Tracking efficiency in the residential and commercial sector

JunGyu PARK | International Energy Agency

Joint APEC-IEA Training Workshop on End-use Energy Consumption Data, June 29th 2021

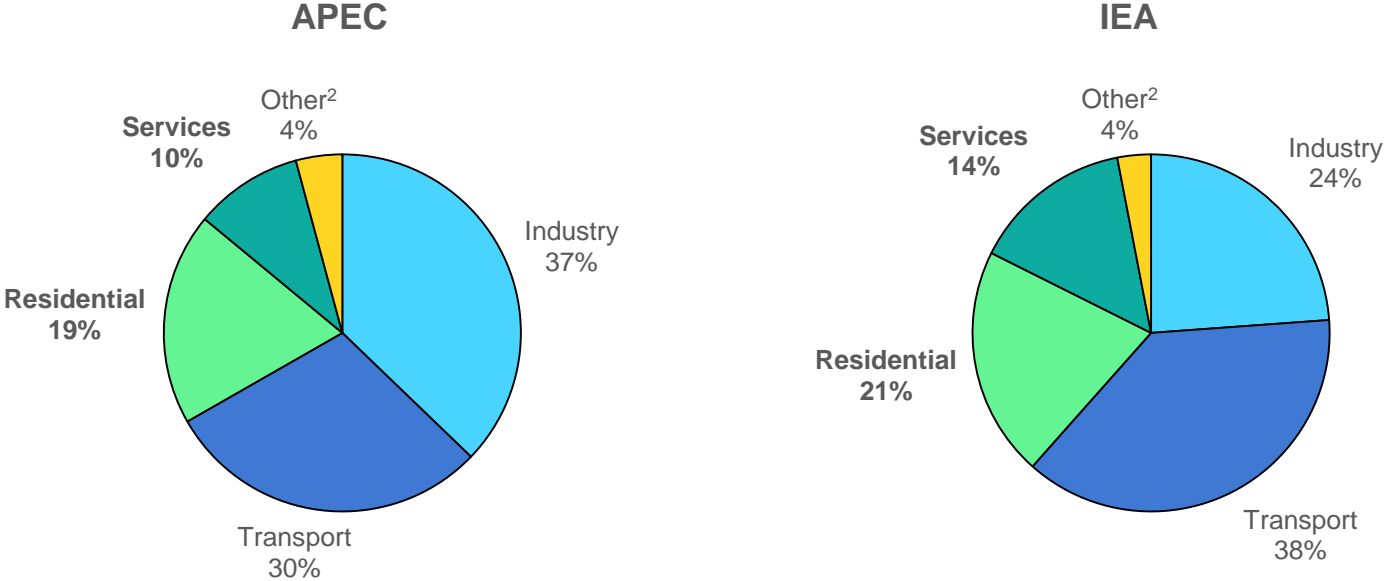# Why is the residential and services sector important?

Residential and services (buildings) determine our quality of life!

Overview

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

2. What can we learn from **energy efficiency indicators**?

3. **Developing** energy efficiency indicators

4. How to perform **temperature correction**?

5. How to **collect data**?

What can we learn from energy balances?

Buildings have a lower share in APEC compared to IEA

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

APEC

Other[2]
4%

Services
10%

Industry
37%

Residential
19%

Transport
30%

IEA

Other[2]
4%

Services
14%

Industry
24%

Residential
21%

Transport
38%

[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

**In the APEC economies, buildings sector accounts for almost 29% of final energy consumption.
In the IEA, it represents 35%.**

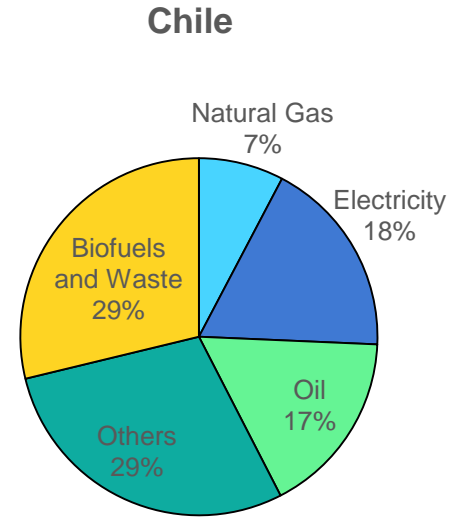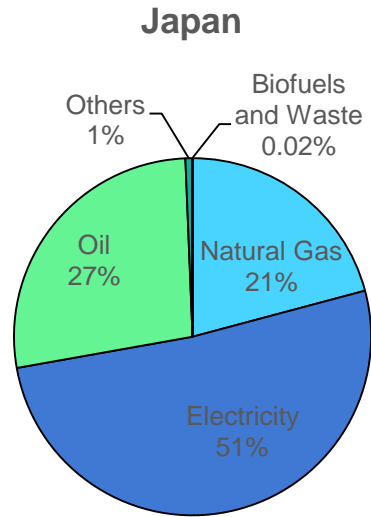# Residential energy consumption varies from the country to country

Energy consumption in residential per capita
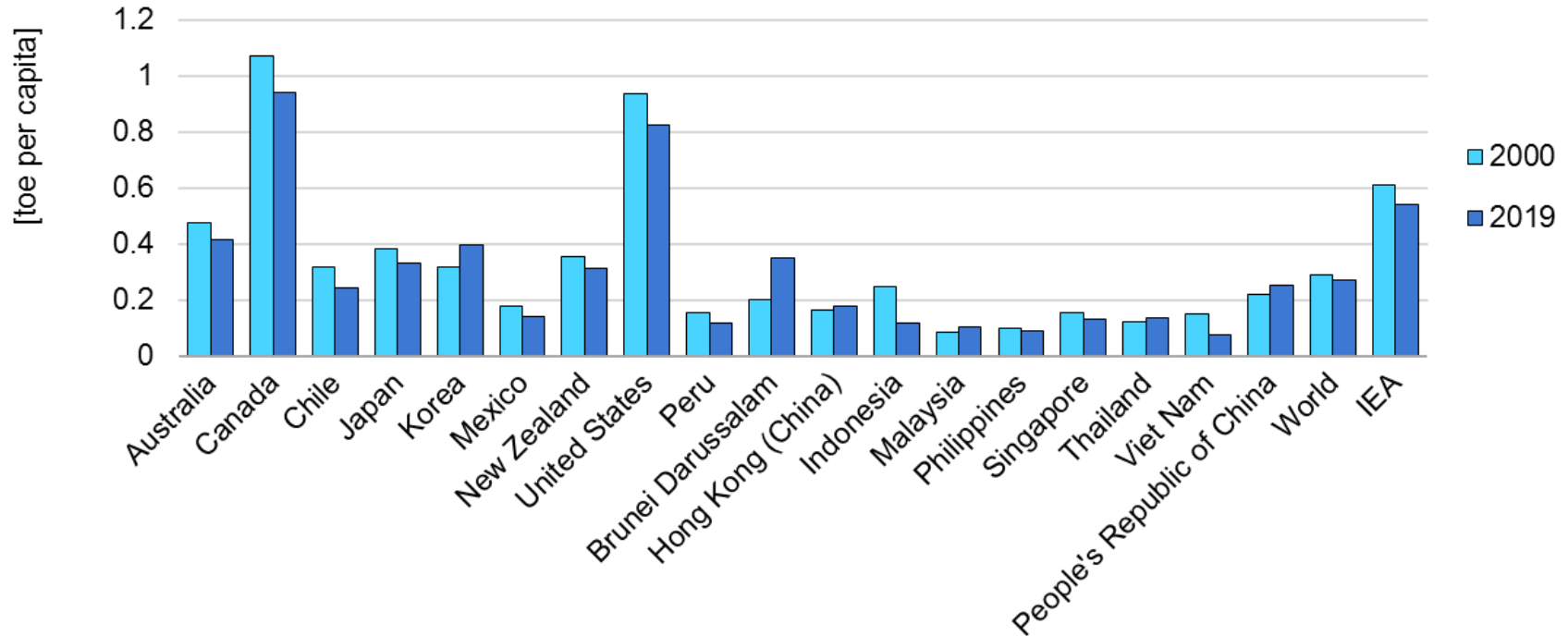
Source: *IEA Energy Balances, 2021*

Fuel share in residential sector

Energy consumption in residential sector in Japan and Chile in 2019

Japan

Others 1%
Biofuels and Waste 0.02%
Oil 27%
Natural Gas 21%
Electricity 51%

Chile

Natural Gas 7%
Electricity 18%
Biofuels and Waste 29%
Oil 17%
Others 29%

Source: IEA Energy Balances, 2021

Fuel share may vary depending on heating and cooling systems, main fuel for cooking, and use of residential appliances.

What else do we need to know to track efficiency in residential?

- What **end use** consumes most of the energy (cooking/heating…%)?

- Which **aspect of our life** will be affected in case of **electrical breakout**?

- What is the **share of LPG/electricity** used for cooking?

- Are we using energy for **space heating** more efficiently over time?

Energy consumption and emissions trend in services sector

Growth of energy consumption and emissions in services sector for APEC economies

Index (1990=100)

— Energy consumption
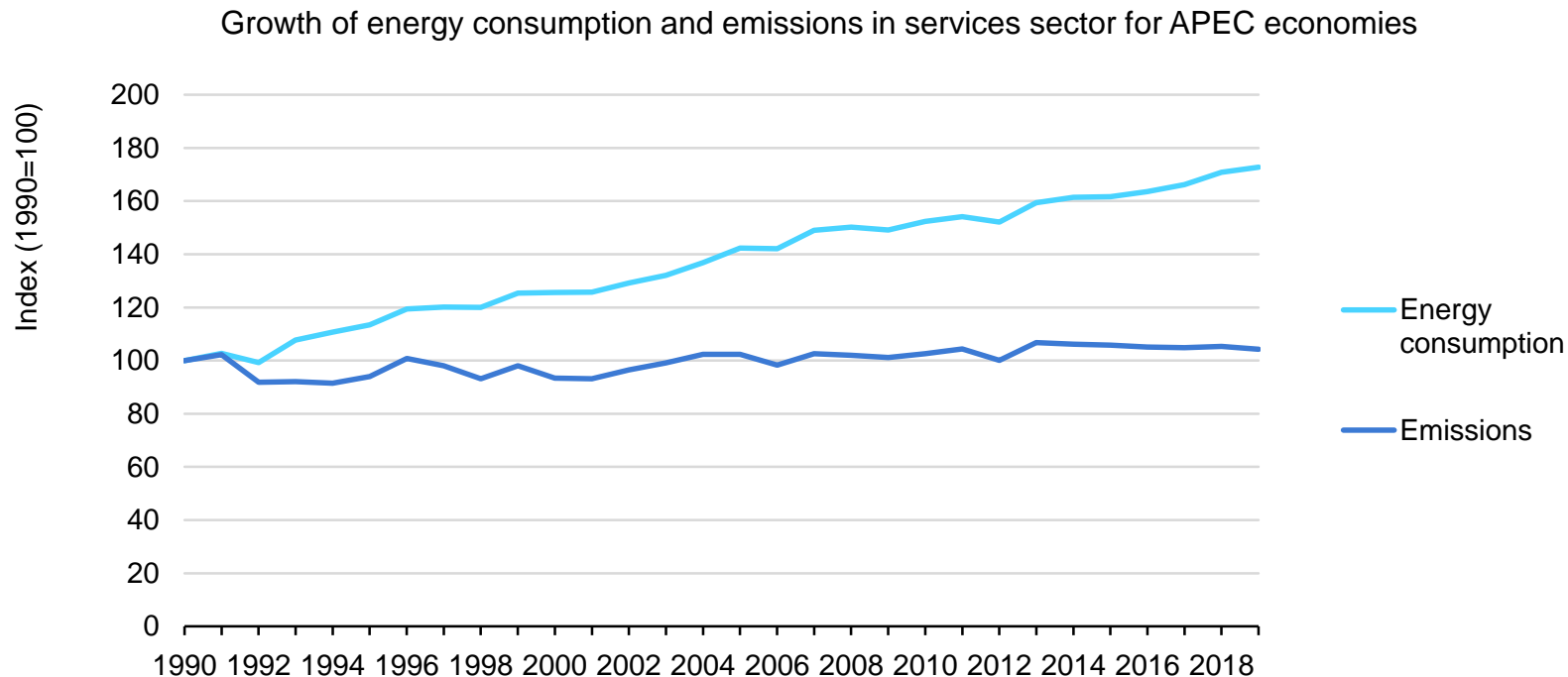
— Emissions

Source: IEA Energy Balances, 2021
IEA CO_2 Emissions from Fuel Combustion, 2021

Services energy consumption increased by 70% from 1990 while emissions remained the same level.

What else do we need to know to track efficiency in services?

- What **end use** consumes most of the energy (heating/cooling/lighting…%)?

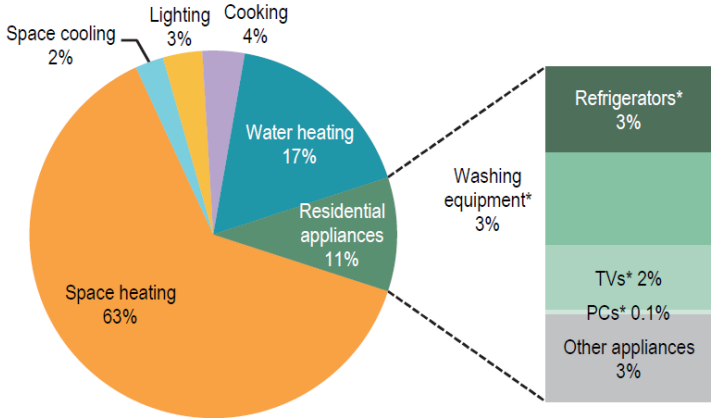- Which **activity** drives energy consumption and emissions?

- Why do the **emission** levels remain constant even with increased activities?

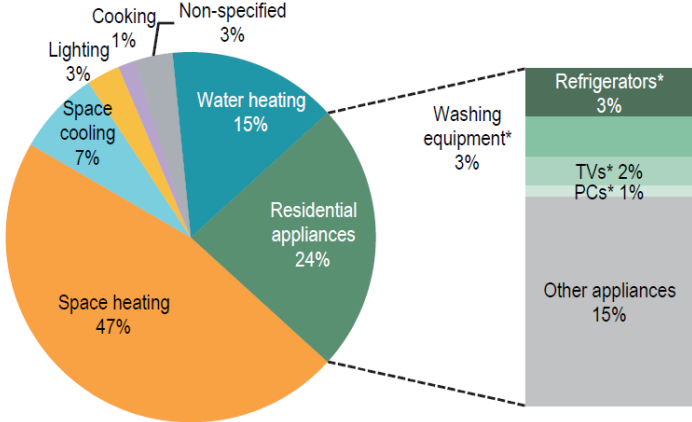# What can we learn from energy efficiency indicators?

Detailed data provides more information - Residential

Residential energy consumption by end use in Canada and the United States, 2018

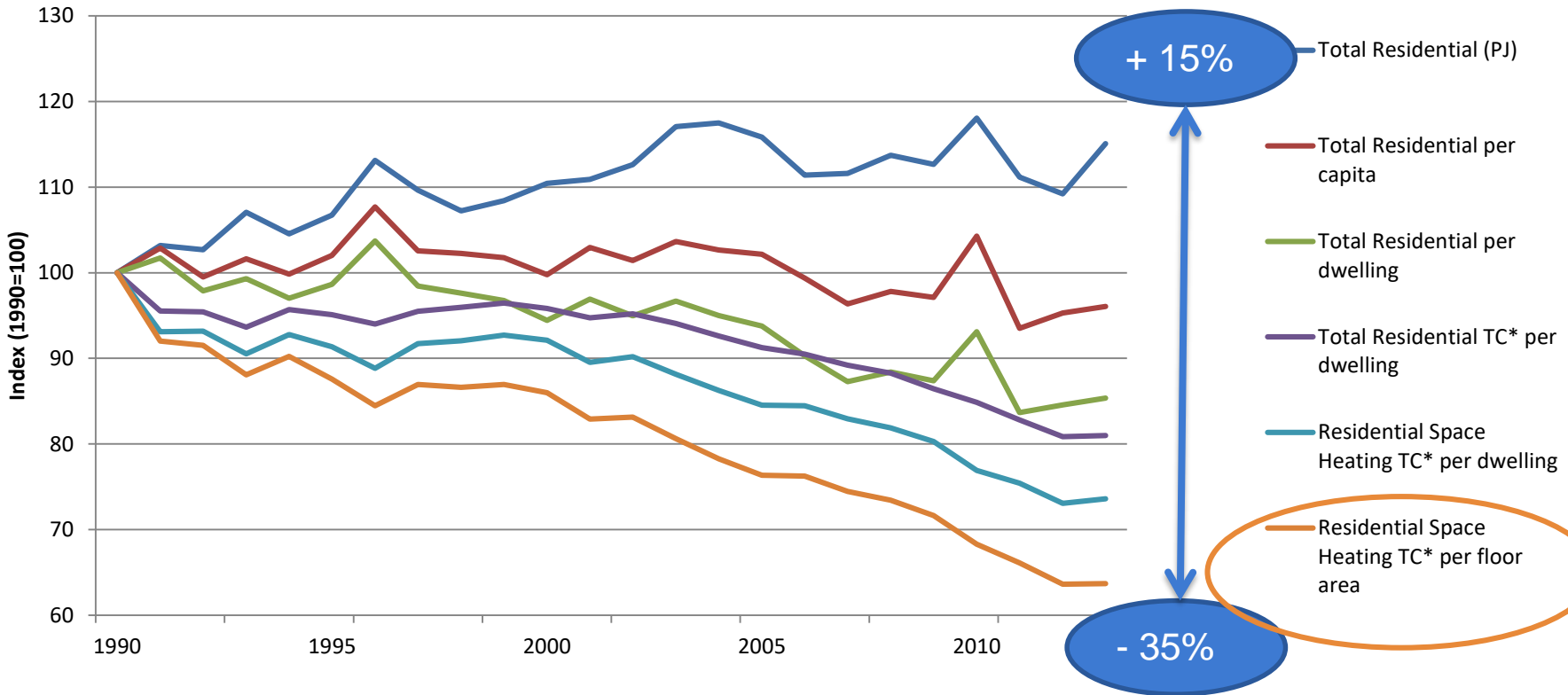## Canada

- Space cooling 2%
- Lighting 3%
- Cooking 4%
- Water heating 17%
- Residential appliances 11%
- Space heating 63%

- Refrigerators* 3%
- Washing equipment* 3%
- TVs* 2%
- PCs* 0.1%
- Other appliances 3%

United States

- Cooking 1%
- Non-specified 3%
- Lighting 3%
- Space cooling 7%
- Water heating 15%
- Residential appliances 24%
- Space heating 47%

- Refrigerators* 3%
- Washing equipment* 3%
- TVs* 2%
- PCs* 1%
- Other appliances 15%

Source: IEA Energy Efficiency Indicators highlights, 2020

**Above two countries have similar energy intensity (Canada: 0.94 toe/capita; United States: 0.82 toe/capita).
However the share of end uses consumptions are not similar.**

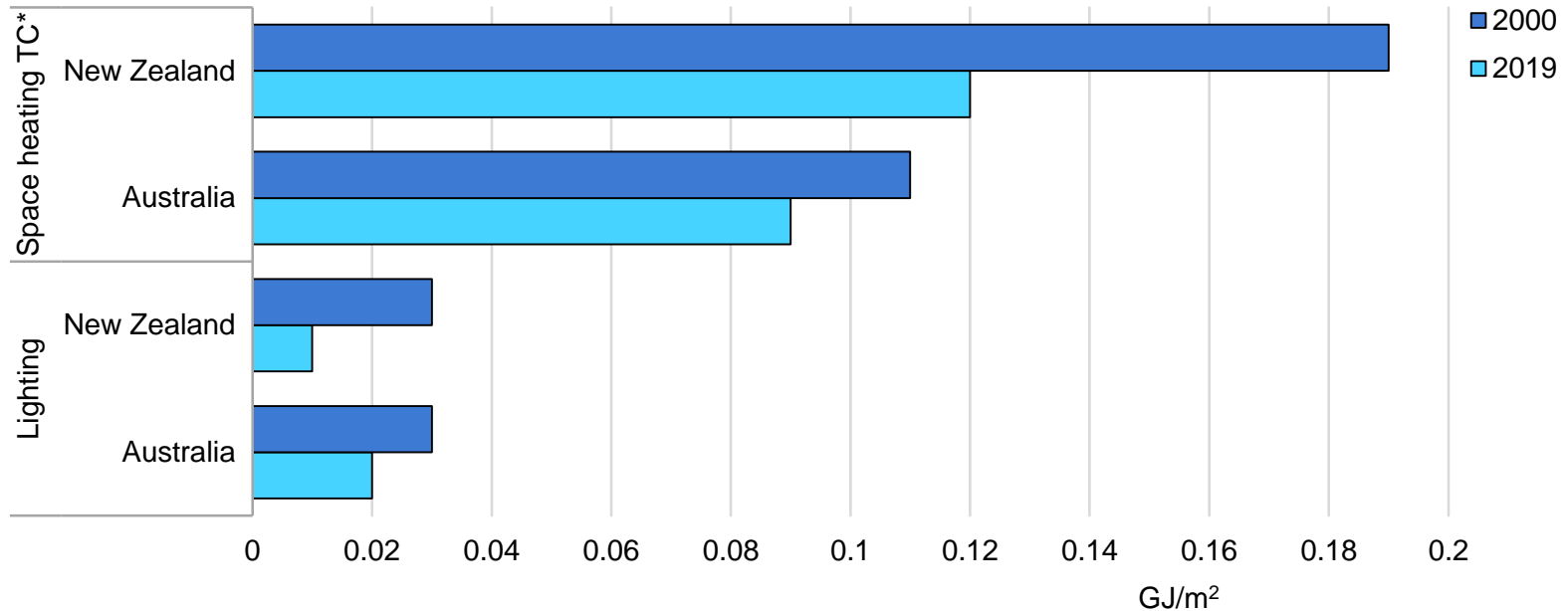# Efficiency indicators explain basic consumption patterns

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.*

How country reduced energy intensities - Residential

Energy intensities of space heating TC* and lighting per floor area, 2000-2019

GJ/m^2

* TC – Temperature correction

What drives energy consumption - Residential

Drivers of residential energy consumption, Australia, 2000-2018

Legend: Energy, Activity, Structure, Efficiency

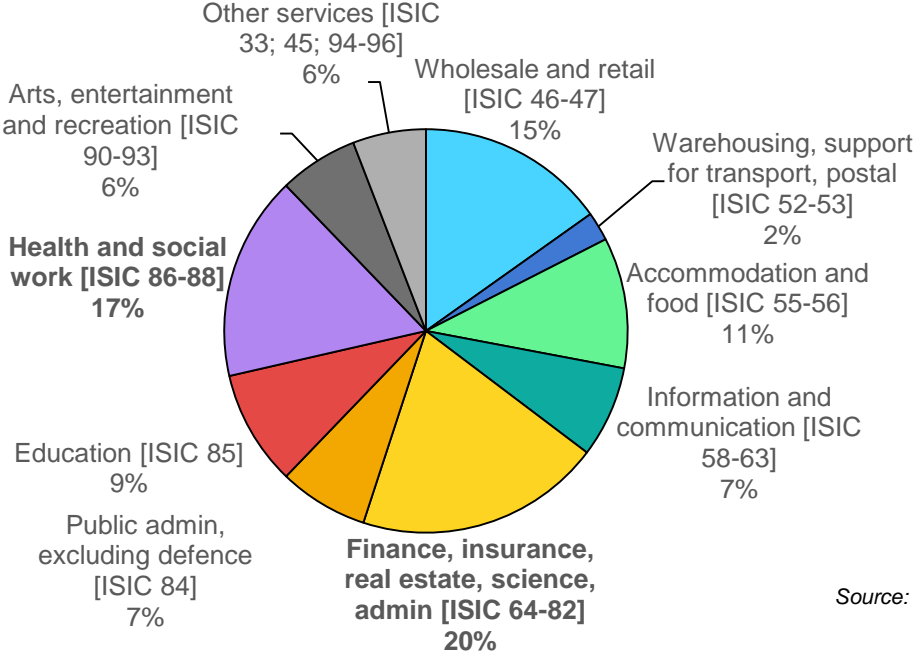Y-axis: Index (base 100 in 2000)

X-axis: 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018
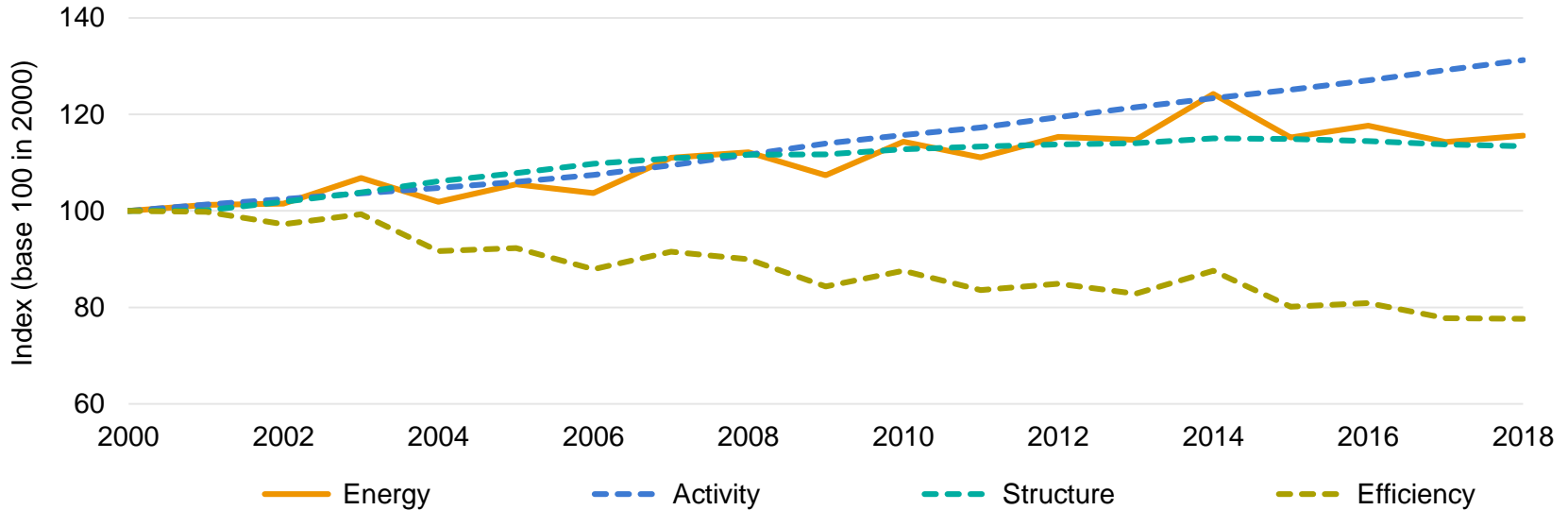
Source: IEA Energy Efficiency Indicators, 2021

What drives energy consumption - Residential

Sector	Subsector/ End use	Activity	Structure	Efficiency effect
Residential	Residential space heating	Population	Floor area per population	Temperature corrected space heating energy consumption per floor area
	Residential water heating	Population	Occupied dwellings per population	Water heating energy consumption per occupied dwelling
	Residential cooking	Population	Occupied dwellings per population	Cooking energy consumption per occupied dwelling
	Residential space cooling	Population	Floor area per population	Temperature corrected space cooling energy consumption per floor area
	Residential lighting	Population	Floor area per population	Lighting energy consumption per floor area*
	Residential appliances	Population	Appliances stock per population	Appliances energy per appliance stock

Source: IEA Energy Efficiency Indicators, 2021

Detailed data provides more information - Services

Services energy consumption by services activity, 2019, France

Other services [ISIC 33; 45; 94-96]
6%

Wholesale and retail [ISIC 46-47]
15%

Arts, entertainment and recreation [ISIC 90-93]
6%

Warehousing, support for transport, postal [ISIC 52-53]
2%

Health and social work [ISIC 86-88]
17%

Accommodation and food [ISIC 55-56]
11%

Information and communication [ISIC 58-63]
7%

Education [ISIC 85]
9%

Public admin, excluding defence [ISIC 84]
7%

Finance, insurance, real estate, science, admin [ISIC 64-82]
20%

Source: IEA Energy Efficiency Indicators, 2021

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

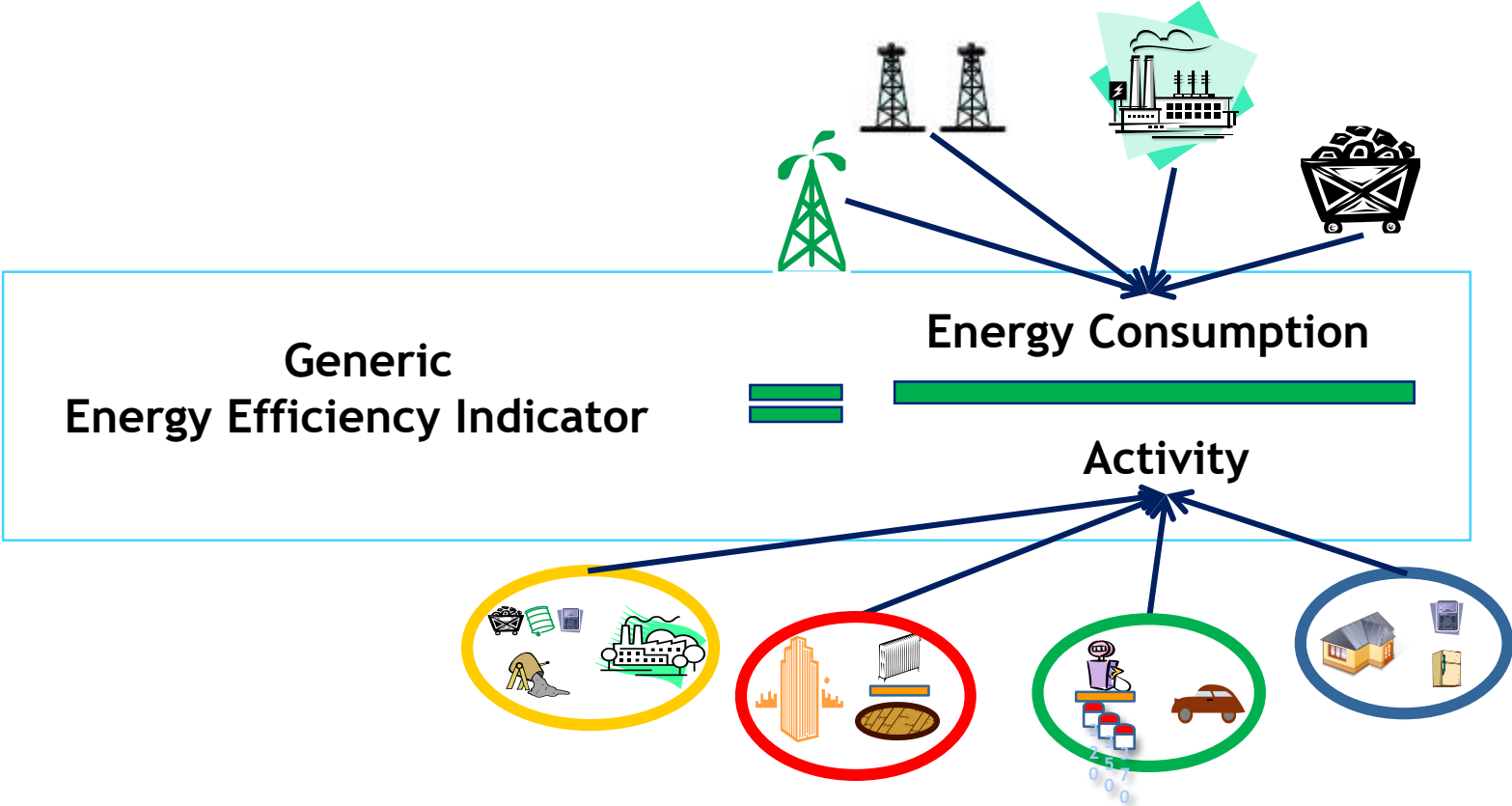# How country reduced energy and carbon intensities - Services

Value added energy and carbon intensity of services sector, 2000-2018
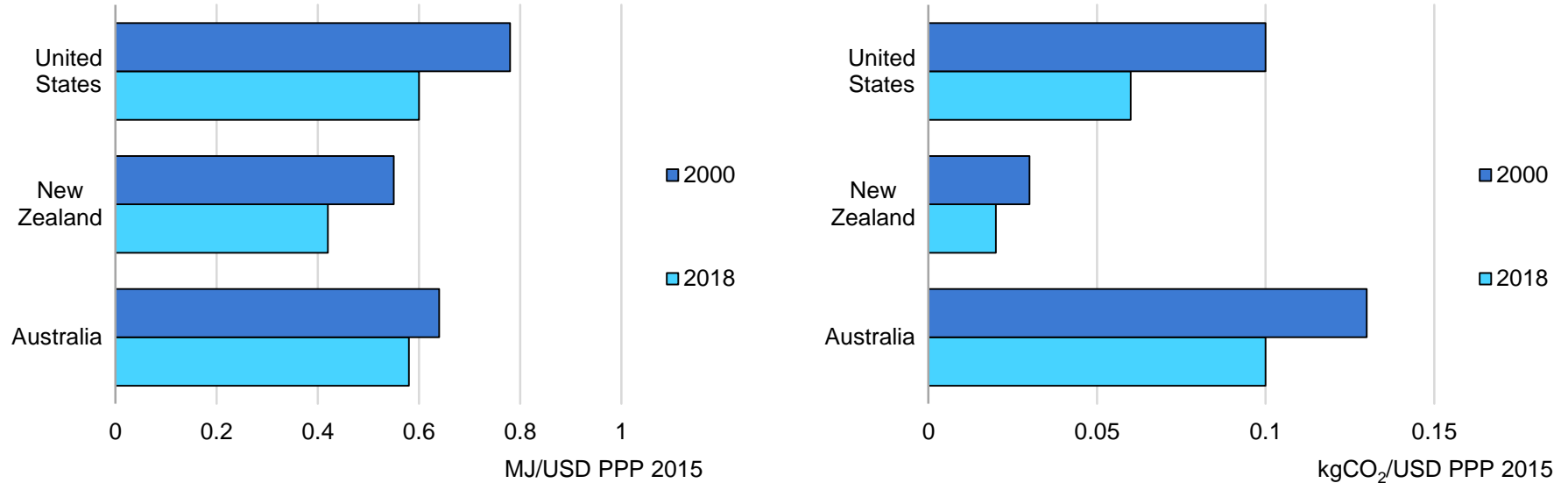
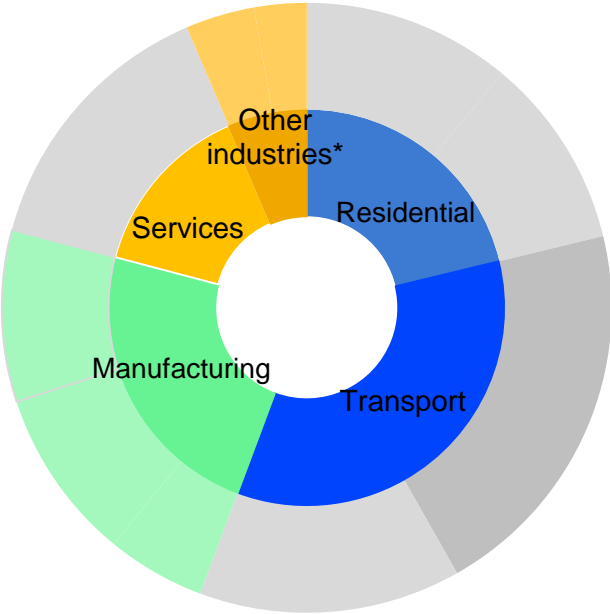**Some countries reduced their carbon intensity even more than their energy intensity.**

Source: IEA Energy Efficiency Indicators, 2021

Developing energy efficiency indicators

Generic
Energy Efficiency Indicator

Energy Consumption

Activity

End use consumption data - Data coverage ambition

Energy balance

Energy efficiency indicators

Other industries*

Services

Manufacturing

Residential

Transport

Space heating
Space cooling
Water heating
Lighting
etc.

Sewerage
Wholesale
Warehousing
Etc.

Other industries*

Services

Manufacturing

Transport

Residential

Passenger cars

Freight cars

Space heating
Space cooling
Water heating
Cooking
etc.

Passenger cars
Buses
Motorcycles
Passenger trains
etc.

Freight trucks
Freight trains
etc.

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

Primary residences

Unoccupied dwellings

Vacation homes

Data and indicators for the services sector

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 defence [ISIC 8422]
- Education
- Health and social work
- Arts, entertainment and recreation
- Other services activities

Activity data:

- Value added
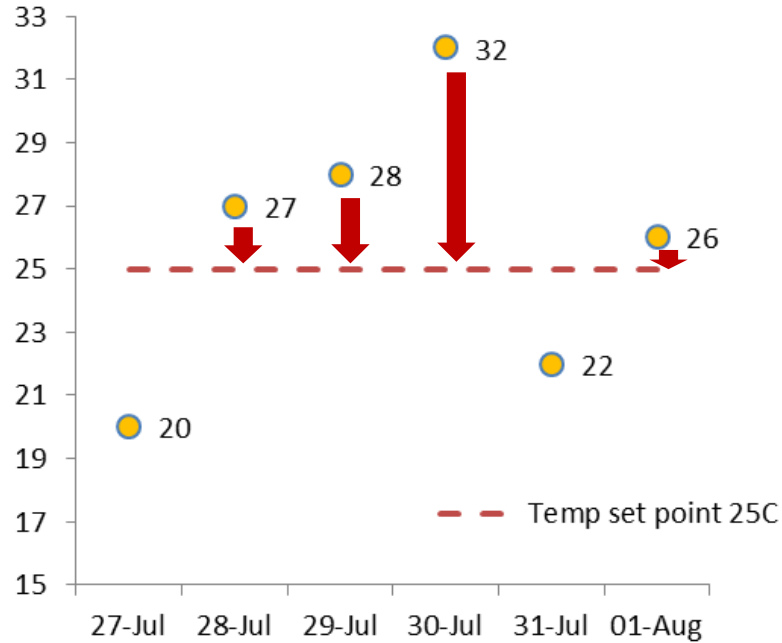- Service floor area
- Number of employees

Value added

Surface

# of employees

How to perform temperature correction?

Temperature correction: cooling degree days

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

With warmer weather, we consume more for space cooling (residential and services)

Temperature correction: adjusting energy consumption
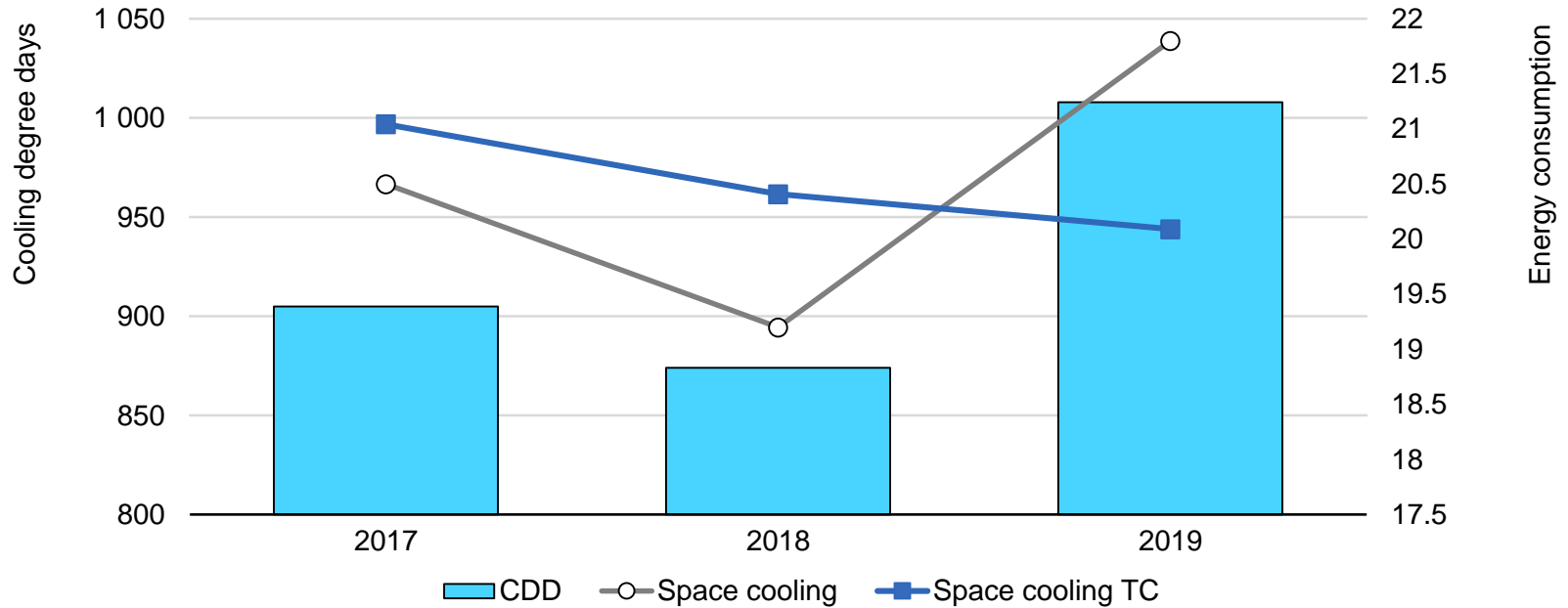
➢ Adjusted energy for space cooling (simplified method):

➢ Actual energy for SC (current year) × $\dfrac{\textbf{Average CDD (period)}}{\textbf{CDD (current year)}}$

➢ Calculation example:

Avg. CDD: **929**

	2017	**2018**	**2019**
CDD	905	874	1008
Energy for SC (PJ)	20.5	19.2	21.8
Adj. Energy for SC (PJ)	20.5×929÷905	19.2×929÷874	21.8×929÷1008

Temperature correction: adjusting energy consumption

How to collect data on buildings?

Methods used to collect data for indicators

- ➤ Administrative sources
  - o Basis as often gathers many data
  - o To be consulted before starting new data collection

- ➤ Surveys
  - o The key: a representative sample
  - o Possibly expanding existing surveys

- ➤ Metering and measuring
  - o Costly but very effective for monitoring specific equipment efficiency

- ➤ Modelling
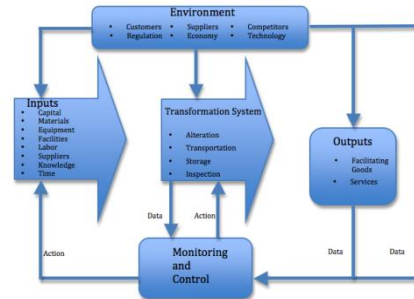 - o Complementary to surveys or stand alone

How to collect data for residential – sources and methodologies

Table 4.2 ● *Summary of the main data needed for residential indicators and examples of possible sources and methodologies*

Data	Source	Methodology
Energy data		
Total residential consumption	National energy balance	Administrative sources Modelling
Energy consumption by source	National energy balance Utilities	Administrative sources Modelling
Activity data		
Floor area	National statistics offices Real estate Regional governments Taxation registers	Administrative sources Surveys
Number of dwellings	Land registry National statistics offices	Administrative sources Surveys
Heating equipment	Building registers Manufacturers/Vendors Subsidy registers	Administrative sources
Number of appliances	Manufacturers National statistics offices	Administrative sources Surveys

IEA Energy Efficiency Indicators: Fundamentals on Statistics, 2014

How to collect data for services – sources and methodologies

Table 5.3 ● *Summary of the main variables needed for services indicators and examples of possible sources and methodologies*

Data	Source	Methodology
Energy Data		
Total services consumption	National energy balance	Administrative sources Modelling
Service category consumption	Utilities	Administrative sources Modelling
Activity data		
Floor area	National statistics offices Regional governments Business taxation offices through national or regional networks Building permits offices National services sector surveys	Administrative sources Surveys
Value added	National statistical office	Administrative sources
Unit of activity	National statistics offices Chambers of commerce, etc.	Administrative sources Surveys
Equipment	Manufacturers, Importers, etc.	Administrative sources Surveys

IEA Energy Efficiency Indicators: Fundamentals on Statistics, 2014