

## Annex 61 – Technology Day and Experts Workshop



### Energy Efficient Building Envelopes Deep Energy Renovation Policy

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21 September 2014  
Tallinn, Estonia



**Technology Roadmap**  
Energy efficient building envelopes



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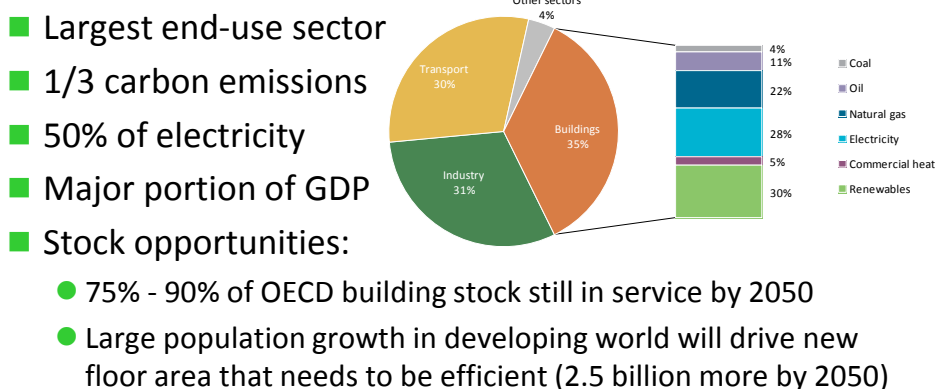


## Overview

- Introduction – *Transition to Sustainable Technology: Opportunities and Strategy to 2050*
- Energy Efficient Building Envelope Technology Roadmap
- Deep Energy Renovation Strategy and Approach – Integration with Systems
- Data Needs to Drive Policy – Participation with IEA Activities

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## Importance of Buildings Sector

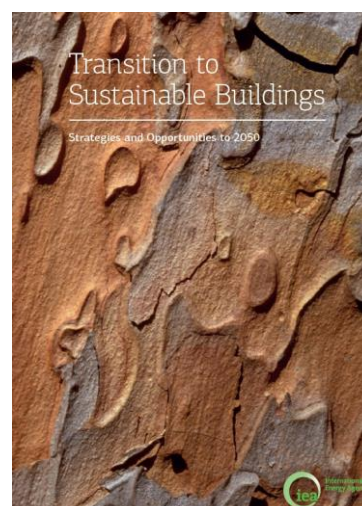


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## Transition to Sustainable Buildings: Strategies and Opportunities to 2050



- The overall ETP strategy for buildings
- Global and regional analysis, energy savings and emissions reduction forecasts
- Technical opportunities and recommendations: envelope; heating and cooling; appliances, lighting and cooking
- Policies to transform buildings



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# Technology Roadmaps & Policy Pathways

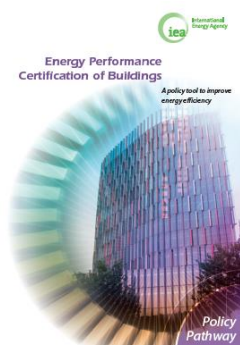


## ■ Technology Roadmaps



Technology Roadmap  
Energy-efficient Buildings: Heating and Cooling Equipment

Technology Roadmap  
Solar Heating and Cooling



## ■ Policy Pathways

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# Technology Roadmap Energy Efficient Building Envelopes



- Construction transformation strategy
- Provides technical, economic and strategic framework
- Assessment of high priority areas for 12 regions of the world
- Policy criteria and evaluation



Technology Roadmap  
Energy efficient building envelopes

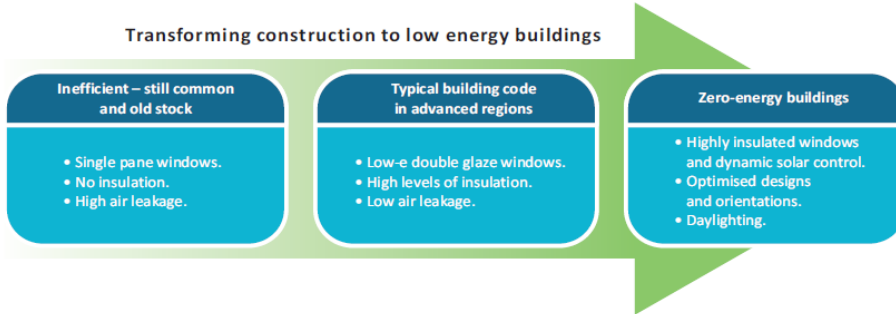


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# Transformation to Low-Energy Buildings



## Transforming construction to low energy buildings



**KEY POINT:** the world needs to shift from very old buildings to modern buildings, and then to low-energy or zero-energy buildings.

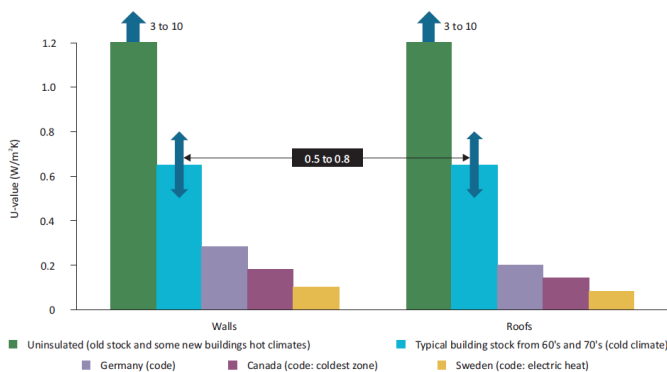
## First Step – reduce the need for heating and cooling!!

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## Insulation Opportunity



- Very stringent U-values for electric resistance heaters in Sweden, and Canada's coldest climate zone
- IEA recommending goal for average wall and roof U-values  $\leq 0.15$  W/m<sup>2</sup>K cold climate,  $\leq 0.35$  W/m<sup>2</sup>K hot climate based on LCC



Source: Adapted from IEA (2013a), "Transition to Sustainable Buildings: Strategies and Opportunities to 2050", Organisation for Economic Co-operation and Development (OECD) Publishing, Paris.

**KEY POINT:** levels of insulation vary widely for the existing stock of buildings, as well as for new construction.

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## Validated Air Sealing



- Validated air sealing is a critical measure for building codes and renovation
- Majority of energy performance certificates do not require validation
- More research needed to offer more affordable testing and solutions (mostly for developing markets)



Source: Oak Ridge National Laboratory

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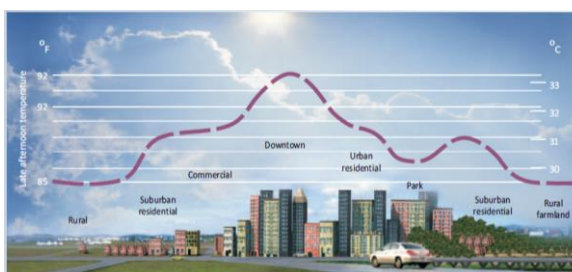
## Reflective Roof Opportunity



Table 3: Performance characteristics and energy-savings potential for reflective roofs

	<i>SR of a dark roof</i>	<i>SR of a white roof</i>	<i>SR of a cool-coloured roof</i>	<i>Roof energy-savings potential (with high level of insulation)</i>	<i>Roof energy-savings potential (with low level of insulation)</i>
Roof performance characteristics	SR 5 (black) to SR 20 (grey)	SR 60 (soiled) to SR 80 (clean)	SR 25 (darker colour) to SR 50 (lighter colour)	13%	25%

Note: High insulation refers to a U value of 0.29 W/m<sup>2</sup>K, and low level of insulation has a U value of 0.51 W/m<sup>2</sup>K or higher.

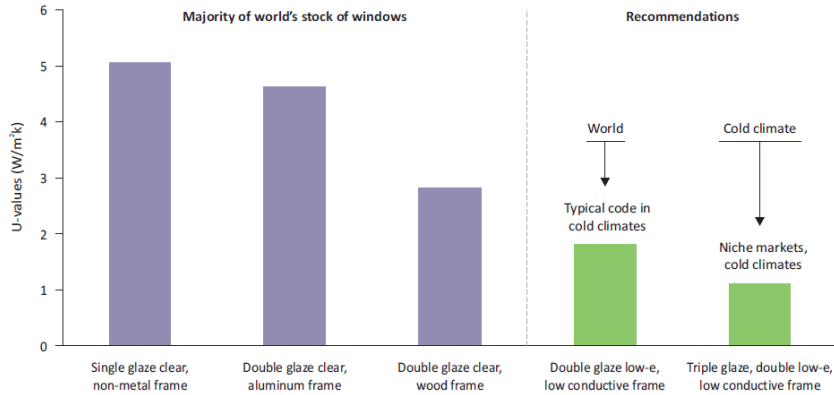


Source: LBNL, Heat Island Group

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# Windows Market/Opportunity

Figure 3: Most common types of windows in service and being sold today

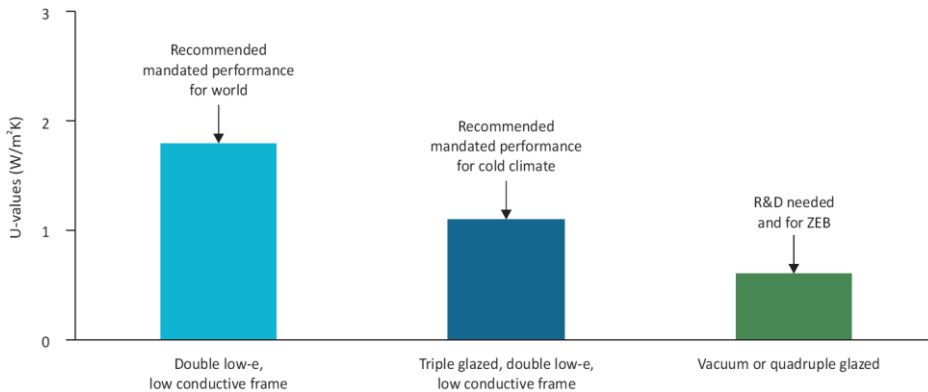


Note: U-values presented in this roadmap represent whole-window performance unless noted in accordance with ISO 15099, thus an ISO 10077 standard of 1.0 W/m<sup>2</sup>K is roughly equal to 1.1 W/m<sup>2</sup>K per ISO 15099.

**KEY POINT:** *the majority of the world's installed windows can be significantly improved and more work is needed to ensure that new sales meet more stringent performance criteria.*

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# Window Requirements/ R&D



High or low solar heat gain based on climate!

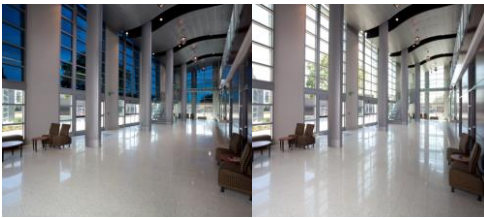
U-value in accordance with ISO 15099, most advanced EU windows are rated 10% to 15% more favourably than they should be.

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## Dynamic solar control – more R&D needed



- Lower cost, more economic viable dynamic exterior shading for global markets (lower energy prices)
- Dynamic glazings – large investment recently, on cusp of market viability for non-niche applications



Source: Roadmap, Sage Electrochromics



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## Assessment of Advanced Envelope Components



Market maturity/saturation	ASEAN	Brazil	China	European Union	India	Japan/Korea	Mexico	Middle East	Australia/Zealand	Russia	South Africa	United States/Canada
Double-glazed low-e glass	●	▲	▲	★	▲	●	●	▲	●	●	●	★
Window films	▲	▲	▲	●	▲	●	▲	▲	●	▲	▲	●
Window attachments (e.g. shutters, shades, storm panel)	●	▲	●	★	▲	●	▲	●	●	▲	●	●
Highly insulating windows (e.g. triple-glazed)		▲	▲	●		▲		▲	▲	▲	▲	▲
Typical insulation	★	●	★	★	●	★	●	★	★	★	●	★
Exterior insulation	●	▲	●	★	●	●	▲	●		▲	▲	★
Advanced insulation (e.g. aerogel, VIPs)				▲		▲				▲	▲	▲
Air sealing	●	▲	▲	★	▲	●		▲	▲	▲		●
Cool roofs	▲	▲	▲	●	▲	▲	▲	▲	▲			★
BIPV/advanced roofs	▲	▲		▲	▲	▲			▲	▲	▲	▲

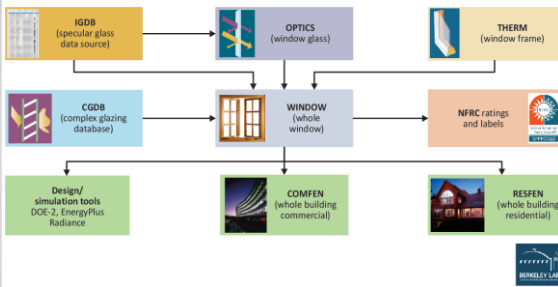
★ Mature market ● Established market ▲ Initial market

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# Performance Research: Essential in Developing Economies – Global Priority



Thermal Chamber, Source: Fraunhofer, IBP



Window Simulation Tools, Source: LBNL

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# Performance research assessment



Table 8: Building envelope material test, rating and labelling assessment

Level of test and labelling infrastructure	ASEAN	Brazil	China	European Union	India	Japan/Korea	Mexico	Middle East	Australia/New Zealand	Russia	South Africa	United States/Canada
Window test protocols	●	▲	●	★	▲	●	●	▲	●	★	●	★
Window labels	●	▲	▲	▲	▲	●		▲	●	▲		●
Window attachment test protocols	●			★		▲		●	▲	▲		▲
Window attachment labels	▲			●		▲		●		▲		▲
Insulation test protocols and certificates	●	▲	●	★	●	●	●	●	★	★	●	★
Air sealing validation testing	●			★	▲	●		●	▲	▲		●
Cool roofs aged ratings and certificates	▲	▲	▲	▲	▲	▲	▲				▲	★
Moisture evaluation of envelopes			▲	★	▲	●		▲	▲			★

★ Mature ● Established ▲ Initiating

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## Criteria for Policy Assessments, IEA Perspective



Policies	ASEAN	Brazil	China	European Union	India	Japan/Korea	Mexico	Middle East	Australia/New Zealand	Russia	South Africa	United States/Canada
Governance	L	M	H	H	M	M	M	L	M	L	M	M
Energy prices	L	M	M	H	M	H	L	L	M	L	M	M
Infrastructure and human capacity	M	L	M	H	M	H	M	L	M	M	M	H
Commodity of efficient materials	L	M	H	H	M	H	M	L	M	M	L	H
Voluntary programmes	L	L	L	M	L	L	L	L	L	L	L	L
Mandatory building codes	L	L	M	H	L	M	M	L	M	M	M	H

Note: H: high, M: medium, L: low

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## Deep Energy Renovation Approach and Strategy



- Require stringent component specifications during replacement (much more often than systems level approach)
- Develop system level criteria (e.g. >50% savings or not more than 60 kwh/m<sup>2</sup>/yr (GBPN definition))
- Only provide financial incentives (whole building and/or components) for very high performance
- Move market to adopt deep energy renovation as part of normal renovation (currently ~1% per year in EU but level may be higher if buildings are refurbished every 30 to 40 years)

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## Major Paradigm Shift Required to Upgrade Building Stock by 2050



- 1) Document and replicate cost effective deep energy renovation as part of normal business activity (current renovation) – **Should be highest priority within OECD and we have a lot of work to do!!!**
- 2) Establish business case for buildings not currently planned for renovation – challenging goal and potentially not life-cycle-cost neutral (establishing real value for non-energy benefits may be essential)
- 3) Establish mitigation cost for early renovation – would likely require carbon trading and be a lower cost option compared to other solutions such as carbon capture and storage

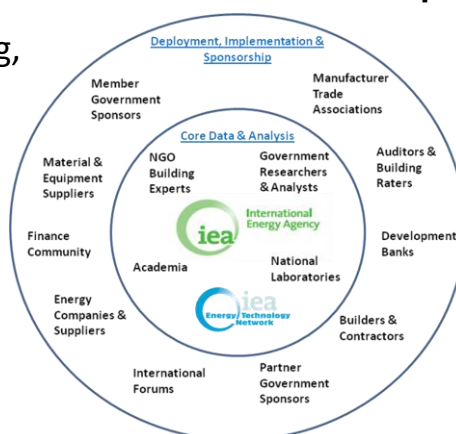
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## Working with the IEA



- Collaboration on country, regional and global modelling, and data sets
- Participation in specific projects (e.g. extensive data and metrics to drive policy, transforming construction implementation plan)
- Attending and active participation at workshops (Nov 12<sup>th</sup>/13<sup>th</sup> in Paris)

### Framework for Partnership



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## Tracking Progress – Data to Drive Policy



- Much more data is needed  
(e.g. new technology adoption rates, market share of zero-energy buildings, energy intensity of stock and most advanced buildings by end-use/building type, district heating and CHP, etc)
- More specific performance criteria needed even for most advanced regions  
(e.g. EU specifications for renovation in public buildings, definition of near zero energy buildings by type and climate, etc)
- IEA initiating improved collaborations

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## Deep Energy Renovation Data Requirements



- Capitol cost/performance curves for specific building types in regional markets
  - System level packages including technology components, installed cost, and savings potential indexed to climate
  - Component replacements, price premiums and savings potential indexed to climate
- Work with investment community to help derive required metrics for action and project approval
- Derive typical energy saving benefits, but also multiple benefits beyond efficiency (new IEA report released, 9 Sept 2014)

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## Recent IEA Outreach



- **May/June 2014 Webinar Series**
  - Webinar 1 - Building's Programmatic Priorities and ETP 2014 (Building Related Results)
  - Webinar 2 - Capacity Building and Construction Transformation in Emerging Economies
  - Webinar 3 - IEA's Building Activities/Partnership - Project Plans for Discussion
  - Webinar 4 - IEA Building Modelling and Data Review
  - <http://www.iea.org/topics/energyefficiency/subtopics/sustainablebuildings/>
- **Sustainable Buildings Workshop, IEA, Paris**
  - November 12<sup>th</sup> and 13<sup>th</sup>
  - <http://www.iea.org/workshop/iea-sustainable-buildings-workshop12-13-nov.html>
  - Registration <https://fr.surveymonkey.com/s/6NV27NS>

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### **Download Envelope Roadmap - free**

<http://www.iea.org/publications/freepublications/publication/name,45205,en.html>

### **Download Building Code Policy Pathway – free**

[http://www.iea.org/publications/freepublications/publication/PP7\\_Building\\_Codes\\_2013\\_WEB.pdf](http://www.iea.org/publications/freepublications/publication/PP7_Building_Codes_2013_WEB.pdf)

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