



Demand-side energy data in the industrial sector

IEA Demand Side Data and Energy Efficiency Indicators Workshop for Southeast Asia
Agnieszka KOSCIELNIAK, Statistics Manager, End-use data and efficiency indicators

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

Importance of collecting good energy data for industry

Why is the industry sector important?

- ✓ Economic development
- ✓ Employment
- ✓ Social welfare
- ✓ Competitiveness



- **SDG9:** Build resilient infrastructure, promote **inclusive and sustainable industrialization** and foster innovation

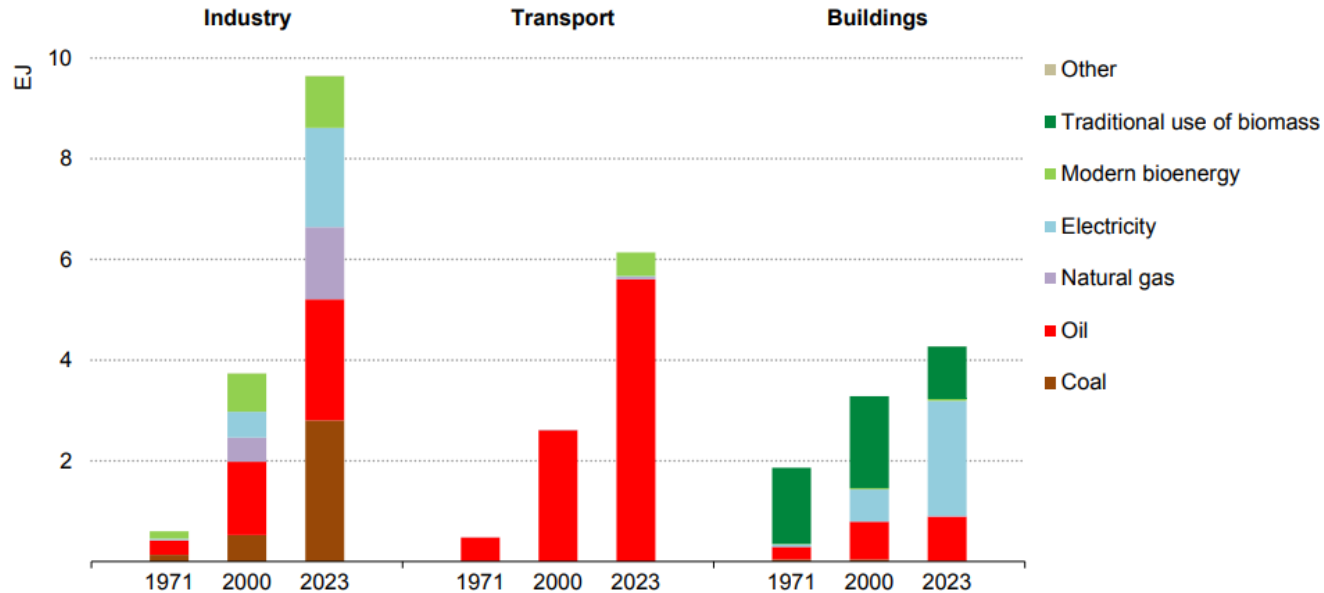
hand in hand with

- **SDG7:** Ensure access to **affordable, reliable, sustainable and modern energy for all**

**Energy is a key industrial resource: improved energy use helps meeting SDGs 9 and 7.
Tracking it is essential!**

Industry and transport have driven strong growth in energy consumption

Energy consumption by sector, 1971-2023



IEA. CC BY 4.0.

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

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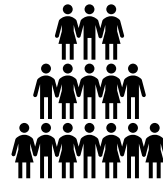
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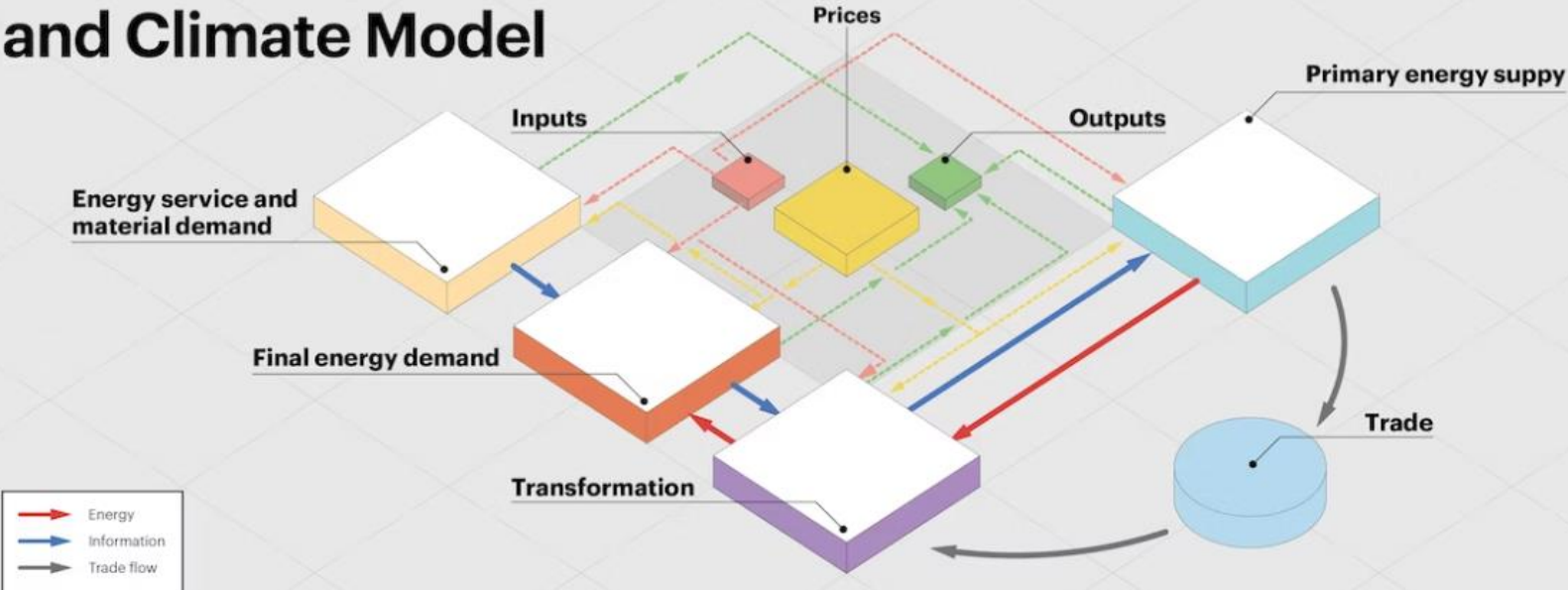


Which country are you currently
based in or represent?



Why end-use data are important?

Global Energy and Climate Model



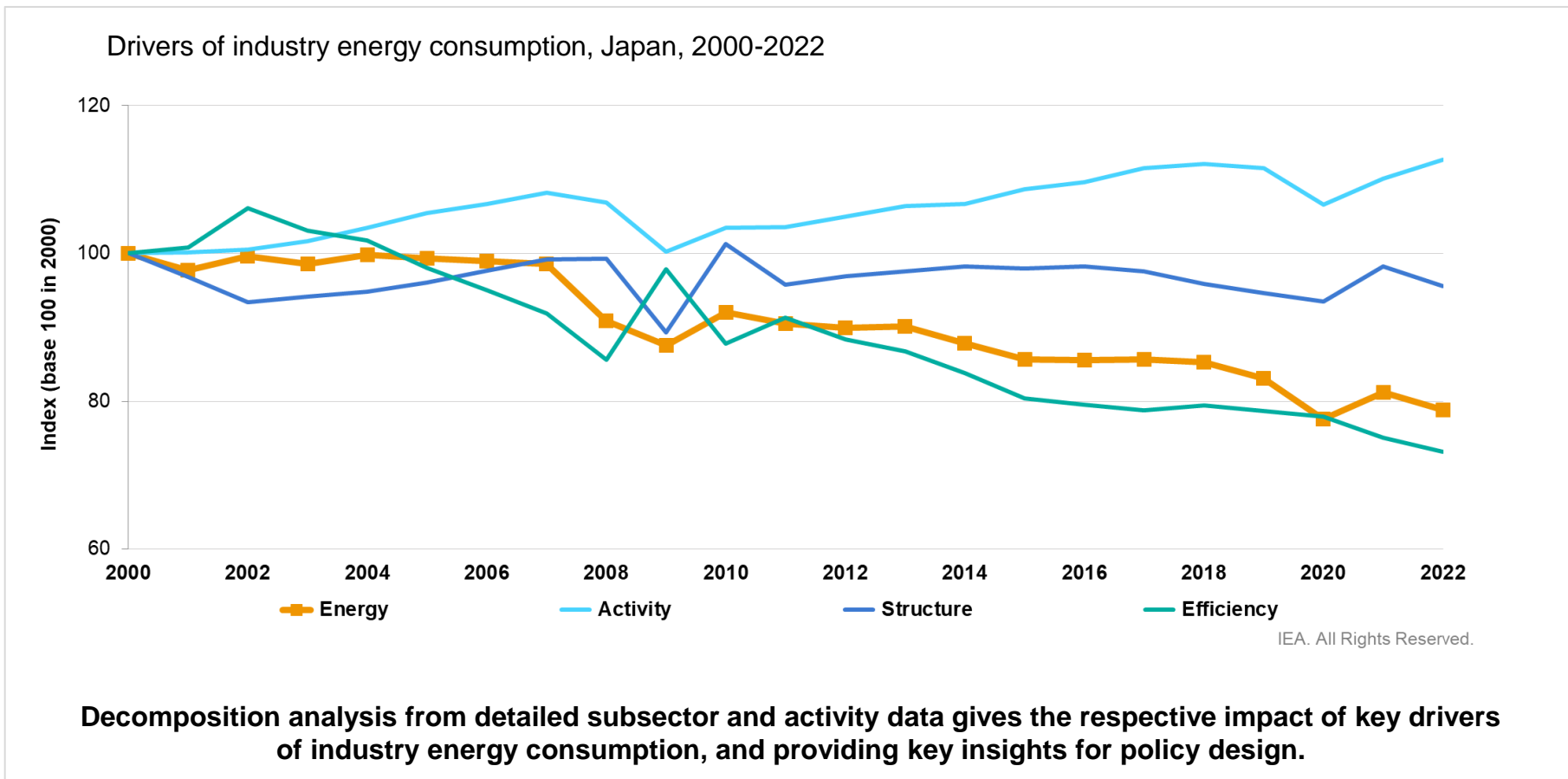
Disaggregated data allow more precise models and therefore policies

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

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

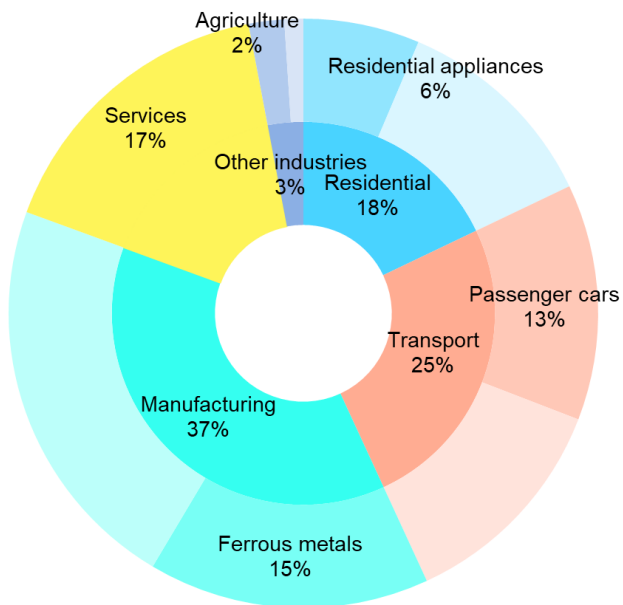
- **Energy efficiency indicators** are computed at the **end-use or sub-sectoral level**, or at an even more disaggregated level and **require disaggregated energy consumption data**.
- For example,
 - *space cooling energy consumption per dwelling,*
 - *passenger cars energy consumption per passenger-kilometre.*

What drives the industry energy consumption?



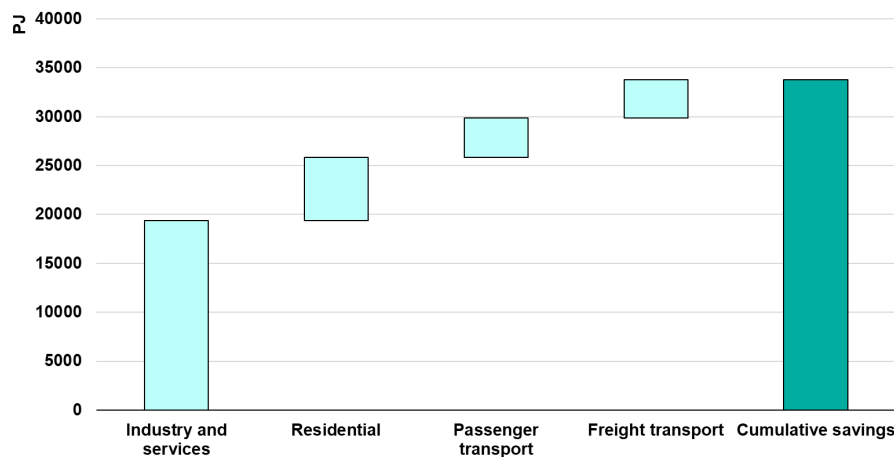
What we can learn from efficiency indicators – key points

Largest end uses by sector, 2022, Japan



Total final consumption: 10 221 PJ

Estimated cumulative energy savings from efficiency by sector, 2000-2022, Japan



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In the past two decades, Japan cumulatively saved quarter of its 2022 energy consumption. These savings mostly come from industry and services.

How to classify sub-sectors and products?

Energy balances are a compact source of information

2022

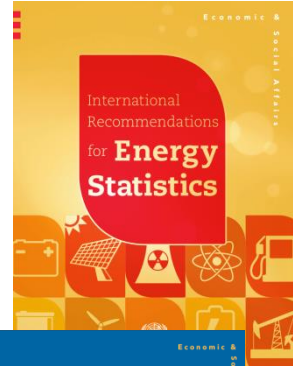
		MILLION TONS OIL EQUIVALENT										
SUPPLY AND CONSUMPTION		Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geotherm Solar etc.	Biofuels & waste	Electricity	Heat	Total
Supply	Production	4249.8	4499.2	-	3502.6	700.3	374.0	454.2	1290.3	-	1.5	15071.9
	Imports	802.5	2345.2	1365.6	1028.1	-	-	-	38.6	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	-	-	-
TES		4105.8	4549.3	-61.3	3436.9	700.3	374.0	454.2	1301.3	-2.2	1.5	14860.0
Transformation and energy industries own use	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
Final consumption	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 service	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

Demand side

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



- In the United Nations (UN) International Recommendations of Energy Statistics (IRES):
 - **Industry** refers to the manufacture of finished goods and products, as listed under “**manufacturing industries and construction**” within the UN IRES and outlined International Standard Industrial Classification (ISIC) codes.
 - IEA: Definition of industry sector activities follow IRES definitions, and outlined ISIC codes.
 - Services sector separate in IRES.
 - Excludes upstream power generation, refineries, and distribution of electricity, gas and water (transformation sector).
- In terms of energy consumption, the industry sector covers all energy-using activities across industries.
 - It excludes all transport related activities.

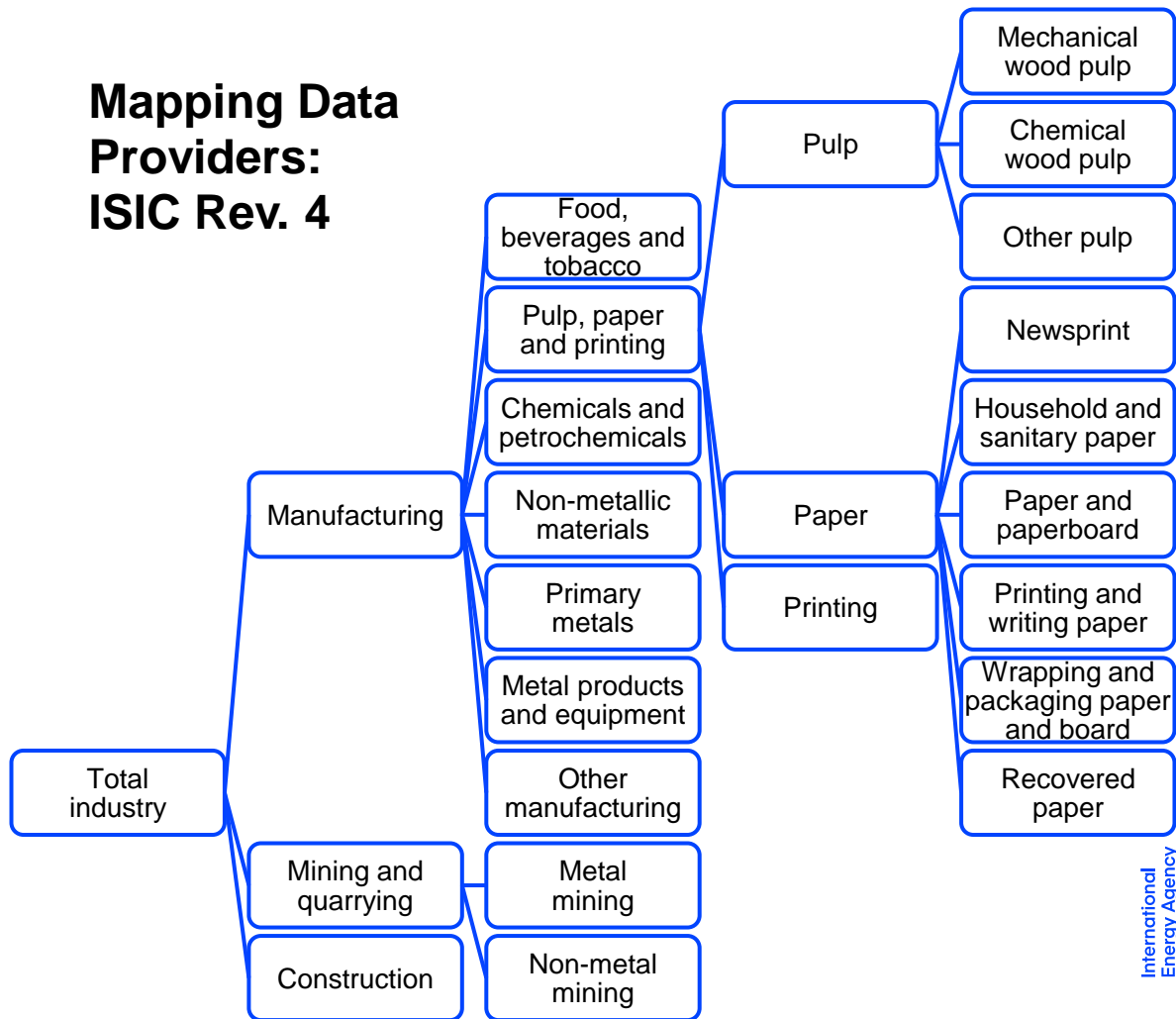


Section	Divisions	Description
A	01-03	Agriculture, forestry and fishing
B	05-09	Mining and quarrying
C	10-32	Manufacturing
D	35	Electricity, gas, steam and air conditioning supply
F	41-43	Construction
E, G-U	33, 36-39, 45-99	Commercial and public services

International Standard Classification of Economic Activities (ISIC)

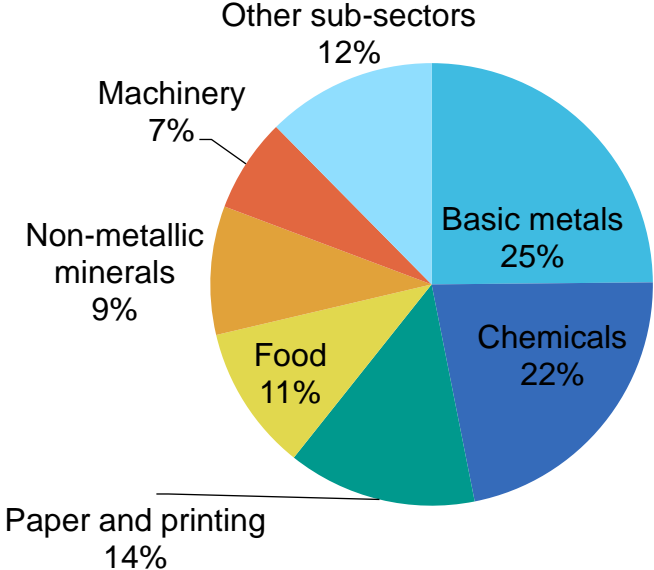


Mapping Data Providers: ISIC Rev. 4



Focus on manufacturing energy use: what are the key sectors?

Manufacturing energy consumption by subsector, 2021, IEA



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

Products scope – detail information on coal, gases, oil, ect.

PRODUCT	FLOW	Total final consumption	Industry	Mining and quarrying	Construction	Manufacturing	Iron and steel
Anthracite		20,901	17,816	53	22	10,734	1,657
Coking coal		18,286	18,285	0		13,426	6,000
Other bituminous coal		533,225	403,403	4,396	1,779	332,971	106,300
Sub-bituminous coal		20,870	20,191	299	7	16,918	930
Lignite			7,688	58	33	7,473	64
Patent fuel			3,975	57	0	3,816	1,226
Coke oven coke			79,151	1,704	15	76,973	55,777
Gas coke		6	6			6	6
Coal tar		10,086	7,948	3		7,829	1,270
BKB		2,802	1,716	31	7	1,672	406
Gas works gas	t	7,460	6,545	65		6,350	184
Coke oven gas		40,551	34,649	248		33,722	28,393
Blast furnace gas		100,875	100,873			100,873	100,719
Other recovered gases		15,245	15,226			15,226	15,111
Peat		281	88			88	0
Peat products		385	108	0	1	107	
Oil shale and oil sands		75	19				
Natural gas	t	1,690,396	674,543	9,221	12,785	463,297	58,961
Crude oil		3,414	1,791		0	2	
Natural gas liquids		3,464	28			22	
Refinery feedstocks							
Additives/blending components		48					
Other hydrocarbons							
Refinery gas		11,723	8,544			8,285	0
Ethane		97,506	190			190	0
Liquefied petroleum gases (LPG)			34,365	469	953	27,723	1,197
Motor gasoline excl. biofuels			2,058	229	458	191	6
Aviation gasoline			0			0	
Gasoline type jet fuel							
Kerosene type jet fuel excl. biofuels		268,787	178	31		3	
Other kerosene		31,326	2,059	25	480	907	94
Gas/diesel oil excl. biofuels		1,293,858	114,426	21,740	33,884	26,321	2,169
Fuel oil		241,558	47,515	2,459	675	19,005	2,188

COAL

OIL

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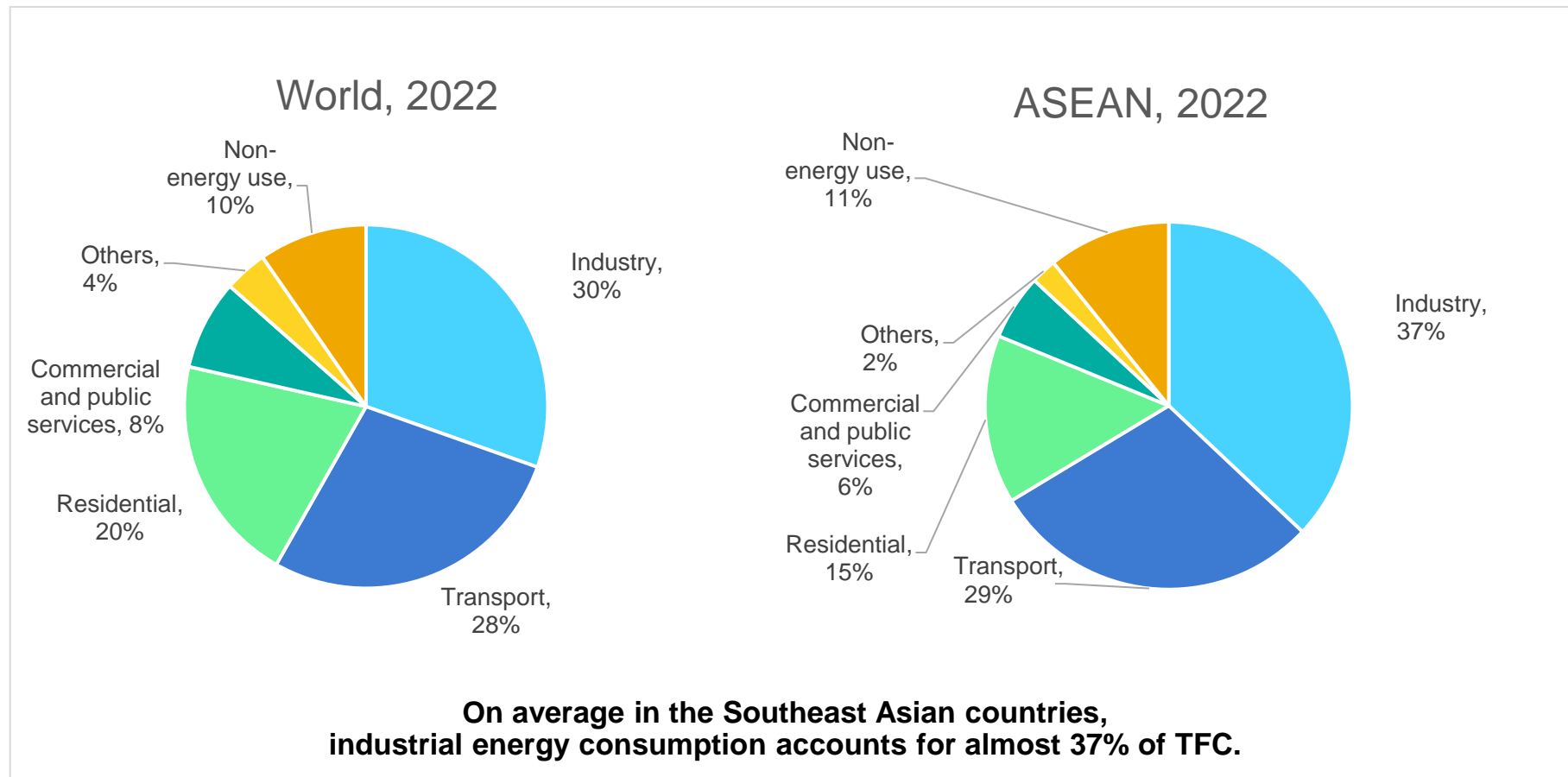
What can we learn from sub-sectoral data?

What can we learn from detailed industry consumption data?



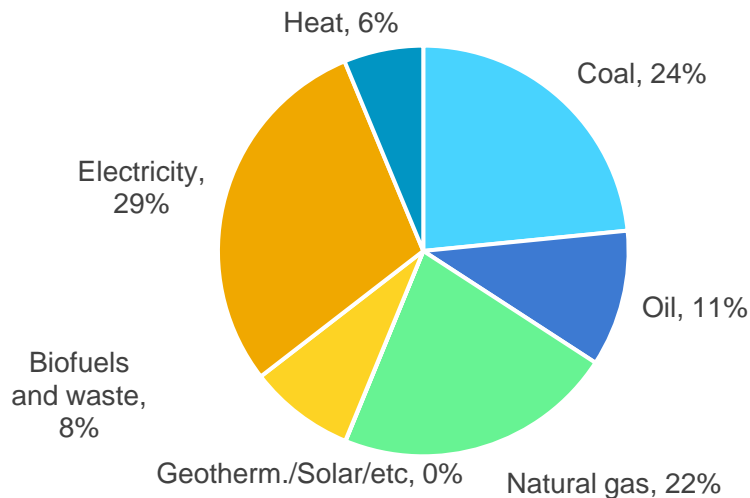
- Which **subsector produce** the most?
How does it relate to **energy consumption**?
- Which subsector will be the most affected in case of an **energy price spike**?
- How each sector is **exposed to energy security**?
- Are we using energy for manufacturing **more efficiently** over time?
- How does it relate to **GHG emissions**?

Total final consumption (TFC) by sector

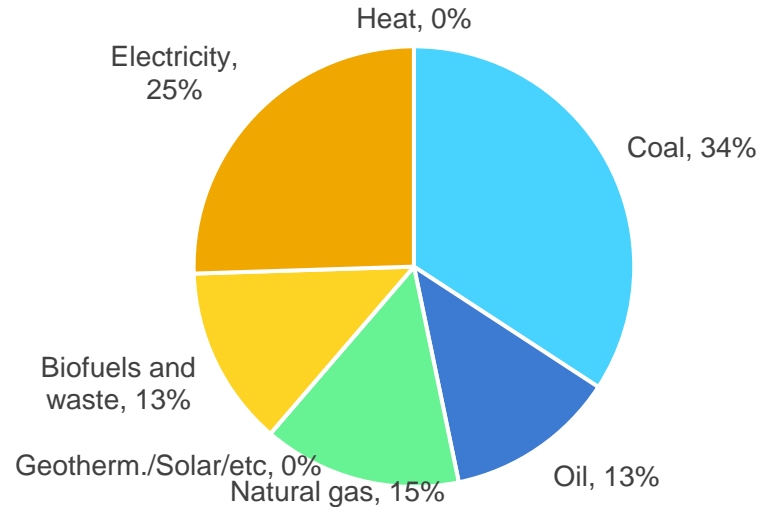


Industry¹ energy consumption by fuel

World, 2022



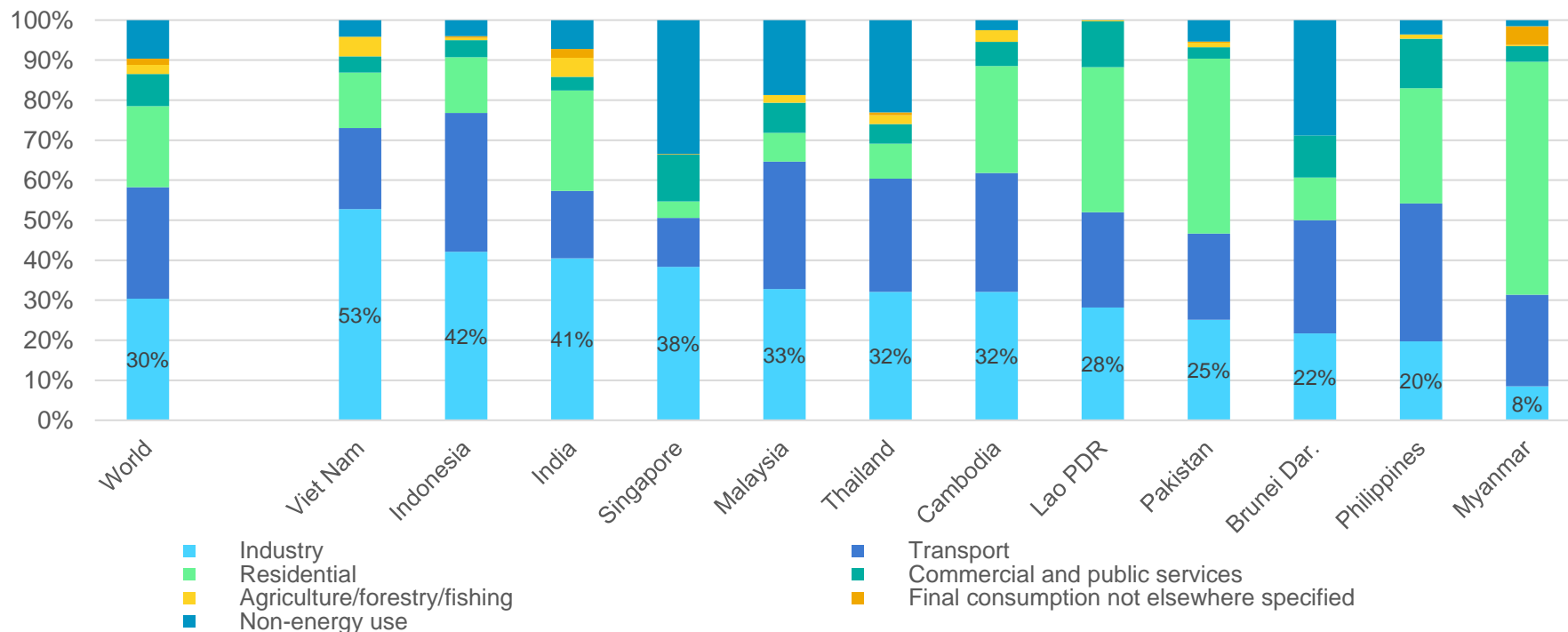
ASEAN, 2022



The industry¹ sector relies on coal for 34% of its energy needs in Southeast Asia.

Which sector drives domestic demand?

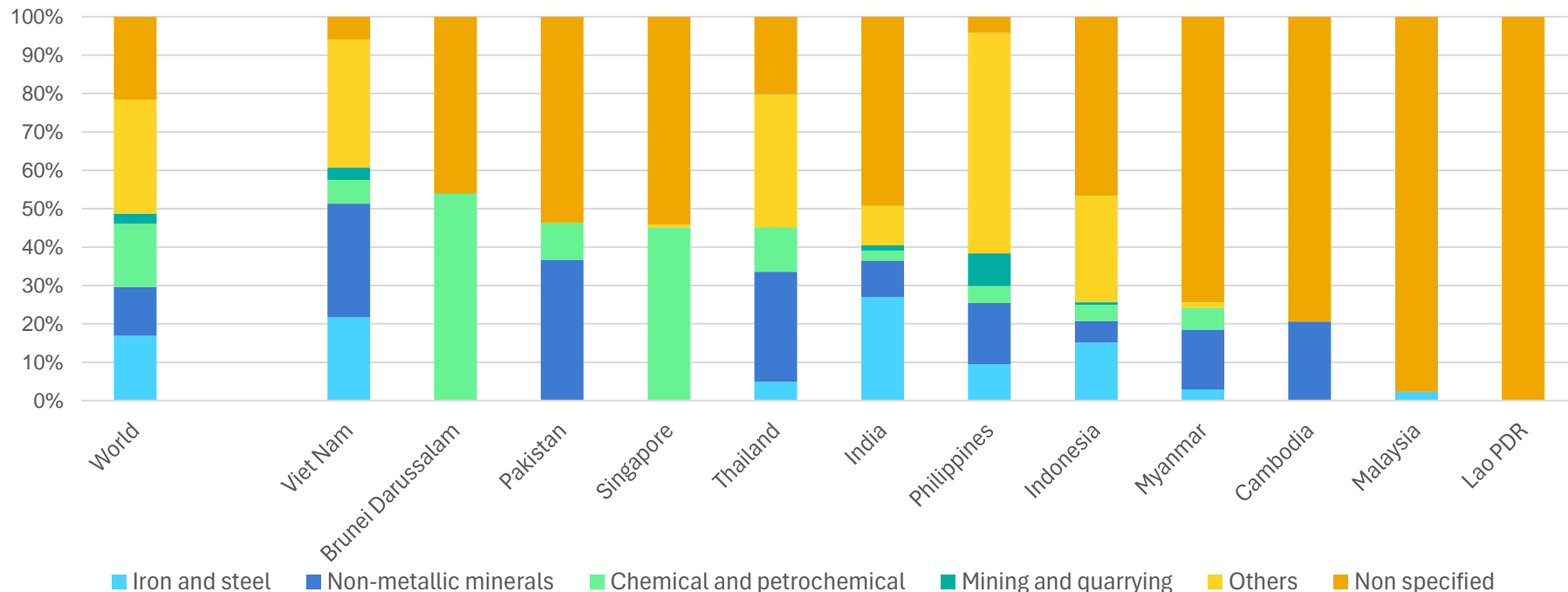
Total Final Consumption (TFC) by sector, 2022



According to the IEA world energy balances, industry consumptions accounts for 8-53% of TFC in.

Industry covers a wide diversity of subsectors

Energy consumption by industry subsector in selected economies in 2022

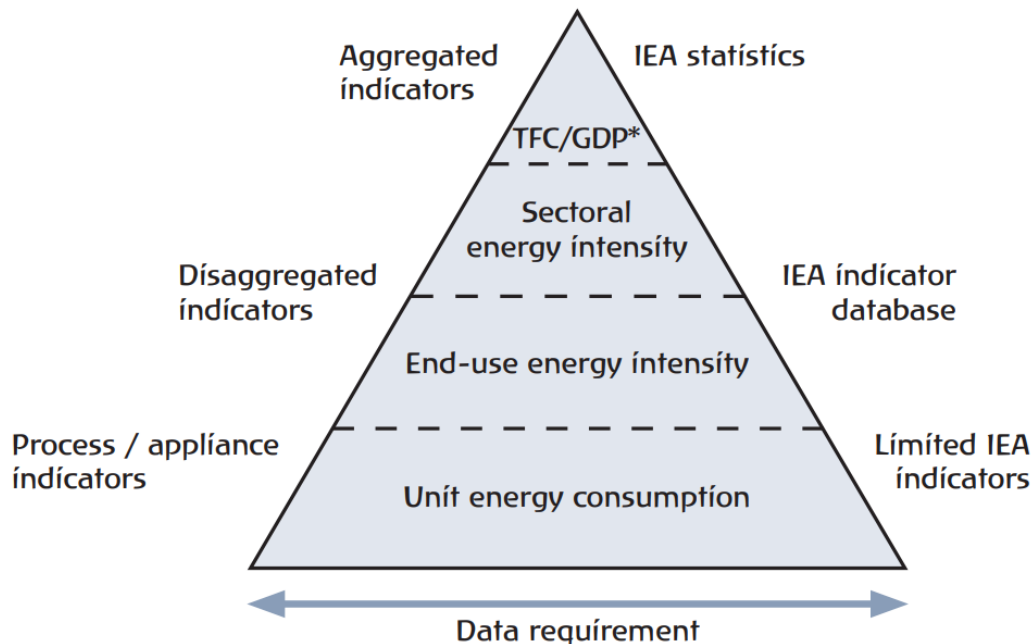


Energy intensive subsectors weigh differently in the industrial consumption of each economy. Steel, cement, chemicals and mining together account for 0 to 58%.

Developing energy efficiency indicators

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

Degree of disaggregation



Source: [Energy Efficiency Indicators: Fundamentals on Statistics](#)

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

Sectoral indicators of intensities – coupling energy with activity data

Consumption data by subsector

- Iron and steel
- Non-ferrous metals
- Pulp and paper
- Chemicals and petrochemicals
- Non-metallic minerals
- Automotive manufacturing
- Textiles
- Food and beverages
- Rubber and plastics
- ...

Activity data

- Value added
- Physical production

Iron and steel



Chemicals



Food and beverages



Rubber and plastics



Non-metallic minerals



Pulp and paper



Automotive



Textile



Physical production

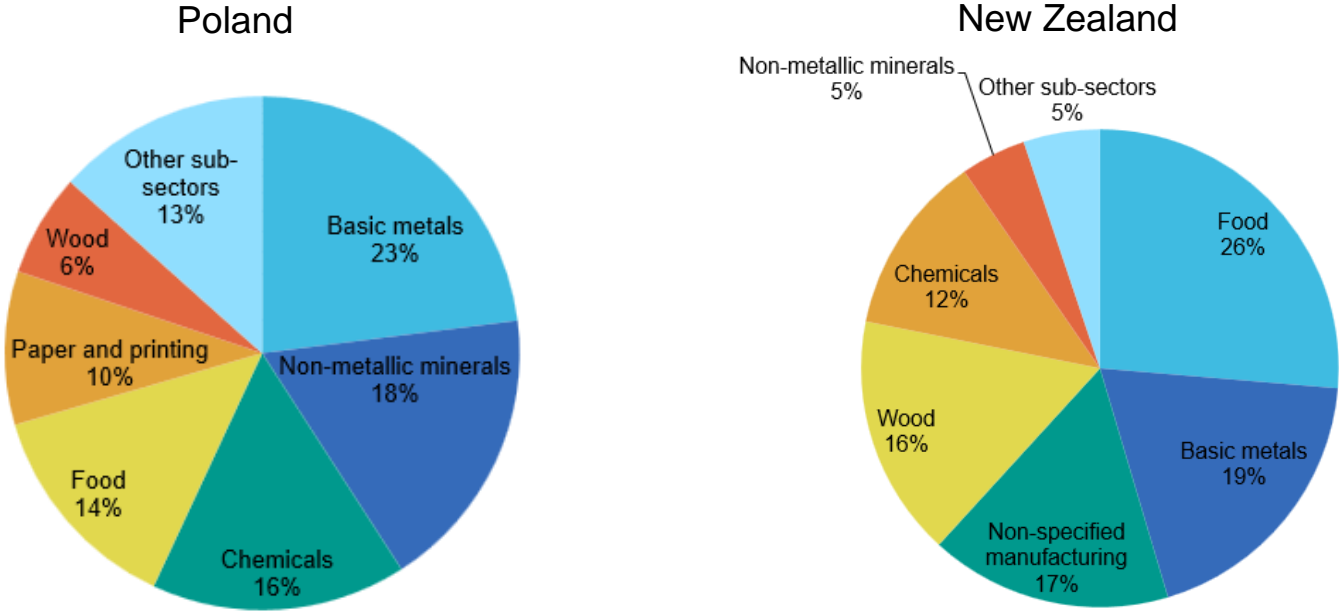


Value added

Detailed subsectoral data provides key information for policy focus



Manufacturing energy consumption by subsector, 2022



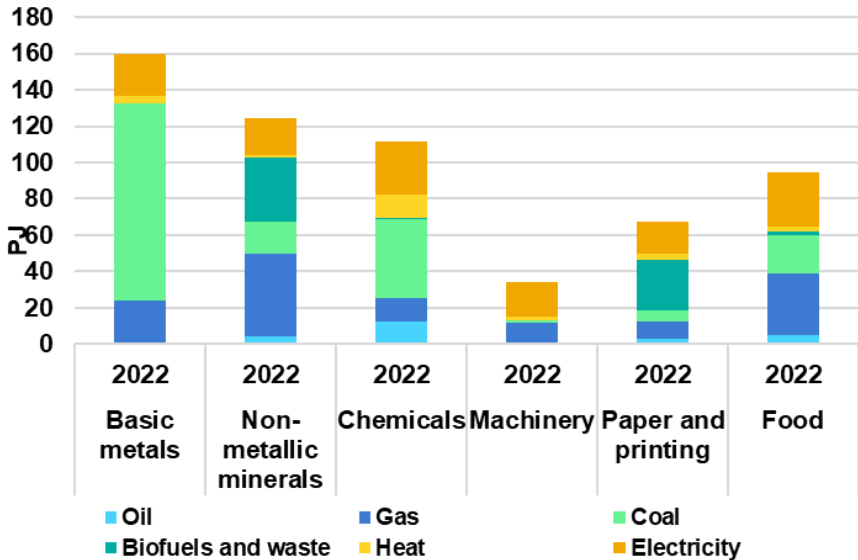
Detailed consumption by subsectors allows to put focus on key subsectors.

Fuel share by end use gives crucial insights on the energy system

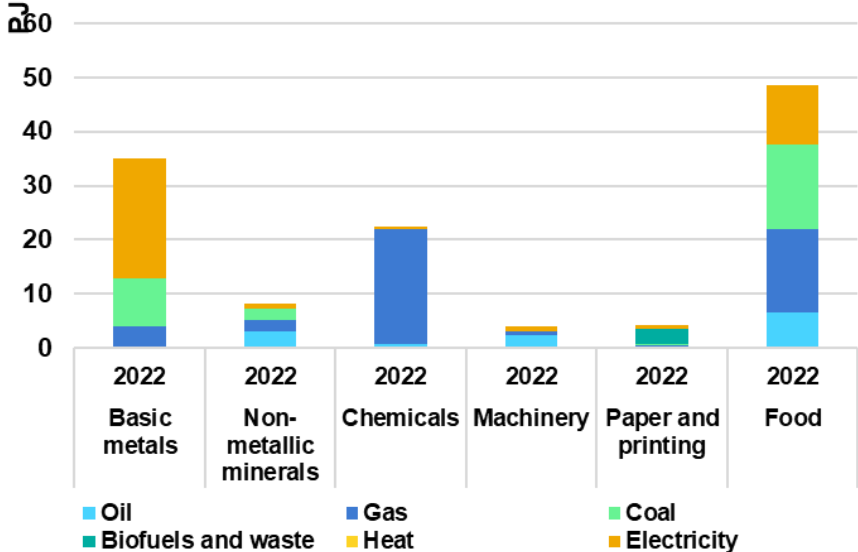


Manufacturing subsectors' energy consumption (selection) by fuel, 2022

Poland



New Zealand



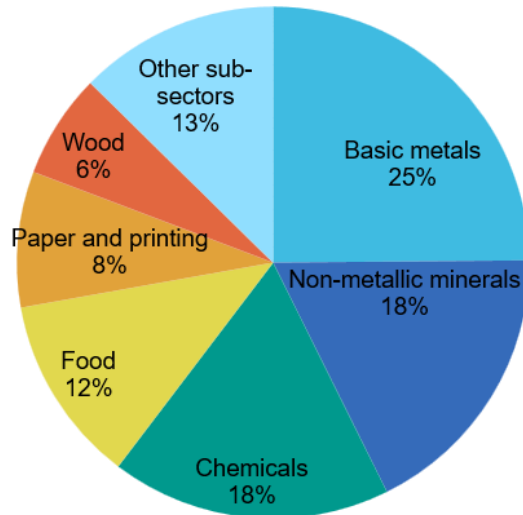
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Subsectors' consumption by fuel allows to understand the impacts of energy supply, technology deployment and prices variations on the industrial system, over time.

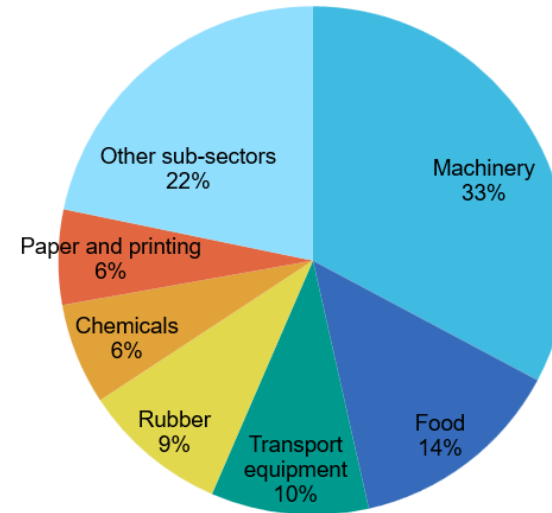
Relevant activity data to build efficiency indicators

Manufacturing data by subsector, Poland, 2022

Energy consumption



Value added

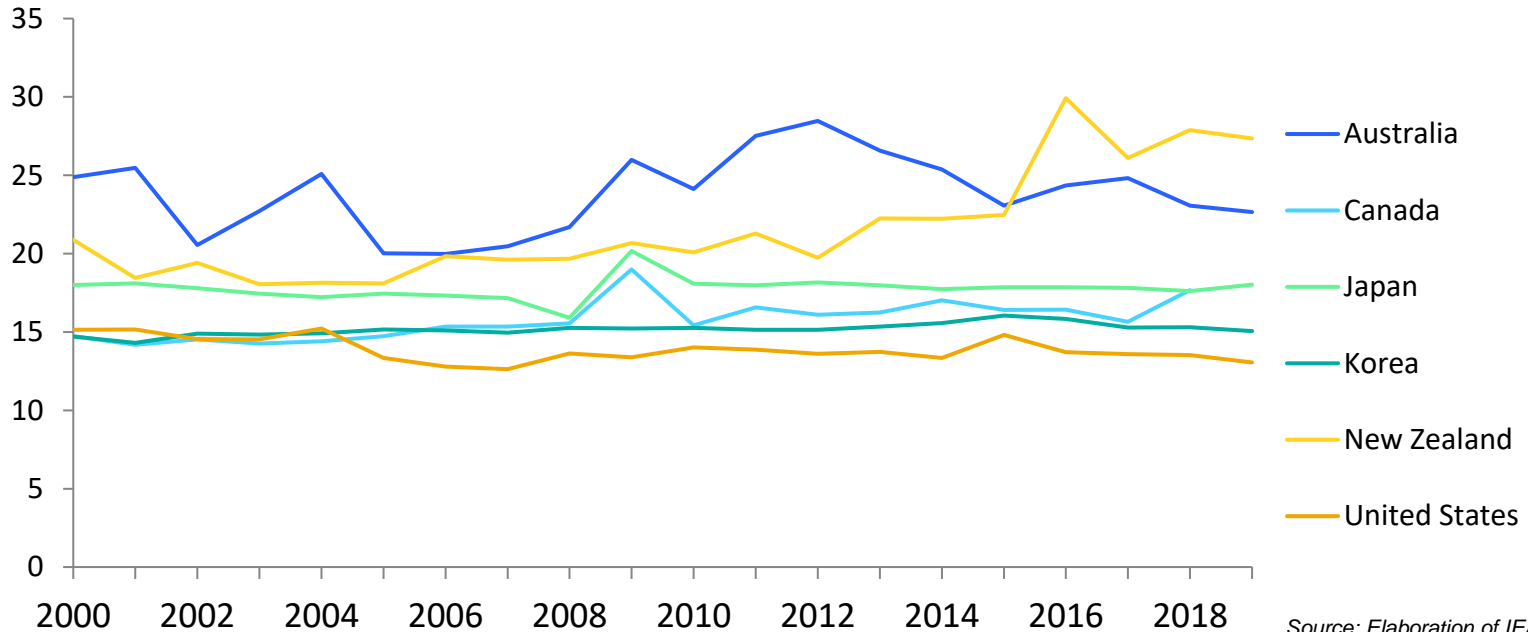


Value added, with similar level of details, is a simple, easily available activity data.

For Poland, basic metals and non-metallic minerals are the most energy intensive sub-sectors while machinery the least.

Physical production for targeted subsectors

Iron and steel energy intensity by tonne of crude steel, selected APEC-IEA economies, 2000-2019



Source: Elaboration of IEA data, based on Energy Efficiency Indicators Database

For some subsectors where products are more homogeneous, energy intensity per physical production can be a useful indicator to track improvements and compare regions.

What indicators to use?

Table 6.2 • Summary list of the most common indicators for the industry sector data

Indicator	Coverage	Energy data	Activity data	Code	Recommended indicator
Energy consumption per unit of physical output	Sub-sector	Total sub-sectoral energy consumption	Sub-sectoral physical output	IS2a	☺
	Process/product type	Process/product type energy consumption	Process/product type output	IS3a	
Energy consumption per unit of value added	Sub-sector	Total sub-sectoral energy consumption	Sub-sectoral value added	IS2b	
	Process/product type	Process/product type energy consumption	Process/product type value added	IS3b	

Each indicator has its benefits and drawbacks.

Best is to work with the available data, keeping in mind the hypotheses and the analysis' limitations.

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Methods of collecting data

Methods to collect industrial end-use and activity data



Administrative sources

Basis as many data are often already gathered. Essential starting point.

Ministry of Industry, Chamber of commerce
Industry associations
Reports of production / sales



Survey

Costly but **very effective**. To be **designed carefully**, ideally from existing one. **Representative sample** is key.

Energy companies (suppliers)
Manufacturers (e.g. cement)
Vendors and sale points



Measuring

Costly but **very effective**. Often **focused** on specific equipment.

Conventional meters
Smart meters (utilities inflow, consumption at point of use...)



Modelling

Complementary to survey (e.g. for higher frequency) or stand-alone. Requires **robust input** data.

Energy consumption from produced quantities
Use down the supply chain

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

Data Providers and Reporting: Basic Survey for all enterprises

- **Responsibility:** National Statistics Offices /Ministry in charge of Energy.
- **Questionnaire:** Enterprise's energy balance
- **Reporting period:** Calendar year Y-1
- **Periodicity:** Annual
- **Data providers:** All large and medium enterprises; small enterprise sample
- **Source:** Statistical National Register of enterprises
- **Implementation:** January – May, Y-0

Basic Survey Questionnaire

One question: Enterprise's energy balance

- Network-supplied electricity, gas and heat
- Market purchases (coal, oil, petroleum products, biomass)
- Energy from own stocks
- Energy produced in own transformation processes
- Energy used for processing
- Energy used for transportation, non-energy use, and other
- Value-added by service sector sub-category

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IEA tools for data capacity development.

National data collection practices

Methodologies to collect data on energy end-uses across sectors (transport, industry, residential, services)

Countries
Australia, Austria, Belgium, Brazil, Canada, Czech Republic, Denm... ▾

Sectors
0 selected ▾

Methodologies
0 selected ▾

Methodologies
0 selected ▾

Search
Questionnaire|

16 practices found

Practice	Country	Sector	Methodology	Available content
I/Su/02	Austria	Industry	Surveying	Yes
I/Su/05	Belgium	Industry	Surveying	Yes
I/Su/06	Belgium	Industry	Surveying	Yes
I/Su/08	Canada	Industry	Surveying	Yes

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.

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>

Essentials for policy makers:

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

IEA e-learning courses on energy efficiency data:

- <https://elearning.iea.org/>



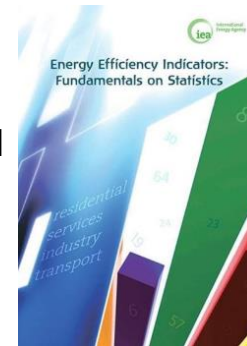
International Energy Agency

[Energy Efficiency Indicators: Fundamentals on Statistics](#)

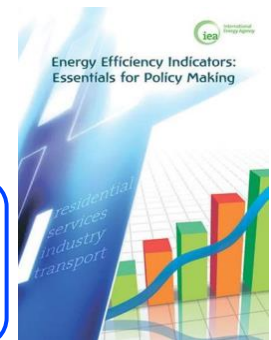


International Energy Agency

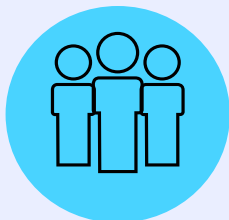
[Energy Efficiency Indicators: Essentials for Policy Making](#)



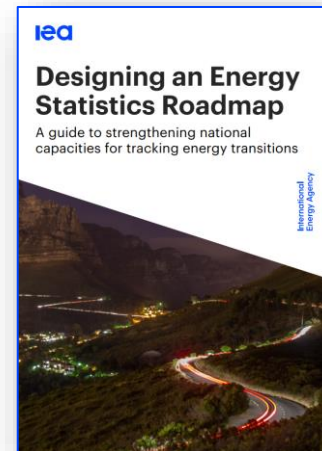
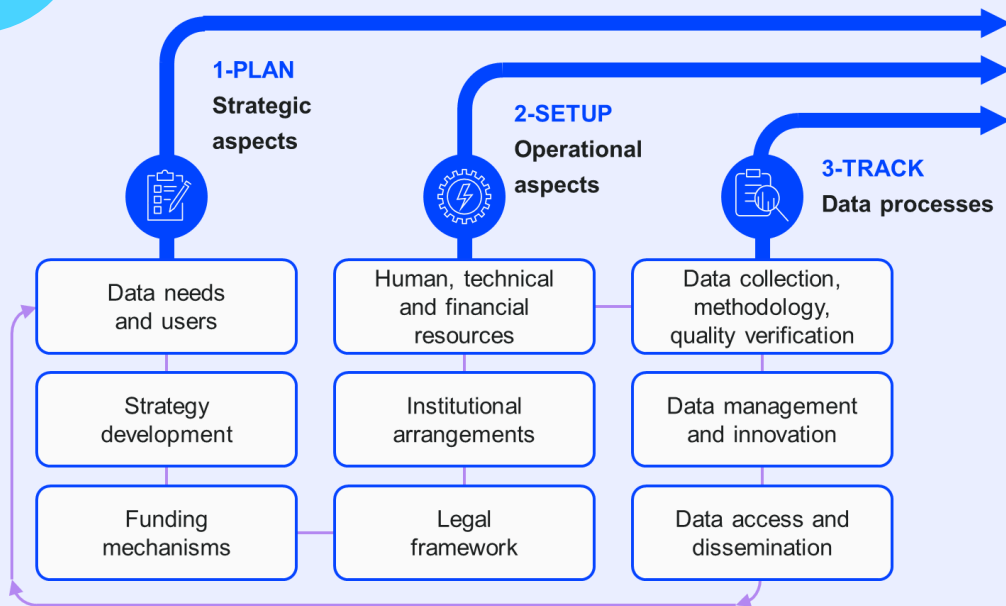
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Chinese



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



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

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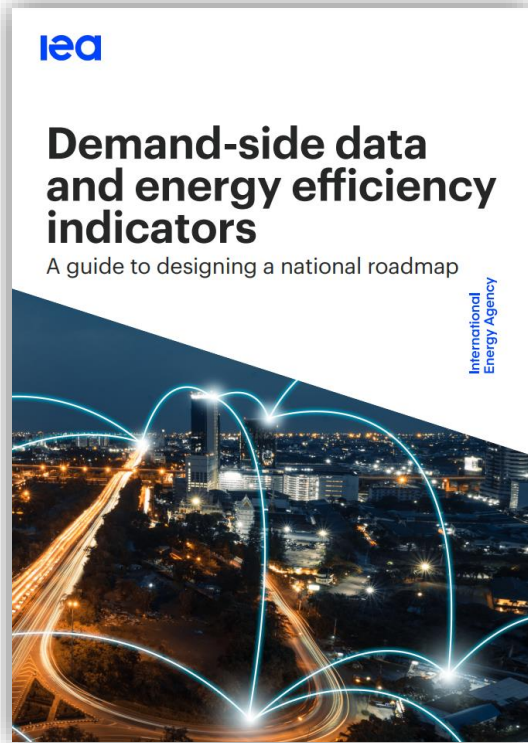
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The IEA guide to designing a data collection roadmap



<https://www.iea.org/reports/demand-side-data-and-energy-efficiency-indicators>

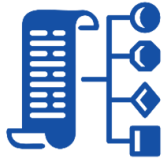
International frameworks based on real experiences foster capacity building on disaggregated data collections.

Practical Toolkit to derive indicators from various sources

WORK IN PROGRESS

The IEA is developing a **toolkit** which will serve for countries to **model the end-use data** bridging the gap from raw data to the end use data. The countries will be trained to use them, building capacity to produce end-use data on their own.

Country balances data



Ad hoc surveys



Third party surveys



Toolkit

Model (Excel file) where to insert the input data and calculate the end-use data using some default (or tailored) assumptions. Word file with guidelines with the explanation of the assumptions to take and for the use of the tool



End-use and efficiency indicators data

