"ODYSSEE-MURE Fit-4-55: Monitoring the Energy Efficiency Pillar for Climate Neutrality"

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Overview of macro-economic indicators in Energy Community Parties

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Macro-economic indicators

- The focus of ODYSSEE is on detailed indicators by end-use or sub–sector.

- However, for most EnCs, it takes time to have access to detailed data; thus, the priority has been to focus first on macro indicators, i.e. indicators that can be easily calculated with the usual energy balance and macroeconomic/ demographic data.

- The most common macro indicators are energy intensities, that relate energy consumption to a macro-economic variable (GDP or VA).

- This presentation will show the macro indicators that are available and introduce more advanced indicators .

Enerdata

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Overview of macro indicators

Aggregate indicators: primary/final intensity (2/2)

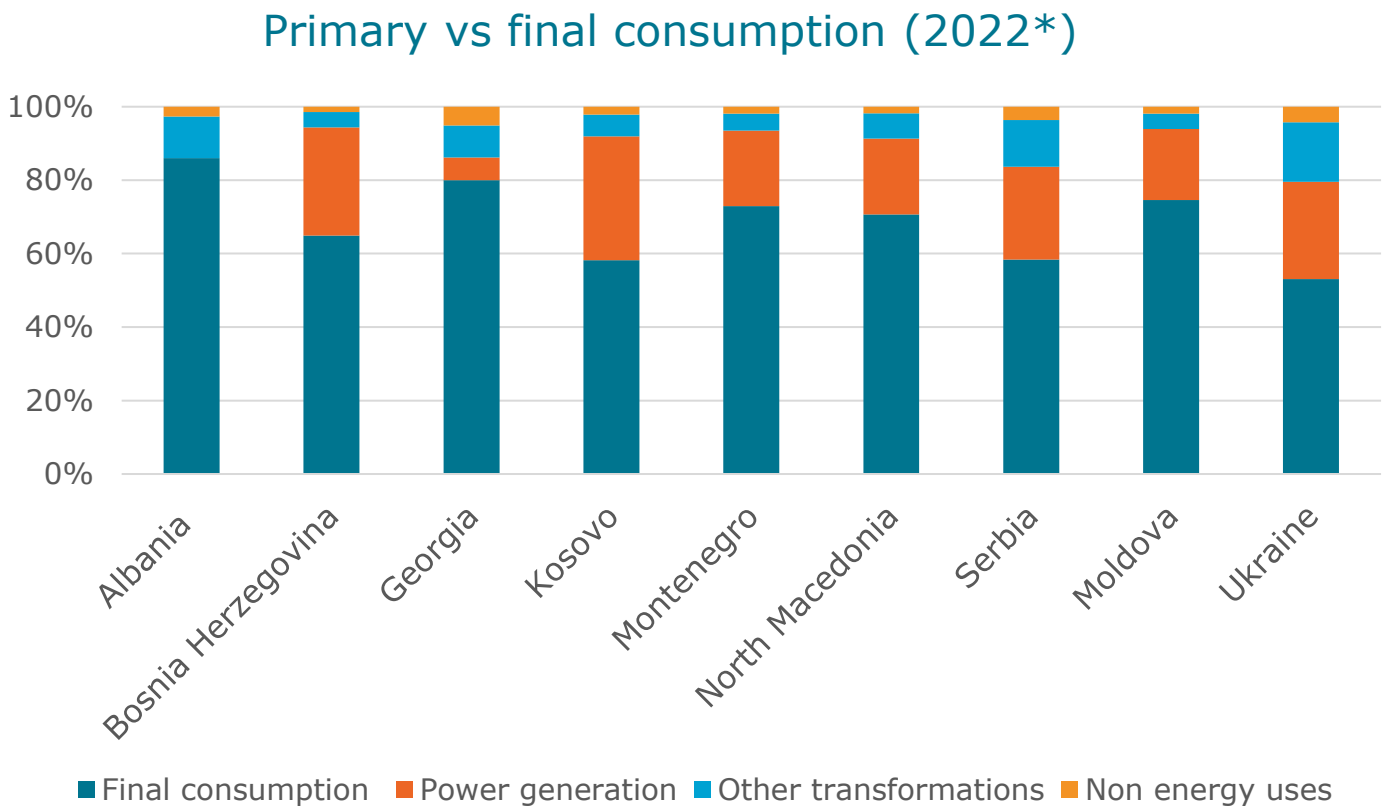
Indicator*	Interpretation
Final energy intensity (final energy consumption/GDP)	• Evaluates the overall energy efficiency of final consumers from an economic viewpoint, what is often called the "energy productivity". • Preferred macro indicator, as most EE policy measures targets final users.
Primary energy intensity	• Reflect in addition the effect of changes in the power sector (power mix, power trade) which are not linked to energy efficiency.

Both intensities provide a broader assessment of energy efficiency than what is understood by energy efficiency from a policy or engineering viewpoint

*Final consumption includes industry (excluding energy transformations), transport, households, services and agriculture; exclude non energy uses, that are not related to EE. Primary consumption: final consumption + consumption and losses in energy transformations + non energy uses.

Primary vs final consumption

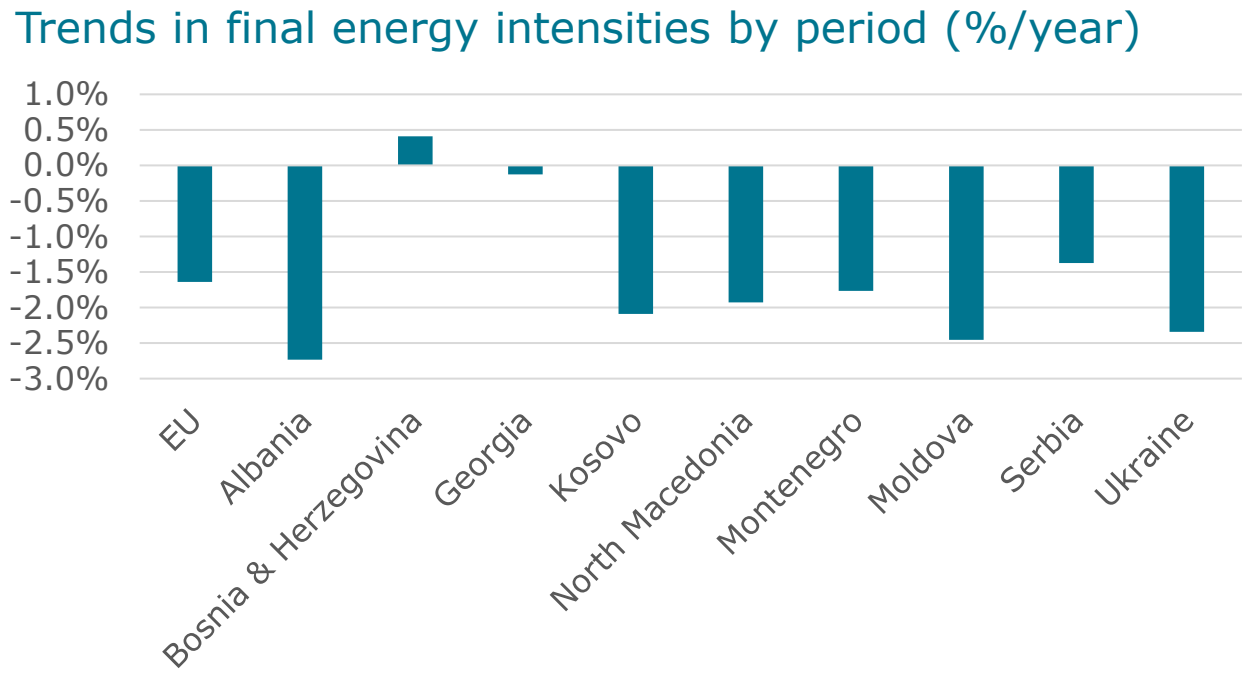
Final energy consumption represents 50% to 85% of primary consumption. Power generation is the second largest component of primary consumption (20% to 35%, except in Albania where it is negligible as most of power is coming from hydro, i.e. without losses, as well as in Georgia (8%)).



Ukraine: 2021

Final intensities in EnC

- Final intensity has decreased in most EnC countries over 2010-2022, with yearly fluctuations, at an average rate of around 2%/year.
- Stability or slight increase in Georgia and Bosnia and Herzegovina

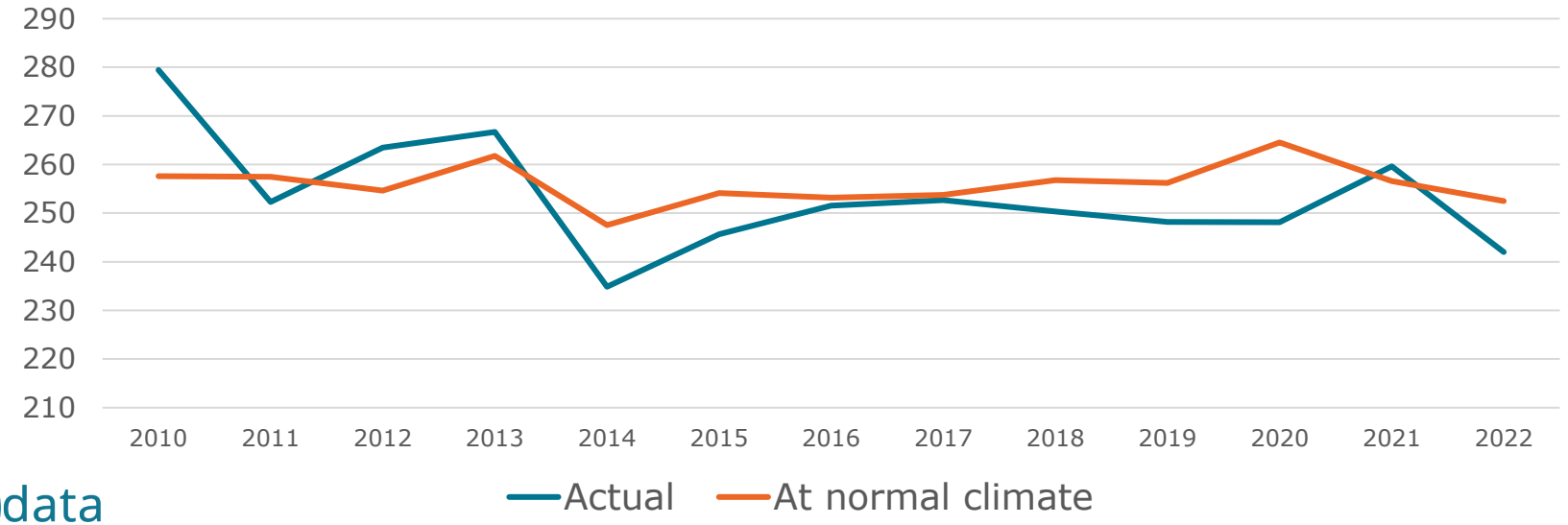


Data corrected for climate variations.
Sources: Odyssee, except Bosnia and Herzegovina (before 2014), Georgia (before 2016), Kosovo (before 2017) and Moldova (before 2015), and Ukraine (<2016 and > 2019) (Eurostat+World Bank).

Climatic corrections

- Climatic corrections have been done in a linear way on the space heating part of consumption on the basis of the ratio between the number of normal heating degree days and actual number of heating degree days.
- The normal number of HDD represents a long-term average: 12 years for most EnC countries.
- In EnC, 2011, 2012 10% colder for all ; 2014 10% warmer for Albania, Serbia, North Macedonia and Kosovo; 2020 10% warmer.

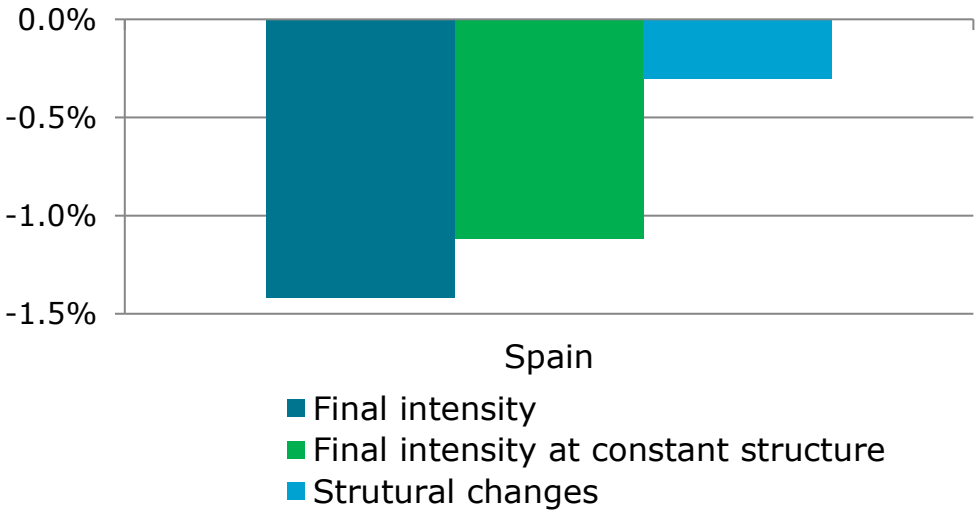
Household consumption in the EU : actual vs value at normal climate (Mtoe)



Impact of structural changes in GDP on final intensity

- Services are much less intensive than industry (5.5 times less at EU level, 3 to 9 times less in EnC).
- If the share of services in GDP is increasing to the detriment of industry, this contributes to reduce the final intensity.
- In EnCs, the share of services in GDP has only slightly increased, except in Ukraine ➔ structural changes in GDP had a limited impact.
- In Spain, for instance, the share of services in the GDP has increased by 4 points between 2010 and 2022, from 65% to 69%, which reduced the final intensity by 0.3%/year.

Structural changes and final intensity variation in Spain (2010-22)



Source: Odyssee

Primary vs final intensity trends (1/3)

- In many countries, primary and final energy intensities have very different trends. In EU countries, primary intensities are decreasing much faster than final intensities.

- Such difference comes mainly from a reduction in power generation losses, due to several factors:

  - An increasing share of renewables in the power mix, which reduces power conversion losses and primary consumption because of very different efficiencies*.

  - Higher imports (or fall in consumption, as in 2022), which reduce power losses: the replacement of 1 Mtoe of power generation by imports translates into a larger decrease in primary consumption (~2 Mtoe).

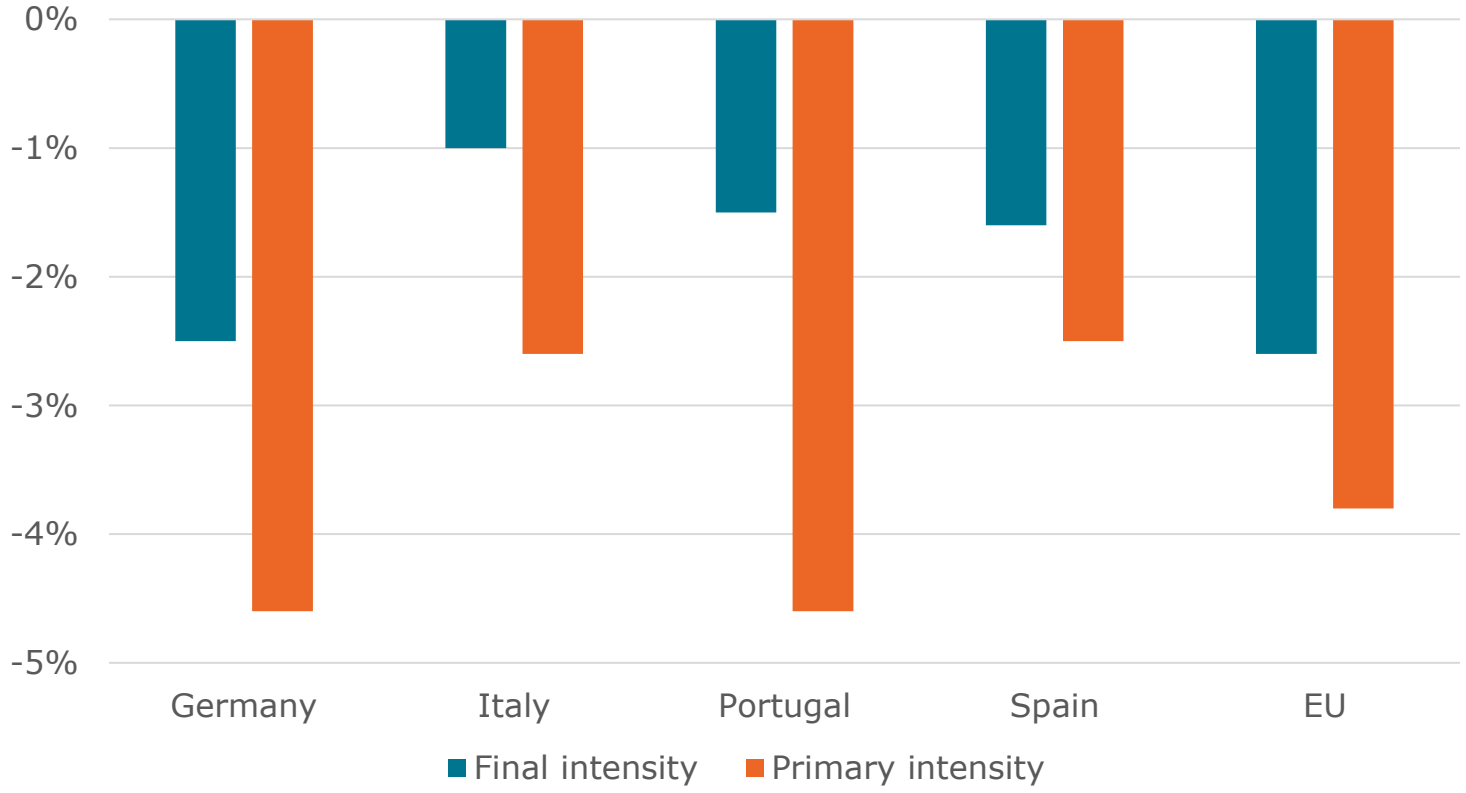
  - A higher efficiency for thermal power.

* 100% for hydro, wind, solar, 30-50% for thermal and 33% for nuclear

Primary vs final intensity trends in EU countries (2/3)

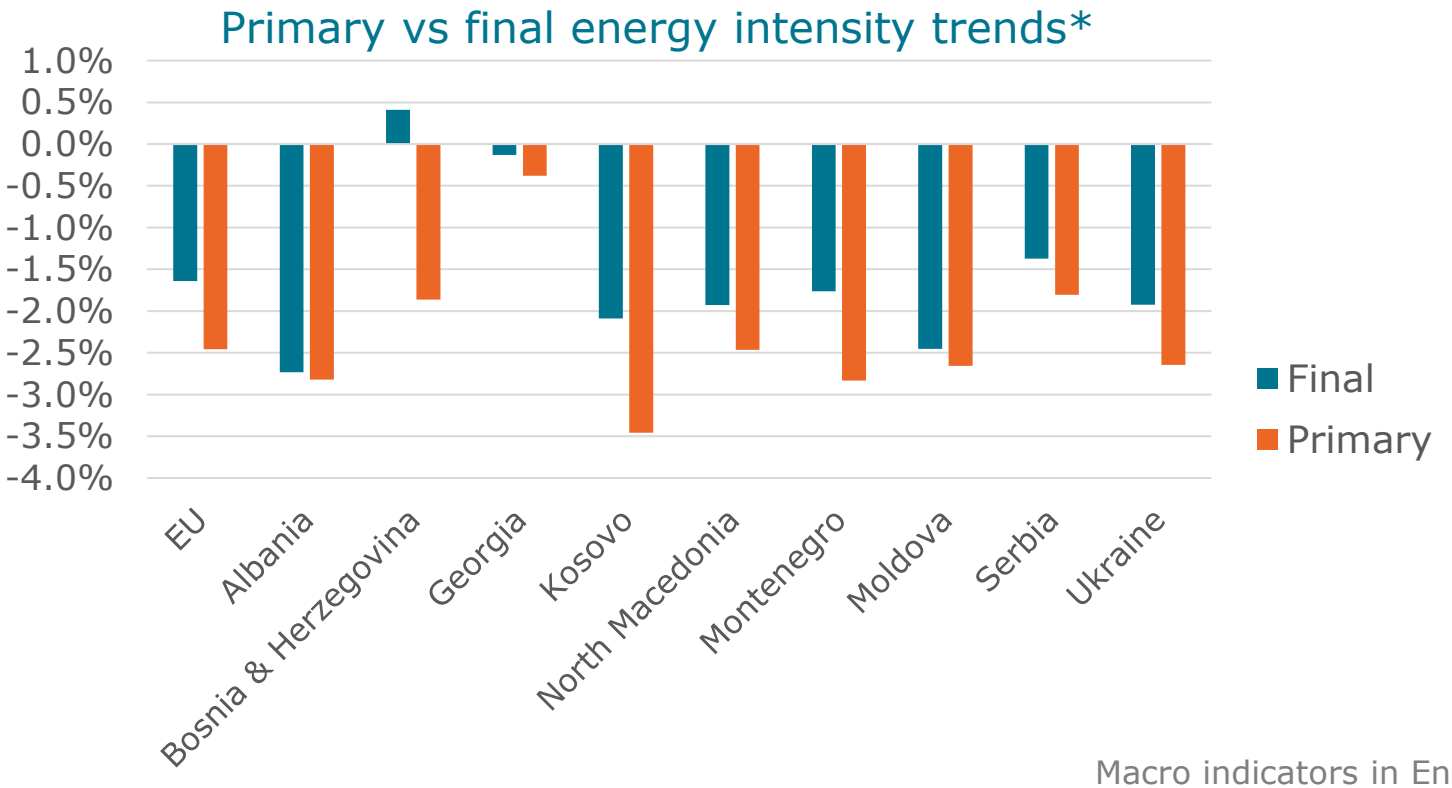
In Portugal and Italy, 70% of the decline in primary intensity since 2019 comes from the electricity sector and especially from the penetration of renewables (50% in Germany and 1/3 at EU level and in Spain).

Primary vs final intensity trends in selected EU countries (%/year, 2019-23)



Primary vs final intensity trends in EnCs (3/3)

- At EU level, in Kosovo or Montenegro, primary intensity decreased 60% to 70% faster than final intensity since 2010; it decreased 30% to 40% faster in Serbia, North Macedonia and Ukraine; in Bosnia & Herzegovina primary intensity decreased while final intensity increased.
- Different explanations behind these trends, depending on the country:
  - Montenegro: higher efficiency of thermal power, higher imports;
  - North Macedonia: higher efficiency of thermal power and share of RES
  - Serbia: higher imports and share of RES.



From simple to advanced indicators

Need for advanced indicators

- Macro-economic indicators are not really energy efficiency indicators as their variation is influenced by other factors than just efficiency, although they are often used to monitor energy efficiency, because of their simplicity.

- Their interpretation can however be improved to remove some of the factors not directly linked to energy efficiency, as explained before, mainly by removing the effect of changes in the power mix for the primary intensity and changes in the structure of the GDP and industry.

- More advanced indicators are needed to provide an overall assessment of energy efficiency improvements, both at the overall level and at the level of sectors as this will be presented in the second session.

Advanced energy efficiency indicators in ODYSSEE

1. Energy efficiency index to measure EE improvements at sector level.

2. Energy savings to quantify the amount of energy saved at sector level.

3. Decomposition analysis to explain energy consumption variation over a period by sector.

4. Financial indicators to show the financial benefit of energy savings.

5. Benchmarking indicators to compare energy efficiency performances among countries.

Energy efficiency index in ODYSSEE

- Energy efficiency progress is measured by sub sector (or end-use or transport mode) with indicators of specific consumption measured in physical units :
  - For industry in toe/ton for energy intensive products (steel, cement, paper), in toe/IPI for other branches.
  - For households in toe/m2 or household for heating, in toe/household dwelling for cooking or water heating, etc.
  - For transport in toe/km or vehicle, toe/pkm and toe/tkm, etc

- ODYSSEE calculates an **energy efficiency index** by sector, called "**ODEX**" *.
  - by expressing trend in specific consumption by sub sector, as an index of variation, and
  - by calculating an average index by sector weighted by the share of each sub-sector in the sector's consumption.
  - An index of 80 in 2022, with a base year 2010, corresponds to a reduction of the index by 20%: this means that energy efficiency improved by 20% or 1.8%/yr**

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

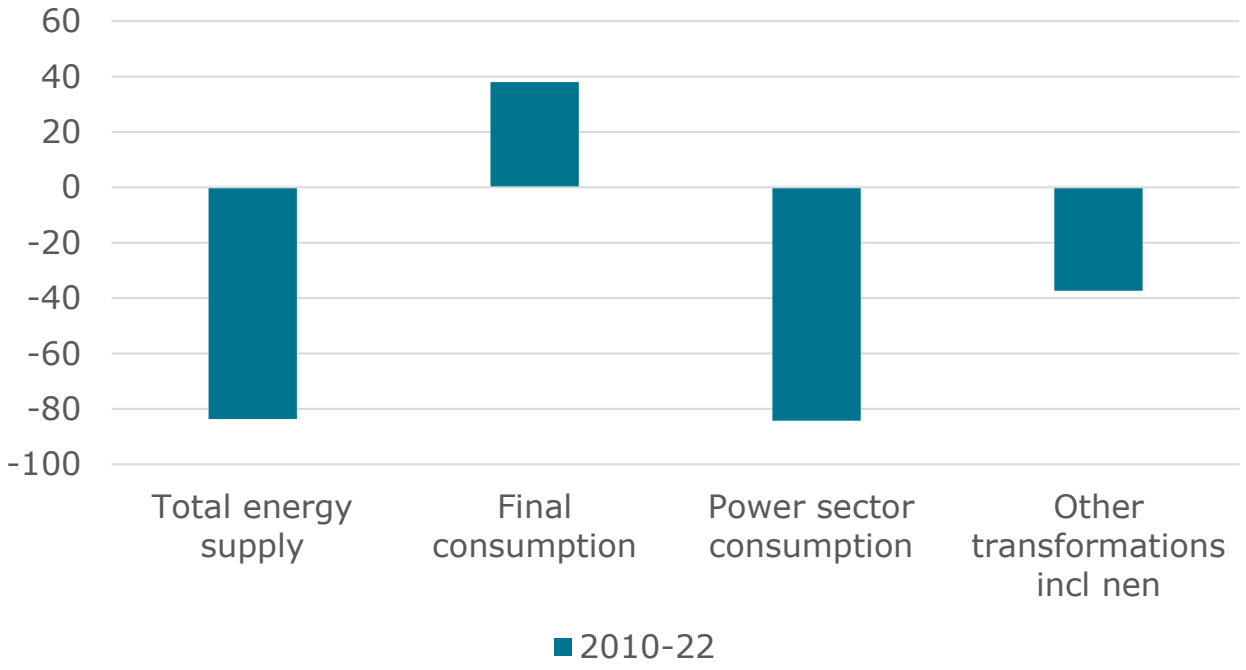
** (80/100)^(1/12)-1 =1.8%/yr

Examples of advanced indicators: decomposition of energy consumption variation and comparison of intensities

Example of decomposition of energy consumption variation: case of primary consumption

- Primary consumption variation is explained from the consumption of 1) final consumers, 2) power sector, 3) other transformations incl. nen*.
- For example, in Montenegro, primary consumption decreased by 84 ktoe from 2010 to 2022, although final consumption increased by ~ 40 ktoe.
- This reduction is due to a decrease in net consumption of the power sector and also in consumption of other transformations

Factors of variation of primary consumption in Montenegro (ktoe)

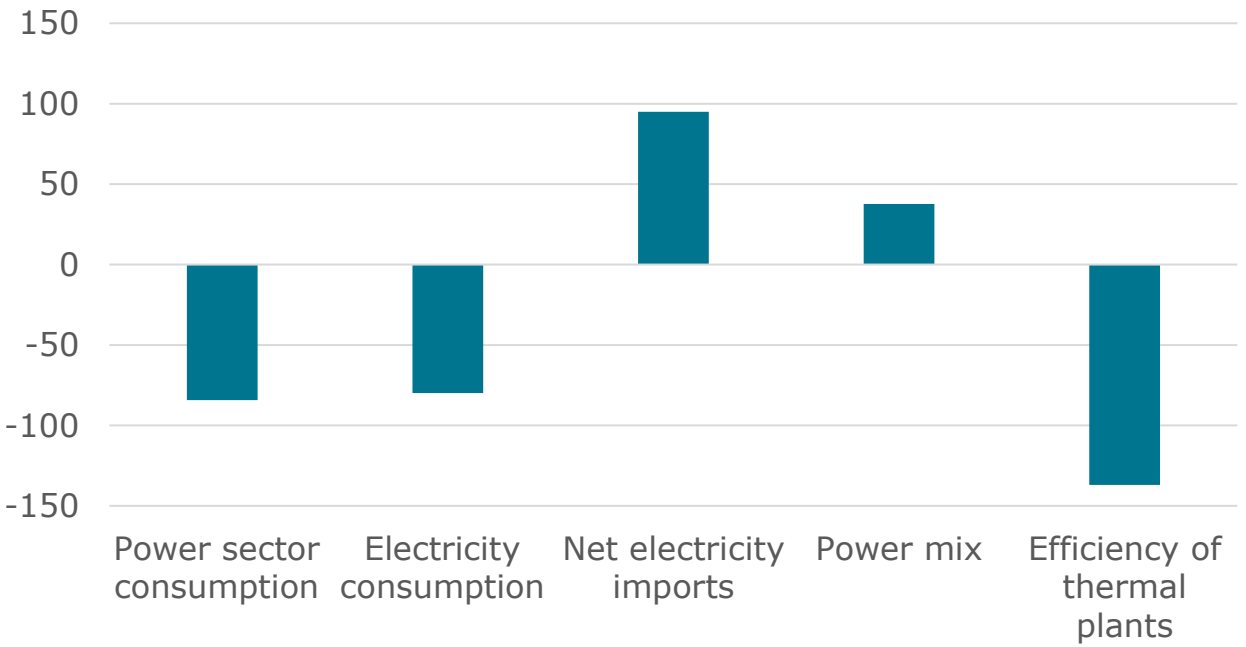


*nen: non energy uses.

Example of decomposition of consumption: case of power sector

- In Montenegro, the consumption of the power sector decreased by 84 Mtoe between 2010 and 2022, as result of various factors:
  - Decrease in power consumption (-80 ktoe)
  - Increase in T&D losses (+95 ktoe)
  - Higher share of thermal (power mix) (+38 ktoe)
  - Improved efficiency of thermal power generation (-137 Mtoe)

Factors of variation of primary consumption in Montenegro (ktoe)



Comparisons of indicators: case of energy intensities using purchasing power parities to adjust for price differences:

- For countries' comparison, energy intensities are measured in the same monetary unit (€) by converting national currencies in €.

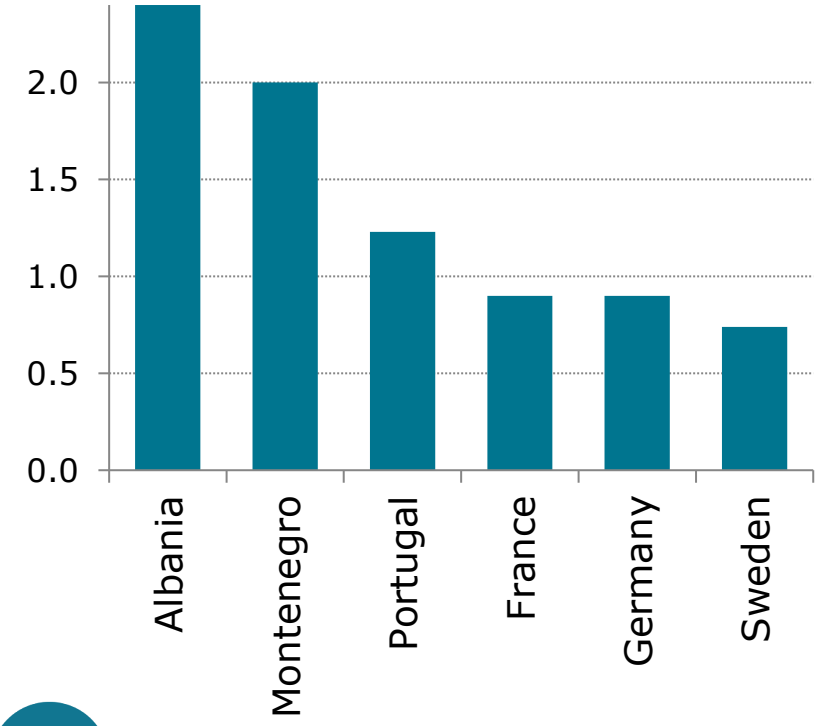
- Conversion with market exchange does not reflect the fact that in less developed countries consumer prices are much lower than in more developed countries.

- The use of Purchasing Power Parities (PPP) improve the comparison as it accounts for the real purchasing power of incomes.

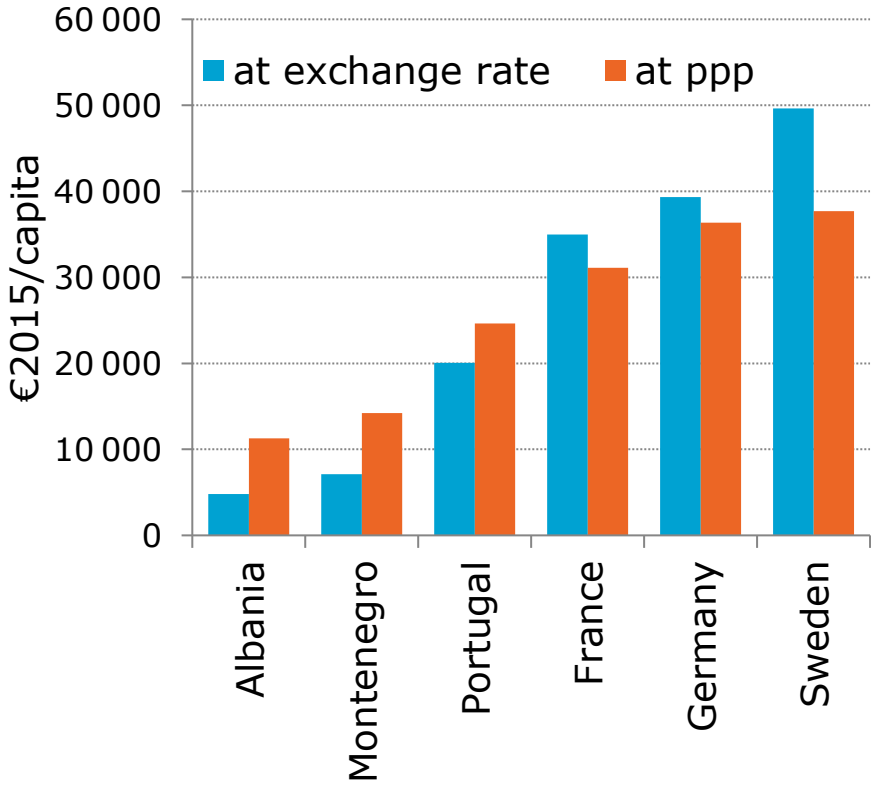
- PPP are provided by international organizations (e.g. Eurostat, World Bank, IMF).

- In Albania the exchange rate in 2015 was 140 lek/€; at ppp it was 2.4 times lower (59 lek/€) ➔ GDP is 2.4 times higher at ppp.
- For EU countries, this goes the other way around: GDP at ppp is lower than at exchange rate, by ~10% for France or Germany.
- Conversion of GDP at ppp increases the GDP of countries with low cost of living… and decrease their energy intensities

Ratio exchange rates over purchasing power parities (2015)



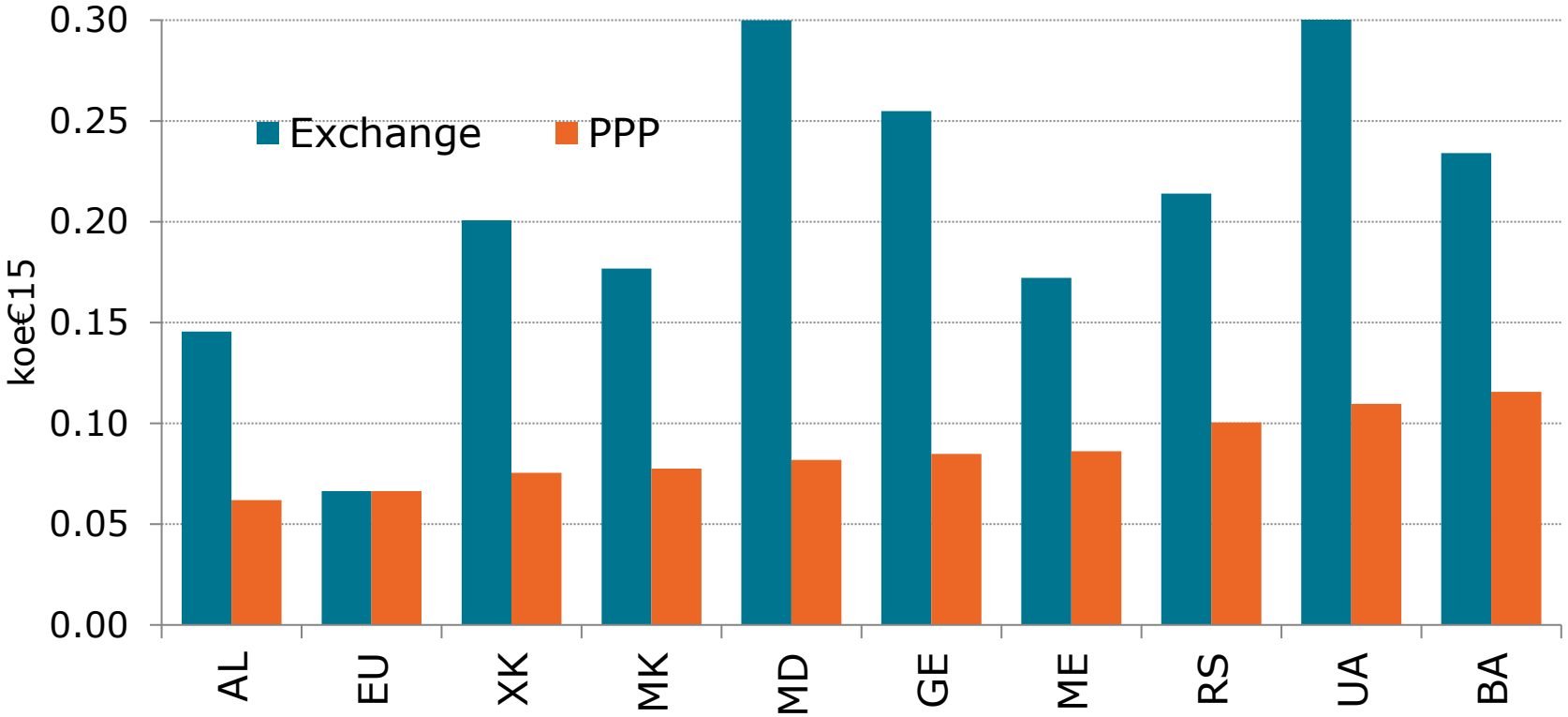
GDP per capita (2022)



Source: Enerdata from World Bank

- Using PPP instead of exchange rates affect the relative energy intensity values between countries (their "ranking") and narrow significantly differences across countries.
- Energy intensities measured at ppp are more relevant for comparison of energy intensities as they measure the real level of economic activity.

Final energy intensities (2022)



Source: ODYSSEE; Enerdata estimates for XK, GE, UA)

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About Enerdata:

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