

Regional training on indicators « *ODYSSEE-MURE* »

2. Energy efficiency trends by sector: ODEX

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ODYSSEE DATABASE



KEY INDICATORS





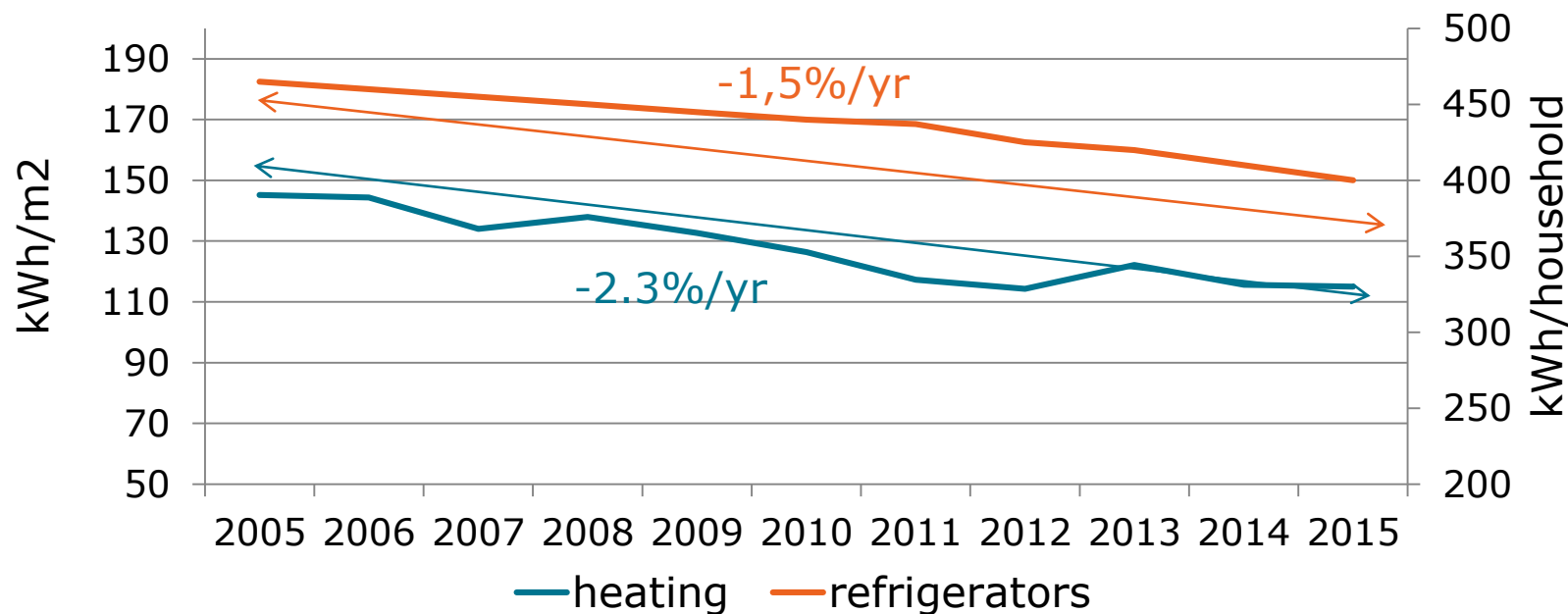
Introduction to the energy efficiency index

Measuring energy efficiency progress at the level of a sub-sector

- The ODYSSEE data base provides a variety of indicators of specific consumption, measured in **physical units**, at a detailed level:
 - ✓ By sub sector in industry (e.g. toe/ton for steel, cement) and services (e.g. kWh/employee, /per m²/per bed...),
 - ✓ By end-use/appliances for households (e.g. toe/m² for heating, kWh/household for electrical appliances and AC...)
 - ✓ By transport mode/ vehicle type in transport (e.g. km/l or pkm for cars, toe/tkm for freight ...)
- These detailed indicators can be used to assess energy efficiency progress at the level of **sub sectors**, end-uses and mode of transport.

How to measure energy efficiency progress at sector level from all these detailed indicators?

- For households, we may obtain for instance different energy efficiency trends: 1.5%/yr for refrigerators and 2.3%/yr for heating.



- The question now is: **what is the overall energy efficiency progress for households?**
- Or, in other words, how to combine the different assessments of energy efficiency progress by end-use to get one trend for the whole sector.
- This is the objective of the energy efficiency index, called **"ODEX"**.

An energy efficiency index to measure energy efficiency progress at sector level

- In ODYSSEE, an energy efficiency index is calculated at **sector** level (i.e. industry, transport, households) and for all final consumers to assess energy efficiency progress.
- The energy efficiency index by sector **combines** the trends observed in the various indicators of specific energy consumption by sub-sector or end-use, by **weighting** indices of specific consumption by sub-sector (or end-use) with the share of each sub-sector in the sector's energy consumption.
- Indices are used to enable to express specific consumption by sub-sector or end-use **in different physical units** so as to be as close as possible to energy efficiency evaluation (e.g. toe/ton, toe/IPI for industry, toe per pkm or tkm in transport, toe/m² or kWh/appliance for households).

Calculation of energy efficiency index in 3 steps

1. Calculation of energy efficiency indicators by sub-sector from energy consumption and activity data by sub-sector and conversion in **indices** ;
2. Calculation of **weighting factors** by sub-sector, i.e. shares of sub-sector's consumption in total consumption of the sector;
3. Calculation of the energy efficiency index for the sector as a whole.

Principle of calculation of energy efficiency index*

| 1. Specific consumption (Index by sub-sector) | 2010 | 2011 | 2012 | 2013 |
|--|---------------|--------------|--------------|--------------|
| Chemicals (toe/100) (index) | 8.5 (100) | 8.3 (98) | 8.2 (96) | 8.2 (96) |
| Steel (toe/tonne) (index) | 0.30 (100) | 0.29 (97) | 0.26 (87) | 0.25 (83) |
| 2. Energy consumption (Weight) | | | | |
| Chemicals (Mtoe) (%) | 20 (50) | 20 (48) | 20 (44) | 22 (46) |
| Steel (Mtoe) (%) | 20 (50) | 22 (52) | 25 (56) | 26 (54) |
| 3. Sector index | 100 | 97.4 | 90.9 | 88.6 |

$$IE_{2011} = IE_{2010} \times (98 \times 0.48 + 97 \times 0.52) = 97,4$$

$$IE_{2012} = IE_{2011} \times (96/98 \times 0.44 + 87/97 \times 0.56) = 90.9$$

$$IE_{2013} = IE_{2012} \times (96/96 \times 0.46 + 83/87 \times 0.54) = 88,6 \rightarrow \text{Energy efficiency improvement of 11.4\% between 2010 and 2013 (=100-88.6)}$$



Gross index vs technical index: definition of ODEX

Exact calculation formula for the energy efficiency index (1/2)



The final **calculation method** was defined so as to have the same value of energy savings (see Annex),

- Whether they are calculated as the sum of energy savings by sub-sector i (or end-use),
- Or derived directly from the energy efficiency index:

$$ES = E \times ((100/EEDEX)-1)**$$

***The energy efficiency index at sector level is equal to the ratio between the energy consumption at year t (E) and a fictive consumption that would have happened without energy savings (ES) → $EEDEX = E/(E+ES)*100$ and $ES = E \times ((100/EEDEX)-1$*

Energy efficiency index calculation: from gross to “technical” value? (2/2)

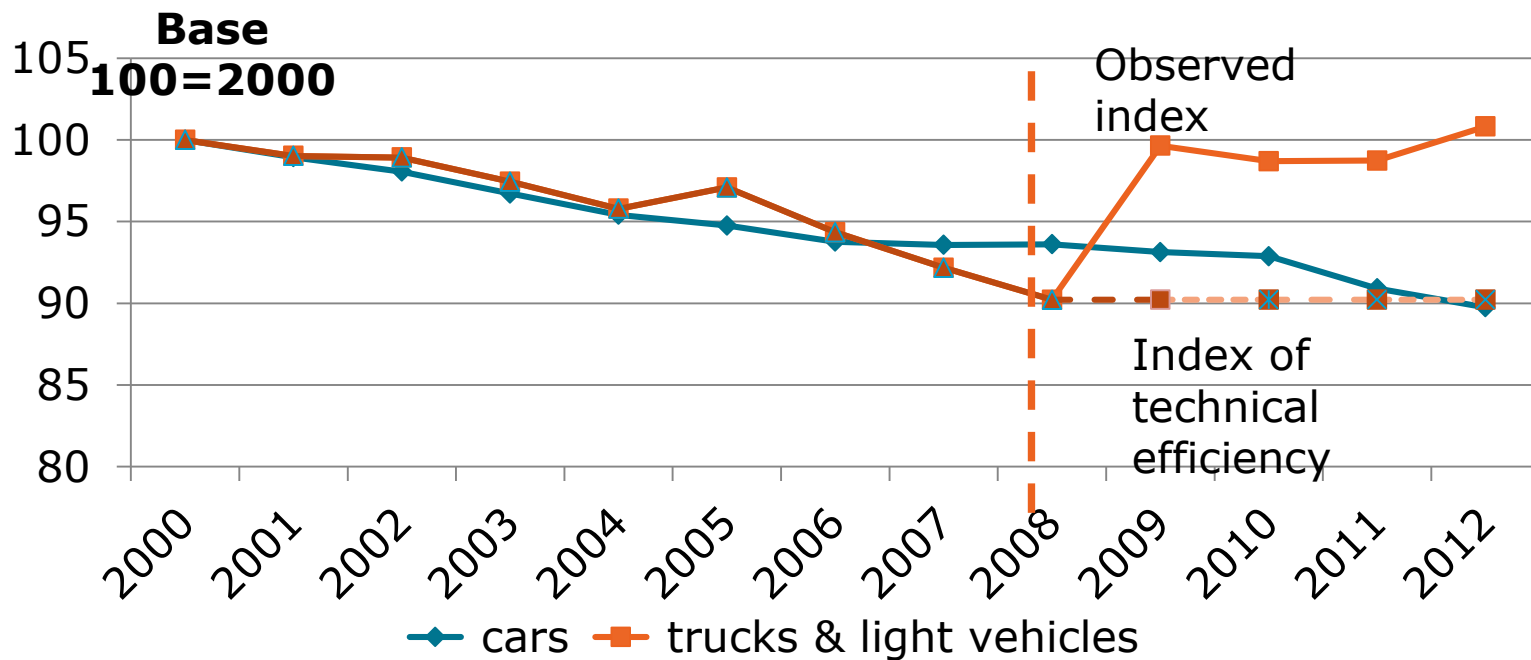


- Two adaptations are done in ODYSSEE to the gross value of the energy efficiency index to derive the final value, called ODEX:
 - ✓ Only technical efficiency is taken into account, i.e. ODEX is corrected of negative efficiency trends due to inefficient operation of facilities or behaviors : an increase in the indices by sub-sector is not associated to a decrease in efficiency, but as no energy efficiency progress*.
 - ✓ ODEX is expressed for each year as a 3 years moving average to smoothen the trends.
- Two values are published in the ODYSSEE data base:
 - ✓ The gross energy efficiency index
 - ✓ The technical energy efficiency index or ODEX
- All reporting and analysis in ODYSSEE publications and tools use the technical ODEX.

Technical versus gross energy efficiency index : case of road freight transport

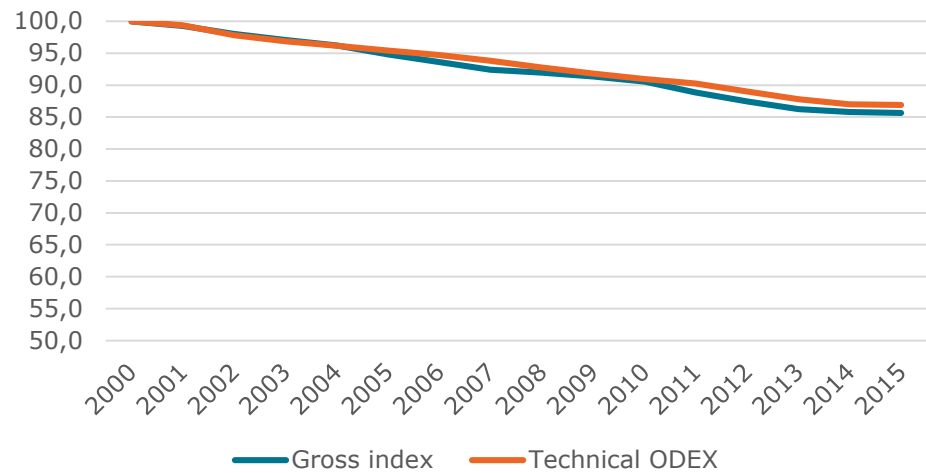


The technical energy efficiency index is corrected of negative efficiency trends due to inefficient operation of trucks : an increase in the gross index is not associated to a decrease in efficiency, but as no energy efficiency progress.

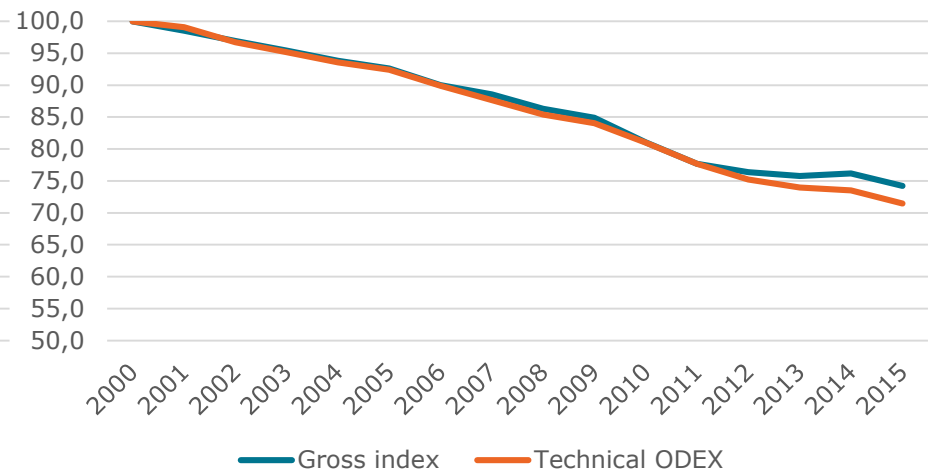


Gross energy efficiency index vs technical index (ODEX): EU

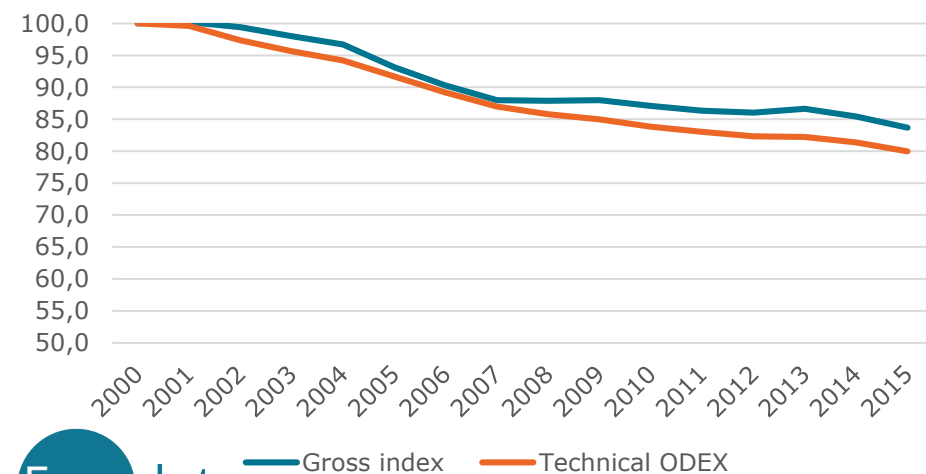
ODEX transport (EU)



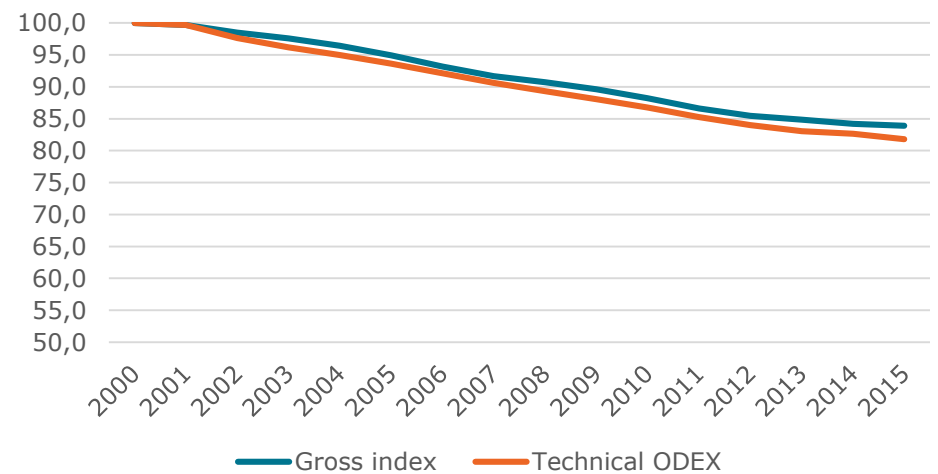
ODEX Households (EU)



ODEX industry (EU)

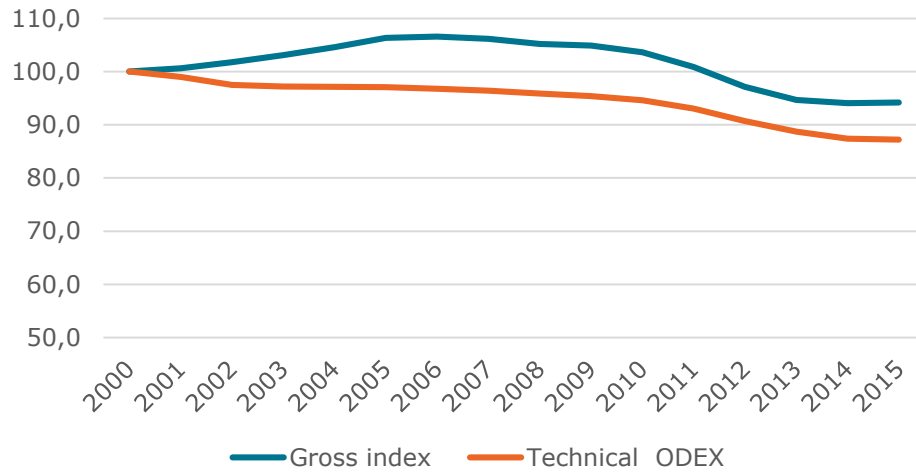


Global ODEX (EU)

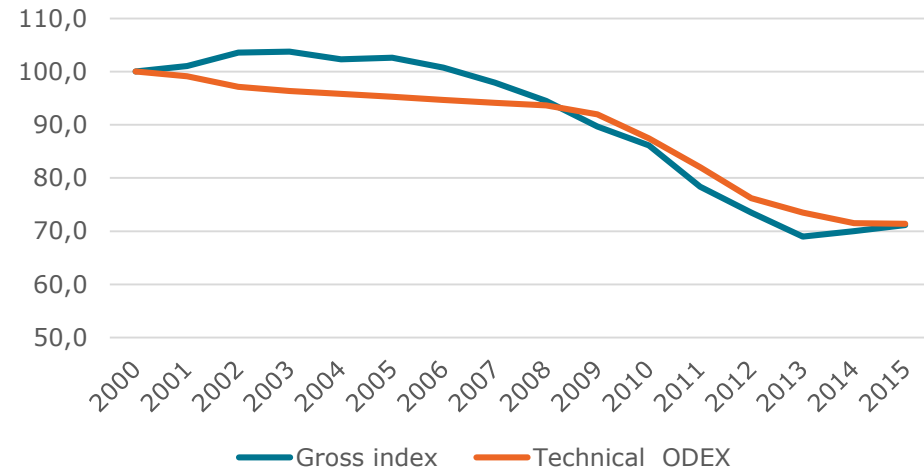


Gross energy efficiency index vs technical index (ODEX): Spain

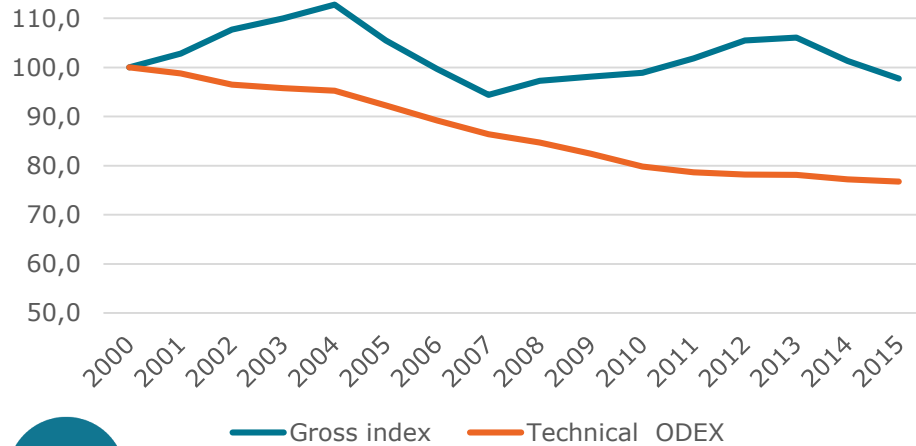
Transport ODEX (Spain)



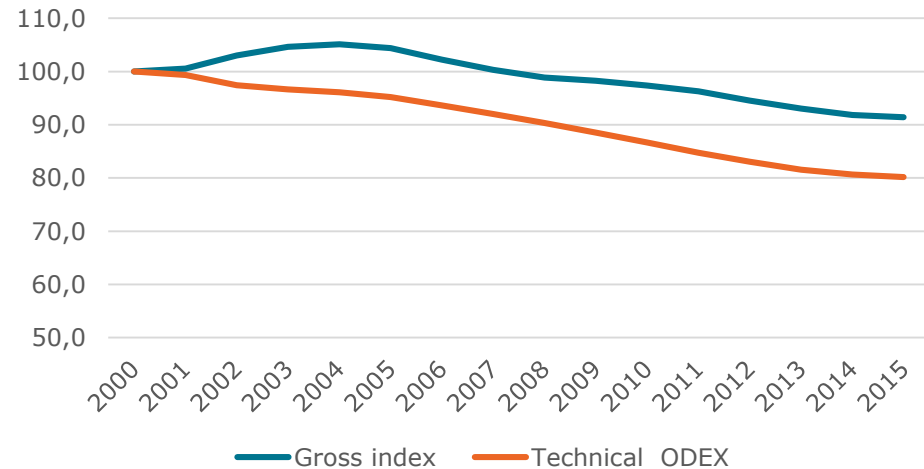
Households ODEX (Spain)



Industry ODEX



Global ODEX



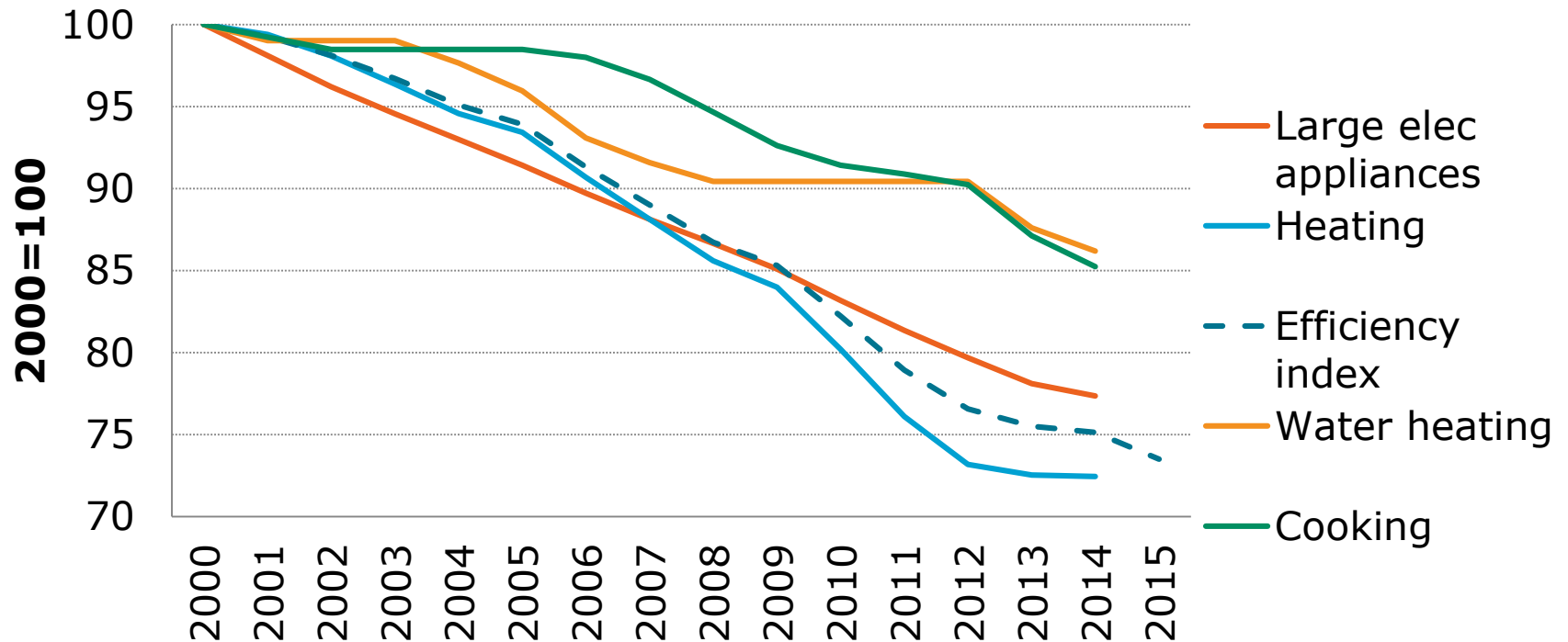


Energy efficiency trends in the EU based on ODEX

Example of ODEX: households in the EU



- ODEX equal 73.5 in 2015 → households energy efficiency has improved by 26.5% at EU level between 2000 and 2015 (or 2%/year on average).

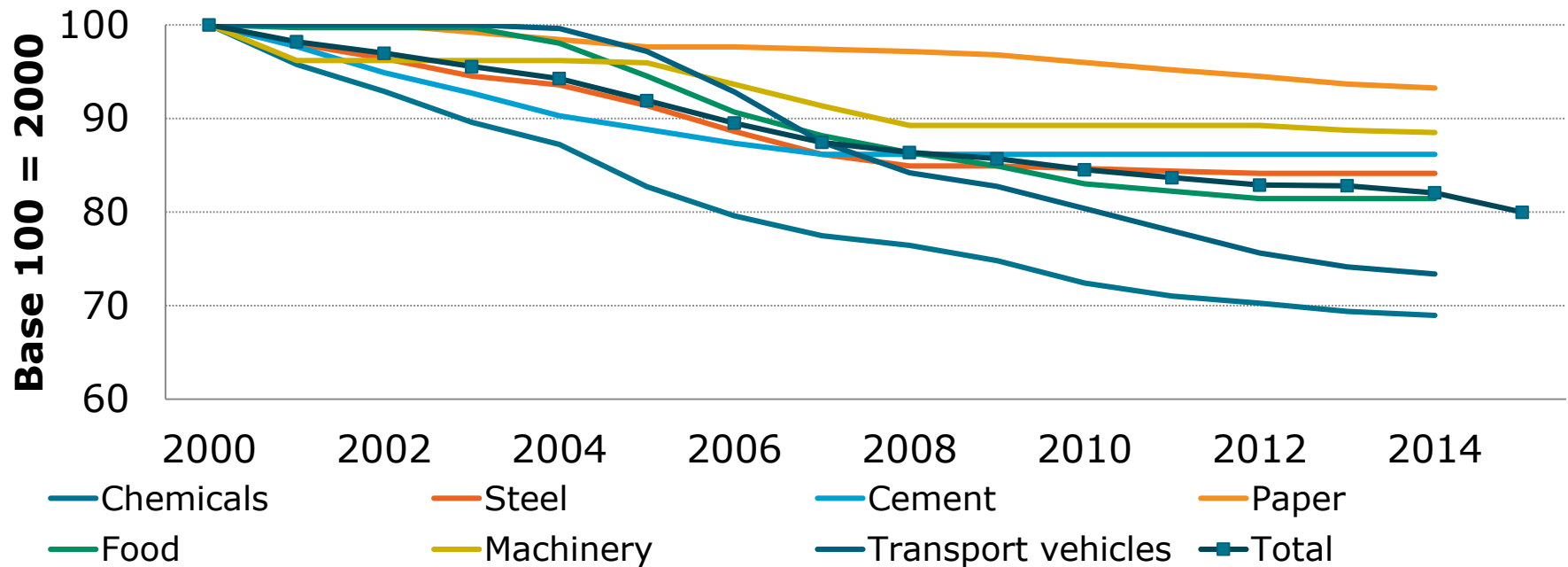


Only main end-uses shown; ODEX calculated on the basis of 8 end-uses/appliances : heating (toe/m²) (separation new/ existing dwellings), water heating, cooking (toe/dwelling), refrigerators, freezers, washing machine, dishwashers (k

Example of ODEX: industry in EU

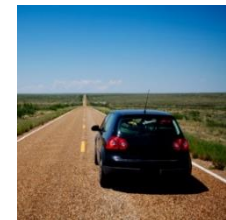


- Energy efficiency has improved by 1.4%/year since 2000 or 17%).
- Rate of improvement **divided by 2** since the economic crisis (0.9%/year since 2007 compared to 1.9%/year before).

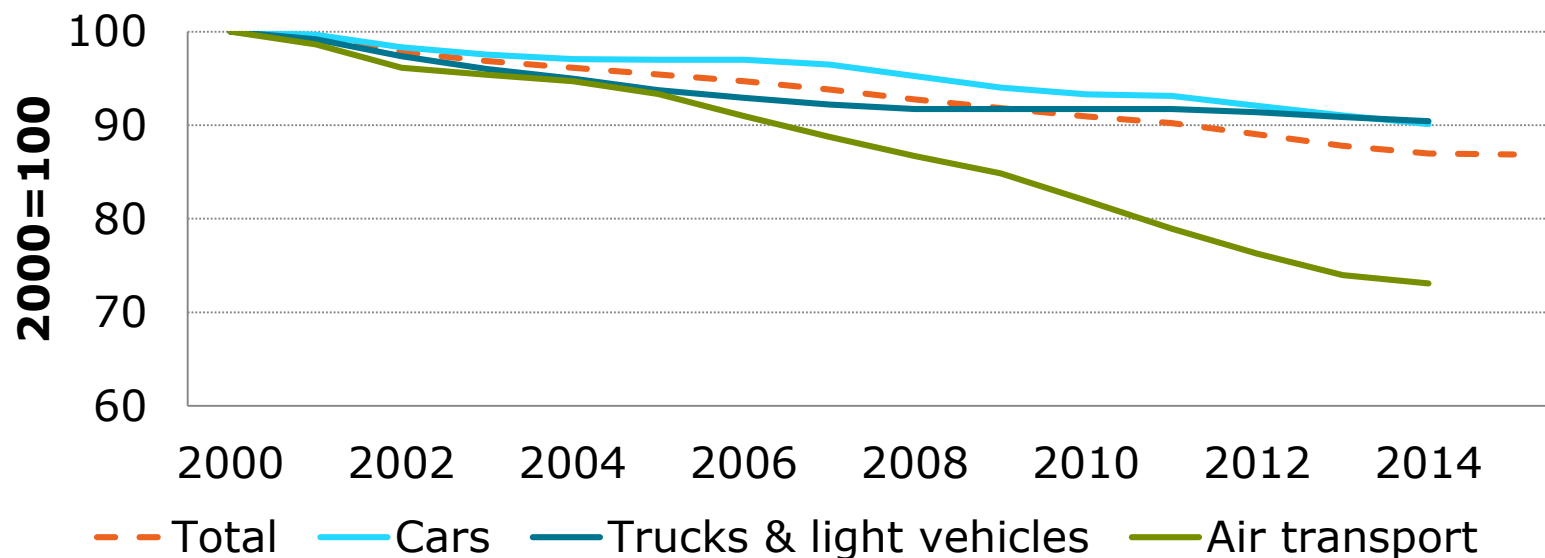


ODEX measured at the level of 14 branches based on specific consumption per ton for steel ,cement and paper; consumption per IPI for other branches.

Example of ODEX: transport in the EU



- The energy efficiency of transport improved by 0.9%/year in the EU since 2000 (or 13% compared to 2000 level).
- Greater progress was achieved for airplanes.
- Energy efficiency progress has slowed down for trucks and light vehicles since 2007 due to a less efficient operation of trucks (less loaded and empty running).



ODEX calculated on 7 modes: cars (koe/pkm), trucks & light vehicles (toe per tkm), air (toe per passenger); rail, water (toe/ tkm); motorcycles, buses (toe/vehicle).

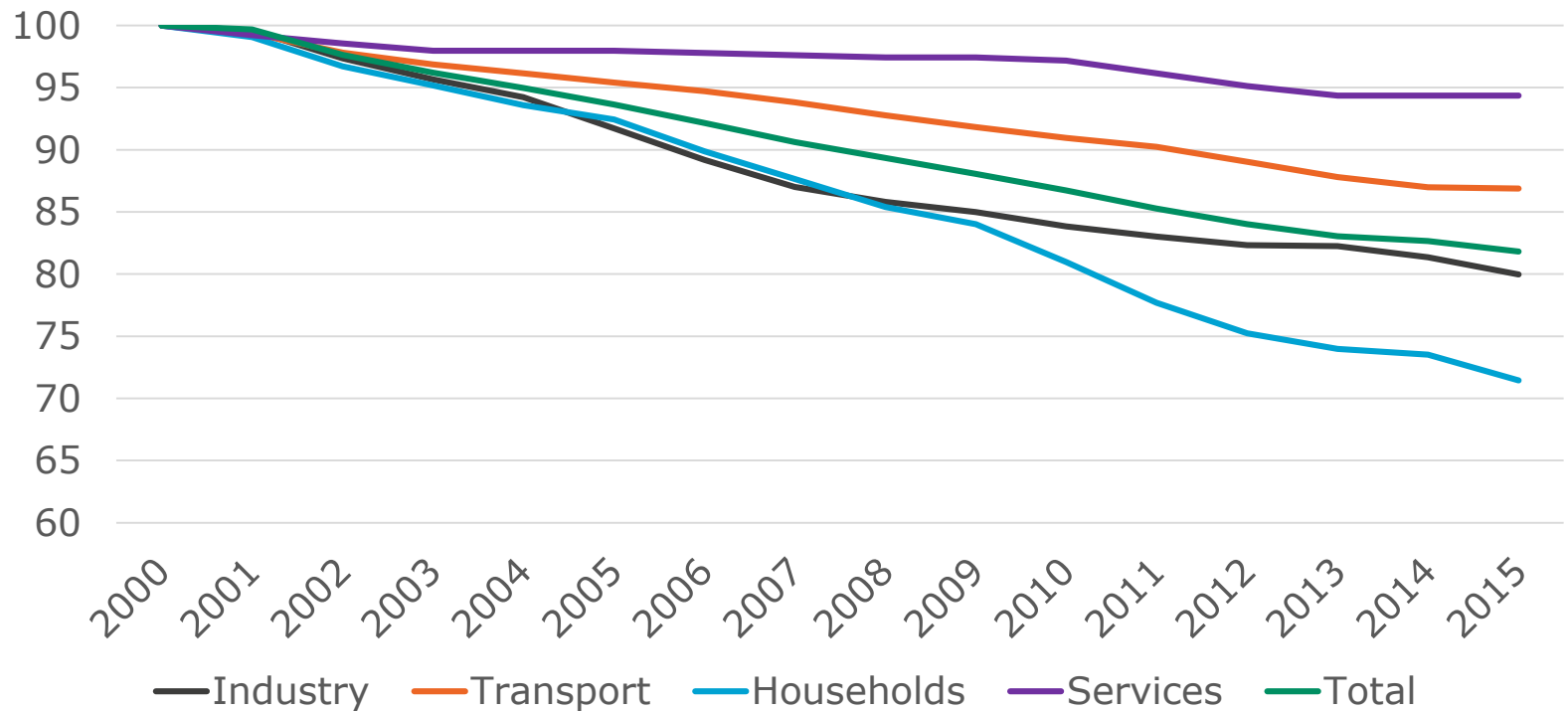
Total ODEX for final consumers



- Energy efficiency progress for final consumers is then evaluated as a weighted average of ODEX by sector for industry, transport, households and services and the share of each sector in the final energy consumption.
- The indicators used, plus the high level of disaggregation enable to remove structural changes or other factors that have nothing to do with energy efficiency (e.g. increase in comfort or equipment ownership, structural changes in industry, climate variations) → **it is much closer to energy efficiency than energy intensity.**

- Energy efficiency of final consumers improved by **1.3%/year** between 2000 and 2015 with a **slight slow down** (from 1.4%/yr before 2007 to 1.2% /yr since 2010).
- **Larger gains** for households while regular but limited improvement in transport (1%/year).

Energy efficiency index (ODEX) for final consumers (EU)



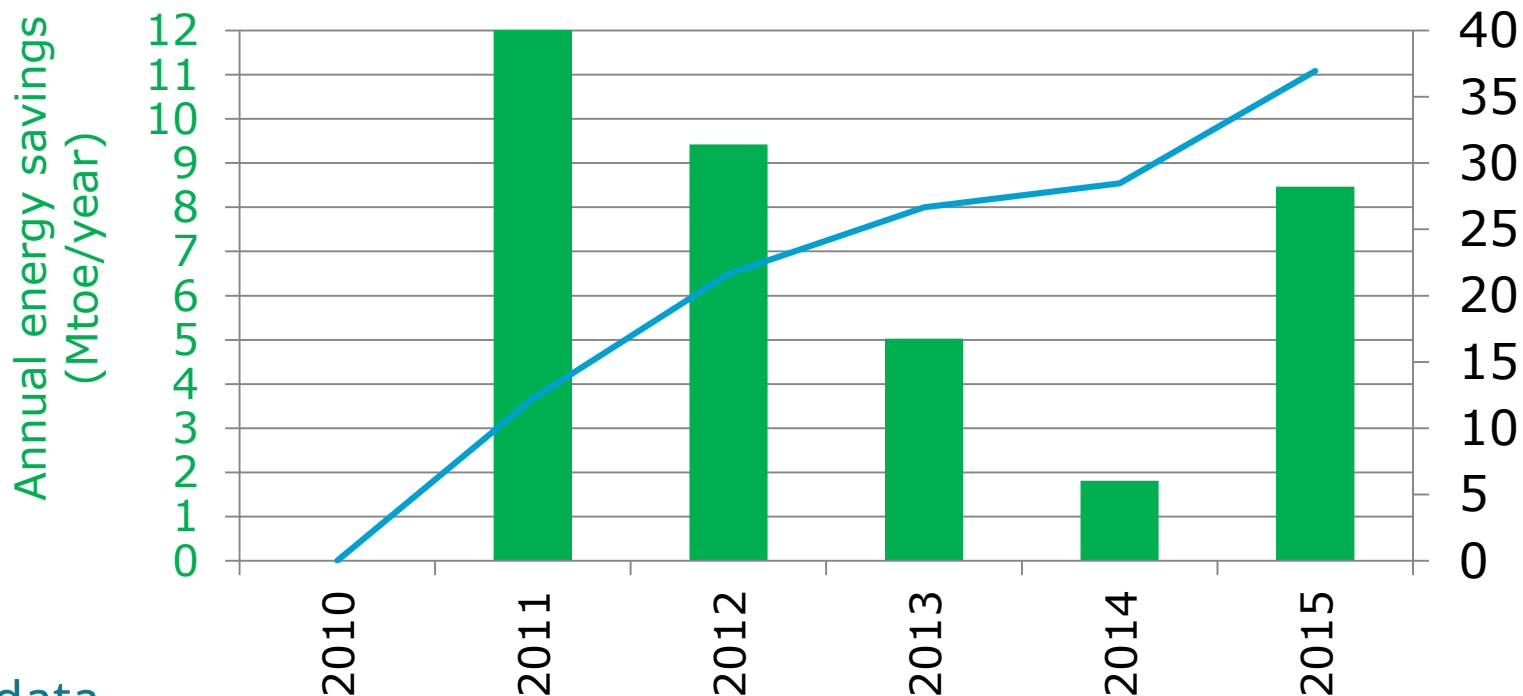


Energy savings at sector level in ODYSSEE

Energy savings in ODYSSEE

- In ODYSSEE, energy savings are **first** calculated as **additional annual energy savings in reference** to the previous year (**green bar**).
- They are then calculated **over a period in reference to a base year** (e.g. 2010) (**blue line**).

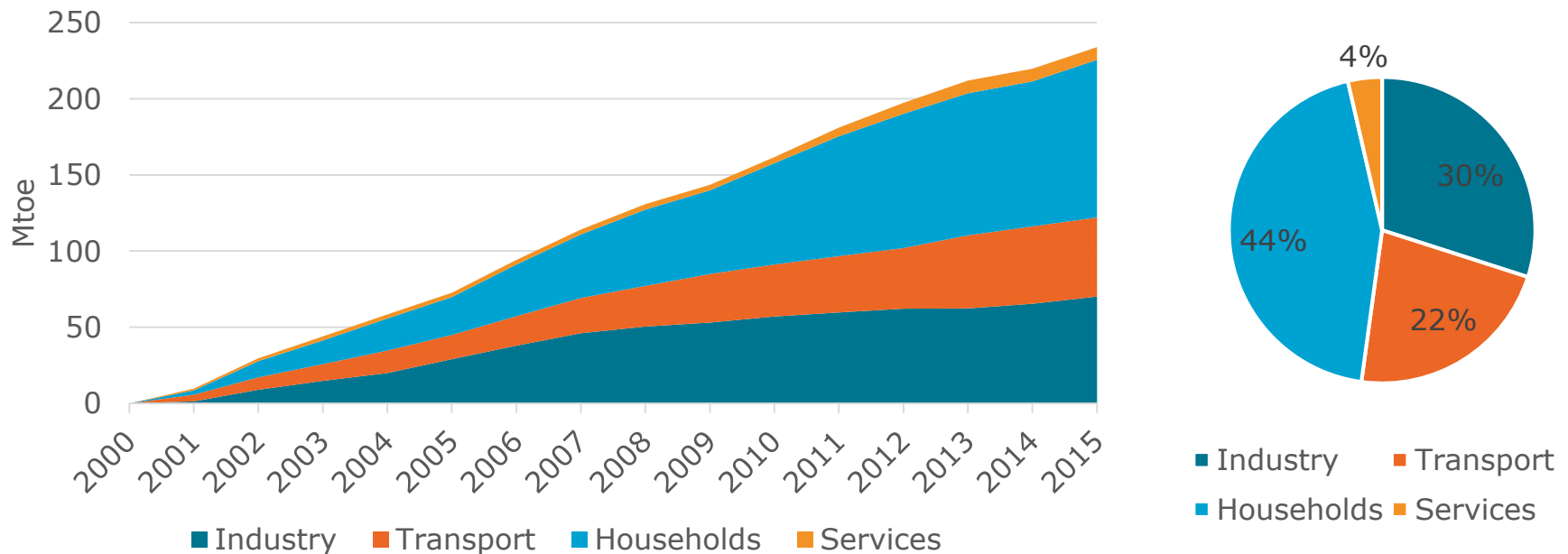
Different calculation of energy savings : case of households (EU)



Total annual final energy savings at EU level

- Around 230 Mtoe energy savings in 2015 compared to 2000 (i.e. 20% of final energy consumption).
- Without these savings the final energy consumption would have been 20% higher in 2015.
- Most of these savings come from households (44%), 30% from industry, 22% from transport and 4% from services.

Annual energy savings for all final consumers compared to 2000 (EU)



Energy savings by period

- In 2015, annual savings for households reached 105 Mtoe compared to 2000: without savings 2000, energy consumption would have been 105 Mtoe higher in 2015) (green bar): .
- Cumulated savings for households since 2000 amount to 800 Mtoe (right axis in blue): (i.e. total cumulated quantities of energy not consumed over the period as defined in Article 7 of EED).

Energy savings over a period: case of households (EU)

