International experience with end-use data collection

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September 2018, Mexico, Technical Workshop on energy efficiency indicators and data

IEA

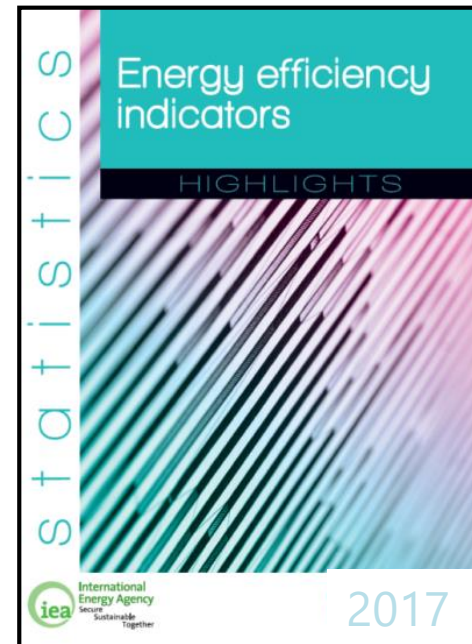# IEA Members recognize the value of sharing end-use data and indicators

End-use data and indicators collected and published each year by IEA.
We are delighted as the upcoming 2018 edition will include data for Mexico!

A sound energy balance: starting point to understand the energy system

http://www.iea.org/Sankey/index.html

From high-level to end-uses to better track energy demand trends

energy balances

TPES / GDP

TFC / Population

....

Aggregated Indicators

energy efficiency data

End-use efficiency indicators

Energy / tonne steel

Space heating / floor area

...

Process/appliance efficiency indicators

Energy / tonne clinker (dry process)

...
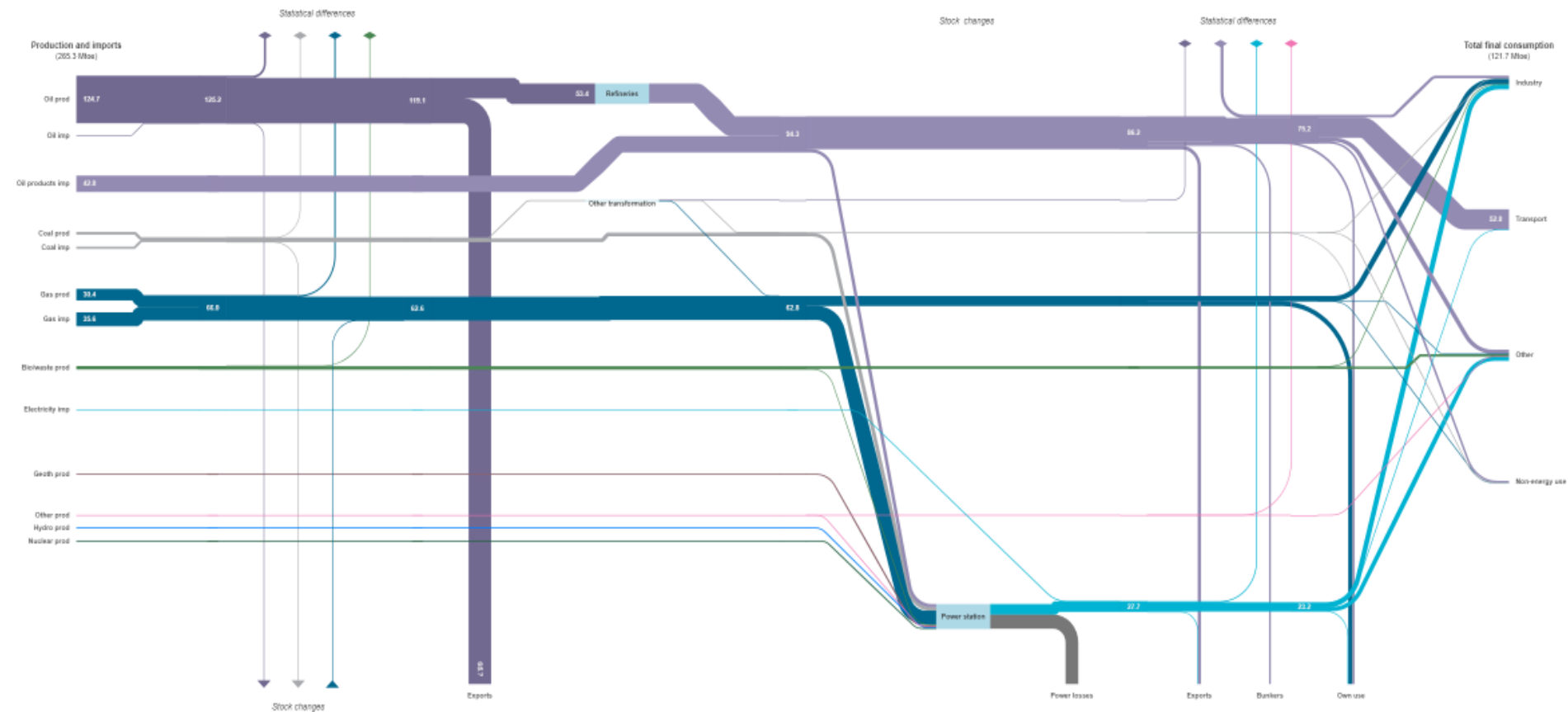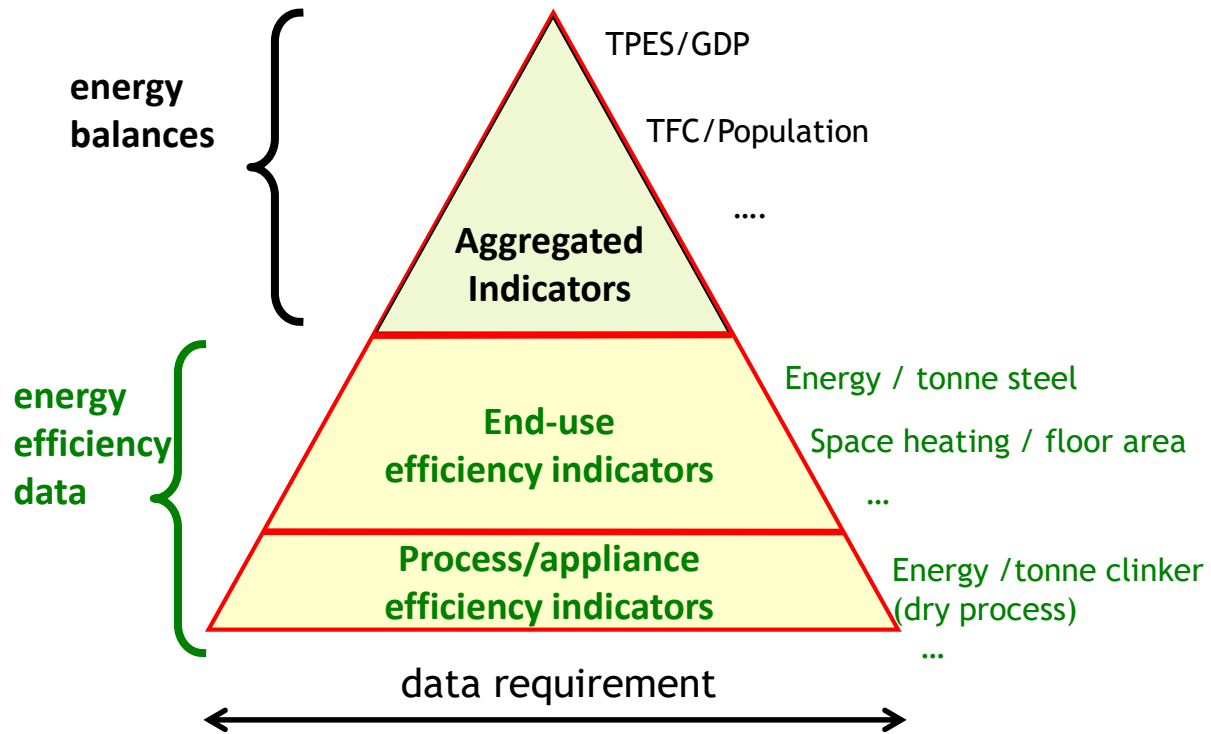
data requirement

Given enhanced data requirements, optimising data collection is essential

Methods used to collect data for efficiency indicators

➤ Administrative sources
- before starting new data collection

➤ Surveys
- representative sample
- possibly expanding existing surveys with key questions

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

➤ Modelling
- complementary to surveys or stand alone

In most cases, countries integrate different methods

Activity data: often scattered across players beyond energy domain

Buildings

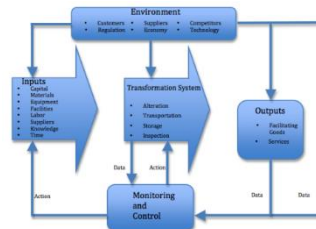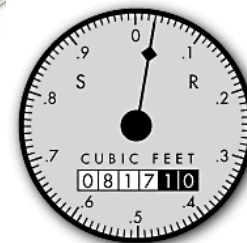| Activity data	
Floor area	National statistics offices Real estate Regional governments Taxation registers
Number of dwellings	Land registry National statistics offices
Heating equipment	Building registers Manufacturers/Vendors Subsidy registers
Number of appliances	Manufacturers National statistics offices

Industry

Activity data	
Value added	National statistics offices National accounts International sources**
Sub-sectoral production output	Manufacturers Industry associations*
Process/product type output	Manufacturers Industry associations*
Equipment	Manufacturers Industry associations*

* Examples of industry associations are given in Box 6.1

Transport

Activity data	
GDP, population	National statistics offices
Vehicle-km (vkm)	Vehicle registers/ Roadworthiness testing services/ Inspecting organisations Municipalities/Transport authorities National and international databases Transport ministries
Passenger-km (pkm)	National and international databases Transport ministries
Tonne-km (tkm)	National and international databases Transport ministries

IEA Energy Efficiency Indicators:
Fundamentals on Statistics, 2014

Administrative sources: what are pros and cons?

Pros	Cons

Administrative sources: mapping existing data that fit your purposes

Pros	Cons
Typically **less expensive** than a new data collection process	**Boundary issues**: potential mismatch between existing and needed data
Relatively **quick availability**	Challenges in establishing and keeping **institutional communication**
Increased synergy between institutions	Possible **costs** (e.g. purchase data, change data formats...)
Raise profile of **energy efficiency** among different services	**Time investment** in research to find the right sources

The importance of establishing a framework – including MoUs

The experience of CONUEE shows opportunities in administrative data

De la integración de fuentes oficiales a la obtención IEE avanzados

Surveying: what are the pros and cons?

Pros	Cons

Surveying: collecting ad-hoc data from a representative sample

Pros	Cons
Relatively cost-effective, given extensive information collected	Potentially high absolute cost
Ad-hoc design of items collected based on purpose	Time consuming and requires trained staff
Representativeness / statistical significance	Need for further estimation (e.g. extrapolation between years)
Usually comprehensive and good quality data	Risk of incomplete responses, biases, sampling errors

Leveraging on national statistical capacity (NSO) and on existing surveys

How are countries collecting end-use data?
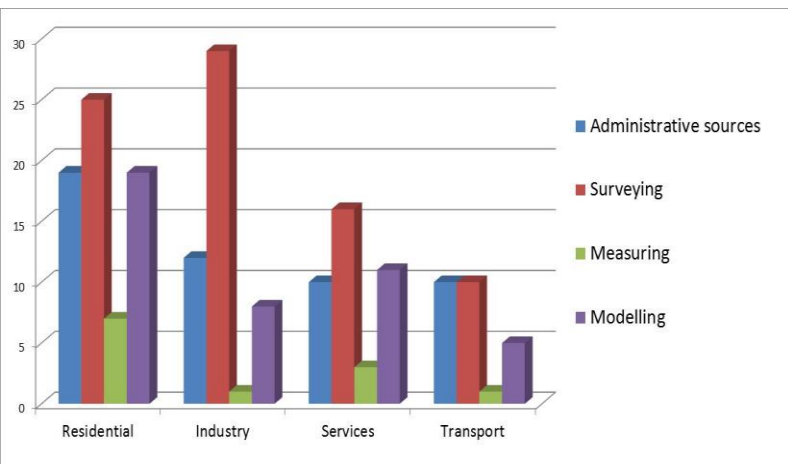
Results from an IEA survey for 160 practices from more than 40 countries
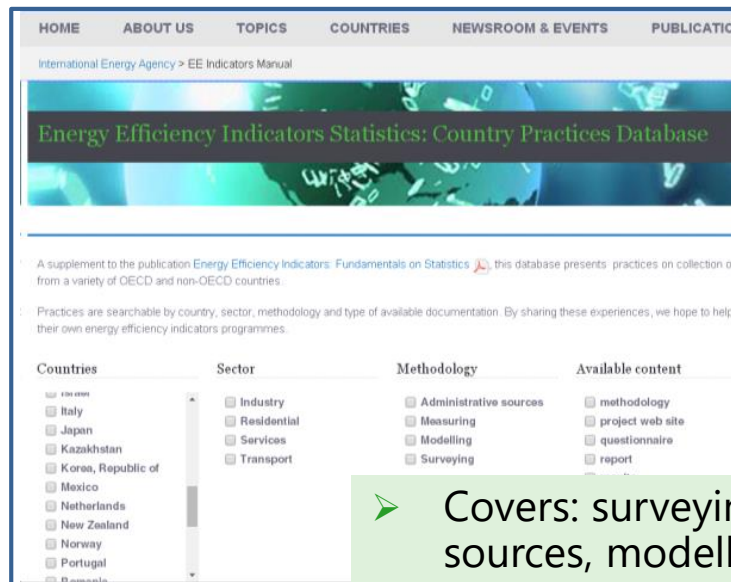
> ➤ Covers: surveying, administrative sources, modelling and metering across sectors
>
> ➤ Questionnaires and other material available
>
> ➤ Links to various national administrations wesbites

IEA online database of country practices
http://www.iea.org/eeindicatorsmanual

Administrative: example for transport (Japan)

Manual for passenger vehicles average fuel economy performance calculation

Key data sources:

- Automobile Inspection/Registration (registered vehicles by type and year)

- Japan Automobile Manufacturers Association (Sales, fuel economy)

- Japan Automobile Importers Association (imports)

- Japan Mini Vehicles Association (sales)

- Ministry of Land, Infrastructure, Transport, and Tourism (passenger vehicle traffic volume)

- Energy Ministry (energy consumption)

Passenger Vehicles Average Fuel Economy Performance Calculation Manual

(FY2006:2nd edition/Ver.2)

August, 2008

Japan Automobile Manufacturers Association, I

http://libterra.co.jp/Manual(JAMA2006V2).pdf

Administrative: example of data matching: UK NEED framework

Figure 2.1: Structure of domestic NEED

HEED/Ofgem/BEIS — Energy efficiency measures

Energy Suppliers — Consumption (Elec. and gas)

AddressBase Unique property reference

VOA — Property attributes

Experian — Household characteristics
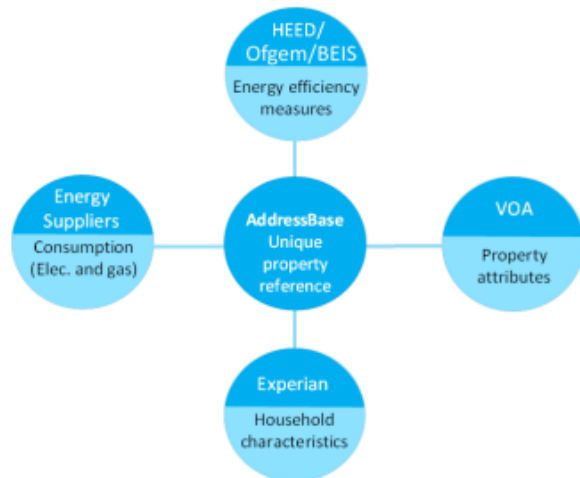
Seven key data sources have been used to analyse domestic energy consumption and the impact of installing energy efficiency measures:

Framework for **combining data from existing sources** to track impact of energy efficiency measures are on **gas and electricity** consumption in properties.

Data from different sources can be matched through **unique property reference number** based on **address** information.

https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework

Survey: household example – some lesson learnt (Austria)

Questionnaire

- For all fuels used in households **quantities and expenditures** as well as purposes of use are asked

- Only **absolutely necessary** questions are asked

- Only questions the respondents can answer are asked

- Different units are allowed

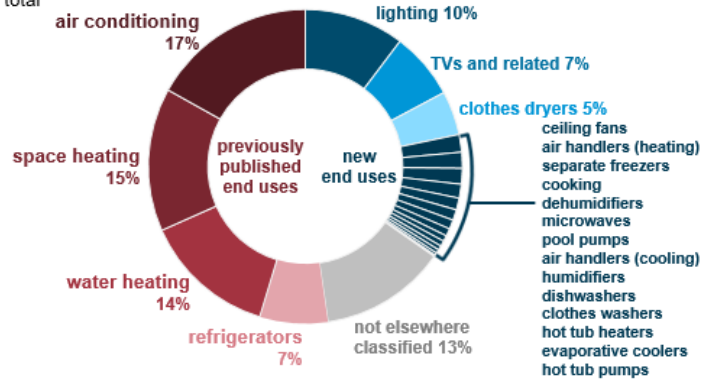www.statistik.at   slide 6 | 25 September 2018

Preparation

➢ Interviewer training
 – Interviewers should have a good knowledge on the different fuels.
 – Interviewers should be well trained on consumption pattern of different stove types as well as on typical consumption pattern of different purposes (e.g. for space heating, water heating and cooking).
 – Practical leaflets with region-specific bills (electricity, natural gas and heat from district heating) could help the interviewers to assist the respondents
➢ Respondents information (notification letter)
 – the purpose and the content of the survey
 – the data they will be asked for and
 – the question to prepare bills

www.statistik.at   slide 8 | 25 September 2018

Survey results generally require modelling to estimate energy end uses

JUNE 5, 2018

EIA's residential energy survey now includes estimates for more than 20 new end uses

Residential electricity consumption by end use, 2015
percent of total

- air conditioning 17%
- lighting 10%
- TVs and related 7%
- clothes dryers 5%
- space heating 15%
- water heating 14%
- refrigerators 7%
- not elsewhere classified 13%

previously published end uses

new end uses:
- ceiling fans
- air handlers (heating)
- separate freezers
- cooking
- dehumidifiers
- microwaves
- pool pumps
- air handlers (cooling)
- humidifiers
- dishwashers
- clothes washers
- hot tub heaters
- evaporative coolers
- hot tub pumps

Source: U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey

End-Use Estimation

Overview

For the RECS program, an energy end use is a particular need, appliance, or device in a housing unit that consumes energy. Because direct measures of energy end uses, which often require installing special devices in homes, are rare, national estimates of energy consumption by end use must rely on some amount of modeling. The RECS Household Survey collects characteristics about a household's end uses, and the annualized ESS data dictate how much total energy was used by each fuel present. End-use estimation is done using both Household Survey and ESS data, combined with publicly available weather data.

End-use estimation is done in two main steps:

1. A suite of engineering *end-use models* is used to estimate the expected consumption of each end use present.
2. The known total consumption is used to *calibrate* the engineering model-based end-use estimates.

https://www.eia.gov/consumption/residential/reports/2015/methodology/pdf/2015C&EMethodology.pdf

Measurement: example for transport (Canada CVUS)

Canadian Vehicle Use Study by Transport Canada Vehicles equipped with **GPS and a screen** for driver input.

Not only for energy purposes: The electronic data logger also uses the GPS technology to support analysis of traffic congestion, road safety and infrastructure planning
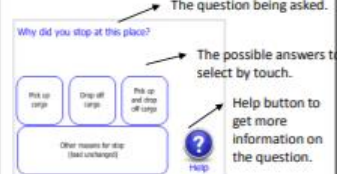
Elements collected:

- Trip patterns over time

- Fuel consumption over time

- Carrier utilisation pattern and impact on fuel economy

- Impact of fuel switching on vehicle fuel economy

https://www.statcan.gc.ca/eng/conferences/symposium2014/program/14257-eng.pdf

Emerging opportunities for end-use statistics from digital world

Many of our readers have run into issues with their smart meters. CREDIT: NICK (?) AK/ALAMY

Microwave   Kettle   Toaster
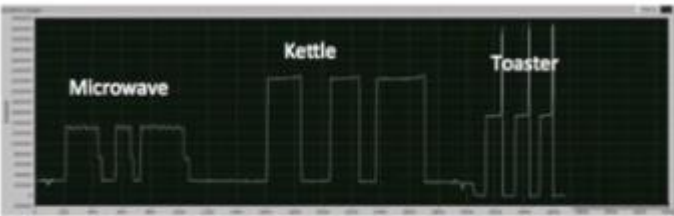
- Every appliance has its own energy draw on the power line

Beyond models, EIA has begun testing new technologies to objectively measure end use demand. Recent research shows:

- So-called "NILMs" (Non-Intrusive Load Monitoring) are definitely *the* hot topic, and shared by different interests:
  - Energy Efficiency, Demand Response, Measurement & Verification, Energy Audits, Appliance Diagnostics, Cost of Service, etc.

In this initial pilot study of NILM technologies, EIA will conduct analyses to…

- Compare usage <u>patterns</u> between NILM device and respondent, (e.g., number of clothes washer cycles

- Compare usage <u>characteristics</u> (e.g., self-reported versus observed water temperature for a clothes washer or heated drying for a dishwasher)

- Compare actual consumption by end use to the RECS 2015 model results

We'll prioritize the research in three tiers in preparation for the 2020 RECS:

Priority	Products
Tier 1	Refrigerators, Dishwashers, Clothes Washers, Dryers, Cooking, Air Conditioning, Heating
Tier 2	Computers, Televisions, Home Entertainment
Tier 3	Lighting, Rare End Uses, Residual

Pilot experiences across countries to assess statistical applicability

Energy efficiency data collection opportunities – for discussion

Collect from existing data sources

- Optimise data sharing across institutions – including MoUs
- Maximise the use of administrative data from government and programmes

Collect from new data sources

- End-use data surveys (Consider adding questions to existing surveys)
- Consider new methods (automated, meters, sensors, GPS, etc.)

Resources and planning

- Ensure establishment of institutional capacity
- Enable timely data collection resources, <u>because having no data will cost more!</u>

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