



energy

Department:
Energy
REPUBLIC OF SOUTH AFRICA

Toolkit: Evaluation and energy efficiency indicators

Buildings: Maxine Jordan, IEA and Ian Hamilton, UCL Energy Institute

Pretoria, Wednesday 16th October 2019

Buildings energy efficiency sessions in partnership with:

UCL ENERGY
INSTITUTE



Energy Efficiency Training Week: Buildings programme

1. Where to start: Energy use in buildings
2. Where to start: Energy efficiency potential in buildings
Special session: GlobalABC Regional Roadmaps
3. Toolkit: Energy efficient building design technologies
4. Toolkit: Energy efficient building system technologies
Special session: Green Building in Africa – *Elizabeth Chege, KGBS*
Special session: The GlobalABC Africa Roadmap for buildings and construction
5. What are the steps? Determining the current status of policies
6. Toolkit: Energy efficiency policies and target setting *with guest speaker: Hlompho Vivian, GBC SA*
7. What are the steps? Implementing codes and standards
8. What are the steps? Building operations and procurement *with guest speaker: Christelle Van Vuuren, Carbon Trust*
Special session: The multiple benefits of energy efficiency
- 9. Did it work? Evaluation and energy efficiency indicators**
Special session: Financing energy efficiency in buildings
10. Buildings quiz

Energy Efficiency Training Week: Buildings

9. Did it work? Evaluation and energy efficiency indicators

Trainers: Maxine Jordan, IEA and Ian Hamilton, UCL Energy Institute

Purpose: To teach the fundamentals of tracking progress with energy efficiency indicators that are applicable to the buildings sectors. The course will include a discussion of IEA's methodologies and how to collect or model data that can be used to estimate progress from energy efficiency efforts.

Scenario: Leadership wants to know how effective the building energy efficiency policies have been.

Discussion question: How do you determine the benefits of your policies and programmes?

Evaluation

What is evaluation?

Ex-ante evaluation

Ex-post evaluation



What is evaluation?

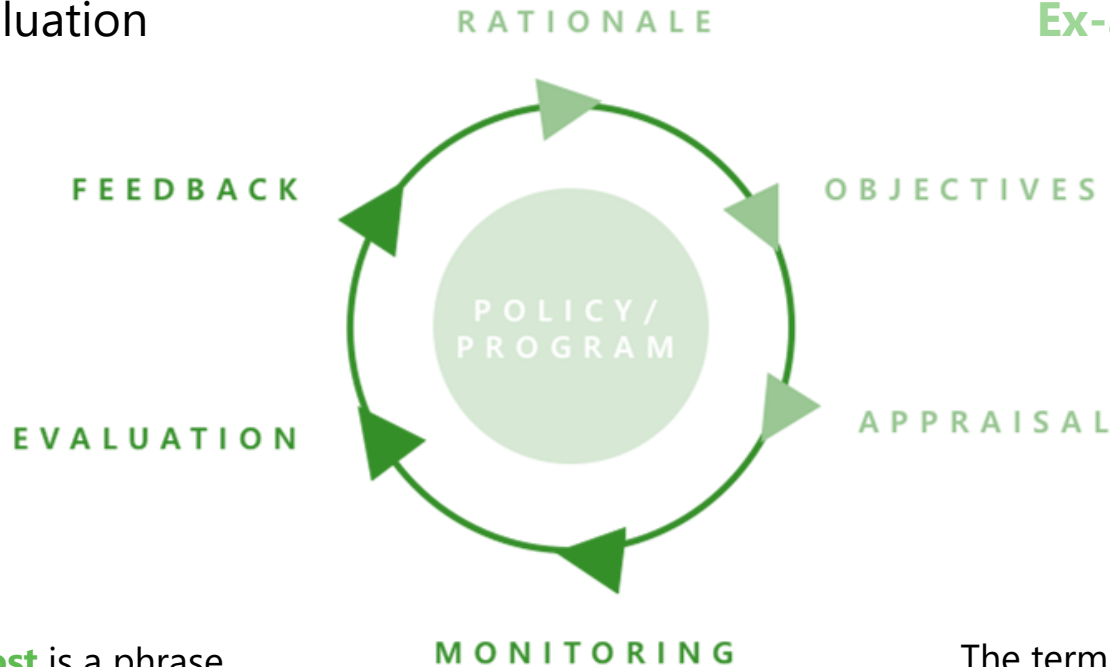
Evaluation is an **objective** process of understanding **how** a policy or programme was implemented, **what** effects it had, for whom and **why**.

It leads to **more effective** policies and programmes

When should you evaluate?

Ex-post evaluation

Ex-ante evaluation



The term **ex-post** is a phrase meaning "after the fact"

The term **ex-ante** is a phrase meaning "before the event"

Ex-post evaluation: did it work?

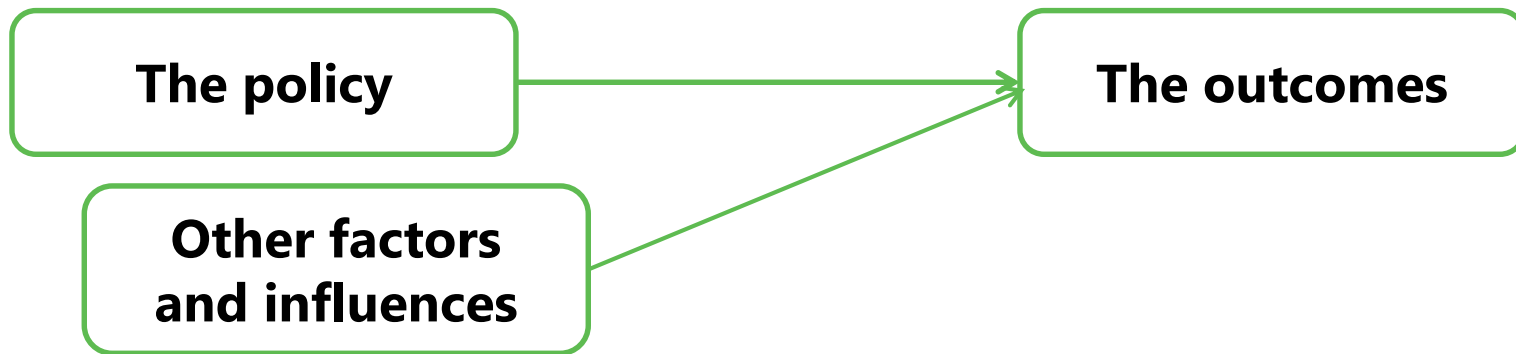
Measuring activities and outputs is straightforward, if not simple. Outcomes / impacts are more difficult...



Why is it more difficult?

Ex-post evaluation: did it work?

Measuring activities and outputs is straightforward, if not simple. Outcomes / impacts are more difficult...



Other factors include:

Global, national, local trends / events

Other policies

Something you haven't even thought of...

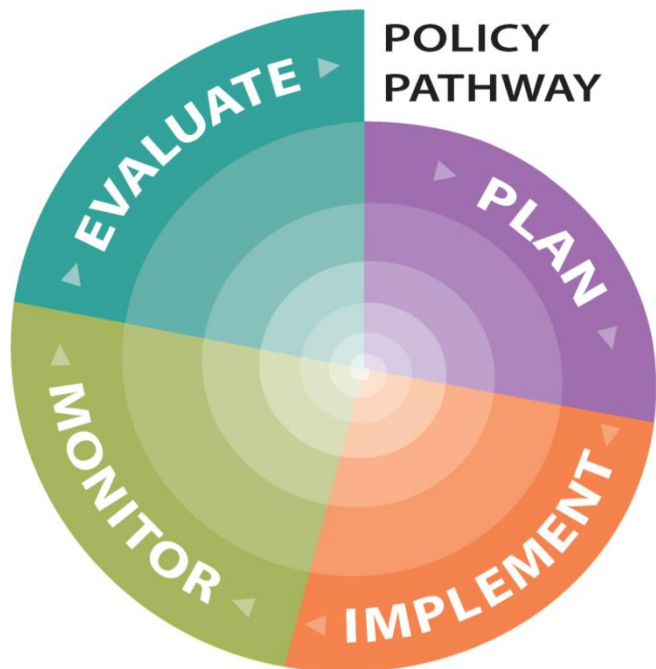
Energy efficiency data

Indicators manuals

Indicators data pyramid



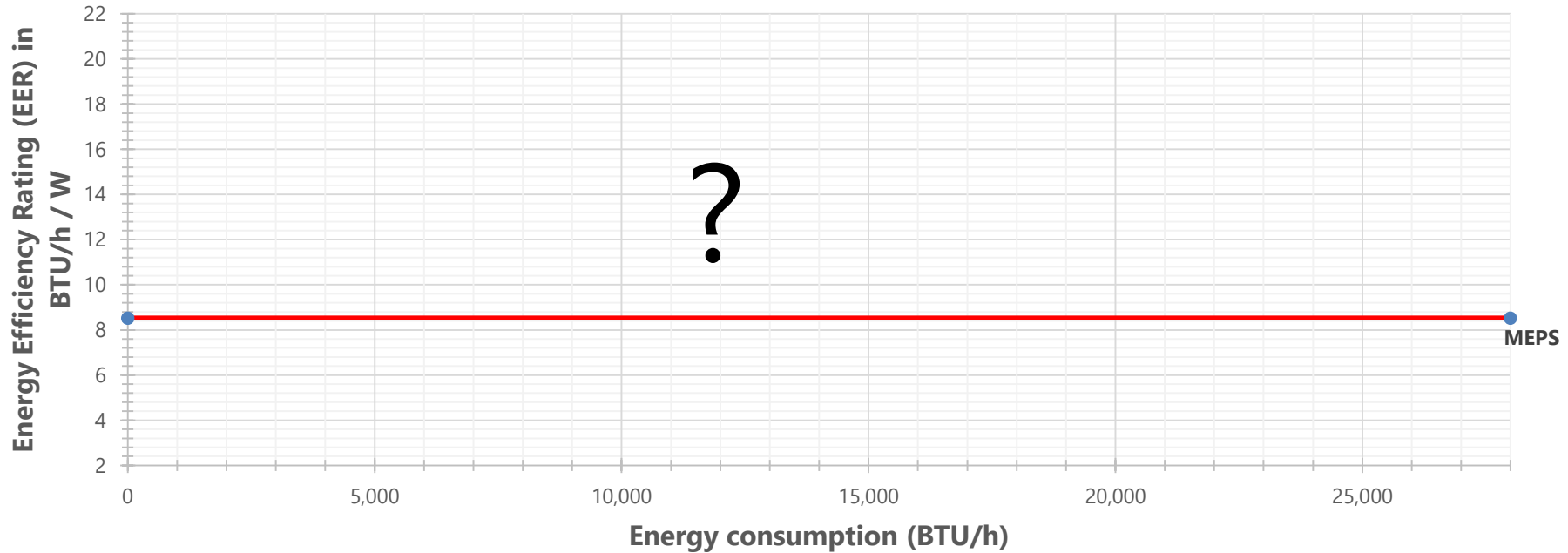
Data is essential at all stages of the policy cycle



- **Plan:** Inform policy design based on current state and ambition
- **Implement:** Adapt the policy during adoption and enforcement stages
- **Monitor:** Track how the policy is performing
- **Evaluate:** Use the data to see what happened and why

Each step requires appropriate data to be effective

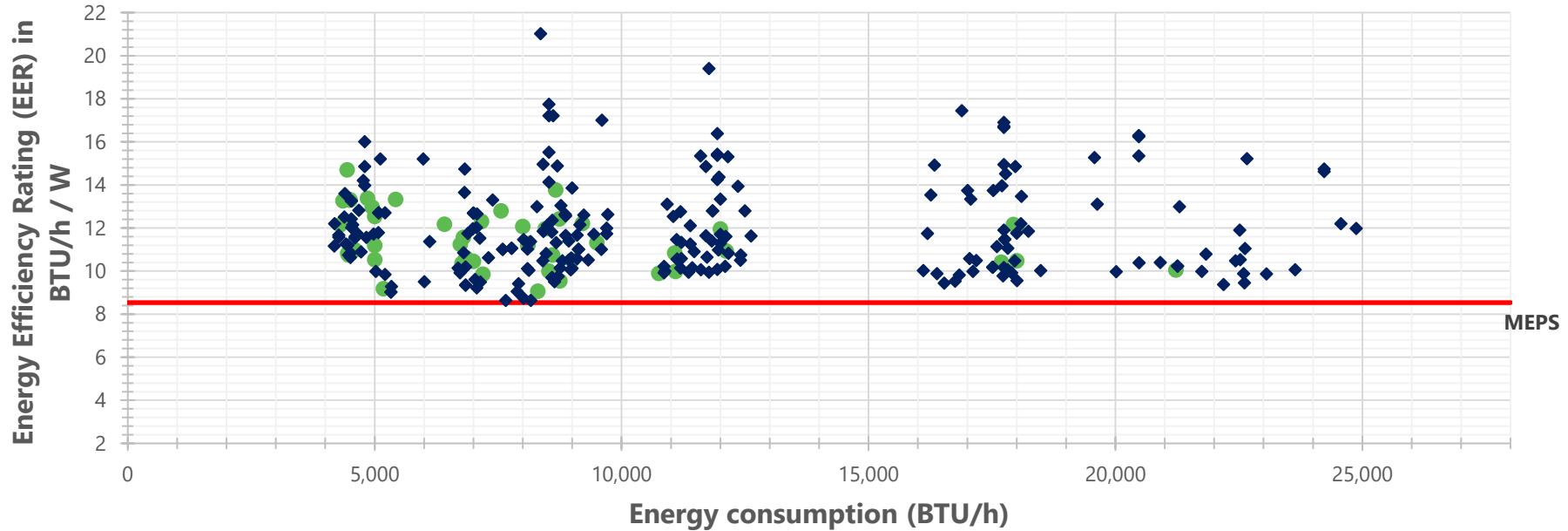
Why do we need data for policy design?



Where do you set your minimum energy performance standards (MEPS)?
Without national market data, you may set the MEPS here...

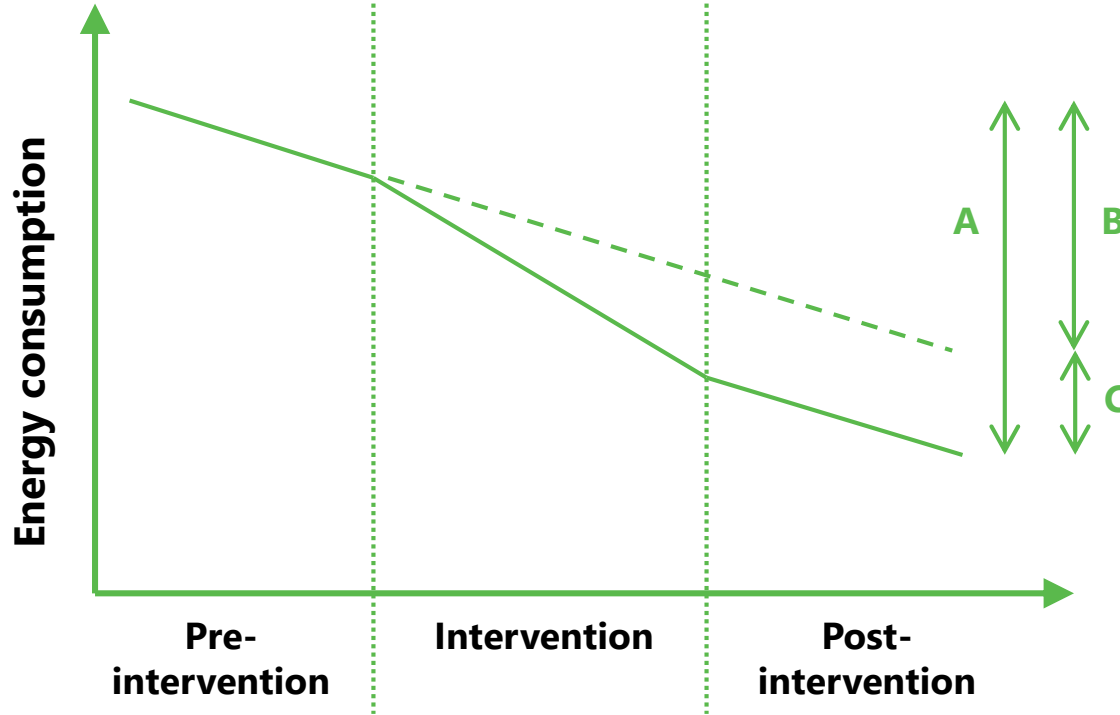
Why do we need data for policy design?

Efficiency of air conditioners - collected after MEPS were final



In this case, without appropriate data, MEPS were set too low.
Providing an unfair advantage to benefit importers over local companies...

How does data help in implementation?



Impacts are assessed compared to "control" group (what would have happened)

Monitoring and Evaluation

- **Monitoring** provides headline data on policy performance
 - What happens as a result of the policy?
- **Evaluation** provides an understanding of what is happening / has happened
 - Why and what can be done about it?
- **Why is monitoring and evaluation needed?**
 - Understand what happens as a result of the policy
 - Verify the policy is performing as expected
 - Ability to change policy during its implementation
 - Learn for other policies
 - Understand the energy efficiency and energy market more
 - What drives changes in the market?
 - How do energy consumers react?

Main sources of data, information and indicators

- Management information/reporting
- Measurement e.g. meter readings, compliance data
- Experiments/testing
- Modelling
- Surveys
- Interviews and focus groups

Resource of methods for capturing data, information and indicators

Home » ClassicStats » Topics » Energy efficiency » EE Indicators Manual

Energy Efficiency Indicators Statistics: Country Practices Database

A supplement to the publication [Energy Efficiency Indicators: Fundamentals on Statistics](#), this database presents practices on collection of data for developing efficiency indicators from a variety of OECD Members and non-Members.

Practices are searchable by country and territory, sector, methodology and type of available documentation. By sharing these experiences, we hope to help countries and organisations to develop their own energy efficiency indicators programmes.

Countries, territories and economies

- ☐ Albania
- ☐ Australia
- ☐ Austria
- ☐ Belarus
- ☐ Belgium
- ☐ Bosnia and Herzegovina
- ☐ Brazil
- ☐ Bulgaria
- ☐ Canada

Sector

- ☐ Industry
- ☐ Residential
- ☐ Services
- ☐ Transport

Methodology

- ☐ Administrative sources
- ☐ Measuring
- ☐ Modelling
- ☐ Surveying

Available content

- ☐ methodology
- ☐ project web site
- ☐ questionnaire
- ☐ report
- ☐ results

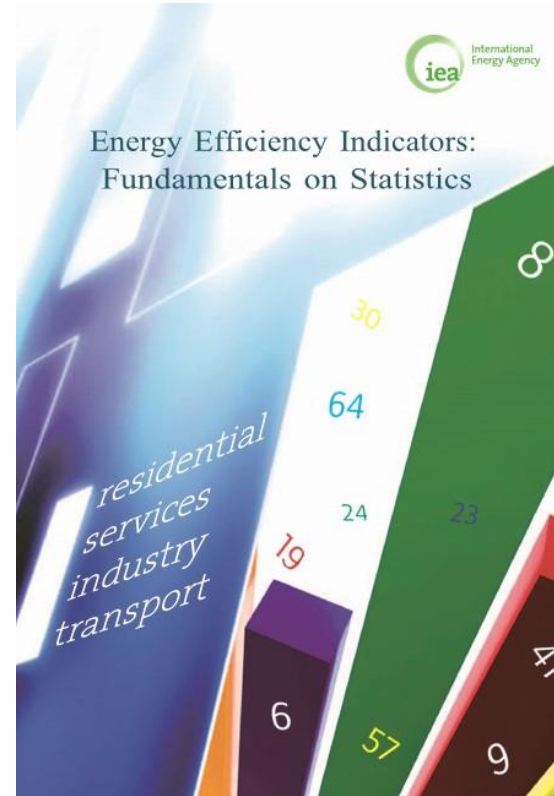
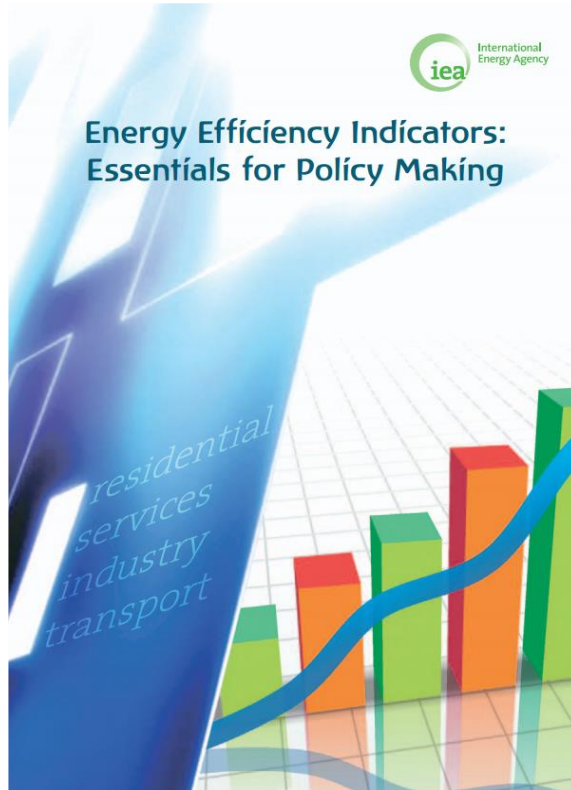
Search by keywords

Reset

Search



Energy efficiency indicators: manuals



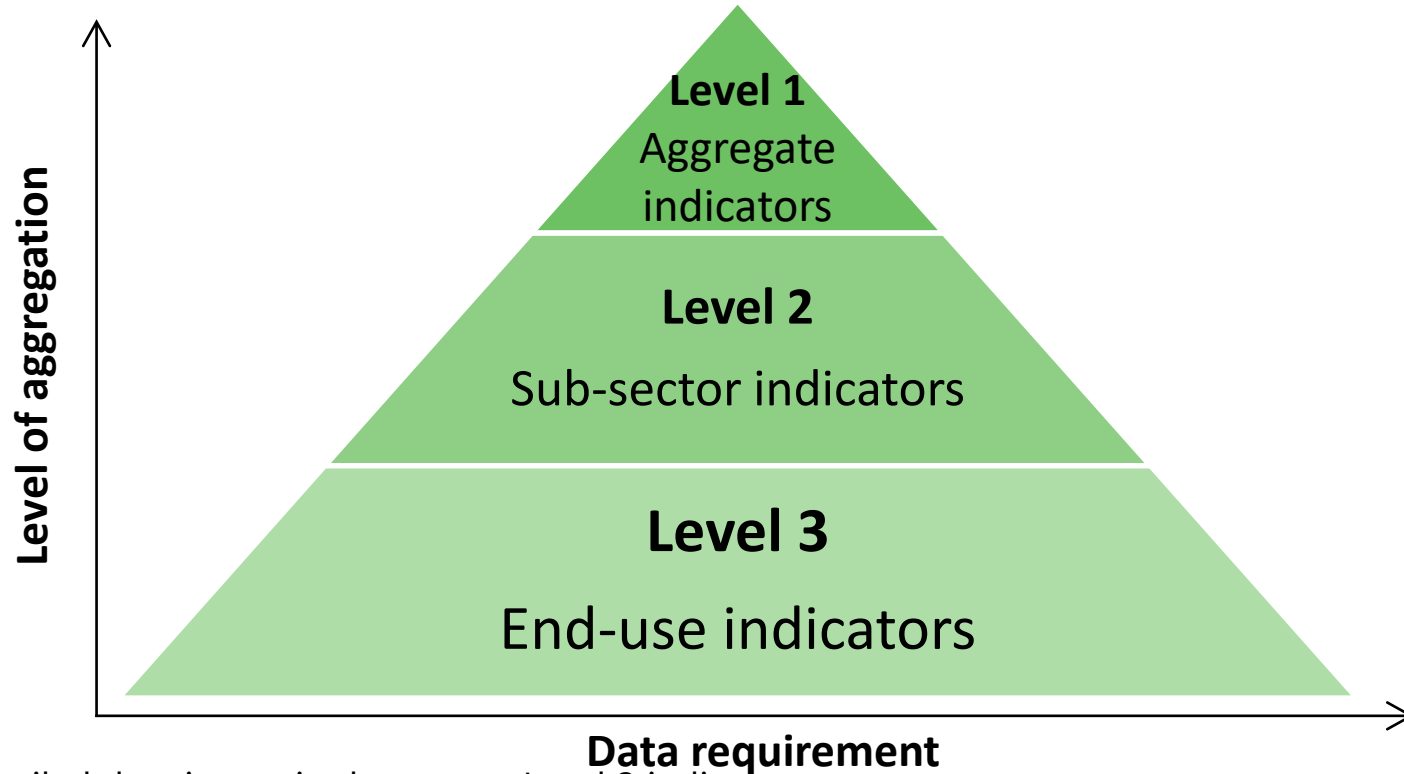
Source: IEA energy efficiency indicators
IEA 2019. All rights reserved.



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Energy efficiency indicators pyramid



More detailed data is required to get to Level 3 indicators

Energy efficiency indicators: online courses

[Sign in](#)[Register](#)

Welcome to the IEA online course on Energy Efficiency Indicators.

By joining our first online professional courses, you will come face-to-face with the IEA's work to train and build capacity, allow experiences to be shared and global progress to be tracked.

- Step-by-step and sector-by-sector through energy efficiency indicators.
- Self-paced and interactive.
- No set time limit to complete the course, to fit into your professional and personal lives.



International Energy Agency

Energy Efficiency Indicators: Fundamentals on Statistics

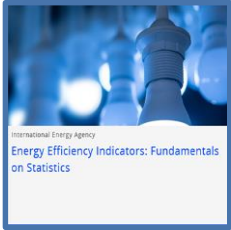


International Energy Agency

Energy Efficiency Indicators: Essentials for Policy Making



After completing the course, participants will be able to:



Statistics

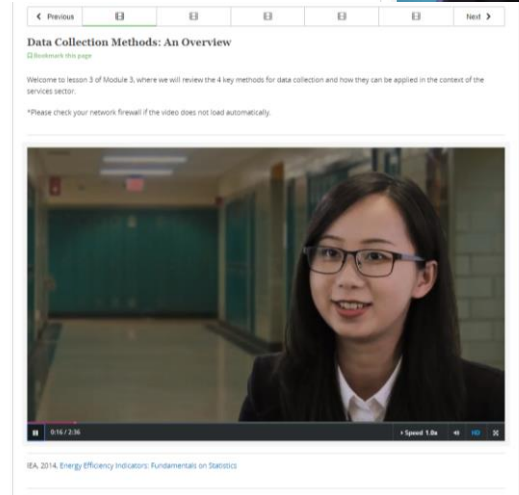
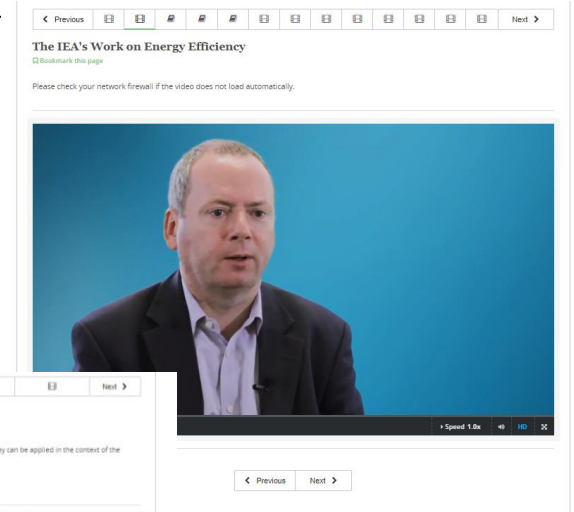
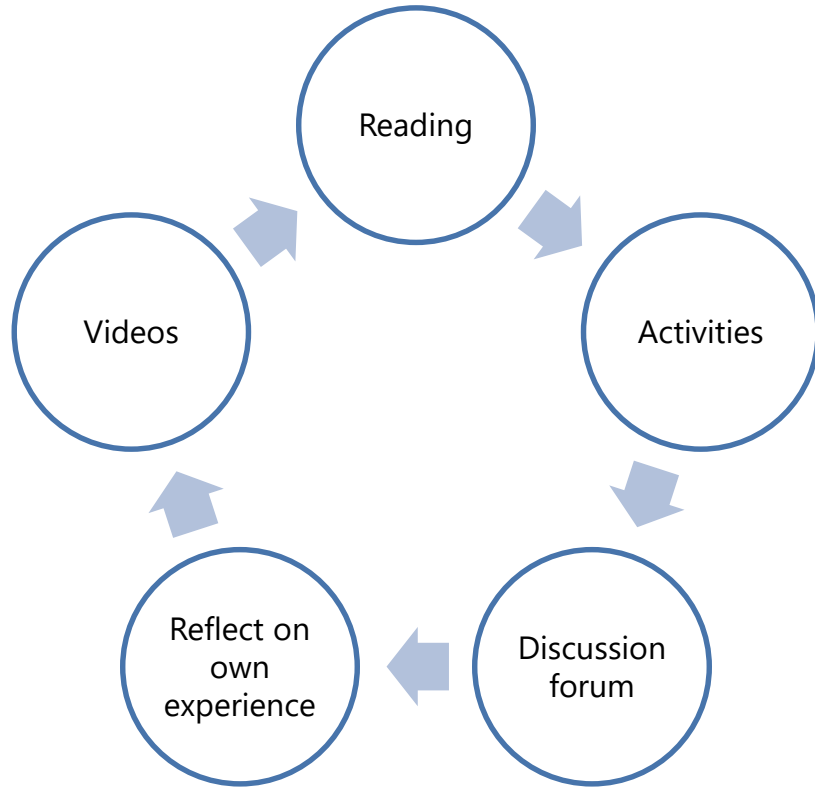
- Identify the set of indicators that can be developed across sectors, as well as the data required
- Clarify the role of detailed data collection for effective EE indicators and policies
- Explain the process of formulating disaggregated EE indicators (applying IEA's methodology)
- Define available approaches for EE surveying, metering and modelling in specific sectors
- Discuss the setup of a data collection programme for EE indicators in specific sectors.



Policy

- Explain the importance of data for effective energy efficiency policies;
- Discuss the role of energy efficiency indicators at various levels for prioritising sector-specific energy efficiency policies;
- Explain the importance of data for effective energy efficiency policies;
- Discuss the role of energy efficiency indicators at various levels for prioritising sector-specific energy efficiency policies;

Pedagogical approach



Course: Introduction: Energy Efficiency 101 > Lesson > Energy Efficiency Potential In Four Sectors

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Energy efficiency gains can be realised in many economic sectors. The graph below shows the realised vs unrealised potential for energy efficiency in four sectors. Do you know which sectors offer the highest potential? Have a guess and try to associate the four sectors with each column. Drag and drop accordingly. This exercise does not count for your final grade.

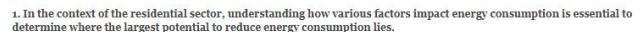


Energy and activity data are indispensable for the construction of indicators. Energy consumption data usually serves as a numerator, while activity data serves as a denominator. For example, to construct the indicator "space cooling energy consumption per value added" (C2a) we need the energy data "total cooling energy consumption" and the activity data "total value added".

Have a look at the incomplete equations, as well as the list of energy and activity data beneath them. Drag and drop the data to build five indicators, each one associated to an end use in the services sector. Reflect on the level of disaggregation of the indicators you constructed.

Other equipment _____ = ?

ENERGY DATA	ACTIVITY DATA
<ul style="list-style-type: none"> Total heating energy consumption Total cooling energy consumption Water heating energy consumption in office buildings Lighting energy consumption in schools Other equipment energy consumption in warehouses 	<ul style="list-style-type: none"> Total floor area cooled Total floor area heated Number of employees for warehouses Number of students for schools Number of employees for offices

[Bookmark this page](#)

1.0 point possible (graded)

☒ True

☐ False

 Save

1.0 point possible (graded)

☐ Space heating

[← Previous](#)

Next ➤

[Bookmark this page](#)Topic: / Energy efficiency indicators for the services sector [Hide Discussion](#)

Side Discussion

[Add a Post](#)

- Barriers to data collection in the services sector
To construct energy efficiency indicators, statisticians need both energy data and activity data. Yet in the case of services sector both activity and energy data might be hard to come by.
- Main end use in the services sector in your country
What is the main end use in the services sector in your country?
- Addressing data collection challenges in the services sector
Think about these challenges in the case of your country and try to propose possible solutions for improving data collection in key services subsectors such as office buildings.

<https://edx.iea.org/>



Evaluation approaches

Energy performance metrics: Typically primary level indicators (e.g. energy per person) that do not clearly show the role of efficiency.

Energy demand analysis: A “bars held” or “what if” approach by holding indicators constant than can under-estimate energy efficiency gains

Decomposition analysis: Can be complex to understand, but very valuable

Energy performance metrics

Limitations

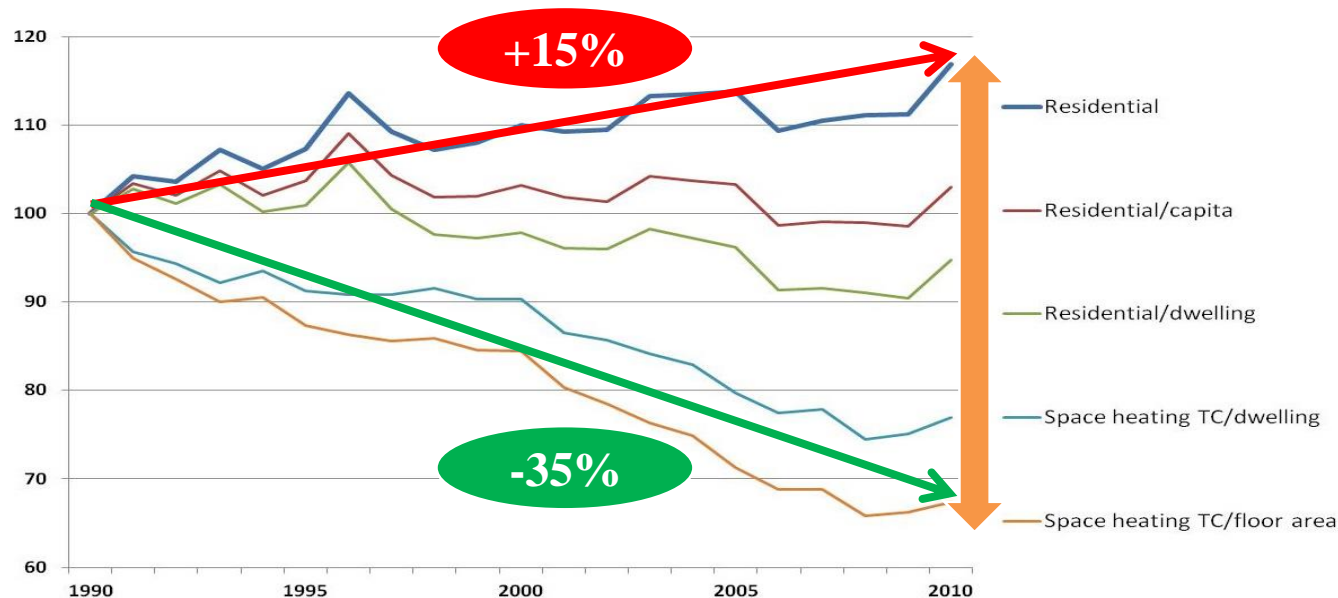
Energy consumption

Energy per person

Energy per floor area



Evaluation: choosing the right metric



What are these types of energy performance metrics not telling us about energy demand and efficiency progress?

Behaviour?

Technology?

Efficiency?

Income?

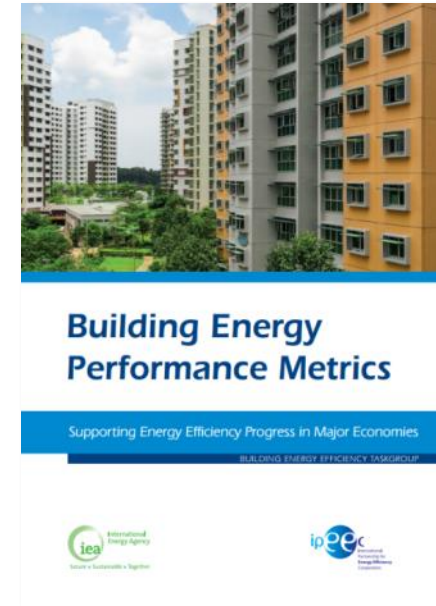
Index: 1990=1. Data for IEA18 (Australia, Austria, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA). TC: Temperature Corrected.

The right energy performance metric is crucial to understanding & tracking progress over time.

Evaluation: Building energy performance metrics

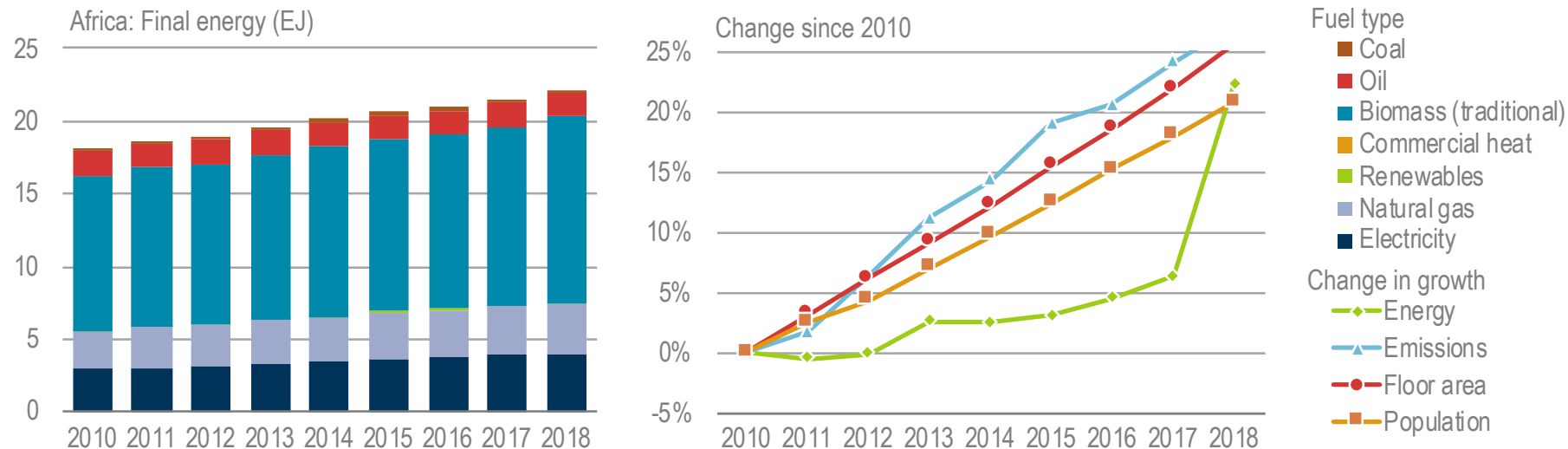
Limitations of Energy Performance Metrics

- Metrics cannot predict variation in overall energy consumption or quantify the impact of individual components or factors on overall energy consumption.
- It is often necessary to undertake more detailed analysis to fully understand the combined impact of a number of different factors or driving forces on overall energy consumption.



Africa buildings

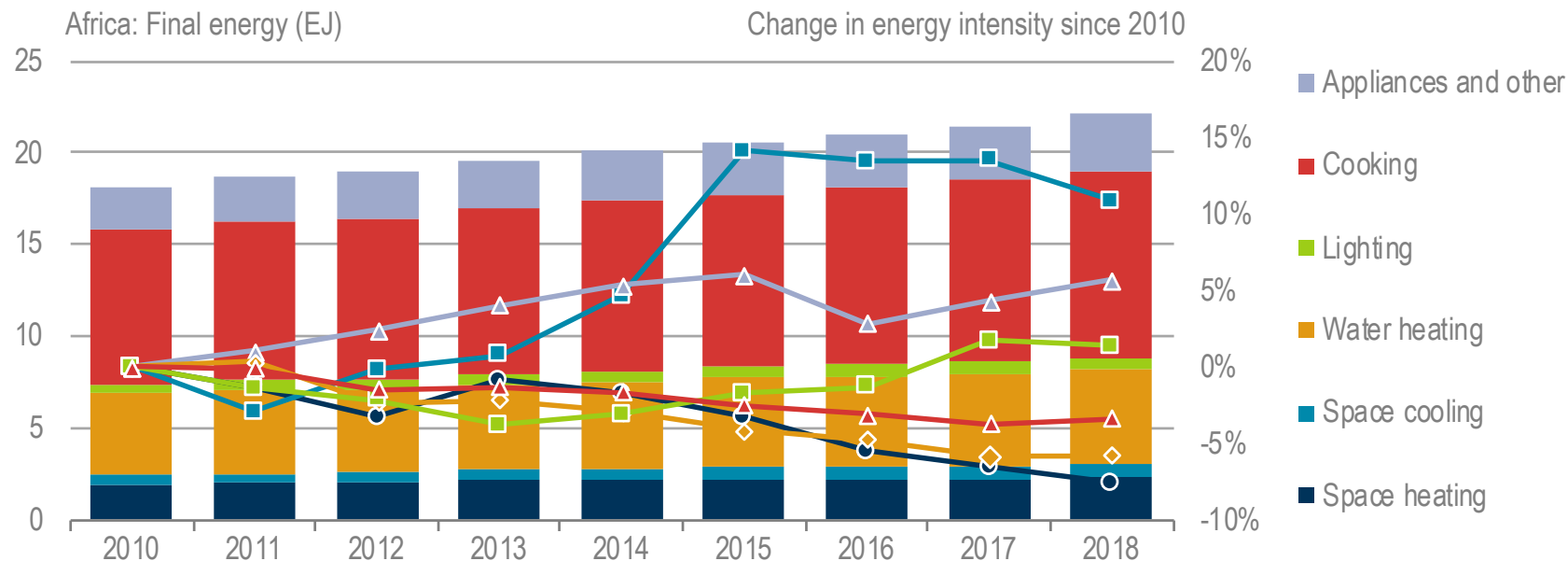
Africa final energy use by fuel type and change in indicators, 2010-18



Growth in Biomass, natural gas and electricity

Africa buildings

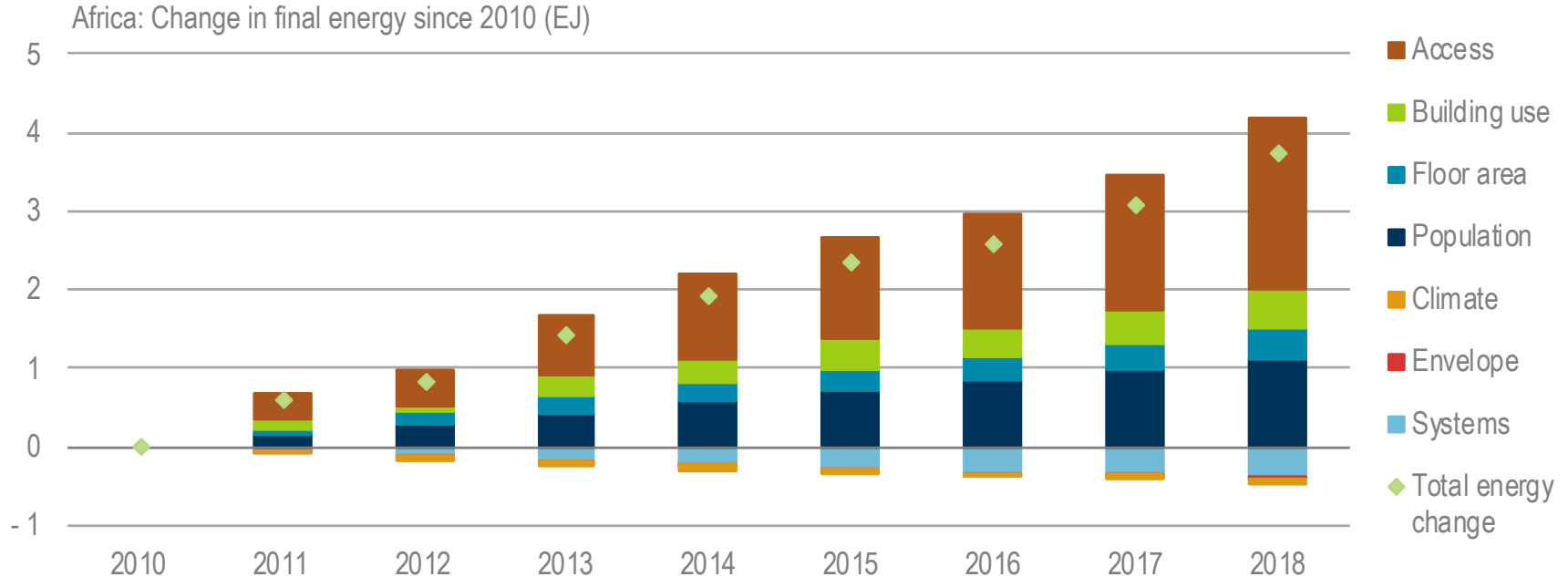
final energy use and intensity change by end use 2010-18



Growth in cooling, though small share, and appliance and lighting

Africa buildings

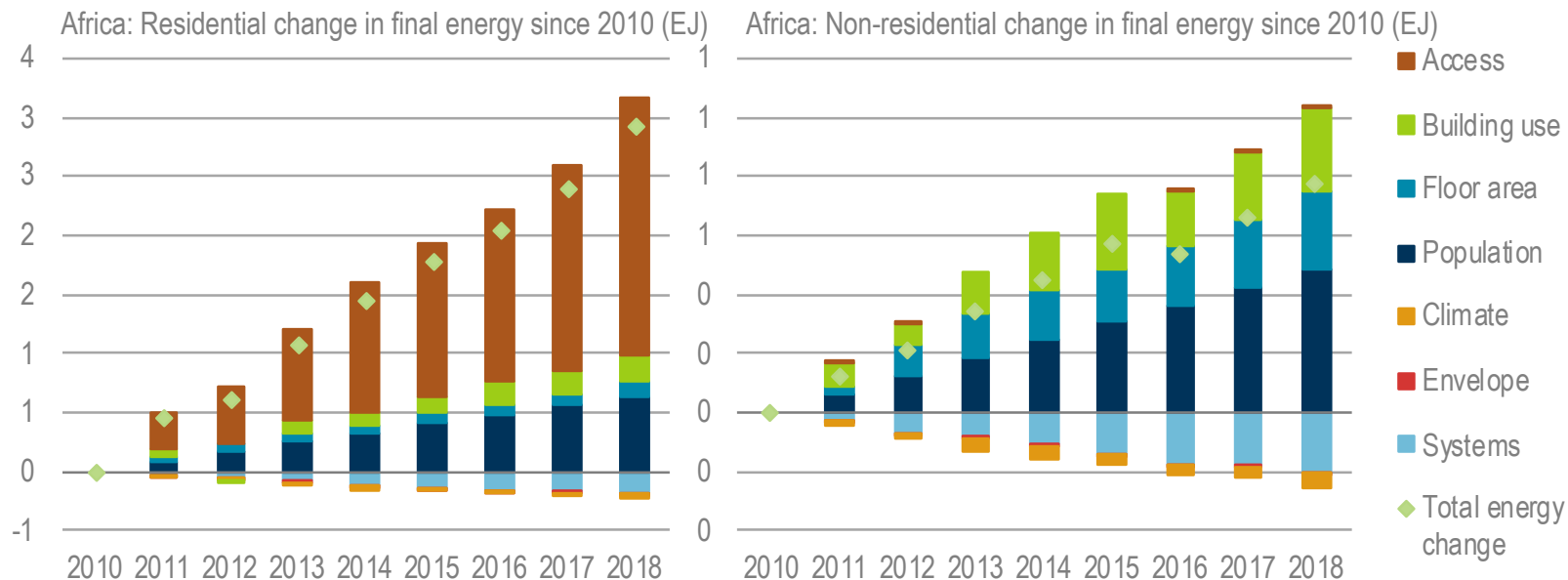
Final energy use and intensity change by end use 2010-18



Demand for services through access and population dominate growth, with small amount of system improvement change

Africa buildings

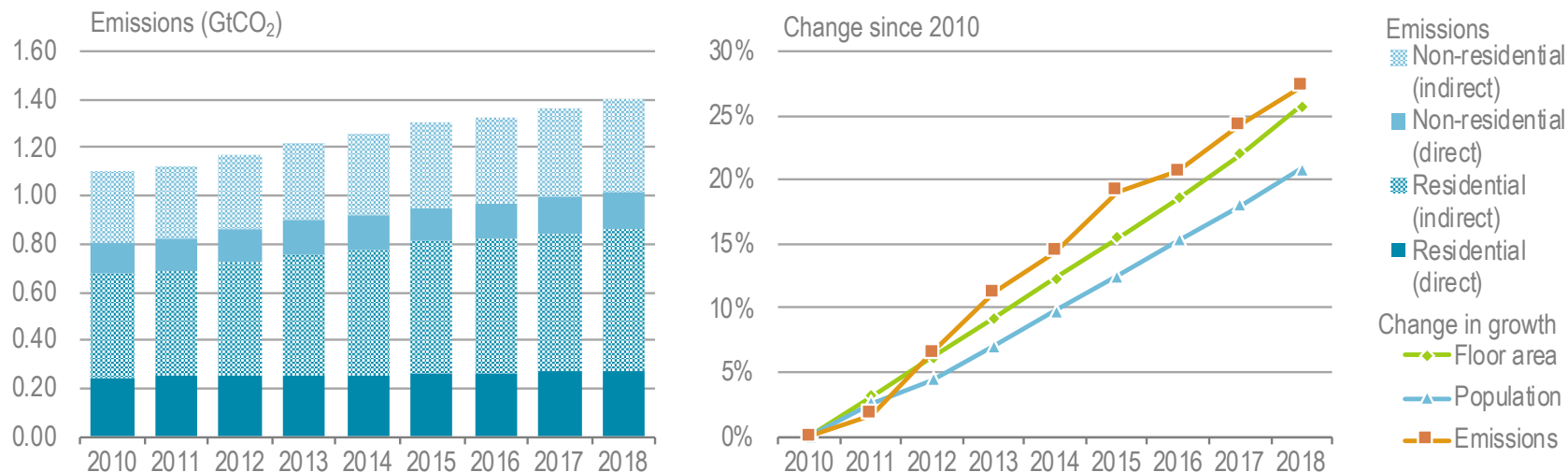
Influence of factors buildings energy use by building type in Africa, 2010-18



Growth in access in residential sector compared to population, more intense buildings and floor area growth in non-residential

Africa buildings

Africa buildings energy-related emissions by building type and change in indicators, 2010-18

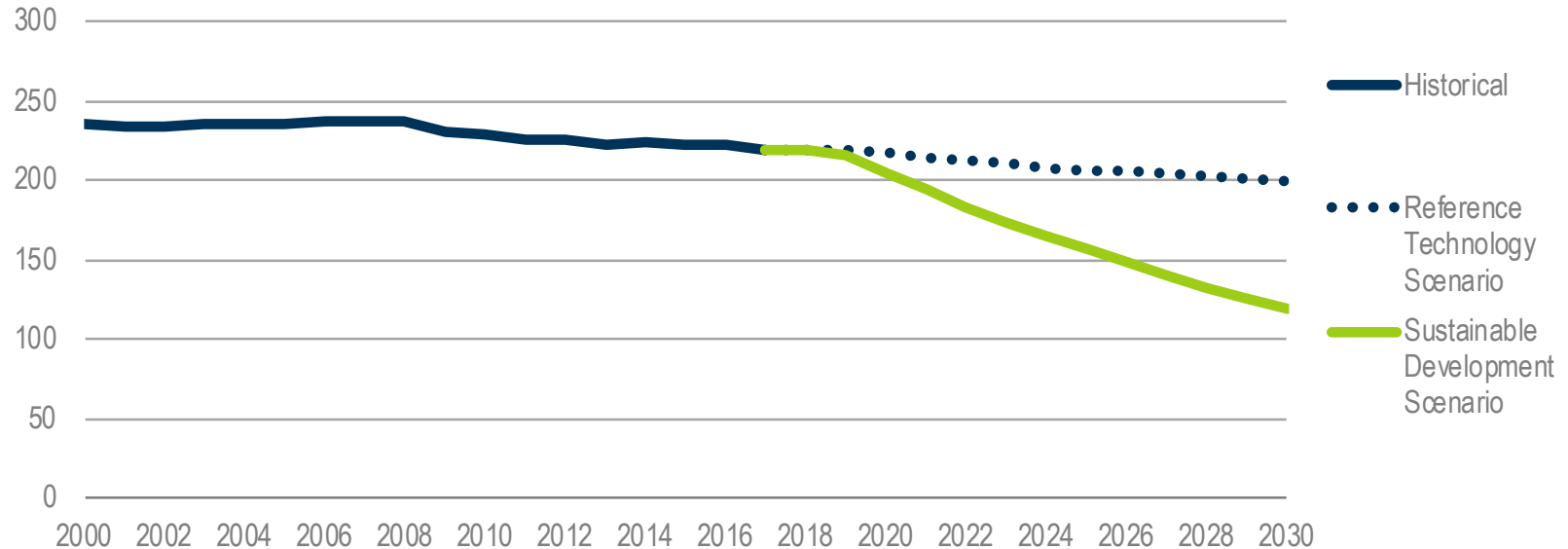


Emissions and tightly linked to population and floor area growth, mostly in residential access to electricity

Africa supporting the path to sustainable development goals

Energy intensity under the sustainable development scenario, 2000-2030

Africa: Energy intensity (kWh/m²)



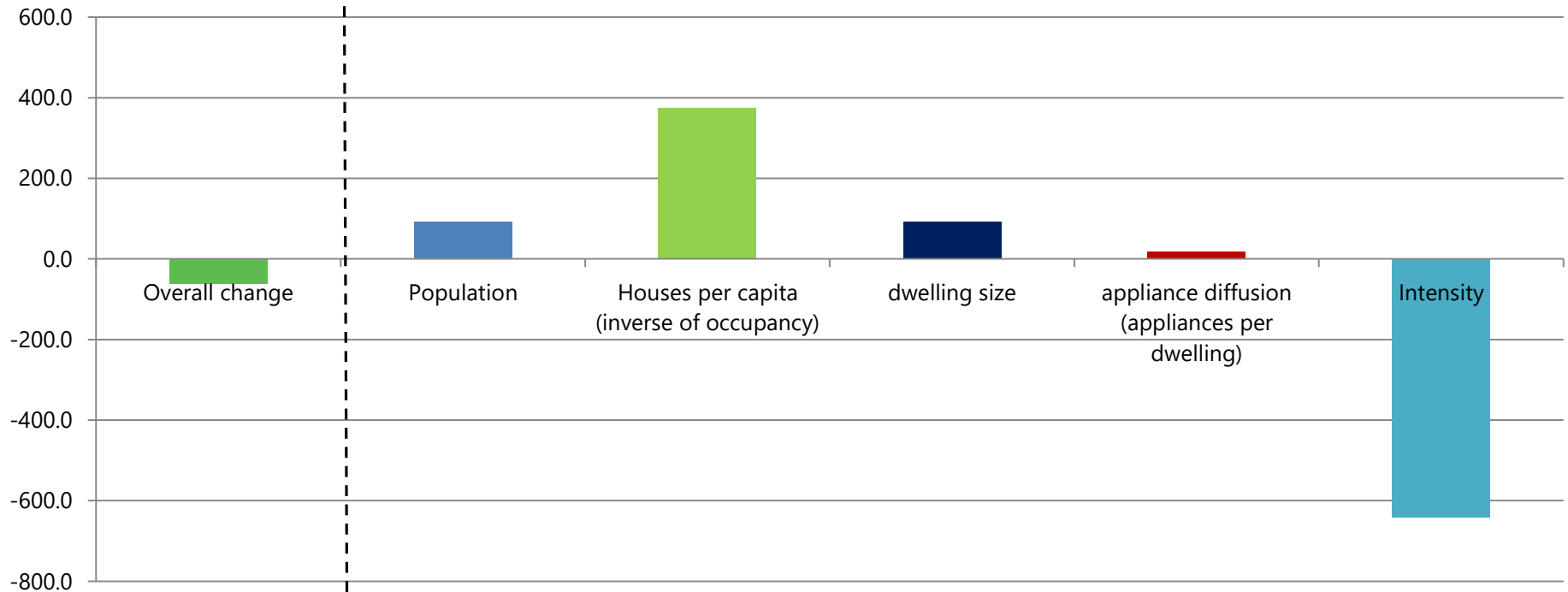
Energy use per m² in buildings needs to be reduced by 40% by 2030

Decomposition

Logarithmic Mean Divisia Index (LMDI)



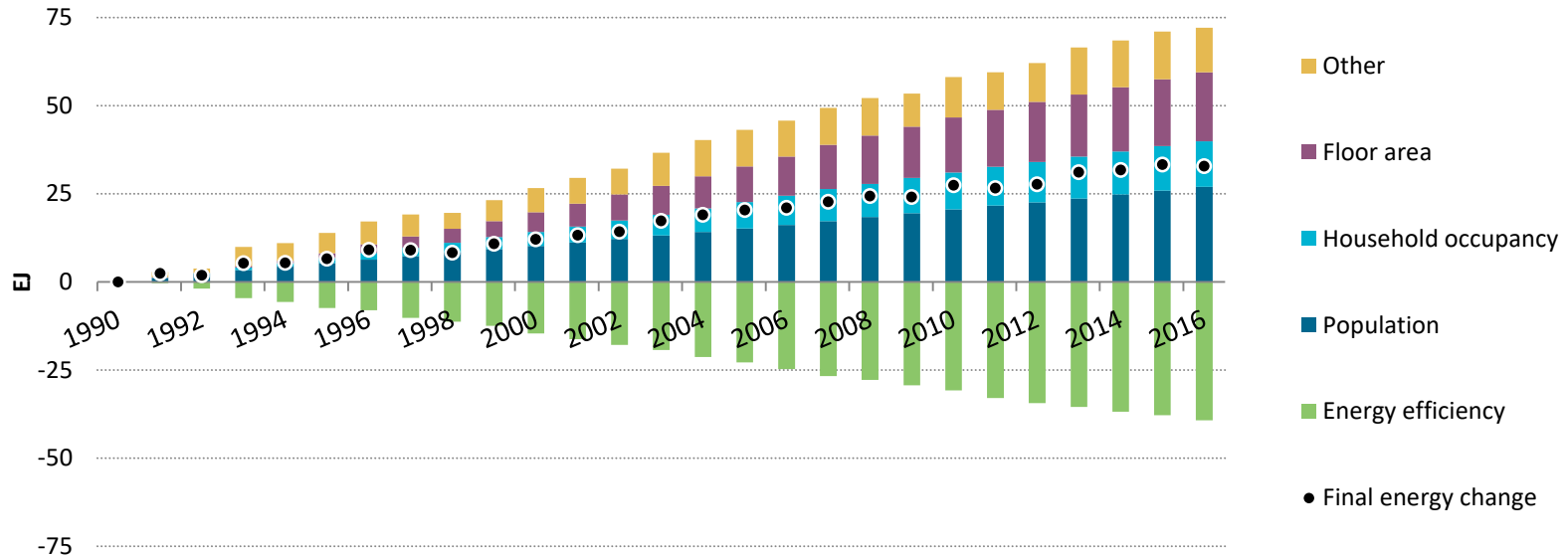
Evaluation: Building energy decomposition



Proportional distribution of energy savings by holding only changing one indicator at a time.
Decomposition analyses can be extremely valuable – but complex.

Evaluation: Building energy decomposition

Decomposition of global final energy demand in buildings by key contribution



Through decomposition, we can see that energy efficiency is significant, but not keeping up with the growth in total energy consumption in buildings.

Process for Tracking Progress

Key steps in the process

Examples



Tracking progress: Key steps in the process

Step 1: Identify what needs to be tracked

- What story should be told?
- What were the objectives?
- What are the risks?

Step 2: Define the tracking indicators

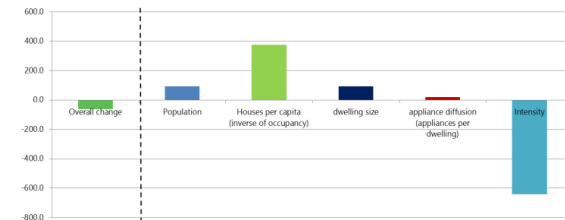
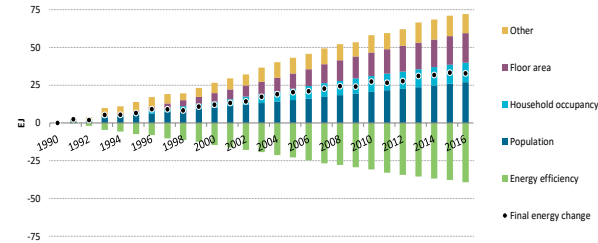
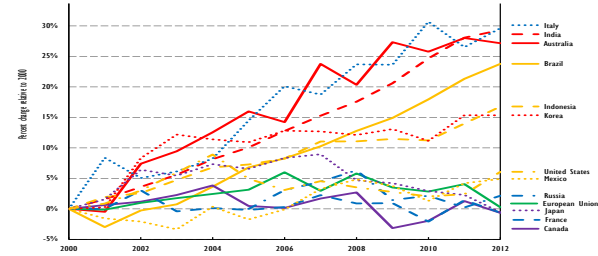
- What performance metrics can you use?
- What data is needed?

Step 3: Assess the data

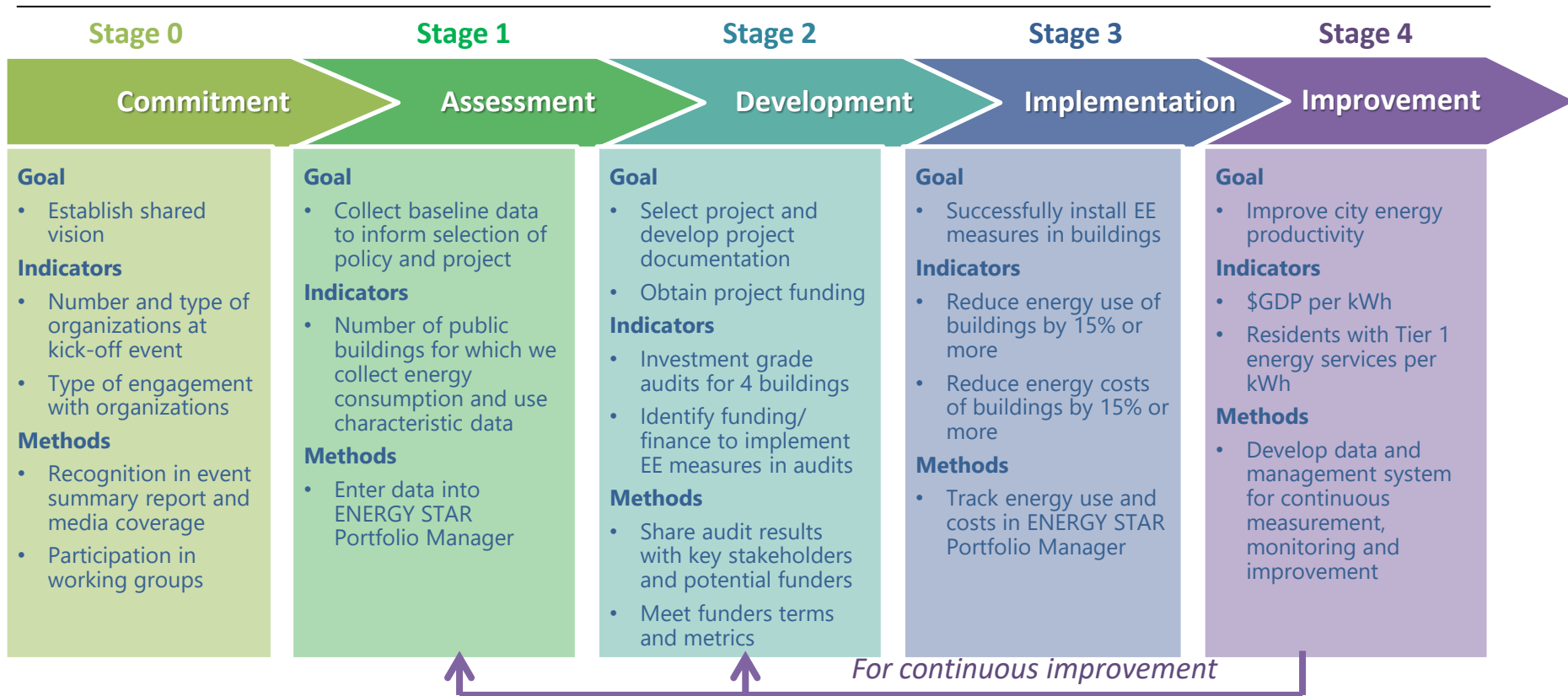
- What analysis method should you use?

Step 4: Tell the story

- How do you visualise the results?
- How would it vary across countries?



Example: Tracking progress in the Building Efficiency Accelerator



Tracking progress example: cooling

Step 1: Identify what needs to be tracked

- What story should be told about the impact of cooling?
 - What objectives could be achieved through policies on cooling?
 - What are the risks and threats from increasing cooling energy use?

Potential issues related to cooling

- Demand for and access to cooling thermal comfort
- Energy used for cooling based on AC efficiency levels
- Peak electricity loads, grid stability and power sector investments
- Job creation through design, manufacturing, selling or installing ACs
- Sales tax and public budgets financial impacts
- Market availability of efficient products

Tracking progress example: cooling

Step 2: Define the tracking indicators

- What performance metrics can you use?
- What data do you have on cooling and buildings?

Issues with metrics and indicators

- How do you separate the influences? (Income; demand; population; climate; efficiency)
- What options are there for metrics?
 - Final energy use for cooling
 - Final energy use for cooling per square meter cooled per cooling degree-day
 - Change in average efficiency of ACs (stock, sold, manufactured, imported, exported)
 - Share of products covered by labels or MEPS policies

Tracking progress example: cooling

Step 3: Assess the data

- What analysis method can you use?
- Which method will provide the information needed?

Step 4: Tell the story

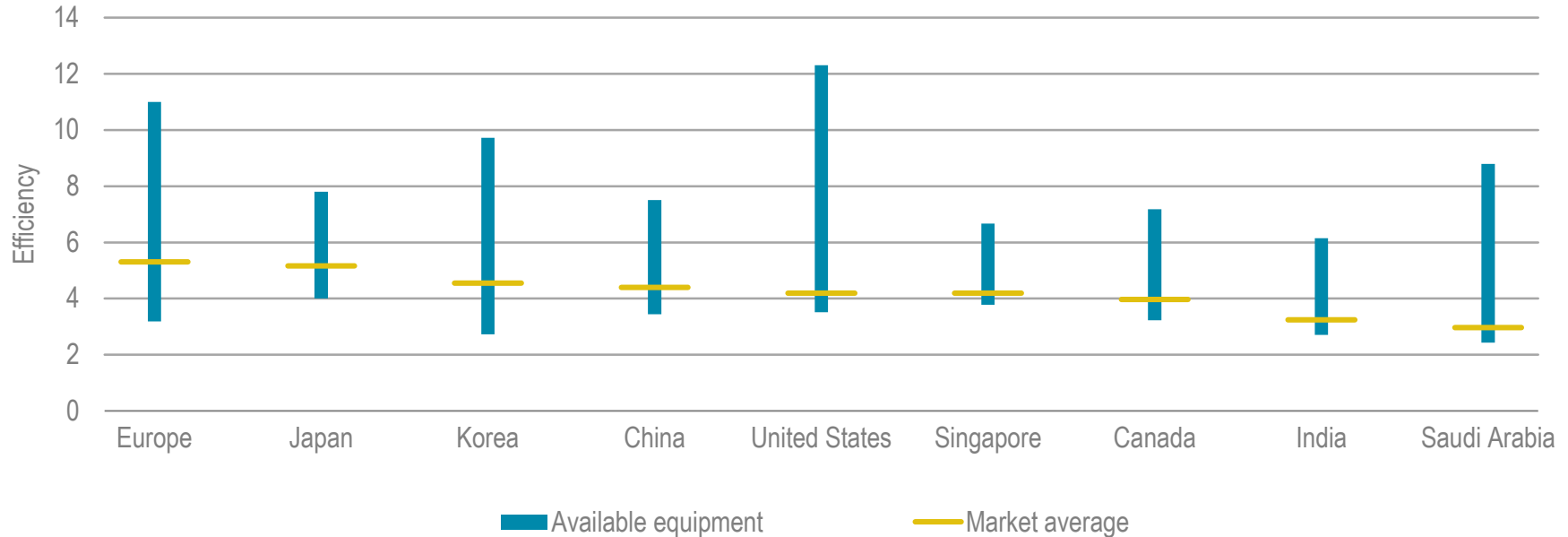
- How do you visualise the data?
- What part of the story is important for your country?

Issues with metrics and indicator analysis methods

- What results will be compelling and told with simple visuals or statements?
- What options are there for methods?
 - Energy performance metrics
 - Bars held analysis
 - Energy decomposition (LMDI)

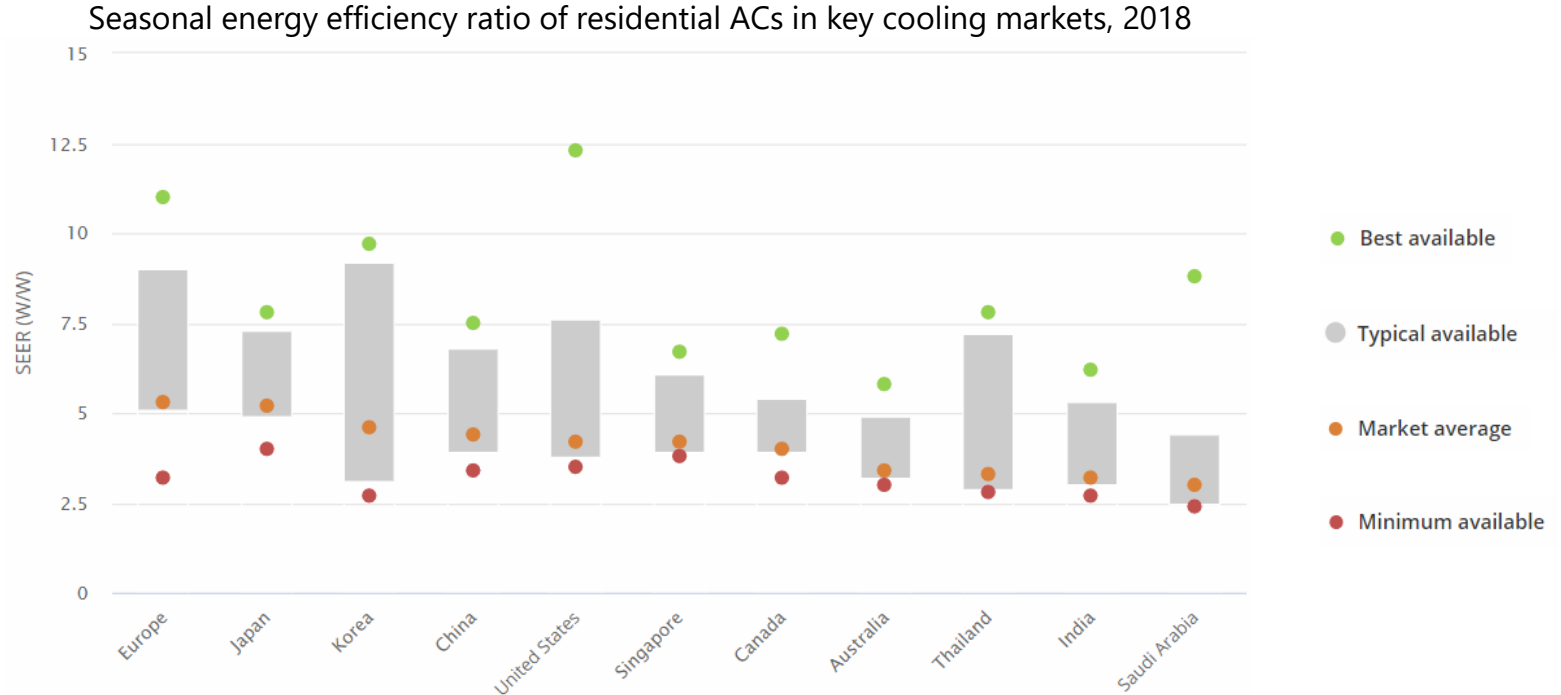
Tracking progress: cooling example 1

Efficiency of air-conditioners by country, 2017



Best available technology efficiency levels vary widely between countries.
And, best available technology is much more efficient than the market average.

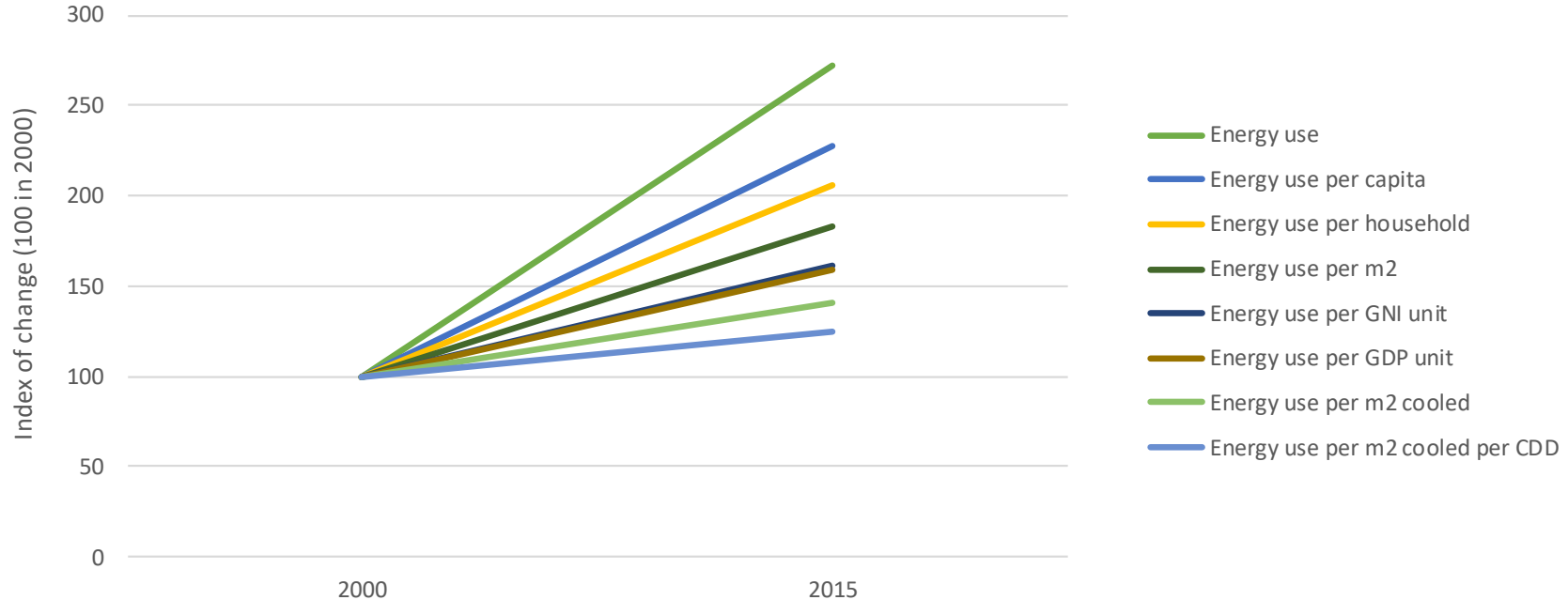
Tracking progress: cooling example 1



Market-available technology is more than twice as efficient as the average performance, while best available technology can be as much as five times more efficient.

Tracking progress: cooling example 2

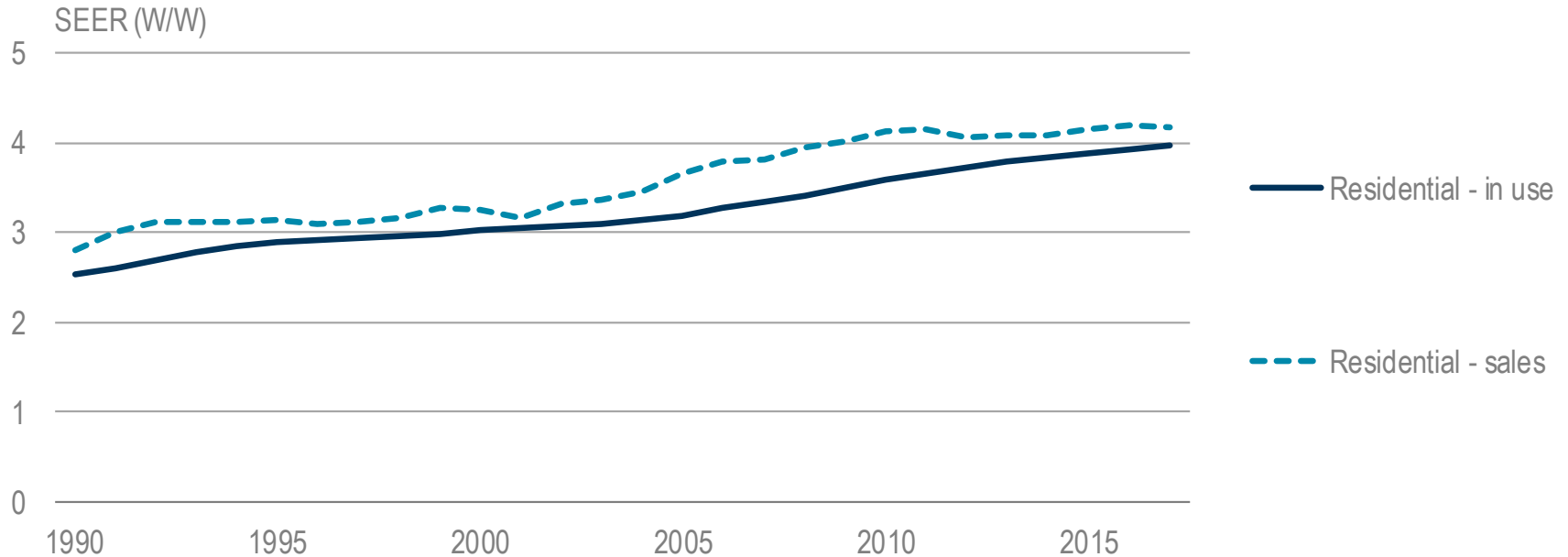
Change in global cooling energy use illustrated by different metrics, 2000-15



“Energy use per m2 cooled per CDD” may be an accurate performance indicator at the building. But depending on the story you want to tell, “energy use” offers a different story for the country.

Tracking progress: cooling example 3

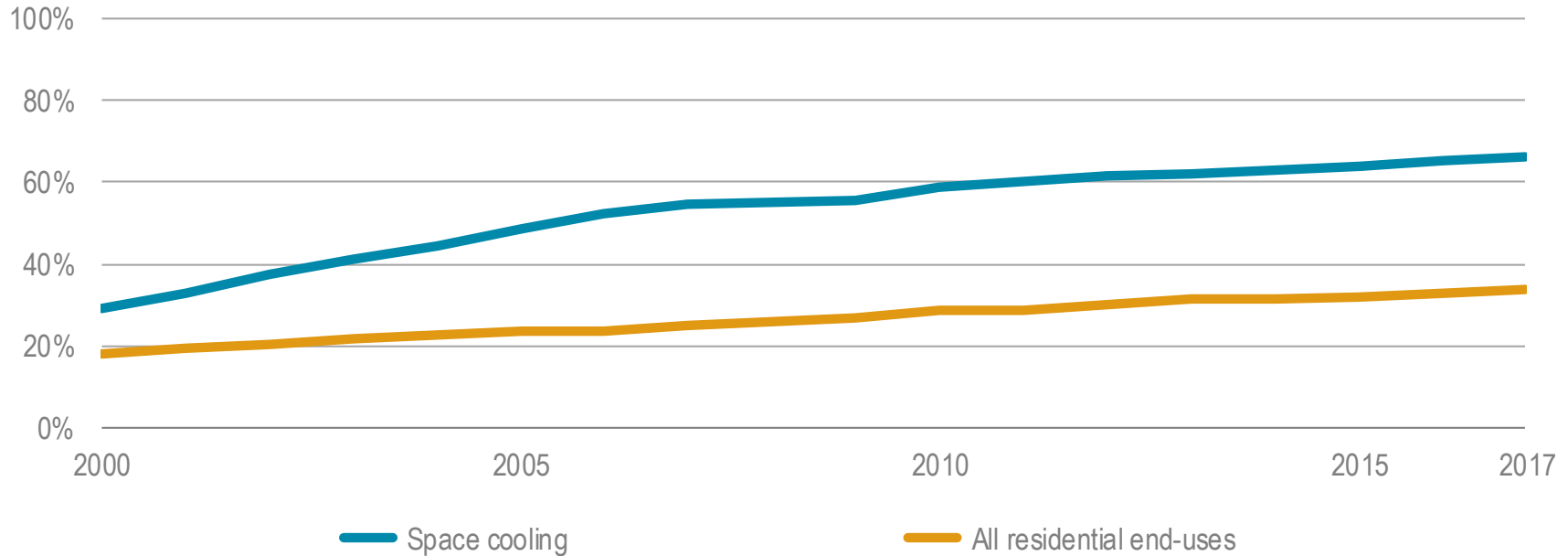
Global weighted average residential SEER of air-conditioners, 1990-2017



More efficient cooling technologies are being sold.
But the efficiency levels are well below the best available technologies.

Tracking progress: cooling example 4

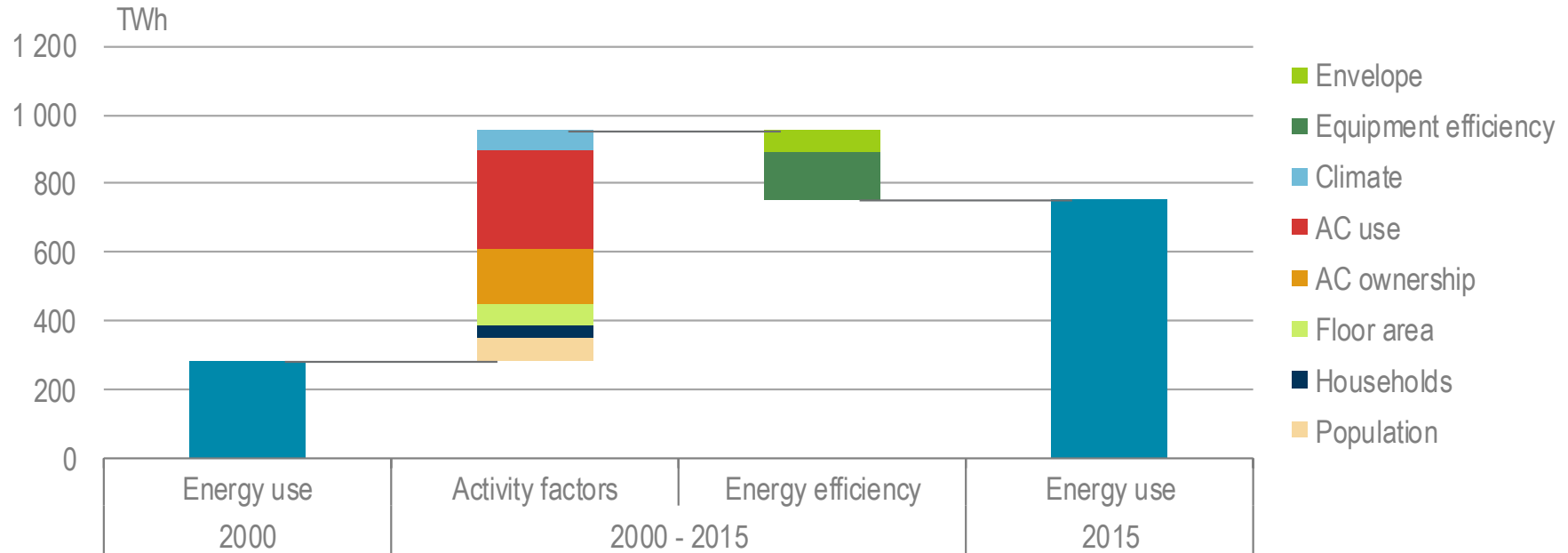
Share of building energy use covered by regulations, 2000-17



Increasingly more policies are covering space cooling energy use.
But the strength of those policies are not keeping pace with best available technologies.

Tracking progress: cooling example 5

Global decomposition of final energy use for cooling by key contribution, 2000-15



Energy efficiency has saved 200 TWh of cooling final energy from 2000 to 2015, but this has been offset by activity factors contributing to a 650 TWh increase during this period.

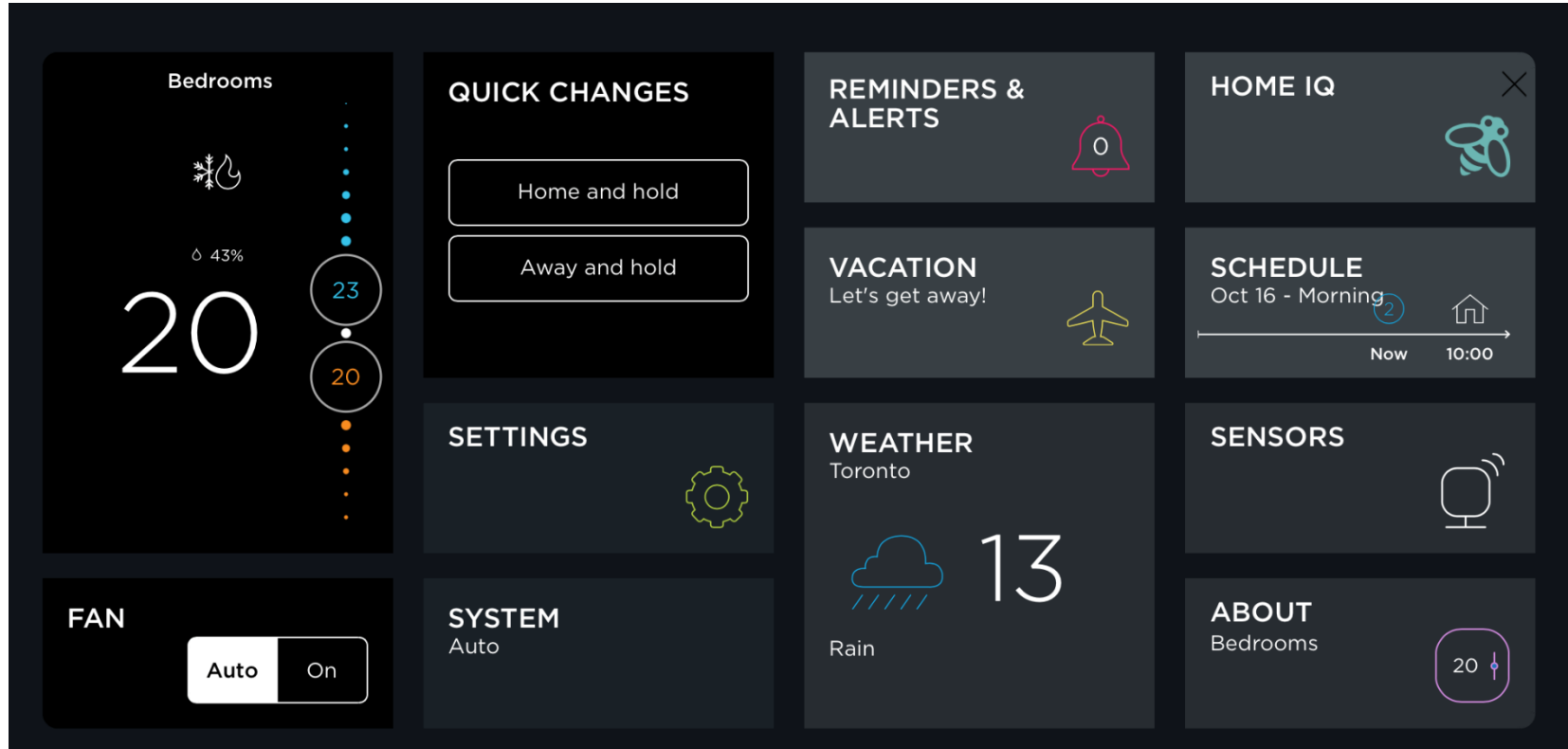
Energy Efficiency Training Week: Buildings

Scenario:

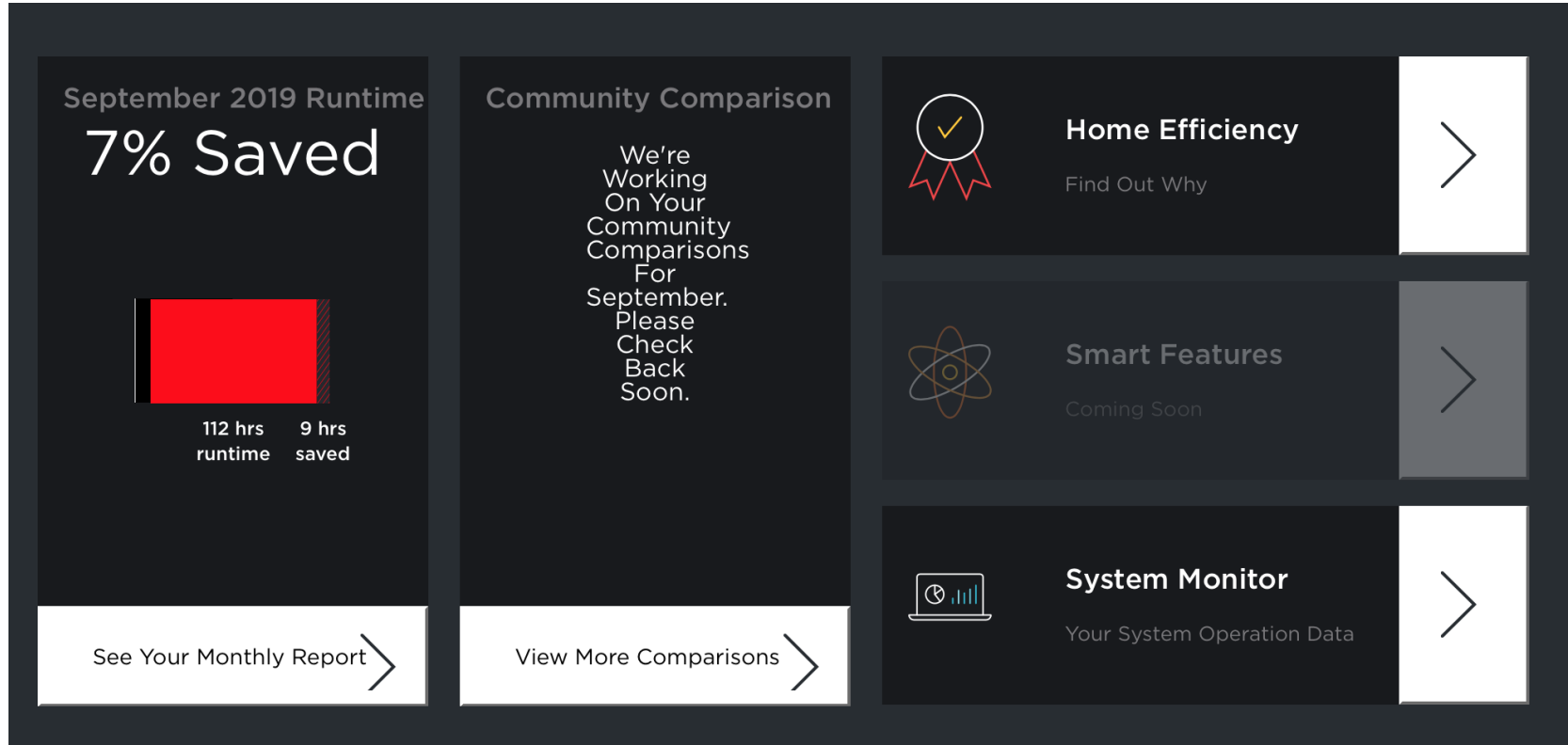
Leadership wants to know how effective the building energy efficiency policies have been.

How do you determine the benefits of your policies and programmes?

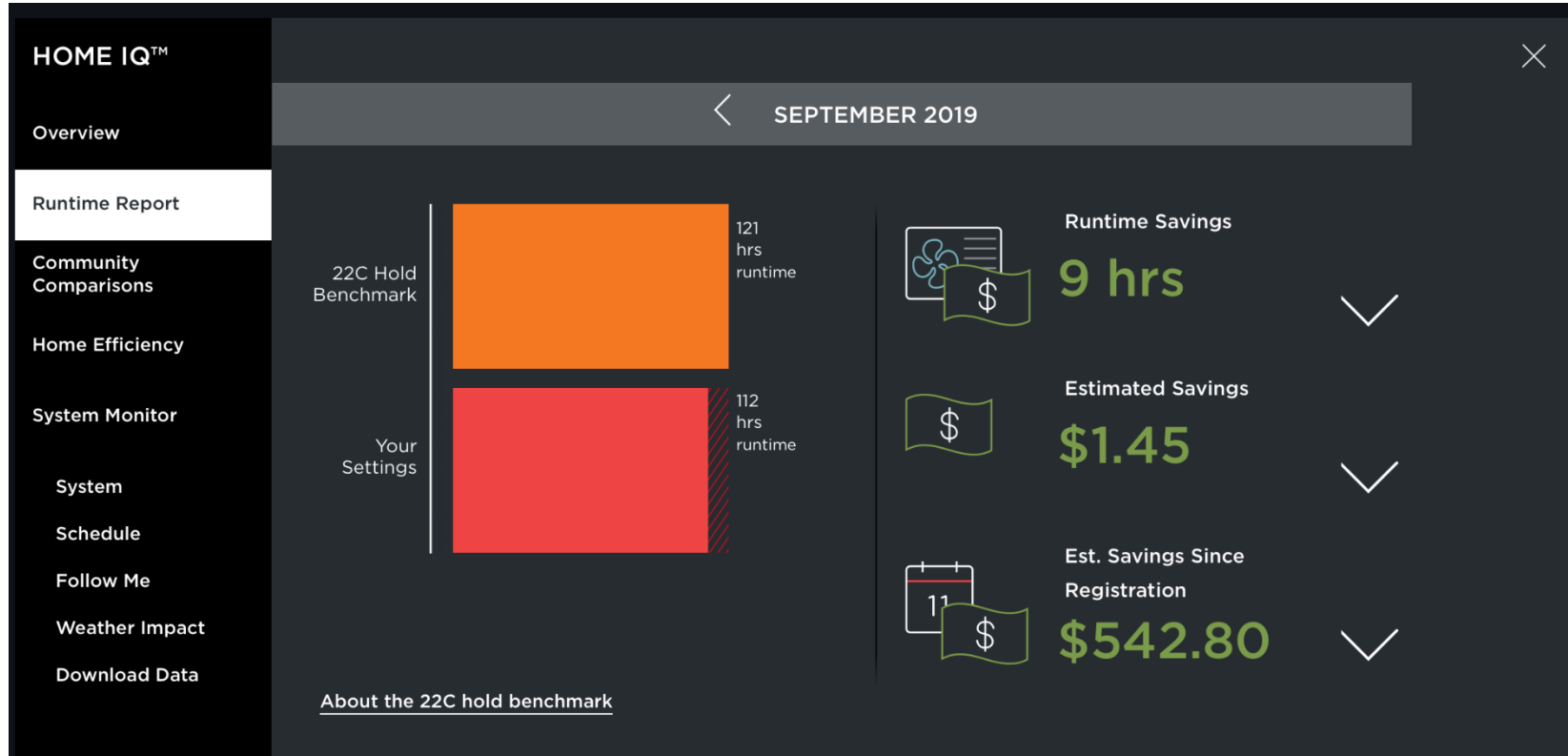
Metrics of performance



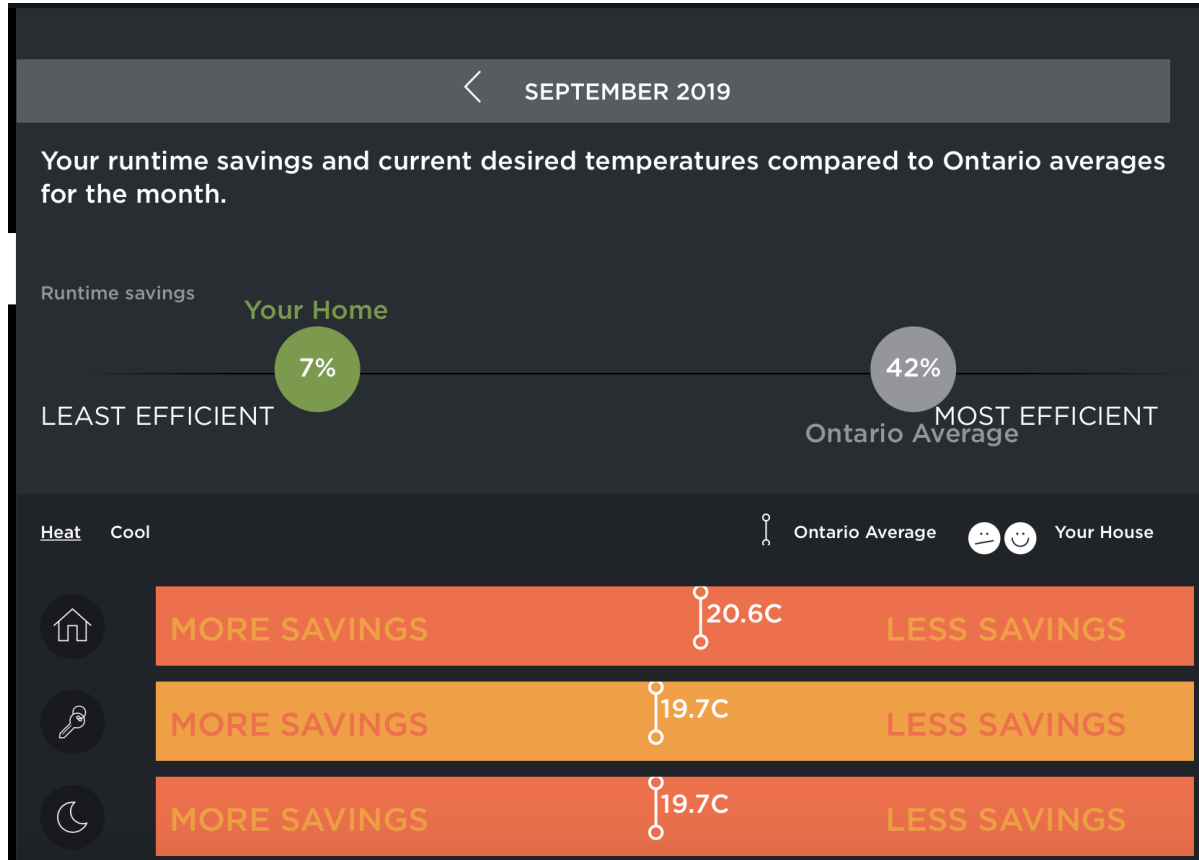
Metrics of performance



Metrics of performance



Metrics of performance





240mi

Range

140mph

Top Speed

5.3s

0-60 mph

Select Your Car

Purchase Price

Include potential savings*

Rear-Wheel Drive

Partial Premium Interior

Standard Range Plus

\$38,990

Dual Motor All-Wheel Drive

Premium Interior

Long Range

\$47,990

Performance

\$55,990

Metrics of performance



240mi

Range

140mph

Top Speed

5.3s

0-60 mph

Select Your Car

Purchase Price

Include potential savings*

Rear-Wheel Drive

Partial Premium Interior

Standard Range Plus

\$32,815*

Dual Motor All-Wheel Drive

Premium Interior

Long Range

\$41,815*

Performance

\$49,815*



energy

Department:
Energy
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