Importance of Buildings Sector

- Largest end-use sector
- 1/3 carbon emissions
- 50% of electricity
- Major portion of GDP

Opportunities/challenges:
- 75% - 90% of OECD building stock still in service by 2050
- Large population growth in developing world will drive new floor area that needs to be efficient (2.5 billion more by 2050)
Ukraine Building’s Energy Balance (2012)

- Major dependence on gas for space and water heating

- Gas: 50%
- Oil/LGP: <1%
- Coal: 3%
- Biomass: 3%
- Commercial heat: 25%
- Electricity: 19%
- Oil/LGP: <1%
- Coal: 3%
- Biomass: 3%
- Commercial heat: 25%
- Electricity: 19%
Global Heating Impact

- Space heating is 30% globally of the buildings sector and with water heating up to 50%

Global space heating consumption and fuel shares in 2012 (exajoules)
Gas represents 35% of EU building’s fuel share, but around 60% of final energy gas consumption of the economy.
KEY IEA BUILDING PUBLICATIONS

Transition to Sustainable Buildings
Strategies and Opportunities to 2050
June 2013

Technology Roadmap
Energy efficient building envelopes
Dec 2013

Linking Heat and Electricity Systems
Co-generation and District Heating and Cooling
Solutions for a Clean Energy Future
April 2014
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
### Priority Recommendations

Note: Recommendations limited to top two for technology and policy, all items could be relevant for most countries. Red indicates immediate priority, while gold indicates second priority.

<table>
<thead>
<tr>
<th>Technology</th>
<th>ASEAN</th>
<th>Brazil</th>
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<td>Deep renovation of existing buildings</td>
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</table>
- Promote integrated policy packages
- Deep renovation critical for Ukraine
- Building codes critical in emerging markets
- Systems level performance supported by advanced components
Ukraine Establishing its Own Buildings Policies – Whole Building Label

- Energy Performance Certificates
- The “happy medium”
  - Many EU low quality, but high market uptake
  - United States high quality, very low market uptake
- Need to inspect property, measure air leakage, basic qualifications for rater
Many EU product labels need to be re-scaled: start with a “clean slate” and have real impact in the market place.

Some new EU country window labels have “A+” for what should be a “C”: define with future in mind (ZEB or energy positive windows).

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<tr>
<th>EU</th>
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<th>Example for Ukraine Criteria</th>
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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
Transformation to Low-Energy Buildings

Transforming construction to low energy buildings

Inefficient – still common and old stock
- Single pane windows.
- No insulation.
- High air leakage.

Typical building code in advanced regions
- Low-e double glaze windows.
- High levels of insulation.
- Low air leakage.

Zero-energy buildings
- Highly insulated windows and dynamic solar control.
- Optimised designs and orientations.
- Daylighting.

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!!
Example in Envelope Roadmap: Systems Approach – Envelope and Heat Pump

- Very poor existing building and equipment example but represents core life cycle cost economic analysis.

LCC analysis of efficiency options

- Base case
- Integrated (no reduction in heating equipment)
- Heating only
- Envelope only
- Integrated with smaller heating equipment

Energy savings (%) vs. LCC (USD)
Key Strategies for Ukraine Buildings

- **Immediate solutions to reduce heating**
  - Weatherisation, energy management, sub-metering, etc

- **Pursue deep energy renovation**
  - Motivate market through public building renovation
  - Incentives for high performance components and large systems improvements (> at least 50% heat demand reduction)
  - Development banks need to look at aggregated building sector the same as large energy supply projects

- **Key infrastructure outcome**
  - Long lasting human capacity development
  - Mature high performance commodity technology options
  - Manufacturing and construction job creation in lieu of energy import and more supply extraction
Validated air sealing is a critical measure for building codes and renovation.

Testing of large multi-family buildings can be expensive – possible to institute sampling and workmanship criteria to reduce cost.

More research needed to offer more affordable testing but many low cost and simple solutions exist today.

Source: Oak Ridge National Laboratory
Air Sealing – Immediate and Cost Effective

- Air sealing is very important
  - Typically 10% to 30% heat reduction
- Performance can be verified
  - Infrared camera, air leakage, statistical sampling, etc
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/m²K is roughly equal to 1.1 W/m²K 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.
What is Low-e (low emissivity) Glass?

- Transparent metal coatings that reflect radiant heat (long wave radiation)
- Often combined with solar selective coatings that reflect visible light and near-infrared light (heat we feel)
- In winter, low-e glass reflects heat back into the building and in summer reflects heat back outside from the sun
- Immediate retrofit low-e storm panels and low-e window films when window replacement is not possible

What is the Ukraine current market share of low-e?
- Very stringent U-values in coldest climate zone
- IEA recommending goal for average wall and roof U-values ≤ 0.15 W/m²K cold climate, ≤ 0.35 W/m²K hot climate based on LCC


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

- Best approach to reduce thermal shorts
- Part of “stucco” types of systems
- Applicable to all buildings, new/existing, commercial/residential

Before

After

Source: Sto Corporation
Construction material energy performance ratings are essential

Ukraine can pursue collaborative effort including government, academia, and industry – supports building codes and can drive market for commodity priced EE product availability
Criteria for Policy Self-Assessments to Promote Efficient Construction

- Ukraine can use IEA criteria to conduct self-evaluation among policy, technology, industry and academia experts
- If progress is not made, EE construction will be stagnant

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Note: H: high, M: medium, L: low
Pending Report - Joint IEA/IPEEC Study on Building Energy Performance Metrics

- Focused on G20 and MEF countries
- Example with Ukraine, final building energy consumption per capita (kwh/person)
- Ukraine is much lower but growing!
- Increased GDP drives larger spaces, more comfort, appliances, electronics, etc
Next Steps

- Significant investment needed for immediate and longer term comprehensive renovations
- Building energy efficiency and advanced district heating optimised for total system benefits
- Move towards local manufacturing and construction jobs instead of energy supply extraction and import (a core Ukraine and EU strategy)
Contact Data

International Energy Agency
9, rue de la Federation
757 Paris Cedex 15, France

P Marc LaFrance, CEM
Energy Analyst Buildings Sector Lead, Energy Technology Division
marc.lafrance@iea.org, +33 (0)1 40 57 67 38

Buildings – www.iea.org/topics/energyefficiency/subtopics/sustainablebuildings/