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DRIVING TRANSFORMATION TO ENERGY EFFICIENT BUILDINGS

Policies and Actions: 2nd Edition

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FOREWORD

Current projections indicate that 70 percent of the world's population will live in cities by 2050. Buildings form the fabric of these rapidly growing urban landscapes. Sustainable development objectives can only be met if we increase the energy and resource efficiency of our buildings, aligning economic, social, and environmental objectives

The UN Sustainable Energy for All initiative aims to double the global rate of improvement in energy efficiency by 2030. This goal is achievable; however, the scale and pace of current actions around the world are insufficient to transform buildings into engines of the sustainable, energy efficient economy. Government policies can accelerate the rate of growth in energy efficiency in buildings.

This report reviews policy options that can accelerate those energy efficiency improvements and introduces a building efficiency policy assessment tool that provides a simple framework to help decision-makers set policy priorities through dialogue and input from key stakeholders.

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BIG PICTURE

Executive Summary

The Sustainable Development Opportunity in Buildings

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EXECUTIVE SUMMARY

UN Secretary-General Ban Ki-moon is leading the Sustainable Energy for All initiative, with an objective to double the global rate of improvement in energy efficiency by 2030.[1] Efficient buildings are vital to achieving sustainable development because they align economic, social, and environmental objectives, creating triple bottom line benefits. However, the scale and pace of current actions around the world are insufficient to transform buildings into an engine of the sustainable, energy efficient economy. Government policies can accelerate the rate of energy efficiency in buildings. This report reviews policy options that can accelerate those energy efficiency improvements. Policymakers need to come together with stakeholders in the buildings market to review and prioritize the building efficiency policy options. This report includes a building efficiency policy assessment tool, which provides a simple framework to help decision makers set policy priorities through dialogue and input from key stakeholders.

Buildings and building efficiency have significant impacts in triple bottom line goals.

Economic development goals depend on buildings. Buildings consume nearly 40 percent of energy globally – and energy costs can be a significant burden on a household or business budget. Increasing energy productivity through measures like building efficiency has the potential to slow the growth of energy demand in developing countries by more than half by 2020. Each additional $1 spent on energy efficiency avoids more than $2, on average, in energy supply investments.[2] Between now and 2020, global energy demand is projected to rise by an average 2.2 percent per year, the majority occurring in the developing world.[3] Investments in building efficiency free up scarce resources for other purposes.

Social development goals depend on buildings. Current projections indicate that 70 percent of the world's population will live in cities by 2050. Buildings form the fabric of these rapidly growing urban landscapes. There is a tremendous opportunity today to shape tomorrow's cities and buildings and avoid "locking in" inefficiencies. In addition, efficient buildings can help improve the quality of life of millions of people because they are often higher-quality buildings, with improved comfort and indoor and outdoor air quality. Energy efficiency can stretch existing electricity resources further, helping provide better energy access, reliability and security in under-served areas of the world.

Environmental goals depend on buildings. A study by International Energy Agency (IEA) shows that if implemented globally, energy efficiency measures could deliver two-thirds of the energy-related CO_2 emissions reductions needed to achieve climate protection.[4] Making ***new*** but also ***existing*** buildings more efficient worldwide offers more potential carbon emission mitigation than any other major abatement strategy. In addition, sound building materials selection, building water conservation efforts, and wise siting decisions can help meet other environmental goals.

In some developing countries, the stakes are even higher. Development investments are at risk where building investments are not designed for extreme weather events and other impacts of climate change. In the building efficiency community, climate resilience remains a new area of work, though analogous efforts have focused on preparedness for earthquakes and floods. With the right design, many buildings can be made more resilient to the impacts of climate change. At the city level, there is increasing awareness of the opportunity to improve climate resilience in buildings.[5]

There are opportunities to improve the energy efficiency of buildings throughout their lifecycles. Today, a number of policy options are being developed around the world in recognition that there are significant market, financial, technical, awareness and institutional barriers to building efficiency. These policies will help bridge the efficiency gap, illustrated below, enabling critical actors in the market to make decisions to promote energy efficiency. The policy pathway that can transform the built environment is unique in each country or city, and the options that best apply to local markets should be given first priority.

Figure 1.
Crossing the Bridge to more Energy Efficient Buildings



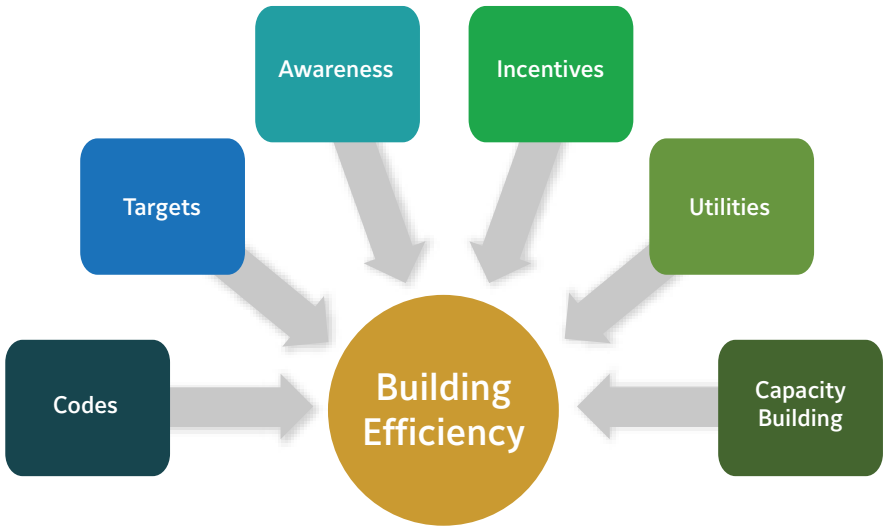
Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

This report reviews many recent efforts around the world to transform buildings through policy and presents two illustrative case studies. The options for government action and policy fall into six categories:

- **Building efficiency codes and standards** are regulatory tools that require a minimum level of energy efficiency in buildings, appliances, equipment or lighting. If they are well designed, they can cost-effectively decrease energy costs over each item's lifetime.
- **Energy efficiency improvement targets** are goals that can be set for a country or city. Setting a target for an entire geography can motivate greater action, especially if there is an entity responsible for meeting that target. In addition, governments can set efficiency improvement targets for publicly owned buildings to build capacity and stimulate the building efficiency market.
- **Policies and actions that increase awareness, information and market transparency** can enable building owners, tenants and operators to make informed energy management decisions. Transparent, timely information can help in tracking performance against goals. These policies and actions include competitions, audits, rating and certification programs like LEED, disclosure of energy performance, and public awareness campaigns.

- **Financial incentives** can help energy efficiency projects overcome cost barriers. These include grants and rebates, tax incentives, government risk mitigation guarantees, revolving loan funds, tax-lien financing, and policies that enable energy performance contracting. Scaling up building efficiency ***will require new forms of engagement with the investor community*** to design scalable, replicable financing mechanisms with a special focus on emerging economies.
- **Utility programs** engage utilities in making their customers more energy efficient. These programs include energy efficiency spending requirements for utilities, on-bill financing, advanced metering, and pricing that more accurately reflects the cost of producing electricity.
- **Human and technical capacity** can be built through policies and actions both inside government through direct technical assistance and in the market through workforce training programs.

Figure 2.
Policies Can Enable Transformation



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Financing for viable energy efficiency programs includes three critical phases: readiness, prototyping, and critical mass. In the readiness phase, the policy pathway is defined and capacity is built that will enable the market to scale up over time. In the prototyping phase, governments support the development and financing of initial projects and actions. In the phase when the market reaches critical mass, financing mechanisms are created that enable the market to scale up.

Tracking performance is important in order to confirm that building efficiency goals are being met. Results of building efficiency actions can be tracked at the city or national level or in individual buildings. Performance tracking offers a key area for combining know-how in the assessment of energy savings at the building level and in the assessment of policy. In some buildings, new technologies are also enabling individual tenants to track their energy use and their progress toward energy efficiency goals.

Market conditions affect private sector investment decisions and business viability. Creating the right conditions requires aligning the interests of architects, construction companies, building trades such as electricians and plumbers, equipment manufacturers, and government offices and officials. To achieve greater energy efficiency, there must be a compelling view to why it is to everyone's benefit to change current business practice. Private-sector investment will follow demand. Demand for energy efficient buildings does not always exist today. Policies can help drive that demand: government incentives, rebates and other policies rank among the top drivers for commercial building owners to invest in energy efficiency technologies and practices.[6]

The report concludes with a building efficiency policy assessment tool, which provides a simple framework to help decision-makers set policy priorities with input from stakeholders. The assessment tool supports a collaborative process for exploring building efficiency policy options based on the local importance of energy efficiency and the relative difficulty of achieving it, as well as the current policy status and a vision of the suite of policies that would best foster energy efficiency implementation. The tool includes a facilitator's guide for how to run a workshop, along with templates and analysis tools. The workshop is designed to support consensus-based, multi-stakeholder collaboration and uses visual tools to build consensus and prioritize building efficiency policy options and strategies.

The Sustainable Energy for All goal – to double the rate of improvement in energy efficiency by 2030 – is achievable. The transformation will bring economic, social and environmental benefits. In the dialogue on creating a green economy, the private sector and policymakers can work together in the creation of effective building efficiency policies that yield measurable results.

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5. For an example, see "Resilient Cities: The Global Forum," organized annually by ICLEI http:// resilient-cities.iclei.org/bonn2011/about/ or the consortia of practitioners http://www.resilientcity.org

6. Institute for Building Efficiency, Energy Efficiency Indicator 2012. http://www.institutebe.com/Energy-Efficiency-Indicator.aspx

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THE SUSTAINABLE DEVELOPMENT OPPORTUNITY IN BUILDINGS

Sustainable development means having the capacity to provide the people of today as well as future generations with the triple benefits of economic progress, social equity and environmental protection. Building efficiency is central to sustainable development because it aligns economic, social, and environmental objectives by increasing energy productivity; increasing energy access; greening urbanization; improving energy, water and materials efficiency; mitigating greenhouse gas emissions; and improving building quality. This section reviews the connections between sustainable development and the built environment.

Energy efficient buildings can help achieve sustainable development goals through cooperation of industry, governments, and other stakeholders. By changing policy approaches and decision-making, prioritizing life-cycle and performance metrics, and engaging in more integrated planning processes, the design, construction and renovation of buildings can contribute to broader national and urban sustainability goals.

The need to focus on the sustainability of the built environment exists in both developed and developing countries. In developed economies, achieving sustainable development will require renovating the existing building stock. In an emerging economy such China, only 40 percent of the building stock of 2020 exists today[1] – there is tremendous potential to access and implement best-in-class building practice today to avoid "locking in" decades of inefficiency.

Efficient buildings bring many benefits to their owners, their occupants, and society as a whole. Owners benefit from lower operating costs due to reduced energy usage, and occupants benefit from greater comfort and improved health through better insulation and lighting. Benefits to society as a whole include increasing energy security, reducing greenhouse gas emissions, and improving air quality through lower consumption of electricity, the majority of which comes from burning fossil fuels. Buildings lie at the heart of many economic and environmental challenges facing cities and countries today.

The discussion of "green growth" and "the green economy" complements and expands the scope of low-carbon development by including additional dimensions, such poverty reduction, water and biodiversity



Energy efficient, sustainable buildings can help align economic development, social and environmental goals.

Design, construction and renovation of buildings are large contributors to GDP and employment, making the transition to energy efficient, sustainable buildings a crucial component of the green economy.

Increasing energy productivity through measures like building efficiency has the potential to slow the growth of energy demand in developing countries by more than half by 2020. Each additional $1 spent on energy efficiency avoids more than $2, on average, in energy supply investments.

Rapid urbanization creates a tremendous opportunity to shape what tomorrow's cities and buildings will look like.

The environmental impact of buildings can be reduced through design, siting decisions, materials selection, energy and water use, and waste management.

Energy efficient buildings contribute to better indoor and outdoor air quality with benefits to human health and productivity, as well as enhanced comfort for improved quality of living.

protection, and payment for ecosystem services. Green growth has been defined as growth that ensures "that natural assets continue to provide the resources and environmental services on which our well-being relies."[2]

The concept of a green economy gained traction in 2008 as policymakers looked for new engines of growth and job creation in response to the global recession. Korea, a leading advocate of green growth, will have spent $38.5 billion between 2009 and 2012 in green recovery measures and has secured an allocation of two percent of GDP for 2009-2013 to create a green budget.[3] The green economy will be a central theme of the United Nations Conference on Sustainable Development, better known as the Rio+20 summit – a UN gathering of the international community that will mark the 20th anniversary of the historic Earth Summit of 1992 in Rio de Janeiro. Rio+20 will place a strong focus on the links between the green economy and efforts to eradicate poverty.[4]

ECONOMIC DEVELOPMENT

Given the large role that buildings play in the economy, transforming the built environment to be more energy efficient is a crucial component of transitioning to a green economy. Emerging economies can implement policies today to align economic development, social and environmental goals.

Construction is a Major Economic Driver

Design, construction and renovation of buildings are large contributors to GDP and employment. Construction will make up 16.5 percent of GDP in emerging markets by 2020,[5] making it a crucial component of the green economy. Making buildings more energy efficient will create additional economic opportunities and employment in the construction sector. For example, studies have shown that in Europe, higher building efficiency requirements would result in an estimated half-million new positions in the European construction sector.[6] In addition, investing in energy efficient infrastructure today can deliver significant cost savings over the lives of the buildings. Higher-quality buildings can aid in achieving other economic development goals by providing high–quality, comfortable spaces that increase worker productivity.

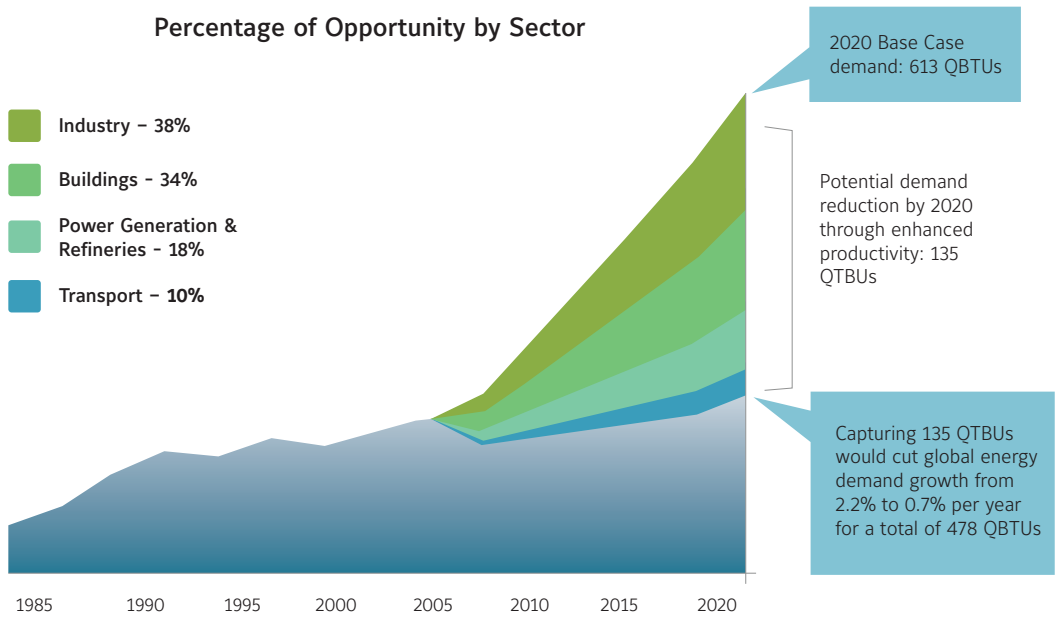
Improved Energy Productivity and Reduced Demand

The concept of "energy productivity" focuses on systems-level efficiency: How effectively are energy resources used? Buildings use over 80 percent of electricity and 40 percent of all energy globally. They consume over 50 percent of energy globally if construction materials are considered.[7] Between now and 2020, global energy demand is projected to rise by an average 2.2 percent per year, the majority of which will occur in the developing world.[8]

Improving the efficiency (and productivity) of our energy systems is the most cost-effective way to meet increasing energy needs. McKinsey and Company estimate that robust investment in energy efficiency would cost about ***half as much*** as an investment in energy supply infrastructure to meet the same demand.[9] Furthermore, increasing energy productivity through measures like building efficiency has the potential to slow the growth of energy demand in developing countries by more than half by 2020 – from 3.4 percent to 1.4 percent a year –

reducing demand by about 25 percent below business as usual in 2020.[10] Globally, residential and commercial buildings make up approximately 34 percent of the energy productivity opportunity.

Figure 1.
Opportunities for Improving Energy Productivity and Slowing Demand Growth by 2020



Source: Adapted from the McKinsey Global Institute, 2007, "Curbing Global Energy Demand Growth: The Energy Productivity Opportunity," Executive Summary, pg. 13

Efficiency frees up valuable capital for other strategic investments in economic development. Reduced electricity use in efficient buildings can slow the need to invest in electricity supply, helping liberating funds for other national objectives. Also, reduced electricity use in efficient buildings can be a strategy to help improve overall electric grid reliability. For example, increasing the amount of local renewable energy in the electric grid is an important complement to energy efficiency.

Efficiency would also reduce exposure to volatile fossil fuel prices. Reduced dependence on fossil fuels (the source of most energy and electricity) directly improves the balance of trade of fossil-fuel importing countries, helping to protect those countries from international fluctuations in energy prices.[11]

Greater Resiliency from Avoided Energy Supply Shortages

When countries are unable to meet rising demand, energy crises can occur. Whether they are caused by severe weather events, aging supply infrastructure, or market failures, electricity shortages happen when consumption outpaces available supply and are a risk for countries

Box 1.

The Economic Impacts of Electricity Shortages[12]

The 2008 electricity crises in South Africa caused a four-day shutdown of the mining industry, the largest economic engine of that country and one of the largest employers. Emergency negotiations to put production back online meant implementing load shedding (scheduled black-outs) all over the country, disproportionately affecting businesses and consumers in the poorest communities.

In Pakistan, the 2008-2009 power crisis resulted in a loss of electricity for periods ranging from two to 12 hours per day, depending on the part of the country. Power shortages cost the economy 7 percent of industrial output and 2 percent of gross domestic product (GDP) in fiscal year 2009, further stressing an already weakened economy and compounding political strife.

Power outages resulting from the 2009-2010 electricity shortfall in Ethiopia led to an estimated GD P loss of 1.5 percent.

Box 2.

Avoiding Energy Crises by Implementing Long-Term Energy Efficiency Plans – Chile's National Energy Efficiency Program[13]

Too often, emergency response measures to save energy are put in place too late – after an electricity crisis has occurred. Embedding energy conservation measures such as energy efficient buildings in long-term development plans can help reduce the chances of electricity crises and quickly mitigate the negative socioeconomic impacts in the event of an energy shortage, as demonstrated by Chile in 2007 and 2008. Chile experienced an average annual growth in GDP of 5.8 percent from 1990-2003. During the same period, electric power consumption rose by an average of 8.2 percent per year. Recognizing the strain on the power sector, the Chilean Ministry of the Economy created the National Energy Efficiency Program, which conducted baseline studies and market analyses for energy efficiency measures in industrial sectors, public and commercial buildings, and home appliances. This preparation was instrumental in helping the government identify energy efficiency measures during Chile's 2007-2008 electricity shortage. Through strategies implemented before and during the crisis, such as public information campaigns and distribution of compact fluorescent light bulbs, Chile was able to avoid interruptions to its electricity supply. As a result, electricity consumption remained flat in 2008 alongside a GDP growth of 3.2 percent. Since the shortage, the national government has put further emphasis on efficiency by increasing the budget of the National Energy Efficiency Program and creating a new government agency for energy efficiency. Chile is currently drafting a 10-year plan focused on improving efficiency in the commercial, residential, industrial, and transport sectors.

whose economic growth is not matched by energy conservation or new generation. Prolonged shortages can cause significant detrimental economic and humanitarian impacts (see Box 1).[14] Reduced electricity use in efficient buildings can be a strategy to help improve overall electric grid reliability and foster greater resiliency.

Decision-makers can help mitigate the negative impacts of electricity supply shortage by implementing energy efficiency measures, which will allow for economic growth and increase the stability of electricity supply (see Box 2).

SOCIAL DEVELOPMENT

Buildings lie at the heart of two major social development challenges – energy access and urbanization. Investments in efficiency lower the cost of achieving universal energy access. The rapid demographic changes of urbanization provide tremendous potential to implement best-in-class building practices today and avoid "locking in" decades of inefficiency.

Increased Energy Access

In both in urban and rural areas, electricity is fundamental to basic services such as education, clean water, and access to quality medical care. Inadequate energy supplies threaten economic development and social well being, hindering global competitiveness and raising barriers to poverty eradication. Efficient buildings can help increase energy access and reduce fuel poverty for low-income residents. The United Nations estimates that 2.6 billion people rely on traditional biomass for cooking and an estimated 1.6 billion people lack access to electricity.[15] Many people who do have access to electricity are under-served. Combinations of low income levels, high energy prices and poor housing quality can force households to choose between adequate energy services and other essentials.[16] Occupants of energy efficient homes are likely to spend less money lighting, heating and cooling them. For example, savings from energy efficient home provide additional spending power for low-income residents.

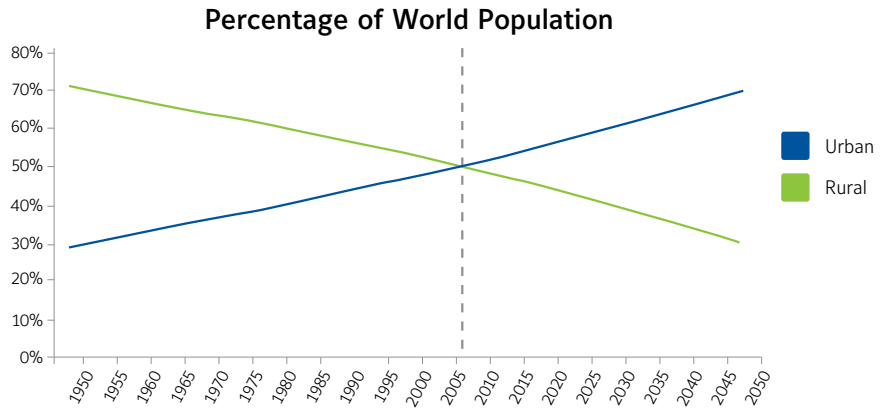
Policymakers seeking to provide affordable, reliable energy to populations that have been un-served, or under-served should look to energy efficiency as a key component of the solution. Efficiency is one of the most effective and lowest-cost measures to help expand energy access and distribute scarce energy resources. Making the best use of existing supply is crucial to improving access to energy, especially in high-growth countries such as Brazil, China and India.[17] Each additional $1 spent on energy efficiency in electrical equipment, appliances and buildings avoids more than $2, on average, in energy supply investments.[18]

Sustainable Urbanization: Rapid Demographic Change

Buildings form the fabric of the rapidly growing urban landscape. In 2008, for the first time in history, more than half of the world's population – 3.3 billion people – lived in urban areas. That number is expected to increase to 5 billion by 2030. Such scale of urban growth in developing countries is unprecedented (see Figure 2). Rapid urbanization means there is a tremendous opportunity today to shape tomorrow's cities and buildings. Cities may be key sources of innovation and action – many have been independently pioneering approaches to improve the efficiency and resilience of new and existing buildings.

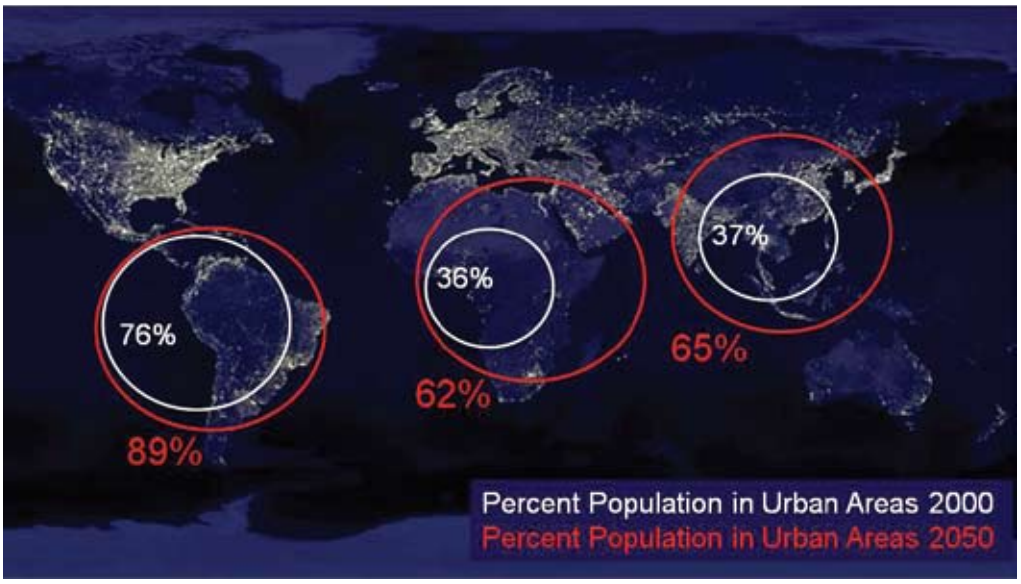
Urbanization is happening at the fastest rates in emerging economies. For example, more than half the world's current population lives in Asia, and 28 percent of those people will move from rural to urban areas by 2050.

Figure 2.
The pace of urbanization is unprecedented



Source: United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2006 Revision (2007) [19]

Figure 3.
Percent Population Growth in Urban Areas, 2000-2050



Source: NASA image. United Nations, World Population Prospects: The 2008 Revision (medium scenario) (2009) [20]

With urbanization comes rapid growth in construction of buildings. According to a report by Global Construction Perspectives and Oxford Economics,[21] the global construction market will grow from $7.2 trillion today to $12 trillion by 2020. By 2020, emerging markets will account for 55 percent of global construction, up from 46 percent today.

The massive changes that urbanization, growth and economic development are bringing to urban environments mean that countries and cities are at a crossroads. They can choose to "lock in" energy inefficient buildings and their accompanying greenhouse gas emissions, or they can choose to pursue a low-carbon future. There is a need today to design policies and markets that enable a basic systemic change in which cost-effective, low-carbon opportunities like energy efficiency are captured. Investments in efficient buildings can play a key role shaping the urban energy future.

ENVIRONMENT AND HEALTH

Buildings use large quantities of raw materials, including energy, water and construction materials, competing with other sectors of the economy for these scarce resources. The environmental impact of the built environment can be minimized with energy efficient buildings

Box 3.
Low-Carbon Cities in China[22]

China has pledged to reduce carbon emissions by 40-45 percent per unit of GDP by 2020, compared to 2005 levels. The central government expects to meet this goal in part through the development of low-carbon city projects. According to China's 12th Five Year Plan, by 2015 China will establish 100 model cities, 200 model counties, 1,000 model districts and 10,000 model towns under a green and new energy theme to showcase its achievements in low-carbon development. According to a study by the Chinese Society for Urban Studies (CSUS), 276 of the 287 cities in China with municipality status have proposed low-carbon or Eco-City goals. Of these, more than half have begun construction projects in an effort to fulfill these goals, while more than a quarter have specific plans for action in the near future. Chinese low-carbon cities are predominantly new developments and have been encouraged under China's 2009 economic stimulus package, which promised to invest RMB201 billion (US$32.8 billion) in energy efficiency and alternative energy industries.

In addition, the National Development and Reform Commission (NDRC) in China's 12th Five Year Plan designated eight cities as national pilots for low-carbon development, including Tianjin, Shanghai, Hangzhou, Chongquing and Baoding. Plans for low-carbon cities generally place more importance on building efficiency when the city enjoys a high level of post-industrialization, as in Tianjin, Shanghai and Hangzhou. In cities where the level of post-industrialization is relatively low, as in Chongquing and Baoding, building efficiency is not central to the overall low-carbon development strategy, as carbon reductions can be achieved more easily in the industrial sector.

that mitigate greenhouse gas emissions, as well as with environmentally sound siting decisions, materials selection, water use, and waste management. In addition, energy efficient buildings contribute to better indoor and outdoor air quality, leading to health benefits.

Mitigating Climate Change

Buildings make up a large portion of greenhouse gas emissions today, and under a business-as-usual scenario they will contribute even more emissions by 2030. A study by International Energy Agency (IEA) shows that if implemented globally, energy efficiency measures could deliver two-thirds of the reductions of the energy-related CO2 emissions needed to move from business-as-usual to a 450 ppm trajectory by 2030,[23] with most abatement coming from end-use measures. A global GHG abatement cost curve for energy efficiency measures through 2030[24] shows that many building efficiency measures actually have a negative cost of abatement for CO_2e. This suggests that over the life of the building, the energy savings outweigh the up-front cost increases of designing and constructing a more energy efficient building.

In addition to being a low-cost source of greenhouse gas mitigation, energy efficient buildings can be designed to increase resilience to the impacts of climate change. Resilience to climate change impacts can be integrated into the design, construction and management of buildings. This is especially important in developing countries, where inadequate buildings may put at risk the lives of millions of people. For more details on the ways energy efficient buildings can mitigate carbon emissions and increase building resilience to climate change, see the Climate Action section.

Efficient Use of Water, Waste, Land and Building Materials

Sustainable buildings go beyond energy efficiency to minimize many other environmental impacts. Buildings have an impact on the environment from land use decisions at the time of siting, selection of materials during design and construction, the use of energy and water over the building's life, and the management of the waste produced in the building.

The siting of a building has an impact on the environment. Decisions must be made about matters such as placing the building on a brownfield site or virgin natural landscape, locating it close to public transportation, and choosing a site with high-quality solar energy resources. Decisions also affect the building's orientation for solar energy or daylighting, strategies to control sediment and erosion, and the impact of the building on stormwater runoff.

Buildings are also big users of water. The world's cities take up just two percent of the Earth's surface, yet account for roughly 60 percent of the water tapped for use by people.[25] There are many potential ways to increase water efficiency, including installing low-flow faucets, toilets, showers and washers and fixing leaks. In addition, in arid areas, rooftop water catchment systems can be considered for collecting rainwater and using it for landscape irrigation.

In addition, construction materials and interior design elements like furniture and carpeting can be sourced sustainably. And, waste from the building can be recycled both daily basis and at the time of a major renovation, when building materials need to be disposed of.

Many green building certification programs exist around the world. A leading example is the LEED Green Building Rating System developed by the U.S. Green Building Council, which provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance

solutions. LEED provides independent, third-party verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. The number of LEED certified buildings has been growing rapidly. LEED registered and certified projects now represent nearly 9 billion square feet of building space, and 1.6 million square feet of real estate is LEED certified per day around the world. LEED and other certification programs are transforming the way built environments are designed, constructed, and operated.

Improved Indoor and Outdoor Air Quality

Efficient buildings that are adequately ventilated tend to be healthier than conventional buildings. Indoor air quality is an extremely important issue. For example, one study shows that American's spend more than 90 percent of their time in buildings.[26] According to the same study, indoor air quality was on average five times (and as high as a 100 times) worse than outdoor air quality. Efficient, green buildings help create healthier conditions by supporting more stable indoor climates, with less draft from windows, walls, floors, and ceiling constructions in cold climates, and better shading and ventilation for less heat encroachment in hot climates. All of these benefits result in an improvement in the quality of life of building occupants.

Inefficient energy consumption contributes to air pollution produced by the combustion of fossil fuels used to make electricity. Reducing energy consumption in buildings can reduce the amount of fossil fuels needed for power generation. Emissions from power generation affect air quality, and reducing fossil fuel emissions can reduce the frequency of illnesses such as asthma and lung cancer, as well as lower the overall mortality rate.[27] One study analyzed the health impacts of increasing residential insulation for new housing in the U.S. from current practice to best practice. According to the International Energy Conservation Code, NOx emissions decreased by 30,000 tons and SO2 emissions decreased by 40,000 tons over 10 years.[28] Another study by the Harvard School of Public Health found that insulation retrofits of single-family homes in the U.S. would result in 100,000 fewer tons of NOx and 190,000 fewer tons of SO2 per year, leading to an estimated 240 fewer deaths, 6,500 fewer asthma attacks, and 110,000 fewer restricted activity days per year.[29]

CONCLUSION

The opportunity exists today to align rising energy demand and urbanization trends with sustainable development goals by making buildings more efficient. Efficient buildings improve energy, water and materials efficiency, enhance indoor and outdoor air quality, and contribute to greenhouse gas emission mitigation. The resource efficiency of effcicient buildings can help cities and countries meet economic development goals while also meeting social and environmental goals.

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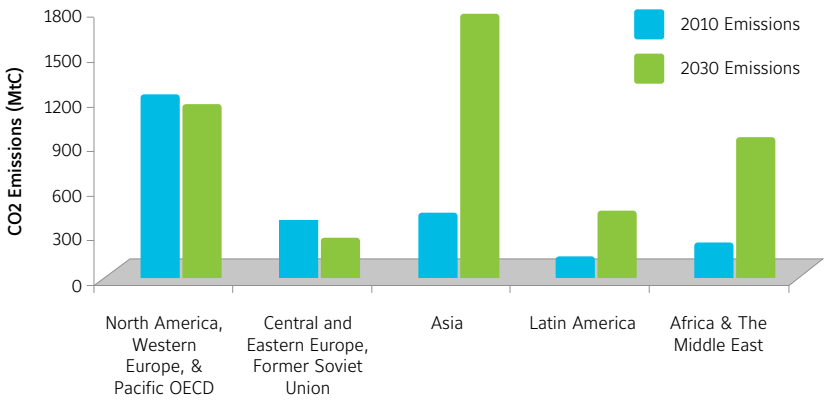
CLIMATE ACTION AND BUILDINGS

Energy efficient building policies are tools that can contribute to greenhouse gas mitigation efforts and a sustainable energy future. Changes in commercial, public, and residential buildings design and construction are widely identified as the most cost-effective greenhouse gas abatement opportunities. Two mechanisms, nationally appropriate mitigation actions (NAMAs) and low-emission development (LED) planning, present opportunities for emerging economies to receive assistance in the design and implementation of building efficiency policies. Today, building efficiency policies often receive less attention than renewable energy projects and other abatement opportunities even though the mitigation potential per dollar spent is greater.

EFFICIENT BUILDINGS: A SOURCE OF COST-EFFECTIVE EMISSION REDUCTIONS

Buildings make up a large portion of greenhouse gas emissions today, and under a business-as-usual scenario they will contribute even more emissions by 2030.

Figure 1.
Current and Projected Building Sector Emissions by World Region



Source: IPCC A1 scenario, www.ipcc.ch[1]

For example, the McKinsey estimates that about 50 percent of the world's new building construction between 2008 and 2015 will take place in China, making buildings a significant driver behind China's greenhouse gas emissions.[2]



Energy efficient buildings are a source of significant and cost-effective mitigation of greenhouse gas emissions.

Every US$1 of support for energy efficiency catalyzes a reduction of about 2.2 tons of CO2. The same investment in renewable energy catalyzes a reduction of only 0.4 tons.

Investing in building efficiency can help emerging economies build sustainable communities and avoid "locking in" high emissions amid rapid urbanization.

Nationally appropriate mitigation actions (NAMAs), low-emission development (LED) strategies (low-carbon development), and city actions offer new opportunities for accelerating and scaling up building efficiency in developing countries due to their emphasis on long-term policy planning.

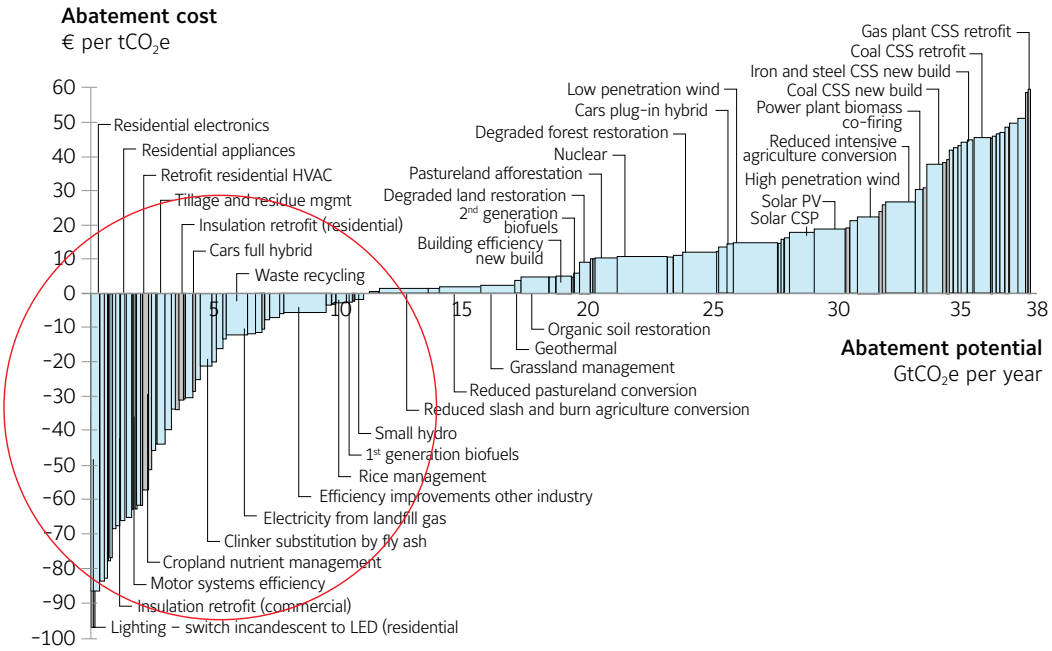
Today, building efficiency policies often receive less attention than renewable energy projects and other abatement opportunities, despite being identified as least-cost strategies for governments and investors.

Energy efficient buildings can increase resilience to the impacts of climate change.

According to a Technology Roadmap completed by the International Energy Agency (IEA), low/zero-carbon and energy efficient heating and cooling technologies for buildings have the potential to reduce CO2 emissions by up to 2 gigatonnes (Gt) and save 710 million tonnes oil equivalent (Mtoe) of energy by 2050. Other technologies like building shell, lighting and system control technologies have the potential to increase that CO2 emission savings in the buildings sector to 5.8 Gt by 2050, lowering emissions by 83 percent below the study's baseline scenario.[3] Most of these technologies are commercially available today. But IEA notes that to achieve a scenario with these emission reductions, strong policies will be needed from governments around the world. Policies can create the economic conditions that will enable a transition to low-carbon buildings.

Efficient buildings can help meet both economic and climate goals. A McKinsey abatement cost curve shows that many building efficiency measures actually have a negative cost of abatement for CO2e.[4] This suggests that over the life of the building, the energy savings outweigh the up-front cost increases of designing and constructing a more energy efficient building.

Figure 2.
Global GHG Abatement Cost Curve Beyond Business-As-Usual – 2030



Source: McKinsey & Co. "Pathways to a low-carbon economy. Version 2" (2009)[5]

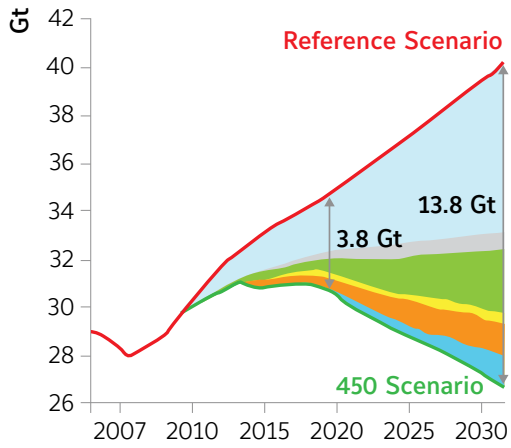
The climate benefits of energy efficient buildings also mean that emerging economies can tap into climate-related donor funds, such as the Global Environment Fund, the Climate Investment Fund, the Green Climate Fund and other sources of financing for NAMAs and LED's.

Another study by IEA shows that if implemented globally, energy efficiency measures could deliver two-thirds of the reductions of the energy-related CO2 emissions needed to move

from business-as-usual to a 450 ppm trajectory by 2030,[6] with most abatement coming from end-use measures.

Buildings play a critical role in a global package of 25 priorities on energy efficiency suggested by the IEA. Five steps to making buildings more efficient – including codes for new buildings, energy efficiency in existing buildings and certification schemes – could deliver 4.8 Gt of CO2 reduction.[7] Under a business-as-usual scenario, CO2 emissions from buildings would increase over 14 Gt by 2030, compared to 8.6 Gt in 2004.[8] Because much of the mitigation can be met through low-cost options, no other major abatement category can deliver the economical mitigation potential that can be achieved in this sector.[9]

Figure 3.
End-Use Efficiency: The Largest Abatement Potential to 2030



	Share of abatement % 2020	2030
Efficiency	65	57
End-use	59	52
Power Plants	6	5
Renewables	18	20
Biofuels	1	3
Nuclear	13	10
CCS	3	10

Source: IEA, World Energy Outlook (2009) [10]

By 2050, current technologies could reduce energy use in buildings by 41 percent and avoid 11.5 Gt of CO2, or 40 percent of CO2 emissions.[11] Much of the potential is found in the developing world.

NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMAS)

At the 2007 Framework Convention on Climate Change Negotiations, nations set the stage for two types of climate actions and structures for support, depending on the development level of each country. The Bali Action Plan created a process for developing countries to submit and undertake NAMAS in exchange for financial and technical support from developed countries (including support for policy and project design and implementation). Three years later, in 2010, countries agreed on a package that further elaborated elements contained in the Bali Action Plan (2007) and the Copenhagen Agreement (2009).[12] The Cancun Agreement formalized that developed countries would undertake quantified economy-wide emissions ***targets***,[13] while developing countries would undertake NAMAs. NAMA is an umbrella term that can include any ***voluntary*** efforts by developing countries to deviate from business–as-usual emissions growth by 2020 "in the context of sustainable development supported and enabled by technology" from developed nations.[14]

For the first time, large emerging economies acknowledged their mitigation actions under the UN Convention on Climate Change.[15] NAMAs are a new concept for policymakers in emerging economies as well as donor countries. A compilation of initial NAMAs submissions was officially published in March of 2011.[16] Many countries did not submit energy efficient building-related NAMAs in this first round of submissions, but are continuing to develop NAMA approaches. Interestingly, as of March 2011, many of the NAMAs were more directed at changing the energy supply mix – looking at cleaner ways of generating electricity – but few looked at ways to reduce energy demand over time.

Developing countries have agreed to measure, report and verify (MRV) mitigation actions (NAMAs) that require ***international*** support.[i] Actions that are ***domestically*** supported will be monitored, verified and reported at the national level and recorded in a separate section of the registry. The Cancun decisions also provide an international registry that will provide information on the NAMAs for which international support is sought in the form of technology, finance or capacity-building, with the goal of matching actions with potential supporters (see Box 1). A process of international consultation and analysis (ICA) of ***biennial*** reports by developing countries will be designed in 2011, along with the guidelines for matching NAMAs and support as well as for MRV.[17]

Box 1.

Mechanisms for support: finance, technology and capacity building[18]

International support for NAMAs will come in the form of funding, technological cooperation and capacity building. The Cancun Agreement formalized the pledges made by developed countries in Copenhagen to:

- Provide US$30 billion between 2010-2012
- Jointly mobilize US$100 billion a year by 2020 to support climate action needs in developing countries (A significant portion of these funds is expected to flow through the Green Climate Fund that is in the process of design and implementation).

In Cancun, governments also decided to establish a **Technology Mechanism**

- It should be operational by 2012. A Technology Executive Committee will need to strengthen the development and deployment of new technologies and help increase investment in technology.
- A Climate Technology Centre and Network will facilitate technology networks, organizations and initiatives, providing direct assistance to developing countries and stakeholder collaboration.

The structure of the arrangements for **capacity building** and for monitoring the effectiveness of capacity building is under development.

i. In the Cancun Agreement, developed countries agreed to submit detailed annual inventories of greenhouse gas emissions and report progress in emission reductions every two years. In 2011, countries were discussing how best to meet these reporting requirements.

LOW-EMISSION DEVELOPMENT (LED) PLANNING

The concept of LED first emerged in 2008 in the UN international climate negotiations[19] and has gained traction in the international community ever since. Members of the international community are increasingly seeking to build connections between sustainable development goals and the mechanisms that can be supported through the United Nations Framework Convention on Climate Change (UNFCCC). LED plans are also known as "low-carbon development plans", low-carbon growth plans and low-carbon, climate-resilient strategies. The goal is to develop a national roadmap based on country priorities to guide the shift toward a low-emissions trajectory and a climate- resilient economy, following a clear timeframe and long-term implementation plan.[20]

Box 2.

Pathways to low-carbon growth and development: Illustrative efforts[22]

Preliminary lessons from the first generation of LEDs point to the importance of data-driven analysis; the specification of concrete goals, targets and timelines; and explicit treatment of institutional capacity and financing plans. Some pioneering examples include:

South Africa. The government put together a national multi-stakeholder process that pioneered the consensus-based identification of long-term mitigation planning scenarios to 2050. The process led to strategic options for South Africa, including a set of measures that aim to close the gap between "growth without constraints" and "growth required by science" national trajectories (about 1,300 Mt of CO2). The process was launched in 2006, the scenarios were publicized in 2008, and the process continues today. Since 2009, the National Planning Commission of South Africa, in charge of strategic planning for the country, operates through a group of external experts, not ministers.

South Korea. The government put together a long-term green economy plan that includes a recovery package of over US$30 billion, as well as an allocation of 2 percent of GDP to reinforce R&D of 10 key green technologies. Much of the emphasis is on creating a favorable investment environment for green industries. Several incentives for green investment by the private sector are available, such as a package of green loans (US$6.3 billion for 2010-12) and guaranteed support for green industries (US$4.8 billion 2010-12). Government action plans are available for 27 core green technologies, as well as tax benefits, such as acquisition/registration tax exemption for environmentally friendly housing and customs duty reduction on renewable energy materials.

United Kingdom. In 2008, the UK was the first country to impose a mandatory reduction of 34 percent in greenhouse gas emissions by 2020 and at least 80 percent reduction by 2050. The UK Low Carbon Transition Plan is the national strategy for energy and climate. To meet the 2050 goal, carbon budgets have been introduced, and the first four extend to 2027. An independent commission monitors progress and reports yearly.

Fostering growth and development ***while*** reducing greenhouse gas emissions and climate vulnerability calls for a long-term policy pathway. Models based on ad hoc implementation on a project-by-project basis will be insufficient to catalyze a shift toward a low-carbon economy at the scale and pace needed.[21] To encourage systemic change, a number of pioneering countries have taken the first steps in the design of longer-term pathways that promote LED (See Box 2 for examples).

Building efficiency is a natural fit for LED plans given the strong emphasis of these plans on **long-term planning** among climate, energy and development policymakers in developing countries. New emphasis is placed on the need to create synergies across sectors and institutions in low-carbon development plans, and building efficiency policy design and implementation often requires this kind of coordination across different government institutions and sectors of the economy (See examples in Box 3). The design of long-term scenarios and action plans offers an opportunity for collaboration between national and local governments and experts from the building efficiency and resilience communities.

Box 3.
Building Efficiency in Low Emission Development Plans[23]

Building Efficiency in Mexico
In working with the Mexican government to prioritize options for low-carbon development, the Energy Sector Management Assistance Program (ESMAP) outlined a plan that focused on the net cost or benefit of each instrument to reduce emissions along with an analysis of implementation feasibility. In this plan, efficiency interventions in the residential and nonresidential building sectors were projected to reduce up to 18 million tons of CO2e per year, with a cumulative net benefit of US$62 per ton of CO2e reduced.

Building Efficiency in Poland
In Poland, energy efficiency measures across buildings, transport, and industry played a central role in the country's marginal abatement cost curve analysis because of their low price and little impact on growth. In particular, the report generated by ESMAP in cooperation with the Polish government found that end-use measures had lower capital costs and earlier returns. If implemented successfully, cross-sector energy efficiency measures can deliver nearly 30 percent of Poland's greenhouse gas emission abatement obligations at a negative cost of -14€ per ton of CO2e reduced.

THE CLIMATE FINANCE GAP FOR EFFICIENT BUILDINGS

The Global Environment Facility (GEF) has shown that every US$1 of GEF support for energy efficiency catalyzes a reduction of about 2.2 tons of CO2. The same investment in renewable energy catalyzes a reduction of only 0.4 tons. In 2011, the independent evaluation arms of the GEF, the World Bank Group, the Asian Development Bank, and the European Bank for Reconstruction and Development analyzed investments in energy efficiency across these institutions and found that significant biases were hampering the financing of energy efficiency

projects, despite larger mitigation returns on investment when compared to energy generation projects.[24]

A look at climate finance data shows that even though building energy efficiencyprojects have been identified as least-cost strategies for governments and investors, development institutions lag both in approving such projects and in dispersing the funds. Data from the website ***Climate Funds Update*** showed that out of 417 cataloged mitigation projects, just 84 projects were related to either energy efficiency, standards and labeling, efficient appliances, or lighting.[25] Of these projects, less than half of the approved funds had been received by recipient countries at the time of writing this report. Only 32 projects specifically addressed the building sector at the public, commercial, or residential level.

EFFICIENT BUILDINGS: INCREASED RESILIENCE TO THE IMPACTS OF CLIMATE CHANGE

Extreme weather can affect buildings because of increased ***heat*** (higher temperatures in the summer, higher peak temperatures, more heat waves, warmer nights, hotter cities, urban heat islands), changes in exposure to ***cold*** (much lower temperatures in the winter; some areas with increased winter precipitation, often as ice, and unsafe conditions in poorly insulated households) and/or changes in access and availability of ***water*** (potential extreme storms, floods and landslides, increased humidity, droughts, and freshwater scarcity).

Resilience to climate change impacts will need to be integrated into the design, construction and management of buildings, especially in developing countries where inadequate buildings may put at risk the lives of millions of people. Integrated designs that plan for energy efficiency and climate resilience improve building performance in multiple ways.[26] Integrated design choices can help communities select physical locations of buildings that can increase their resilience – for example, by choosing higher locations instead of floodplains. Also, efficient buildings that save water can reduce demand and help improve water management in cities.[27]

A growing number of countries, such as Bangladesh and Maldives, are designing integrated policies that increase their capacity to adapt to climate change and build resilience. These efforts may offer a landing point for further actions on the built environment as national and local governments seek to put in place fit-for-purpose infrastructure.[28]

Some of the initial actions that can be incorporated in integrated, climate-friendly design are suggested in Box 4.

Today, growing concerns about climate vulnerability have increased the impetus of the adaptation agenda. In December 2010, the ***Cancun Adaptation Framework*** was established to support planning and implementation of adaptation measures in developing countries through increased financial and technical support. A work program on how to tackle ***loss and damage*** from climate change impacts in developing countries was created in Cancun to identify ways of managing and reducing ***climate change risk*** in developing nations – for example, the design of a climate risk insurance facility. The program also includes ways of addressing rehabilitation from the impacts of such climate-change-related events as sea-level rise.

Box 4.

Examples of Integrated Climate-Friendly Design in Buildings[29]

- Enhanced structures that can manage future winds, subsidence and heave.
- Heating, ventilation, and air conditioning systems that can be adjusted for new climates – such as areas with increased heat waves.
- Passive cooling to avoid discarding heat that can worsen heat islands.
- Drainage systems, permeable paving and entrance thresholds that can handle more intense rainfall.
- Exteriors designed to reduce heat gain in the summer to better handle heat waves; insulation that allows poor households to stay warm during extremely cold winters; exteriors that provide the level of precipitation resistance needed for a new climate.
- Water usage efficiency to help tackle freshwater scarcity.

Box 5.

Cities and Adaptation[30]

Cities have historically adapted to changes – adaptation is part of their business-as-usual practice – and are uniquely placed to tackle the imperative for building efficiency and resilience, perhaps even faster than national governments. Some of the actions cities are to undertake include the mainstreaming of climate and disaster risk reduction as factors in urban planning, project design and decision-making. Municipalities are often at the forefront of innovation on adaptation measures, encouraging cooperation with other cities and sharing best practices. City planners and other decision-makers seek to attract investment at scale to build infrastructure that can resist potential climate-related effects, such as flooding, sea-level rise, and shifts in precipitation. The search for new mechanisms to finance the "Resilient City" illustrates the stronger emphasis among local governments on developing solutions for the urban environment.

While a significant opportunity exists to increase resilience, actions are just beginning. For now, these efforts consist of pilot projects supported by international cooperation. The challenge going forward is to identify scalable, financially viable solutions that can be adjusted and replicated.

CONCLUSION

Under a business-as-usual scenario, building sector contributions to greenhouse gas emissions are set to rise rapidly in fast-urbanizing developing countries in Asia, Latin America and Africa. Studies show that improved energy efficiency in buildings has the potential to be a sizable, cost-effective greenhouse gas emission abatement opportunity. Energy efficient buildings can also contribute to making cities more resilient to climate change. Progress has been made in recent years to integrate building efficiency into climate change mitigation and adaptation plans, but more can be done. Mechanisms such as NAMAs and LED plans present an opportunity for developing countries to receive assistance in the design and implementation of building efficiency policies.

In the Cancun Agreement, developed countries agreed to submit detailed annual inventories of greenhouse gas emissions and report progress in emission reductions every two years. In 2011, countries were discussing how best to meet these reporting requirements.

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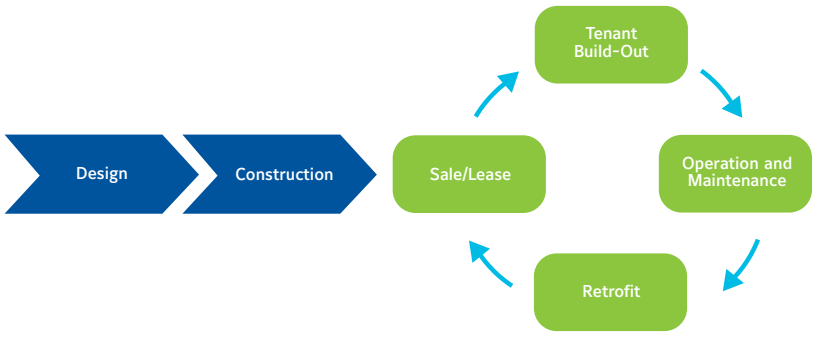
TRANSFORM BUILDINGS: A POLICY PATHWAY OVER THE EFFICIENCY GAP

THE BUILDING'S LIFECYCLE

Buildings begin their lives in the architect's imagination and design, and end with demolition decades or centuries later. Making buildings energy efficient requires an up-front investment that can then be repaid many times over through energy cost savings. In order to recover that up-front investment in energy efficient buildings, every actor, at every stage in the building's life, must select appropriate sets of energy efficient actions and technologies.

Policies can help align the interests of all actors around implementing cost-effective energy efficiency options at each stage of a building's lifecycle. The following figure illustrates the lifecycle of a building.

Figure 1.
Lifecycle of a Building



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)



Opportunities to increase the energy efficiency of buildings exist at each stage of a building's life.

Building energy efficiency faces many barriers in implementation; various policy options exist to tackle these barriers and enable markets to overcome the energy efficiency gap.

Policies range from incentives to regulation, and vary in the ease of design and implementation.

Countries or cities must map out their own policy pathways to transform the built environment in a way that is most appropriate for them.

Mexico and Singapore have each pioneered sets of policies that are beginning to transform their built environment to greater energy efficiency.

The following examples illustrate how these options work throughout the lifecycle of a building:

- The ***design and construction process*** includes the orientation, the number of floors, and the types of insulation and windows. These factors help determine and may lock in the energy efficiency levels of the building.
- When the building is sold, the developer, realtor, appraiser, owner and lender must be able to accurately value the future operating cost, including energy costs. If future operating costs are accurately estimated, then they can be included in the valuation of the property, as well as in the bank's evaluation of the owner's future ability to repay the loan.
- Building out new tenant space inside an existing home or building creates an opportunity to invest in high-performance, energy efficient options. For instance, the components a tenant might undertake include energy efficient lighting, plug load management, and occupancy-controlled HVAC systems with efficient zone control.
- The tenant and owner will make ***operation and maintenance*** decisions on an ongoing basis. Many of these decisions affect energy usage and provide an opportunity to improve energy efficiency.
- Existing buildings that were not built with energy efficiency in mind may need an energy efficiency ***retrofit*** to upgrade the original design and construction and make the whole system more energy efficient.
- Finally, a building may go through a ***major renovation***, which starts the cycle over again with design and construction.

Policies that aim to support building efficiency should align the interests of all actors around implementing cost-effective energy efficiency options at each stage of a building's life.

INTRODUCTION TO BARRIERS AND POLICY OPTIONS

Summary of Barriers: The Efficiency Gap

Multiple barriers to energy efficiency exist, creating the 'efficiency gap.' These barriers prevent actors from making cost-effective investments in energy efficiency. At each stage in a building's lifecycle, barriers are well documented in the literature on energy efficiency. They range from split incentives that prevent investors from valuing energy efficiency to awareness issues that accrue from lack of information about building performance.

Table 1 clusters the main barriers into five major categories.

Table 1.
Barriers to Energy Efficiency

Market	· Price distortions prevent consumers and investors from valuing energy efficiency. · Split incentives – transactions where economic benefits of energy savings do not accrue to those who invest in energy efficiency, as when building owners pay for investments in energy efficiency, but occupants pay the energy bills. · High transaction costs. · Externalities associated with fossil fuel consumption are not priced; imperfect competition. · Dispersed and diffuse market structure with multiple locations and small end users. · Multiple industries – construction, efficiency, energy industries – are involved in building efficiency, posing a multi-sectoral challenge. · Energy tariffs discourage energy-efficient investments.
Financial	· Organizations rely on constrained internal capital and operational budgets. · High up-front costs and dispersed operational benefits discourage investors. · Perception that energy efficiency investments are complicated and risky. · Financial institutions lack awareness of financial benefits. Perception remains that financial benefits from energy efficiency are non-existent or exaggerated. · For building owners, a lack of external finance. · For financial institutions, small transaction sizes may require bundling of buildings or improvement measures to make them suitable for financing.
Techinical	· Lack of affordable energy efficiency technologies (or know-how) suitable to local condition. · Insufficient capacity to identify, develop, implement, and maintain energy efficiency investments. · Lack of firms that can aggregate multiple projects; lack of implementation firms that can deliver cost-optimal energy efficiency project.
Awareness	· Lack of sufficient information and understanding on the part of consumers/tenants/building owners to make rational consumption and investment decisions. · Lack of information about the performance of buildings. · Energy information may not be provided or analyzed by end users, energy providers, or other implementing agencies. · Benchmarks for performance may not exist. · Perception that energy efficiency measures make buildings more expensive.
Institution	· Governments, especially in developing countries, have limited technical capacity to design and implement energy efficiency policies, programs, building codes and standards. · Inter-agency coordination to ensure policy coherence (at different levels of government, between various energy policy goals, or across scattered energy efficiency initiatives) is limited. · Regulators pay limited attention to demand-side measures. Traditionally, policy packages rely on supply-side interventions. · Energy providers are compensated by selling energy, instead of by delivering energy efficiency. · Government and the private sector rarely work through partnerships that tackle energy efficiency in a collaborative manner.

Sources: IEA Energy Efficiency Governance (2010)
EEI Survey,Institute for Building Efficiency (2011)
Christiana Figueres, Executive Secretary, United Nations Framework Convention on Climate Change (2011) [1]

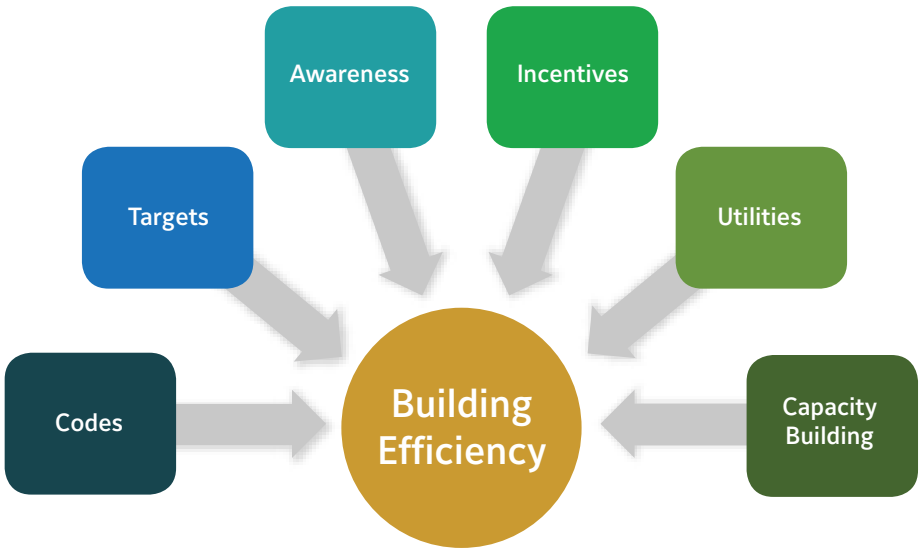
Barriers vary in importance between countries. For example, awareness and technical barriers play a bigger role in less-developed energy efficiency markets, whereas market and finance barriers are likely to be the biggest challenges in markets that have more experience pursuing energy efficiency opportunities.[2]

The institutional barriers listed in Table 1 are very important for policymakers to take into account when planning building efficiency policies. This paper focuses the most attention on how to overcome the first four categories of barriers; the solutions to institutional barriers may best be addressed by experts in designing direct technical assistance programs. In addition, this paper does not delve into energy efficiency governance issues, which are well defined in a recent International Energy Agency report.[3] It is important that governments select policies and actions for which government capacity exists to design, implement and enforce that policy or action.

Summary of Policy Options

A policy package can be designed targeting key barriers to energy efficiency in any given market, bridging the efficiency gap created by these barriers and opening the opportunity for greater investment in energy efficiency. Many cities, regions, and countries have designed policies that improve the energy efficiency of their built environments. Today these policies are at different stages of implementation, but there are many lessons to be learned from policies being tried around the world today. The policy options available to governments to improve the energy efficiency of the built environment can be grouped into six categories. A few more details are given on each of these categories in Table 2, and each category will be covered in detail in its own section. Each country needs to choose the policy mix that transforms the built environment in a way that fits the local circumstances.

Figure 2.
Building Efficiency Policy Categories



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Table 2.
Policy Options for the Built Environment

Codes	· building energy codes · appliance and equipment standards
Targets	· building efficiency improvement targets · government procurement targets
Awareness	· data collection and baseline development · competition and awards programs · audits – voluntary and mandatory · ratings and certification programs · disclosure of energy performance certificates · public awareness campaigns
Incentives	· grants and rebates · risk mitigation guarantees · revolving loan funds · energy performance contracting enablers · tax incentives · tax-lien financing
Utilities	· utility public benefits fund · on-bill financing · revenue decoupling · advanced metering infrastructure · dynamic pricing of electricity · demand response
Capacity Building	· direct technical assistance · workforce training

Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

TACKLING THE EFFICIENCY GAP

Policies can enable the market to overcome the barriers to energy efficiency at each stage in a building's lifecycle. An effective policy package will build on an analysis of the barriers in a market and may be targeted at specific decision points in a building's lifecycle. The following figure shows how policies can help the market overcome barriers to energy efficiency.

Figure 3.
Crossing the Bridge to more Energy Efficient Buildings



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Different policies are needed depending on whether the focus is on increasing the efficiency of ***new*** buildings or retrofitting the ***existing*** building stock. Additional policies are needed to help the market fully capture the value of energy efficiency in the sale, lease and operation of efficient buildings. The following sections discuss the policy combinations that can help the market overcome each of the barriers at each stage in a building's life.

Given the unprecedented scale and pace of urbanization in emerging economies, it may become imperative for the policy packages in these countries to pay explicit attention to the attributes and needs of the new generation of building stock. In industrialized nations, such as European countries, a central policy question is how to improve the efficiency of the aging building stock and infrastructure. In both cases, it may be important to plan policies that help the market overcome barriers to the sale, lease and operation of efficient buildings.

Overcoming Barriers to Efficient Design and Construction

When architects, engineers, developers and others begin to plan a new building, there are various barriers that prevent them from undertaking energy efficient design and construction.

A fundamental barrier is that critical actors may not be ***aware*** of the opportunity, or they may not have the ***technical*** capability to evaluate the cost effectiveness of energy efficiency investments. These barriers can be overcome with policies that build greater ***awareness*** and ***technical*** capacity in the market. Policies that build ***awareness*** and ***technical*** capacity include:

- Competition and awards programs that give companies public recognition for beginning to track and improve upon the energy performance of their buildings.
- Energy audits or other voluntary programs and requirements that inform building owners and users about ways to improve their energy performance.
- Rating and certification programs (like LEED and ENERGY STAR in the U.S.) that help building owners and users understand how their building compares to others in the market.
- Programs that require the mandatory disclosure of building performance give even greater information and transparency to the market.
- Utility programs, public awareness campaigns, and smart meters to help customers understand and better manage their energy.
- Workforce training programs to build the technical capabilities in the market needed to successfully evaluate and implement building efficiency projects.

There are also ***market*** and ***financial*** barriers to making new buildings and major renovations more energy efficient. For example, developers and architects don't pay the energy bill in the buildings they build – the occupant typically pays the monthly energy bill. This is referred to as a split incentive. "First cost" is another common barrier: Any energy efficiency component that costs more than standard components will require an additional investment from the developer. Before making such investments, developers want to know that they will see a proportionate increase in the sale price in order to recoup that investment.

- The perception of investment risk can be overcome with building energy codes and appliance/equipment standards that establish certain energy performance standards for the market. Building energy codes should be tailored to climate zones and not draw too heavily on building regulations and practices from other climate zones. For example, in tropical zones, there is a greater need to address humidity and ventilation, and less need for thermal insulation.
- A more informed, transparent market can also help all actors accurately evaluate the value of an investment in energy efficiency. Rating and certification programs such as LEED and ENERGY STAR help provide the transparency to the market to enable developers to recoup their investment in additional energy efficiency. Mandatory disclosure of energy ratings is even more effective because then buyers know the energy ratings of all buildings they are considering, and they can factor future energy costs into their purchase decisions.

Overcoming Barriers to the Sale, Leasing and Operation of Efficient Buildings

When a building is sold or rented, there are various barriers that prevent owners and tenants from fully valuing energy-efficient components. In addition, many decisions are made in the operation and maintenance of a building that determine its energy efficiency.

When a building is being sold, the owners, tenants, financers and real estate agents generally do not have access to information on its energy performance. They, therefore, cannot assign a value to an efficient property as opposed to properties that may have higher operating costs or poor performance. Similar to the barriers to the design and construction of an energy-efficient building, at the time the building is sold or rented, the owner, tenants, financers and real estate agents may not be ***aware*** of the future cost savings they will receive by purchasing an energy efficient building, or they may not have the ***technical*** capability to evaluate those cost savings. The policy options to tackle these barriers are similar to those listed in the previous ***Design and Construction*** section, such as programs that require mandatory disclosure of building performance.

Additional policy options that can help overcome barriers to the sale and lease of efficient buildings are financial incentives that utilities or local governments can put in place to enable an investment in energy efficiency to be repaid on the utility bill or property tax bill – thereby overcoming the split incentives between the owner and tenant. See the section on ***Incentives and Utilities*** for more details on these policy options.

Also, when a building is being operated and maintained, there are many market barriers to energy efficient operation and maintenance. Utility policies that remove price distortions in the energy market, such as revenue decoupling, advanced metering, and time-based pricing, can enable more energy-efficient behavior on the part of end users.

Overcoming Barriers to Efficient Building Retrofits

When a building is older and could be renovated to improve its energy efficiency, there are various barriers that often prevent energy efficiency from being a priority.

Critical actors in an energy efficiency retrofit may not be ***aware*** of the opportunity, or they may not have the ***technical*** capability to evaluate the cost-effectiveness of an energy efficiency investment. The policy options to tackle these barriers are similar to those listed in the previous Design and Construction section.

There are ***market and financial*** barriers to energy efficiency retrofits. Many of the policies described in the last two sections to target these barriers also help enable more energy efficiency retrofits. In addition, a number of policies have been specifically designed to help enable the market for energy efficiency retrofits.

- Government procurement of energy efficiency retrofits in public buildings can stimulate market development.
- Revolving loan funds, government risk mitigation guarantees, tax-lien financing such as the Property Assessed Clean Energy (PACE) program (which repays an investment in energy

efficiency through an environmental upgrade charge on the property taxes) and utility on-bill financing programs are mechanisms often designed specifically to support the development of building efficiency retrofit projects.

- Policies that enable energy performance contracting (EPC) can enable energy service companies (ESCOs) to pursue more energy efficiency retrofits in the market. EPC-enabling policies include those that promote standardized, streamlined, and transparent project development and vendor selection processes, create umbrella contracts and ESCO pre-selection, provide project facilitators or consultants, and standardize measurement and verification procedures.

MAPPING POLICY OPTIONS: TOOLS FOR POLICYMAKERS

Mapping Policies Against Barriers

The barriers and policies presented in this section are a great starting point for policymakers looking to understand how to design a policy pathway to a more energy-efficient built environment, but the details of each barrier and policy vary by geography and by the sector of the market being targeted. For example, large office buildings in Thailand require a different set of detailed policy solutions than low-income housing might need in Colombia. But the barriers and policy solutions for each mostly fall in the general categories presented here. The following table shows the policies that can help the market overcome each barrier to energy-efficient buildings. Each country or city could fill in this map for itself for each sector of the market as a tool to help think through possible policy options.

Table 1.
Policies Enable the Market to Overcome Specific Barriers to Energy Efficiency

		Codes		Targets		Awareness						Incentives						Utilities						Capacity Building	
	BARRIERS	Building Energy Codes	Appliance and Equipment Standards	Building Efficiency Target	Government Procurement	Data Collection and Baseline Development	Competition and Awards Programs	Audits – Voluntary and Mandatory	Rating and Certification Programs	Disclosure of Performance	Public Awareness Campaigns	Grants & Rebates	Risk mitigation guarantee	Revolving Loan Fund	Energy Performance Contracting Enablers	Tax Incentives	Tax Lien Financing	Utility Public Benefit Fund	On-bill Financing	Revenue Decoupling	Advanced Metering Infrastructure	Time-based Pricing	Demand Response	Direct Technical Assistance	Workforce Training
Market	Split incentives																■	■	■						
	Transaction Costs	■	■									■													
	Dispersed Market Involving Many Sectors							■	■	■								■							
	Price Distortions in Energy Market															■				■	■	■	■		
Financial	Up-front Cost, Constrained Budgets	■	■		■							■	■	■	■		■		■						
	Perception of Investment Risk	■	■									■	■	■	■	■	■		■						
	Low Financial Institution Awareness										■	■	■	■			■		■						
	Lack of External Finance											■	■	■			■		■						
	Small Transaction Size											■	■	■			■		■						
Technical	Lack of Technical Capacity in Market	■	■		■		■											■						■	■
	Lack of Affordable Technology in Market	■	■									■				■									
Awareness	Lack of Information about Energy Performance and Improvement Opportunities					■	■	■	■	■	■							■			■	■	■		
Institutional	Low Government Capacity on New Policy				■	■																		■	
	Inter-agency Coordination Challenges																							■	
	Little Public-Private Coordination																							■	

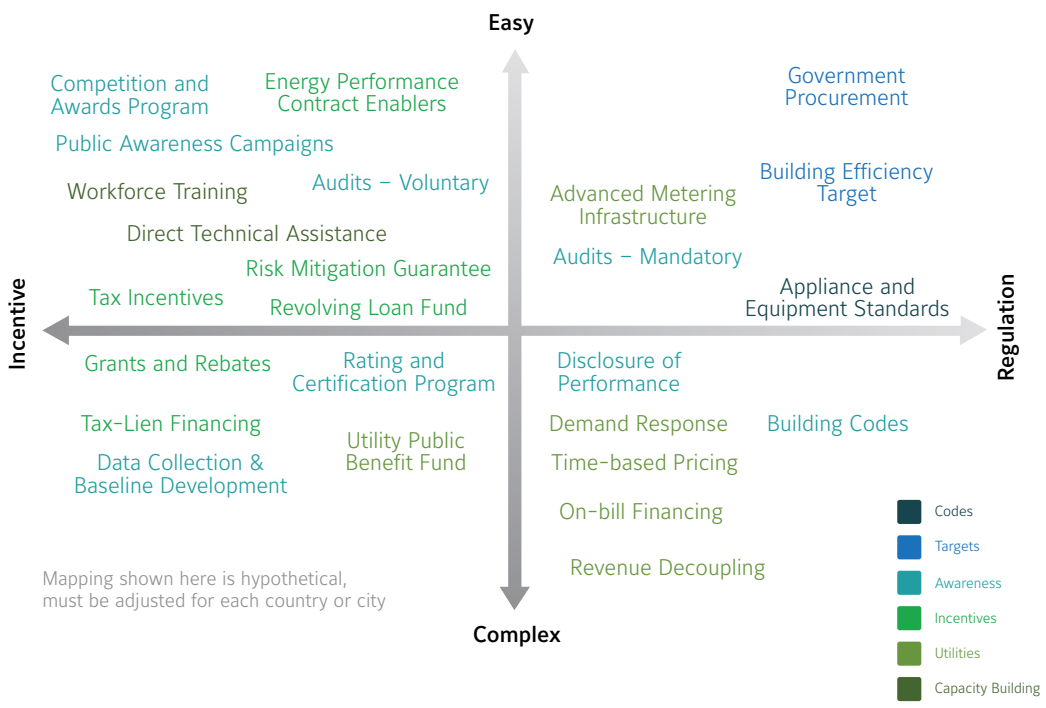
Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Mapping Trade-offs in Policy Sequencing

The following figure maps each policy on a scale of incentive vs. regulation. It also maps the ease with which policies and actions may be designed, developed and enforced.

- ***Incentives*** can improve market transparency and motivate voluntary action. They complement ***regulations*** that can mandate efficiency gains (horizontal axis).
- Policies can vary dramatically in the ***ease*** or ***complexity*** with which they can be developed, implemented and enforced (vertical axis).
- Each country, region or city that wants to develop a policy pathway for an energy efficient built environment should map out policy options. The locations of the policies on the map will depend entirely on local circumstances.
- Each locality must then determine its own best starting point on the map.

Figure 4.
Illustrative Trade-offs Among Policy Options



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

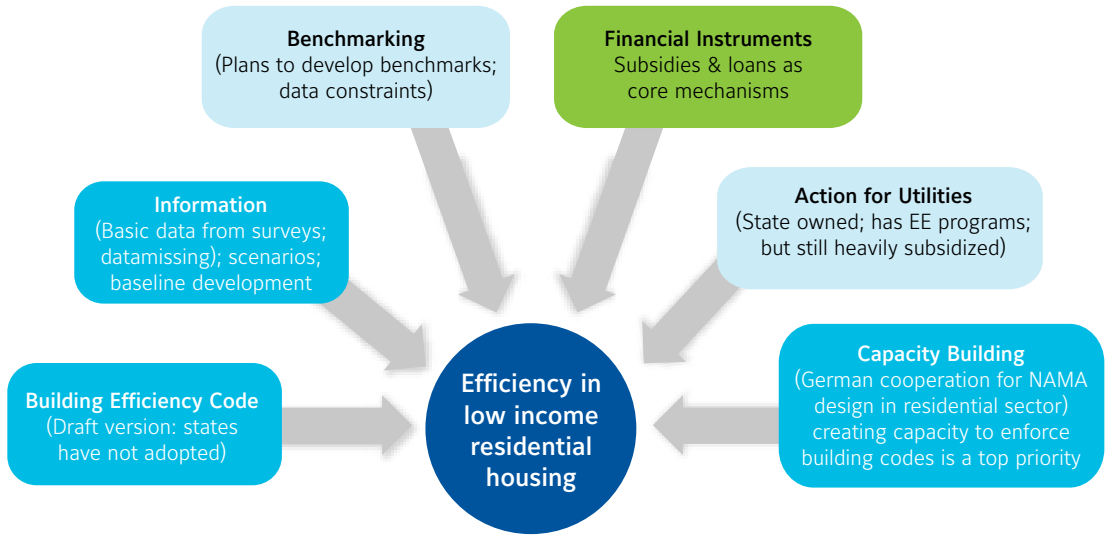
The mapping exercise is a tool to help policymakers think through possible policy options. What is not on this map is an evaluation of the scale of impact each policy will have on transforming the built environment to be more energy efficient. Impact is hard to generalize across geographies. While we have not tried to treat it here, it is an essential consideration as policymakers plan their own policy pathways.

EXAMPLES OF POLICIES COMING TOGETHER TO TRANSFORM THE BUILT ENVIRONMENT

Mexico

Mexico has pioneered a suite of policies and measures to transform its low-income residential housing market. Financial instruments are at the core of the strategy, providing an additional credit line for mortgages on properties that incorporate sustainable and energy efficient technologies, and subsidizing housing developers who achieve minimum energy efficiency criteria. Also, Mexico has developed model building codes and has begun to build government capacity to enforce the new laws as well as improve the technical capacity of actors in the market.

Figure 5.
Mexico's Approach

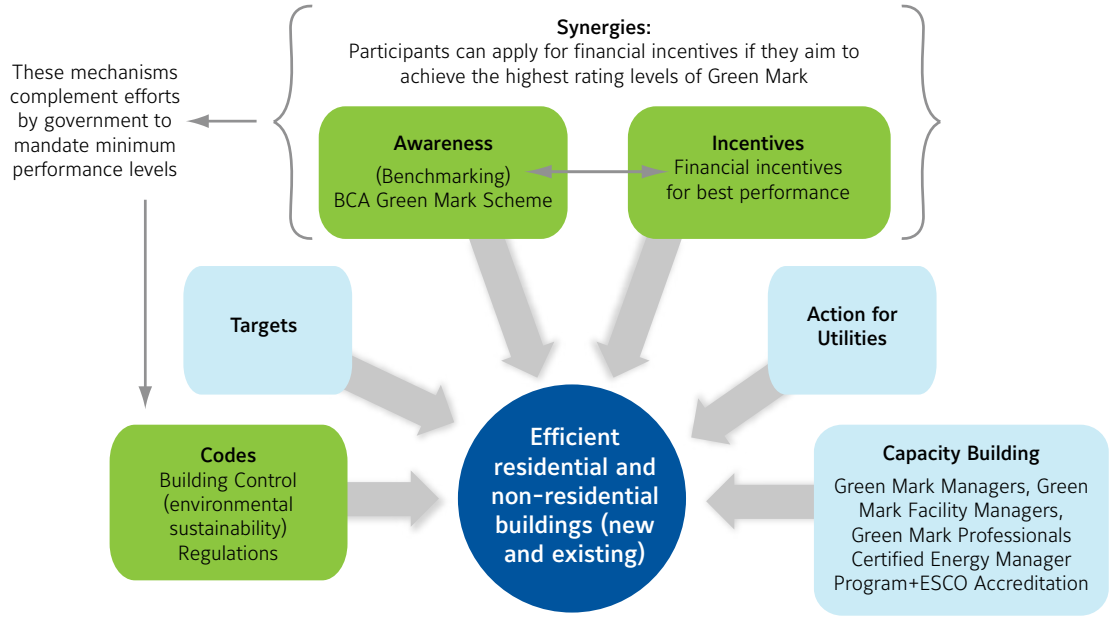


Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Singapore

Singapore has been a pioneer in the design of a balanced approach to transforming the market for building efficiency and environmental sustainability, combining incentives and regulation (carrots and sticks) and engaging key stakeholders in the lifecycles of buildings.

Figure 6.
Singapore's Approach



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

More details are provided on both Mexico's and Singapore's approaches in case studies on the Institute for Building Efficiency website: www.InstituteBE.com

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   Statement by Christiana Figueres, Executive Secretary, United Nations Framework Convention on Climate Change. Energy Efficiency Global Forum, Brussels, 14 April 2011.

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POLICY OPTIONS

Building Efficiency Codes and Standards

Energy Efficiency Improvement Targets

Increase Awareness: Information and Market Transparency

Financial Incentives

Actions for Utilities

Capacity Building

Case Studies (Mexico and Singapore)



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BUILDING EFFICIENCY CODES AND STANDARDS

BUILDING ENERGY EFFICIENCY CODES

Building energy efficiency codes are regulatory tools that establish minimum levels of energy efficiency for different building types, and may comprehensively cover the design and construction of all energy systems. Energy codes play a fundamental role in energy efficiency objectives, particularly for new construction, making them a priority policy pathway for developing and middle-income economies.[1] Codes include specifications regarding wall and ceiling insulation, window and door specifications, roofs and foundations, heating, ventilation, air-conditioning, equipment efficiency, water heating, lighting fixtures, and controls). These codes also include natural ventilation, shading, and renewable energy.

Codes can apply to new buildings as well as major renovations of existing buildings, depending on the policy design. They are particularly critical for new construction, as it is more costly to undertake deep energy retrofits later in the building's lifecycle. Without codes for new buildings, countries may literally be "locking in" inefficiencies for decades to come, with unseen energy and economic consequences.

There is no single energy code or set of requirements suitable for all economies and climates. Countries developing new building codes may seek advice from development agencies and tailor existing best practices to local climatic conditions as well as local, cost-effective, available technology. Boxes 1-4 give case studies showing how Indonesia, Singapore, China and India are implementing building codes to achieve greater energy efficiency in their built environments.



Codes and standards are regulatory tools that require a minimum level of energy efficiency in buildings, appliances or equipment. If they are well designed, they can cost-effectively decrease energy costs over the lifetime of that building, appliance or equipment.

In the absence of minimum energy efficiency codes and standards, rapidly urbanizing emerging economies risk "locking in" an inefficient, high-emission built environment for years to come.

Building energy codes ensure that all new buildings and major renovations are optimally energy efficient.

Appliance and equipment efficiency standards require all appliances and equipment to be more energy efficient.

Though not the focus of this paper, governance issues of good policy design and enforcement are particularly challenging and important for strong regulatory policies such as codes and standards.

Box 1.
Indonesia

Indonesia's new building codes were developed by analyzing cost-effective ways to get an average 30-percent energy savings in new buildings.

Sensitivity analysis of energy efficiency options for Jakarta shows that energy savings of more than 30-40% can be achieved from simple measures.

	High Impact Measures	Office	Retail	Hotel	Hospital	Apt.	School
	**Photoelectric controls** (inclusion of controls to maximize daylighting)	18%	11%	NA	17%	NA	10%
	**Solar shading** (addition of horizontal and vertical devices)	17%	11%	18%	18%	8%	2%
	**Glass performance** (higher solar and thermal properties)	15%	6%	16%	14%	11%	5%
	**Efficient Chillers** (higher chiller COP)	11.4%	8%	6%	7%	9%	12%
	**Variable-speed drives** (inclusion of variable drives on pumps)	9%	3%	3%	5%	0.0%	0.0%
	**Percentage glazing** (limiting window-to-wall ration of the facade)	8%	4%	9%	7%	2%	0.0%
	**Low-energy lights** (limiting the power density for artificial lighting)	7%	8%	7%	16%	6%	5%
	**Thermostat Management** (limiting the minimum temperature)	2%	3%	3%	7%	6%	11%
	**Heat Recovery** (adding heat recovery unit to fresh air inlet)	2%	5%	3%	8%	0.0%	0.0%

Source: Prashant Kapoor, IFC Green Building Strategy, World Bank Group, Washington D.C. (2011) [2]

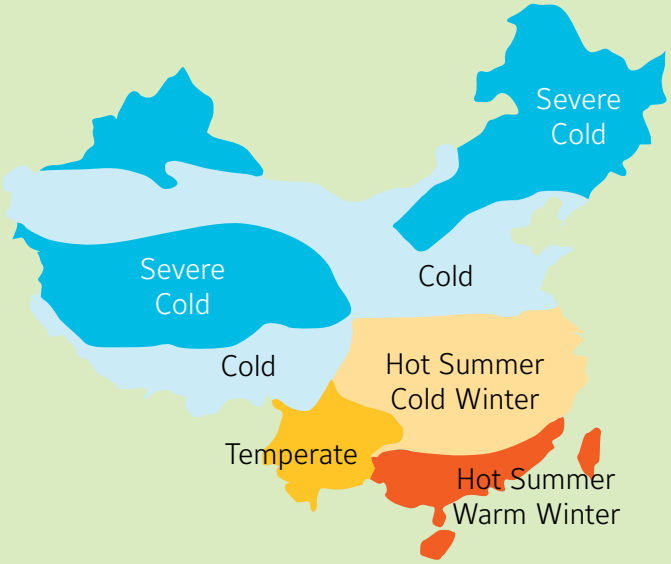
Box 2.
Singapore

In Singapore, the building energy code defines energy efficiency standards for residential and commercial construction. The requirements cover the building envelope, indoor air quality, lighting, ventilation, air conditioning, water efficiency and other environmental quality aspects. Bonus points are awarded for use of renewable resources.

Source: Code on Environmental Sustainability of Buildings, Singapore Building and Construction Authority (2008) [3]

Box 3.
China

Buildings account for 28 percent of Chinese energy consumption (IEA 2009) and this share is likely to grow. China's building energy codes require 50 percent energy savings at less than a 10 percent cost increase compared to pre-existing buildings, based on the Chinese building standard from the 1980s. China faces complexity in designing building codes, since the country has a number of distinct climate zones. China has adapted its building codes to each climate zone.



EXAMPLE: Tianjin, China

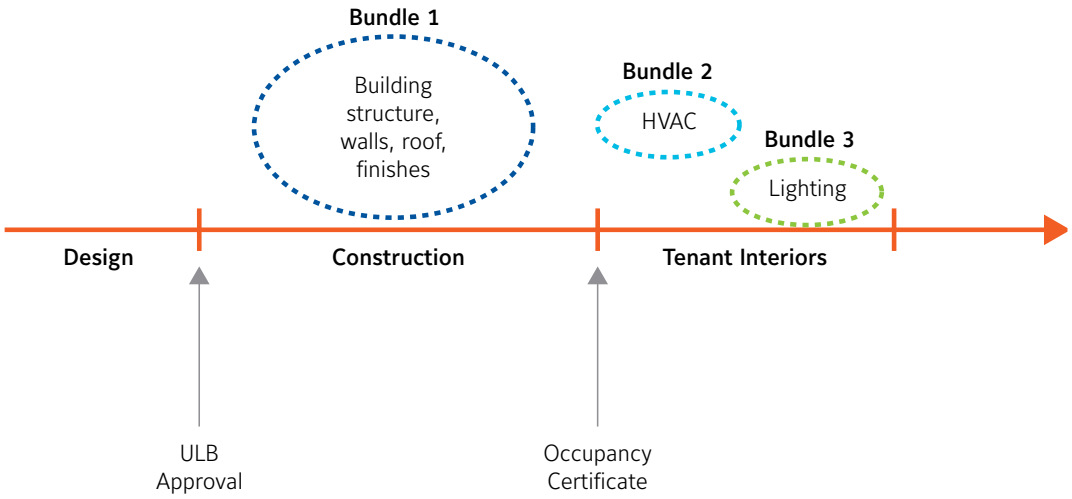
According to the World Bank's Energy Sector Management Assistance Program (ESMAP), Tianjin is one of the most successful Chinese cities in compliance enforcement of building energy efficiency codes – with nearly 100 percent compliance even though Tianjin is in China's coldest climate region with the strictest building codes in terms of thermal integrity. Compared with the baseline, the estimated simple payback period for compliance with building code based on avoided cost of heating service is less than seven years. Successful compliance was possible because of:

- a well-established building construction management system
- standardized and structured procedures for compliance enforcement
- broad-based capacity of the construction industry to meet compliance requirements, including technical skills and availability of parts and materials
- consumers' ability and willingness to pay for the costs of compliance
- local government resources, support, and commitment to implementing increasingly stringent policies

Sources: Energy Balances of Non-OEcD countries 1971-2007, iEa (2009)
Enforcing Building Energy codes in china: Progress and comparative lessons, PNNI (2010)
Tianjin, China - Enforcement of Residential Building Energy Efficiency codes, ESmaP, World Bank (2011) [4]

Box 4.
India

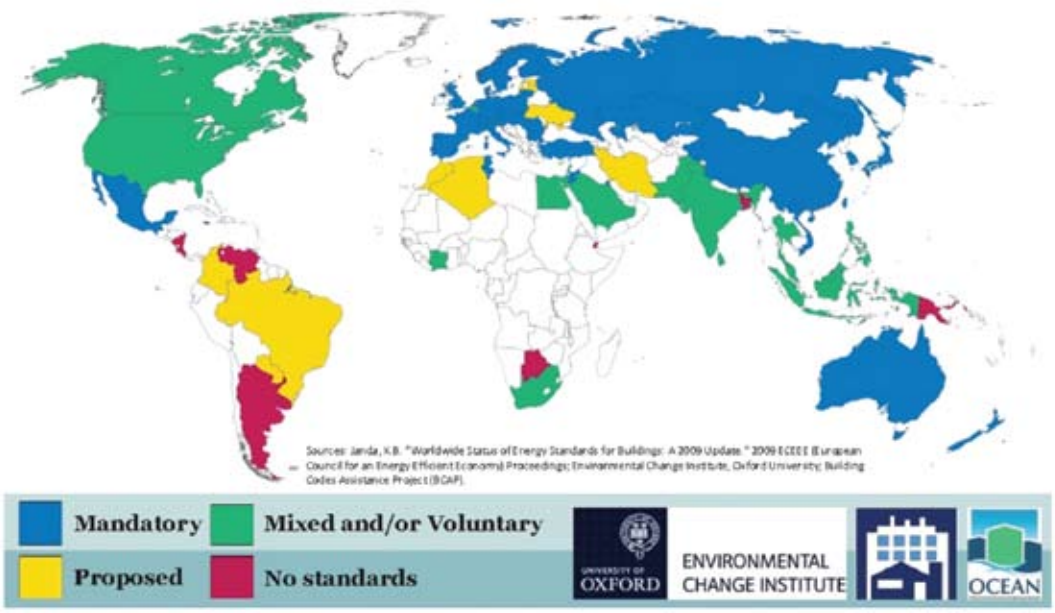
In India, the Bureau of Energy Efficiency is trying a new stepped bundle approach to its Energy Conservation Building Codes. Bundle 1 contains measures involving the building structure, walls, roof and finishes – all measures that can be checked when the building shell is completed and ready for approval by the Urban Local Body. Bundle 2 contains measures that could be implemented by the developer or owner, such as HVAC system efficiency improvements. Bundle 3 contains measures that are difficult to enforce with labeling programs or with the current Urban Local Body Approval process, such as lighting measures. These measures may require a third independent party to do the compliance check.



Source: Energy Conservation Building Codes – Stepped Bundles, Shakti Sustainable Energy Foundation (2011) [5]

The number of energy efficiency building codes around the world is on the rise (See Figure 1). According to the World Bank's ESMAP, building energy efficiency codes are the most effective way to improve the efficiency of new homes and commercial buildings.

Figure 1.
Global Status of Building Energy Efficiency Codes and Standards for Non-Residential Sector



Source: Worldwide Status of Building Energy Codes/Standards, European Council for an Energy Efficient Economy, Oxford University [6]

APPLIANCE, EQUIPMENT AND LIGHTING ENERGY STANDARDS

Increasing appliance, equipment, and lighting efficiency reduces energy demand. Appliance use is expected to increase in a number of developing countries,[7] following the trend observed in many developed countries, where household appliance energy use grew by 16 to 21 percent between 1990 and 2005, despite increased efficiencies.[8] The U.S. Agency for International Development (USAID) and several other organizations identified the need to support policymakers in their efforts to implement energy efficiency standards and labeling programs, and so developed a guidebook along with the Collaborative Labeling and Appliance Standards Program (CLASP).[9] CLASP helps countries figure out how efficient appliance programs can be tailored to their own needs, circumstances and political preferences.

One recent example of tackling this challenge is the Super-Efficient Equipment and Appliance Deployment (SEAD) Initiative, launched in the context of the Clean Energy Ministerial in 2009. SEAD is a multi-government-led global market transformation initiative that includes the private sector and leading experts. Between January 2010 and April 2011, SEAD partners put into effect appliance and equipment efficiency standards that by 2030 will save $10 billion per year in energy-related expenditures.[10]

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ENERGY EFFICIENCY IMPROVEMENT TARGETS

BUILDING EFFICIENCY TARGETS

Political leaders with a vision of an energy-efficient, sustainable built environment often begin by setting an energy efficiency improvement goal for their country, region or city. A goal can focus the work of the many stakeholders who will then need to be involved in implementing and enforcing that goal. For example, the European Union has set the goal of cutting its annual primary energy consumption by 20 percent by 2020, and buildings are responsible for 40 percent of final energy use in the EU, making them a core component required to meet this goal. The EU has subsequently enacted a series of directives (policies) designed to help them meet their efficiency goal.

A goal is even stronger if a certain party is held responsible for meeting the goal. The two types of policies discussed below highlight the ways in which lawmakers have tried holding both utilities and building owners accountable for energy efficiency improvements.

- **Energy Efficiency Standard –** An Energy Efficiency Standard, often called an Energy Efficiency Resource Standard (EERS) in the U.S., requires more efficient production, transmission, and use of electricity and natural gas by mandating utilities and other energy distributors to seek specific energy-use reductions from their customers. Pioneering efforts in places such as the U.S. states of Connecticut and Vermont, the Australian state of New South Wales, and the countries of Italy and the U.K. have helped diffuse these standards, which expand across 26 states in the U.S. (as of January 2011) and other European countries.[1]
    - In some cases, EERS can include an energy savings certificate (ESC) program, which enables efficiency gains to be traded as ***energy efficiency certificates, energy efficiency obligations, tradable white certificates,*** or ***white tags.*** By issuing these certificates to commercial and industrial companies, utilities can increase compliance with energy efficiency targets. Some examples of governments using these tools are Connecticut, New South Wales (Australia), Italy, the U.K., and France.[2] Projects that can lead to ***white tags*** include commercial and industrial lighting upgrades, cogeneration, and measures for buildings such as insulation and increased efficiency of air conditioning.



A national energy efficiency improvement target or goal can align interests and spur action.

An Energy Efficiency Standard mandates utilities and energy distributors to seek energy reductions over time – avoiding the need for power generation ("negawatt").

An Energy Efficiency Scheme requires energy consumption reductions by large electricity end-users.

Government efficiency standards for public buildings build capacity in the market and reduce energy costs.

The measurement and verification procedures as well as the penalty structures vary by EERS program.

- **Energy Efficiency Scheme** – Under an energy efficiency scheme, the obligation to reduce energy consumption is placed directly on large end-users of electricity.

Box 1.
United Kingdom

The U.K. Carbon Reduction Commitment (CRC) Scheme requires organizations with commercial and residential buildings that consumed more than 6,000 megawatt-hours (MWh) per year in 2008 to disclose their emissions and to purchase emission allowances to cover those emissions. These organizations are responsible for around 10 percent of the U.K.'s emissions. The scheme features an annual performance league table that ranks participants on energy efficiency.

Source: The CRC Energy Efficiency Scheme User Guide, UK Department of Energy and Climate Change (2010) [3]

Box 2.
Tokyo, Japan

The city of Tokyo has the first cap-and-trade program, which mandates total reduction of CO_2 emissions from large facilities. The program was implemented in April 2010 and regulates the 1,300 largest CO_2 emitting facilities in the Tokyo area, each of which consumes more than 1,500 kiloliters (crude oil equivalent). Between 2010 and 2014 the program requires a 6 percent reduction below base-year emissions, and between 2015 and 2019 the program requires a 17 percent reduction below base-year emissions. Trading of excess reductions is allowed after the second year. Tenants are obliged to cooperate with building owners in reducing their emissions.

Source: Tokyo Cap and Trade Program, Environment Tokyo (2010) [4]

GOVERNMENT LEADERSHIP

Government efficiency standards for public buildings build capacity in the market as well as reduce energy costs and lower greenhouse gas emissions. National, state and city governments can improve the energy efficiency of their own office buildings, public lighting, schools and hospitals. Developing countries could save up to 40 percent of the energy used in public office buildings if energy efficient measures were incorporated.[5] Energy waste can be addressed in the public sector by making incremental adjustments in budgeting and procurement procedures, and by actively promoting the energy efficiency service industry through bundled tenders and financing programs for retrofit projects. Use of performance contracts can allow public agencies to outsource energy efficiency projects from development to financing to monitoring, and yield quick gains with less hassle.[6] For example, the EU has required its member government buildings to consume "nearly zero" energy by the end of 2018.[7] The U.S. Government has set a goal to reduce total energy consumption in public buildings by 30 percent by 2015, using FY 2003 as baseline.[8] And the city of Melbourne, Australia, is retrofitting 13 city buildings totaling 950,000 square feet and accounting for 80 percent of total energy use from city buildings.[9]

Box 3.
Lviv, Ukraine

The Ukrainian city of Lviv was able to reduce annual energy consumption in its public buildings by about 10 percent and tap water consumption by about 12 percent through a Monitoring and Targeting program to control energy and water consumption. This generated an estimated net savings of 9.5 million UAH (US$1.2 million) as of 2010. The program provided the city management with monthly consumption data for district heating, natural gas, electricity and water in all of the city's 530 public buildings. Targets for monthly utility consumption are determined annually. Actual consumption is reviewed monthly against the target, with deviations spotted and acted upon immediately. The performance of buildings is communicated to the public through a display campaign.

Source: Lviv, Ukraine – Energy Management Systems in Public Buildings, ESMAP, World Bank, (2011) [10]

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INCREASE AWARENESS: INFORMATION AND MARKET TRANSPARENCY

DATA COLLECTION AND BASELINE DEVELOPMENT

Reliable data and baselines can help with energy efficiency investment planning in individual buildings, as well as policy planning across the entire building sector in a country.

Gathering building sector energy data is a priority during policy design, as it helps select policies that are technically feasible with an appropriate level of impact to drive market development. Knowing the building sector baseline is also key to establishing a policy monitoring, reporting and verification system. That said – a country does not need to collect all the data it might like to have in order to get started with building efficiency policies. A benchmarking system can be developed over time as data becomes available on types of buildings, climatic zones, economic groups, and the potential payback on various building efficiency measures, like lighting, insulation and cooling or heating load reduction. As more data becomes available, more complex policies can be designed and implemented with a higher level of success. International organizations and development agencies can support this effort through financial and technical assistance.[1]

The owners and managers of buildings can make better energy management decisions if they have reasonable and convenient access to energy consumption data for their entire buildings. Better access to data from utilities supports energy efficient building operations, consumer energy cost-savings, local economic growth, energy benchmarking, and participation in voluntary green building recognition programs.[2] Organizations that measure energy use have been shown to be more likely to improve their energy efficiency. Today, utilities report clear energy usage information to many end-users, but some building owners and tenants continue to lack access to good information they would need in order to make informed decisions about their energy use. Access to good data not only enables good energy management decisions but also enables the measurement and verification of energy savings from those decisions, thereby overcoming one of the key barriers to energy efficiency: the uncertainty of savings.



Greater information and data on energy consumption in buildings enables owners, operators and tenants to make informed energy management decisions. Transparent, timely information can help track performance against goals.

The collection of general statistical information about buildings' energy use will enable better policy and program design.

Competitions incentivize participants to develop benchmarking capabilities and reward the best performers.

Audits provide information on the technologies and building structures that drive energy consumption. They offer analysis of efficiency improvements that can be achieved by upgrading specific building components.

Rating and certification programs organize building data and information into a format that enables benchmarking across a number of buildings. Benchmarking is increasingly used to differentiate buildings in the real estate market.

Performance certificates share energy consumption information, enabling energy efficiency information to be factored into real estate decisions. Depending on design, disclosure may occur at point of building sale as part of a real estate transaction, in a public space, or via an on-line database.

Public awareness campaigns seek to raise awareness among users and owners about the benefits of energy efficiency.

COMPETITION AND AWARDS PROGRAMS

Governments can also design competitions and reward publicly the best performers as an indirect way of benchmarking good practice.

- The U.S. EPA's "Battle of the Buildings" involves teams from 245 buildings in the U.S. that seek to outperform each other in the search of energy savings.[3]
- The Sri Lanka Sustainable Energy Authority will present its first energy efficiency award in 2012 to a contending state-owned building, commercial building or hotel.
- The city of Frankfurt, Germany created an architectural award to stimulate "innovative, exceptionally well-designed and sustainable" buildings.[4]

ENERGY AUDITS

Policies that involve both voluntary and mandatory building audits can at minimum aid awareness about energy consumption and, depending on how the policy is designed, open up opportunities for energy use disclosure, subsequent market reaction, and eventual reduction in energy use and GHG emissions. Audits can be incorporated into building codes or incentivized financially. However, audits only provide information about energy use, and thus action on the part of the building owner to implement improvements is still required. Therefore, this policy tool is most effective when paired with complementary policies and subsidies for energy efficiency upgrades.[5] Unlike a whole-building audit, commissioning (or retro-commissioning) is a process to provide systematic testing of a building's energy systems in order to ensure performance optimization. Like audits, mandatory commissioning can be included in building codes, incentivized, or targeted through public education campaigns.

RATING AND CERTIFICATION PROGRAMS

Rating and certification programs can enable building owners to improve building performance through voluntary actions. Rating systems and certifications are most often used to ***reward*** top performers, generally through a prescriptive or performance-based pathway to achieving a "green" or highly efficient building rating. Governments can support voluntary rating systems through public-private partnerships, financial incentives for the private sector, and public building portfolio adoptions and procurement policies. Many successful rating systems have been developed around the world. Examples include:

- **The Leadership in Energy and Environmental Design** (LEED) rating system, developed in the U.S., has projects in 41 countries including China, Brazil, Mexico and India.[6]
- **Minergie**, a Swiss standard, is one of the most stringent rating system for new and refurbished buildings[7] and claims market penetration rate at 25 percent.[8] Its success is partly due to strict federal regulation and ambitious city-level initiatives.[9]
- In the U.K., the **Building Research Establishment Environmental Assessment Method** (BREEAM) is an assessment and rating system for buildings that has certified over 200,000 buildings since 1990.[10]

- The **Green Rating for Integrated Habitat Assessment**, or GRIHA, is used by the Indian government for its national building stock and increasingly in the private sector.
- Chinese public-private partnership has resulted in the **Three Star Rating System** for green commercial buildings.
- Australia and South Africa both use **Green Star**, a rating system with over 8 million square feet of registered space.
- The U.S. EPA uses the **ENERGY STAR** program to certify whole-building energy performance based on a percentile benchmark scale.[11]

DISCLOSURE OF ENERGY PERFORMANCE CERTIFICATES

Energy Performance Certificates (EPCs) issued to buildings can offer information on energy consumption and in some cases CO_2 emissions. These types of disclosure policies serve as measures to increase awareness about energy consumption among the public and individual building owners, integrate energy efficiency information into the real estate market, and incentivize efficiency improvements by publicizing poor performance.

- In the European Union, buildings that are constructed, rented or sold require such certificates. These certificates must be disclosed by commercial properties that are being sold or rented in order to provide prospective buyers or tenants information.[12] In some cases, such as certain government-owned buildings, EPCs are required to be displayed in a publicly prominent location.[13]
- In Australia, the commercial building disclosure program is designed to improve the energy efficiency of large office buildings by requiring a Building Energy Efficiency Certificate.[14]
- In 2008, the U.K. began to require the energy performance of a home or commercial office building to be disclosed anytime it is sold or rented. Appraisers need to work with the owners to finalize a methodology for disclosure.

PUBLIC AWARENESS CAMPAIGNS

Some government agencies lead campaigns to raise awareness about the benefits of energy efficiency.

One recent example from Spain is the Institute Diversification and Saving of Energy (IDAE) multi-video campaign with the national soccer team – World Cup Champions in 2010 – encouraging citizens to consume less energy at home.[15]

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FINANCIAL INCENTIVES

Governments will need to balance the use of strict requirements for buildings, such as building energy codes, with the use of incentives that tackle the problem of up-front costs of energy efficiency, the perception of investment risk, low financial institution awareness, lack of external finance, and the small transaction size of energy efficiency projects. A variety of financial tools can be used to accelerate action.

GRANTS OR REBATES

Rebates pay down costs of systems and equipment, R&D and commercialization and encourage the use and development of energy efficiency. Most rebate programs offer support for multiple technologies. States, utilities and a few local governments offer rebates to promote the installation of energy efficiency projects. Utilities manage most rebate programs that support energy efficiency. In the U.S., rebate amounts vary widely by technology and program administrator.[1]

Grants are available primarily to the commercial, industrial, utility, education and government sectors. Most grant programs are designed to pay down the cost of eligible systems or equipment, though some focus on research and development or support technology commercialization. Grants are usually awarded via competitive processes.

RISK MITIGATION GUARANTEES

The government can lower the cost of capital for investments in energy efficiency by agreeing to guarantee a certain low level of risk to banks that lend to building energy efficiency improvement projects. That means the government will step in and cover the agreed-upon portion of losses if any borrowers default on the loans. Risk-sharing mechanisms such as a partial credit guarantee with first-loss coverage on a portfolio can catalyze local sources of financing for smaller projects.[2]

China's Utility-based Energy Efficiency Finance Program (CHUEE) supports financing services for energy users to implement energy efficiency projects in China. CHUEE brings together financial institutions, utility companies, and suppliers of energy efficiency equipment to create a new financing model for the promotion of energy efficiency.[3]



Financing energy efficiency efforts remains a significant challenge around the world. A variety of programs can be designed to support energy efficiency investments.

Grants and rebates as well as tax incentives help pay down some of the up-front cost of investing in energy efficiency.

Risk mitigation guarantees, revolving loan funds and tax-lein financing all lower the cost of capital for investments in energy efficiency projects.

Policies that enable energy performance contracting can speed the deployment of this proven business model in which energy bill savings are used to repay an investment in energy efficiency.

REVOLVING LOAN FUNDS

Public funds are used to finance energy efficiency investments, to lower the interest rate, or to guarantee a bank's investment in energy efficiency. Thailand's Energy Conservation Promotion Fund (ENCON Fund) was financed by a levy of US$0.001/liter on petroleum products. The fund provides capital at no cost to Thai banks, which then provide low-interest loans to energy efficiency projects.

ENERGY PERFORMANCE CONTRACTING (EPC) ENABLING LEGISLATION

EPCs are a financing mechanism that allows energy efficiency investments to be repaid through guaranteed energy savings over time. Policies can promote standardized, streamlined, and transparent project development and vendor selection processes, create umbrella contracts and ESCO pre-selection, provide project facilitators or consultants, and standardize measurement and verification procedures.[4]

An energy service company (ESCO) manages the project from start to finish: building audits, detailed design and engineering, business case analysis, installation, commissioning, and ongoing performance measurement and verification.[5] Critically, the company assumes the performance risk for the project, providing a long-term financial guarantee to ensure that the projected operational cost savings materialize and are preserved over time.

TAX INCENTIVES

Often, a tax deduction is given to cover costs related to building efficiency.

- The U.S. established a tax deduction in 2005 to cover energy efficient building expenditures made by a building owner or tenant, including retrofit expenses that can be capitalized.[6] The tax deduction has been extended until the end of 2013.[7]
- China aims to put in fiscal incentives for developers to use more efficient materials (and adopt renewable energy).[8]
- South Africa is in the process of implementing a new law that will enable taxpayers to claim an allowance for energy efficiency savings resulting from activities in the production of income.[9]

TAX-LIEN FINANCING

Known in the U.S. as Property-Assessed Clean Energy, or PACE, this tool allows property owners to borrow money to pay for renewable energy and energy efficiency improvements and repay it over several years through a special tax assessment on their property taxes.[10]

Major programs for commercial buildings have been launched in the cities of Los Angeles and San Francisco in the U.S., and in Sydney and Melbourne in Australia.

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ACTIONS FOR UTILITIES

UTILITY PUBLIC BENEFITS FUNDS

This approach works by having a utility charge an additional percentage on the utility bill that is used to finance energy efficiency projects. Often, utilities use these funds to buy efficient light bulbs for consumers.

- California raises $228 million per year for energy efficiency in a program that involves four utilities.[1] A variation of this approach is the charging of a fee on the utility bill to cover efficiency delivery services.
- Vermont charges a 4.5 percent fee to each customer's electricity bill and uses the funds to provide technical assistance and subsidize the purchase of energy-efficient products.[2]

Often, a utility public benefit charge accompanies an Energy Efficiency Standard (EES), under which a utility is obliged to make a certain percent efficiency gain across all of its customers. The EES is covered in detail in the section on ***Targets***.

ON-BILL FINANCING

This approach requires utilities to allow energy efficiency retrofits to be repaid as a line item on the energy bill, thereby making the savings and payment source one and the same.

Mexico has a program that allows the repayment of a new energy efficient refrigerator through the electricity bill. The program is set up so that households should have more energy cost savings each month from the refrigerator than they pay each month to repay the loan.[3]

REVENUE DECOUPLING

Revenue decoupling is a utility pricing policy that separates a utility's profits from the amount of electricity it sells through a rate adjustment mechanism. This removes the disincentive for investment in energy efficiency. Revenue decoupling functions by authorizing per-customer margins that are subject to a true-up mechanism to maintain a given level of revenue per customer. Variations from the targeted revenue are subsequently recaptured from ratepayers through a surcharge or credit.[4]



Utilities have direct access to building energy data and information, and they have relationships with owners and tenants due to the billing cycle.

Many countries, states and cities have enacted programs that require utilities to spend a certain amount of revenue to make their customers more energy efficient – these are often called utility public benefit funds.

A few utilities have more sophisticated programs – called on-bill financing – in which individual customers can repay an investment in energy efficiency on their utility bill each month.

Utilities can also be required to change electricity pricing structures through revenue decoupling and time-based pricing policies. Utilities can help large energy users react to time-based pricing and the capacity needs of the electric grid through advanced metering and demand response infrastructure.

ADVANCED METERING INFRASTRUCTURE (AMI)

These systems measure, collect and analyze energy usage through two-way communication metering devices. Such smart meters enable the time-based pricing and demand response policies described below.

Brazil has established a system for certifying smart meters and has begun approving providers. The utility ELO was approved in October 2011 by Brazil's National Institute of Metrology, Quality and Technology (Inmetro) agency for its complete product portfolio. This includes single-phase, poly-phase and current transformer meters that conform to the Brazilian market standards.

TIME-BASED PRICING

This concept includes time-of-use pricing policies that set prices for specific times of day, and dynamic pricing, whereby electricity prices may change as often as hourly. Dynamic pricing is also known as inverted block tariffs. Prices rise as consumers use more electric power, with the goal of stimulating a demand response. A consumer pays a low rate for using less electricity and a higher rate for using more, particularly at peak times. A survey of the U.S. experience found evidence that residential users did respond to higher prices by lowering consumption.[5]

DEMAND RESPONSE

Demand response describes an energy saving strategy used to encourage consumers to reduce their demand for electricity, thereby reducing the peak demand on the utility grid. When demand for electricity approaches available supply, the risk of electrical emergencies such as blackouts increases. Demand response programs use rates, incentives and other strategies to help better manage electricity used during periods of high demand. Reducing peak electricity use can help utilities avoid building new generation to cover peak demand.[6]

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CAPACITY BUILDING

Capacity building is connected to all of the policy options outlined in this paper at varying levels. Successful implementation often depends on regulatory and institutional frameworks, combined with technical training and workforce skill. For example, projected energy savings from building energy codes can be dramatically affected by the ability to enforce them. Providers of energy audits and energy efficiency improvements may be certified to ensure safety, quality, and performance. Policies that leverage private-sector finance or lending schemes require stable financial institutions, governance, and lending environments. Therefore, policy pathways for energy efficiency should be considered in tandem with supporting capacity building measures, such as those outlined below.

DIRECT TECHNICAL ASSISTANCE

International development assistance helps build local technical expertise in multiple areas, from data collection and policy development to implementation and evaluation. It can also support development of governance frameworks (such as formulating legislation or establishing energy efficiency agencies), and facilitate stakeholder involvement.[1] One example in the area of building efficiency is the collaboration between Switzerland and India as part of a $2.3 million program (1998 to 2011) to help reduce energy consumption in new commercial buildings in India and build capacities among builders, architects, engineers, researchers and development laboratories. The program leverages Swiss expertise gained from 30 years of implementing energy efficiency programs.[2]

There are many ongoing green building programs throughout the world. The U.N. and the Government of Austria jointly support a project to build capacity in green buildings in Macedonia.[3] As countries embark upon measurement, reporting and verification (MRV) strategies, regulators need capacity to evaluate the results. MRV strategies will be further discussed in the section on *Tracking Results*.



Direct technical assistance helps build expertise inside governments covering multiple areas of policy development: data collection, development of policy, governance, legal frameworks, implementation, evaluation, and stakeholder facilitation.

Workforce training programs increase the skills of workers and job-seekers by providing education or training in energy efficiency.

WORKFORCE TRAINING

A major barrier to deploying energy efficiency projects in developing countries is lack of workforce training. This gap in training represents a missed opportunity given high unemployment; the energy efficiency sector could create millions of jobs around the world (1.3 million in the U.S. by 2020)[4]. Even in developed countries, governments and utilities have difficulty hiring candidates who have education or training in energy efficiency. In Japan, the Institute for Building Environment and Energy Conservation provides training on building design, construction techniques, insulation requirements, and calculating energy efficiency to support the Energy Conservation Law.[5]

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CASE STUDY: MEXICO

EFFICIENCY AS A PILLAR OF MEXICO'S URBAN PLANNING

The Mexican government is tackling rapid housing sector growth while aiming to meet ambitious carbon mitigation objectives.[1] In 2004 the National Housing Commission (CONAVI) launched a sustainable housing policy to begin to reduce greenhouse gas emissions from their residential sector, which is growing at 800,000 new homes per year.[2] In 2008 they started the Special Program on Climate Change (2008) with energy efficiency as key component. The program set specific objectives for residential building efficiency. Energy efficiency in low-income housing is part of a broader effort to plan new housing communities for greater sustainability – including more walkable communities that are well connected with public transportation.

PATHWAY TO SCALE

The challenge is to move from a voluntary program toward a holistic building efficiency policy based on mandatory building efficiency code that state governments adopt. A building efficiency code has been designed and is in draft form but it needs to be endorsed by state governments in order to be implemented. The building codes face barriers such as limited capacity to enforce codes and regulations (e.g. almost no capacity enforce penalties for non-compliance) and a lack of coordination between federal government and state and city governments; scarcity of financial resources to scale up lending.

Mexico is currently designing a National Appropriate Mitigation Action (NAMA) for residential sector with aims to scale up existing residential building efficiency programs in order to attract additional international climate finance.

- **First steps towards scaling-up:** Government commissioned the design of four scenarios of nationally appropriate mitigation actions (NAMAs) for buildings:
  - NAMAs would increase the penetration rates of the existing program (the goal is 800,000 houses by 2012 and current rates are <150,000 houses)
  - International support for NAMAs call for the design and implementation of a system for monitoring, reporting and verification (MRV) of actions and reductions; lack of available data is still a challenge but Mexico is currently working on the design of this system and producing additional data.



Mexico has been developing sustainable, energy efficient housing policies since 2004 to help meet both development and climate objectives of the country.

Underpinning the sustainable housing policy is a unique combination of instruments that include both financial incentives and regulations, which have resulted in 20% of new houses being built more energy efficient.

"Green mortgage program" provides additional credit line for mortgages for low income home buyers that incorporate sustainable and energy efficient technologies.

"Esta es tu casa" program subsidizes housing developers who achieve minimum energy efficiency criteria for Greenfield development or refurbishments targeting low income groups.

Building codes and norms are set at the municipal level. The National Housing Commission, CONAVI, has developed a national model building code and is promoting its adoption at the municipal and state level.

Mexico is submitting a NAMA to the UNFCCC on their suite of sustainable housing policies.

Mexico is also in the earlier stages of pursuing policies that would transform the rest of the built environment.

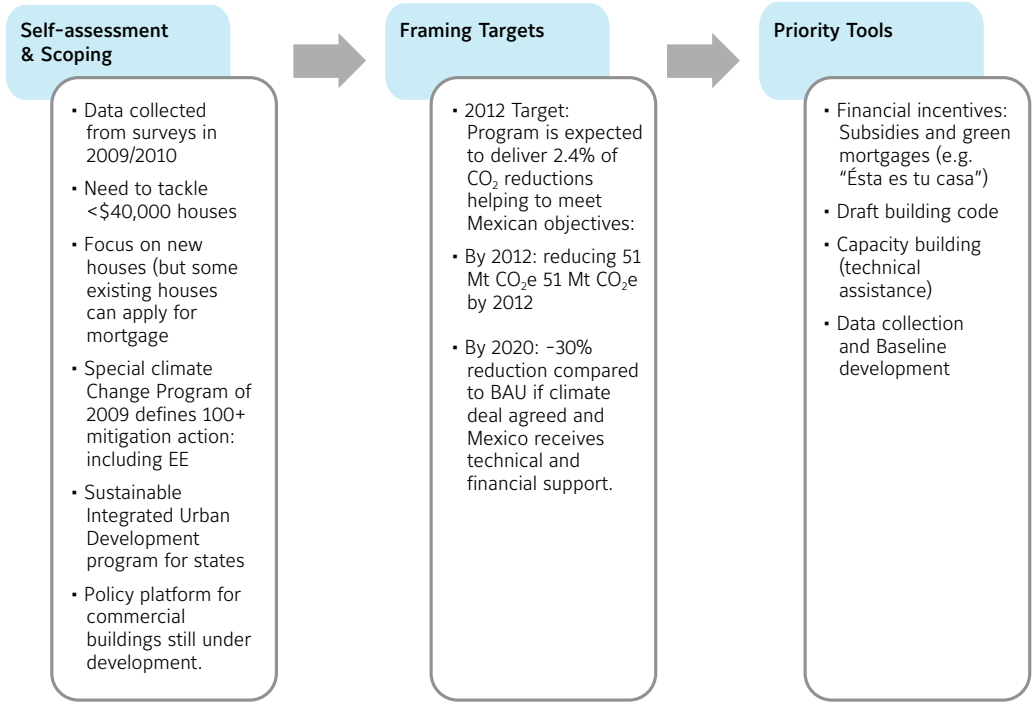
ELEMENTS OF THE POLICY PATHWAY

The following sections outline what Mexico has done, how they have implemented their policies and who within the government was given the responsibility for policy design and implementation.

What?

- Mexico decided to focus initially on improving the energy efficiency of new homes valued under $40,000.
- Mexico set a broad target to reduce their emissions 30% below business as usual by 2020 if the climate deal is agreed to and they receive technical and financial support. They then set a specific target for the efficient housing program as well.
- Mexico selected a complementary set of policies to transform their low income housing sector. The set of policies align the interests of each key stakeholder with energy efficiency – the new home owner now has access to finance for energy efficiency and saves money every month on their energy bill, the home builder makes a greater profit by building energy efficient homes.
  - **"Efficient housing and green mortgages"** provides additional credit line for mortgages for low income home buyers who purchase homes that incorporate sustainable and energy efficient technologies.[3] The credit line is available for low-income housing, valued <$40,000. The National Housing Commission (CONAVI) developed it with the National Workers Housing Fund (INFONAVIT), and by 2012, it is expected to help meet the CO2 reductions targets set in climate policy.
    - Penetration rate: 20% for new houses (120,000 houses in 2010). Forecast by 2020 (216,000 houses); 37% of eligible new houses.
  - **"Esta es tu casa"** program in which subsidies are given to housing developers who achieve minimum energy efficiency criteria for Greenfield development or refurbishments targeting low income groups. This means that developers can get a market premium for houses that are green and qualify for a "green mortgage". Most low-income houses are now built to be compliant. Home buyers save more on energy bills than the increase in the monthly payment on their home. The programs also involve capacity building and technical assistance.
  - **Utility efficiency programs** – the Ministry of Energy manages the state owned utility. They run programs to change out incandescent light bulbs for CFL's and to give people new energy efficient refrigerators, with on-bill repayment for the refrigerators. The electricity in Mexico is subsidized, so any efficiency gains in the system save the state-owned utility money.[4]
  - **Sectoral metrics and tracking progress:** Energy surveys were conducted in 2009-2010 and the government and biggest developers plan to jointly estimate the CO_2 from the Mexican supply chain. No in-depth system for assessing progress is in place yet.

Figure 1.
What?

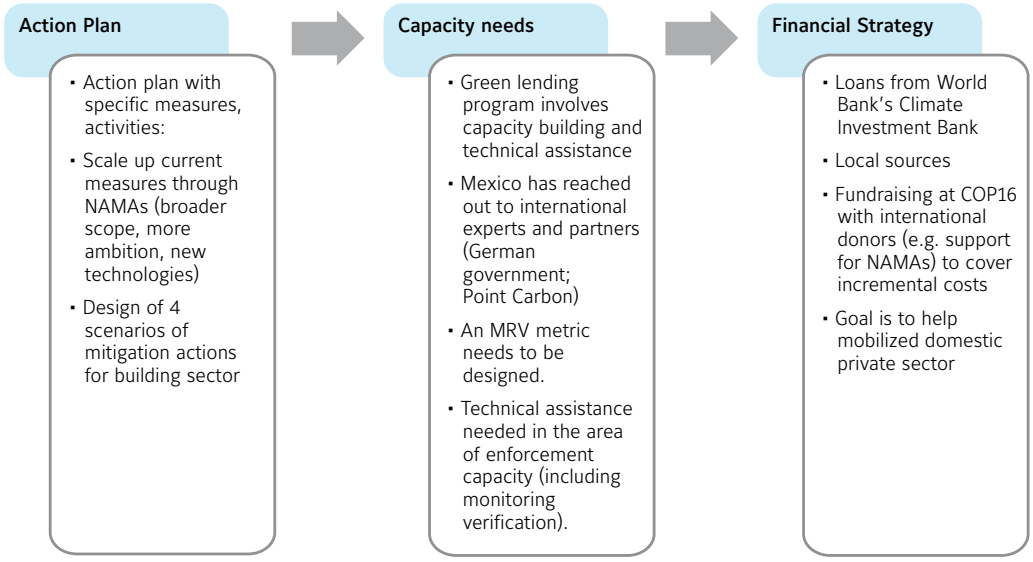


Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

How?

- Mexico has a detailed action plan that takes the program from inception to scale. Leveraging funding from NAMAs is a key part of their plan to go to scale.
- Mexico built the technical capacity in the market that is needed to make the green lending program a success.
- Mexico financed the policy development of their energy efficient housing program initially through the World Bank and other donors. The actual energy efficiency improvements in houses are financed through the National Workers Housing Fund (INFONAVIT).

Figure 2.
How?

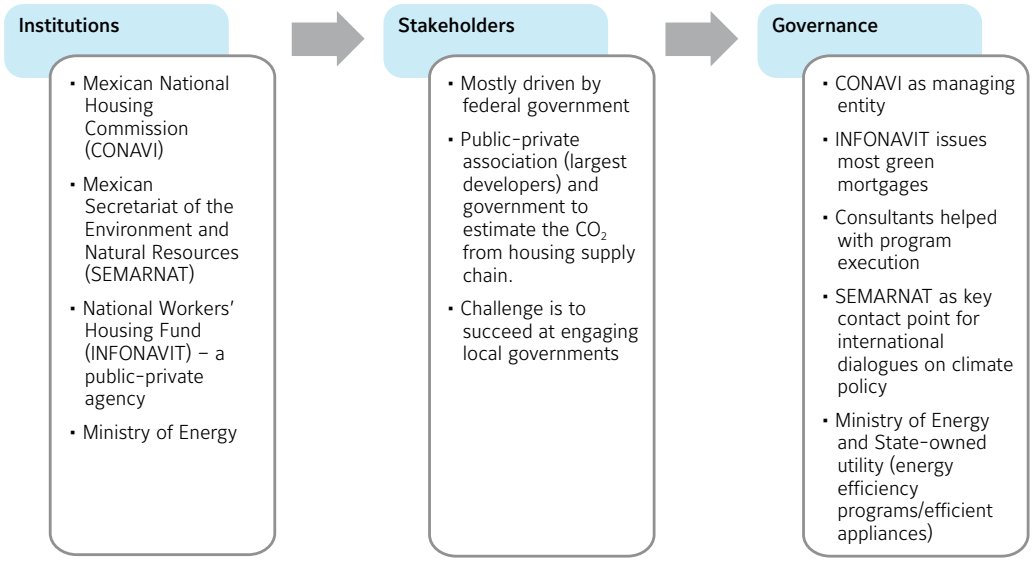


Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Who?

- A number of key Mexican institutions worked together to make the energy efficient housing program a success. The Mexican Secretary of the Environment and Natural Resources (SEMARNAT) helped set broad goals and get the program started. The Mexican National Housing Commission (CONAVI) was created to provide regulatory guidance to the housing sector. The public-private agency, the National Workers Housing Fund (INFONAVIT) handles all low-income mortgages in Mexico, and make the energy efficiency mortgage a standard part of their offering. The Ministry of Energy played a supporting role by running utility energy efficiency programs through the state owned utility.
- The program was driven forward by the federal government, but they involved key stakeholders from the housing sector along the way. For example, today they are working with a number of major stakeholders from the private sector to help develop an estimate of CO_2 from the housing supply chain.
- The key Mexican institutions together have created a complementary governance structure.

Figure 3.
Who?

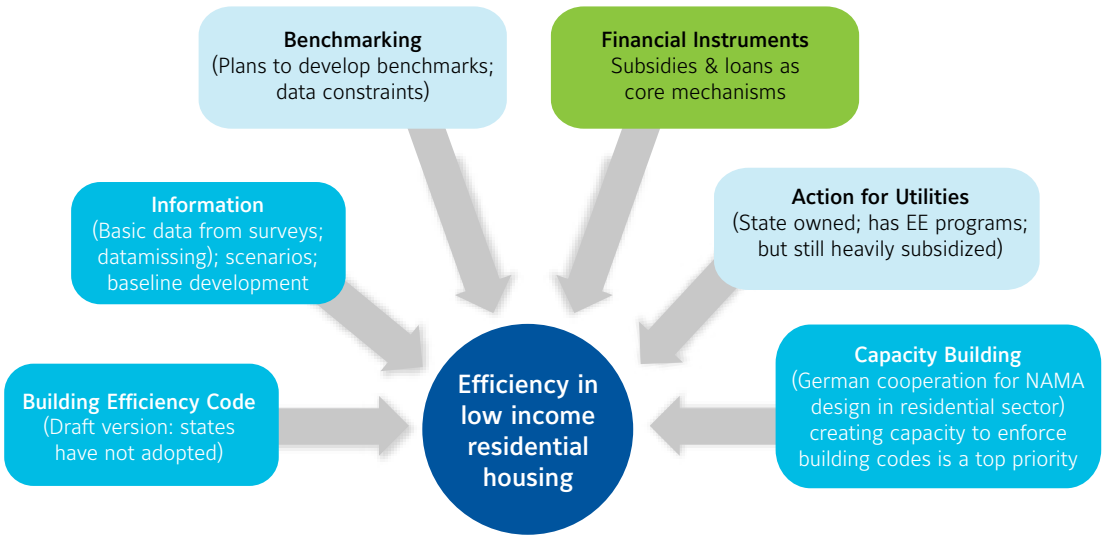


Source:Institute for Building Efficiency, Johnson Controls Inc.(2011)

SUMMARY

Mexico has been a pioneer in the design of a balanced approach to transforming the market for building efficiency combining incentives and regulation—"carrots and sticks"—and engaging key stakeholders in the life-cycle of the buildings.

Figure 4.
Mexico's Approach



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

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CASE STUDY: SINGAPORE

EFFICIENCY AS A PILLAR OF SINGAPORE'S COMPETITIVENESS

Singapore is dependent on imported fossil fuels for its energy. Singapore is a small island state and has limited local energy sources, making energy efficiency a national priority. The government has implemented renewable energy programs, but given Singapore's small size and high density, energy efficiency is a critical national priority and a source of international competitiveness. The national energy efficiency plan "E2 Singapore" targets industry, buildings, and transport.

Increased attention to the built environment

Buildings contribute to one third of domestic energy consumption (20%–40% of the total operating cost for a typical building). A building energy code is in place as well as energy efficiency standards for residential and commercial construction. The requirements cover the building envelope, indoor air quality, lighting, ventilation, air conditioning, water efficiency and other environmental quality aspects. Bonus points are awarded for use of renewable resources.

Benchmarking as starting point

Since 2005 Singapore has developed a certifiable rating system in collaboration with private sector and other government agencies. Underpinning Governmental policy is the national green building rating system also known as the BCA Green Mark scheme.

A holistic approach to buildings

The Inter-Ministerial Committee on Sustainable Development (IMCSD) that was set up in January 2008 designed a national framework and identified priority strategies that the government took on board. Singapore aspires to develop a holistic approach to buildings ensuring not only energy efficiency but also broader benefits.

CREATING DEMAND FOR GREEN BUILDINGS

Toward a market for green buildings

- Singapore's Building and Construction Authority (BCA) developed the Green Mark Scheme in 2005, with a strong focus on energy efficiency.



In 2005 Singapore developed a certifiable rating system that created a market for green buildings and was the first step in a longer-term policy pathway.

Underpinning the policy strategy is a unique combination of instruments, including ***voluntary*** building certification and ***legal*** requirements for efficiency in new buildings.

Efficiency actions in the built environment are embedded in economy-wide policy that aims to increase energy efficiency of industry, transport and buildings in Singapore.

The focus in Singapore has moved beyond actions for new buildings; the government provides incentives to transform the existing building stock as well.

Capacity building has played a key role in the creation of a market for green buildings.

- Buildings can be awarded Certified, Gold, GoldPLUS or Platinum ratings, corresponding to an energy efficiency improvement of about 10-15%, 15-25%, 25-30% or +30% respectively. Other criteria include water efficiency, site/project development and management, indoor environmental quality and environmental protection, as well as innovation.

Pathway to Scale

- Over the years, BCA has worked with other agencies to enhance the BCA Green Mark scheme. The BCA Green Building Master plan outlines the strategic thrusts and key initiatives to green 80% of all buildings.
- BCA has also gone "beyond buildings" to inspire and promote environmental sustainability in parks, districts, rapid transit systems and supporting infrastructure through the various Green Mark schemes. More recently, efforts are made to go "within buildings" to get the end-users to play their part in greening their premises. BCA has developed the Green Mark schemes for Office Interior and now Restaurants to support businesses in driving green initiatives within their premises.
- The market has gone from 17 green buildings in 2005 to 840 in 2011.

Creating technical capacity

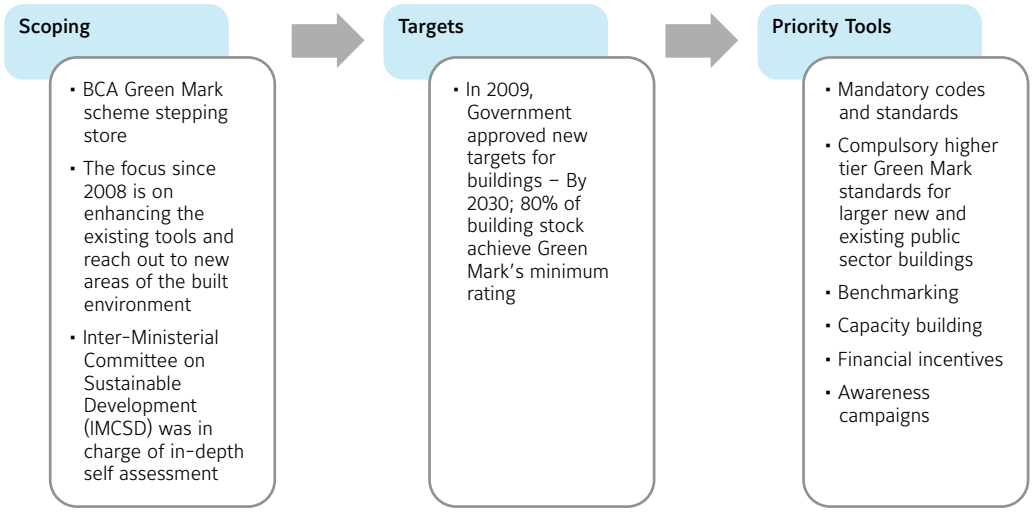
- BCA enables the industry to raise its capability to develop more green buildings by providing a comprehensive training framework. This is to ensure an adequate supply of green building professionals to meet the expected strong demand for green buildings.
- Formal training and certification schemes for green building specialists at professional, supervisory and technical level are provided at the BCA Academy, which aim to raise technical competence in the various areas of green building design and practices, such as the Green Mark Managers and Green Mark Professional courses.
- In parallel and complementing the efforts, the National University of Singapore has developed a Singapore Certified Energy Manager program offering formal training and certification system in the area of energy management. They also operate an accreditation scheme for Energy Services Companies (ESCOs) to enhance the professionalism and quality of energy services offered.

ELEMENTS OF THE POLICY PATHWAY

What? A unique combination certification and legal minimum requirements

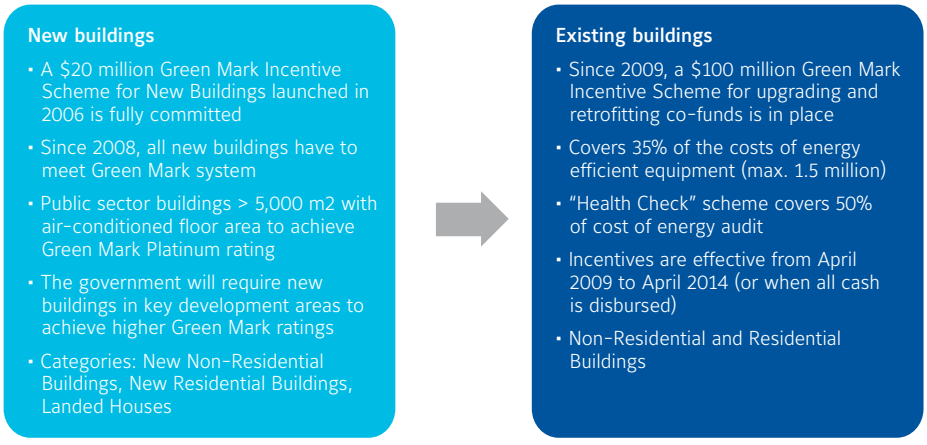
- Singapore has put together a distinctive mix of policy instruments: on the one hand it tries to create market dynamics offering incentives for business participation but also is one of the few emerging economies, if not the only one, to mandate green building standards. The BCA Green Mark scheme is a central pillar of the policy strategy. Ambitious targets were set to 2030 and several priority tools were selected.
- Governmental incentives include: Gross Floor Area incentive scheme; incentives for existing building retrofit; Research Fund for Built Environment; Incentives for Design Prototypes; Incentives for New Buildings.
- The BCA green building master plan consists of 6 strategic pillars: 1) Public sector taking the lead; 2) Spurring the private sector; 3) Furthering development of Green Building Technology; 4) Building industry capabilities; 5) Profiling Singapore and Raising awareness; and 6) Imposing minimum standards.

Figure 1.
What?



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

Figure 2.
Incentives for New and Existing Buildings



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

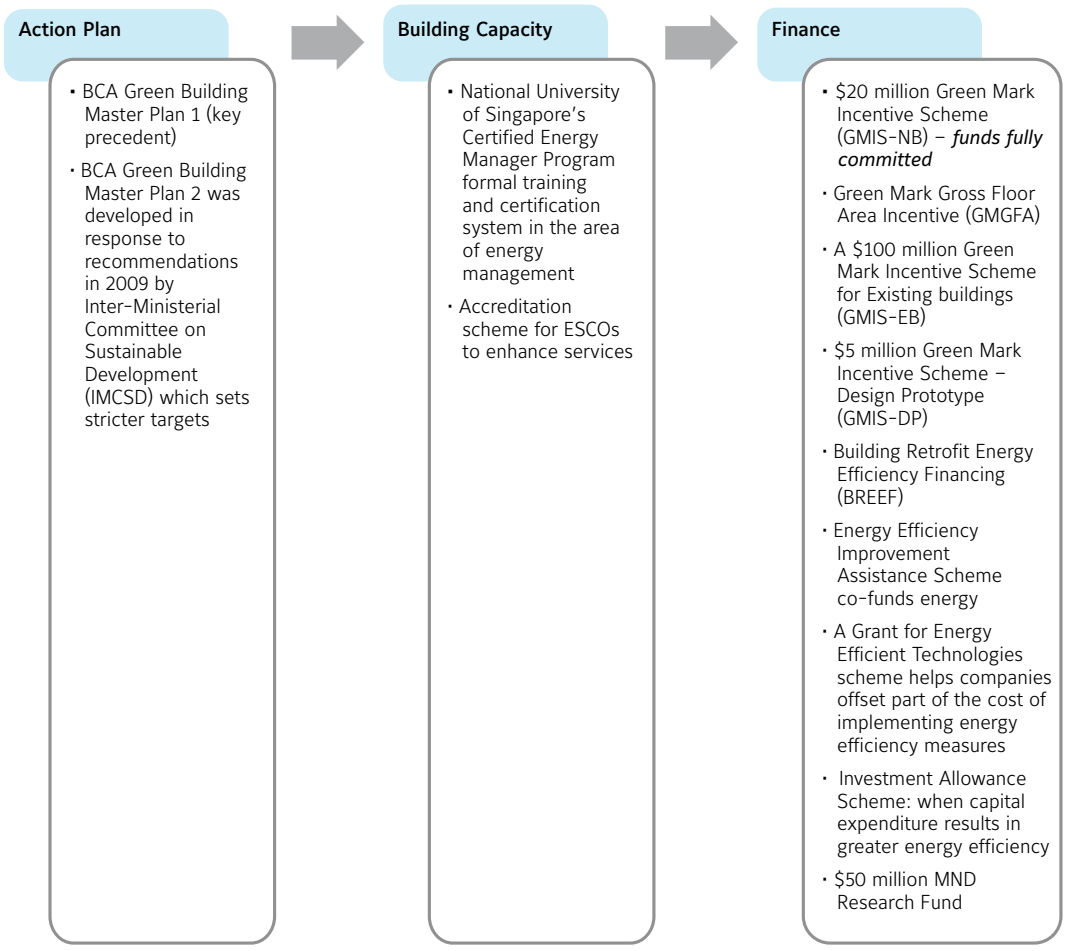
- The government has used regulation as well as incentives: The Ministry of National Development and the BCA enhanced the Building Control Act and put in place the "Building Control (Environmental Sustainability) Regulations" in 2008 to require a minimum environmental sustainability standard for new buildings and existing ones going major retrofits.
- Incentives were defined to help tackle the existing building stock.

- The system is subject to continuous improvement: A major revision took place in Dec 2010. This requirement is equivalent to the Green Mark Certified Level for new buildings and existing ones that undergo major retrofitting:
  - All new building works with gross floor area of 2,000 m^2 or more;
  - Additions/extensions to existing buildings by 2000 m^2 or more;
  - Building works which involve major retrofitting to existing buildings (>2000 m^2)
  - Alteration to existing buildings without major retrofitting: not subject to requirement.

How?

- Singapore has a clear, detailed master plan, the BCA Green Buildings Master Plan, which is updated regularly.
- Singapore has dedicated resources to building the technical capacity needed in the market to make buildings more energy efficient.
- Singapore has provided a number of financial incentives to help stimulate the market.

Figure 3.
How?

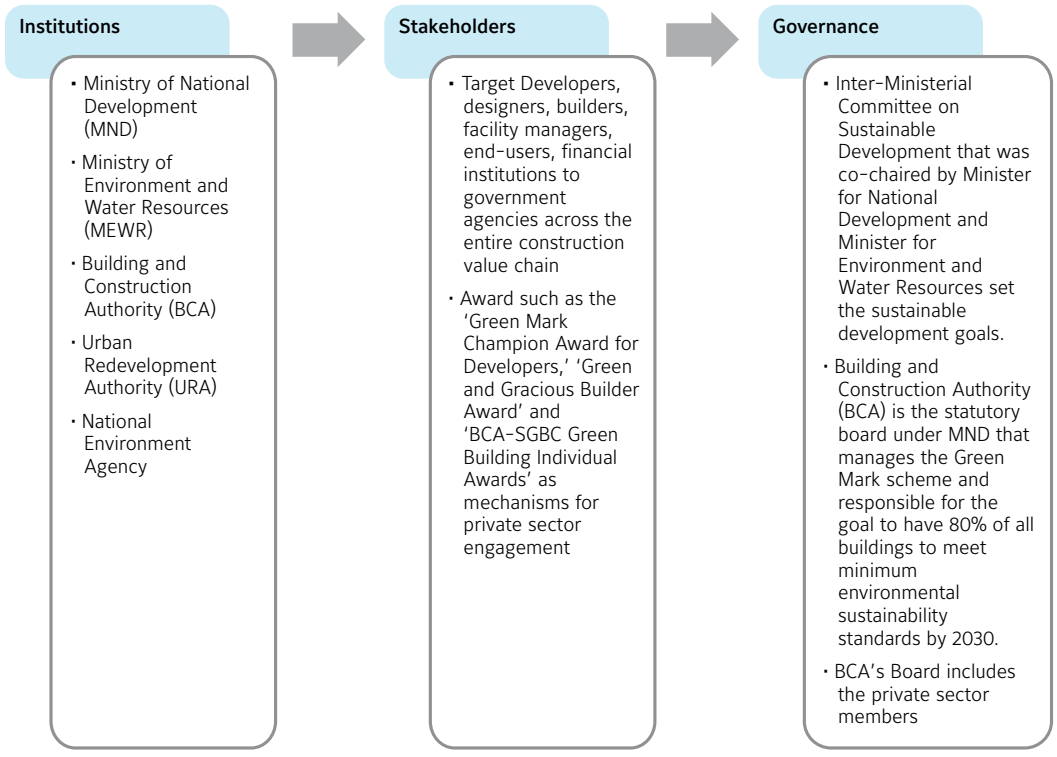


Source:Institute for Building Efficiency, Johnson Controls Inc.(2011)

Who?

- Singapore's building efficiency policies are driven forward not only by the Building and Construction Authority (BCA), but also other critical government institutions who have a role in regulating the built environment.
- Singapore has engaged a diverse group of stakeholders, often using awards as a mechanism to engage the private sector.
- An inter-ministerial committee set Singapore's sustainable development goals. The Building and Construction Authority (BCA) is responsible for the goal to have 80% of all buildings meet minimum environmental sustainability standards by 2030. BCA's board is from both the public and private sector.

Figure 4.
Who?

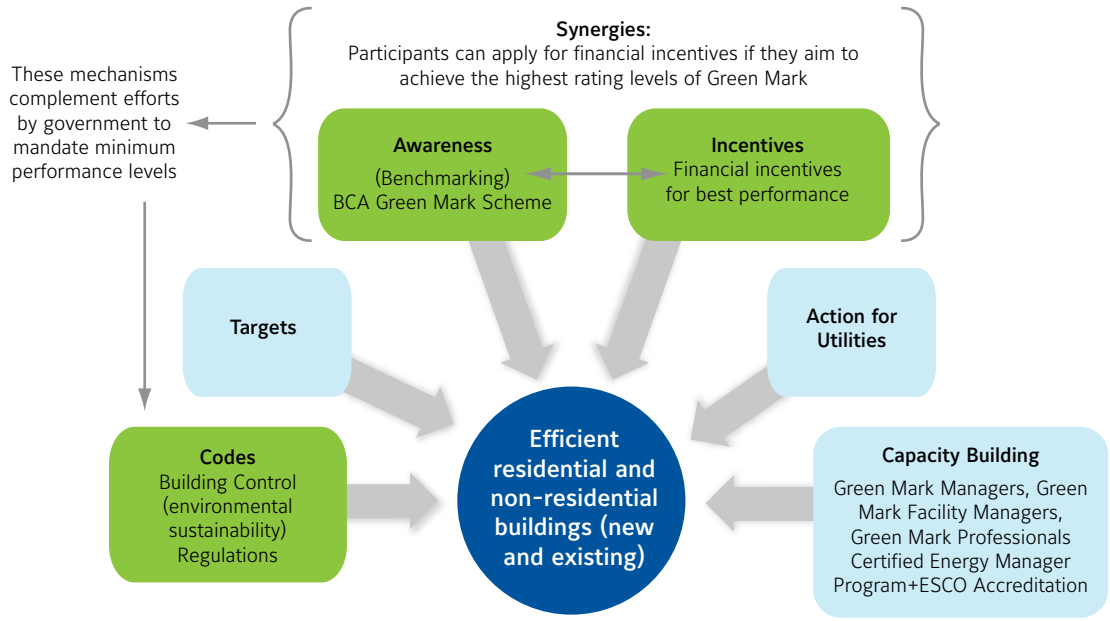


Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

SUMMARY

Singapore has been a pioneer in the design of a balanced approach to transforming the market for building efficiency combining incentives and regulation—'carrots and sticks"—and engaging key stakeholders in the life-cycle of the buildings.

Figure 5.
Singapore's Approach



Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

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TAKING ACTION

Getting Started

Designing a Financial Pathway

Private Sector Role and Perspective



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GETTING STARTED AND TRACKING RESULTS

A central question for many policymakers is: **How to get started?** No universal approach exists to design a policy pathway for delivering building efficiency. Policymakers can meet building efficiency objectives through a wide array of policy tools and mechanisms. Governments can take advantage of the multiple lessons from pioneering efforts and modify them as needed to apply to their local circumstances.

The nature and depth of a policy package will vary depending on the national objectives, the institutional conditions, and the market structure, among other factors. For example, in some cases, a national objective may be to increase the efficiency of new buildings, whereas in other instances the priority may be to be retrofit the *existing* building stock. One possible way to organize the process that leads to a long-term policy pathway is to address some core questions.



WHAT? PRIORITIZING POLICY OBJECTIVES AND INSTRUMENTS



Scoping

A potential first step is to **assess** the institutional and legal setting, the data availability, and the key stakeholders. Ideally, this scoping exercise is done for each segment of the building's market (residential/commercial, new/existing), and also for each key phase of the building lifecycle. It is also necessary to examine first-order obstacles to building efficiency, as this informs the selection of a set of countervailing measures (and incentives for change) that can overcome context-specific barriers.



A central question policymakers face is how to get started with building efficiency actions and policy development. Policymakers may organize the process into three related categories:

- **What?** Prioritizing policy objectives and instruments
- **How?** Defining the sequence to support policy implementation
- **Who?** Creating a framework to deliver effective governance

To confirm that policy goals are being met, policymakers should include in their planning the metrics and evaluation approaches for tracking progress over time.

At the building level, there are protocols already established for measuring and verifying energy upgrades made in buildings that can help build confidence and reduce risk to owners and managers.

At the tenant level, new displays, dashboards and computer/phone applications can provide analysis of energy use in tenant space as well as in entire buildings.

Targets

The scoping phase focuses on the selection of objectives and targets. Countries and cities can choose to set broad targets in terms of, energy savings, CO_2 reductions, or other specific benefits. These broad targets – for example, reducing government building energy consumption by 20 percent over 10 years – need to be filled in with detailed interim milestones and targets and must include an action plan to support implementation. National and sectoral baselines can be useful in selecting targets. In order to facilitate implementation, any target should be stated simply and should be straightforward to monitor. Common options are:

- Defined improvements in performance (GWh or CO_2)
- Intensity (energy consumption or CO_2 emissions per unit of economic activity)
- Benchmarks (energy consumption or CO_2 emissions relative to others)
- Transactional (number of buildings constructed or retrofitted or compact fluorescent lamps installed)

Once a target is chosen, it is necessary to set a clear **time frame** – for example, annual, mid-term (5-20 years) and long-term (20+ years) targets with interim reviews. When defining the **scope** of the targets, a choice should be made early on: Will the strategy focus on the design and construction of new buildings? Will it tackle retrofits? Will it combine both? A key element that will affect the implementation of the policy strategy is the **level of aggregation**: Who in the lifecycle of buildings will be the targets of the policy intervention? Common options include the construction company, energy service provider, building owner, or manager of public and commercial buildings.

Priorities

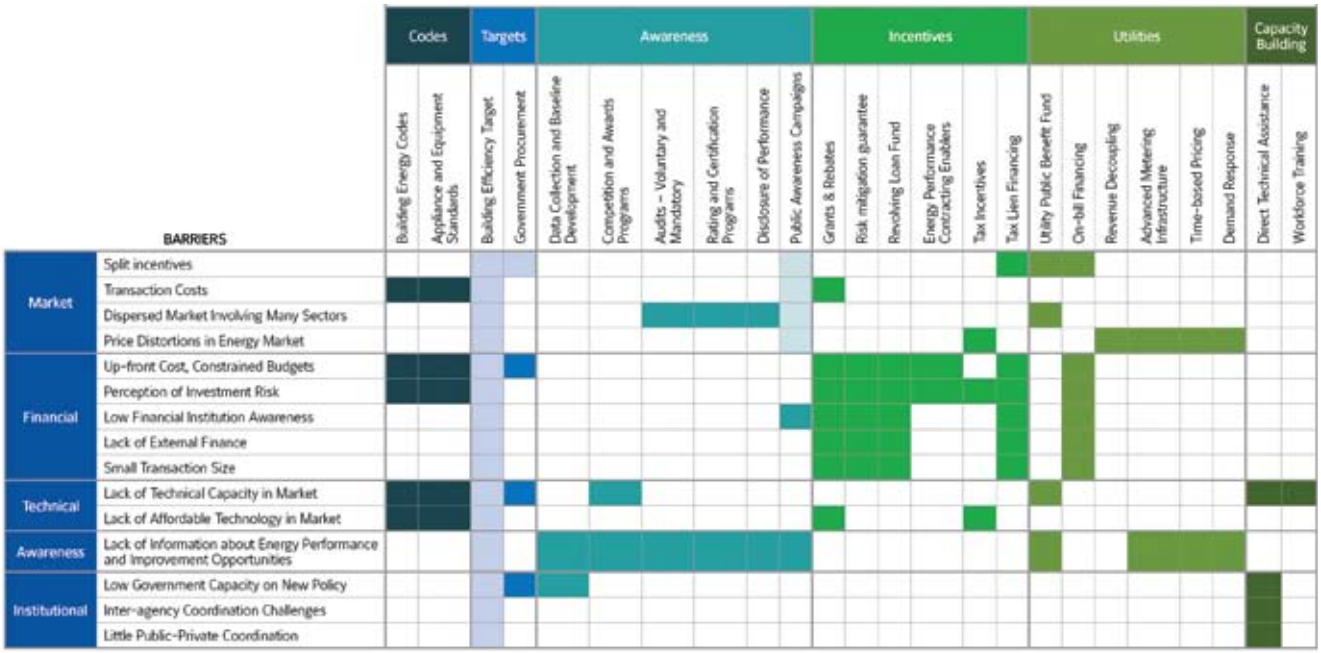
Designing a strategy to transform the built environment to be more energy efficient is not a simple process. No single government policy can drive the transformation on its own, but a combination of policies can help transform buildings to be far more energy efficient over time. The Building Efficiency Policy Assessment Tool, presented in the section by that name, provides a simple framework to help decision-makers set policy priorities with input from stakeholders.

The Building Efficiency Policy Assessment Tool supports a collaborative process for exploring building efficiency policy options based on the local importance of each policy option and the relative difficulty of achieving it, as well as the current policy status and a vision of the suite of policies that would best foster energy efficiency implementation. The tool includes a facilitator's guide for how to run a workshop, along with templates and analysis tools. The workshop is designed to support consensus-based, multi-stakeholder collaboration and uses visual tools to build consensus and prioritize building efficiency policy options and strategies.

As decision-makers set policy priorities, they should begin with an analysis of the barriers to energy efficiency in their market or country and match the policy options that address those barriers. One way of doing this is to match the first-order barriers that were identified with the most appropriate policy solutions. A hypothetical example is offered in Table 1.

Table 1.

Policies Enable the Market to Overcome Specific Barriers to Energy Efficiency



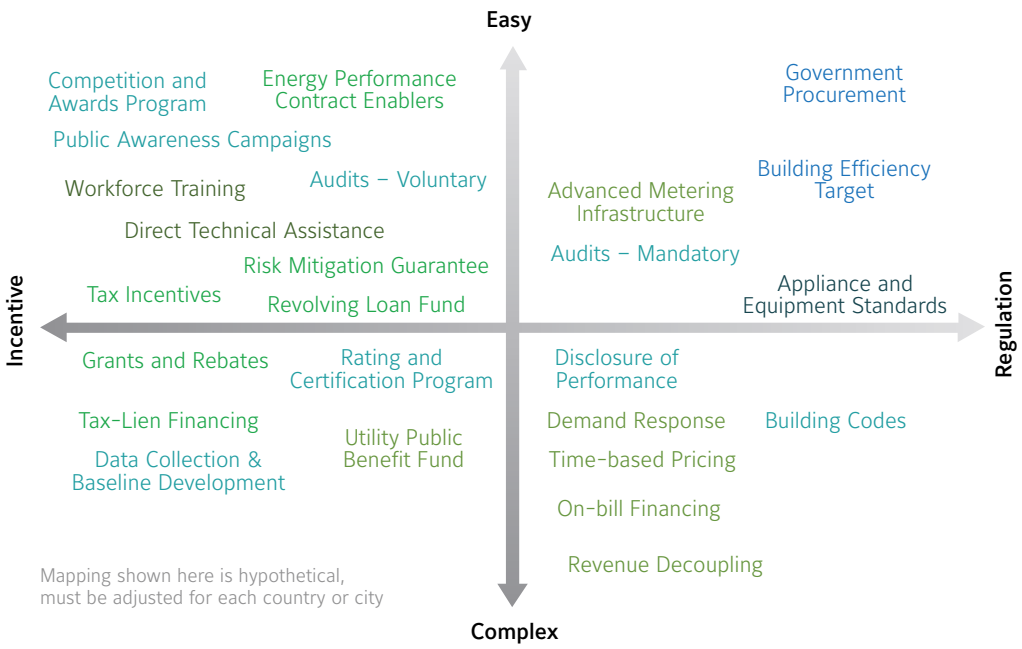
Source: Institute for Building Efficiency, Johnson Controls Inc.(2011)

The Building Efficiency Policy Assessment Tool generates a map of difficulty vs. importance for each of the policies, thereby showing easy and important policies that might make good starting points, and difficult yet important policies that might make good long-term goals. In addition to the analysis of difficulty vs. importance, difficulty might be mapped against other policy attributes. In particular, policymakers might analyze the pros and cons of using incentives versus mandatory requirements (carrots versus sticks) to achieve the right balance and promote complements. Figure 2 offers a potential categorization of the most common policy options and instruments in use today.

The horizontal axis captures the diversity of options that exist when policymakers need to choose between ***regulation***, which offers a strong signal when efficiency goals need to be met by a certain date; and ***incentives***, which can improve market transparency and motivate voluntary changes in energy consumption. Ideally, the goal is to make both types of instruments reinforce each other.

The vertical axis captures the ease or complexity associated with each of these policies as they are developed and/or implemented. Each country, state or city that aims to develop a building efficiency policy needs to examine the viability of each priority option under the local circumstances. For the initial phase, it is necessary to go through a careful selection of initial measures that can be positive starting points, building confidence and demonstrating the ***feasibility*** of building efficiency policy.

Figure 2.
Illustrative Trade-offs Among Policy Options



Source: Institute for Building Efficiency, Johnson Controls Inc. (2011)

HOW? DEFINING THE SEQUENCE TO SUPPORT POLICY IMPLEMENTATION



Action Plan

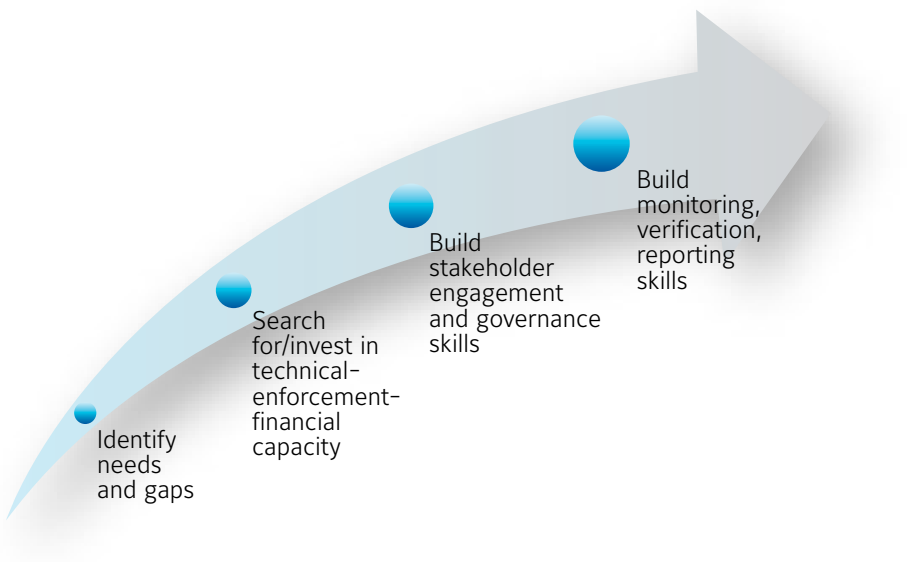
Complementing the guiding objectives with an action plan is the first step in the transition to implementation. In some instances, countries have designed ambitious national strategies (e.g. sustainable development or climate action) but lack the ***executive roadmap*** that will guide actions on the ground. An action plan is based on a set of performance indicators that allow policymakers to assess progress over time. How to track progress is a fundamental task and will be addressed separately.

Capacity

An early identification of capacity needs can inform the definition of a package of technical assistance on aspects related to enforcement, legal affairs, and technological issues. The

effectiveness of implementation and the assessment of performance depend, to a large degree, on the quality of training of the staff working on enforcement. Building the right capabilities takes time and requires an explicit plan with the right allocation of funding. International cooperation programs can play a catalytic role in helping developing countries build the right capacities.

Figure 3.
Building Local Capacity: A Suggested Pathway



Source: Institute for Building Efficiency, Johnson Controls, Inc. (2011)

Finance

The design of a policy package will benefit from paying specific attention to the finance dimension of the actions the government will mandate or incentivize. Will private capital be leveraged? If so, how? What public-private partnerships will be necessary to finance building efficiency? Some governments may map the pools of capital that could be mobilized: public and private, local and international, grants and loans. Ultimately, the objective of this exercise is to identify potential financing gaps and to understand the link between these gaps and the pace of implementation. (How to build a financial strategy is treated in the section on Financial Pathway).

WHO? CREATING A FRAMEWORK FOR DELIVERING EFFECTIVE GOVERNANCE



Institutions

Experience from OECD countries that have implemented energy efficiency policies shows the difficulties associated with intra-governmental agency coordination. Coordination within and among ministries does not always occur, and once one ministry sets a policy, ensuring policy coherence at other levels of government may pose challenges. In order to tackle institutional challenges and ensure that the right capacities are in place, it is necessary to specify ***key roles and players*** early on.

Stakeholders

In tackling institutional challenges, it is helpful to adopt a proactive approach to engaging the relevant players in delivering building efficiency. The creation of multi-stakeholder processes is necessary before and during the policy design process. Buy-in from critical players is likely to bring benefits in the long term. Engaging incumbents is also necessary.

Without formal mechanisms for collecting private-sector feedback with respect to policy options and finance, these measures are unlikely to have buy-in. Lack of buy-in, in turn, may harm the prospects of private investments in efficient buildings. The process will vary from country to country. The common task, however, is to tailor an institutional roadmap with explicit steps for engaging stakeholders and to understand their roles at different stages of a building's lifecycle.

Governance

When energy efficiency policies fail to deliver their full potential, it is most often because little attention was paid to the governance underpinning the implementation. In order to define a governance framework, it is necessary to define ***who*** within government will be responsible for what parts of the action plan. The responsibilities need to be set at different levels and must be explicit and transparent. The institutional responsibility of the monitoring system also needs to be planned at the outset. Often in developing countries, the capacity for monitoring is limited, and good governance and a system for gradual improvement may play a critical role.

TRACKING RESULTS

To confirm that policy goals are being met, policymakers should include in their planning the metrics and evaluation approaches for tracking progress over time. The results of building efficiency actions can be tracked at the city or national level or the individual building level.

Performance tracking offers a key area for combining know-how in the assessment of energy savings at the building level (M&V) and in the assessment of policy, called Measurement, Reporting and Verification (MRV) in the case of the UN Framework Convention on Climate Change. In some buildings, new technologies are also enabling individual tenants to track, in real time, their energy use and their progress toward energy efficiency goals.

Tracking progress at the policy level

Up-front planning for how policy performance will be tracked over time is essential in order to confirm that building efficiency goals are being met. Several methodologies are available to help policymakers assess progress: Are the policies and measures in place delivering the energy efficiency objectives? As a starting point, policymakers in national and city governments could build a tracking system using some or all of the following tools:

- **Policy impact studies.** An independent assessment is carried out to assess a specific policy at the national, provincial or city level. There are many examples of this type of macro-analysis, often in the form of comparative or benchmarking studies. These assessments play an important role as governments try to justify publicly a particular policy or budgetary contribution needed to achieve energy savings objectives. There is still an ongoing debate on who should lead the verification of performance: Should it be done in-house or through third parties? For example, in the United Kingdom, a Committee on Climate Change was created as an ***independent*** body under the Climate Change Act of 2008 to assess U.K. performance in meeting its climate targets and annual carbon budgets, and to disclose the results to the public on an annual basis.[1]
- **Energy consumption surveys.** These surveys take a sample of buildings, analyze their energy-related characteristics, energy consumption and expenditures, and extrapolate the results to represent the entire population of buildings. The process helps track progress toward energy efficiency goals. One example is the survey of commercial buildings that the U.S. Energy Information Administration has conducted for 30 years.[2]
- **Assessments by utilities or government agencies.** Utilities and government agencies have developed evaluation, measurement and verification using an array of methods to assess energy savings from their policy efforts and thus demonstrate good stewardship of ratepayer and taxpayer funds. California, for example, has developed several detailed protocols.[3]

The ambition and scope of a monitoring system will vary depending on the policy choices each country makes, such as ***geographical scope*** (national, sectoral or city performance), ***time frame*** (short, medium or long term) and ***level of aggregation*** (performance at the building unit or aggregated information according to types of buildings: public, commercial, residential). Consequently, a variety of tracking systems will ***co-exist*** internationally before a standardized set of best practices is identified.

Adding impetus to the search for best practices in tracking performance in developing countries is the commitment by developing countries in the United Nations context to monitor, report and verify emission reductions associated with nationally appropriate mitigation actions (NAMAs). Because there is no universally accepted methodology for designing MRV systems, countries are still in the pilot phase, and many are requesting financing for building capacity in this area.[4]

Tracking progress at the building level

Protocols already established for measuring and verifying energy upgrades made in buildings can help build confidence and reduce risk to owners and managers. ***Uncertainty of savings*** is one of the key barriers to individual building energy efficiency projects, especially among practitioners in emerging economies, according to the 2011 Global Energy Efficiency Indicator (EEI) survey.[6] As a result, a central challenge in developing a credible system for tracking results is to conduct assessments of energy savings by using methodologies that relevant stakeholders find reliable.

At the building level, measurement and verification (M&V) of energy savings is the process of "quantifying a reduction in energy use, peak demand, greenhouse gas emissions, or some other quantity, usually resulting from a program or project."[7] Because M&V plays a key role in scaling up energy efficiency and carbon reduction, decision-makers in governments and the private sector are paying increasing attention to these activities. The basic concept behind all types of M&V is the comparison between ***actual*** and ***business-as-usual***

Box 1.
Common Carbon Metric[5]

This metric aims not only at measuring, reporting, and verifying energy savings but also greenhouse gas emissions (GHG). The metric can potential to provide a international measurement for both policy and individual building's GHGs. The International Organization for Standardization is considering adopting the Common Carbon Metric as the international standard.

What does it do?

- CCM defines buildings using the UNFCCC building typologies.
- CCM provides two key metrics, the first on **energy** (kWh/m2/yr) and the second on **climate** (kgCO2e/m2/yr and kgCO2e/occupant/yr)
- It combines a bottom-up and top-down approach to measurement.
  - Top down: performance of a whole region or nation performance based on estimated data on fuel and electricity consumption.
  - Bottom up: performance of individual buildings. The bottom-up data can then be used to verify the accuracy of the top-down approach.

How is the Metric evolving?

- Pilot Phase 1: To road test the methodology, developed consensus methodology using 9 country participants and 49 buildings on several continents.
- Pilot Phase 2: More building types were included and work was done to improve the comparability of top-down and bottom-up calculations. Eighteen countries participated.

Source: www.unep.org

consumption. In practice, calculating the baseline –what would happen if the project had not been done – poses one of the biggest challenges for M&V.

The specifics associated with different levels of M&V – stakeholders, practical limitations of the measurement, and the right methodology – will vary considerably depending on the nature and scope of the project. At the building level, international organizations have focused on standardizing approaches to mseasuring and verifying the performance of energy efficiency, and development of standards and guidelines has increased in recent years. For example:

- **The International Performance Measurement & Verification Protocol (IPMVP)** offers best-practice techniques for verifying the results of energy efficiency, water efficiency, and renewable energy projects in commercial and industrial facilities. It is supported by the Efficiency Valuation Organization[8] and has worldwide application. It provides four M&V options depending on the *scope of the project* (single piece of equipment or whole building), *predictability of savings* (climate sensitivity, operational factors) and the *availability of data*.[9]
- **The Sustainable Buildings & Climate Initiative** is a partnership led by the U.N. with public and private stakeholders in the building sector. It developed the Common Carbon Metric (see Box 1), which consists of a calculation that defines MRV for energy savings and greenhouse gas emissions associated with the operation of buildings in particular climate regions. It is designed for national, regional, and local governments.[10]
- **The U.S. Department of Energy's Federal Energy Management Program (FEMP)** offers guidelines for U.S. government decision-makers conducting M&V of energy, water, and other efficiency projects.[11] The FEMP guidelines are a cornerstone of the Energy Savings Performance Contracts program[12] for retrofits of U.S. government facilities.

Tracking performance at the tenant level

In some buildings, new technologies are also enabling individual tenants to track, in real time, their energy use and their progress toward energy efficiency goals. In the case of M&V of building performance and consumer behavior, scalable and rigorous practices will rely especially on:

- **Standardization,** which continues to improve and gain wider acceptance (although more work is needed at the national and international levels[13]).
- **Metering,** such as smart metering that makes M&V simple and scalable.
- **Automation and controls technology,** which enables consumers to approve automated controls for simple everyday needs.

It is precisely the improvements in M&V hardware that help scale up energy efficiency efforts, thus helping countries, cities and companies meet mitigation objectives.

Over the long term, consumer behavior can help decide the success of energy efficiency initiatives. Real-time information about energy usage and pricing can lead to different decisions by consumers.[14] Utilities in several developed countries (and increasingly in developing countries) have designed a variety of approaches to engage energy users including

smart meters. Rolling out advanced meters and improving the resolution of customer energy data creates valuable customer information. New technologies can help turn this data into a driver of greater efficiency by providing consumers with better energy information. Choices include real-time monitoring systems and monthly comparative reports using neighbors and peers.

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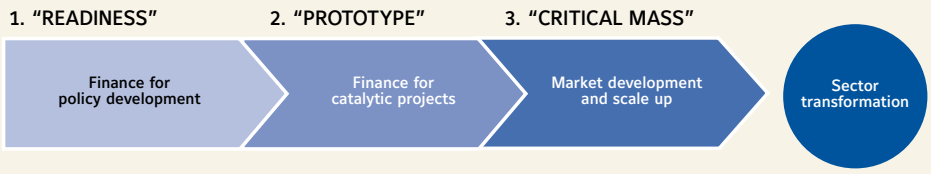
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DESIGNING A FINANCIAL PATHWAY

Investing time and resources in design of a financial pathway is critical to successful implementation of climate actions for the built environment. Without a quality financing strategy, these actions are unlikely to deliver change. One possible starting point in designing a financial pathway for a country or a city is to define the objective of the financing at different phases. What exactly is being financed at each phase? The figure below proposes a framework for addressing this question:



1. An initial and essential phase tries to mobilize **financing for policy development.** Because a market might take years to create, it becomes decisive to invest resources in setting the right conditions during the early stages of policy design (e.g. a sectoral approach for the built environment rather than isolated projects).

2. The next phase happens in the early stage of implementation and focuses on **financing catalytic projects** – a mix of priority policy options (e.g. standards) and financing mechanisms to enable the most promising projects to catalyze public and private capital. The goal is to create local precedents, build confidence, and demonstrate that building efficiency is **financeable.**

3. In a more mature phase, the focus is on further **market development and scaling up.** Critical mass is gained by adjusting financial mechanisms and creating new ones, depending on local market dynamics.

International support from the United Nations Framework Convention on Climate Change (UNFCCC) and other international aid programs may be structured to provide support at any of these phases. Because all three phases are crucial to driving a transformation to energy efficient building, support should be provided for each phase with an understanding of the priorities and needs of the other phases.



There are three critical phases in developing ***financeable*** energy efficiency programs

Readiness – defining the policy pathway and capacity building needed to support conditions that will enable the market to scale up over time.

Prototyping – support for financing initial projects and actions

Critical mass (going to scale) – because there are financial barriers, even developed economies need to continue to focus on the financing mechanisms to scale up the market. The 2011 Global Energy Efficiency Indicator survey shows that rebates and incentives continue to be important at each phase.

To start policymakers can ***define the objective*** of each critical phase (readiness, prototyping, and critical mass).

Securing financial support for policy development is critical; policymakers need to design actions that are ***financeable*** in the short, medium, and long run.

Efforts to finance building efficiency programs are on the rise. The challenge ahead is to ensure that these financing efforts are scalable and reproducible.

The building market has many sectors that need to be transformed, including single-family homes, multi-family residences, commercial office space, hotels, schools, malls, government buildings, and hospitals. Investing in a sector-specific strategy that moves the sector through these three phases can be a valuable way to focus attention and to support that sector's transition.

1. READINESS: FINANCE FOR POLICY DEVELOPMENT

The first area for financial support is in the readiness phase, which includes policy development and design as well as human capacity development. The goal in this phase is to develop policies and capacities to support conditions that will enable the market to scale up over time.

Support from international development institutions can be helpful in formulating policy, designing efficiency programs and actions, establishing an energy efficiency agency with

Box 1.
Building Efficiency Measures in Jakarta

Indonesia's new building codes were developed with direct technical assistance from the International Finance Corporation (IFC) by analyzing cost-effective ways to get an average 30 percent energy savings in new buildings.

Sensitivity analysis of energy efficiency options for Jakarta shows that energy savings of more than 30-40% can be achieved from simple measures.

	High Impact Measures	Office	Retail	Hotel	Hospital	Apt.	School
	**Photoelectric controls** (inclusion of controls to maximize daylighting)	18%	11%	NA	17%	NA	10%
	**Solar shading** (addition of horizontal and vertical devices)	17%	11%	18%	18%	8%	2%
	**Glass performance** (higher solar and thermal properties)	15%	6%	16%	14%	11%	5%
	**Efficient Chillers** (higher chiller COP)	11.4%	8%	6%	7%	9%	12%
	**Variable-speed drives** (inclusion of variable drives on pumps)	9%	3%	3%	5%	0.0%	0.0%
	**Percentage glazing** (limiting window-to-wall ration of the facade)	8%	4%	9%	7%	2%	0.0%
	**Low-energy lights** (limiting the power density for artificial lighting)	7%	8%	7%	16%	6%	5%
	**Thermostat Management** (limiting the minimum temperature)	2%	3%	3%	7%	6%	11%
	**Heat Recovery** (adding heat recovery unit to fresh air inlet)	2%	5%	3%	8%	0.0%	0.0%

Source: Prashant Kapoor, IFC Green Building Strategy, World Bank Group, Washington D.C. (2011) [1]

the expertise to develop and implement new energy efficiency policies and programs, and facilitating stakeholder involvement. Greater human capacity and technical expertise can be built in areas such as data collection and analysis, policy and program development and implementation, and policy and program evaluation.

One task that requires attention among policymakers is the design of a sectoral strategy for the built environment that is ***financeable***. Without considering the financing element explicitly, the risk is that many actions may never be implemented. The design of a specific finance strategy will benefit both the government and the private sector, to the extent that it delivers a clear long-term plan with clear signals for the many stakeholders involved in the building cycle.

Policy design needs to consider how public policy can ***attract private- and public- sector*** capital into building efficiency. The creation of these linkages will vary geographically, but one feature is common: the need for a mix of ***requirements*** to use energy efficiently. These include building codes or energy efficiency targets for the country, and ***incentives*** for good performance. Legal requirements or voluntary actions alone are unlikely to create a market at scale; the challenge for policy design is to find a balance between the two.

2. PROTOTYPING: FINANCE FOR CATALYTIC PROJECTS

The second area for financial support lies in the financing of projects and programs in the market itself. For a policy or program to enable the building efficiency market to scale up, it should focus on investments in policies and programs that structure the market in a way that allows for more rapid market development.

In order to transform a sector, a scalable financing model is necessary. Buildings tend to have high up-front costs and low operating costs because of efficiency gains that lower the total cost throughout the building's life cycle. For this reason, much of the public debate on energy efficiency finance deals with the question of ***cost optimality*** – how best to address the cost curve of projects over the life of the building.[2]

Lessons from experiences in energy efficiency finance in developing countries point to the importance of adopting an ***investment-grade*** approach to low-carbon energy policy to ensure that the country or city offers enabling conditions for investors, both local and international.[3] Without the right investment conditions, international capital may never be deployed, even if the policy package is technically sound.

The financing of energy efficiency projects can use a variety of mechanisms, such as grants, tax measures, and special-needs funds. The question for many governments in developing countries is how to achieve the best mix of mechanisms, and of ***domestic*** and ***external*** sources of financing. Thus far, the examples of energy efficiency finance in the built environment rely on international support at least in the initial phase. As middle-income economies increase their appetite for investing in energy efficiency, many of them are requesting credits from multilateral development banks. As a result, experimentation with financing mechanisms is ongoing.

In practice, many developing countries, for example China, are using energy service companies (ESCOs) as a mechanism for financing energy efficiency in the built environment. It is still early to draw definitive lessons, but the performance of these mechanisms might offer valuable insights into what works and what does not in practice. The case of Mexico (Box 2) illustrates a programmatic approach to financing energy efficiency measures in housing.

A core challenge for policymakers in developing countries is to build a financial strategy that attains critical mass, going beyond the financing of isolated projects. The focus of banks and cooperation programs tends to be on the financing of pilot projects. As a result, the challenge for policymakers who want to transform a sector is to create credible signals through mechanisms that boost investment in the sector by ***several orders of magnitude***.

Box 2.
Example of Mexico's Financing Plan for Energy Efficiency Measures (2009-2013)

- Mexico was the first country to submit a national low-carbon investment plan to the World Bank's Climate Investment Funds (CIF).
- The investment plan has a strong energy efficiency component in various sectors of the Mexican economy. The energy savings potential within the productive sector is between 15 and 40 percent of sector consumption, and the estimated investments are $5.6 billion.
- The government plans to increase the efficiency of 30,000 existing and new houses in hot climates by replacing inefficient equipment and upgrading the house envelope. The intermediate target for 2011 was 12,000 units. This included the installation of thermal-insulated roofs and walls and double-glass-pane windows by specialized companies, and the replacement of air conditioners and refrigerators.
- Part of a loan from the CIF will be used to remove barriers to energy efficiency: The funds will help reduce the cost to consumers of buying efficient equipment and devices for their houses. Financing will be available for low-income populations through local loans and guaranteed commercial bank loans.
- Companies that will buy new and efficient equipment will have access to a line of soft financing. The financing of energy efficiency in Mexico, until 2013, is mostly international, combining grants, loans, carbon markets, and private-sector funds reaching a sum of approximately $415 million.

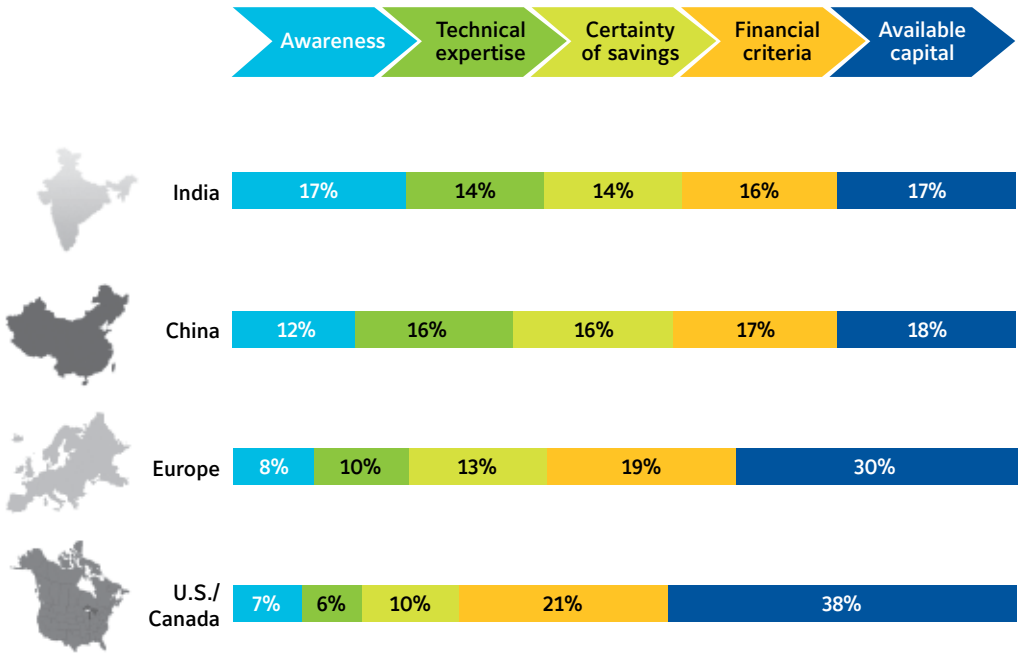
Source: Mexico's Low Carbon Investment Plan submitted to the World Bank's Clean Technology Fund [4]

3. CRITICAL MASS: MARKET DEVELOPMENT AND SCALE-UP

Economies around the world are struggling with similar barriers and challenges as they try to scale up markets for energy efficiency. Financing building efficiency projects remains one of the most persistent barriers to energy efficiency, even in developed countries with substantial markets for energy efficient buildings. As shown by the 2011 Global Energy Efficiency Indicator

Survey, conducted annually by the Johnson Controls Institute for Building Efficiency, the ***lack of available capital*** to pay for improvements is named as the top barrier to pursuing energy efficiency. It is named more frequently in more developed markets for building efficiency, such as Europe and the U.S., than in developing markets for building efficiency, such as India and China.

Figure 1.
Top Barrier to Building Efficiency from Building Energy Management Decision-Makers



Source: Institute for Building Efficiency, Johnson Controls, Inc. Global EEI Survey (2011) [5]

The United Nations Environmental Program Finance Initiative (UNEP FI) has pointed out that challenges to energy efficiency finance at scale include:

- The so-called ***aggregation challenge:*** large corporate banks will not conduct due diligence for investments lower than $100 million because the opportunity cost is too high.
- ***Split incentives:*** the entity paying for the energy efficiency investments is not the same as the entity benefiting, especially in buildings when many parties are involved.
- ***Lack of guarantees:*** insufficient mechanisms for energy efficiency lending to smaller companies.[6]

Initiatives tackling building energy finance in developing countries are on the rise, including efforts at the city level. One example is the Clinton Climate Initiative (CCI), which works with financial institutions and providers of capital to adapt existing and create new financial products that are specifically tailored to building energy efficiency projects.[7]

A recent example from the U.K. shows how policymakers are attempting to achieve critical mass and market scale-up through a combination of regulations and finance initiatives (Box 3).

Box 3.

Financing the retrofits of old buildings: Market creation through regulation in the U.K.

- As part of the Green Deal in the U.K., the government aims to stimulate a 'step change' in the energy efficiency of British properties while putting in place mechanisms to attract the financial community to the energy efficient economy.[1]
- The basis for action is the U.K. Energy Bill of 2010, which aims to ***regulate*** greenhouse emissions and energy. As a result, the government is establishing a framework to enable private firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at ***no up-front cost,*** and to recoup payments through a charge in installments on the energy bill. From 2012, households will be able to access up to £10,000 (US$16,500) up front to pay for energy efficiency work. Similar support will be available to businesses and vulnerable people, or those living in homes that need extra work.
- The Green Deal is expected to create a retrofit market worth **£7 billion to £11billion** (US $11 billion to $17 billion) per year over the next 15 years, a major ramp-up from existing investment of £1 billion to £2 billion (US $1.5 billion to $3.0 billion) per year.[2] This is an example of a policy-driven market that could not be created without mandatory requirements for building efficiency. It therefore highlights the linkages between policy making and long-term financing.

Source: UK Department for Energy and Climate Change (DECC) [8]

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PRIVATE SECTOR ROLE AND PERSPECTIVE

Building efficiency investments can improve energy productivity, foster economic growth, improve energy access, energy security and the environment. Each additional $1 spent on energy efficiency in electrical equipment, appliances and buildings avoids more than $2 in energy supply investments, on average, according to the International Energy Agency.[1] Improving building efficiency makes it more cost effective to achieve sustainable urbanization, meet growing energy, demand and increase energy access for the poor. Buildings that cost less to illuminate, heat and cool free up resources for other investments.

Market conditions affect private-sector investment decisions and business viability. Creating the right conditions requires aligning the interests of architects, construction companies, building trades such as electricians and plumbers, equipment manufacturers, and government offices and officials. To achieve greater energy efficiency, there must be a compelling view to why changing current business practice benefits everyone.

Private-sector investment will follow demand. Demand for energy efficient buildings does not always exist today. Policies can help drive that demand: Government incentives, rebates and other policies rank among the top drivers for commercial building owners to invest in energy efficiency technologies and practices.[2]

Once there is demand for energy efficient buildings, there also need to be suppliers in the market to provide the energy efficient materials, equipment and services, and banks that want to finance any additional up-front costs of efficiency projects. Building materials, equipment and service providers may view energy efficient buildings as either an opportunity or a threat to business as usual, depending on their ability to supply such buildings. Companies with efficient materials, equipment and services will likely view increased building efficiency as an opportunity, whereas those with inefficient materials, equipment or services may see the shift to efficient buildings as a threat. Policies can be designed to help ensure an adequate supply of cost-effective building efficiency products and services, available financial services to cover the up-front investments, and proper valuation of buildings based upon their energy attributes.

The Institute for Building Efficiency at Johnson Controls explored the general market conditions and building efficiency public policies that can drive increased investment in building efficiency in developing



Creating the right supporting market conditions for investment in energy efficient buildings can leverage private-sector capital, technology and services to scale up the market.

Policies should be designed to target one segment of the market at a time. The four major segments in the buildings market are: commercial new construction, residential new construction, commercial retrofits, and residential retrofits.

The private sector can play a role in setting policy priorities and designing policy options. The private sector can also have a role in implementing some policy priorities through public-private partnerships.

countries. We investigated these questions with U.S. and European-based building efficiency companies who are investing in developing countries, including, energy service companies (ESCOs), building equipment manufacturers, building material manufacturers, architecture and engineering firms and financial institutions. Through an online questionnaire and a roundtable discussion with a group of industry leaders and industry associations, we reviewed options and discussed policy priorities that would support a robust efficiency market. A list of round-table participants is included at the end of this section. The analysis and interpretation of these materials are the authors' alone and are not necessarily shared by the roundtable participants. We hope our findings might serve as a starting point for similar discussions with the private sector at the country and city level, as priorities will vary by geography and local conditions.

GENERAL MARKET CONDITIONS

Companies from the building efficiency sector indicated that specific building efficiency policies are important when making decisions to invest in emerging economies, but that policies exist within a set of general market conditions that are also important to investment decisions. The roundtable discussed both positive factors that drive investment and negative obstacles (barriers), that make investment less appealing.

Investment Factors

Three factors emerged as having the greatest influence on decisions by companies to invest in building efficiency in emerging economies: the size of the market, the regulatory regime, and a stable investment framework. Companies at the roundtable reflected on the importance of these market fundamentals. For example, if it takes two years to sort out the property rights to site a manufacturing facility in a given country, then that is a significant deterrent to investment.

Obstacles to Investment

Risk is the greatest obstacle to investment by building efficiency companies. Risk can come from many sources, but participants specifically noted that the investment horizon is very important where there is significant political risk, such as regime change. In high political risk situations, companies will only make investments with quick paybacks, so as to avoid the potential for stranded investments. The relatively short payback times for some building efficiency projects can be attractive for service providers; longer-term projects with deeper efficiency gains may be harder to support.

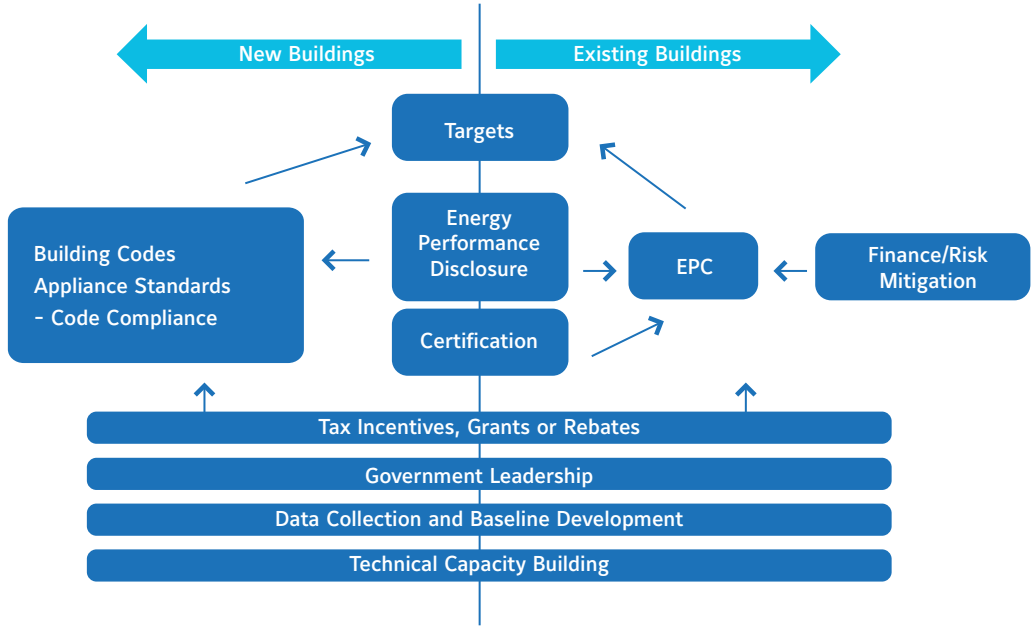
The second greatest obstacle to investment cited at the roundtable was government corruption. Companies noted that they expect to operate globally with strict business integrity, making it unattractive and difficult to operate in markets where bribes and other forms of government corruption are the norm. Other obstacles to investment in emerging economies include lack of available data and under-developed legal systems. Lack of a strong legal intellectual property rights structure was also noted as a barrier to investment.

POLICY PRIORITIES

The roundtable dialogue held with U.S. building efficiency companies identified 10 private-sector policy priorities. In discussing these priorities, participants highlighted the importance of each and the ways in which the policies interact to support investment and energy efficiency action. This dialogue, coupled with the short questionnaire, offers insights that may be helpful to policymakers regarding the opportunities to support investment and market development. We share these findings from our small sample group, not because they are conclusive or broadly representative of voices in the participants' communities, but because we hope they will provide interesting fodder for stakeholder discussions about policy priorities in other countries and cities around the world.

As an overview, each of the 10 policies and some of the ways they interact with and support each other are shown in the following diagram.

Figure 1.
Interactions Among Policy Priorities



Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

In looking closely at Figure 1 in the new buildings category, building codes are the key policy for meeting building efficiency targets. For existing buildings, energy performance contracting policy can facilitate renovation. Energy performance disclosure requirements are a key driver for both of those policies, and voluntary certification can also help. Building retrofits using energy performance contracts need to be financed, so policies that help make financing

available for those projects can provide key support. In addition, supporting policies for greater efficiency in new or existing buildings can include:

- Tax incentives, grants or rebates
- Government leadership through efficient public buildings
- Data collection and baseline development to inform building management, efficiency investment and policy decisions
- Technical capacity building

The following sections provide a short review of each policy category (some are combinations of a few categories given in the full report), the role of the private sector in developing and implementing each policy, and examples of best practices for each policy from around the world. Policies are listed in approximate order of priority based on our private-sector questionnaire and discussion. For example, public awareness and education campaigns were not a high priority from a private-sector investment perspective, so we have excluded them from this list. However, in any given market or effort, this may be a higher priority among other stakeholders.

In evaluating policy options, it is critical for policymakers to recognize that different policies can target different segments of the buildings market. The four major market segments in the buildings market are commercial new construction, residential new construction, commercial retrofits, and residential retrofits. In addition, institutional buildings such as hospitals, schools and government buildings may also be considered as unique vertical markets. Policies may be designed to target one segment of the market at a time. Examples of best policy practices will be pulled from among these market segments.

1. Building Efficiency Targets

Building efficiency targets are overarching efficiency targets for the commercial or residential building sector at the local, regional or national level. Energy efficiency improvement goals, energy efficiency resource standards (EERS), and energy efficiency trading schemes (white certificates) are all examples of building efficiency targets.

Building efficiency targets came out as a top priority because they can catalyze many other actions in both the public and private sectors by focusing all stakeholders around a clear goal. The enforceability of targets and degree to which targets are compulsory was noted as a key determining factor in their effectiveness.

2. Building Energy Codes

Building energy codes require minimum thresholds for energy efficiency in commercial or residential buildings. This category includes whole-building design and construction requirements, performance requirements, and appliance, equipment and lighting efficiency requirements. Such codes and requirements are particularly key to transforming new buildings to be more energy efficient. Codes and requirements also can be put in place for energy efficiency when a building undergoes a major renovation. For example, insulation (R-value) requirements could be put in place for building envelope renovations. Energy performance standards for appliances, equipment and lighting efficiency reduce energy consumption in

buildings, and setting or revising appliance standards will have an impact on energy demand through the replacement of inefficient equipment with more efficient equipment over time.

Building energy codes face a significant challenge in many countries around compliance and enforcement. Roundtable participants noted two particular ways enforcement might be improved. The first was simply to have other supporting policies in place – such as incentives for demonstrated compliance, or mandatory disclosure of energy performance. The second was to use current technologies to track and monitor building energy usage remotely. Tracking performance may be another mechanism to help review whether a building was built to code, though it may not be a complete substitute for on-site inspections. Remote monitoring and testing before to the issuance of occupancy permits may be another tool that could complement the more costly on-site inspections. Developing countries may be able to leapfrog past the challenges developed countries have faced with building energy code enforcement by complementing traditional enforcement approaches with remote performance testing.

3. Building Energy Performance Disclosure

Building energy performance disclosure is a requirement to give building owners and users information on building energy consumption. Such information may be required at the time of sale or rental of the building, or may be required to be publicly available at all times. Today, when a building is bought or rented, little information is known about that building's efficiency, or the energy costs required to operate it. In contrast, many countries require disclosure of an automobile's fuel economy (miles per gallon) to consumers when they purchase or lease a car. Building energy performance disclosure would require this same type of energy performance information to be available when a tenant or prospective buyer considers renting or building a building. For example, in New York City, building energy performance must be measured and disclosed once every five years.

Energy costs are a significant monthly expense in the operation of a building. According to the U.S. Department of Energy, energy use is the single largest operating expense in commercial office buildings, representing approximately one-third of typical operating budgets.[3] The Institute for Market Transformation points out that the typical U.S. household spends more on energy each year than on property taxes or homeowners' insurance, yet unlike those two expenses, energy costs are not routinely underwritten in a mortgage loan.[4] The disclosure of building energy performance would provide transparency about the energy costs and energy efficiency of different buildings so that the value and cost savings from energy efficiency could be easily passed between actors during transactions in the buildings market. The value of energy efficiency can be shared across the building's value chain. Efficiency benefits the building occupant who pays the energy bills and sees direct savings from being in an energy efficient building. It also increases the value of the building to the owner (in higher resale value and increased occupancy and rent), and increases the value to the developer, thereby overcoming the challenge of split incentives.

The disclosure of estimated energy costs can also be required for appliances, equipment, and lighting. Total estimated cost of ownership labels could be required in addition to efficiency labels on those items.

Building performance disclosure is a private-sector priority because it facilitates proper valuation of buildings based upon their energy performance, enabling the value of energy

efficiency to be passed easily along a building's value chain and shared among all stakeholders. When all stakeholders share in the cost-saving benefits of greater energy efficiency, the building efficiency market should grow.

4. Building Rating and Certification Programs

Building rating and certification programs are systems for labeling buildings with a rating or certification that indicates its level of efficiency and sustainability. Rating systems benchmark buildings against each other, creating the spirit of competition. Building rating and certification programs can come in many forms. The simplest ratings often consist of the requirements of the energy performance disclosure policies listed above. Also common are voluntary rating and certification systems that provide more detailed insights in to a building's energy systems or measure building sustainability features beyond only energy. Such voluntary rating and certification programs can have a powerful transformative effect on the buildings market. For example, the roundtable discussion noted that when one building in an area achieves a LEED certification from the U.S. Green Building Council, owners of neighboring buildings who compete for the same tenants seeking high-quality, sustainable space can be inspired to pursue certification as well.

5. Tax Incentives, Grants or Rebate Programs

Tax incentives, grants or rebate programs can be used to incentivize a range of measures, from purchasing energy efficiency equipment and products to completing whole-building upgrades. Such incentives can be key to invigorating a new market for building efficiency. In the global 2012 Energy Efficiency Indicator survey[5] of nearly 4,000 facility managers and executives, conducted annually by the Institute for Building Efficiency, 31 percent of respondents selected tax incentives or rebates as the policy that would have the greatest impact on improving energy efficiency in buildings.

6. Government Leadership

When governments lead by example, by making their own buildings more energy efficient, they create demand for efficient buildings and help jump-start the building efficiency market. A focus on improving ***public buildings*** owned or operated by local or national governments is often a good starting point in a comprehensive policy pathway and provides three major benefits at once:

- Improving the efficiency of government buildings saves money for public agencies, freeing up capital for other public programs.
- Efficiency measures in public buildings support the market growth of energy efficient building products and services and create jobs.
- A comprehensive policy to address all government-owned or financed buildings has far-reaching impacts on society, and particularly on vulnerable populations that depend on government services. Policies can be structured to apply efficiency criteria to improve social housing, hospitals, and public schools.
- Governments can require that their new buildings be energy efficient, that they retrofit their existing building stock to be more efficient, that they lease space only in efficient

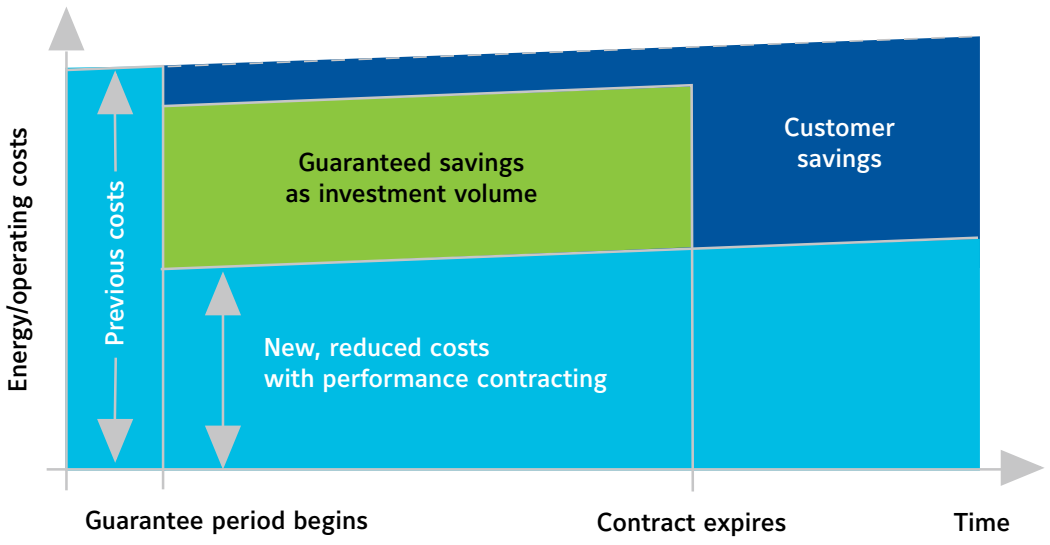
buildings, and that only efficient appliances, equipment and lighting be used in the buildings. To meet this demand, designers and construction companies will have to learn how to build efficiently, energy service companies will grow in the market to retrofit existing buildings, banks and financial institutions will learn how to finance these projects, and appliance, equipment and lighting manufacturers will have to supply efficient products to the market.

7. Energy Performance Contracting Enablers

Policies that enable energy performance contracting (EPC) can help create standardized, streamlined, and transparent project development and vendor selection processes that lower the transaction costs for the use of EPCs to retrofit existing buildings. These include policies that establish standard contracts; pre-approved lists of providers, project facilitators or consultants; and standardized measurement and verification (M&V) protocols. EPCs address barriers to building efficiency such as up-front costs, lack of technical capacity on the ownership team, perceived project risk, and uncertainty of savings.

In energy performance contracting, an ESCO plans and executes a retrofit to make a building more energy efficient. The ESCO then guarantees the energy savings for the customer through an EPC. Figure 2 illustrates how this tool works in practice.

Figure 2.
Energy Performance Contracting[6]



Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

Box 1.

Energy Performance Contracting: The European Bank For Reconstruction And Development (EBRD) In Romania And Ukraine

The EBRD launched its Sustainable Energy Initiative (SEI) in 2006 to address the dual challenges of improving energy efficiency and combating climate change in the regions of central Asia, Eastern and Central Europe, and Russia. Recognizing the necessity to stretch limited public funds, SEI has successfully leveraged enough private-sector finance with its strategic investments so that external funds now occupy the largest share of SEI's total project value, maximizing the positive impacts on local economies and the environment.[7]

Technical assistance, regulatory preparation, and financing for energy performance contracts (EPC) in the region have been a major EBRD focus for helping national and municipal governments reach their energy-saving goals and for driving the market for energy efficiency practices and lending.

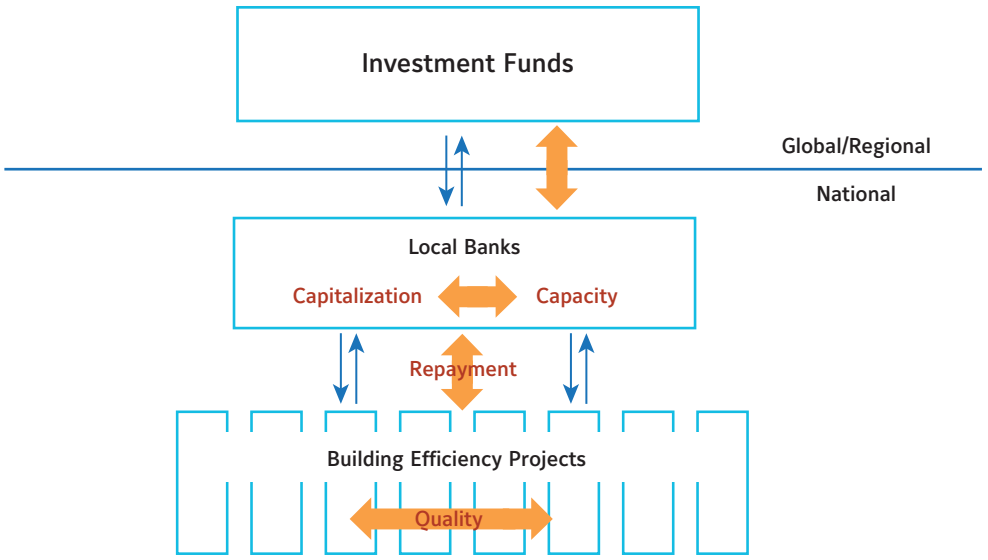
- In 2011, to help Romania's national government achieve its goal of 20 percent energy savings by 2020, EBRD granted a €10 million corporate loan to EnergoBit ESCO to finance energy-saving initiatives for Romanian municipalities through EPC. This loan builds on EBRD's ongoing, extensive technical assistance program for local authorities to prepare and manage energy efficiency improvements based on EPC services.[8]
- Facilitated by a grant from the Czech Republic, EBRD has launched a technical assistance project in the Ukraine to identify and develop mechanisms for private-sector financing for energy efficiency improvements in public buildings such as schools and hospitals.[9]
- The project assessed the legal and commercial framework for EPC services in Ukraine, conducted market analyses for ESCO services, and identified and facilitated the regulatory reforms needed to fully enable the uptake of EPCs in Ukraine, while minimizing risk for the private lenders.
- **Results:** In Romania, technical assistance combined with the €10 million EBRD loan has helped to catalyze a pipeline of €45 million in projects to be implemented over the next 10 years, ranging from energy efficient street lighting to cogeneration projects in municipal hospitals. The EPC project in the Ukraine is being piloted for public buildings in the Ukrainian cities of Dnipropetrovsk, Odessa and Zaparozhia with the goal to expand nationally.

8. Risk Mitigation

Risk mitigation programs can encourage the finance sector to lend money to building efficiency projects by transferring risk from financial institutions to either a government entity or multilateral development banks. Risk mitigation can take many forms. The greatest sources

of risk should be identified through discussions with financial institutions, and policies should be designed to mitigate those specific risks. Roundtable participants noted that if risk mitigation mechanisms are not well designed or are too cumbersome and complicated to use, then the private sector may not use them, or may underutilize them.

Figure 3.
Type of Investment Risk



Source: Adapted from a draft figure by the US State Department

Figure 3 shows five kinds of risk that the government may want to mitigate in order to make financing available for building efficiency projects. The design of finance policies will be different for the residential and commercial markets, and potentially sub-sectors of those markets, but the same basic categories of risk exist in each.

Currency risk may be of concern if international investment funds are to invest in local markets. Local financial institutions may need help tackling some of the risks that come with initial entry to the building efficiency market.

Capacity risks may surround the development of new financing instruments for building efficiency projects. Without a large pipeline of projects, financial institutions may hesitate to dedicate the capacity to develop new financing instruments, and without financing instruments the pipeline of building efficiency projects may never materialize. In this case, government may be able to support the development of building efficiency financing instruments, thereby helping financial institutions overcome the capacity risk.

Capitalization risks come with dedicating capital to those new financing instruments.

Repayment risks come with new financing instruments that have little track record to demonstrate repayment. Repayment risk is present in every market – in developed and

developing countries. The roundtable discussion noted that repayment risk is particularly key because the best-engineered and best-executed building efficiency project still will not generate repayment if the underlying host is not viable, or goes out of business.

Quality risks exist in whether the expected energy and cost savings from a building efficiency project actually materialize. Quality risk depends on the way building efficiency projects are engineered and executed.

Some of these risks may not need government mitigation: For example, an EPC could mitigate the risk of project quality. The five risks discussed here do not constitute an exhaustive list but simply a starting point for discussing the design of risk mitigation with the finance sector.

Box 2.

Public Finance Credit Lines for Energy Efficiency: Thailand's Energy Efficiency Revolving Fund for Local Financial Institutions

Building off public funds initially dedicated in 1992 by the country's nationwide energy conservation legislation,[10] the Royal Thai Government established its Energy Efficiency Revolving Fund (EERF) in 2003 with the goal of catalyzing commercial lending for energy efficiency in buildings and industry. Today, the EERF represents one of the most successful examples of a public-private partnership between the national government and local financial institutions dedicated to energy efficient buildings in the developing world.

- The Royal Thai Government conducted an initial market assessment to estimate the economic potential for improving energy efficiency in buildings and industrial facilities. The results recommended an initial USD$55 million for the EERF pilot program.
- The EERF was designed as a three-year pilot program to provide zero-interest sub-loans to participating Thai banks to encourage them to finance qualifying energy efficiency projects, stipulated by contracts between the government and each participating bank. Banks provide low-interest loans to projects with an average seven-year repayment term.
- **Results:** The EERF has been renewed twice since 2003 and, as of 2010, 11 partnering banks had financed 335 energy efficiency projects for an estimated energy cost savings of USD$154 million.[11]

Box 3.
Risk Mitigation: China's Utility-Based Energy Efficiency Finance Program (CHUEE) and Loan Guarantee Scheme

Two distinct risk-mitigation programs in China are working to unlock private-sector finance for energy efficient buildings through innovative multi-donor partnerships between the Global Environment Facility (GEF), the International Finance Corporation (IFC), the World Bank, and donor countries. The China Utility-Based Energy Efficiency Finance Program (CHUEE) operates as a risk-sharing facility, while the China Energy Conservation Project (CECP) is helping China strengthen its ESCO market through loan guarantees.[12]

- CHUEE was created in 2006 to serve as the intermediary between local financial institutions (LFIs), utilities, and suppliers of energy efficient products and services, and to provide technical support.
- Under CHUEE, a Loss-Sharing Agreement with Chinese banks provides that IFC and the GEF will share a portion of the loss for all loans within a greenhouse gas emission reduction portfolio, with differing ratios on first and second losses.
- Under the CECP, the World Bank and the GEF provided USD$16.5 million to the Chinese Ministry of Finance to establish loan guarantee reserves for ESCO projects. Through a state-owned guarantee company that handled the contracts and claims, the Chinese government was able to issue a 90 percent guarantee on loans made by LFIs to ESCOs for qualifying energy efficiency projects.
- **Results:** CHUEE has helped facilitate a total investment of USD$512 million in energy efficiency projects for an estimated reduction of 14 million tons of CO2 per year. Over four years, the CECP leveraged USD$52 million of public finance in the form of loan guarantees for a total of USD$90million in energy performance contracting investments by Chinese ESCOs.[13]

9. Data Collection and Baseline Development

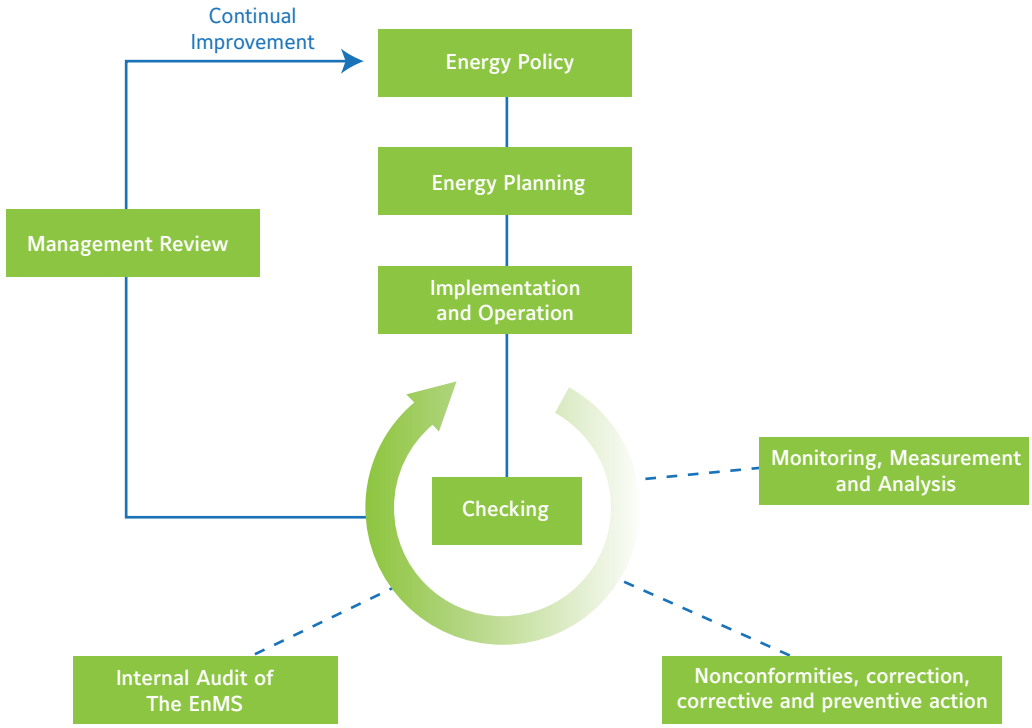
Reliable and transparent data on building energy use is important for good day-to-day energy management decisions, as well as for the design of building efficiency policy measures. In addition, good data and information on building energy usage is crucial for the measurement and verification of building efficiency gains from the project through to the policy level.

Good building energy usage data is an essential component of smart energy management in buildings, as well as in the development of building policies and strategies for countries and cities. Energy usage data can enable the use of building management practices such as ISO 50001, the international energy management standard (Figure 4).

ISO 50001 provides a process for managing and continuously improving energy performance – in a building, on a campus, or across an entire building portfolio. One key element of the

ISO 50001 process is to monitor and measure building energy performance to ensure that the benefits of energy management do not wane with time. Measurement and verification of energy efficiency can help secure financing of building efficiency projects. At the city or country level, a similar need exists to monitor and measure the impacts of building efficiency policies over time, and to improve upon and adapt those policies when needed.

Figure 4.
ISO 50001 Framework for Energy Management



Source: Institute for Building Efficiency, Johnson Controls Inc. (2012)

While continuous improvement in energy management, such as that achieved using ISO 50001, is ideal, much also can be done to improve energy efficiency by using data and baselines to implement simpler energy management processes.

10. Technical Capacity Building/Workforce Training

Successful implementation of policies, and growth of the building efficiency market, often require an increase in capacity in both the government and private sectors. The roundtable discussion noted that capacity building and workforce training programs are often key enablers of the private-sector entry into the building efficiency market in emerging economies.

PRIVATE SECTOR ROLE AND IMPACT

The role of the private sector in designing and implementing policies, as well as the direct or indirect nature of the impact of those policies on growth of the building efficiency industry, will be discussed in this section. The private sector can play a role in the development and design of policies, and also at times in the implementation of policies through public-private partnerships (PPPs).

Role of the Private Sector

Buildings are generally designed, constructed, built, financed, retrofitted, and managed by private-sector actors. Transforming buildings to be more energy efficient requires these actors to benefit when making energy efficiency investments. Aligning the interests of all these stakeholders to deploy building efficiency at scale will require dialogue and engagement with the building construction industries and the, private sector can provide input on policy strategy and design.

PPP's offer some of the greatest opportunities for directing private-sector capital toward sustainable development.[14] There are two types of PPPs – those that have legal structure and those that are efforts to work together simultaneously to achieve a common goal.

The more formal PPPs for energy efficiency, according to the International Energy Agency (IEA), commonly have the following features:

- A contractual relationship or agreement between a public entity and a private organization
- Risk sharing between the public and private partners
- Mobilization of private-sector financing
- Payments to the private sector for delivering services to the public sector[15]

Governments increasingly looking to these types of PPPs to help overcome barriers to improving efficiency and to achieving energy savings targets. In the building sector, PPPs with ESCOs and local financial institutions can be helpful in targeting specific market barriers, without the need for direct government subsidies.[16] They also allow governments to achieve targets and save on long-term costs with only a fraction of the public funding that would otherwise be required, a crucial consideration for governments facing debt crises.

Other forms of PPPs include looser collaborations, such as the collection of private-sector input on selection of building efficiency targets or in developing building codes.

Impact on the Private Sector

Some policies have a very direct impact on driving growth in the private-sector market for energy efficient buildings, while other policies have an indirect impact. The direct or indirect impact in the building efficiency market varies by segment of the buildings market and by private-sector stakeholder, but thinking through the kinds of impacts each policy will have is important to good policy design.

Figure 5 analyzes the role of the private sector and the impact on the private sector of each of the 10 policy options discussed as policy priorities in this paper.

Figure 5.
Private Sector Role and Impact

Private Sector Role and Impact	Informs Policy Design	Assist in Policy Implementation (Public Private Partnership)	Direct Impact on Growth in Building Efficiency Industry	Indirect Impact on Growth in Building Efficiency Industry
Building Efficiency Targets	■			■
Building Energy Codes	■		■	
Building Energy Performance Disclosure	■		■	
Building Rating Systems or Building Certification Programs	■	■		■
Tax Incentives, Grants or Rebate Programs	■		■	
Government Leadership Programs	■	■	■	
Energy Performance Contracting Enablers	■	■	■	
Risk Mitigation	■	■	■	
Data Collection And Baseline Development	■			■
Technical Capacity Building Programs/Performance Training and Education	■	■		■

Source: Institute for Building Efficiency, Johnson Controls Inc. (2012)

Box 4.
Melbourne, Australia's Set of Building Efficiency Policies

The city of Melbourne has combined some best-practice policies for transforming existing commercial buildings to be more energy efficient.

1. The city set a net zero emissions goal to achieve by 2020. This goal will require a 50 to 60 percent improvement in building efficiency.
2. The Federal Government of Australia has introduced building energy codes that require a certain efficiency standard to be met when a building undergoes reconstruction, major renovation, refurbishment or retrofit
3. The federal government is also developing a requirement that building energy performance be disclosed at the time of sale or rental of a commercial office building.
4. Melbourne's Environmental Upgrade Agreement Program enables the city council to enter into Environmental Upgrade Agreements (EUAs) with commercial property owners seeking upfront financing for projects that improve energy, water and environmental efficiency, and with financial institutions willing to fund those retrofits. The owner or occupier pays an ongoing Environmental Upgrade Charge (EUC), levied by the council, that essentially matches the principal and interest. The payments are then passed on to the lender. The EUA structure makes the loan

Box 4. (con't.)
Melbourne, Australia's Set of Building Efficiency Policies

transferable to subsequent owners and enables owners to legally pass the repayment costs along to occupants, who see the energy savings on their energy bills.

The suite of policies implemented my Melbourne demonstrates the type policy combination that has potential to transform existing commercial buildings to be far more energy efficient.

CONCLUSION

The right general market conditions and an effective combination of building efficiency policies can help create a robust market, enabling private-sector capabilities and capital capabilities to scale up the market for energy efficient new and existing buildings. The private sector can play a role in both developing and implementing some building efficiency policies. The Policy Assessment Tool, introduced earlier in this report, can help policymakers determine what building efficiency policies should take priority in their own markets.

ACKNOWLEDGEMENT OF ROUNDTABLE PARTICIPANTS

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Mark McKinley, AECOM
Melinda Kimble, UN Foundation
Robert Wilkins, Danfoss
Sean Kidney, Climate Bonds Initiative
Stacey Davis, Center for Clean Air Policy

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BUILDING EFFICIENCY POLICY ASSESSMENT TOOL

Facilitators Guide

Assessment Sheets

Output Charts



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BUILDING EFFICIENCY POLICY ASSESSMENT TOOL: FACILITATORS GUIDE

Designing a strategy to transform the built environment to be more energy efficient is not a simple process. No single government policy can drive the transformation on its own, but the right combination of policies can help transform buildings to be far more energy efficient over time. The Building Efficiency Policy Assessment Tool presented in this section provides a simple framework to help policymakers begin to design a policy strategy that will achieve transformation in the built environment.

The tool will be most effective when used to assess policy options and priorities for one market segment at a time, such as residential new construction or existing commercial buildings. Market segments might be selected based on potential energy savings, economic impact, or other factors.

The tool provides a framework for structuring discussions in a workshop setting with key stakeholders from across the building efficiency market, including government, civil society, and the private-sector. Stakeholders that might be involved include national, sub-national and municipal governments, architecture and engineering firms, energy service companies, building equipment/appliance/controls manufacturers, building materials manufacturers, energy service providers, financial institutions, real estate management companies, and non-governmental organizations (NGOs). The recommended workshop agenda includes three activities – visioning, assessment, and action planning.

THE BUILDING EFFICIENCY POLICY WORKSHOP

The most important step in organizing a policy workshop is inviting the right set of stakeholders. The goal should be to have balanced representation from all key stakeholder groups – public sector, private sector, and NGO. Participants should have a comparable and complementary level of knowledge of market conditions and opportunities. If the differences in experience or position are too large, it will be difficult to maintain engagement and build consensus around specific strategies. Workshops that include 15-30 diverse stakeholders will be large enough to facilitate active collaboration without being so large as to inhibit discussion. Figure 1 provides an overview of the flow of a workshop.



The right combination of policies can help transform buildings to be far more energy efficient over time.

The policy assessment tool provides a simple framework to help policymakers to set policy priorities with input from stakeholders.

The assessment tool supports a collaborative process for exploring building efficiency policy options based on local importance and difficulty, as well as current policy status and the desired suite of policies for implementation.

The tool includes a facilitators guide for how to run a workshop, templates and analysis tools. The workshop is designed to support consensus-based, multi-stakeholder collaboration and uses visual tools to build consensus and prioritize building efficiency policy options and strategies.

Figure 1.
Flow of Building Efficiency Policy Workshop



Source: Institute for Building Efficiency, Johnson Controls Inc. (2012)

The policy workshop has been designed around a nominal half-day format but can be easily expanded or shortened to meet any time frame. The workshop space should ideally include a U-shaped seating area for facilitated discussion and plenty of wall space for hanging flip chart paper and policy assessment sheets. Necessary materials include tent-style name cards, flip chart paper, masking tape, flip chart markers, sticky notes, thin-point markers, sheets of small colored sticky dots (three colors), and the building efficiency policy assessment sheets.

WORKSHOP FACILITATOR'S GUIDE

The workshop should open with a welcome from the sponsoring organization and short introductions from each participant. Tent cards should be used to identify each participant's name and organization. Each participant gets a pad of sticky notes, a thin-point marker and a sheet of small colored sticky dots with the colors assigned to specific stakeholder groups (e.g., green for government, blue for private sector, red for NGO)

VISIONING

The first exercise is a visioning exercise to get the participants thinking positively about how policy can enhance the efficiency of the built environment. The facilitator asks the following:

"If we transported ourselves ten years into the future and were interviewed by a reporter, what would we like to say we had accomplished because of enacting new building efficiency policies?"

Every participant writes a couple of future accomplishments or desired outcomes on individual sticky notes. The facilitator then asks for volunteers to share one of their ideas with the group while grouping the sticky notes into categories on flip chart paper. When all ideas are shared, the flip charts are hung on the wall and the first assessment exercise begins.

ASSESSMENT

Step 1 – Current Policy Status

Have all participants stand near the 10 policy assessment sheets, which have been taped individually to the top of a sheet of flip chart paper and placed along a large wall. The policy assessment sheets include 10 policy options that are included as priorities in the Private Sector Role and Perspectives section of this report. A spreadsheet containing the 10 standard assessment sheets is available in a spreadsheet format in English at http://bit.ly/K8CDNP, and in Spanish at http://bit.ly/Lp59H4 . The assessment sheets can be translated into other languages, and additional ones can be created depending on the needs of the workshop.

The first exercise involves establishing the current state of policy in the region of interest (national, sub-national or municipality). Using the building efficiency policy assessments sheets, each participant assesses what he or she believes the current state of the policy is for the selected sector in the given region by placing one of the colored dots in one of the five areas of each sheet labeled Step 1 - Current Status. The categories are:

- No policy or planning currently in place
- Planning to pilot or implement policy
- Piloting the policy on a limited basis
- Limited or sub-national level implementation
- Comprehensive national level implementation

The participants should be encouraged to ignore the other participants' votes and rely on their first impressions. After everyone has voted, the facilitator should discuss the results of each policy and encourage participants who voted outside of the norm to explain (not defend) why they did so.

Step 2 – Policy Importance and Difficulty of Implementation

The next exercise assesses the relative importance and difficulty in implementing each policy for the specified sector. The assessment sheet includes a 5x5 grid that allows participants to place a colored dot in one of 25 locations, indicating a rating for both importance (ranging from "not at all important" to "extremely important") and difficulty (ranging from "not at all difficult" to "extremely difficult"). The facilitator needs to clearly define both importance and difficulty with the help of the participants so that everyone is using a consistent set of assessment criteria. Building efficiency policies often involve various government ministries, agencies and departments at many levels of jurisdiction at the national, sub-national and municipal levels. The assessment criteria and workshop participation need to be matched to the sector, region and jurisdiction of interest.

The *importance* of each building efficiency policy depends on its potential to:

- Generate energy and carbon reductions
- Reduce energy costs for home and building owners
- Drive economic development
- Attract private capital

The *difficulty* of implementing each building efficiency policy depends on having the requisite:

- Capacity to implement
- Capability to implement
- Readiness to implement
- Willingness to implement

After everyone has voted once on each sheet, the facilitator should discuss the results for each policy and encourage participants who voted outside of the norm to explain (not defend) why they did so. Policies with a large concentration of dots in the lower right hand corner are relatively high in importance and relatively low in difficulty. These would be good options for short-term priorities. Similarly, policies with a large concentration of dots in the upper right hand corner are relatively high in importance and relatively high in difficulty, making them candidates for longer-term priorities.

A helpful next exercise is to have the participants identify the key barriers and challenges facing implementation of each policy (e.g., why implementation is difficult). The facilitator can capture these on the flip chart page located under each assessment sheet. Next, the facilitator should list ideas that participants contribute to address the barriers and challenges and reduce the difficulty of implementation. This is a good time to share examples, case studies and best practices from the ***Driving Transformation to Energy Efficient Buildings*** report and other sources.

Step 3 – Desired Short-Term and Long-Term Policy States

The next exercise uses the remaining area of the policy assessment sheet to define the desired future states of each policy in the short and long term. It is important that the facilitator define short and long term so that all participants are using the same criteria. If the policy workshop is focused on policies at a national level, then longer time frames are probably appropriate (such as five years for short-term and 10 years for long-term). If the policy workshop is focused on a state or city policy in a specific sector, then two years for short-term and five years long-term may be preferable.

The participants should be encouraged to review the consensus input on current policy status, importance and difficulty before making their selections for desired short-term and long-term states. After everyone has voted, the facilitator should discuss the results for each policy and encourage participants who voted outside of the norm to explain (not defend) why they did so.

The final exercise in the assessment activity is to facilitate a discussion about which policies should be implemented in combination, in both the short and long term, in order to maximize the beneficial impact and improve the chances of success. Many of the policies have natural

complements, such as building codes, performance disclosure and green building rating systems, that should be considered as a group.

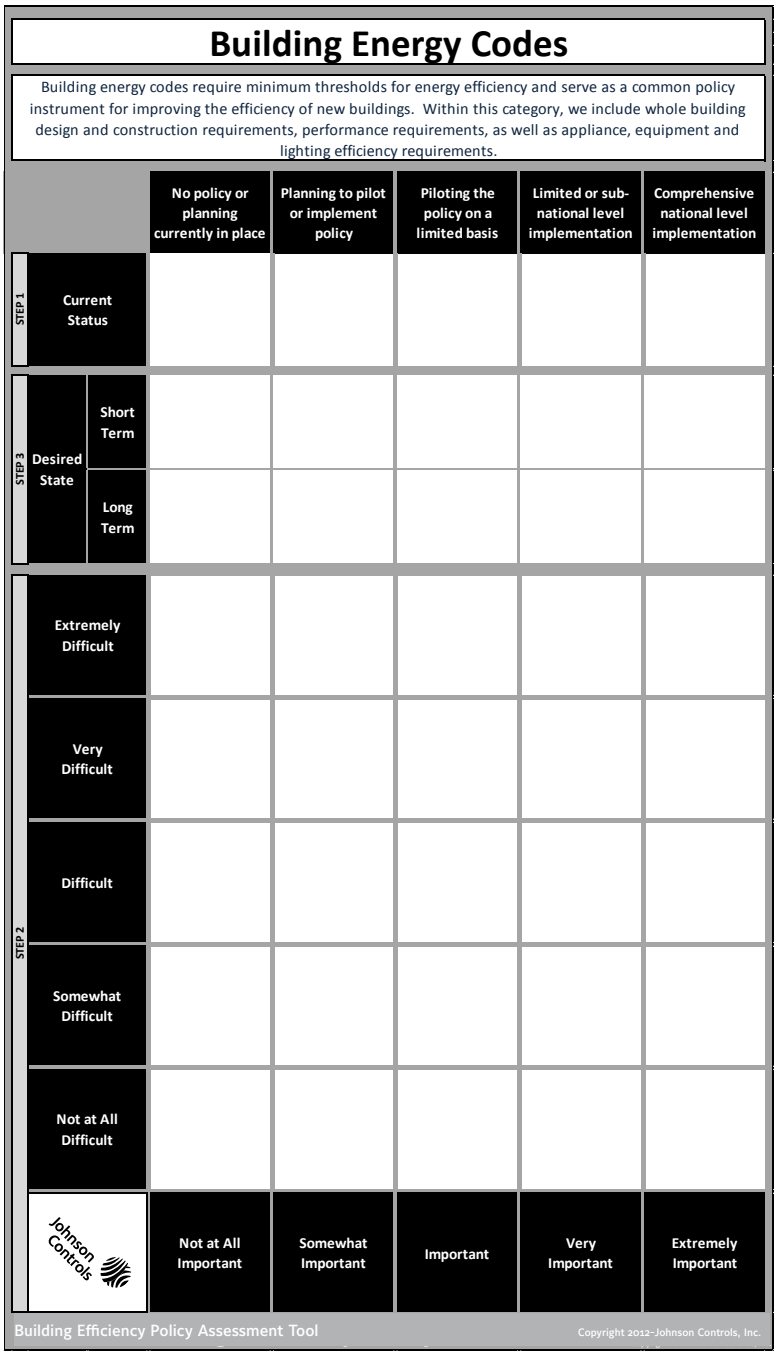
NEXT STEPS AND ACTION PLANNING

After the assessment exercises are complete, the facilitator should lead a discussion on the next steps and actions the group should take to maintain interest and momentum in the transformation process. The first priority should be to schedule a time for the group to get back together to review the results of the workshop and develop a strategy and detailed action plan – the who, what, when and where – to gain support and sponsorship for the selected strategies and policy initiatives. This meeting may include additional stakeholders who were not involved in the policy workshop as a way to begin broadening the education, outreach and support for the initiative. The facilitator should be responsible for preparing a report that summarizes the activities of the workshop, including visual output and analysis of the assessment input. A spreadsheet-based report generator has been included in English at http://bit.ly/K8CDNP, and in Spanish at http://bit.ly/Lp59H4 to assist in creating standard charts using input from the assessment sheets.

POLICY ASSESSMENT SHEET

Figure 2 is an example policy assessment sheet included in the Building Efficiency Policy Navigator toolkit.

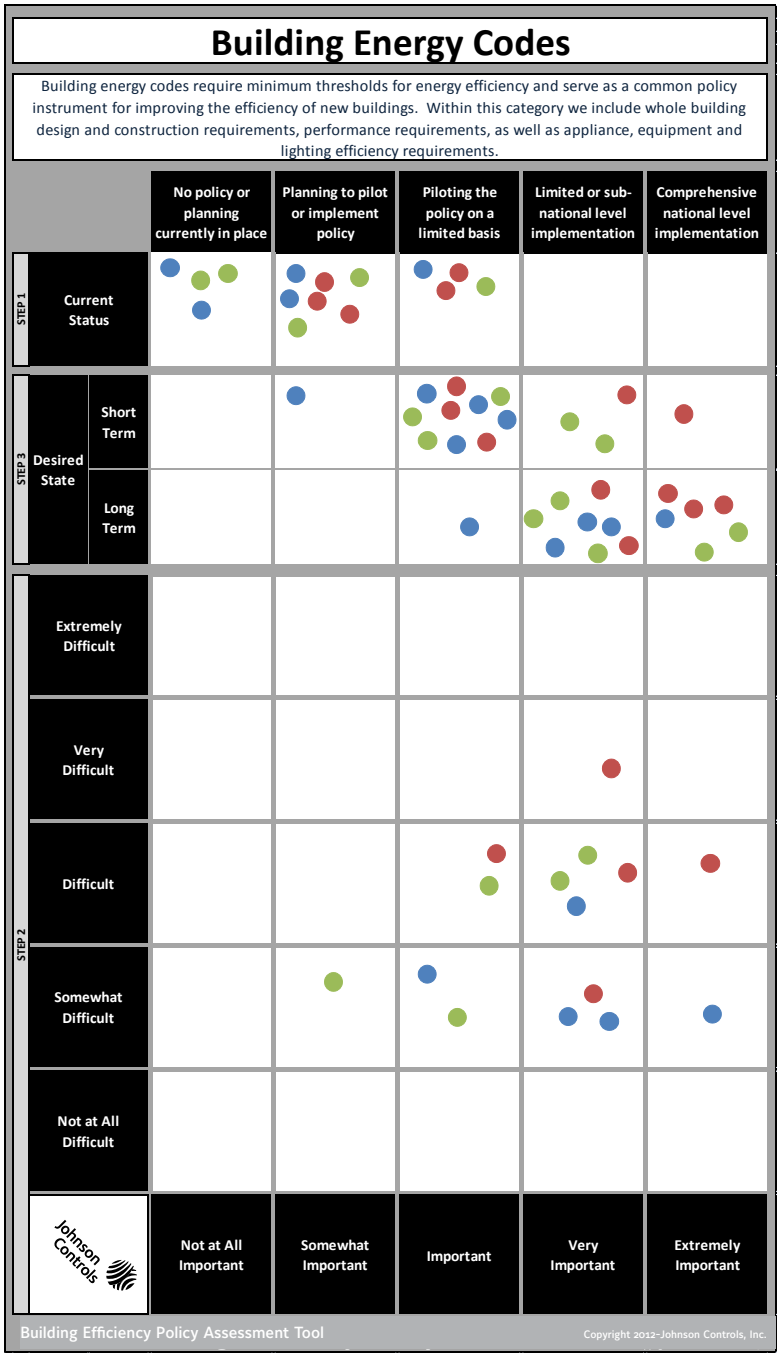
Figure 2.
Sample Policy Assessment Sheet



Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

Figure 3 illustrates what a policy assessment sheet looks like after participants complete the three assessment exercises.

Figure 3.
Sample Policy Assessment Sheet After Exercise

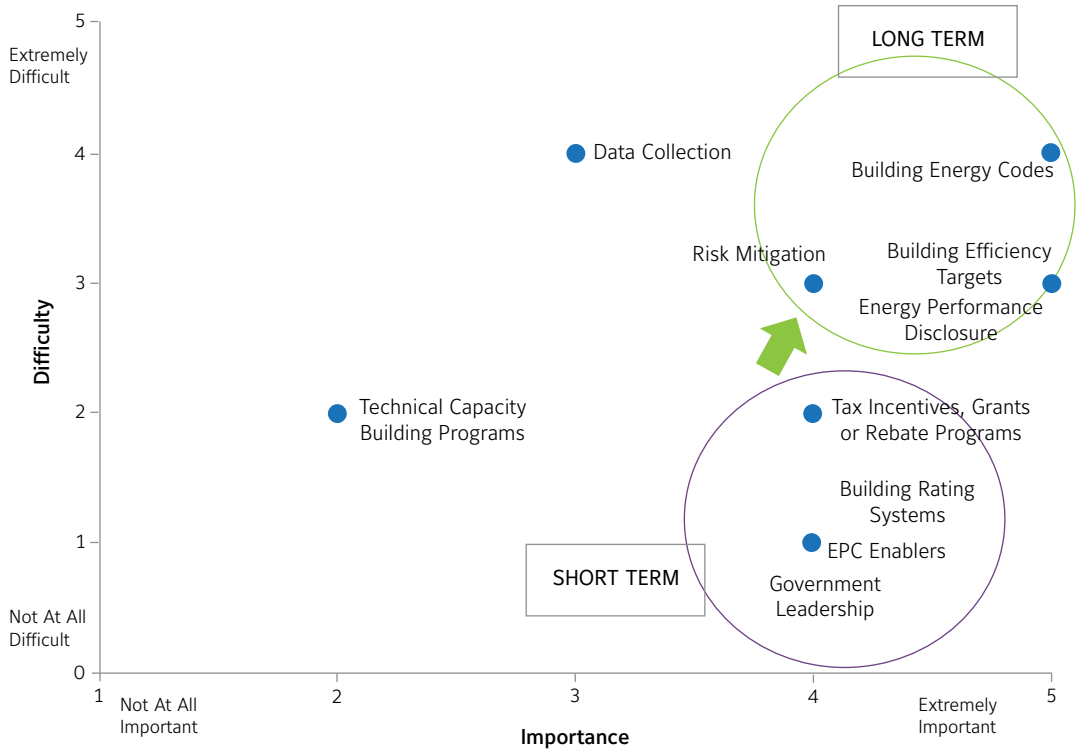


Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

SAMPLE REPORT GENERATOR OUTPUT

Figure 4 is an example of a policy importance vs. difficulty map:

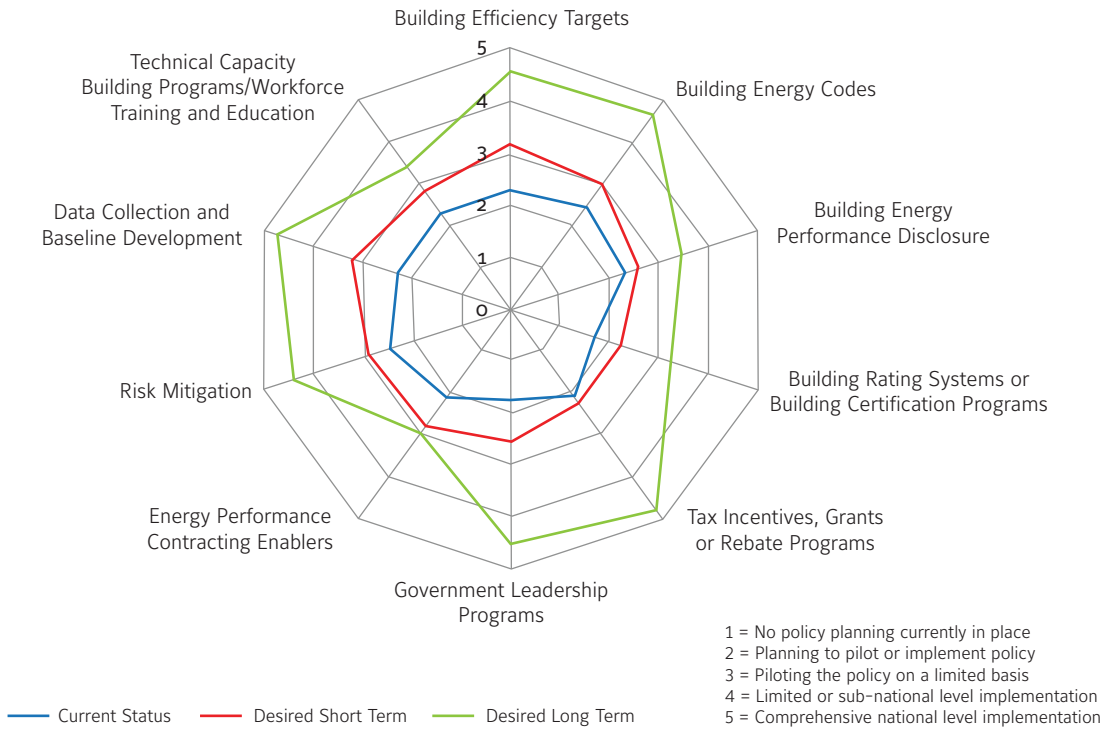
Figure 4.
Building Efficiency Policy Map: Importance vs. Difficulty



Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

Figure 5 is an example of a policy current and desired status map:

Figure 5.
Building Efficiency Policy Radar Map



Source: Institute for Building Efficiency, Johnson Controls Inc.(2012)

ADAPTING THE TOOL FOR MULTIPLE PURPOSES

The simple framework presented here can be adapted as needed to serve different purposes and audiences. For example, a different version of the tool might be adapted by local policymakers to guide decisions at different levels of government – one tool might focus more on making political assessments, while another might focus on technical questions. The tool also can be adapted to cover additional policy categories and sub-categories as well as to consider additional assessment factors that may be of interest to the stakeholders. We hope the tool and workshop format described in this chapter can help guide and accelerate collaborative, multi-stakeholder efforts to make that critical first step toward transforming the built environment through strategic policymaking.

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Building Efficiency Targets

Overarching efficiency targets for the commercial building sector at the local, regional, or national level. Energy efficiency goals, energy efficiency resource standards (EERS) and energy efficiency trading schemes (white certificates) are examples of efficiency targets.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
		Long Term					
STEP 2	Extremely Difficult						
	Very Difficult						
	Difficult						
	Somewhat Difficult						
	Not at All Difficult						
			Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Building Energy Codes

Building energy codes require minimum thresholds for energy efficiency and serve as a common policy instrument for improving the efficiency of new buildings. Within this category, we include whole building design and construction requirements, performance requirements, as well as appliance, equipment and lighting efficiency requirements.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
		Long Term					
STEP 2	Extremely Difficult						
	Very Difficult						
	Difficult						
	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Building Energy Performance Disclosure

Building performance disclosure requirements give building owners and users information on the energy consumption and carbon emissions of a building and incentivize efficiency improvements.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
		Long Term					
STEP 2	Extremely Difficult						
	Very Difficult						
	Difficult						
	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Building Rating Systems or Certification Programs

National or international rating systems for sustainable buildings help to generate a strong market for green and energy efficient products and services.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
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	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Tax Incentives, Grants or Rebate Programs

Tax credits, incentives, grants and rebate programs can be used to incentivize a range of measures, from purchasing energy efficiency equipment and products to whole building upgrades.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
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	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Government Leadership Programs

Government adoption of energy efficiency or sustainable building standards for government-owned or leased spaces as well as the procurement of appliances, equipment and IT equipment.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
		Long Term					
STEP 2	Extremely Difficult						
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	Difficult						
	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Energy Performance Contracting Enablers

Policies that standardize and streamline the energy performance contracting (EPC) process enable more EPC's to be used. EPC's enable up-front energy efficiency investments to be repaid through guaranteed energy savings over time.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
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	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Risk Mitigation

Risk mitigation programs spur lending for energy efficiency projects by transferring risk from local financial institutions to either a government entity or a third party lender (i.e., a multilateral development bank).

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
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	Somewhat Difficult						
	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Data Collection and Baseline Development

Reliable and transparent data on building energy use is important for the establishment of baselines and to evaluate the impact of new policies and measures in any given region.

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STEP 1	Current Status						
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	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

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Technical Capacity Building, Training & Education

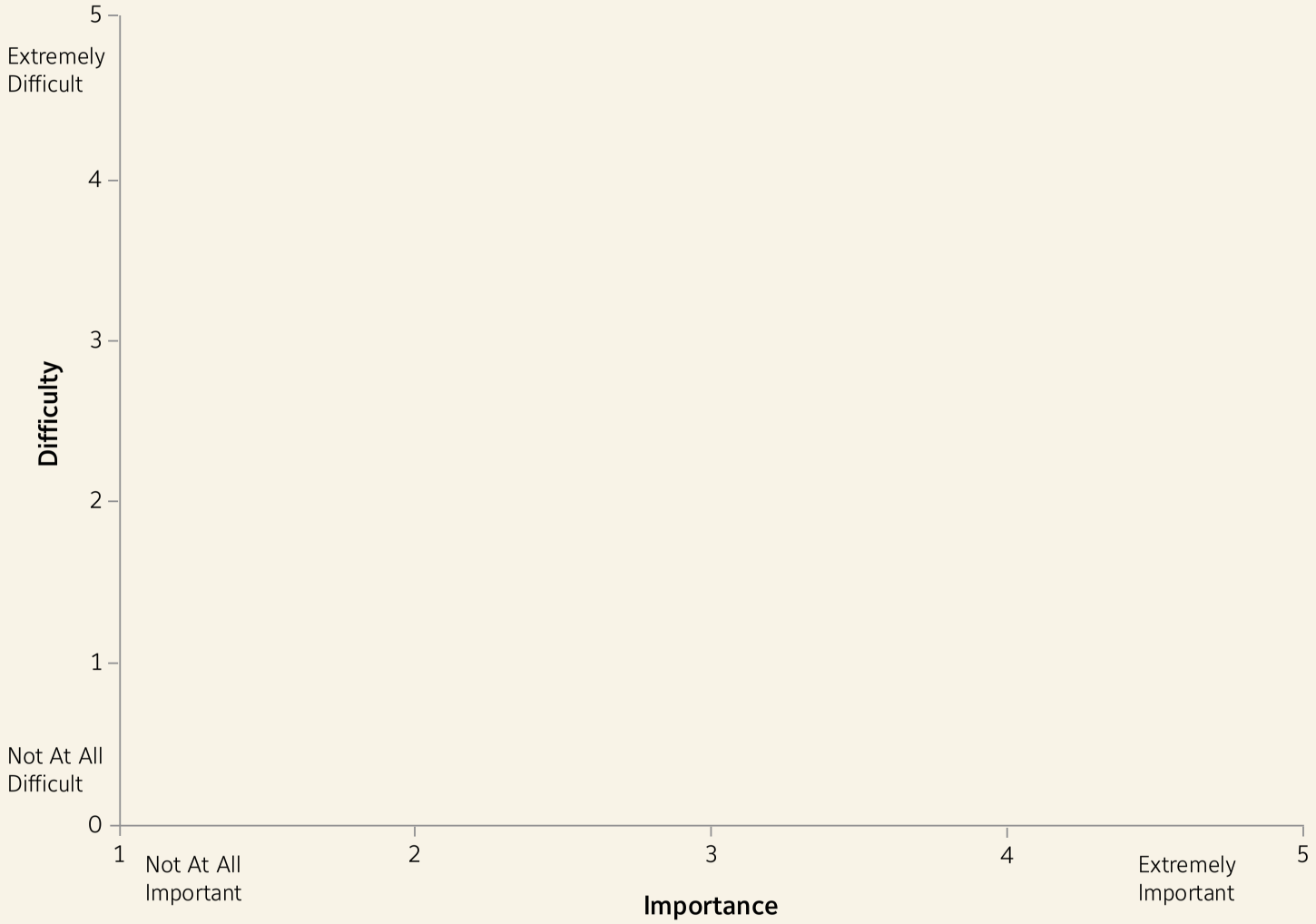
Successful implementation of policies, as well as new market growth, often requires a combination of governance, financial, and workforce capacity as well as technical knowledge.

			No policy or planning currently in place	Planning to pilot or implement policy	Piloting the policy on a limited basis	Limited or sub-national level implementation	Comprehensive national level implementation
STEP 1	Current Status						
STEP 3	Desired State	Short Term					
		Long Term					
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	Not at All Difficult						
	Johnson Controls		Not at All Important	Somewhat Important	Important	Very Important	Extremely Important

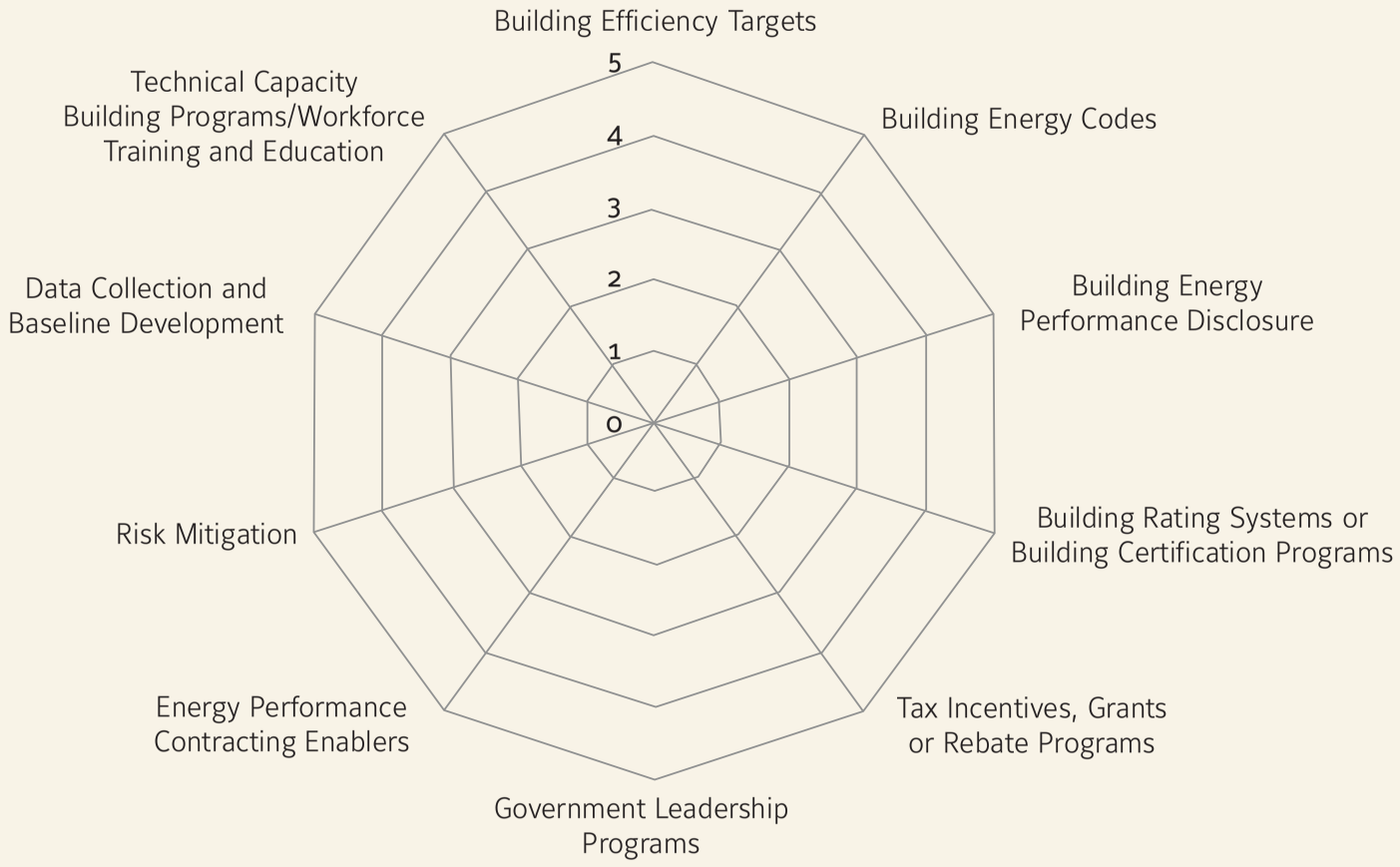
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Building Efficiency Policy Map: Importance vs. Difficulty



Building Efficiency Radar Map



1 = No policy planning currently in place
2 = Planning to pilot or implement policy
3 = Piloting the policy on a limited basis
4 = Limited or sub-national level implementation
5 = Comprehensive national level implementation

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The Business Council for Sustainable Energy (BCSE) represents a broad portfolio of existing clean energy business sectors, including renewable energy, supply-side and demand-side energy efficiency, natural gas and electric utilities in North America. Founded in 1992, the Council advocates for policies at state, national and international levels that increase the use of commercially-available clean energy technologies, products and services. Visit: www.bcse.org

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The World Green Building Council (WorldGBC) is a network of national green building councils from around the world, making it the largest international organisation influencing the green building marketplace. Green building councils are member-based organisations that partner with industry and government in the transformation of their building industries towards sustainability through the adoption of green building practices. On the ground in 89 countries, GBCs create change in their local markets as a way to globalize environmentally and socially responsible building practices. Visit: www.worldgbc.org

WORLD GREEN BUILDING COUNCIL

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If you are interested in contacting the authors, or engaging with the Institute for Building Efficiency, please email us at: InstituteforBE@jci.com.

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