Demand-side energy data in buildings

IEA Demand Side Data and Energy Efficiency Indicators Workshop for Southeast Asia

Sonia GARCIA LORENZANA, Energy Data Officer, End-use data and efficiency indicators

International Energy Agency

Overview

1. Importance of collecting good energy data for buildings
2. Why end-use data are important?
3. How to classify end-uses and fuels?
4. What can we learn from the energy balances?
5. What can we learn from end-use data?
6. Developing energy efficiency indicators
7. Methods of collecting data
8. IEA tools for data capacity development
9. Conclusion

Importance of collecting good energy data for buildings

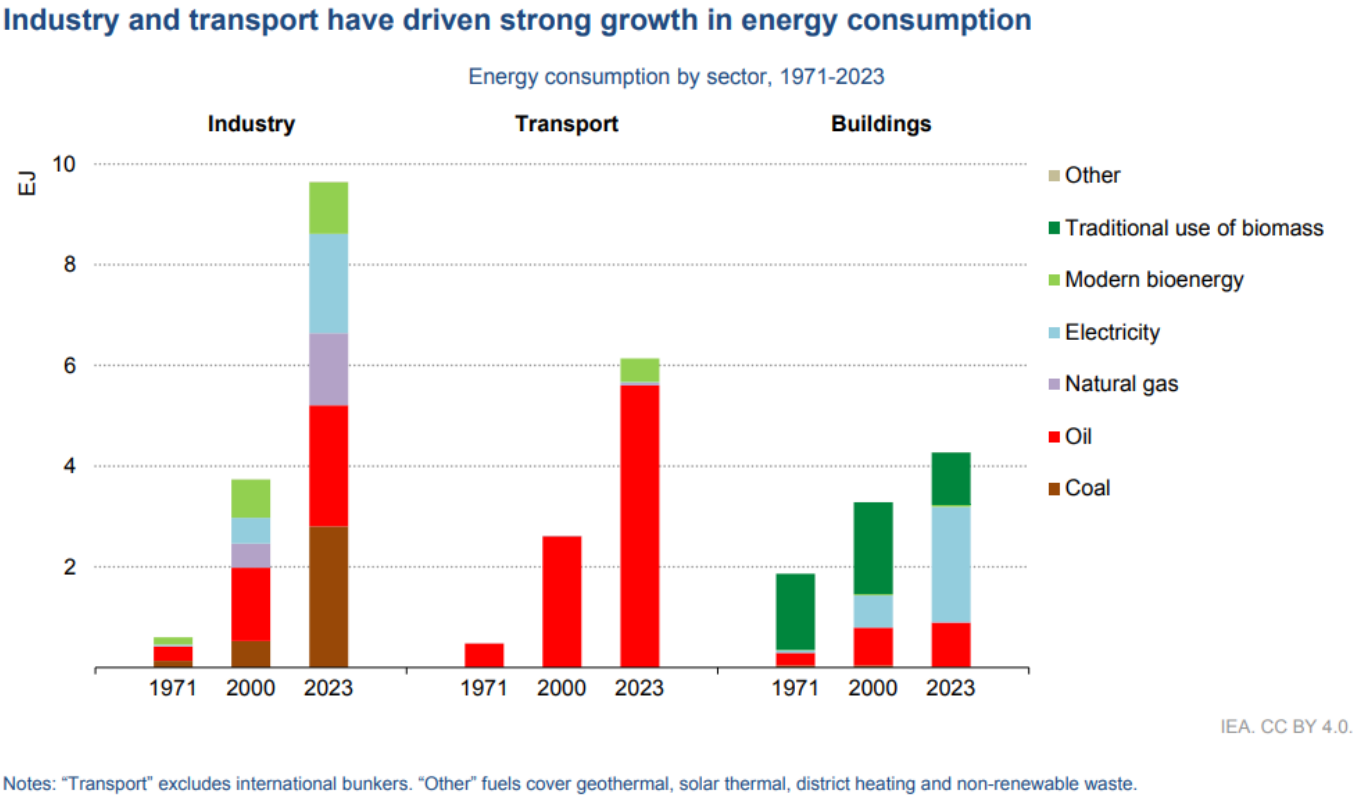
Why is the buildings sector important?





Buildings and appliances determine our quality of life!

Energy in Southeast Asia



Notes: "Transport" excludes international bunkers. "Other" fuels cover geothermal, solar thermal, district heating and non-renewable waste.

Source: IEA, Southeast Asia Energy Outlook 2024

Scope: Brunei, Singapore, Lao PDR, Cambodia, Malaysia, Myanmar, Thailand, Viet Nam, Philippines, Indoesia.

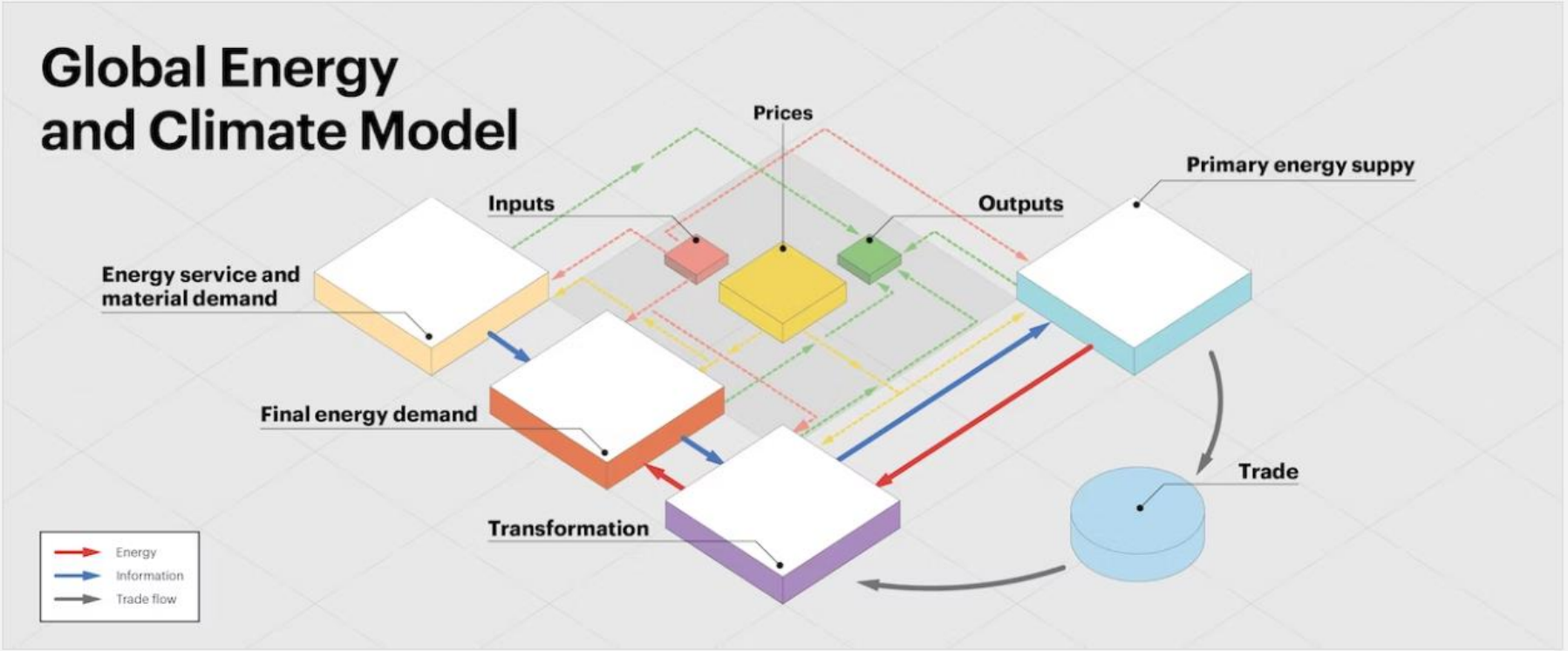
Quiz

Go to:
https://www.menti.com/
and use this code:
8269 5001

Or join using
the QR code:

Why end-use data are important?

Demand side data are the pillars of modelling and policy activities



Disaggregated data allow more precise models and therefore policies

End-use data are the basis to develop efficiency indicators

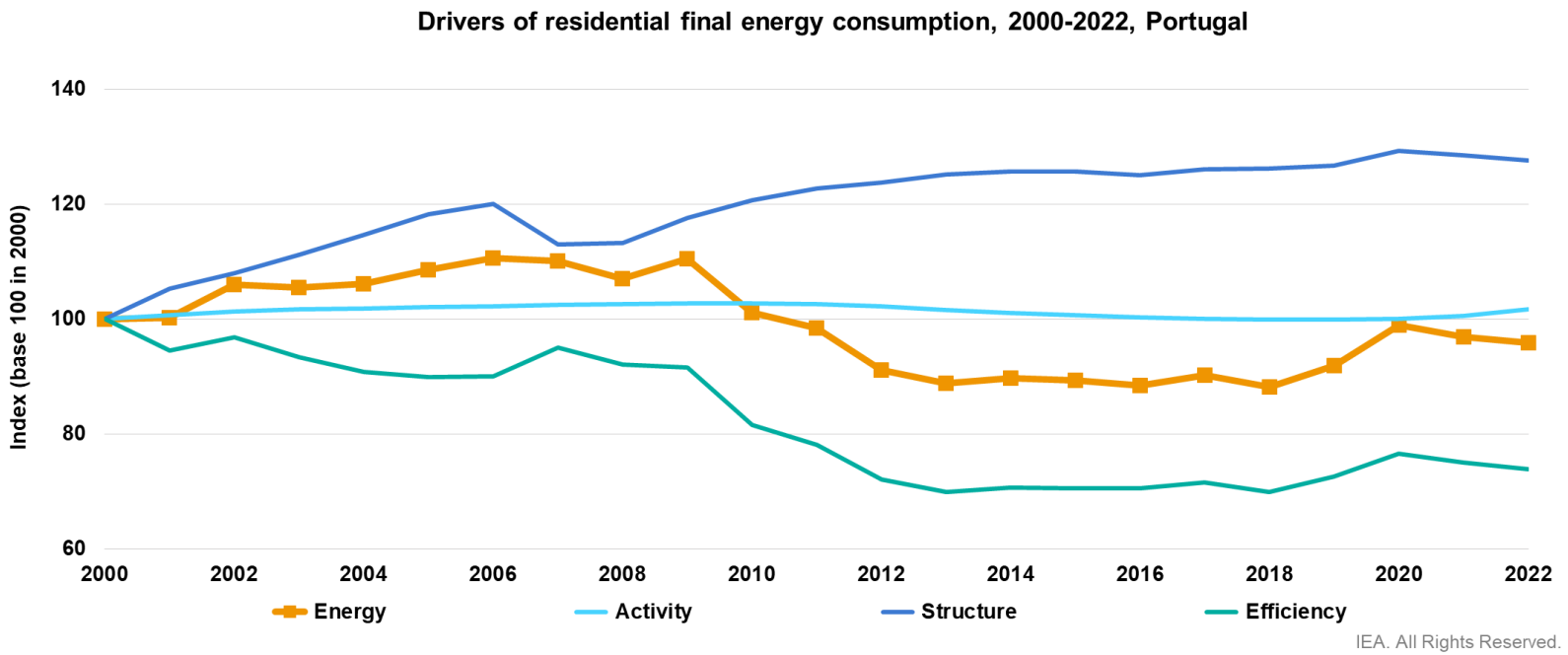
- Energy efficiency indicators are defined as a ratio between energy consumption and activity data.

$$Energy\ efficiency\ indicator = \frac{Energy\ consumption}{Activity\ data}$$

- **Energy efficiency indicators** are computed at the **end-use or sub-sectoral level**, or at an even more disaggregated level and **require disaggregated energy consumption data.**

- For example,
  - *space cooling energy consumption per dwelling*,
  - *passenger cars energy consumption per passenger-kilometre*.

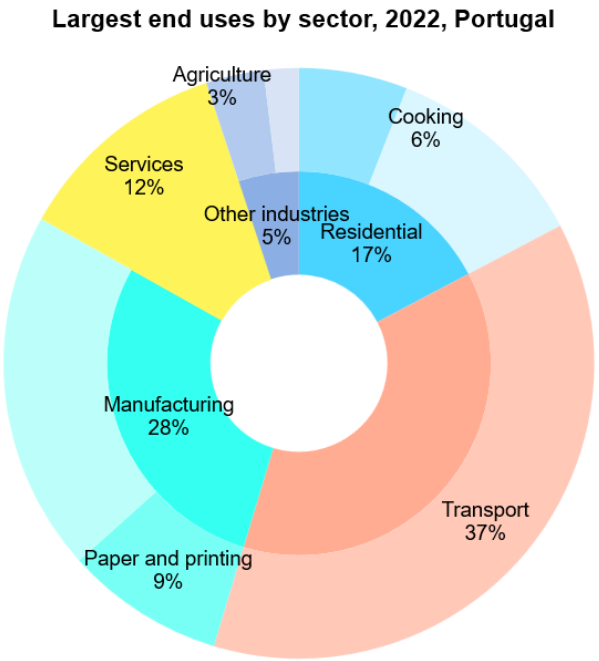
What drives the residential energy consumption?



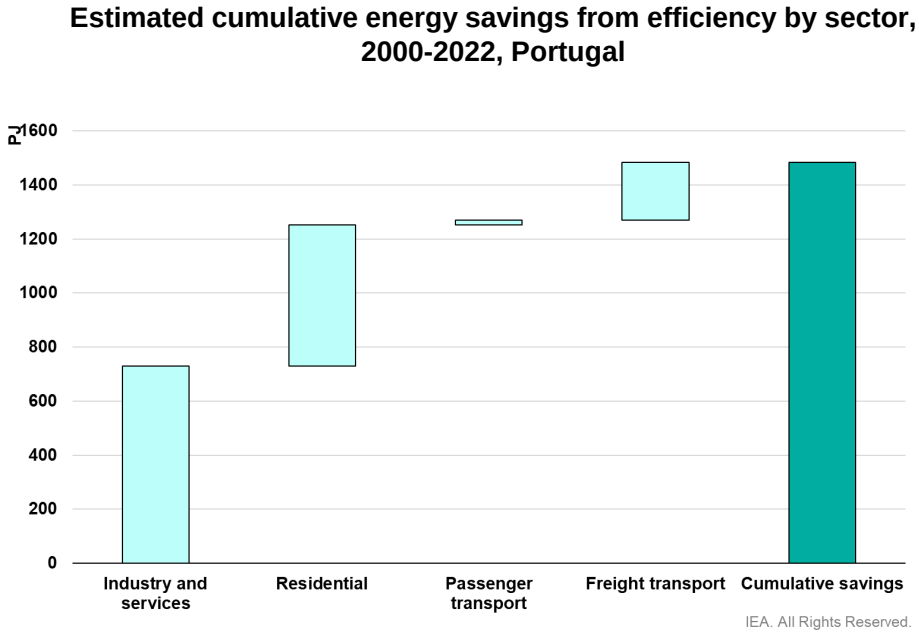
Decomposition analysis from detailed subsector and activity data gives the respective impact of key drivers of energy consumption, and providing key insights for policy design.

Source: IEA Energy End-Uses and Efficiency Indicators, 2024

What we can learn from efficiency indicators – key points



Total final consumption: 621 PJ

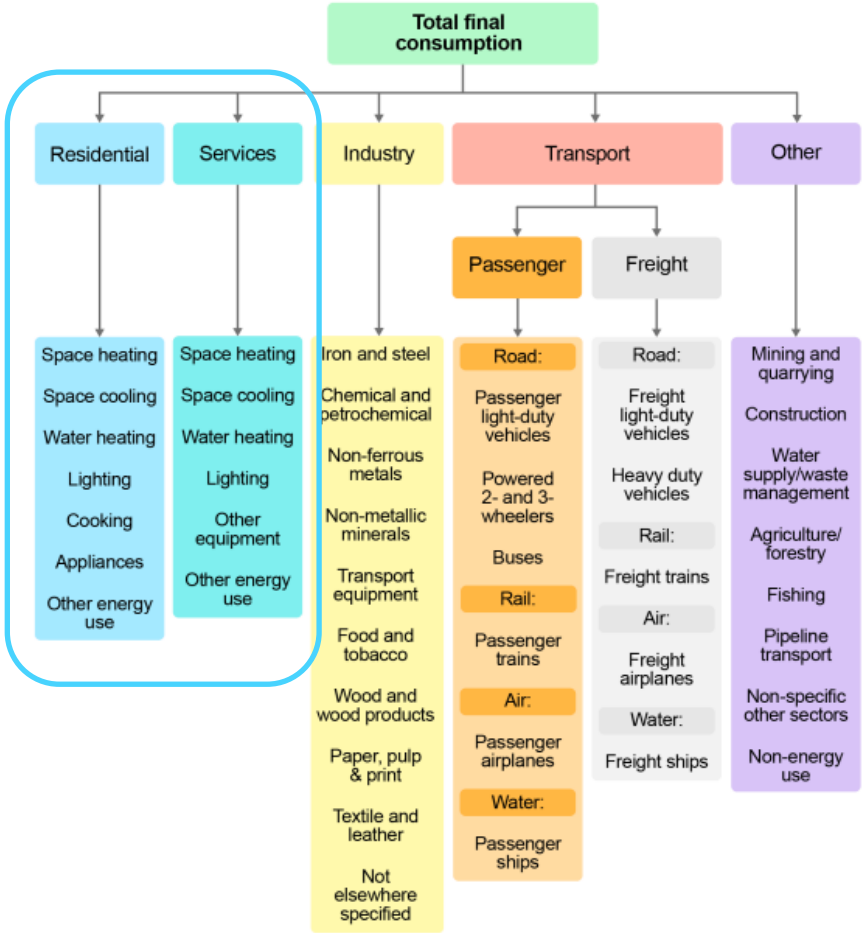


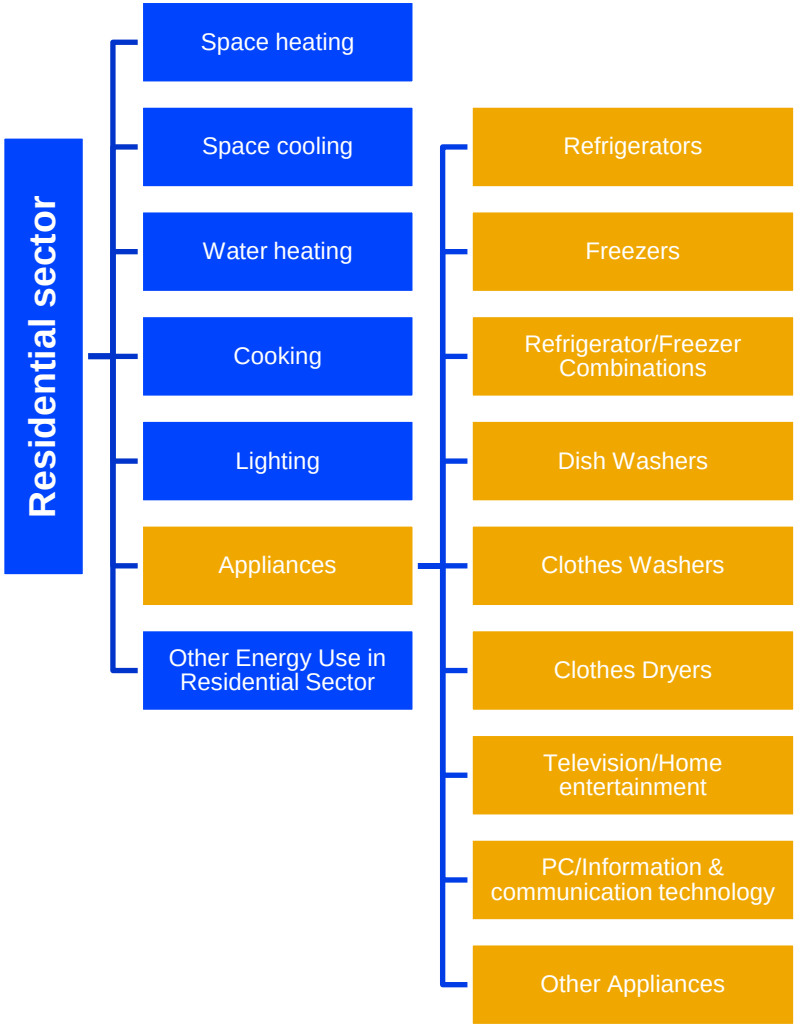
In the past two decades, Portugal cumulatively saved almost 20% of its 2022 energy consumption. These savings mostly come from residential sector.

Source: IEA Energy End-Uses and Efficiency Indicators, 2024

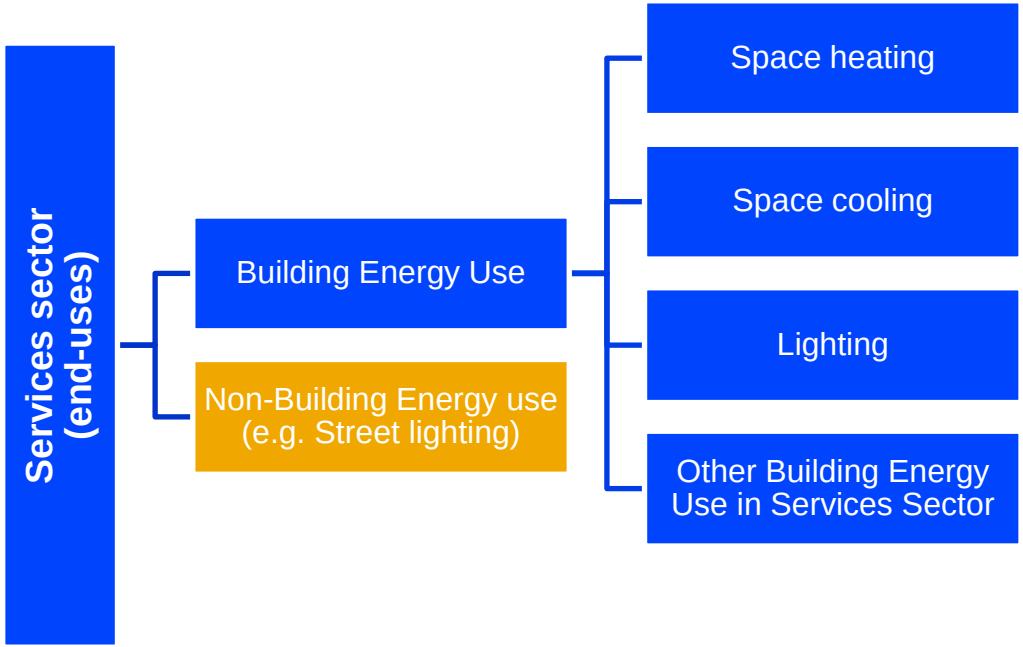
How to classify end-uses and products?

Sectors, sub-sectors or end-uses of total final consumption





International Energy Agency



International Energy Agency

Services sectors (sub-sectors)

- [37-39] Sewerage, waste collection and remediation activities
- [46-47] Wholesale and retail trade
- [52-53] Warehousing, support activities for transportation, postal services
- [55-56] Accommodation and food services
- [58-63] Information and communication
- [64-82] Financial, insurance, real estate, scientific, and administrative activities
- [84] Public administration, excluding defense [ISIC 8422]
- [85] Education
- [86-88] Health and social work
- [90-93] Arts, entertainment and recreation
- [33; 45; 94-96; 99] Other services activities
- Data centres

International Energy Agency

Products scope – information on coal, gas, oil, etc.

RESIDENTIAL	units	2010	2011	2012	2013	2014	2015	2016
Menu / Legend / Check all/none	Add rem							
Space Heating								
Oil & Oil Products	PJ	4.52	4.27	4.12	3.86	3.76	3.48	3.74
Natural Gas	PJ	78.80	72.16	75.29	76.17	69.95	70.19	78.61
Coal & Coal Products	PJ	294.29	253.93	268.17	258.21	236.56	232.48	247.69
Biofuels & Waste	PJ	99.60	101.97	104.11	105.14	96.34	94.10	99.87
Heat	PJ	136.48	122.48	125.98	123.18	114.08	113.75	114.25
Electricity	PJ	4.73	4.68	4.69	4.71	4.65	4.68	4.70
Other	PJ	0	0	0	0	0	0.56	0.59
Total	**PJ**	**618.42**	**559.49**	**582.35**	**571.27**	**525.34**	**519.22**	**549.45**
Space Cooling								
Natural Gas	PJ	0	0	0	0	0	0	0
Electricity	PJ	0	0	0	0	0	0	0
Other	PJ	0	0	0	0	0	0	0
Total	**PJ**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Water Heating								
Oil & Oil Products	PJ	1.69	1.60	1.54	1.44	1.40	1.35	1.46
Natural Gas	PJ	37.01	33.89	35.36	35.77	32.85	32.96	36.92
Coal & Coal Products	PJ	31.38	27.07	28.59	27.53	25.22	24.76	24.78
Biofuels & Waste	PJ	12.53	12.83	13.10	13.23	12.12	9.29	9.29
Heat	PJ	58.49	52.49	53.99	52.79	48.89	48.75	48.75
Electricity	PJ	7.61	7.52	7.53	7.57	7.47	7.52	7.52
Other	PJ	0	0	0	0	0	1.77	2.06
of which: solar thermal	PJ	0	0	0	0	0	1.57	1.85
Total	**PJ**	**148.70**	**135.40**	**140.11**	**138.33**	**127.96**	**126.40**	**130.78**
Cooking								
Oil & Oil Products	PJ	23.17	21.89	21.10	19.77	19.25	19.56	20.33
Natural Gas	PJ	32.56	29.82	31.11	31.48	28.90	29.03	29.62
Coal & Coal Products	PJ	4.46	3.85	4.07	3.92	3.59	3.50	3.53
Biofuels & Waste	PJ	2.33	2.38	2.43	2.45	2.25	2.28	2.28
Heat	PJ	0	0	0	0	0	0	0
Electricity	PJ	11.10	10.97	10.99	11.04	10.90	10.97	11.25
Other	PJ	0	0	0	0	0	0	0
Total	**PJ**	**73.62**	**68.90**	**69.70**	**68.66**	**64.89**	**65.34**	**67.00**
Lighting								
Oil & Oil Products	PJ	0	0	0	0	0	0	0
Electricity	PJ	15.54	13.46	13.02	12.81	11.90	11.84	0
Other	PJ	0	0	0	0	0	0	0

What can we learn from the energy balances?

Energy balances are a compact source of information

2022

MILLION TONS OIL EQUIVALENT

SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geotherm. Solar etc.	Biofuels & waste	Electricity	Heat	Total
Production	4249.8	4499.2	-	3502.6	700.3	374.0	454.2	1290.3	-	1.5	15071.9
Imports	802.5	2345.2	1365.6	1028.1	-	-	-	38.6	69.4	0.0	5649.5
Exports	-832.8	-2309.2	-1406.0	-1053.8	-	-	-	-27.3	-71.6	-0.0	-5700.8
Intl. marine bunkers	-	-	-	-	-	-	-	-	-	-	-
Intl. aviation bunkers	-	-	-	-	-	-	-	-	-	-	-
Stock changes	-113.7	14.1	-20.9	-40.0	-	-	-	-0.2	-	-	-160.7
TES	**4105.8**	**4549.3**	**-61.3**	**3436.9**	**700.3**	**374.0**	**454.2**	**1301.3**	**-2.2**	**1.5**	**14860.0**
Transfers	-7.2	-265.6	306.2	-	-	-	-	0.0	-	-	33.4
Statistical differences	-125.7	9.7	-5.4	-38.1	-	-	0.2	0.2	-9.2	8.3	-160.1
Electricity plants	-1826.5	-40.4	-147.0	-960.9	-699.7	-374.0	-379.4	-152.7	2129.1	-	-2451.5
CHP plants	-808.3	-0.0	-13.7	-326.5	-0.5	-	-4.2	-85.6	376.4	317.3	-545.0
Heat plants	-31.8	-0.5	-11.2	-62.3	-0.1	-	-2.2	-14.2	-	106.0	-16.4
Blast furnaces	-190.0	-	-0.1	-0.0	-	-	-	-0.0	-	-	-190.3
Gas works	-34.5	-	-3.7	17.6	-	-	-	-2.9	-	-	-23.5
Coke/pat. fuel/BKB plants	-84.8	-	-2.5	-0.0	-	-	-	-0.1	-	-	-87.4
Oil refineries	-	-4310.6	4212.2	-	-	-	-	-	-	-	-98.3
Petrochemical plants	-	43.5	-43.1	-	-	-	-	-	-	-	0.5
Liquefaction plants	-26.3	22.6	-	-16.9	-	-	-	-	-	-	-20.6
Other transformation	-0.7	13.9	-0.6	-23.0	-	-	-	-93.4	-0.5	-0.4	-104.6
Energy industry own use	-78.0	-8.1	-222.7	-306.3	-	-	-0.0	-13.1	-207.4	-48.8	-884.3
Losses	-1.7	-6.8	-0.2	-30.1	-	-	-0.0	-0.3	-173.1	-23.9	-236.0
TFC	**890.5**	**6.9**	**4007.0**	**1690.4**	**-**	**-**	**68.6**	**939.3**	**2113.2**	**360.0**	**10075.9**
Industry	717.7	1.8	327.3	674.5	-	-	0.8	255.2	894.9	191.9	3064.2
Transport	0.9	0.0	2539.9	123.5	-	-	-	99.4	38.8	-	2802.5
Residential	49.6	-	213.9	490.4	-	-	53.5	538.3	580.5	119.1	2045.3
Comm. and public servic	19.5	-	72.4	204.1	-	-	11.3	28.7	430.4	39.1	805.4
Agriculture/forestry	10.0	0.0	110.6	12.7	-	-	2.5	13.0	69.7	3.6	222.2
Fishing	0.0	-	6.5	0.1	-	-	0.1	0.0	0.9	0.1	7.6
Non-specified	14.4	0.0	27.4	5.9	-	-	0.4	4.7	98.1	6.3	157.3
Non-energy use	78.4	5.1	708.9	179.0	-	-	-	-	-	-	971.5

Supply

Transformation and energy industries own use

Final consumption

Demand side

Energy balances are a compact source of information

2022

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Intl. marine bunkers	-	-	-	-	-	-	-	-	-	-	-
Intl. aviation bunkers	-	-	-	-	-	-	-	-	-	-	-
Stock changes	-113.7	14.1	-20.9	-40.0	-	-	-	-0.2	-	-	-160.7
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Statistical differences	-125.7	9.7	-5.4	-38.1	-	-	0.2	0.2	-9.2	8.3	-160.1
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CHP plants	-808.3	-0.0	-13.7	-326.5	-0.5	-	-4.2	-85.6	376.4	317.3	-545.0
Heat plants	-31.8	-0.5	-11.2	-62.3	-0.1	-	-2.2	-14.2	-	106.0	-16.4
Blast furnaces	-190.0	-	-0.1	-0.0	-	-	-	-0.0	-	-	-190.3
Gas works	-34.5	-	-3.7	17.6	-	-	-	-2.9	-	-	-23.5
Coke/pat. fuel/BKB plants	-84.8	-	-2.5	-0.0	-	-	-	-0.1	-	-	-87.4
Oil refineries	-	-4310.6	4212.2	-	-	-	-	-	-	-	-98.3
Petrochemical plants	-	43.5	-43.1	-	-	-	-	-	-	-	0.5
Liquefaction plants	-26.3	22.6	-	-16.9	-	-	-	-	-	-	-20.6
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Supply

Transformation and energy industries own use

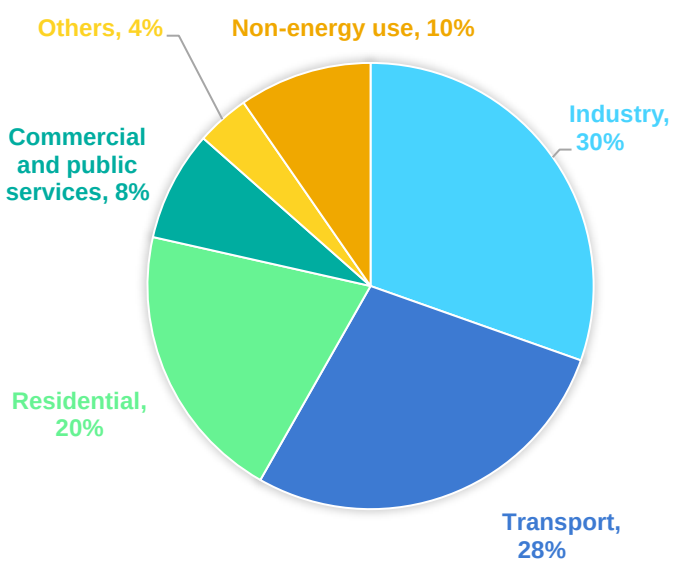
Final consumption

Demand side

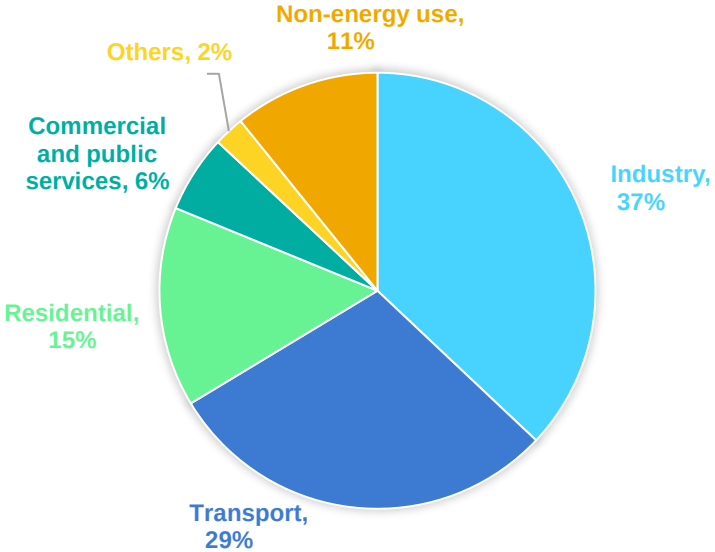
Buildings related

Total final consumption (TFC) by sector

WORLD, 2022



ASEAN, 2022



On average in the Southeast Asian countries, residential energy consumption accounts for 15% of TFC and Commercial and public services for 6% of TFC

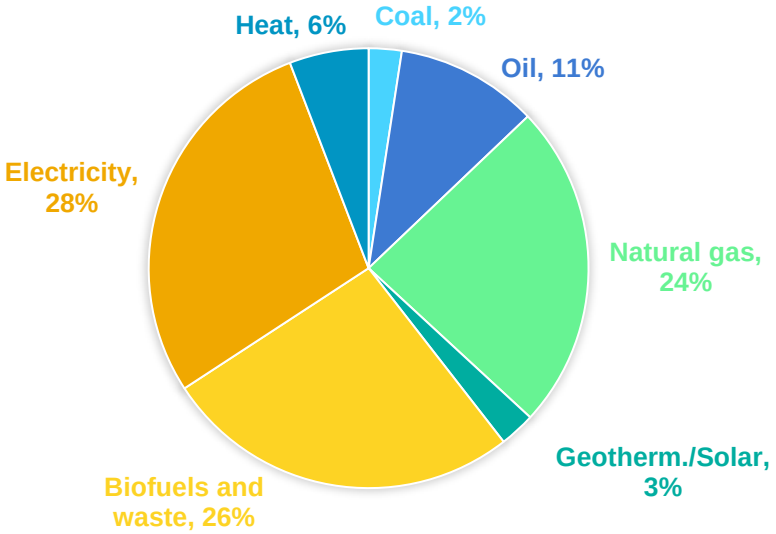
Source: IEA (2024), World Energy Statistics and Balances 2024, www.iea.org/statistics/.

Other includes agriculture, forestry, fishing and non-specified final consumption

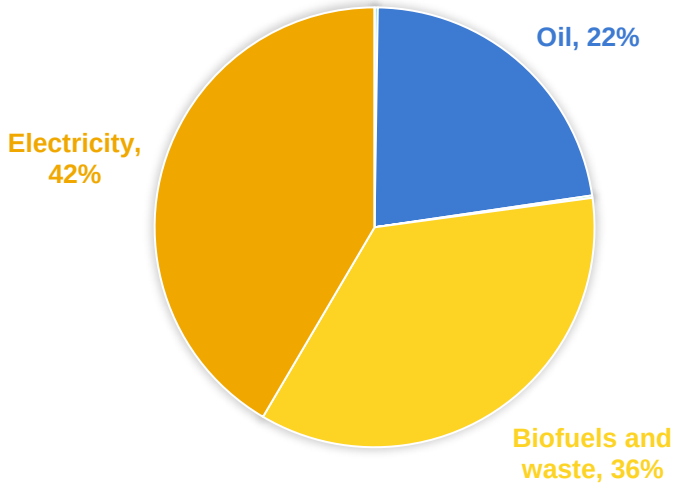
Category industry here follows energy balances definitions and includes construction as well as mining and quarrying

Residential energy consumption by fuel

WORLD, 2022



ASEAN, 2022

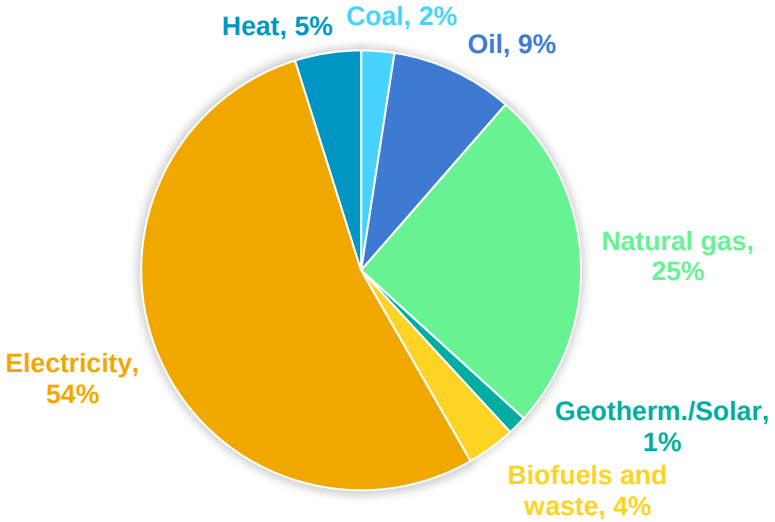


The residential sector relies on electricity for 42% and biofuels and waste for 36% of its energy needs in Southeast Asia.

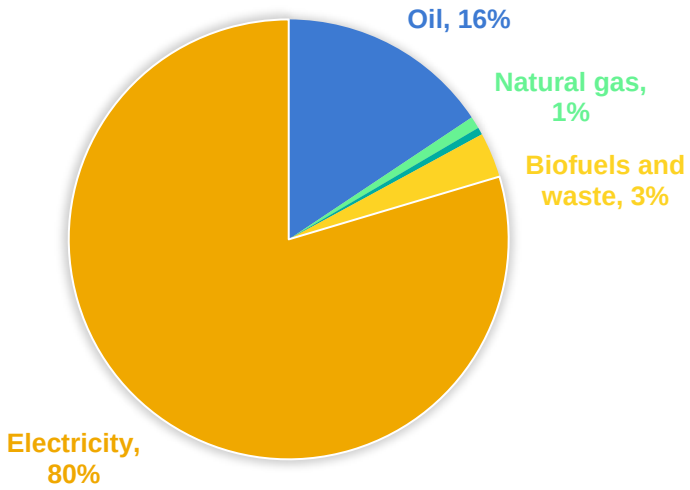
 Source: *IEA (2024), World Energy Statistics and Balances 2024, www.iea.org/statistics/.*

Commercial and public services energy consumption by fuel

WORLD, 2022



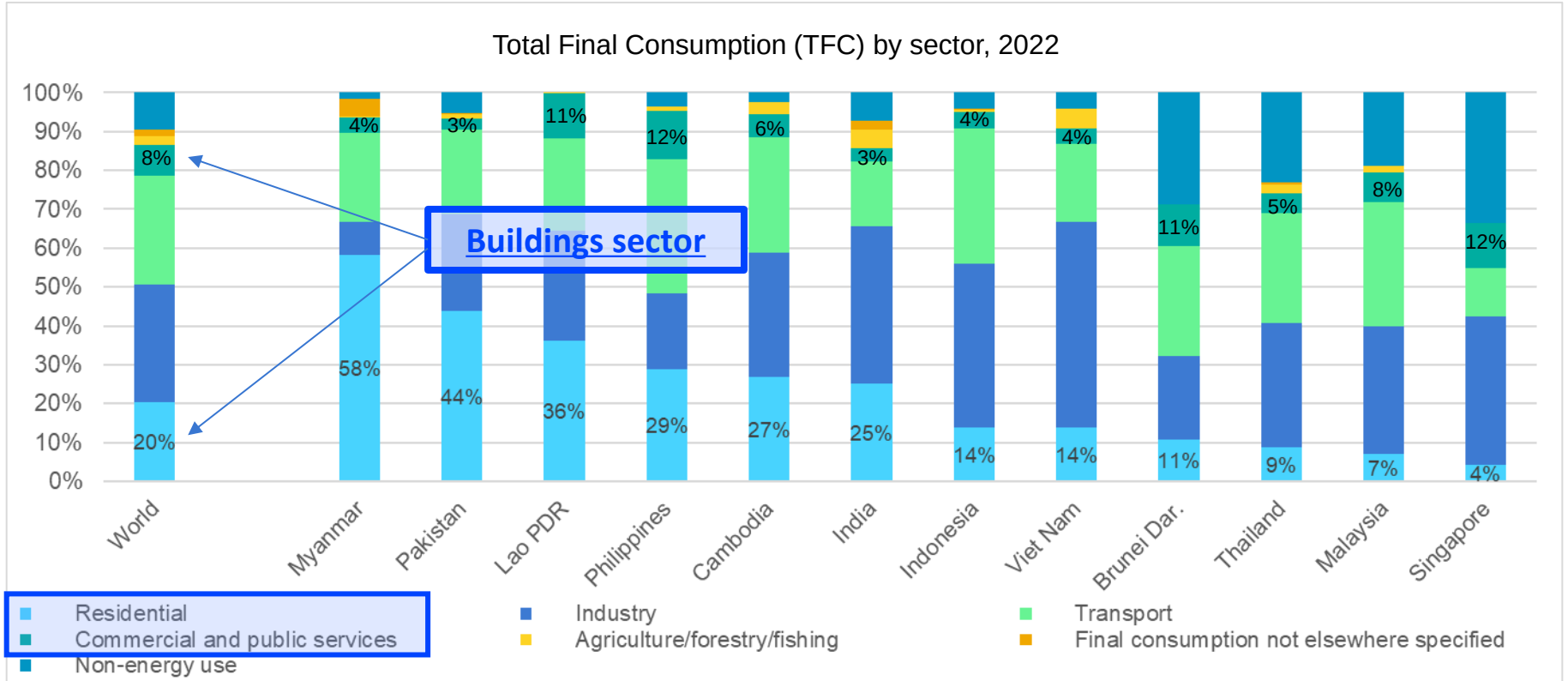
ASEAN, 2022



The commercial and public services sector relies on electricity for 80% of its energy needs in Southeast Asia.

 Source: *IEA (2024), World Energy Statistics and Balances 2024, www.iea.org/statistics/.*

Which sector drives domestic demand?



According to the IEA world energy balances, residential consumptions accounts for 4-58% of TFC and commercial and public services accounts for 3-12%

Source: *IEA (2024), World Energy Statistics and Balances 2024, www.iea.org/statistics/.*

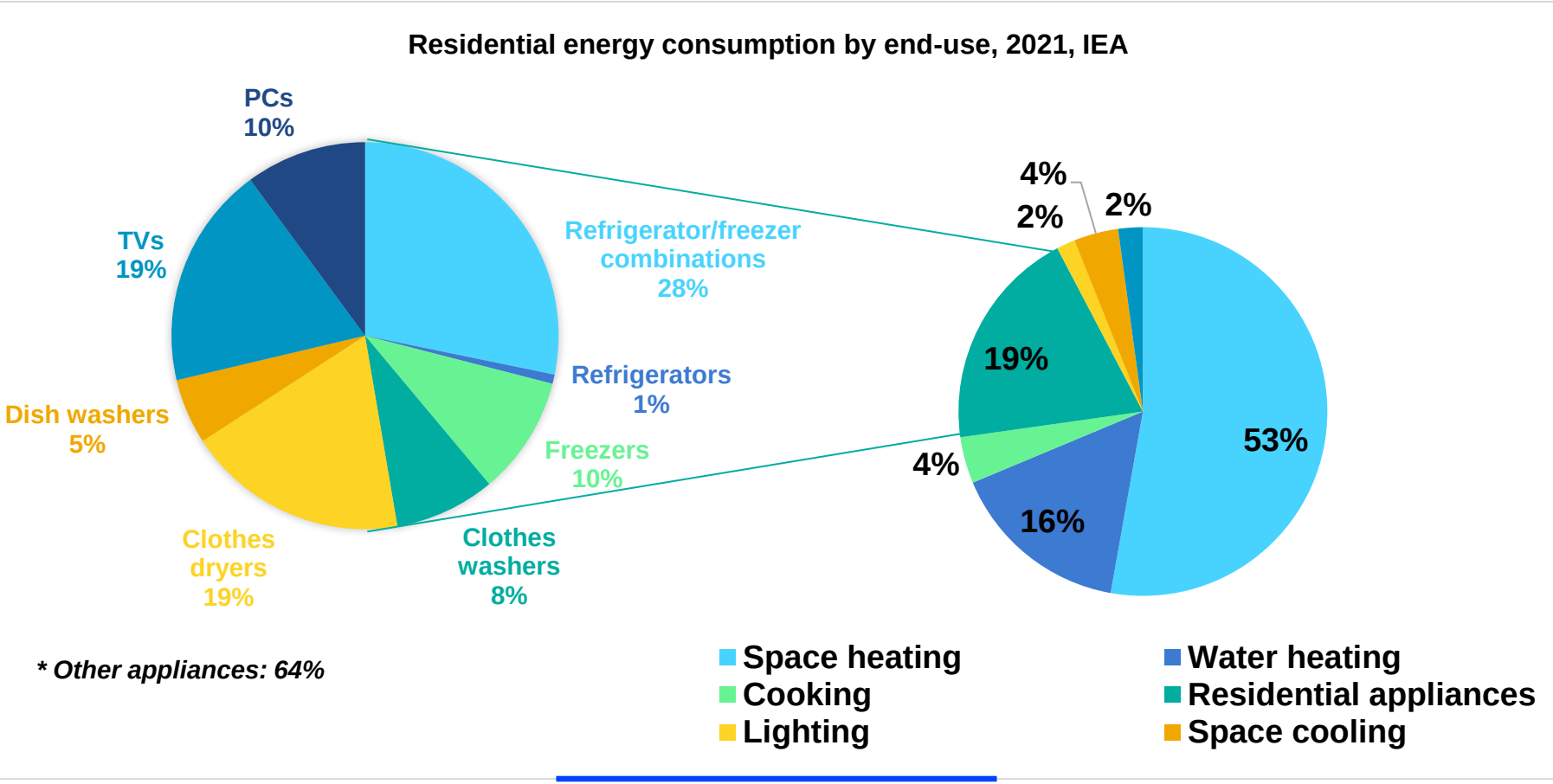
1) *Category industry here follows energy balances definitions and includes construction as well as mining and quarrying*

What can we learn from end-use data?

What can we learn from end-use data in the building?

- Which **end uses** consume the most energy (heating, cooking, cooling…)?
- Which **aspect of our life** will be affected in case of **energy price spike**?
- What is the **share of LPG / electricity** used for cooking?
- Are we using energy for **space heating** more efficiently over time?

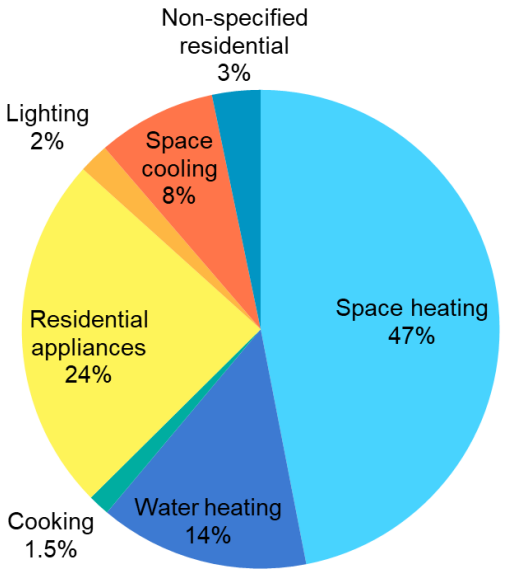
With additional data we can see where energy is used



Source: IEA Energy End-Uses and Efficiency Indicators, 2023

Focus on residential energy use: what are the key end-uses?

Residential energy consumption by end use, 2022, United States

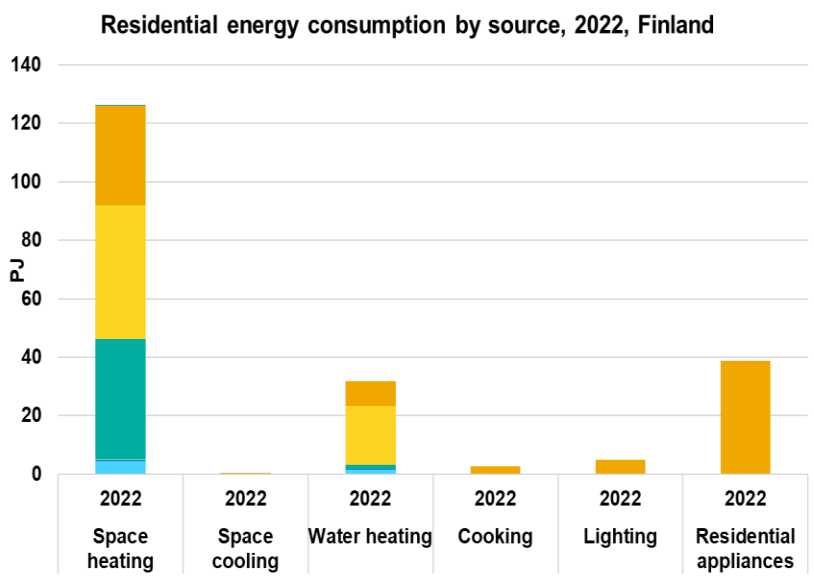


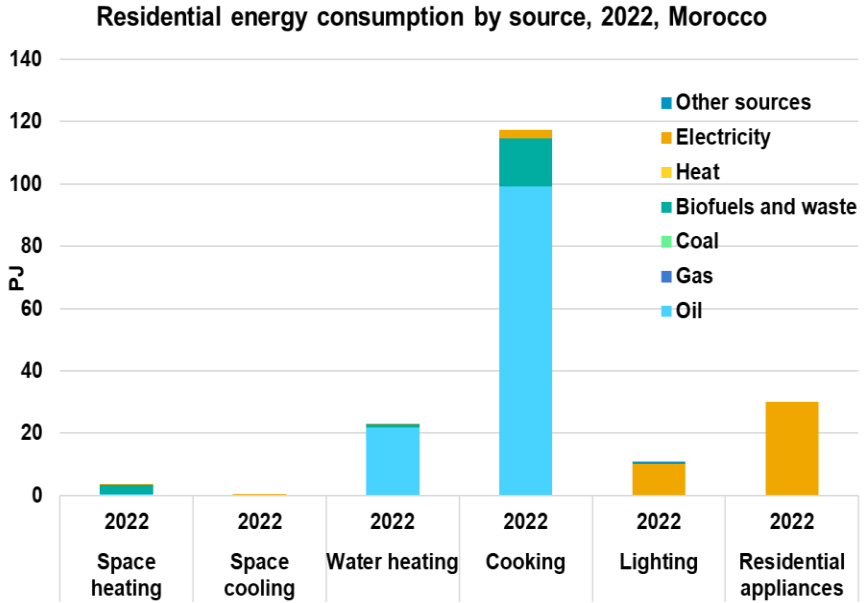
Priority subsectors require more detailed data for energy and activities to understand "structure".

Source: IEA Energy End-Uses and Efficiency Indicators, 2024

Fuel split by end-uses gives crucial insights on our standard of living

Residential energy consumption by fuel and end use, in **Finland** (left) and **Morocco** (right), in 2022





Consumption data split by end use and by fuel allows to understand the impact of weather, technology deployment and cultural habits on the energy system.

Source: IEA Energy End-Uses and Efficiency Indicators, 2024

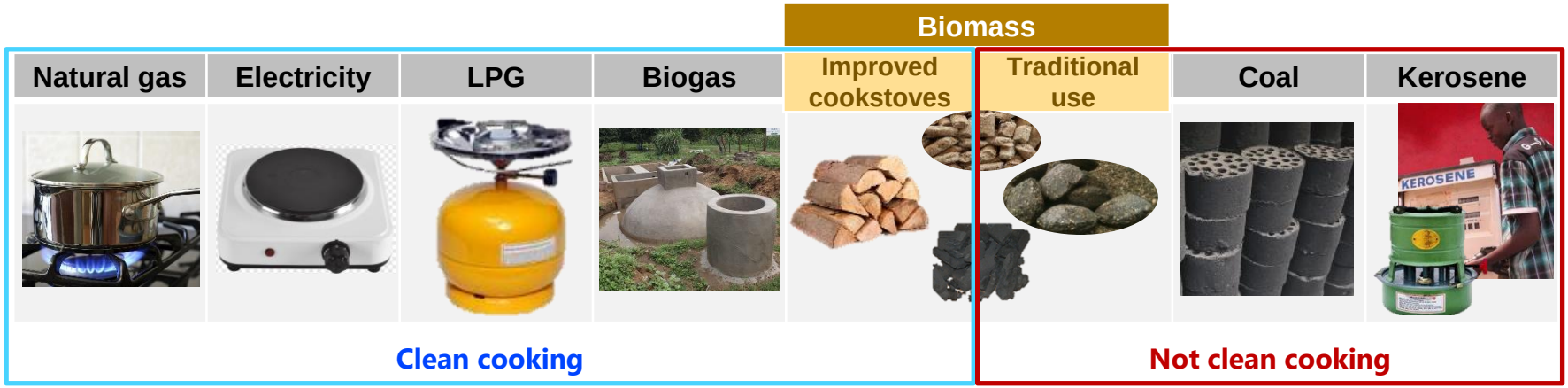
Which are the clean cooking fuels?

- Solid biofuels in developing countries are mainly used for cooking, a topic covered under the climate and sustainable goals

SUSTAINABLE DEVELOPMENT GOAL 7

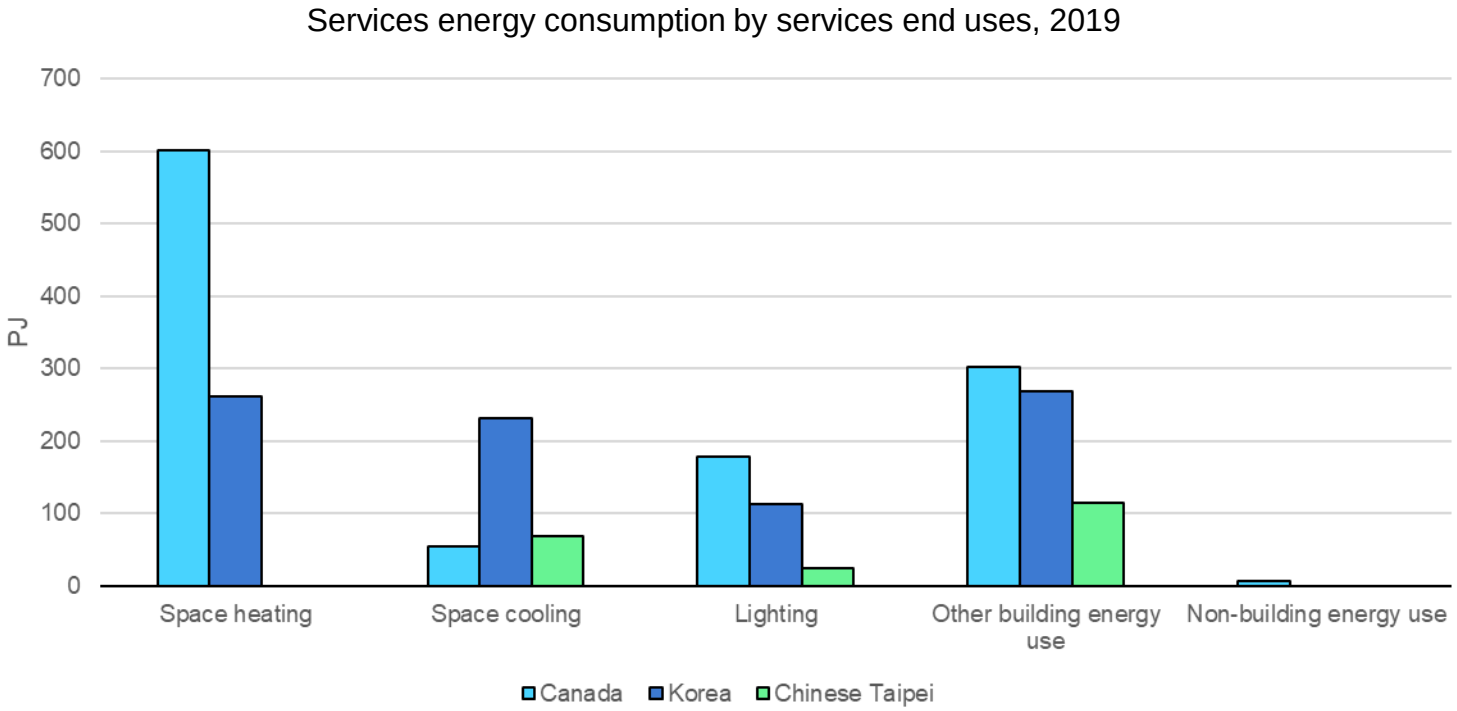
Ensure access to affordable, reliable, sustainable and modern energy for all

  - Target 7.1: Ensure universal access to affordable, reliable and modern energy services
  - Indicator 7.1.2: Proportion of population with primary reliance on **clean fuels and technology**



Definition : According to SDG tracking, access to clean cooking facilities means access to (and primary use of) **modern fuels and technologies**

Detailed data provides more information – services end uses

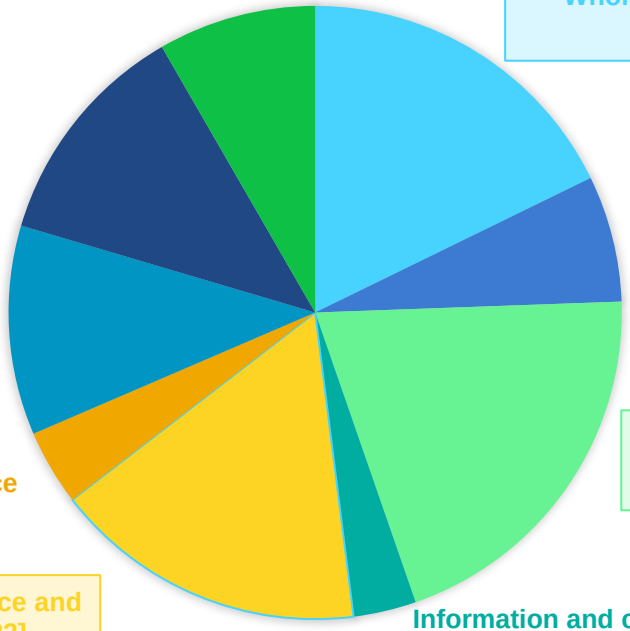


Detailed data allow to understand which end-use/activity drives energy consumption and emissions.

Source: IEA Energy End-Uses and Efficiency Indicators, 2024

Detailed data provides more information – services categories

Total services energy consumption by services categories, Switzerland, 2022



Detailed data allow to understand which activity drives energy consumption and emissions.

Source: IEA Energy End-uses and Efficiency Indicators, 2024

Quiz

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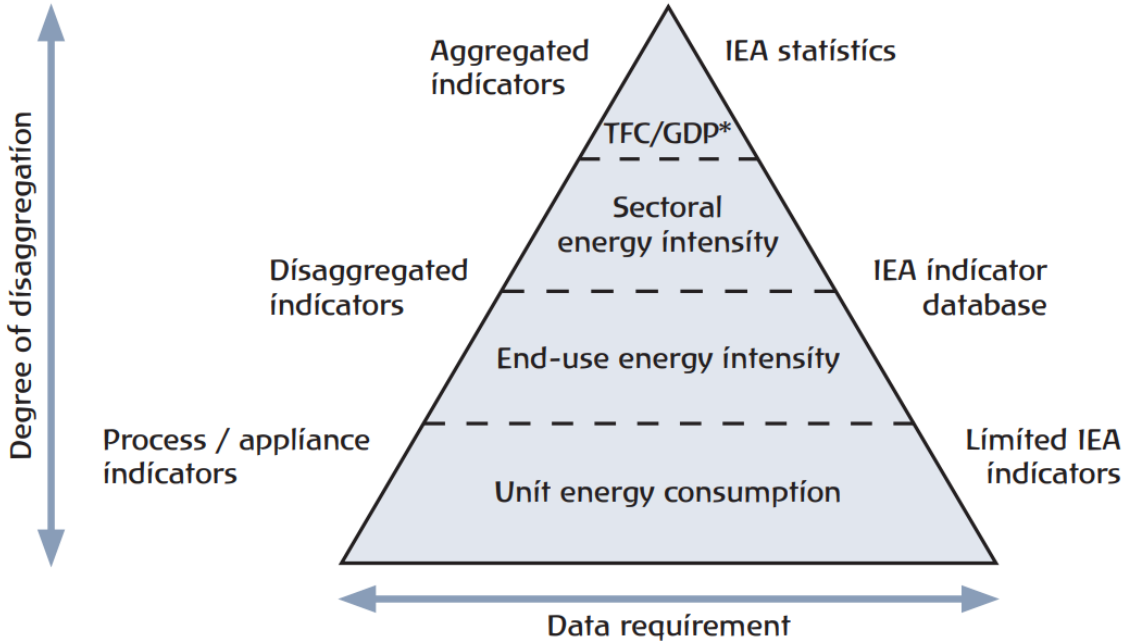
Developing energy efficiency indicators

Methodology to build indicators - the energy indicators pyramid

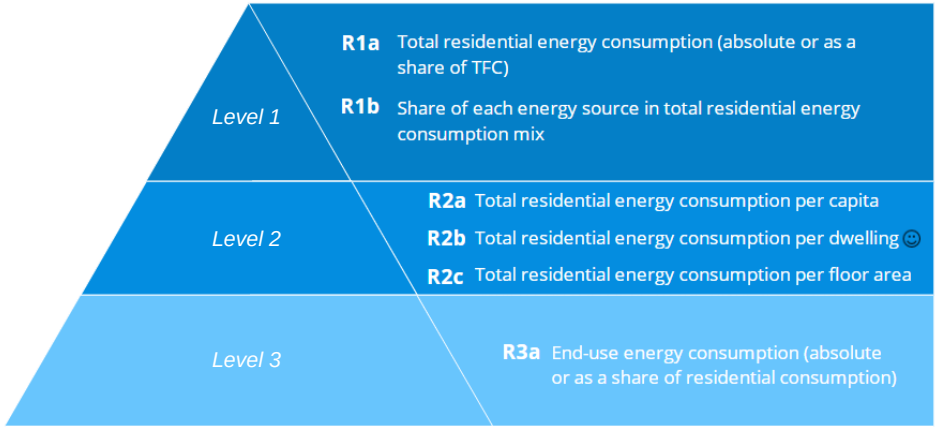
$$\text{Efficiency indicator} = \frac{\text{Energy}}{\text{Activity}}$$



Source: [Energy Efficiency Indicators: Fundamentals on Statistics]

More refined data are necessary to build detailed indicators at the sub-sectoral (or process) level.

Methodology to build indicators - the energy indicators pyramid



Source: Energy Efficiency Indicators: Fundamentals on Statistics

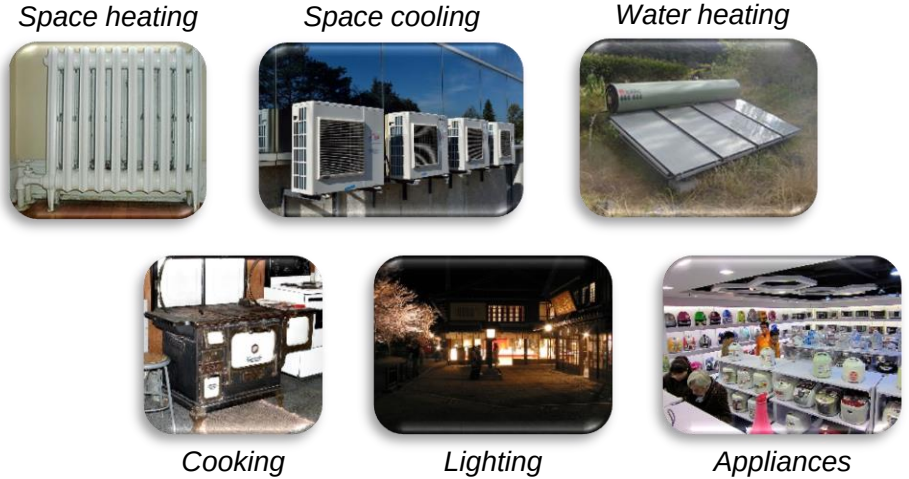
The further one goes down the pyramid of indicators the more detailed the data requirements are. Level one is the most aggregated and level three the most disaggregated.

Residential indicators – Energy and activity data

Energy consumption data

- Space heating*
- Space cooling*
- Water heating
- Cooking
- Lighting
- Appliances energy consumption
  (refrigerator, freezer, cloth washer, cloth dryer, dish washer, TV, computer)

**: Temperature corrected, using HDD and CDD*



Activity data

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

Residential indicators – Energy and activity data

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Population

Occupied dwellings

Residential floor area

Appliances stock and diffusion

Icon credits: agus raharjo (creative commons)

Occupied dwellings *vs* total dwellings

Primary residences

Unoccupied dwellings

Vacation homes

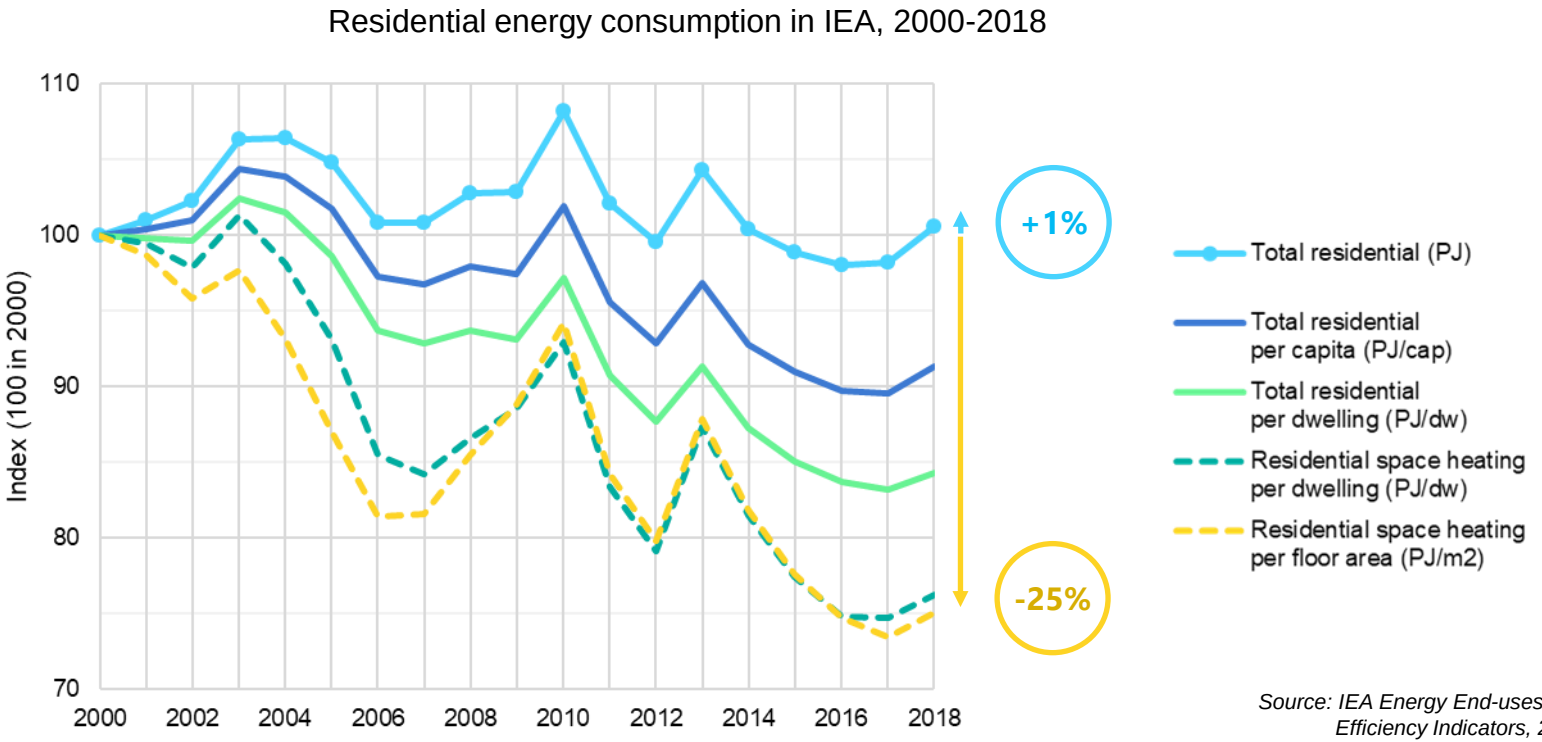
What indicators to use?

Indicator	Coverage	Energy data	Activity data	Code	Recommended indicator
Space cooling energy consumption per dwelling with air conditioning (A/C)	Overall	Total space cooling energy consumption	Total number of dwellings with A/C	C2a	
Space cooling energy consumption per floor area of dwellings with A/C	Overall	Total space cooling energy consumption	Total floor area cooled	C2b	☺
	By dwelling type	Space cooling energy consumption of dwellings type A	Floor area cooled of dwellings type A with A/C	C3a	
	By type of cooling system	Space cooling energy consumption of dwellings with A/C system α	Floor area cooled of dwellings with A/C system α	C3b	
	By energy source	Space cooling energy consumption of dwellings with A/C system energy source Z	Floor area cooled of dwellings with A/C energy source Z	C3c	
Lighting energy consumption per capita	Overall	Total lighting energy consumption	Total population	L2a	
Lighting energy consumption per dwelling	Overall	Total lighting energy consumption	Total number of dwellings	L2b	☺
	By dwelling type	Lighting energy consumption of dwellings of type A	Number of dwellings of type A	L3a	
Lighting energy consumption per floor area	Overall	Total lighting energy consumption	Total floor area	L2c	
	By dwelling type	Lighting energy consumption of dwellings of type A	Total floor area of dwellings type A	L3b	
Cooking energy consumption per capita	Overall	Total cooking energy consumption	Total population	K2a	

Each indicator has its benefits and drawbacks.
Best is to work with the available data, keeping in mind the hypotheses and the analysis' limitations.

Source: IEA (2014) – Energy efficiency indicators, Fundamentals on statistics

Explaining consumption trends require disentangling its drivers



Source: IEA Energy End-uses and Efficiency Indicators, 2020

Efficiency indicators help understand the trends and key drivers of energy consumption, here thanks to residential activity data: population, dwellings occupancy and size of dwellings.

Quiz

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Services energy end-use consumption and activity data

Energy data by end use

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

**: Temperature corrected, using HDD and CDD*

Energy data by subsector

11 subsectors
+ Of which: data centres

Activity data

- Value added
- Services floor area
- Number of employees

Space heating

Space cooling

Water heating

Lighting

Appliances

Services energy end-use consumption and activity data

Energy data by end use

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

**: Temperature corrected, using HDD and CDD*

Energy data by subsector

11 subsectors
+ Of which: data centres

Activity data

- Value added
- Services floor area
- Number of employees

Retail

Education

Warehousing

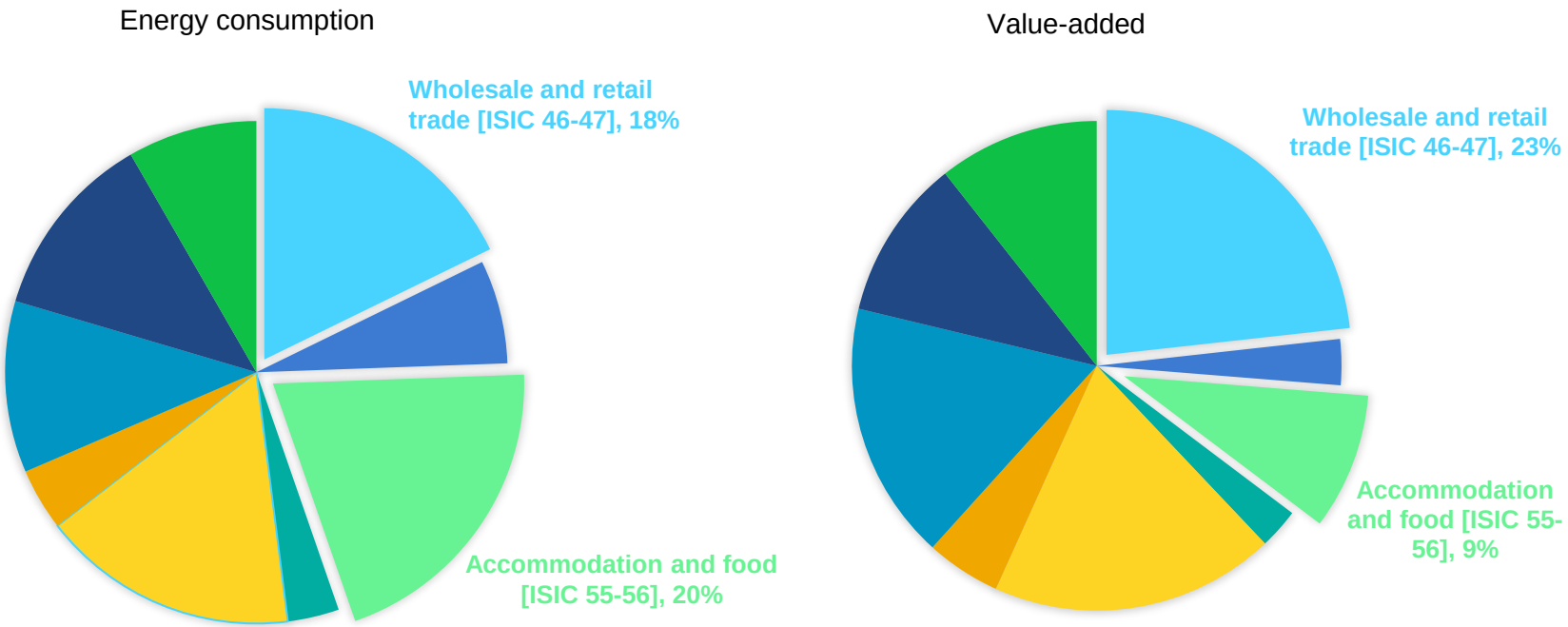
Health

...

Data centres

Detailed services data by sub-sector: consumption and value-added

Services by services sub-sector, Switzerland, 2022



Source: IEA Energy End-uses and Efficiency Indicators, 2024

Detailed data allow to understand which activity drives energy consumption and emissions.

Quiz

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Methods of collecting data

Methods to collect residential end-use and activity data

 *Administrative sources*	**Basis** as many data are often already gathered. Essential starting point.	*National statistics office* *Land registry* *Building registers*
 *Survey*	Costly but **very effective**. To be **designed carefully**, ideally from existing one. **Representative sample** is key.	*Real estate* *Manufacturers / vendors* *Building managers or residents*
 *Measuring*	Costly but **very effective**. Often **focused** on specific equipment.	*Utilities* *Fuel vendors* *Smart meters*
 *Modelling*	**Complementary to survey** (e.g. for higher frequency) or stand-alone. Requires **robust input** data.	*Sales, stocks and replacement rates of heating / cooling systems and appliances* *New dwellings*

Always check what data may be available in other institutions and how to complete existing data collection, before setting a new one up.

Icon credits: Iconiqu; Nithinan Tatah

Survey Parameters

- **Sample size:** Compliant with other national household surveys (1 000 – 8 000 households)
- **Data collection:** on-site (computer-assisted, or pen and paper diary combined with metering); telephone
- **Timeframe, planning and collecting data:** about 3 months
- **Timeframe, processing and publishing:** about 2 weeks
- **Processing and publishing:** prepare survey results for administrative regions

Questionnaire Design: Detailed Surveys

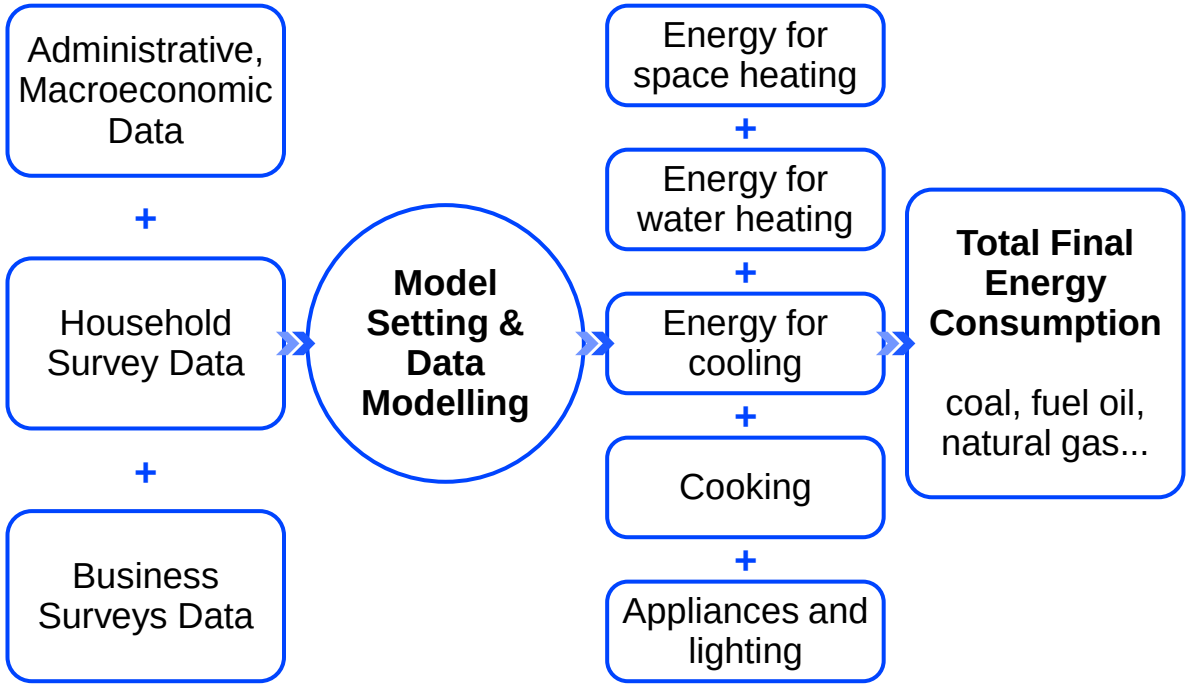
Purpose of energy use: cooking, cooling, space heating, water heating, appliances and lighting

	Energy forms	How many households use this energy product?	Out of which for: COOKING	Out of which for: LIGHTING	Out of which for: SPACE HEATING	Out of which for: WATER HEATING	Out of which for: COOLING	Out of which for: LIGHTING	Out of which for: OTHER PURPOSES
		Number	Number	Number	Number	Number	Number	Number	Number
	1	2	3	4	5	6	7	8	9
1a	Electricity from grid								
1b	Electricity from mini grids								
1c	Electricity from batteries								
1d	Electricity from own solar PV (solar energy)								
1e	Electricity from own Wind PP								
2	Liquid petroleum gas								
3	Gas/diesel oil (LNG)								
4a	Fuel oil – direct use								
4b	Fuel oil – for electricity generator								
5	Coal								
6	Charcoal								
7a	Fuel wood								
7b	Wood waste and wood chips								
7c	Wood pellets, brickettes, others								
8	Paraffin oil (official “Kerosene”)								
9	Animal waste/dung								
14	Other								

- **Expanded basic data questionnaire**
- **Key target: identifying** structure of end-uses

Processing Models for Survey Data

- Significant human resources: statisticians, energy analysts, energy experts
- 3-5 months' work for first-time model setting
- After setting data processing models, set annual model for data calibration between survey years



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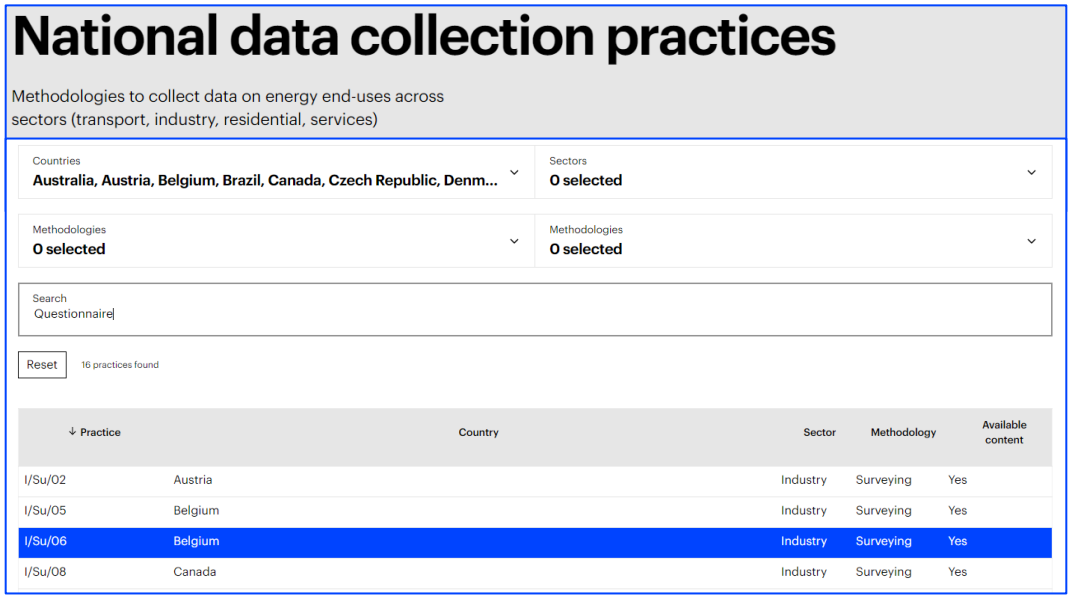
IEA tools for data capacity development.

An experience database to foster dialogue with other countries



Contact us at EnergyIndicators@iea.org and share your practice

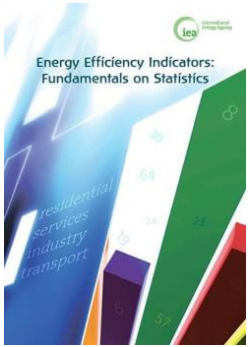
https://www.iea.org/articles/national-data-collection-practices

A searchable database, gathering data collection practices from a variety of countries, to share expertise worldwide.

IEA resources : methodologies on indicators and e-learning courses

Fundamentals on statistics:
to provide guidance on how to collect the data needed for indicators

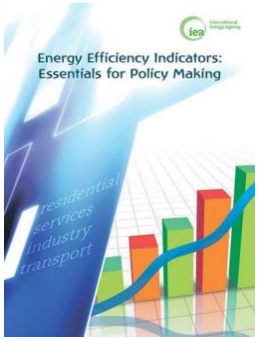
- Includes a compilation of existing practices from across the world
- https://www.iea.org/reports/energy-efficiency-indicators-fundamentals-on-statistics



Available in:
Spanish
Russian
Chinese
French

Essentials for policy makers:

- To provide guidance to develop and interpret indicators
- https://webstore.iea.org/energy-efficiency-indicators-essentials-for-policy-making



Available in:
Spanish
Russian
Chinese

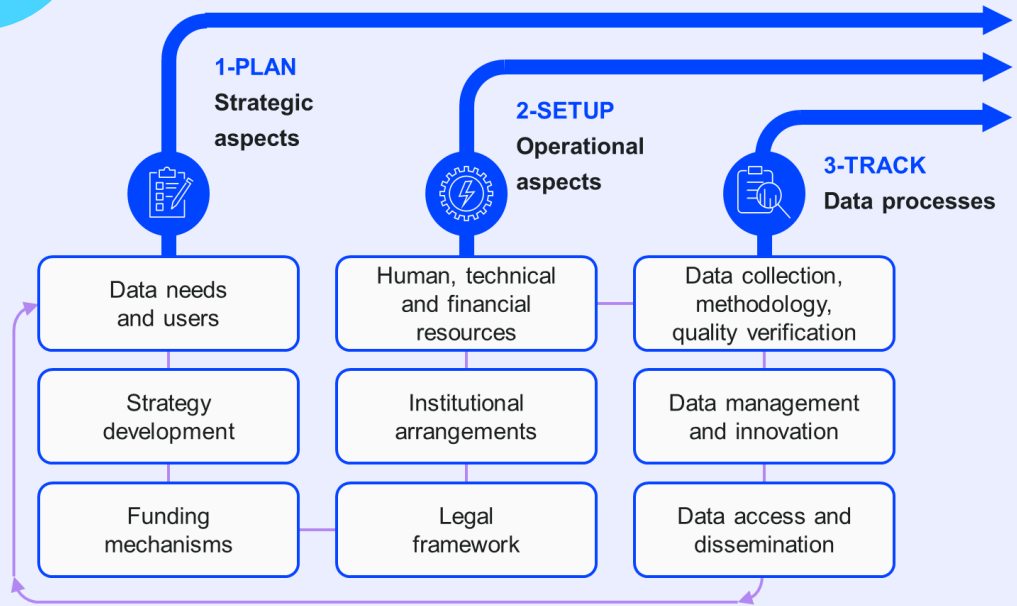
IEA e-learning courses on energy efficiency data:

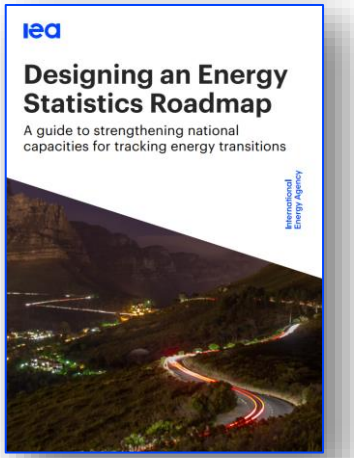
- https://elearning.iea.org/

https://www.iea.org/data-and-statistics/data-product/energy-efficiency-indicators#documentation

New IEA guidebook – released in September 2024

Based on IEA's **international collaborative experience**, including a **consultation** of several country data experts worldwide





https://www.iea.org/reports/designing-an-energy-statistics-roadmap

Conclusion

The importance of detailed end-use and energy demand data

- ✓ By providing detailed insights into energy consumption, demand-side data **enables policymakers, researchers, and industry stakeholders to make informed decisions, track progress, and implement effective strategies.**

- ✓ Reliable demand-side data also **improves energy modelling, allowing for more accurate projections of future energy needs.** Detailed demand-side energy data, coupled with activity data, **enables the development of energy efficiency indicators that track progress and measure improvements over time.**

- ✓ IEA is pleased to collaborate with countries to enhance demand-side data collection and analysis.

Thank you for your attention

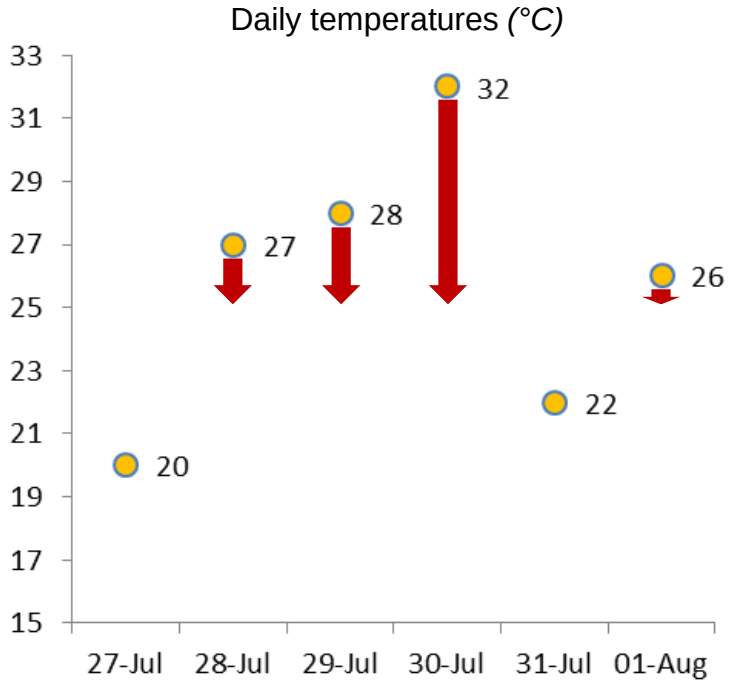
Any question? EnergyIndicators@iea.org

APPENDIX
How to perform temperature correction?

Temperature correction – Cooling degree days

Method for CDD

1. Set a temperature threshold
2. For each day, compute the positive difference to the threshold
3. Sum up over the period



$$CDD = \sum_{i=1}^{365} (T_i - T_{base})^+$$

$T_{base} < T_i$

$CDD_{(27Jul\text{-}01Aug)} = 0 + 2 + 3 + 7 + 0 + 1 = 13$

With warmer weather, we consume more for space cooling in buildings.

Temperature correction – Adjusting energy consumption

Adjusted energy for space cooling
(simplified method)

$$E_{SC}^{adj.} = E_{SC} \times \frac{CDD^{avg}}{CDD_Y}$$

Adjusted energy consumption

Actual energy consumption

CDD of current year

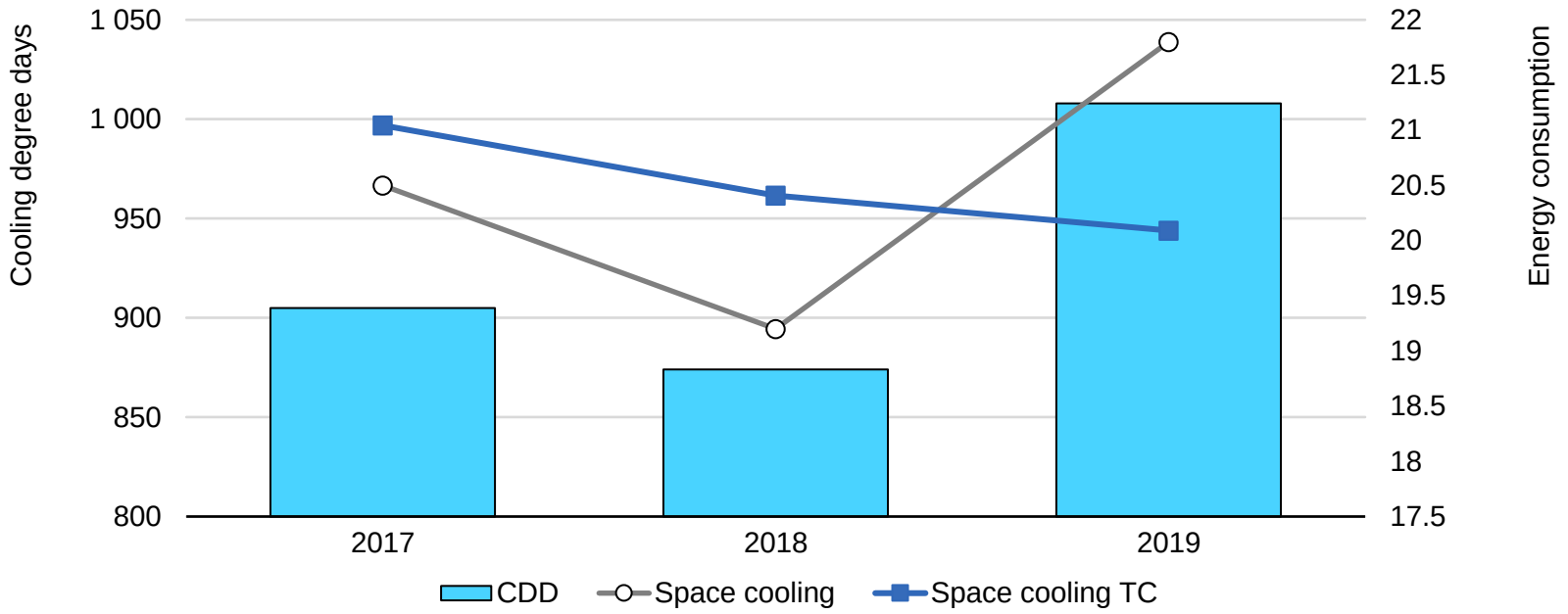
Average CDD

Calculation example

Average CDD over the period $CDD^{avg} = 929$

Year – Y	2017	2018	2019
CDD of year Y – CDD_Y	905	874	1008
Energy for space cooling – E_{SC} *(PJ)*	20.5	19.2	21.8
Adjusted energy for space cooling – $E_{SC}^{adj.}$ *(PJ)*	$20.5 \times \frac{929}{905} = 21.0$	$19.2 \times \frac{929}{874} = 20.4$	$21.8 \times \frac{929}{1008} = 20.1$

Temperature correction – Adjusted energy consumption



Temperature correction allows to identify more clearly the trends, removing the weather impact on consumption.

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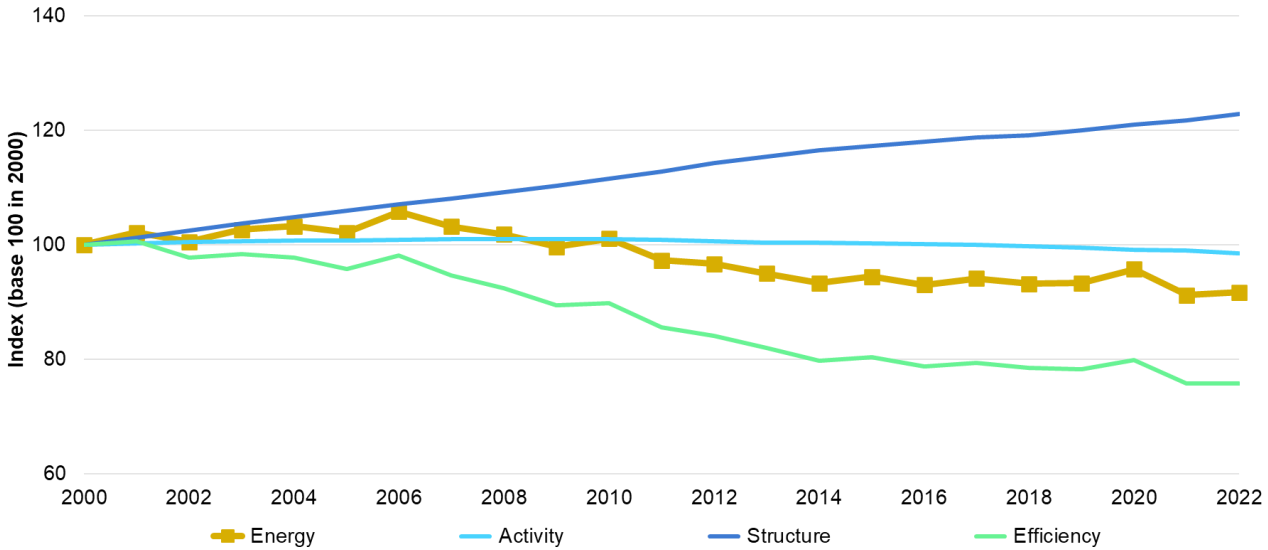
What drives the residential energy consumption?

Drivers of residential final energy consumption, Japan, 2000-2022



Source: IEA Energy End-uses and Efficiency Indicators, 2024

Kaya-like equation

Energy consumption

Energy efficiency (energy / activity)

$$E = \sum_{s,f} \frac{E_{s,f}}{A_s} \cdot \frac{A_s}{A} \cdot A$$

Economic structure (sectoral activity / total activity)

Total activity

for each end use s and for each fuel f

Decomposition analysis from detailed subsector and activity data gives the respective impact of key drivers of sectoral energy consumption, and providing key insights for policy design.