Introducing energy efficiency indicators

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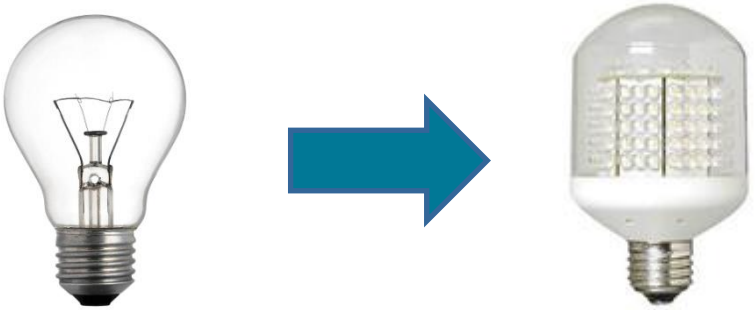
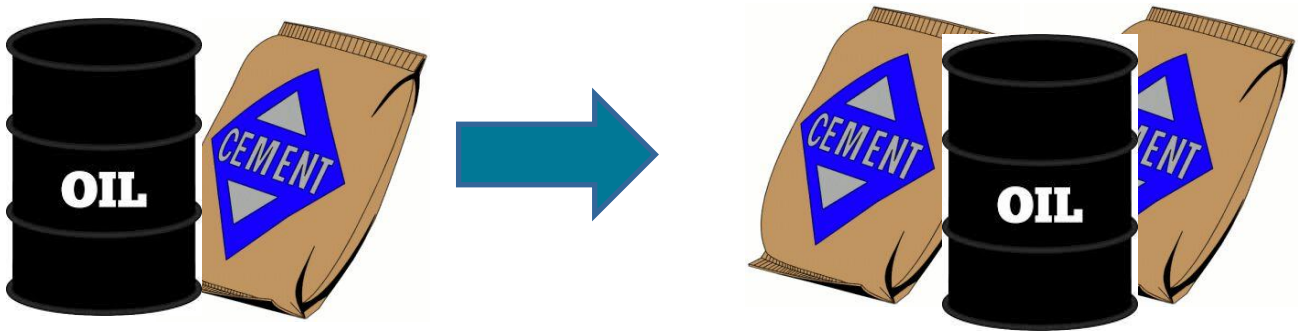
What is energy efficiency?

- Consuming **LESS** energy to provide **SAME** service
  (e.g. substitute incandescent bulbs with LED)

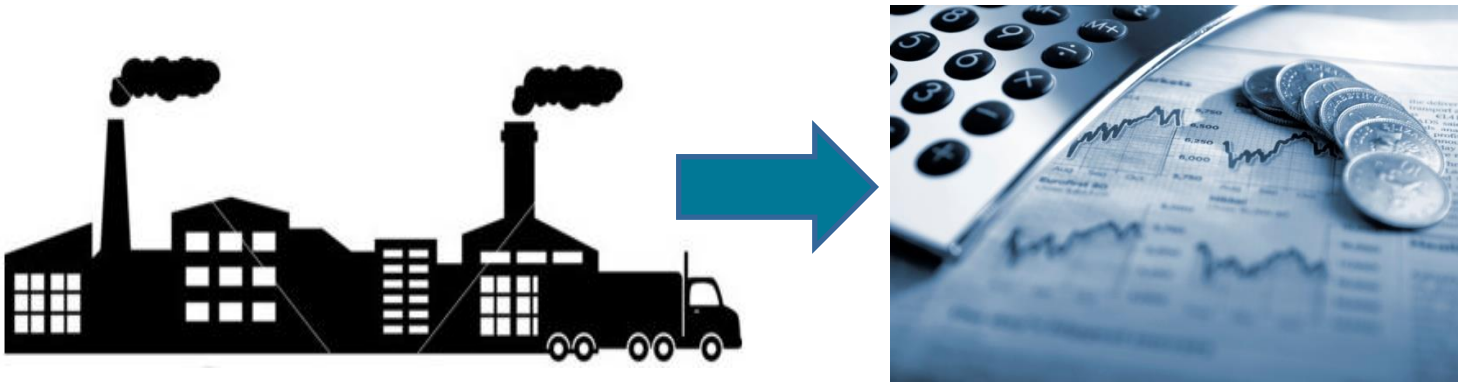


- Consuming **SAME** energy to provide **MORE** service
  (e.g. increase industrial output using the same energy)



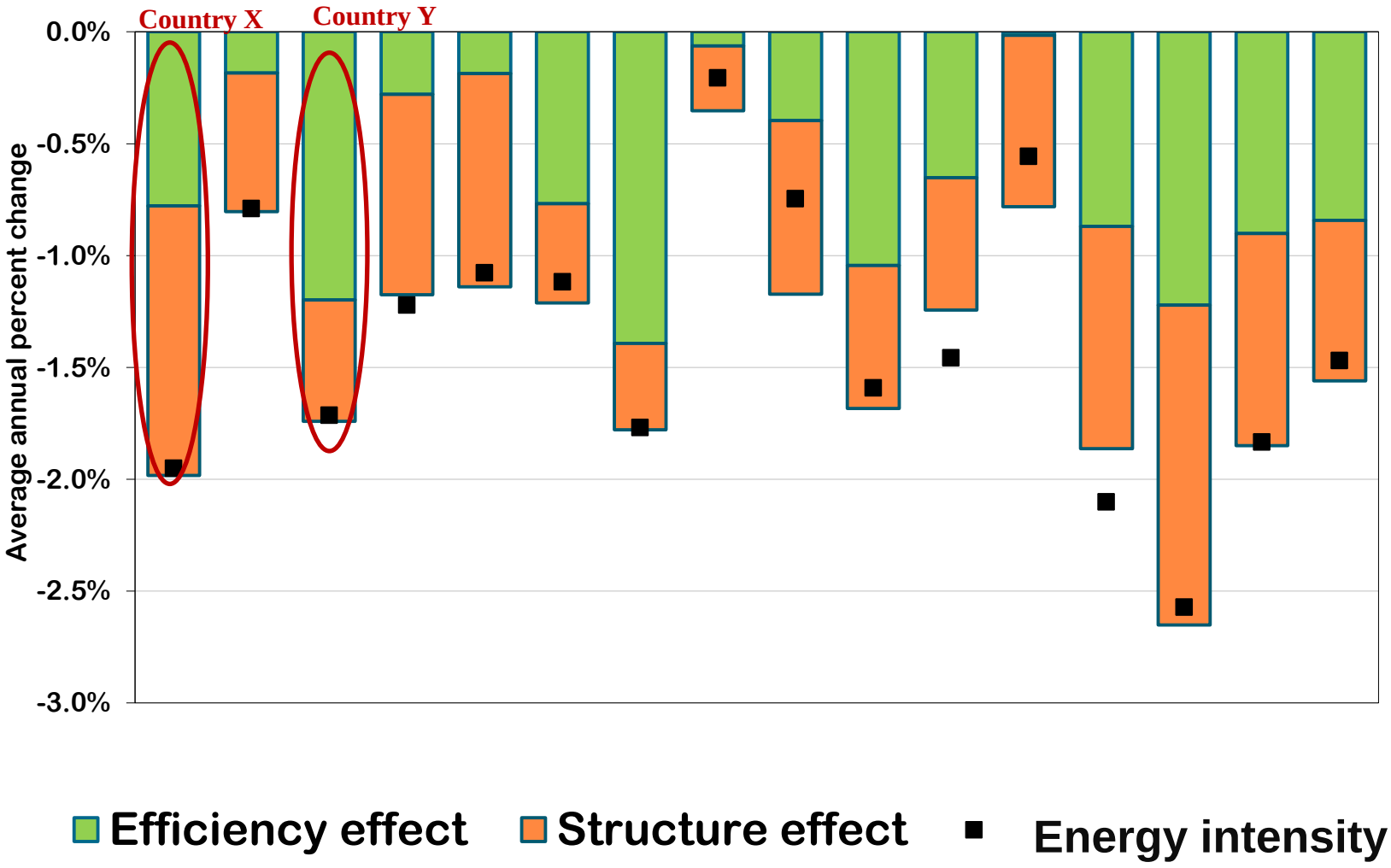
Energy efficiency is not….

- Consuming **LESS** energy because of **CHANGE** in service (e.g. economic restructuring)



How to monitor energy efficiency?

Aggregate indicators could be misleading



Energy balances are not enough

South Africa: Balances for 2011

in thousand tonnes of oil equivalent (ktoe) on a net calorific value basis

201 ▼ | Indicators | Balances | Coal and Peat | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total*
Production	142745	143	0	1112	3519	177	82	14799	0	0	162577
Imports	1769	20346	6362	2682	0	0	0	0	1023	0	32183
Exports	-46037	0	-1897	0	0	0	0	-273	-1287	0	-49494
International marine bunkers**	0	0	-3037	0	0	0	0	0	0	0	-3037
International aviation bunkers**	0	0	-856	0	0	0	0	0	0	0	-856
Stock changes							0	0	0	0	0
							82	14526	-264	0	141372
							0	0	0	0	223
rences							0	0	0	0	-3017
ts							-11	-98	22324	0	-39636
							0	0	0	0	0
							0	0	0	0	0
							0	0	0	0	-4255
							0	0	0	0	536
ation							0	0	0	0	-1608
lants	-1481						0	0	0	0	-13212
nation	0	0	0	0	0	0	0	-3791	0	0	-3791
ustry own use	0	0	-1215						377	0	-3593
Losses	0	0	0						92	0	-1892
Total final consumption	16676	0	24321						80	0	71127
Industry	11106	0	987						89	0	25566
Transport	0	0	17278						12	0	17591
Other	4200	0	2467						78	0	23012
Residential	2293	0	707						29	0	15323
Commercial and public services	1170	0	599						65	0	4334
Agriculture / forestry	227	0	1161						20	0	1908
Fishing	0	0	0						0	0	0
Non-specified	511	0	0						865	0	1447

Residential:
No breakdown by end use
- space heating
- space cooling
- water heating
- lighting
- cooking
- appliances

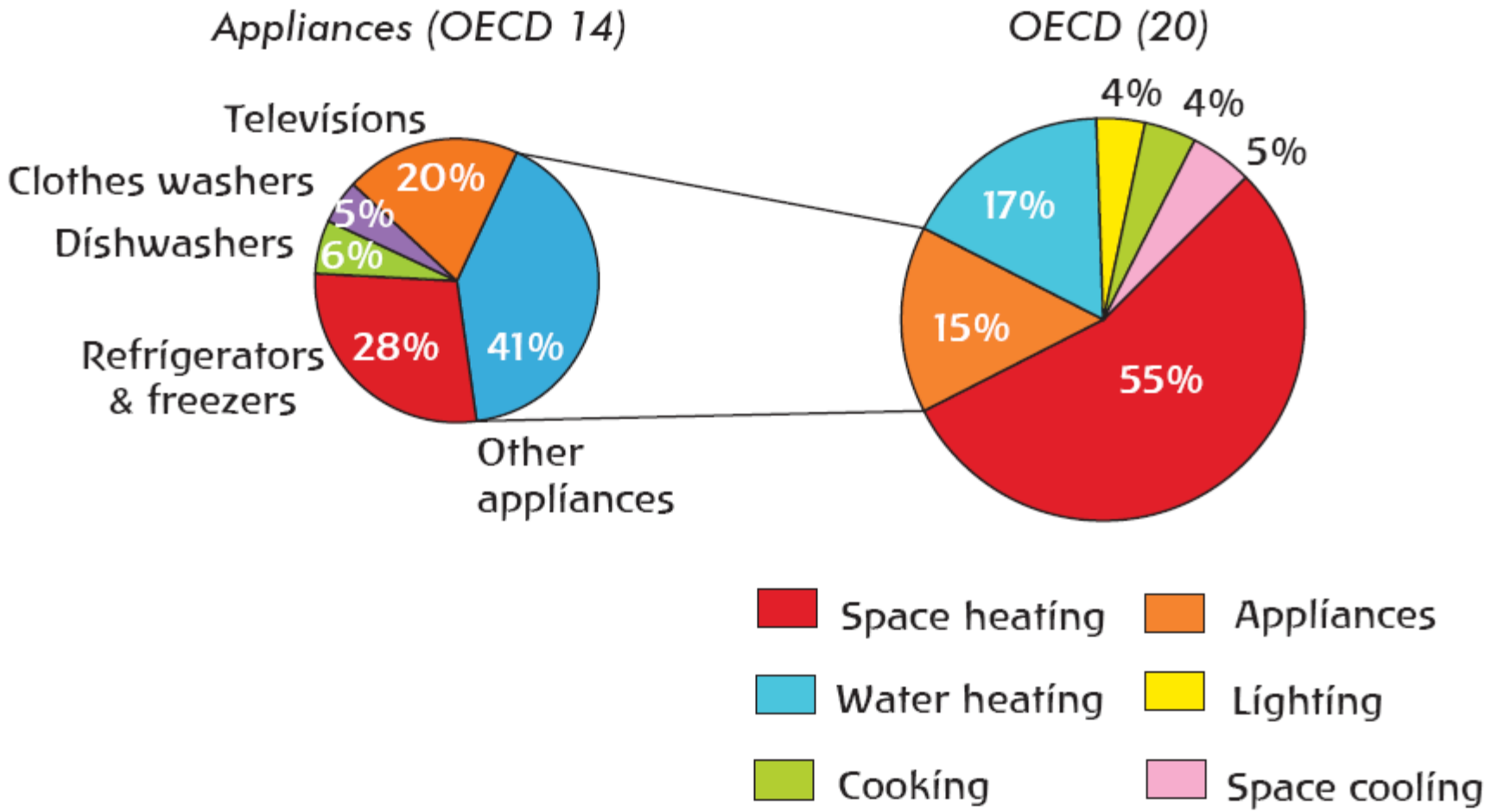
Transport:
No breakdown by segment
- passenger / freight

nor by vehicle type
- Light duty vehicles / trucks, ….

Services:
No breakdown by end use
- space heating
- space cooling
- water heating
- lighting
- other equipment

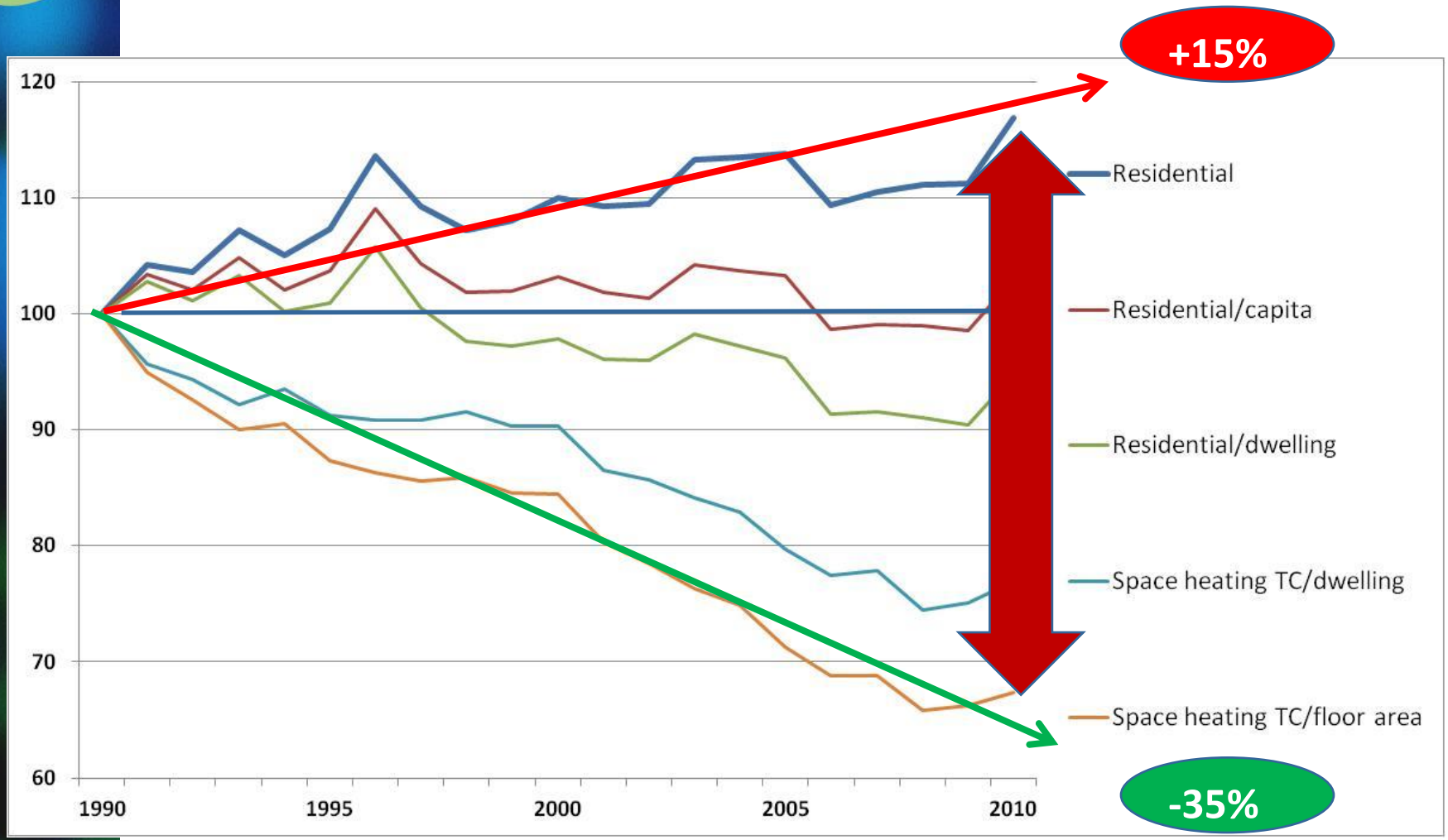
Different end-uses drive sectoral consumption

Figure 4.4 • *Breakdown of residential consumption by end use in 2010 for 20 selected OECD countries*



Note: The breakdown into individual appliances is available only for 14 countries.

Data need to be specific to your need



Index: 1990=1. Data for IEA18 (Australia, Austria, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA). Source: IEA energy efficiency indicators database.
TC: Temperature Corrected. Source: IEA, 2014.

What indicators for what sectors? The IEA experience

The IEA energy efficiency indicators template

Energy Efficiency Indicators Template

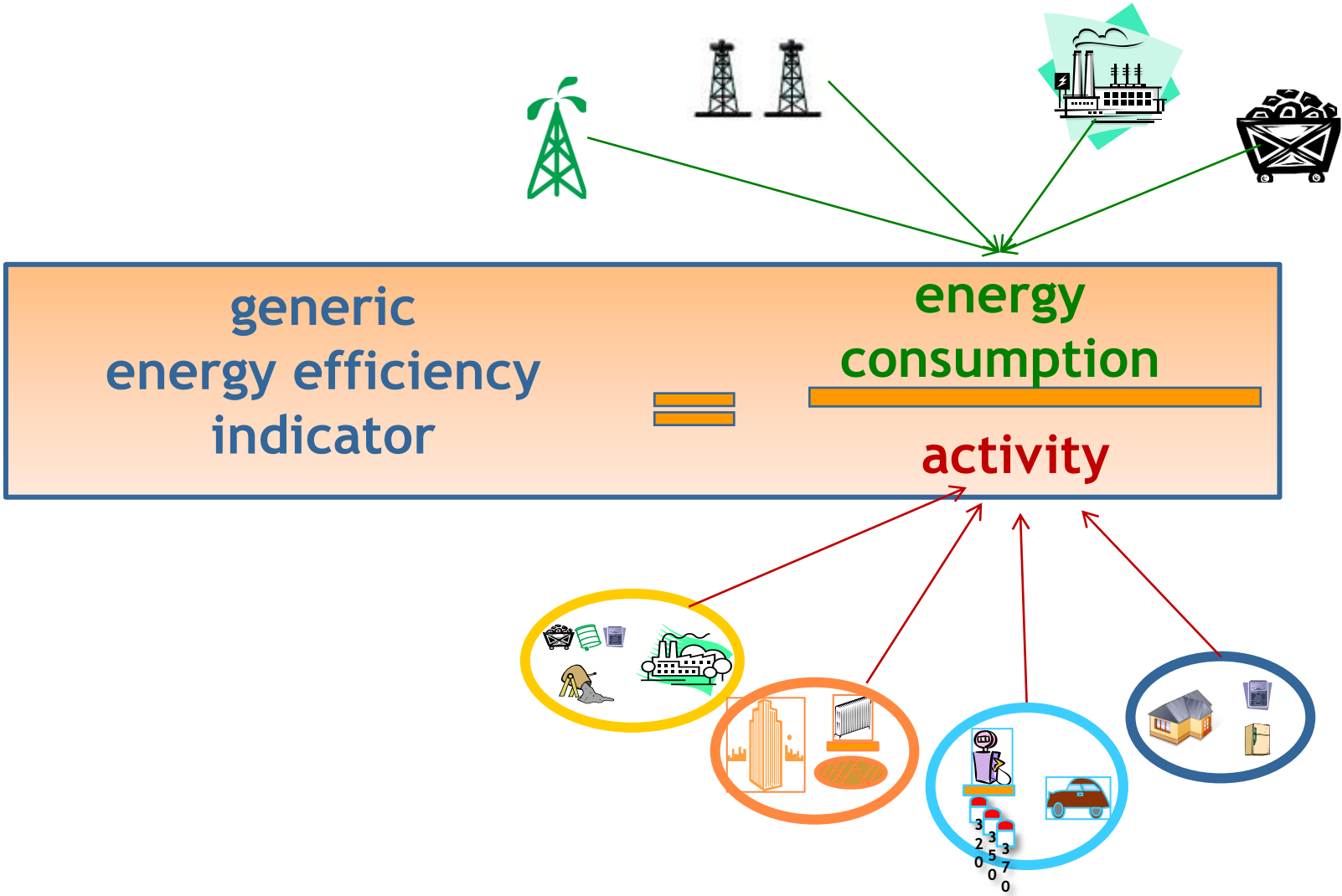
country name

Energy consumption & **Activity** data for:

- INDUSTRY
- SERVICES
- RESIDENTIAL
- TRANSPORT

COUNTRY DATA SECTION (to be re	
MACRO ECONOMIC DATA	
COMMODITIES	
INDUSTRY	
SERVICES	
RESIDENTIAL	ances data
TRANSPORT	
IEA DATA and AGGREGATE INDICA	
ELECTRICITY GENERATION	Electricity generation from combustible fuels and efficiencies
BASIC INDICATORS	Predetermined set of aggregate energy and activity indicators
SUPPORT TOOLS	
USER REMARKS	To incorporate comments associated to the data from the individual sheets
DATA COVERAGE	Generates a graphical summary of data coverage (completed vs. expected)
SINGLE INDICATOR GRAPHS	To generate a graph for one energy indicator
MULTIPLE INDICATORS GRAPHS	To generate a graph comparing trends from multiple indicators
CONSISTENCY CHECKS	To run the integrated consistency checks

What is an energy efficiency indicator?



Residential sector indicators

energy efficiency indicator = $\frac{\text{energy}}{\text{activity}}$

# of dwellings

floor area (m^2)

For each end-use:

- **Space heating***
- **Space cooling***
- **Water heating**
- **Cooking**
- **Lighting**
- **Appliances (energy use, stock, diffusion)**
  - Refrigerator
  - Freezer
  - Dishwasher
  - Clothes washer
  - Clothes dryer
  - TV
  - Computers

* Temperature corrected, using HDD

Services sector indicators

For each end-use:

- Space heating*
- Space cooling*
- Lighting
- Other building use
- Non-building use

* Temperature corrected, using HDD

$$\text{energy efficiency indicator} = \frac{\text{energy}}{\text{activity}}$$

Value added ($)

Floor area (m²)

# of employees

Transport sector indicators

- Transport segments
  passenger / freight
- Transport modes
  Road / rail / air / water

energy efficiency indicator = energy / activity

Passenger-km or ***tonne-km***

Vehicle stock

×

Distance travelled

×

Occupancy

Load

Industry sector indicators

For major sub-sectors
and some key product types

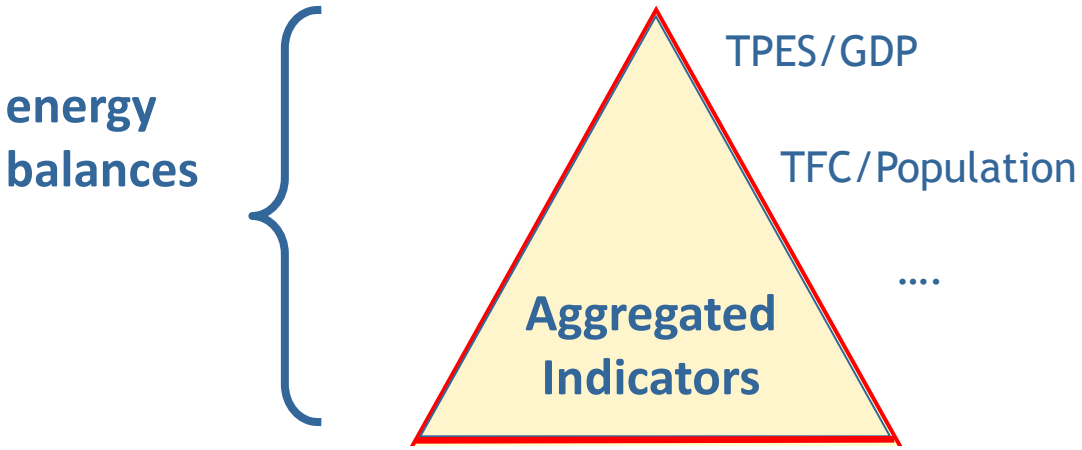
energy efficiency indicator = energy / activity

Value added ($)

Physical production (t)

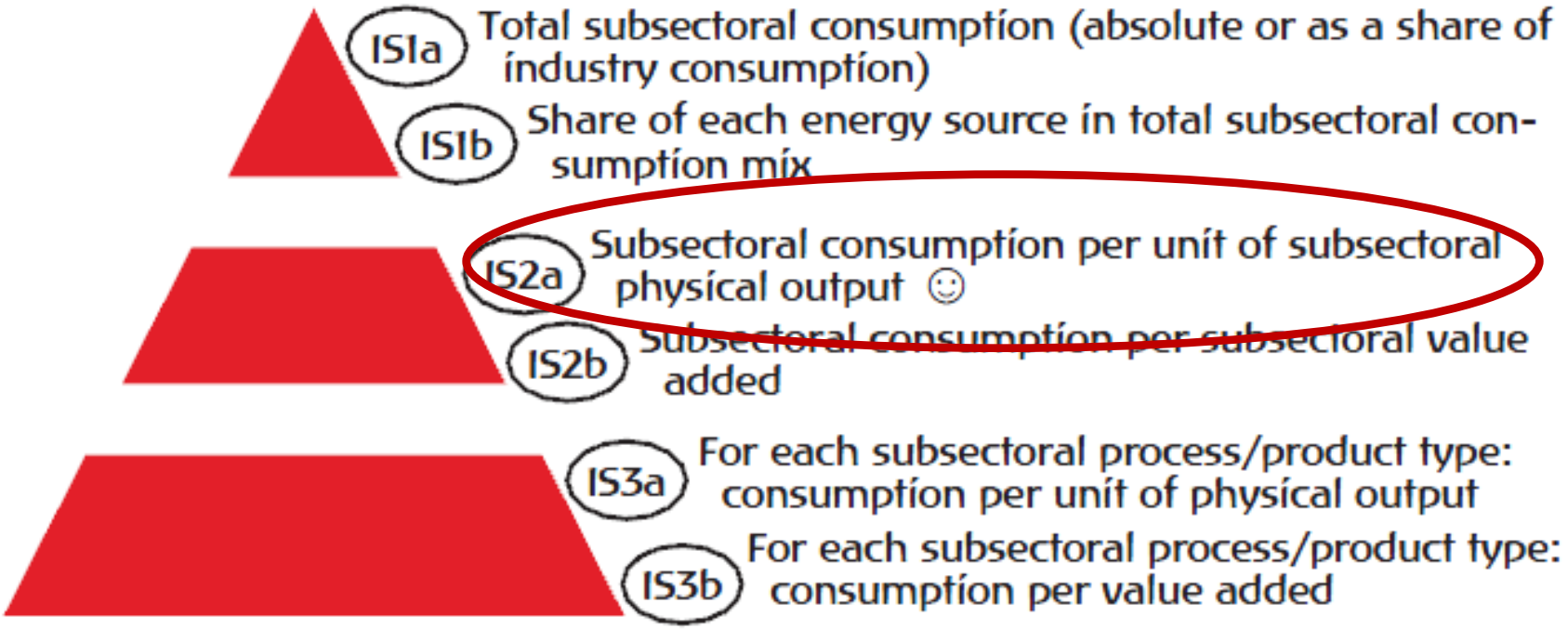
Prioritizing indicators: a pyramidal approach

The need to collect disaggregated data



The example of industry: what energy efficiency indicators to use?

Figure 6.6 • Pyramid of industry sub-sectors indicators



IS2a example: energy consumption per unit steel produced

Example: monitoring efficiency in industry

Table 6.1 • Examples of typical processes or product types for selected industry sub-sectors

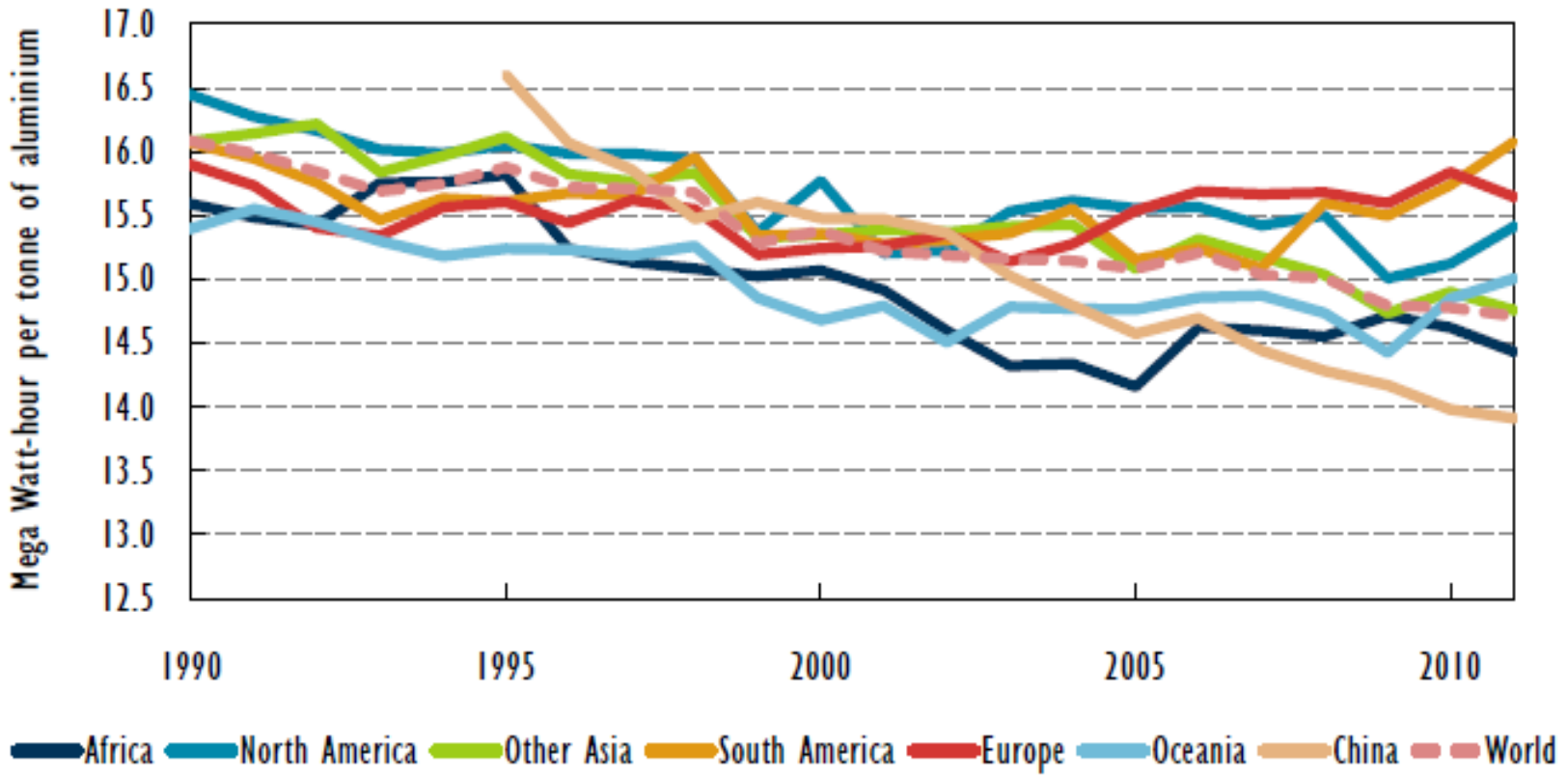
Sub-sector	Processes/product types	Sub-product
Iron and steel	Basic Oxygen Furnace (BOF) Electric Arc Furnace (EAF) Direct Reduced Iron (DRI)	
Chemical and petrochemical	Ethylene Propylene Benzene, toluene, xylene (BTX) Ammonia Methanol Butadiene	
Non-ferrous metals	Aluminium Copper	Bauxite Alumina Primary Recycled
Non-metallic minerals	Cement Clay brick and tile Building ceramics Glass Lime	Clinker (wet and dry) Cement
Pulp, paper and print	Pulp Recovered paper Paper and paperboard	Chemical pulp Mechanical pulp Household and sanitary paper Newsprint Printing, writing paper Wrapping, packaging paper, paperboard

sub-sector (energy balance)

product type / process / sub-product

Ambition: to monitor efficiency at product level

Figure 5.12 • Regional specific electricity consumption in aluminium smelting

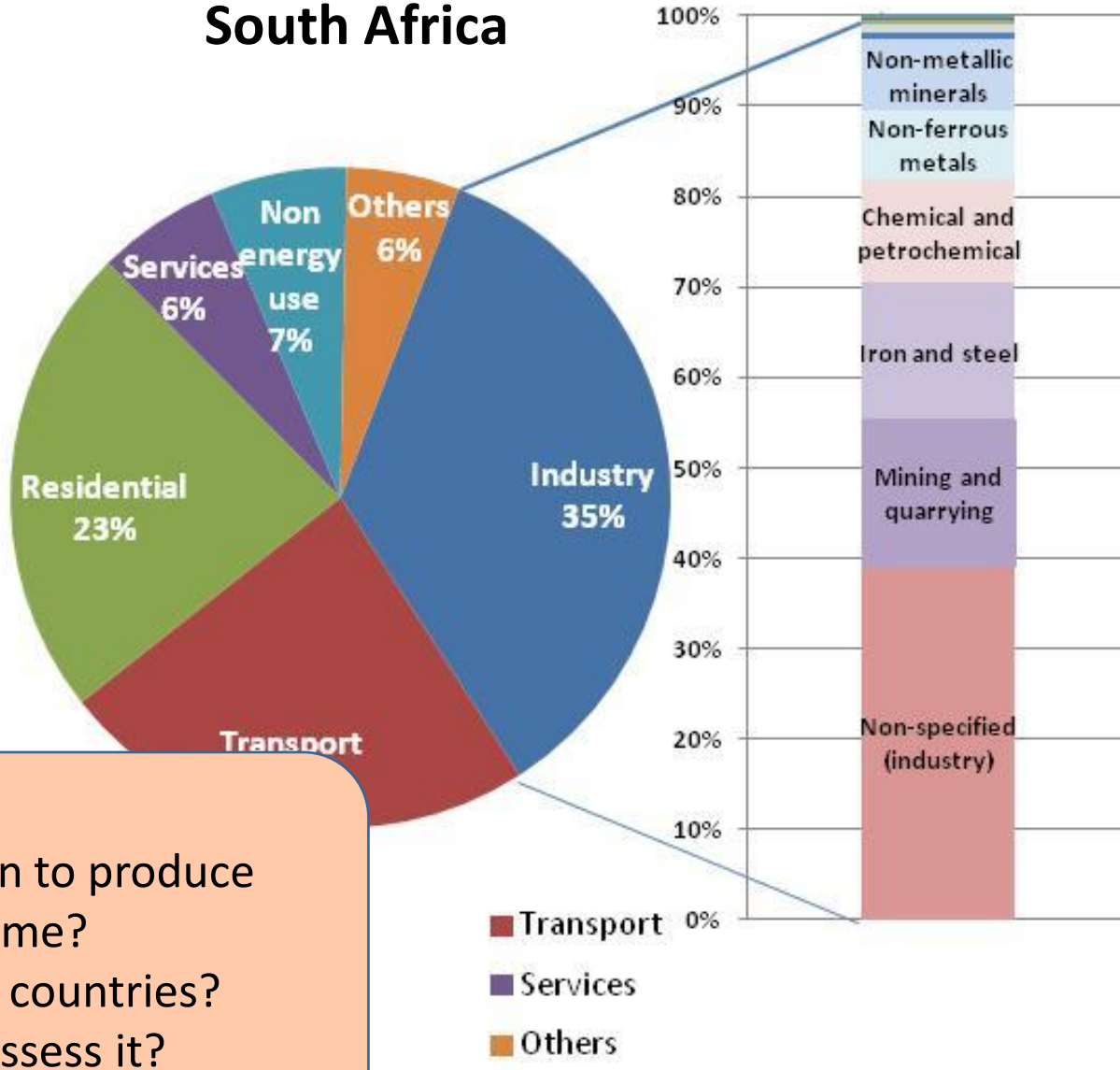


Note: MWh = megawatt hour.

Source: IAI (International Aluminium Institute) (2013), Primary Aluminium Production, IAI, London. See *http://www.world-aluminium.org/statistics/* for definitions of geographical aggregations.

For discussion: understanding final consumption

South Africa



Examples of key questions:

- How has the energy consumption to produce one tonne of (…iron) evolved in time?
- How does it compare with other countries?
- Where are information gaps to assess it?
- …

Source: IEA, 2014

A few concluding remarks

- A consistent methodological framework to monitor efficiency across sectors and end uses
- Varying levels of information detail across sectors depending on country-specific priorities, policy needs, data availability, …
- Identify where information is available and major gaps to be addressed based on country's priorities

Thank you

energyindicators@iea.org

Case study: understanding intensities across sectors

Sectors of the economy	Energy consumption		Value Added	
	PJ		billions of 2005$ PPP	
	1990	2010	1990	2010
National Total	**3540**	**4570**	**1105**	**1500**
Services	**646**	**1120**	**643**	**1118**
Industry	**2458**	**2914**	**340**	**269**
food products	216	264	42	39
textiles	26	61	8	16
wood	69	100	5	7
paper and printing	364	512	18	24
chemicals and chemical products	535	557	38	29
rubber and plastics products	49	45	13	9
other non-metallic mineral products	253	294	12	14
basic metals	552	642	18	20
machinery	151	182	129	61
transport equipment	78	71	36	33
Other manufacturing	165	186	21	18
Others				
Agriculture, forestry and fishing	154	177	30	24
Mining and quarrying	273	350	36	38
Electricity, gas, steam, air conditioning, ar	3	3	45	39
Construction	5	7	11	13

Case study: understanding intensities across sectors

Q1. How has the total intensity of the economy evolved in time?

Sectors of the economy	Energy consumption		Value Added	
	PJ		billions of 2005$ PPP	
	1990	2010	1990	2010
National Total	3540	4570	1105	1500

Energy intensity		Intensity change
MJ/US$PPP		
1990	2010	1990-2010
3.2	3.0	-5%

Energy intensity:

Energy consumption / Value added

Case study: understanding intensities across sectors

Q2. What are the largest consuming sectors in 2010?

Sectors of the economy	Energy consumption		Value Added	
	PJ		billions of 2005$ PPP	
	1990	2010	1990	2010
National Total	**3540**	**4570**	**1105**	**1500**
Services	**646**	**1120**	**643**	**1118**
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machinery	151	182	129	61
transport equipment	78	71	36	33
Other manufacturing	165	186	21	18

Case study: understanding intensities across sectors

Q3. What are the three most intensive sectors in 2010

Sectors of the economy	Energy consumption		Value Added		Energy intensity	
	PJ		billions of 2005$ PPP		MJ/US$PPP	
	1990	2010	1990	2010	1990	2010
National Total	3540	4570	1105	1500	3.2	3.0
Services	646	1120	643	1118	1.0	1.0
Industry	2458	2914	340	269	7.2	10.8
food products	216	264	42	39	5.1	6.8
textiles	26	61	8	16	3.1	3.7
wood	69	100	5	7	13.0	14.9
paper and printing	364	512	18	24	20.3	21.7
chemicals and chemical products	535	557	38	29	14.2	19.4
rubber and plastics products	49	45	13	9	3.8	4.8
other non-metallic mineral products	253	294	12	14	20.6	20.7
basic metals	552	642	18	20	30.7	32.4
machinery	151	182	129	61	1.2	3.0
transport equipment	78	71	36	33	2.2	2.2
Other manufacturing	165	186	21	18	7.9	10.3

Case study: understanding intensities across sectors

Q4. Has any subsector decreased its intensity ?

Sectors of the economy	Energy consumption		Value Added		Energy intensity		Intensity change
	PJ		billions of 2005$ PPP		MJ/US$PPP		
	1990	2010	1990	2010	1990	2010	1990-2010
National Total	**3540**	**4570**	**1105**	**1500**	**3.2**	**3.0**	**-5%**
Services	**646**	**1120**	**643**	**1118**	**1.0**	**1.0**	**0%**
Industry	**2458**	**2914**	**340**	**269**	**7.2**	**10.8**	
food products	216	264	42	39	**5.1**	**6.8**	**32%**
textiles	26	61	8	16	**3.1**	**3.7**	**20%**
wood	69	100	5	7	**13.0**	**14.9**	**15%**
paper and printing	364	512	18	24	**20.3**	**21.7**	**7%**
chemicals and chemical products	535	557	38	29	**14.2**	**19.4**	**37%**
rubber and plastics products	49	45	13	9	**3.8**	**4.8**	**25%**
other non-metallic mineral products	253	294	12	14	**20.6**	**20.7**	**0%**
basic metals	552	642	18	20	**30.7**	**32.4**	**5%**
machinery	151	182	129	61	**1.2**	**3.0**	**156%**
transport equipment	78	71	36	33	**2.2**	**2.2**	**0%**
Other manufacturing	165	186	21	18	**7.9**	**10.3**	**30%**

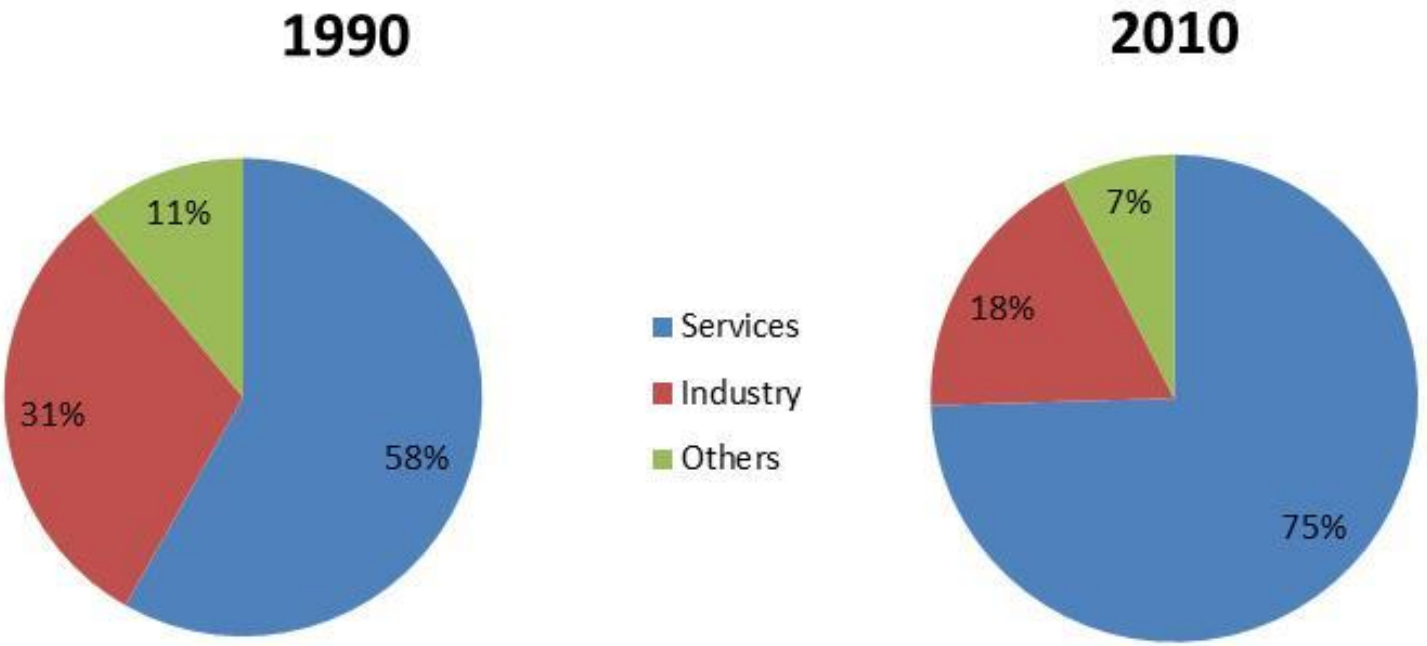
Case study: understanding intensities across sectors

Q5. What is the reason for the trend in total intensity?

Sectors of the economy	Energy consumption		Value Added		Energy intensity		Intensity change
	PJ		billions of 2005$ PPP		MJ/US$PPP		
	1990	2010	1990	2010	1990	2010	1990-2010
National Total	**3540**	**4570**	**1105**	**1500**	**3.2**	**3.0**	**-5%**
Services	**646**	**1120**	**643**	**1118**	**1.0**	**1.0**	**0%**
Industry	**2458**	**2914**	**340**	**269**	**7.2**	**10.8**	
food products	216	264	42	39	**5.1**	**6.8**	**32%**
textiles	26	61	8	16	**3.1**	**3.7**	**20%**
wood	69	100	5	7	**13.0**	**14.9**	**15%**
paper and printing	364	512	18	24	**20.3**	**21.7**	**7%**
chemicals and chemical products	535	557	38	29	**14.2**	**19.4**	**37%**
rubber and plastics products	49	45	13	9	**3.8**	**4.8**	**25%**
other non-metallic mineral products	253	294	12	14	**20.6**	**20.7**	**0%**
basic metals	552	642	18	20	**30.7**	**32.4**	**5%**
machinery	151	182	129	61	**1.2**	**3.0**	**156%**
transport equipment	78	71	36	33	**2.2**	**2.2**	**0%**
Other manufacturing	165	186	21	18	**7.9**	**10.3**	**30%**

Case study: understanding intensities across sectors

Q5. What is the reason for the trend in total intensity?



The importance of disentangling efficiency improvements from structural changes of the economy