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International
Energy Agency

An introduction to decomposition analysis

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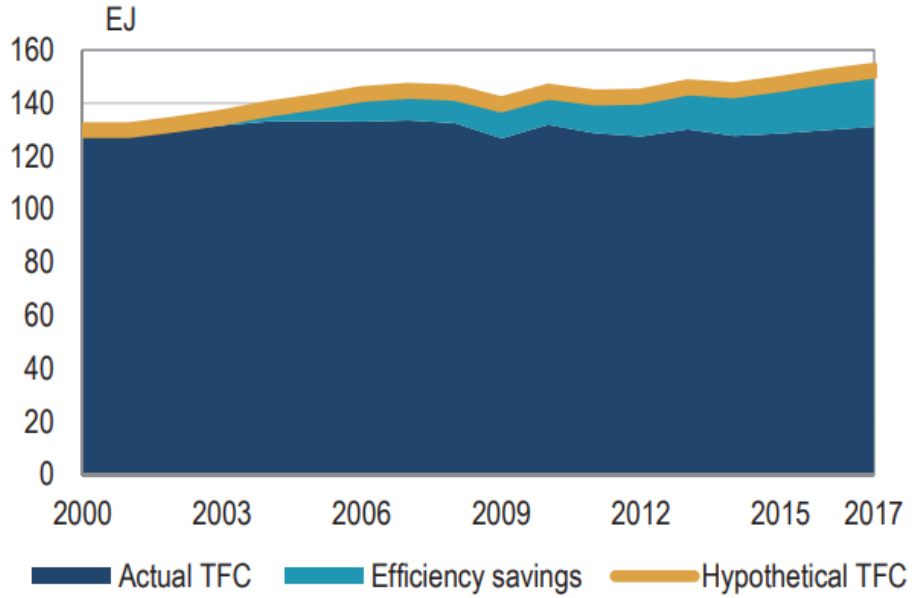
Pretoria, 16 October 2019

IEA #energyefficientworld

How to estimate energy savings from efficiency over time?



Source: adapted from IEA (2018) *Energy efficiency 2018*, based on the IEA Energy efficiency indicators database, 2018.

Estimated energy savings since 2000 in IEA reached approximately 21EJ, equivalent to energy consumption of Germany, France and UK together.

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- Drivers of energy consumption: 3 main effects

- **Activity effect**
  - Change in the **overall level** of the activity / level of action that drives energy consumption.

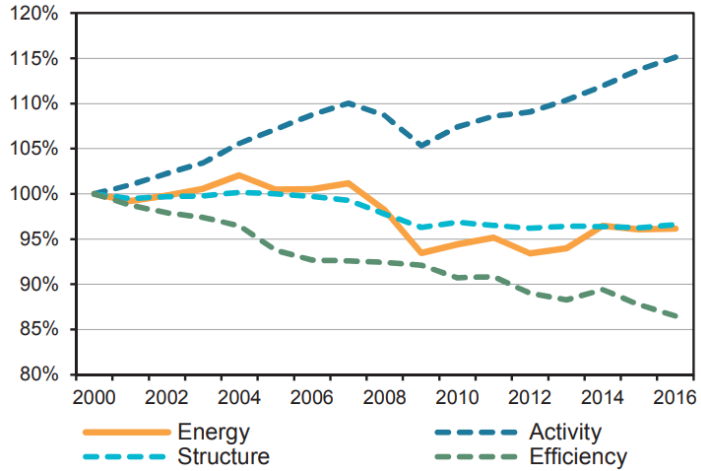
- **Structure effect (Activity mix)**
  - Change in the **mix of activities** within a sector

- **Energy efficiency effect (Intensity)**
  - Changes in **sub-sectoral energy intensities** (i.e. energy used per unit of activity)

Understanding what drives energy consumption is complex

Purpose of decomposition analysis:

Quantify **contribution of specific factors** to the change in energy consumption between a base year and another point in time



Source: IEA Energy Efficiency Indicators database (2018 edition)

Need to disentangle different factors: activity, structure and efficiency

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Decomposition analysis

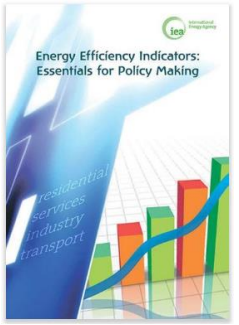
- There are **different methods** – the IEA uses the LMDI

  LMDI = Logarithmic Mean Divisia Index

- Can be applied to specific subsectors or end uses (e.g. space cooling, cars,…) to estimate the energy savings from efficiency.

➢For more detail: *Energy efficiency indicators: Essentials for policy makers:*

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



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Data requirements and indicators for decomposition analysis

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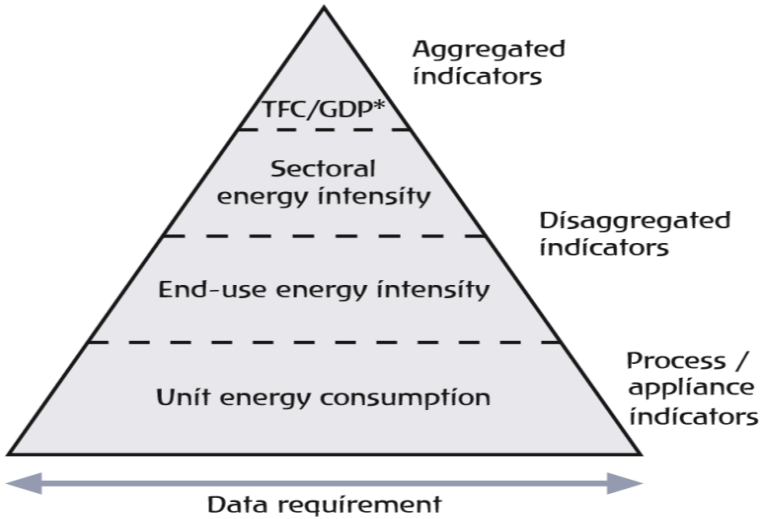
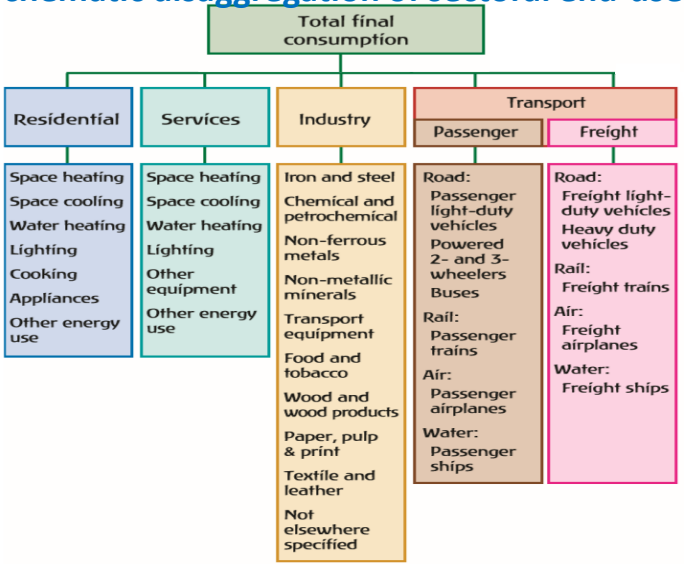
EEI data requirements

- Degree of disaggregation of EEI needed affects the data collection requirements
- Sub-sectoral /end-use energy consumption

Schematic representation of energy indicators



Schematic disaggregation of sectoral end-uses



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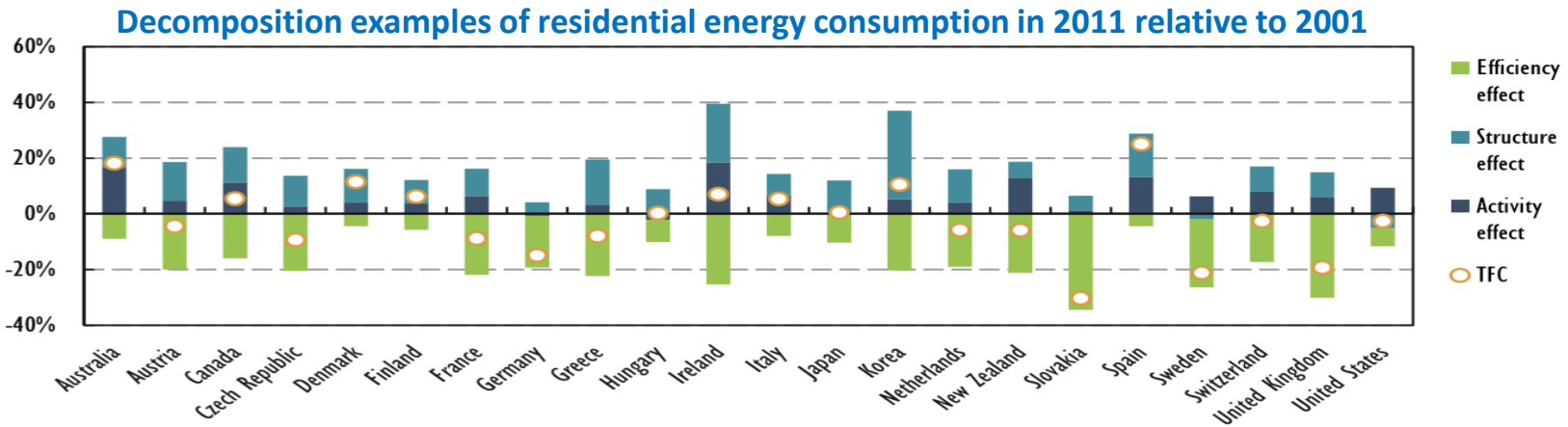
Decomposition Analysis in Residential Sector

- Metric examples for residential energy decomposition

End-use	Activity (A)	Structure (S)	Intensity (I)
Space heating	Population	Floor-area / Person	Space heating energy* / Floor-area
Space cooling	Population	Floor-area / Person	Space cooling energy** / Floor-area
Water heating	Population	Occupied-dwelling / Person	Water heating energy / Occupied-dwelling
Cooking	Population	Occupied-dwelling / Person	Cooking energy / Occupied-dwelling
Lighting	Population	Floor-area / Person	Lighting energy / Floor-area
Appliances	Population	Appliance stocks / Person	Appliance energy / Appliance stocks

* Adjusted energy using HDD compensation, ** Adjusted energy using CDD compensation



Decomposition Analysis in Industry Sector

- Metric examples for industry energy decomposition

Sub-sector	Activity (A)	Structure (S)	Intensity (I)
Food products, beverages, tobacco products (ISIC* 10-12)	Value-added	Share of Value-added	Energy / Value-added
Paper and paper products (ISIC 17)	Value-added	Share of Value-added, Production / Value-added	Energy / Value-added, Energy / Production
Chemicals and chemical products (ISIC 20-21)	Value-added	Share of Value-added, Production / Value-added	Energy / Value-added, Energy / Production
Non-metallic mineral products (ISIC 23)	Value-added	Share of Value-added, Production / Value-added	Energy / Value-added, Energy / Production
Basic metal (ISIC 24)	Value-added	Share of Value-added, Production / Value-added	Energy / Value-added, Energy / Production
Fabricated metal products, machinery and equipment (ISIC 25-28)	Value-added	Share of Value-added	Energy / Value-added
Other industry (ISIC 10-32, excluding ISIC 19 and those described above)	Value-added	Share of Value-added	Energy / Value-added

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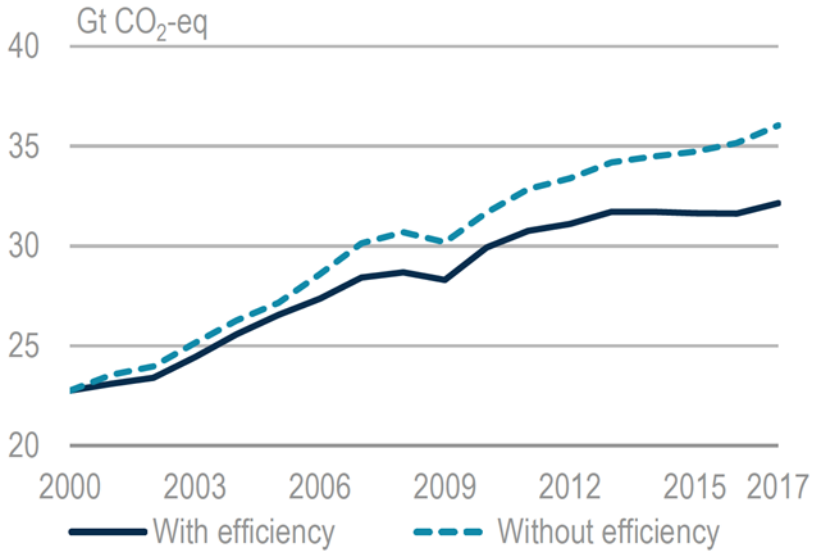
Decomposition Analysis in Transport Sector

- Metrics examples for transport energy decomposition

Mode	Activity (A)	Structure (S)	Intensity (I)
Passenger road (cars, buses…)	Passenger-km	Share of Passenger-km, Registered Vehicle / Passenger-km	Energy / Passenger-km, Energy / Vehicle
Passenger rail	Passenger-km	Share of Passenger-km, Passenger / Passenger-km	Energy / Passenger-km, Energy / Passenger
Passenger domestic air	Passenger-km	Share of Passenger-km, Passenger / Passenger-km	Energy / Passenger-km, Energy / Passenger
Freight road (HDVs)	Tonne-km	Share of Tonne-km, Tonne / Tonne-km	Energy / Tonne-km, Energy / Tonne
Freight rail	Tonne-km	Share of Tonne-km, Tonne / Tonne-km	Energy / Tonne-km, Energy / Tonne
Freight domestic shipping	Tonne-km	Share of Tonne-km, Tonne / Tonne-km	Energy / Tonne-km, Energy / Tonne

Energy efficiency & emissions savings

Avoided global GHG emissions from energy efficiency improvements



Source: IEA (2018), *Energy Efficiency Market Report*, OECD/IEA, Paris.

Energy efficiency reduced GHG emissions by 4 $GtCO_2$-eq, or 12% of total CO2 emissions in 2017.

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