Industry indicators and related data

Didier Bosseboeuf, ADEME
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09 – 11 MAY 2023
MARRAKESH - MOROCCO

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1. Energy in industry
2. Aggregate indicators
3. Indicators by branch
4. Structural changes
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Characteristics of energy use in industry

- In industry, energy is a factor of production.
- Very wide dispersion of energy intensities
- A few factories may account for most of the industry's energy demand:
- Industrial energy demand may change simply because of changes in the structure of production
- Difficulty in quantifying the volume of production in a consistent and robust manner:
  - energy is structurally determined by physical production: production indicators must be as close as possible to physical reality
  - value added - the only aggregable indicator of the volume of production across industries - is determined as much by physical output as by the general economic conditions for valuing that output

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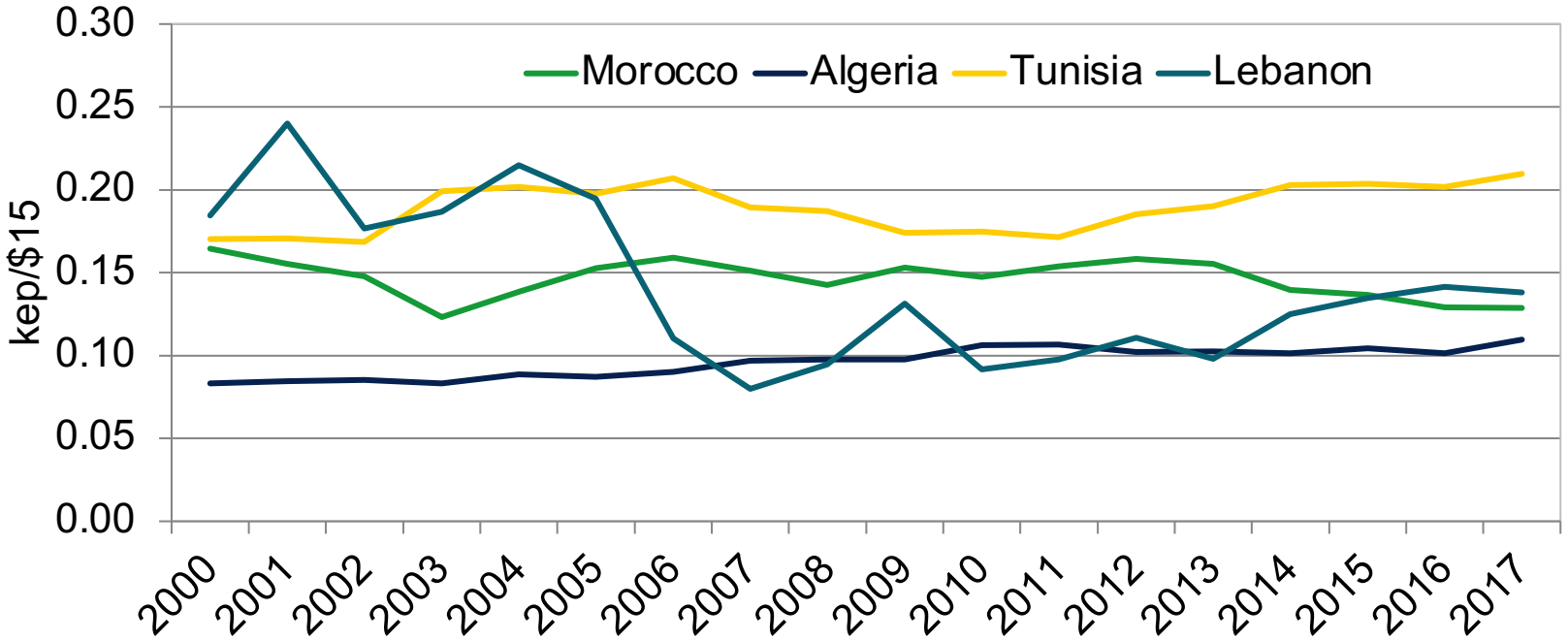
Energy intensity of industry: what progress in energy efficiency?

- Industrial energy intensity measures the ratio of industrial final energy consumption to industrial value added (GDP produced by industry).

- A decrease means that the industry is more economically efficient but this may be due to economic factors (change in product valuation or industry structure) or technical factors (energy savings).

Evolution of the energy intensity of industry



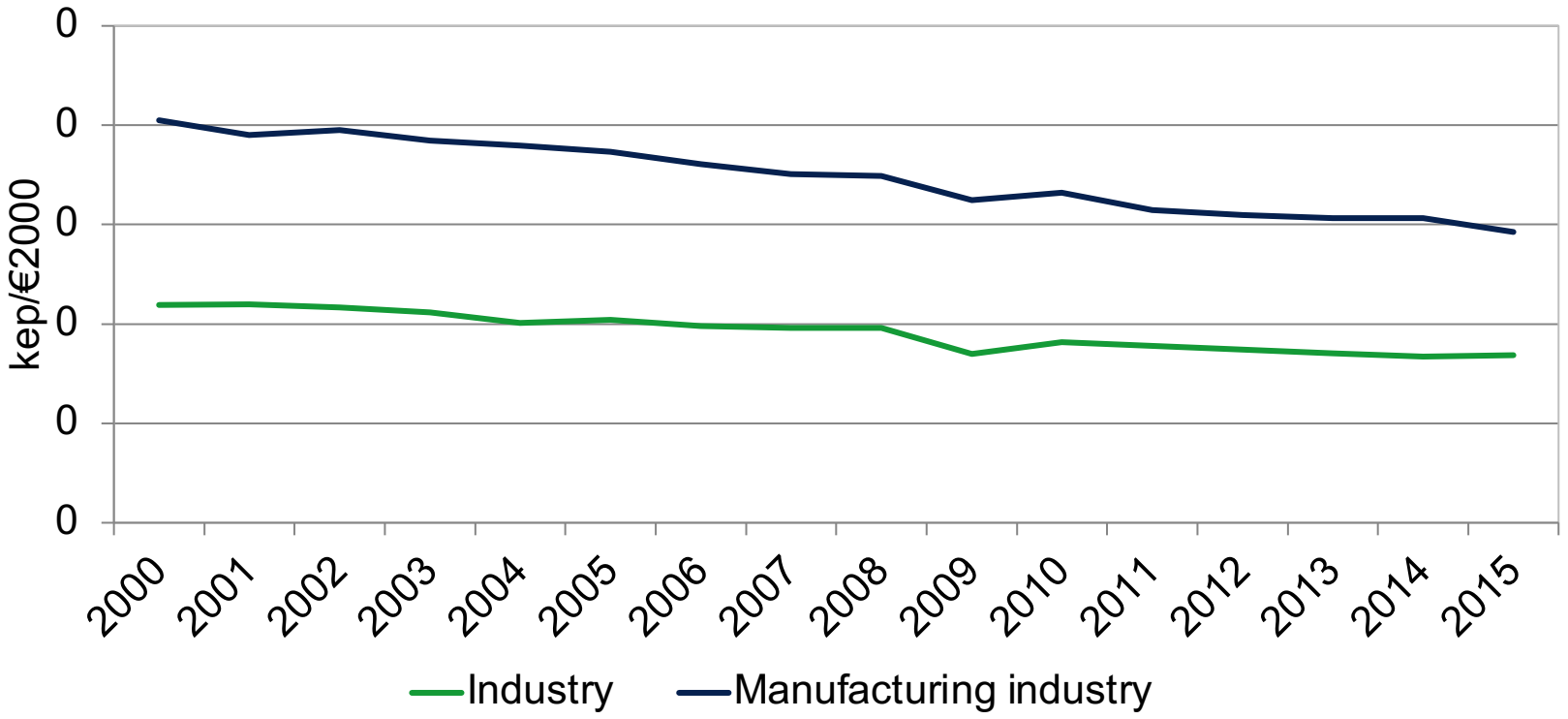
Industry classification by branch

- The industry sector is organised into 4 main branches:
  - the mining industry
  - manufacturing industry
  - construction (BTP)
  - the electricity, gas and water sector
- These branches are themselves subdivided into sub-branches characterised by 2, 3, 4 or 5 digit codes ("digits").
- We generally work at the level of 2 digits, or even with groups.
- IGCEs are usually 3 or 4 digits long.

Industry intensity: total vs. manufacturing

- The energy intensity of industry can be measured at two levels:
  - Manufacturing industry
  - Total industry (including construction)
- Manufacturing intensity is always the highest because the construction sector has high VA but low energy consumption.

Industry intensities in France



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Energy efficiency indicators in industry

- **Specific energy consumption**: ratios linking energy consumption to the physical output of a plant toe/t GJ/t, kWh/t
- If more than one product, the main output (e.g. Cement) or the main intermediate product should be used (e.g. Raw Steel).
- If there is no dominant production (i.e. different types of products), two indicators can be used:
  - An industrial production index
  - Or a monetary indicator can be used.

- Specific energy consumption should be measured in physical units as much as possible in order to be able to carry out analyses of technological change.

Energy efficiency indicators in industry

	Specific energy consumption per tonne (toe or kWh/t)	Specific consumption per IPF (kWh/IPF)	Energy intensity (kWh/€)
Assets		•Simple to calculate •Better measurement of technical efficiencies	•Simple to calculate •Measures energy efficiency from an economic perspective
Boundaries	•Can only be used for branches with a homogeneous main product (e.g. steel, cement, paper, glass)		•Takes into account non-technical and non-energy efficiency related factors (i.e. variation in margin, shares and product quality...)

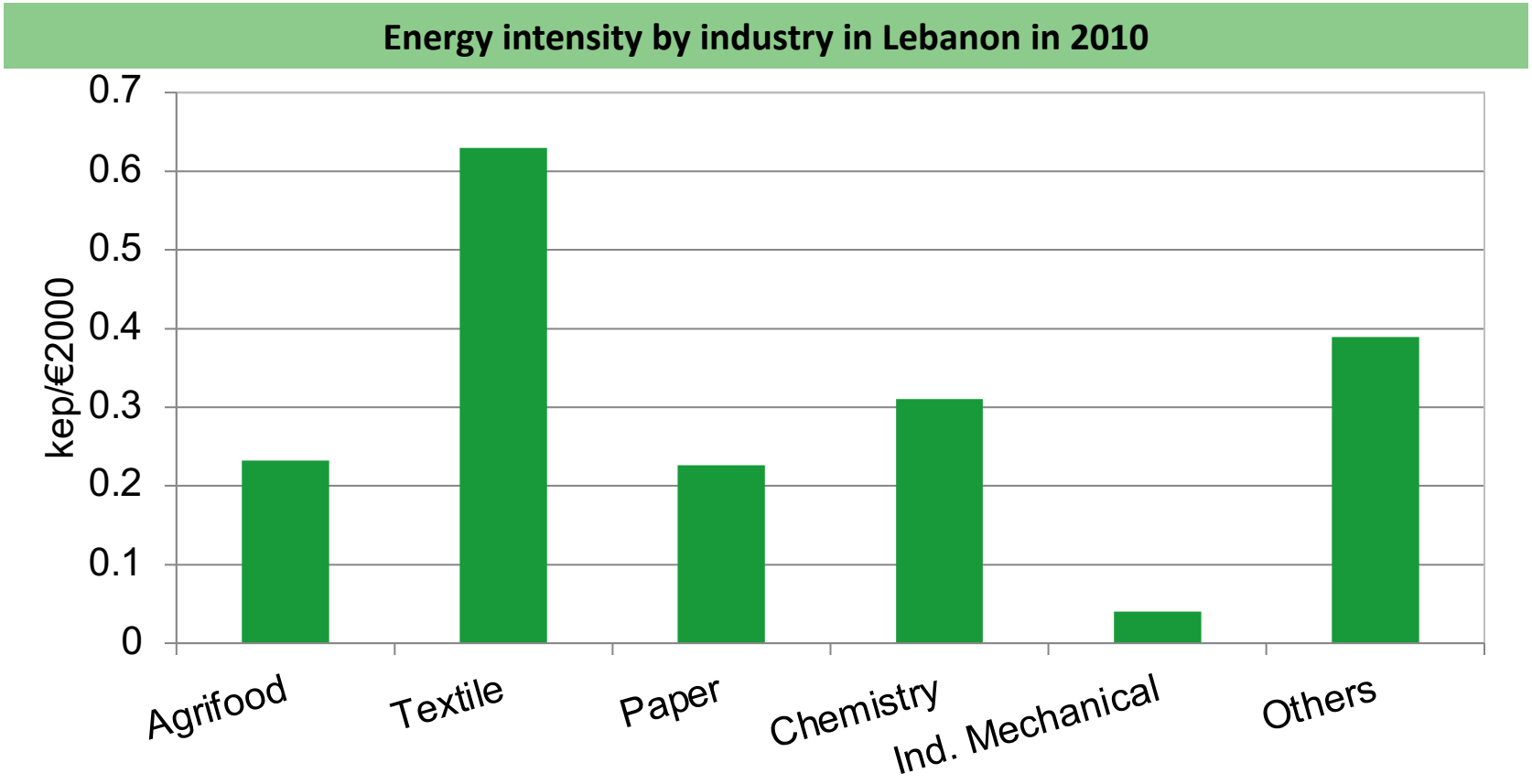
International Industrial Classification: 2-digit classification (ISIC Rev 4)

05-08	Mines
10-33	Manufacturing industry
10-12	Agri-food (and tobacco)
13-15	Textile
16	Wood
17-18	Paper (and printing)
19	Refining
20-21	Chemistry
23	Non-metallic minerals
24	Primary metals
25-28	Metal products, equipment
29-30	Transport equipment
31-33	Other
35-39	Electricity, gas and water
41-43	Construction

International classification of energy-intensive industries: 2-4 digit classification

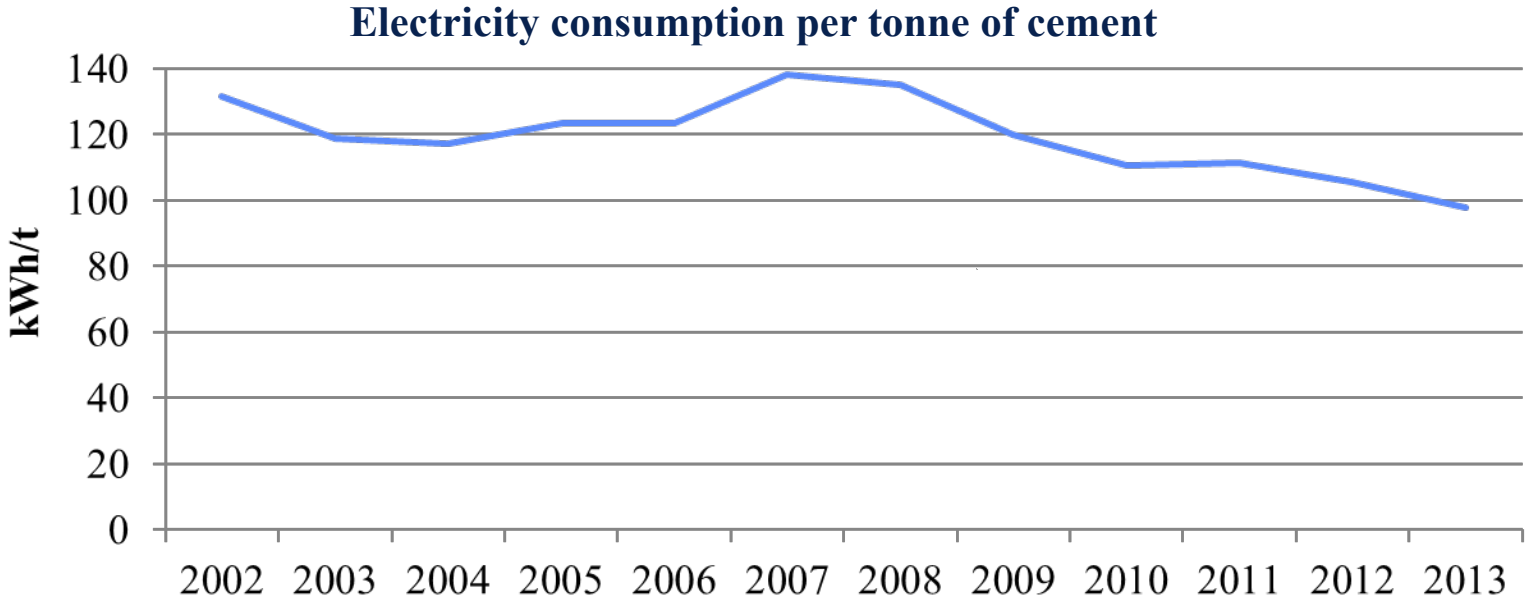
17-18 17 18	Paper (and printing) •Pulp and paper manufacturing •Printing
20-21 2012	Chemistry •Fertilizers
23 2394	Non-metallic minerals •Cement
24 241 and 2431 242 and 2432	Primary metals •Steel industry •Non-ferrous metals

Energy intensity by branch : Example of Lebanon



Measuring energy efficiency gains: example of the cement industry

- In the cement industry, EE gains are usually measured by a unit consumption indicator in toe or kWh/t.
- A decrease in this indicator generally means an improvement in energy efficiency.
- For example, between 2002 and 2013, the decrease in unit electricity consumption from 131 to 98 kWh means that efficiency gains were 25% (98/131) over this period.

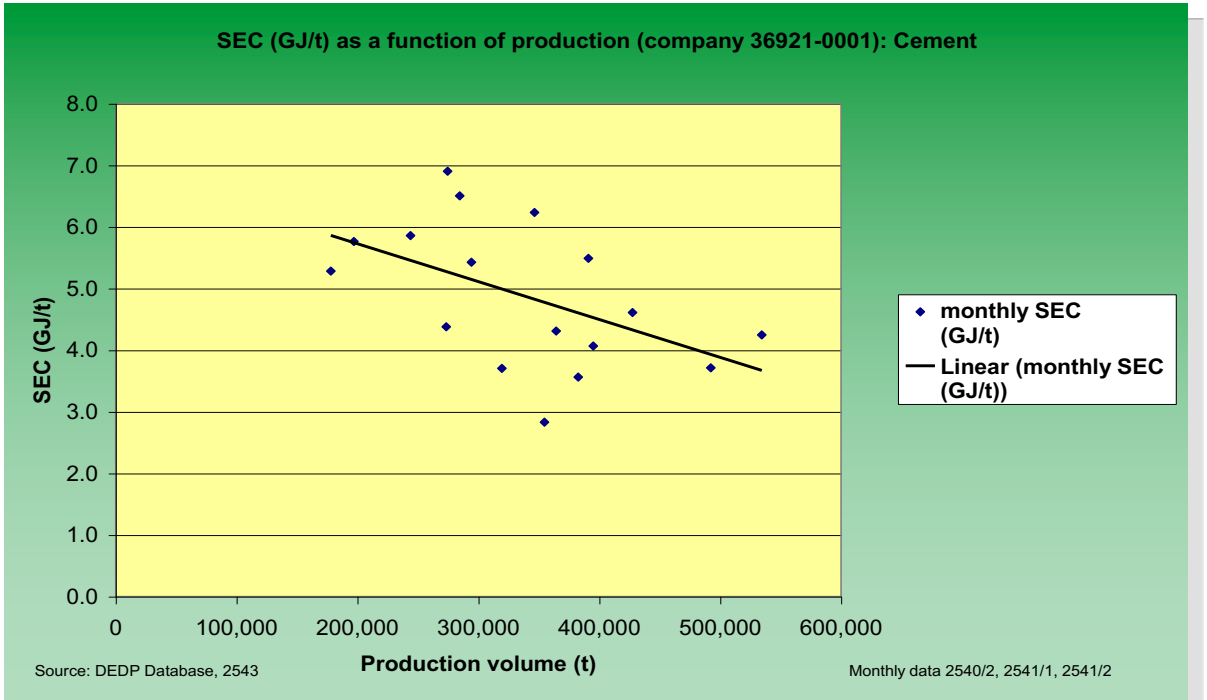


Variation factors for specific consumption and energy intensity

- The variation in specific consumption can be linked to various factors:
  - Consumer energy saving actions, linked to prices and policies
  - Changes in the fuel mix (substitutions) due to differences in efficiency (e.g. coal to gas, gas to petcoke)
  - Fluctuations in industrial activity ("business cycles")
  - Process changes (e.g. dry/wet route for cement)
  - Change in product content (e.g. % clinker/additive for cement, type of paper)

Economic fluctuations, what happens at the micro level?

Unit consumptions (or intensities) increase if there is an economic slowdown (less efficient equipment, no reduction of fixed consumptions)



Energy consumption does not decrease linearly with reduction

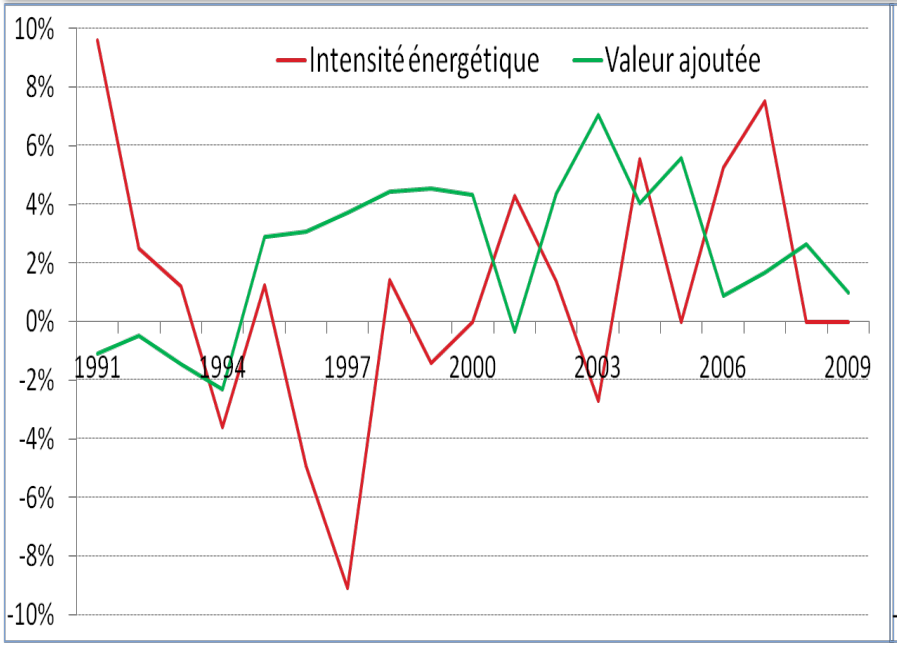
➔ unit consumption (GJ/t) does not remain constant but increases: it almost doubles with a division by 3 of production

➔ loss of energy efficiency (lower kiln output and fixed consumption)

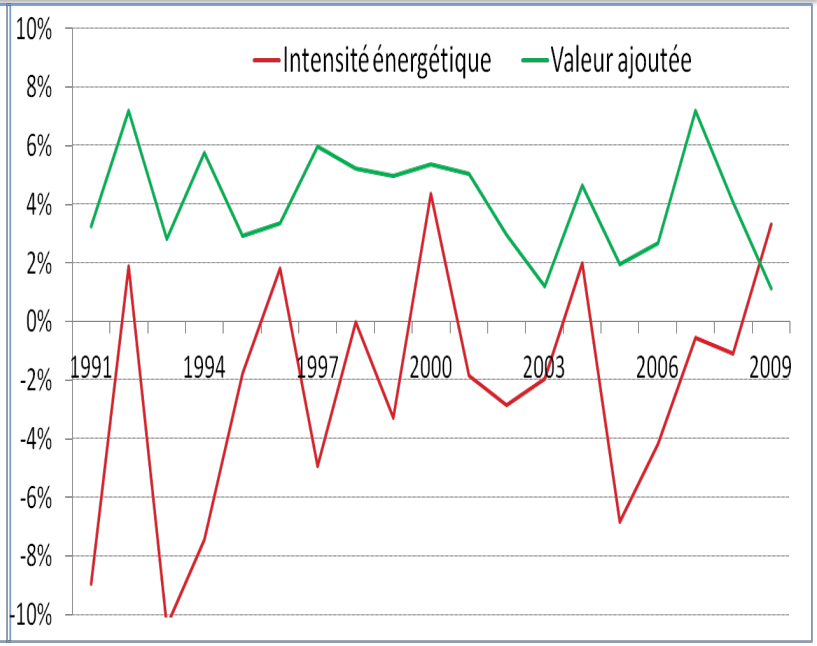
Relationship between value added and energy intensity in industry

Strong decrease in energy intensity with high industrial growth (high capacity utilisation, high investment) and increase in case of industrial slowdown

Average annual growth rate of energy intensity and value added



Tunisia



Algeria

Inverse correlated curves

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The necessary data

- Activity data:
  - Value added at constant prices by industry
  - Physical production for energy-intensive industries
  - Industrial production indices by industry

- Energy consumption by industrial sector

Activity data: value added, production index

- Activity data by industry: usually collected by national statistical institutes
- National classifications usually based on international classifications:
  - ISIC: International Classification, developed and maintained by the UN
  - NACE: Statistical Classification of Economic Activities in Europe
- Underlying problems: frequent revision of classifications; some time series may be defined according to different classifications (currently ISIC rev 4 and NACE rev 2)

3. Presentation of the sectoral tabs: Industry

Industry

- Value added by industry
- Production indices by industry
- Physical production for energy intensive products;
- Final energy consumption by industry

Data

Indicators

- Unit consumption of intensive industries
- Energy intensity by industry
- Energy intensity at constant prices and ppa

Activity data: physical output of IGCEs

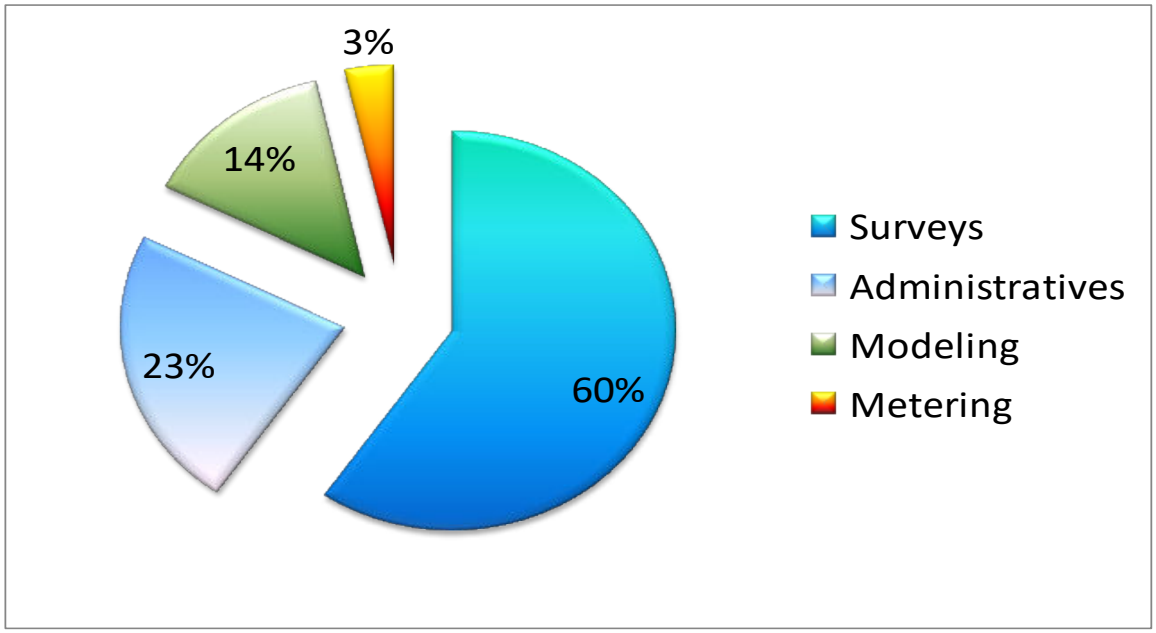
- Generally published by statistical institutes
- Also available from trade associations at national, regional (e.g. Cembureau in Europe for cement, http://www.cembureau.be) or international level (e.g. World Steel Association http://www.worldsteel.org)
- Regularly updated data
- Data can only be defined for homogeneous industries with a dominant production.

Energy consumption by industry: main sources

- Different sources of information are available:
  - The most comprehensive sources are the industrial surveys
  - Administrative sources
  - Modelling can be used to complete the information for the intermediate years
  - Measurements (through audits) can only be used at national level if the sample is representative.

Consumption by industry: overview of sources

- According to the IEA consultation, of the 36 organisations that responded*, industrial surveys represent 60% of the sources.
- The other main source is administrative sources (20% of methods).
- About 1/3 of the organisations rely on more than one method.



Source: IEA Survey 2011 (March 2012), based on 57 methods, where a source can be characterised by several methods.

* Including several sources other than official statistics in the 22 countries

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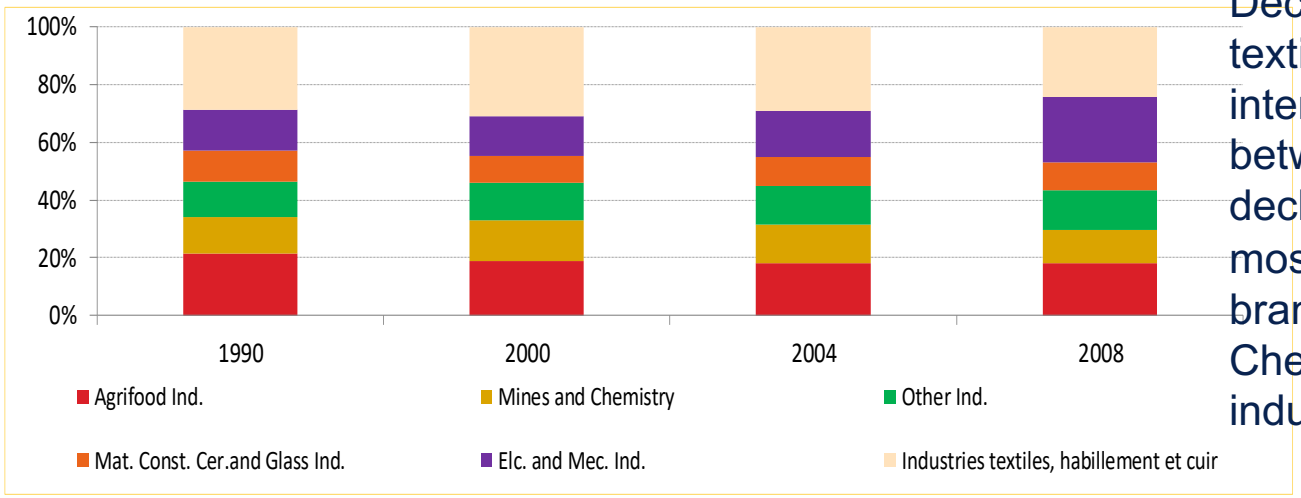
Structural change: what is it?

- Not all industrial branches grow at the same speed: the share of branches in industrial value added changes over time "changes in industrial structures

Changes in the structure of industrial value added in Tunisia



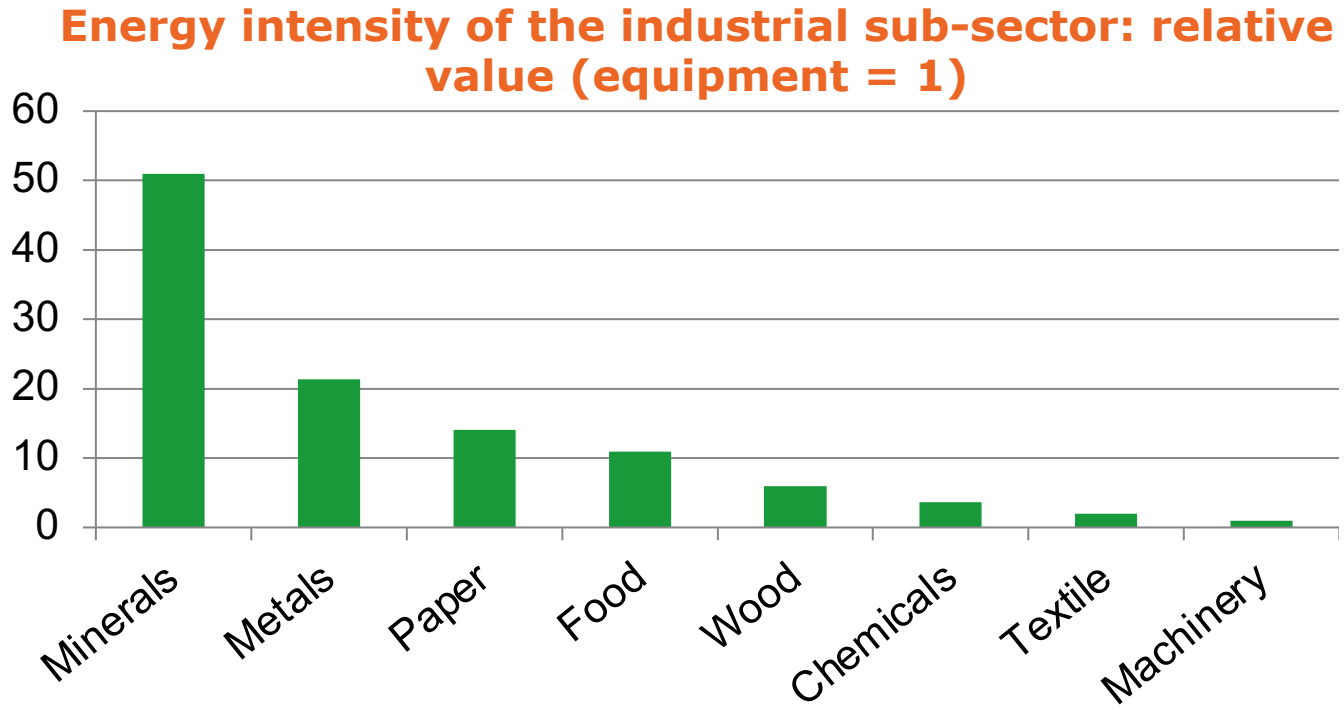
Decline in the weight of textiles, the least energy-intensive branch, since 2000; between 2004 and 2008, decline in the weight of the most energy-intensive branches (IMCCV and Chemicals - mining) change in industrial structure

Impact of changes in industrial structures

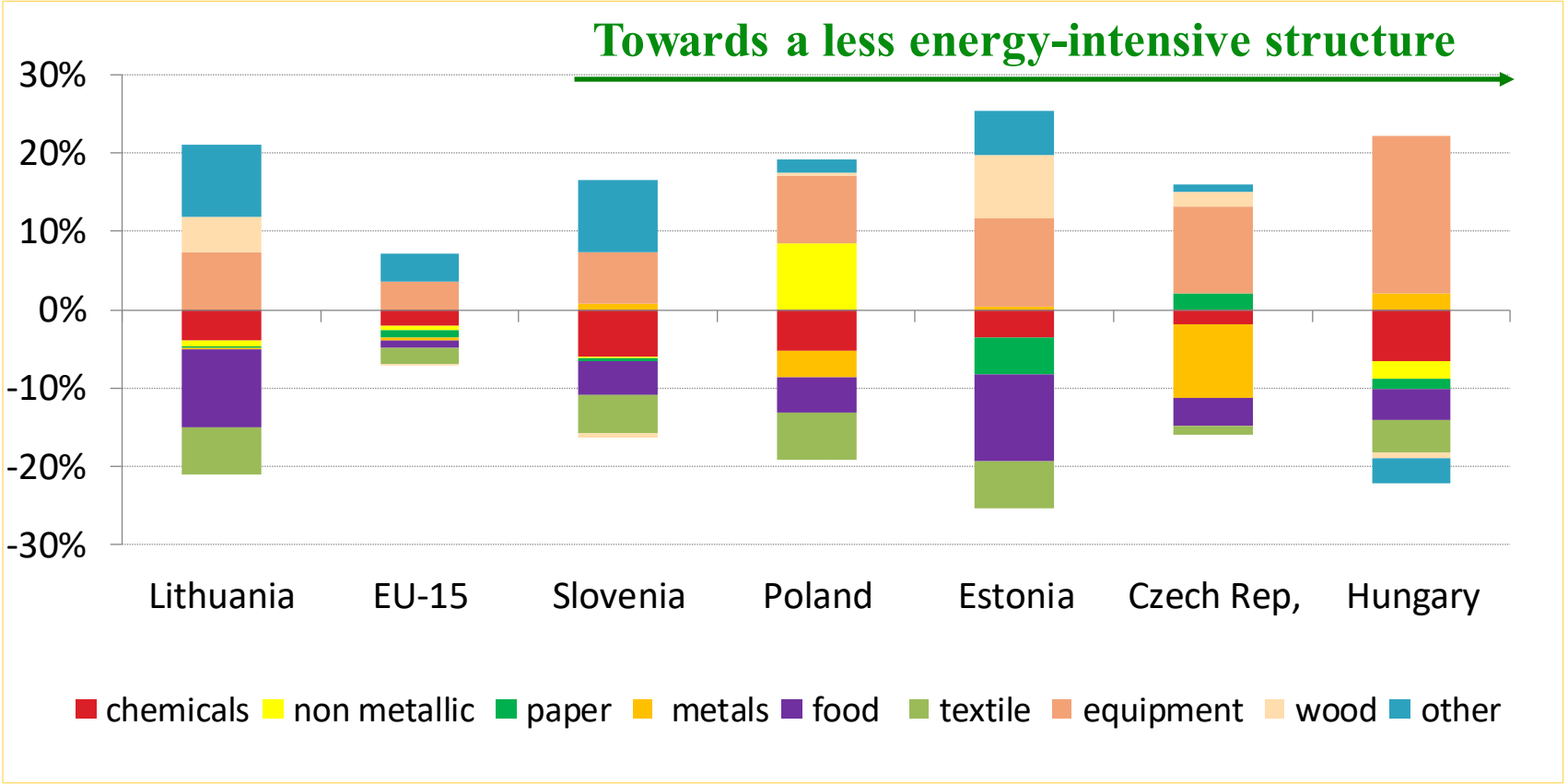
- Structural changes will have a significant impact on energy demand if they affect industries with different energy intensities.
- For example, if the equipment industry grows much faster than the metal industry, all other things being equal, the industry's specific consumption will decrease because equipment is less energy intensive.
- This can occur independently of energy efficiency gains.
- Depending on industry specialisation trends, this phenomenon may play an important role in the long term.

Differences in intensity between industrial branches

The non-metallic minerals and metals sectors require 50 and 20 times more energy to produce €1 of value added than equipment, the least energy intensive sub-sector.



Change in the industrial structure: change in the share of industrial branches in industrial value added



Measuring the impact of structural changes in the industry

- To measure the impact of structural changes in industry, the usual approach is to calculate a national energy intensity with a constant structure, i.e. assuming that the structure does not change with respect to the reference year.
- There are two main methods for calculating energy intensity at constant structure, depending on the choice of base year.

1. Use a fixed reference year:
    - Advantage: simple to understand
    - Disadvantage: the results are very dependent on the choice of the reference year
2. Use a variable reference year Divisia method (used in ODYSSEE)

Calculation of constant structure intensity in industry with a fixed reference year

- The simplest method to estimate the impact of structural changes on the energy intensity of industry is to calculate a fictitious energy intensity with the constant structure of a base year, i.e. assuming that the structure does not change with respect to this base year (e.g. 2000).

- This constant structure intensity (CSI) is calculated in year t with the sectoral intensities in year t and the value added structure of the base year (2000):

$$IES_t = (VAi/VA)_{2000} * (Ei/VAi_t)$$

- The impact of structural changes is measured by comparing the trend in real energy intensity with the trend in constant structure intensity.

Industrial intensity at constant structure: example

	value added structure (%)		sectoral intensities (toe/€00)	
	1990	**2000**	**1990**	**2000**
primary metals	6%	3%	400	200
chemicals	12%	15%	100	70
non metallic minerals	7%	4%	450	350
equipement,other	75%	78%	25	20
total	100%	100%	86	46

The energy intensity at constant 1990 structure is :

Somme (VA_i / VA ima) $_{1990}$ * I_{i} = **60**

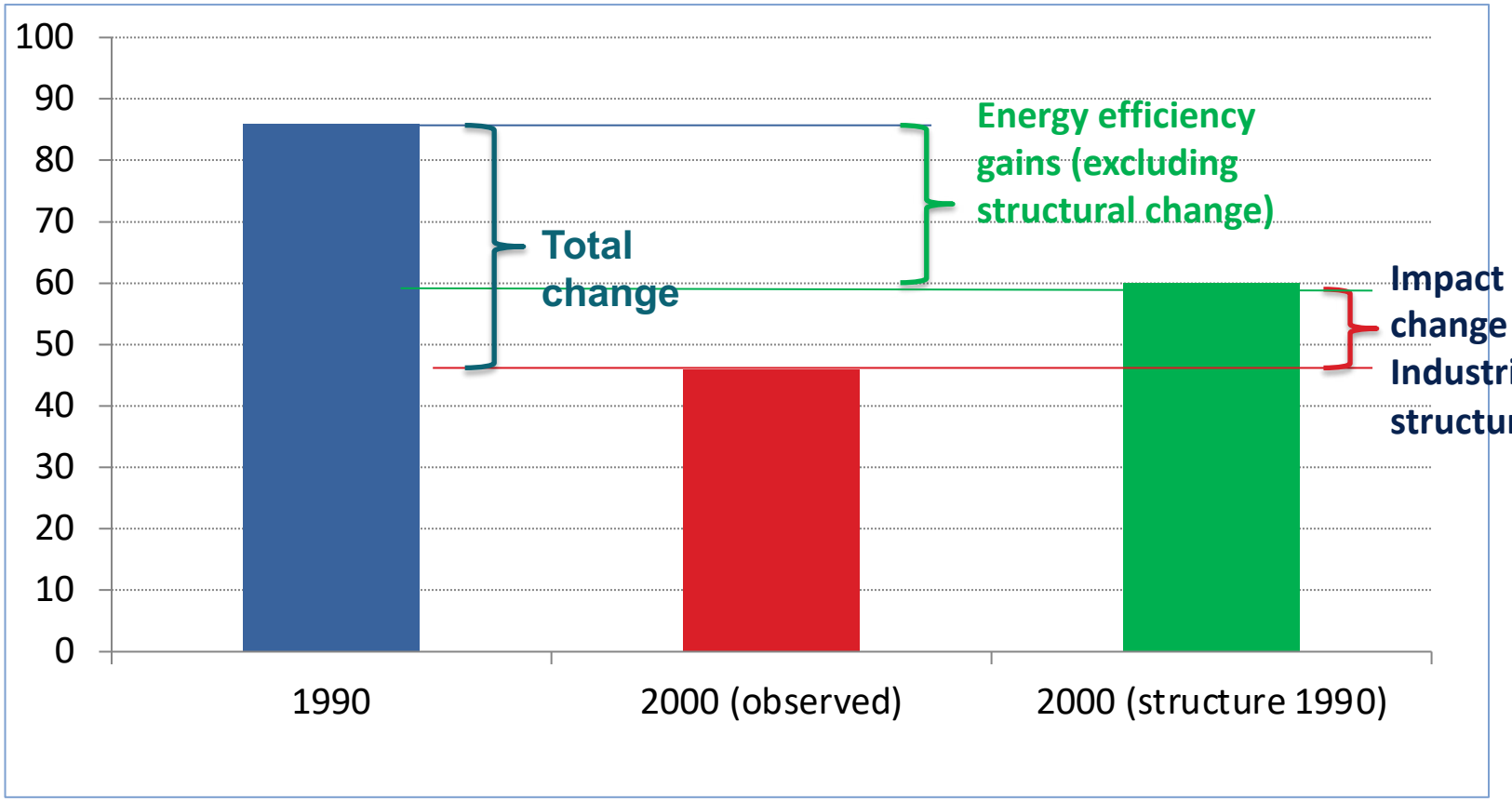
with VA = value added of sector i

I i= Energy intensity of sector i

*= 200*0,06+70*0,12+350*0,07+20*0,75*

Shift in industrial structure towards less energy-intensive industries

Interpreting the change in industrial intens
example



Interpreting the change in industrial intensity: example

Changes in the structure of industrial activity have had a very different impact on the decline in industrial energy intensity in different countries.