



Where to start?

Energy efficiency potential

Buildings

 IEA #energyefficientworld

*Buildings energy efficiency
sessions in partnership with:*



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
9. **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 Pierre Jaboyedoff

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?



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)*

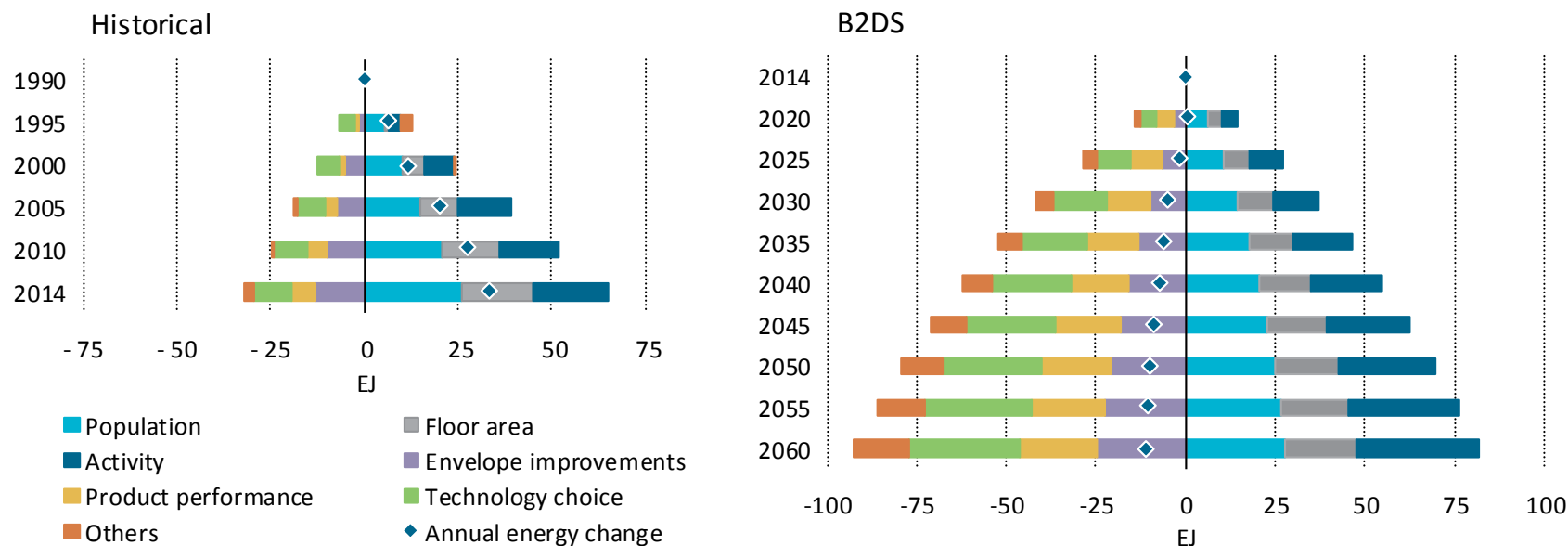
Technical potential, economic potential and market potential are used for different purposes

Energy efficiency potential by sector



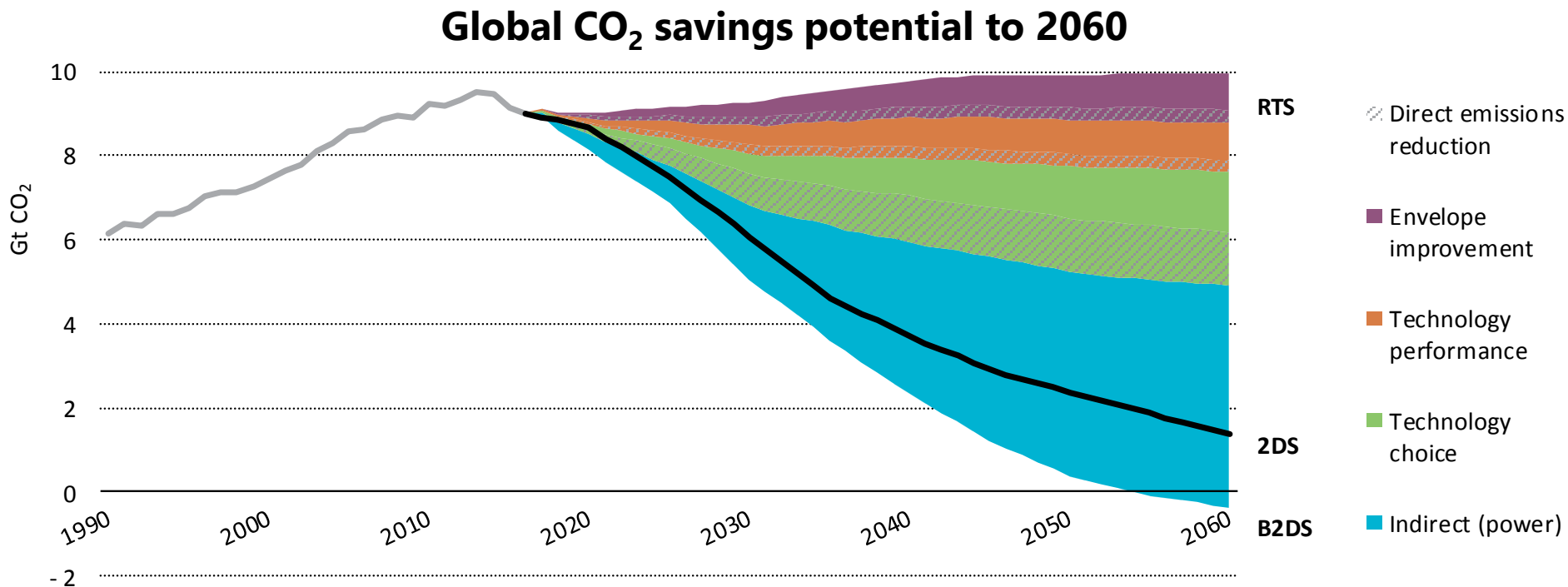
70% of the economic potential to improve energy efficiency in buildings remains untapped

Decomposition of global final energy demand in buildings by key contribution



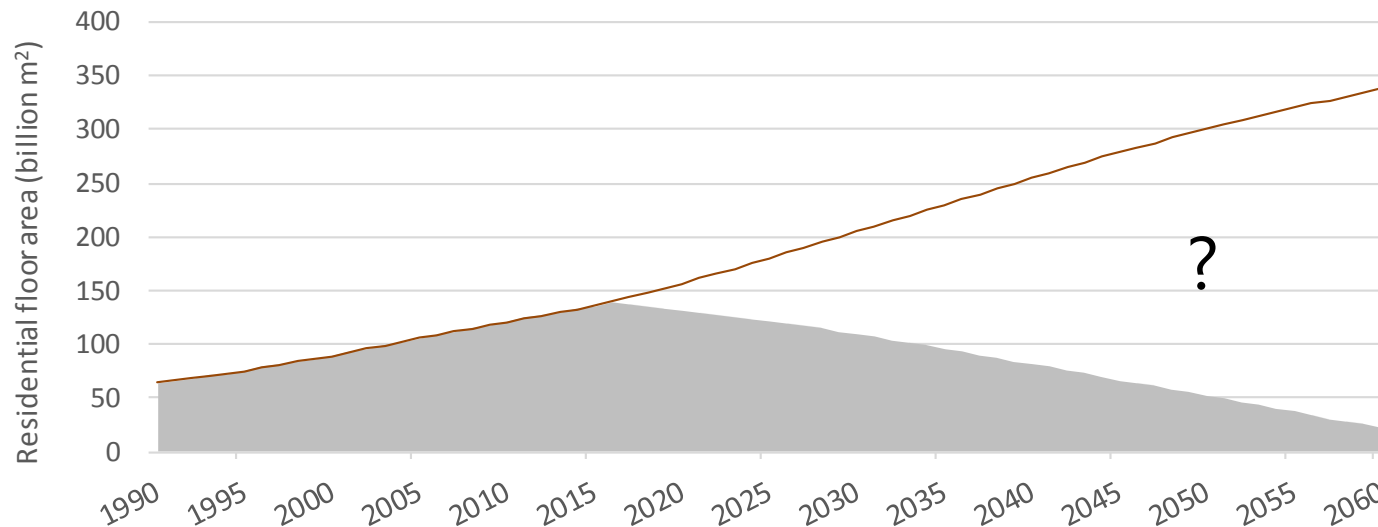
Energy efficiency measures can reverse historical trends, offsetting the effect of increasing global population, building activity and growing floor area in buildings.

Global emissions savings potential



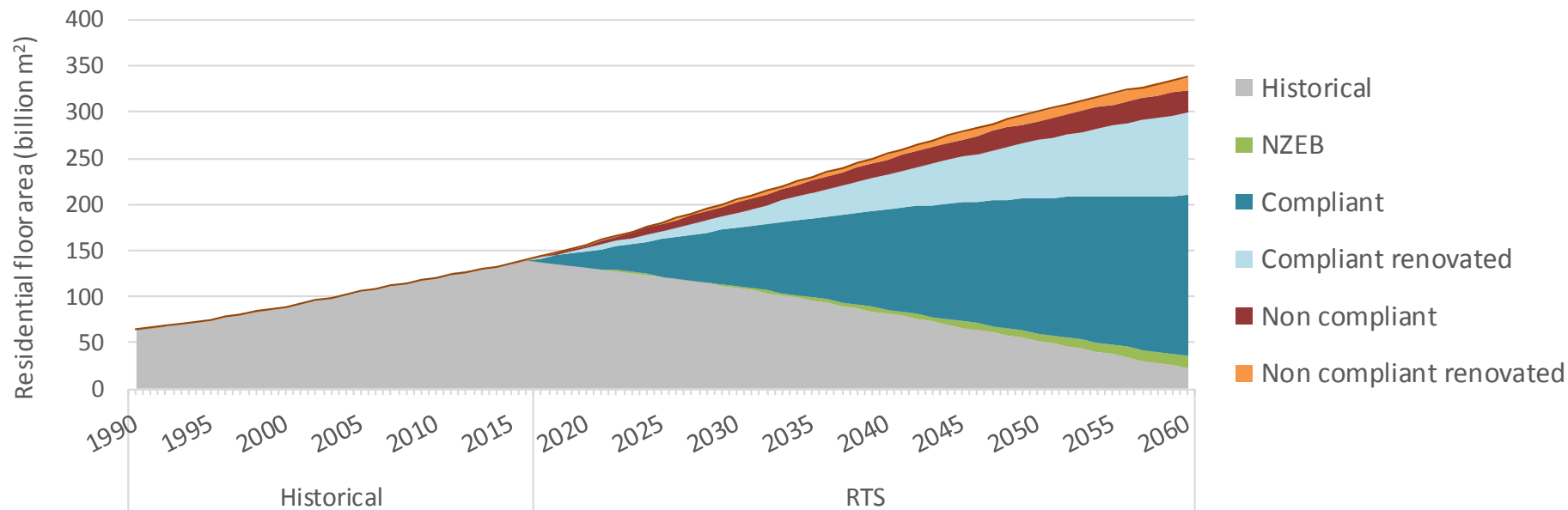
More than 50% of cumulative CO₂ emissions reduction in buildings to 2060 under the B2DS results from shifts to low-carbon and high-performance technologies.

Global residential floor area growth and opportunity



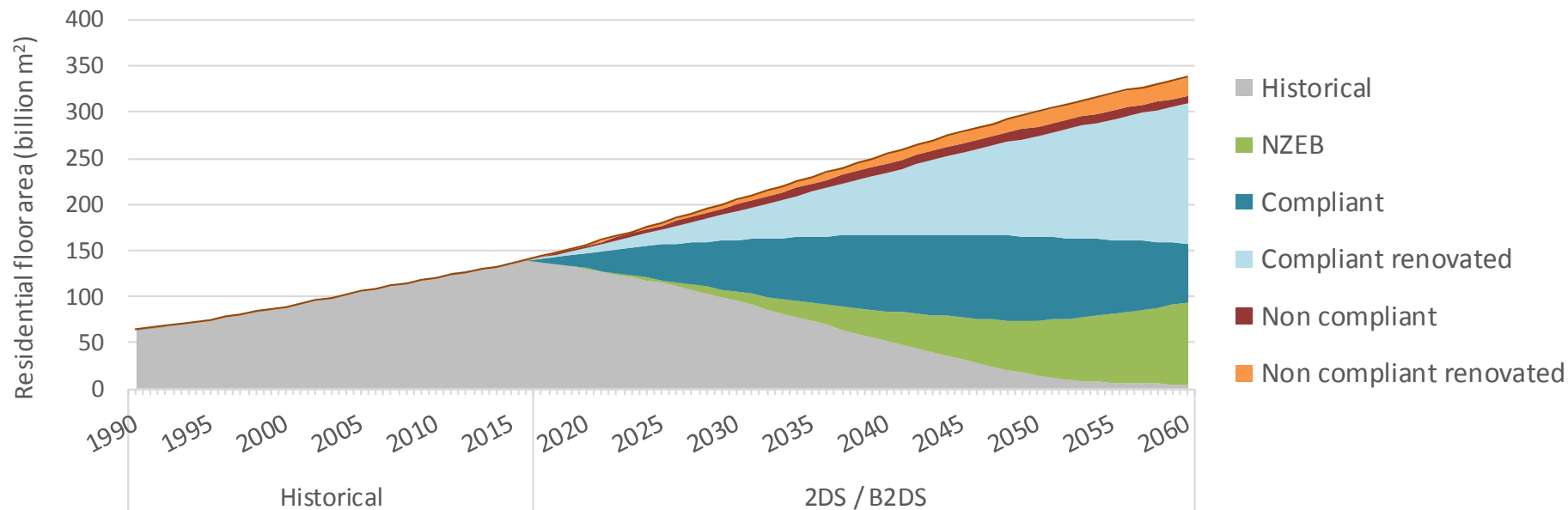
Opportunity exists in both the historic stock and new building additions.

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



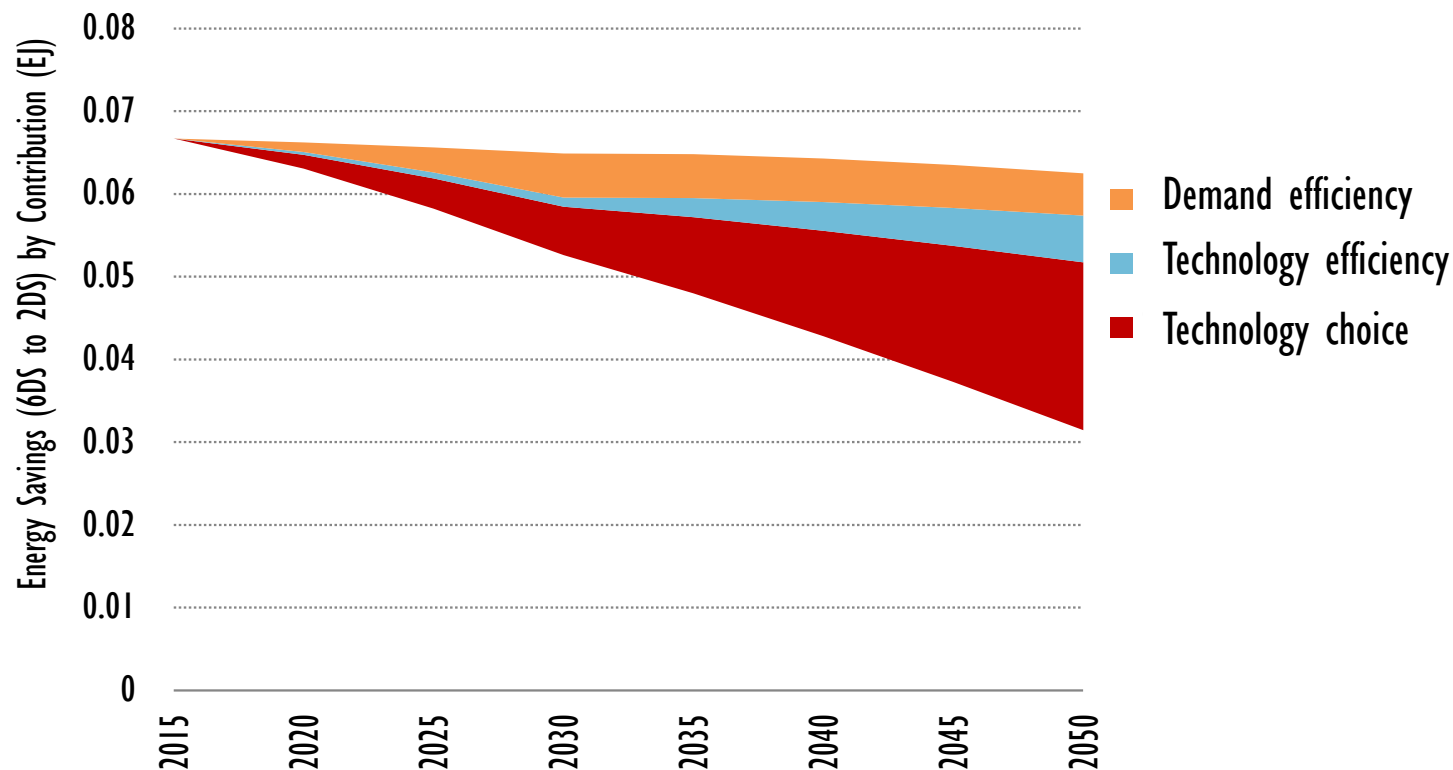
With business as usual growth, we expect continued high levels of non-compliance in new construction and minimal retrofits of existing stock.

Global residential floor area growth and opportunity (more efficient)



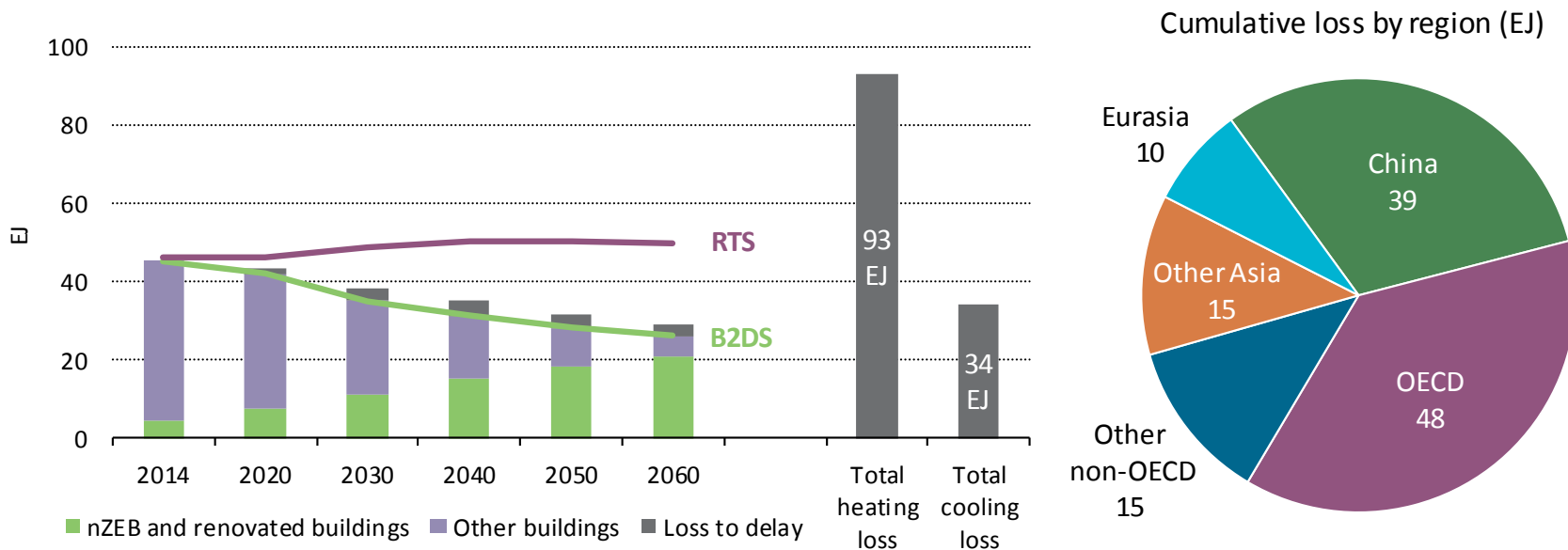
In a below 2 degree scenarios, we expect less non-compliance and high levels of deep energy retrofits that can contribute to significant energy reductions.

What can drive potential: building technologies



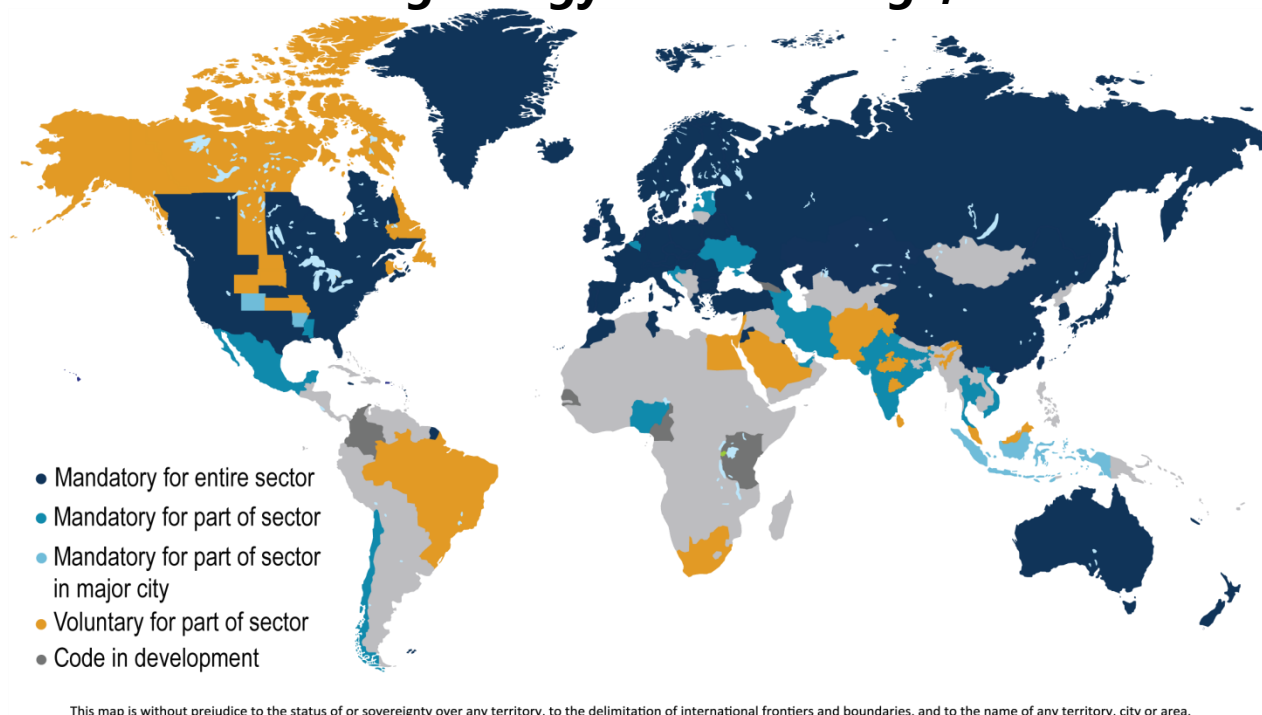
There are multiple ways to increase the efficiency through building technologies

Consequences of a ten-year delay



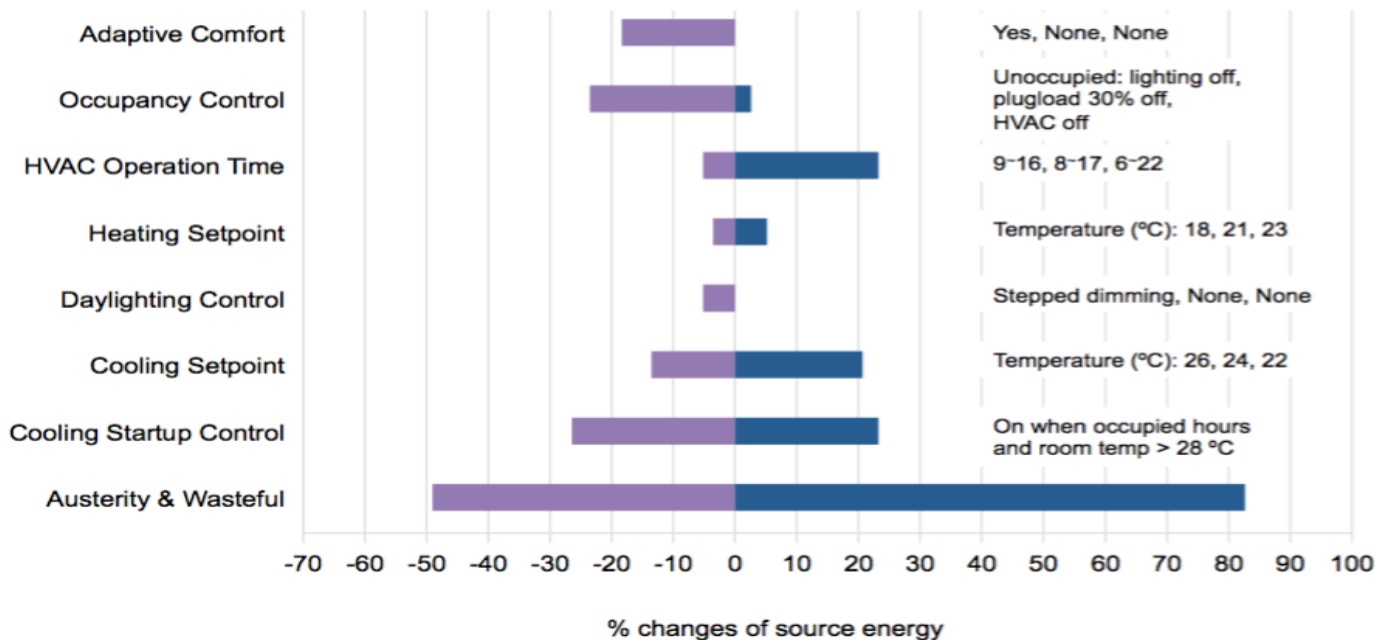
Delaying implementation and enforcement of building envelope measures would result in the equivalent of three years of additional energy consumption for heating and cooling in the buildings sector.

Building energy code coverage, 2017



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

Impacts of Occupant Behaviour



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.

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



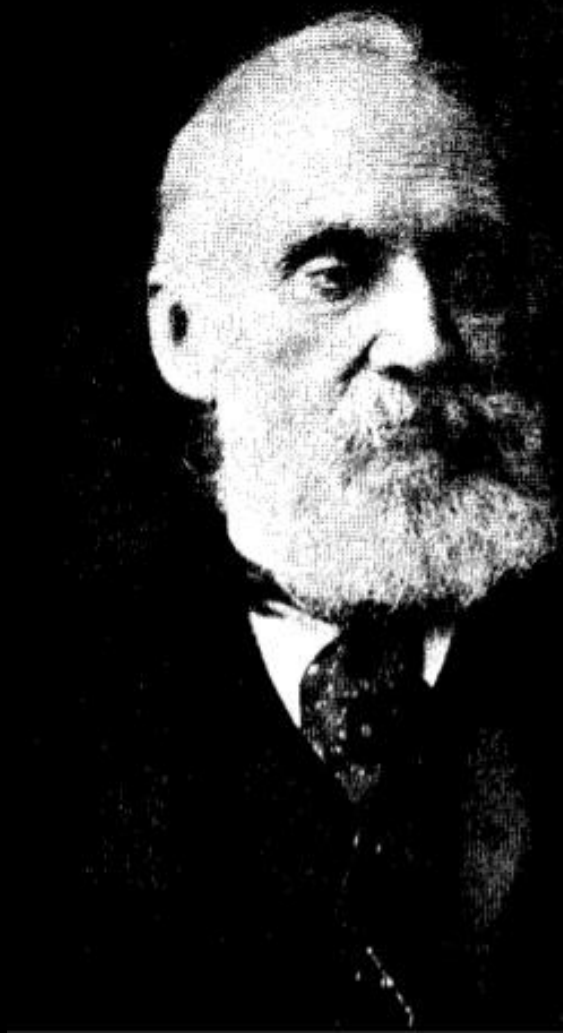
Asking some questions...

- 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

Data

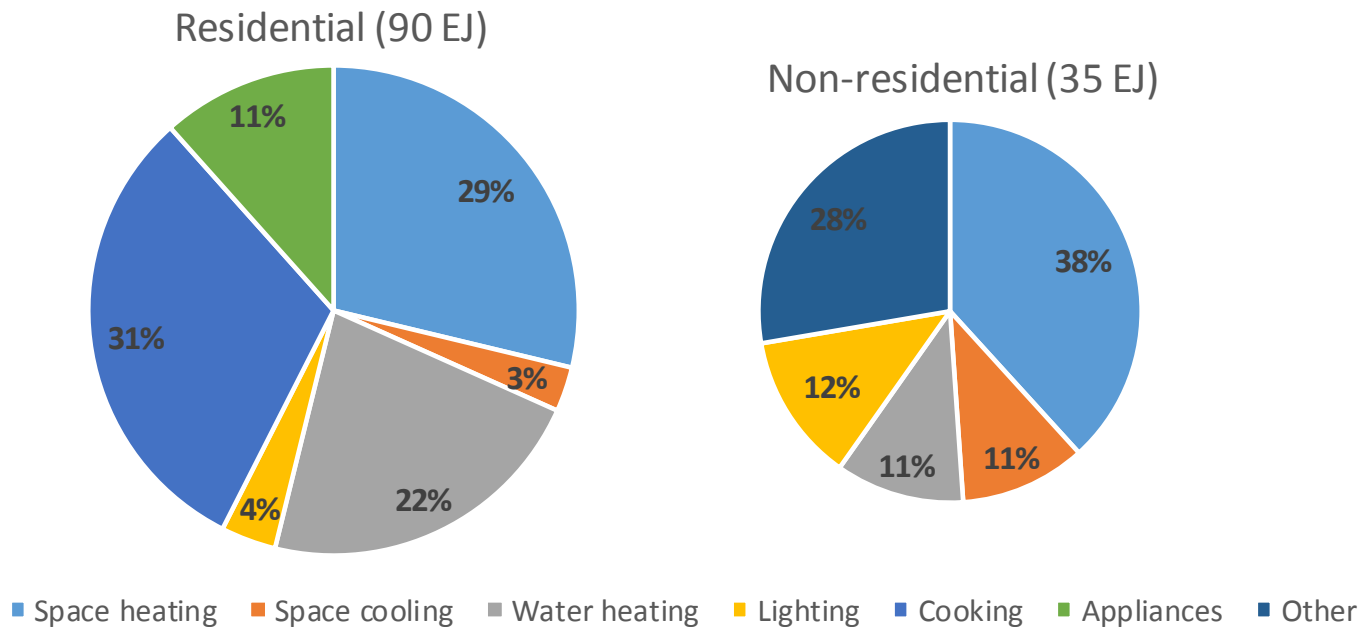


If You Can't
Measure It,
You Can't
Improve It

(William Thomson, Lord Kelvin)

How do I calculate potential: data

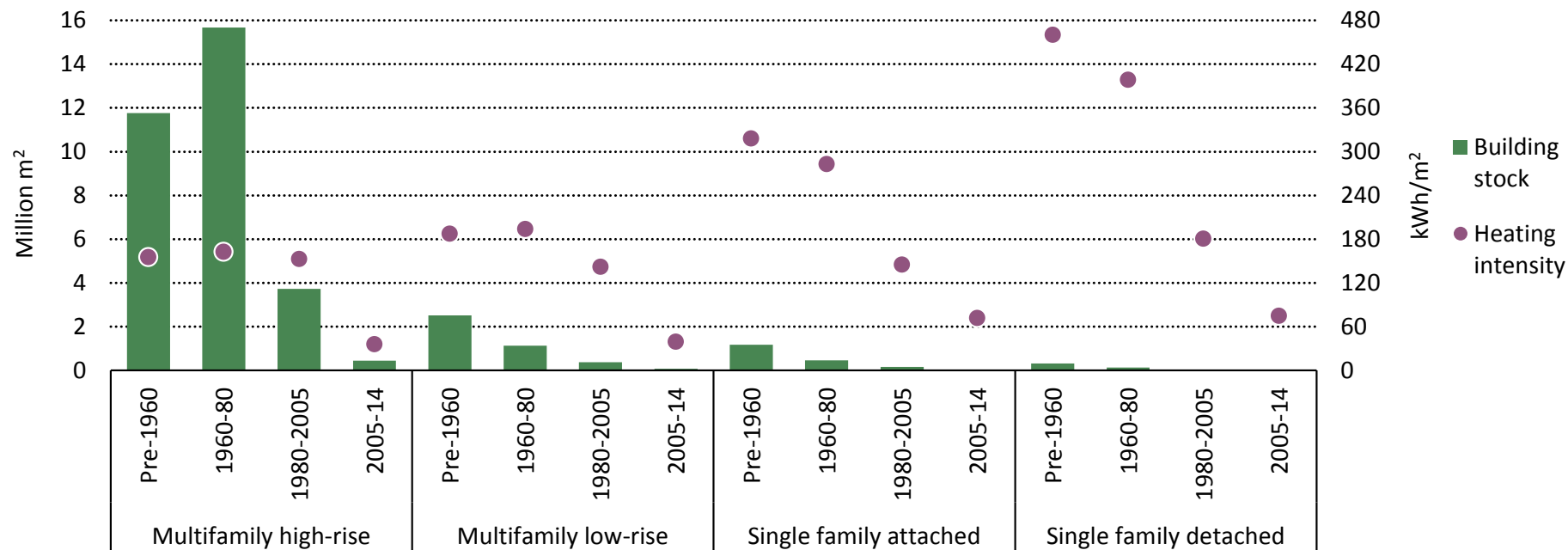
Start with the existing data (as shown in Session 1 and discussed in detail in Session 9)



Use existing data to understand the energy efficiency potential.

How do I calculate potential: data

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 under-performing 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

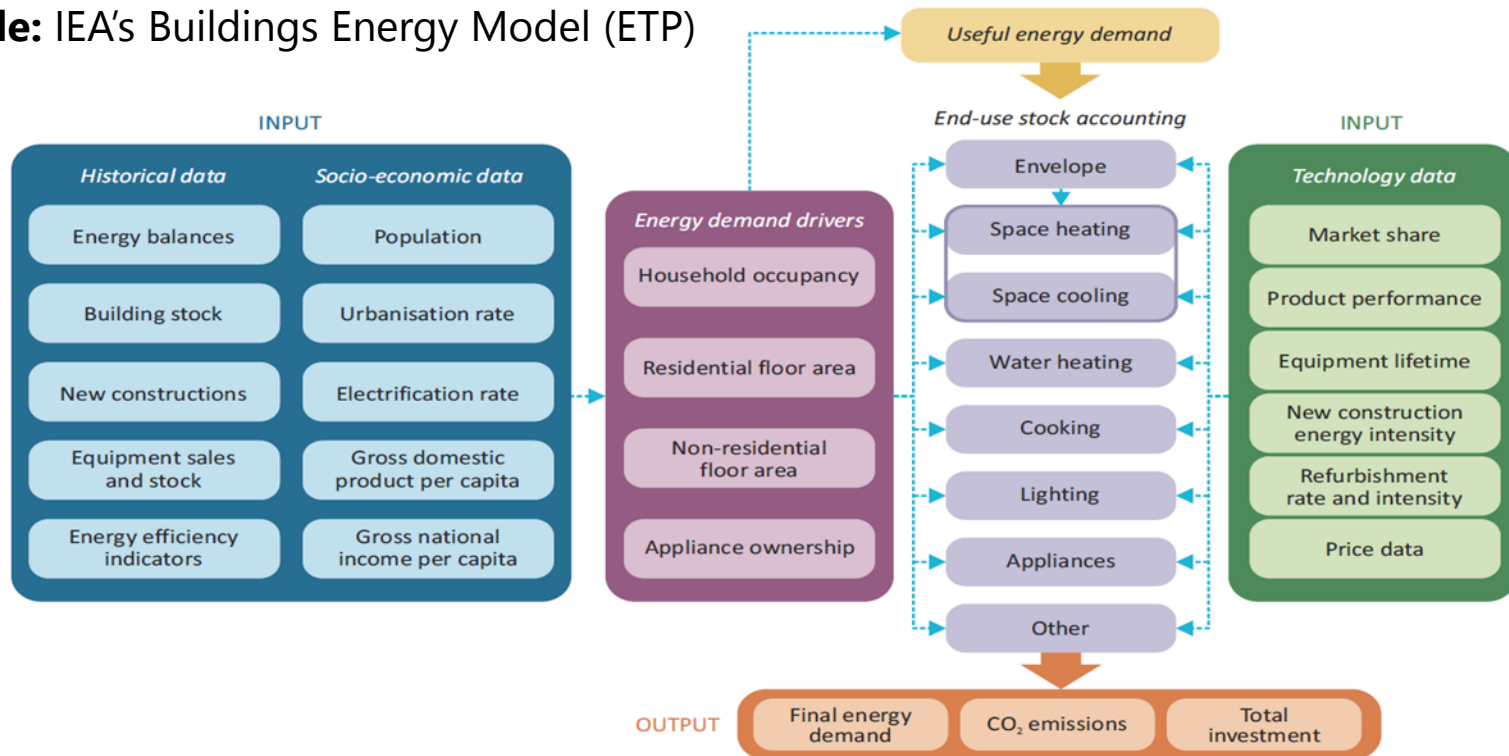
Web Resource

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

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

Example: IEA's Buildings Energy Model (ETP)



Energy models are essential to better estimating the energy efficiency potential

Scenario:

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

How do you determine where to start?



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