International Energy Agency

# Tracking energy efficiency indicators in the industrial sectors

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Joint APEC-IEA training workshop on end-use energy consumption data – Nov. 17th 2022

# Why is the industry sector important?

**Industrial production provides us with fertilizers, processed food, various materials, tools and so much more!**

# Overview

1. What we can learn from the **energy balances**?

2. What can we learn from **end-use data and energy efficiency indicators**?

   **Examples** from APEC economies

   Collecting end use data and **developing indicators**

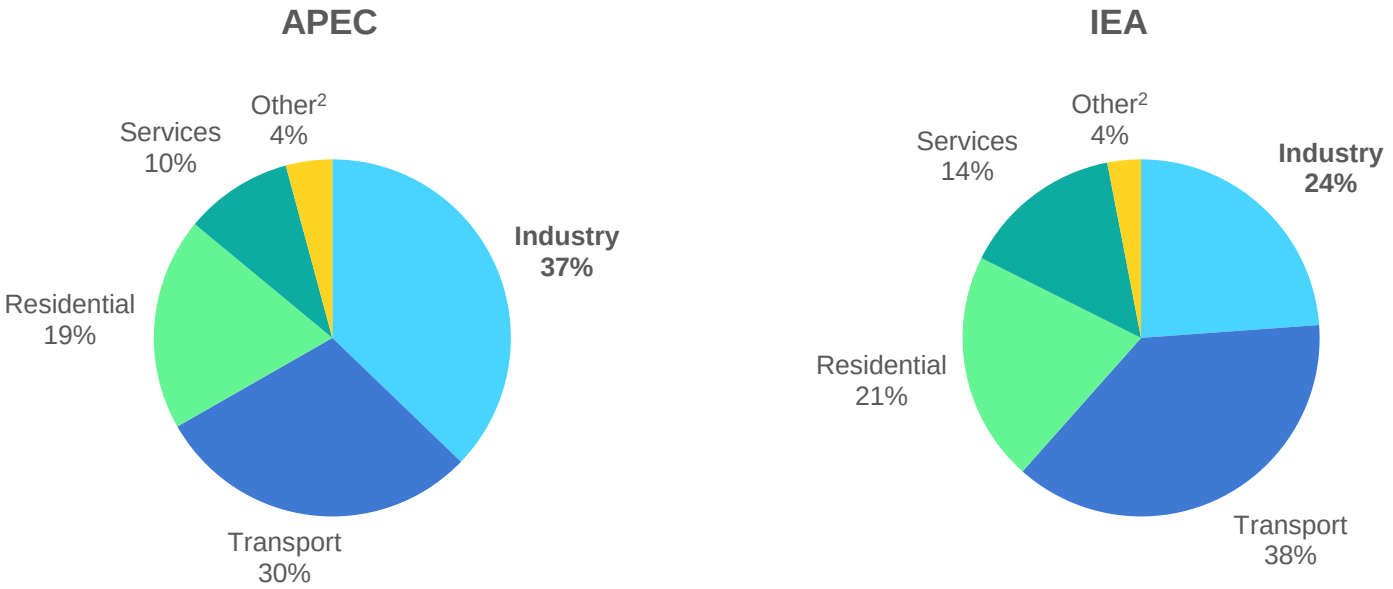
3. How to **collect data** on industrial subsectors?

   Data collection: **a dialogue** with other economies

# What can we learn from the energy balances?

# Industry consumes more than a third of final energy in APEC

Total final energy consumption[1] in APEC and IEA in 2019

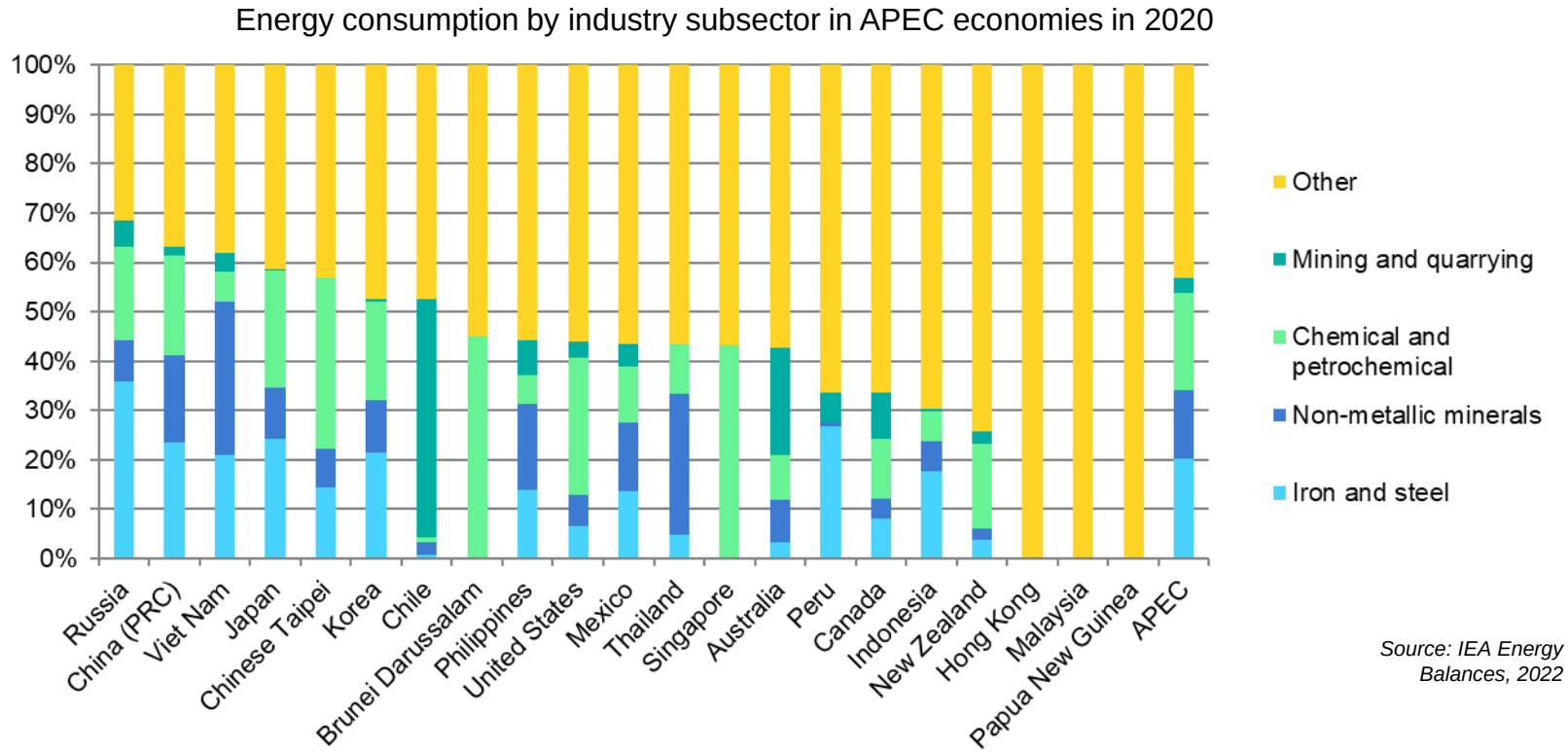



[1] *Total final energy consumption excluding non-energy use*
[2] *Other includes agriculture, forestry, fishing and non-specified final consumption*

*Source: IEA Energy Balances, 2021*

**Industry is the largest consuming sector in APEC, where it accounts for 37% of the final energy consumption, compared to 24% in the IEA. Its share has been stable within +/-2% over the past decade.**

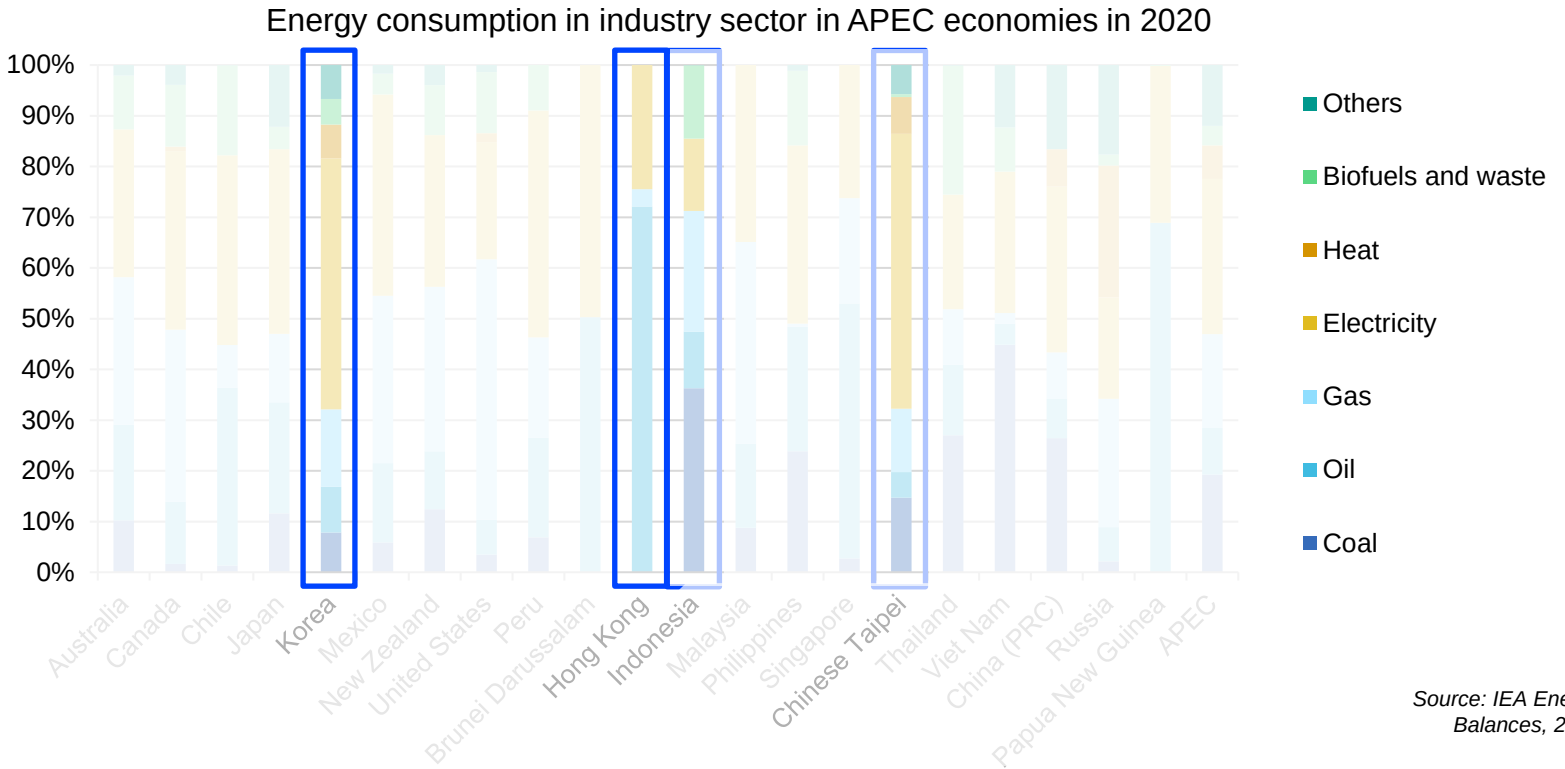
# Industry covers a wide diversity of subsectors




*Source: IEA Energy Balances, 2022*

**Energy intensive subsectors weigh differently in the industrial consumption of each economy. Steel, cement, chemicals and mining together account for 0 to 68%, and in most cases above 40%.**

# Fuel share in industrial sectors




*Source: IEA Energy Balances, 2022*

**Fuel share may vary depending on major sectors, electrification and fuels availability.**
**For instance, power and heat share range from 14 to 61%, while (direct) fossil fuels range from 32 to 76%.**

# What else do we need to know to track efficiency in industry?

- 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**?

*Photo credits: National Institute of Standards and Technology*

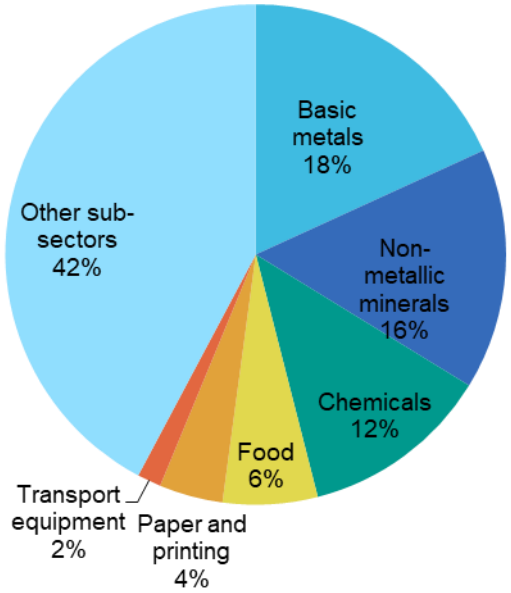
# What can we learn from end-use data and energy efficiency indicators?

# Examples from APEC economies

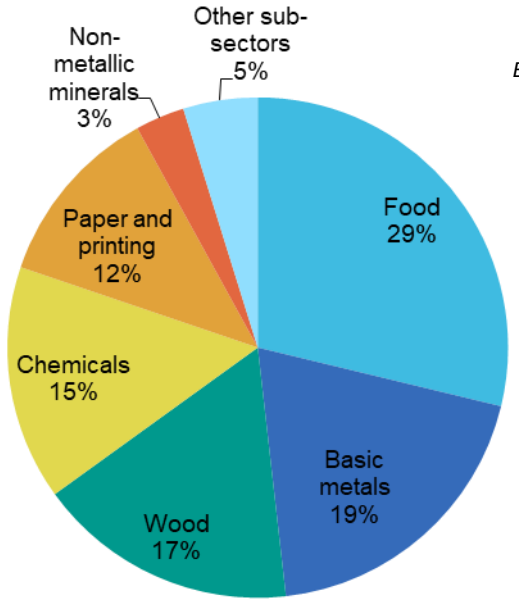
# Detailed subsectoral data provides key information for policy focus

Manufacturing energy consumption by subsector, 2020

Mexico




New Zealand



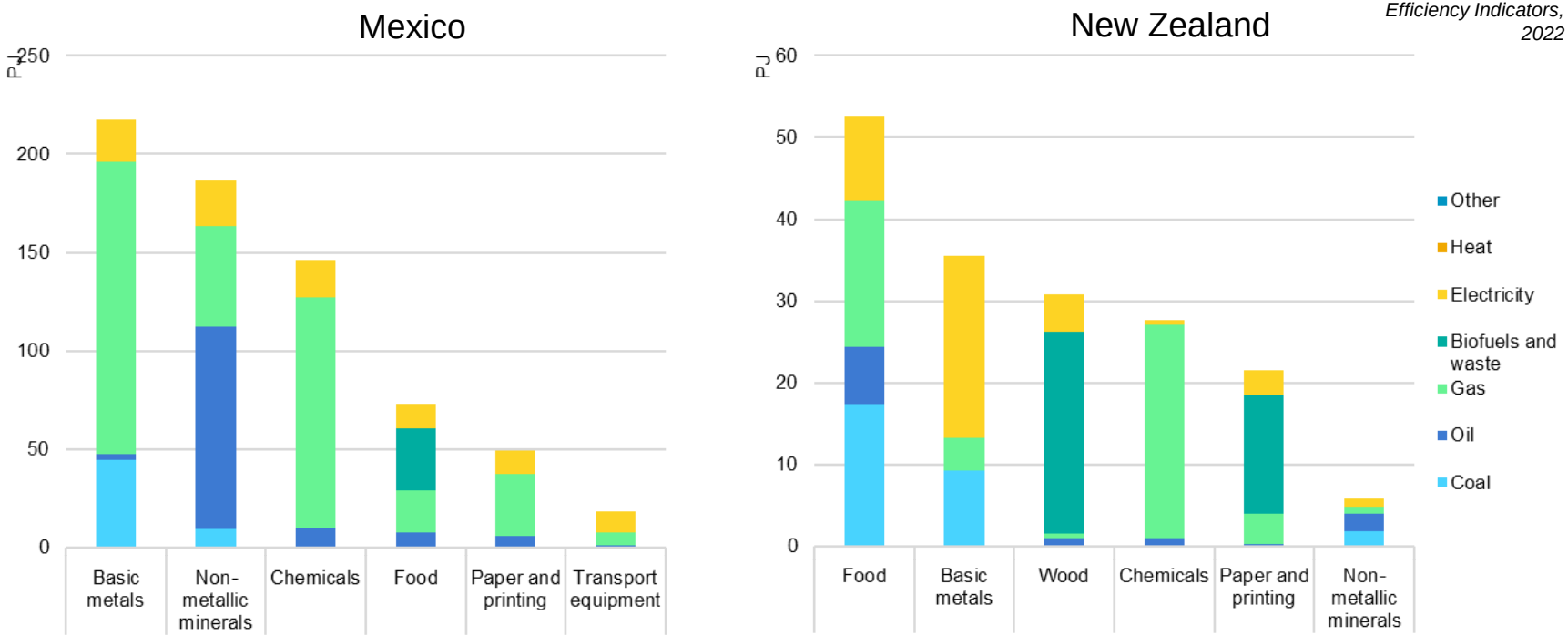

*Source: IEA Energy Efficiency Indicators, 2022*

**Detailed consumption by subsectors allows to put focus on key subsectors.**
**Mexico and New Zealand have similar share for some intensive subsectors (basic metals, chemicals).**

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

Manufacturing subsectors' energy consumption (selection) by fuel, 2020

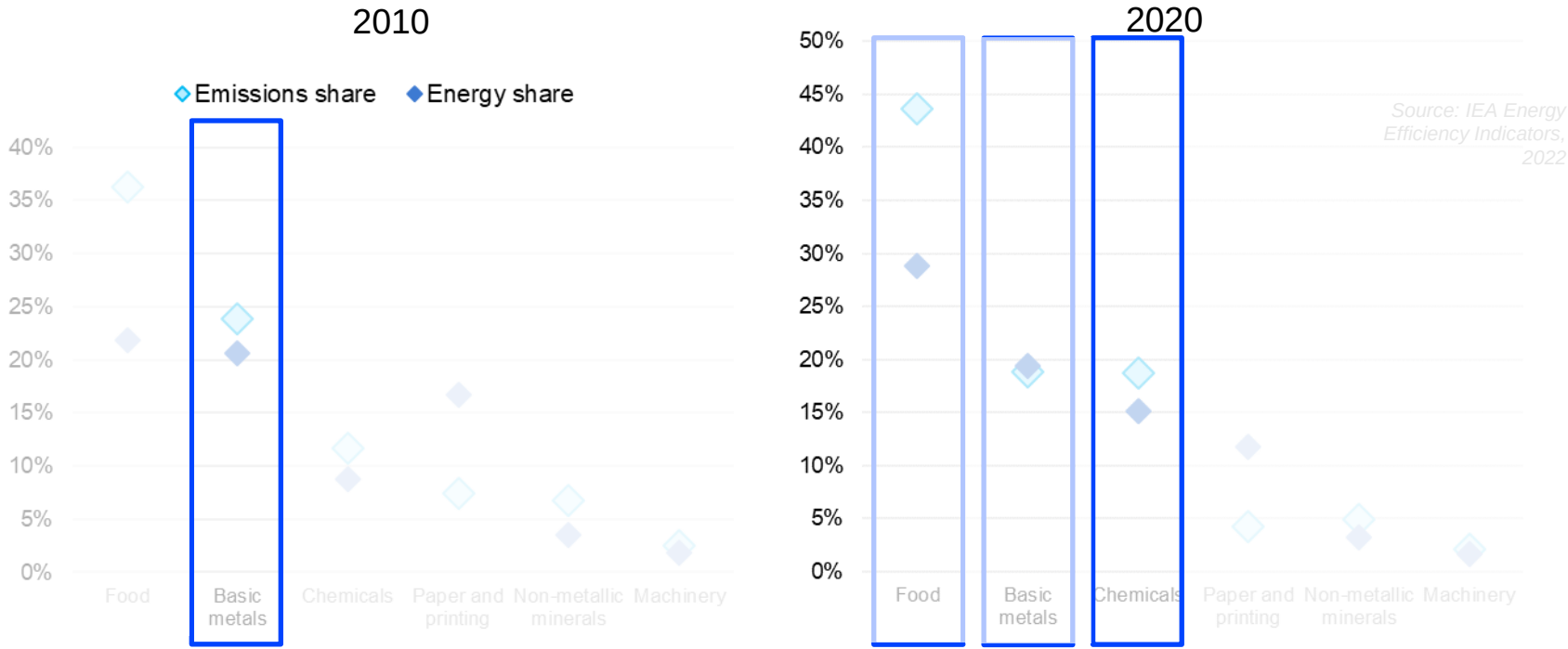
*Source: IEA Energy Efficiency Indicators, 2022*




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

# Energy consumption by fuel gives carbon emissions

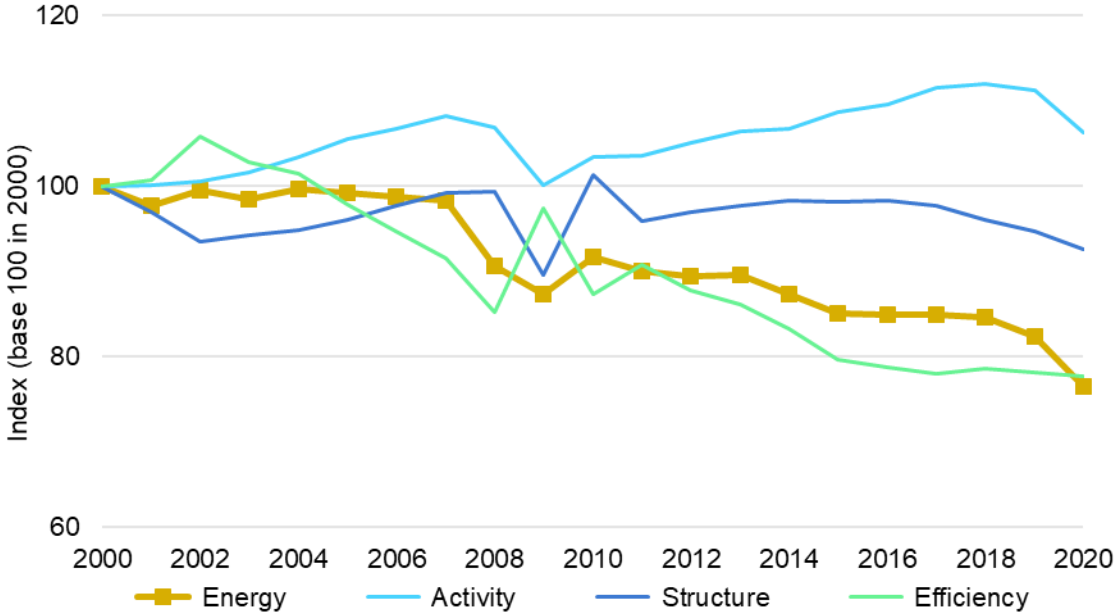
Share of manufacturing energy consumption and carbon emissions by subsectors, New Zealand, 2010 and 2020




**Subsectors' share of carbon emissions can be compared to their share of energy consumption, to identify the most carbon intensive subsectors. Tracking this over time gives essential feedback on energy policies.**

# What drives the industry energy consumption?

Drivers of industry energy consumption, Japan, 2000-2020




*Source: IEA Energy Efficiency Indicators, 2021*

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 industry energy consumption, and providing key insights for policy design.**

# Decomposition analysis for the residential sector

Factors of activity, structure and efficiency effects in our decomposition analysis, for industry subsectors and other sectors

| Sector | Subsector/ End use | Activity | Structure | Efficiency effect |
|---|---|---|---|---|
| Manufacturing | Food and tobacco [ISIC 10-12], Textiles and leather [ISIC 13-15], Wood and wood products [ISIC 16], Paper pulp and printing [ISIC 17-18], Chemicals and chemical products [ISIC 20-21], Rubber and plastic [ISIC 22], Non-metallic minerals [ISIC 23], Basic metals [ISIC 24], Machinery [ISIC 25-28], Transport equipment [ISIC 29-30], Other manufacturing [ISIC 31-32] | Value added | Share of value added | Energy per value added |
| Other | Agriculture, forestry and fishing [ISIC 01-03], Construction [ISIC 41-43] | Value added | Share of value added | Energy per value added |

*Source: IEA Energy Efficiency Indicators, 2022*

**Activity is tracked though value added for homogeneity. Various sector-specific indicators can be build, but relevance and comparability need to be assessed on a case-by-case basis.**

# Collecting end use data and developing energy efficiency indicators

# 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
- …

*Iron and steel*

*Chemicals*

*Food and beverages*

*Rubber and plastics*

*Non-metallic minerals*

*Pulp and paper*

*Automotive*

*Textile*

…

**Activity data**

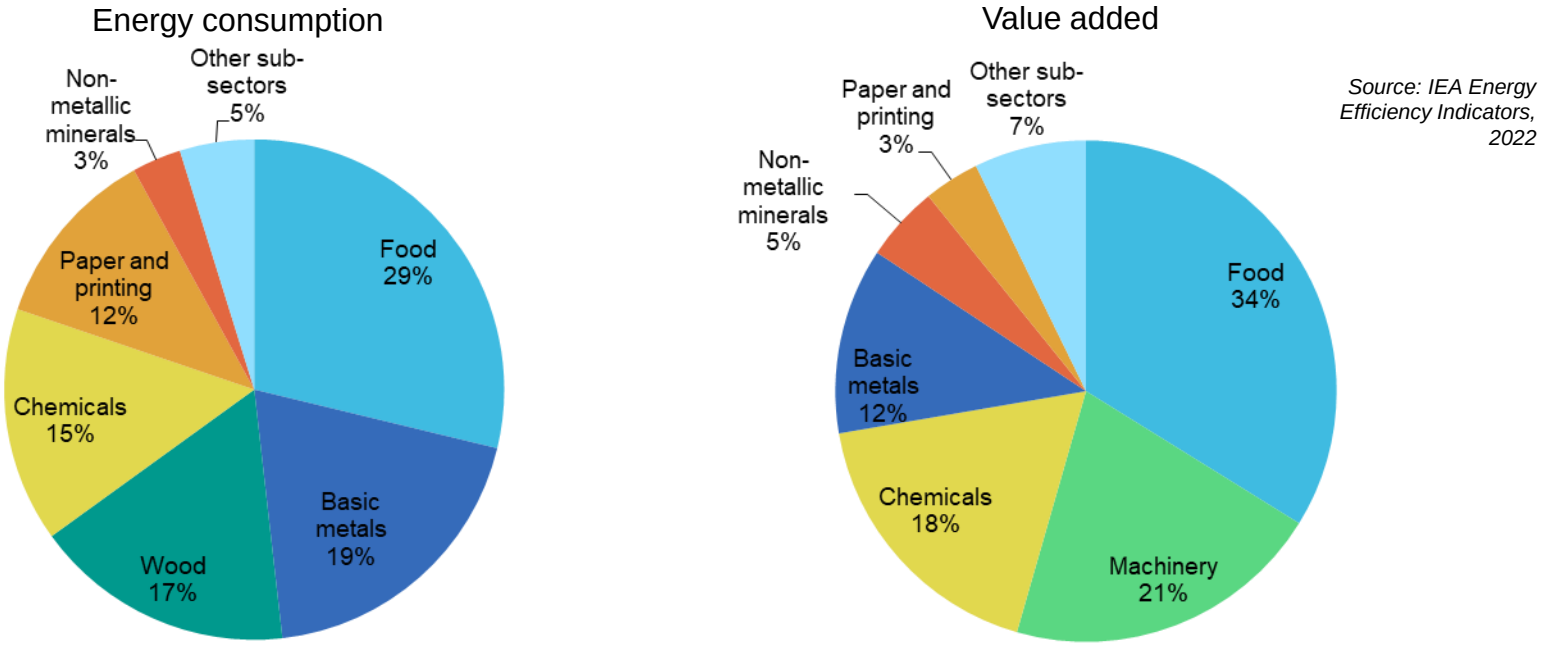
- Value added
- Physical production

*Physical production*

*Value added*

# Relevant activity data to build efficiency indicators

Manufacturing data by subsector, New Zealand, 2020

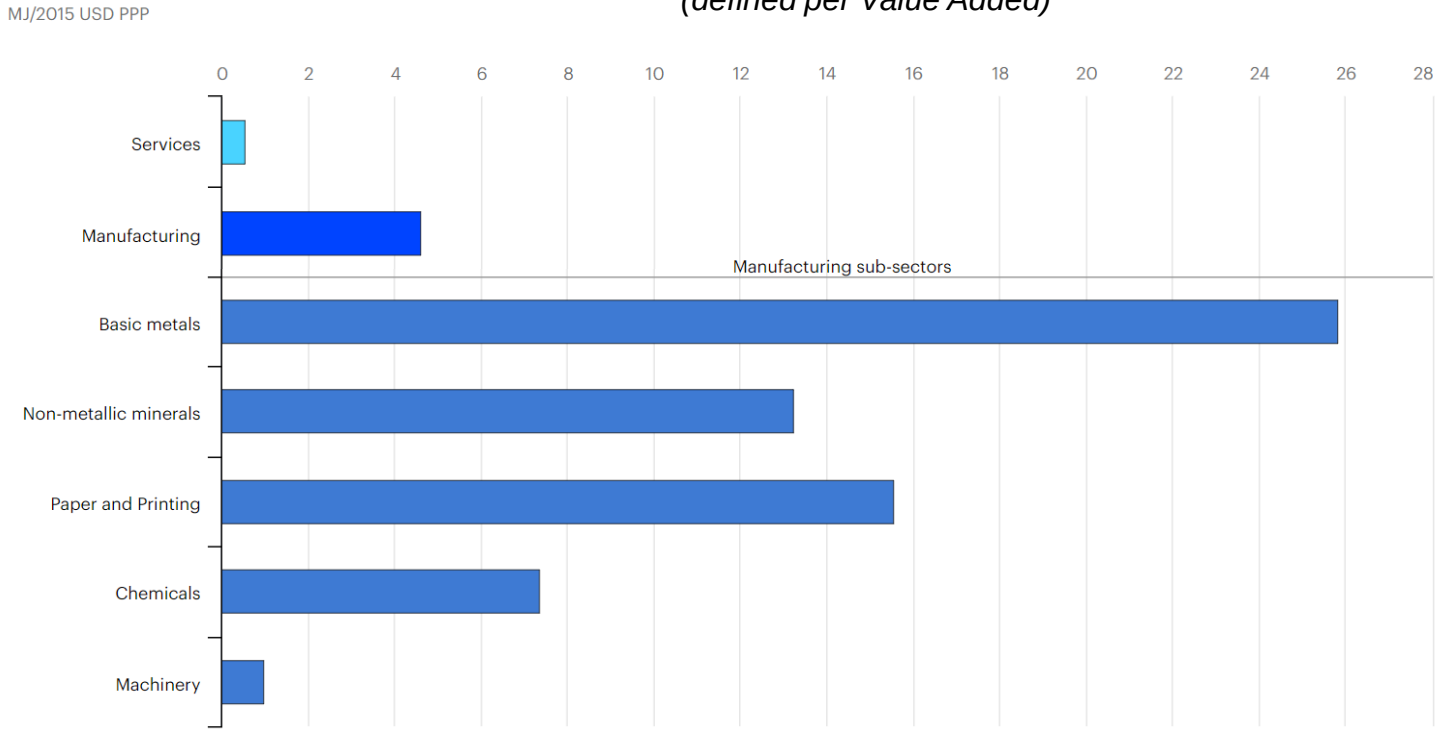



*Source: IEA Energy Efficiency Indicators, 2022*

**Value added, with similar level of details, is a simple, easily available activity data.**
**For New Zealand, it shows paper and printing and basic metals are more intensive sectors than food or chemicals.**

# Energy intensity as the energy required per unit of economic output

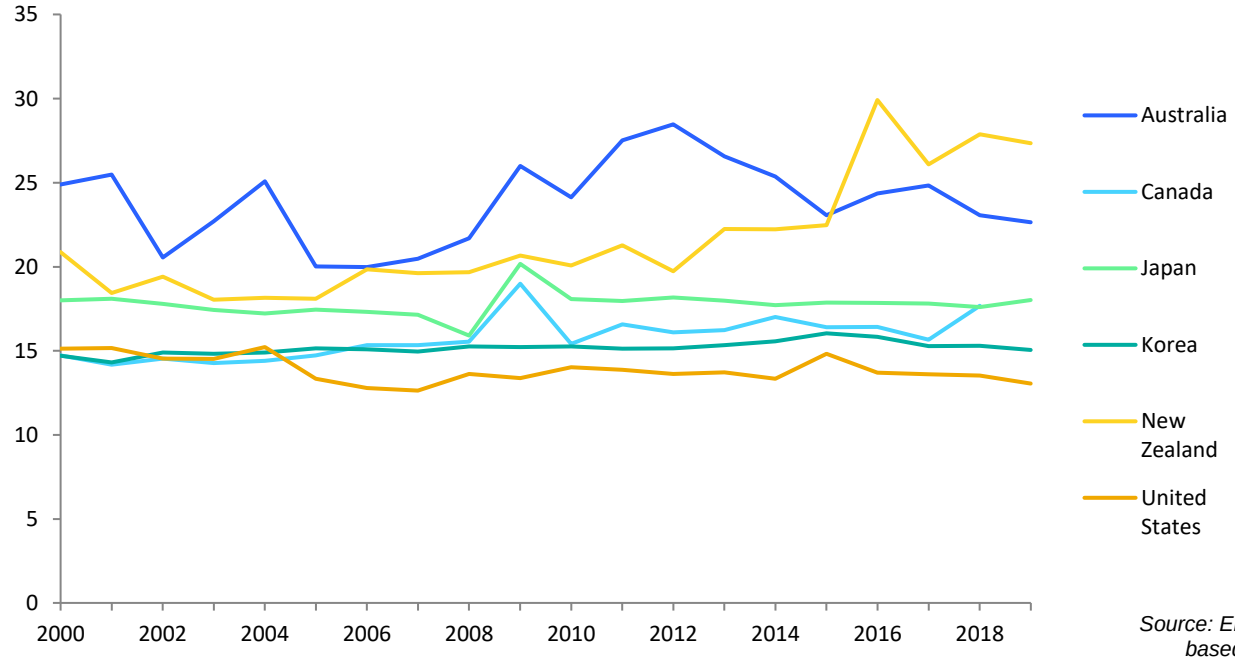
*Manufacturing and services: selected intensities in IEA, 2018*
*(defined per Value Added)*




**Intensities vary greatly across sectors, and their trends track efficiency progress.**

# Physical production for targeted subsectors

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

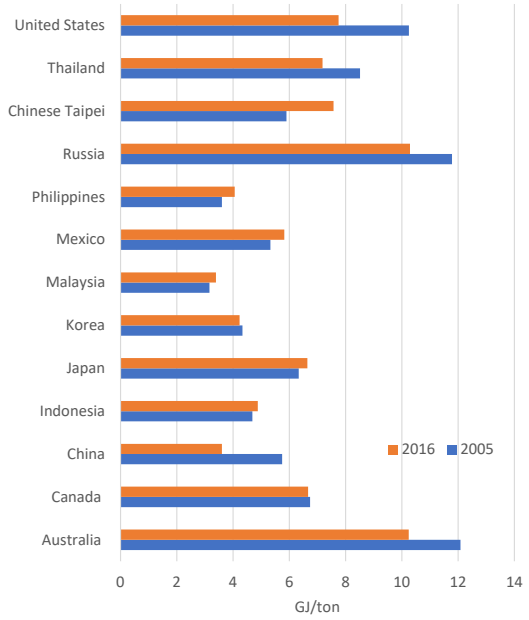



*Source: Elaboration of IEA data, based on Energy Efficiency Indicators Database*

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

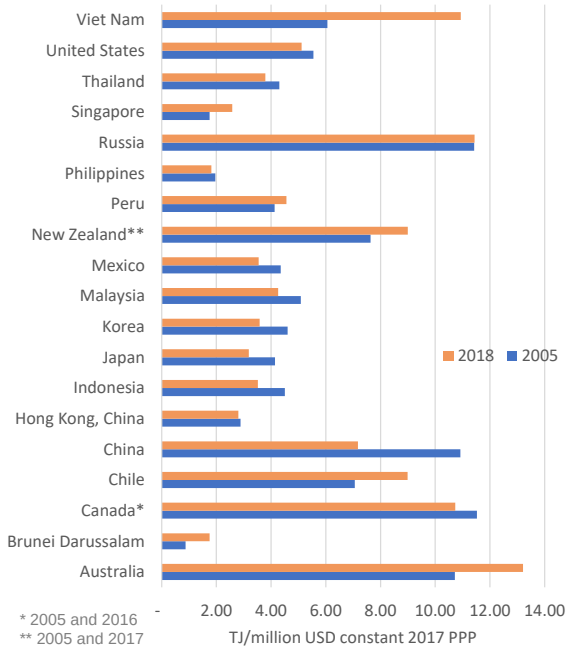
# Manufacturing intensity: per value added vs. per physical production

## Energy intensity per ton of cement




*Source: APEC, IEA and EDMC*

## Energy intensity per value added




* 2005 and 2016
** 2005 and 2017

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

# How to collect data on industry?

# 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*<br>*Industry associations*<br>*Reports of production / sales* |
|  *Survey* | Costly but **very effective**. To be **designed carefully**, ideally from existing one. **Representative sample** is key. | *Energy companies (suppliers)*<br>*Manufacturers*<br>*Vendors and sale points* |
|  *Measuring* | Costly but **very effective**. Often **focused** on specific equipment. | *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*<br>*Use down the supply chain* |

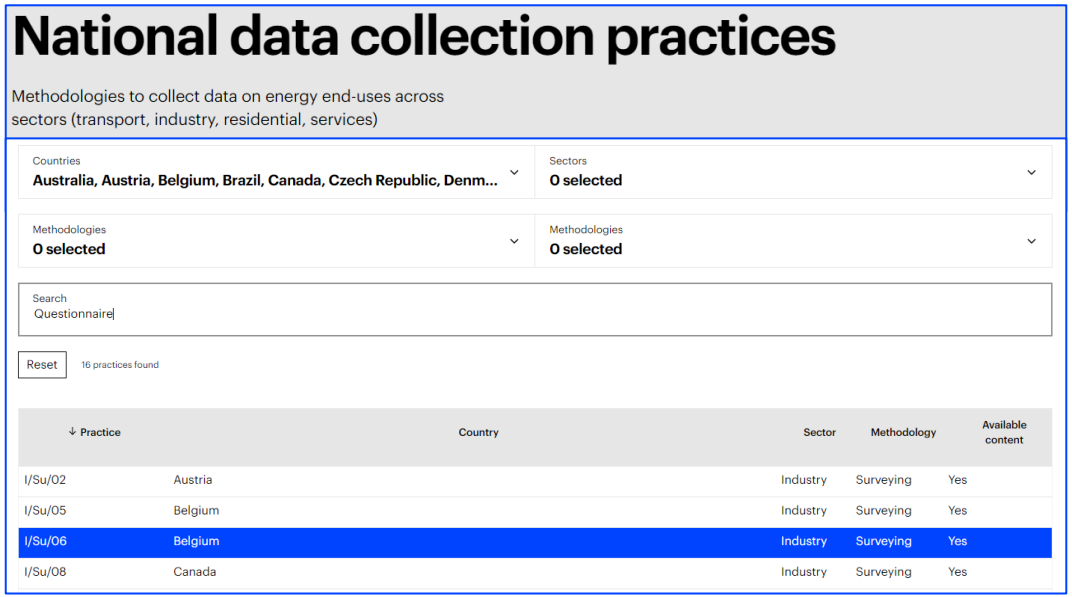
**Always check what data may be available in other institutions and how to complete existing data collection, before setting a new one up.**

*Icon credits: Iconiqu; Nithinan Tatah*

# Data collection: a dialogue with other economies

*What worked well? What to avoid?*

# IEA sharing platform – An experience database




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 economies, to share expertise worldwide**

# Successful data collections – Tools

| | | |
|---|---|---|
| *Measuring* | **Japan** | Ensure the use of **modern, adapted, high quality** measurement tools |
| *Modelling* | **Mexico** | Design **in connection with other data collections**, as a mean to complete a survey |
| *Survey* | **Indonesia** | Design with the aim to **build benchmarks and track policy impacts** |
| | **Thailand** | Design **in connection with other data collections**, as a mean to build modelling capacity |
| | **USA** | Switching **from paper to online** collection helped on **data quality**, efficient **assistance** (calculations, errors…), lower **cost**, smoother follow-up, confidentiality, etc. |

**Carefully designed tools, based on needs and available resources, are essential for efficient data collections.**

*Icon credits: Iconiqu; Nithinan Tatah*

# Successful data collections – Resources and methodology

| | | |
|---|---|---|
|  *Administrative sources* | **Australia** | Challenge to **reconcile and harmonise** various sources and historical time series |
|  *Modelling* | **Canada** | Lack of resources **limit capacity to expand and improve** the model |
| | **USA** | Need to keep an **up-to-date documentation**, with definitions and data processes |
|  *Survey* | **Canada** | Challenge to **get robust data**: time and geography aggregates, adequate coverage, fuels definitions… |
| | **China** | Lack of resources to **check and process** the collected data |
| | **New Zealand** | Lack of human / financial **resources and expertise**, for collecting team and respondents |

**Durable resources – in staff, finances and expertise – need to be allocated to ensure robust data collections.**

*Icon credits: Iconiqu; Nithinan Tatah*

# Successful data collections – Human factor

| | | |
|---|---|---|
|  *Administrative sources* | **Australia** | Need **robust institutional arrangements** (e.g. MoU) to harvest the **numerous resources** available |
| | **USA** | **Build trust** at all levels and, if necessary, legal agreements, to deal with **confidentiality issues** |
|  *Modelling* | **Mexico** | Work with **industry associations for model review** |
|  *Survey* | **Japan** | Mandatory survey with **various incentives** (on-site inspections, fine) to improve the response rate |
| | **Mexico** | Voluntary survey with **non-financial incentives** (performance review) to improve the response rate<br>Work with **industry associations for survey review** and data sharing |
| | **New Zealand** | Get help from **experts or dedicated working group for questionnaire review** and testing |

**Foster relationships with every partner – institutions, companies, communities – is key for high quality data.**

*Icon credits: Iconiqu; Nithinan Tatah*