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SYNTHESIS REPORT
**ACCELERATING
BUILDING EFFICIENCY**
Eight Actions for Urban Leaders

In partnership with

**Johnson
Controls**



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FOREWORD

Nearly 70 percent of the world's population will live in cities by 2050. Buildings form the fabric of these rapidly growing urban landscapes. Architectural designs, construction practices, and technologies are available today that minimize energy and resource use in buildings and optimize the benefits to people of high performance—cleaner air, more comfortable homes and workspaces, and lower utility bills. And improved building efficiency is a win for city leaders and local planners: every \$1 invested in efficiency saves \$2 in new power plants and electricity distribution costs.

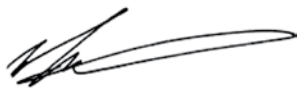
Accelerating Building Efficiency: Eight Actions for Urban Leaders provides a path forward to deliver better buildings before cities “lock in” decades of inefficiency—taking this path will be key to meeting our global sustainable development goals (SDGs). The report focuses on eight categories of policies and actions that can help decision-makers plan for transformative change in their cities. It highlights policies that can drive building energy performance, actions that cities can take to lead by example, and the enabling conditions that will deliver success.

The United Nations Sustainable Energy for All Initiative aims to double the global rate of improvement in energy efficiency by 2030.

Working in alignment with national policies, local governments can and must play a significant role if we are to deliver on this ambitious goal. The more efficient our energy use, the further we can stretch our existing power supplies, and the more our renewable energy technologies can contribute to meeting energy demand. We must shift public and private investment to deliver more efficient building solutions.

Our organizations—and over a dozen co-authors and contributors to this guidebook—are committed to working within markets and with policymakers to build a bridge from business-as-usual investments to innovative transactions that will create the sustainable buildings of the future. Sub-national jurisdictions have both the authority and the appropriate policy levers to build better, more efficient buildings, help direct budgets and investment into efficient buildings, and contribute to more livable cities. National governments can set the stage and provide support for the transformation. Sustainable Energy for All, the SDGs, and the recent Paris Climate Agreement mark a turning point from problem identification toward solutions and action.

We stand ready to help advance building efficiency in cities around the world.



Naoko Ishii
CEO and Chairperson
Global Environment Facility



Rachel Kyte
Chief Executive Officer and
Special Representative of the
UN Secretary-General
Sustainable Energy for All



Andrew Steer
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SYNTHESIS REPORT

This guide provides local governments and other urban leaders in cities around the world with the background, guidance, and tools to accelerate building efficiency action in their communities. The primary intended audience is local government officials in urban areas.

Efficient buildings—those that make highly productive use of natural resources—are vital to achieving sustainable development: They align economic, social, and environmental opportunities, creating so-called “triple bottom line” benefits.

- **Economic development:** Buildings are responsible for 32 percent of global energy consumption and one-quarter of global human-induced CO₂ emissions.¹ 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, spent on energy supply investments.² Building efficiency frees up capital for other strategic investments, helping city governments face multiple competing demands for scarce financial and human resources.³
- **Social development:** Current projections indicate that 66 percent of the world's population will live in cities by 2050.⁴ Buildings form the fabric of our urban landscapes. There is a tremendous opportunity today to shape tomorrow's cities and buildings and avoid "locking in" inefficiencies by applying resource efficient planning and design to buildings and the urban environment. In the coming decades, as these cities face rapid urbanization, buildings will play an ever-increasing role. Efficient buildings can help improve the quality of life of millions of people because they are often higher-quality buildings, with greater comfort and improved indoor and outdoor air quality. Energy efficiency can stretch existing electricity resources

further, helping to provide better energy access, reliability, and security to urban residents.

- **Environmental sustainability:** A study by the International Energy Agency (IEA) shows that, if implemented globally, energy efficiency measures in the building sector could deliver CO₂ emissions savings as high as 5.8 billion tonnes (Gt) by 2050, lowering greenhouse gas emissions by 83 percent below the business-as-usual scenario.⁵ Most of these technologies are commercially available today and many of them deliver positive financial returns within relatively short payback periods.⁶

Rapid rates of urbanization in much of the world will lead to an unprecedented expansion of the built environment. The choices being made today about how to build, design, and operate these buildings will affect urban services and livability for decades. Efficient, high-performance, and productive buildings will be a major factor in creating sustainable cities, which, in turn, contribute to sustainable development goals at the regional and national level.

Local governments can influence the efficiency of new and existing buildings in their communities as owners/investors, conveners/facilitators, or regulators. They can deploy a variety of policy options, ranging from setting targets and leading by example to implementing codes and performance systems, providing financial and non-financial incentives,



and supporting stakeholders in buildings in ways that improve the business case for pursuing or financing energy or water efficiency.

Efficiency goals should connect to specific priorities of local governments and communities, ensuring that the government and citizens optimize, minimize, or manage water, energy, and waste, as appropriate. Policies and programs can support efficient use of resources to provide heating, cooling, lighting, and domestic water, as well as to operate appliances and equipment installed or used in a building. This report serves as a reference guide for identifying and prioritizing appropriate actions to advance efficiency in both communities and organizations.

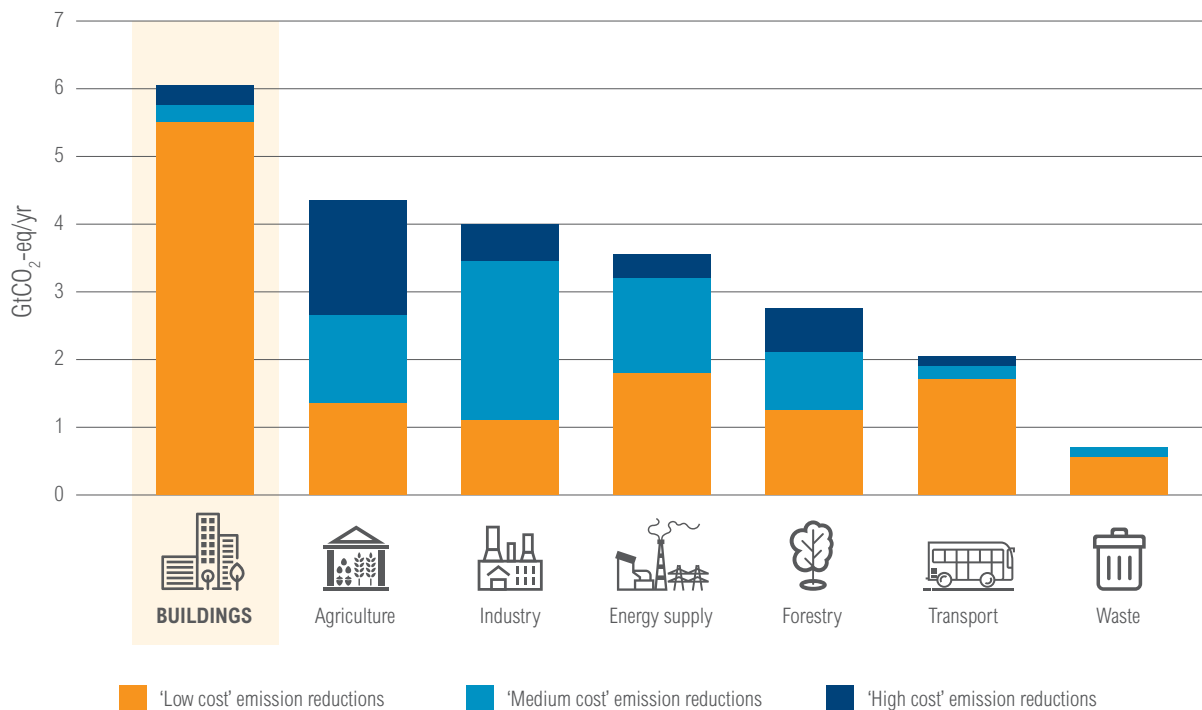
Policy design processes incorporating multi-stakeholder, integrative planning efforts can be an effective tool. Integrative planning that engages the

buildings sector will help inform governance, policies, and decision-making. Integration of building efficiency in broader urban planning activities can also help institutionalize efficiency strategies across disparate departments within a government.

Policy can help align the interests of all actors around implementing cost-effective efficiency options at each stage of a building’s lifecycle. These stages and their relationship to energy and resource performance comprise the following:

- **Land-use and other urban planning** decisions may affect buildings both before and after their construction is proposed. Policies already in place determine many aspects of building design. Urban planning acts as a constraint on private development, and may be intended to improve health, safety, or other desired characteristics of a city or neighborhood. Combining

Figure 1 | **Economic Mitigation Potential by Sector, 2030**



Note: 'Low cost' emission reductions = carbon price <20 US\$/tCO₂-eq. 'Medium cost' emission reductions = carbon price <50 US\$/tCO₂-eq. 'High cost' emission reductions = carbon price <100 US\$/tCO₂-eq.
 Source: IPCC. 2007. IPCC Fourth Assessment Report: Climate Change 2007: Synthesis Report. "4.3 Mitigation options."
https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains4-3.html

urban planning with energy and resource planning provides a unique opportunity to accelerate efficiency in the built urban environment.

- The **design and construction** process includes the siting, orientation, shape, and height of a building as well as the materials and design features of the building. These factors, and the quality of the construction process, will determine indoor and outdoor comfort and energy performance of the building.
- When the building is put up for **sale or lease**, the developer, realtor, appraiser, owner, and lender should be able to consider the building's efficiency in the property value assessment. In addition, future operating costs, including energy use, should be a factor in the bank's loan evaluation of potential buyers.
- **Building out new tenant space** inside an existing building creates an opportunity to invest in high-performance, resource efficient options, including lighting and energy control systems.
- Tenants and owners make ongoing **operations and maintenance decisions**. Many of these decisions—from setting the schedule for heating or cooling to how often equipment is tuned up—affect resource usage, and provide an opportunity to improve efficiency.
- Existing buildings periodically need an efficiency **retrofit** to upgrade equipment, renovate the design, and ensure that building systems are performing well and are energy and water efficient. Improvements to space heating, ventilation and air conditioning (HVAC), water heating, insulation, water fixtures, energy control systems, and lighting are common retrofit measures.
- Finally, a building may experience major re-building, or be identified for **deconstruction or demolition**, which starts the cycle over again and offers new opportunities for finding efficiencies.

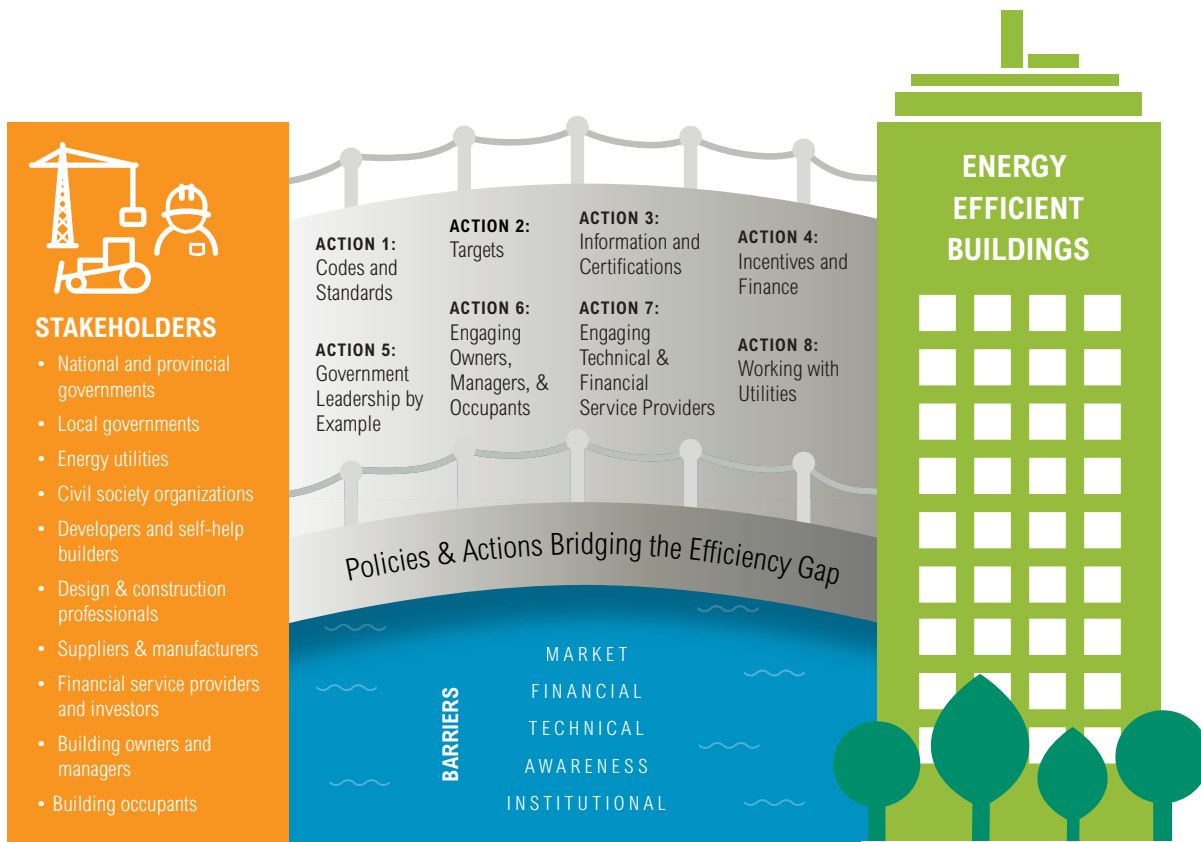
Multiple barriers to building efficiency exist, which may make efficiency a lower priority for investment. More specifically, local governments are

often confronted with an “efficiency gap,” which can be defined as the difference between technically possible savings, and the savings that are easily achieved. The barriers to improving efficiency are well established, although their severity varies among countries and cities.⁷ Barriers consist of market, financial, technical, institutional, and awareness-related issues, which can prevent or deter people from making efficiency investments. Policies can help overcome these barriers when they align the interests of all actors at each stage of a building's lifecycle in order to make pursuing building efficiency a compelling choice (see Figure 2). Policy packages can be designed to target key barriers to energy efficiency in any given market, bridge the efficiency gap, and create an opportunity for scaling up efficiency solutions and investment.

The options for local government actions to improve the energy efficiency of the built environment fall into eight categories:

- **ACTION 1: Building efficiency codes and standards** are regulatory tools that require a minimum level of energy efficiency in the design, construction and/or operation of new or existing buildings or their systems. When well designed and implemented, codes and standards can cost-effectively decrease energy expenses over a building's lifetime.
- **ACTION 2: Efficiency improvement targets** are energy reduction goals that can be set by a local government, either at the citywide community level, or applied to its own publicly owned or rented building stock. City governments can also introduce voluntary targets as a way to incentivize the private sector.
- **ACTION 3: Performance information and certifications** enable building owners, managers, and occupants to make informed energy management decisions. Transparent, timely information allows decision-makers and city leaders to measure and track performance against targets. Examples of building performance policies include: requiring energy audits, retro-commissioning, formalizing rating and certification programs, and implementing energy performance disclosure requirements.

Figure 2 | Crossing the Bridge to More Efficient Buildings



- **ACTION 4: Incentives and finance** can help energy efficiency projects overcome economic barriers, such as those related to upfront costs and “split incentives.” They include grants and rebates, energy-efficient bond and mortgage financing, tax incentives, priority processing for building permits, floor-area allowances, bond and mortgage financing, revolving loans, dedicated credit lines, and risk-sharing facilities.
- **ACTION 5: Government leadership by example** involves policies and projects undertaken by the government that serve as an example to create greater demand/acceptance for efficient buildings in the market. This approach can take the form of improving the public building stock, private-public partnership pilot projects, setting ambitious energy efficiency standards and targets, encouraging or mandating procurement of efficient products and services, and stimulating the energy service company (ESCO) market through municipal energy performance contracting (EPC) tenders.

- **ACTION 6: Private building owner, manager, and occupant engagement** includes technical programs that help motivate building stakeholders. These include local partnerships for efficient buildings, “green lease” guidance, and behavioral mechanisms such as competitions and awards, user-feedback information via kiosks or computer displays, and implementing strategic energy management activities.
- **ACTION 7: Technical and financial service provider engagement** can facilitate the development of skills and business models to meet and accelerate demand for efficiency. These include technical workforce training, procurement officer education on performance contracting, engagement with the financial industry to help standardize investment terms and reduce transaction costs, establishing revolving loan funds or dedicated credit lines, and considering public-private risk sharing facilities for investments.

Table 1 | Policy Options for the Built Environment

TYPE	SUMMARY
ACTION 1: BUILDING EFFICIENCY CODES AND STANDARDS (CHAPTER 5)	<ul style="list-style-type: none"> ■ New building energy efficiency codes ■ Retro-commissioning ■ Lighting upgrades ■ Performance requirements ■ Appliance, equipment, and lighting energy standards
ACTION 2: EFFICIENCY IMPROVEMENT TARGETS (CHAPTER 6)	<ul style="list-style-type: none"> ■ Public-sector targets ■ Private-sector targets
ACTION 3: PERFORMANCE INFORMATION AND CERTIFICATIONS (CHAPTER 7)	<ul style="list-style-type: none"> ■ Benchmarking and baseline development ■ Energy audits ■ Energy performance certificates ■ Rating and certification programs
ACTION 4: INCENTIVES AND FINANCE (CHAPTER 8)	<ul style="list-style-type: none"> ■ Grants and rebates ■ Tax incentives ■ Green mortgages ■ Non-financial incentives ■ Dedicated revolving loan funds ■ Tax-lien financing
ACTION 5: GOVERNMENT LEADERSHIP BY EXAMPLE (CHAPTER 9)	<ul style="list-style-type: none"> ■ Improving public building stock ■ Energy performance requirements ■ Energy efficiency targets ■ Public procurement ■ Energy performance contracting tenders
ACTION 6: ENGAGING BUILDING OWNERS, MANAGERS, AND OCCUPANTS (CHAPTER 10)	<ul style="list-style-type: none"> ■ Local partnerships for efficient buildings ■ Green leases ■ Competitions and challenges ■ Occupant engagement ■ Occupant feedback ■ Strategic energy management
ACTION 7: ENGAGING TECHNICAL AND FINANCIAL SERVICE PROVIDERS (CHAPTER 11)	<ul style="list-style-type: none"> ■ Supporting business development for contractors ■ Policies to enable energy performance contracting ■ Working with product suppliers and manufacturers ■ Workforce capacity and training ■ Overcoming lack of standardization and high transaction costs ■ Risk mitigation facilities
ACTION 8: WORKING WITH UTILITIES (CHAPTER 12)	<ul style="list-style-type: none"> ■ Improving access to energy usage data ■ Customer-funded utility programs and public benefits funds ■ Efficiency business models for utilities ■ On-bill repayment ■ Demand-response

- **ACTION 8: Working with utilities** can improve access to energy usage data and support utilities' efforts to make their customers more energy efficient. These programs include energy-use data access, utility public benefit funds, on-bill financing, revenue decoupling, and demand-response programs, to name a few.

Individual policies can strengthen and complement each other. City planners or officials may improve the outcomes and impact by considering and planning for a set of integrated, related policies through a buildings sector action plan or package of policy measures. This guide is designed to help with the development of such a plan. Key steps of an action plan include identifying the goal, identifying governance of the process, working with local technical experts, securing financing, mobilizing stakeholders, and tracking progress.

A central question faced by policymakers is how to get started with building efficiency and related policy development. One recommendation is to define the following (see Figure 3):

- *What* tools can be employed to accelerate energy efficiency in buildings
- *How* policy and programs can support and accelerate efficiency in buildings
- *Who* can leverage the acceleration of energy-efficient buildings

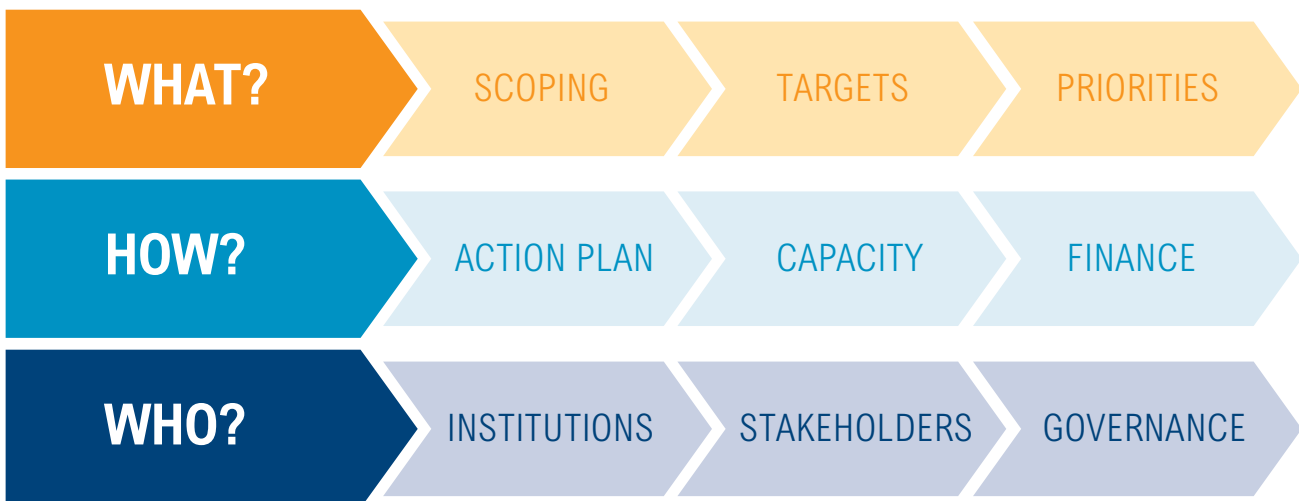
What?

- A necessary first step in answering the question of “*What?*” is assessing and understanding a city’s current institutional and legal setting and framework, the data availability on building stock and energy use, and the key stakeholders (scoping).
- The next step is to focus on the selection of objectives and targets. Targets should be bold and ambitious. Cities can choose to set broad targets in terms of energy savings, CO₂ reductions, or other specific benefits. A target should also include a clear timeframe.
- Designing a strategy to transform the built environment to be more energy efficient, however, is not a simple process, and to be successful it requires prioritization.

How?

- An action plan is an important part of the “*How?*” step because it helps to establish targets and assists in the transition from planning to implementation. A robust action plan will include a set of performance indicators allowing policymakers to assess progress over time.
- Identifying the local capacities that need to be developed is important. Early identification of workforce capacity strengths and gaps can inform a package of technical support measures

Figure 3 | **Indicative Roadmap for Taking Action on Building Efficiency**



and trainings that may be required on aspects related to enforcement, legal affairs, and technological knowledge.

- Investing time and resources in the design of a financial pathway is critical to successful implementation of a package of building efficiency policies. Without a quality financing strategy, these actions are unlikely to deliver much change.

Who?

- The question “Who?” helps to establish the stakeholders who need to be involved in the process, and their roles.
- As part of the process, local governments can start by thinking about their own institution. Successful implementation generally requires significant coordination among municipal

Figure 4 | Stakeholders Involved in the Governance of Buildings



Source: Authors and World Business Council for Sustainable Development. 2009. "Transforming the Market: Energy Efficiency in Buildings." <http://www.wbcSD.org/transformingthemarketeeb.aspx>.

departments as well as with provincial/state and national governments. Problems tend to arise when actions taken by government ministries or departments are not aligned. In order to tackle institutional challenges and ensure that the right capacities are in place, it is helpful to specify key roles and players early in the planning process.

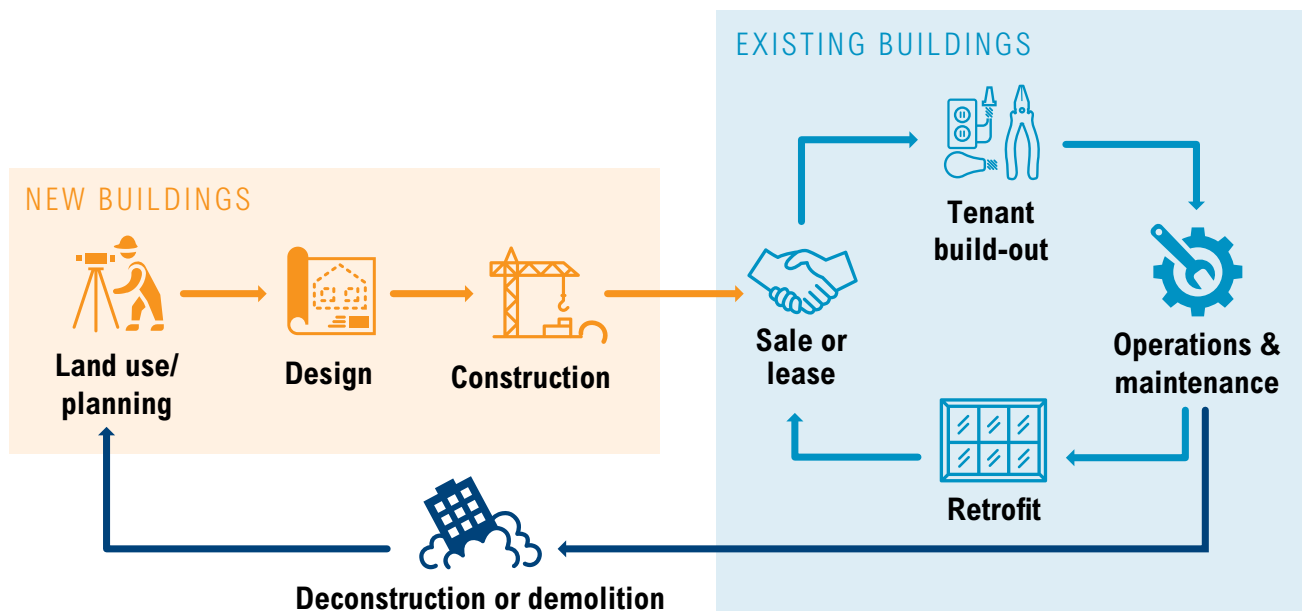
- The creation of multi-stakeholder processes allows cities to identify needs and interests of different groups and facilitates early assessment of program or policy feasibility. Stakeholder engagement can further serve to foster cooperative relationships with industry players and drive program acceptance. In the case of regulatory requirements such as mandatory building audits, it also encourages higher compliance rates.
- When policies fail or underperform, lack of clear authority or accountability is often to blame. Sufficient attention must be paid to the governance structure underpinning the program. 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.

Finally, 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, policy, building, or even building-occupant level.

A suite of tools, focusing on either building efficiency policy or technical assessment, is freely available in the market. Policy tools can help municipal policymakers go through the policy cycle and effectively implement policy packages, while project tools help to design a construction or renovation building project, calculate building energy performance, and estimate potential savings.

In conclusion, although no single government policy or program can drive the transformation toward more efficient buildings on its own, a clever combination of policies and other relevant actions can help transform buildings to be far more efficient over time, providing many benefits to cities and their residents for decades to come.

Figure 5 | **Lifecycle of a Building**



KEY TAKEAWAYS FROM OTHER CHAPTERS

This section aggregates key takeaways from the full *Accelerating Building Efficiency* report.

For more detail, see the full report at www.wri.org/buildingefficiency or visit our website at www.buildingefficiencyinitiative.org.

THE SUSTAINABLE DEVELOPMENT OPPORTUNITIES OF BUILDINGS

The Built Environment and Sustainable Development

- Efficient buildings can advance economic, social, and environmental goals.
- Design, construction, operation, and renovation of buildings are large contributors to a city's economy and to local employment. Building efficiency creates many direct and indirect job opportunities for low and high skilled workers to provide energy related products and services.
- Efficient design and construction techniques could dramatically increase energy access and affordability for poor residents of cities. Energy, particularly electricity, is fundamental for access to many basic services such as education, clean water, and quality medical care.
- Building efficiency has the potential to significantly reduce energy demand and associated emissions of greenhouse gases and other pollutants, particularly in developing and emerging countries.

The Role of Buildings in Achieving Sustainable Urbanization

- Rapid urbanization and expansion of the built environment create a major challenge as well as a tremendous opportunity to shape tomorrow's cities and buildings.
- Buildings are long-lived structures and the building choices being made today will impact urban services, livability, and the environment for decades.
- Efficient, high-performance, and productive buildings will be major contributors to solutions for sustainable cities. Many efficient technologies and practices can be deployed today.
- Buildings are critical components of urban systems, both as physical structures and as providers of social and economic services. Improving building energy efficiency is one of the fastest and most cost-effective ways to achieve economic, environmental, and social benefits for city inhabitants.
- If the efficiency of buildings in cities is improved, the effects radiate outward and the performance of urban energy and resource systems can be enhanced at the district and community scales.

The Role of Local Government in Shaping Livable Cities

- Decisions about buildings in urban areas are governed by a mix of public and private actors with varied forms of formal and informal authority. Multi-stakeholder, integrative planning is an effective tool to support building sector governance, policies, and decision-making.
- Local governments have a variety of mechanisms available to influence the efficiency of buildings in their communities. Local governments can act as owners/investors, conveners/facilitators, and regulators.
- Building efficiency can be integrated into citywide plans for economic development, resource security, pollution reduction, sustainability, or other issues.

Policy Paths to Transforming Buildings: Bridging the Efficiency Gap

- Opportunities to increase the efficiency of buildings exist at each stage of a building's lifecycle.
- Building efficiency faces many barriers in implementation; various policy options exist to tackle these barriers and enable markets to overcome the efficiency gap.
- Policies range from incentives to regulation, and vary in the ease of design and implementation, and in their relative importance as part of a local government-driven policy package at city level.
- Cities can map out their own policy pathways to transform the built environment in ways that are appropriate for them and take into account their "capacity to act."
- Working with stakeholders to leverage their expertise and unique perspective is essential for developing policies that are feasible to implement and provide the greatest benefit at the lowest cost.

POLICIES AND ACTIONS TO ACCELERATE BUILDING EFFICIENCY

ACTION 1: Building Efficiency Codes and Standards

- Building efficiency codes and standards are regulatory tools that require a minimum level of energy and resource efficiency in buildings. No single energy code or set of requirements will suit all types of economy and climate.
- In the absence of minimum efficiency codes and standards, rapidly urbanizing emerging economies risk “locking in” an inefficient built environment for years to come.
- Codes commonly focus on measures that optimize the design and construction of buildings and core building services such as heating, cooling, ventilation, and lighting. Building energy codes are generally prescriptive requirements. Increasingly, however, performance-based codes are emerging in advanced markets.
- Local governments are often responsible for adapting, adopting, and implementing national building codes in their jurisdiction.
- Local governments can also require existing buildings to meet energy standards to improve their performance. Often these policies make use of building performance information or appliance and equipment standards.

ACTION 2: Efficiency Improvement Targets

- A citywide efficiency improvement target or goal can align interests and spur action.
- Government efficiency targets for the public building portfolio can build capacity and drive uptake of building efficiency in the market.
- Voluntary efficiency targets for the private sector can spur interest in and accelerate uptake of building efficiency, particularly in the commercial building sector.

ACTION 3: Performance Information and Certifications

- Access to information on building energy and resource consumption enables owners, operators, and tenants to make informed management decisions, and is often a prerequisite for implementation of other actions. Transparent, timely information can help track performance against goals.
- The collection of general statistical information about energy use in buildings at the jurisdictional or building scale enables better policy and program design.
- Energy performance certificates (EPC) for buildings share energy consumption information, enabling energy efficiency information to be factored into real estate decisions.

- 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.

ACTION 4: Incentives and Finance

- Upfront cost is a major barrier to improving energy efficiency in buildings. A variety of programs can be designed to overcome this barrier and encourage greater investments by building owners, managers, and occupants.
- Incentives can lower the costs or increase the benefits of action. Grants and rebates as well as tax incentives help pay down some of the upfront cost of investing in energy efficiency.
- Non-financial incentives, such as granting developers priority processing of permits or a greater allowed floor area for development, may be attractive to the private market while requiring little or no investment by local governments.
- Financing products can spread the initial cost of efficiency investment over many years, allowing financial benefits to be received sooner. Revolving loan funds, trust funds, and tax-lien financing are mechanisms to expand the pool of available funds for efficiency investments.

ACTION 5: Government Leadership by Example

- Local governments can lead by example by making their own building portfolio more energy- and resource-efficient and setting ambitious efficiency targets that create demand for efficient buildings.
- Budgeting and procurement procedures can be amended so that all government-owned and leased building space meets certain efficiency standards, and buildings use only efficient appliances, equipment, and lighting.
- Local governments can promote the use of energy performance contracts, allowing public agencies and institutions to outsource efficiency projects to an energy service company.

ACTION 6: Engaging Building Owners, Managers, and Occupants

- Buildings are generally designed, constructed, financed, and managed by private-sector actors. Partnerships between the private sector and local governments are essential to achieve widespread success.
- Cities can help overcome “split incentives” between building owners and occupants by guiding the real estate market with green lease contract clauses, which align the interests of owners and tenants.

- Behavior change among private-sector actors can be motivated by workplace engagement programs, competitions, challenges, awareness campaigns, and other incentives that reward the best performers.
- Strategic energy management (SEM) uses coaching, education, and training to teach building owners and managers the business case for energy efficiency practices, and to adopt them.

ACTION 7: Engaging Technical and Financial Service Providers

- Local governments can design policies, programs, and guidance to support the development of building efficiency products and services, including financing.
- Policies that enable energy performance contracting can speed up the deployment of this business model in which energy bill savings are used to repay an investment in energy efficiency.
- A skilled workforce is essential to completing projects that effectively achieve energy and resource savings. Local government can support workforce training.
- Risk mitigation programs, such as loan guarantees, make efficiency financing a more attractive market for private lenders and can help overcome the reluctance of financial institutions to invest in energy efficiency.

ACTION 8: Working with Utilities

- Utilities have direct access to building energy- and water-use data, which provide critical insights into usage trends and patterns, and they have valuable relationships with owners and tenants.
- Many countries, states, and cities have enacted programs that require energy and water utilities to invest in helping their customers consume more efficiently. Others have implemented policies, such as revenue decoupling and performance incentives, to ensure that utilities have the financial incentive to work actively to achieve greater customer efficiency.
- Some utilities have programs in which individual customers can repay investments in efficiency through their utility bills.
- Through demand response programs, utilities encourage their energy users to reduce energy use at times of peak demand on the electricity grid.

TAKING ACTION AND ENABLING CHANGE

Developing a Policy and Program Pathway

- Designing a strategy to improve building efficiency is not a simple process, but a clever combination of policies and other relevant actions can effectively transform buildings to be more energy-efficient over time.

- Maintaining stability of staffing levels, capacity, and project financing is a critical element of long-term success. Stability may be enhanced through careful design of the action plan.
- Early identification of key players within and outside government, and of their roles and responsibilities, is essential to maintain program coherence and coordination.
- Policymakers should include metrics and evaluation approaches in their planning to track progress over time and confirm that policy goals are being met.

Building Efficiency Tools for Cities

- There is no single tool that will enable all cities to increase their building efficiency; rather there is a range of tools to help municipal officials develop targets, implement new programs, and track performance.
- Tools use modeling, assumptions, and best-practice data to link policy goals with building- and city-level outcomes. Such tools are effective only when they are used with due consideration of local data and context.
- Tools can leverage consensus-based multi-stakeholder collaboration to better prioritize building efficiency actions.
- Policy-assessment tools provide a simple framework to help municipal officials set policy priorities based on input from stakeholders.
- Building-project tools can help municipal officials, building owners, and developers improve building efficiency and quantify the contribution of such actions to achieving city-level policy goals.

Assessment Tool for Building Efficiency Policies

- The right combination of policies can help transform buildings to be far more energy efficient over time.
- The Assessment Tool for Building Efficiency Policies provides a simple framework to help policymakers set policy priorities with input from stakeholders.
- The 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 facilitator's guide to running 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.

POLICY AND PROJECT TOOLS FOR BUILDING EFFICIENCY

This appendix provides an overview of technical assessment tools applicable to building efficiency policies and projects, which municipal policymakers can use to set targets, draft and implement programs, and assess performance. The tools described here are a subset of the large and diverse range of resources available to city stakeholders. The available tools have been categorized into two groups: policy tools and project tools.

Policy tools provide assistance to policymakers at every stage of the policy cycle. Each stage of the policy cycle has its challenges and involves a number of steps. Policy tools can help policymakers go through the policy cycle and effectively design and implement policy packages, as well as track their impacts. To maximize cost-effectiveness, policymakers can use multiple analytical and information tools to support their decisions and actions.

Project tools help stakeholders comply with and go beyond minimum efficiency standards. They can be used to support the design, construction, or renovation of a building project, calculate building energy performance, and estimate potential savings that support and/or comply with energy efficiency policies. Project tools can play an important role at the implementation as well as the evaluation and reporting stages. Evaluation of the actual performance of constructed or renovated buildings provides feedback on the effect of the policies and the energy efficiency measures that were utilized. The data from this evaluation can be fed back into the tools.

Where comprehensive data are available, building performance assessment tools can provide detailed benchmarking, savings potential, project management, and ex-post measurement information. When local building-specific data are limited, municipal officials can use online asset-rating systems to estimate energy use. Given that building design differs considerably between countries, climates, and even cities, estimates based on data from another region are likely to have a considerable error margin.⁸



Table 2 | **Building Efficiency Tools**

NAME OF THE TOOL	DEVELOPER	URL	SCOPE	
			PROJECT	POLICY
25 Recommendations for Buildings	IEA	https://www.iea.org/publications/freepublications/publication/25recom_2011.pdf		●
Assessment Tool for Building Efficiency Policies	World Resources Institute	http://www.buildingefficiencyinitiative.org/tool		●
Benchmarking and Energy Saving Tool for Low Carbon Cities (BEST)	LBNL	https://www.iea.org/publications/freepublications/publication/25recom_2011.pdf		●
BigEE Policy Guide	Wuppertal Institute	http://www.bigee.net/		●
Build Upon Resources	World Green Building Council	http://buildupon.eu/resources/		●
Build Upon Stakeholder Mapping Tool	World Green Building Council	http://buildupon.eu/stakeholders/#stakeholder-maps		●
Building Energy Efficiency Policies (BEEP)	IEA	http://www.iea.org/beep/		●
Building Energy Optimization (BEopt)	NREL	https://beopt.nrel.gov/	●	
Building Energy Performance Metrics	IEA-IPEEC	http://www.buildingrating.org/sites/default/files/1448011796IEA_IPEEC_BEET4_Final_Report.pdf		●
Building Upgrade Value Calculator	U.S. EPA, U.S. DOE	http://www.energystar.gov/buildings/tools-and-resources/building-upgrade-value-calculator	●	
Capturing the Multiple Benefits of Energy Efficiency	IEA	http://www.iea.org/publications/freepublications/publication/capturing-the-multiple-benefits-of-energy-efficiency.html		●
City Energy Efficiency Scorecard	ACEEE	http://aceee.org/local-policy/city-scorecard		●
ClearPath	ICLEI USA	http://icleiusa.org/clearpath/		●
Co-Benefits Risk Assessment (COBRA)	U.S. EPA	https://www.epa.gov/statelocalclimate/co-benefits-risk-assessment-cobra-screening-model		●
Commercial Building Analysis Tool for Energy-Efficiency Retrofits (COMBAT)	LBNL	https://china.lbl.gov/tools/commercial-building-analysis-tool-energy	●	
Common Carbon Metric (CCM)	UNEP	http://www.unep.org/sbci/pdfs/UNEPSBCICarbonMetric.pdf		●
EE Governance Handbook	IEA	http://www.iea.org/publications/freepublications/publication/gov_handbook.pdf		●
EE Indicators	IEA	https://www.iea.org/publications/freepublications/publication/IEA_EnergyEfficiencyIndicatorsFundamentalsonStatistics.pdf		●
Energy Efficient Cities Case Studies Database	World Bank, ESMAP	http://www.esmap.org/node/231		●
Energy Forecasting Framework and Emissions Consensus Tool (EFFECT)	World Bank, ESMAP	http://esmap.org/EFFECT		●
Energy Model Input Translator (EMIT)	RMI	http://www.rmi.org/rmi/ModelingTools	●	

Table2 | **Building Efficiency Tools (continued)**

NAME OF THE TOOL	DEVELOPER	URL	SCOPE	
			PROJECT	POLICY
EnergyPlus and eQUEST	U.S. DOE	http://apps1.eere.energy.gov/buildings/energyplus/	●	
ENERGY STAR Energy Treasure Hunt Guide	U.S. EPA, U.S. DOE	http://www.energystar.gov/sites/default/files/buildings/tools/Energy_Treasure_Hunt_Guide_Jan2014.pdf	●	
ENERGY STAR Portfolio Manager	U.S. EPA, U.S. DOE	http://www.energystar.gov/buildings/tools-and-resources/portfolio-manager-quick-start-guide	●	
Excellence in Design for Greater Efficiencies (EDGE)	World Bank / IFC	http://www.edgebuildings.com/#/	●	
Fifth Assessment Report (AR5), Chapter 9	IPCC	http://mitigation2014.org/report/publication/		●
Fourth Assessment Report (AR4), Chapter 6	IPCC	https://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter6.pdf		●
Global Protocol for Community-Scale GHG Emissions (GPC)	C40 Cities, ICLEI, WRI	http://www.ghgprotocol.org/city-accounting		●
Good Practice Guide: Municipal Building Efficiency	C40 Cities	http://www.c40.org/custom_pages/good_practice_guides		●
Green Resources & Energy Analysis Tool (GREAT)	LBNL	https://china.lbl.gov/tools/green-resources-energy-analysis-tool		●
Handbook of Sustainable Building Policies	UNEP	http://www.unep.org/sustainablebuildingpolicies/pdfs/SPoD-Handbook%20final-Full.pdf		●
Improving Energy Efficiency in Buildings: Mayoral Guidance Note	World Bank, ESMAP	http://www.esmap.org/node/55263		●
Key Principles for Collaborative Policy-Making	World Green Building Council	http://www.worldgbc.org/infohub/key-principles/		●
Local Energy Efficiency Policy Calculator (LEEP-C)	ACEEE	http://aceee.org/local-energy-efficiency-policy-calculator-leep-c		●
Policy Tool for New Buildings	GBPN	http://www.gbpn.org/databases-tools/purpose-policy-tool-new-buildings		●
Policy Tool for Renovation	GBPN	http://www.gbpn.org/databases-tools/purpose-policy-tool-renovation		●
RenoWiki	World Green Building Council	http://buildupon.eu/initiatives/#information-tool		●
RETScreen	NRCAN	http://www.nrcan.gc.ca/energy/software-tools/7465	●	
Solutions Gateway	URBAN LEADS, ICLEI, UN HABITAT	http://www.solutions-gateway.org/solution?code=5#popup1		●
Target Finder	U.S. EPA	https://www.energystar.gov/buildings/service-providers/design/step-step-process/evaluate-target/epa%E2%80%99s-target-finder-calculator	●	
The Co-benefits Evaluation Tool for the Urban Energy System	UNU-IAS	http://tools.ias.unu.edu/sites/default/files/manual/Energy_Evaluation_Tool_Guidebook.pdf		●
Tool for Rapid Assessment of City Energy (TRACE)	World Bank, ESMAP	http://esmap.org/TRACE		●
Urban Efficiency report	C40 Cities			●

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Energy Efficiency Global Forum. 2011. Statement by Christiana Figueres, Executive Secretary, United Nations Framework Convention on Climate Change. 14 April, 2011, Brussels, Belgium. http://unfccc.int/files/press/statements/application/pdf/110414_speech_ee_global_brussels.pdf
8. China and other countries also have building asset rating systems; see <http://aceee.org/files/proceedings/2010/data/papers/2173.pdf>.
The U.S. DOE Building Energy Asset Score tool is one publicly available resource. <http://energy.gov/eere/buildings/building-energy-asset-score>

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