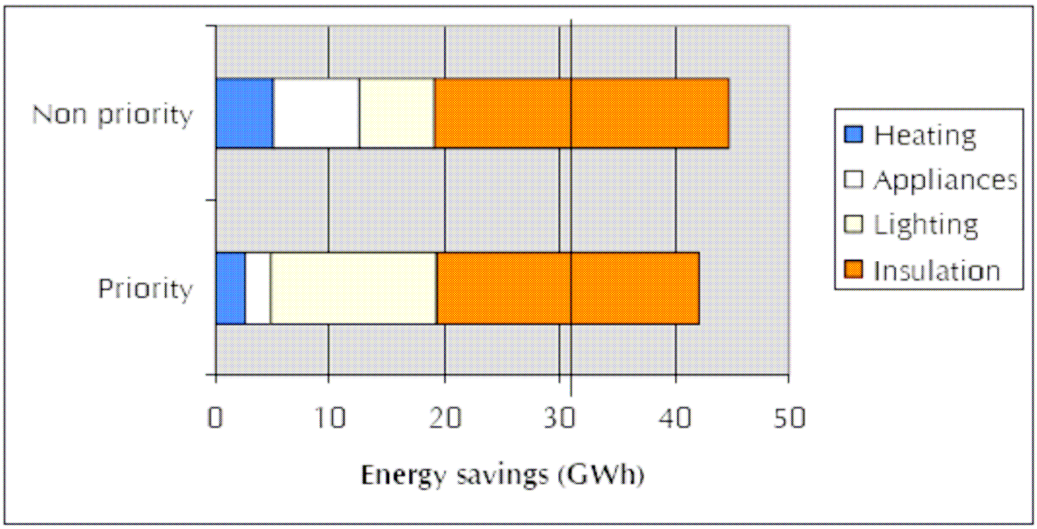
Will monitor the suppliers' activity

Will have the legal powers to enforce the target

Will not constrain the choice of technologies used by suppliers

Enerdata

Results achieved from 2002–2005



More than 6 million appliances promoted
More than 300,000 condensing gas boilers installed
Almost 40 million CFLs distributed
Around 1 million homes insulated

Enerdata

Summary of evaluation for EEC 2002–2005

Overall savings against the target were 86.8 TWh

50% of the target was in the Priority Group

Around 10 million households in Great Britain have benefited

Customers will save around £350 million per year

Expected to cut household carbon emissions by 1%

Work continues under the EEC 2005 – 2008

Enerdata

EEC 2005 – 2008

Similar scheme to EEC 2002 – 2005

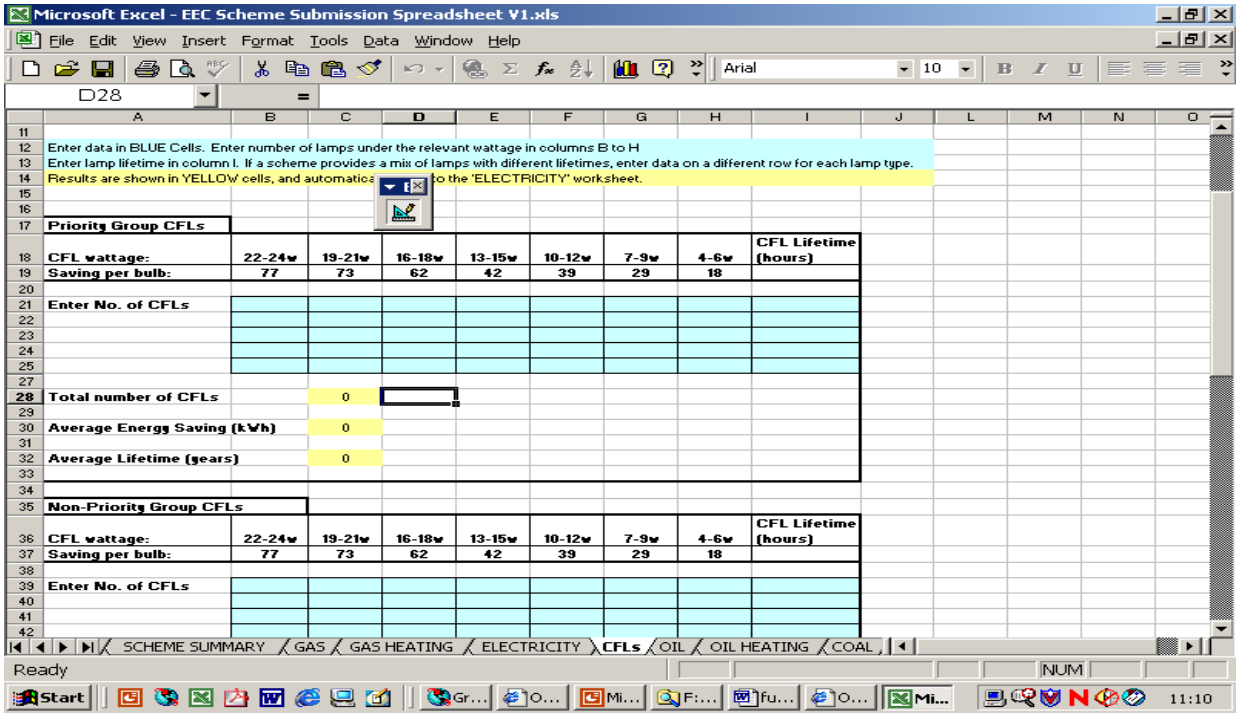
New, higher, target of 130 fuel standardised, lifetime discounted TWh

Additional savings from EEC 2002-2005 can be carried forward to help meet target

So activity in 2005 – 2008 period will have to save 95 TWh

Enerdata

Monitoring: case of energy savings from CFLs



Enerdata

White certificates in France (1)

Energy suppliers have to meet a target of energy savings (or pay a penalty)

They can implement actions or buy certificates

Other bodies (building owners, companies, communities…) can finance energy saving equipments and get certificates

Energy savings must not be “business as usual”

Obligations are given to electricity, gas, LPG, heat, cooling and heating fuel suppliers

The savings can be made everywhere (except plants under CO2 quota Directive) => Whatever the sector, the supplier,the energy source…

Enerdata

White certificates in France (2)

Target 54 TWh (discounted 6% rate) for the first three years (2006/2008)

Obligation for suppliers with sales > = 400 GWh/year (still in discussion)

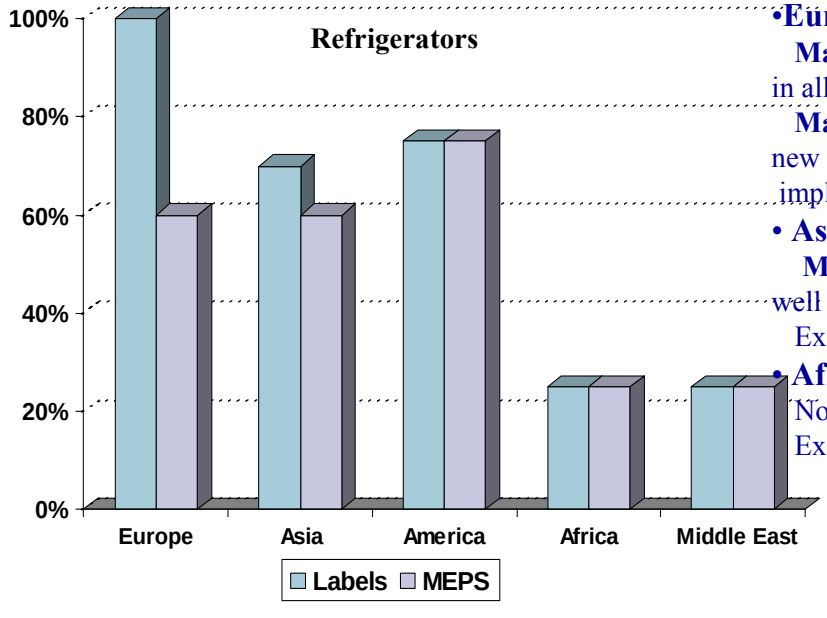
Expected cost : 10 /MWh

(max 20 /MWh = penalty)

Minimal program size : 3 GWh

Enerdata

WEC survey : Regulations Electrical appliances

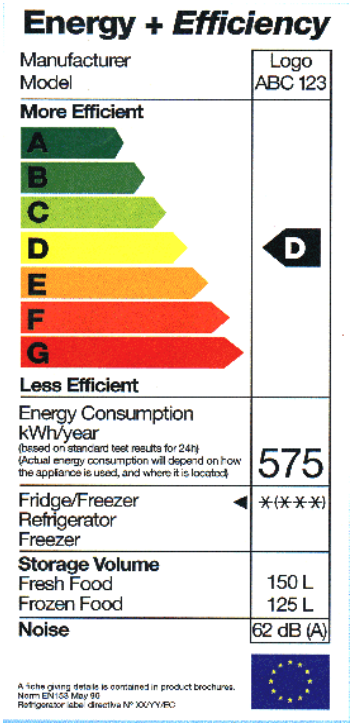


- **Europe**
  - **Mandatory labelling** of main appliances in all countries
  - **Mandatory efficiency standards** for new refrigerators **in all EU** countries; under implementation in Accession countries
- **Asia and America**
  - **Mandatory labelling and standards** well developed for refrigerators
  - Existing for **AC** in 2/3 of countries
- **Africa & Middle East**
  - Not well spread
  - Existing for AC in 30% of countries

MEPS: Minimum Energy Performance Standard; AC: Air Conditioning

Enerdata

Labels for electrical appliances



Enerdata

Labelling of cold appliances (Directives of 1994 for classes A to G and of 2003 for new class A+ et A++

Enerdata

Economic and fiscal incentives for purchasing efficient equipment or for renovation

- Economic incentives

---Subsidies

--- « Soft loans »

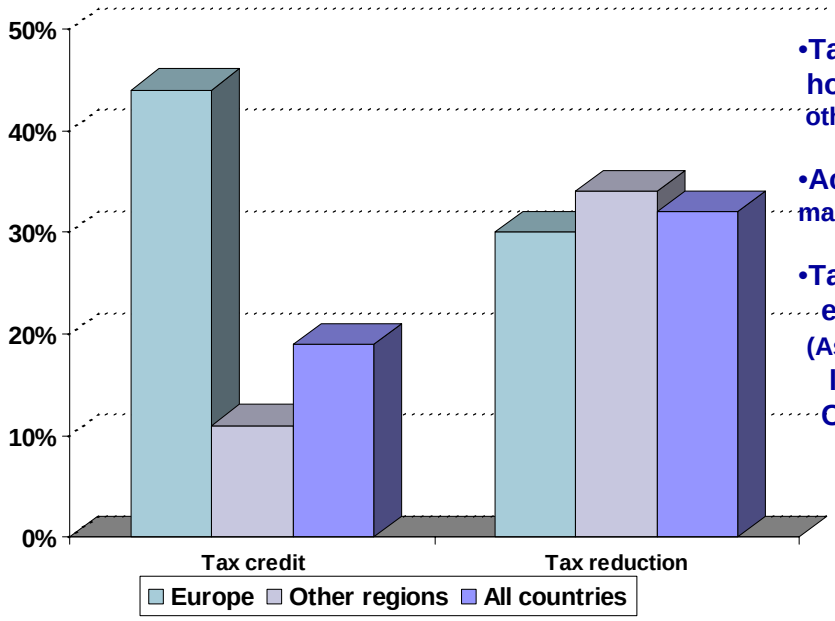
- Fiscal incentives

---Tax credit

--- Reduction in taxes (VAT on labour cost in France, import taxes)

Enerdata

WEC survey : Fiscal measures



- **Tax credit or tax deduction: households (8 countries) ,but also other sectors**
- **Accelerate depreciation: industry mainly (8 countries)**
- **Tax reduction on: energy efficient equipement (Asia, Africa & Middle East) labour cost (2 countries) CO2 tax (industry)**

Enerdata

Rate of tax credit for energy efficiency and renewables in France

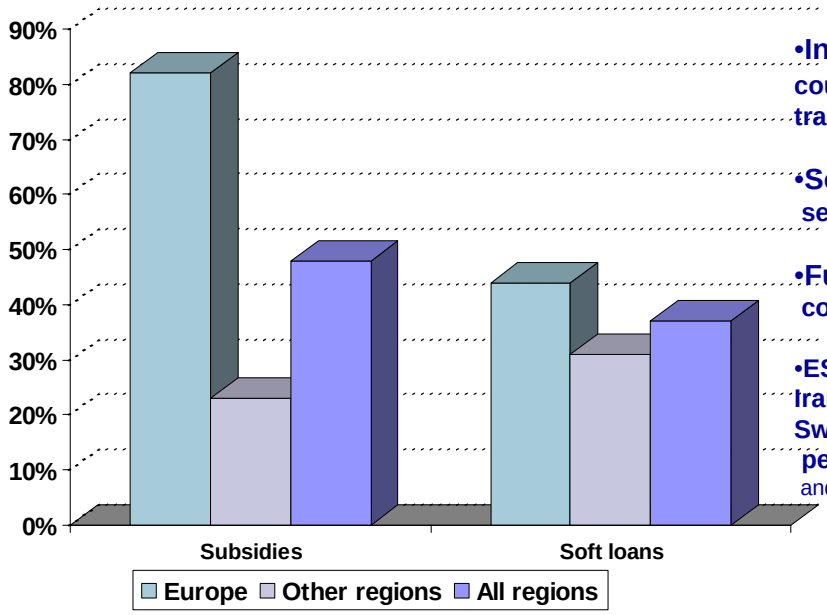
Levels of tax credit : evolutions from 2005	*Before 1st January 2005*	*After 1st January 2005*	*After 1st January 2006*
Low temperature boiler	15 % (only for collective dwellings)	15 %	25%*
Condensation boiler	15 %	25 %	40%*
Thermal insulatio products	15 %	25 %	40%*
Heating regulation equipement	15 %	25 %	40%*
Energy producing equipment using renewable energy	15 %	40 %	50%

* for works carried out in house during the 2 following years after the purshase

Rate applied to the price of equipment and materials (excluding labour costs); subsidy given for households not paying income tax (maximum expenditures between 8000 (1 person household) and 17 500 for family with 3 children)

Enerdata

WEC survey : Economic incentives



- **Investment subsidies: Industry (21 countries), services (18),households (14) transport (10)**
- **Soft loans: industry (15 countries) services (11), households (8)**
- **Funds: guarantee funds (2),often combined with environment funds**
- **ESCO's : significant in Germany, Japan, Iran, Australia, Austria, Hungary and Switzerland; average turn over of 0.5 M$ per ESCO** (much higher in Hungary and Canada)

Enerdata

Subsidies for households: case of the Netherlands : "Energy Premiums" (2000 – 2003)

Energy Premiums for:

- Energy efficient equipment (refrigerators)
- Generation on sustainable energy as PV systems
- Saving adaptations to houses (p.e. insulation measures)
- Energy Performance Advice

Number of units with premium requests:

- 222.000 high efficiency boilers
- 11,5 Mm^2 insulation floor/bottom
- 2,2 M of high efficiency glass
- 27,9 MWp PV
- 10.000 individual solar heaters and 4500 m^2 collective solar

Enerdata

Subsidies for electricity savings for households: case of Norway

Grants for investments in heat pumps, fireplaces using pellets and electric heating control devices

Only one application time; 15 March 2003 (due to very high electricity prices winter 2003)

45 902 applications approved

19 734 grants finally approved

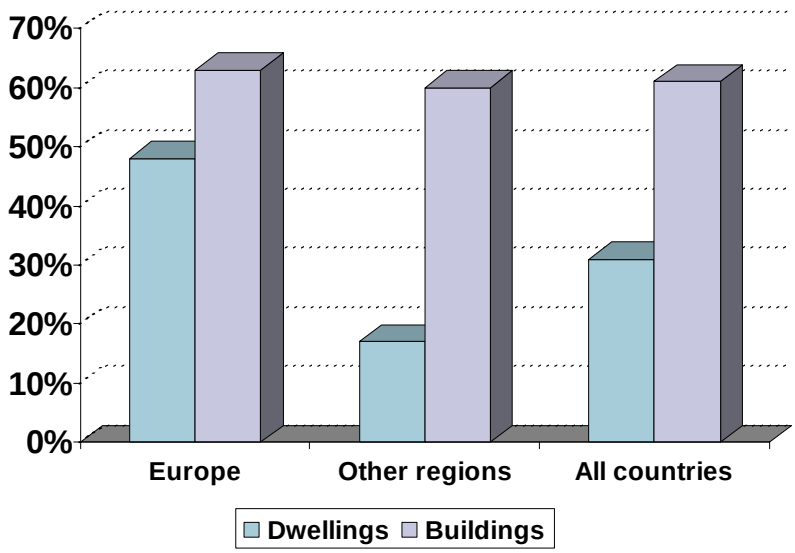
92% heat pumps, 6% pellets stoves, 2% control devices

Calculated energy savings 100-150 GWh/year

83.5 mill NOK in grants (10 mill.)

Enerdata

WEC survey : Energy audits



- **Households**

•Audits schemes mainly in Europe

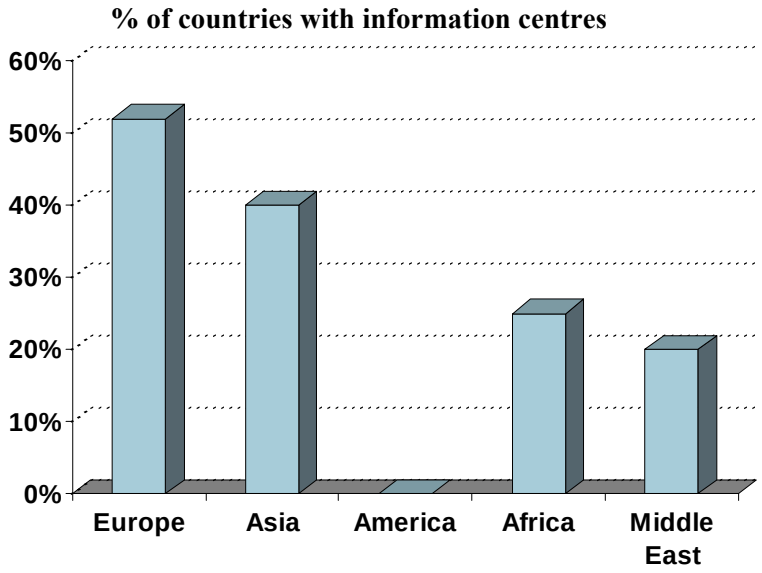
Enerdata

Audits in buildings in France (household and service sector)

	2000	2001	2002	2003	2004
Total audits	6550	4175	7935	11704	4261
Pilot studies	29	47	88	85	80
Energy savings ktoe	7	4	8	12	4
CO2 (ktCO2/year	9	6	11	16	6

Enerdata

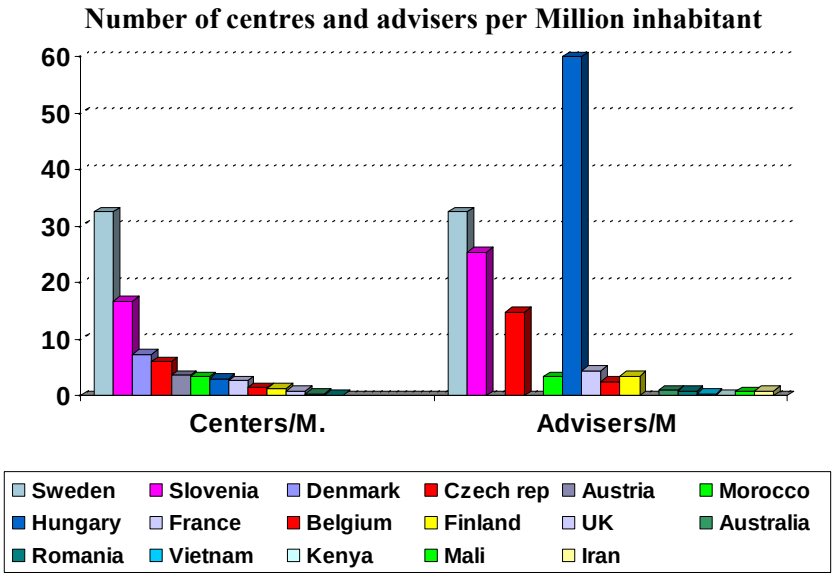
WEC survey : local energy information centres



- **Europe**
  - 14 countries
  - About 750 centres
  - About 1600 advisers
- **Asia-Pacific**
  - 4 countries
- **Africa-Middle East**
  - 4 countries
- **America**
  - No centre

Enerdata

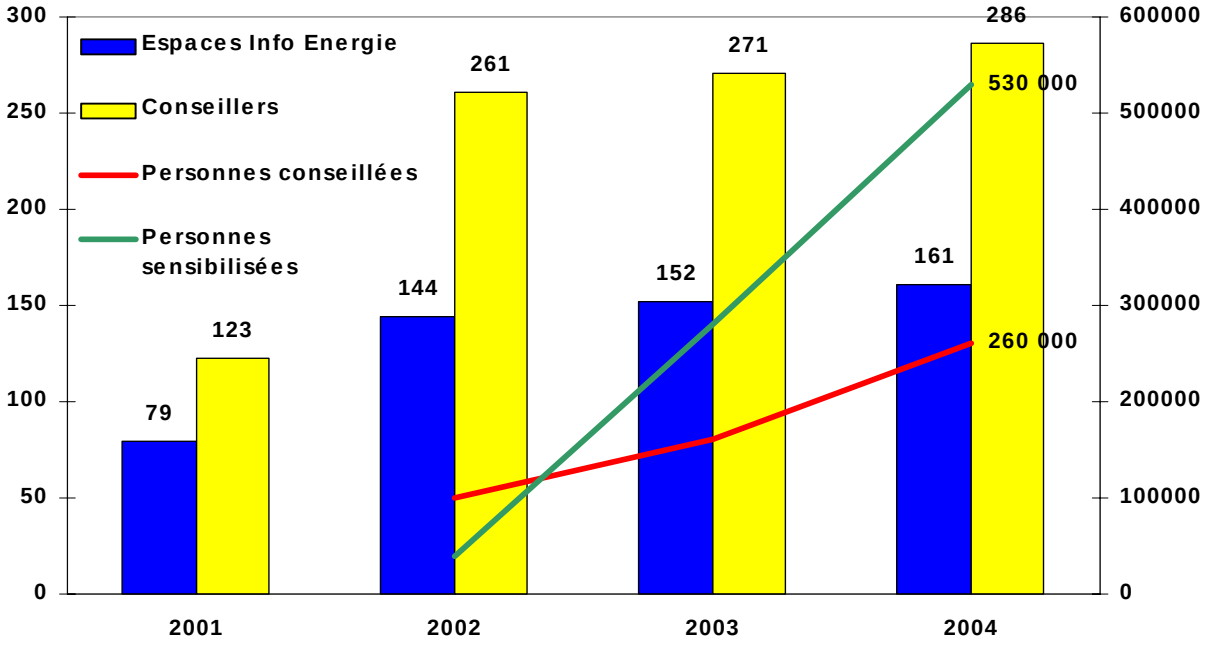
Local energy information centres (2)



- **Number of centers or advisers per capita high in** 5 countries : Hungary , Sweden Slovenia, Denmark, Czech Rep Morocco, France and Austria
- Around 1 to 3 advisers per centre

Enerdata

Local information centers in France: evaluation of activities (2004



Enerdata

Local information centers in France: evaluation of activities (2004)

790 000 persons have beneficiated of advices, of which households (82%); companies or professionals (10%); organisms or local authorities (8%)

Advice asked for building envelop (12%); space heating and indoor air quality (30%); hot water (18%);other energy end uses (9%); travels modes (1%); vehicle use (2%), general information on energy (24%); on environment (4%)

On average, six months after the contact with a centre

One advised person out of four decided to realise a project

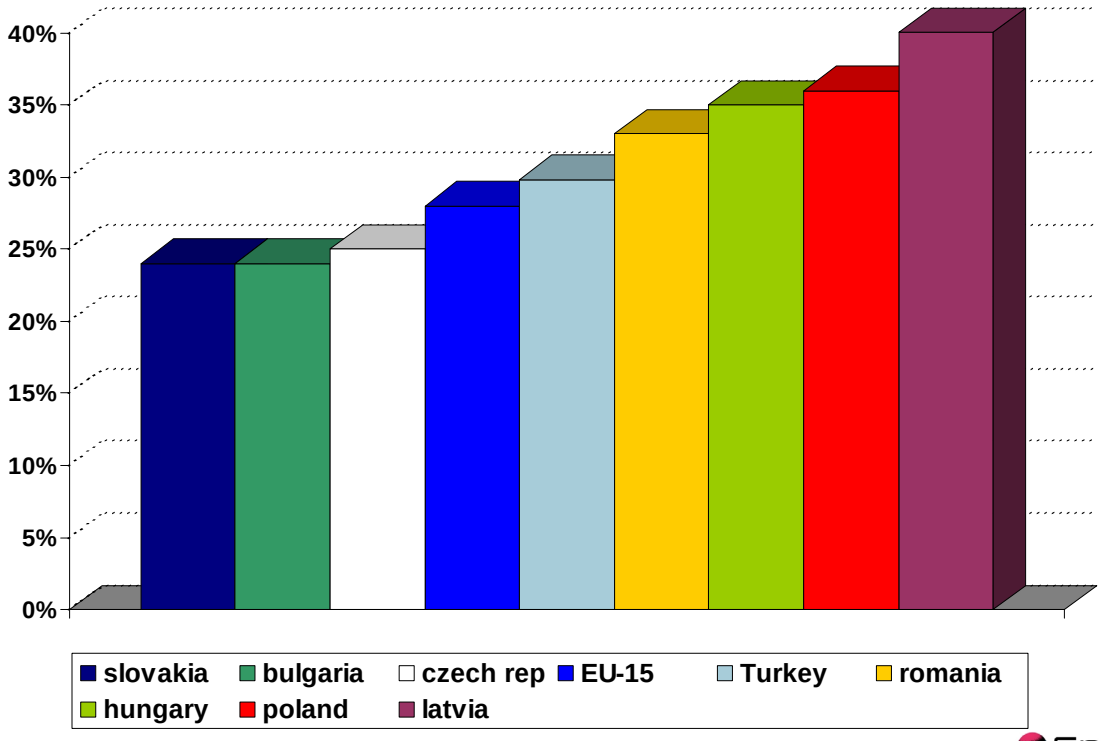
- **50% of the other persons continue to investigate for a project**
- **Main decided action are heavy investment**
- **50% of actions are due to the local centre**
- **The average investment : 7500 euros**

Enerdata

Energy consumption trends in the household sector

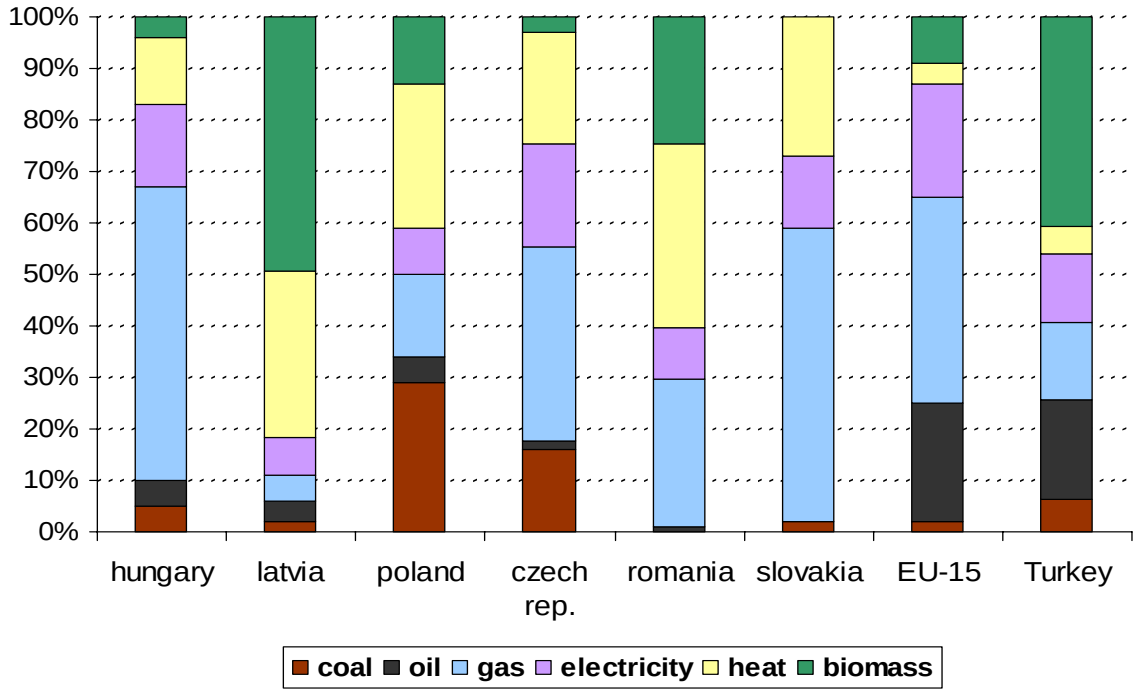
Enerdata

Share of households in final energy consumption (2001)



Enerdata

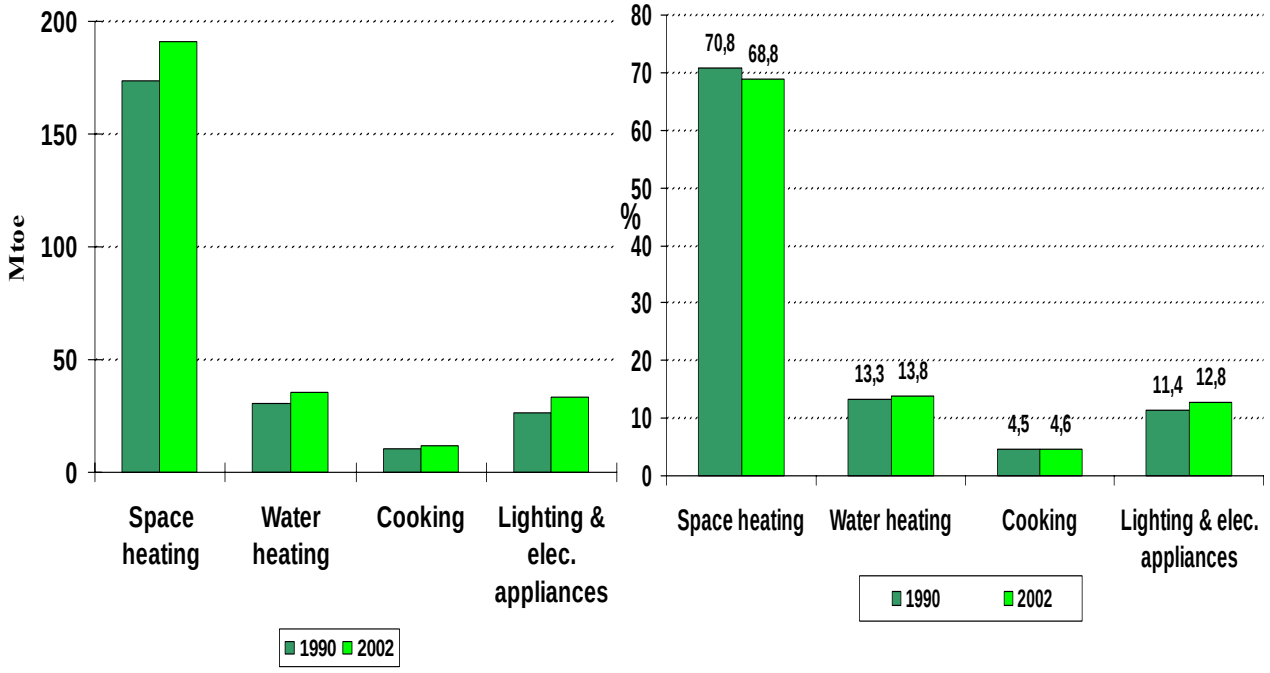
Consumption of households by type of energy (2001)



Enerdata

Household energy consumption in the EU 15 :

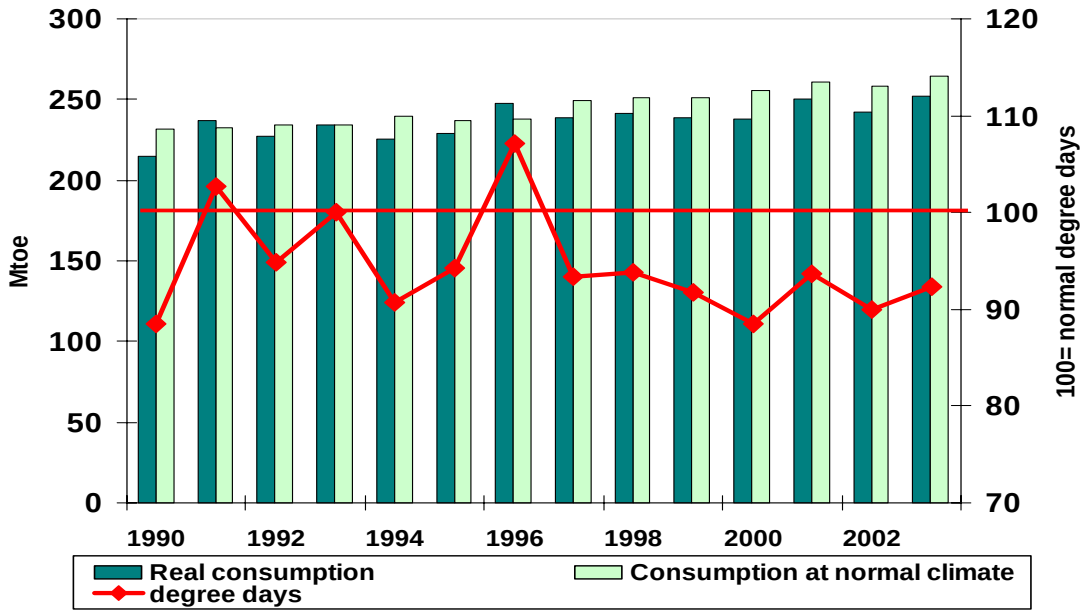
declining share for space heating; increasing share of for electrical appliances and lighting



Enerdata

Consumption of households: large climatic variations in the 90's :

Large fluctuations from 2000 to 2003; 1997 to 2003 about 5-10% warmer than normal; only 3 winters colder than long- term average since 1990 Ł importance of climatic corrections



Enerdata

Climatic corrections : Methodology

Ł linear correction of the space heating consumption on the basis of the ratio normal degree days actual degree days

Ł for countries with yearly data: direct correction on space heating consumption

Ł for other countries , corrections on the space heating part of the consumption estimated from an exogenous and constant heating share (= method recommended by DIW to EUROSTAT)

Enerdata

Climatic corrections : Methodology

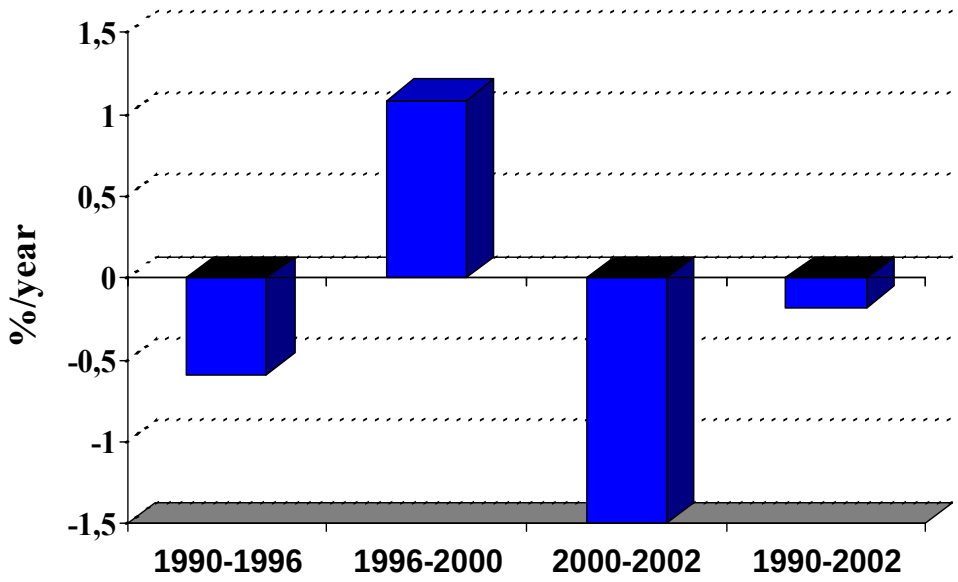
- Countries with heating consumption data)
  SH=SHn x (DD/DDn) or SHn= SH x (DDn/DD) (by fuel)

- Countries without annual space heating consumption data
- E = En x (1-K)+ En x K x (DD/DDn)
  or En = E x 1/ (1-K x (1-DD/DDn))

with K= heating share for normal year
or K= r x a with r = heating share for normal year and a = share of heating dependant on degree days (eg 90%)

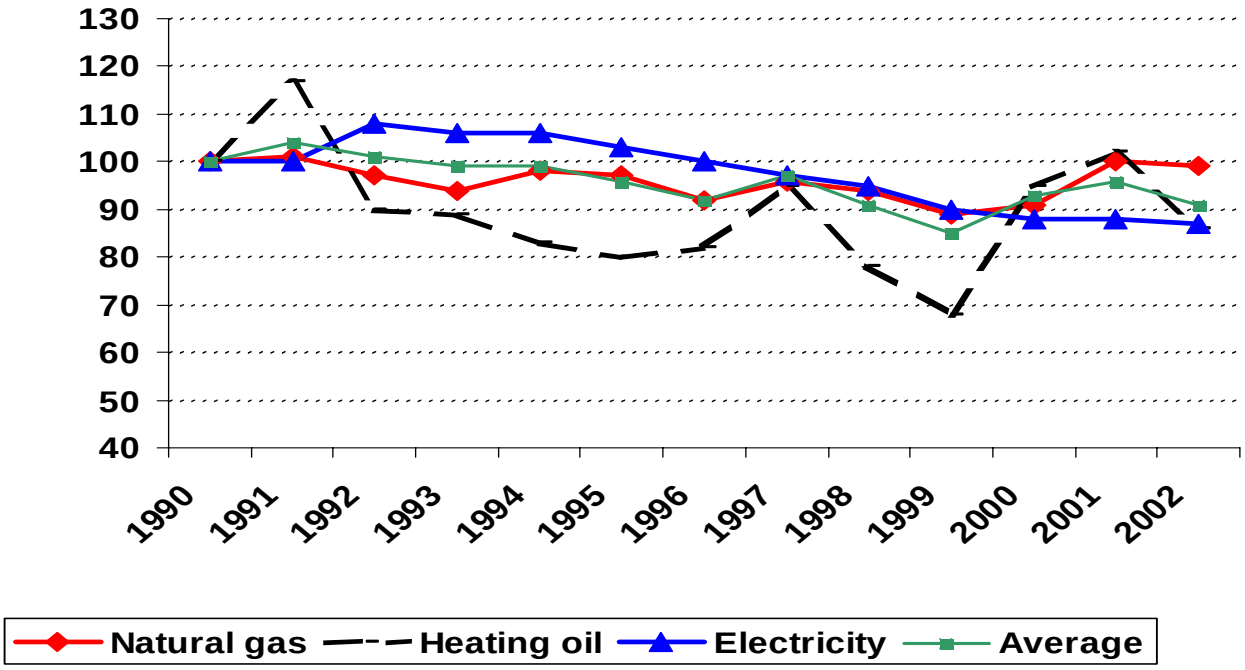
Enerdata

Average consumption per dwelling in the EU15: great fluctuations over the period: decrease between 1991 and 1996, and after 2000; progression between 1996 and 2000 ; on average slight decrease



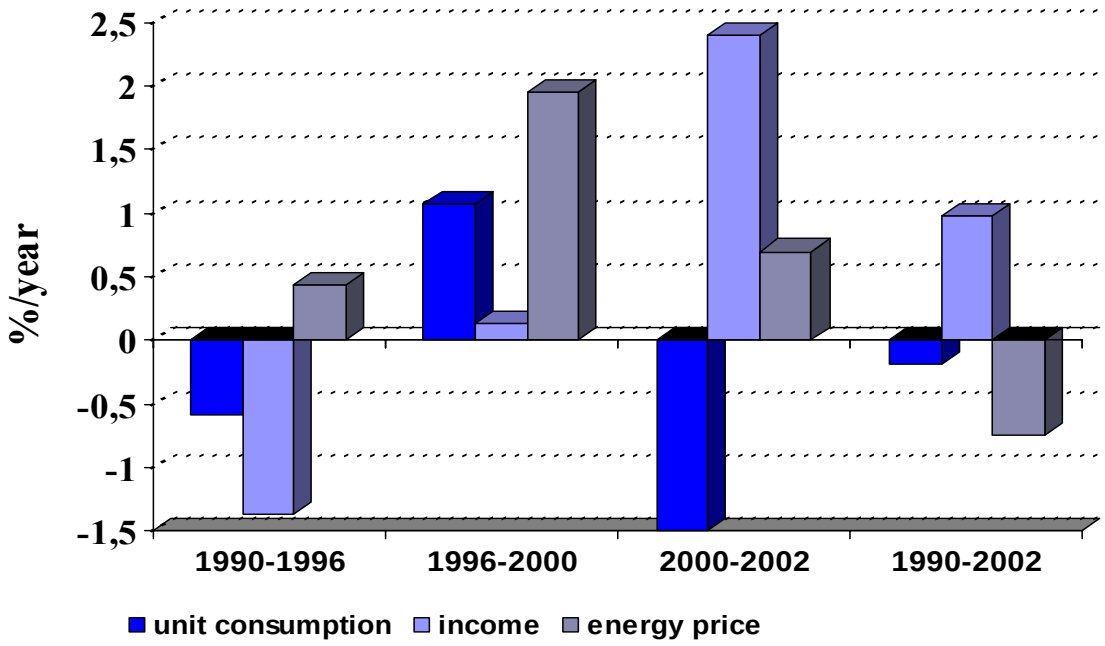
Enerdata

Real energy price for households in the EU15: decline until 1999 (-2.2%/ yr) and increase afterwards (+ 2.4%/ yr) ; regular decline for electricity since 1992 (-2.2%yr)



Enerdata

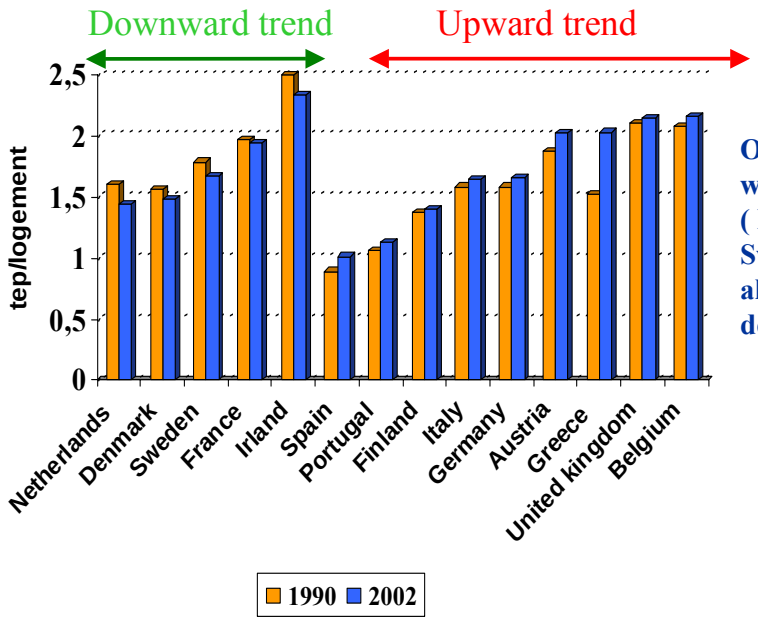
Influence of income and energy price in the variation of the average consumption per dwelling in the EU15



Enerdata

Average consumption per dwelling: increase in most of EU countries

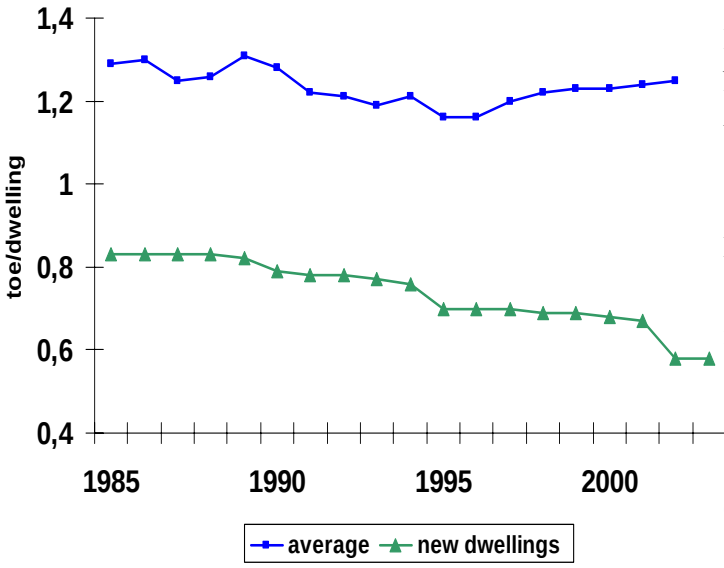
Consumption per dwelling adjusted to average UE-15 climate



One exception : 3 countries with remarkable performances (Netherlands, Denmark, Sweden) where consumption is already very low and steadily decreases.

Enerdata

Heating consumption per dwelling in the EU15 ; regular reduction for new dwellings because of reinforcement in standards



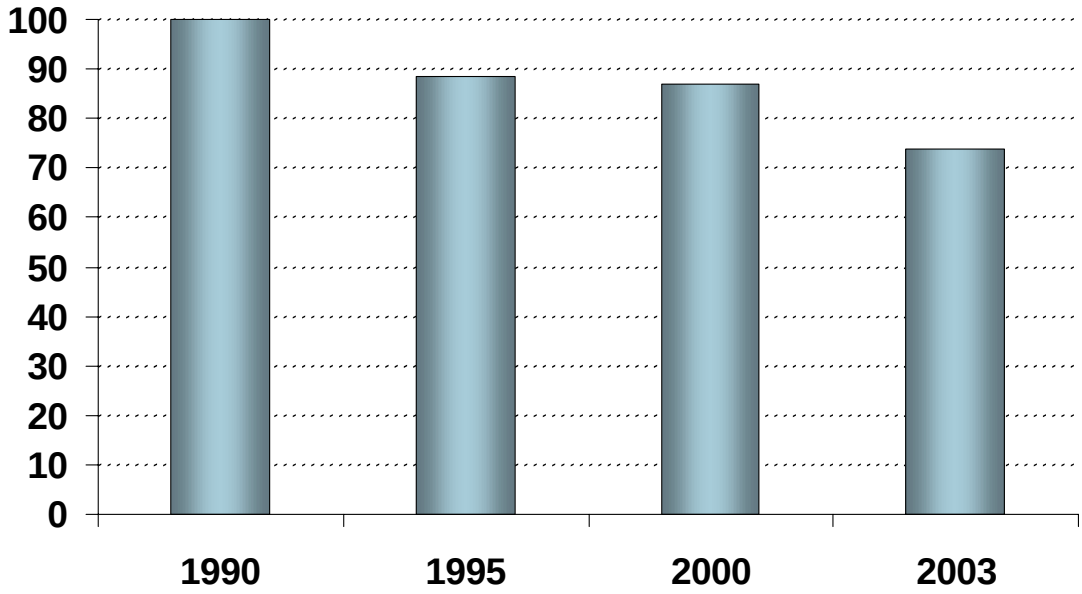
- Recent revisions in 8 countries

Italy (94), Germany (95 & 02), Denmark(95) Netherlands (95, 98 & 00), Ireland (97), Austria France (01), Greece (95 & 01)

- Planned reinforcement in 3 countries : Finland (03), UK , France and Denmark (05)
- On average, 4 revisions since 1973 in most countries with an energy saving of 60% for dwellings built now compared to 1973
- But limited impact on average unit consumption: in 2002, dwellings built since 1990 only represent 16% of total heating consumption

Enerdata

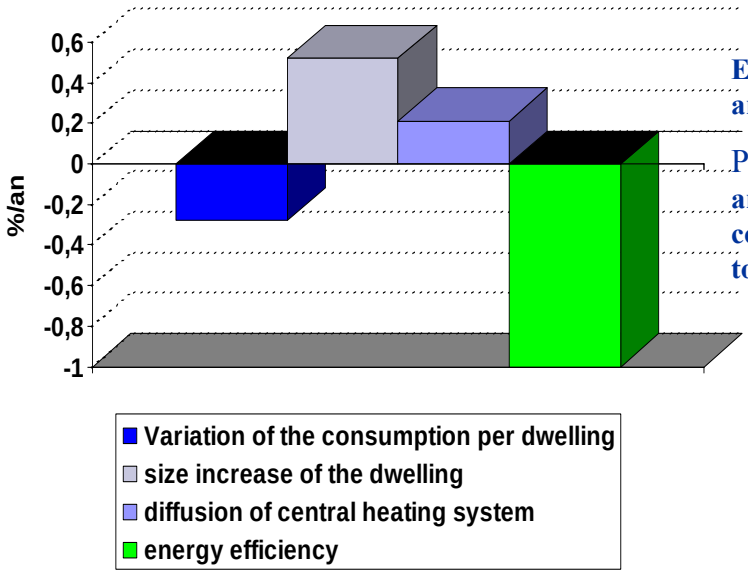
Impact of building codes on the consumption of new dwellings in the EU15



Enerdata

For space heating, the increasing size of the dwelling and the penetration of central heating have absorbed around 75 % of the energy efficiency progress

Factors of variation of space heating consumption per dwelling in the UE 15 (1990-2002)



Energy efficiency gains are estimated around 1 %/year

Penetration of central heating system and the increasing size of dwelling contribute to increase the energy needs to 0,2 % and 0.5%/year respectively

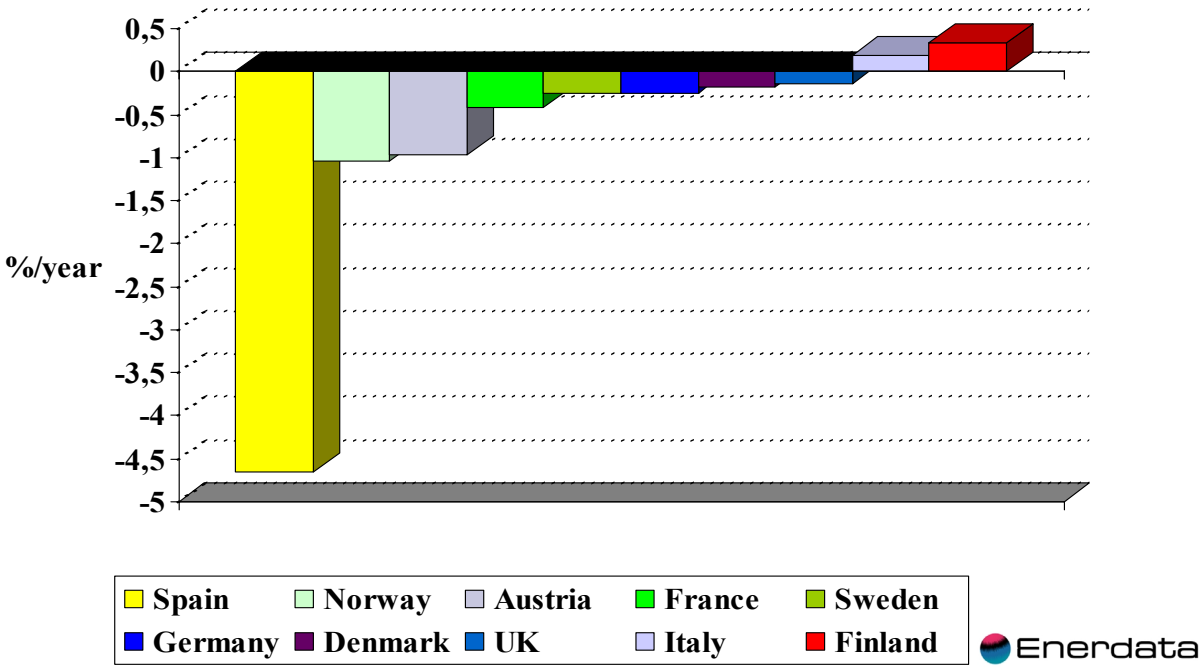
Enerdata

Impact of energy substitution on unit consumption per dwelling for space heating (1990-2001)

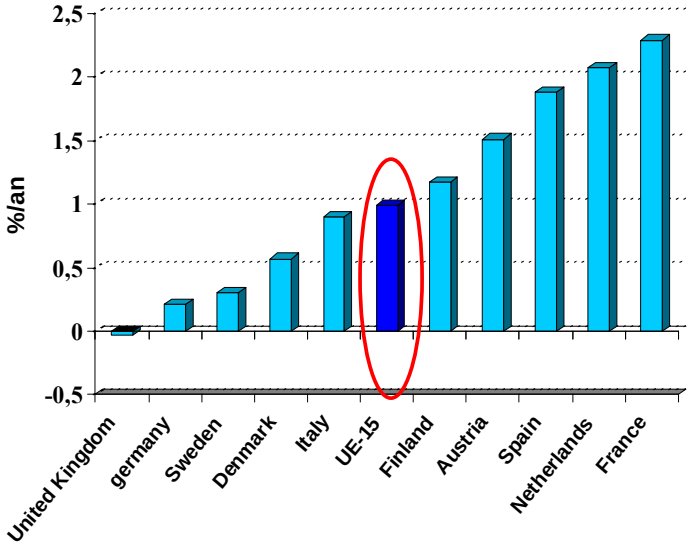
Calculated as the difference in the yearly variation of the unit consumption per dwelling :

•In final energy

•In useful energy, taking into account reference end- use efficiencies



Electricity consumption per dwellings for electrical appliances and lighting



Increases of 1 %/year in the UE-15: larges discrepancies among countries

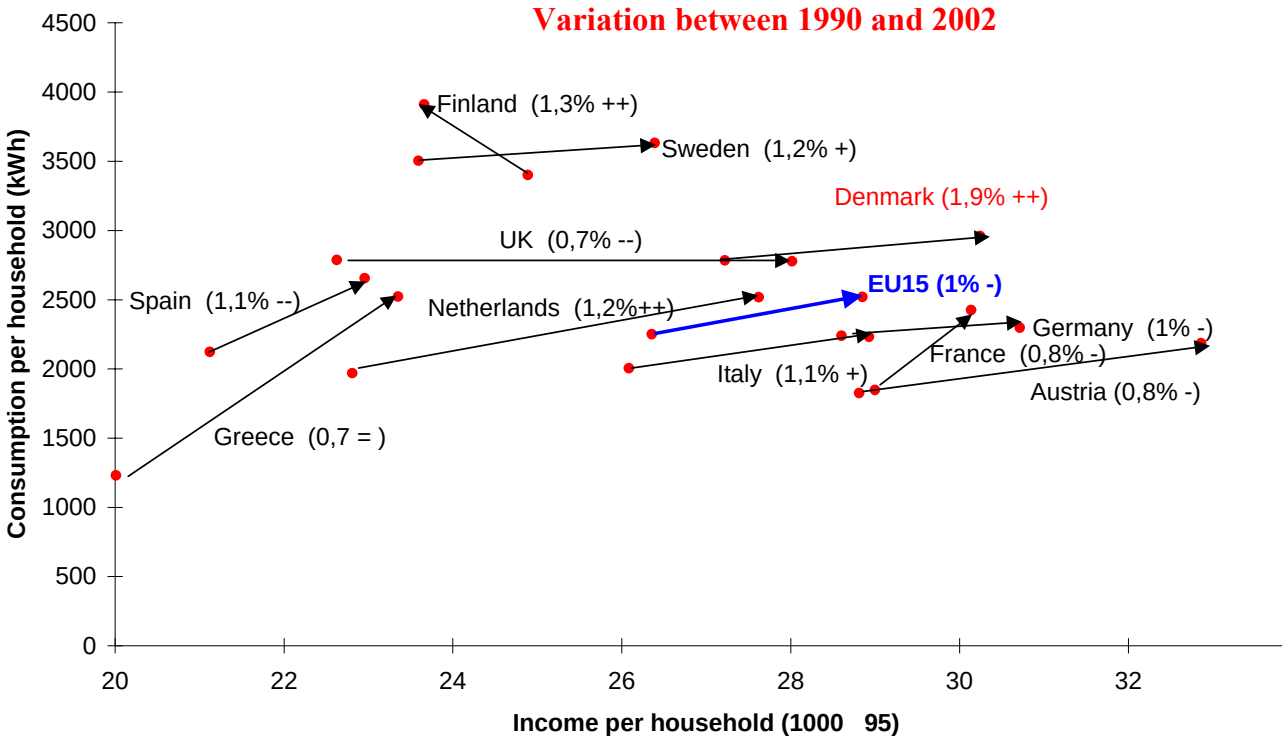
Slow evolution in United Kingdom, Germany, Sweden and Denmark? (ownership close to the saturation)

Rapid growth in France (low and decreasing share of electricity expenditures in the household budget), in the Netherlands (income effect) and in Spain (recovering of equipment ownership rate)

1990-2002

Enerdata

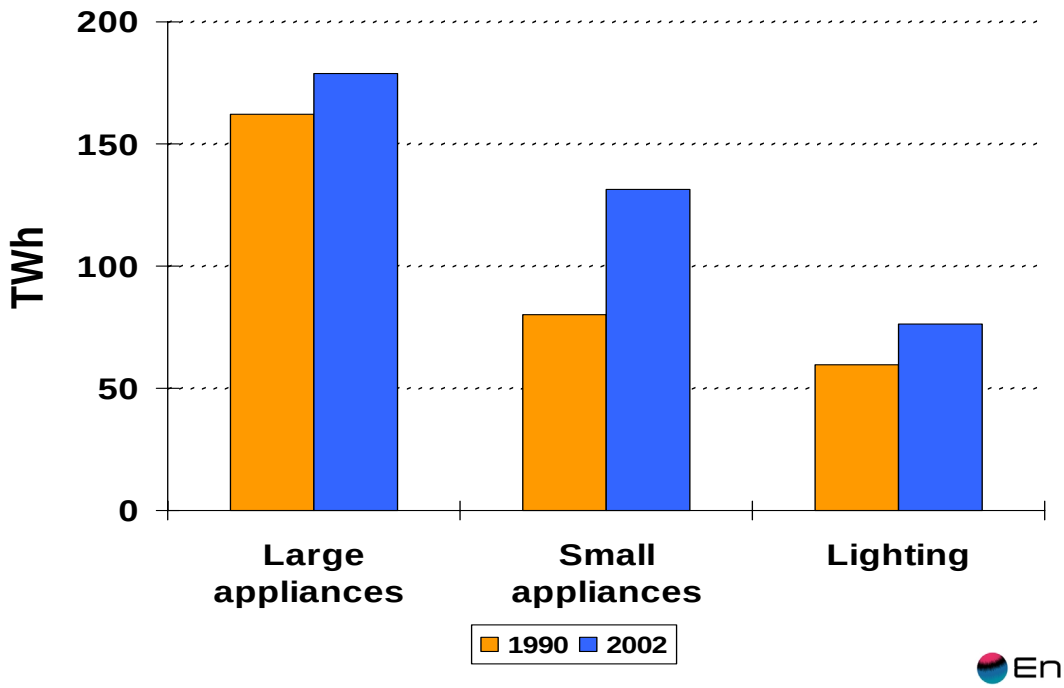
Consumption per dwelling for electrical appliances & lighting as a function of income & price



In bracket change in budget coefficient

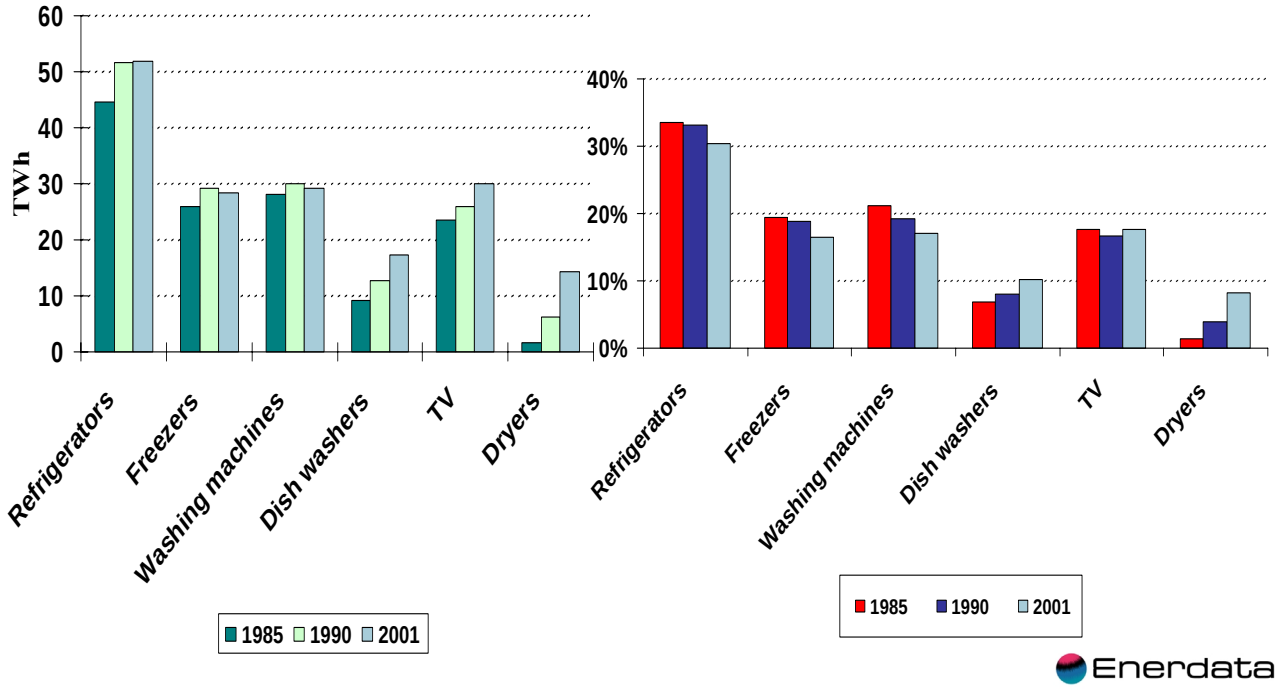
Enerdata

Consumption for electrical appliances & lighting in the EU15 : decreasing share of large appliances (46 % in 2002 ; 54% in 1990); rapid progression for small appliances



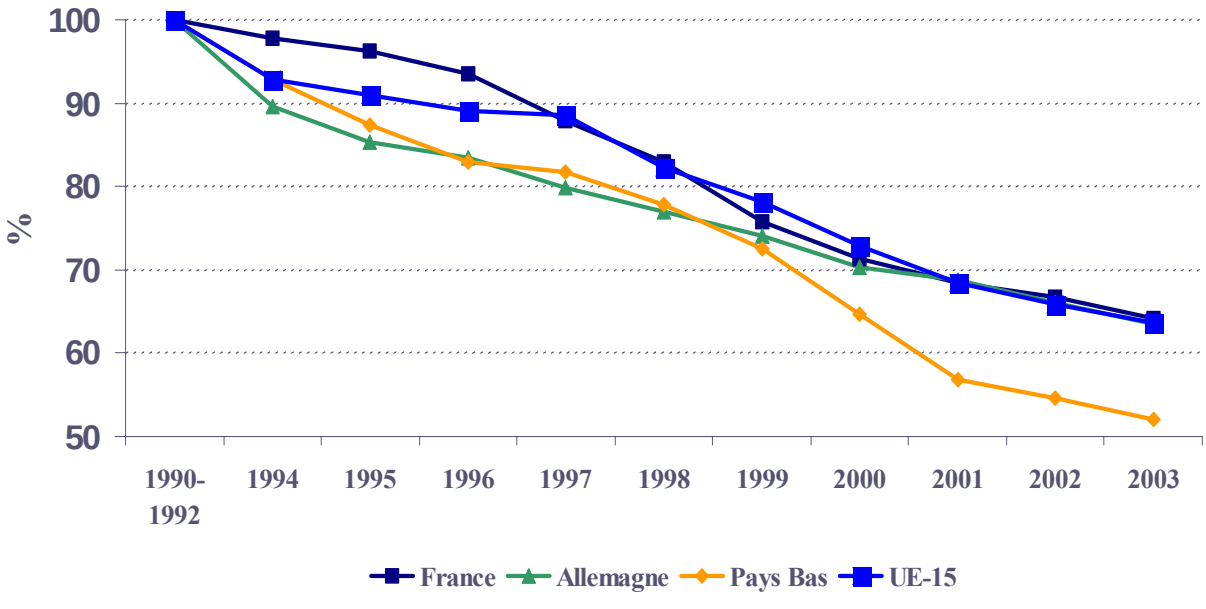
Enerdata

Consumption of large electrical appliances in the EU15 : decreasing share of cold appliances; increasing role of dryers



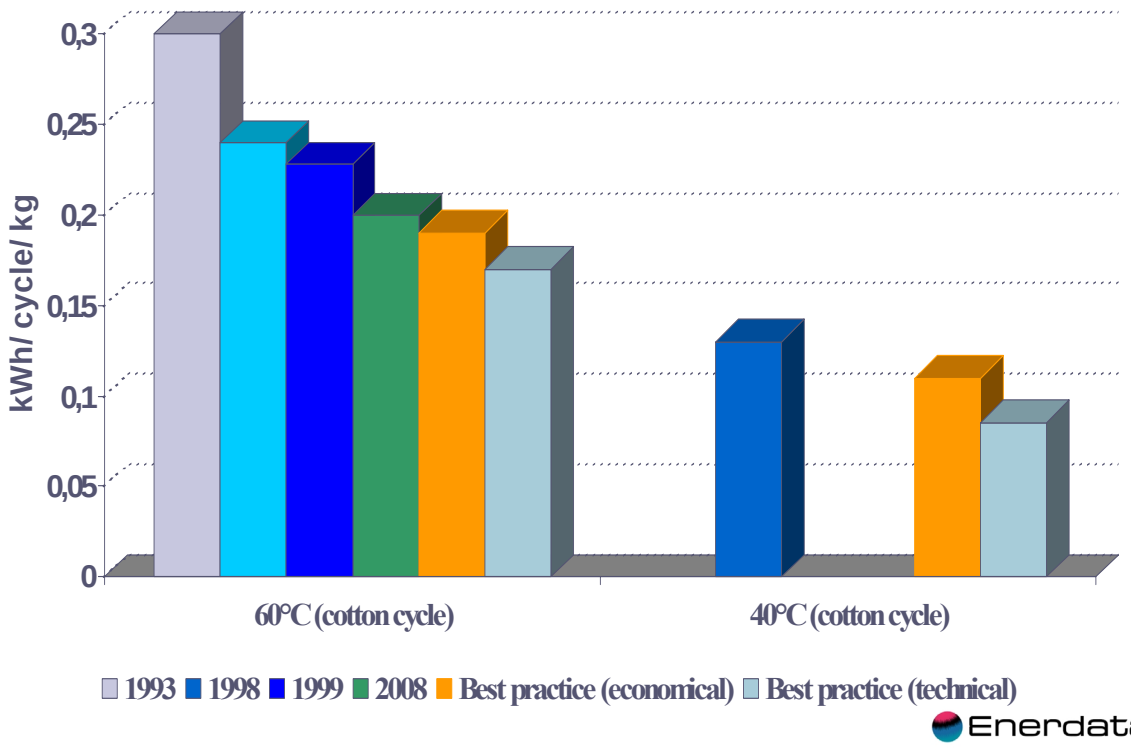
Enerdata

Energy efficiency progress with cold appliances



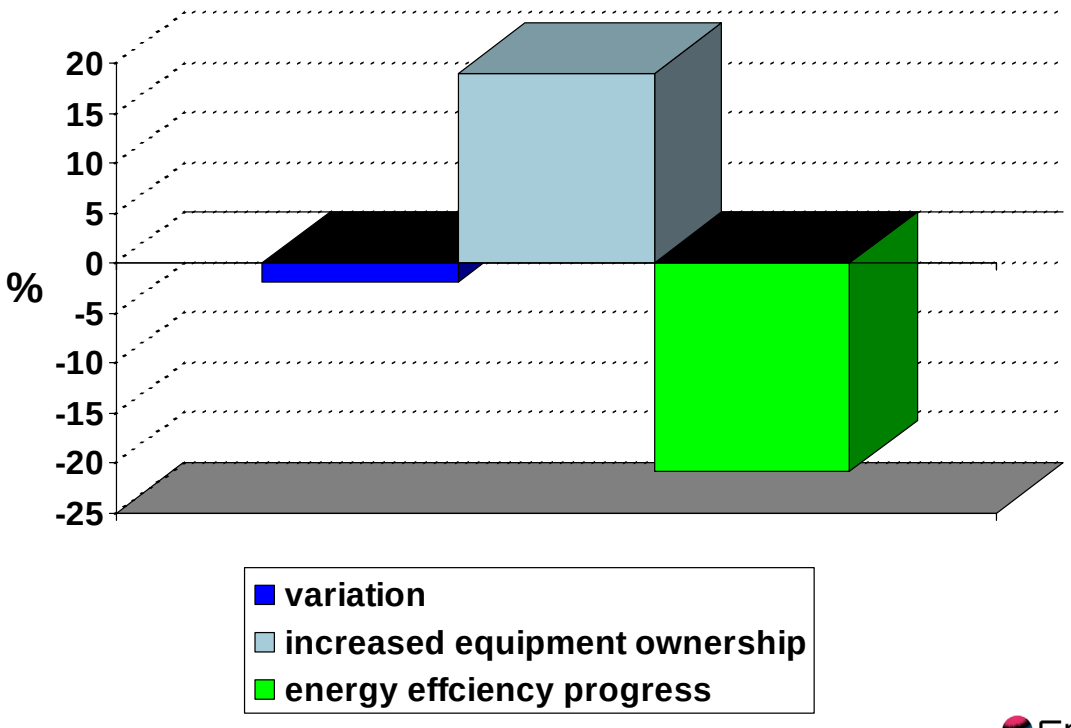
Enerdata

Energy efficiency progress with washing machines



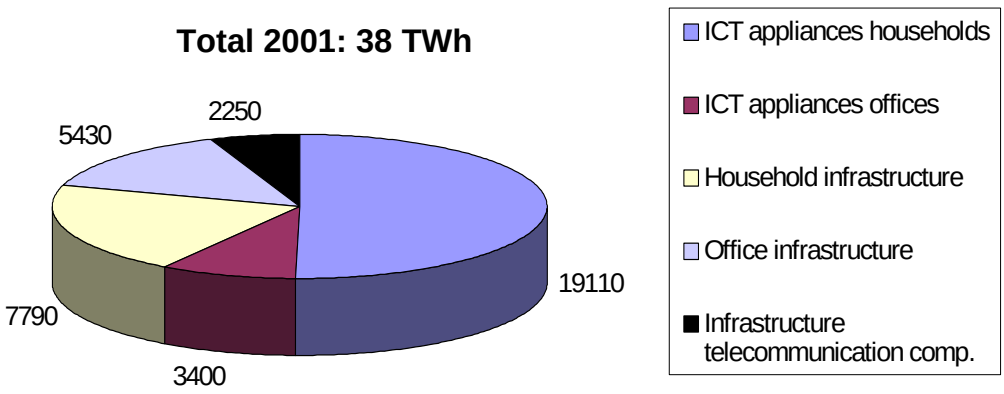
Enerdata

Variation of the consumption per dwelling for large appliances in the EU15



Enerdata

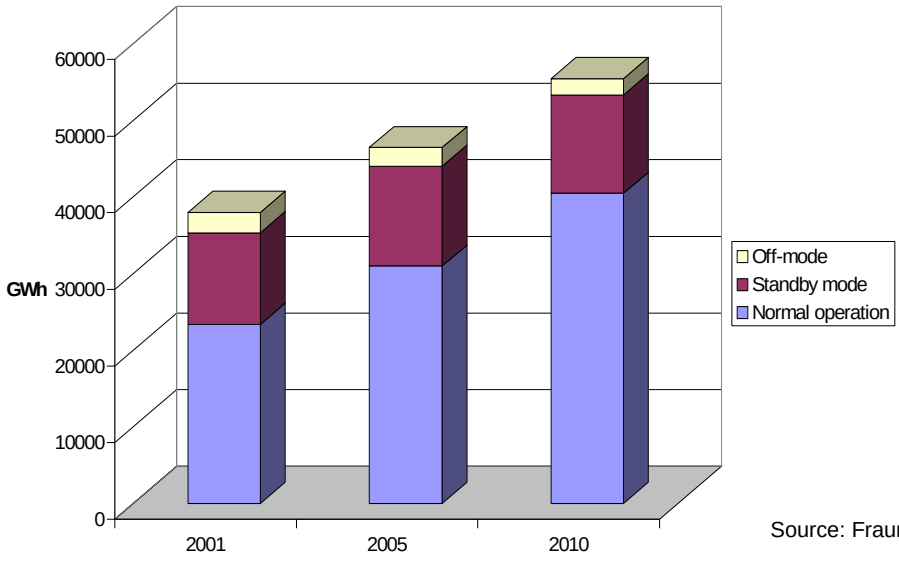
Energy consumption of ICT appliances and associated infrastructure in households and offices in Germany 2001



Source: Fraunhofer ISI

Enerdata

Energy consumption of ICT appliances and associated infrastructure by operation modes in Germany

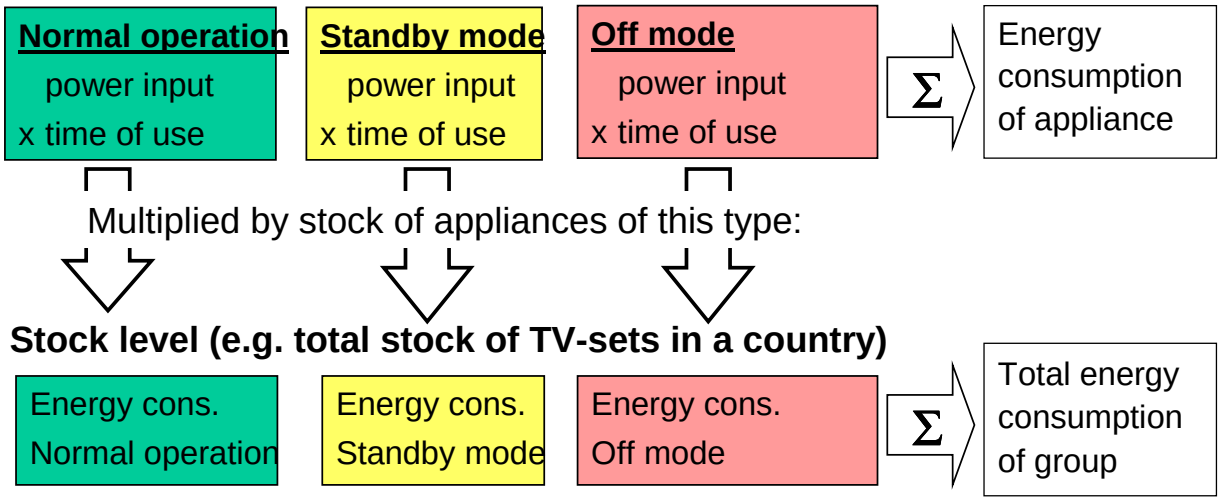


Source: Fraunhofer ISI

Enerdata

Model to determine electricity demand of ICT appliances

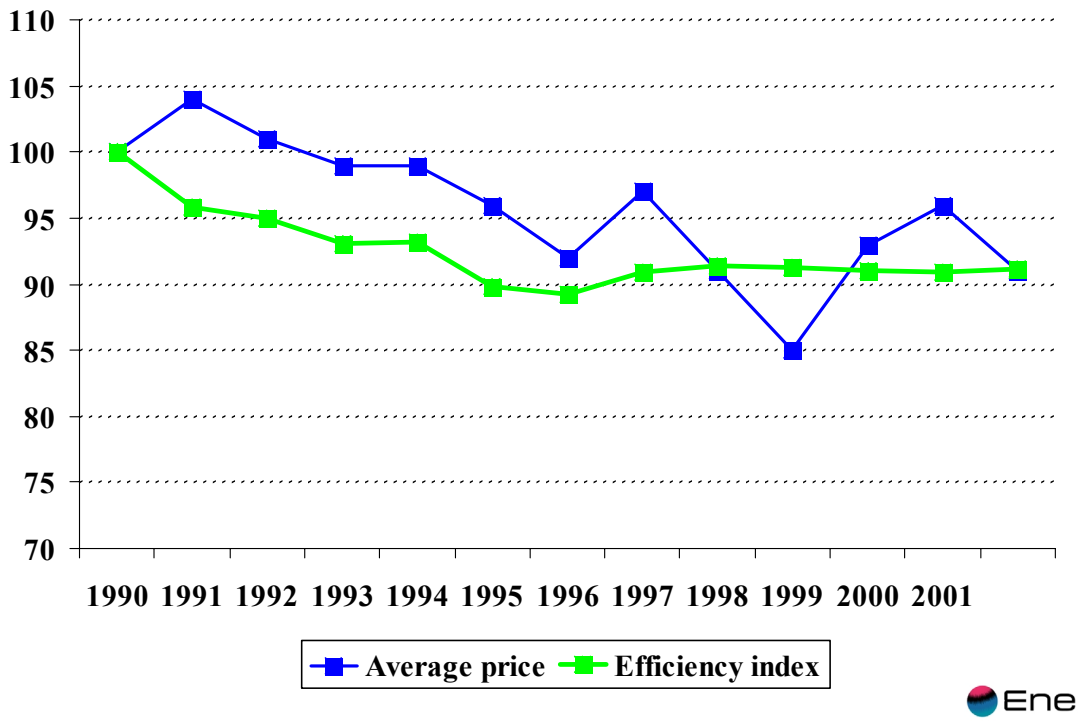
Appliance level (e.g. single TV-set)



Enerdata

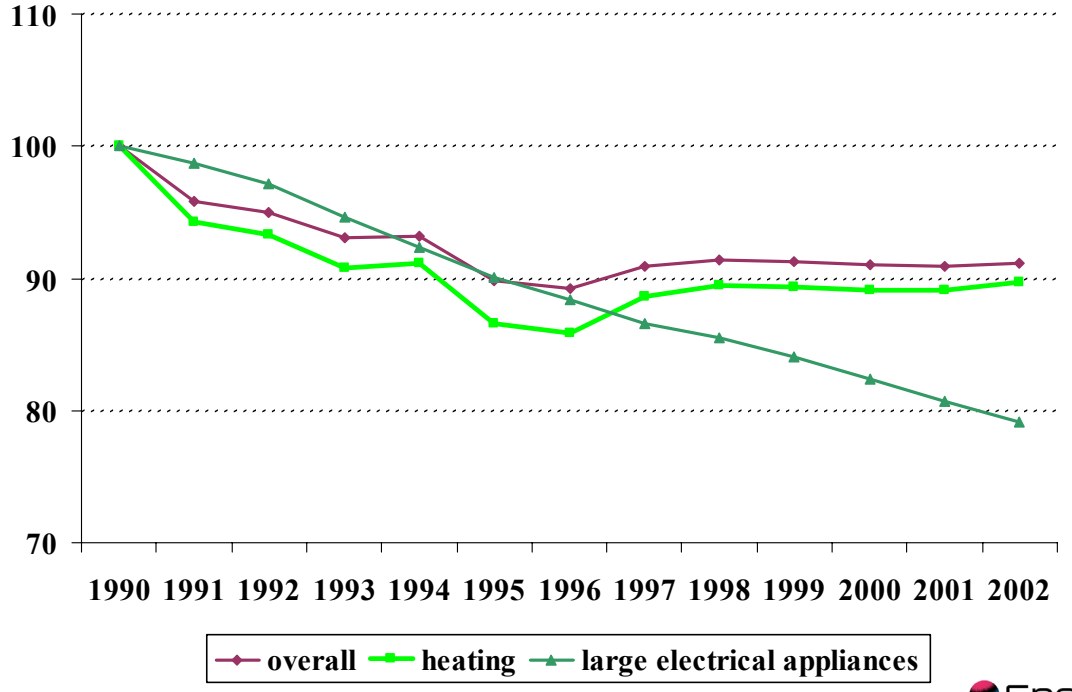
Energy efficiency index for households in the EU15 : about 6

% efficiency progress between 1990 and 1996 ; no progress since 1995



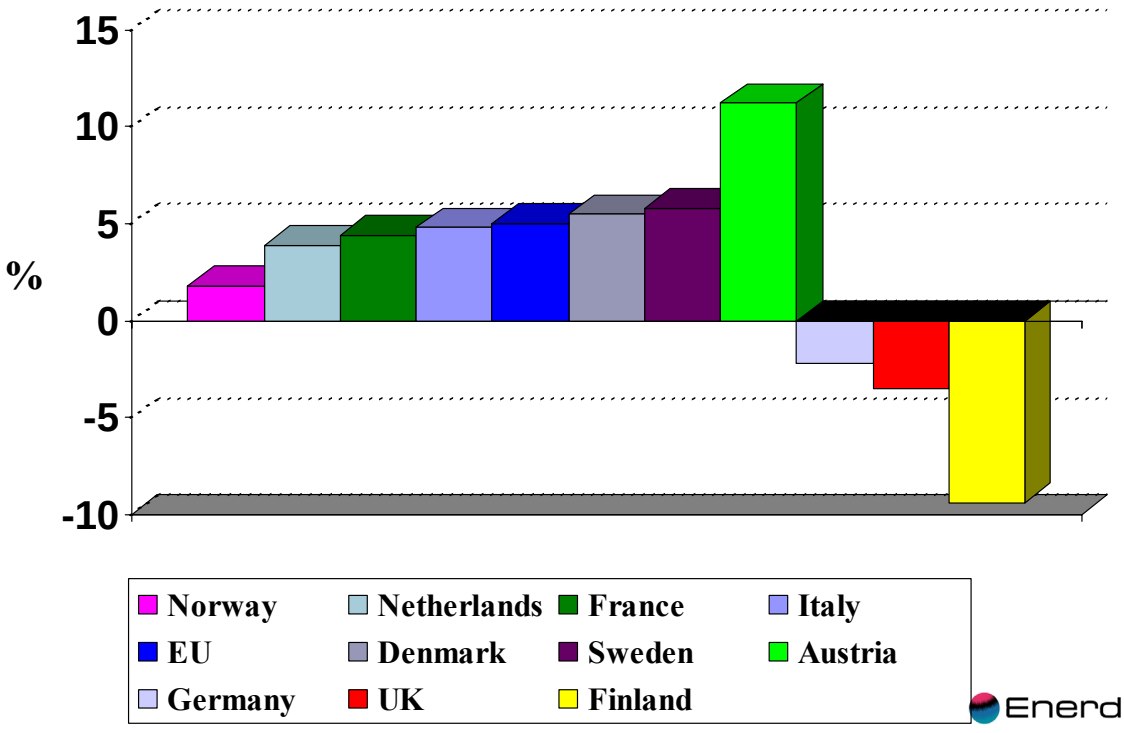
Enerdata

Energy efficiency progress for households in the EU15 : about 10 % gain between 1990 and 1996 ; no progress since; regular improvement for large appliances



Enerdata

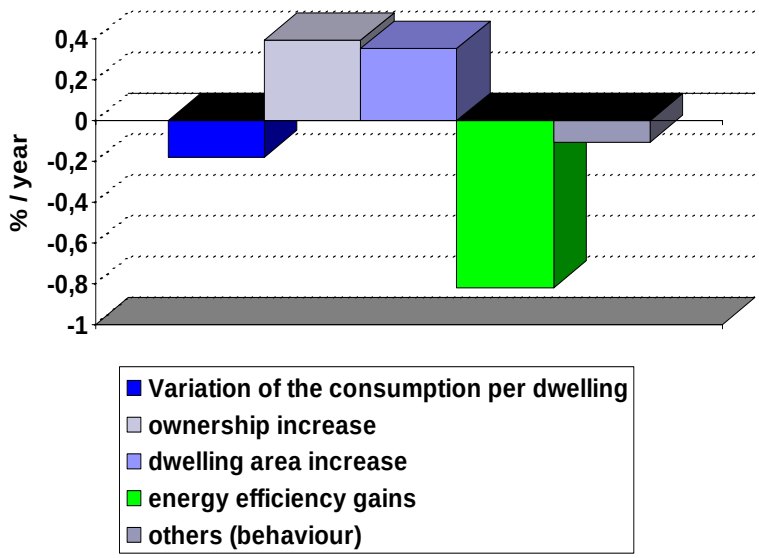
Energy efficiency improvements in the household sector for EU and Norway between 1990 and 2000



Enerdata

The evolution of life styles has practically offset all the realised energy efficiency improvements

Factors of variation of the average energy consumption per dwelling in the UE 15 (1990-2002)

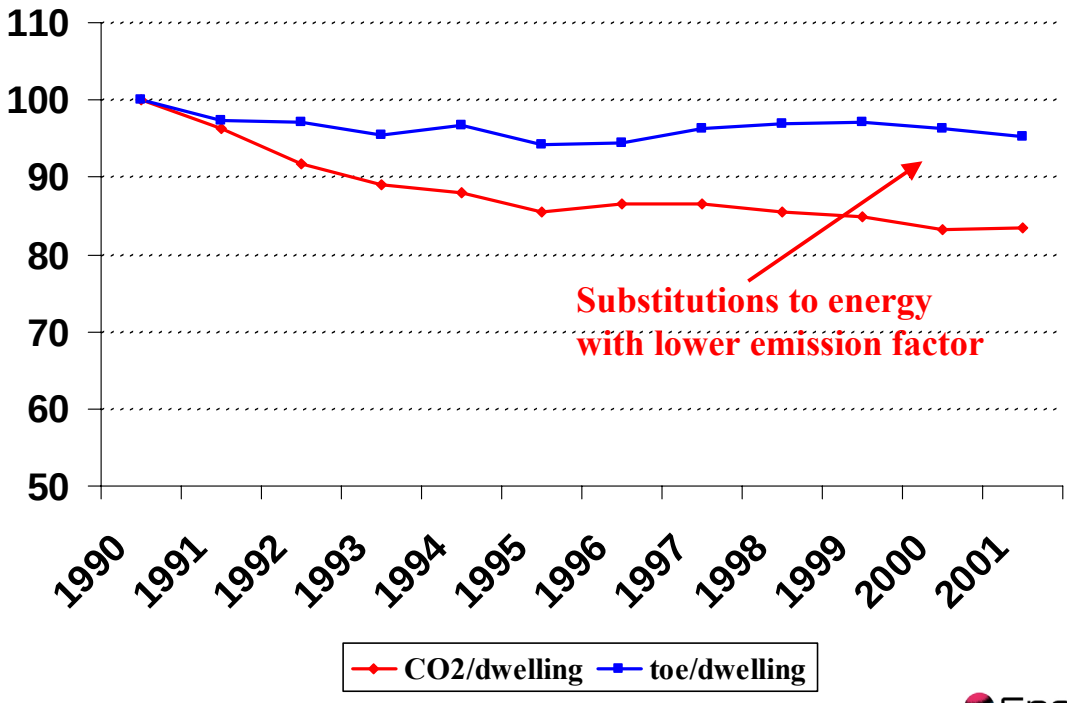


Consumption per dwelling in 2002, at the same level as in 1990, despites energy efficiency has improved of e 0,8%/year i.e. 10% .

Increase of dwelling area, and ownership (electrical appliances and central heating systems) have boosted this consumption of around 0,4 %/year each.

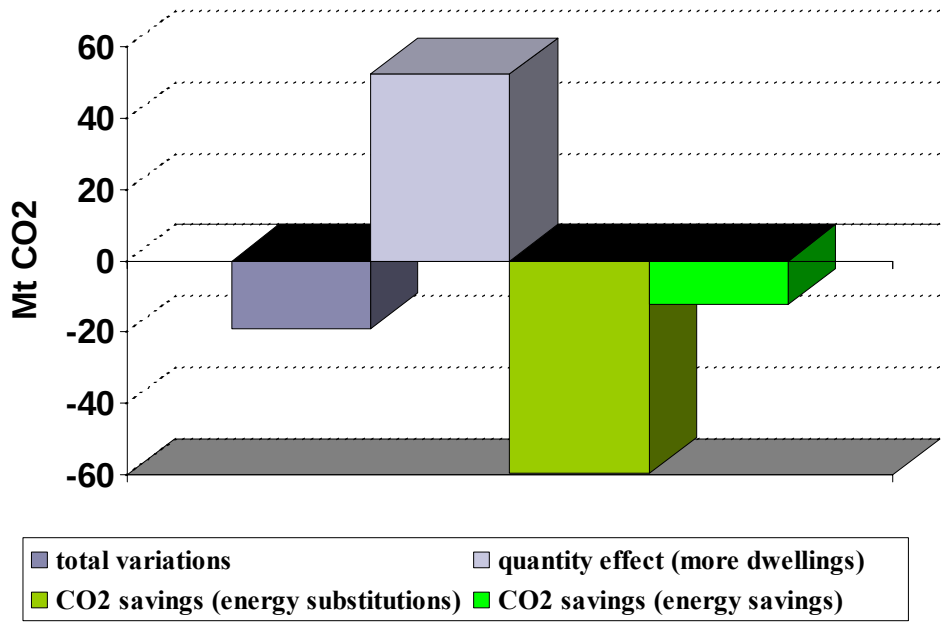
Enerdata

Unit consumption per dwelling versus CO2 emissions per dwelling



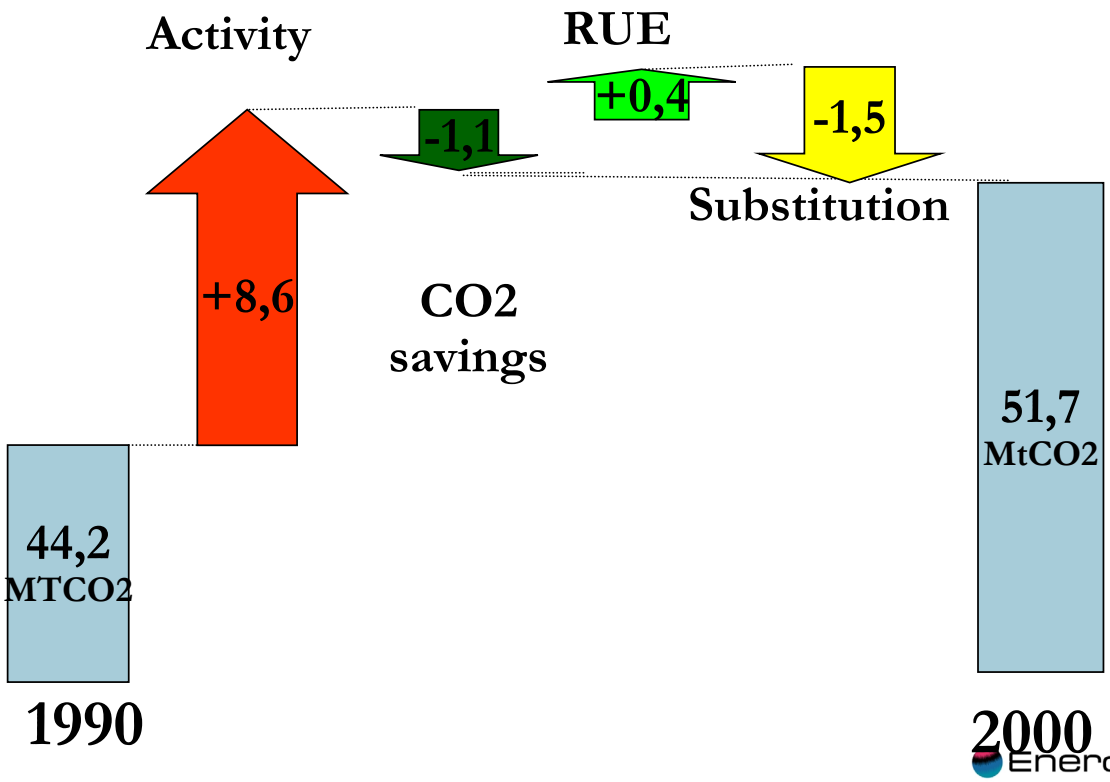
Enerdata

Interpretation of CO2 emissions variations for households in the EU15 (1990-2002)



Enerdata

CO2 savings for household in France

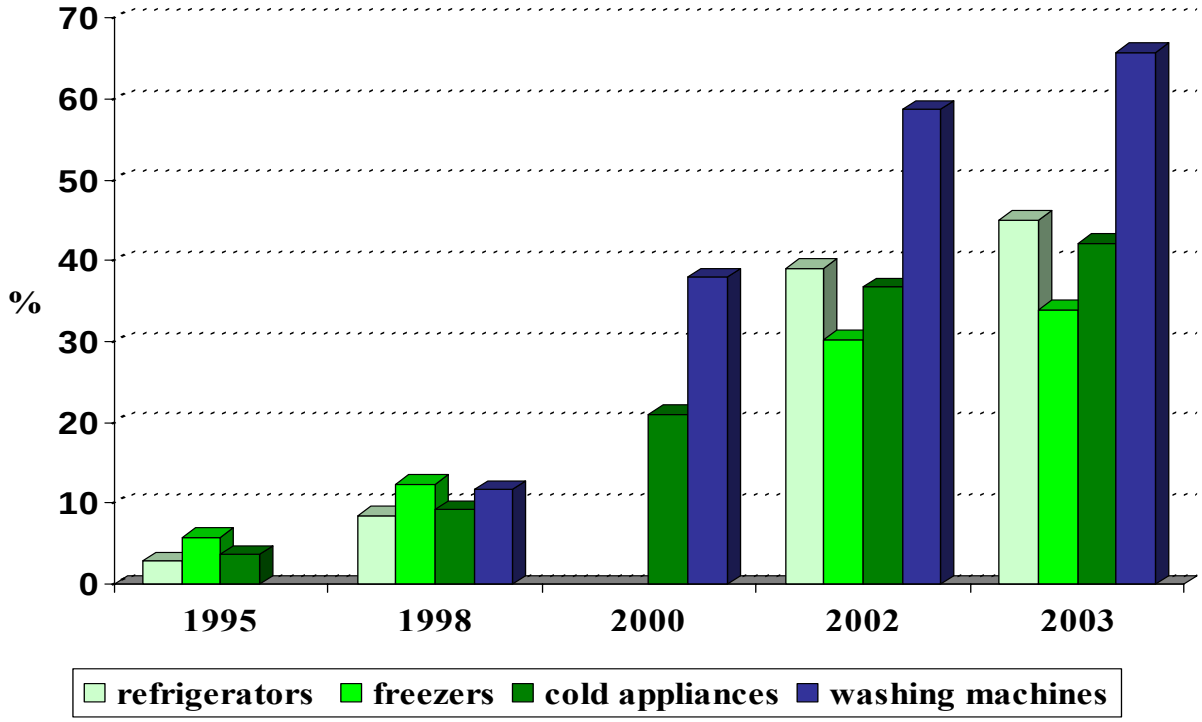


Enerdata

Indicators of diffusion of efficient technologies

Enerdata

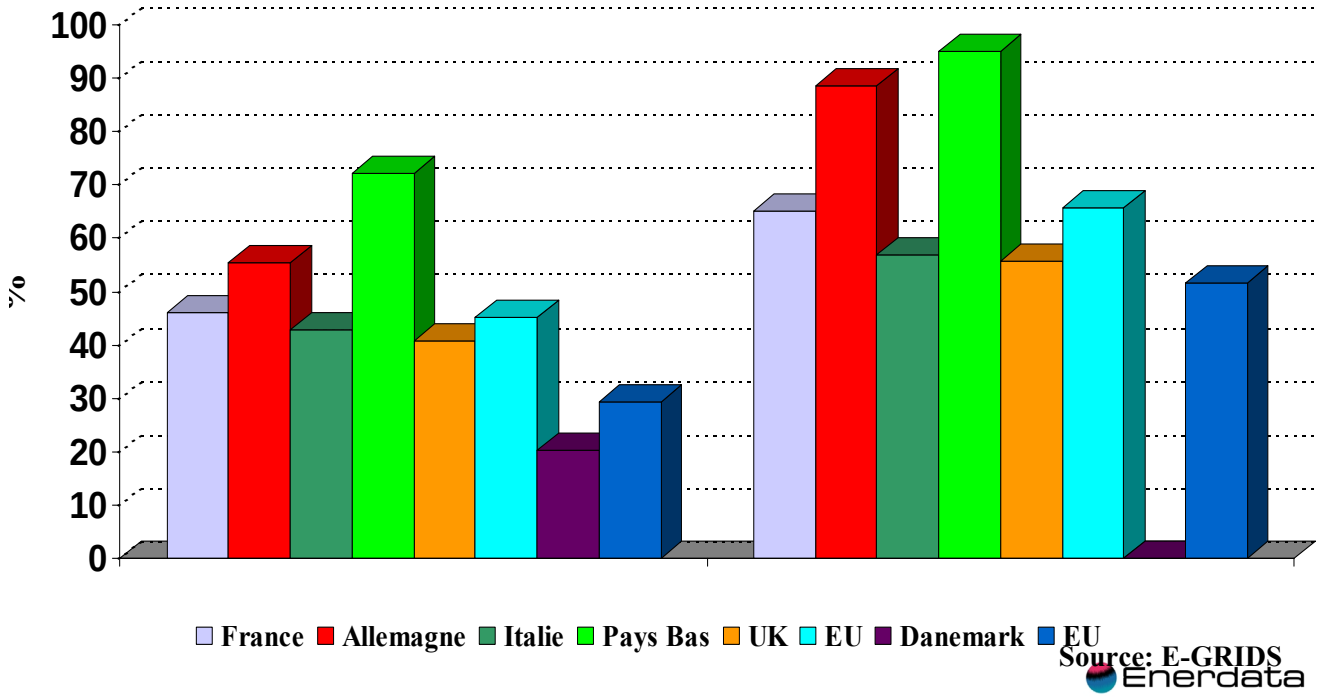
Market share of label A for cold appliances and washing machines in the EU



Source: Monitor, GFK, E-Grids, own calculation

Enerdata

Penetration of labels A for cold appliances (refrigerators / freezers) and washing machines (2003)

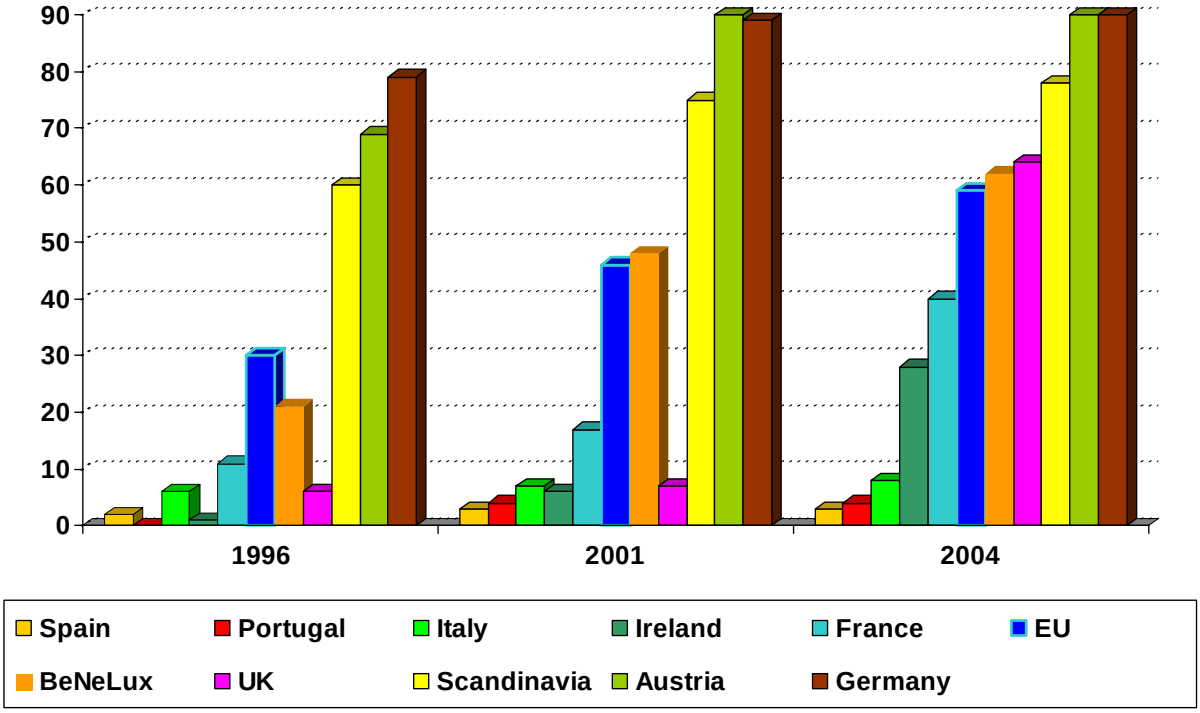


Source: E-GRIDS

Enerdata

Share of low emission glazing (in sales of insulation glass)

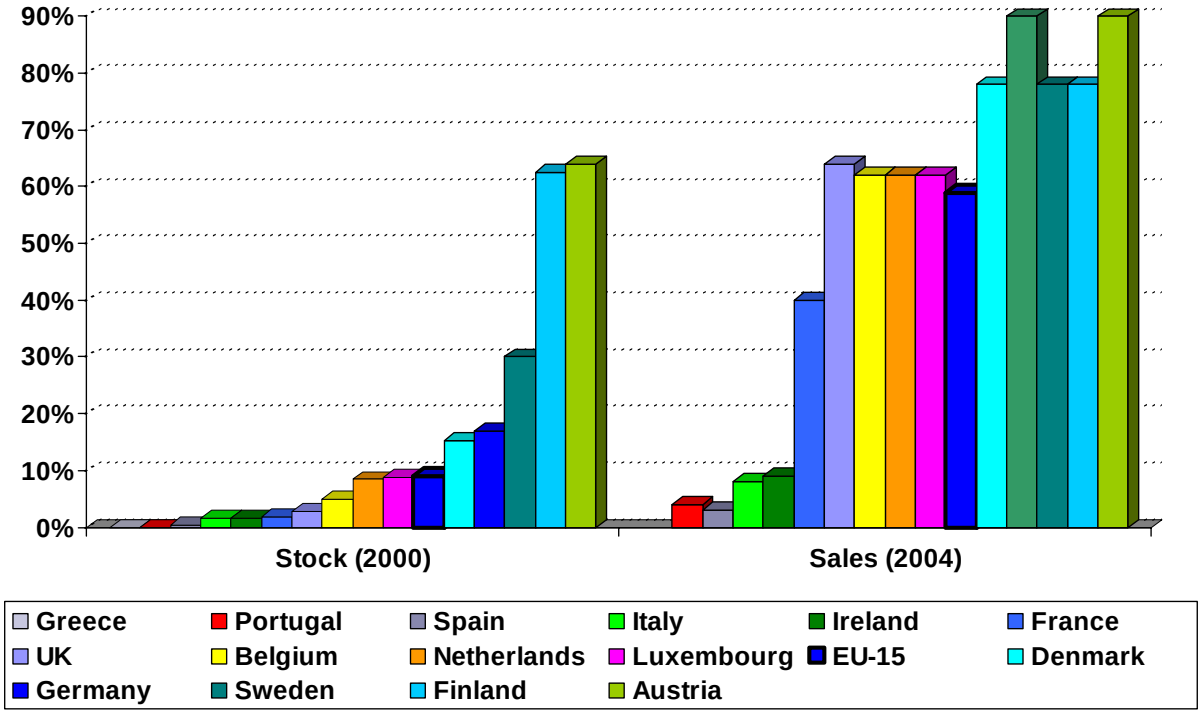
(%)



Source : Saint Gobain

Enerdata

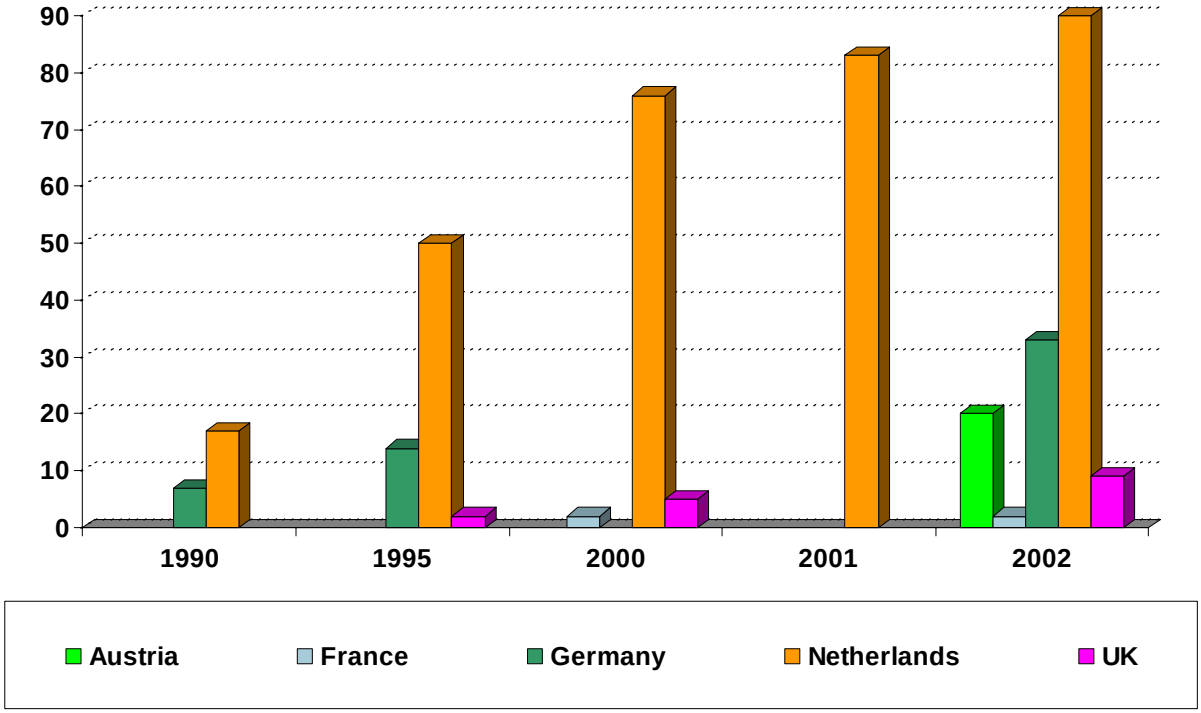
Penetration of low emission glazing



Source : GEPVP (stock), Saint Gobain (sales)

Enerdata

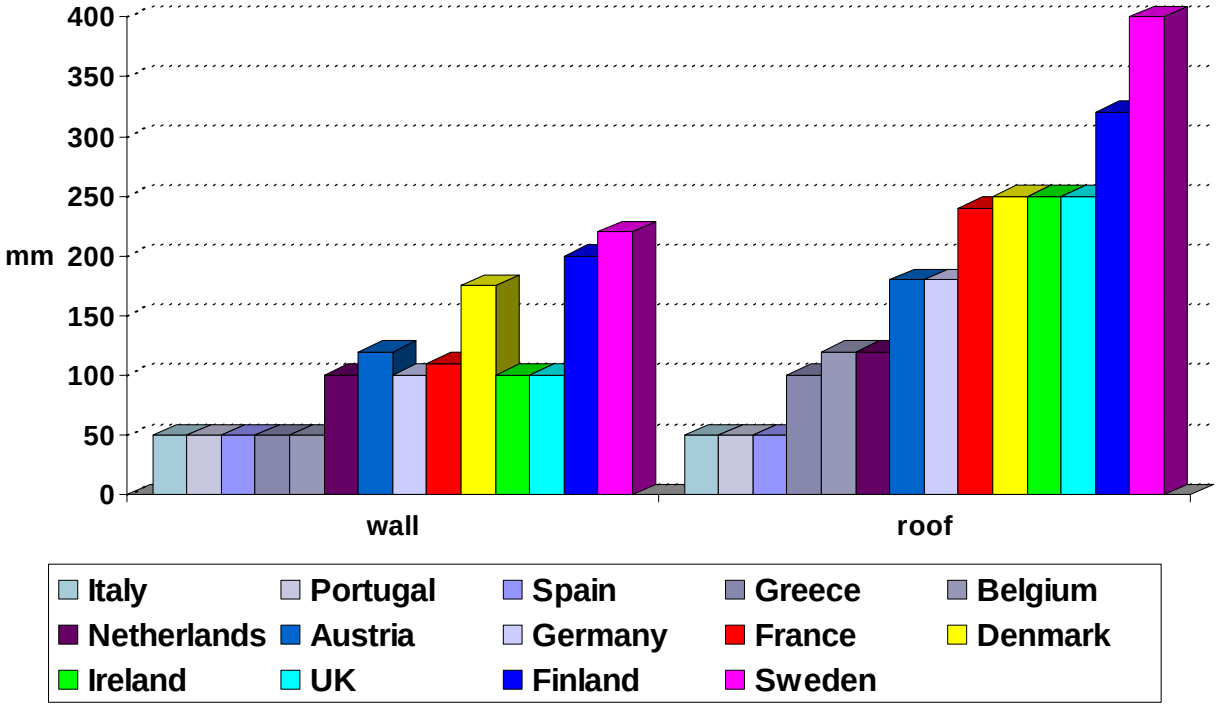
Indicators of monitoring for heating equipment: sales of condensing boiler



Source : Odyssee from STEM and EHIA

Enerdata

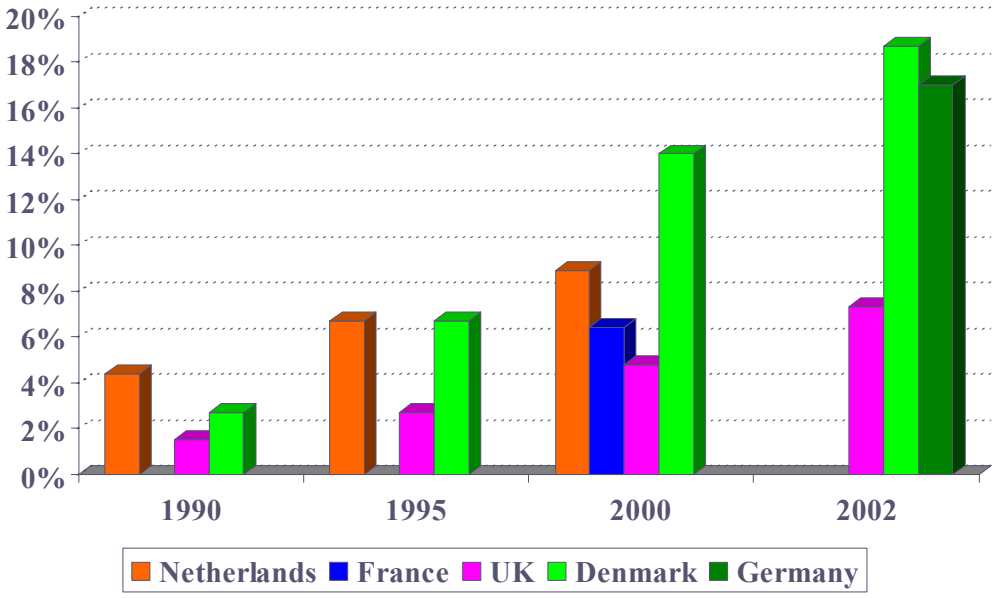
Indicators of monitoring for new dwellings: use of insulation materials



Source : Eurima

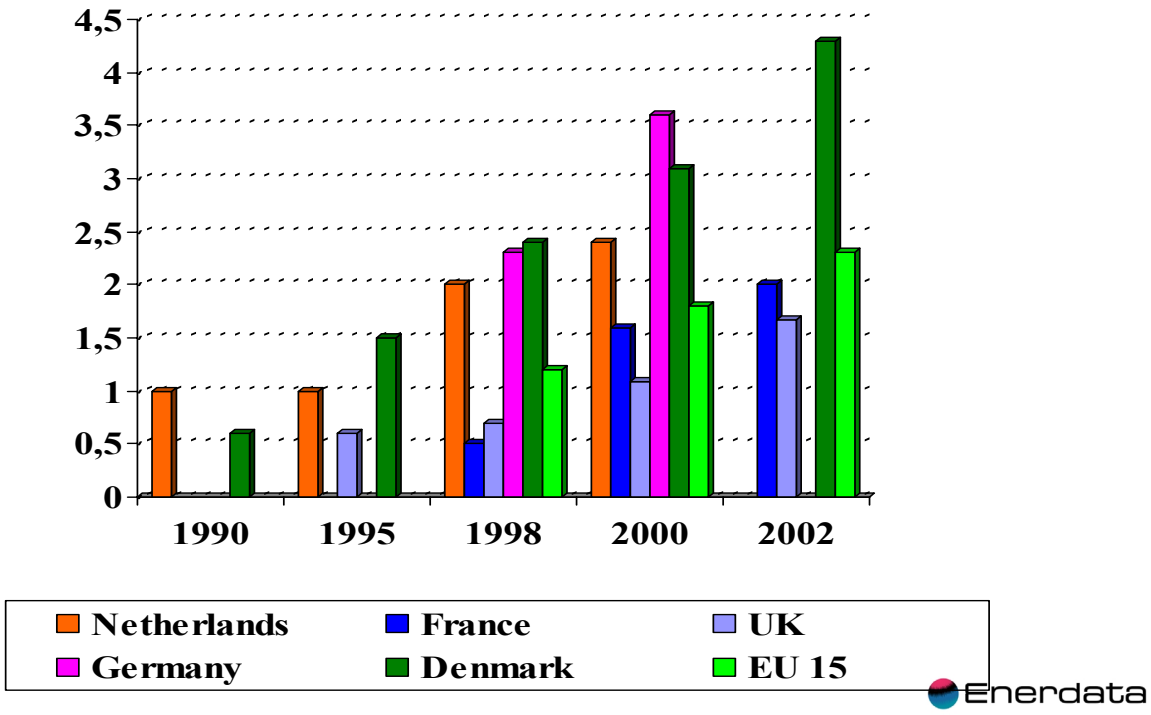
Enerdata

Diffusion of CFL lamps : market share



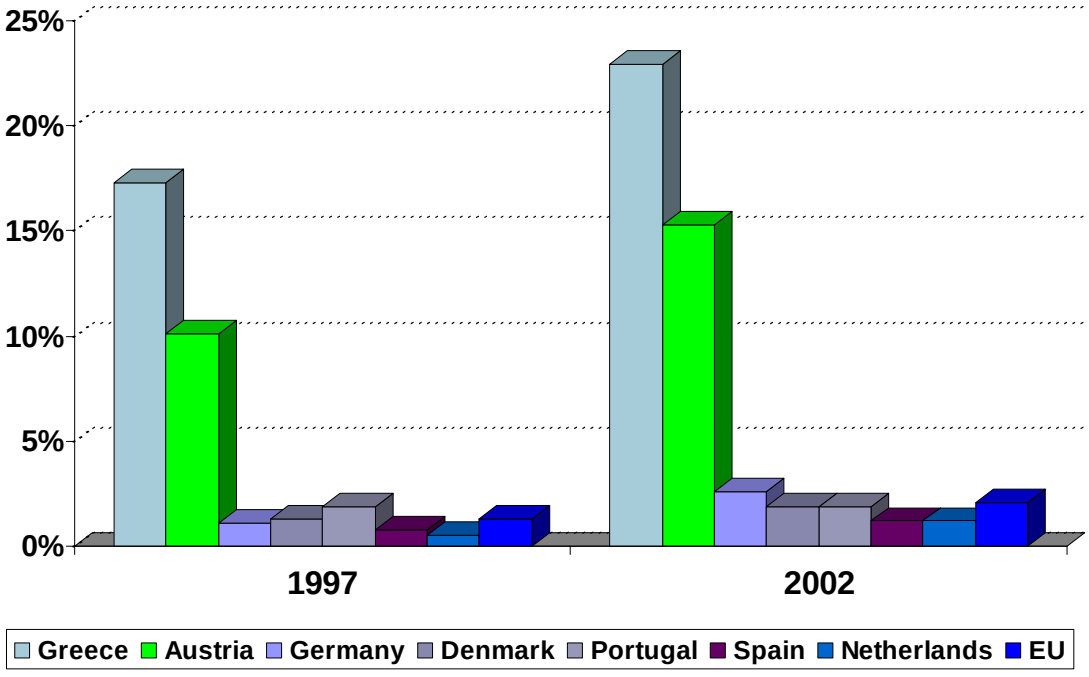
Enerdata

Diffusion of CFL lamps : number of lamps per household



Enerdata

Indicators of monitoring for water heating: % of dwellings of solar water heaters



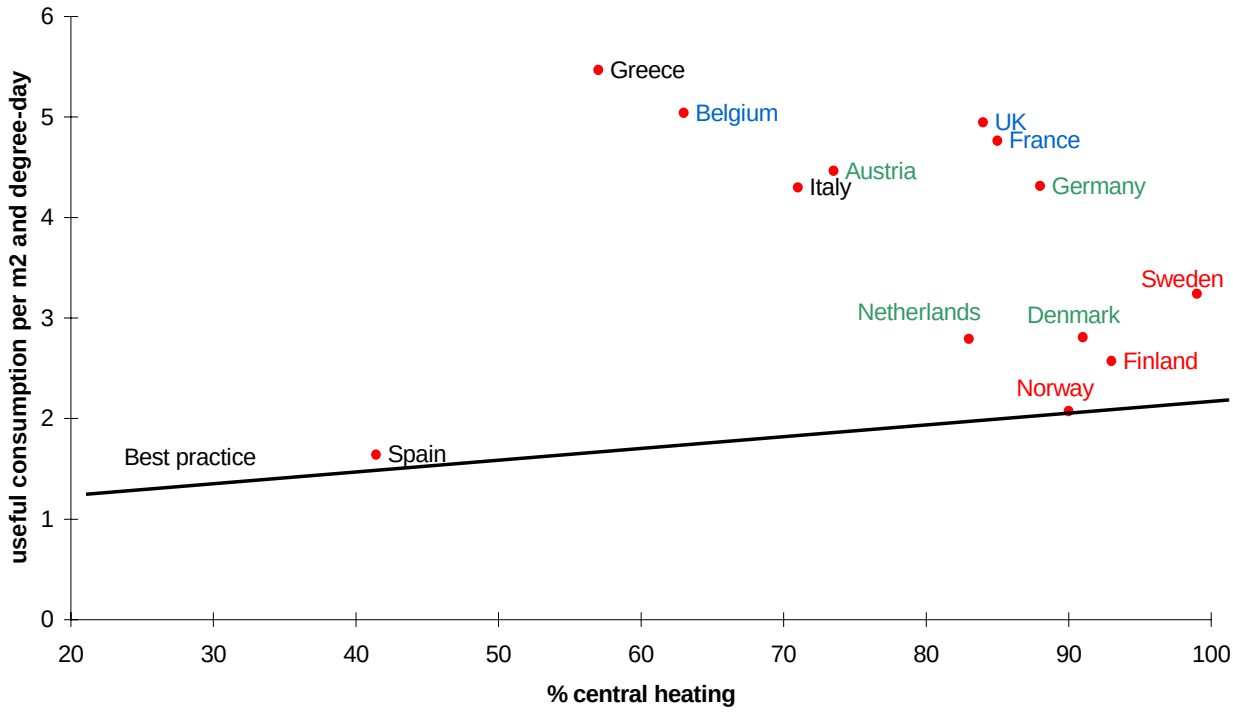
Source : own calculation from installed capacity in m2 from ObservER

Enerdata

Target indicators

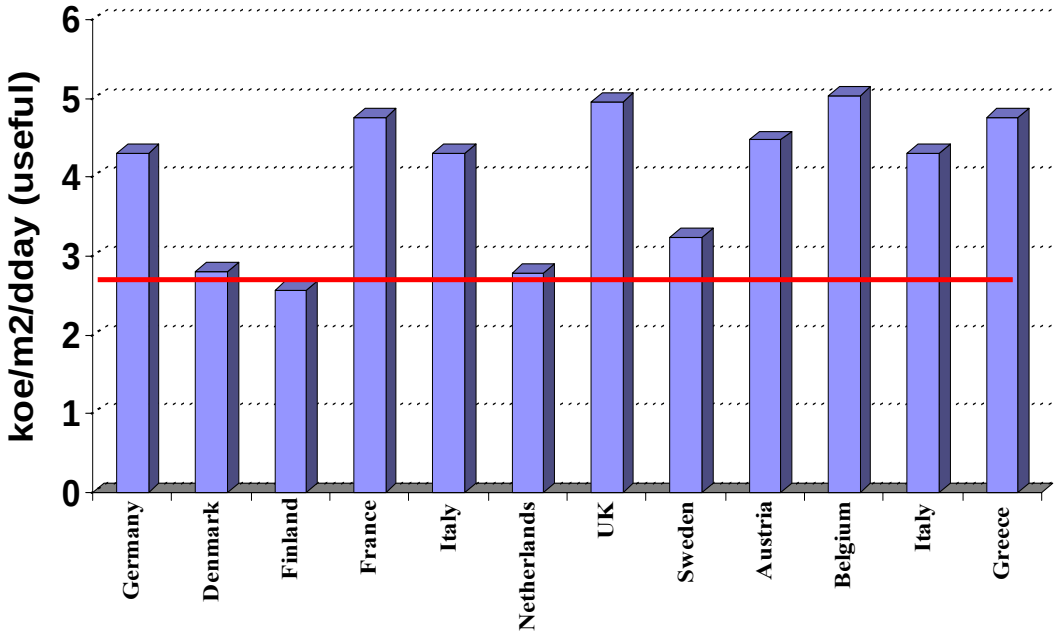
Enerdata

Household space heating : possible targets



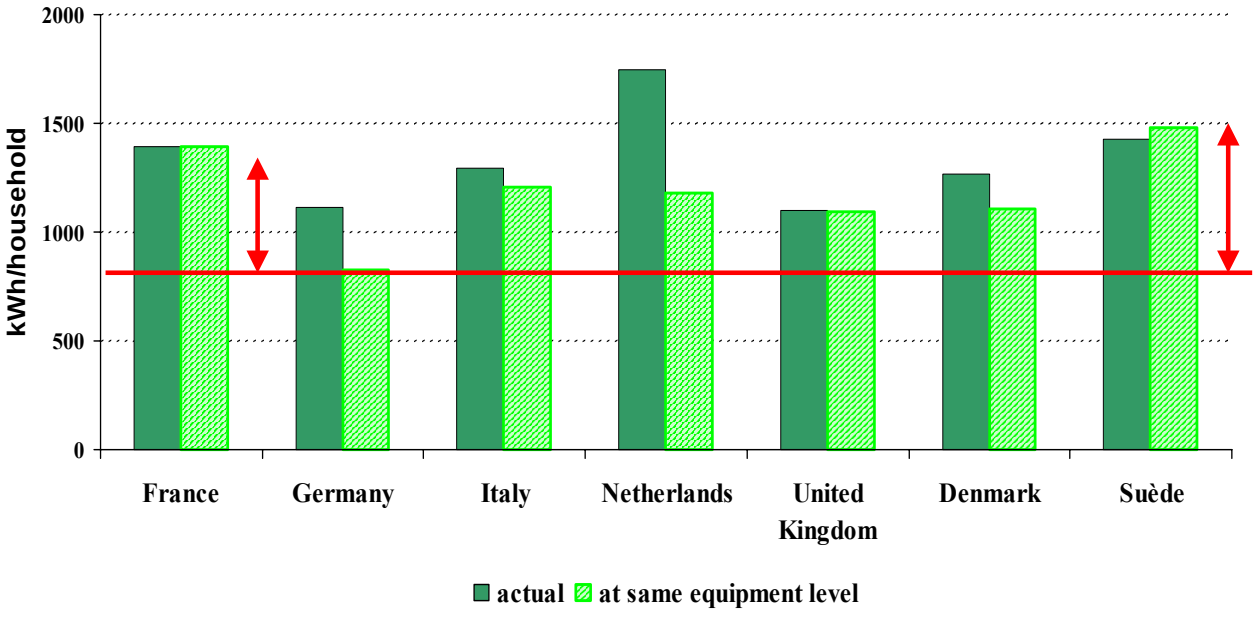
Enerdata

Household space heating : possible targets



Enerdata

Target for large electrical appliances



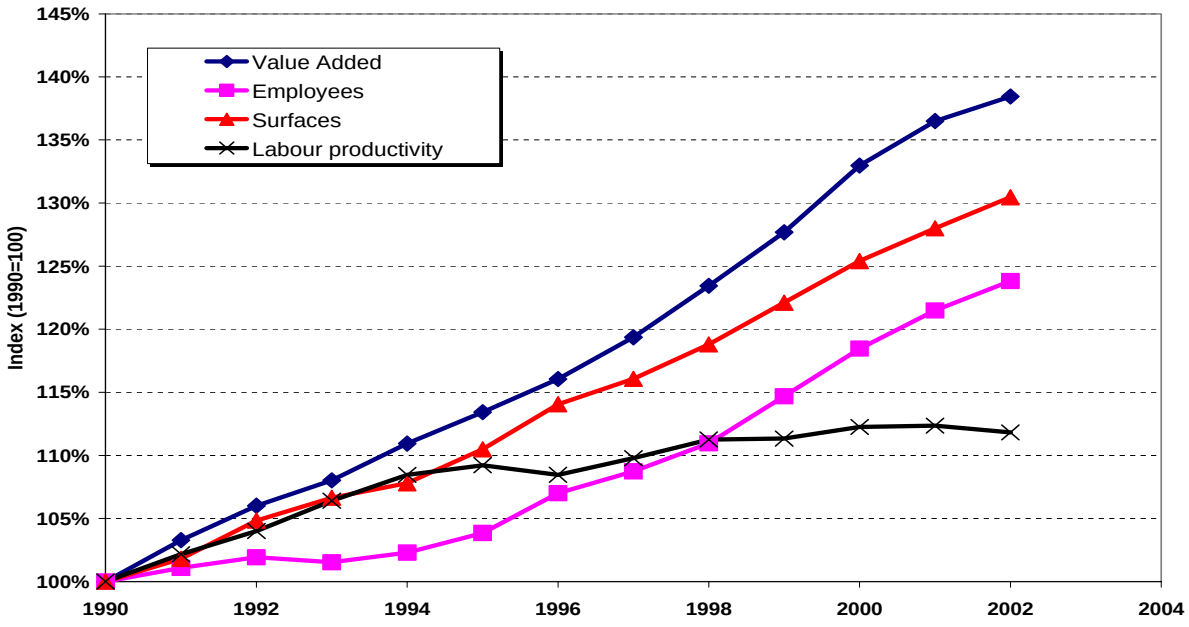
* large appliance

Enerdata

Energy efficiency trends in the service sector

Enerdata

Increase in value added by 40 %, by 30 % for space (m2) and by 25 % for employment. Labour productivity in / employee rising steadily by about 12 %(EU-15)

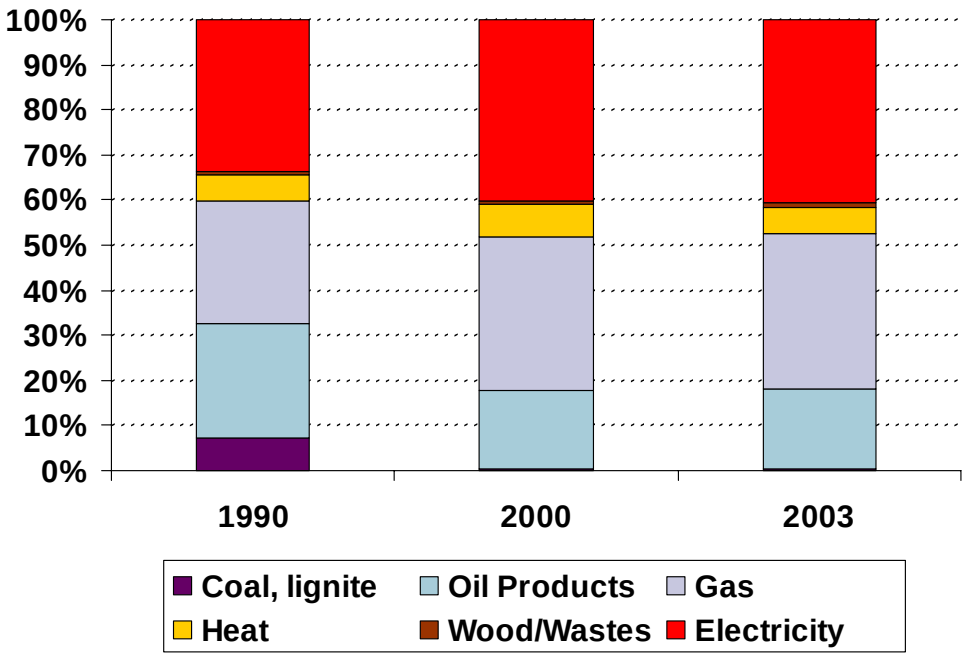


Source: Odyssee Database July 2004

Enerdata

Final consumption in the service sector (EU-15)

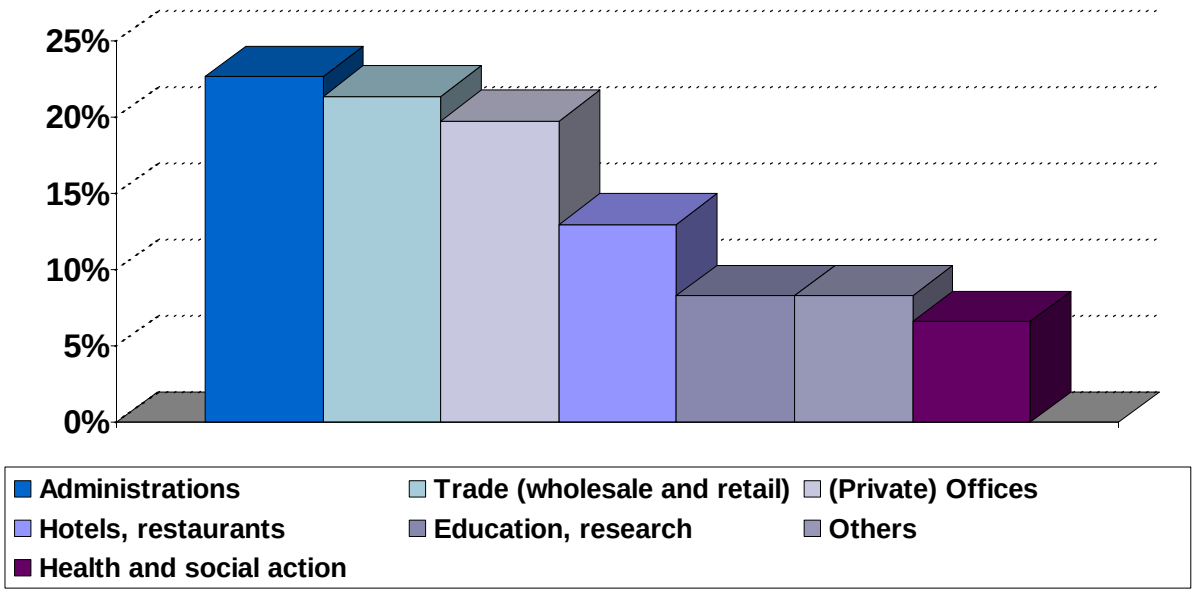
Fuel substitution in the service sector continues but also seems to be levelling off in recent years; gas and electricity meet 75% of the demand in 2003 compared to 60% in 1990



At real climate; source Eurostat

Enerdata

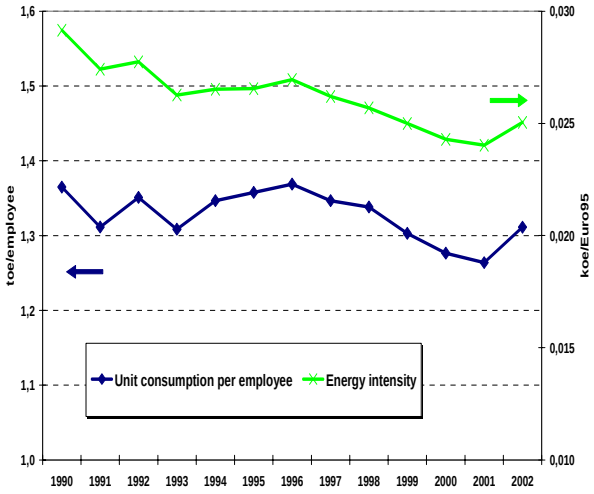
Public administrations, trade and private offices are the largest sub-sectors in terms of energy consumption

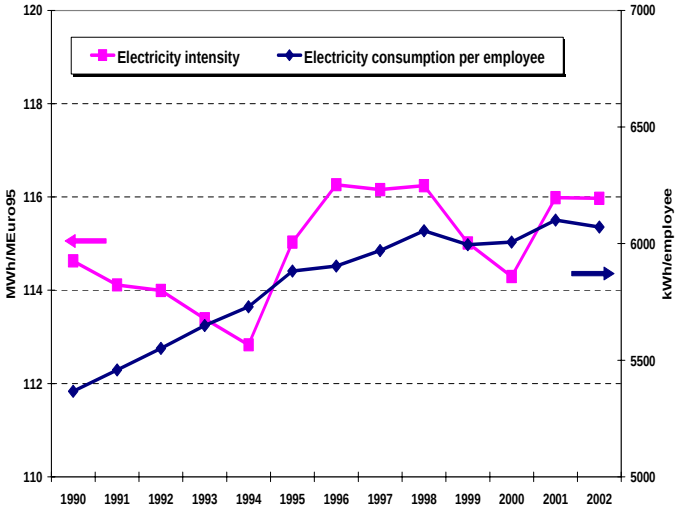


Based on samples of 7-9 countries (depending on sector) representing about 3/4 of total energy consumption (2001)

Enerdata

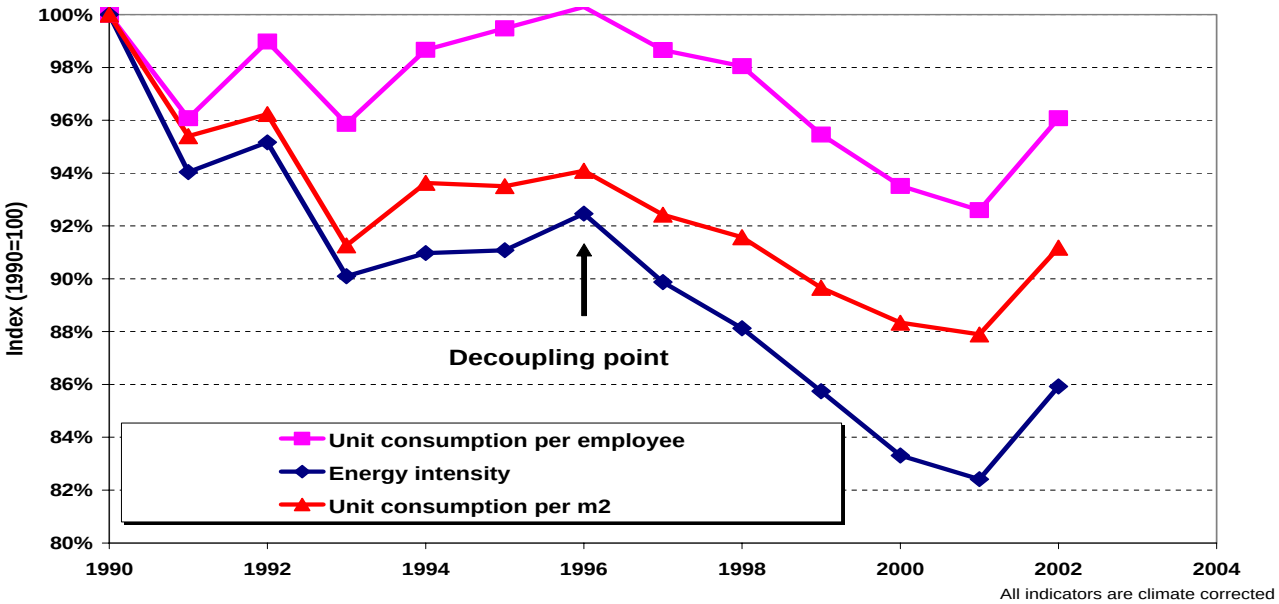
Final energy intensity decreased by 1.3 %/year (1990-2002), the unit consumption (per employee) only by 0.3 %/year





Enerdata

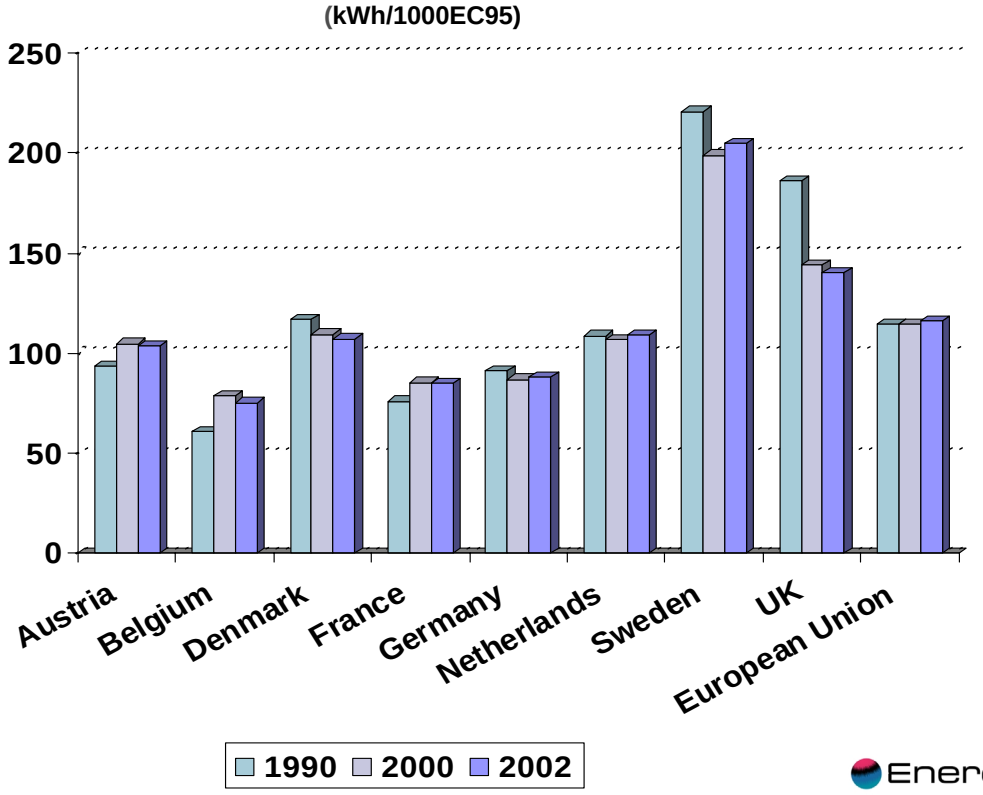
Consumption per employee only slightly decreasing ; stronger declining trend for consumption per m2 and energy intensity



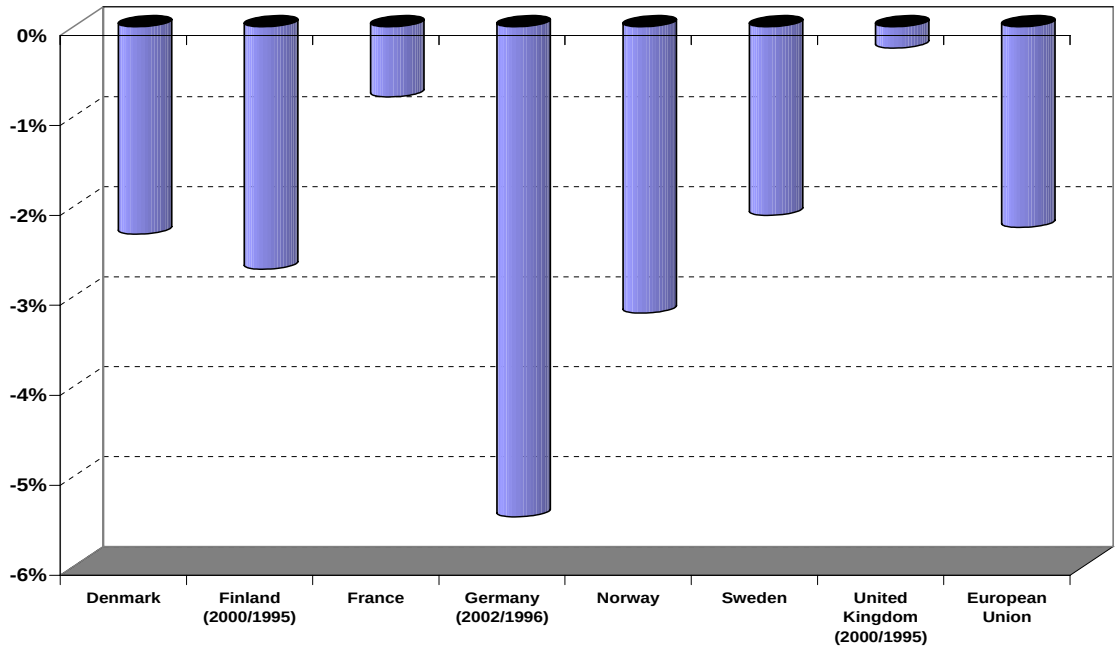
All indicators are climate corrected

Enerdata

Electricity intensity in the service sector declining: electricity consumption and activity are decoupled



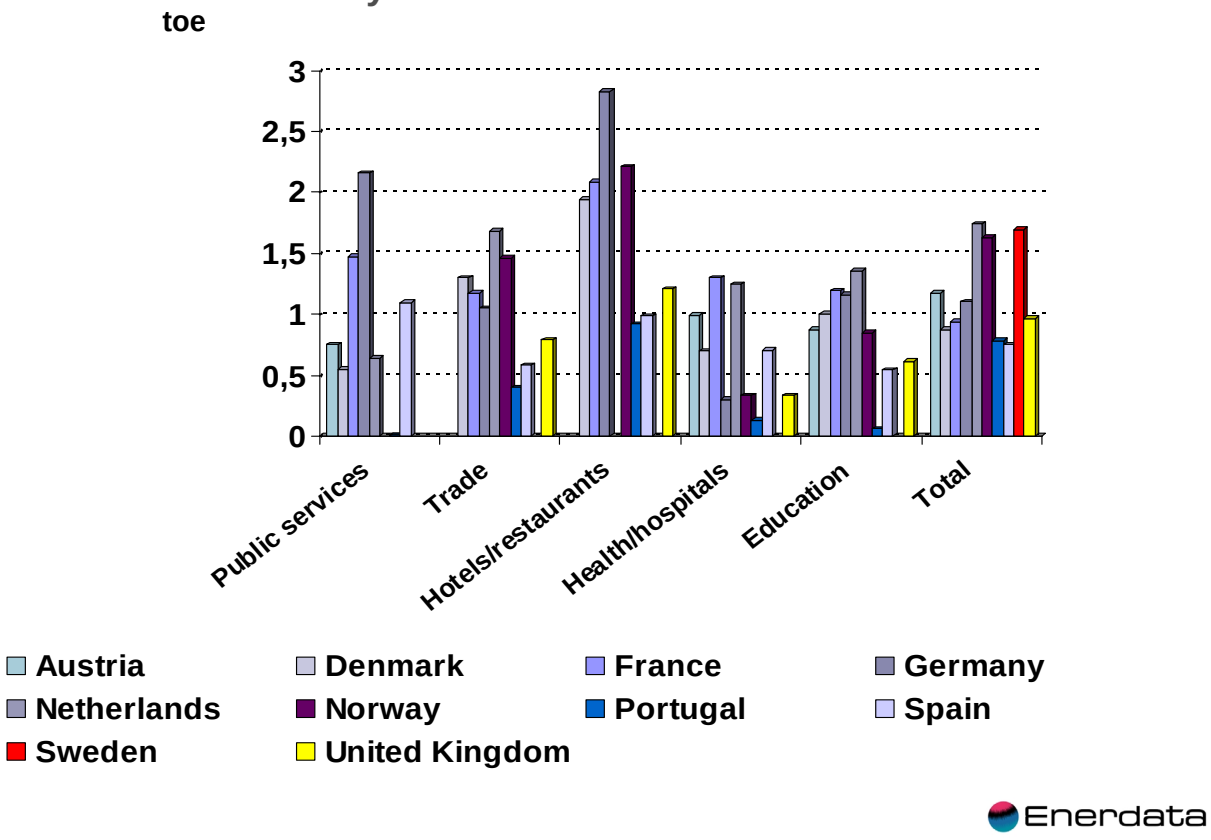
Thermal building codes seem to have had substantial impacts on reducing the fuel consumption of service sector buildings



Annual decrease unit consumption of fuels per square metre

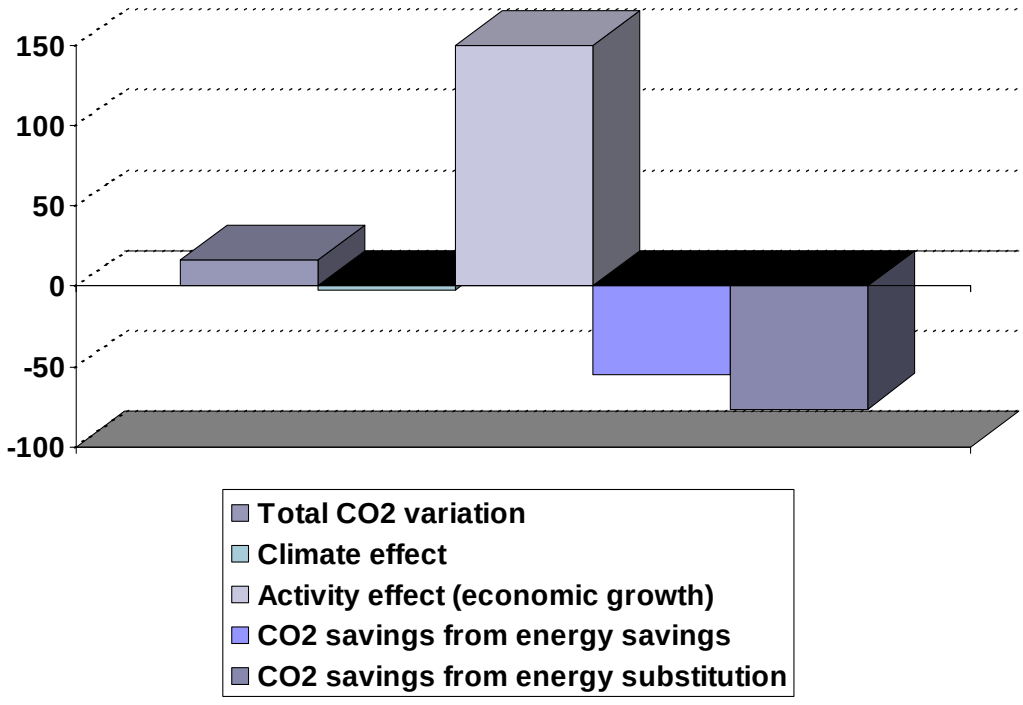
Enerdata

Energy consumption per employee in services by branch: small differences



Enerdata

Fuel substitution contributed around 60 % of the CO_2 reduction achieved between 1990 and 2002.



Enerdata

CO2 savings in the service sector in France