

Kick of Meeting of Phase 2 TGEP-EEDP projects on Energy
Efficiency Indicators in Thailand

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Content of spreadsheet data base and review of EEI indicators by sector

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- ▶ **1. Content and organisation of spreadsheet data base**
- 2. Review of EEI indicators by sector and data required

Introduction to the data spreadsheet

- Collecting data for energy efficiency indicators requires a certain organization, with:
 - A well presented and user friendly format;
 - A good documentation of data with units, sources and references;
 - A linkage between different data corresponding to the same entity to guarantee consistency among sectors and avoid duplication of data inputs and corrections.
- Enerdata has a long experience of developing such data spreadsheets:
 - For regional data bases in Europe (Odyssee), Latin America (BIEE), Mediterranean countries (Medener), which means the same format for all countries;
 - For national data bases, which enable to adapt the format to the data availability and classification → case of Thailand

Introduction to the data spreadsheet

- Based on our experience, a database spreadsheet developed in Excel with one sheet by sector is very well suited, as it enables:
 - The control of data consistency and calculation of indicators linked to the data with transparent formulas;
 - To track easily all disruptions or problems in the data and indicators ;
 - To transfer easily the data to a larger data base (e.g. Oracle) or to a web data base for a user friendly consultation of data.
 - To centralize all data in one place with a uniform format, even if several persons are involved.
 - To update the base year of a demand forecasting model

Content and organisation of the data spreadsheet

- The database spreadsheet developed for the TGEP-EEDP project is organized by in 5 sectoral sheets, as follows:
 1. **Industry:** data by industrial branch
 2. **Services:** public an commercial sectors
 3. **Households:** data on equipment and end-use
 4. **Transport:** data by transport mode
 5. **Macro:** GDP by sector and energy balance data on primary energy consumption and final energy consumption by sector and energy types

Content and organisation of the data spreadsheet

- The data template will combine **top-down data** coming from the various statistical sources, identified in Phase 1, as well as **bottom-up data** coming from the reporting of **designated** industrial facilities and buildings to DEDE. It will include the reconciliation of these two types of data to derive additional data and indicators.
- The sheet **industry** includes all data related to manufacturing, mining and construction.
- The sheet **households** includes all residential buildings, including large condominiums apartments that are presently classified in the commercial sector in DEDE statistics, so as to harmonize with international practices.
- The sheet **macro** will include indicators already published by DEDE.

Organisation of the sheets

- Each Excel sheet is organised into 3 parts:
 - A **data** section for data inputs;
 - An **indicator** section where all indicators are calculated with automatic graphs to visualise the trends, so as to identify easily disruptions or aberrant values;
 - A data **control** section to check the consistency of data (control of coherence between sum of sub sectors and total) and calculation of the variations over the last 5 years for a selection of indicators.

Presentation of the data file : data series

col 1 :
Title

col 2 :
Units

col 3-n :
Data (eg
1990-2012)

col n+1:
Source
(acronym or
abbreviation)

col n+2:
References,
notes

Services						
Top -down data						
Energy consumption of the service sector	units	2009	2010	2011	source	
LPG consumption of tertiary sector	ktoe					
electricity consumption of tertiary sector	ktoe					
Total consumption of tertiary sector	ktoe					
Electricity consumption by branch and type of buildings						
Total Consumption	GWh					
Health sector	GWh					
Hospitals	GWh					
Wholesale and retail trade	GWh					
Department stores	GWh					
Retail stores	GWh					
Wholesale stores	GWh					
Hotels and restaurants	GWh					
Hotels	GWh					
Restaurants	GWh					
Fiancial institute	GWh					
Floor area in service sector buildings						
hospitals	Mm2					
hotels	Mm2					

Presentation of the data file : data controls

➤ Automatic data control to check the data consistency

	2009	2010	2011
Data control			
Top down data			
Electricity consumption by branch			
Sum of all branches compared to total			
Sum of all buildings of a branch with branch total			
VA by branch			
Sum of all branches compared to total			
Employment by branch			
Sum of all branches compared to total			
Bottom-up vs top-down data			
Electricity consumption by type of building			
Sum of all buildings from BU data compared to top-down data			

➤ Control of indicators trends

Main Indicators		variation of the 5 last year (%/year)				
		2007/2006	2008/2007	2009/2008	2010/2009	2011/2010
Energy consumption per unit of private consumption	koe/M\$93					
Electricity consumption per unit of private consumption	koe/M\$93	-1%	8%	1%	-6%	-3%
Electricity consumption per electrified households	kWh/household	0%	2%	-1%	-5%	0%
Unit consumption of households per dwelling	toe/dw.	2%	0%	-1%	-4%	0%

Presentation of data file : calculation of indicators

Top down		
<i>Total energy intensity and unit consumption per employee</i>		
Energy intensity of services		kep/MIxx
Energy consumption of services per employee		tep/emp
<i>Electricity Intensity and unit consumption</i>		
Electricity intensity of services		MWh/MIxx
Electricity intensity of health sector per employee		kWh/emp
Electricity intensity of wholesale and retail per emp		kWh/emp
Electricity intensity of hotels, restaurants per empl		kWh/emp
<i>Electricity consumption per employee</i>		
Electricity consumption of services per employee		kWh/emp
Electricity consumption of health sector per employ		kWh/emp
Electricity consumption of wholesale and retail per		kWh/emp
Electricity consumption of hotels, restaurants per e		kWh/emp
<i>Electricity consumption per unit of activity</i>		
Electricity consumption per bed in hospital		kWh/emp
Electricity consumption of hotels per person night		kWh/emp
Bottom-up		
Electricity consumption per m ² by type of building		
Electricity consumption per unit of activity by type c		kWh/emp

Presentation of the data file: visualisation of indicators trends

➤ The user can choose each indicator and visualize the trends through graphs

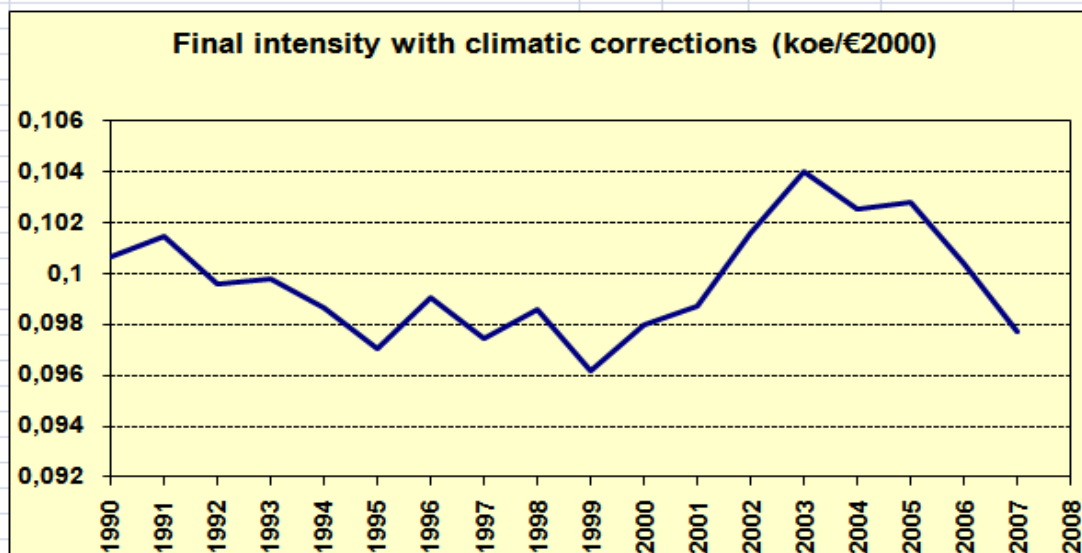
Macro economic data and energy balances

Gross Domestic Product		country	units	1990	1991	1992	1993	1994
gdp	GDP in current national currency	aut	M€	136213	146083	154207	159160	167010
gdp	GDP at constant prices, national currency	aut	M€2000	161727	167126	170281	170918	174701

Exchange rate		country	units	1990	1991	1992	1993	1994
txch	Exchange rate: national currency / € (1 for EU euro area)	aut	1	1	1	1	1	1

To visualise your indicators, replace the title & values below :

Final intensity with climatic corrections (koe/€2000)	1990	1991	1992	1993	1994
	0,101	0,101	0,100	0,100	0,099



1. Content and organisation of spreadsheet data base
- ▶ **2. Review of EEI indicators by sector and data required**
 - **Industry**

Energy efficiency indicators for industry

- Two types of indicators will be produced in industry:
 - **Top-down** indicators by sub-sector;
 - Bottom-up indicators for selected energy intensive products based on data collected through the reporting of designated factories;

- Three types of **top-down** indicators will be considered
 - Indicators of **specific energy consumption** by industrial sub-sector (at 2 digits TSIC level), calculated by relating the energy consumption to an index of production ;
 - Specific energy consumption for energy intensive products per unit of physical production (at 3 to 5 digit level);
 - An indicator of **energy intensity of industry at constant structure** showing the impact of changes in the industry structure (structural changes).

- **Bottom –up** indicators will only be specific energy consumption per unit of physical production.

Examples of indicators by industrial sub-sector

food	E/IPI
ice production	EL/P
non metallic	E/IPI
of which cement	E/P , EL/P
chemical	E/IPI
basic metal	E/IPI
steel	
fabricated metals	E/IPI
electronics	EL/IPI
automobile	EL/IPI
paper	E/P

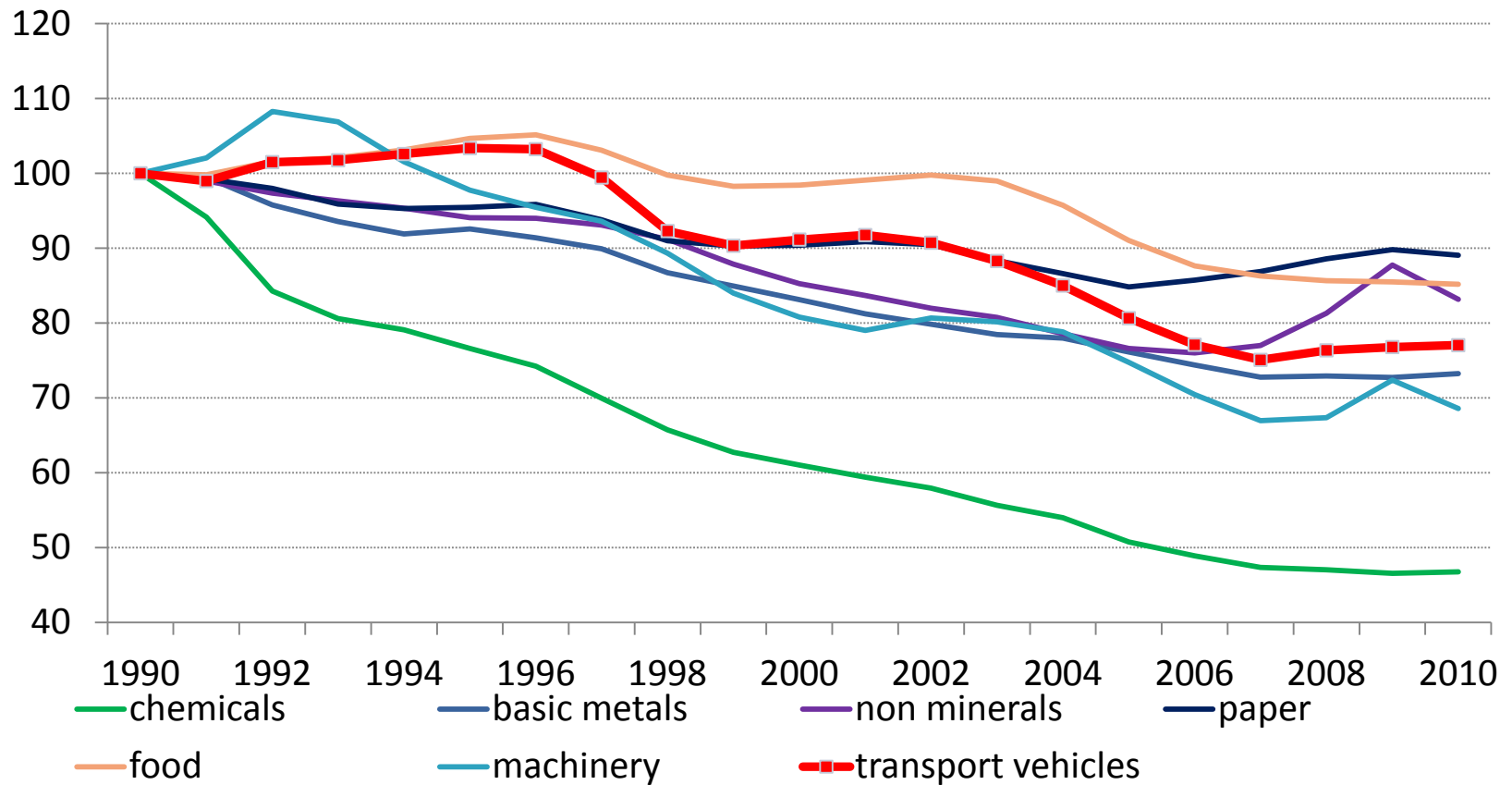
E/IPI: total energy consumption divided by production index;

EL/IPI: electricity consumption divided by production index;

E/P: total energy consumption divided by physical production;

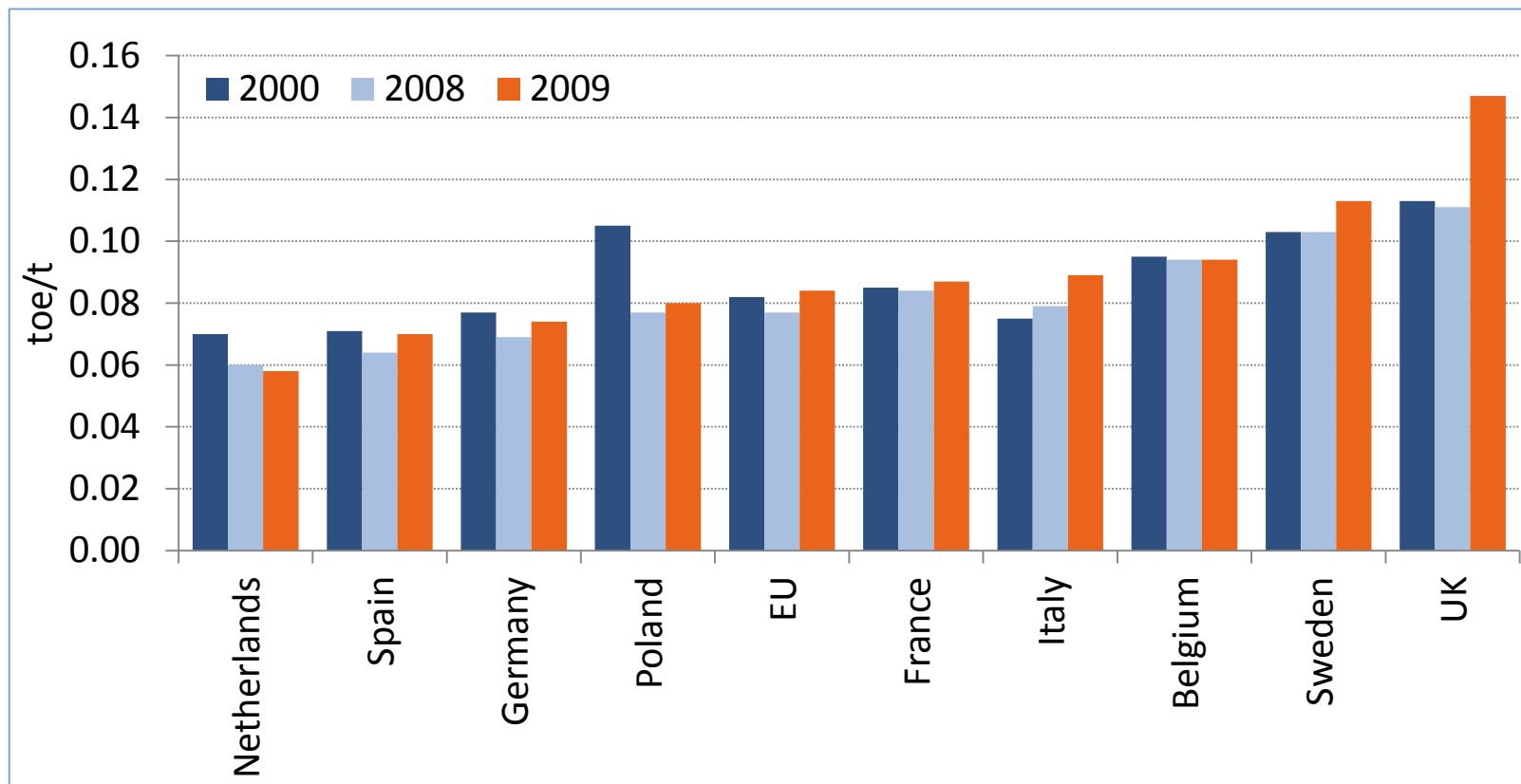
EL/P: electricity consumption divided by physical production.

Top-down indicators of specific energy consumption of industrial sub-sectors per unit of production index



Top-down indicators of specific energy consumption of industrial product per unit of physical production

Specific energy consumption per ton of cement

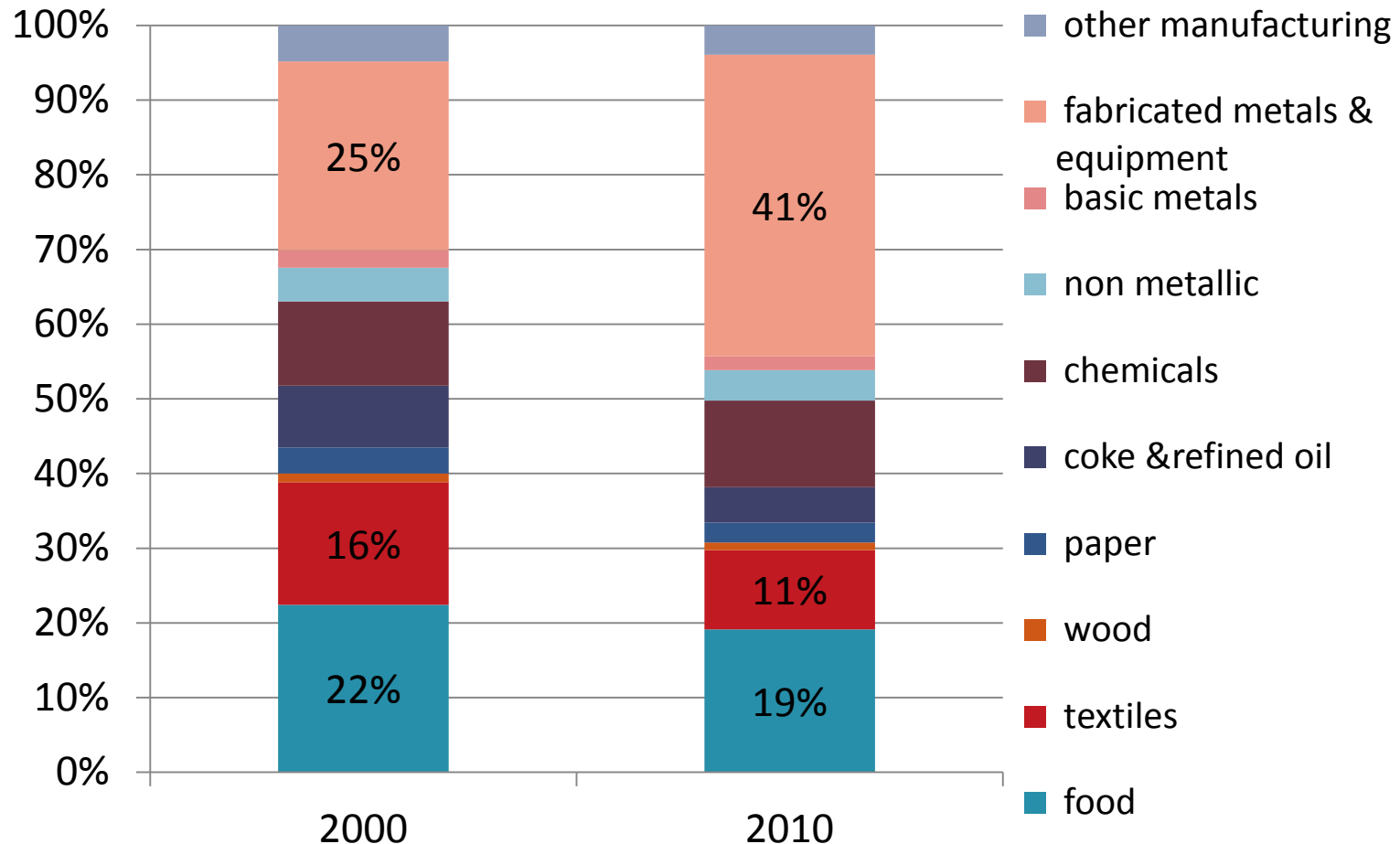


Indicator to measure the impact of structural changes in industry

- All industrial sub-sectors do not require the same amount of energy inputs to produce 1 Baht of value added. Some industrial branches are very energy intensive, such as non metallic or basic metals. Others require much less energy, such as fabricated metals, machinery and electronics (20 times less than non metallic in the case of Thailand).
- Industrial growth is not uniform: some sub-sectors grow faster than others. As a result, the share of each sub-sector in the total industry value added of manufacturing change over time: this is what is called **structural changes**.
- If less energy intensive sub-sectors grow faster than energy intensive sub-sectors, this will reduce the overall energy intensity of manufacturing, all other things being equal, and this is not linked to energy efficiency improvements.

Example of structural changes in manufacturing industry : case of Thailand

Changes in the share of each sub-sector in the total value added of manufacturing



Indicators to measure the impact of structural changes in manufacturing

- To quantify the impact of structural changes on the energy intensity of manufacturing industry, the usual approach is to calculate a fictive energy intensity at constant structure, i.e. assuming that the structure did not change compared to a base year (e.g. 2000).
- This intensity at constant structure is calculated at year t with the sectoral intensities of year t and the value added structure of manufacturing (i.e. the share of each sub-sector i in the total value added of manufacturing of the base year 0):

$$IE_s = \sum (VA_i/VA)_o * (E_i/VA_i)_t$$

with :

IE_s : intensity at constant structure

VA_i: value added of sub-sector i;

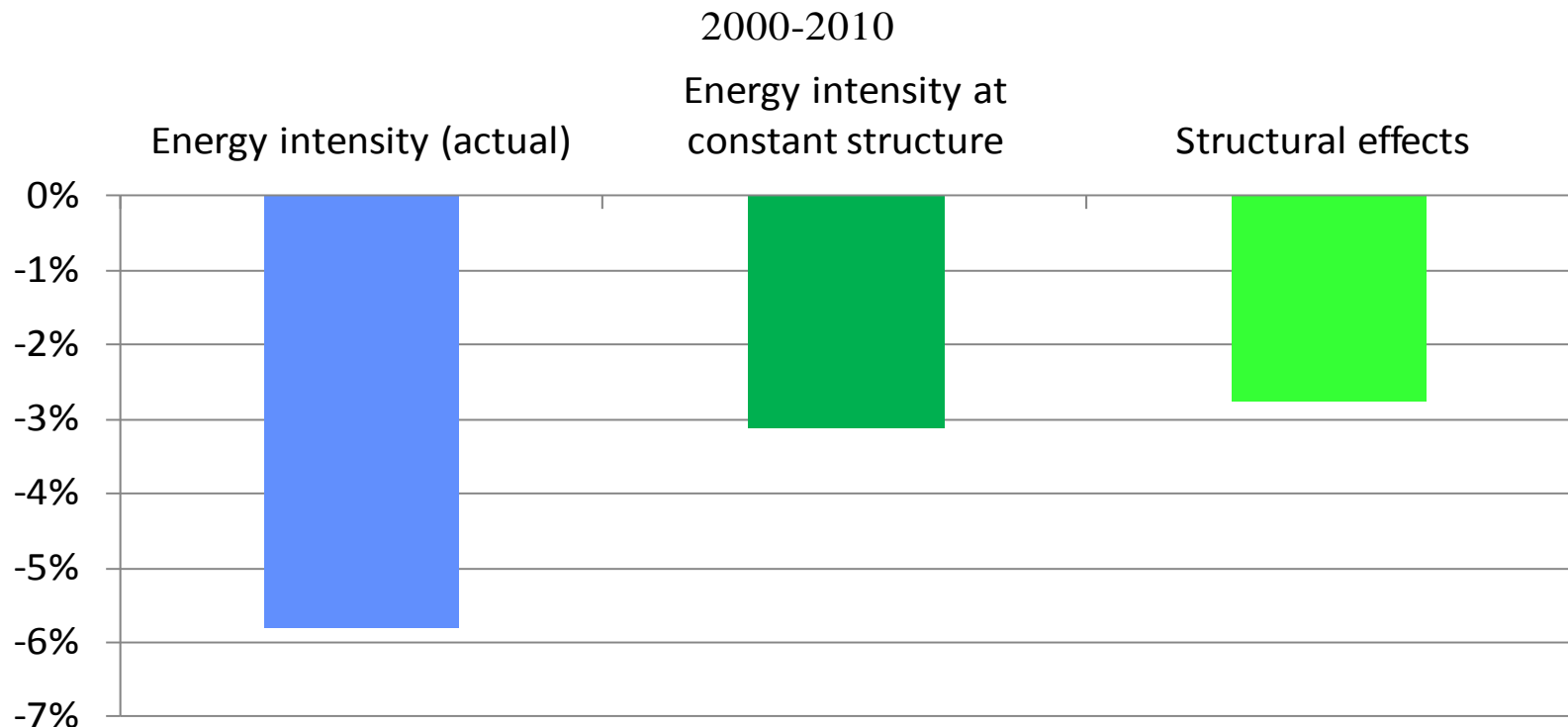
VA: total value added of manufacturing;

E_i: energy consumption of sub-sector i;

o :base year (e.g. 2000) and t: current year

Indicators in industry to measure the impact of structural changes

- The comparison of the annual variation of the energy intensity of manufacturing with the annual variation of the intensity at constant structure of manufacturing shows the impact of structural changes, the so called “structural effects”.
- In the example, almost half of the reduction in the energy intensity of manufacturing is due to structural changes and one half to energy efficiency improvements.



Data requirements by sector: industry

- Energy consumption by main manufacturing sub-sector (from DEDE)
- Energy consumption of selected energy intensive products: steel, cement, automobile, electronics, ice (from EEPO for electricity, DEDE data on designated factories)
- Value added by sub-sector at constant price;
- Production index by sub-sector;
- Physical production of intensive products.

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 - **Services**

Energy efficiency indicators for service sector

- Two types of indicators will be produced in the service sector:
 - Top-down indicators **by branch** (according to TSIC classification) or by type of buildings (from utilities/ EEPO classification);
 - Bottom-up indicators **by type of buildings**, based on data collected for designated buildings by DEDE;

- As the dominant source of energy is electricity (around 80% of the total), the focus will be on electricity indicators. If data collected on LPG at the bottom-up level used can be extrapolated at national level indicators covering the total consumption may also be considered by allocating the LPG consumption by sub sector.

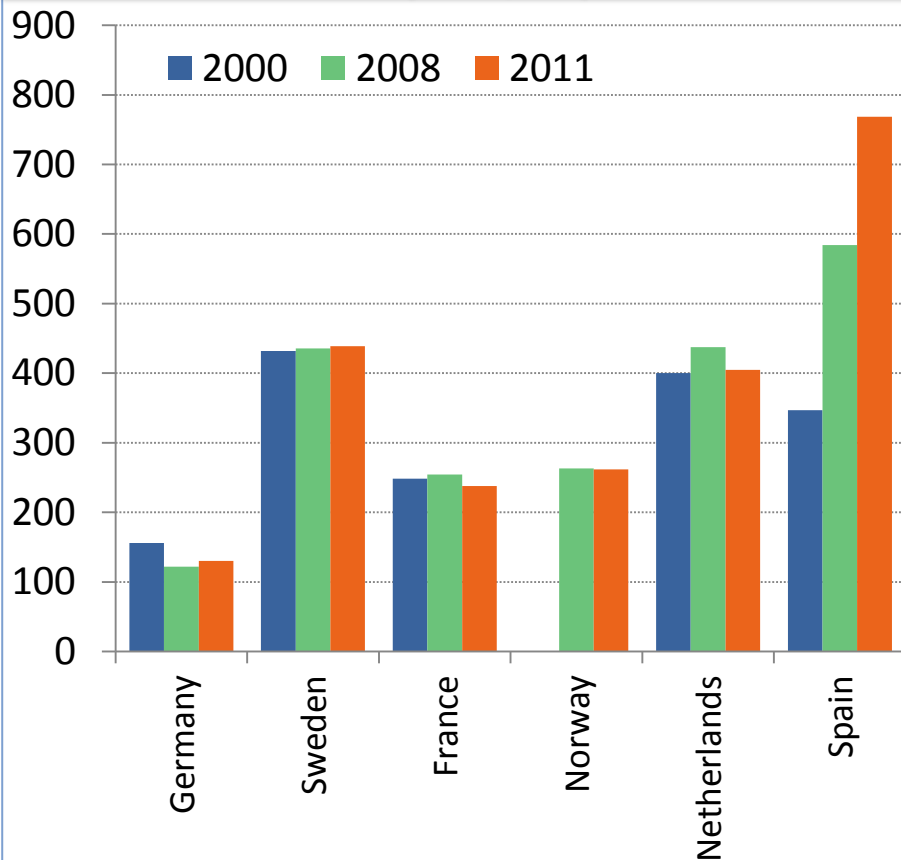
Top-down indicators for service sector

- It is proposed to consider 3 main sub-sectors:
 - Wholesale and retail trade,
 - Hotels and restaurants
 - Health and social work activities.
- In each **branch** a specific focus will be given on certain types of **buildings** (hotels in “hotels and restaurants”; hospitals in “health and social work”; department stores, retail store and wholesale store in “wholesale and retail trade”).
- Three types of **top-down indicators** can be considered in services*:
 - Electricity intensities in kWh per unit of **VA** (constant Baht) by **branch**;
 - Specific electricity consumption **per employee** in kWh **by branch**;
 - Specific electricity consumption **per unit of activity** by **branch** and type of **buildings** (e.g. kWh per person-nights in hotels, per bed in hospitals);

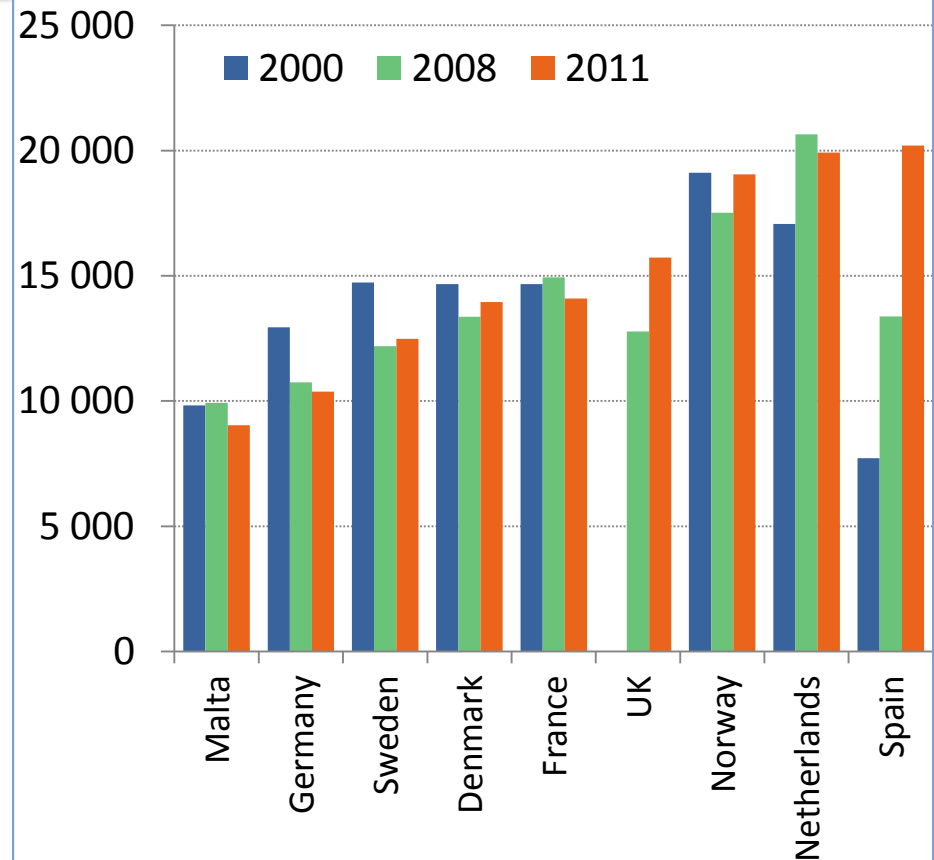
Given the uncertainty of getting top-down data on floor area it is proposed not to consider in a first step specific energy consumption in kWh **per m² by **branch** or type of **buildings** .*

Top-down indicators of specific energy consumption for wholesale and retail trade

Energy consumption per m² in trade sector (kWh/m²)

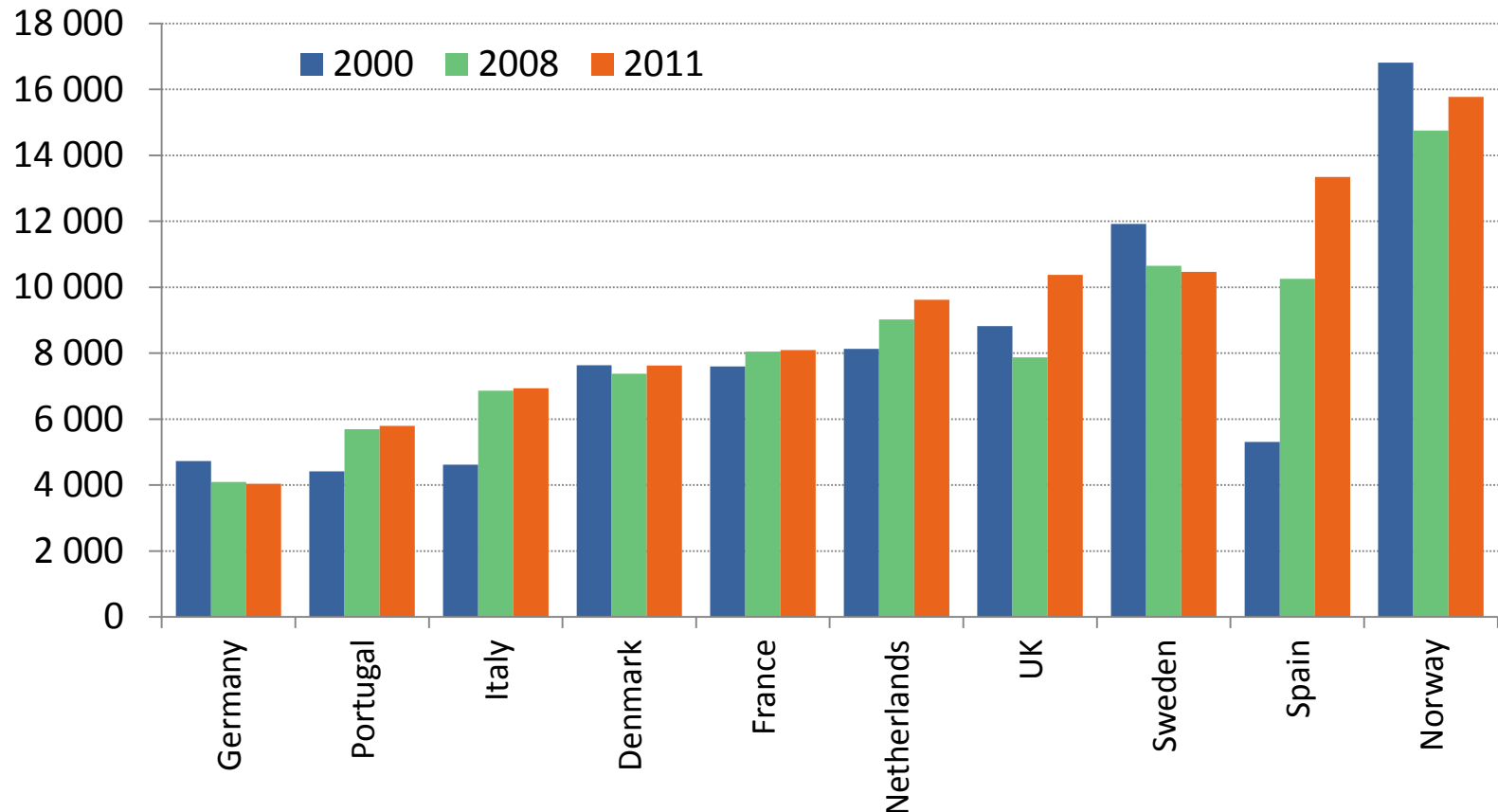


Energy consumption per employee in trade sector (kWh/emp)



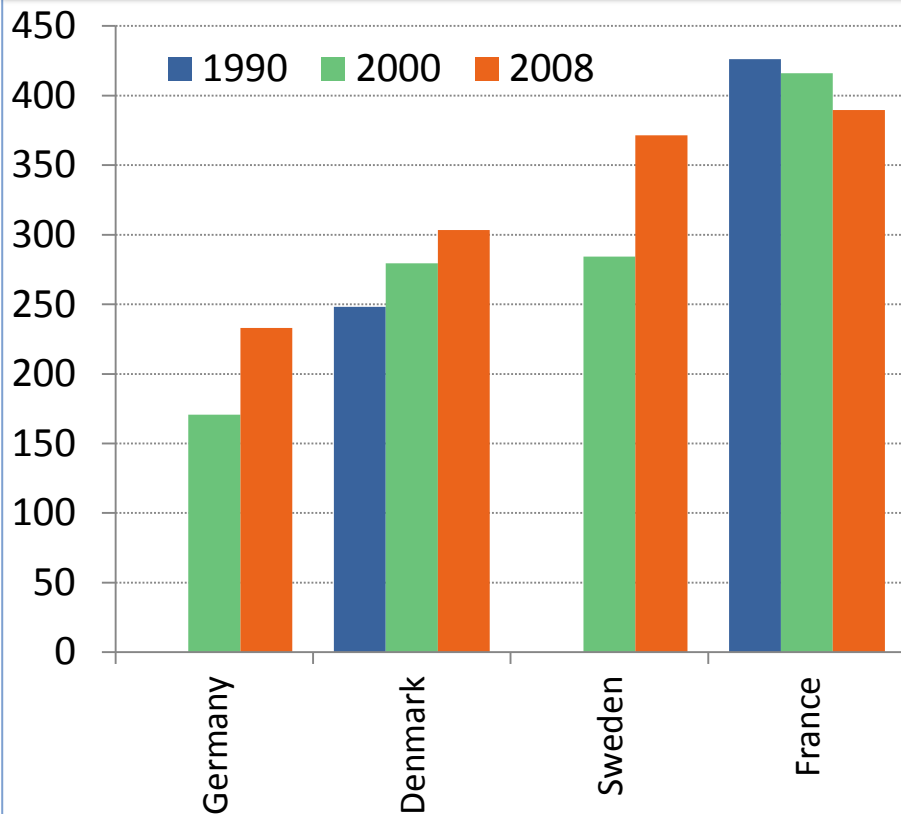
Top-down indicators of specific energy consumption for the branch “wholesale and retail trade”

Electricity consumption per employee in trade sector (kWh/employee)

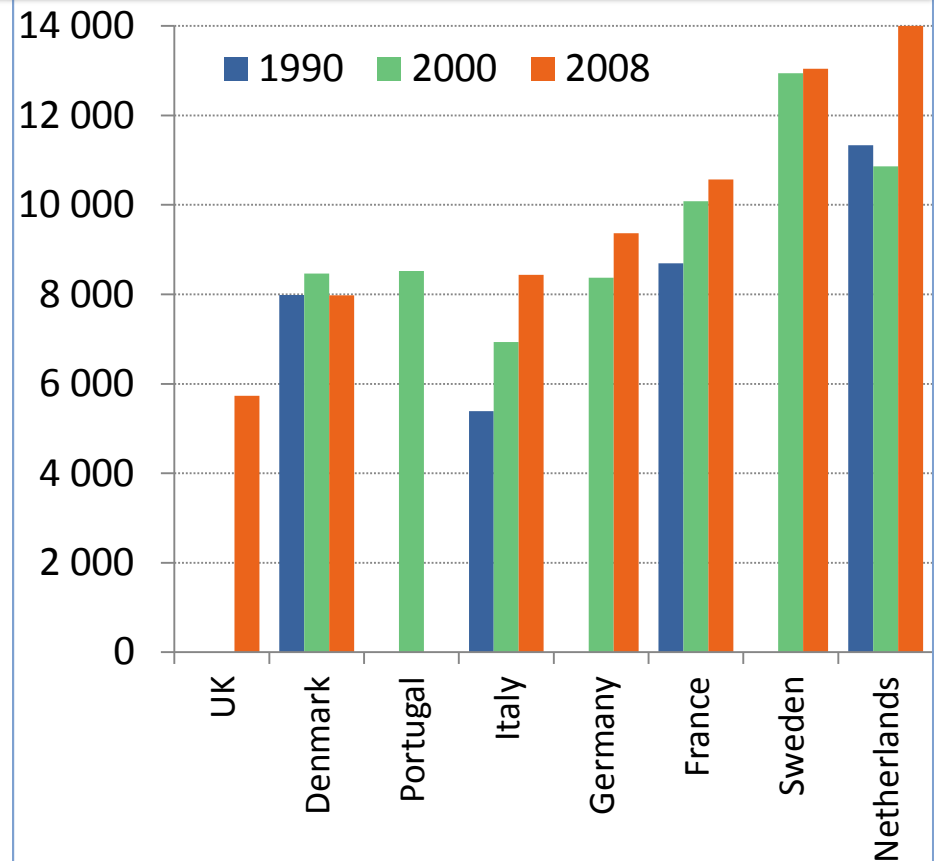


Top-down indicators of specific energy consumption for the branch “hotels -restaurants »

Energy consumption per m² in hotel/restaurant sector (kWh/m²)



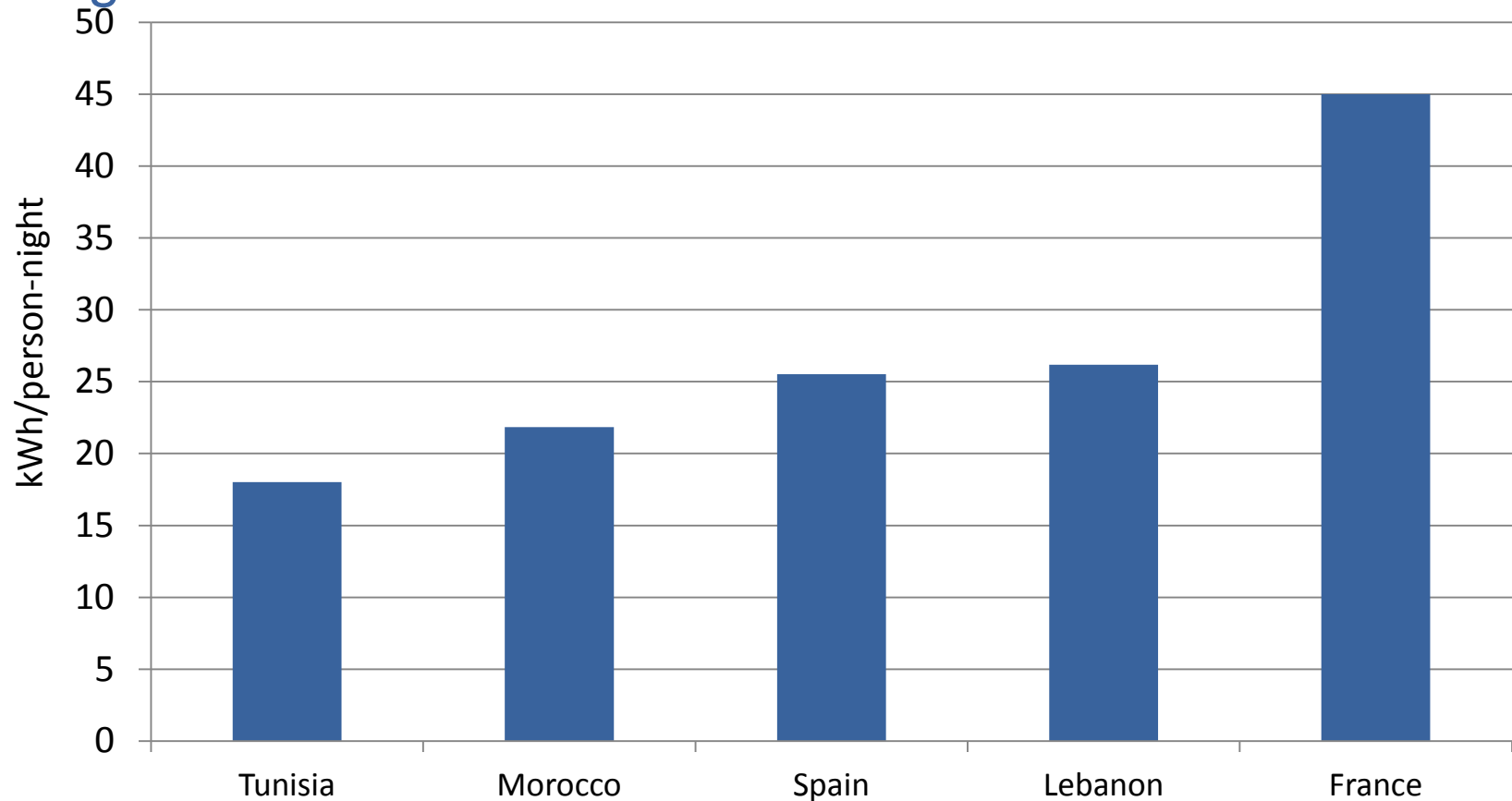
Energy consumption per employee in hotel/restaurant sector (kWh/emp)



Top-down indicators of specific electricity

- consumption per unit of activity

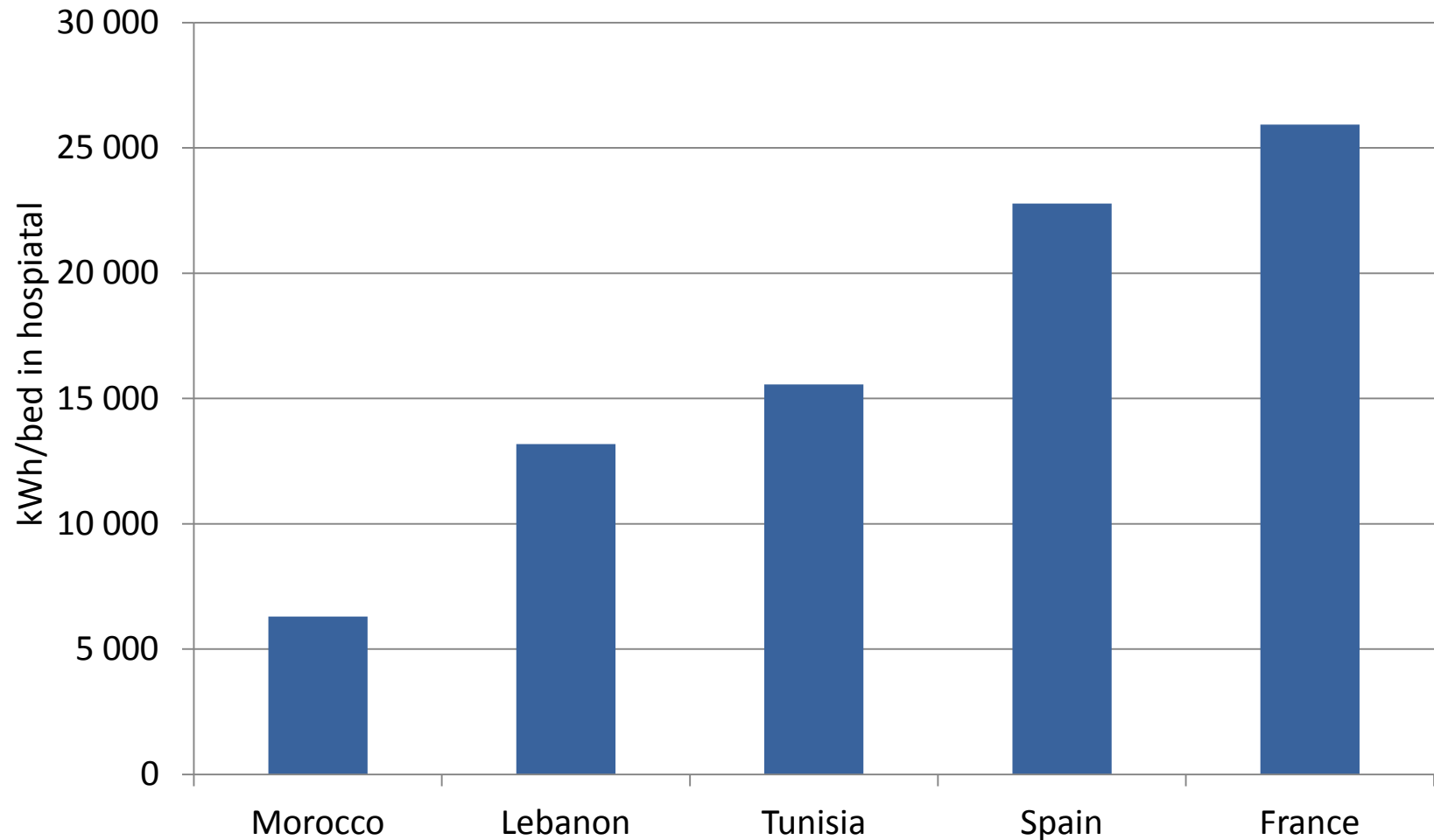
Case of the specific electricity consumption per person night in hotels



Source: Medener : <http://medener-indicateurs.net/uk/datamapper/>
and <http://medener-indicateurs.net/uk/documents-fourth-reunion.html>

Top-down indicators of specific electricity consumption per unit of activity

Case of the specific electricity consumption per bed in hospitals



Source: Medener : <http://medener-indicateurs.net/uk/datamapper/>
and <http://medener-indicateurs.net/uk/documents-fourth-reunion.html>

Bottom-up indicators for service sector

- Two types of **bottom-up indicators** can be considered in services sector buildings:
 - Specific energy and electricity consumption per unit of activity by type of **buildings** for hotels and hospitals (e.g. toe and kWh per person-nights in hotels, per bed in hospitals);
 - Specific energy and electricity consumption (toe and kWh per m² by type of **buildings**).
- The buildings types to be monitored will include buildings considered at top-down level (e.g. hotels, hospitals ...) and other types of buildings, for instance large office buildings and education buildings.

Data requirements and sources for services

➤ **Top-down data**

- **Data by branch** (from national statistics)
 - Electricity consumption by branch (EEPO);
 - Employment: total and by branch
 - Value Added by branch
 - Sectoral indicators of activities (person-nights, number of beds...)
- **Data by type of building**
 - Electricity consumption by type of buildings (from EEPO)

➤ **Bottom-up data by type of buildings**

- Electricity consumption
- LPG consumption
- Floor area
- Sectoral indicators of activities

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 - **Households**

Energy efficiency indicators for households

- Household sector = residential sector
- Indicators for the total consumption (electricity, LPG and traditional fuels) and electricity for the household sector as whole and
 - Household energy consumption per dwelling (or household);
 - Household electricity consumption per dwelling (or household);
 - Household electricity consumption per electrified household;
 - Household energy consumption per unit of private consumption;
- Electricity indicators for two categories of buildings:
 - Large condominiums and apartment buildings (specific electricity consumption per dwelling and per m²).
 - Other dwellings (small apartment buildings and houses) (specific electricity consumption per dwelling).

Data requirements by sector: Households

- Number of dwellings (ie houses, apartments and condominium units)
- Number of households
- Equipment ownership for electrical appliances;
- Diffusion of efficient equipment: number, sales of CFL and solar water heaters; share of new sale with efficiency labels (refrigerators, AC, rice cookers)

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 - **Transport**

Energy efficiency indicators in transport

The following indicators are proposed in transport:

- Energy consumption of road transport per vehicle in toe per vehicle
- Energy consumption of road transport per car equivalent (total, gasoline, diesel)
- Unit consumption of rail transport in koe per gross ton-km
- Unit consumption of passenger rail transport in goe per passenger-km
- Unit consumption of rail transport of goods in goe per ton-km
- Unit consumption of water transport in koe per ton-km
- Unit consumption of air transport per passenger

EEI in transport

- The unit consumption of road transport per equivalent car relates the total consumption of road transport to a fictitious stock of all road vehicles, measured in terms of a number of equivalent cars. It is measured in toe/car equivalent.
- The stock of road vehicles is converted in car equivalent on the basis of coefficients reflecting the difference in average yearly consumption between each type of vehicle and a car : if, for instance, a bus consumes on average 15 toe/year and a car 1 toe/year, one bus is equal to 15 equivalent cars.
- These coefficients can be derived from surveys or can also be adapted from similar countries in terms of vehicle characteristics and patterns of use.
- Compared to the energy consumption of road transport per vehicle, the indicator per car equivalent takes into account the change in stock composition towards light vehicles or heavier vehicles and is a better proxy to assess the efficiency of total vehicle stock.

Data requirements by sector: transport

- Stock of vehicles by fuel type
- Energy consumption by mode (road, rail, water, air)
- Passenger and freight traffic of rail and water transport
- Passenger traffic by air

References of EEI data bases

- Odyssee data base (EU countries):
 - Data tools: <http://www.odyssee-mure.eu/data-tools/>
 - Reports : <http://www.odyssee-mure.eu/publications/>
- BIEE (Cepal/Eclac)
 - Data base: <http://www.biee-cepal.enerdata.eu/>
 - Reports : <http://www.cepal.org/cgi-bin/getProd.asp?xml=/drni/noticias/noticias/5/51575/P51575.xml&xsl=/drni/tpl/p1f.xsl&base=/drni/tpl/top-bottom.xsl>
- Mediterranean countries (Medener)
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