Energy efficiency indicators in the residential sector

Mafalda Silva  Energy efficiency indicators
Jakarta, 16-20 July 2018
Why is the residential sector important?

It determines our quality of life!
Overview

- What we can learn from **energy balances** *(wrap up from yesterday)*?
- What can we learn from **energy efficiency indicators**?
- Developing **energy efficiency indicators** – discussion
- How to perform **temperature correction**?
What we can learn from energy balances?
Fuel mix in residential sector

Fuel mix in the residential sector varies across countries

Source: IEA Energy Balances, 2018
In the Asian focus region, the residential sector accounts for ~29% of final energy consumption.
High level indicators trends

Energy consumption in residential sector/population

Source: IEA Energy Balances, 2018
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.
Final consumption – data coverage ambition

Energy balance

Energy efficiency indicators

Source: IEA Energy Efficiency Indicators, 2016
What else do we need to know?

• What **end use** consume most of the energy (cooking/heating...)?

• Which **aspect of our life** will be affected in case of **electrical blackout**?

• What is the **share of LPG** used for cooking?

• Are we using energy for **space heating** more efficiently over time?
What can we learn from energy efficiency indicators?
With more detailed data we can see where energy is used.

Figure 4.4 • Breakdown of residential consumption by end use in 2010 for 20 selected OECD countries

Note: The breakdown into individual appliances is available only for 14 countries.

Example of insights from end use data: residential sector

Example of shares of end-uses on energy consumption

- Space heating: 62%
- Water heating: 19%
- Residential appliances: 10%
- Lighting: 4%
- Cooking: 4%
- Space cooling: 1%
- Refrigerators*: 3%
- Washing equipment*: 3%
- TVs*: 2%
- Other appliances: 2%

Example of selected energy intensities

- Space heating
- Lighting
- Water heating
- Cooking
Understanding the trends - decomposition

Drivers of the variation in the consumption in Philippines (1980-2005)

- Similar approach to IEA decomposition analysis, at a macroeconomic level - GDP and Population

- This example does not include more detailed data: appliances stocks, travel activity data, share of VA in industry

Source: Finland futures Research centre “Key Trends of Climate Change in the Asean Countries”, 2012
Developing energy efficiency indicators - discussion
Energy efficiency indicators: definition

Generic Energy Efficiency Indicator

Energy Consumption

Activity
Data and indicators for the residential sector

<table>
<thead>
<tr>
<th>Energy consumption data:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating*</td>
</tr>
<tr>
<td>Space cooling*</td>
</tr>
<tr>
<td>Water heating</td>
</tr>
<tr>
<td>Cooking</td>
</tr>
<tr>
<td>Lighting</td>
</tr>
<tr>
<td>Appliances energy consumption:</td>
</tr>
<tr>
<td>Refrigerator</td>
</tr>
<tr>
<td>Freezer</td>
</tr>
<tr>
<td>Dishwasher</td>
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<tr>
<td>Clothes washer</td>
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<tr>
<td>Clothes dryer</td>
</tr>
<tr>
<td>TV</td>
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<tr>
<td>Computers</td>
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</tbody>
</table>

* Temperature corrected, using HDD & CDD

<table>
<thead>
<tr>
<th>Activity data:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
</tr>
<tr>
<td>Number of occupied dwellings</td>
</tr>
<tr>
<td>Residential floor area</td>
</tr>
<tr>
<td>Appliances stock and diffusion</td>
</tr>
</tbody>
</table>

# of people  # of dwellings  Surface  # of appliances
Pyramid of residential* indicators – What indicator would you choose?

- **R1a** Total residential energy consumption (absolute or as a share of TFC)
- **R1b** Share of each energy source in total residential energy consumption mix
- **R2a** Total residential energy consumption per capita
- **R2b** Total residential energy consumption per dwelling
- **R2c** Total residential energy consumption per floor area
- **R3a** End-use energy consumption (absolute or as a share of residential consumption)

*Note that this disaggregation applies to the total sector, as well as to each of the dwelling types (e.g. detached single-unit houses, semi-detached dwellings, etc)
Pyramid of space cooling indicators – What indicator would you choose?

C1a: Total space cooling energy consumption (absolute or as a share of residential consumption)

C1b: Space cooling electricity consumption (absolute or as a share of residential electricity consumption)

C2a: Space cooling energy consumption per dwelling with air conditioning

C2b: Space cooling energy consumption per floor area cooled

C3a: For each dwelling type: space cooling energy consumption per floor area cooled

C3b: For each type of space cooling system: space cooling energy consumption per floor area cooled

C3c: For each energy source: space cooling energy consumption per floor area cooled
Pyramid of lighting indicators – What indicator would you choose?

L1a  Total lighting energy consumption (absolute or as a share of residential consumption)

L2a  Lighting electricity consumption (absolute or as a share of residential electricity consumption)

L2a  Lighting energy consumption per capita
L2b  Lighting energy consumption per dwelling
L2c  Lighting energy consumption per floor area

L3a  For each type of dwelling: lighting energy consumption per dwelling
L3b  For each type of dwelling: lighting energy consumption per floor area

Star symbol indicates the recommended indicator.
Pyramid of cooking indicators – What indicator would you choose?

- **K1a** Total cooking energy consumption (absolute or as a share of residential energy consumption)
- **K1b** Share of each energy source in total cooking energy consumption mix
- **K2a** Cooking energy consumption per capita
- **K2b** Cooking energy consumption per dwelling
- **K3a** For each energy source: cooking energy consumption per dwelling

[Image of pyramid diagram]

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Pyramid for appliances indicators – What indicator would you choose?

- **A1a** Total appliances energy consumption (absolute or as a share of residential energy consumption)
- **A1b** Total appliances electricity consumption (absolute or as a share of residential electricity consumption)
- **A2a** Appliances energy consumption per capita
- **A2b** Appliances energy consumption per dwelling (and per dwelling with electricity)
- **A3a** For each appliance type: energy consumption per appliance unit
Occupied dwellings vs total dwellings

Primary residences

Unoccupied dwellings

Vacation homes
How to perform temperature correction?
Temperature correction: cooling degree days

With warmer weather, cooling needs increase (residential and services)

CDD\(_{(27\text{Jul}-01\text{Ago})}\) = 2+3+7+1 = 13
Temperature correction: adjusting energy consumption

- Adjusted energy for cooling (simplified method):

- Actual energy for SC (current year) × \( \frac{\text{Average CDD (period)}}{\text{CDD (current year)}} \)

Calculation example:

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDD</td>
<td>905</td>
<td>874</td>
<td>1008</td>
</tr>
<tr>
<td>Energy for SC (PJ)</td>
<td>20.5</td>
<td>19.2</td>
<td>21.8</td>
</tr>
<tr>
<td>Adj. Energy for SC (PJ)</td>
<td>(20.5 \times \frac{929}{905})</td>
<td>(19.2 \times \frac{929}{874})</td>
<td>(21.8 \times \frac{929}{1008})</td>
</tr>
</tbody>
</table>

Avg. CDD: 929