Building Energy Efficiency

Opportunities for International Collaboration

A report of the
IPEEC Building Energy Efficiency Taskgroup
in response to a request by the
Major Economies Forum on Energy and Climate

May 2014

ipeec
International Partnership for **Energy Efficiency** Cooperation

Contents

Abbreviation List

BAU Business as usual
BEET Building Energy Efficiency Taskgroup
CEN European Committee for Standardisation
CLASP Collaborative Labeling and Appliance Standards Program
CO_2 Carbon dioxide
ECLAC Economic Commission for Latin America and the Caribbean
EDGE Excellence in Design for Greater Efficiencies
EJ Exajoules
EPBD Energy Performance in Buildings Directive
GBPN Global Buildings Performance Network
GDP Gross Domestic Product
GHG Greenhouse gas
HVAC Heating, Ventilation, Air Conditioning
IEA International Energy Agency
IPCC Intergovernmental Panel on Climate Change
IPEEC International Partnership for Energy Efficiency Cooperation
IPEEI Improving Policies through Energy Efficiency Indicators
ISO International Organisation for Standardization
IT Information technology
kWh Kilowatt-hours
kWh/m²/year Kilowatt-hours per metre squared per year
LBNL Lawrence Berkeley National Laboratory
MEDENER Mediterranean Association of National Agencies of Energy Conservation
MEF Major Economies Forum on Energy and Climate
MEPS Minimum energy performance standards
Mtoe Million tonnes of oil equivalent
SBCI Sustainable Buildings and Climate Initiative
SEAD Super-Efficient Equipment and Appliance Deployment
TWh Terawatt-hours
UNEP United Nations Environment Programme
4E Energy Efficient End-use Equipment Implementing Agreement of the IEA

Design by Sensical Design & Communication
Cover photo © iStock

1

Executive Summary

The building sector is the largest consumer of energy worldwide and is on a trajectory of increasing energy demand over time. Without new action to improve efficiency, energy use in the building sector is expected to rise 50% by 2050 from growth in the building stock and in energy-using devices and products (IEA, 2013; IPCC, 2014). Continued growth in building energy use will put greater pressure on energy supplies, drive up energy prices, require costly new energy infrastructure, and greatly increase emissions of heat-trapping greenhouse gases (GHGs).

Improved energy efficiency in buildings will enable the members of the Major Economies Forum on Energy and Climate (MEF) and other governments to curb energy consumption, allowing existing energy supplies to go further, avoiding costly infrastructure, and reducing GHG emissions. It is estimated that an annual energy savings of 40 exajoules (EJ)—equivalent to current energy use in Russia and India combined—could be realized in the building sector in 2050 through the wide deployment of best-available technologies and policies (IEA, 2013). Efficiency improvements in buildings also deliver benefits beyond direct energy savings and associated emission reductions: increased energy security; greater economic growth; social development; financial benefits through savings on electricity and fuels; and improvements in human health and well-being.

This report responds to the MEF leadership's request to the International Partnership for Energy Efficiency Cooperation (IPEEC) to support a MEF buildings initiative aimed at leveraging high level political will among the world's major economies to reduce emissions from and improve the resilience of the global building sector. Specifically, the MEF requested that IPEEC convene appropriate experts to (i) develop options for metrics to gauge progress in building energy performance and resilience; and (ii) identify key areas in the building efficiency sector that would benefit from additional international collaboration.

Based on inputs from participating MEF and IPEEC governments and nongovernmental experts in building energy efficiency (see process in Appendix A), this report identifies key areas for international collaboration in the building efficiency sector, while also underscoring the importance of an integrated approach to policy design, development, and implementation. It is recommended that MEF governments consider these key collaboration areas in the context of holistic building sector transformation policy.

Within each of the key areas, priority recommended actions are highlighted for consideration by MEF and IPEEC governments. These include both inherently collaborative activities as well as within-country activities that could benefit from additional international collaboration. National and regional governments are

ultimately responsible for implementing building energy policy according to national circumstances and hence not all governments are anticipated to participate in all of the collaboration areas below. However, where appropriate, international collaboration can play a critical role in supporting national and regional governments through the sharing of policy best practices, improving analytical capabilities, and providing other resources that accelerate and maximise the benefits of energy efficiency, increase the cost-effectiveness of implemented policies, and help bring new technologies to market.

Policy Collaboration Areas

Building codes/standards/regulations: Ambitious building energy codes are among the most cost-effective policy measures for delivering large-scale and long-term energy savings and GHG emission reductions. Building codes can lower the long-term operating costs of buildings, reduce peak electricity demand, create local employment, and improve the health and well-being of occupants. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Implement cost-effective building energy codes for all new construction and renovation
- Realize larger energy savings from building energy codes through improved code compliance activities and support for local enforcement agencies
- Encourage the transition to net zero energy buildings through exchange of experience and information.

Appliance and equipment standards and labels: Together governments can build on existing initiatives to accelerate progress on achieving the multiple benefits of improved appliance and equipment efficiency. International collaboration on appliance and equipment energy efficiency enables concerted action that can affect global markets, reduce barriers to trade, and accelerate the transition to a clean energy economy. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Revise, on a regular basis, minimum energy performance standards (MEPS) and associated compliance activities, together with complementary policies such as incentives and labels
- Accelerate the availability of energy efficient appliances and equipment through the provision of timely, regulation-ready international metrics, test protocols, and performance levels, supported by collaborative engagement
- Identify major end-use efficiency technology transformation opportunities and associated policy needs, supported by collaborative analysis.

Building rating, labelling, and disclosure: Knowing how well buildings are performing is important for making energy savings visible, promoting transparency in real-estate transactions, and increasing owners and renters' awareness of building energy use. Building energy rating, labelling, and disclosure policies can help overcome information barriers, increase transparency, and spur investment in energy efficiency. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Assess and communicate the energy savings and property valuation impacts of rating policies and schemes around the world, supported by collaborative analysis
- Extend building rating, labelling, and disclosure policies to cover more building types.

Building component standards and labels: Minimum energy performance standards (MEPS) and labelling can effectively increase the energy efficiency of building products. MEPS prevent inefficient products from entering the marketplace, while labelling improves awareness and uptake of energy efficient products. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Improve information availability and facilitate international trade of energy-saving building components through the harmonization of energy performance certifications and labels
- Develop and implement standards and labels for major energy-related building components, with an initial focus on insulation, ducting, windows, and other glazed areas.

Enabling Collaboration Areas

Data availability and quality: Access to high-quality data is needed to support effective building efficiency policy development and implementation. Significant differences in data quality, availability, and methodologies for generating energy and emissions baselines and benchmarking exist across countries. Such inconsistencies make it difficult to analyse the performance of building energy policies and measure progress toward policy goals. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Improve data consistency and comparability by developing common metrics
- Improve the measurement of progress and opportunities in building energy performance through increased collection, storage, analysis, and sharing of data, with an initial focus on upgrading information technology (IT) systems

- Assess and communicate the multiple energy, economic, environmental, and health benefits of energy efficiency, supported by sustained collaborative analysis.

Education and capacity building: Education and capacity building enable the policy areas listed above. Citizens and consumers must be made aware of the benefits of energy efficiency and this should be augmented with targeted training and accreditation of building professionals and trades people. Capacity building supports the growth in energy efficiency investments and the effectiveness of policies and programmes. Enabled by the international sharing of best practices and collaborative capacity building, countries could consider taking the following actions:

- Harness electronic media to enable low-cost delivery of education and capacity building programmes
- Make consumers and building professionals aware of energy efficiency opportunities, with collaborative support for education and communication activities
- Facilitate access to private capital for building efficiency through policy and collaborative engagement of financial and building efficiency communities.

While not listed as key collaboration areas, financing and incentives as well as building resilience were highlighted by a number of MEF and IPEEC governmental contributors. The multiple energy, economic, and environmental benefits of building efficiency were also underscored as an important policy driver and policy goal. Building energy policy should be designed to capture these benefits. Project contributors also stressed the importance of measuring and improving the effectiveness of building energy policy. International collaboration can improve policy effectiveness by supporting policy design, implementation, financing, and ongoing evaluation. This should be a major focus of a collaborative initiative.

Metrics

A number of broad (or aggregate or high-level) energy efficiency metrics and resilience metrics are identified in the report. Monitoring is essential to gauge progress in building efficiency and to identify opportunities for improvement. As an example, floor area energy intensity provides a direct measure of energy consumption relative to floor area. Energy intensity metrics can be compared relative to past performance or to a business as usual (BAU) trajectory and can be further normalised or segmented on the basis of climate, building type, and energy service level. An aspirational broad metric could be the number of buildings or floor area meeting a minimum performance standard, thereby counting as "very low energy" (or a similar label). The report offers some illustrative considerations for further discussion and analysis of options for broad metrics based on the availability of data.

2

Introduction

The building sector is the largest consumer of energy worldwide and is on a trajectory of increasing energy demand over time. Final (end-use) energy consumption in the global building sector doubled between 1971 and 2010 to reach 2794 million tonnes of oil equivalent (Mtoe), representing more than one-third of global final energy consumption (IEA and UNDP, 2013; IPCC, 2014). Without new action to improve efficiency, energy use in the building sector is expected to rise 50% by 2050 from growth in the building stock and in energy-using devices and products (IEA, 2013; IPCC, 2014). Continued growth in building energy use will put greater pressure on energy supplies, drive up energy prices, require costly new energy infrastructure, and greatly increase emissions of heat-trapping greenhouse gases (GHGs).

Improved energy efficiency in buildings will enable the members of the Major Economies Forum on Energy and Climate (MEF) and other governments to curb energy consumption, allowing existing energy supplies to go further, avoiding costly infrastructure, and reducing GHG emissions. It is estimated that an annual energy savings of 40 exajoules (EJ)—equivalent to current energy use in Russia and India combined—could be realized in the global building sector in 2050 through the wide deployment of best-available technologies and policies (IEA, 2013). This energy savings potential from building efficiency as well as complementary measures to improve the climate resilience of the building sector represent key components of the broader action needed to address climate change. Efficiency improvements in buildings also deliver benefits beyond direct energy savings and associated emission reductions: increased energy security, greater economic growth; social development; financial benefits through savings on electricity and fuels; and improvements in human health and well-being.

This report responds to the MEF leadership's request to the International Partnership for Energy Efficiency Cooperation (IPEEC) to support a MEF buildings initiative aimed at leveraging high level political will among the world's major economies to reduce emissions from and improve the resilience of the global building sector. Specifically, the MEF requested that IPEEC convene appropriate experts to (i) develop options for metrics to gauge progress in building energy performance and resilience; and (ii) identify key areas in the building efficiency sector that would benefit from additional international collaboration.

National and regional governments are ultimately responsible for implementing building energy policy according to national circumstances and hence not all governments are anticipated to participate in all of the recommended collaboration areas below. However, where appropriate, international collaboration can play a critical role in supporting national and regional governments through the sharing of policy best practices, improving analytical capabilities, and providing other

resources that accelerate and maximise the benefits of energy efficiency, increase the cost-effectiveness of implemented policies, and help bring new technologies to market.

In order to realize the full potential of a more energy efficient building sector, it is necessary for national and regional governments to establish ambitious, concrete, and effective policies and programmes. Effective policy requires an integrated, holistic approach to design, development, and implementation. Therefore, governments should pursue packages of regulations, incentives, labels, and voluntary schemes based on their individual national circumstances that best accelerate market transformation and reap efficiency benefits at minimal cost.

3

Key Areas for International Collaboration

Based on inputs from participating MEF and IPEEC governments and non-governmental experts in building energy efficiency (see process in Appendix A), this report identifies key areas for international collaboration in the building efficiency sector. Four policy collaboration areas emerged: building codes/standards/regulations; appliance and equipment standards and labels; building rating, labelling, and disclosure; and building component standards and labels. Two enabling collaboration areas also received strong interest: data availability and quality; and education and capacity building. These policy and enabling areas support efficiency improvements across the building sector (Table 1). A number of "other" policy areas were also highlighted as being of interest for possible international collaboration (see Appendix A).

While these individual areas are of high priority and could benefit from increased international collaboration, it is important to stress that effective national and regional policy will integrate complementary policies. Therefore, it is recommended that MEF governments consider these key collaboration areas in the context of holistic building sector transformation policy. Such an integrated approach can optimize complementarities of policies and conserve resources by minimizing overlapping and redundant efforts.

MEF and IPEEC governments and a group of non-governmental energy efficiency experts also emphasised the need to measure and improve the effectiveness of building energy policy. International collaboration can improve policy effectiveness by supporting policy design, implementation, financing, and ongoing evaluation. This should be a major focus of a collaborative initiative. Finally, the multiple benefits of building energy efficiency must be recognized as both an important policy driver and policy goal. Building energy efficiency policy should be designed to capture the multiple energy, economic, and environmental benefits.

Table 1 (next page) maps the key policy and enabling areas for collaboration to new construction and existing buildings. The rows in the table represent priority areas for international collaboration. Data quality and availability as well as education and capacity building are included in a separate row to reflect the fact that they enable the policy areas. Proper compliance and enforcement are also essential for ensuring the success of each of the prioritised areas.

Table 1. Key policy and enabling areas for international collaboration mapped to new construction and existing buildings.

	New Construction	Existing Buildings
Policy Collaboration Areas	New Building Codes/Standards/Regulations	Renovation Codes/Standards/Regulations
	Appliance and Equipment Standards and Labels	
	Building Component Standards and Labels	
	Building Rating, Labelling, and Disclosure	
Enabling Collaboration Areas	Data Quality and Availability Education and Capacity Building	

Building Codes/Standards/Regulations

Ambitious building energy codes (standards, regulations) are consistently regarded as among the most cost-effective policy measures for delivering large-scale and long-term energy savings and GHG emission reductions. As a fundamental element of effective building policy, codes can help reduce long-term operating costs of buildings, reduce peak electricity demand, create local employment, and improve the health and well-being of occupants. Once implemented, building energy codes can be continuously improved in order to gain even larger benefits from efficiency in new and renovated buildings. Implementation of today's most ambitious codes could reduce building energy service demand by 20% - 40% relative to business as usual (BAU) by 2030 (IPCC, 2014). Adoption of state-of-the-art building energy codes and standards by major economies could reduce total thermal energy demand (associated with heating, cooling, and hot water) from buildings by 27% despite a 130% increase in built floor area by 2050 compared with today's levels (GBPN, 2013).

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Implementing cost-effective building energy codes for all new construction and renovation
- Realizing larger energy savings from building energy codes through improved code compliance activities and support for local enforcement agencies
- Encouraging the transition to net zero energy buildings through exchange of experience and information
- Improving code design by sharing validated best practices and technical knowledge

- Increasing the effectiveness of codes through consistent evaluation and benchmarking of the design
- Increasing the consistency of metrics and performance standards while ensuring transparency and flexibility by developing international standards.

Pathways to Implementation

Implementation could include developing a platform for the exchange of best practices on building code design, implementation, compliance, and impact assessment. This could support more consistent monitoring, benchmarking, and improve code effectiveness. International collaboration could leverage the strengths of existing models such as the EU Concerted Action for implementing the Energy Performance of Buildings Directive (EPBD, 2010/31/EU) and IEA Implementing Agreements. Specific bilateral or issue-specific implementation could be achieved through existing mechanisms with development organisations such as GiZ, the U.S. Agency for International Development, and closer collaboration between the European Committee for Standardisation (CEN) and the International Organisation for Standardization (ISO) on performance metrics and standards. An IPEEC taskgroup could potentially serve as a convener that aligns existing activities and initiatives such as the United Nations Environment Programme (UNEP) Sustainable Buildings and Climate Initiative (SBCI) and Sustainable Energy for All; best-practice and capacity building organisations such as the Global Buildings Performance Network (GBPN); and the technical and analytical capabilities of the IEA.

Options for Metrics

Metrics could include: 1) the improvement in energy performance due to increased building code stringency; 2) code adoption rates by relevant jurisdictions; 3) code compliance rates and enforcement criteria (i.e., how compliance is verified); 4) frequency of code updates; 5) percentage of new and existing buildings and types covered by building energy codes; and 6) percentage reduction of actual energy use (i.e., empirically validated) of highly rated buildings.

Appliance and Equipment Standards and Labels

Together governments can build on existing initiatives to accelerate progress on achieving the energy, economic and environmental benefits of improved appliance and equipment efficiency. International collaboration on appliance and equipment energy efficiency enables concerted action that can affect global markets, reduce barriers to trade, and accelerate the transition to a clean energy economy. In many regions around the world, rising energy demand from increased appliance use is overtaxing already strained electricity networks, limiting the electricity available to underserved populations, and contributing to the rise in global GHG emissions. Consumers and governments everywhere are paying much more than needed on both energy bills and infrastructure. Whether for basic services like lighting, heating, and cooling, or for rapidly expanding consumer electronics, opportunities abound

for increasing the energy efficiency of appliances and equipment. Given the rapid turnover and diffusion of appliances and equipment, efficiency improvements can take effect quickly. A recent analysis by the Lawrence Berkeley National Laboratory (LBNL) and the Clean Energy Ministerial's Super-efficient Equipment and Appliance Deployment (SEAD) Initiative estimates cumulative CO_2 emission reductions of 11 billion metric tons between 2015 and 2030, if major world economies implemented appliance energy efficiency policies that maximise energy savings but still save consumers money (Letschert et al. 2012). Those consumers would also reap cumulative financial benefits of USD $1,500 billion from 2015 to 2030. This potential can only be realized through increased government engagement and commitment.

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Revising, on a regular basis, minimum energy performance standards (MEPS) and associated compliance activities, together with complementary policies such as incentives and labels
- Accelerating the availability of energy efficient appliances and equipment through the provision of timely, regulation-ready international metrics, test protocols, and performance levels, supported by collaborative engagement
- Identifying major end-use efficiency technology transformation opportunities and associated policy needs, supported by collaborative analysis.

Pathways to Implementation

Implementation in this space could leverage and enhance existing collaborations under the SEAD Initiative and the IEA's Implementing Agreement on Energy Efficient End-use Equipment (4E), as well as expert organisations such as the Collaborative Labelling and Appliance Standards Program (CLASP), to expand the scope and ambition of existing programmes and accelerate adoption of efficiency programmes where they do not yet exist.

Options for Metrics

Metrics could include: 1) the percentage of residential, commercial, and industrial energy use covered by product standards; 2) rate of improvement in the sales-weighted energy performance of products on the market by product type and energy class label (e.g., refrigerators, air conditioners, etc.); 3) total energy savings over a period of time (TWh or the equivalent number of power plants); 4) frequency of stringency updates to individual standards; 5) technology metrics (e.g., lumens per watt for lighting); and 6) market penetration of high performance products.

Building Rating, Labelling, and Disclosure

Knowing how well buildings are performing is important for making energy savings visible, promoting transparency in real-estate transactions, and increasing

awareness of building energy use. Most building owners, renters, and investors have little or no information on the energy savings potential of individual buildings, or the scale of the opportunity available to reduce energy consumption. Building energy rating, labelling, and disclosure policies can help overcome these basic information barriers, increase transparency, and spur investment in efficient new buildings and energy efficiency renovations. Building energy demand could be reduced by 50% if building energy codes and labelling are widely adopted and strengthened toward net zero energy buildings by 2050 (Urge-Vorsatz, 2012). Rating is also the basis of certification programmes that help recognise and incentivise building energy efficiency and sustainability more broadly. While many rating, labelling and disclosure programmes are too new to be able to assess the collective impact on energy savings and GHG emission reductions of scaling up their implementation, mature schemes are delivering impressive results. For example, the U.S. Energy Star programme is estimated to have prevented emissions of nearly 120 million metric tons of CO_2 equivalent, the annual emissions from the electricity used by more than 60 million U.S. homes. The IPEEC Building Energy Efficiency Taskgroup recently issued a separate report on building rating systems, including knowledge gaps and areas for potential international collaboration (IPEEC BEET, 2014).

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Assessing and communicating the energy savings and property valuation impacts of rating policies and schemes around the world, supported by collaborative analysis
- Extending building rating, labelling, and disclosure policies to cover more building types
- Improving data collection, availability, quality, and impacts information, through the standardisation of rating and simulation metrics and calculation methodologies and tools
- Strengthening policy development and effectiveness through best practice sharing, capacity building, and exchange of expertise.

Pathways to Implementation

A possible pathway for implementation would be an IPEEC taskgroup that engages a broad stakeholder group including policymakers, financiers, investors, utilities, and building owners and operators. A number of existing programmes could be used as models, be better aligned, or strengthened, including: EU Concerted Action, EU Mandate 480, UNEP Common Carbon Metric, BUILD UP, and the International Finance Corporation Excellence in Design for Greater Efficiencies (EDGE) programme for financing.

Options for Metrics

Metrics could include: 1) the annual percent increase in market penetration of "rated" buildings (number of buildings and floor area); 2) percentage of buildings (by type, ownership, size, etc.) participating in voluntary self-rating or subject to mandatory rating; 3) percentage of buildings and floor space (by type, ownership, size, etc.) subject to public energy performance disclosure (vs. disclosure to occupants and prospective renters or buyers); 4) number of buildings represented in aggregate building energy use estimates; 5) improvement in building stock reported by energy efficiency disclosures; and 6) energy savings and cost savings due to energy efficiency disclosure.

Building Component Standards and Labels

Minimum energy performance standards (MEPS) are an effective way to increase the energy efficiency of building products. By specifying a minimum energy performance level, they prevent inefficient building products from entering the marketplace and help to improve overall building energy performance. For owners and renters, this means that buildings that they live and work in use less energy and have lower running costs over the life of the product. Using energy efficient products also reduces GHG emissions. Labelling is a second approach that has proven to be successful in a variety of contexts, including the energy performance of buildings as a whole, in water use, and also gas consumption. This labelling approach can also be applied to building components to reduce overall building energy use. The application of labels to components that impact other energy using products in buildings are particularly important to target, such as building shell components including insulation, roofing, and windows. Labels provide information and help educate consumers on the energy efficiency characteristics of products and can help facilitate compliance with building codes that require particular performance from building products. In order for long-term energy efficiency strategies to be successful, there must be awareness by end-consumers of product benefits and limitations.

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Improving information availability and facilitating international trade of energy-saving building components through the harmonization of energy performance certifications and labels
- Developing and implementing standards and labels for major energy-related building components, with an initial focus on insulation, ducting, windows, and other glazed areas
- Advancing technology and rating systems for building components through the sharing of best practices and targeted implementation with collaborative capacity building

Pathways to Implementation

One approach would to be for an IPEEC taskgroup to serve as a facilitator of a standardisation process with input from ISO and regional standards bodies. Countries could support collaboration by sharing implementation approaches that they have developed. Possible initiatives that could be built on include the UNEP SBCI, EU Concerted Action, and the Asia Pacific Partnership Building Material Test Centres established in Australia, China, and India.

Options for Metrics

Metrics could include: 1) the number and types of energy-using equipment and building products (e.g., insulation, roofing, and windows) subject to labels and standards; 2) the percentage of labelled products (or percentage of product categories) checked for compliance and accuracy each year; 3) percentage of building products installed that do comply with standards; and 4) effectiveness of programmes (e.g., market penetration of double- and triple-glazed low-e windows).

Data Quality and Availability

Access to high-quality data is needed to support effective building efficiency policy development and implementation. Energy performance data enables countries to evaluate energy consumption and associated GHG emissions across building types and over time. This is necessary for identifying and evaluating opportunities for efficiency improvements and for gauging progress towards policy goals. Data also supports policy implementation, for example the projected energy savings needed to obtain project and programme financing. Significant differences in data quality, availability, and methodologies for generating energy and emissions baselines and benchmarking exist across countries. Such inconsistencies make it difficult to analyse the performance of building energy policies and measure progress toward policy goals. Applicable data on building characteristics and the energy performance of buildings are needed to facilitate policies that deliver energy savings and GHG emission reductions from buildings (IEA, 2014a, 2014b).

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Improving data consistency and comparability by developing common metrics
- Improving the measurement of progress and opportunities in building energy performance through increased collection, storage, analysis, and sharing of data, with an initial focus on upgrading information technology (IT) systems
- Assessing and communicating the multiple energy, economic, environmental, and health benefits of energy efficiency, supported by sustained collaborative analysis

- Improving the governance and management of data collection and analysis by promoting transparency in data sharing (i.e., raw data and analysis).

Pathways to Implementation

Continued collaboration on data availability and quality could build on existing initiatives such as Odyssee, the UN Economic Commission for Latin America and the Caribbean (ECLAC), the IPEEC taskgroup on Improving Policies through Energy Efficiency Indicators (IPEEI), the Mediterranean Association of National Agencies of Energy Conservation (MEDENER), the International Energy Agency (IEA) 25 Energy Efficiency Policy Recommendations, and the IEA 4E programme. An IPEEC task-group could possibly act as a facilitator for a data sharing process by replicating the European "liaison committee" at the international level including cooperation with the CEN or ISO.

Options for Metrics

Metrics could include: 1) the number or percentage of buildings annually surveyed or monitored according to building type (e.g., public and private buildings, residential and commercial); 2) an overall rating of governmental data availability and quality by building type, for example by a non-governmental panel of building energy efficiency experts; and 3) core building metrics such as floor area, occupancy rates, appliance saturation, etc.

Education and Capacity Building

Education and capacity building enable building energy policy, help support growth in energy efficiency investments, and improve performance capability. If long-term energy efficiency strategies are to be successful, citizens and consumers must also be aware of the benefits of energy efficiency, the behaviours that maximise the energy efficiency of their buildings, and of the opportunities to invest in deep energy renovations or in very low energy new buildings. Targeted training and accreditation of building professionals and trades people (e.g., engineers, architects, inspectors, installers, builders, property managers, and operators) ensures that the expertise required to design, construct, and operate energy efficient buildings is available. Developing capacity around data collection and the assessment of policy impacts can inform the development of future policies. Training and education can also support innovative business models for low-carbon building development. International collaboration could, for example, provide an assistance function to support education and training in the building sector.

Focus Areas

Possible focus areas for collaboration identified by project contributors include:

- Harnessing electronic media to enable low-cost delivery of education and capacity building programmes

- Making consumers and building professionals aware of energy efficiency opportunities, with collaborative support for education and communication activities
- Facilitating access to private capital for building efficiency through policy and collaborative engagement of financial and building efficiency communities
- Supporting up-skilling of building professionals and policy developers through best practice sharing in bi-lateral, multilateral, and sub-national programmes (e.g., university-to-university, municipality-to-municipality, and train-the-trainer programmes)
- Raising awareness of the potential of energy efficiency by sharing of information on education campaigns.

Pathways to Implementation

Increased international collaboration could support the development of capacity building programmes and education campaigns. Existing projects in this field that could be built upon include the EU's Concerted Action Energy Performance in Buildings Directive, Energy Efficiency Directive, and BUILD UP Skills. Organisations that could enable collaboration in this area include the Clean Energy Solution Centre, GBPN, e-Institute from the World Bank, the IEA, industry associations, professional bodies, and local and regional governments.

Options for Metrics

Metrics could include: 1) the percentage of buildings sector professionals and trades people with a given energy efficiency-related certification (will vary by country); 2) number of people participating in buildings energy efficiency training or certification programmes per year; 3) number of person-hours spent on energy efficiency training per year; and 4) establishment and tracking of technical skills capability (e.g., energy and moisture modeling, energy management, ISO 50001, etc.).

4 Options for Metrics

An international group of non-governmental building energy efficiency experts were asked to develop a list of options for metrics in building efficiency and resilience. In addition to metrics associated with the collaboration areas in Section 3, this included broad (or aggregate or high-level) metrics aimed at gauging overall progress and identifying opportunities for improvement in building energy performance across the building sector as a whole and by major building type. Government representatives were invited to provide feedback on preliminary options for metrics and offered helpful recommendations.

Some options for broad metrics are provided below. Table 2 lists metrics for which data is readily available from the IEA and other organisations, while the other metrics listed below would be illuminating but require further development and improved data. Data availability and data quality are key considerations in the development of metrics and are challenging in part because of the vastness of the building sector and the great diversity in building types and end uses. The development of robust metrics therefore is linked with capacity building around building energy data.

For the metrics listed in Table 2, the IEA has historical data from 2000 through 2011 for all MEF countries. While data quality varies by country and region, the majority of this data has been peer reviewed. Continued effort to evaluate and improve all data sources is in progress and could be expanded. For nearly all of these metrics, the IEA also provides forecasts for MEF countries every five years from 2015 through 2050. It should also be noted that the metrics listed below could be used to derive other metrics, for example the change (or improvement) in a given metric (relative to a prior time interval or relative to a BAU trajectory) or metrics normalised by additional factors such as energy service level or climatic conditions. Some of these possible normalisations are listed below.

Metrics that would be illuminating but require further development and improved data:

- Floor area building energy intensity normalised or segmented by climate (heating and cooling degree days) and/or energy service level (e.g., HVAC present vs. HVAC not present)
- Per capita building energy intensity normalised or segmented by climate (heating and cooling degree days) and/or energy service level (e.g., HVAC present vs. HVAC not present)
- Number of buildings or floor area qualifying as "very low energy," or percentage of new buildings or floor area qualifying as very low energy

Table 2. Options for broad metrics with available data from the IEA and other organisations.

	Illustrative Considerations
Total building sector energy [kWh/year]	Tracks overall energy use in the building sector as a whole, including both residential and commercial buildings. Does not normalise or adjust for key drivers of total building energy use, including growth in both the building stock and in energy-using services in buildings.
Total building energy segmented by building type (residential and commercial) [kWh/year]	Segmentation of building energy use by building type reveals the distinct trends in energy use within residential and commercial buildings. Segmented metrics can also reveal the impacts of policies and programmes targeted at specific building types.
Floor area building energy intensity for the entire building sector or segmented by building type (residential and commercial) [kWh/m^2/year]	Floor area building energy intensity normalises for floor area, a direct driver of total building energy use, and can be segmented by building type. Floor area intensity is impacted by the addition of new energy-using services in buildings and growth of floor area. Energy efficiency improvements (i.e., achieving comparable energy services with less energy) will reduce floor area energy intensity.
Residential building energy per household [kWh/households/year] or per capita [kWh/person/year]	Residential building energy per household or per capita normalises for number of households or number of people, both key drivers of total residential energy use. Does not normalise for floor area, the level of energy services provided, and other factors that contribute to residential energy use.
Commercial building efficiency [kWh/services GDP] or productivity [services GDP/kWh]	Measures the efficiency (energy input per economic output) or productivity (economic output per energy input) in commercial buildings, using services GDP as an indicator of economic output. Does not normalise for floor area and other drivers of commercial building energy use. Services GDP value added data exist on a uniform basis for all MEF countries, however further evaluation may be needed.
Per capita building energy intensity [kWh/person/year]	Per capita building energy intensity normalises for the number of people. This metric will increase with the addition of energy services. Efficiency improvements (i.e., achieving comparable energy service level with less energy) will reduce per capita intensity. Residential building energy use largely reflects individual (personal) energy use and is directly impacted by population, whereas commercial building energy use largely reflects economic activity and is not directly impacted by population.
Energy savings relative to an agreed energy use trajectory or forecast* [units could include kWh/year; number of power plants avoided; kWh/m^2/year; kWh/person/year; etc.]	Energy savings relative to trajectories or forecasts can help evaluate the role of key drivers (including policy) on changes in energy use. The IEA publishes several forecast scenarios for future energy use. Other organisations also have regional and global forecasts. Greater collaborative effort could help improve the knowledge base and understanding of key drivers of energy use (e.g., growth in floor area, appliance saturation, and decline in household occupancy).
Energy savings potential* [units could include kWh/year; number of power plants avoided; kWh/m^2/year; kWh/person/year; etc.]	Potential energy savings are important for identifying, measuring, and prioritizing opportunities for enhanced action. IEA energy savings forecasts exist for MEF countries based on several policy scenarios. Other organisations also have regional and global forecasts. Key assumptions and inputs could be improved through collaborative work on modeling by organizations and national governments (e.g., potential energy savings per technology and per policy, technology uptake potential, fuel switching, among other factors).

* Forecasts (or projections) are important for understanding the role of policy and other key factors in shaping future building energy use. The IEA has scenario projections of the metrics listed in Table 2 out to year 2050 (and associated drivers of energy use such as floor area and population) with the exception of services GDP, which is currently available for multi-country regions out to year 2035.

- Percentage of existing buildings renovated, or floor area of renovations, possibly segmented by building type (e.g., commercial and residential)
- Number of deep energy renovations per year
- Percent reduction in floor area building energy intensity for public buildings
- Energy savings [kWh/year or number of power plants avoided] from product and end-use efficiency improvements
- Percent improvement in the sales-weighted energy performance of products on the market by product type (e.g., lighting, air conditioners, etc.) compared to benchmark years.

Options for Resilience Metrics

With increasing concerns about the capability of buildings to survive and provide shelter following extreme events such as flooding and hurricanes, there is growing recognition of the need for designing and constructing improved resilience characteristics into buildings. Research has shown that certain energy efficiency strategies can improve building survivability and comfort following these types of events, especially at times when normal utility energy services may be disrupted because of the event. Despite this, resilience was not ranked highly as an area for international collaboration in the present project. This may be in part because input was solicited primarily from energy efficiency experts and the fields of building energy efficiency and building resilience are not yet strongly linked. Some options for building resiliency metrics include:

- Economic value in the building sector at risk from extreme events, changes in weather patterns, and coastal flooding (with risk to be defined)
- Number of homes at risk of harm (with harm to be defined)
- Number of occupants at risk of harm
- Number of new resilient homes constructed (with resilient to be defined)
- Floor area of new resilient construction
- Number of resiliency renovations
- Percentage of new construction covered by building codes/standards/regulations that provide minimum performance criteria for resilient components and design.

Appendices

5

Appendix A. Government Ratings of Collaboration Areas and Outreach Process

	Priority Level					Supportiveness of Increased International Collaboration		
	No. of responses	High		High or Medium		No. of responses	High or Moderate	
		No.	%	No.	%		No.	%
Building Codes/Standards/Regulations	13	12	92	13	100	12	6	50
Appliance Standards and Labels	13	12	92	13	100	11	7	64
Building Rating, Labelling, and Disclosure	13	11	85	13	100	12	7	58
Data Quality and Availability	13	9	69	13	100	12	6	50
Building Components Standards and Labels	13	8	62	13	100	11	4	36
Education and Capacity Building	12	7	58	12	100	11	6	55
Innovation in Specific Building Types	13	6	46	10	77	12	7	58
Financing, Markets, and Incentives	13	5	38	12	92	12	6	50
Sub-national and Private Sector Engagement	12	4	33	12	100	11	4	36
Public Procurement	13	4	31	12	92	12	3	25
Building Resilience	11	2	18	8	73	10	4	40
Other: Healthy Buildings	1	1	100	1	100	1	1	100
Other: Multiple Benefits	1	1	100	1	100	1	1	100
Other: Economic Impacts of Energy Efficiency Policies	1	1	100	1	100	1	1	100
Other: Building Performance Metric Standards	2	2	100	2	100	2	2	100

More than half of respondents labeled these items a high priority

The Global Buildings Performance Network (GBPN) conducted a survey with MEF and IPEEC governments as well as several non-governmental experts to gather input on areas of international collaboration in building energy performance policy. The number and percentage of government responses to the following two survey

questions are provided in the table above: (1) In your national circumstances, are the following building policy areas of high, medium, or low priority for improving building energy performance? (2) To what degree would increased international collaboration support your government's efforts in the following areas of building energy policy (not at all, somewhat, moderately, or highly supportive)? The areas rated as a high priority by most governments are highlighted. Some policy areas that project contributors emphasised but are not included in the high priority areas discussed above include building resilience and finance and incentives. A number of "other" policy areas were also identified for possible international collaboration by governmental contributors in survey responses and in workshop discussions: healthy buildings, the multiple benefits of building efficiency, the economic impacts of energy efficiency policies, and building performance metric standards, as well as integrated renewables. The responses to the open-ended survey questions inform the body of the report.

Acknowledgements

The IPEEC Building Energy Efficiency Taskgroup gratefully acknowledges the governmental and non-governmental building efficiency expert contributors, the Global Buildings Performance Network (GBPN), the Lawrence Berkeley National Laboratory (LBNL), and collaboration with the International Energy Agency (IEA).

References

Global Buildings Performance Network, 2013: Buildings for our Future—The Deep Path for Closing the Emissions Gap in the Building Sector. Available at: http://www.gbpn.org/reports/buildings-our-future-deep-path-closing-emissions-gap-building-sector

Intergovernmental Panel on Climate Change, 2014: Fifth Assessment Report, Working Group 3, Chapter 9. Available at: https://www.ipcc.ch/report/ar5/wg3/

International Energy Agency, 2013: Transition to Sustainable Buildings—Strategies and Opportunities to 2050.

International Energy Agency and United Nations Development Programme, 2013: Modernising Building Energy Codes to Secure our Global Energy Future. Available at: http://www.iea.org/publications/freepublications/publication/PolicyPathwaysModernisingBuildingEnergyCodes.pdf

International Energy Agency, 2014a: Energy Efficiency Indicators: Essentials for Policy Making.

International Energy Agency, 2014b: Energy Efficiency Indicators: Fundamentals on Statistics.

International Partnership for Energy Efficiency Cooperation Building Energy Efficiency Taskgroup, 2014: Building Energy Rating Schemes: Assessing Issues

and Impacts. Available at: http://www.buildingrating.org/sites/default/files/IPEEC_BuildingEnergyRatingSchemes_February2014.pdf

Letschert, V. E., N. Bojda, J. Ke and M. A. McNeil, 2012: Estimate of Cost-Effective Potential for Minimum Efficiency Performance Standards in 13 Major World Economies. Available at: http://www.superefficient.org/en/Resources/~/media/Files/BUENAS%20CEP%20Scenario-%20LBNL-5723E.pdf

Urge-Vorsatz, D., 2012: Best Practice Policies for Low Carbon & Energy Buildings Based on Scenario Analysis. A research report prepared by the Center for Climate Change and Sustainable Energy Policy for the Global Buildings Performance Network. Available at: http://www.gbpn.org/sites/default/files/08.CEU%20Technical%20Report%20copy_0.pdf

International Partnership for Energy Efficiency Cooperation
9, rue de la Federation, 75739 Paris Cedex 15, France
Email: contact@ipeec.org **Tel:** +33 (0)1 40 57 65 24
Web: ipeec.org