



# Where to start:

## Energy efficiency potential in buildings

---

Buildings: Session 2

*Buildings energy  
efficiency sessions  
in partnership with:*



**INDO-SWISS BUILDING  
ENERGY EFFICIENCY PROJECT**

**UCL ENERGY  
INSTITUTE**



1. **Where to start:** Understanding 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

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

5. **Toolkit:** Enabling investment with energy efficiency policies

6. **What are the steps :** Building energy codes and standards

**Site Visit:** Schneider Electric

7. **What are the steps:** Set targets and develop policies

8. **Did it work:** Evaluating the multiple benefits of energy efficiency

9. **Did it work:** Tracking progress with 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:** John Dulac and Ian Hamilton

**Session:** 1 hour

**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?

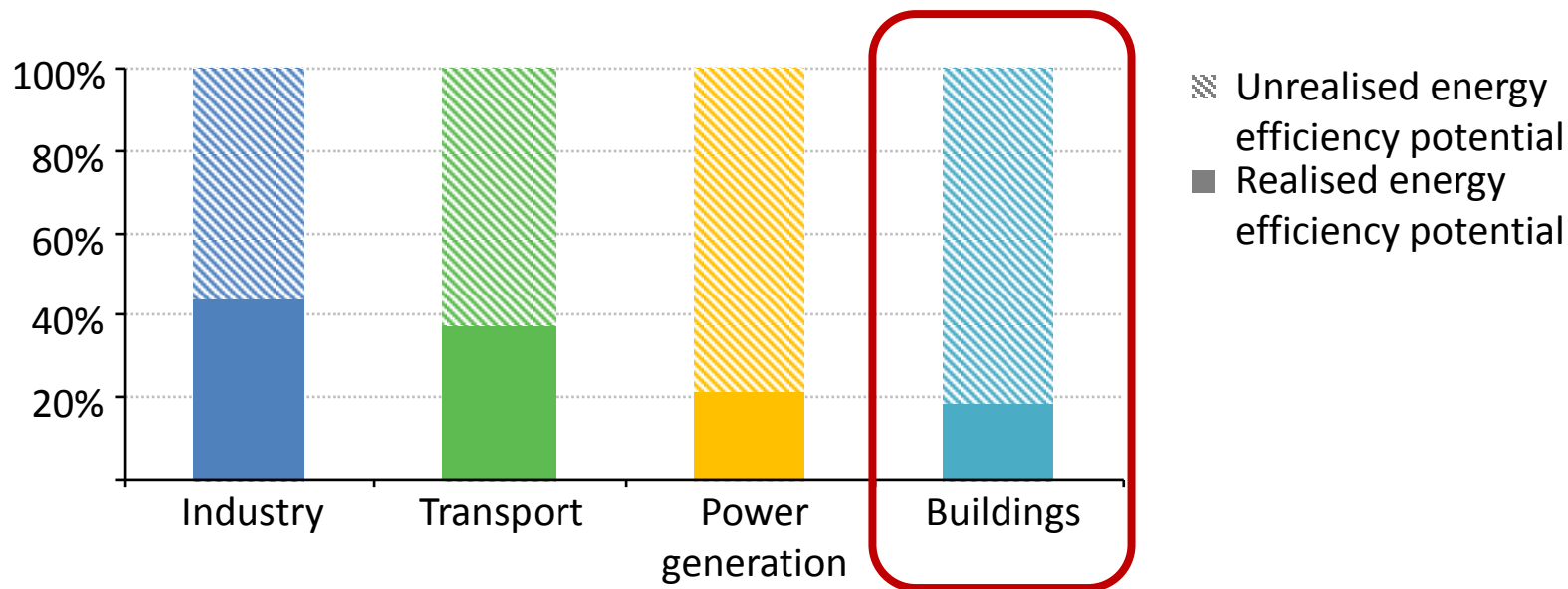
What can drive the potential?



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*)

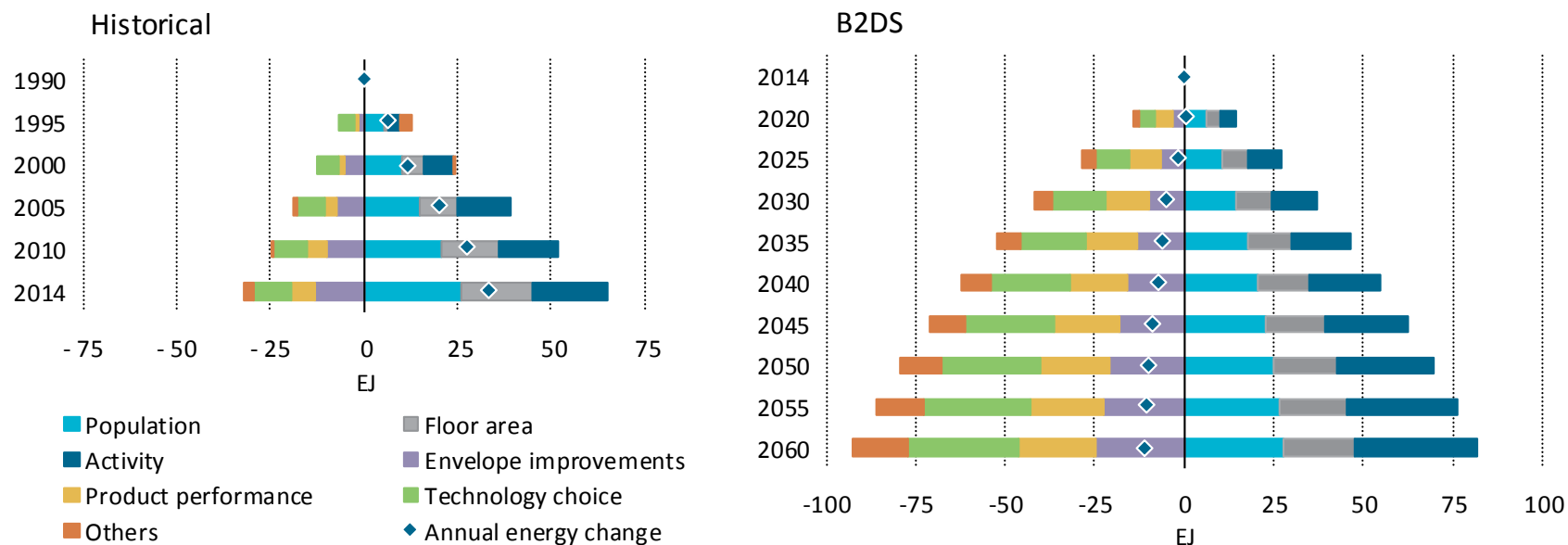
Technical potential, economic potential and market potential are used for different purposes

## Energy efficiency potential by sector



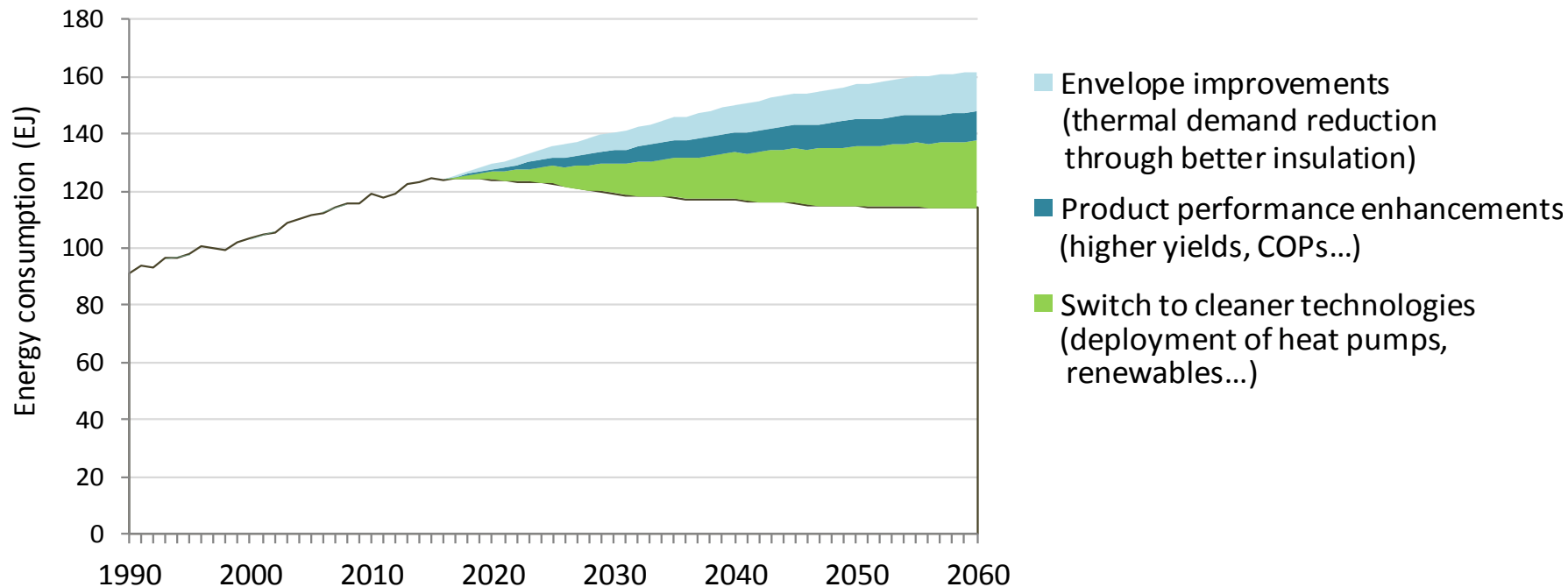
**80% of the economic potential to improve energy efficiency in buildings remains untapped**

## Decomposition of global final energy demand in buildings by key contribution



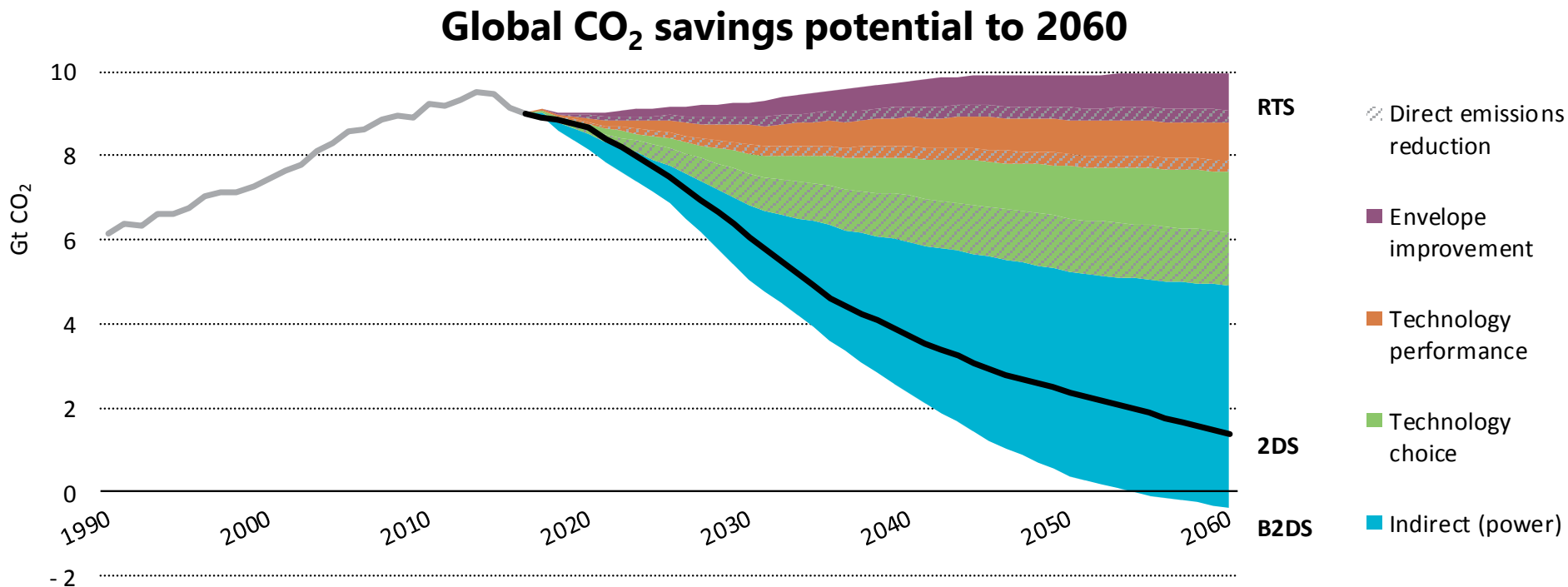
**Energy efficiency measures can reverse historical trends, offsetting the effect of increasing global population, building activity and growing floor area in buildings.**

## Global energy savings potential to 2060



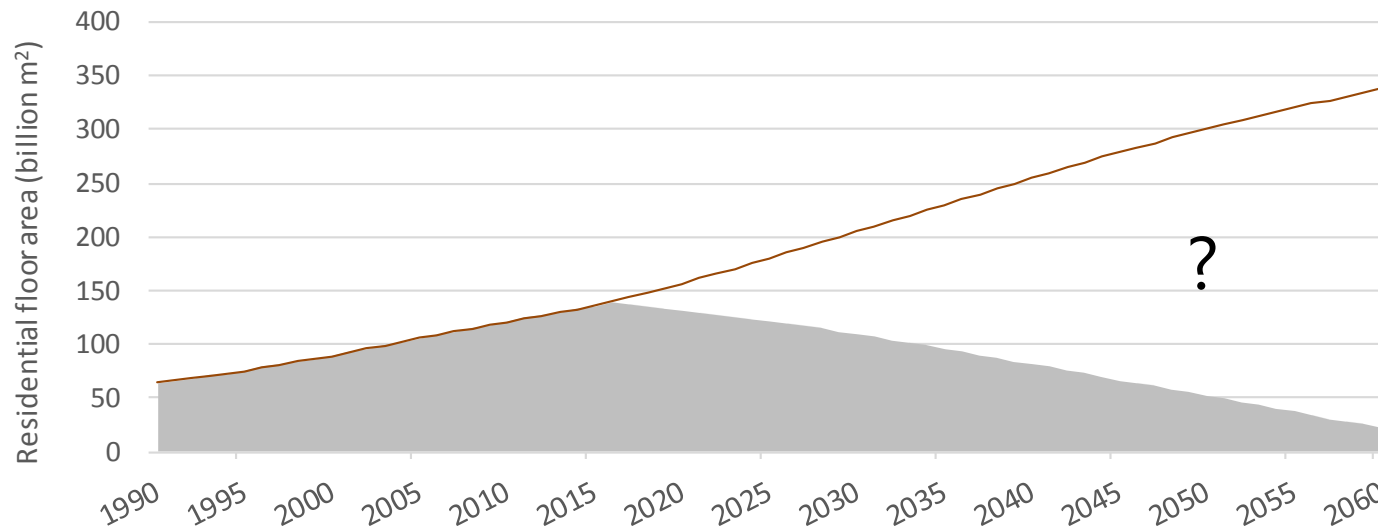
**Energy efficiency can save 1750 EJ cumulatively to 2060,  
14 times the energy consumed by buildings in 2017.**





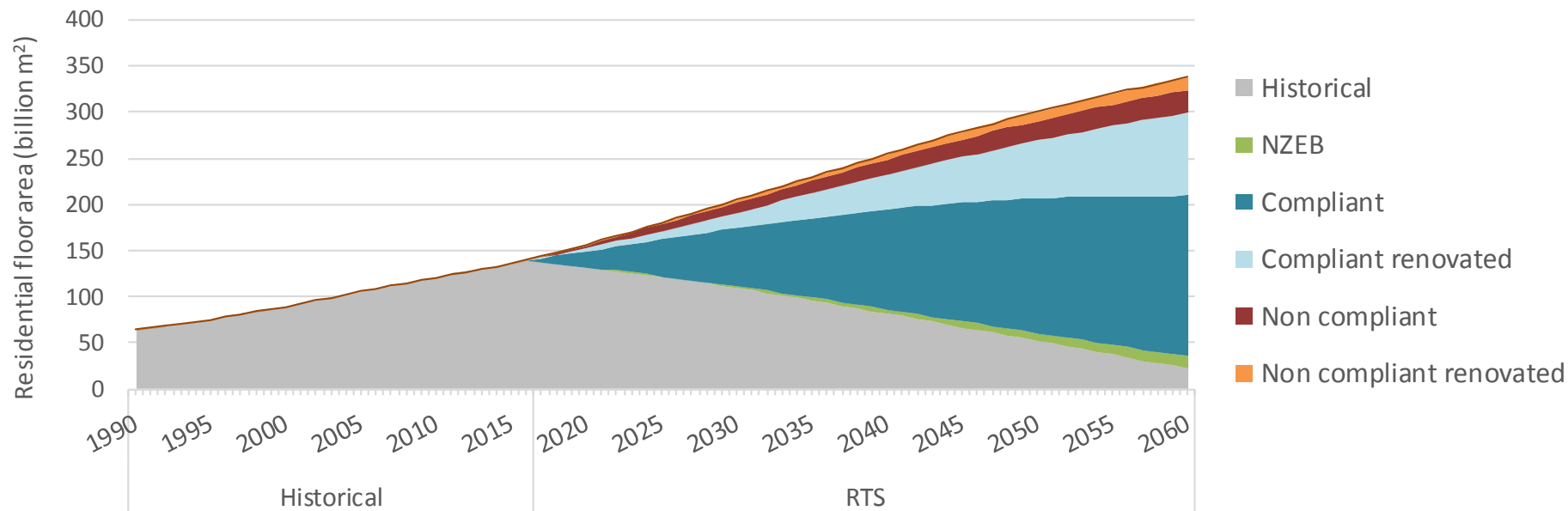
**More than 50% of cumulative CO<sub>2</sub> emissions reduction in buildings to 2060 under the B2DS results from shifts to low-carbon and high-performance technologies.**

## Global residential floor area growth and opportunity



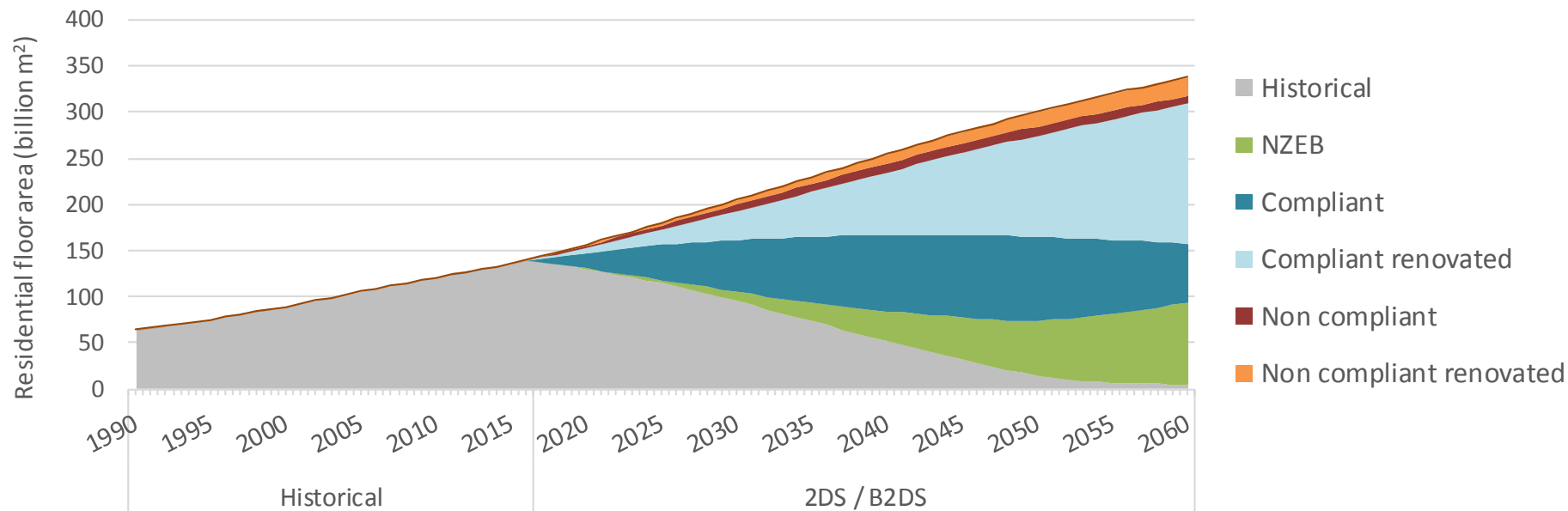
**Opportunity exists in both the historic stock and new building additions.**

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



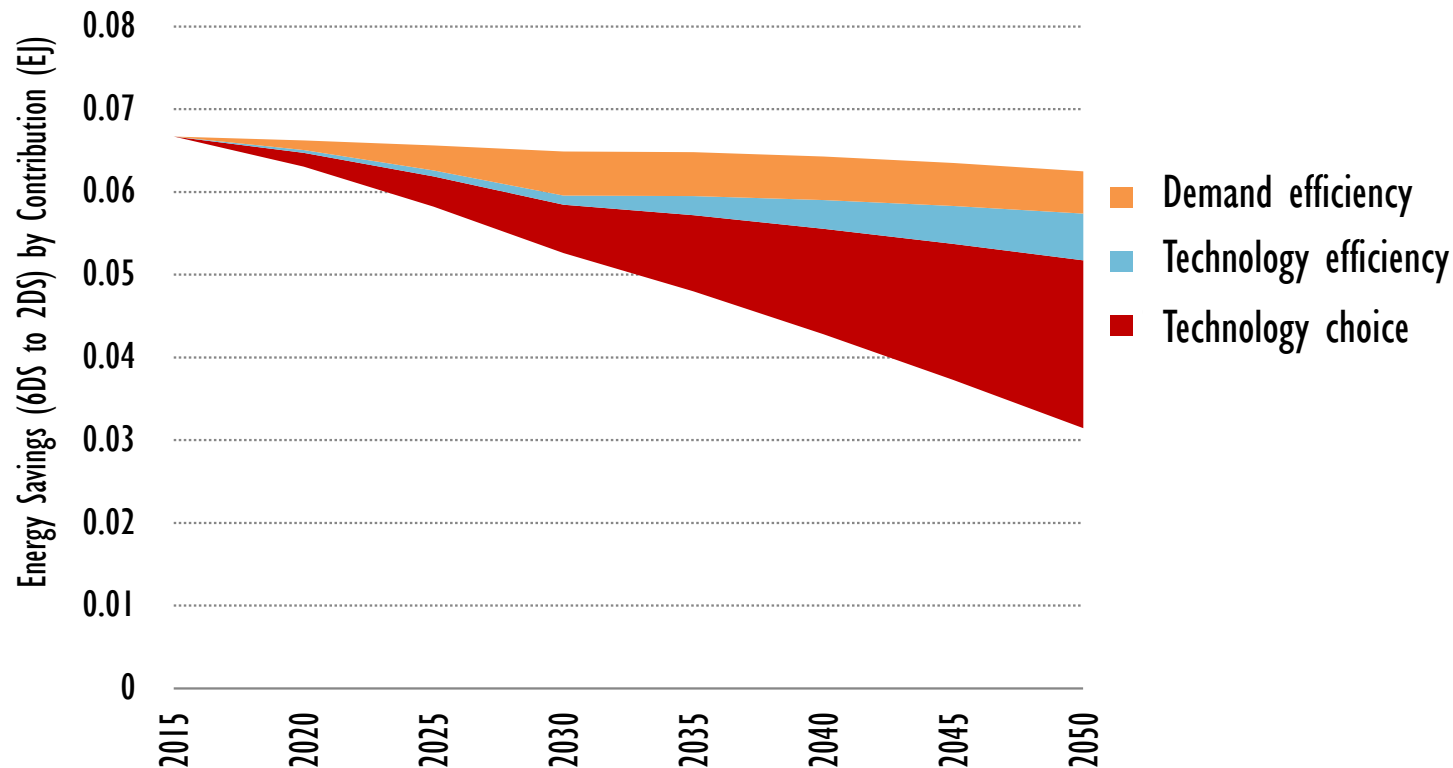
**With business as usual growth, we expect continued high levels of non-compliance in new construction and minimal retrofits of existing stock.**

## Global residential floor area growth and opportunity (more efficient)



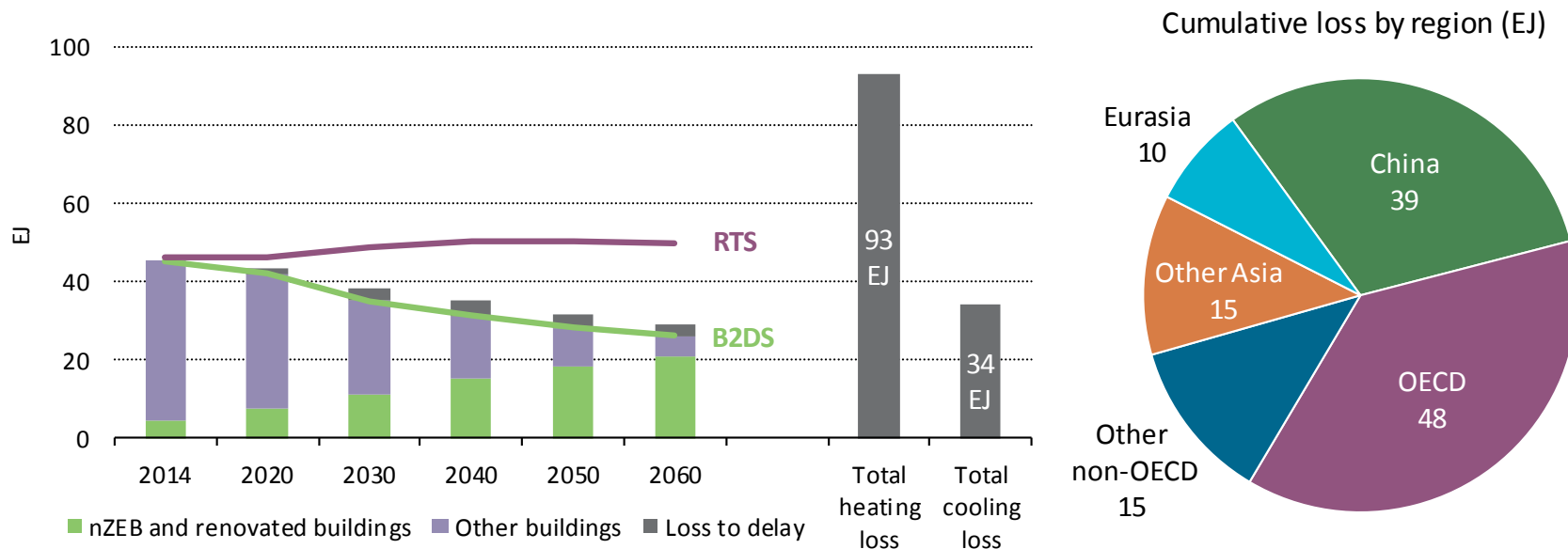
**In a below 2 degree scenarios, we expect less non-compliance and high levels of deep energy retrofits that can contribute to significant energy reductions.**

# What can drive potential: building technologies



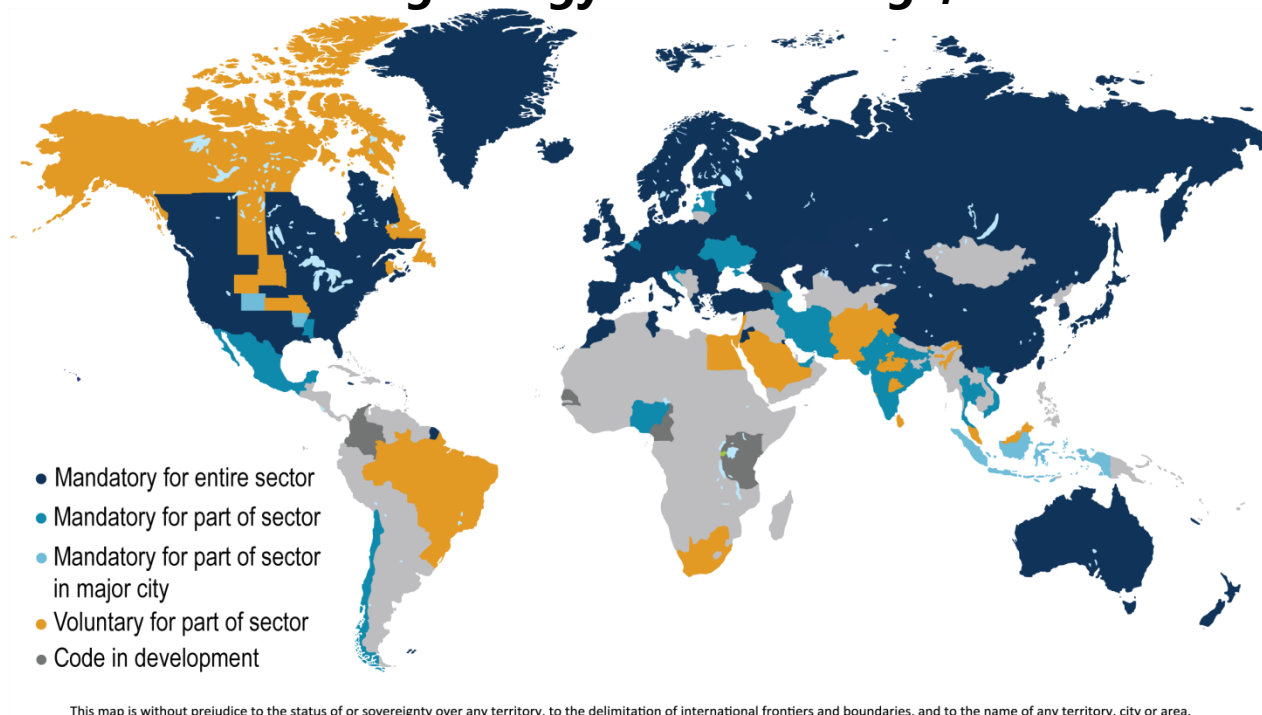
**There are multiple ways to increase the efficiency through building technologies**

## Consequences of a ten-year delay



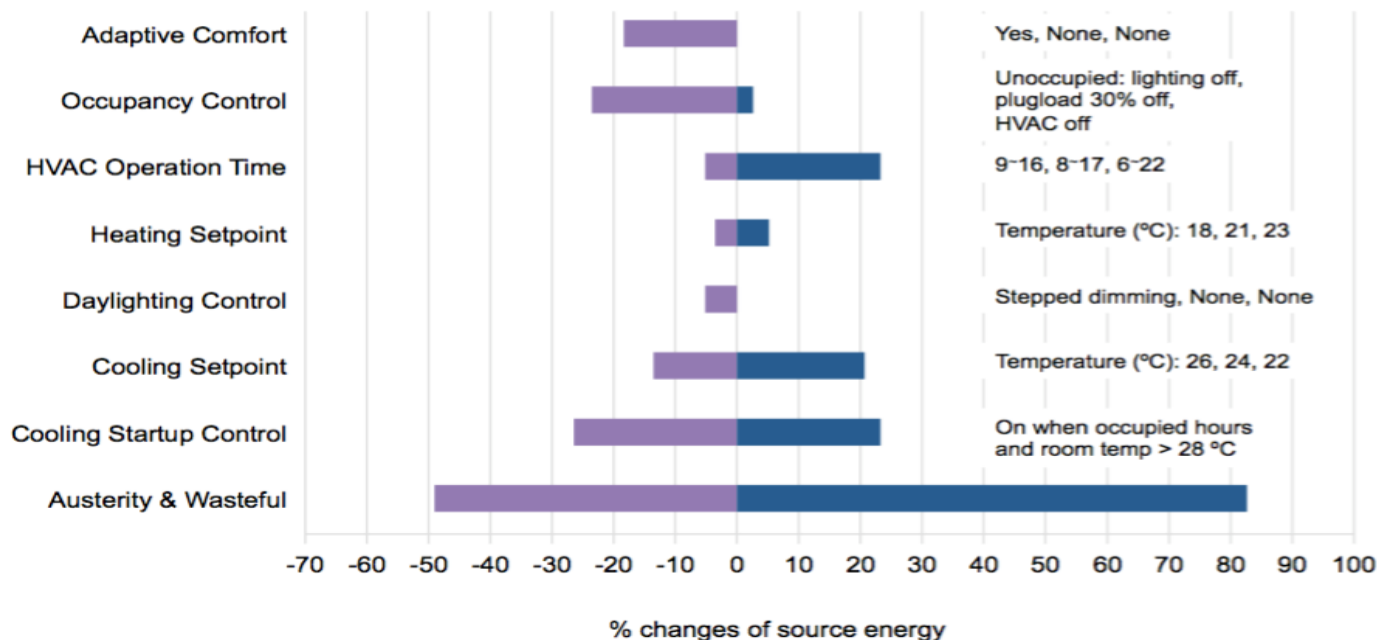
**Delaying implementation and enforcement of building envelope measures would result in the equivalent of three years of additional energy consumption for heating and cooling in the buildings sector.**

## 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

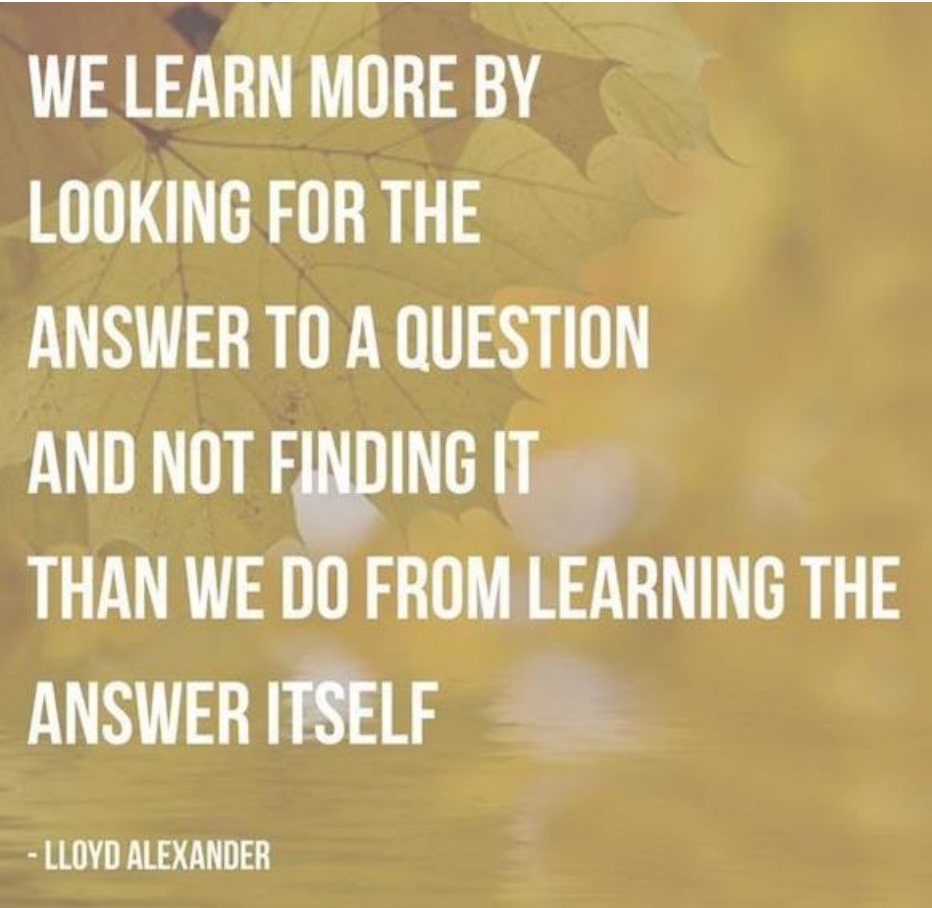
Data

Modelling



## Asking some questions...

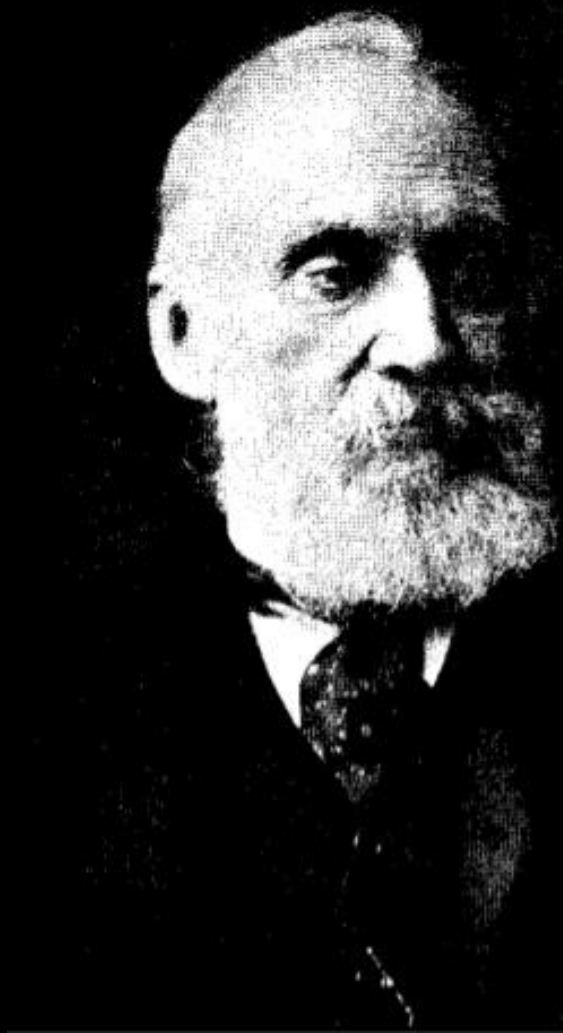
- Why is it important to know the potential?
- What is energy efficiency potential in buildings?
- How big is it?
- How do I estimate it?
- What are the challenges?

A quote by Lloyd Alexander overlaid on a background of autumn leaves. The text is in white, bold, uppercase letters. The background is a close-up of yellow and orange leaves, with some leaves in sharp focus and others blurred.

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

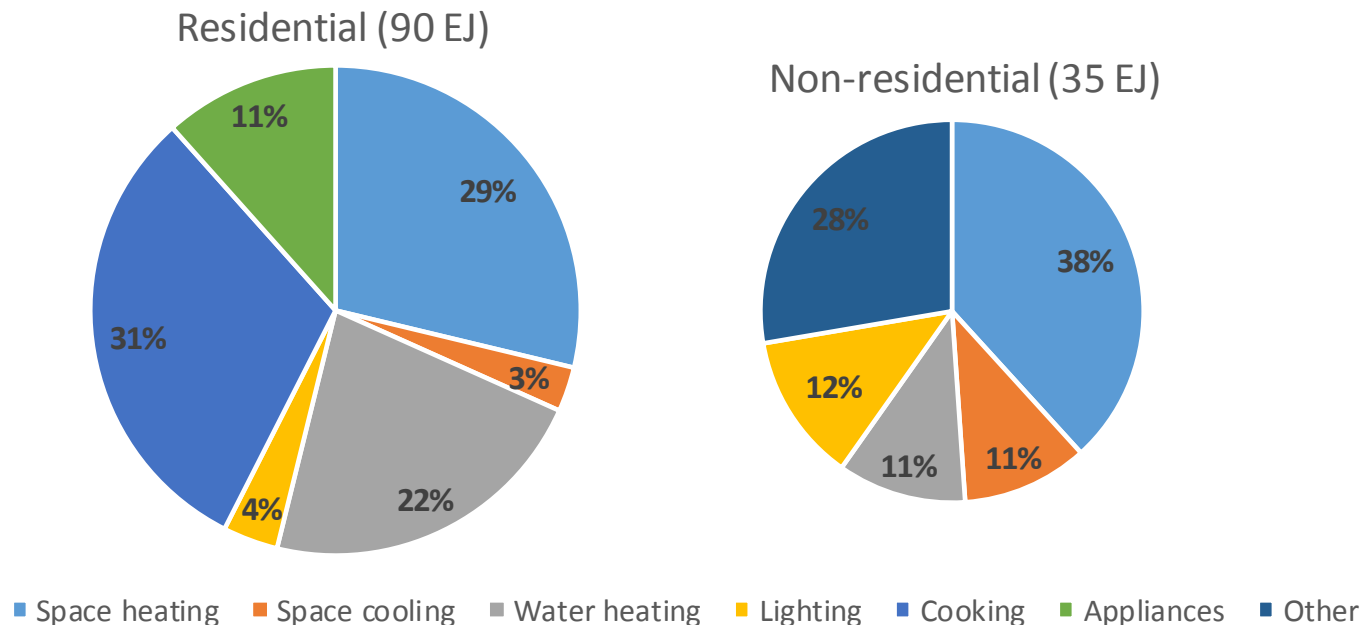


If You Can't  
Measure It,  
You Can't  
Improve It

*(William Thomson, Lord Kelvin)*

# How do I calculate potential: data

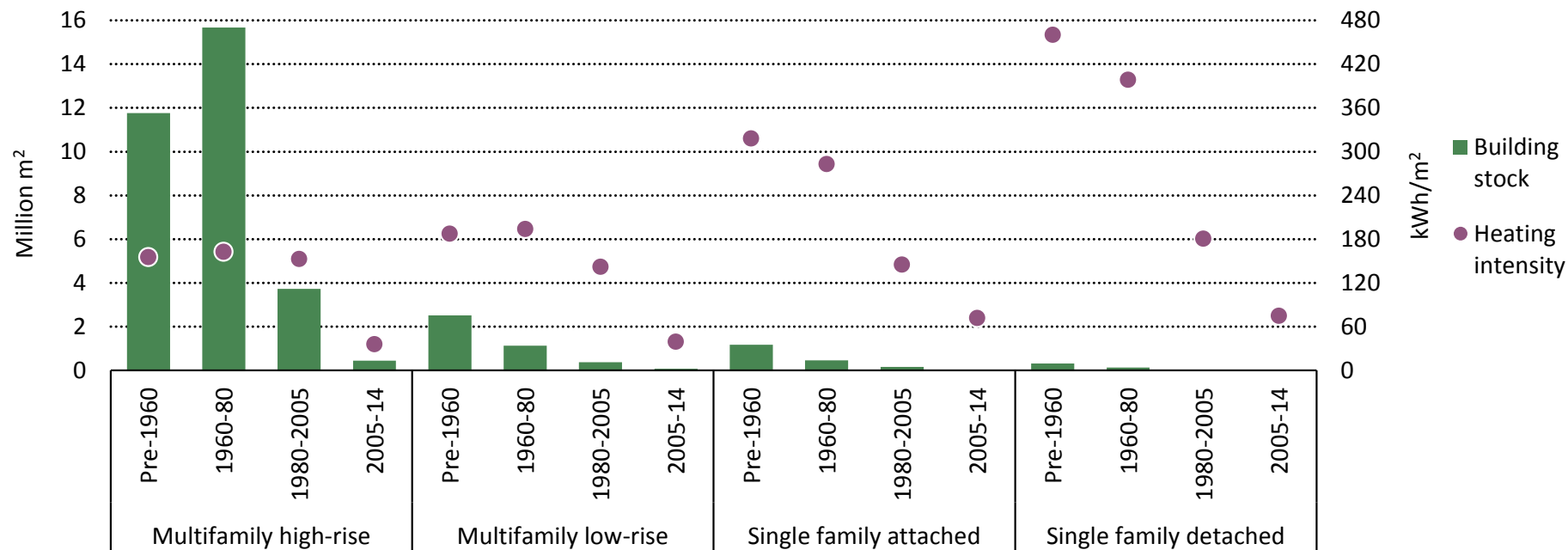
**Start with the existing data (as shown in Session 1 and discussed in detail in Session 9)**



**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

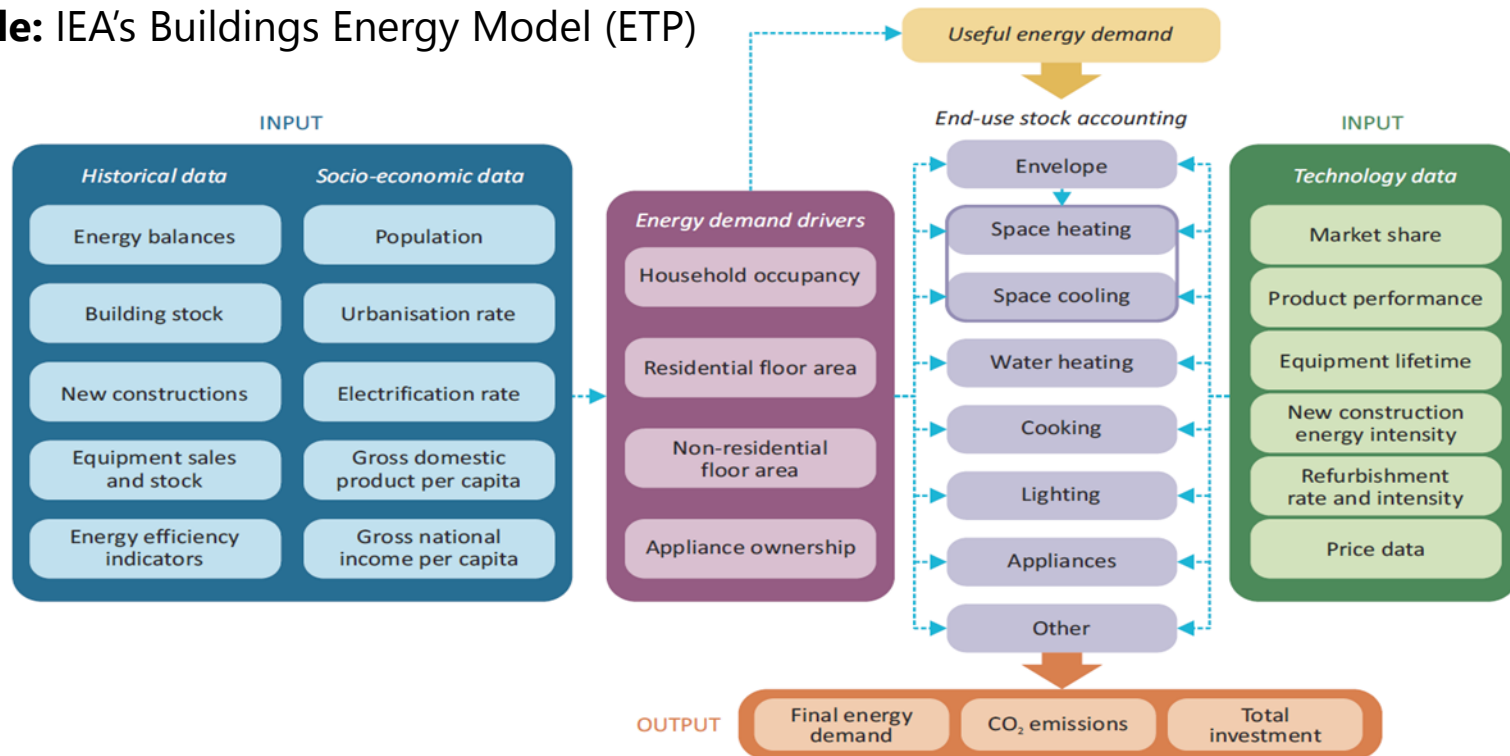
Web Resource

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

- Do you have data on energy consumed in residential buildings vs. non-residential?
- Do you have data on the overall floor area stock, and annual new additions to the stock?
- What portion of building energy is used in urban areas vs rural areas?
- Do you have an building sector energy model?





[www.iea.org](http://www.iea.org)

