4. Decomposition of energy consumption variation in ODYSSEE

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Decomposition of energy consumption variation

Industry, Households, Transport, Services

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Introduction

- The decomposition of energy consumption variation aims at identifying the role of different factors.
- The methodology used in ODYSSEE focuses on energy savings as one of the main driver and was developed so as to be consistent with the calculation of energy savings, in particular technical savings and to be easy to understand.
- Other methods used in other studies rely on the Divisia decomposition methodology, with the most common one is referred to as LMDI* (e.g. IEA, JRC ISPRA, Fraunhofer ISI).

**Logarithmic Mean Divisia Index*

Decomposition of the energy consumption variation in industry

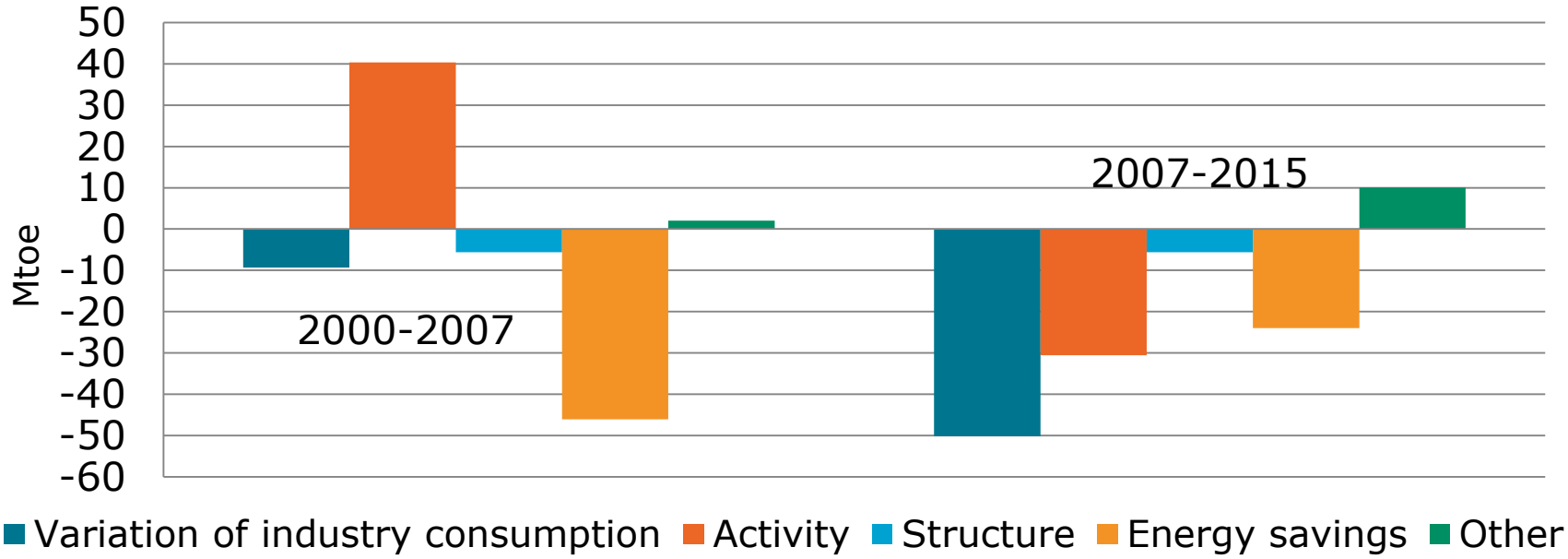
Industrial energy consumption is changing under the influence of various factors:

- Change in total industrial activity, measured with the production index (IPI) ("activity effect");
- Structural changes, i.e. the fact that the production* of individual branches with different specific consumption are not growing at the same rate (e.g. if production of machinery is growing much faster cement production, this will decrease the overall consumption of industry, all things being equal, as machinery less energy intensive);
- Technical energy savings (i.e. change in the branches' specific energy consumption) (calculated from ODEX);
- Other effects: mainly "negative" savings due to inefficient operations in industry.

*Production measured in physical units or with IPI

Decomposition of the energy consumption variation in industry

- Since 2007 the reduction of activity is the main driver of the decrease of consumption (-50 Mtoe);
- Energy savings had a much lower impact since 2007 (3.4 Mtoe/yr compared to 7.6 Mtoe/yr over 2000-2007).
- Structural effects had a low impact on the consumption variation.



Energy savings: technical savings; based on specific consumption per unit of production (in physical terms or production index)
Other: "negative" savings due to inefficient operations

Decomposition of the variation of the energy consumption in households

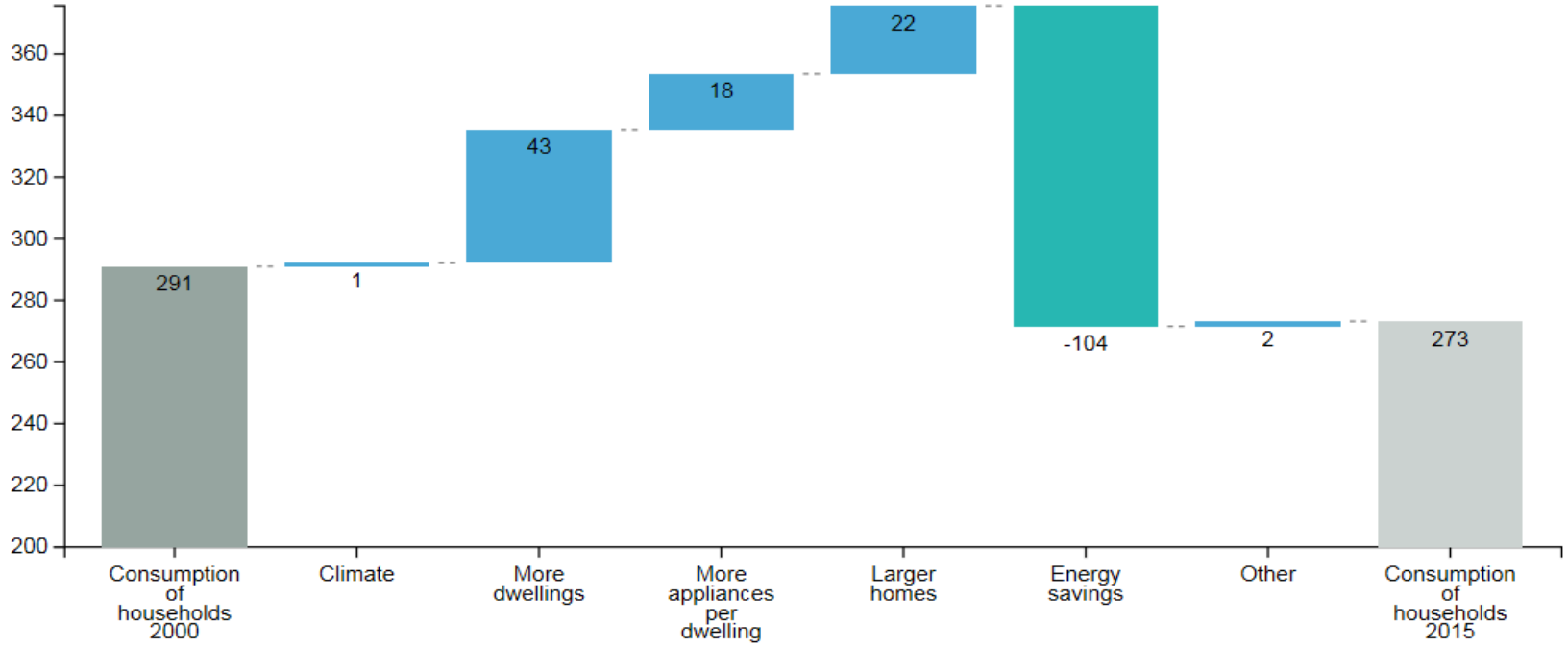
Energy consumption of households between two years, t and t_0 is changing under the influence of various factors :

- Climatic effect (due to climatic difference between years t and t_0);
- Change in number of occupied dwelling ("more dwellings effect");
- Evolution of lifestyles:
  - Average floor area of dwelling for space heating ("larger homes");
  - More appliances (electrical appliances, central heating);
- Technical energy savings (calculated from ODEX);
- Change in heating behaviors.

Decomposition of the variation of the energy consumption in households

- Two factors contributed to increase the household consumption since 2000:
  - Increasing number of dwellings (43 Mtoe);
  - Growing comfort due to the increase in the number of household appliances and dwelling size (18 and 22 Mtoe, respectively).
- Energy savings (technical) lowered consumption by 104 Mtoe (~7 Mtoe/yr).
- Other effects or behavioural effect are mainly due to the combined effect of price increases and of the economic recession

EU 2000-2015



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Decomposition of the energy consumption variation in transport

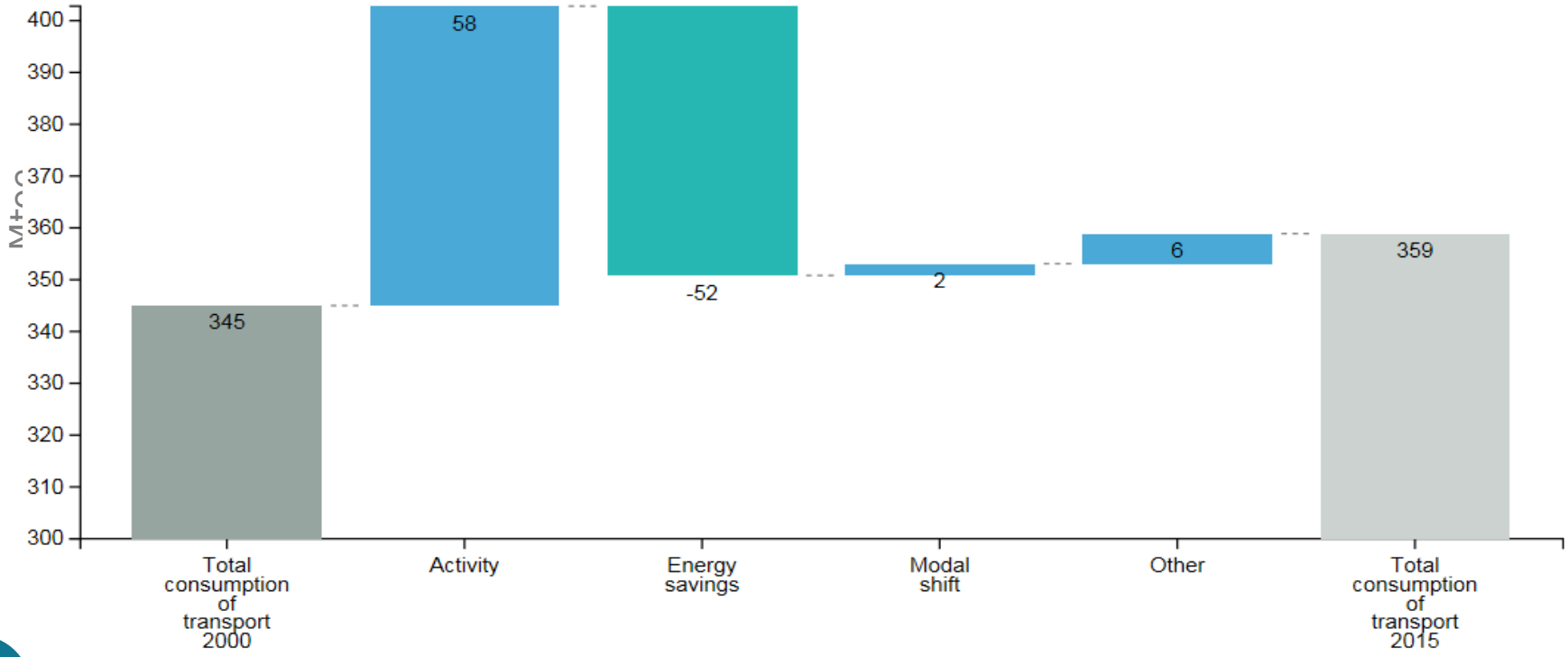
Energy consumption in transport is changing under the influence of the following factors :

- Change in passenger traffic including air and traffic of goods ("activity effect");
- Technical energy savings (i.e. change in the efficiency of cars, trucks, airplanes etc.) (calculated from ODEX);
- Modal shift for land transport, i.e. change in the share of each transport mode in the total land traffic;
- Other effects, i.e behavioral effects and "negative savings" in freight transport due to low capacity utilization.

Decomposition of the energy consumption variation in transport

- In 2015 the energy consumption of transport was 15 Mtoe higher than in 2000
- Increase of traffic contributed to raise consumption by 58 Mtoe .
- Energy savings decreased the consumption by 52 Mtoe.
- Other effects: behavioral effects and "negative savings".

Drivers of energy consumption variation in transport (Mtoe, EU 2000-2015)



*Energy savings: technical savings; based on specific consumption per unit of traffic

Decomposition of the energy consumption variation in services

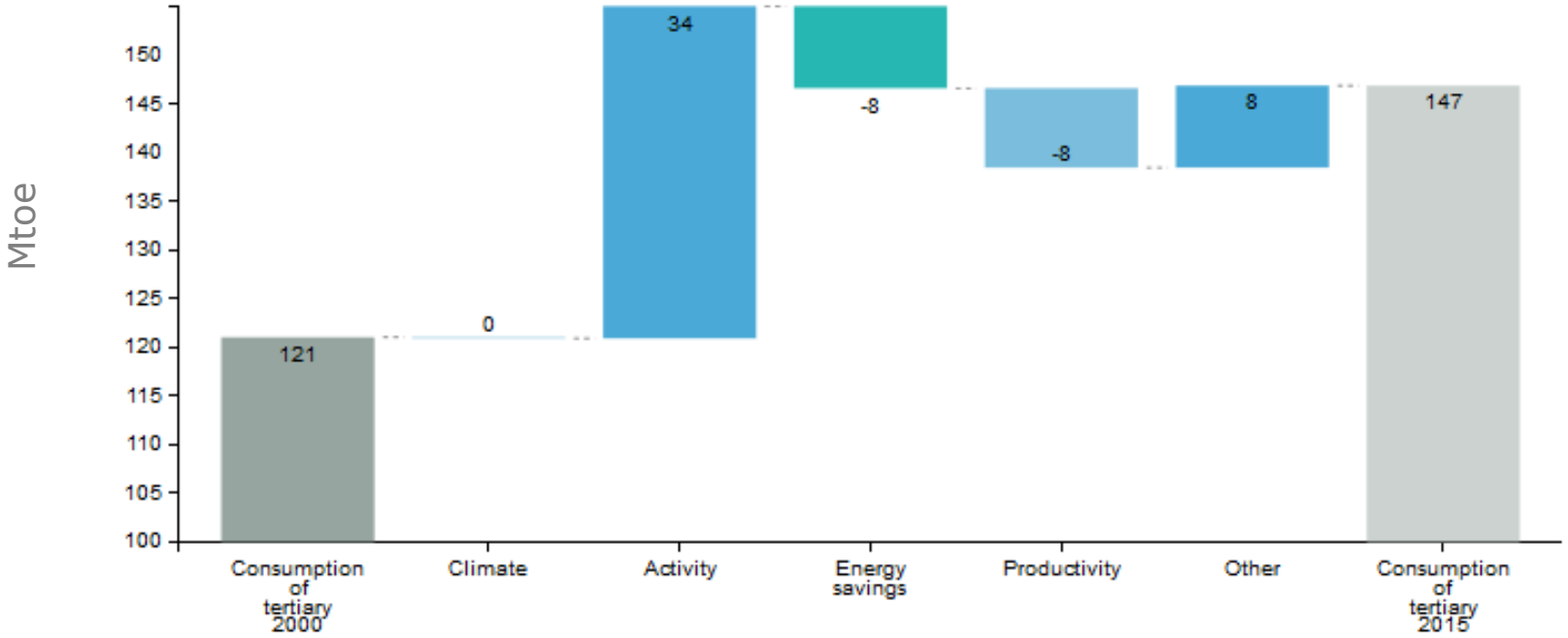
Energy consumption in services is changing under the influence of various factors :

- Change in economic activity (increase in value added);
- Energy savings (reduction in energy consumption per employee);
- Productivity effect (change in VA per employee);
- Climatic effect (due to climatic difference between years t and t_0).
- Other effects (behavioral effects and "negative savings").

Decomposition of the energy consumption variation in services

- The energy consumption of services increased by 26 Mtoe from 2000 to 2015.
- Increase of the value added contributed to raise consumption by 34 Mtoe .
- Energy savings and labour productivity gains (VA/employee) decreased the consumption by around 8 Mtoe each.

Drivers of energy consumption variation in services (Mtoe, EU 2000-2015)

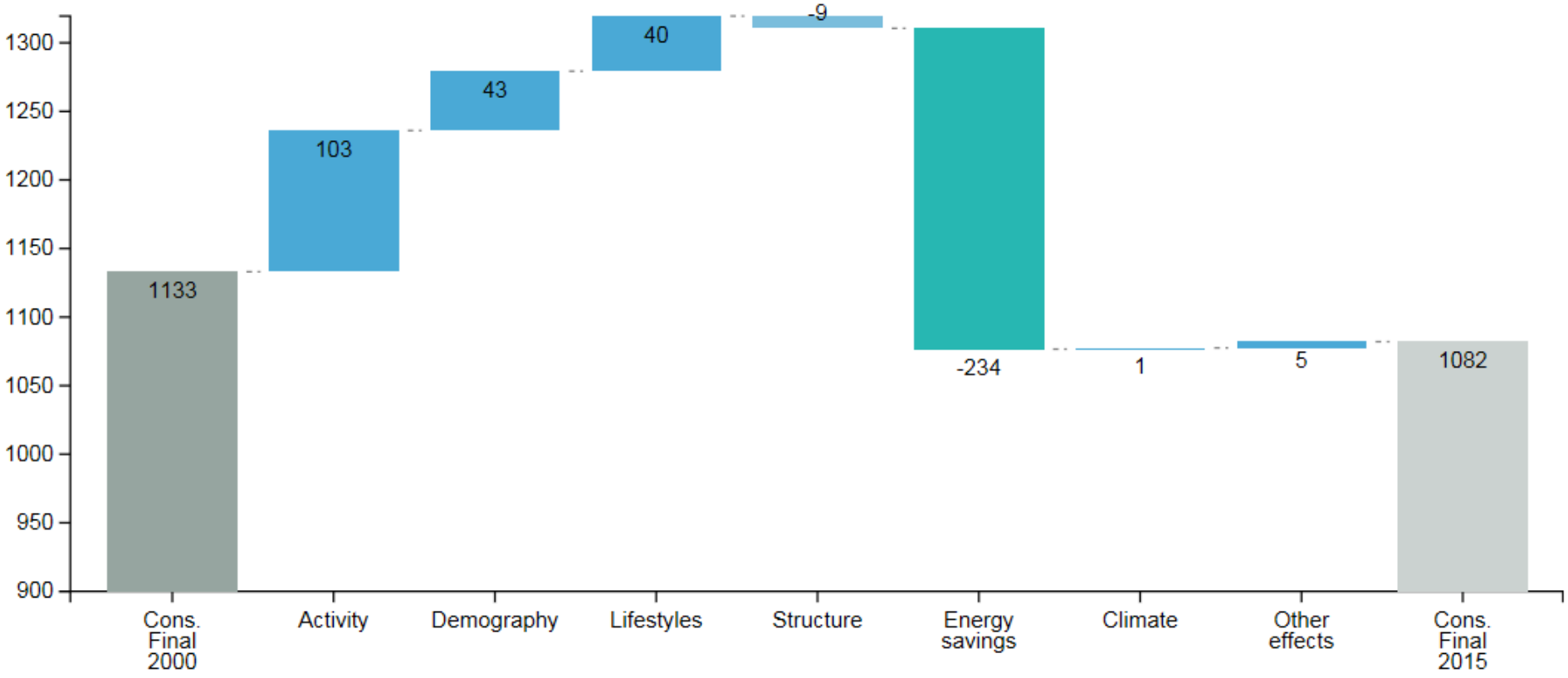


*Energy savings: technical savings; based on specifc energy consumption per employee

Decomposition of total final consumption

- The final energy consumption decreased by 51 Mtoe between 2000 and 2015.
- Increase in activity contributed to raise consumption by 103 Mtoe, lifestyles and demography by around 40 Mtoe each.
- Technical energy savings decreased the consumption by 234 Mtoe.

Drivers of final energy consumption variation (Mtoe, EU 2000-2015)



Decomposition of energy consumption variation

Power sector

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Principles of the decomposition of the consumption of the power sector

Four main effects explain the variation of the net consumption for power generation over a period*:

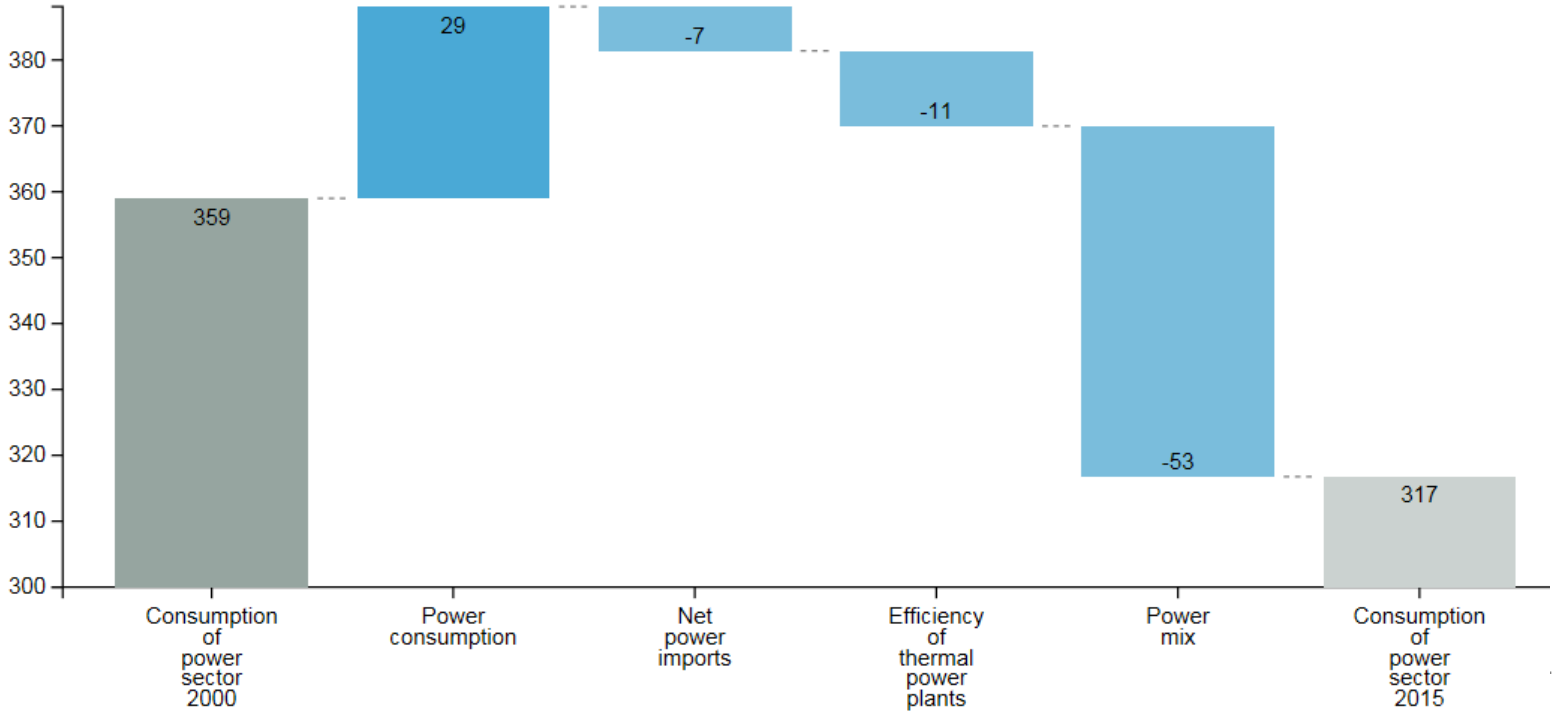
1. The increased consumption of electricity, that all things being equal, contribute to increase the losses in power generation.
2. Change in the electricity trade.
3. Changes in the power mix between different sources with very different efficiencies:
    - Wind, hydro, PVs (100% efficiency);
    - Thermal (between 30 and 50% depending on fuel mix and technology);
    - Geothermal and nuclear (respectively 10% and 33%);
4. Variation in the efficiency of thermal power generation.

**net consumption for power generation= sum of input and outputs for electricity generation (including cogeneration and district heating)*

Decomposition for the power sector

- The increase in electricity consumption between 2000 and 2015 (+215 TWh) increased the power sector consumption by 29 Mtoe, all things being equal.
- The increasing share of renewables (from 14 to 24%) contributed to decrease the power sector consumption, by 53.
- The low increase in thermal power efficiency (+ 1 point to 38.5%) had a marginal impact (-11 Mtoe).

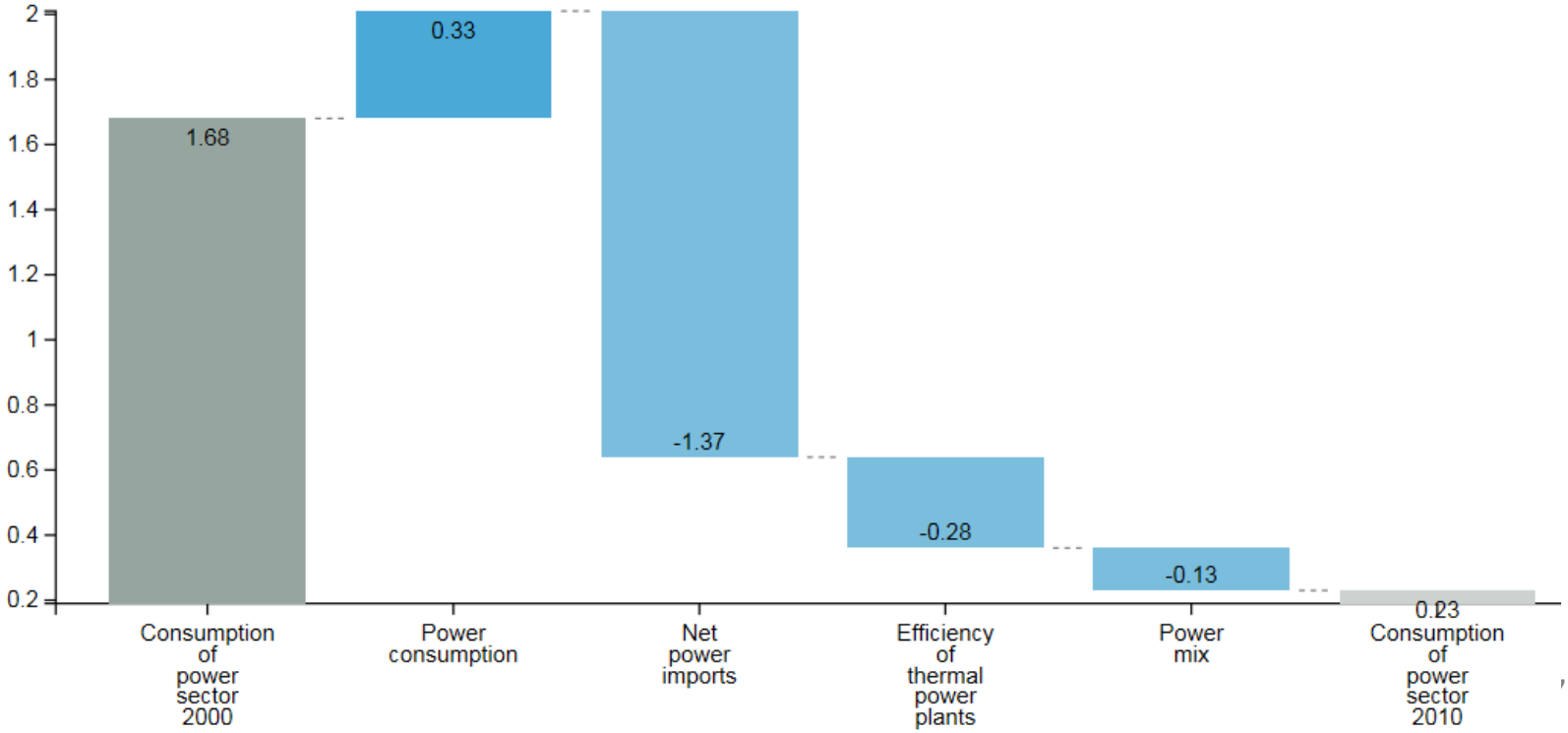
Drivers of the net energy consumption variation of the power and heat sector (Mtoe, EU 2000-2015)



Decomposition for the power sector: case of Lithuania

- The net power consumption decreased a lot between 2000 and 2010 in Lithuania because of a drop in power exports linked to the closure of the nuclear plant. It contributed to decrease the power sector consumption, by80% (- 1.37 Mtoe).

Drivers of the net energy consumption variation of the power and heat sector for Lithuania (Mtoe, 2000-2015)



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Decomposition of energy consumption variation

Primary consumption

Decomposition of the primary and gross inland energy consumption

- Gross inland energy consumption (Eurostat or TPES at IEA) includes non energy uses whereas, according to EED, primary energy consumption excludes them.

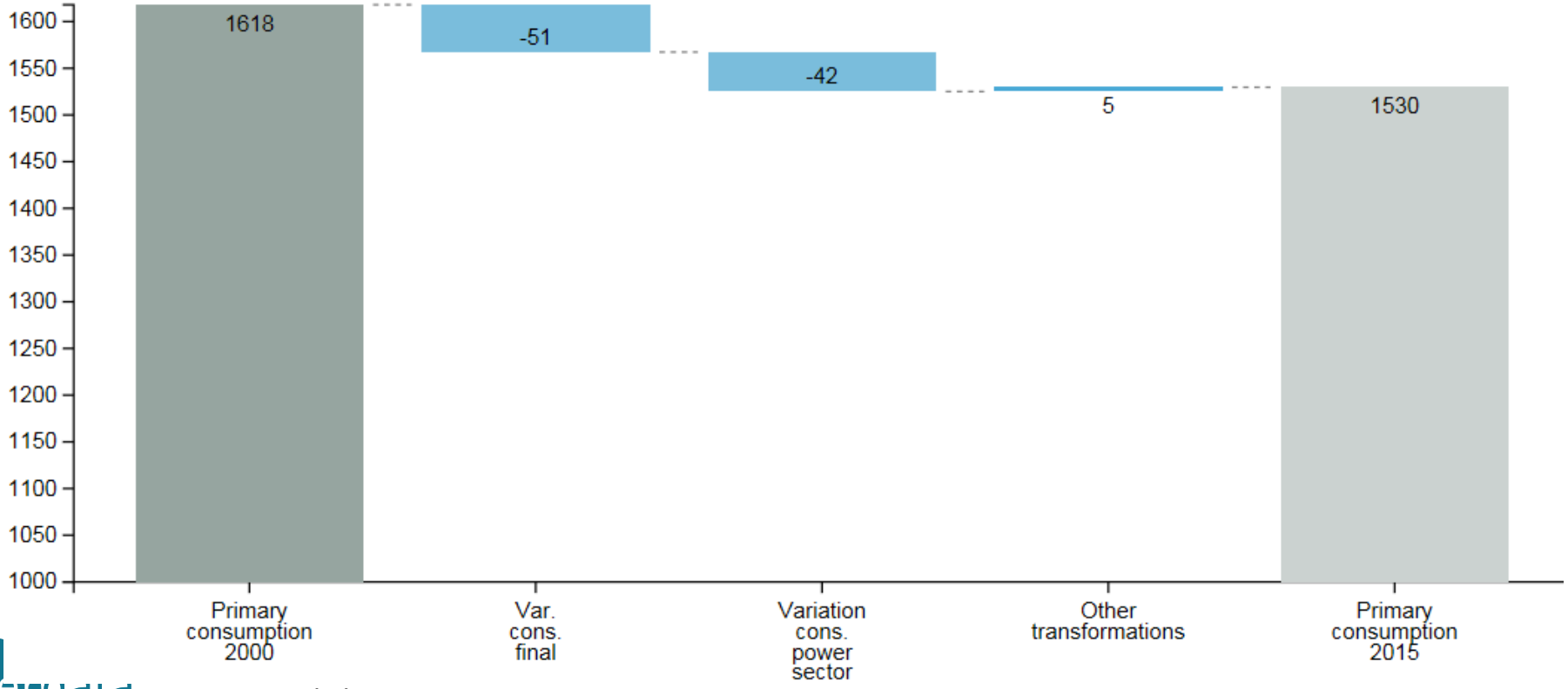
- The variation of the **primary energy consumption** is explained by:
  - the variation of the final energy consumption;
  - the variation of the net consumption of the power sector;
  - the variation of the consumption for other transformations.

- The decomposition of the final energy consumption is done by summing the effects in the different end-use sectors: industry, households, transport, services and agriculture.

Decomposition of the primary energy consumption

- The primary energy consumption decreased by 88 Mtoe between 2000 and 2015: this is the combined effect of a reduction in the final consumption (-51 Mtoe) and of lower consumption in the power sector (-42 Mtoe).

Drivers of primary energy consumption variation (Mtoe, EU 2000-2015)



at normal climate