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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

UCL

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

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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

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What is evaluation?

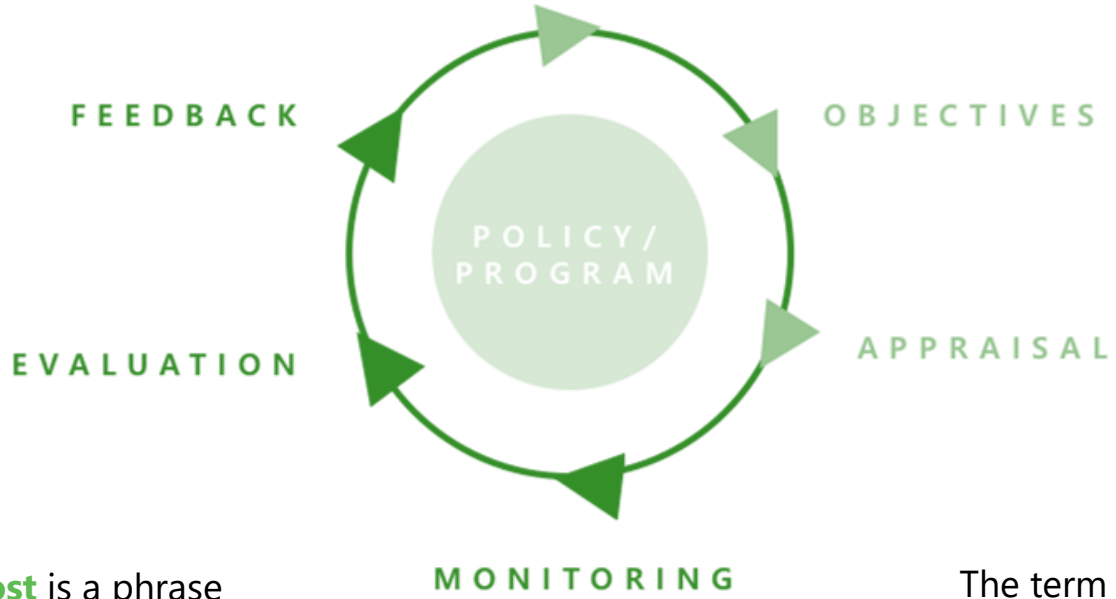
Evaluation is an objective process of understanding how a policy or programme was implemented, what effects it had, for whom and why.

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"

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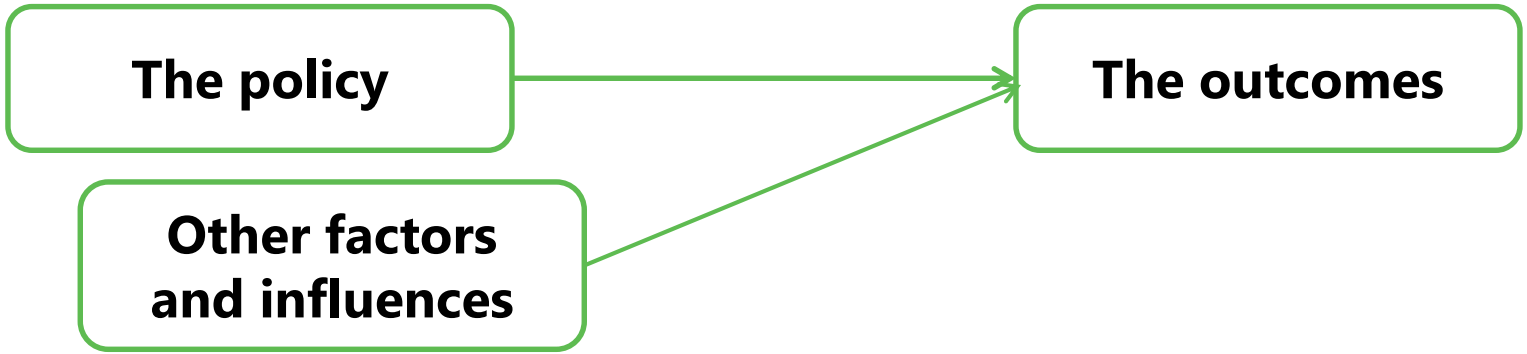
Ex-post evaluation: did it work?

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

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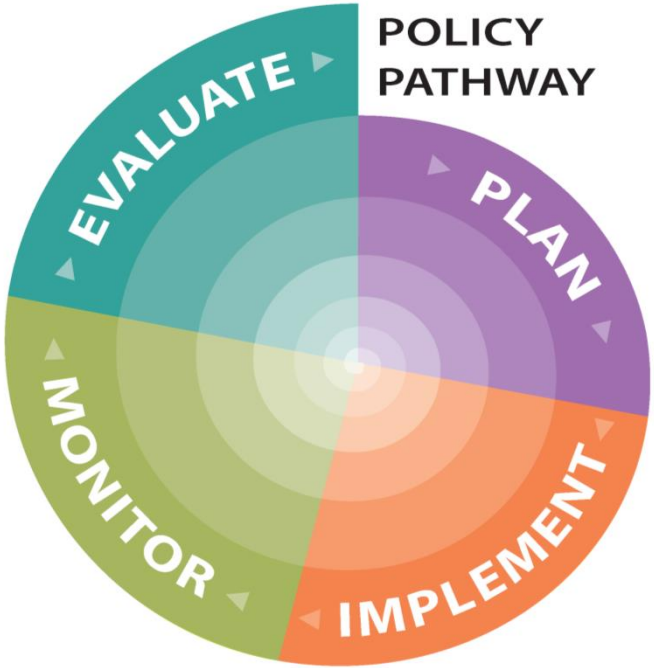
Data is essential at all stages of the policy cycle



- **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

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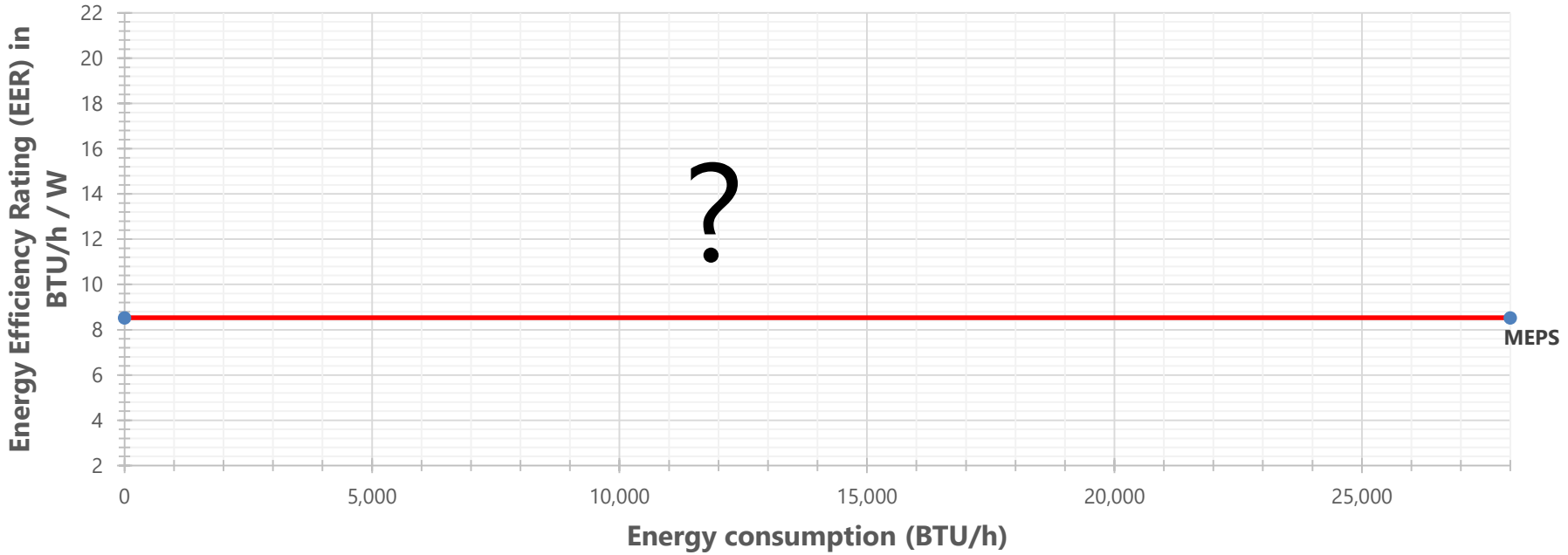
Why do we need data for policy design?



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

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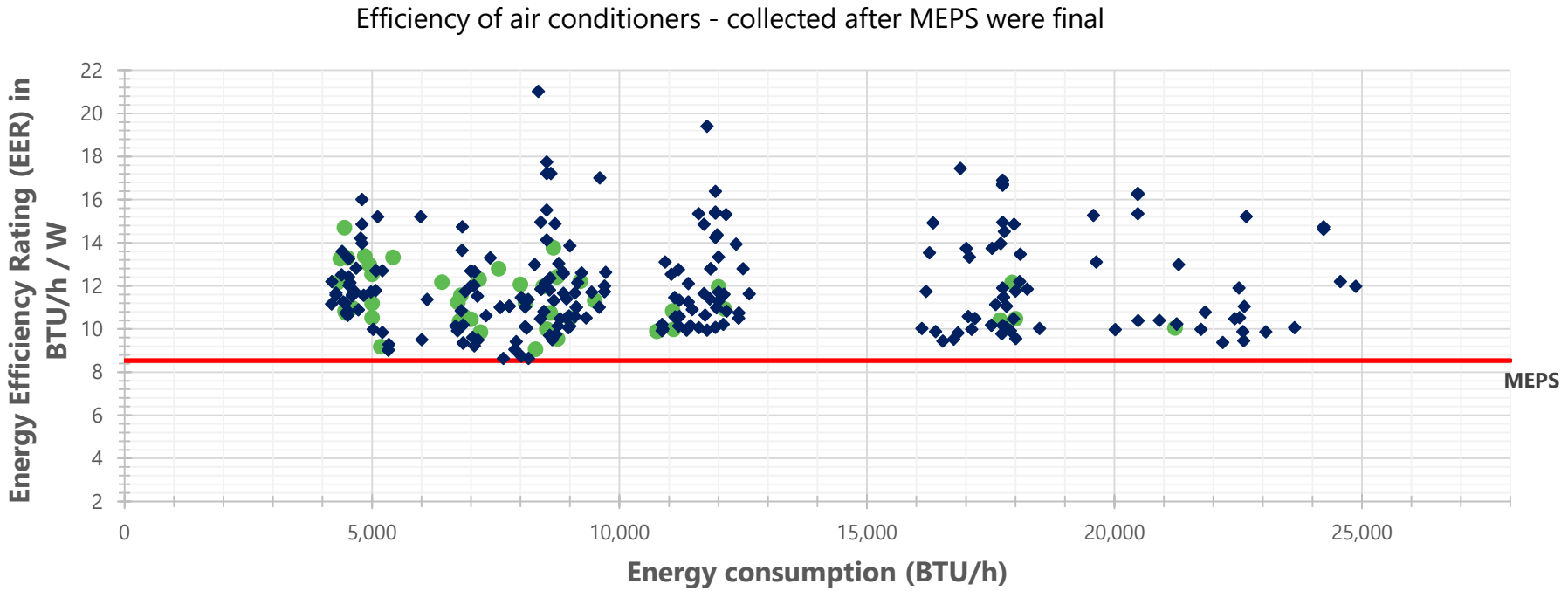
Why do we need data for policy design?



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

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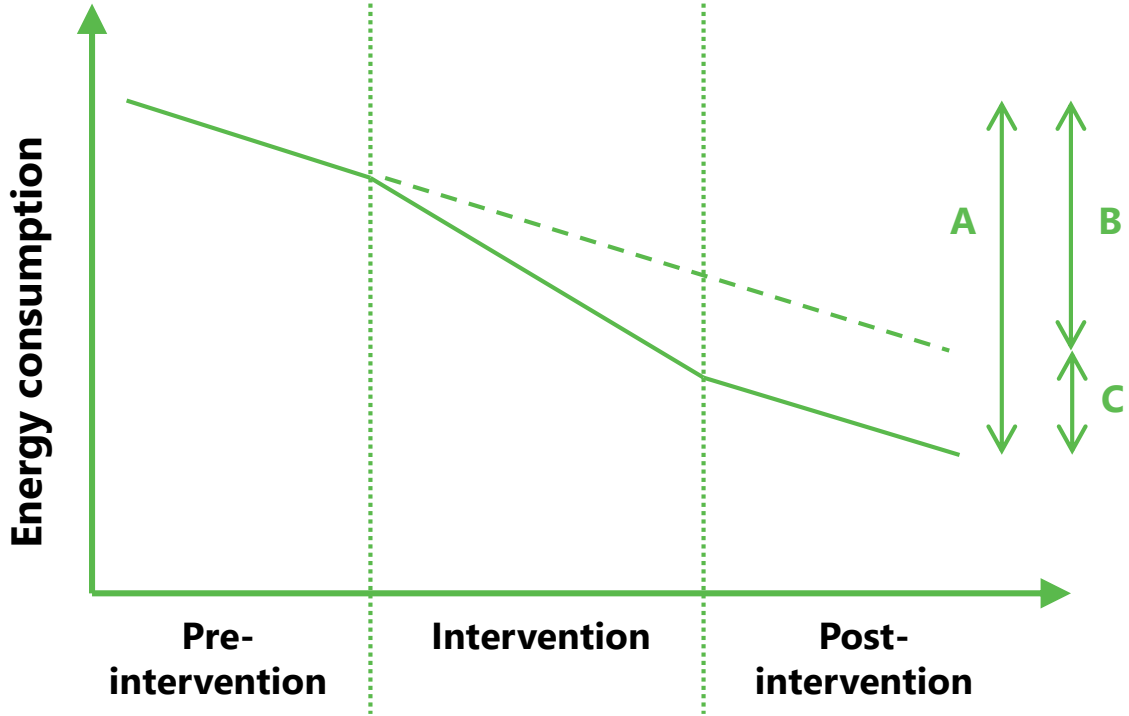
How does data help in implementation?



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

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Monitoring and Evaluation

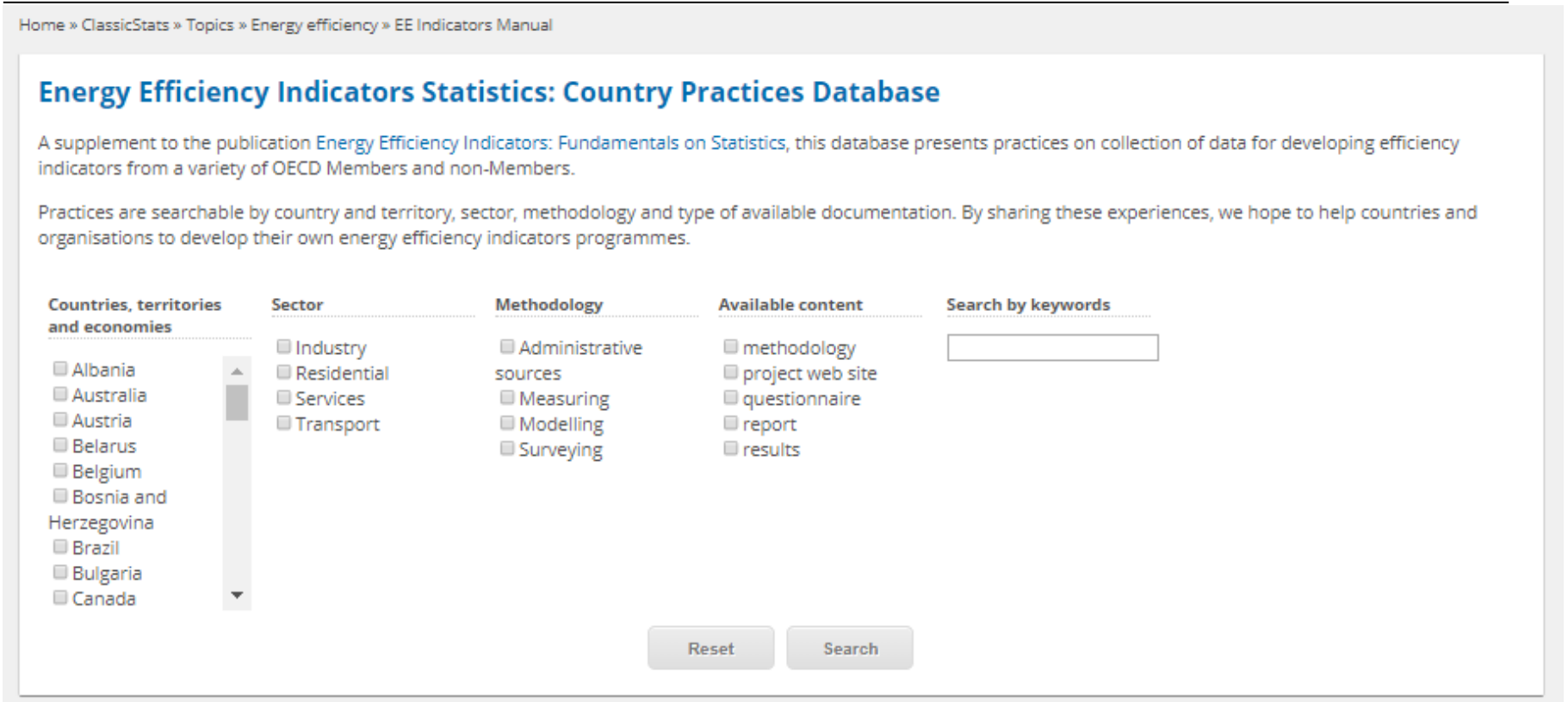
- **Monitoring** provides headline data on policy performance
  - What happens as a result of the policy?
- **Evaluation** provides an understanding of what is happening / has happened
  - Why and what can be done about it?

- **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?

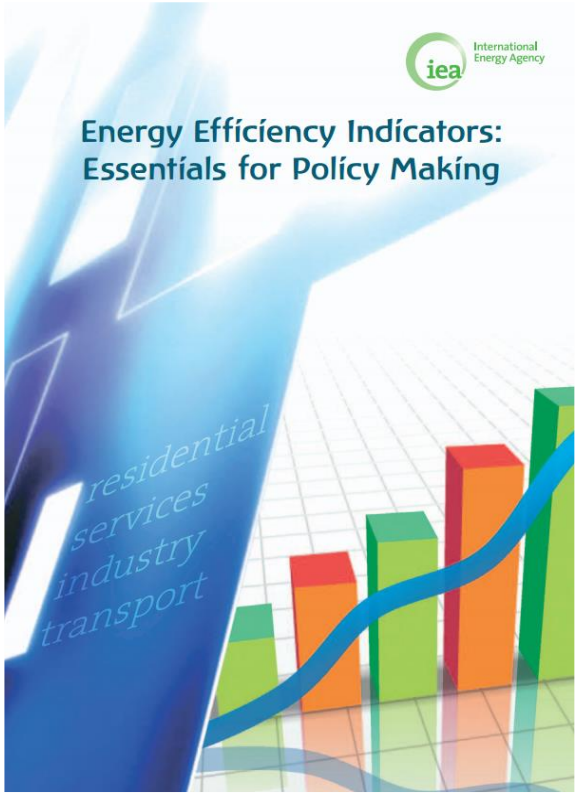
Main sources of data, information and indicators

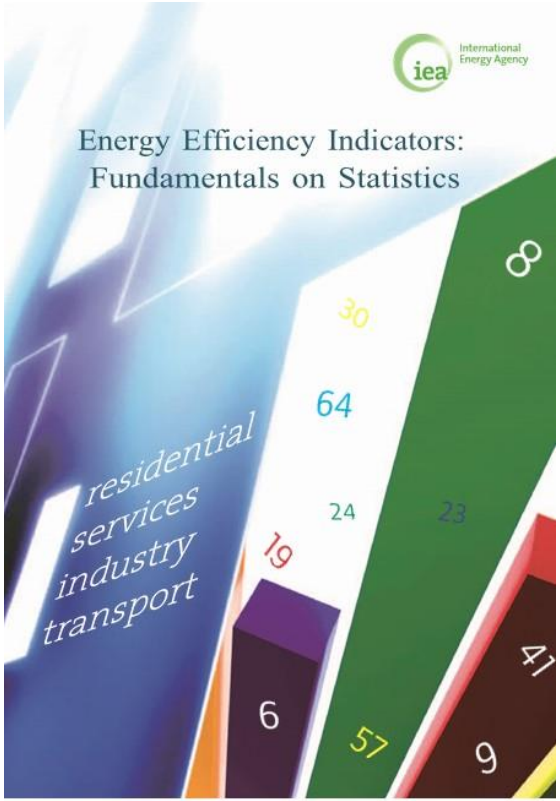
- Management information/reporting
- Measurement e.g. meter readings, compliance data
- Experiments/testing
- Modelling
- Surveys
- Interviews and focus groups

Resource of methods for capturing data, information and indicators



Energy efficiency indicators: manuals





Source: IEA energy efficiency indicators

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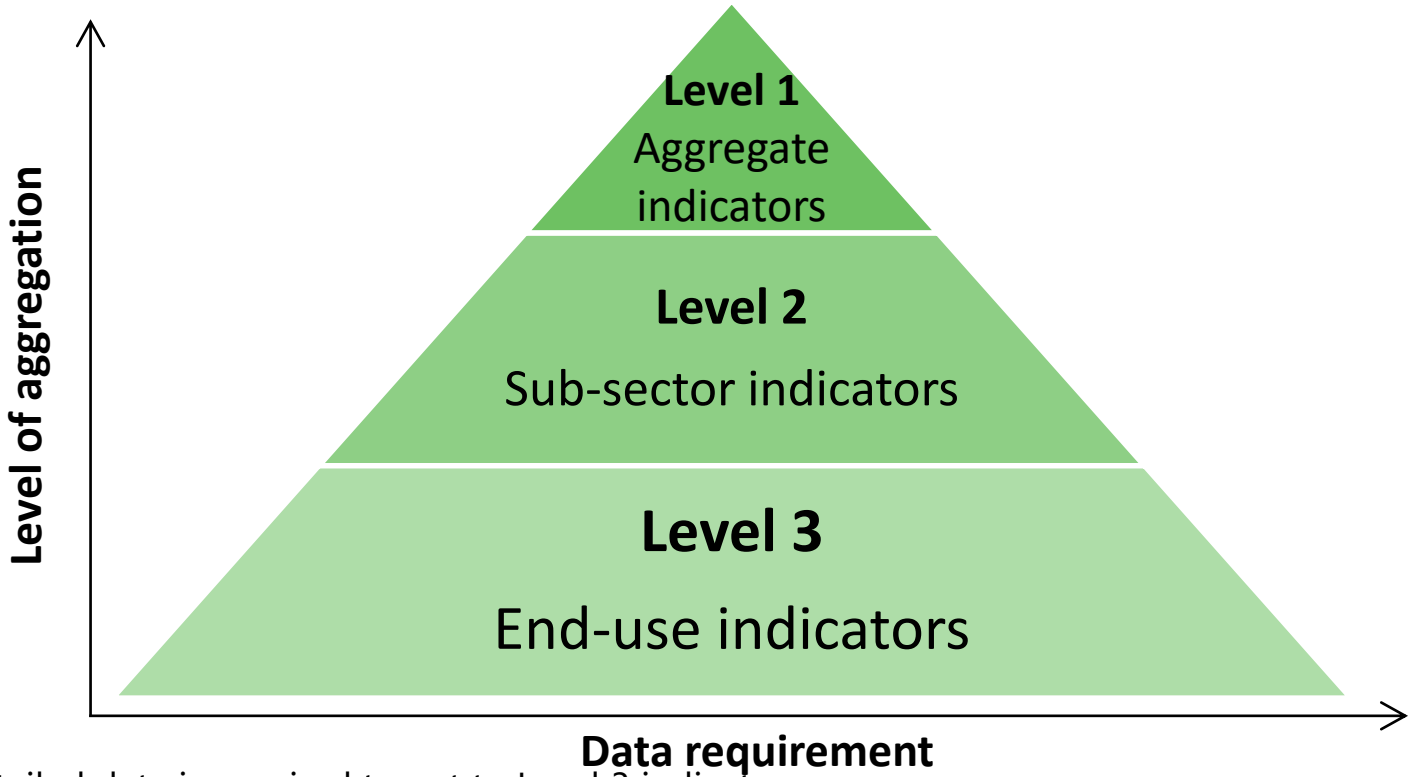
Energy efficiency indicators pyramid



More detailed data is required to get to Level 3 indicators

Source: IEA energy efficiency indicators

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Energy efficiency indicators: online courses

- 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.

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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;

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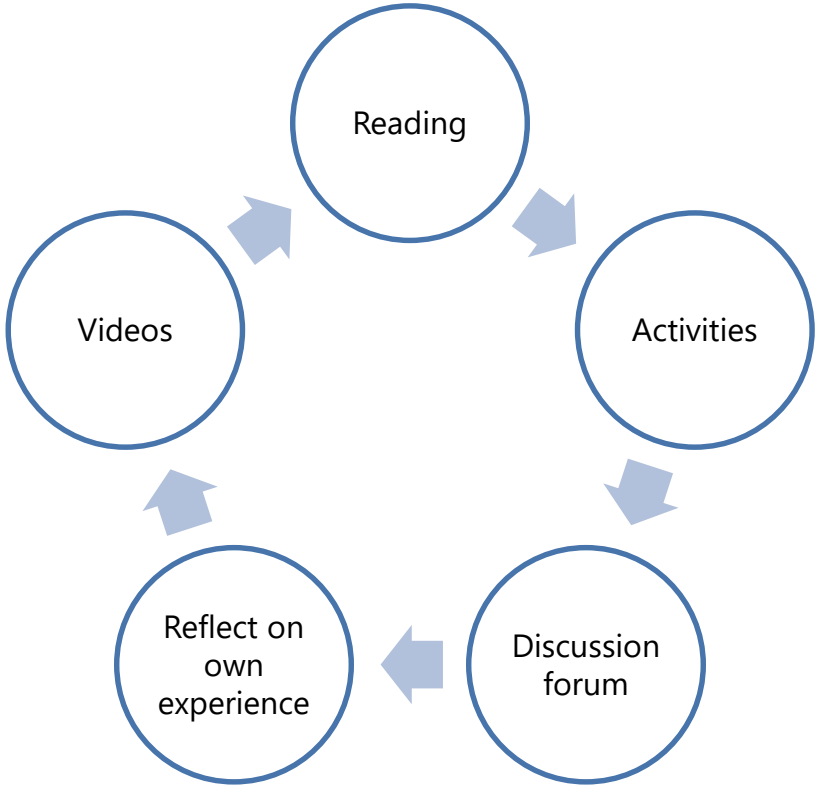
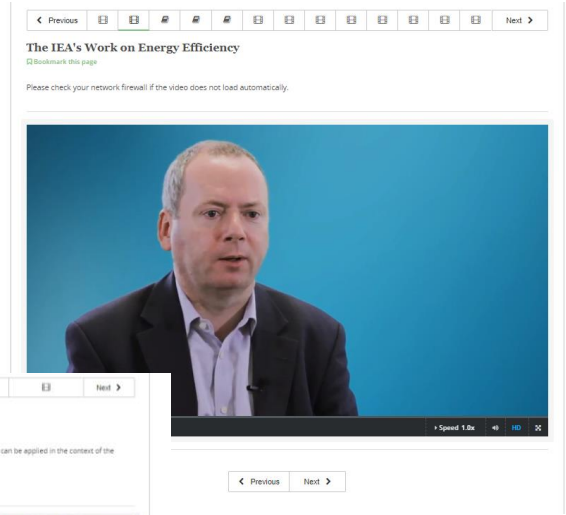
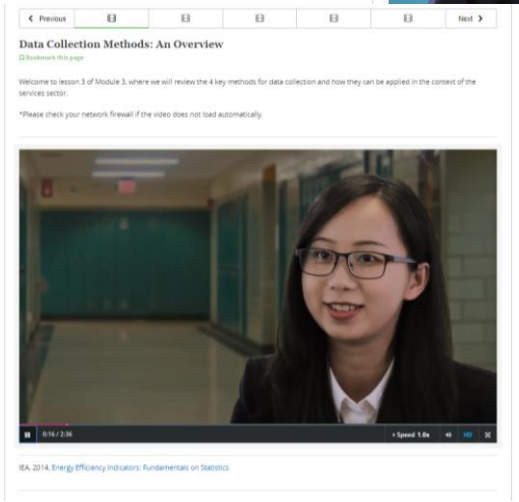
Pedagogical approach







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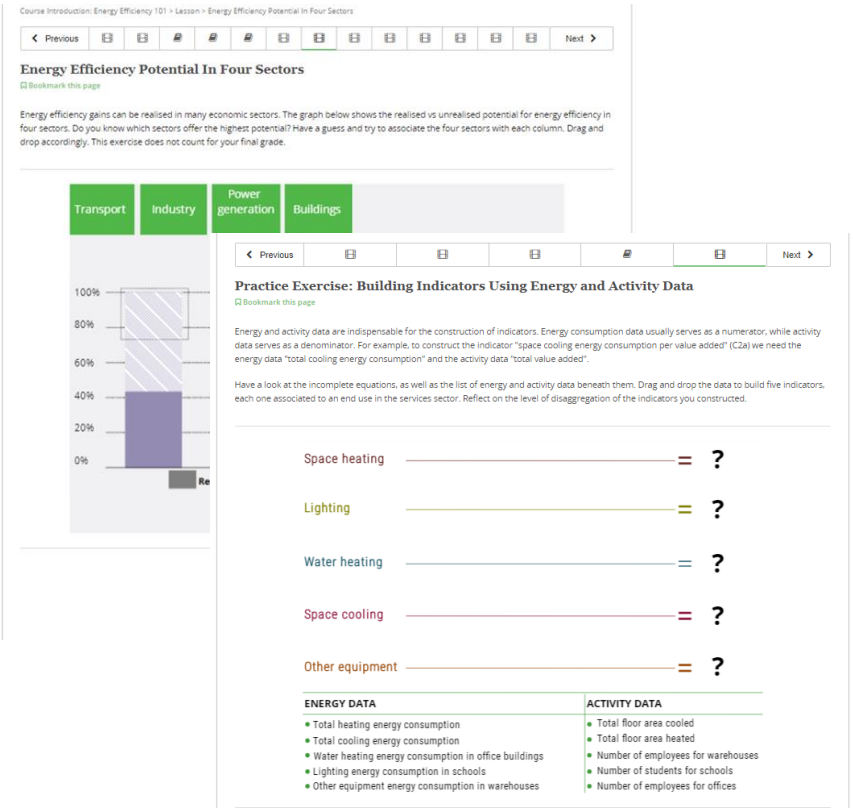
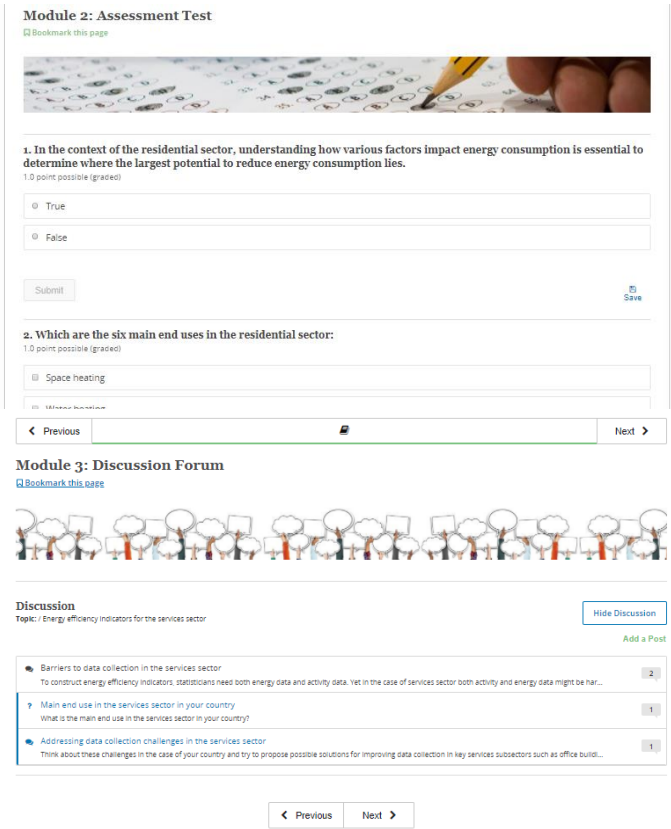
Energy efficiency indicators online course:





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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

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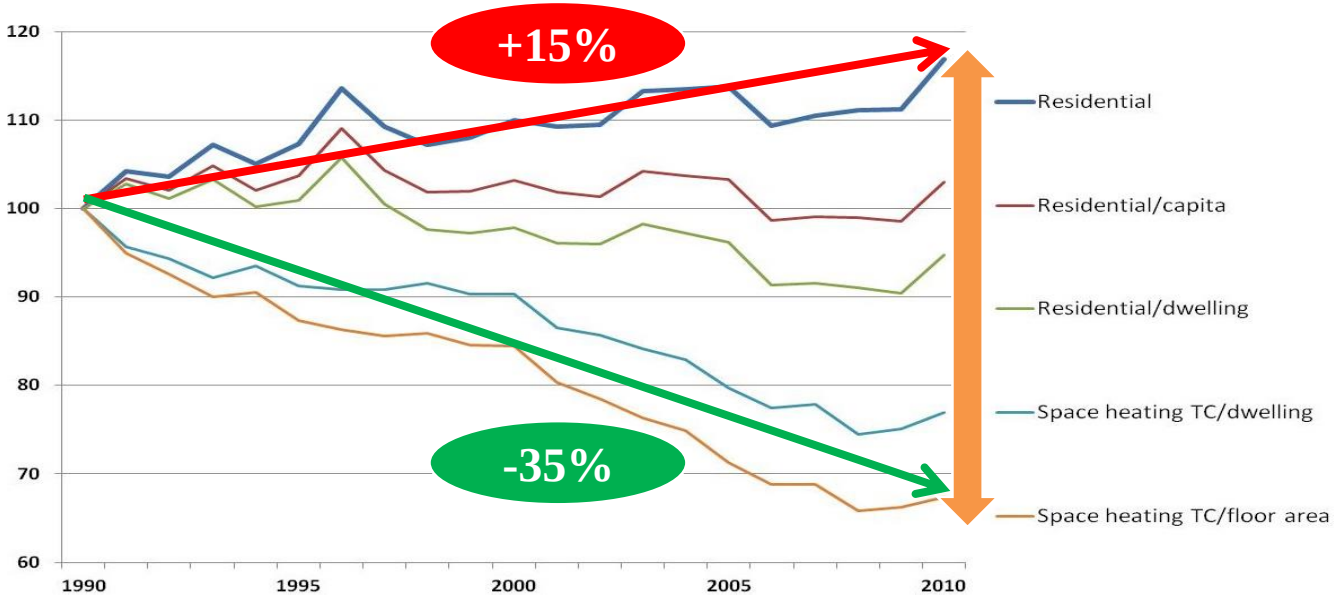
Evaluation: choosing the right metric



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.

Source: IEA energy efficiency indicators database

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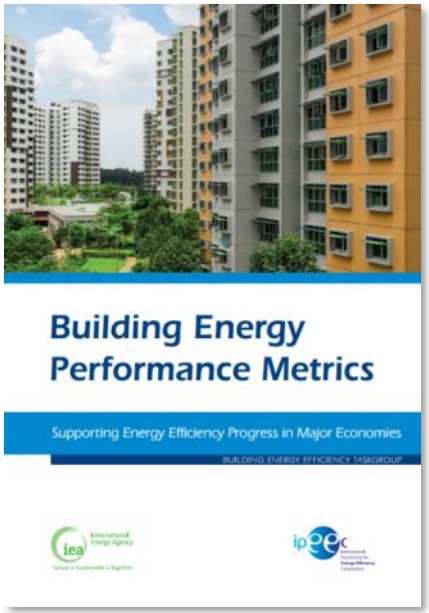
Evaluation: Building energy performance metrics

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.



Source: IEA Building Energy Performance Metrics 2015

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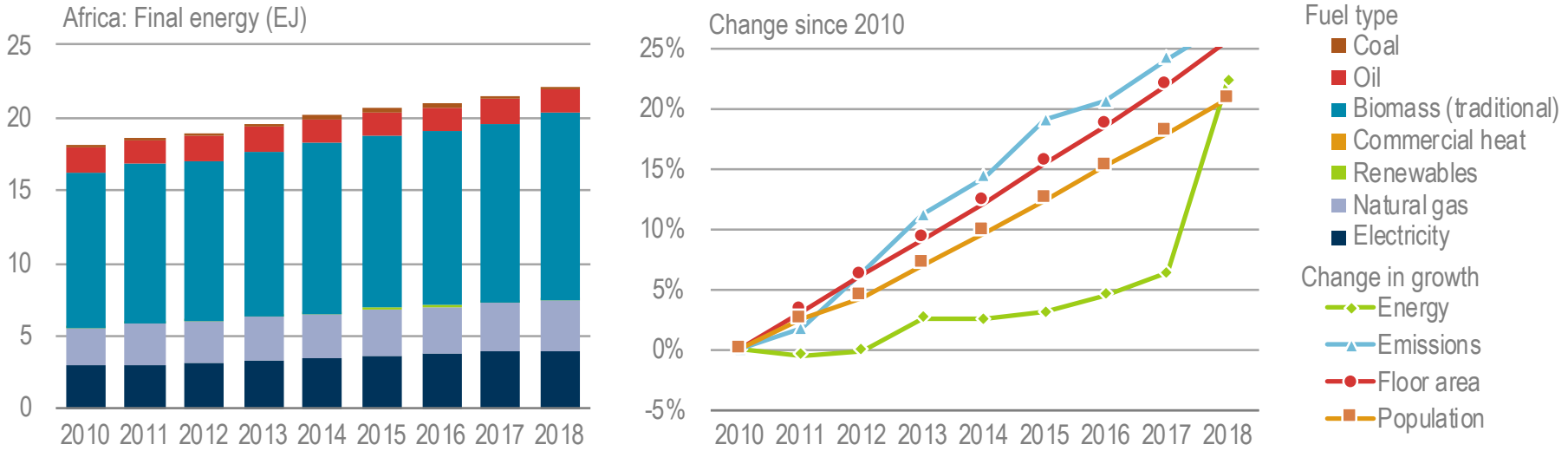
Africa buildings

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



Growth in Biomass, natural gas and electricity

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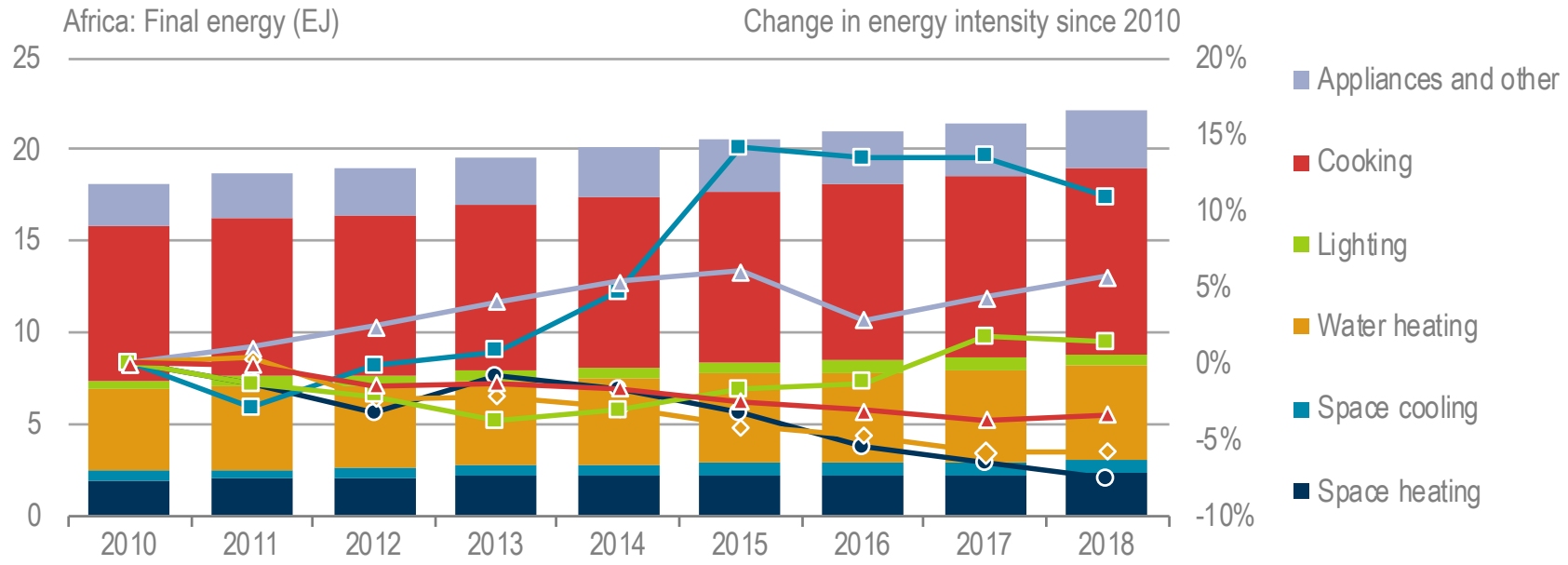
Africa buildings

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



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

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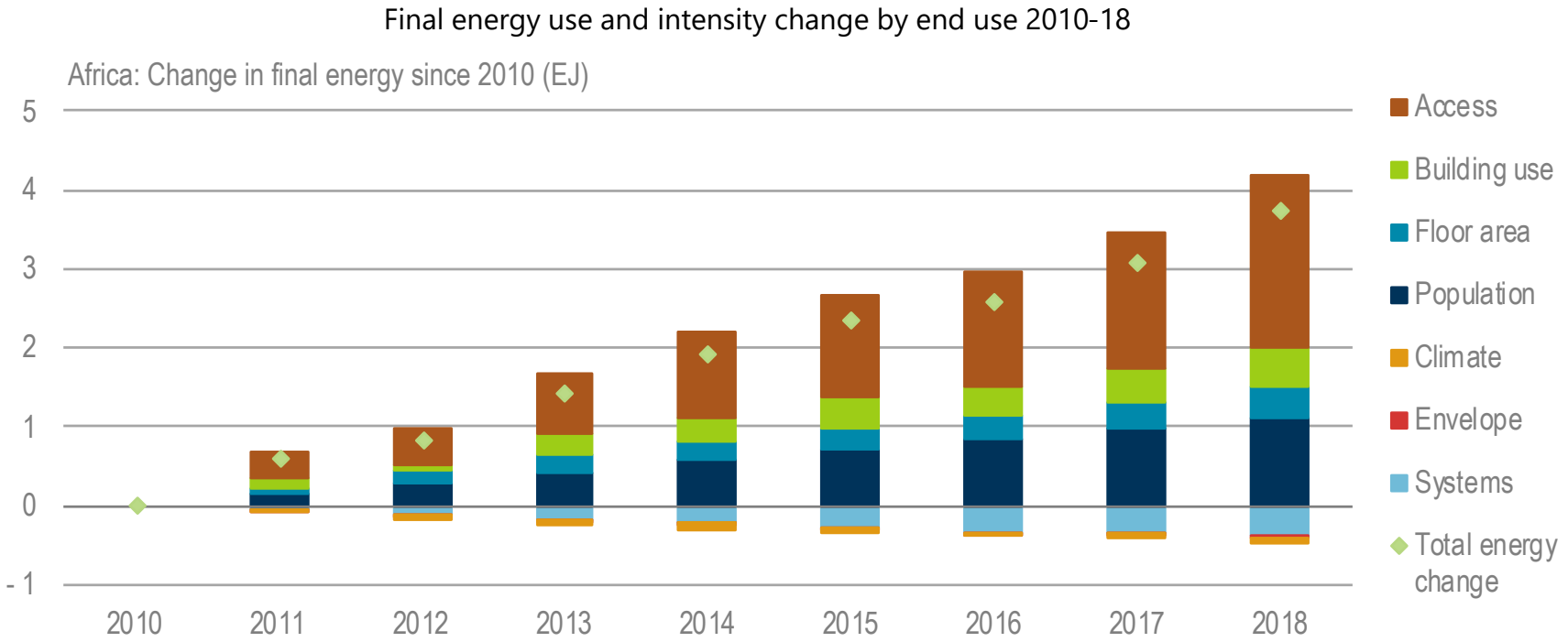
Africa buildings



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

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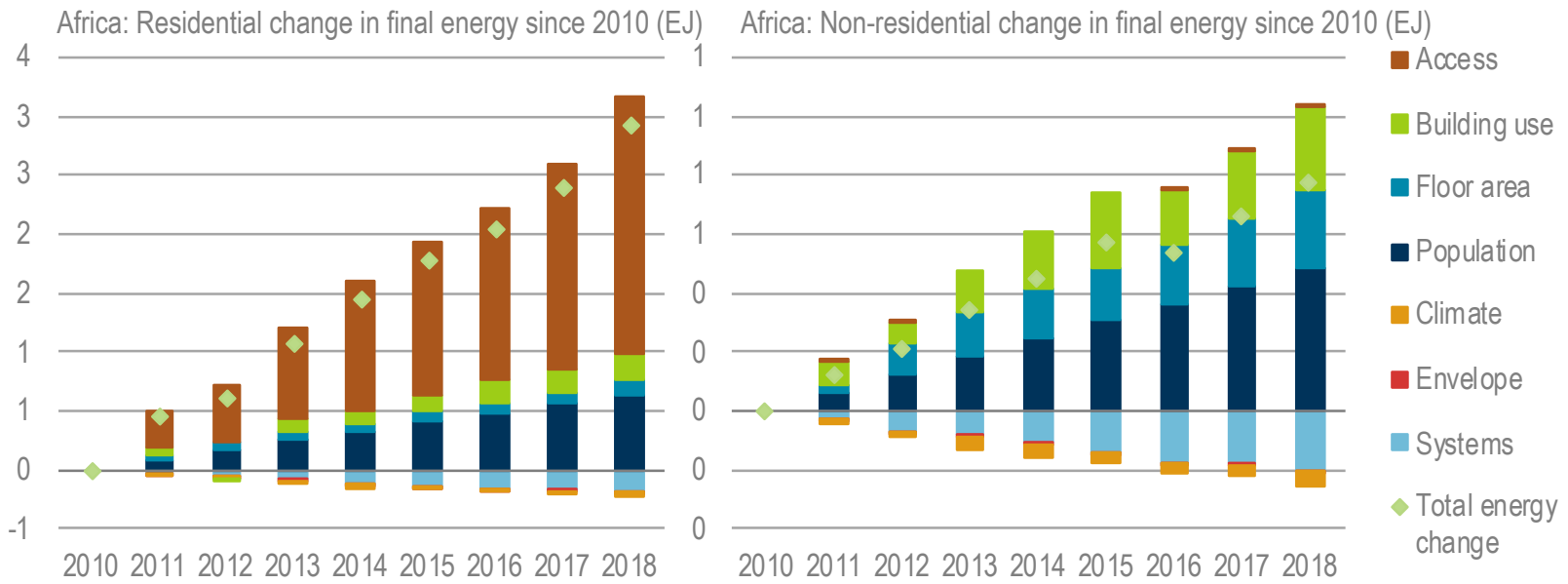
Africa buildings

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

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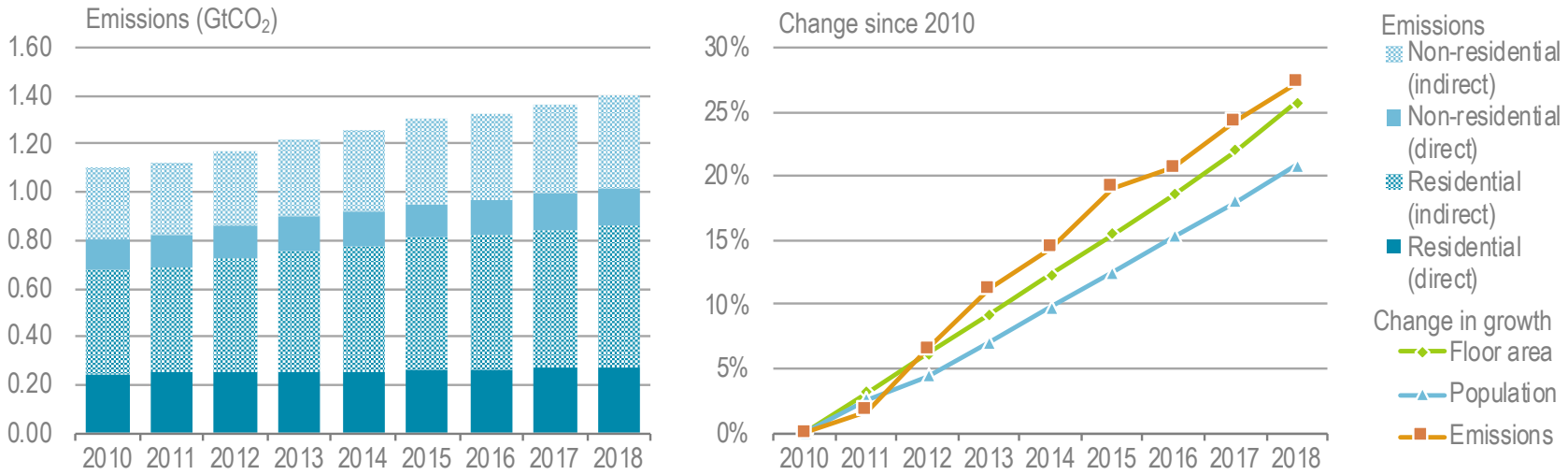
Africa buildings

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

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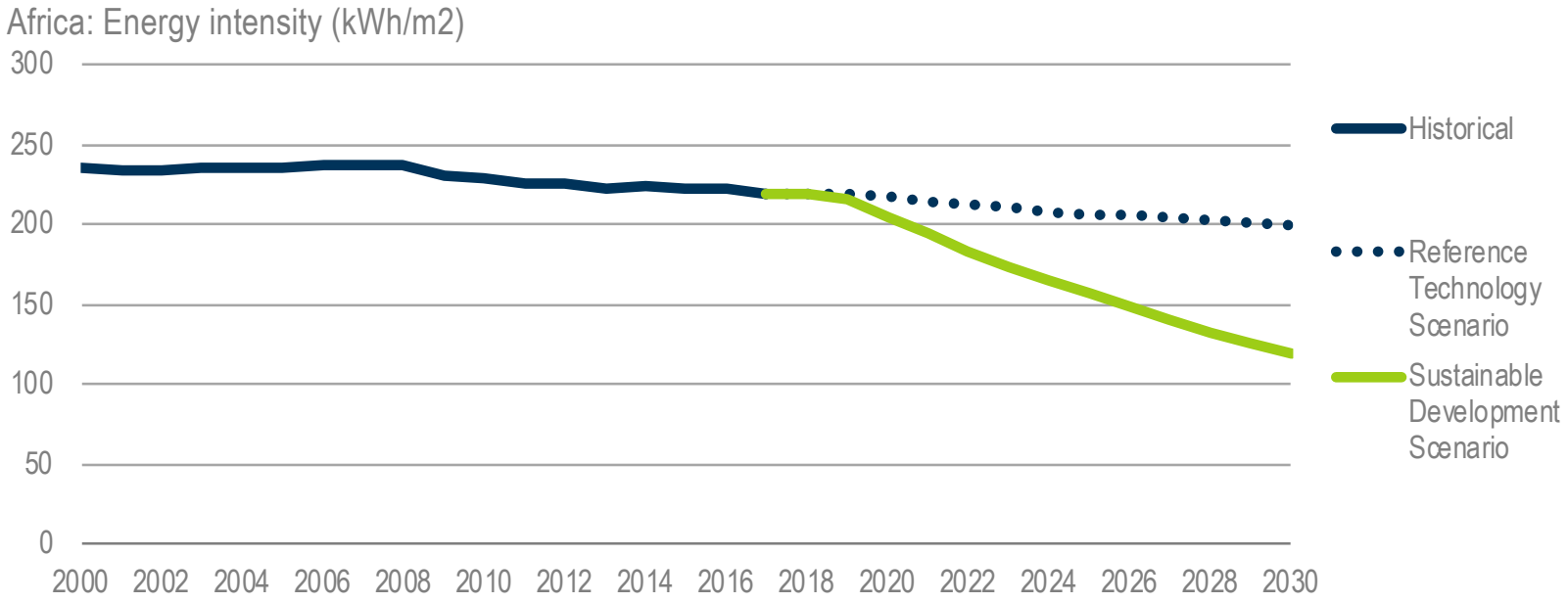
Africa supporting the path to sustainable development goals

Energy intensity under the sustainable development scenario, 2000-2030



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

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Decomposition

Logarithmic Mean Divisia Index (LMDI)

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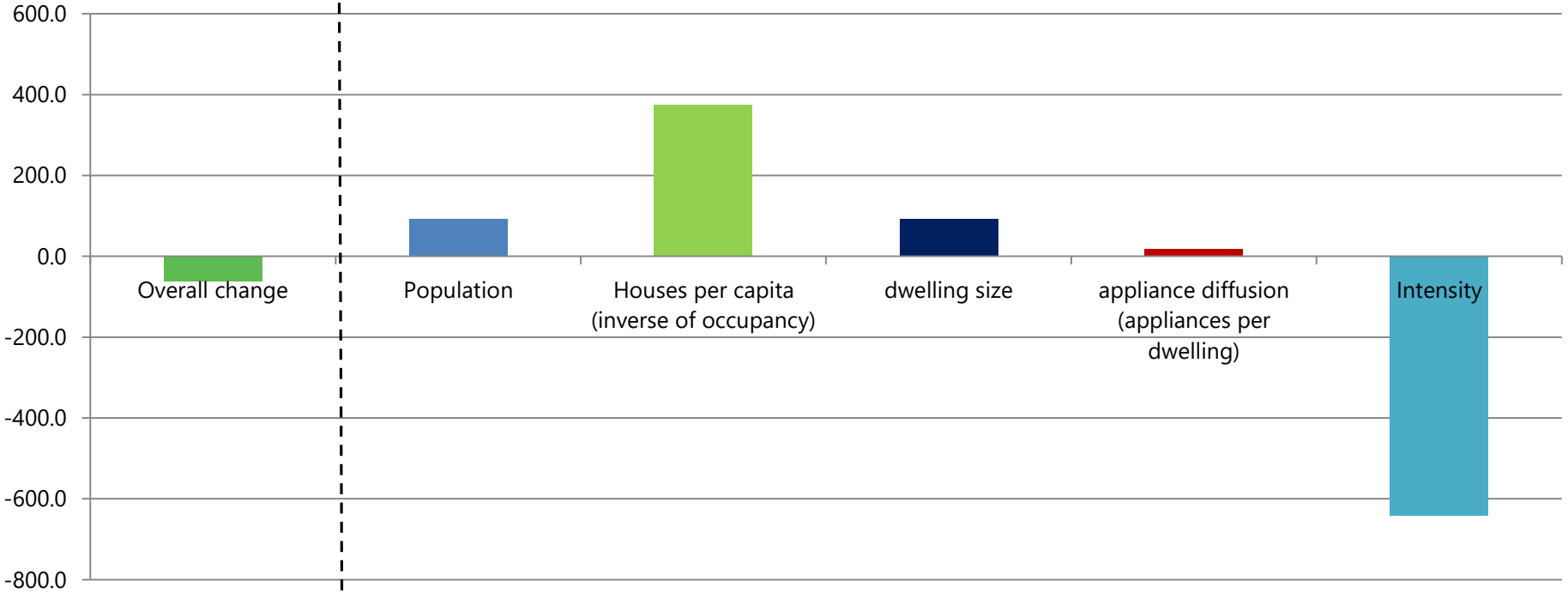
Evaluation: Building energy decomposition



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

Source: IEA Energy Technology Perspectives

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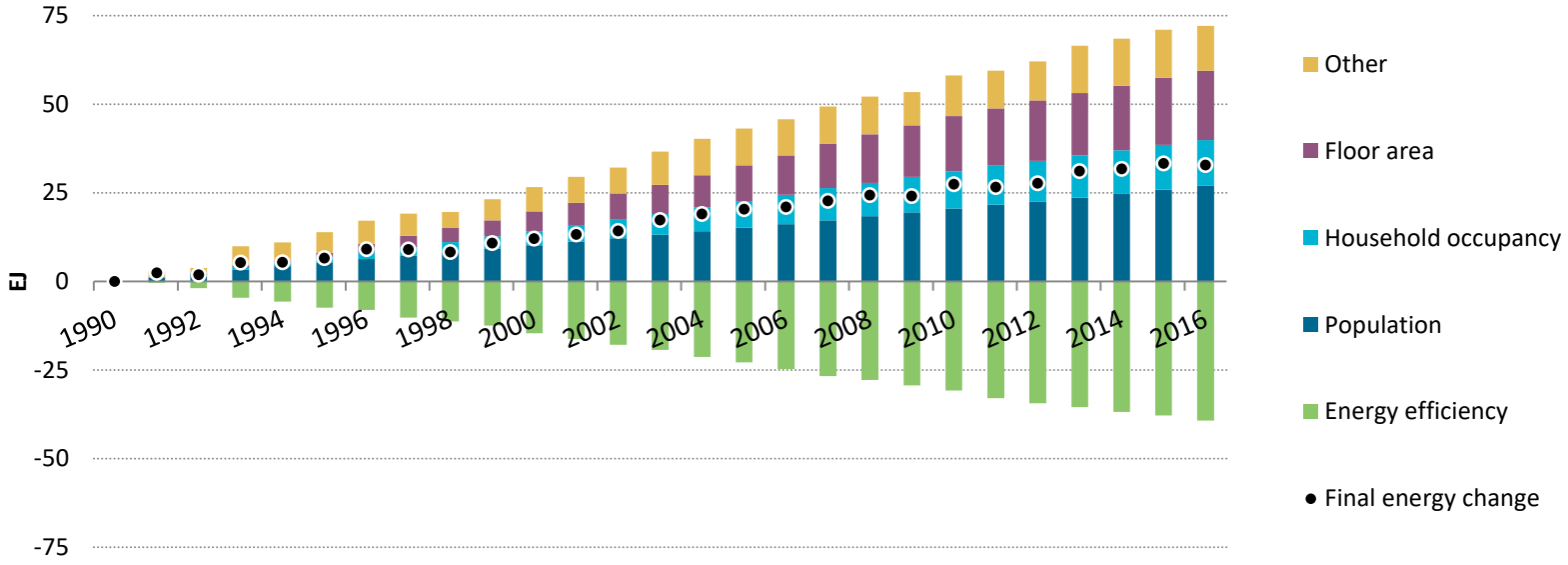
Evaluation: Building energy decomposition

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.

Source: IEA Energy Technology Perspectives 2017

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Process for Tracking Progress

Key steps in the process

Examples

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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

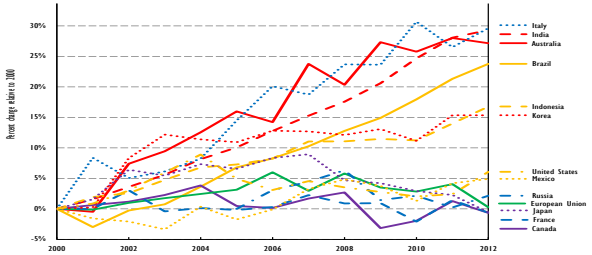
- What performance metrics can you use?
- What data is needed?

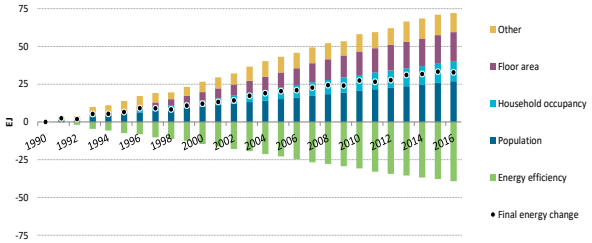
Step 3: Assess the data

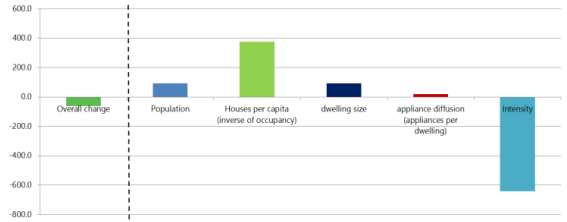
- What analysis method should you use?

Step 4: Tell the story

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







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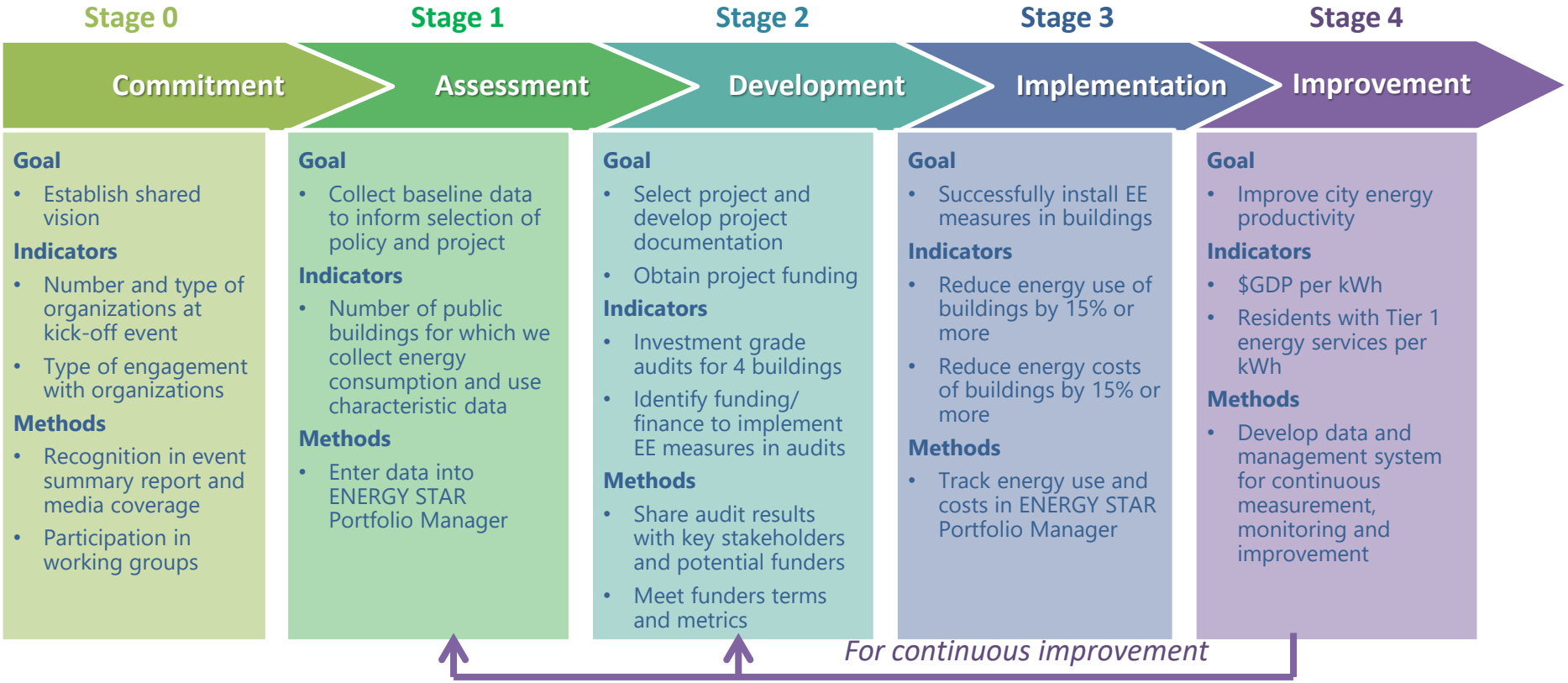
Example: Tracking progress in the Building Efficiency Accelerator



Source: Building Efficiency Accelerator

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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?

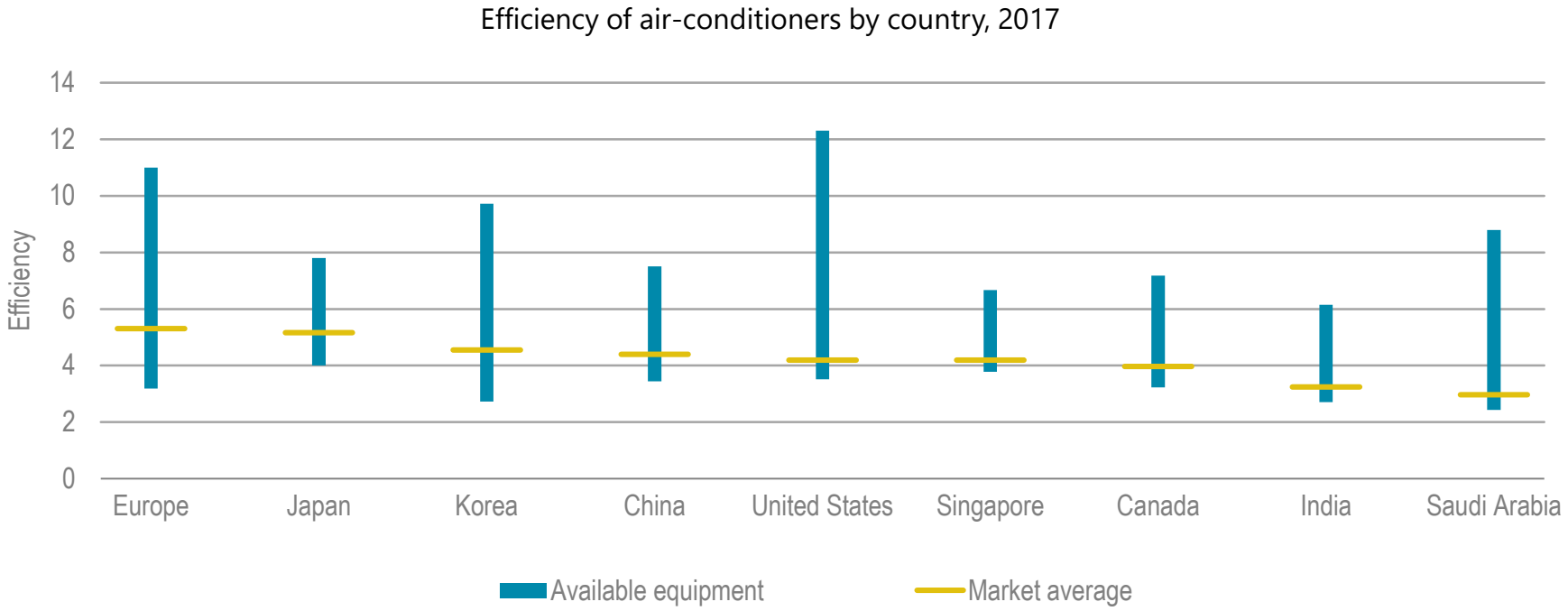
Step 4: Tell the story

- 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



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

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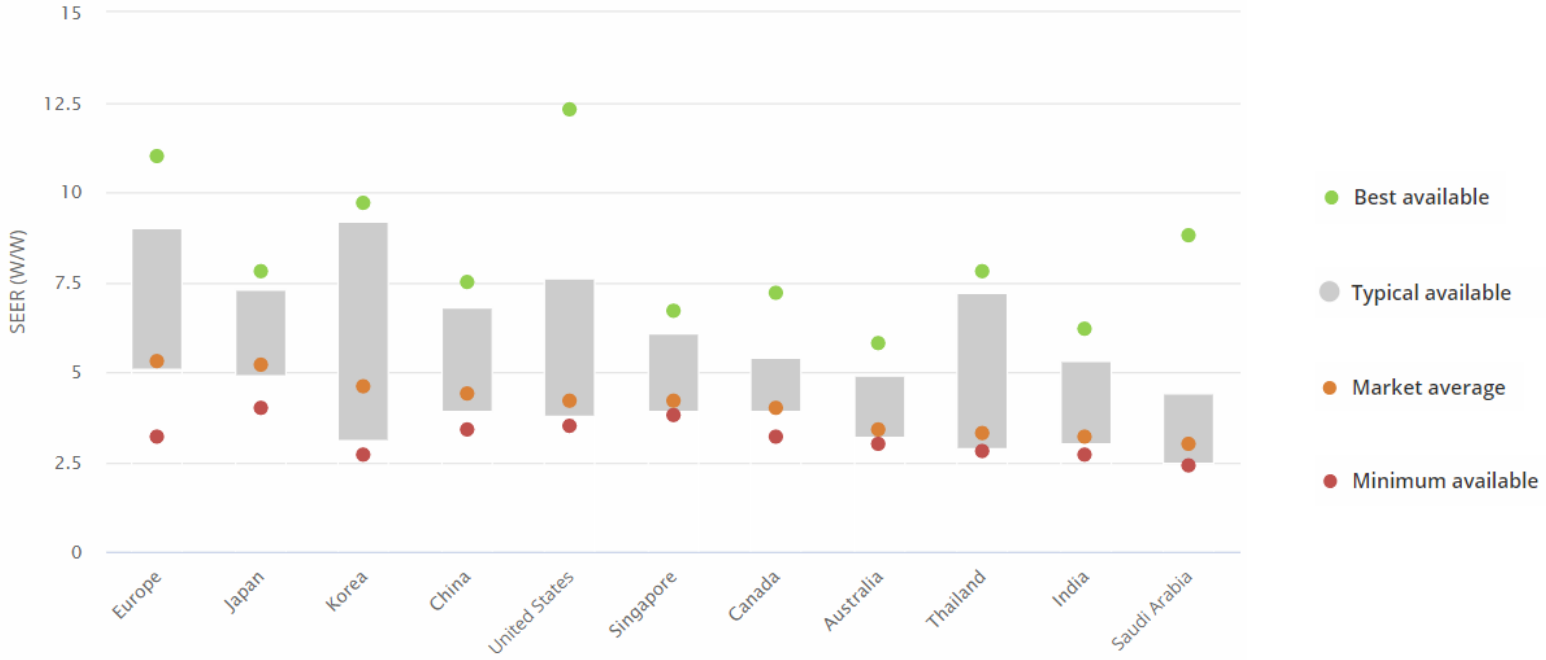
Tracking progress: cooling example 1

Seasonal energy efficiency ratio of residential ACs in key cooling markets, 2018



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.

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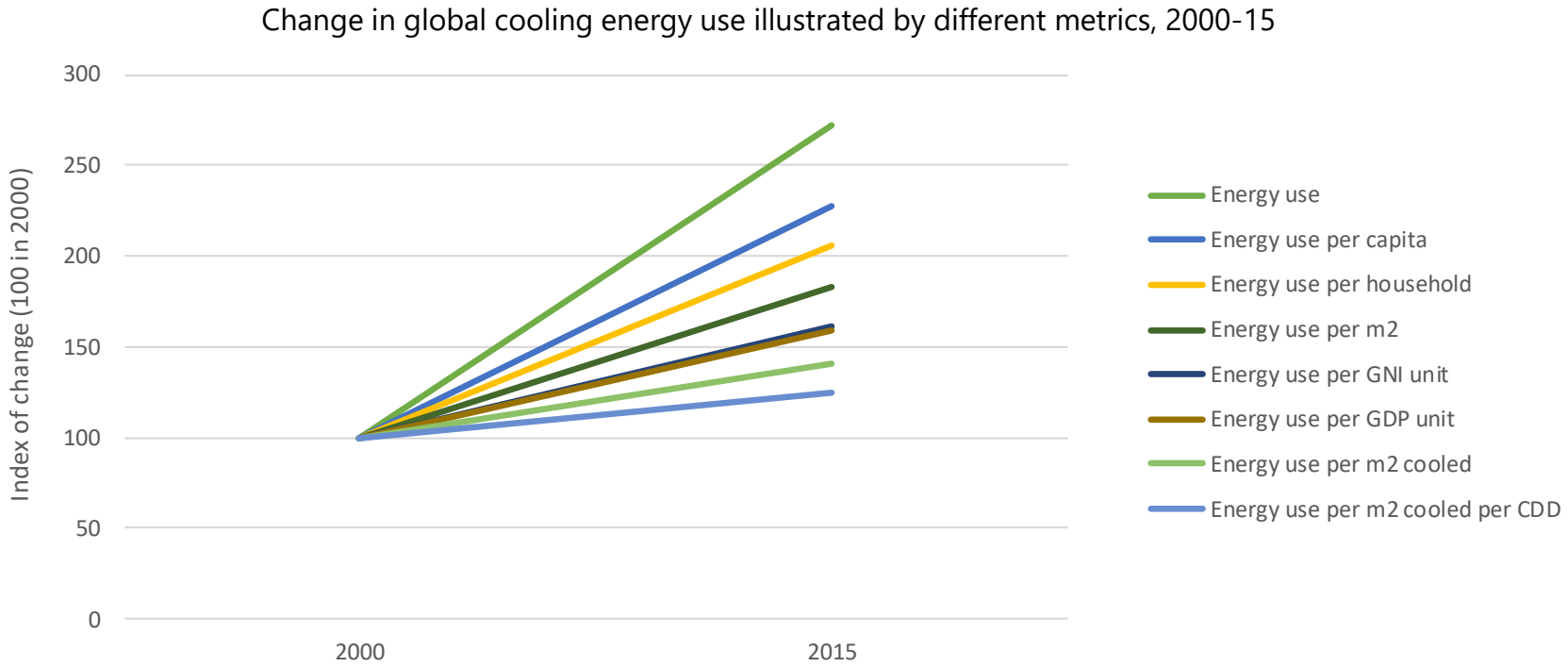
Tracking progress: cooling example 2



"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.

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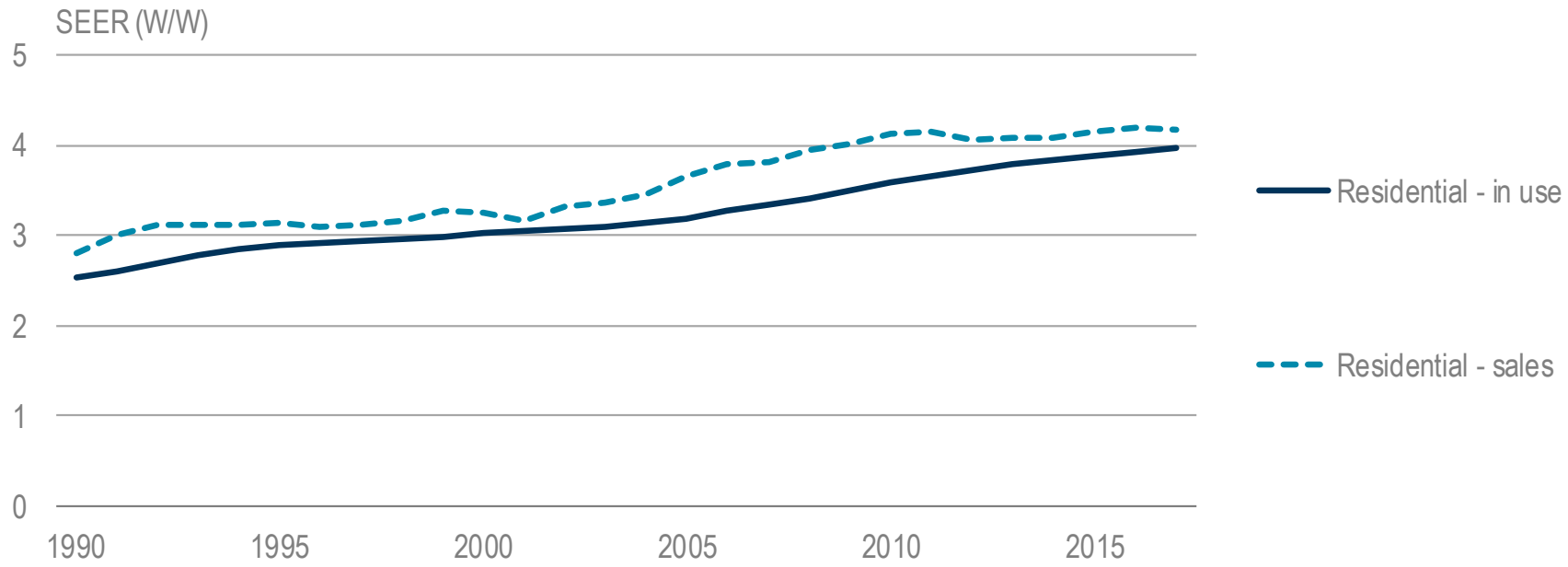
Tracking progress: cooling example 3

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.

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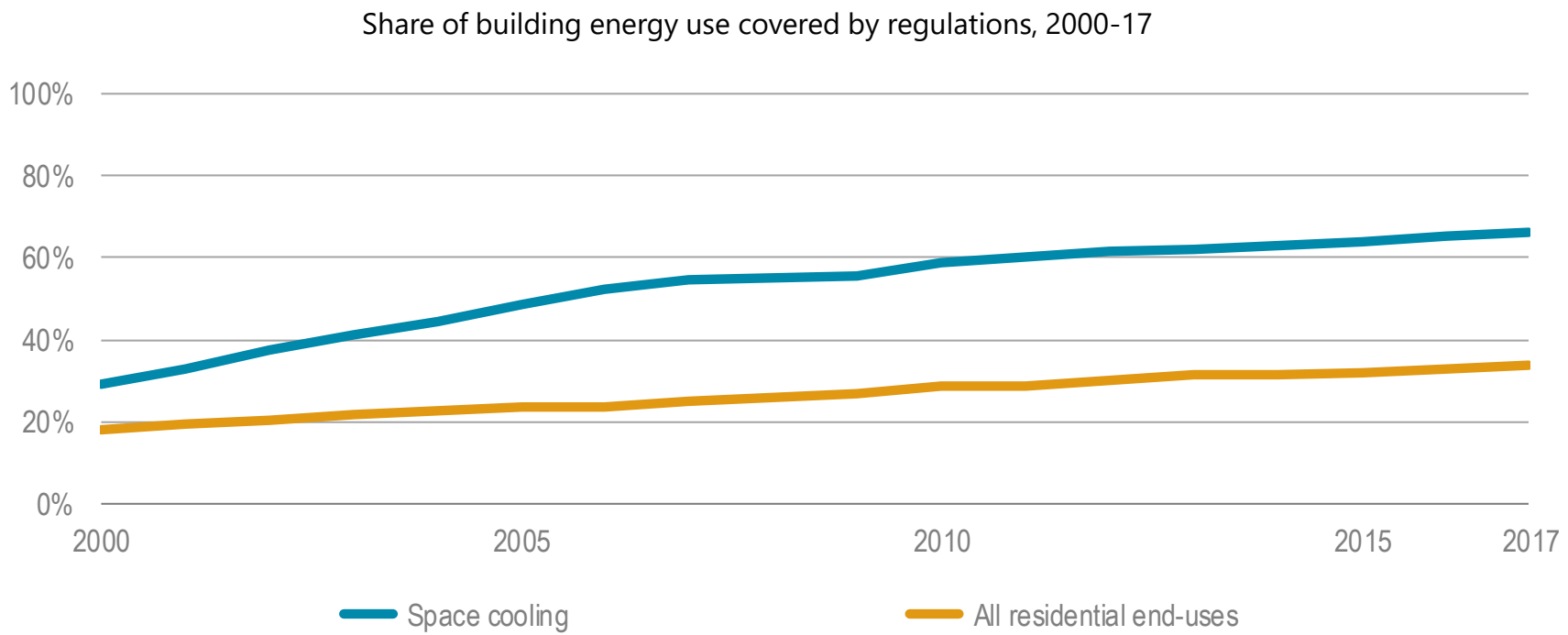
Tracking progress: cooling example 4



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

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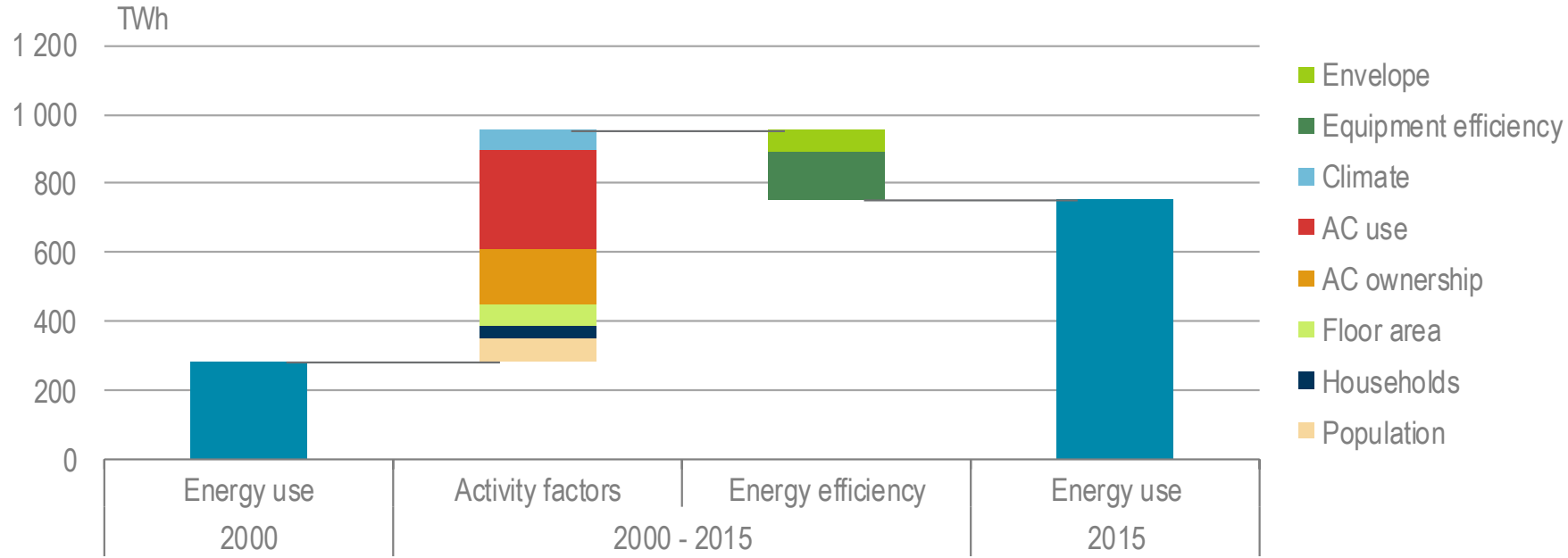
Tracking progress: cooling example 5

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.

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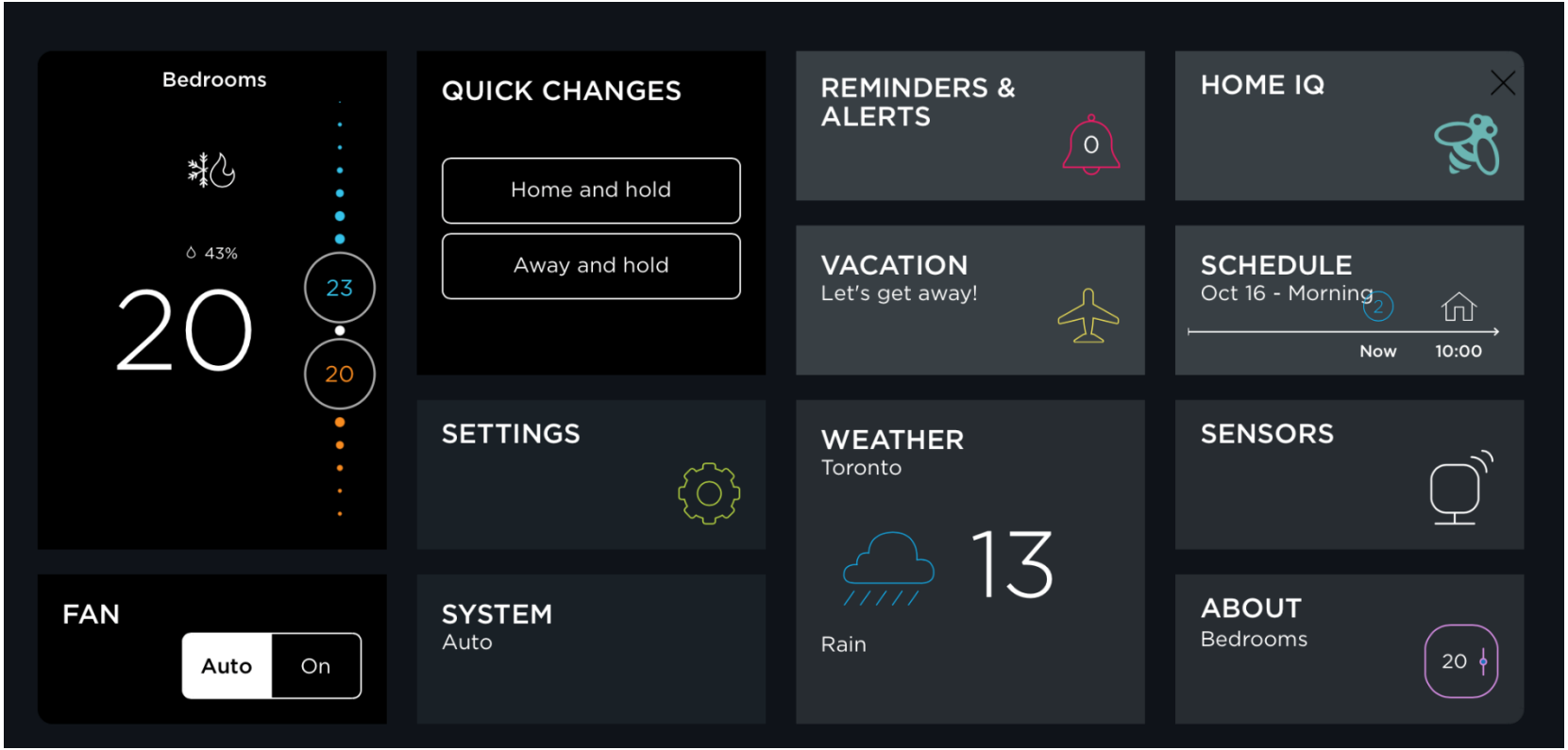
Energy Efficiency Training Week: Buildings

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



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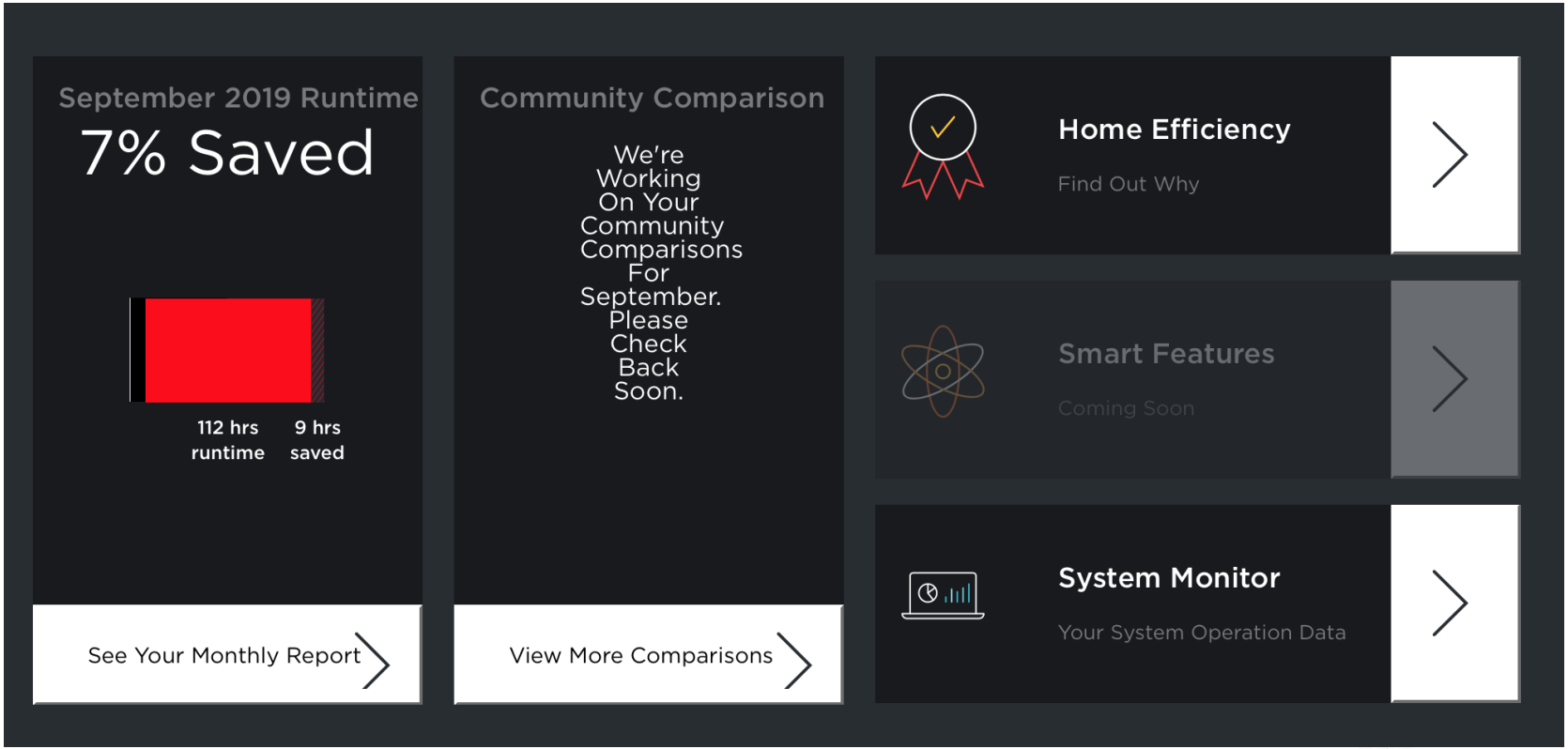
Metrics of performance



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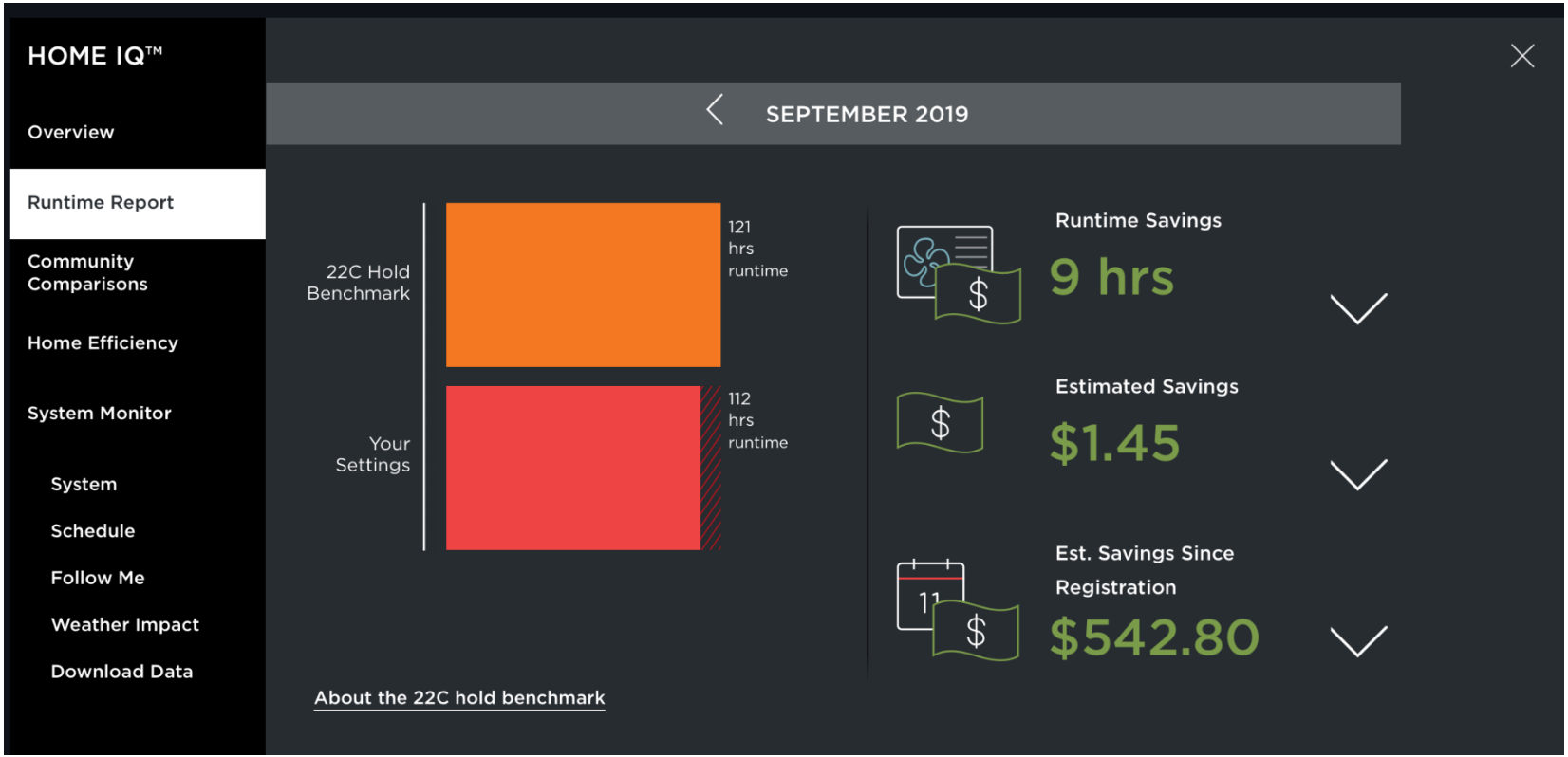
Metrics of performance



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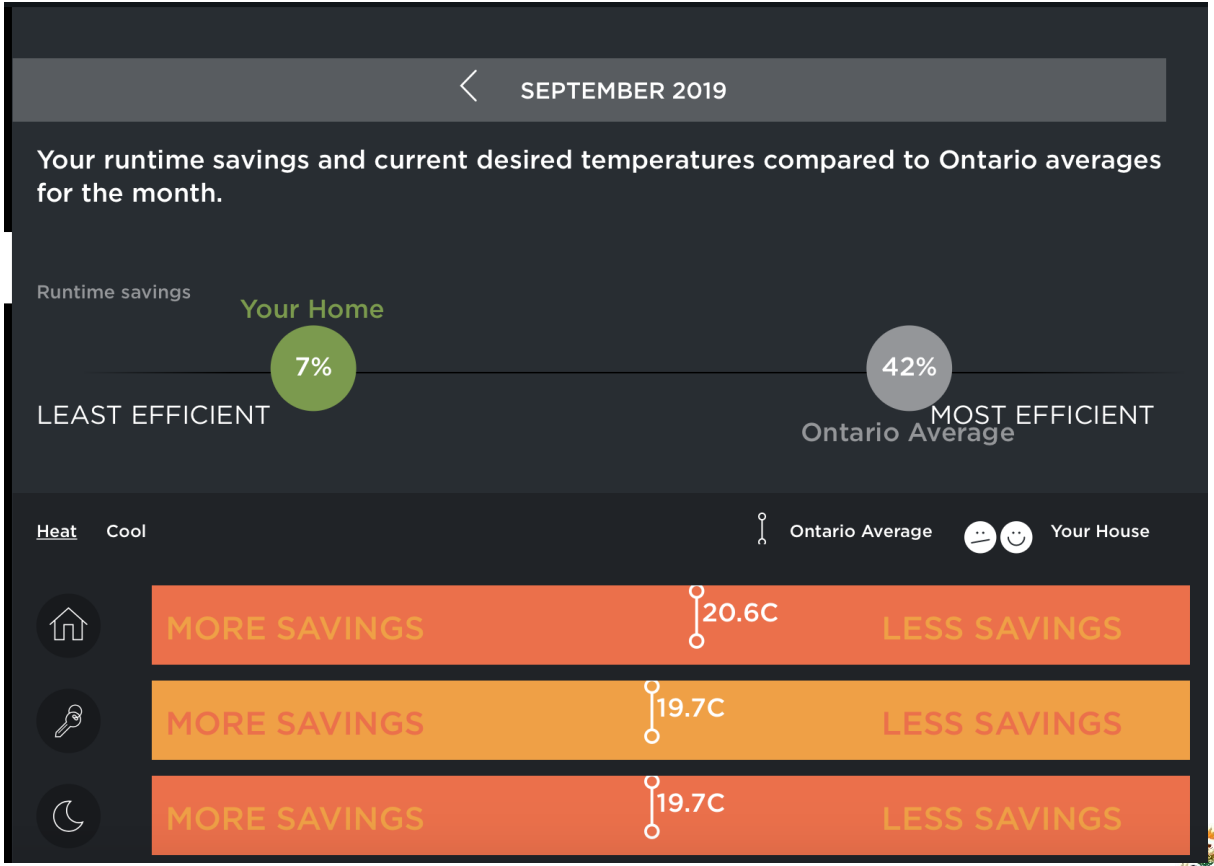
Metrics of performance



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1. Car | 2. Exterior | 3. Interior | 4. Autopilot | 5. Payment

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

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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*

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