

Building Sector Opportunities: Analysis to Drive Policy & Technology

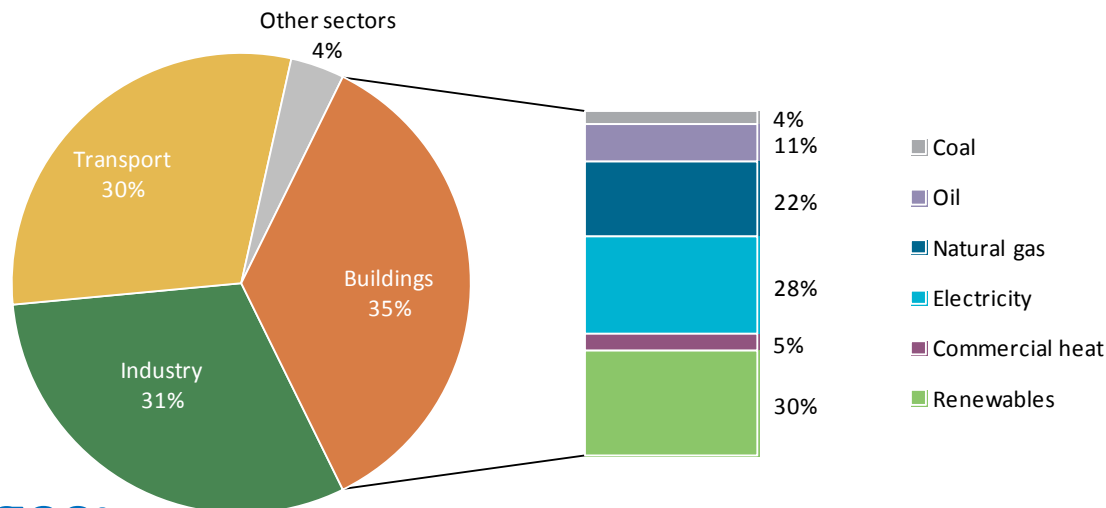
IEA Sustainable Buildings Workshop

Marc LaFrance, IEA

Paris, 12 November 2014

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)

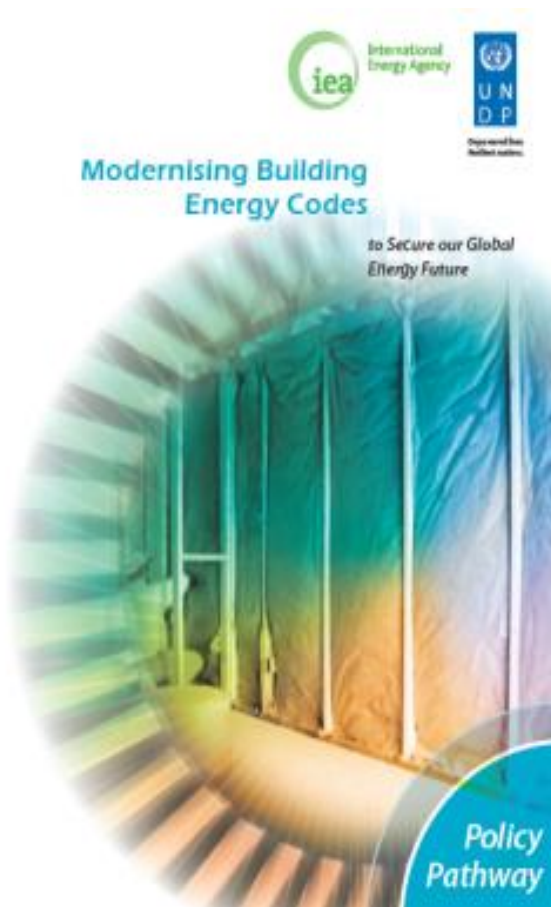


Technology Roadmap

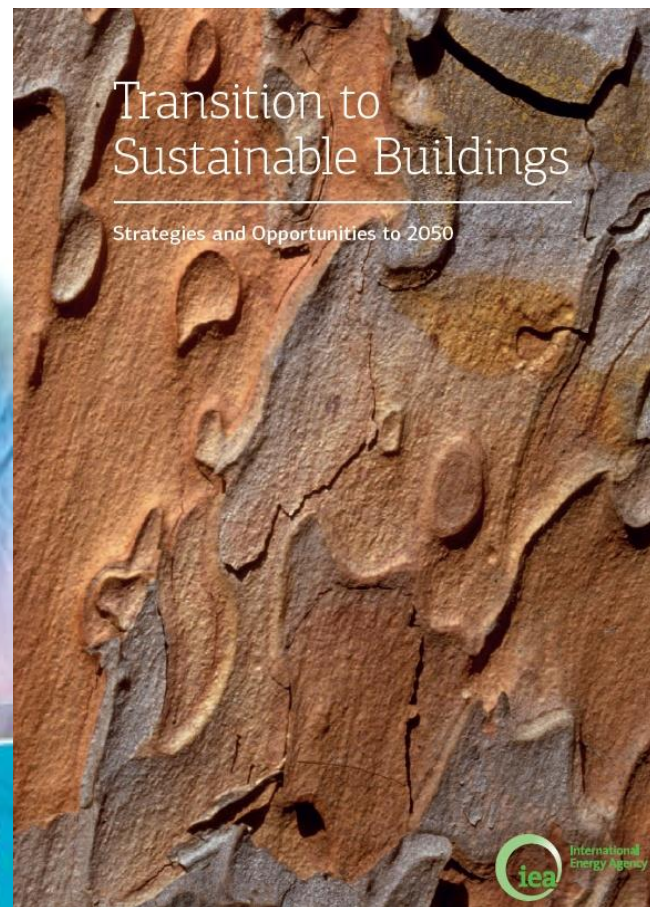
Energy efficient building envelopes



Dec 2013



Aug 2013



Jun 2013

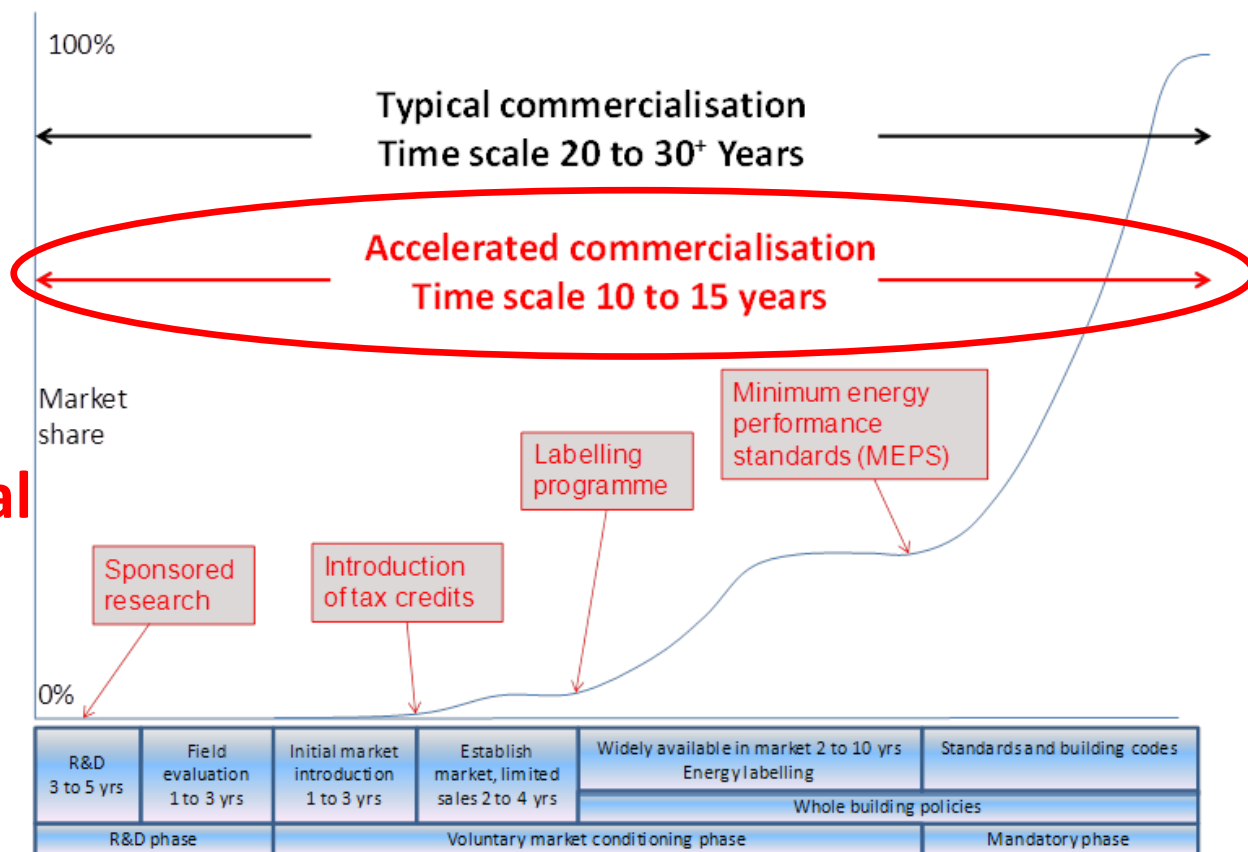
Priority Recommendations

| | ASEAN | Brazil | China | European Union | India | Mexico | Russia | South Africa | United States |
|---|-------|--------|-------|----------------|-------|--------|--------|--------------|---------------|
| Technology | | | | | | | | | |
| Advanced envelope – cold climate | | | Red | Gold | | | Red | | Red |
| Reduced cooling loads – hot climates | Gold | Gold | | | | Gold | | | |
| Heat pumps | | | Gold | Red | | | Gold | | Gold |
| Solar thermal | | Red | | | Gold | Red | | Red | |
| More efficient use of biomass | Red | | | | Red | | | Gold | |
| Policy | | | | | | | | | |
| Building codes with supporting infrastructure | Gold | Gold | Gold | | Red | Gold | Gold | Gold | |
| Appliance and equipment standard | Red | Red | Red | | Gold | Red | | Red | |
| Deep renovation of existing buildings | | | | Red | | | Red | | Red |
| Zero-energy new buildings | | | | Gold | | | | | Gold |

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.

Integrated Policies – Systems and Components

- Promote integrated policy packages
- Deep renovation critical in mature markets**
- Building codes critical in emerging markets**
- Systems level performance supported by advanced components



Latest Policy Recommendations (ETP 2014)

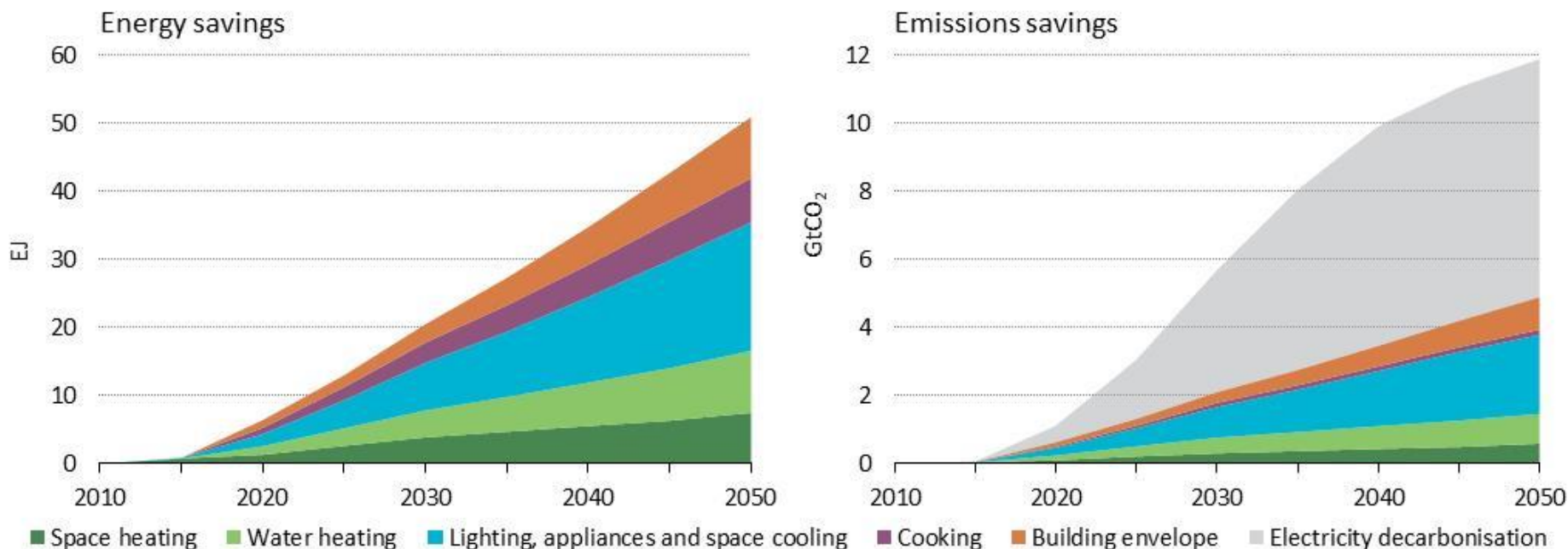
Table 1.1

Policy areas for near- and long-term action

| Policy action area | Near-term actions (through 2025) | Long-term actions (2025 to 2050) |
|--------------------------------------|---|---|
| Whole building systems | Promulgate enforceable building codes, striving for zero-energy buildings (ZEBs) in OECD. Implement policies to drive deep renovation to 2% per year or higher. | Promulgate enforceable building codes, striving for ZEBs all regions. |
| Building envelope | Promote very high performance envelopes. R&D: Highly insulating window (< 0.6 U-value watts per square metre per degree Kelvin [W/m^2K]) and super thin insulation. | Mandate minimum performance for world, double-glaze low-emissive windows ($U\text{-value} \leq 1.8 W/m^2K$); cold climate, highly insulating (≤ 1.1 U-value W/m^2K) with climate-appropriate solar heat gain coefficients. Passivehaus ¹¹ standard based on life-cycle cost. |
| Heating and cooling equipment | Greater promotion of heat-pump technology, with R&D for cold climates and gas thermal systems. Mandate use of gas condensing boilers. | Prohibit use of electric resistance heaters as main heating source. Regulations requiring heat pumps. Promotion/incentives for gas thermal heat pumps with $COP > 1.2$; mandate in some regions. |
| Water heating | Promotion/incentives for heat-pump water heaters and instantaneous gas condensing water heaters. R&D on low-cost solar thermal systems. | Mandate heat-pump water heaters with coefficient of performance of ≥ 1.5 . Mandate instantaneous gas condensing water heaters unless solar thermal systems are installed and intended to provide expected demand $\geq 75\%$ annual load. |
| Lighting | Ban all incandescent and halogen light bulbs, OECD. R&D and promotion of SSL and other innovated designs. | Ban all incandescent and halogen light bulbs, all countries. Performance criteria that require 50% of fixtures ≥ 100 lumens/watt. |
| Appliances and cooking | Implementation and active updating of minimum equipment standards. Promote efficient options and improved access to modern energy with least carbon footprint. | Establish performance metrics on total electricity use per square metre, with all loads considered. Incentives/high tariffs to promote progress and compliance. |

Note: this summary is not exhaustive and does not provide details required to support specific policies. For example, the goal for ZEBs and definitions for site-energy and renewable grid power are further described in the referenced publications.

ETP 2014 Savings



■ ETP 2014 ~50 EJ savings, up from ETP 2012 and Buildings Book (~40 EJ)

- Represents unprecedented policy implementation but not based on full technology potential (aggressive but achievable)
- Greater savings potential on renovation of existing stock could be pursued, especially to reduce heating loads

- **China Building Energy Consumption Report**
Joint project with Tsinghua University (1st Qtr 2015)
- **Macro Building Performance Metrics**
Collaboration with IPEEC on MEF Countries (2nd Qtr 2015)
- **Model improvements, integrated analysis and expanded capability**
Main workshop focus for ETP 2016
- **Transforming Construction Implementation Plan**
(possible new project)

IEA Global Buildings Model

31 Country/Regional Forecasts

Countries

| | | |
|---------|---------|----------------|
| Brazil | Germany | Mexico |
| Canada | Iceland | Norway |
| Chile | India | Russia |
| China | Israel | South Africa |
| Denmark | Italy | Sweden |
| Finland | Japan | United Kingdom |
| France | Korea | United States |

Will add Australia, Indonesia and New Zealand in 2015, possibly others.

Regions

| |
|---|
| ASEAN |
| Other Africa |
| Other developing Asia |
| Other Latin America |
| Other non-OECD Europe and Eurasia member non-member of the EU |
| Other non-OECD Europe and Eurasia member of the EU |
| Other OECD Asia Oceania |
| Other OECD Europe member of the EU |
| Other OECD Europe non-member of the EU |
| Middle East |

Excel Based Model – Output to Supply Times Model

■ Residential Module

- Floor area and households (Driver)
- Space heating
- Water heating
- Lighting
- Cooking
- Space cooling
- Appliances
 - Refrigerators & freezers
 - Washers & dryers
 - Televisions
 - Miscellaneous electricity

■ Services Module (commercial)

- Floor area (Driver)
- Space heating
- Water heating
- Lighting
- Space cooling
- Other

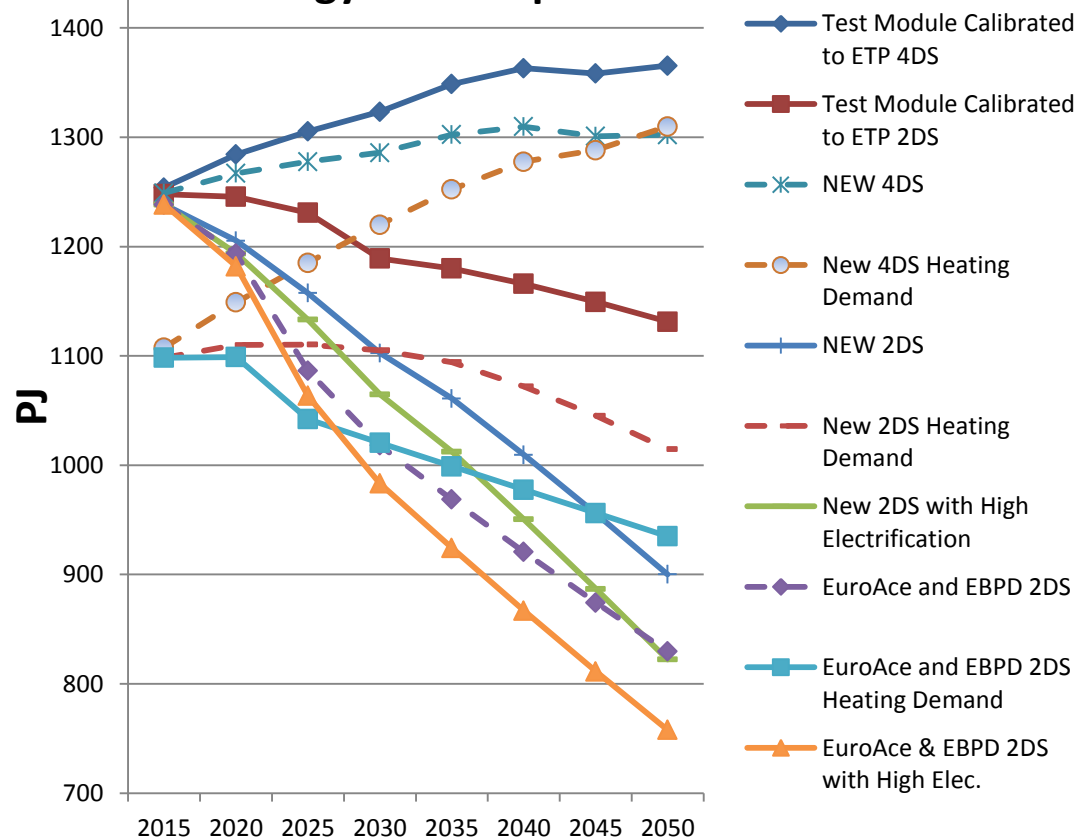
Model Improvements and Data for Policy

- **Macro Drivers – IEA/Tsinghua University Joint Project**
- **Expanded data sources – informal and formal partnerships**
- **Possible data beyond modelling to help drive policy – market share data for high priority components, testing, and system perspectives (e.g. Tracking Clean Energy Progress)**

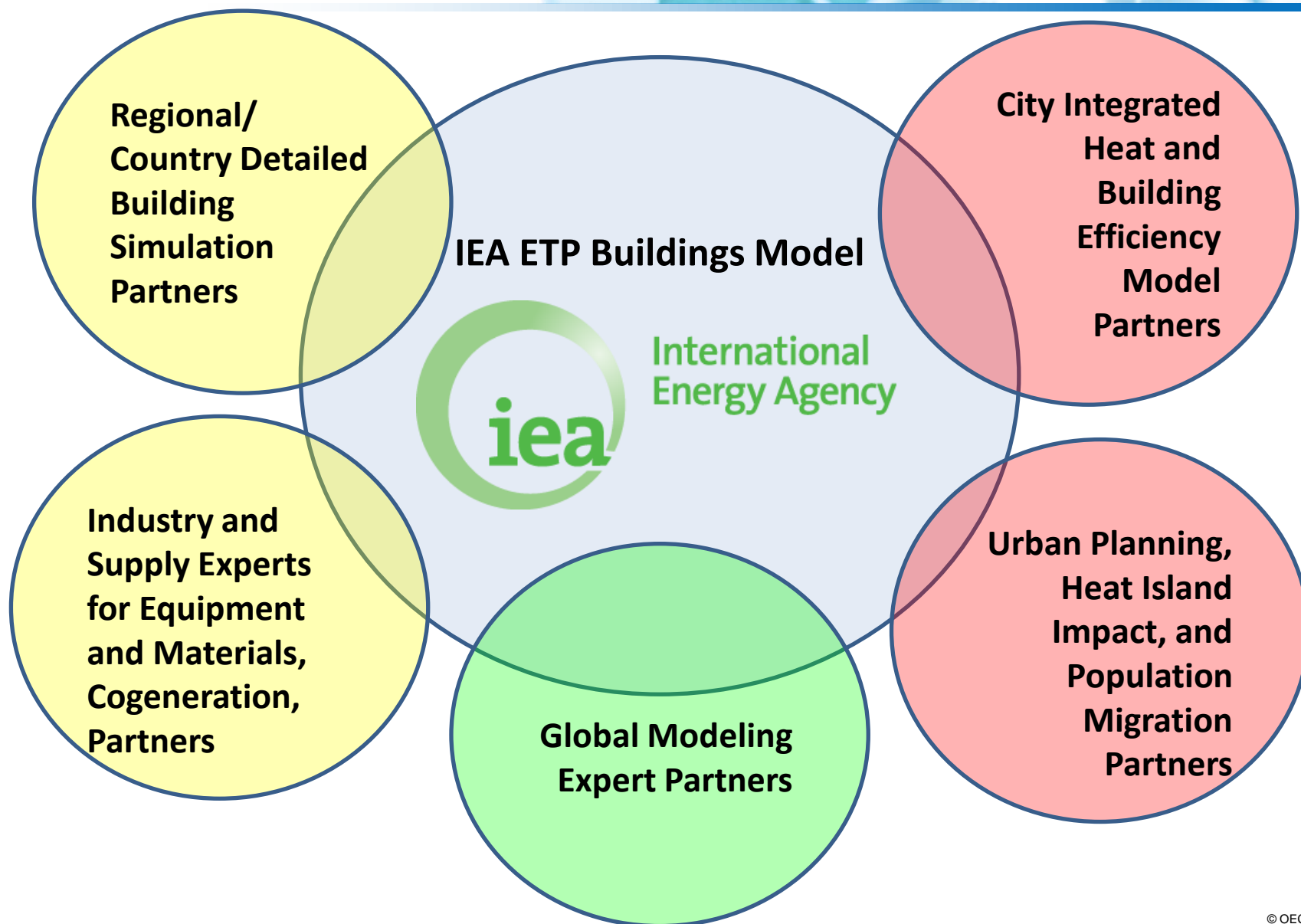
Expanded Model Capability will Require More Detailed Data

- Existing stock segmentation (vintage, configuration, intensity and saturation)
- New construction segmentation (saturation and intensity of code compliance, non-compliance, NZEB, etc)
- Simple average data possible for emerging markets

Sample "France" Residential Heating Energy Consumption and Demand



Flexible Model Framework with Limited Resources



Beyond Building Envelope and Equipment Efficiency

- **Urban Environment**

Difficult to harvest large renewable energy resources on buildings (PV and solar thermal)

- **Integration Analysis**

Pursue clean district heating resources along with low energy intensity buildings

- **Independent Analytical Framework for City Planners**

Possible joint annex (project) by several IEA Implementing Agreements (e.g. DHC (district heat), EBC (building efficiency), HPP (heat pumps), and ECES (storage))

Moving Forward – Expanding Collaboration

- High interest from a variety of partners
- Need to collaborate on data sources compatible with IEA requirements rather than raw data availability
- Sponsorship is also essential to build IEA capability –
thankful for 2014 support from French Government, ClimateWorks Foundation, and US DOE

Framework for Partnership



Concluding Remarks

- Grateful for today's workshop participation
- Looking forward to input on peer review details – material provided in advance and more detailed distribution to individuals as requested
- Expanded collaboration and sponsorship to drive policy analysis and implementation for energy efficient buildings

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Buildings Webinar Series (May/June 2014) and Materials from this Workshop

www.iea.org/workshops