ODYSSEE-MURE

Enerdata intelligence + consulting

Energy efficiency trends in buildings in the EU

Odyssee-Mure webinar series on Energy Efficiency
organised by Leonardo ENERGY

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AGENCE DE LA TRANSITION ÉCOLOGIQUE

About ODYSSEE-MURE

- This webinar is organized in the framework of the ODYSSEE MURE project, that is supported by the H2020 programme of the European Commission. The project is coordinated by ADEME, with the support of Enerdata and Fraunhofer-ISI. www.odyssee-mure.eu
- The webinar relies on data and energy efficiency indicators prepared in the framework of the project and disseminated in a database, called **ODYSSEE,** and in 5 data tools.
- ODYSSEE covers 31 countries*. It is updated up to 2018 from national sources and completed with **early estimates for 2019****.
- The consumption data correspond to the final energy or delivered energy.

28 EU Member States (UK included)+ Norway, Serbia and Switzerland

*** see methodology at https://www.odyssee-mure.eu/publications/other/early-estimates-methodology.html*

Outline

- Introduction
- Energy consumption trends
- Energy efficiency trends
- Conclusion

Introduction

Introduction

- Why is the building sector so relevant?
  - In 2018, buildings account for:
    - 43% of the final energy consumption and 60% of the electricity consumption in the EU-28
    - about 40% of the EU's CO2 emissions related to energy consumption
  - The European Commission states that "currently, ~75% of the building stock is energy inefficient yet almost 85-95% of today's buildings will still be in use in 2050."*

➔ There is a specific need of ambitious policies and measures (PAMs) focusing on buildings to:

➔ meet the targets set out for 2030

➔ making Europe climate neutral by 2050.

* *https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en*

Introduction

Policies and measures (PAMs) designed at the European level (EPDB, renovation wave, …) are declined at the country level (for ex. long term renovation strategies, NECPs…).

The monitoring of these PAMs using appropriate indicators is an essential success factor.

Such indicators help monitoring the impacts of PAMS at the EU or national level. They may highlight the need to review the way PAMs have been designed or their level of ambition.

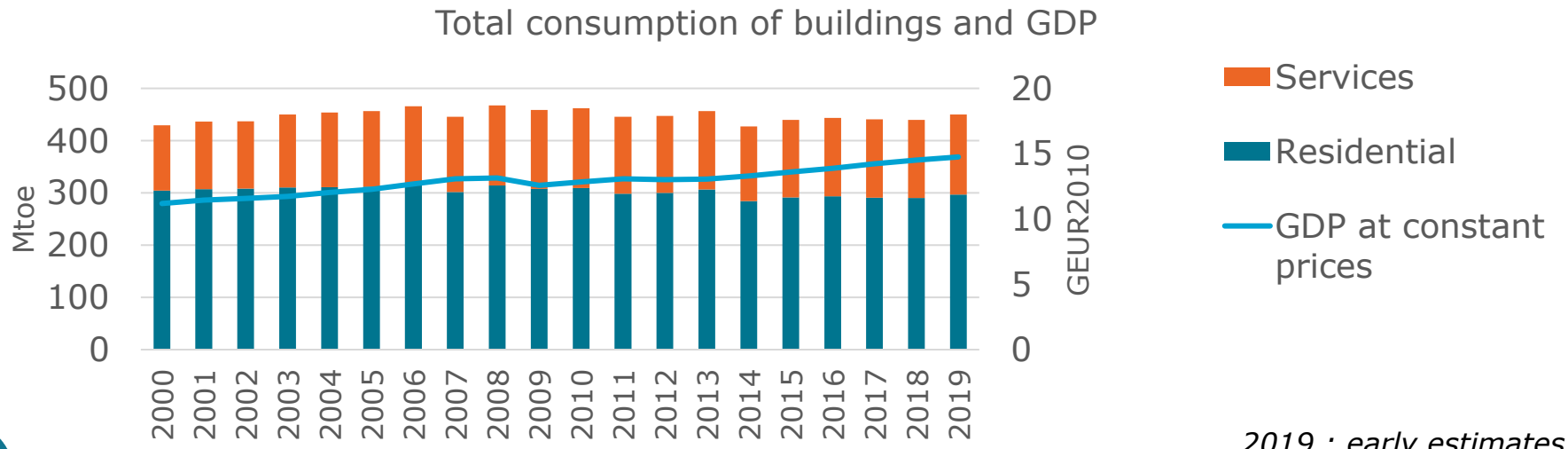
In this presentation, we will present such indicators (Odyssee database) showing trends of energy consumption and energy efficiency. Decomposition analysis will be presented to explore the observed variations of energy consumption in buildings over the last two decades.

Energy consumption trends

Energy consumption : overview

In most European countries, buildings absorb the largest share of consumption sector (43% at EU level).
Their consumption is stable since 2014 while GDP has risen by ~1.5%/year (2014-2019). This follows a decline of consumption after the financial crisis (-1.5 %/year from 2008-2014).

Two thirds of the buildings consumption are for residential buildings.
At the EU level, the share of services has grown from 29% in 2000 to 33% in 2008 and is rather stable since then.



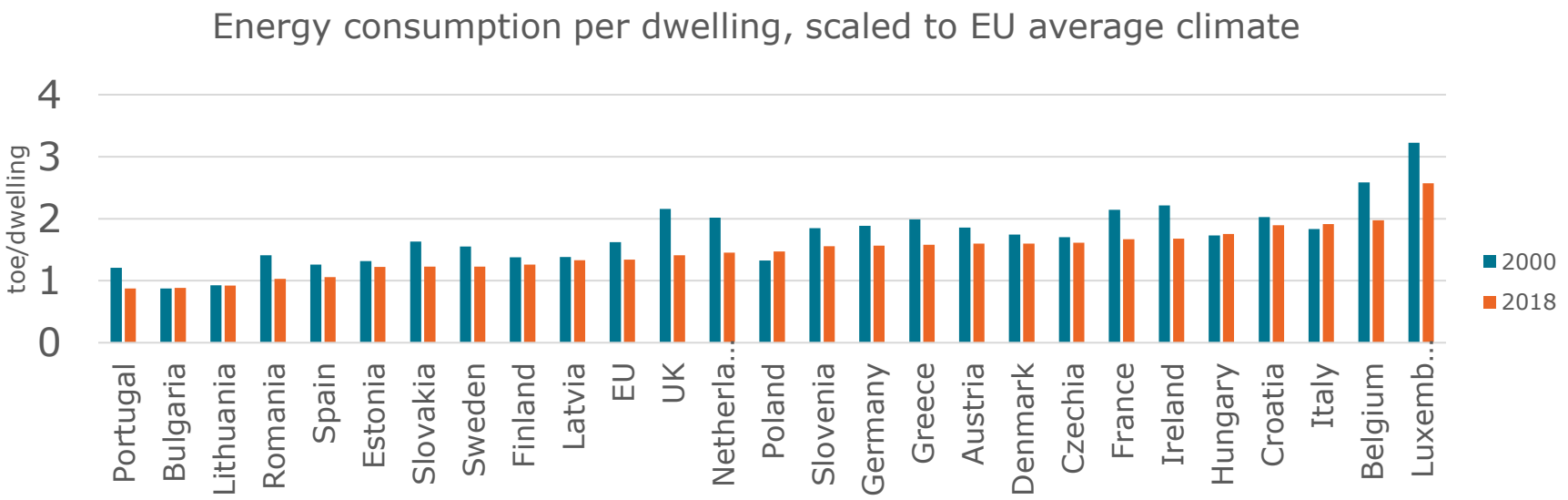
2019 : early estimates

Energy consumption trends in the residential sector

Energy consumption trends in the residential sector

In 2018, the average energy consumption in the EU is 1.3 toe/dwelling. There are large disparities among countries, even after adjustment to the same climate, ranging from 0.9 toe/dw in Portugal to 2.5 times more in Luxembourg (2.5 toe/dw).

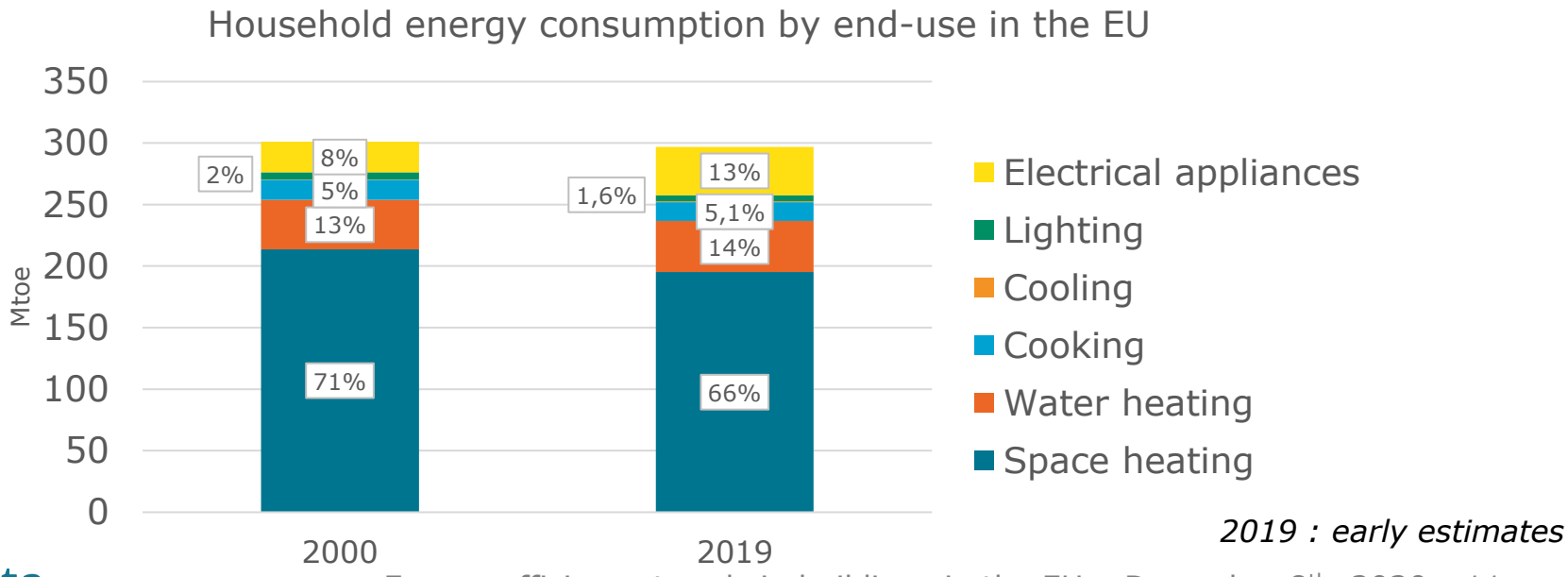
This unit consumption is decreasing in all countries since 2000 (-1.1%/year on the EU scale), except in Bulgaria, Poland, Hungary and Italy.



Energy consumption trends in the residential sector

Between 2000-2019, declining trends are observed for space heating, the dominant end-use with 66% of the households consumption and cooking (only 5% of the total) (-0,5/%year and -0.3%/year respectively).

Over the same period, growing trends are observed for appliances and lighting (1%/year) and water heating (0.2%/year). In 2019, appliances and lighting have overcome water heating. These end-uses now account for 15% and 14% of the households consumption, respectively.



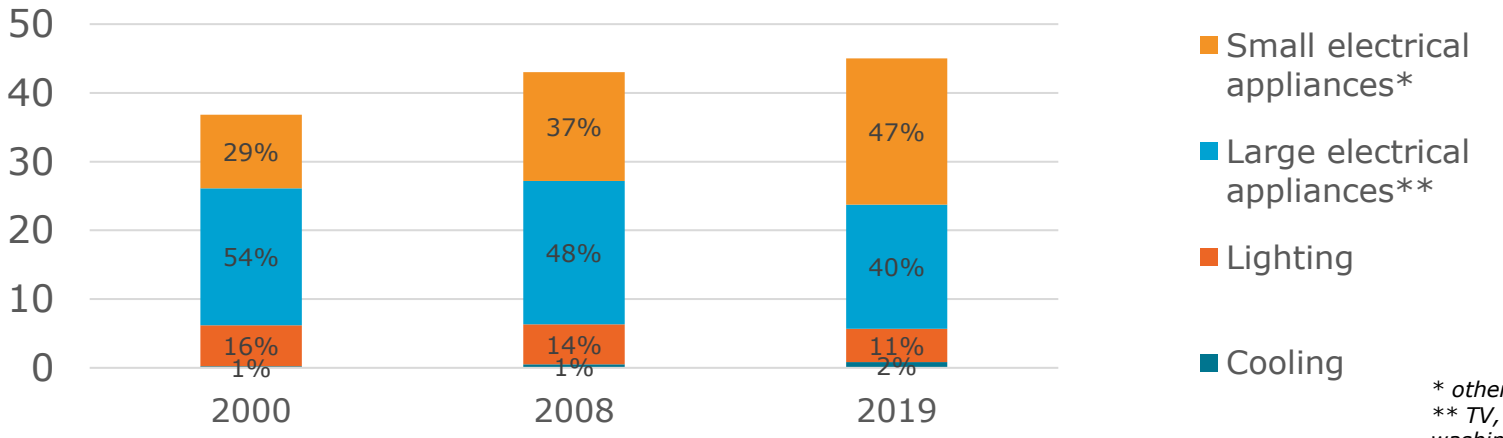
2019 : early estimates

Trends of electricity consumption in the residential sector

In 2019, 87% of the electricity used for captive uses (i.e. outside thermal uses) is for electrical appliances : since 2008, consumption of large appliances has decreased (-1%/year), while it has progressed rapidly for small appliances (3%/year).

Electricity consumption for lighting is declining (-2%/year since 2008). It now represents 11% of the households captive electricity consumption. Cooling still represents a low share (2%) but shows an important growth of 7%/year since 2000 (~10%/year in EU Mediterranean countries).

Households captive electricity consumption by end-use in the EU



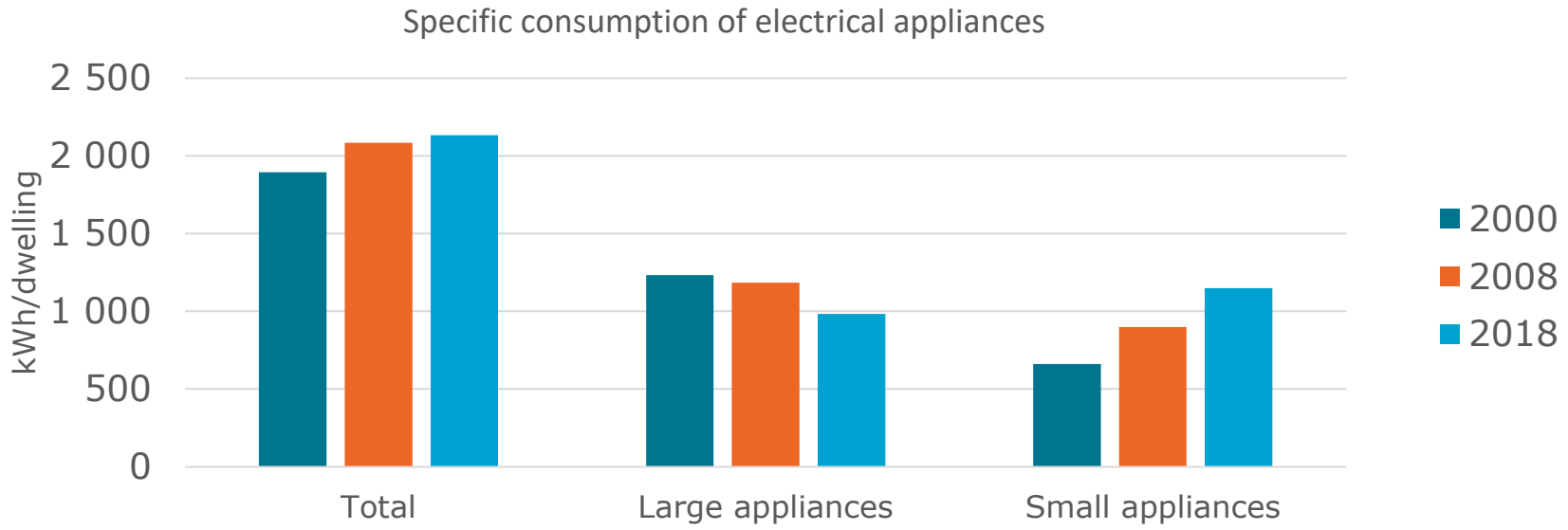
2019 : early estimates

** others*
*** TV, refrigerator, freezer, washing machine, dishwasher, dryer*

Specific consumption of households for electrical appliances

The specific consumption of large electrical appliances* has decreased rapidly since 2008 (-1.8%/year).

The specific consumption of small appliances has increased rapidly, even if this growth has been almost halved between 2000-2008 (4%/year) and 2008-2018 (2.5%/year).



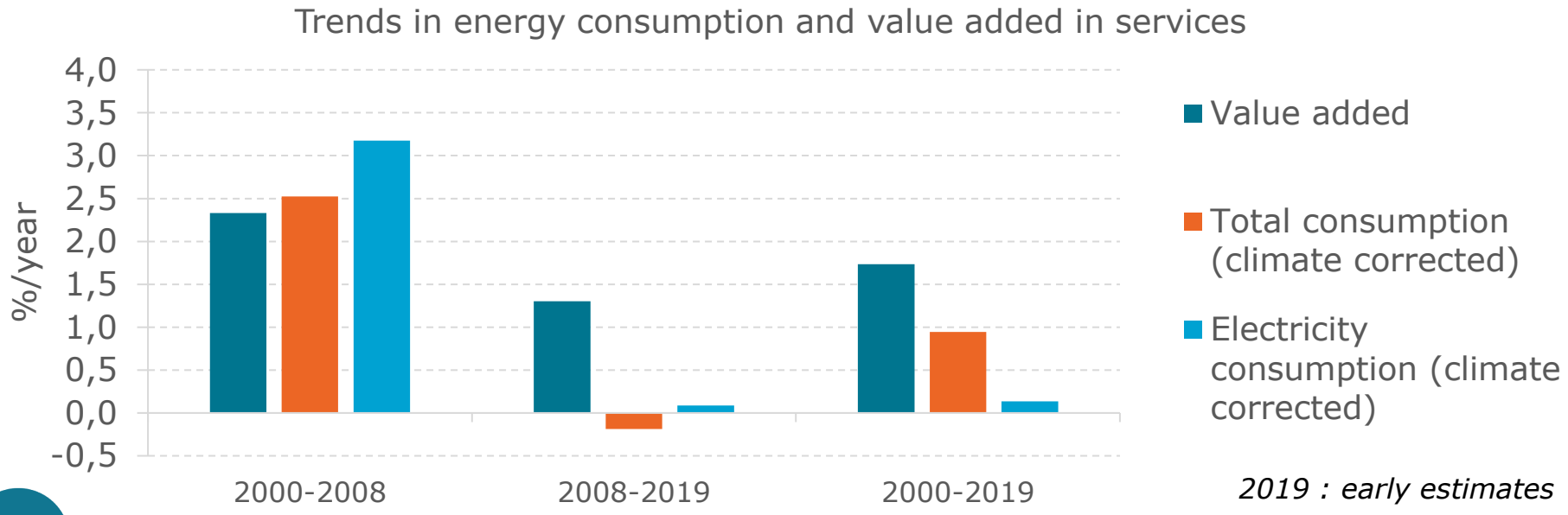
Large appliance: TV, refrigerator, freezer, washing machine, dishwasher, dryer
Small appliances include all others :PC, coffee machine, video etc…

Energy consumption trends in services

Energy consumption trends in services

In 2019, the energy consumption in services was 20% higher than in 2000 despite a decrease after the economic crisis.

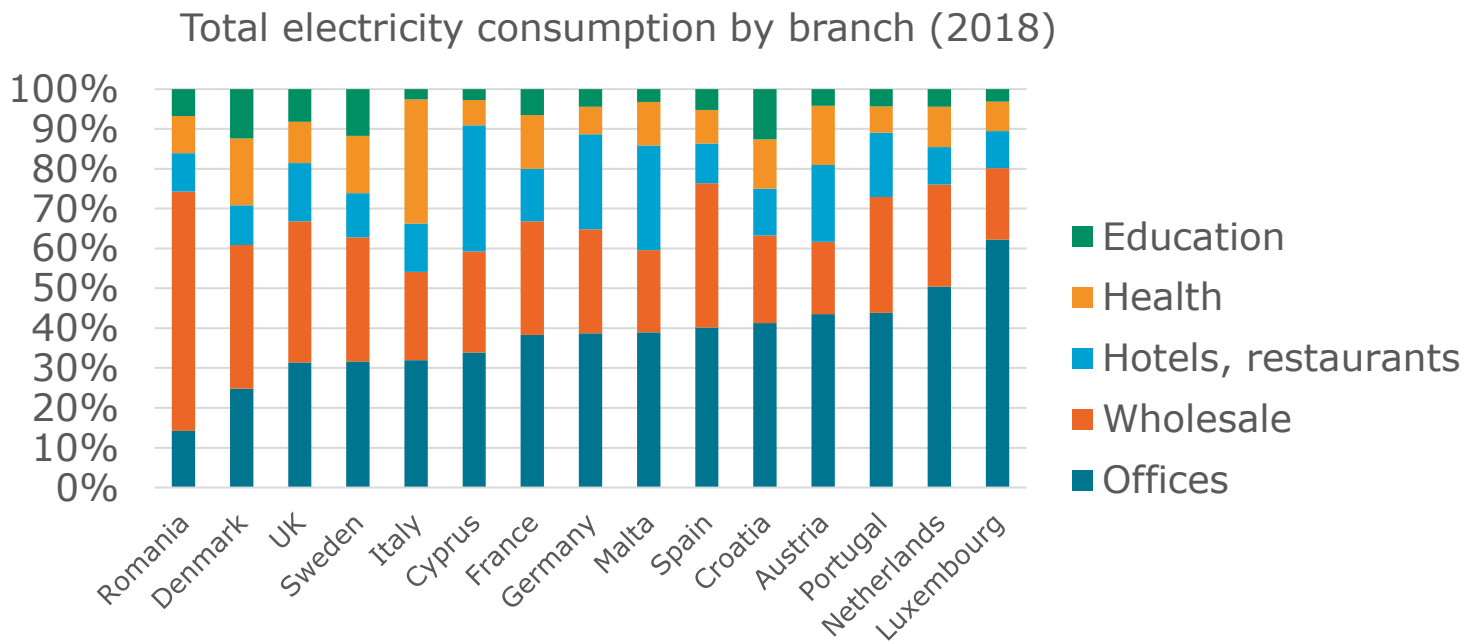
It reached a peak of 155 Mtoe in 2008 after a rapid increase (2.5%/year). It decreased between 2008 and 2014 and remained almost stable afterwards.
Similarly, electricity consumption increased rapidly until 2008 (3.2%/an). It is almost stable since then.



Energy consumption trends in services

Electricity represents almost half of the total energy consumption of services.

Offices and wholesale and trade sector consume around 2/3 of electricity in services* at EU level.

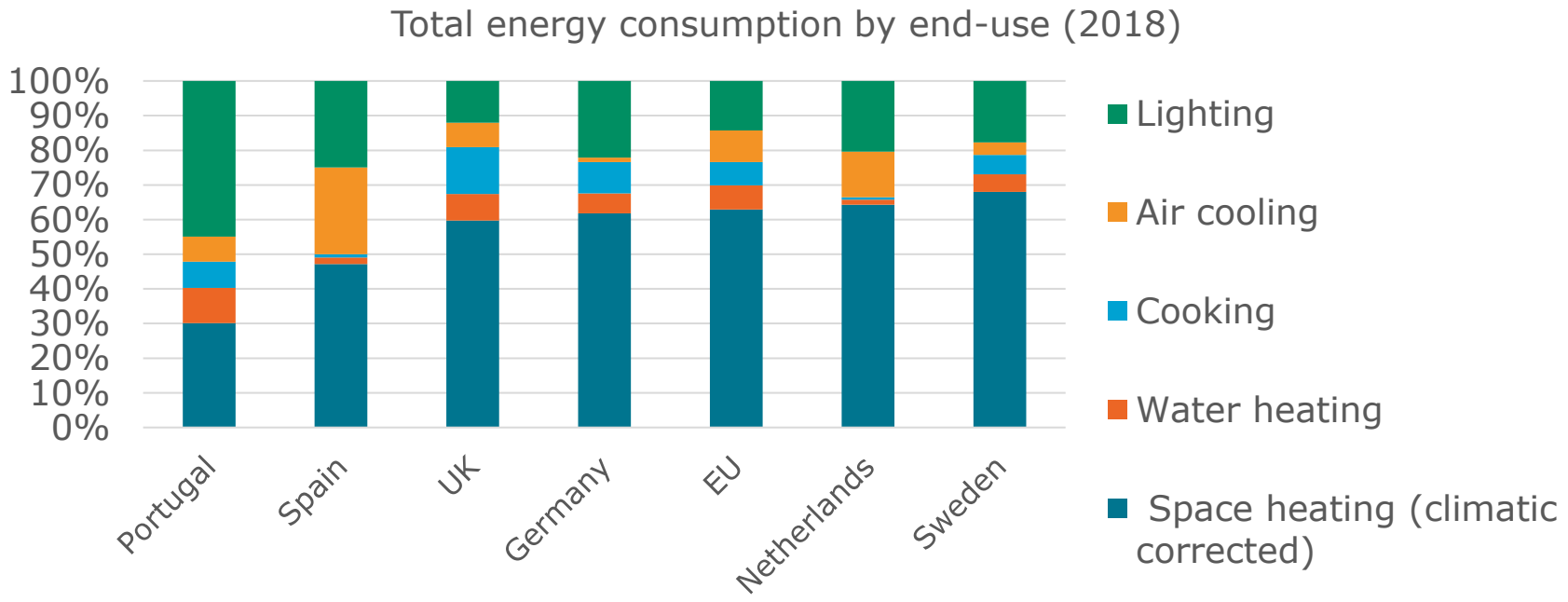


**Services include private and public buildings (offices, shops, schools, hospitals) as well as public lighting.*

Energy consumption trends in services

Space heating represents the largest part of the energy consumption in 6 countries out of 7 for which data are available (between 47% in Spain and 68% in Sweden)

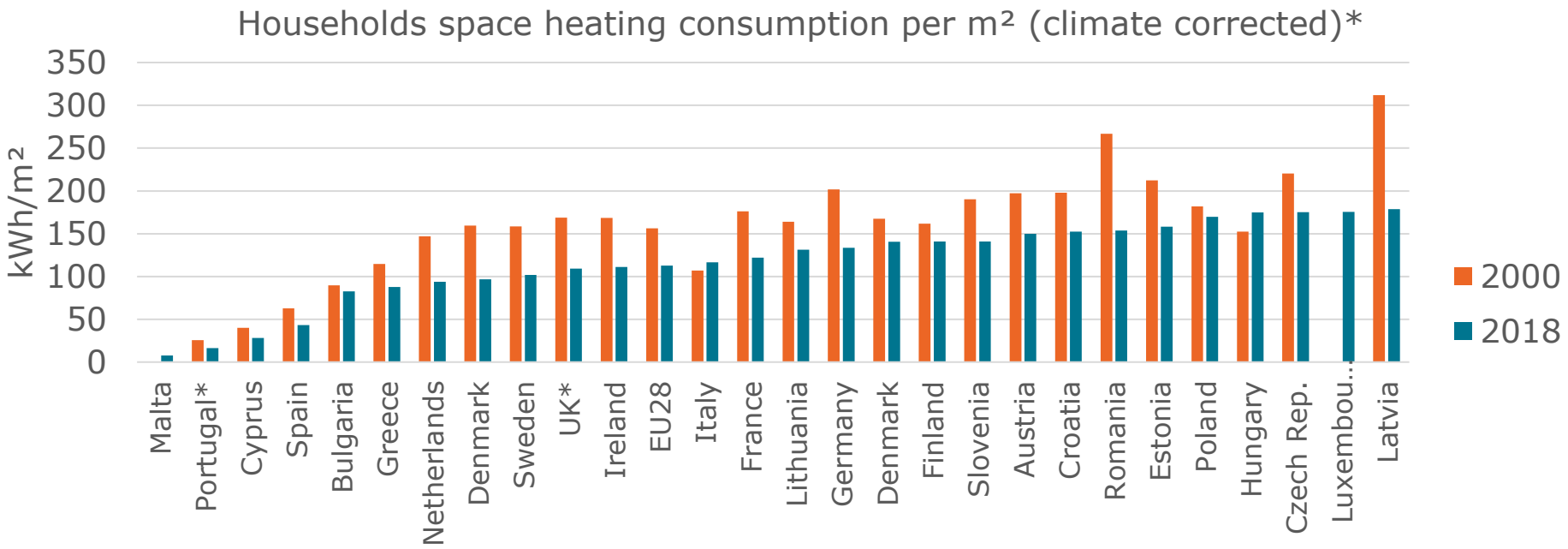
In Portugal, the largest energy consumption is for lighting (45%).



Energy efficiency trends

Specific energy consumption for households space heating

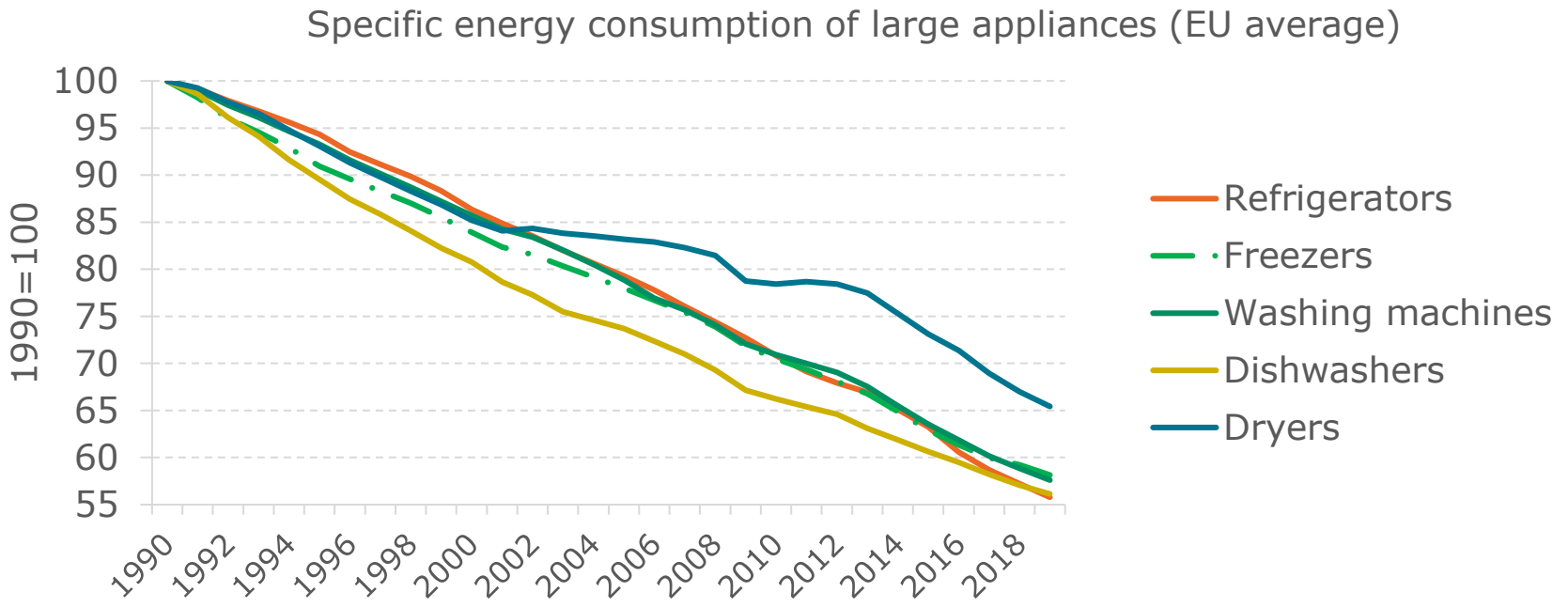
The specific consumption of households for heating has decreased in almost all countries since 2000 (-1.8%/year on average in the EU).
The reduction was above 3%/year in 3 countries (Latvia, Romania and Portugal) and between 2 and 3%/year in 6 others (Ireland, UK, Nethrlands, Sweden, Slovakia and Germany)



- *Climate corrections see methodology at https://www.odyssee-mure.eu/faq/result/1/*
- *2002 for UK, 2003 for Portugal; no data before 2008 for Luxembourg and 2016 for Malta. No data on m2 available for Belgium*

Energy efficiency trends: large households appliances

- The specific consumption of large appliances (measured in kWh per appliance) has decreased steadily since 1990 by the labelling and eco-design regulations.
- Efficiency gains are above 40% (i.e. 2%/year) for cold appliances (refrigerators and freezers), washing machines and dish washers; for dryers, gains are lower, around 35%.



Source ODYSSEE, based on national data

How is measured energy efficiency progress in ODYSSEE?

- Various energy efficiency indicators of specific consumption measured in physical unit are calculated for buildings:
  - by end–use for households
  - by sub-sector for services.

- For households, we obtain different trends for the EU: 2%/year for refrigerators, 1.8%/year for heating, 0.5%/year for water heating etc….

- The question is how to measure the overall energy efficiency progress at sector level?

- This is the objective of the energy efficiency index, called "ODEX", that is calculated separately for households and services in ODYSSEE.

How is calculated ODEX?

- ODEX is calculated:
  - First, by expressing trends in specific energy consumption by end-use (or sub-sector), as an index of variation ;
  - Then by calculating an average index for the sector weighted by the share of each end-use (or sub-sector) in the sector's energy consumption.

- ODEX is presently calculated on the basis of 11 end-uses* or appliances for households and 6 branches in services.

- As for each end-use, index of variation are used, specific consumption can be expressed in different physical units so as to be as close as possible to energy efficiency (e.g. for household: *toe/m2 for heating, toe/household for water heating and cooking, kWh/dwelling for lighting, kWh/appliance for appliances and cooling*.

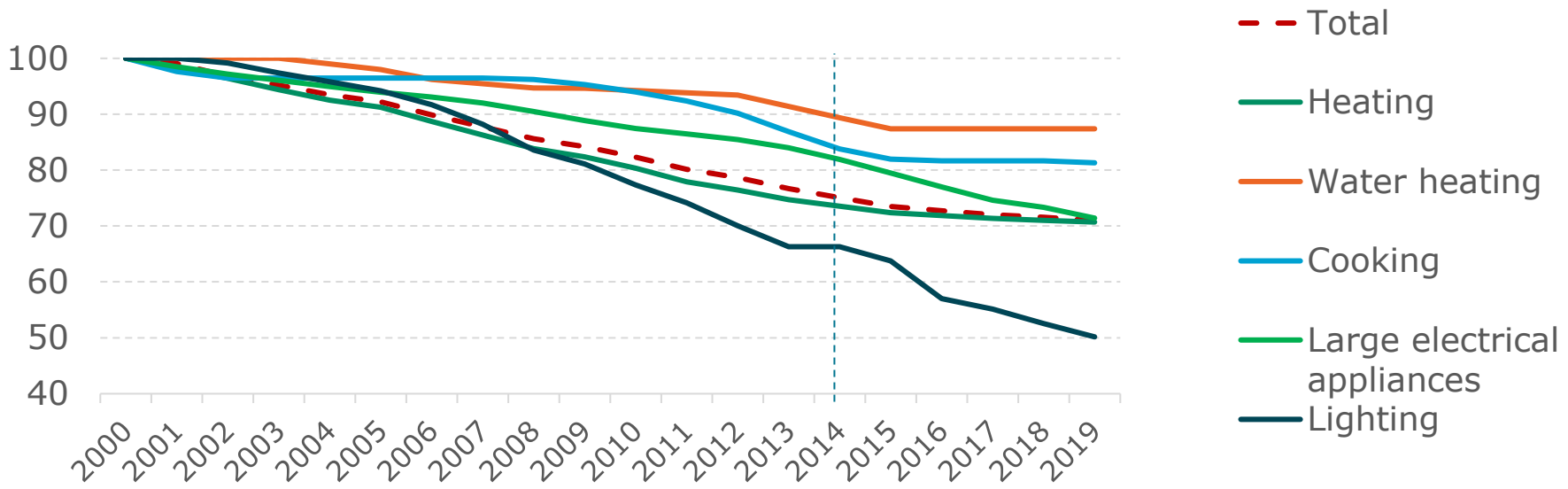
**Heating (separation new/existing dwellings), water heating, cooking, cooling, lighting, refrigerator, freezer, washing machine, dishwasher, dryer, TV.*

For more information on ODEX: https://www.odyssee-mure.eu/publications/archives/odex-indicators-database-definition.html

Energy efficiency trends for households

- ODEX equal 71 in 2019 ➔ households energy efficiency has improved by 29% at EU level between 2000 and 2019 (or 1.8%/year).
- However, there has been a significant slowdown since 2014, with progress twice lower, mainly because of space heating, the largest end-use, and also for water heating and cooking, whereas for large appliances and lighting there is an intensification .

Energy efficiency trends for households at EU level based on ODEX



- *Only main end-uses shown*

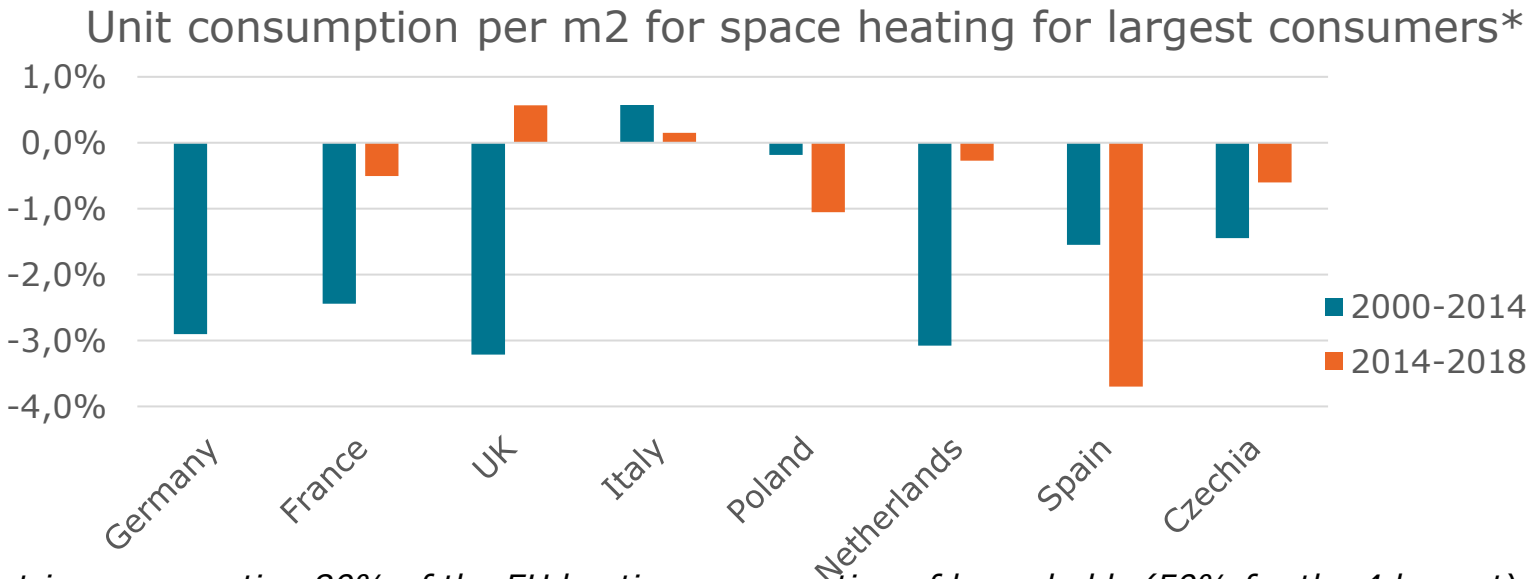
2019 : early estimates

Enerdata *Source: ODYSSEE*

What is happening since 2014? (1/2)

For space heating, the reduction of the unit consumption per m^2 has significantly slowed down since 2014 in most of the largest EU countries, especially in Germany, France, UK and The Netherlands.
Several factors may explain this trend:

- Less new construction, that have very high energy efficiency performance: the rate of construction has decreased by 35% since the financial crisis and only represents every year 0.8% of the existing stock of dwellings (i.e. only 8% of new stock after 10 years);
- Less renovation although it is difficult to have consolidated data.
- Slower diffusion of efficient heating mode (condensing boiler, heat pumps)**.



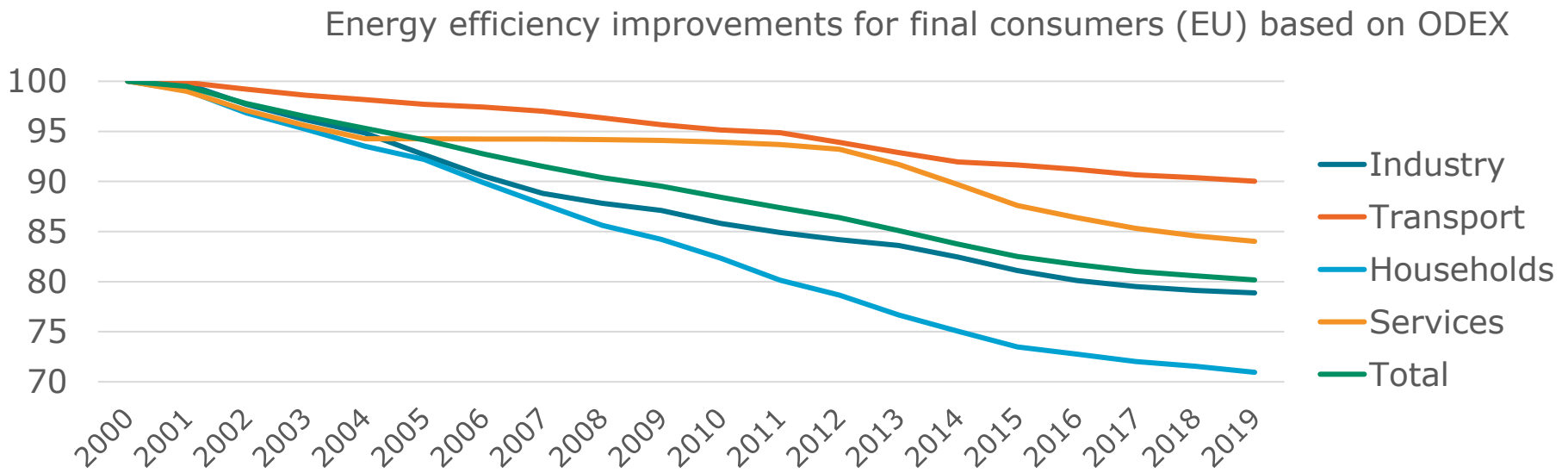
, Countries representing 80% of the EU heating consumption of households (50% for the 4 largest).*
*** Penetration of efficient heating modes at https://www.indicators.odyssee-mure.eu/market-diffusion.html*

What is happening since 2014? (2/2)

- For water heating, the unit consumption reduction has significantly slowed down in 3 large countries (France, Italy, Spain) and has even reversed (i.e. increased) in 3 countries (Austria, Belgium, Romania).
- For cooking the rate of improvement has been divided by 3 since 2014, with an increase in re unit consumption in Germany, Italy, Poland and Czech Rep.
- Are these changes linked to behaviors? We are lacking information to monitor such trends

Energy efficiency in buildings compared to other sectors

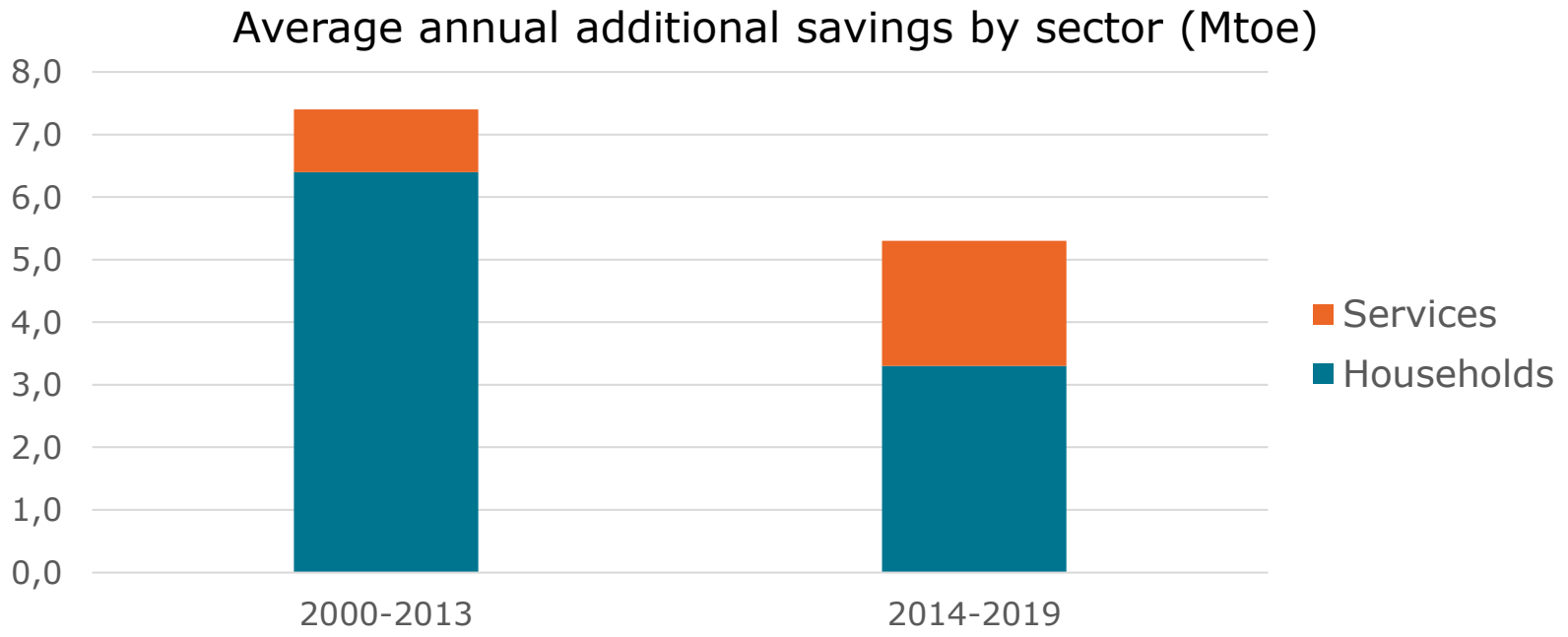
- Since 2000, buildings have registered larger gains than transport or industry.
- Energy efficiency improvements in services are mainly significant since 2014 (1.3%/year for services), and are even faster than for households (1.1 %/year for since 2014)
- Such trends since 2014 can be compared with industry (0.9%/year) and transport (0.4%/year).



2019 : early estimates

Decrease of energy savings in buildings since 2014

- Annual additional energy savings are then calculated from the annual variation of ODEX indicator.*
- Because of the slowing pace of energy efficiency improvement, the annual additional savings have been decreasing by around 30% since 2014: from an average volume of 7.4 Mtoe/year over 2000-2013 to 5.3 Mtoe/year since 2014.

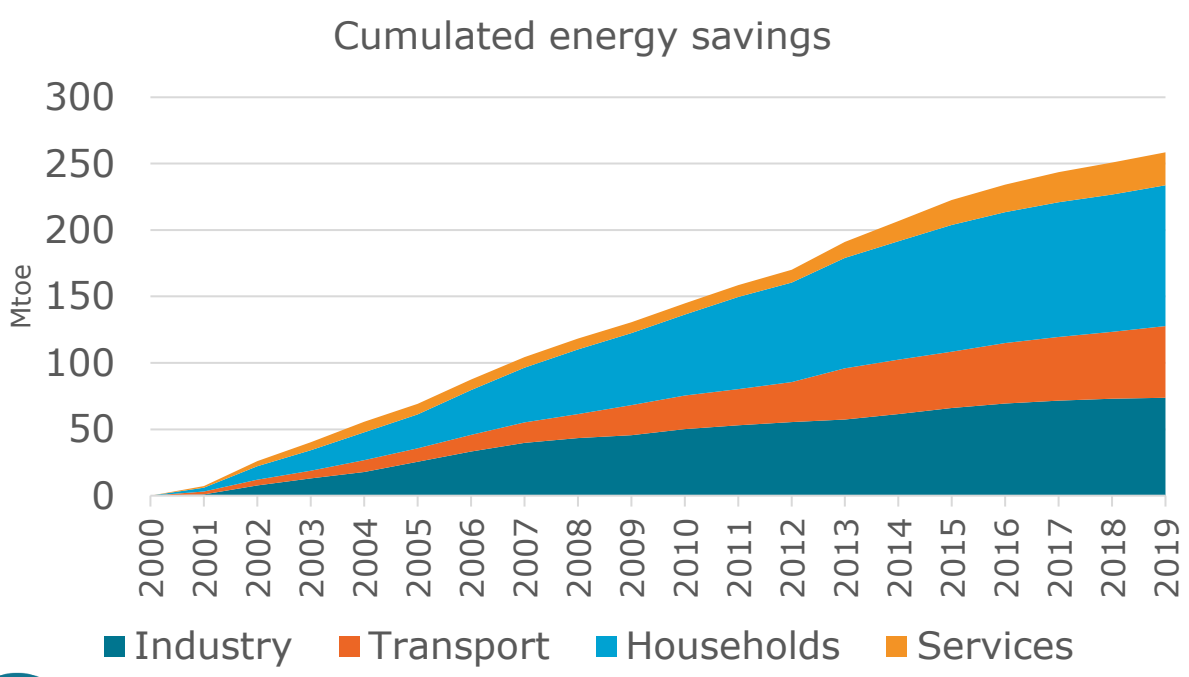


**ODEX is the ratio between the energy consumption and a fictive consumption that would have happened without energy savings (ES): ODEX = E/(E+ES)*100 and ES = E x ((100/EEDEX)-1*

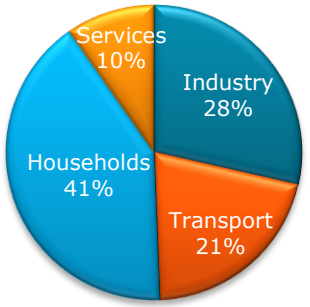
Energy savings vs. consumption

In buildings, the cumulated annual energy savings since 2000 reached 130 Mtoe in 2019, which represents the equivalent of 29% of final energy consumption in 2019. Without these savings the energy consumption of buildings would have been 29% higher.

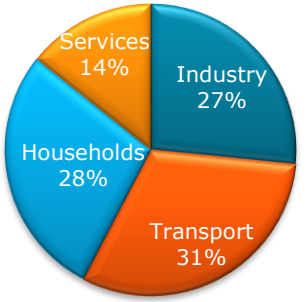
Households, the sector with the highest number of regulations and financial measures, is over represented, with a share of total savings (41%) much higher than its share in consumption (28%).



% of energy savings (2019)



% of energy consumption (2019)

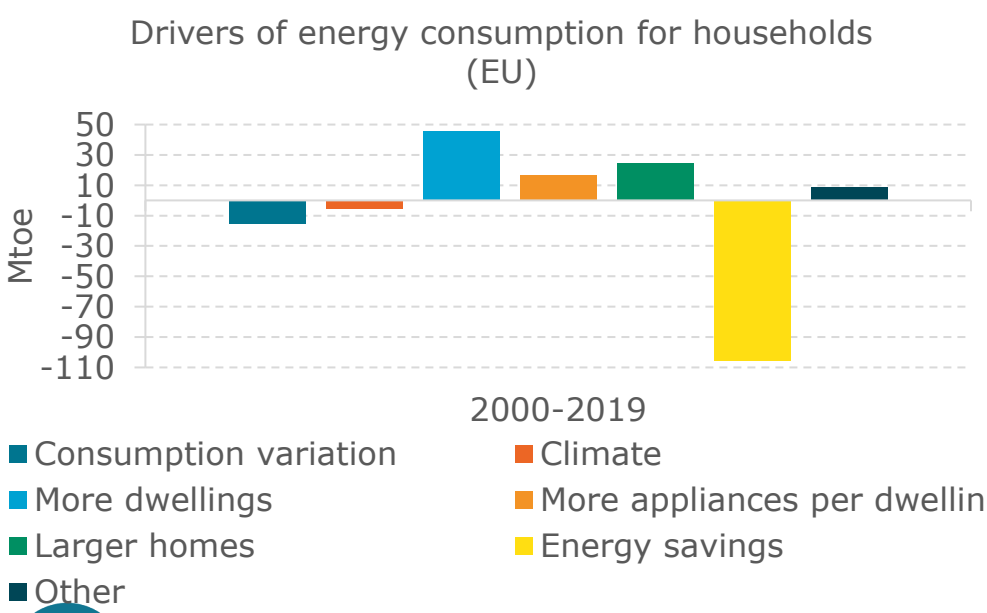


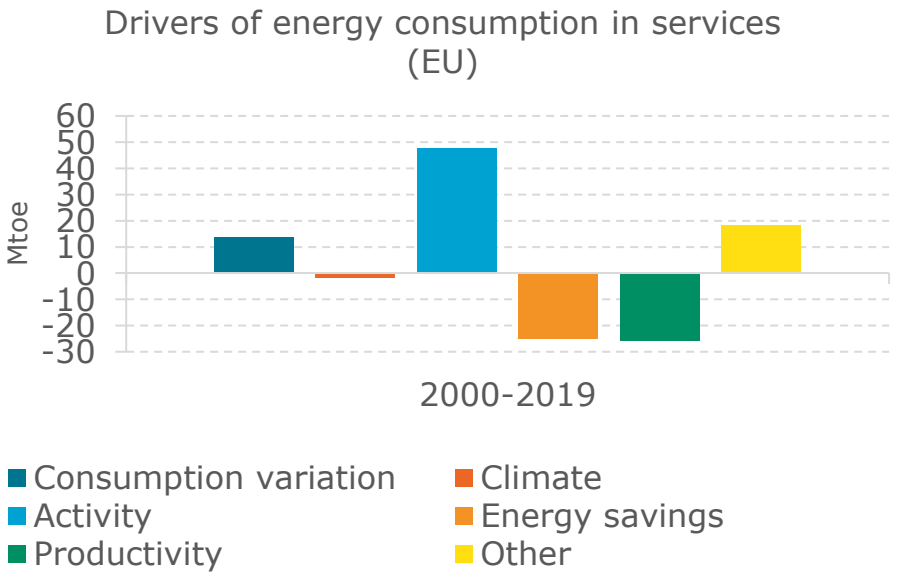
2019 : early estimates

Conclusion

Buildings' consumption variation 2000-2019

- For households, the consumption decreased by 15 Mtoe: the increase in the dwelling stock (more dwellings) and lifestyles (more appliances per dwelling, larger homes) contributed to raise the consumption by 87 Mtoe. Energy savings offset more than this increase by reducing consumption by 105 Mtoe.
- For services, the consumption increased by 13.6 Mtoe: the activity contributed to raise the consumption by 48 Mtoe. Energy savings only decreased consumption by 25 Mtoe, and productivity by 26 Mtoe.

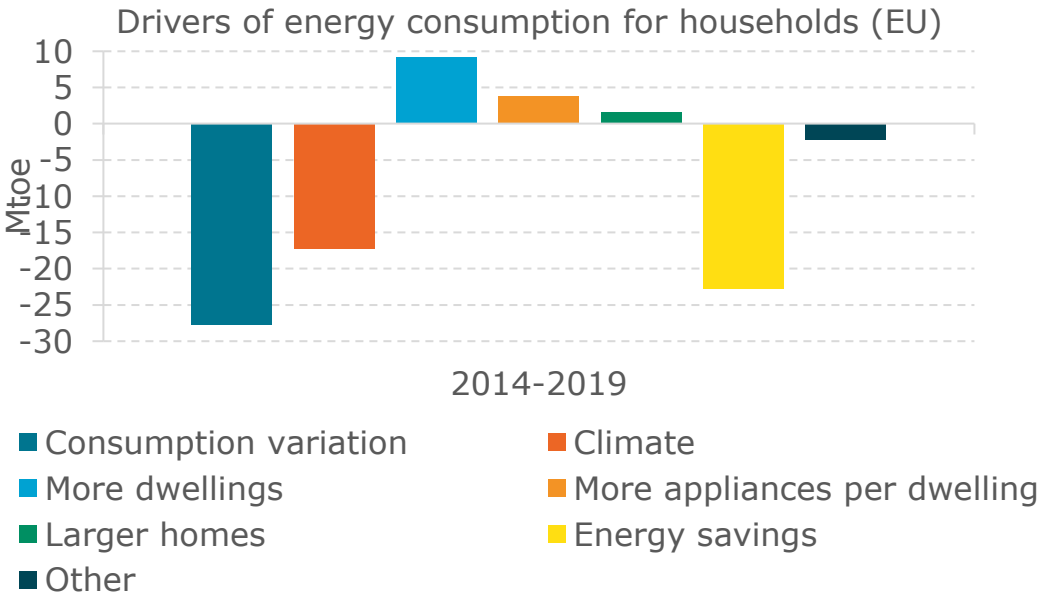


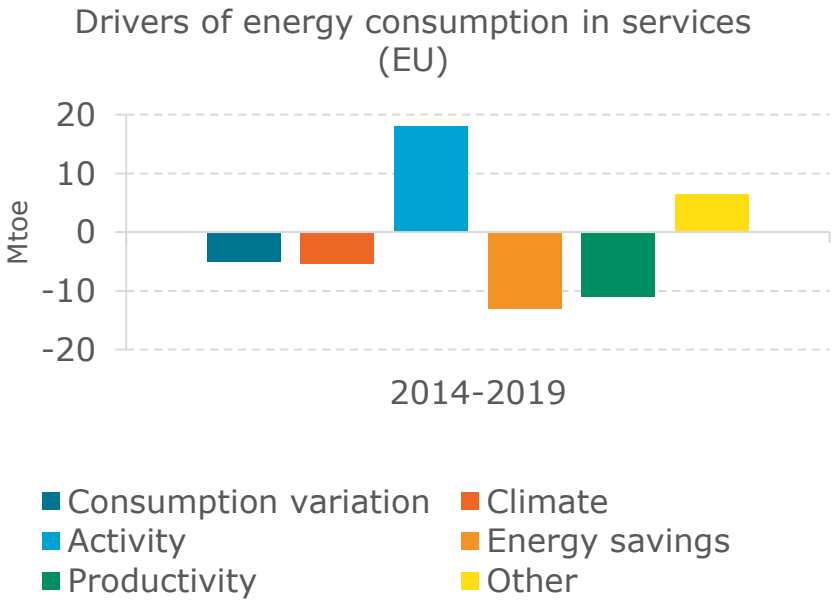


Source: ODYSSEE Decomposition tool: https://www.indicators.odyssee-mure.eu/decomposition.html
2019 : early estimates

Buildings' consumption variation 2014-2019

- Since 2014, the consumption of households decreased by 28 Mtoe. The increase in the dwelling stock and lifestyles contributed to raise the consumption by 15 Mtoe. Energy savings offset more than this increase by reducing consumption by 23 Mtoe. The warmer climate in 2019 reduced consumption by 17 Mtoe .
- For services, the activity contributed to raise the consumption by 18 Mtoe. Energy savings and productivity gains offset this increase by reducing consumption by 24 Mtoe.





Source: ODYSSEE Decomposition tool: https://www.indicators.odyssee-mure.eu/decomposition.html
2019 : early estimates

Conclusion : Key messages

- The energy consumption of buildings has steadily decreased since 2010 despite GDP growth.
- Household energy efficiency improvements have been twice slower since 2014 than before slowing down.
- This is mainly explained by thermal uses and in particular space heating, due to a combination of factors (lower new construction, and renovation, behaviour…), that are difficult to grasp due to a lack of information.
- The energy efficiency of large electrical appliances continues to improve rapidly; however this effect does not counterbalance anymore the rapid growth of the consumption of small appliances.

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About Enerdata:

Enerdata is an energy intelligence and consulting company established in 1991. Our experts will help you tackle key energy and climate issues and make sound strategic and business decisions.
We provide research, solutions, consulting and training to key energy players worldwide.

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