

Energy Efficiency Indicators: Fundamentals on Statistics

Roberta Quadrelli

Head - Energy Balances, Prices, Emissions, Efficiency

Energy Data Centre

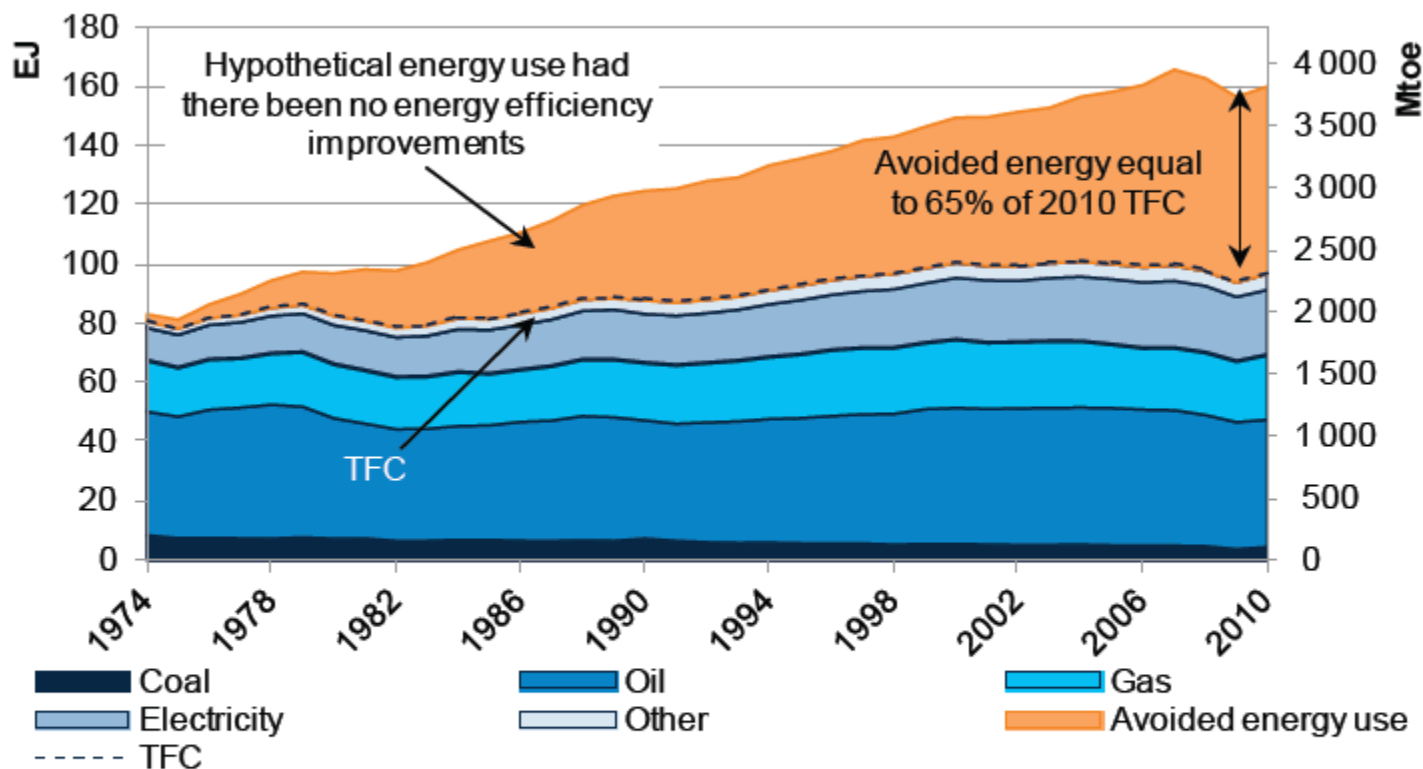
**Capacity Development for Mainstreaming Energy Sustainable Development Goals (SDGs),
Targets and Indicators into Statistical Programmes in Selected Latin American Countries
Panama, February 2015**

The key role of energy efficiency: global and regional perspectives



Energy efficiency: a huge potential

Figure ES.2 The “first fuel”: avoided energy use from energy efficiency in 11 IEA member countries



Notes: TFC = total final consumption. The 11 countries are Australia, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States, those for which sufficient data is available to undertake analysis. “Other” includes biofuels plus heat from geothermal, solar, co-generation and district heating. Co-generation refers to the combined production of heat and power.

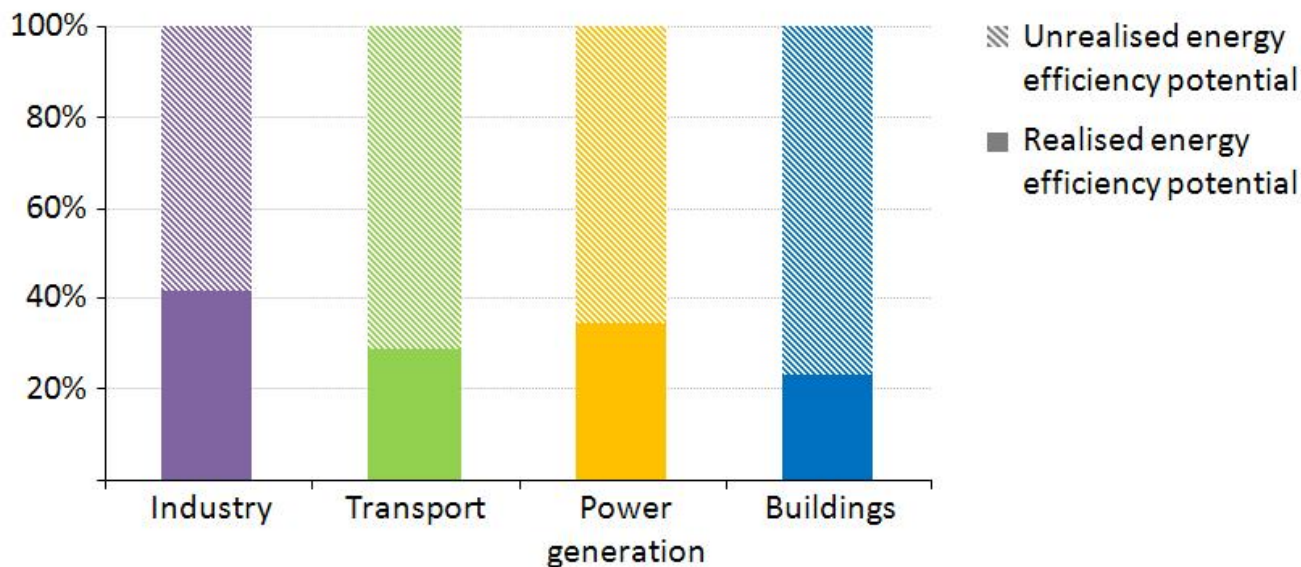
Source: IEA indicators database.

...in all regions...

Energy efficiency: a huge opportunity going unrealised in emerging and developing countries

WORLD ENERGY OUTLOOK 2012

Energy efficiency potential used by sector in non-OECD countries in the New Policies Scenario

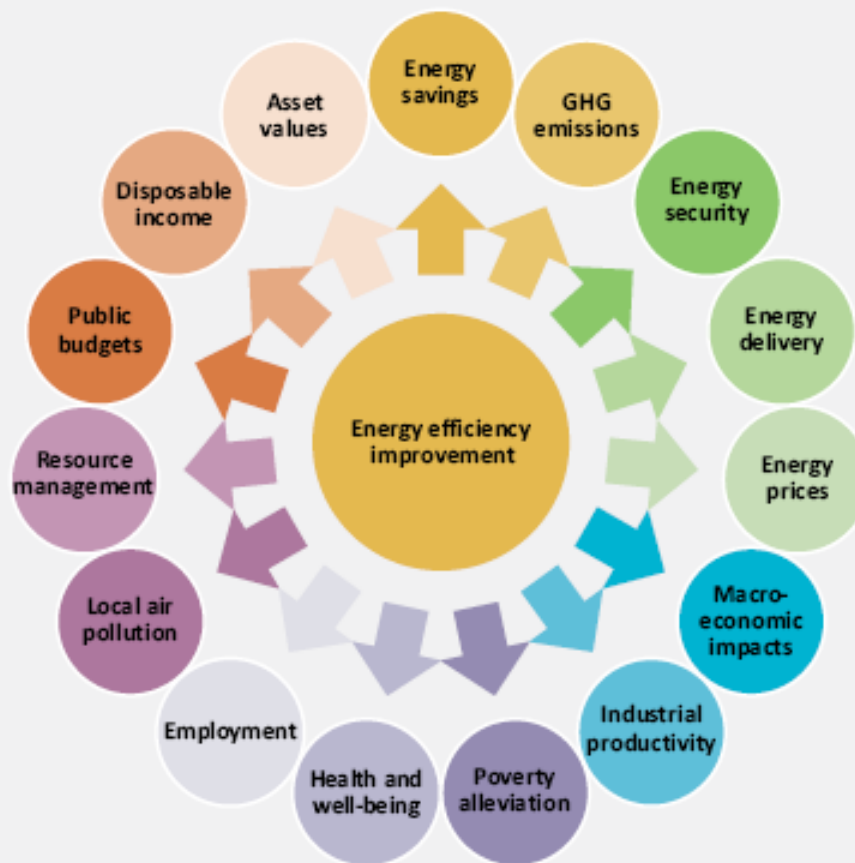


Two-thirds of the economic potential to improve energy efficiency remains untapped in the period to 2035

..and with multiple benefits

Figure ES.2

The multiple benefits of energy efficiency improvements



Note: This list is not exhaustive, but represents some of the most prominent benefits of energy efficiency identified to date.
 Source: Unless otherwise noted, all material in figures and tables in this chapter derives from IEA data and analysis.

Key point

A multiple benefits approach to energy efficiency reveals a broad range of potential positive impacts.

Energy efficiency policies for Latin America and the Caribbean: the IEA perspective



Adapting the 25 Energy Efficiency Policy Recommendations to regional and cultural contexts:

- **Latin America and the Caribbean** – based on discussions held at:
 - Fifth Energy Efficiency Policy Dialogue, Peru (October 2014)
 - Regional Sustainable Energy Training Week for Latin America, Chile (November 2014)
- **Arab-Southern and Eastern Mediterranean Region – 2014**
- **Southeast Asia Region – 2014**

Objective: Support government stakeholders in prioritising and implementing energy efficiency policies

Regional policy recommendations: key messages for Latin America and the Caribbean

Cross-Sectoral

- Designate lead institutions for planning, coordinating, implementing, and monitoring energy efficiency policies and programmes
- Establish regular energy efficiency data collection and indicators
- Remove inefficient energy subsidies
- Stimulate the development of energy efficiency markets
- Develop information and awareness campaigns and educational programmes

Buildings

- Improve energy performance of building components and systems
- Improve building energy performance
- Implement energy labels, certificates or disclosure of energy consumption
- Aim for net-zero energy consumption in buildings

Lighting, Appliances & Equipment

- Implement mandatory Minimum Energy Performance Standards and energy labels for lighting, appliances and equipment, and phase-out least efficient products
- Engage in regional collaboration and harmonisation of standards and testing procedures
- Promote market transformation policies

Regional policy recommendations: key messages for Latin America and the Caribbean

Transport

- Improve transport system planning and efficiency
- Implement mandatory vehicle efficiency standards and labelling
- Promote fuel-efficient non-engine components
- Enhance vehicle operational efficiency

Industry

- Promote energy management and energy efficiency projects
- Promote high-efficiency industrial equipment and systems
- Stimulate the development of energy efficiency services for small and medium enterprises (SMEs)

Report to be published in March 2015 by the IEA

Developing energy efficiency indicators to track efficiency progress: why?





Indicators:

key to set targets and assess policy impacts

Council of Australian Governments (COAG)

National Strategy on Energy Efficiency

July 2009

ENERGY

European Commission

European Commission > Energy > Energy Efficiency > Energy Efficiency Directive

Energy Efficiency


Home

- Energy Efficiency Directive
 - National Energy Efficiency Action Plans
 - Reporting targets
 - Guidance notes
 - Article 4 Building Renovation Strategies
 - Notifications according to Article 5
 - Article 7 notifications
 - Article 14.6 - Exemption Notifications
- Energy Efficiency Plan Financing Energy

Reporting targets

Under Article 24, paragraph 11, of the Energy Efficiency Directive the "Commission shall make the reports referred to in paragraphs 1 and 2 publicly available".

Reports are published on this page as soon as they are received from Member States.




EU Member State	Article 3 indicative national energy efficiency target for 2020	Absolute level energy consumption 2020 [Mtoe]	
		Primary	Final
Austria	Final energy consumption of 1100 PJ	31.5	21.0
Belgium	18% reduction in primary energy consumption by 2020 relative to the Primes 2007 baseline (53.3 Mtoe)	43.7	30.0
Bulgaria	Increase of energy efficiency by 25% until 2020 (5 Mtoe primary energy savings in 2020) and 50% energy intensity reduction by 2020 compared to 2005 levels	15.8	9.0
Croatia	Increase in energy efficiency resulting in final energy consumption reduction of 19,77 PJ in 2016 and 22,76 PJ in 2020	-	9.0
Cyprus	0.463 Mtoe energy savings in 2020	2.8	2.2

STAATSKOERANT, 26 JUNIE 2009 No. 32342 3

GENERAL NOTICE

NOTICE 908 OF 2009



National Energy Efficiency Strategy of the Republic of South Africa

[NRP](#)

Canada.ca | Services | Departments | Français

Canada

Energy Efficiency Act (S.C. 1992, c. 36)

Full Document: [HTML](#) | [XML](#) [61 KB] | [PDF](#) [250 KB]

Act current to 2014-09-01 and last amended on 2009-09-21. [Previous Versions](#)

Previous Page Next Page

Energy Efficiency Act

S.C. 1992, c. 36

Assented to 1992-06-23

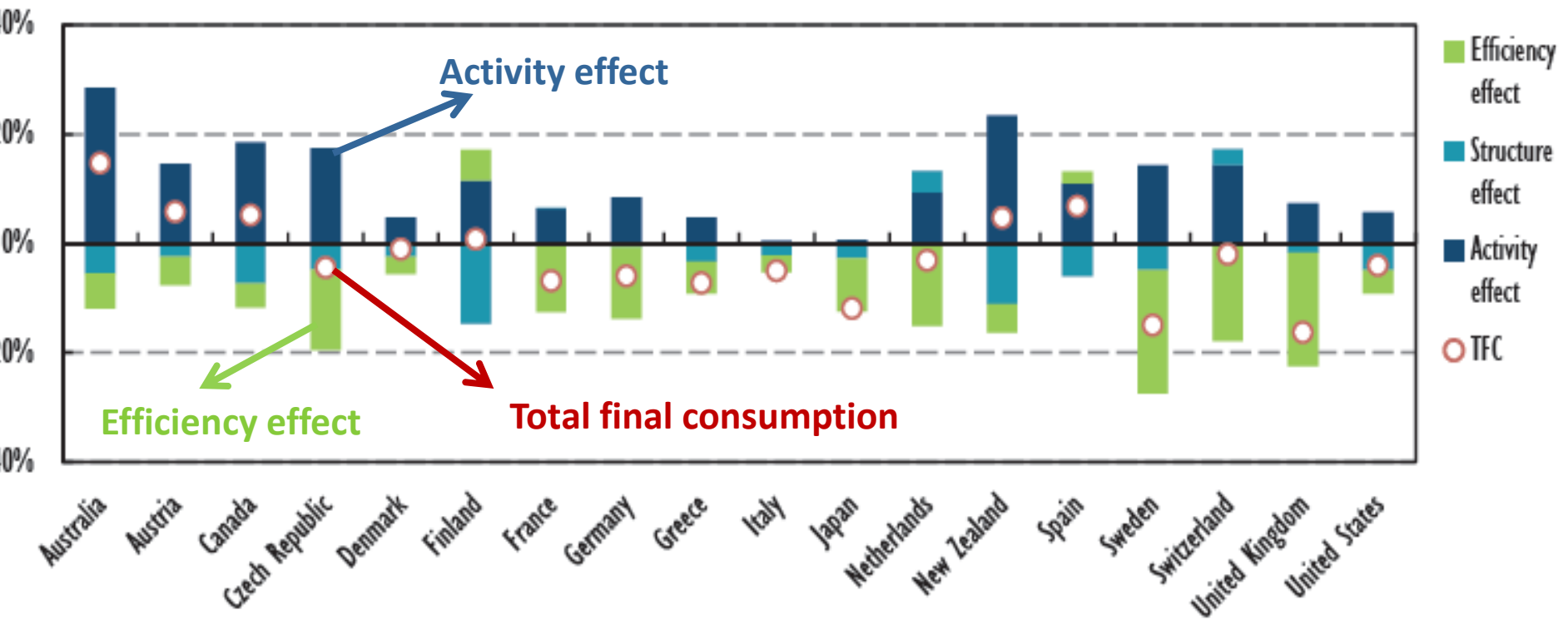
An Act respecting the energy efficiency of energy-using products and the use of alternative energy sources

Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:



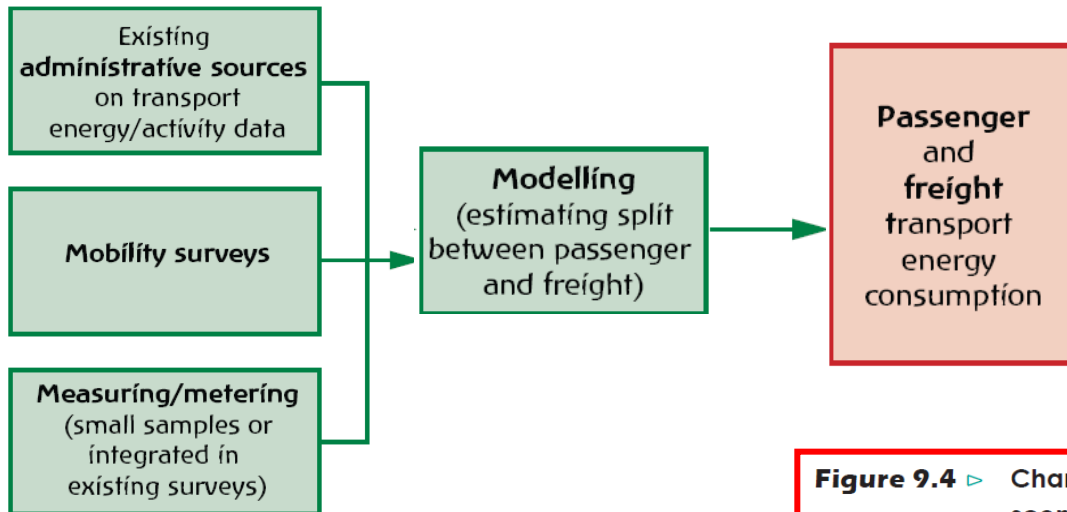
Show whether productivity increases for a given energy consumption

Figure 2.7 Decomposition of TFC between 2001 and 2011 for 18 IEA member countries relative to 2001 levels



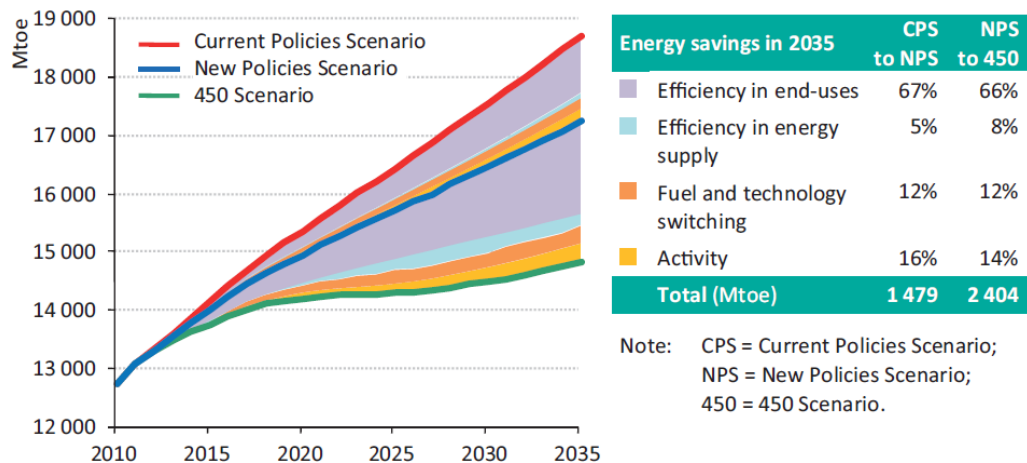
Provide information to forecast energy use across sectors and end uses

Schematics of a transport model: Sources, output and validation



IEA Energy Efficiency Indicators: Fundamentals on Statistics, 2014

Figure 9.4 Change in global primary energy demand by measure and by scenario



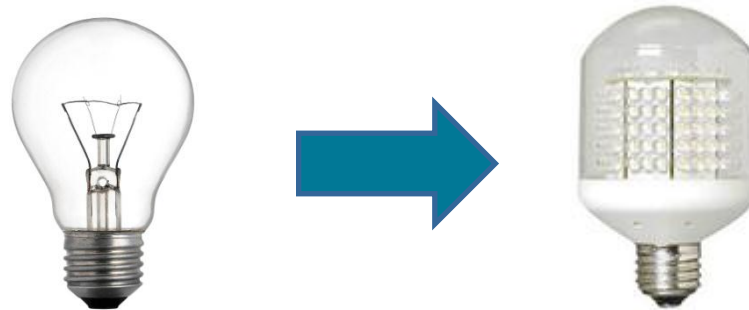
Defining energy efficiency indicators



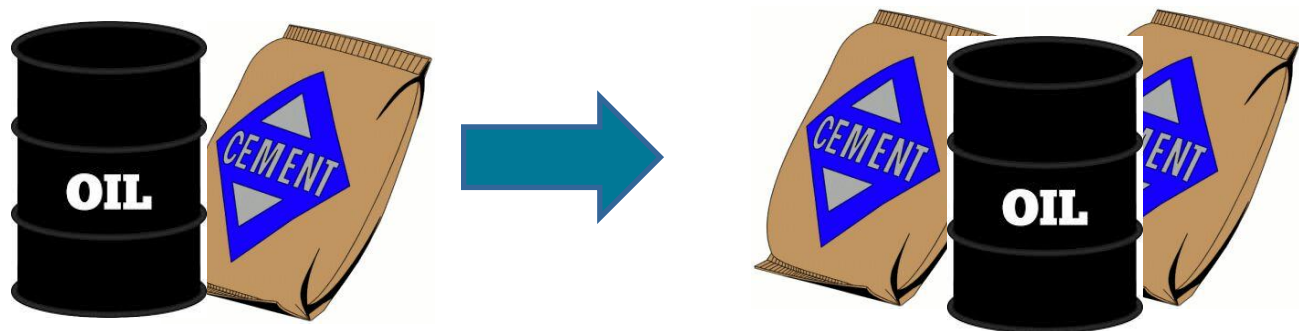
First: what do we mean by energy efficiency?

Are these energy efficiency improvements? (Yes / No / Maybe)

1. Consume **LESS** energy to provide **SAME** service
 - ◆ E.g. substitute Incandescent bulbs with LED



2. Consume **SAME** energy to provide **MORE** service
 - ◆ E.g. increased production with the same energy



What do we mean by energy efficiency?

Are these energy efficiency improvements? (Yes / No / Maybe)

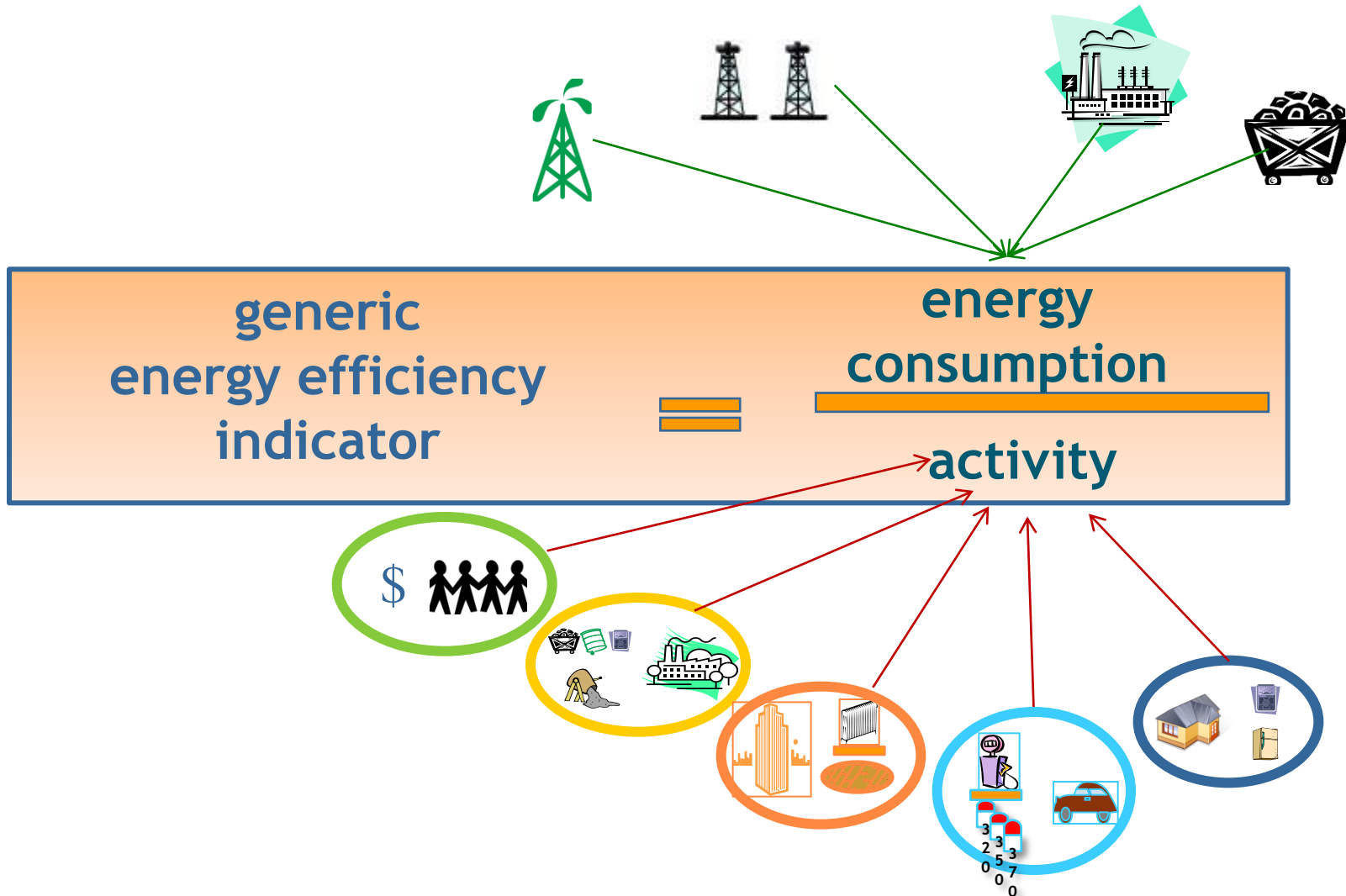
3. Consume LESS energy and provide LESS service
 - ◆ E.g. walk instead of drive



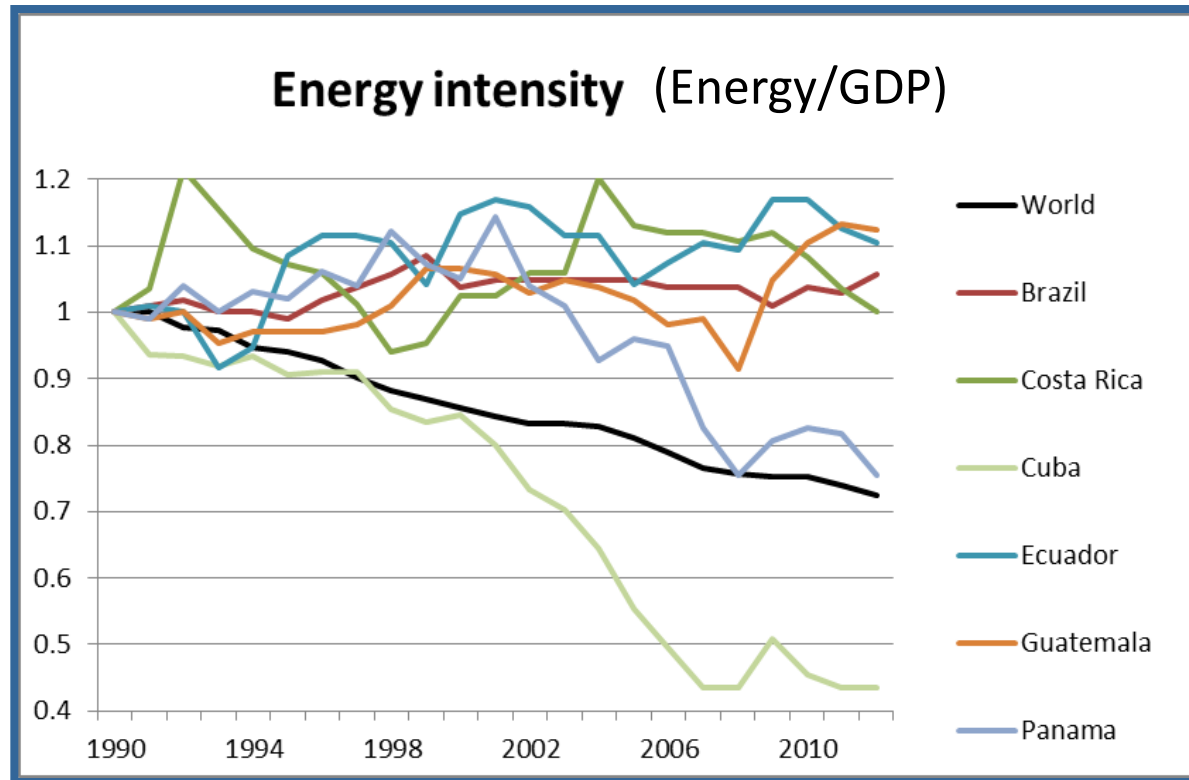
4. Consume LESS energy because of CHANGE in service
 - ◆ E.g. economic restructuring



How to define an energy efficiency indicator?



Understanding high-level indicators...



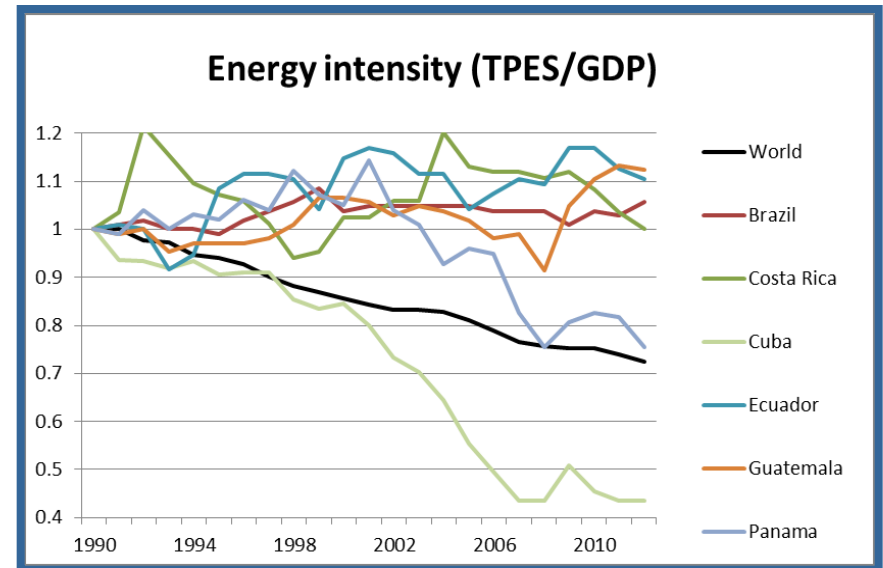
Source: IEA, 2014. TPES (Total Primary Energy supply) /GDP index, based on GDP PPP 2005 USD

What does the energy intensity of the economy tell us?

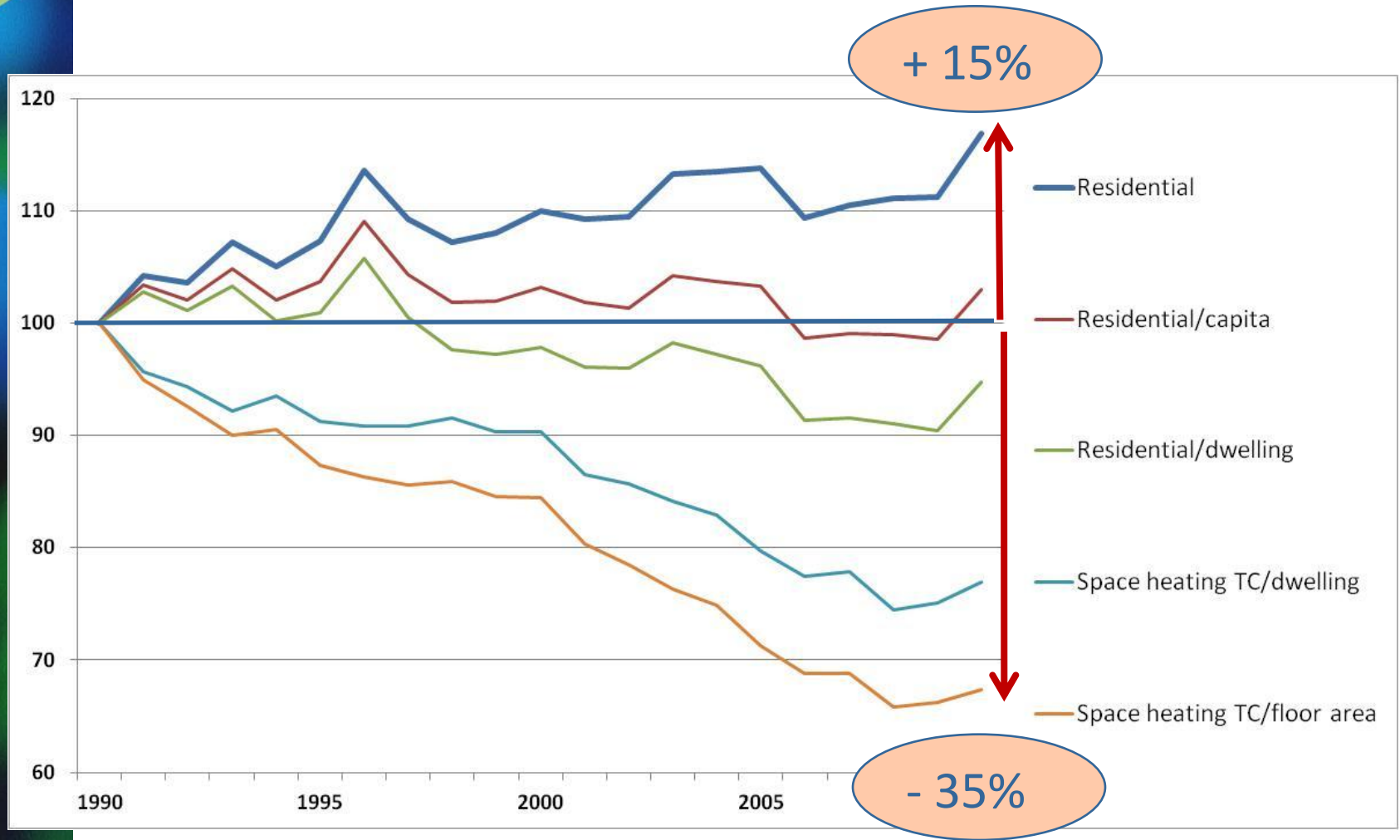
For discussion....

Is TPES/GDP an indicator of energy efficiency?

- Yes
- No
- Maybe



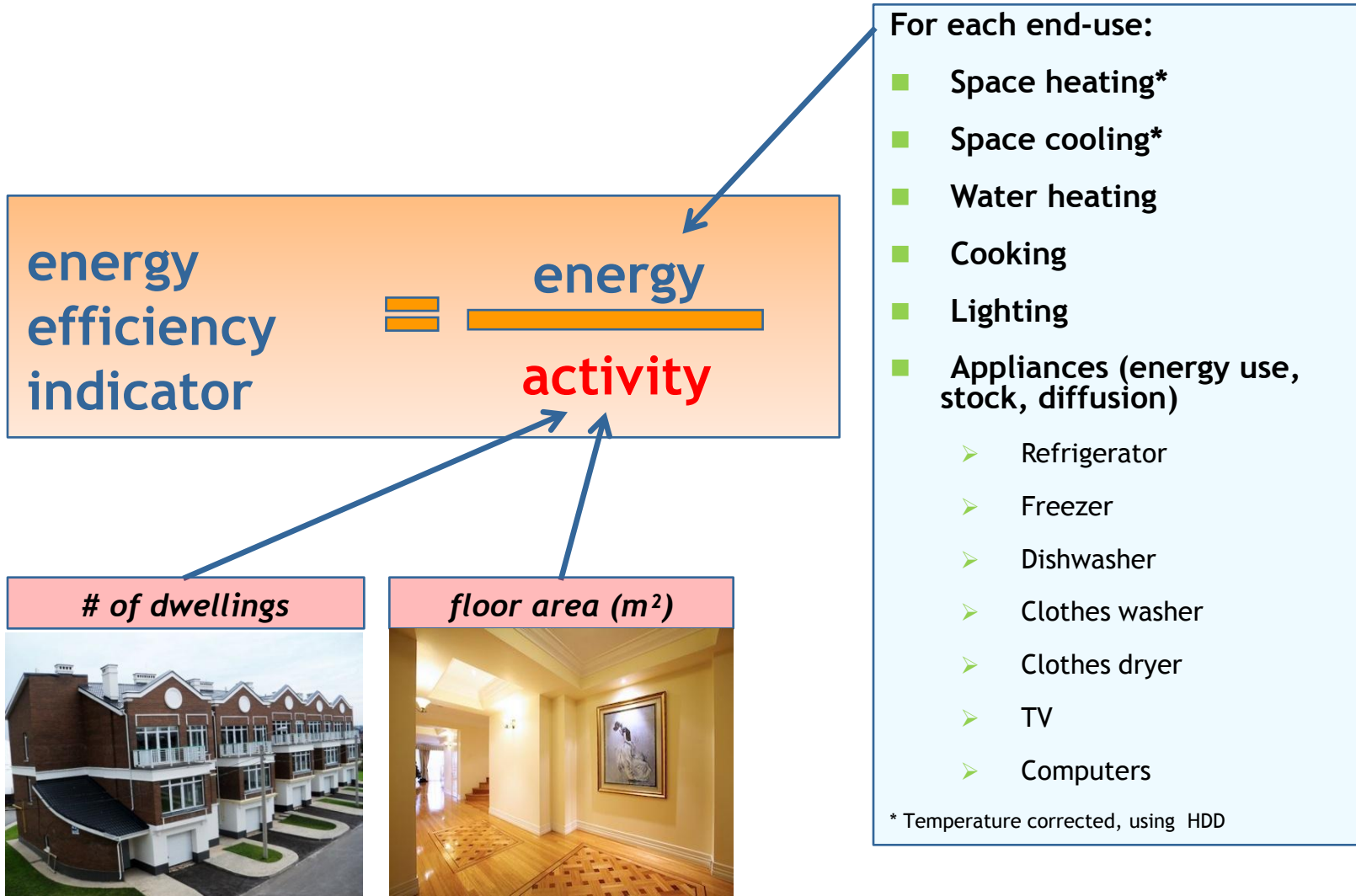
Understanding more detailed indicators



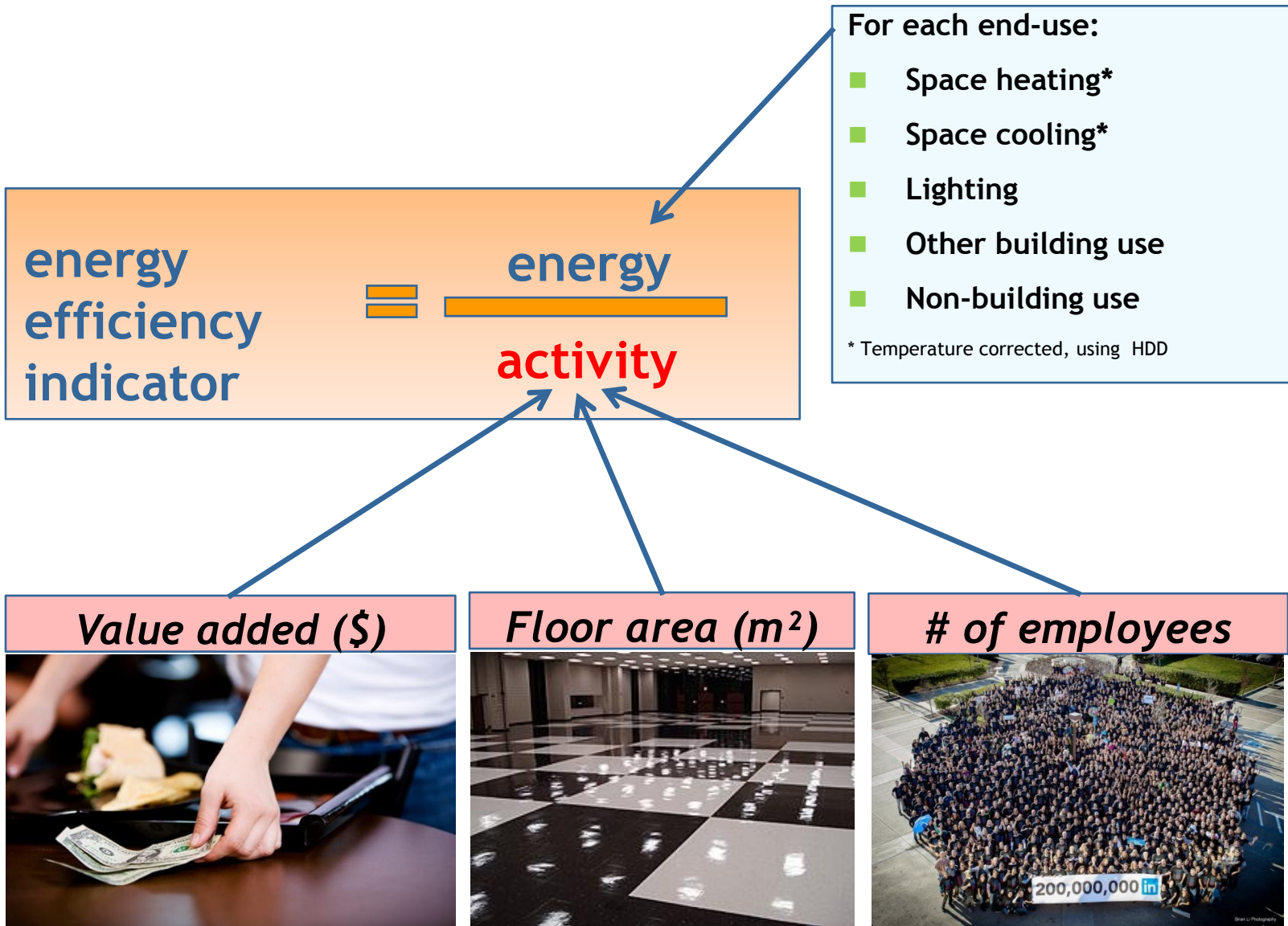
Index: 1990=1. Data for IEA18 (Australia, Austria, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA). Source: IEA energy efficiency indicators database.

TC: Temperature Corrected.

Indicators for the residential sector

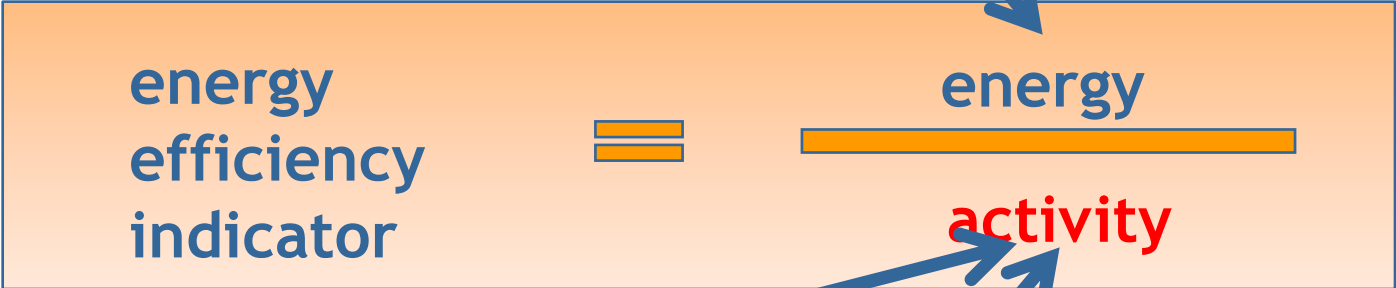


Indicators for the services sector



Indicators for the industry sector

For 19 major ISIC sub-sectors
(by fuel type)



Value added (\$)



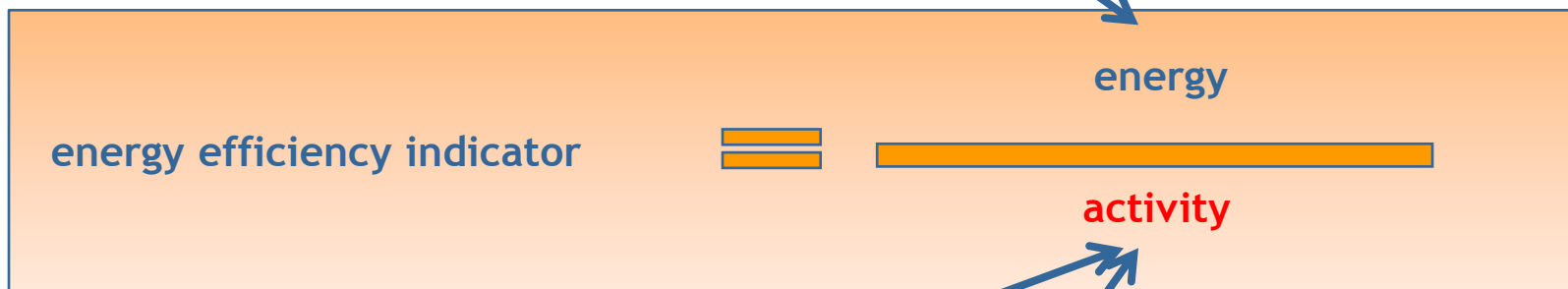
Physical production (t)



- Paper
- Chemicals
- Other non-metallic mineral
- Basic metals

Indicators for the transport sector

- By transport segment
passenger / freight
- By Transport modes
road, rail, air, water, etc.



Passenger-km or tonne-km



Vehicle stock



Distance travelled



Occupancy

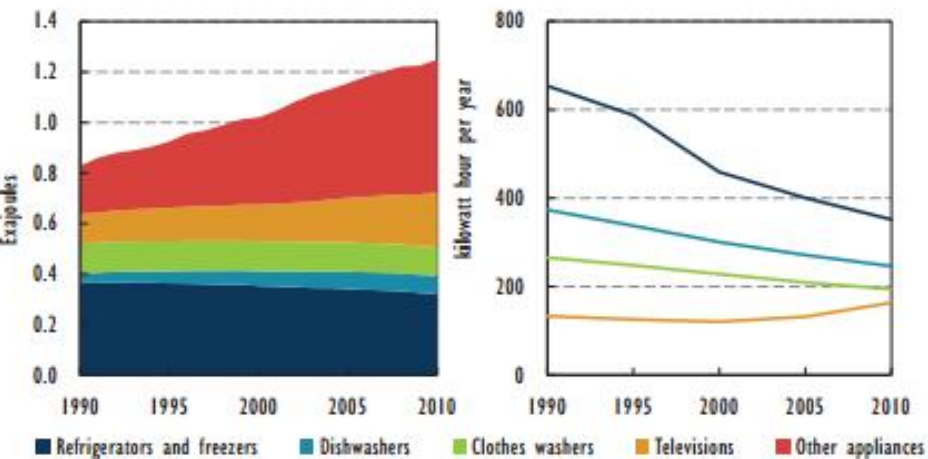


Load factor



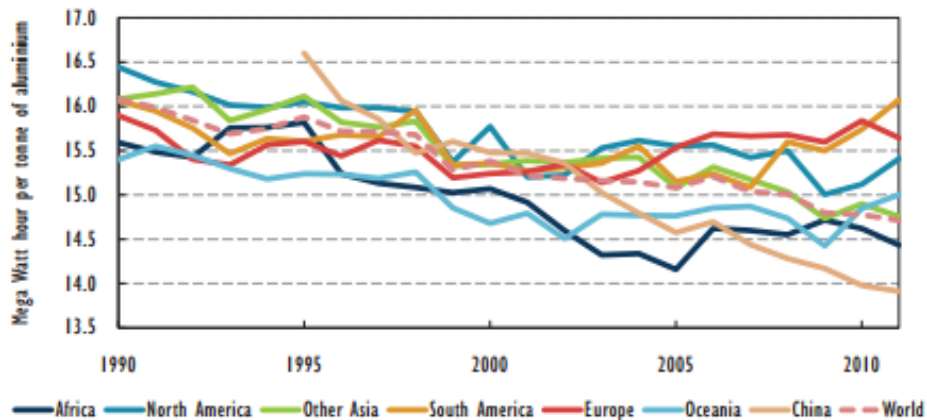
Examples of efficiency indicators across sectors

Figure 3.14 • Energy consumption for large and small appliances



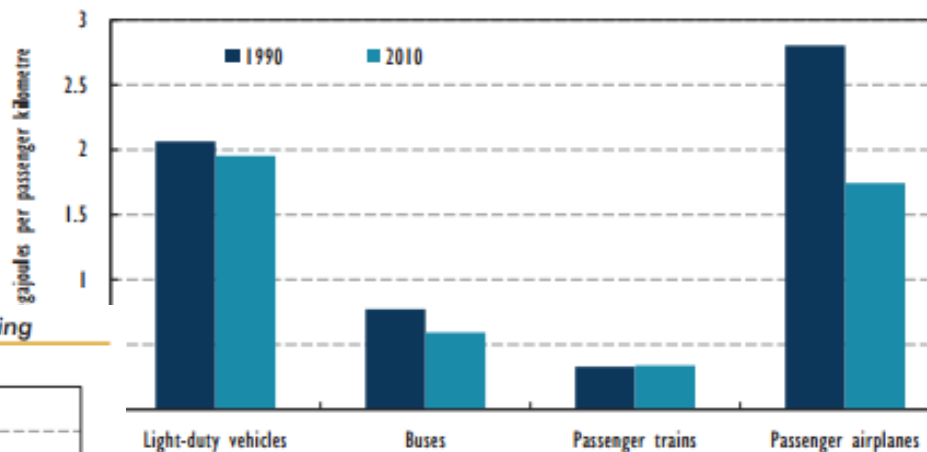
Note: Includes Australia, Austria, Canada, Denmark, France, Germany, Italy, Netherlands, Switzerland and United Kingdom data only.

Figure 5.12 • Regional specific electricity consumption in aluminium smelting



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

Figure 6.7 • Example of level 2 indicators for IEA15: energy consumption per passenger-kilometre by transportation mode





Need end-use information beyond the energy balance

India: Balances for 2012

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

2012	Indicators	Balances										
		Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
	Production	260524	43334	0	33338	8566	10821	3079	184892	0	0	544554
	Imports	90629	188880	15988	15590	0	0	0	0	412	0	311480
	Exports	-2144	0	-88144	0	0	0	0	0	0	0	-88258
	International marine bunkers***	0	0	0	0	0	0	0	0	0	0	-1224
	International aviation bunkers***	0	0	0	0	0	0	0	0	0	0	-3930
	Losses	0	0	0	0	0	0	0	0	0	0	5504
	Total final consumption	88329	0	148419	26190	0	0	0	184892	412	0	788126
	Industry	77135	0	18856	9072	0	0	0	0	0	0	259
	Transport	0	0	70342	1649	0	0	0	0	0	0	-5887
	Other	11194	0	36417	2641	0	0	0	0	0	0	0
	Residential	3041	0	23018	2486	0	0	0	0	0	0	0
	Commercial and public services	4109	0	1358	0	0	0	0	0	0	0	0
	Agriculture + forestry	0	0	9857	155	0	0	0	-11471	96971	0	-214197
	Fishing	0	0	0	0	0	0	0	0	0	0	0
	Non-specified	4045	0	2388	0	0	0	0	0	0	0	0
	Non-energy use	0	0	22805	12828	0	0	0	0	0	0	0

Residential: breakdown by end use

- space heating
- space cooling
- water heating
- lighting
- cooking
- appliances

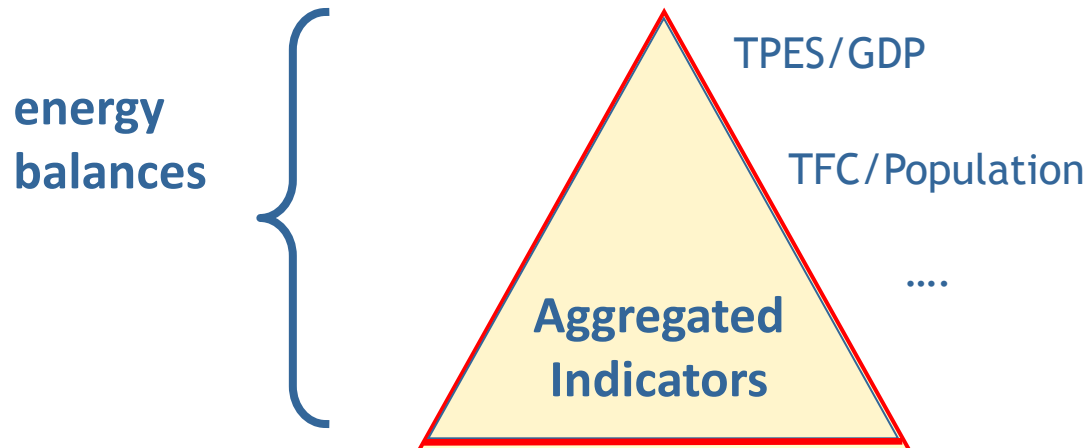
Transport: breakdown by segment - passenger / freight by vehicle type - Light duty vehicles / trucks,

Services: breakdown by end use

- space heating
- space cooling
- water heating
- lighting
- other equipment

by category (hotels,
restaurants, ...)

A pyramidal approach based on data availability



How to develop efficiency indicators at a national level?



1. Prioritise across sectors and sub-sectors

Figure 3.1 • Breakdown of total final consumption by sector for two hypothetical countries

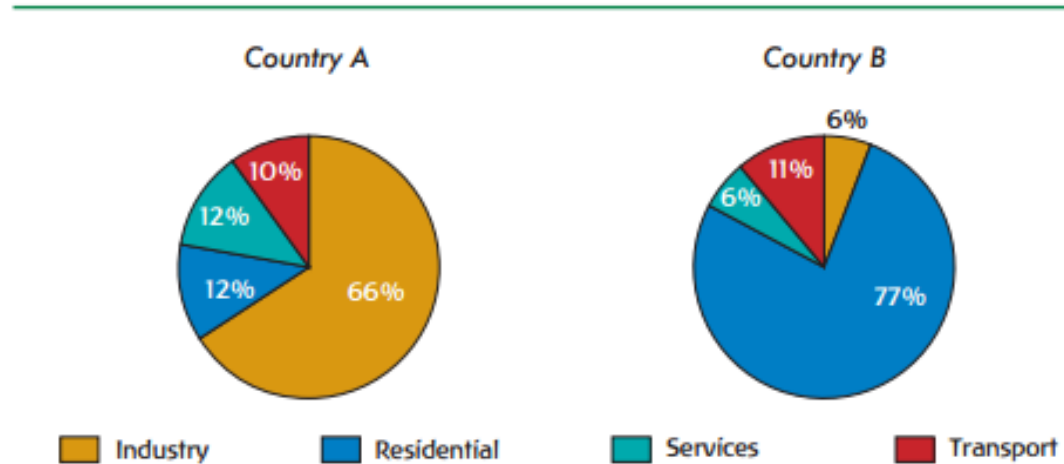
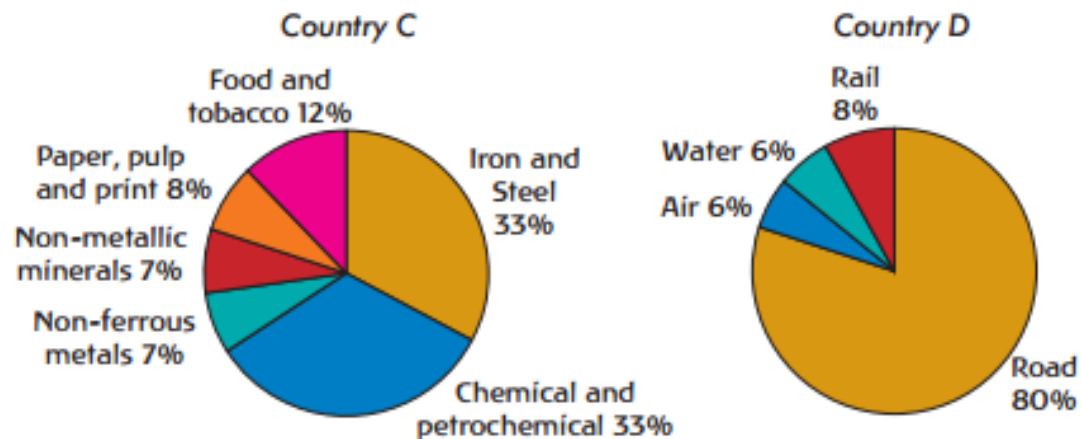


Figure 3.2 • Breakdown of industry and transport energy consumption by sub-sector for two hypothetical countries



For discussion

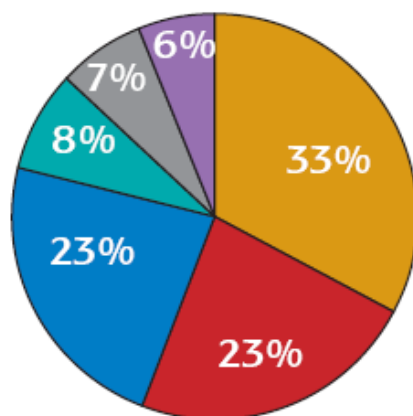
What is the largest energy-consuming sector in the world?

- Residential
- Transport
- Industry

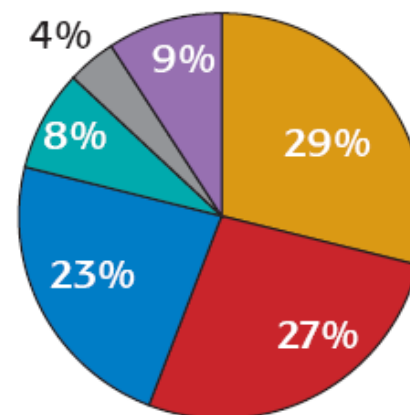


Global final consumption by sector

Figure 3.3 • Shares of sectors in total final consumption for the world (1973 and 2011)



Total: 4 674 Mtoe



Total: 8 918 Mtoe

Industry
 Transport
 Residential
 Services
 Other*
 Non-energy use

* Other includes agriculture/forestry, fishing, non-specified.

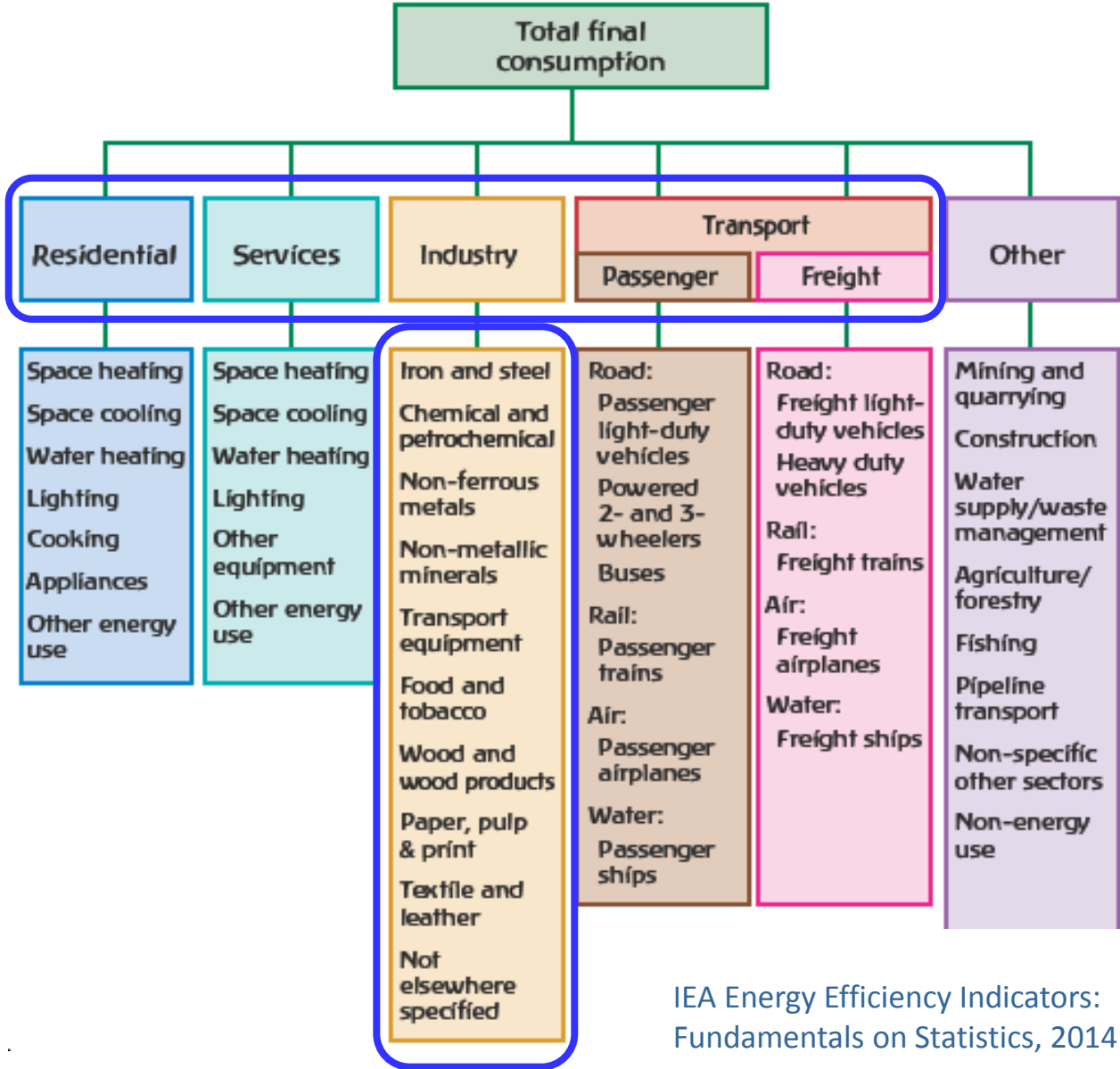
Note: unless otherwise indicated, all tables and figures in this chapter derive from IEA data and analysis.



2. Understand how energy is used across sectors

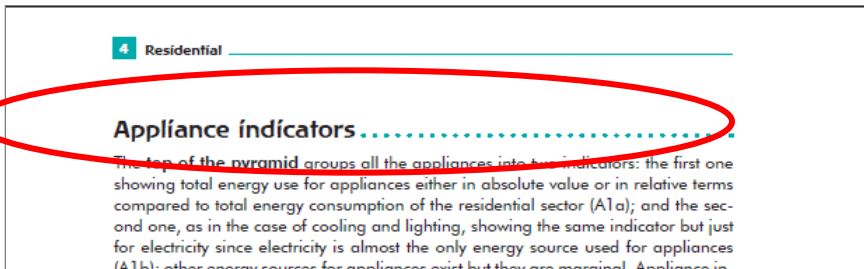
Available in
"energy balances"

Further data
needed



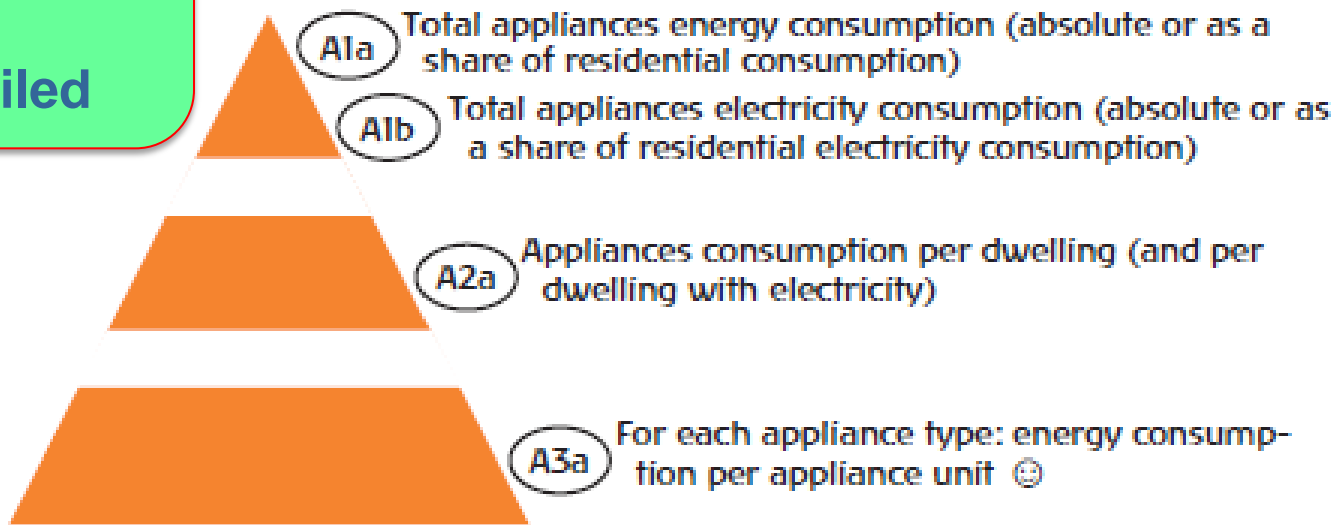
The need to map energy/activity data available at the end-use level

3. Identify preferred indicators based on feasibility and relevance



For each end use:
 1 – general
 2 – detailed
 3 – very detailed

Pyramid of residential appliances indicators



For each indicator of levels 2 and 3, the table gives the name, its coverage (overall or by specific type), the energy data and the activity data to be used. The column before the last gives the code number for the indicator and, when it applies, the last column highlights if the indicator is considered as the preferred indicator for a particular end-use.

4. Identify energy and activity data needed

Table 1 • Summary list of the most common indicators for households

Indicator	Coverage	Energy data	Activity data
Lighting consumption per dwelling	Overall	Total lighting consumption	Total number of dwellings
Lighting consumption per floor area	Overall	Total lighting consumption	Total floor area
Cooking consumption per household	Overall	Total cooking consumption	Total number of dwellings
	By energy source	Cooking consumption on energy source X	Number of dwellings on energy source X
Appliances consumption per dwelling	Overall	Total appliances consumption	Total number of dwellings
Appliances consumption per dwelling with electricity	Overall	Total appliances consumption	Total number of dwellings with electricity
Energy consumption per appliance unit	By appliance type	Energy consumption for all appliances type X	Number of appliances type X

...

Lighting

Cooking

Appliances

...

5. Exploring data sources and collection methods

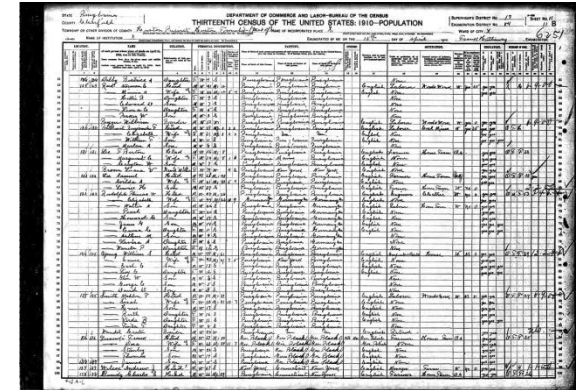
Table 7.3 • Summary of the main data needed for transport indicators and examples of possible sources and methodologies

Data	Source	Methodology
Energy data		
Total transport consumption	National energy balance National energy statistics	Administrative sources Modelling
Consumption by sub-sector	National energy balance National energy statistics	Administrative sources Mobility surveys Modelling
Consumption by segment		Mobility surveys Modelling
Consumption by vehicle type		Mobility surveys Modelling
Activity data		
GDP, population	National statistics offices	Administrative sources
Vehicle-km (vkm)	Vehicle registers/ Roadworthiness testing services/ Inspecting organisations Municipalities/Transport authorities National and international databases Transport ministries	Measurements: odometer readings Measurements: road traffic count Administrative sources Mobility surveys Modelling
Passenger-km (tkm)	Transport ministries	Mobility surveys
Tonne-km (tkm)	National and international databases	Administrative sources

Mapping existing sources of data: key

6. Collect the required data

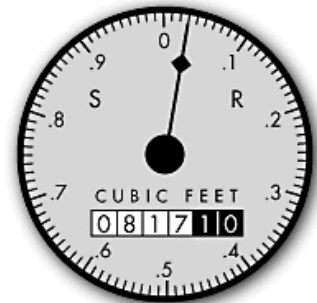
- Administrative sources



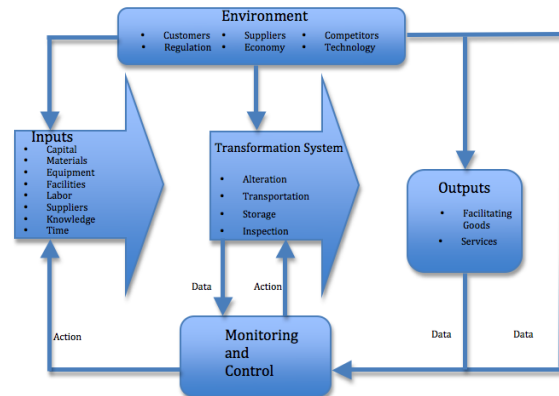
- Surveys



- Metering and measuring




- Modelling



Introducing the IEA tools on energy efficiency indicators



An internationally agreed data collection

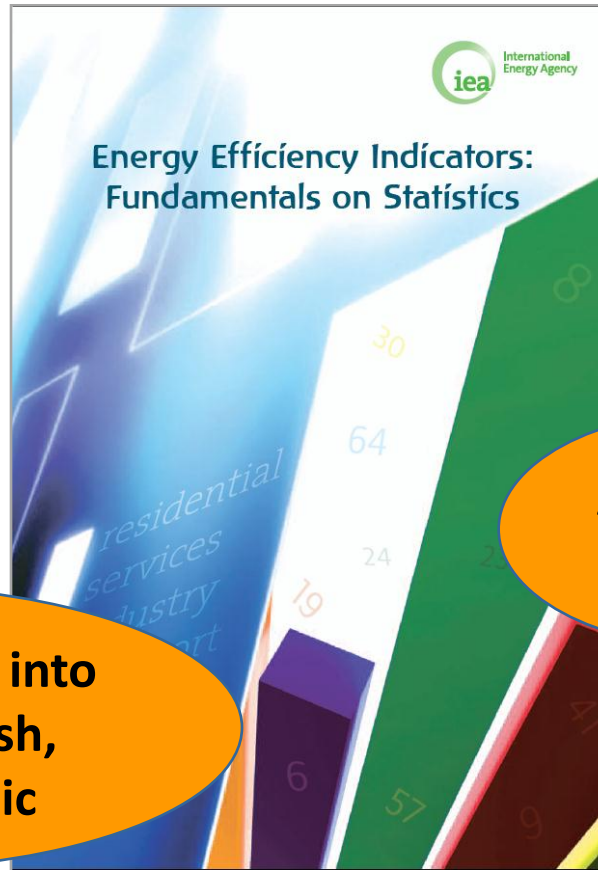
 Draft Energy Efficiency Indicators Template country name	
COUNTRY DATA SECTION (to be reviewed and updated)	
MACRO ECONOMIC DATA	Macro economic and activity data
COMMODITIES	Production outputs from selected energy-consuming industries
INDUSTRY	Energy consumption by ISIC categories
SERVICES	Energy consumption by end-uses in the services sector
RESIDENTIAL	Household energy consumption by end-uses and selected appliances data
TRANSPORT	Energy and activity data for passenger and freight transport
IEA DATA and AGGREGATE INDICATORS	
ELECTRICITY GENERATION	Electricity generation from combustion
BASIC INDICATORS	Predetermined set of aggregate indicators
SUPPORT TOOLS	
USER REMARKS	To incorporate comments associated with data
DATA COVERAGE	Generates a graphical summary of data coverage
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

Available online
Also in Spanish

<http://www.iea.org/statistics/topics/energyefficiency/>

As an answer to a request from IEA Ministers in 2009, the IEA designed a template to collect data for energy efficiency indicators.

A consistent methodological framework to present indicators, data and collection practices



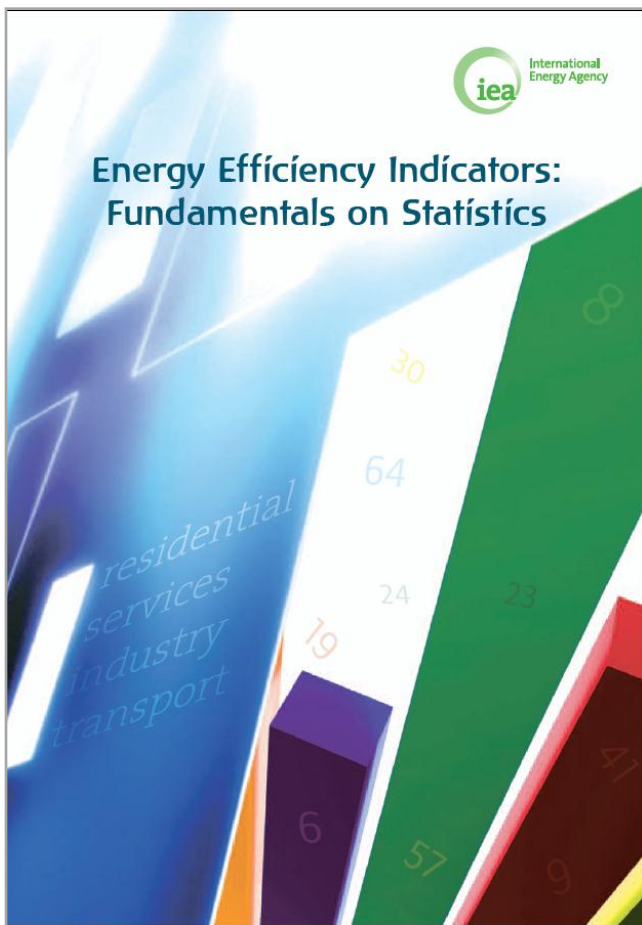
**Being translated into
Russian, Spanish,
Chinese, Arabic**

**Available
online**

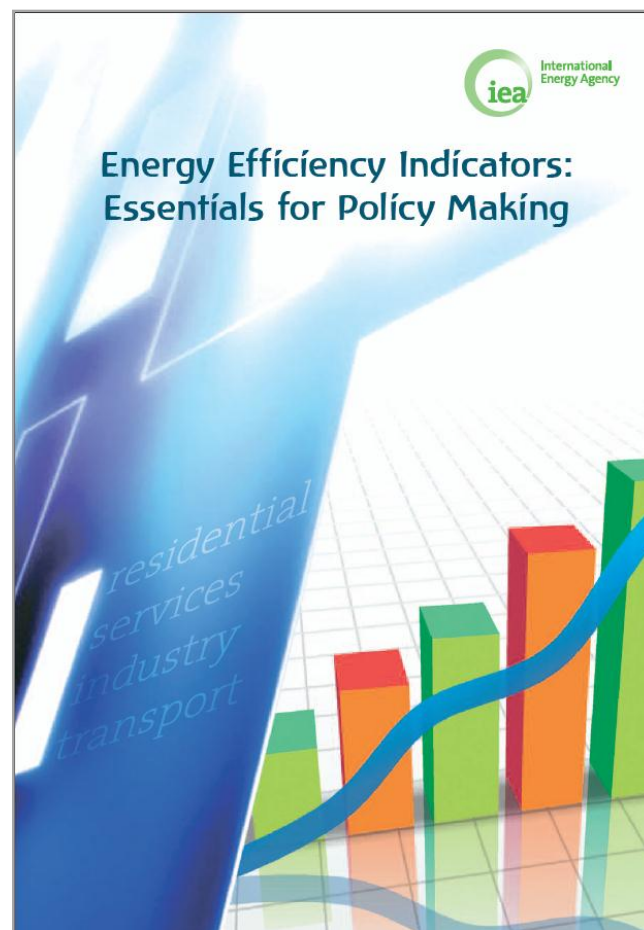
<http://bit.ly/eei-statistics>

**In response to requests from countries,
and in parallel with a manual on indicators analysis**

Sound data for sound analysis



<http://bit.ly/eei-statistics>



<http://bit.ly/eei-policy>



Data collection practices described online



International Energy Agency

Working together to ensure reliable, affordable and clean energy



- HOME
- ABOUT US
- TOPICS
- COUNTRIES
- NEWSROOM & EVENTS
- PUBLICATIONS
- STATISTICS

International Energy Agency > EE Indicators Manual

Energy Efficiency Indicators Statistics: Country Practices Database

- A supplement to the publication *Energy Efficiency Indicators: Fundamentals on Statistics*, this database presents practices on collection of data for developing efficiency indicators from a variety of OECD and non-OECD countries.
- Practices are searchable by country, sector, methodology and type of available documentation. By sharing these experiences, we hope to help countries and organisations to develop their own energy efficiency indicators programmes.

Countries	Sector	Methodology	Available content	Search by keywords
<input type="checkbox"/> Israel <input type="checkbox"/> Italy <input type="checkbox"/> Japan <input type="checkbox"/> Kazakhstan <input type="checkbox"/> Korea, Republic of <input type="checkbox"/> Mexico <input type="checkbox"/> Netherlands <input type="checkbox"/> New Zealand <input type="checkbox"/> Norway <input type="checkbox"/> Portugal <input type="checkbox"/> Romania	<input type="checkbox"/> Industry <input type="checkbox"/> Residential <input type="checkbox"/> Services <input type="checkbox"/> Transport	<input type="checkbox"/> Administrative sources <input type="checkbox"/> Measuring <input type="checkbox"/> Modelling <input type="checkbox"/> Surveying	<input type="checkbox"/> methodology <input type="checkbox"/> project web site <input type="checkbox"/> questionnaire <input type="checkbox"/> report <input type="checkbox"/> results	<input type="text"/>

A searchable database:
<http://www.iea.org/eeindicatorsmanual>

Energy intensity: a case study



Case study: understanding economic intensities across sectors

<i>Sectors of the economy</i>	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, and hot water supply	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. Has any subsector decreased its intensity ?

<i>Sectors of the economy</i>	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%

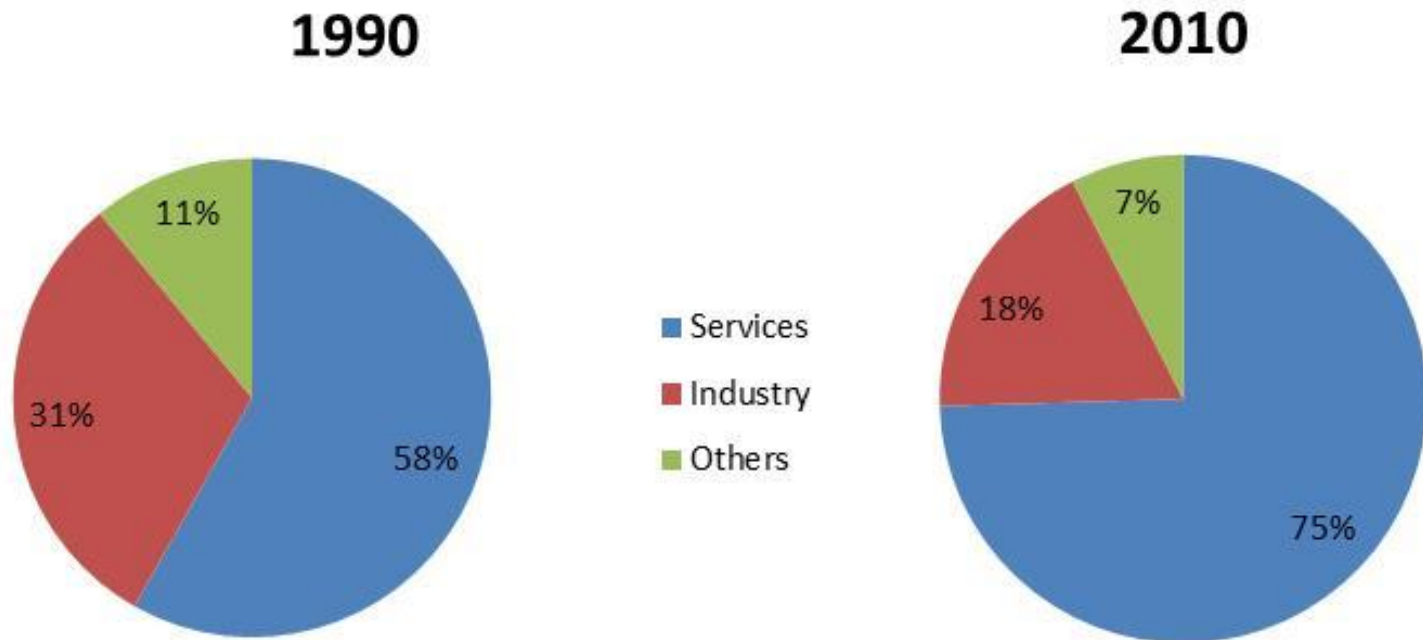
Case study: understanding intensities across sectors

Q3. 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

Q3. What is the reason for the trend in total intensity?



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

Thank you

Energyindicators@iea.org

www.iea.org

The IEA logo consists of a large, semi-transparent blue circle. Inside this circle, the letters "iea" are written in a bold, lowercase, sans-serif font. The "i" has a white dot. The "e" and "a" are blue, matching the outer circle. The background of the slide is a blurred, abstract pattern of blue and green colors.

iea