

Regional training of *ODYSSEE-MURE* *Understanding energy efficiency indicators*

5. Benchmarking of energy efficiency by sector

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Benchmarking and scoring of energy efficiency performances with indicators

- Benchmarking of energy efficiency at sector level is done in ODYSSEE with comparable indicators at sub-sector level and with “adjusted indicators” at sector level .
- Scoring of energy efficiency performance is done for both levels and trends, through the scoring of selected indicators by end-use.

Content

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2. Benchmarking at sector level
3. Scoring countries of energy efficiency performances
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 - ii. Annex 2: list of indicators of the scoreboard and weighting

ODYSSEE DATABASE



KEY INDICATORS





Benchmarking of EEI by sub-sector or end-use

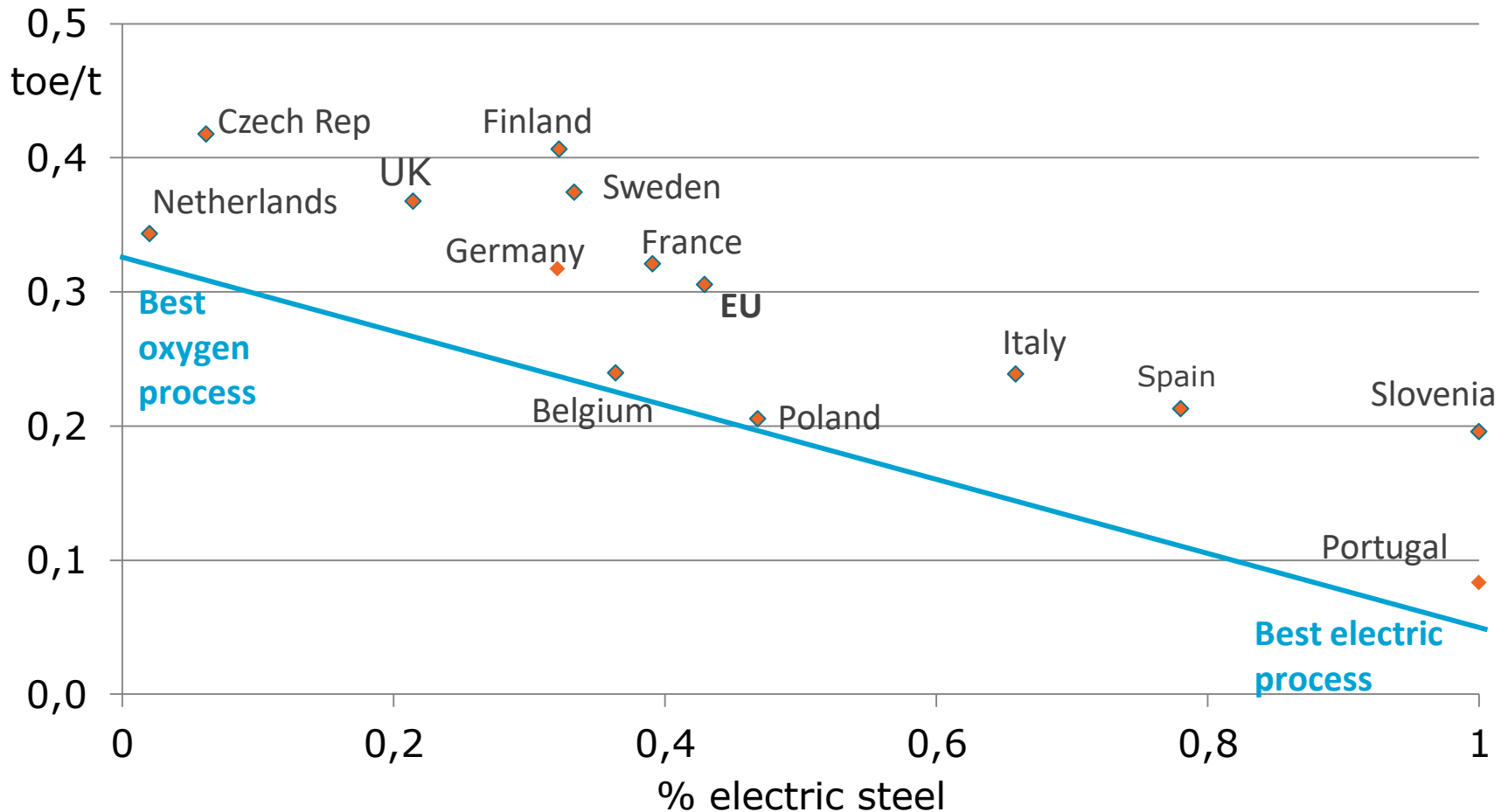
Benchmarking of EEI

- Benchmarking of EEI at end-use or sub sector level should be done by taking into account as much as possible factors of differences that are not linked to energy efficiency:
 - for household heating: differences in terms of climate, fuel mix, dwelling size → heating consumption per m² and degree days in useful energy is more relevant than just comparing heating consumption per household ;
 - for industrial product: differences in process/product mix should be accounted for.
- This is done with specific graphs that show the impact of the most important factors that are not linked to energy efficiency (e.g. comfort for heating, process /product mix in industry)

Difference in specific consumption partly explained by differences in process mix; distance to blue line shows possible potential of energy efficiency gains

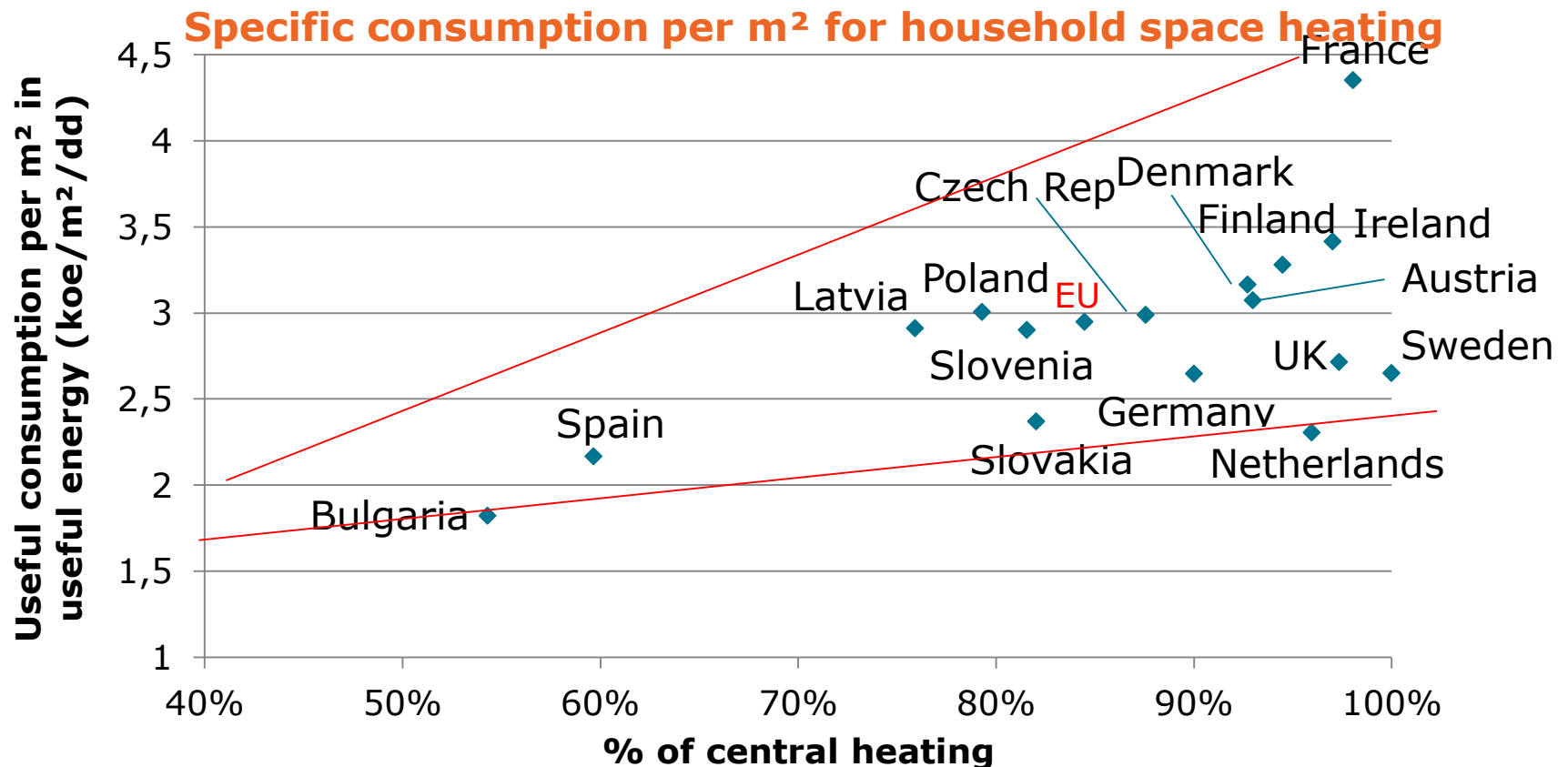


Consumption per tonne of crude steel (2012)



Indicators of benchmarking: space heating

Benchmarking for heating should take into account countries' differences in dwelling size, climate, fuel mix and heating comfort → consumption per m²/ degree-day in useful energy, in relation to central heating penetration → The Netherlands has the best performance among countries well equipped in central heating: 40% better than France.



Central heating includes district and block heating, individual boilers and electric heating (all rooms heated, as opposed to room heating, where a stove provides heat to the main room only.



Benchmarking by sector

Benchmarking at sector level with adjusted indicators in ODYSSEE

- The adjustments made in ODYSSEE take into the following quantifiable differences between countries:
 1. Climate
 2. Fuel mix
 3. Industry structure
 4. Economic structure
- All indicators in monetary terms are measured with purchasing power parities to adjust for differences in general price level.
- A data tool enables to benchmark the countries by doing these adjustments (“ benchmarking tool”) and by showing the impact of each of them individually.

Adjustment to the same climate



- **Climatic differences** are taken into account by calculating an indicator "adjusted" or "scaled" to the **climate** of the **reference country**. The adjustment is done on the heating part of the consumption of the basis of heating degree days.
- The **reference country is the EU** in the ODYSSEE **data base**, the **selected country** in the **benchmarking tool**
- This adjustment is done for:
 - Household consumption per dwelling and per m²
 - Household space heating consumption per dwelling and per m²
 - Service sector energy intensity
 - Final energy intensity adjusted at EU climate: actual and at constant structure
- Adjustements can be done in the same way for air conditioning .

Adjustment to the same fuel mix



- The main sector for which differences in fuel mix have a significant impact on the indicators are the household and power sectors.
- For the household sector, the adjustment is done by calculating a consumption in useful energy and assuming the same fuel mix for each country (that of a reference country*).
- For the primary intensity, the adjustment is done by assuming the same power mix for each country (that of a reference country).

**The reference country is the EU in the ODYSSEE data base and the selected country in the benchmarking tool*



Adjustment to the same industry structure

- Differences in **industry** structure are taken into account by calculating an average industrial intensity with the actual intensity by sub-sector of each country and the same industry structure, that of the reference country* (i.e. share of each industrial branch in total value added).
- The calculation is done in ODYSSEE for:
 - Industry intensity
 - Manufacturing intensity

**The reference country is the EU in the ODYSSEE data base and the selected country in the benchmarking tool*

Adjustment to the same GDP structure

- Differences in GDP structure are taken into account by calculating a final energy intensity with the actual sectorial intensities of each country and the same GDP structure, that of the reference* country (i.e. share of agriculture, industry, services and private consumption in total GDP);
- For industry the industrial intensity used is the adjusted one to also capture the differences in industry structure;
- The calculation is done in ODYSSEE for:
 - Final energy intensity in ppp
 - Final energy intensity in ppp adjusted at EU climate (to combine several adjustments)

**The reference country is the EU in the ODYSSEE data base and the selected country in the benchmarking tool*

Benchmarking tool

ODYSSEE-MURE

Overview Data Tools Publications News Contact



Odyssee

The ODYSSEE indicators are accessible under different data tools: the full data base, the key indicators facility, as well as five specific data facilities that focus on specific issues and provide some interpretation: market diffusion, decomposition, benchmarking, energy saving and indicator scoreboard. The access to the data base is restricted, whereas all other data tools are in public access.

ODYSSEE DATABASE

KEY INDICATORS

MARKET DIFFUSION

DECOMPOSITION

BENCHMARKING

ENERGY SAVING

ENERGY EFFICIENCY INDICATOR SCOREBOARD

Benchmarking facility compares the energy performance of any country with a selection of other countries.



Co-funded by the Intelligent Energy Europe Programme of the European Union

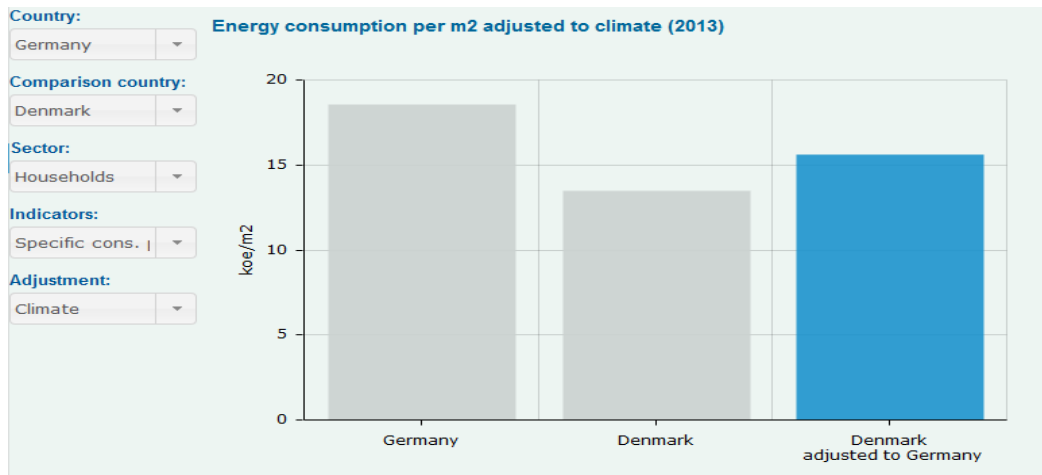


The benchmarking tool: main principles

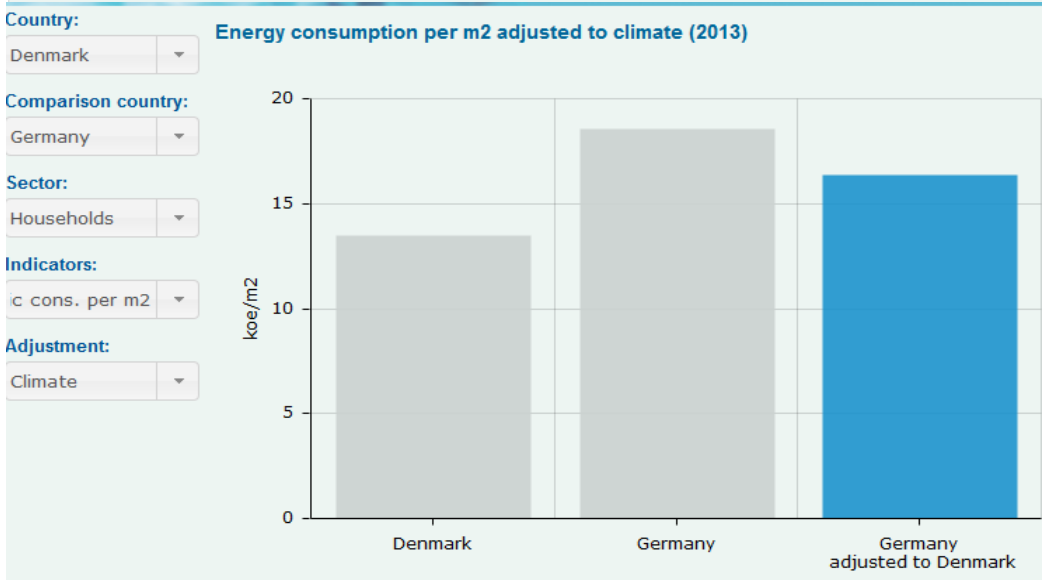


- The objective of this tool is to enable country X to compare with the country(ies) of its choice by adjusting the different indicators to its own characteristics.
- The tool shows for the last year available a graph showing the actual indicator values and the indicator after adjustment to the characteristics of country X.
- The user selects:
 1. the country to benchmark (X),
 2. the countries to which country X will be compared (“**comparison countries**”) (multi-selection available),
 3. the **sector**,
 4. the **indicator** for which the adjustment will be made (selection proposed),
 5. the **type of adjustment** (among a selection proposed).

The benchmarking tool: example



The first graph shows what would be the energy consumption per m2 scaling the household consumption of Denmark to the average climate of Germany.



The second graph shows what would be the energy consumption per m2 scaling the energy consumption of Germany to the climate of Denmark.



Scoring energy efficiency performances

European Energy Efficiency Scoreboard: energy efficiency levels and trends

- Objective : Assess and score the level and progress of countries in energy efficiency, globally and by end-use sector (industry, transport, households, services, total final).
- Energy efficiency is assessed by sector through a selection of indicators:
 - **Indicators of level:** selected indicators e.g. for transport: specific consumption of cars, of goods vehicle, share of public transport...
 - **Indicators of progress :** trends in the previous indicators (e.g. trend in specific consumption of cars and trucks...).

Scoreboard methodology: calculation of the score for each indicator

- **Scoring methodology based on OECD Composite Indicator** (JRC method) which gives normalized scores across the countries within a range of 0-1.
- Methodology based on minimum and maximum values observed in the sample of countries ;

$$\text{Normalized score calculation} = \frac{\text{Indicator} - \text{min indicator}}{(\text{max indicator} - \text{min indicator}) * \text{direction}} + 0.5*(1 - \text{direction})$$

- Direction: = -1 (decline in the indicator favored) /+1 (increase favored)
- Final normalized score is always in the **range (0,1)**.
- Minimum and maximum: average of the lowest and highest 3 country values.

Scoring methodology: example of specific consumption of cars

Specific consumption of cars l/100km

aut	6,6
cro	7,2
cyp	9
dnk	8,0
esp	7,1
fin	6,2
fra	6,8
gbr	5,8
grc	6,0
hun	7,9
irl	6,3
ita	6,1
lat	7,8
nld	7,6
nor	6,4

Maximum: 9

Minimum: 5.8

Direction = -1 (decline in the indicator is favored)

Austria = 6.6

Normalized score =

$$\frac{\text{Indicator} - \text{min indicator}}{(\text{max indicator} - \text{min indicator}) * \text{direction}} + 0.5*(1 - \text{direction})$$

$$\frac{6.6 - 5.8}{(9.3 - 5.8) * (-1)} + 0,5 * (1 - (-1))$$

Normalized score = **0.78**
Austria =

Scoreboard indicator tool

ODYSSEE-MURE

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Odyssee



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KEY INDICATORS



MARKET
DIFFUSION



DECOMPOSITION



BENCHMARKING



ENERGY
SAVING



ENERGY
EFFICIENCY
INDICATOR
SCOREBOARD



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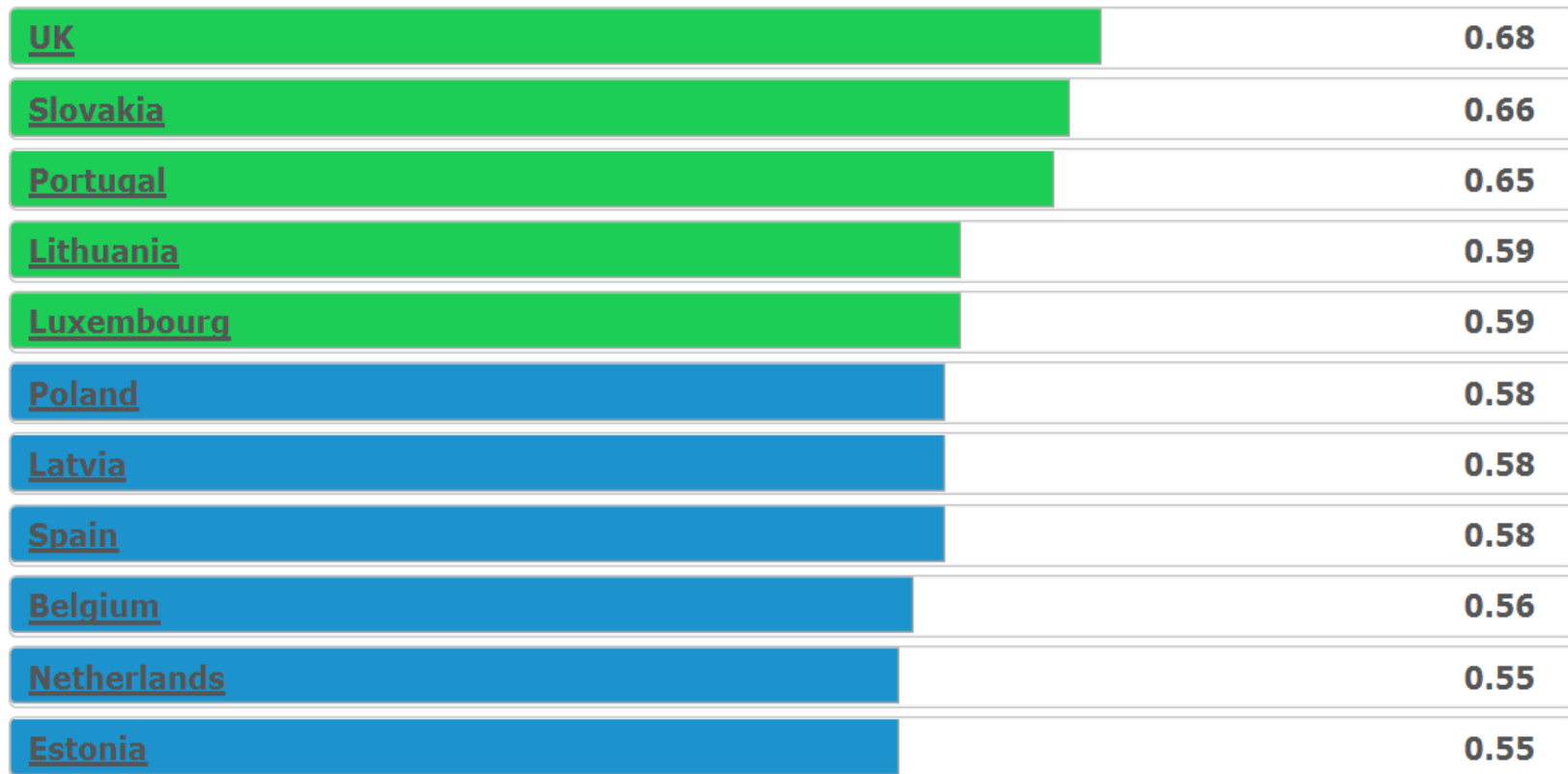
Energy efficiency indicator scoreboard facility maps o
the energy efficiency position of each country, global
and by sector.

Scoreboard: Country ranking (1/2)

Ranking by sector. All countries are displayed with their score: by sector with the possibility to visualise results for **trends and levels** combined or for **trends** or **levels** only.

Possibility to display the ranking by country and indicators (next slide).

Ranking for all sectors (trends and levels)



Scoreboard: Display of the ranking by indicator (2/2)

1 shows the 3 best ranking countries, 2 shows the next ones and so on.

Ranking by indicator: case of transport

	Car efficiency		Road freight per tkm		Air per passenger		% public transport		% rail & water (freight)	
	Level	Trend	Level	Trend	Level	Trend	Level	Trend	Level	Trend
1/ Sweden	7	①	15	20	5	11	15	③	②	9
2/ Portugal	4	4	14	③	8	7	24	10	22	7
3/ UK	①	①	22	19	25	20	23	①	21	5

Indicator scoreboard: new developments

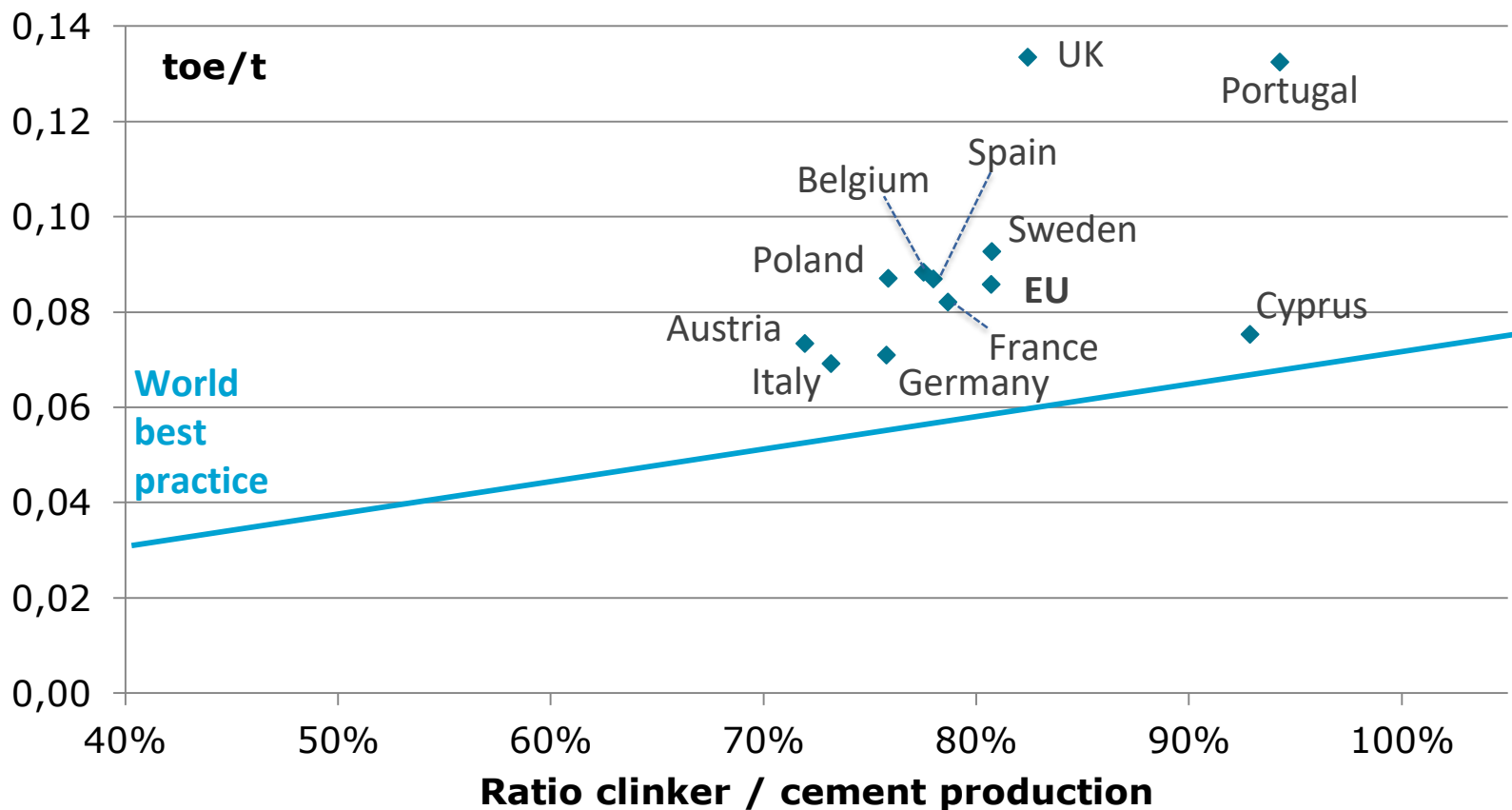
- The **weighting by end-use** for households, transport and services, initially based on the same weight for all countries will be based on the **actual average** share **over the last 3 years** in each country's consumption.
- The **indicator scores for level**, initially based on the last year available, will be calculated as an **average of the last 3 years**, to avoid fluctuations in the score from one year to another (e.g. due to data revisions).
- The **indicators score**, initially calculated with the best 3 countries at 1 will be calculated with **only the best country to 1** to better spread the scores.
- To harmonise with the policy score, where the best country by sector is equal to 1, which never happened for the indicators scores as they are based on different indicators with no country having 1, **the sectoral score and total score** will be **normalized** so as to score **the best country at 1**).

Annex 1: Other benchmarking by sub-sector/end-use

The energy performance of cement production is done in relation to the share of clinker produced in the country in cement production: the higher this ratio, the higher the specific energy consumption. For a given value of the ratio, the distance to the blue line (best practice) indicates the potential of energy savings.



Benchmarking of the specific energy consumption of cement (2012)

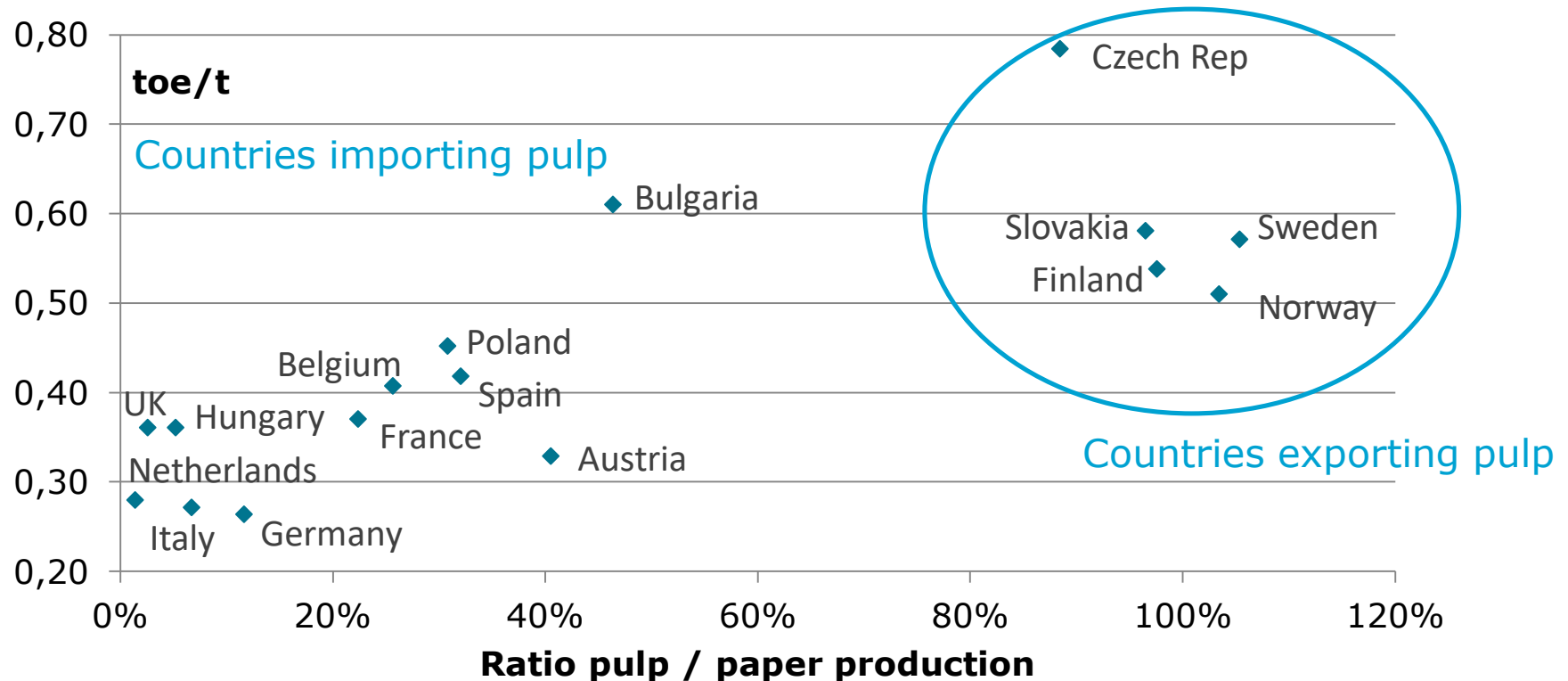


The energy performance of the paper industry, which also includes pulp production is linked to the share of pulp produced in the country in relation to paper production: the higher this ratio, the higher the specific consumption.



Comparisons should be made at similar level of this ratio: for countries with a high production of pulp, Norway and Finland have the best performance.

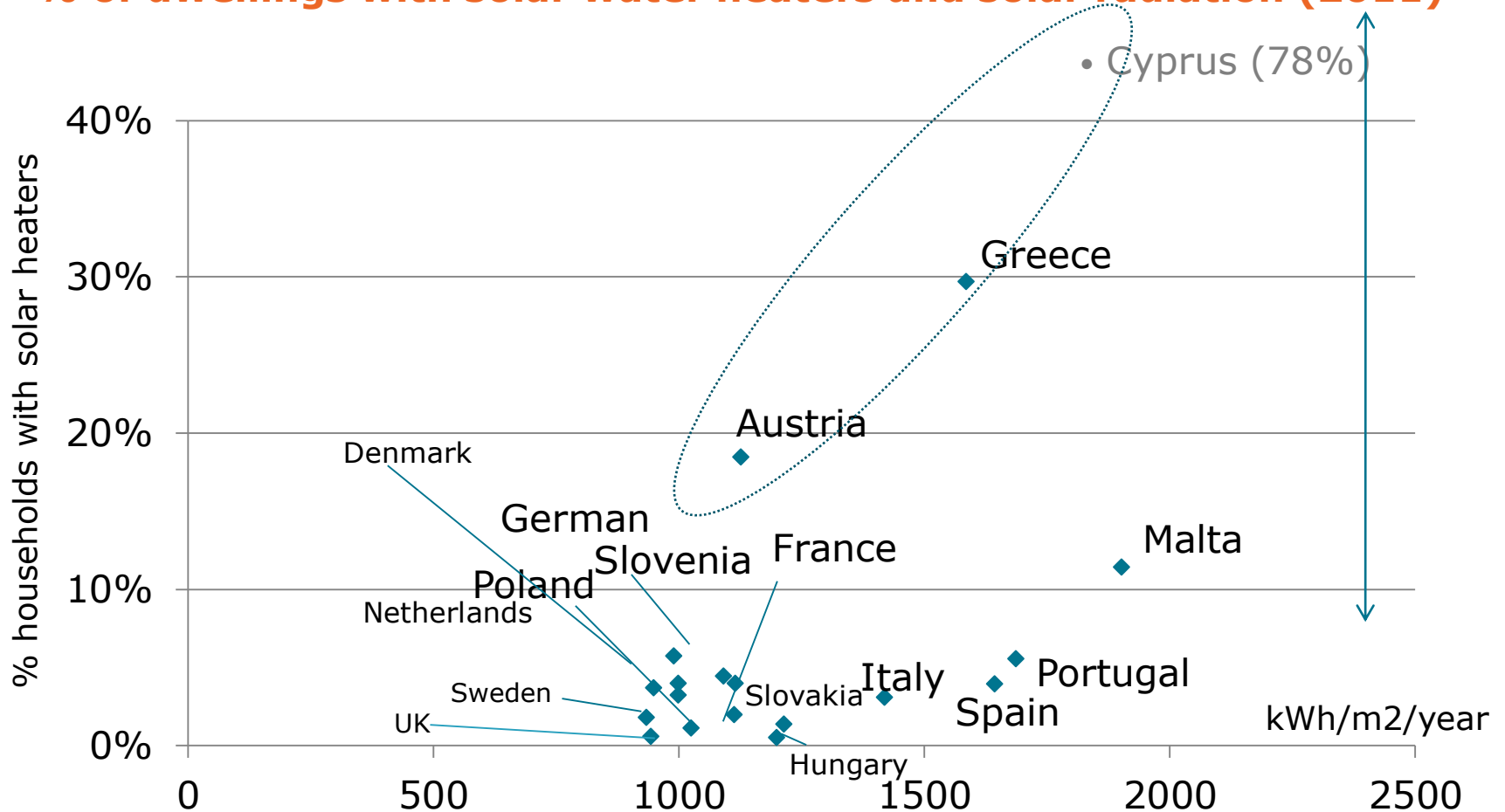
Specific consumption per ton of paper (2012)



Benchmarking of the penetration of solar water heaters should be related to the annual solar radiation: Austria is the benchmark for countries with medium solar radiation (from 3% in 1990 to 18% in 2011) and of course Cyprus for countries with good solar radiation.



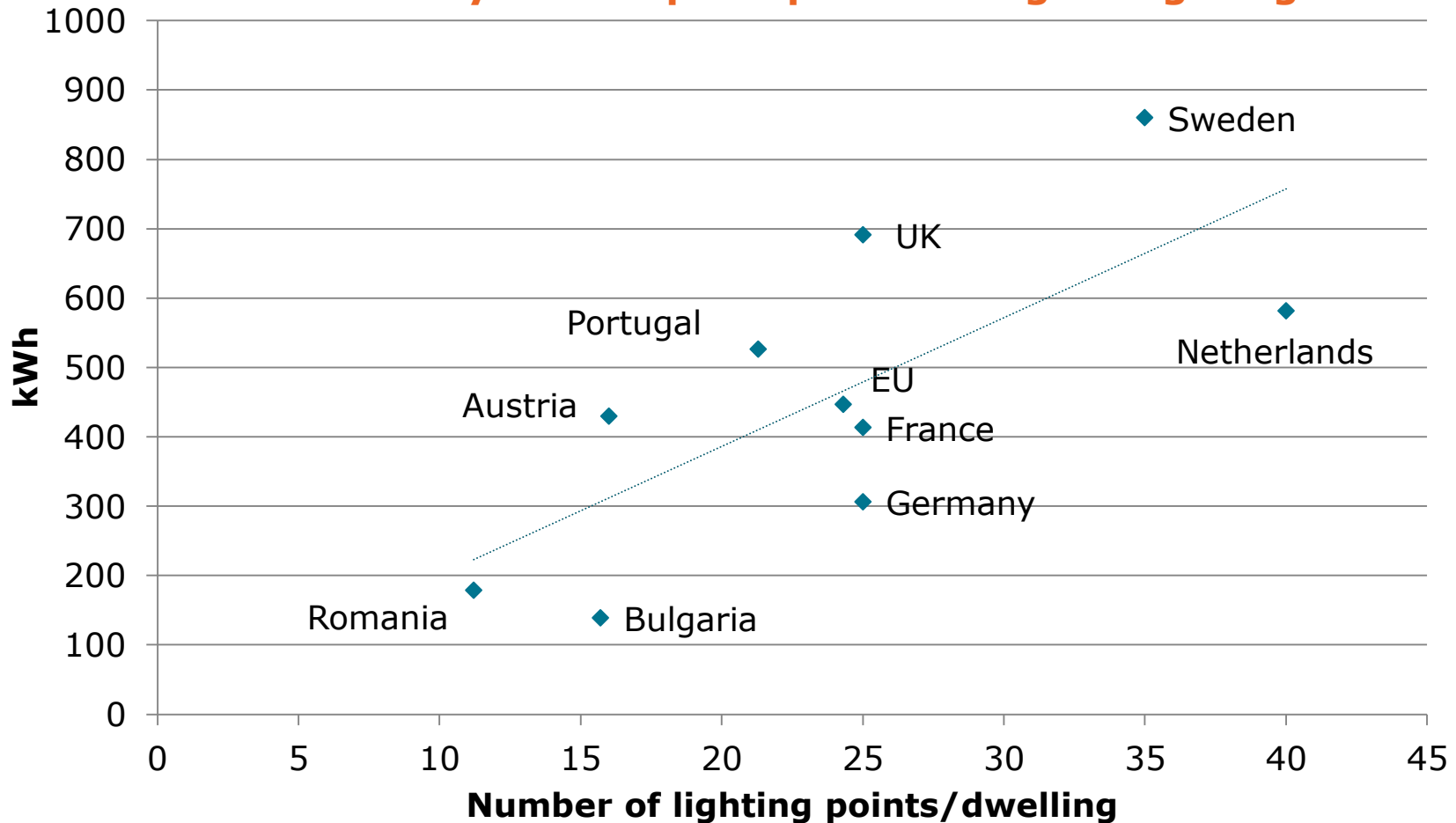
% of dwellings with solar water heaters and solar radiation (2011)



The level of consumption depends on the efficiency of lamps, i.e. the penetration of CFL, but also on the number of lighting points ... and this number is increasing



Electricity consumption per dwelling for lighting



Number of lighting points: compiled by Enerdata from various sources, of which Remodece, JRC-Ispra

Annex 2: list of indicators of the scoreboard and weighting

Residential: selected indicators and indicators weighting

End-use	Indicator	Weight	Weight
		Countries with low heating needs*	All other countries
Heating	Consumption for heating per m ² scaled to EU climate and equivalent to central heating	25%	65%
Other thermal uses	Cons. per dwelling for cooking and water heating	35%	15%
Appliance	Specific consumption of electricity per dwelling for appliances (incl. Air-conditioning)	30%	15%
Solar penetration	% of dwellings with solar water heaters	10%	5%

* Malta, Cyprus and Portugal

Transport: selected indicators and indicators weighting

Modes	Indicator	Weight
Cars	Specific consumption (l/100km)	45%
Trucks and light vehicles	Specific consumption (goe/tkm)	25%
Air	Specific consumption (koe/pass)	15%
Modal split		15%
-Passengers	% of traffic by public mode	10%
-Goods	% of traffic by rail and water	5%

- Weight based on energy consumption breakdown
- Same weight for all countries

Services : selected indicators and weighting

End-use	Indicator	Weight
Thermal uses	Fuel consumption per employee	80%
Specific electricity	Electricity cons per employee	20%

Industry : selected indicators and weighting

Categories	Indicators	Weight
Energy efficiency trend	ODEX (energy efficiency index)	50%
Energy efficiency performance	Adjusted energy intensity at ppp at EU industry structure	50%

Scoreboard facility on energy efficiency indicators

Global score weighting

Weights defined according to sector consumption **by country**

Transport
X%

Residential
Y%

Services
Z%

Industry
T%

Annex 3: Adjustement at PPP

Adjustment for price differences: use of purchasing power parities

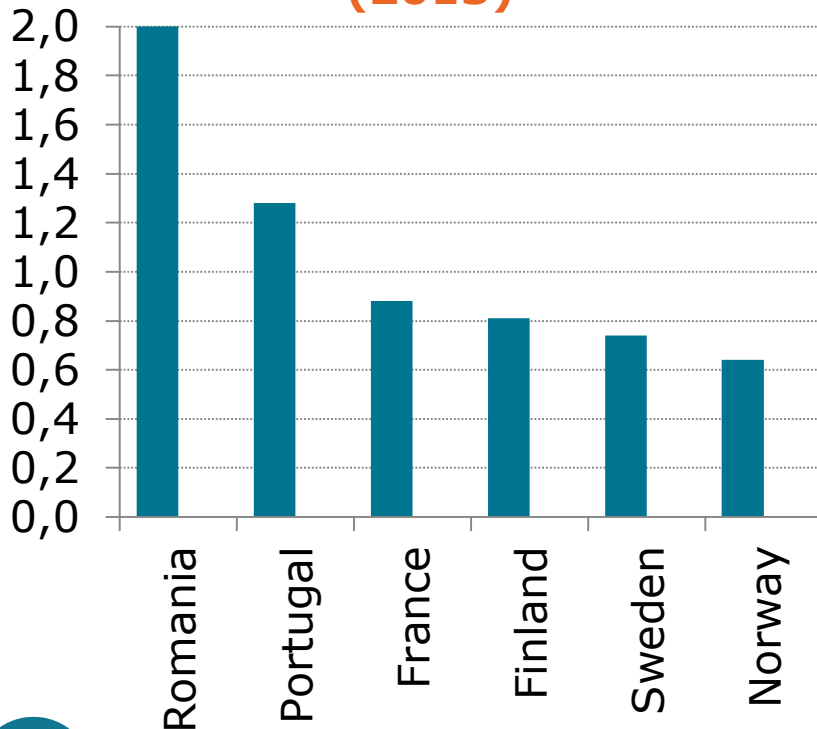


- For countries' comparison, energy intensities are measured in the same monetary unit (€, \$) by converting national currencies in €, \$.
- Conversion with market exchange rates raises two problems:
 - Market exchange rates can vary quite a lot independently of the economic performance of countries which affect the relative energy intensity values between countries (their "ranking") ;
 - The conversion does not reflect the fact that in less developed countries consumer prices are on average much lower than in more developed countries
- The use of Purchasing Power Parities (PPP) improve the comparison as it does not fluctuate and accounts for the real purchasing power of incomes.
- PPP are provided by international organizations (e.g. Eurostat, World Bank, IMF).

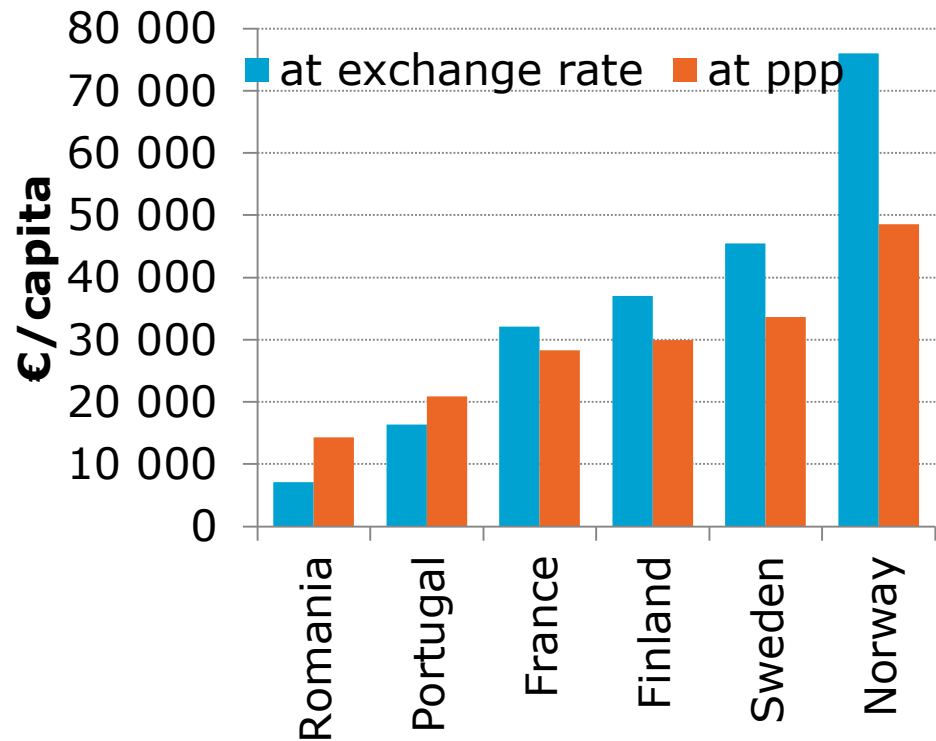


In Romania the exchange rate in 2013 was 4,4 lei/€; at ppp it was twice lower (2,2 lei/€) → the GDP is twice higher in ppp than based on exchange rates; for France, Finland, Sweden and Norway, this goes the other way around, the GDP at ppp is lower than at exchange rate. Conversion of GDP at ppp increases the GDP of countries with low cost of living... and decrease their energy intensities

Ratio exchange rates over purchasing power parities (2013)



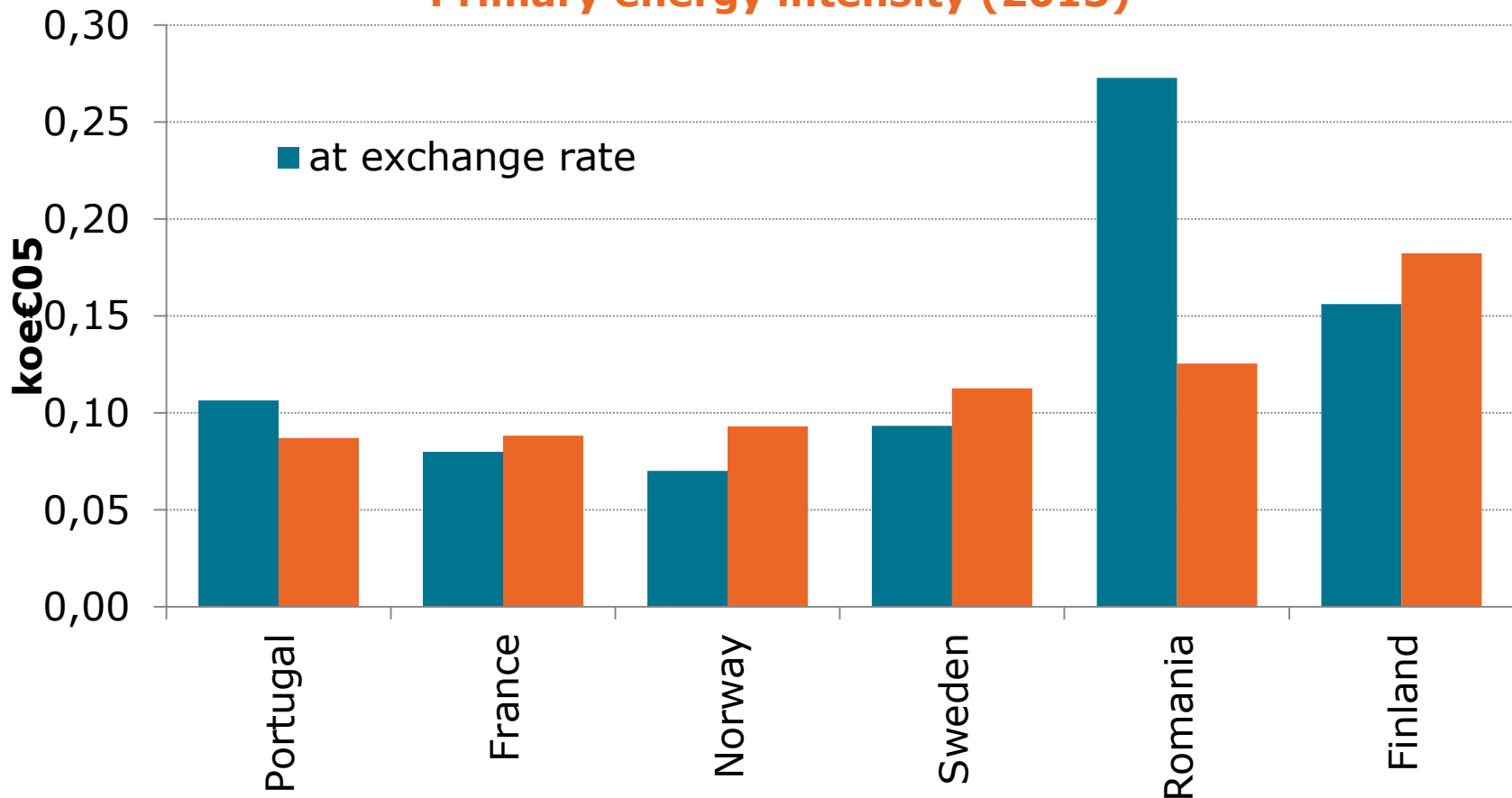
GDP per capita (2013)





- Energy intensities measured at ppp are more relevant for comparison of energy intensities as they measure the real level of economic activity and narrow significantly the differences across countries.
- In the ODYSSEE benchmarking tool, intensities are directly expressed in PPP.

Primary energy intensity (2013)



Why using Purchasing Power Parities for cross country comparisons of energy performance ?



- Let us take 2 factories producing cars : one in France and one in Romania, **with the same technical performance**, i.e. the same energy input by car produced (in toe or GJ per car).
- The value added of each car is mainly made from salaries (capital costs and profits also included), whose relative level across countries are mainly influenced by the average difference in the cost of living (**2 times** lower for Romania*)
- ➔ With the same technical performance, **the energy used per unit of value added** (« **energy intensity** ») for the car industry will be **twice** higher in Romania than in France with exchange rates but **the same at ppp**.
- ➔ Energy intensities differences at ppp are closer to differences in technical performance.

* Based on ppp published by Eurostat for 2014

Energy intensities trends: exchange rate versus at purchasing power parities



- Use of PPP increases GDP and, thus, decreases energy intensity of countries with low cost of living; conversely intensity of rich countries increases → ppp affects the ranking of intensities among countries **but does not change the trends**

Final energy intensity of Portugal (normal climate) (koe/€2005)

