International Energy Agency

Energy Efficiency Training Week

Indicators and Evaluation

Charles Michaelis, Mafalda Silva and Fabian Voswinkel

2nd – 6th May 2022

Most memorable learning point from yesterday

- Please go to www.menti.com and enter the following code

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Mentimeter

What did we learn yesterday?

- Indicators are necessary to monitor how a policy is being implemented and the effects that it is having

$$Energy\ efficiency\ indicator\ = \frac{Energy\ consumption\ (by\ fuel\ or\ as\ a\ total)}{Activity\ (by\ end\ use)}$$

- Evaluation is an objective process of understanding how a policy or programme was implemented, what effects it had, for whom and why.
- Monitoring and evaluation are key elements of the policy making process
- Theories of change are core to monitoring and evaluation
- Gender Equality and Social Inclusion (GESI) should be considered at all stages of policy development, monitoring and evaluation

Any questions?

Overview of day 3

- Energy balances as the basis for efficiency indicators
- The importance of energy efficiency Indicators
- IEA energy efficiency indicators methodologies
- Data collection tips
- Monitoring of policy effects by other factors - GESI

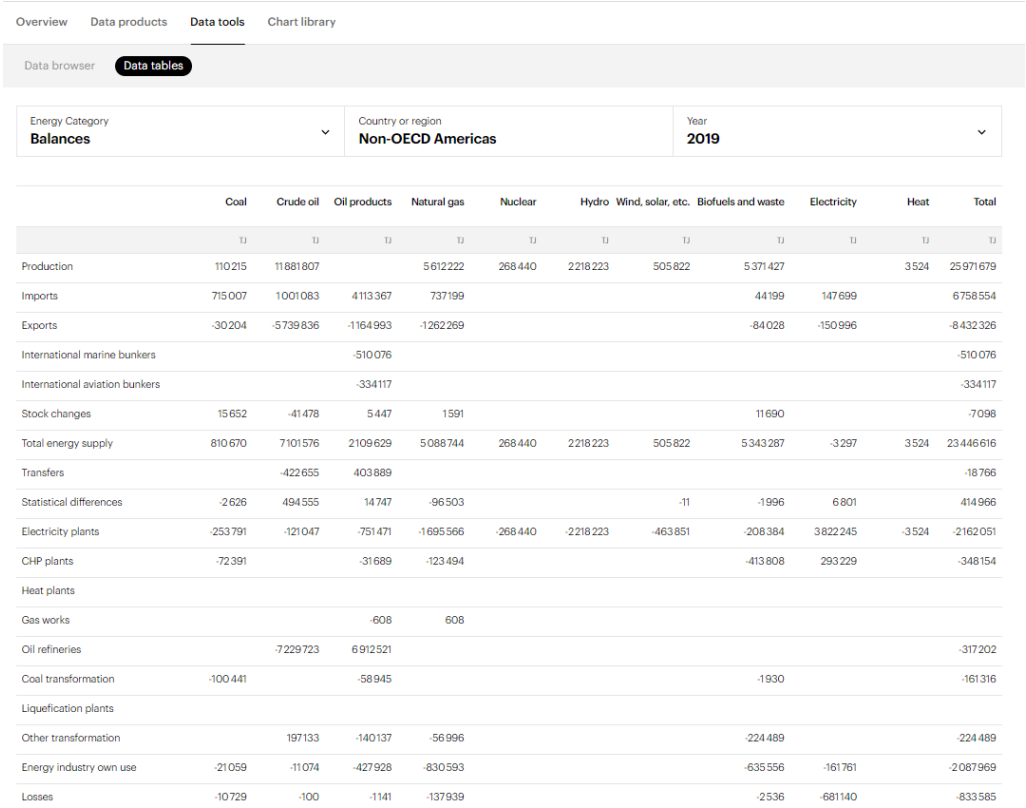
- Networking tables
- End of day check in

Energy balances
as the basis for efficiency indicators

Energy balances: the basis of energy statistics

*"… An accounting **framework** for compilation of data on **all energy products entering, exiting, and used** within the **national territory** of a given **country** during a reference period."*

Source: International Recommendations on Energy Statistics (IRES), UNSD, 2011



Overview | Data products | Data tools | Chart library

Data browser | Data tables

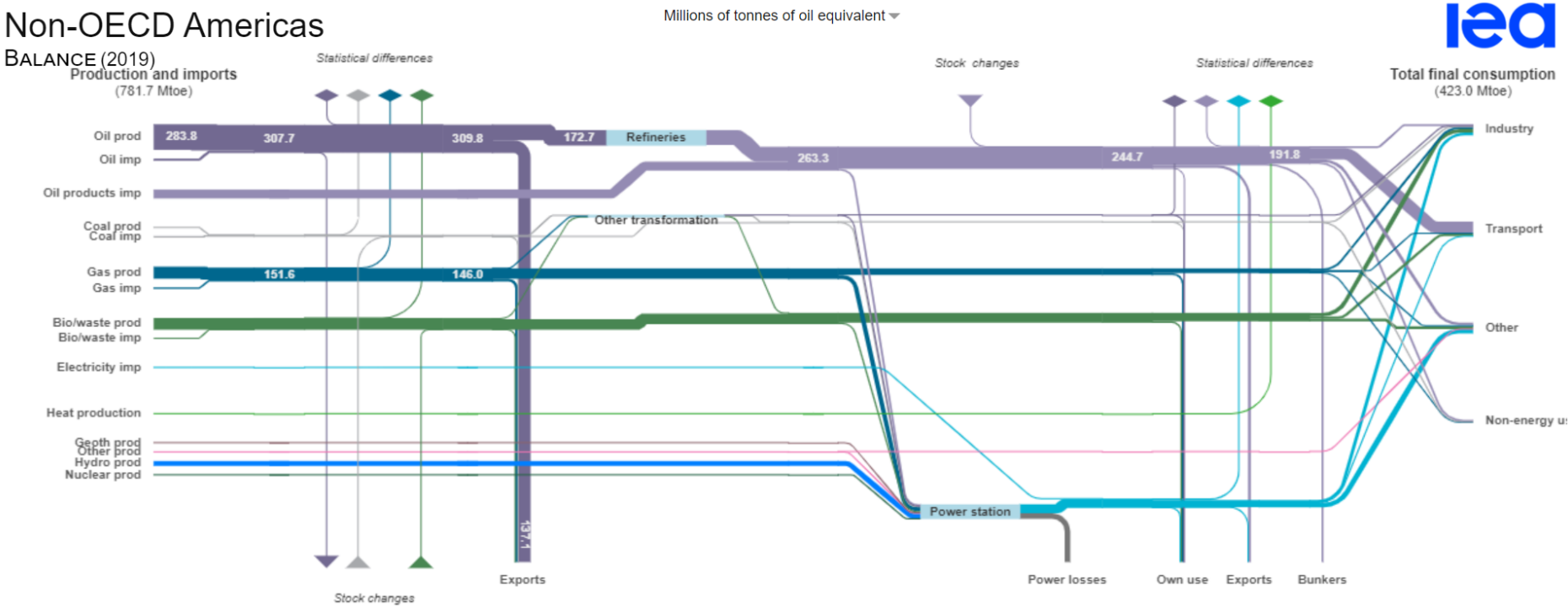
Energy Category: Balances

Country or region: Non-OECD Americas

Year: 2019

	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste	Electricity	Heat	Total
	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ
Production	110215	11881807		5612222	268440	2218223	505822	5371427		3524	25971679
Imports	715007	1001083	4113367	737199				44199	147699		6758554
Exports	-30204	-5739836	-1164993	-1262269				-84028	-150996		-8432326
International marine bunkers			-510076								-510076
International aviation bunkers			-334117								-334117
Stock changes	15652	-41478	5447	1591				11690			-7098
Total energy supply	810670	7101576	2109629	5088744	268440	2218223	505822	5343287	-3297	3524	23446616
Transfers		-422655	403889								-18766
Statistical differences	-2626	494555	14747	-96503			-11	-1996	6801		414966
Electricity plants	-253791	-121047	-751471	-1695566	-268440	-2218223	-463851	-208384	3822245	-3524	-2162051
CHP plants	-72391		-31689	-123494				-413808	293229		-348154
Heat plants											
Gas works			-608	608							
Oil refineries		-7229723	6912521								-317202
Coal transformation	-100441		-58945					-1930			-161316
Liquefication plants											
Other transformation		197133	-140137	-56996				-224489			-224489
Energy industry own use	-21059	-11074	-427928	-830593				-635556	-161761		-2087969
Losses	-10729	-100	-1141	-137939				-2536	-681140		-833585

The complete picture – Sankey diagram



Sankey diagrams allow to quickly grasp insights from an energy balance

Why to develop energy balances?

- **To understand overall energy use in country,** from supply, to transformation and final consumption sectors.

- **To develop high-level indicators**

- **To estimate CO_2 emissions** from energy use

At present, most of world countries develop national energy balances

Aggregated indicators derived from the energy balances

Supply

Transformation

Final consumption

World

2019

Million tonnes of oil equivalent

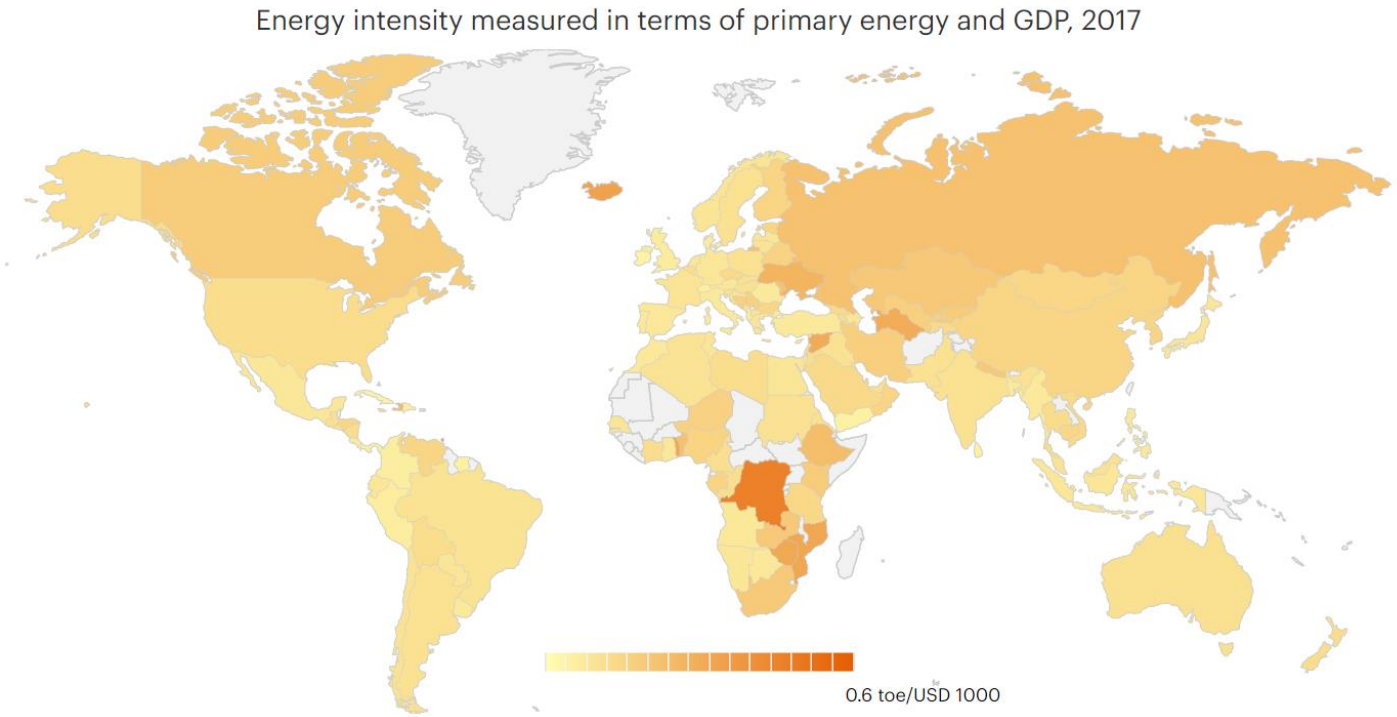
SUPPLY AND CONSUMPTION	Coal[1]	Crude oil[2]	Oil products	Natural gas	Nuclear	Hydro	Geotherm./ Solar/ etc.	Biofuels/ Waste	Electricity	Heat	Total
Production	3657.19	4473.27	-	3032.41	679.65	349.22					
Imports	795.23	2379.32	1329.40	915.52	-	-					
Exports	-833.43	-2354.63	-1414.63	-932.53	-	-					
Stock changes	111.90	-15.32	-7.21	19.55	-	-					
TPES	**3730.89**	**4482.63**	**-92.43**	**3034.95**	**679.65**	**349.22**					
Transfers	-1.36	-233.00	262.09	-	-	-	-	-	-	-	27.73
Statistical differences	28.63	11.25	14.35	-11.26	-	-	0.09	0.84	-1.14	-0.35	42.41
Electricity plants	-1672.04	-40.48	-178.55	-868.18	-672.06	-349.22	-177.96	-120.97	1811.30	-0.72	-2268.88
CHP plants	-623.84	-0.01	-17.99	-314.57	-7.59	-	-2.56	-60.58	335.99	239.30	-451.86
Heat plants	-23.38	-0.83	-10.95	-61.70	-	-					
Blast furnaces	-207.69	-	-0.05	-0.01	-	-					
Gas works	-13.32	-	-2.17	5.42	-	-					
Coke/pat.fuel/BKB/PB plants	-89.82	-	-2.32	-0.03	-	-					
Oil refineries	-	-4246.76	4165.65	-	-	-					
Petrochemical plants	-	35.90	-35.37	-	-	-	-	-	-	-	0.53
Liquefaction plants	-12.08	15.16	-	-16.47	-	-	-	-	-	-	-13.40
Other transformation	-0.30	10.75	-0.54	-13.01	-	-	-	-90.54	-	-0.68	-94.32
Energy industry own use	-75.28	-11.24	-208.00	-296.17	-	-	-0.00	-13.46	-181.96	-36.50	-822.61
Losses	-4.91	-8.69	-0.47	-18.71	-	-	-0.01	-0.14	-169.65	-22.26	-224.84
TFC	**1035.50**	**14.68**	**3893.25**	**1440.26**	**-**	**-**	**43.63**	**1050.88**	**1793.94**	**283.18**	**9555.32**
Industry	826.95	6.66	299.71	537.77	-	-	0.92	198.33	746.69	135.57	2752.60
Transport	0.07	0.01	2533.20	101.89	-	-					
Residential	72.73	-	209.30	431.24	-	-					
Services	33.90	-	85.72	187.45	-	-					
Agriculture/Forestry	16.08	0.01	104.20	9.66	-	-					
Fishing	0.00	-	5.68	0.06	-	-					
Non-specified other	30.08	0.01	18.27	3.42	-	-					
Non-energy use	55.70	8.00	637.17	168.78	-	-	-	-	-	-	869.64

Energy intensity, Self-sufficiency …

Efficiencies of transformation sector

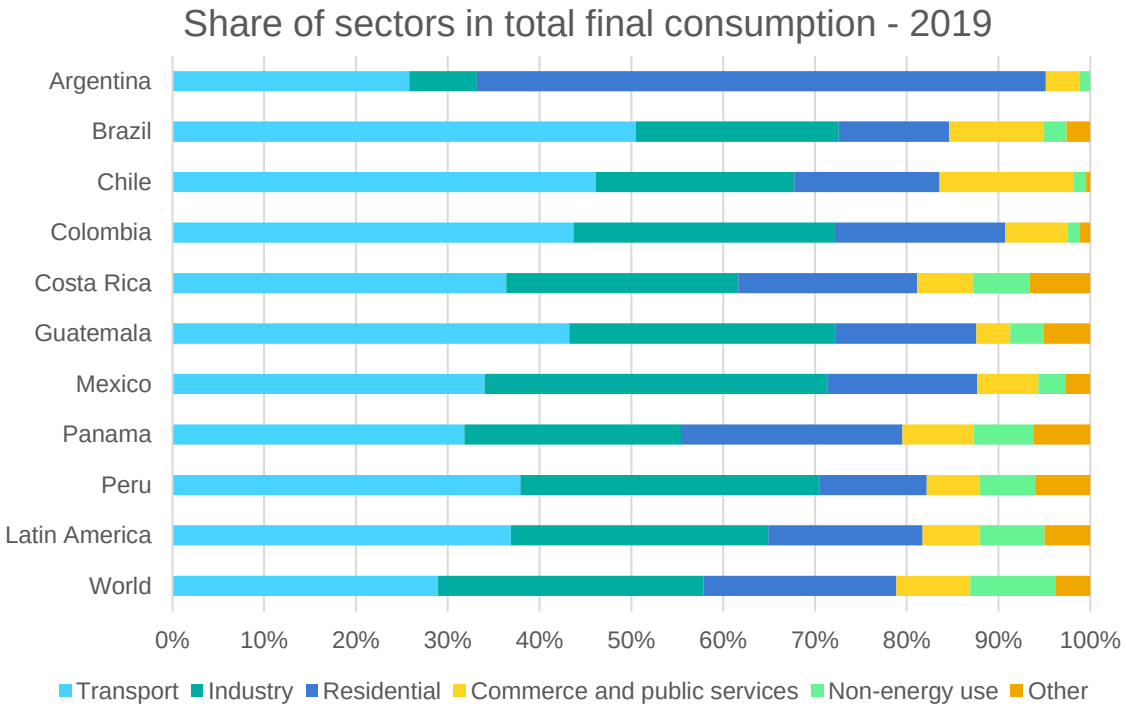
Shares of energy consumption by sector

Tracking SDG 7.3 at global level



Energy (TES) per unit of GDP

…understand the shares of sectors in total final consumption



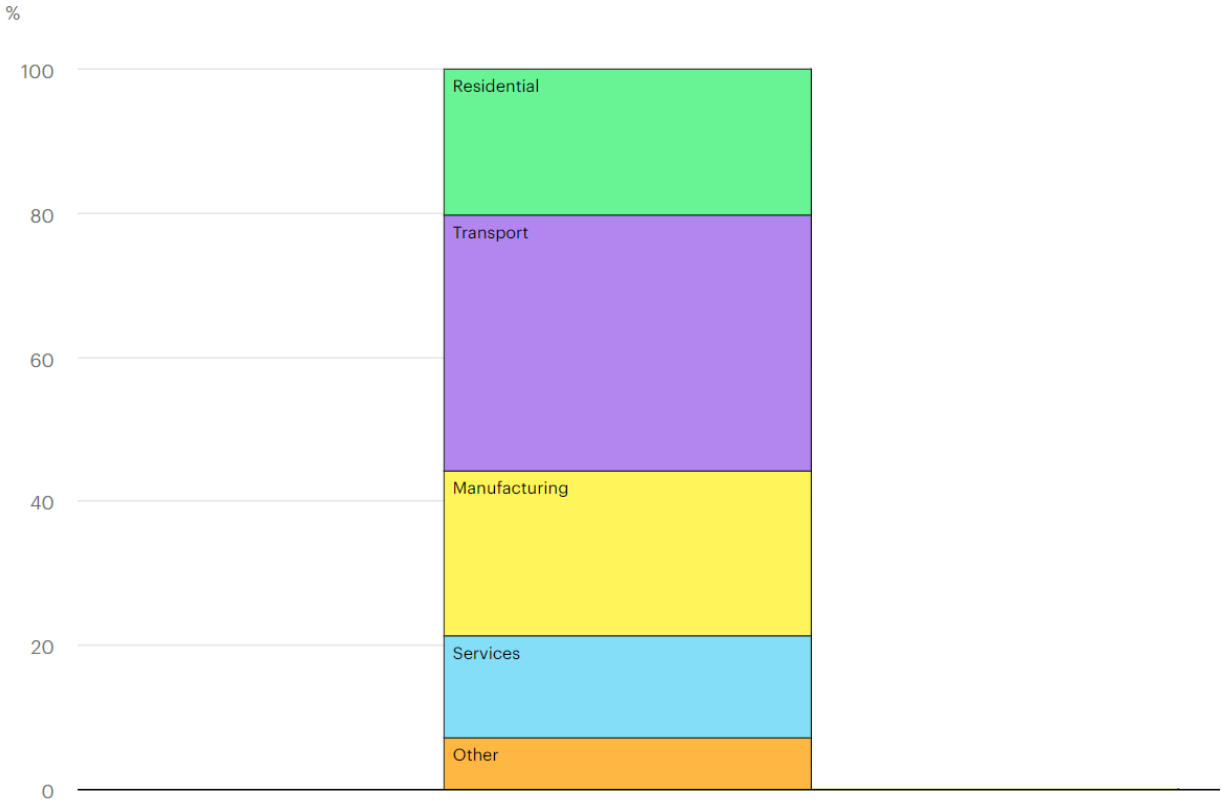
** Total Final Consumption excluding non-energy uses*

Source, IEA World Energy Balances, 2021

Key to understand where energy is used and to define policy priorities

What is it that balances don't tell us?

Largest end uses of energy by sector, selected IEA countries, 2019

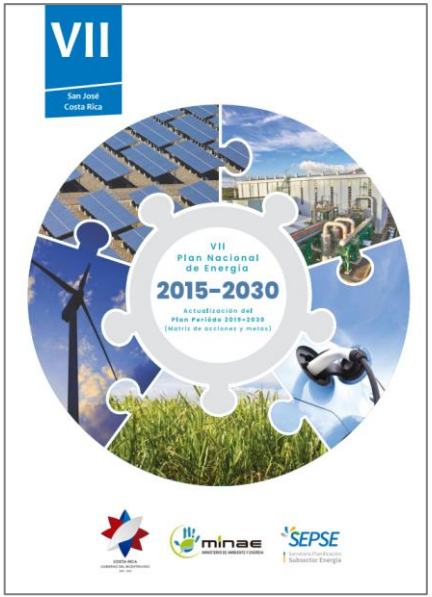


Source
IEA Energy
Efficiency Indicators

The importance of energy efficiency indicators

Why are indicators important?

https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/transporte-rodoviario-de-cargas-no-brasil-benchmarking-internacional

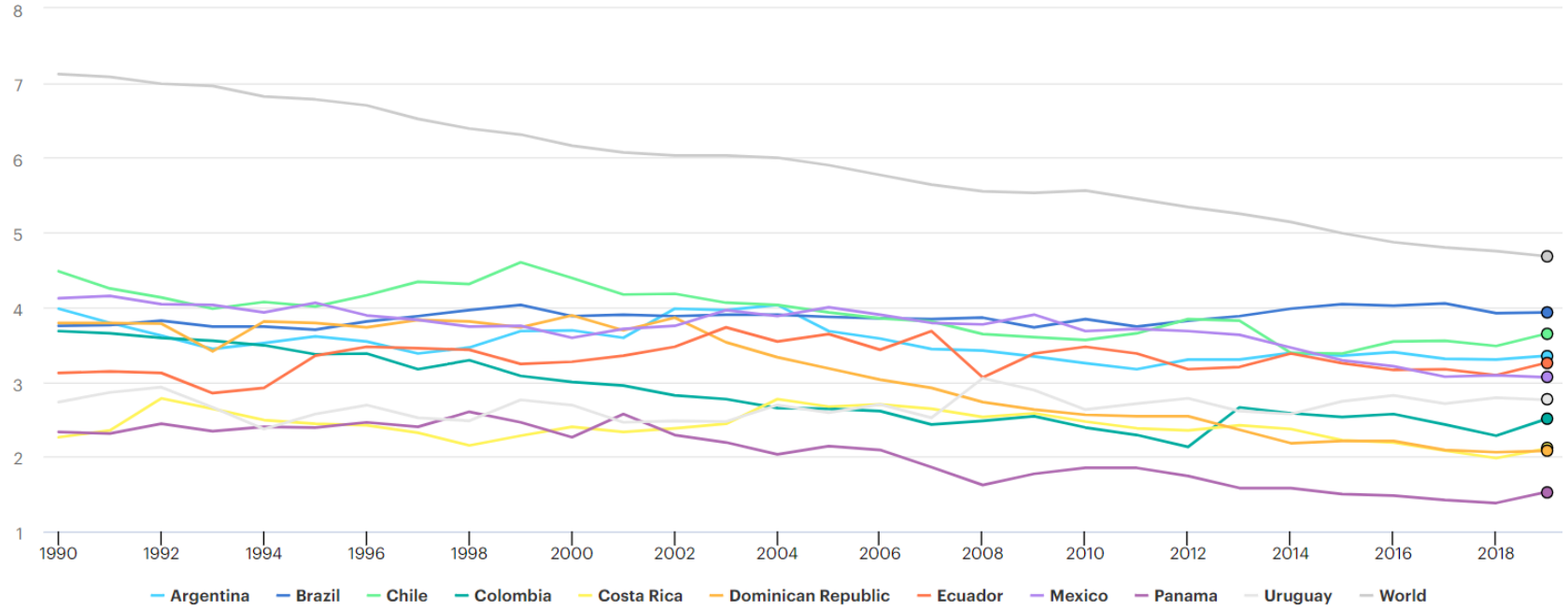


https://sepse.go.cr/wp-content/uploads/2020/06/PLAN-NACIONAL-DE-ENERGIA-JUNIO-FINAL-.pdf

https://energia.gob.cl/sites/default/files/documentos/plan_nacional_de_eficiencia_energetica_2022-2026.pdf

Indicators help understand if a country is on track to meet their targets

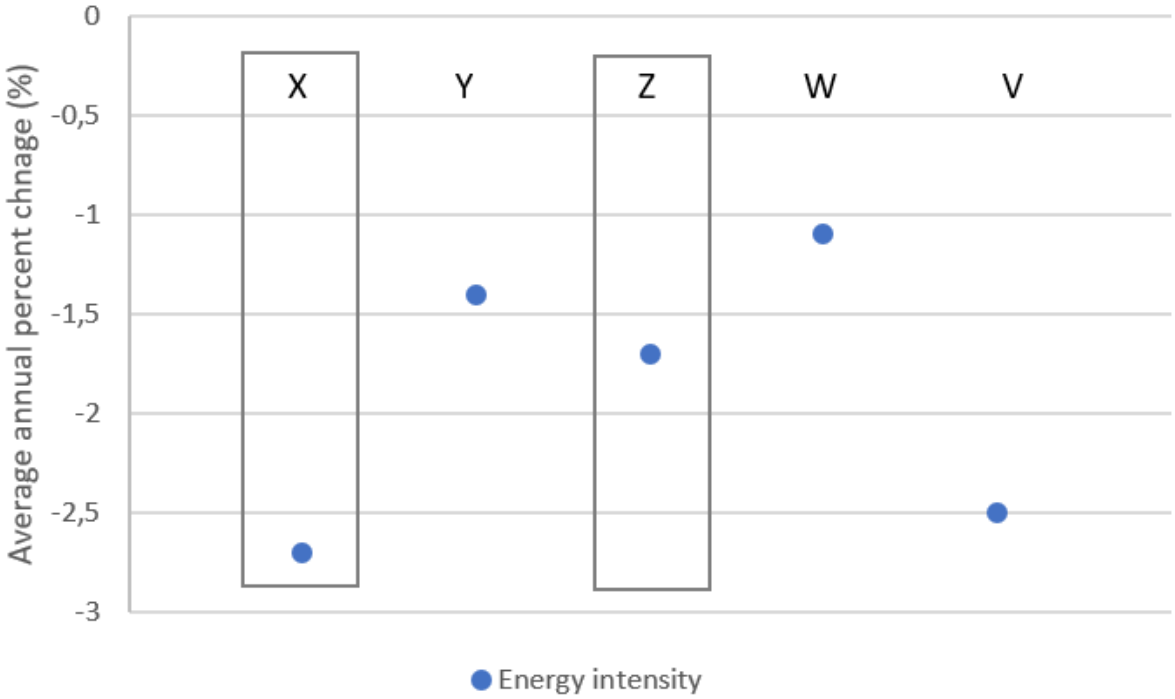
What drives energy intensity trends?



Efficiency progress but also other factors (mainly activity /structural changes)

Source: IEA World energy balances and UNSD

Aggregated Indicators may be misleading



Intensity decreased more in country X

Now it’s on you!

- Please go to www.menti.com and enter the following code

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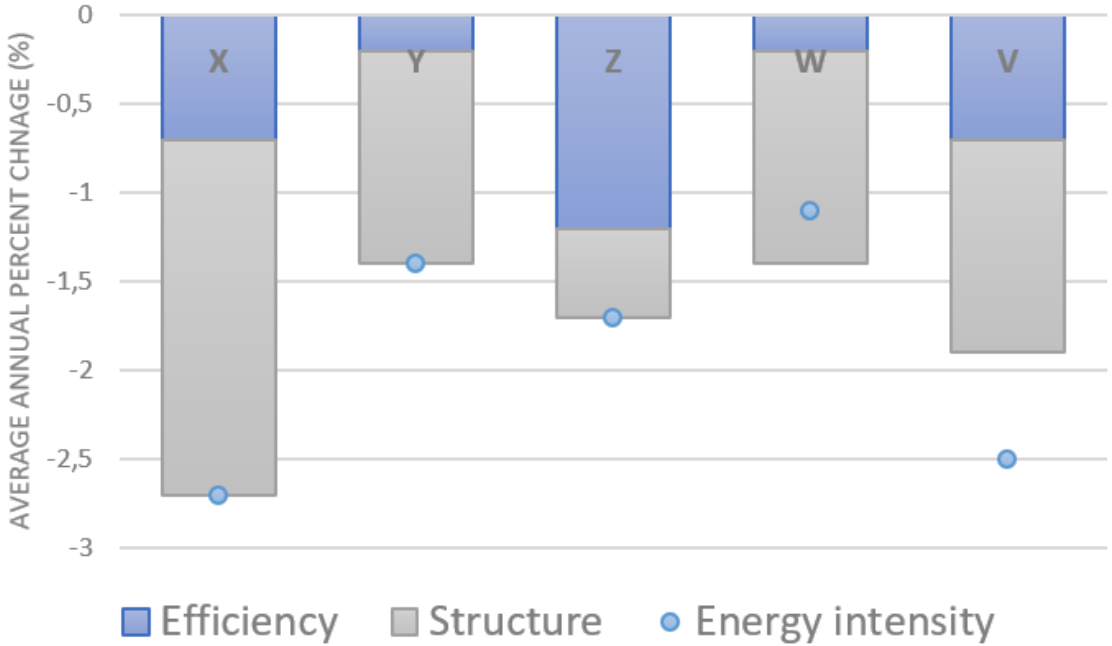
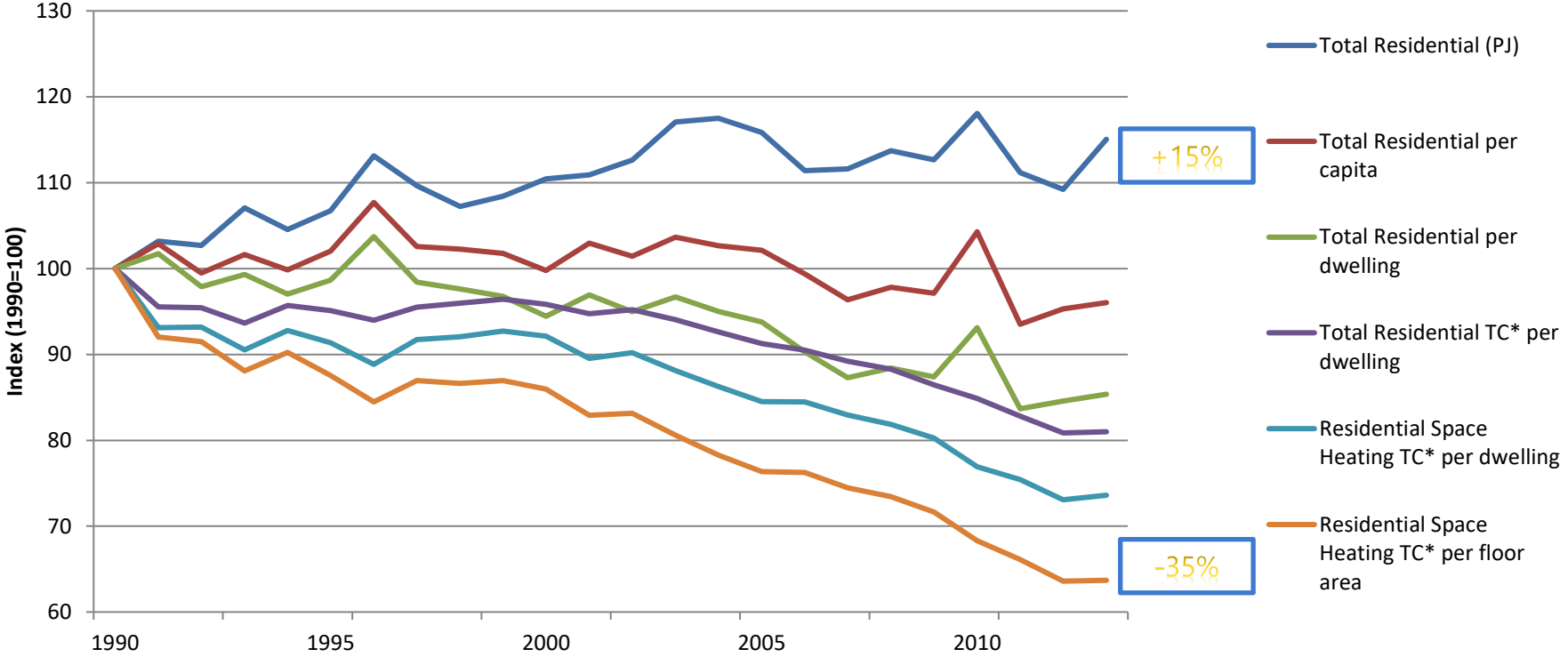
Aggregated Indicators may be misleading



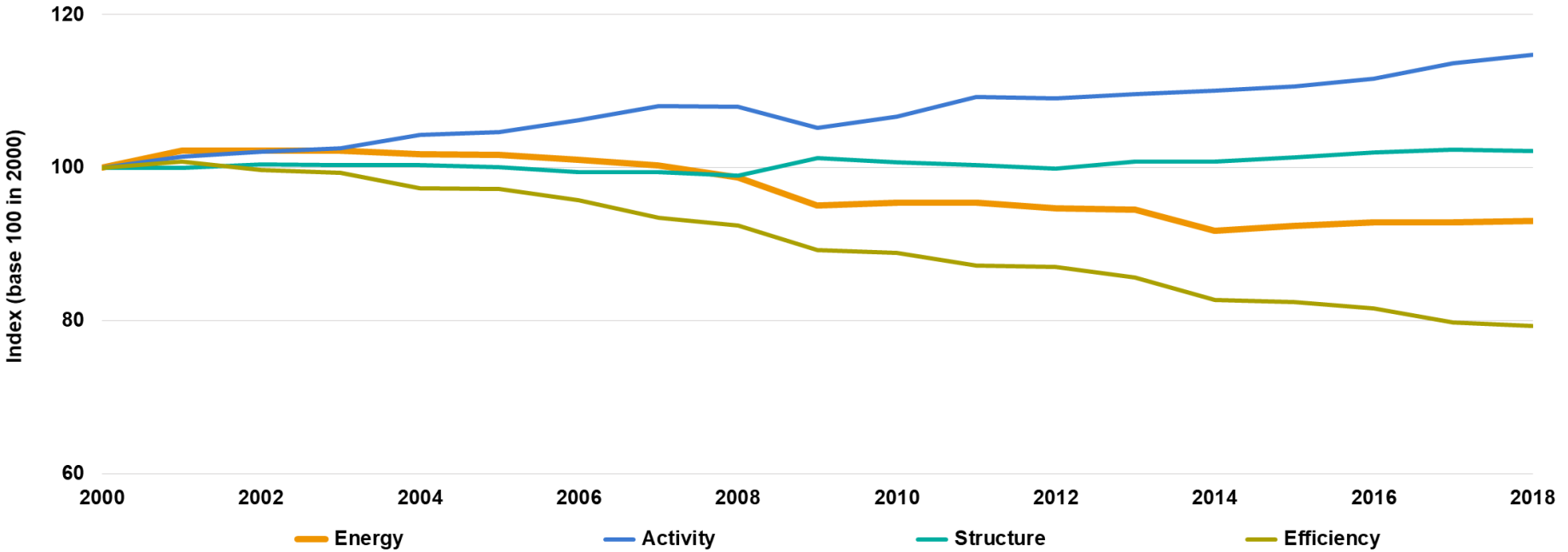
Country X intensity reduction was mostly due to structural changes, while country Y improved more in energy efficiency.

Appropriate indicators can help uncover important trends



Data for IEA 20 (Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA).
* Temperature correction using heating degree days
Data source: IEA, *Energy efficiency indicators, All rights reserved.*

Disentangling efficiency from other drivers

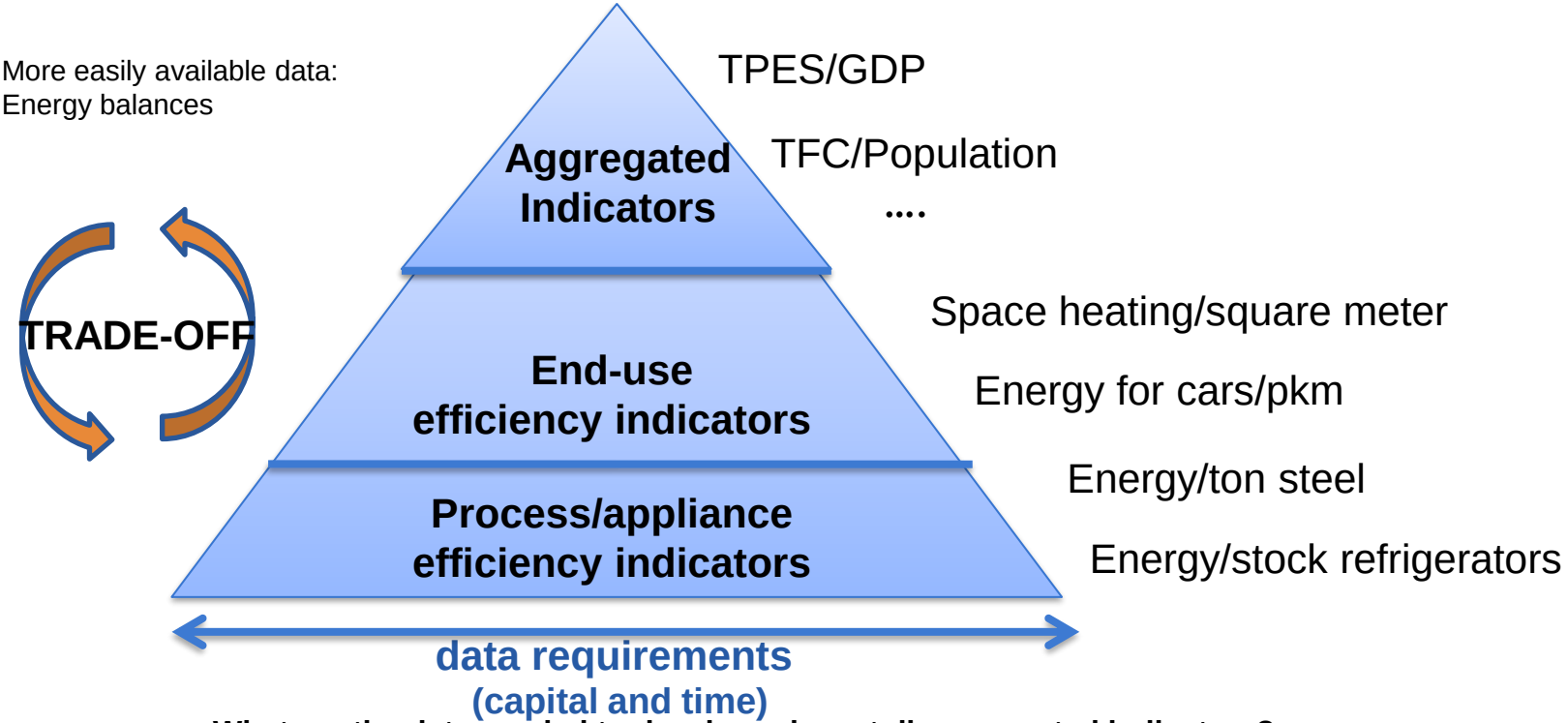


Source: IEA (2021), *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

IEA Energy Efficiency Indicators methodologies

Energy efficiency indicators: stronger data requirements

More easily available data:
Energy balances

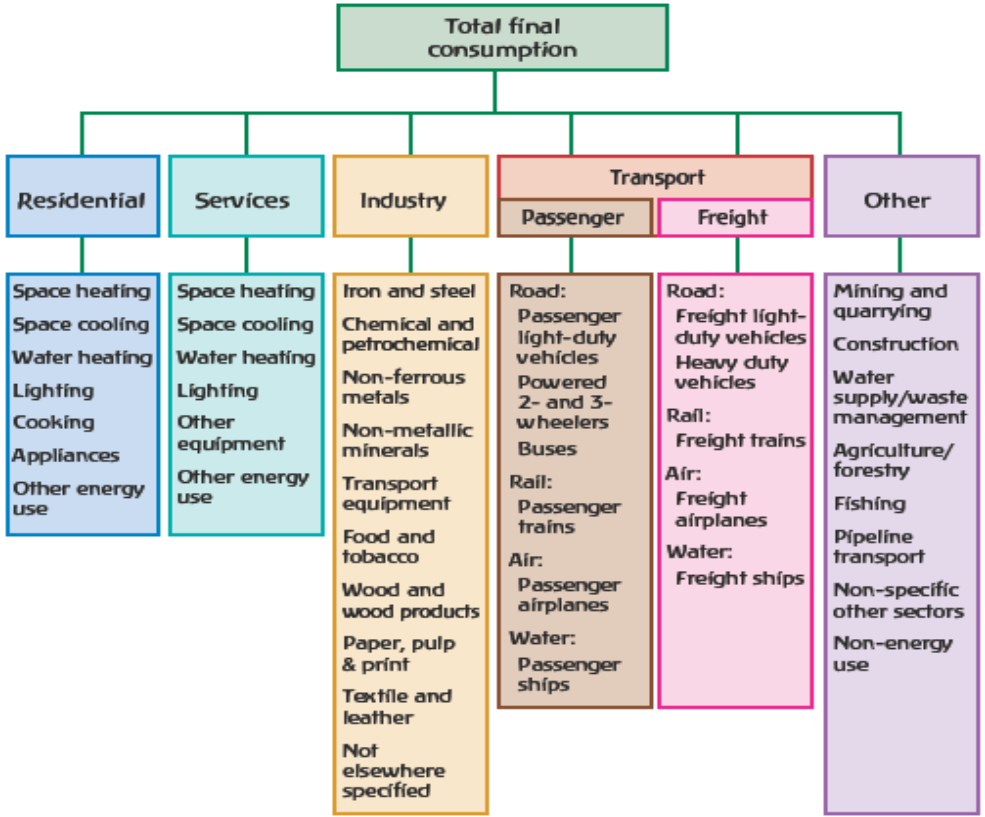


What are the data needed to develop relevant disaggregated indicators?

Understanding end uses across sectors

Energy balances: Sectoral consumption

Energy efficiency: End-use consumption



How to develop energy efficiency indicators?

$$Energy\ efficiency\ indicator\ = \frac{Energy\ consumption\ (by\ fuel\ or\ as\ a\ total)}{Activity\ (by\ end\ use)}$$

A given indicator explains how much energy is needed to provide a certain service

Data and indicators for the residential sector

Energy consumption data:

- Space heating*
- Space cooling*
- Water heating
- Cooking
- Lighting
- Appliances energy consumption:
  - Refrigerator
  - Freezer
  - Dishwasher
  - Clothes washer
  - Clothes dryer
  - TV
  - Computers

* Temperature corrected, using HDD & CDD

Activity data:

- Population
- Number of occupied dwellings
- Residential floor area
- Appliances stock and diffusion

 # of people

# of dwellings

Surface

# of appliances

Now it’s on you!

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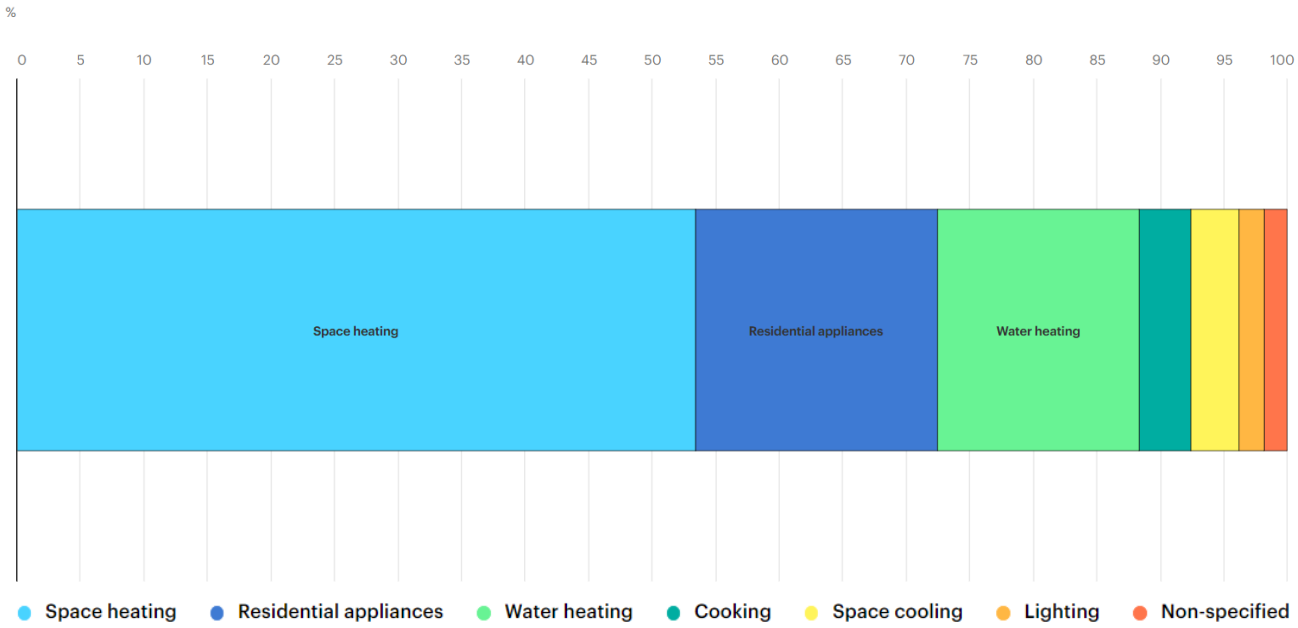
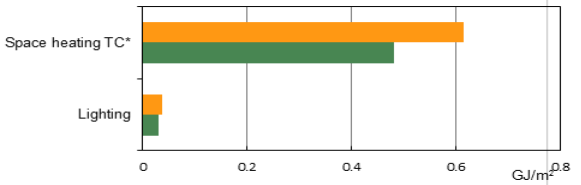
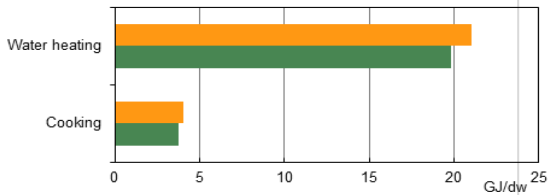
Mentimeter

Examples for the residential sector







Source: IEA (2021), *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

Services

Energy consumption data

By end uses:

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

- Temperature corrected, using HDD & CDD

By ISIC sub-sectors:

- Sewerage, waste collection and remediation activities
- Wholesale and retail trade
- Warehousing, support activities for transportation, postal services
- Accommodation and food services
- Information and communication
- Financial, insurance, real estate, scientific, and administrative activities
- Public administration, excluding defense [ISIC 8422]
- Education
- Health and social work
- Arts, entertainment and recreation
- Other services activities

Activity data:

- Value added
- Service floor area
- Number of employees

Value added

Surface

# of employees

Data and indicators for the industry sector

Energy consumption data

(major ISIC sub-sectors):

- Chemical
- Iron and steel
- Non-ferrous metals
  - Aluminum
- Non-metallic minerals
  - Cement
  - Clinker
- Pulp and paper
  - Pulp
  - Paper
- .... etc.

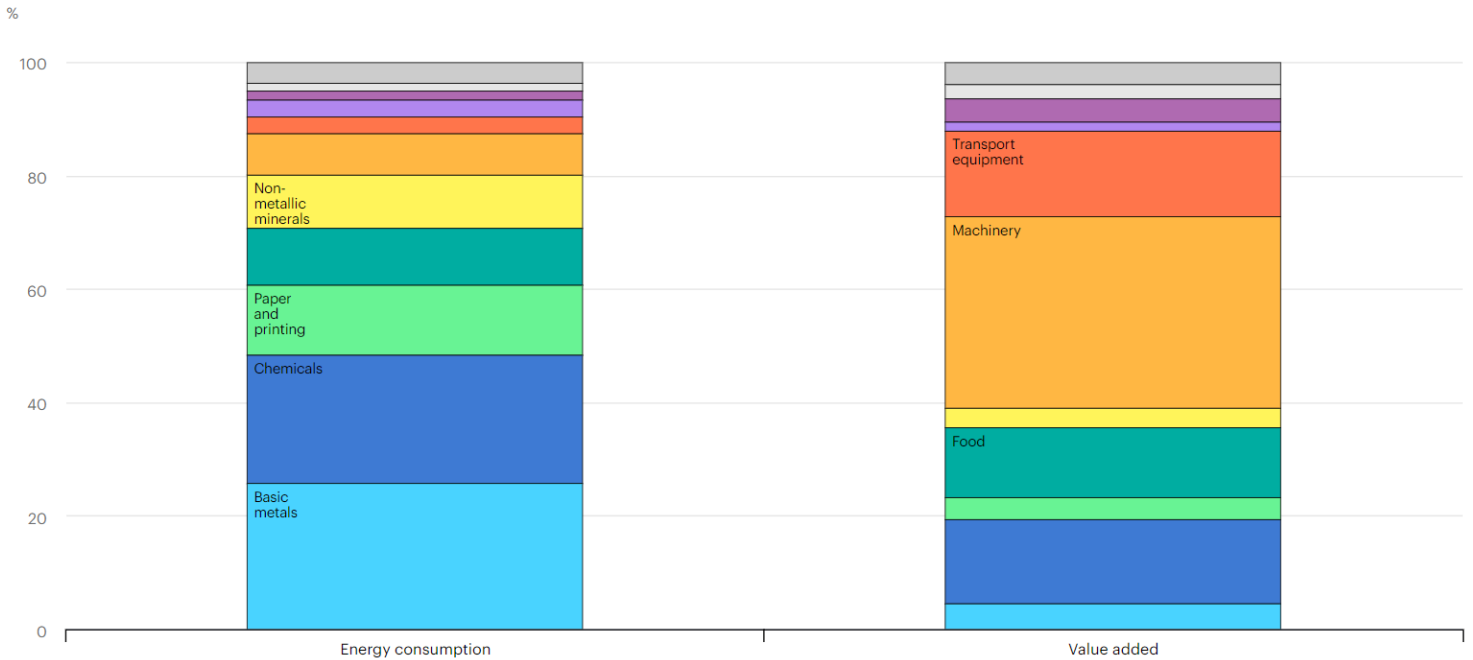
Activity data:

- Value added
- Physical production

Value added

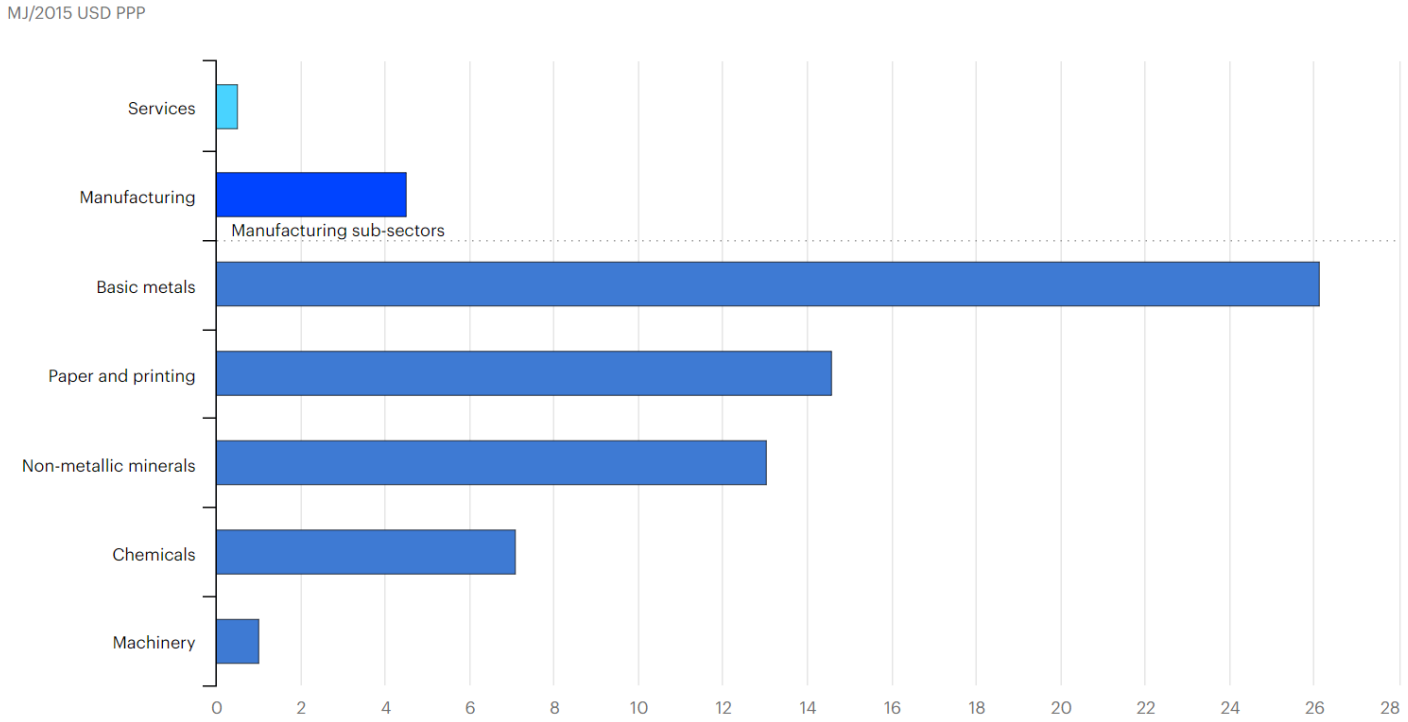
Volume

Examples for the industry sector



Source: IEA (2021), *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

Examples for the industry sector



Source: IEA (2021), *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

Transport

Energy consumption data:

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

Activity data:

- Vehicle stocks
- Vehicle- kilometres
- Passenger-kilometers
- Tonne-kilometers

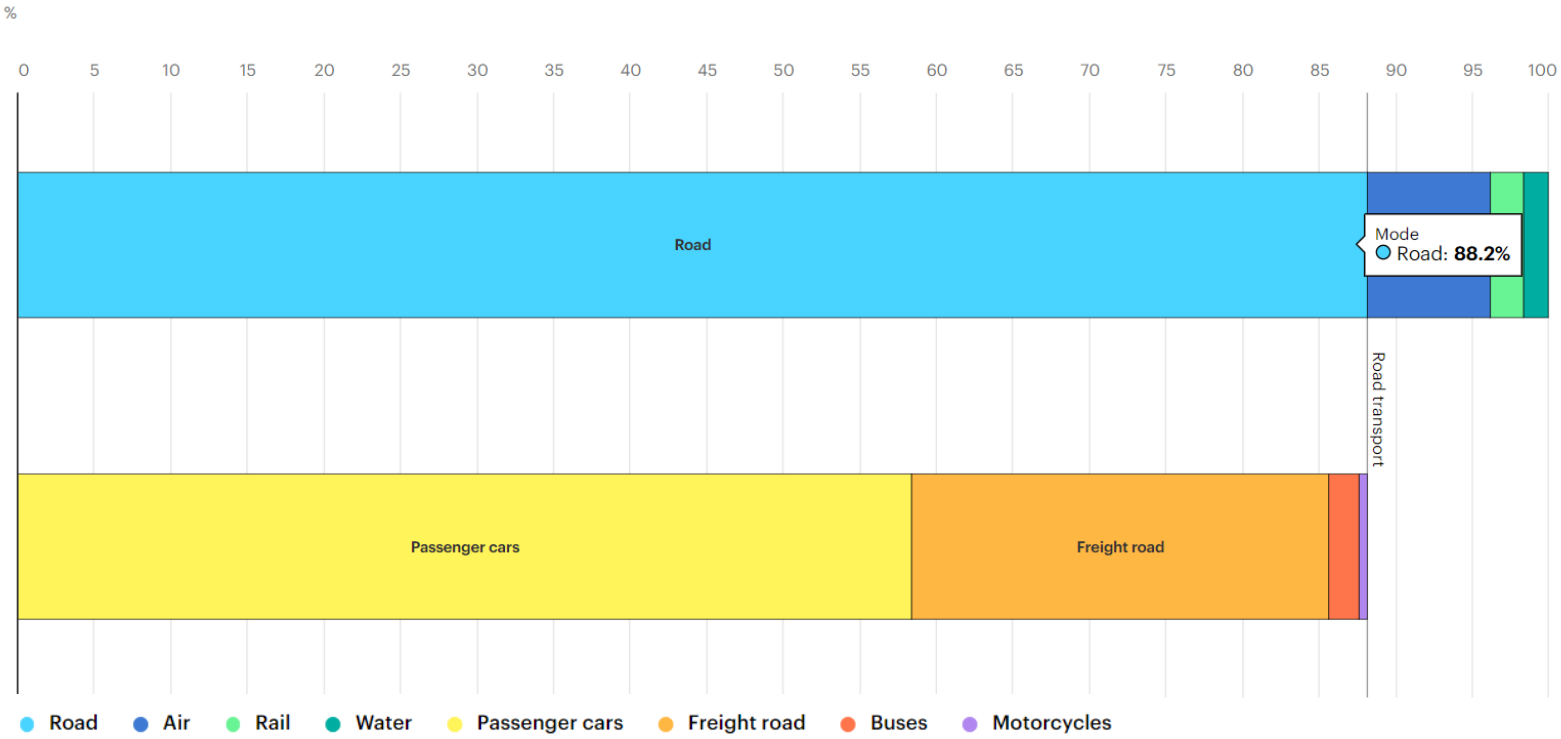
Vehicle stock

Distance travelled

Occupancy

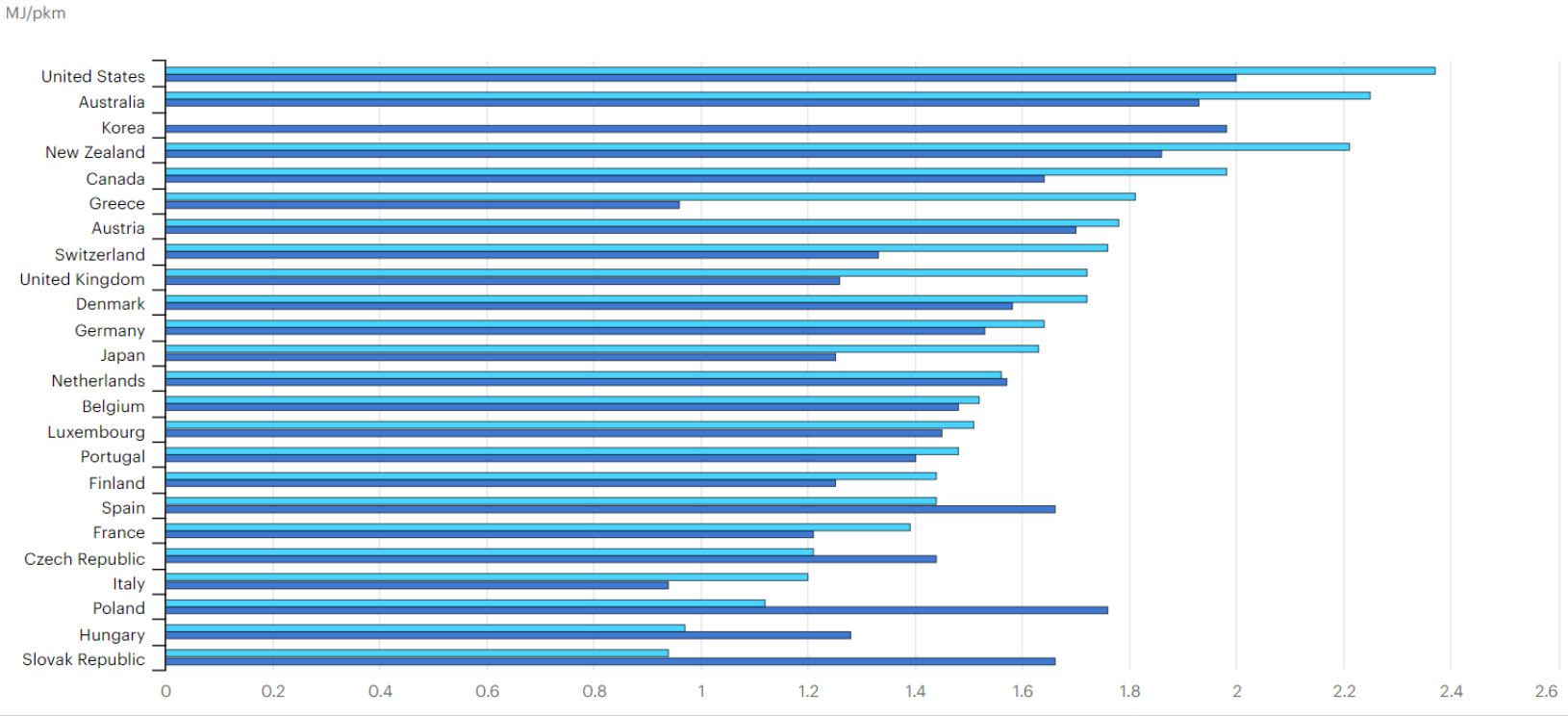
Load

Examples for the transport sector



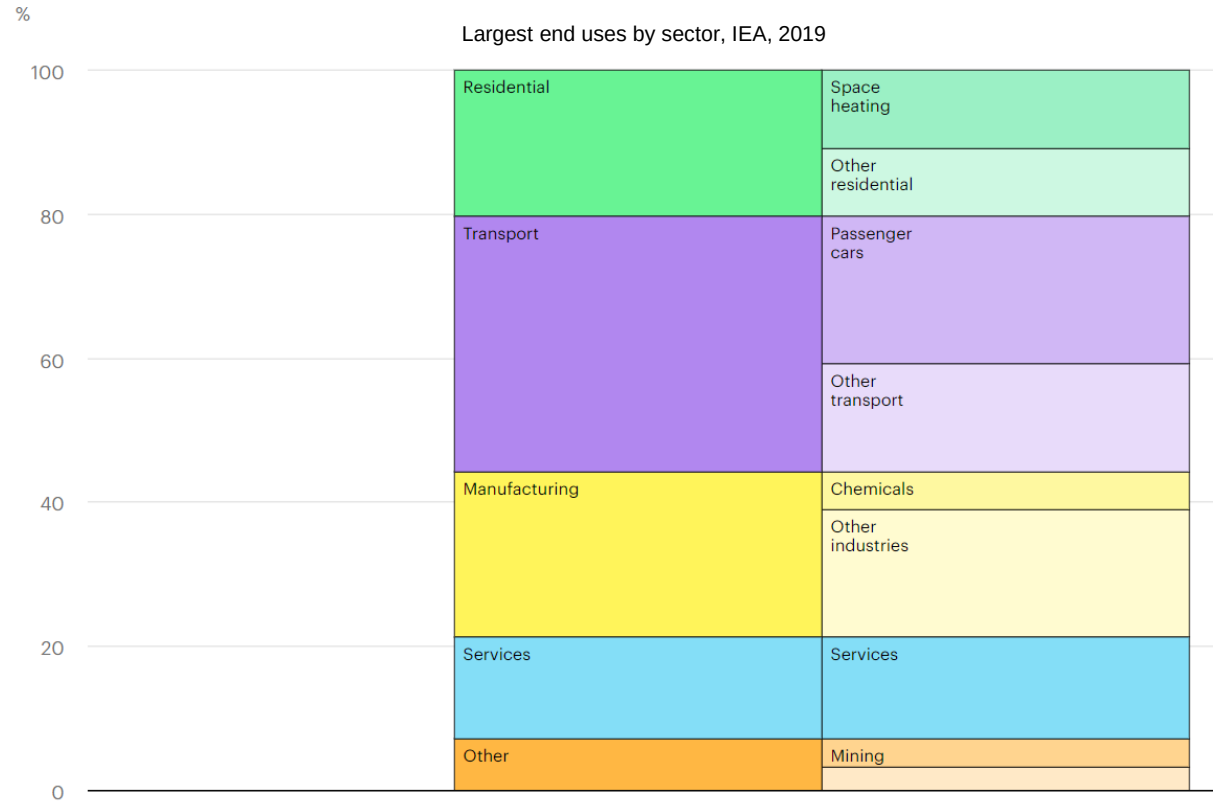
Source: IEA (2021), *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

Examples for the transport sector

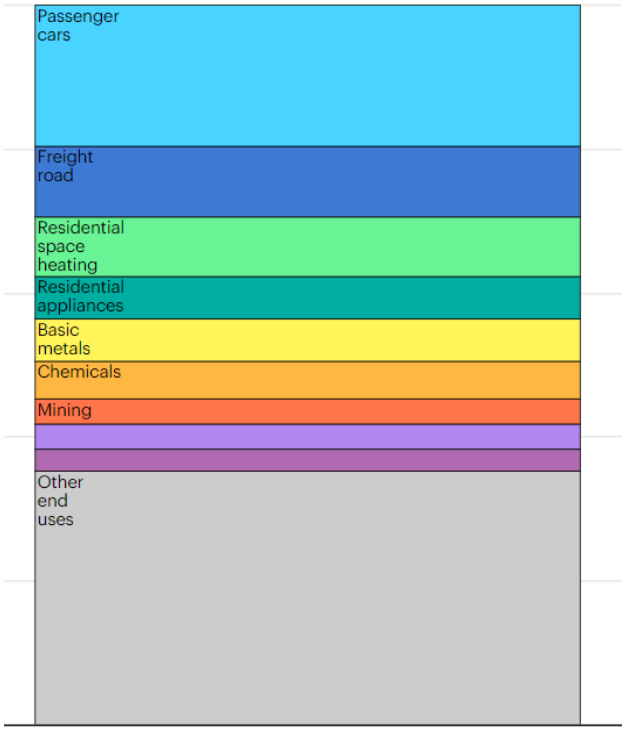


Insights from end use data

Largest end uses by sector, IEA, 2019



Top ten CO_2 emitting end uses, IEA, 2019



What makes a good indicator

- **SMART:** Specific Measurable Achievable Replicable Timebound
- Not too many
- Represent the **outcome of interest** e.g.
  - Is the "number of products sold" a good indicator for understanding energy use?
  - What are the implicit assumptions?
- Beware of **averages**
  - Heavy users might be more likely to buy efficient products
  - Annual consumption may not be a good indicator of peak demand
  - Some sectors of interest may behave differently from the average e.g. rural consumers, poor households, women

What indicators are we interested in?

- National
  - Whole economy
  - Sector e.g. residential
  - End use e.g. space cooling
- Policy/programme effects
  - Compliance/uptake
  - Technology adopted
  - Behaviour change
  - Energy saved
- Policy/programme implementation
- Just transition aspects
  - Gender Equality and Social Inclusion

Monitoring of policy effects by other factors - GESI

For a sensible analysis that features gender equality and social inclusion considerations, indicators can be disaggregated by further factors, if sensible in the specific context.

Gender Identity	Social Factors	Geographical Factors	Other Factors
• Female • Male • Non-binary • Sexuality	• Income • Education Level • Age • Social support benefactor	• Urban • Rural • Local economic structure	• Religion • Ethnicity • Flags of disadvantages

This disaggregation can be considered for energy related indicators, as well as multiple benefits (e.g. job growth, air quality, health effects)

Questions

5 minute break

Data collection tips

Some general principles for end use data collection

Where to start:

- Understanding data needs for policy
- Identifying priority subsectors
- Allocation of resources
- Start with a mapping of data available and identification of gaps
- Consideration of biases for societal groups (gender, income groups etc.)

Key enablers:

- High-level awareness of detailed data needs for policy
- Defining a data collection methodology in line with national profile and allocated budget
- Sharing expertise across countries and organizations

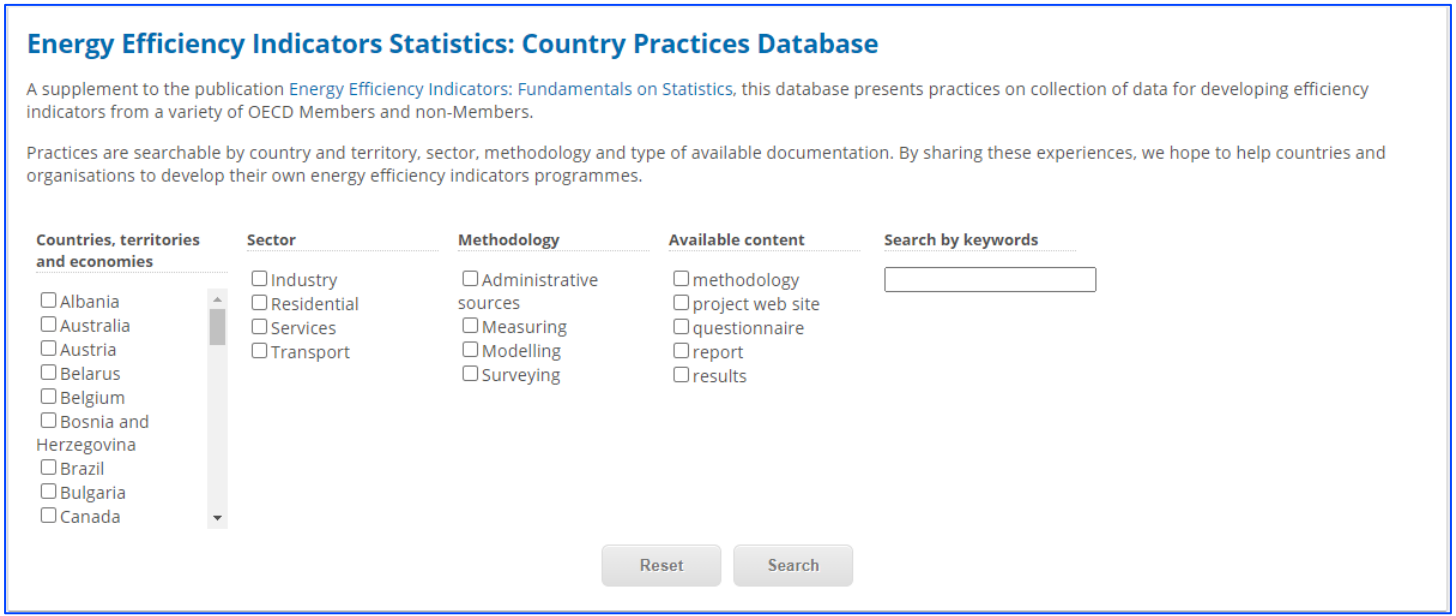
Methods used to collect data for indicators

- Administrative sources
  - before starting new data collection
- Surveys
  - representative sample
  - possibly expanding existing surveys
- Metering and measuring
  - costly but very effective for monitoring specific equipment efficiency
- Modelling
  - complementary to surveys or stand alone

Some sources of evidence

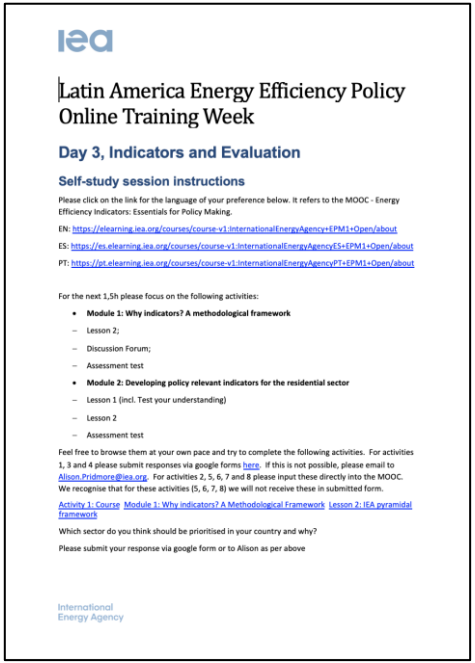
- National statistics (e.g. product sales, ownership levels)
- Utilities (e.g. meter readings)
- Management information/reporting (e.g. registration scheme)
- Measurement (e.g. meter readings, compliance data)
- Modelling (e.g. bottom-up modelling from activity data)
- Surveys (e.g. household energy consumption, label compliance)
- Interviews and focus groups

IEA database – data collection practices



https://delegates.iea.org/delegates/eeindicatorsmanual/

Self study



Latin America Energy Efficiency Policy Online Training Week

Day 3, Indicators and Evaluation

Self-study session instructions

Please click on the link for the language of your preference below. It refers to the MOOC - Energy Efficiency Indicators: Essentials for Policy Making.

EN: https://elearning.iea.org/courses/course-v1:InternationalEnergyAgency+EPM1+Open/about

ES: https://es.elearning.iea.org/courses/course-v1:InternationalEnergyAgencyES+EPM1+Open/about

PT: https://pt.elearning.iea.org/courses/course-v1:InternationalEnergyAgencyPT+EPM1+Open/about

For the next 1,5h please focus on the following activities:

- **Module 1: Why indicators? A methodological framework**
  - Lesson 2;
  - Discussion Forum;
  - Assessment test
- **Module 2: Developing policy relevant indicators for the residential sector**
  - Lesson 1 (incl. Test your understanding)
  - Lesson 2
  - Assessment test

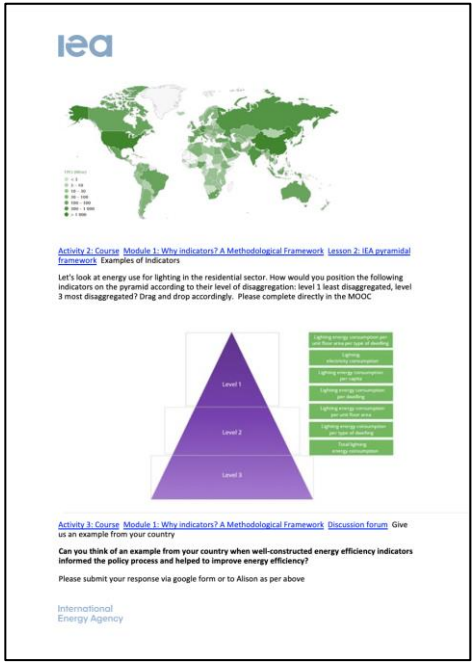
Feel free to browse them at your own pace and try to complete the following activities. For activities 1, 3 and 4 please submit responses via google forms here. If this is not possible, please email to Alison.Pridmore@iea.org. For activities 2, 5, 6, 7 and 8 please input these directly into the MOOC. We recognise that for these activities (5, 6, 7, 8) we will not receive these in submitted form.

Activity 1: Course Module 1: Why indicators? A Methodological Framework Lesson 2: IEA pyramidal framework

Which sector do you think should be prioritised in your country and why?

Please submit your response via google form or to Alison as per above

International Energy Agency



Activity 2: Course Module 1: Why indicators? A Methodological Framework Lesson 2: IEA pyramidal framework Examples of Indicators

Let's look at energy use for lighting in the residential sector. How would you position the following indicators on the pyramid according to their level of disaggregation: level 1 least disaggregated, level 3 most disaggregated? Drag and drop accordingly. Please complete directly in the MOOC

Activity 3: Course Module 1: Why indicators? A Methodological Framework Discussion forum Give us an example from your country

Can you think of an example from your country when well-constructed energy efficiency indicators informed the policy process and helped to improve energy efficiency?

Please submit your response via google form or to Alison as per above

International Energy Agency

Activity 4: Course Module 1: Why indicators? A Methodological Framework Discussion forum
Sources of data in your country

What are the main sources of energy efficiency data and indicators in your country? Do they cover all sectors? What are the main data gaps in your view?

Please submit your response via google form or to Alison as per above

Activity 5: Course Module 1: Why indicators? A Methodological Framework Assessment test
Module 1: Assessment Test

Please complete directly in the MOOC

Activity 6: Course Module 2: Developing Policy Relevant Indicators for the Residential Sector Lesson 1: Trends and Drivers in the Residential Sector Test your understanding

Please complete this directly in the MOOC

Activity 7: Course Module 2: Developing Policy Relevant Indicators for the Residential Sector Lesson 2: Prioritising Indicators for the Residential Sector Disaggregated (Level 2) Indicators (just reading and exploring)

Please complete these directly in the MOOC

Activity 8: Module 2: Developing Policy Relevant Indicators for the Residential Sector: Assessment Test

Please complete directly in the MOOC

International Energy Agency

Self-study

- **MOOC - Energy Efficiency Indicators: Essentials for Policy Making**
- EN: https://elearning.iea.org/courses/course-v1:InternationalEnergyAgency+EPM1+Open/about
- ES: https://es.elearning.iea.org/courses/course-v1:InternationalEnergyAgencyES+EPM1+Open/about
- PT: https://pt.elearning.iea.org/courses/course-v1:InternationalEnergyAgencyPT+EPM1+Open/about

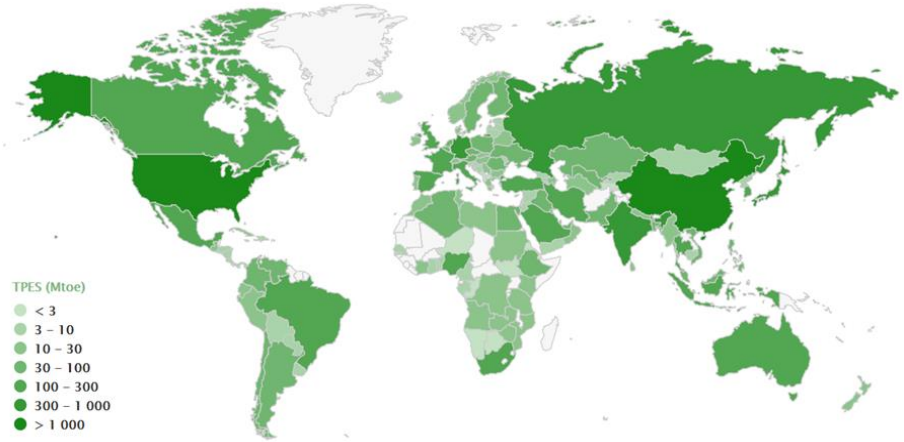
For the next 1,5h please click on the link for the language of your preference and focus on

- **Module 1**: Why indicators? A methodological framework
  - Lesson 2;
  - Discussion Forum
  - Assessment test
- **Module 2**: Developing policy relevant indicators for the residential sector.
  - Lesson 1 (incl. Test your understanding)
  - Lesson 2

Self-study

- Activity 1: Course Module 1: Why indicators? A Methodological Framework Lesson 2: IEA pyramidal framework Which are the Priority Sectors in Your Country?

- Use the map below to identify the total final energy consumption per sector in your country. Which sector do you think should be prioritised and why?

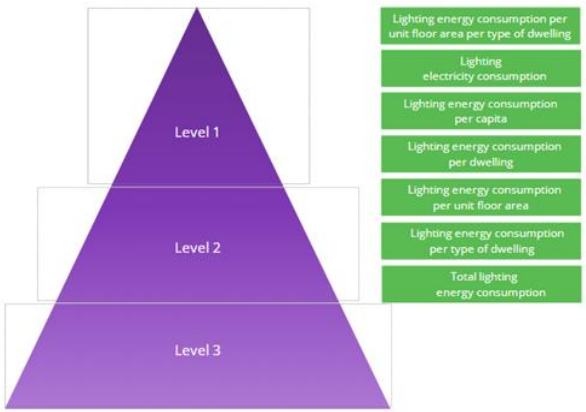


Self-study

- Activity 2: Course Module 1: Why indicators? A Methodological Framework Lesson 2: IEA pyramidal framework Examples of Indicators

- Let's look at energy use for lighting in the residential sector. How would you position the following indicators on the pyramid according to their level of disaggregation: level 1 least disaggregated, level 3 most disaggregated? Drag and drop accordingly.

(0/1 points) passed



Self-study

- Activity 3: Module 1: Why indicators? A Methodological Framework Discussion forum Give us an example from your country

- **Can you think of an example from your country when well-constructed energy efficiency indicators informed the policy process and helped to improve energy efficiency?**

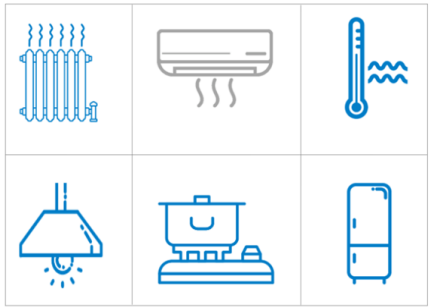
- Activity 4: Module 1: Why indicators? A Methodological Framework Discussion forum Sources of data in your country

- **What are the main sources of energy efficiency data and indicators in your country? Do they cover all sectors? What are the main data gaps in your view?**

- Activity 5: Module 1: Why indicators? A Methodological Framework Assessment test Module 1: Assessment Test

- Activity 6: Module 2: Developing Policy Relevant Indicators for the Residential Sector Lesson 1: Trends and Drivers in the Residential Sector Test Your Understanding

- Activity 7: Module 2: Developing Policy Relevant Indicators for the Residential Sector Lesson 2: Prioritising Indicators for the Residential Sector Disaggregated (Level 2) Indicators



- Activity 8: Module 2: Developing Policy Relevant Indicators for the Residential Sector: Assessment Test

Resources

- IEA Energy efficiency indicators: fundamentals on statistics (MOOC and manual)
- IEA Energy efficiency indicators: essentials for policy-making (MOOC and manual)
- IEA country practices database
- IEA (2014) multiple benefits of energy efficiency.

Breakout groups

- Using the TOC developed on day 1 to identify indicators that could be used to monitor the policy implementation, outputs, outcomes and impacts.
- Identify where the data for those indicators would come from and complete a monitoring plan template.

Monitoring Plan template – Problem description

What indicators would show the context that the policy is operating in? Where would you obtain the data? What analysis would you do?

Monitoring Plan template – Activities

What indicators would show what the policy is doing?
Where would you obtain the data? What analysis would you do?

Monitoring Plan template - outputs

1 **What indicators would show the policy outputs?**
Where would you obtain the data? What analysis would you do?

Monitoring Plan template - outcomes

What indicators would show the policy outcomes?
Where would you obtain the data? What analysis would you do?

Monitoring Plan template - impact

What indicators would show the policy impact?
Where would you obtain the data? What analysis would you do?

Report back from breakout groups

Close – most memorable learning point