

Where to start? Energy efficiency potential

Buildings

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Energy Efficiency Training Week: Buildings programme



- 1. Where to start: Energy use in buildings
- 2. Where to start: Energy efficiency potential in buildings
- 3. Toolkit: Energy efficient building design
- 4. Toolkit: Energy efficient building technologies

Special session. Technology demonstration

Where do I get help? IEA's Technology Collaboration Programmes

- 5. Toolkit: Energy efficiency policies and target setting
- 6. What are the steps? Enabling investment with energy efficiency policies
- 7. What are the steps? Implementing building energy codes and standards
- 8. What are the steps? Building operations and procurement

Special session. The multiple benefits of energy efficiency

- Did it work? Evaluation and energy efficiency indicators
 Where do I get help? International and regional energy efficiency initiatives
- 10. Energy efficiency quiz: Understanding energy efficiency in buildings



2. Where to start: Energy efficiency potential in buildings

Trainers: Brian Dean and Maxine Jordan

Purpose: To teach the fundamentals of the energy efficiency potential in buildings. This includes information on IEA's scenarios analysis modelling to determine potential impacts.

Scenario: You have been asked to create new policies for energy efficient buildings. *How do you determine where to start?*



How much potential is there?

What type of potential is there?

What can drive the potential?



Type of energy efficiency potential: analysis approaches



- 1. **Technical potential:** analysing the total energy efficiency potential without any economic or market constraints (*e.g. analysing the energy savings potential if all buildings used best available technology*)
- 2. Economic potential: analysing the energy efficiency potential assuming economic constraints for cost effectiveness (e.g. analysing the energy savings potential if buildings used the most-efficient cost-effective technology)
- **3. Market potential :** analysing the energy efficiency potential assuming market constraints in implementing energy efficiency (*e.g. analysing the energy savings potential using a adoption curve to estimate typical market implementation given the available policies and technologies)*

Technical potential, economic potential and market potential are used for different purposes

Global energy efficiency potential





Energy efficiency potential by sector

Source: IEA Energy Efficiency Market Report 2018



Decomposition of global final energy demand in buildings by key contribution



Energy efficiency measures can reverse historical trends, offsetting the effect of increasing global population, building activity and growing floor area in buildings.

Global emissions savings potential





Global CO₂ savings potential to 2060

More than 50% of cumulative CO2 emissions reduction in buildings to 2060 under the B2DS results from shifts to low-carbon and high-performance technologies.

Source: IEA Energy Technology Perspectives 2017

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Global residential floor area growth and opportunity



Opportunity exists in both the historic stock and new building additions.

What can drive potential: floor area



Global residential floor area growth and opportunity (business as usual)



With business as usual growth, we expect continued high levels of non-compliance in new construction and minimal retrofits of existing stock.

What can drive potential: floor area



Global residential floor area growth and opportunity (more efficient)



In a below 2 degree scenarios, we expect less non-compliance and high levels of deep energy retrofits that can contribute to significant energy reductions.

What can drive potential: building technologies





There are multiple ways to increase the efficiency through building technologies



Cumulative loss by region (EJ) 100 Eurasia 80 10 China 39 60 **RTS** 93 **Other Asia** 40 15 **B2DS** 20 OECD E 48 Other 0 non-OECD 2014 2020 2030 2040 2050 2060 Total Total 15 heating cooling nZEB and renovated buildings Other buildings Loss to delay loss loss

Consequences of a ten-year delay

Delaying implementation and enforcement of building envelope measures would result in the equivalent of three years of additional energy consumption for heating and cooling in the buildings sector.

What can drive potential: policies





This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

All regions have potential to improve the building energy policies adoption and enforcement.

What can drive potential: behaviour



Impacts of Occupant Behaviour

% changes of source energy

Occupant and Operator Behavior is critical: the impact of day to day comfort and building operations decisions can have a very dramatic impact on energy consumption.

Source: Tianzhen Hong, Lawrence Berkeley National Lab, 2013

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Scenario:

You have been asked to create new policies for energy efficient buildings.

How do you determine where to start?



How do I calculate potential?

Ask questions Data Modelling



How do I calculate potential: where do I start?

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Asking some questions...

- Why is it important to know the potential?
- What is energy efficiency potential in buildings?
- How big is it?
- How do I estimate it?
- What are the challenges?

WE LEARN MORE BY LOOKING FOR THE ANSWER TO A QUESTION AND NOT FINDING IT THAN WE DO FROM LEARNING THE **ANSWER ITSELF** - LLOYD ALEXANDER



If You Can't Measure It, You Can't Improve It

(William Thomson, Lord Kelvin)

Start with the existing data (as shown in Session 1 and discussed in detail in Session 9)



Use existing data to understand the energy efficiency potential.





Example: Building stock accounting for Turin (Italy)

Breaking the data down in a stock model can help you identify where the potential is.



Modelling

All models are wrong but some are useful



George E.P. Box (Statistician)



Modelling approaches:

- 1. **Bottom-up:** constructing a "stock model" of building data to analyse
- 2. **Top-down:** disaggregating economy-wide data
- **3. Hybrid top-down and bottom-up:** using the best available data and calibrating bottom-up data to top-down statistics

How do I calculate potential: modelling (bottom-up)



Use existing resources (many are free)



EnergyPlus

EnergyPlus is DOE's whole-building energy simulation engine.

 Whole-building Energy Simulation | HVAC System Selection and Sizing | Code Compliance

 Last Software Update: 30 September 2015 | Last Entry Update: 12 December 2015

 Ratings ☆☆☆☆ | Reviews 0 | Add to compare



OpenStudio

OpenStudio is an open-source SDK (software development kit) for building energy simulation.

Whole-building Energy Simulation | Energy Conservation Measures | Lighting Simulation Last Software Update: 30 September 2015 | Last Entry Update: 15 December 2015 Ratings ☆☆☆☆☆ | Reviews 0 | Add to compare



eQUEST

eQUEST® is a widely used, time-proven whole building energy performance design tool.

Whole-building Energy Simulation

Last Software Update: 30 June 2010 | Last Entry Update: 03 October 2015

Ratings ☆☆☆☆ Reviews 0 Add to compare

Local Energy Efficiency Policy Calculator (LEEP-C)

Tool / Instrument

The tool provides the opportunity to analyse the impacts of 23 different policy types from 4 energy-using sectors: public buildings, commercial buildings, residential buildings, and transportation.

Target Finder

Tool / Instrument

Target Finder is an online calculator that helps architects, engineers, and property owners and managers assess the energy performance of commercial building designs and existing buildings.

The 2015 City Energy Efficiency Scorecard

Publication / Report

The second biennial ACEEE City Energy Efficiency Scorecard measures the progress of city policies and programs that save energy while benefiting the environment and promoting economic growth.

Tool for Rapid Assessment of City Energy (TRACE)

Tool / Instrument

This tool is a decision-support tool designed to help cities quickly identify underperforming sectors, evaluate improvement and cost-saving potential, and prioritize sectors and actions for energy efficiency (EE) intervention.

The Co-benefits Evaluation Tool for the Urban Energy System

Tool / Instrument

The tool evaluates climate co-benefits for the urban energy system based on different scenarios of socioeconomic, technological and demographic developments.

Tracking Implementation of Building Energy Codes and Certification (Webinar) - 29.07.2016

Web Resource

This is the first in a series of webinars that addresses building energy codes and certification. The target audience includes local and national stakeholders in the building

Many tool resources are already available

Source: US DOE BEST Directory and Copenhagen Center for Energy Efficiency

How do I calculate potential: modelling (top-down and hybrid)





Energy models are essential to better estimating the energy efficiency potential



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