SCALING UP ENERGY EFFICIENCY IN DEVELOPING COUNTRIES

THE BUILDING BLOCKS OF ENERGY EFFICIENCY

November 2020

ABOUT THIS PROJECT

USAID's Energy Efficiency for Development (EE4D) program partners with the Lawrence Berkeley National lab to provide technical assistance to energy system planners, regulators and utility managers in partner countries to overcome challenges associated with implementing energy efficiency programs

ACKNOWLEDGEMENTS

Michael McNeil (Lawrence Berkeley National Laboratory) authored the original version of this report with support from Stephane de la Rue du Can (Lawrence Berkeley National Laboratory) and Alberto Diaz Gonzalex (Lawrence Berkeley National Laboratory). The authors would like to thank Amanda Valenta (USAID) and Monica Bansal (USAID) for their comments and contributions to this report.

FOR MORE INFORMATION

Amanda Valenta, USAID/E3/Energy Division avalenta@usaid.gov
Michael McNeil, Berkeley Lab/Energy Analysis and Environmental Impacts Division MAMcneil@bl.gov

TABLE OF CONTENTS

FIGURES

TABLES

STANDARDS IN ACTION BOXES

ACRONYMS

DOE	Department of Energy
EE	Energy Efficiency
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contracts
IEA	International Energy Agency
ISO	International Standard Organization
GDP	Gross Domestic Product
HVAC	Heating, Ventilation, and Air Conditioning
LEDS	Low Emissions Development Strategies
M&V	Measurement and Verification
MEPS	Minimum Energy Performance Standards
NAECA	National Appliance Energy Conservation Act
NDC	Nationally Determined Contributions
OECD	Organization for Economic Cooperation and Development
U.S.	United States
USAID	United States Agency for International Development

1. EXECUTIVE SUMMARY

ENERGY EFFICIENCY TECHNOLOGIES AND POLICIES

By reducing the amount of inputs needed to provide a desired energy service, energy efficiency minimizes the financial costs of energy and alleviates other negative effects associated with energy production and use. *Energy efficiency policies* address market failures that limit adoption of efficient technologies, thereby providing net economic benefits to users while supporting other public goods.

This document will highlight the building blocks of solid energy efficiency policy planning and implementation in the context of developing economies and will provide practical information and strategies for helping to implement these policies effectively. Building blocks include 1) regulatory actions (standards) to "raise the floor" of efficiency of new equipment and construction, 2) market priming to pave the way for new technologies and thereby "raise the ceiling" of the market, and 3) integrated planning to prioritize energy efficiency in national economic and environmental policy. Well-designed technical assistance can provide the catalyst to pursue these programs and the expertise to help make them successful.

This document is meant as a resource for technical assistance programming that considers energy efficiency policy as a top priority for energy sector technical assistance, and treats it as an integrated whole with multiple interacting and self-reinforcing components.

BENEFITS OF ENERGY EFFICIENCY POLICIES FOR DEVELOPING COUNTRIES

After several decades of energy efficiency policy development in North America, Western Europe, Japan, Korea, and Australia, developing countries began to enact similar policies based on successful models. To date, however, developing countries lag significantly behind their wealthier counterparts in spite of clear potential benefits.

Energy Efficiency Policies are Well-Suited to Meeting Developing Country Goals – As elsewhere, developing countries gain from energy efficiency in multiple ways, including increased energy security, job creation, and environmental mitigation. In addition, a particular benefit for economic development exists in reducing the expense of energy inputs that produce lower net economic output than other goods. Furthermore, energy efficiency contributes to reduction in the need for capital in the power sector and the cost of servicing loans supporting large-scale energy infrastructure.

Energy Efficient Technologies are Widely Available – Most of the technologies that do the "heavy lifting" of energy efficiency – efficient lighting for example– are globally traded commodities available to developing country consumers. The goal of energy efficiency policy is therefore to reduce the price and increase access to these, while giving local producers opportunities for export at the same time.

Policies are Well-Known with Lessons Learned – By now, there is a well-defined toolkit of energy efficiency policies with a proven track record, and these are generally known by responsible ministries and advocates in developing countries.

Despite the proliferation of policies, a close examination reveals that energy efficiency has yet to be scaled fully to meet societal needs in developing countries. A common justification for the lack of ambition in energy efficiency in developing countries is that they have more pressing priorities, including poverty reduction, access to basic services, economic development, acute inequality, and public safety. The unique and critical challenges faced by developing countries highlights the need for international assistance. Furthermore, an economy that incorporates energy efficiency measures can address some of these problems and boost the amount of financial resources a government has at its disposal.

THE BUILDING BLOCKS OF ENERGY EFFICIENCY

Fortunately, the history of energy efficiency policies in major industrialized economies has paved the way for success. A fairly standard portfolio of policy tools exists with a strong track record of lowering energy intensity, saving consumers money and contributing to a cleaner environment. Many of these are found in the buildings sector, including households, businesses, and government. Figure 1 describes the core building blocks of energy efficiency: regulatory support, market priming, and financing and policy planning.

ENERGY EFFICIENCY STANDARDS AND RETROFITS include evaluation of market dynamics, regulatory costs and benefits, development of technical standards and stakeholder engagement.

- Equipment Performance Standards
- Building Codes and Public Sector Retrofits
- ISO 50001 and ESPC/ESCOs

MARKET PRIMING AND FINANCING kick starts markets for high-efficiency technologies by creating economies of scale and facilitating reduction of costs to end consumers.

- Bulk Procurement
- Incentive Programs
- Efficiency Funds, Low Income and Small Business Programs

POLICY PLANNING integrates energy efficiency into national power development and integrated resource plans, enabling targets and strategies for low emissions development strategies (LEDS), and implementation of Nationally Determined Contributions.

- Energy Efficiency Policy Prioritization and Road-mapping
- Energy Efficiency Resource Planning

FIGURE 1: THE BUILDING BLOCKS OF ENERGY EFFICIENCY

STRATEGIES FOR SUCCESS

Despite their benefits, energy efficiency policies are perceived to be complex and difficult to implement. Technical assistance resources are indispensable to clarifying and simplifying each step in the process. While there is some standardization of technical assistance and tools, there is no "one-size-fits-all" approach to implementing good policy, since each country has unique priorities and limitations. Whatever the context, strategic implementation can greatly increase the chance of success.

Communicate Benefits Effectively – Political leaders at the national level of large developing countries usually have some understanding of the main energy efficiency policies but may not see them as core to their government's mission and broader national goals. Furthermore, developing country governments may be most concerned about economic development, poverty alleviation, energy security, trade relations, or air pollution. Some of the most important but less-often communicated benefits of energy efficiency include economic development, job creation, energy security, reduced need for capital, and net subsidy reduction.

Design Integrated Programs – Successful and sustainable energy efficiency technical assistance follows a strategy of Integrated Policy Planning that deploys a complete set of tools with the long-term goal of reaching mass adoption of high-efficiency technologies. Figure 2 illustrates this approach.

As high-tech products enter the market, consumer awareness is boosted first by awards followed by government procurement guides, incentives, and labelling programs. Such programs boost market shares and create economies of scale that subsequently lower consumer prices. Once the technology becomes cost effective for most consumers, it can be considered for minimum efficiency standards and other policies that guarantee mass adoption. In countries where energy efficiency policies work together in this way, the process is cyclical, driving ever-increasing innovation.

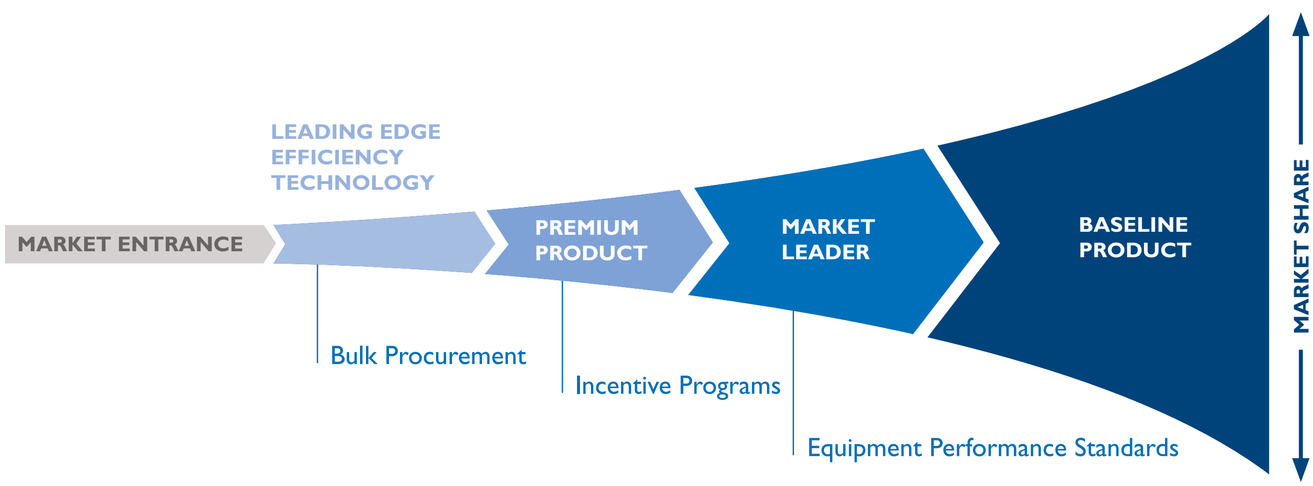


FIGURE 2: BUILDING BLOCKS WORK TOGETHER TO TRANSFORM MARKETS FOR ENERGY EFFICIENCY

Set Goals and Integrate Energy Efficiency in National Plans – Increasingly, developing country governments are setting forth long-term national goals related to energy efficiency. These goals should be quantified in terms of well-defined metrics. Furthermore, they should include both short and long time periods due to the nature of policies such as regulations for equipment production and building construction, which continue to have cumulative effects long after implementation. Like any program, support for energy efficiency benefits from rigorous monitoring and evaluation. Specific metrics to measure progress are energy savings and greenhouse gas emissions mitigation, financial benefits, development impacts, and increased technical capacity.

II. THE VALUE OF ENERGY EFFICIENCY POLICIES

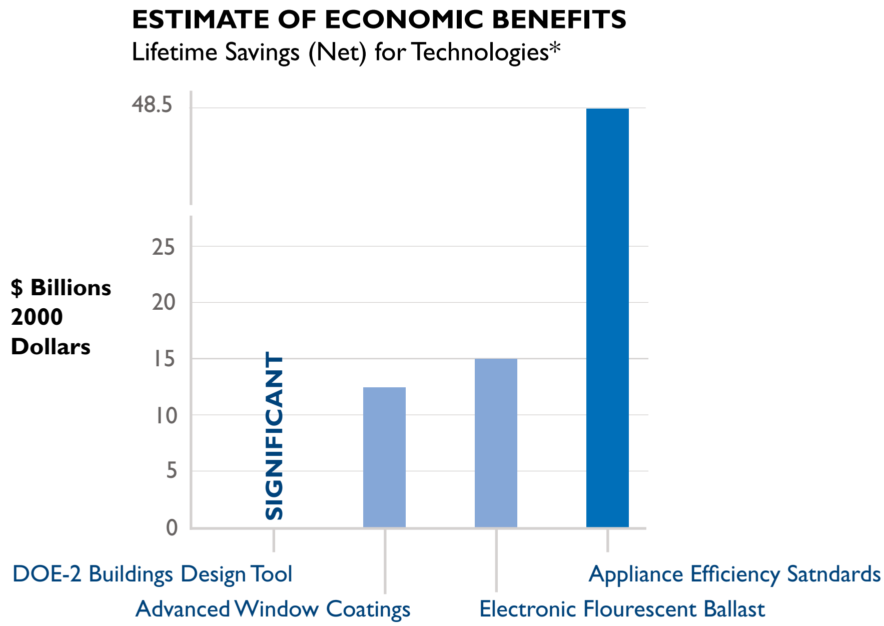
At its core, *energy efficiency* means minimizing the energy inputs needed to provide a desired energy service (i.e., using less electricity to power an office building). Energy efficiency decreases the financial costs of energy as well as other negative impacts associated with energy production and use. *Energy efficient technologies* include equipment and materials designed to provide energy services with lower energy inputs compared to the status quo. Familiar examples of energy efficient technologies are electric lamps that produce the same light at lower wattage, refrigerators that cycle less often, fuel efficient cars, and heating systems that use less fuel than "baseline" technologies. Energy efficient technologies compete with conventional technologies and are selected by users who wish to reduce energy consumption in order to lower energy costs, benefit the environment, contribute to energy security, etc. They are often more expensive than conventional technologies, but provide a net positive financial return over time. Often, users do not select energy efficient technologies despite a favorable return on investment due to a variety of market failures including lack of information (consumers are not aware of benefits); lack of financing (consumers can't afford up-front costs); or "split incentives" (e.g., building tenants do not install equipment but do pay energy bills).

Energy efficiency policies are actions taken by governments to address these market failures. Typically, energy efficiency policies provide net economic benefits to users while supporting other public goods, some of which are discussed below. It is important to clarify what is meant by "policies," how they differ from energy efficiency projects more generally, and how policies "act at scale." All energy efficiency projects seek to reduce energy inputs and produce financial benefits. While a *project* may target a specific industrial facility or large commercial building, for example, *policies* create a set of rules and practices for an entire subsector or type of energy-using equipment. In doing so, they affect a much larger total energy footprint, often transforming national markets as a whole. While the resulting savings and benefits accrued may take years to be fully realized, the overall impact can be orders of magnitude larger and have a lasting effect on energy dynamics of an economy. For this reason, creating successful energy efficiency policies should be a top priority for governments.

ENERGY EFFICIENCY IN INDUSTRIALIZED ECONOMIES

Energy efficiency policy as implemented in the United States (U.S.) has its origins in the OPEC oil crisis of the 1970s, at which point "energy conservation" emerged as a national priority in order to safeguard the energy security of the United States and other major economies.[1] During that period, the U.S. developed fuel efficiency standards for cars and enacted the National Appliance Energy Conservation Act (NAECA). NAECA established the role of the newly formed Department of Energy to regulate the efficiency of consumer appliances and lighting equipment. Since that time, energy efficiency has been identified as a critical consumer protection policy, shielding consumers from excessive energy bills while maintaining consumer utility. Only later, in the late 1990s and early 2000s, was energy efficiency viewed as a key environmental policy with an important role in reducing greenhouse gas emissions as well as other contaminants such as acid rain and air pollution.

[1] A history of energy efficiency policy in the United States is provided by (ACEEE 2015) and (ASE 2013).



* National Research Council. 2001. *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000.* Washington, DC: The National Academies Press. https://doi.org/10.17226/10165.

FIGURE 3: ESTIMATES OF ECONOMIC BENEFITS. Source: Lawrence Berkeley National Laboratory

A 2001 study found that appliance efficiency standards, a regulatory policy that requires household appliances and commercial building and industrial equipment meet minimum levels of efficiency, produced more than three times as much benefit as any other DOE program. (National Academy of Sciences 2001) Building on this success, the program has since been expanded to cover 60 categories of appliances and equipment types. Through this program, U.S. consumers saved $63 billion on their utility bills in 2015 alone, representing about $500 per household. By 2030, cumulative operating cost savings from all standards in effect since 1987 will reach nearly $2 trillion (Meyers 2016). Products covered by standards represent about 90 percent of home energy use, 60 percent of commercial building use, and 30 percent of industrial energy use, making standards one of the most effective energy savings policies in U.S. history.

ENERGY EFFICIENCY IN DEVELOPING COUNTRIES

After several decades of the proliferation of energy efficiency policies in North America, Western Europe, Japan, Korea, and Australia, developing countries began to develop similar policies. To date, however, developing countries lag significantly behind their wealthier counterparts in deploying energy efficiency efforts, despite the demonstrated benefits of doing so.

Generally, the benefits of energy efficiency policy in countries with low average incomes but rapidly developing economies are not identical to high-income countries, but there is a great deal of overlap. Furthermore, there are particular needs in low-income countries that are well-addressed by energy efficiency policy. Put simply, while resources are sparse in developing countries and many people still live in poverty, the cost of energy, which is provided through globally traded fossil fuels and electricity infrastructure, is on par with richer countries, and therefore places a relatively higher burden on developing economies. Energy is an expensive commodity that is needed to increase household living standards and fuel small businesses and major industries alike. For these and other reasons, the central role of energy efficiency in supporting economic development has not been overlooked by leading global organizations. The International Energy Agency for example, has promoted energy efficiency as "the first fuel" of economic development (IEA 2016).

STANDARDS IN ACTION

SCALED ENERGY EFFICIENCY IMPACTS – MEXICO

The case of Mexico demonstrates how energy efficiency policies can yield scaled impacts. Energy efficiency policies and programs began in earnest in the late 1990s with lightbulb substitution programs and minimum efficiency standards for household appliances as well as industrial electric motors. Equipment regulations issued by a dedicated energy efficiency agency called CONAE (now CONUEE) proved particularly effective. The first set of standards (for refrigerators, room air conditioners, and washing machines) were issued in1996 and have been updated every few years as new technologies become affordable for Mexican consumers. Meanwhile many other products have been studied and are now regulated.[2] In 2016, CONUEE completed a study demonstrating impacts of energy efficiency programs in Mexico (Figure 4). As the figure shows, residential electricity consumption growth has slowed since the energy efficiency program started, implying 30 percent lower consumption levels by 2014 relative to the historical trend. As expected, savings grow well beyond the initial set of regulations, as new equipment is introduced into households and businesses and new standards come online.

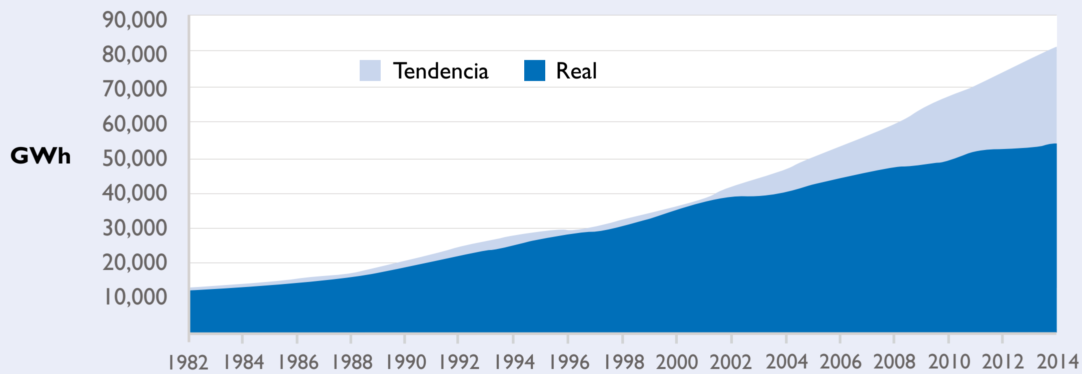


FIGURE 4: IMPACTS OF ENERGY EFFICIENCY PROGRAMS IN MEXICO. Source: CONUEE. 2018.

Unfortunately, developing countries and the domestic and international finance institutions that support them have tended to focus more on increasing energy sector capacity than minimizing the need for it, thus limiting the cost to society of providing energy services. Furthermore, while energy production and delivery are important components of local economies, they are capital-intensive, and thus create fewer jobs per dollar than more labor-intensive enterprises. Energy subsidies further exacerbate the barriers to energy efficiency. Because energy efficiency investments are paid back in time through lower energy costs, artificially low energy prices cause a market distortion. In this case, the government is effectively subsidizing waste. Alternatively, subsidization of energy efficiency through state-owned utilities may present a win-win proposition, since in this case both the public sector and consumers reap the financial benefits of energy efficiency investment. Sadly, in spite of these arguments, the assumption that only rich countries can afford energy efficiency persists and presents a strong barrier to progress.

[2] CONUEE now manages more than 20 official Mexican standards, with a policy of standards harmonization with the United States as well as many independent regulations. CONUEE also participates actively in programs for industrial energy efficiency, building codes, energy management training, and training programs for municipalities.

Energy Efficient Technologies are Widely Available

Developing country governments also suffer from the persistent belief that they lack access to energy efficient technologies. While it is true that the cutting edge of technology may be out of reach for most consumers in lower-income countries, most of the technologies that do the "heavy lifting" of energy efficiency – efficient lighting and HVAC, for example – are globally traded commodities. Developing country markets usually offer these, but they are perceived by most consumers as being too expensive. The goal of energy efficiency policy is therefore first and foremost to reduce the price of technology in order to make these accessible to the widest possible audience. Local manufacturers may also perceive barriers to producing high efficiency models, but they are generally capable of adopting better practices if provided a market since the basic research and development is already complete. Adoption of best practices may also enhance export opportunities to local producers.

Policies are Well-Known with Lessons Learned

By now, there is a well-defined toolkit of energy efficiency policies with a proven track record, and these are generally known by the appropriate ministries and advocates in developing countries. For example, data collected by the World Energy Council[3] demonstrates the proliferation of two major policy tools – minimum energy performance standards (MEPS) and mandatory energy efficiency building codes (for the residential sector).[4] As Figure 5 shows, as of 2019, 67 countries applied MEPS for domestic refrigerators and 72 had energy efficiency building codes. Since the largest economies tend to adopt policies first, this implies that most of the world's population and economic activity are now within jurisdictions employing some energy efficiency policies. Importantly, developing (non-OECD) countries with energy efficiency policies number only slightly less than OECD countries in both categories. Adoption remains low in Commonwealth of Independent States countries.

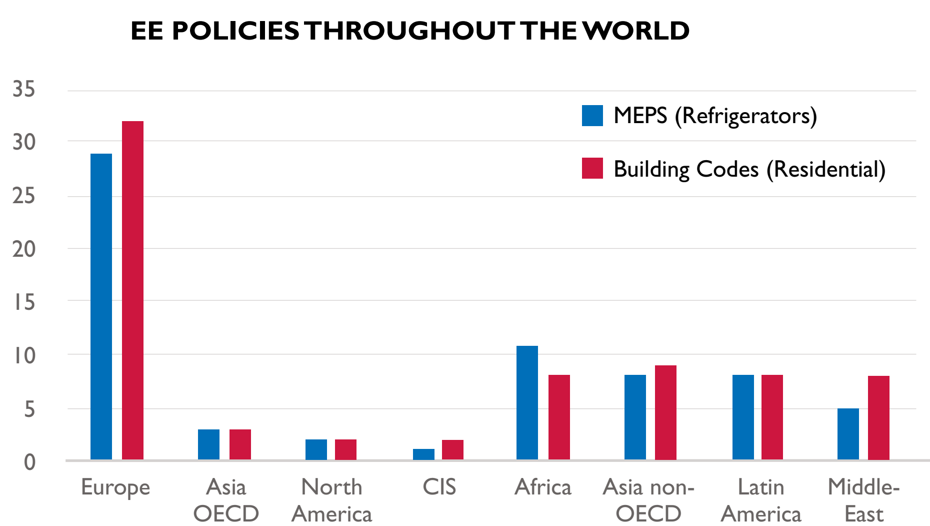


FIGURE 5: PROLIFERATION OF MEPS AND RESIDENTIAL ENERGY EFFICIENCY BUILDING CODES
Source: World Energy Council 2014

Despite the proliferation of policies on the books, a close examination of policies in developing countries reveals that energy efficiency has yet to be implemented robustly and at sufficient scale to achieve the goals either common to or distinct from the developed world. For example, an analysis by LBNL in 2016

---

[3] Data available from World Energy Council.

[4] MEPS shown are for domestic refrigerators, which is indicative of a program for appliance and equipment MEPS, since this product is usually among the first regulated. MEPS and building codes are both key energy efficiency policy tools, and are discussed more fully in the following sections.

(McNeil et al. 2016) showed that savings from appliance efficiency standards implemented in 2010-2016 strongly favored OECD countries despite the large and growing savings opportunity in non-OECD countries (Figure 6). There are two major reasons for this. First, policies still tend to cover only select technologies and tend to focus on the residential sector. Second and more importantly, the policies are not stringent enough or they lack robust enforcement. For example, while major domestic appliances are covered in large developing countries, standards often remain far below those in rich countries, and in many cases standards are set a level below the market baseline, resulting in low or no market impact. Meanwhile, building codes are generally not enforced at the federal level but instead rely on implementation by municipalities, which suffer from low technical and administrative capacity. As a result, they are not adequately tied to building permitting, where enforcement is more complete, though spotty.[5] In summary, having weak or toothless policies on the books results in low or no benefit. In fact, these half-hearted efforts can even be counterproductive, because they undermine trust in the process and in the perceived value of energy efficiency policy in general. In this case, government resources and "political capital" is wasted.

The criteria for stringent energy efficiency policies implemented in developing countries should be the same as in their higher-income counterparts – namely that policy should target the maximum level that delivers net financial savings to end users. If energy subsidies reduce the cost-effectiveness of higher efficiency, government should also subsidize energy efficiency in order to maximize benefits to society as a whole.

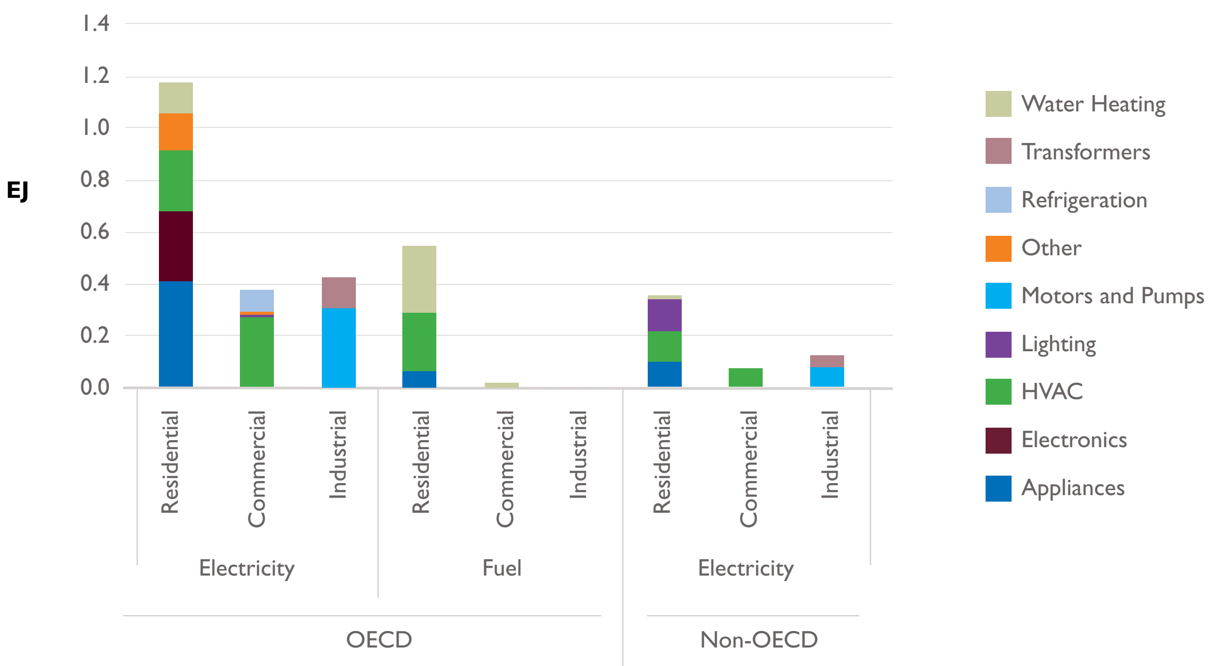


FIGURE 6: PROJECTED SAVINGS FOR EQUIPMENT EFFICIENCY STANDARDS IN MAJOR ECONOMIES – 2010-2015.
Source: McNeil et al. 2016.

A common justification for the lack of ambition in energy efficiency in developing countries is that they have more pressing priorities, including poverty reduction, access to basic services, economic development, acute inequality, and public safety. The unique and critical challenges faced by developing countries highlights the need for international assistance. Furthermore, an economy that incorporates energy efficiency measures can address some of these problems and boost the amount of financial resources a government has at its disposal.[6]

[5] As building codes for safety, zoning, or seismic stability become more common, energy efficiency has an opportunity to "piggyback" on already-existing enforcement frameworks.

[6] An interesting case is that of Mexico, where government spending on electricity subsidies exceeds that of most social programs.

III. THE BUILDING BLOCKS OF ENERGY EFFICIENCY

Fortunately for developing country governments, the history of energy efficiency policies in major industrialized economies has paved the way for success. As a result of trial and error, there exists a standard portfolio of policy tools with a strong track record of lowering energy intensity, saving consumers and businesses money and contributing to a cleaner environment. Many of these are found within the buildings sector, including households as well as businesses and public institutional facilities. While great opportunities also exist within industries, government often has less direct influence over these, and industrial energy use is also more complex due to the diversity of industrial processes that use energy.[7] Therefore, many of the strategies for developing scaled energy efficiency policies considered below are part of the global toolkit for energy efficiency in buildings.

The advantage of applying energy efficiency to buildings is two-fold. First, buildings contribute a major and growing share of an economy's electricity consumption,[8] which is both expensive to consumers and contributes to greenhouse gas emissions through thermally-generated electricity. Second, buildings consume energy through an array of fairly standardized equipment and practices. Households use lightbulbs and appliances sold by the millions by large, often multinational companies; likewise, businesses use information technology and large mass-produced HVAC systems and refrigeration systems. Construction materials vary, but can be specified clearly in terms of thermal properties and overall building design characteristics. The industrial sector can benefit tremendously from energy efficiency, but often relies more heavily on large custom-designed and installed systems that require individual optimization and investment at the plant level. Some electricity consumption in industry is standardized, however, such as ubiquitous general-purpose electric motors and power distribution transformers. In addition, standardized processes and operating standards have been developed that support energy management at the plant or enterprise level.

The following is a concise – not comprehensive – list of well-known energy efficiency policy types appropriate for implementation (primarily in the building sector) by developing country governments. Examples of success in developing countries exist for each of them (Table 1). It is important to note, however, that each country has political, economic, and institutional circumstances that make some policies more feasible than others. The application of any of them requires careful and well-informed analysis of the local landscape and probability of success and sustainability.

[7] This is not to imply that effective industrial energy efficiency policies exist, especially for high energy-intensity "heavy" industrial sectors. Furthermore, some ubiquitous equipment types, such as electric induction motors are regulated for energy efficiency in many countries.
[8] In the U.S., for example, the Alliance to Save Energy notes that buildings account for 70 percent of electricity consumption.

TABLE 1: ENERGY EFFICIENCY BUILDING BLOCKS AND OBJECTIVES

ENERGY EFFICIENCY STANDARDS AND RETROFITS

include evaluation of market dynamics, regulatory costs and benefits, development of technical standards and stakeholder engagement.

Objectives

Equipment Performance Standards	• Efficient Technology Market Assessment • Analysis of Financial Costs and Benefits • National Energy, Economic and Environmental Impacts
Building Codes and Public Sector Retrofits	• Technical Specification for Energy Efficient Construction • Benchmarking Tools • Enforcement Protocols
ISO 50001 and ESPC/ ESCOs	• ESCO Capacity Building • ISO 50001 Workforce Training • ISO 50001 Subsector Targets

MARKET PRIMING AND FINANCING

kick starts markets for high-efficiency technologies by creating economies of scale and facilitating reduction of costs to end consumers.

Objectives

Bulk Procurement	• Technical Specifications for Qualified Products • Product Registry and Procurement Handbook
Incentive Programs	• Technical Specifications for Qualified Products • Rebate Amount and Financing Mechanism • Public Awareness Campaigns
Energy Efficiency Funds, Low Income and Small Business Programs	• Technical Capacity Building of Fund Administrators • Awareness Raising / Stakeholder Outreach • Program Design

POLICY PLANNING

integrates energy efficiency into national power development and integrated resource plans, enabling targets and strategies for low emissions development strategies (LEDS), and implementation of Nationally Determined Contributions to International Climate Agreement.

Objectives

Energy Efficiency Policy Prioritization and Road-mapping	• Bottom-Up Energy Demand Forecasting • Planning Department Capacity Building • National Energy Efficiency Roadmapping
Energy Efficiency Utility Resource Planning	• Utility Perspective Energy Efficiency Cost-Benefit Analysis • Energy Efficiency Measure Supply Curve • Utility Staff Capacity Building and Implementation Planning

The impact of energy efficiency measures and programs is often judged by the amount of energy saved, financial benefit and environmental mitigation for every dollar spent on the program, including money spent providing technical assistance. In a context in which resources are scarce and needs are urgent, governments and donors need to identify actions that have the "biggest bang for the buck" in terms of major market transformations and long-term impacts. While implementation of the latest technologies in a single facility or sub-sector are helpful, the broadest impacts can be had by implementing government policies through regulation or large-scale financing. It is useful to outline how and why these policies work at scale.

Policies work best at scale because they distribute and amplify investment across a wide range of actors. To illustrate this, we consider the case of MEPS, one of the most common and best-regarded regulatory measures throughout the developed world. The initial investment comes from the government in terms of the staff, usually in a department of the energy ministry, that develops and issues a regulation according to the rules governing it by some framework legislation.[9] In addition to this, developing countries may receive resources directly from international donors in the form of technical assistance or financing support through loans from development banks. These two sources collectively form the government investment, which is many millions of dollars per year in the case of the U.S. and Europe, but generally much less for developing countries. When this resource is effectively put to use, the local government can issue regulations requiring, for example, that new equipment (light bulbs, refrigerators, air conditioners, etc.) sold on the local market be of a higher level of efficiency than would have occurred without the MEPS.[10]

Higher efficiency equipment requires new designs, more expensive components or totally new technologies, which in turn requires investment in the form of research and development, factory retooling, and/or higher supply-chain costs. A major role of technical analysis, often paid for through technical assistance, is to ensure that the proposed regulation does not unduly burden manufacturers, relies only on technologies available in the local market, and will result in net financial gains to consumers. Once this due diligence is completed and with adequate stakeholder consultation and sufficient lead time for implementation, manufacturers must change their product lines to meet the new requirements. The required investment for this is borne not by the government, but by private sector companies and their investors. Generally, these costs are then passed on to final consumers. In this way, a modest investment by government is amplified by orders of magnitude, and the investment is shared by many (sometimes millions) of households and businesses, who also reap the benefits.

---

[9] By now, it is common in most countries to have a framework law on energy conservation that gives explicit powers to specific government agencies to issue regulations governing the energy efficiency of appliances, lighting, and other equipment and defines the process for doing so.

[10] MEPS are often referred to simply as "standards," but since that term is also used to describe the technical parameters to define and measure efficiency through testing, the two are distinguished for clarity.

BUILDING BLOCK: ENERGY EFFICIENCY STANDARDS AND RETROFITS

ENERGY EFFICIENCY STANDARDS AND RETROFITS

Energy efficiency standards and retrofits are a suite of tools including equipment performance standards and building energy performance construction codes that are among the most direct and high impact actions that governments can take, and they have a long history of success. Standards and codes are an indispensable part of any energy efficiency strategy that seeks impacts at scale, since they have the potential to affect every piece of equipment sold in a country or every building constructed. Alternatively, the energy performance of existing buildings can be significantly improved through retrofits, including installing high-efficiency lighting, adding roof insulation, replacing windows, sealing leaks, etc. Because existing buildings must be retrofit one at a time, the number of buildings affected is generally smaller than those subject to codes, but can result in deep cuts to energy consumption throughout multiple buildings or facilities. Most large developing countries already have the basic elements of equipment standards and/or building codes programs, but cover only the main household appliances and lighting. They rely on technical specifications to determine efficiency performance, e.g., of appliances and lighting, industrial equipment, or building thermal insulation. Because of this, there is a strong relationship between the quality of technical underpinnings and the success of the program.

Equipment Performance Standards

Energy efficiency regulations for equipment generally take the form of mandatory technical standards or MEPS. MEPS "raise the floor" of efficiency by prohibiting the manufacture or sale of products failing to meet a minimum level of performance according to technical specifications measured in certified laboratories. Technical analysis supporting MEPS identifies the most fruitful options for regulation and helps ensure that MEPS are sufficiently stringent to significantly increase the average efficiency of products available on the market.[11] In a new program or one that includes a range of possible equipment for regulation, a prioritization study is conducted in order to reveal the largest opportunities. The main criteria for prioritization are usually total energy savings and financial benefits, although commercial and political considerations are also taken into account. This study may include a market survey to assess the size of the market and prevailing trends for product types, features, and baseline energy efficiency levels, which is then refined for a specific policy target once identified. The second main component of analysis consists of a detailed cost-benefit analysis that compares the likely increase in consumer retail prices for equipment

TECHNICAL ASSISTANCE TOOLKIT

Mandatory energy efficiency regulations for equipment can have a big impact if done well. Getting regulation right includes:

- ***Efficient Technology Market Assessment*** – Survey determining the availability, performance, and source of high-efficiency equipment currently on the market, as well as usage patterns in homes and businesses.
- ***Analysis of Financial Costs and Benefits*** – Calculation of the cost-effectiveness of investment in technologies required by regulations or programs for individual energy consumers.
- ***National Energy, Economic, and Environmental Impacts*** – Calculation of scaled-up energy savings, greenhouse gas mitigation, and net present value of financial costs and savings over time.

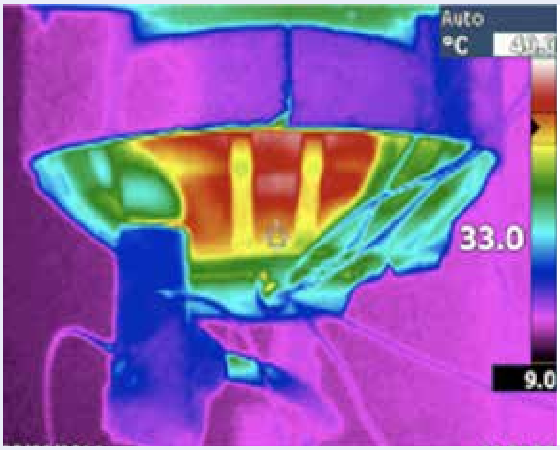
[11] For example, the U.S. Appliance Standards program, which relies on the Department of Energy's National Laboratories and other contractors to identify high-efficiency technologies, perform cost-benefit analysis, and assess program impacts.

against long-term financial benefits across a range of target efficiency levels. The results of this analysis help determine the parameters of the final regulation and build credibility among stakeholders. Finally, development of a schema for monitoring the post-regulation market facilitates analysis of its impact and supports programming integrity.

STANDARDS IN ACTION

EFFECTIVE TECHNICAL ASSISTANCE – SOUTH AFRICA WATER HEATERS

The impact that strong technical assistance can have direct application of the effectiveness of technical support is shown by the example of South African domestic water heater efficiency. In 2014, the Berkeley Lab initiated a collaboration with the South Africa Department of Energy (SADOE) through the SEAD initiative.[12] Since SADOE had recently announced its intention to issue minimum efficiency standards for domestic electric appliances, Berkeley Lab performed an analysis of likely impacts of standards for a range of appliances and determined that domestic electric storage tank water heaters (called "geysers" in South Africa) offered a very large opportunity for improvement due to high penetration rates and poor performance of models on the market because of inadequate insulation. In order to build industry support for standards, Berkeley Lab experts partnered with South African consultants and a local university to evaluate the design of baseline models and analyze the cost-effectiveness of including much higher levels of insulation. This study showed that small investments in production costs would lead to huge benefits in terms of lowered electricity bill. The results of the analysis were presented at a key meeting of stakeholders whereupon industry agreed to a much more stringent regulation. Berkeley Lab subsequently found this standard will likely result in future avoided electricity demand roughly equal to a full-sized coal-fired power plant by 2030.



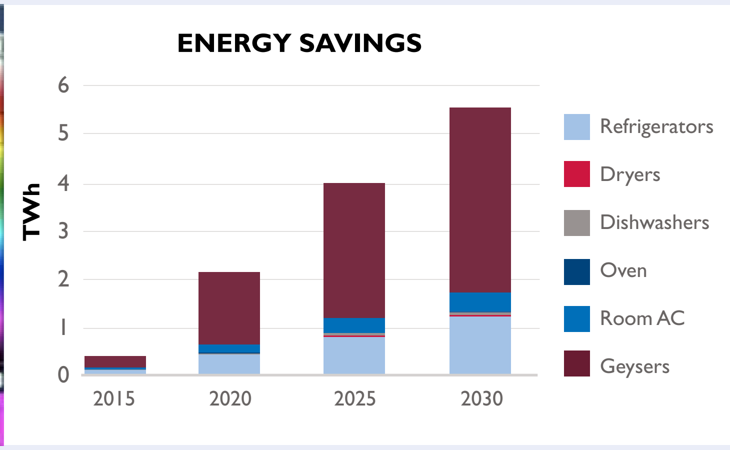


FIGURE 7: THERMAL IMAGE SHOWING HEAT LOSSES IN SOUTH AFRICAN WATER HEATERS (LEFT). SAVINGS PROJECTION OF EFFICIENCY STANDARDS FOR PRODUCTS IN SOUTH AFRICA (RIGHT). Source: LBNL

[12] The Super-Efficient Equipment and Appliance Deployment initiative (SEAD) was a project of the Clean Energy Ministerial, and counted several large developing countries, including South Africa as members. More information about SEAD can be found at www.superefficient.org.

Building Codes and Public Sector Retrofits

Along with equipment standards, mandatory energy efficiency codes for buildings have a huge potential for scalable impact. Like equipment standards, building codes rely on clear technical specifications and methods for builders and inspectors to evaluate compliance. Energy efficiency building codes require incorporation of construction elements that reduce heating and cooling needs through improved thermal insulation. Building codes are applied at the design stage to limit window area, include wall and ceiling insulation, and reduce air leakage (infiltration), as well as other elements. Building codes have the potential to completely eliminate energy consumption from heating and cooling in moderate climates. If the building is also linked to distributed generation resources, it might become a net energy producer.

Building codes are most often applied to new construction because it is generally much less expensive to build in energy efficiency at the design stage. As a consequence, building codes have a growing impact over time and can affect nearly the whole building stock over a period of decades. Since building codes are closely linked to construction permitting, their implementation most often occurs at the level of states, provinces, or municipalities. This creates a major capacity issue, because local governments are less familiar with energy efficiency policy and enforcement resources. As a result, while building codes can be found in many developing countries, their enforcement is fragmented at best, and at times non-existent. The role for technical assistance is to support development of technical standards, but must also include educating local leaders on the value of such a policy, identifying feasible enforcement schemes and supporting a constructive dialogue between government and the construction industry.[13]

TECHNICAL ASSISTANCE TOOLKIT

Where to Start: Technical assistance for energy efficiency building codes and public sector retrofits should include:

- ***Technical Specifications for Efficient Construction*** – The main underpinning of energy efficiency building codes is a technical standard specifying design parameters (e.g., fraction of window coverage or insulation thickness) or performance metrics (e.g., kwh/m2). Technical codes are government-issued, but examples exist from professional associations and international non-profit organizations.
- ***Benchmarking Tools*** – Once reliable energy consumption and building characteristic data are collected, data visualization tools can help pinpoint the most promising areas to cost-effectively save energy through retrofits.
- ***Enforcement Protocols*** – Since building codes rely on effective enforcement, protocols to mandate, verify, and monitor compliance with energy efficiency codes are a major element of technical assistance to municipalities.

Energy efficiency retrofits include some of the same engineering elements as construction codes, but by definition they are implemented after construction. While aggressive retrofits often pay off in the long term, they generally require high up-front investments[14] and/or have a long payback period. For this reason, energy efficiency retrofits are most often undertaken in the public sector, including in government buildings. Whether the target of a retrofit program is, for example, all municipal or federal government buildings, or a group of properties owned by a company, benchmarking is an important technical step to identifying areas of opportunity. In the context of building energy efficiency, benchmarking refers to comparison of the energy performance of a building to a relevant average or typical building under the same climatic conditions according to a well-defined metric, such as energy consumption per square meter of floor area. A benchmarking database is a key element to prioritization and implementation of both building codes and retrofit schemes by the public sector as well as private-sector firms.

[13] An example is Mexico, where energy efficiency building codes are well-defined and required at the federal level, but have not been successfully implemented in any municipality to date.
[14] Costs are generally also more visible to building owners and occupants than costs incurred at design and construction, which are folded into long-term financing.

Energy Management Systems and Energy Service Company (ESCO) Development

Energy management systems are internal programs within firms and organizations integrated with company goals to set policies and targets concerning energy consumption, identify specific areas of opportunity, implement changes and set policies, and subsequently systematically track performance. In order to support these efforts on a global scale, the International Standards Organization (ISO),[15] in consultation with international experts, developed a system of voluntary standards under ISO 50001.[16] ISO develops a set of protocols and procedures for management of energy consumption. ISO 50001 compliance can be used voluntarily for the energy, environmental, and cost benefits it provides. Alternatively, compliance certification can be used as a metric for national industrial energy efficiency goals, or as part of a compulsory government program.

As one of the main ways for private-sector actors to systematically implement energy efficiency, facilitation of energy management systems is an attractive option for developing country governments. Government can provide technical support directly to company staff in order to implement energy monitoring systems, identify energy savings measures, and implement monitoring and evaluation systems. An example of this is the U.S. Department of Energy's *50001 Ready* program, which recognizes facilities and organizations that commit to implementation of ISO 50001 and also provides online implementation tools.[17]

Alternatively, these functions can be provided through energy savings performance contracts (ESPCs) implemented through public or private-sector energy service company (ESCO) models. ESCOs enter into contracts with private or public organizations to implement energy efficiency projects. In return the ESCO is paid based upon calculated energy savings realized by the efficiency project. In many cases, a third-party financier will provide capital for the implementation of the efficiency project. In order for the ESPC market to work, the ESCO, contracting organization (project host), and financier of the implemented efficiency project must have confidence in reported energy savings. By following an agreed upon measurement and verification (M&V) process, a qualified M&V practitioner can calculate energy savings that are acceptable to all interested parties. M&V guidelines, along with a trained workforce, are key to ensuring that the projects are evaluated in a robust and transparent manner.

To be clear, implementation of energy efficiency measures in the private sector and establishment of an ESCO sector can occur independently of energy management systems, but ISO 50001 certification offers a standardized approach to implementation that lends itself to technical assistance in the form of certification and workforce development, as well as implementation of monitoring and verification procedures.

TECHNICAL ASSISTANCE TOOLKIT

Technical assistance for energy management systems, and ESCO sector development include:

- ***ESCO Capacity Building*** – Activities to support development of a robust ESCO sector, including monitoring and verification training, handbooks, and competency standards.
- ***ISO 50001 Workforce Training*** – Workshops, training, and online tools to facilitate energy management systems using the ISO 50001 framework.
- ***ISO 50001 Subsector Targets*** – Analysis of industry subsector opportunities and best practices in support of scaled adoption of energy management systems, through 1) mandatory government regulations for large energy users, and/or 2) voluntary recognition programs.

[15] ISO is an independent non-governmental organization with 165 national standardization bodies as its members.
[16] Details are available at https://www.iso.org/iso-50001-energy-management.html.
[17] More information available at https://www.energy.gov/eere/amo/50001-ready-program.

BUILDING BLOCK: MARKET PRIMING AND FINANCING

MARKET PRIMING AND FINANCING

Market priming and financing policies and programs kick-start markets for high-efficiency technologies by creating economies of scale and facilitating reduction of costs to end consumers. Access to finance is often cited as a barrier to adoption of high-efficiency technologies, especially by low-income consumers. The key to scaling these programs is to develop schemes by which investments in the program are paid back by another benefit to government funds, or to society as a whole. A related set of programs provides an incentive (rebate) that makes enough consumers adopt a certain technology, encouraging manufacturers to increase production and marketing and ultimately leading to economies of scale, which have the effect of lowering prices.

Bulk Procurement

Bulk procurement refers to programs or policies to purchase large volumes of high-efficiency equipment by a single buyer. The most common example of this is the purchase of high efficiency equipment by government agencies through creating a list of eligible products from which procurement officers can choose. In another example, a public sector entity such as an ESCO makes a large purchase and then redistributes the equipment. The goal of bulk procurement is two-fold. First, it helps large organizations such as government agencies improve energy efficiency across the full range of their operations. Second, it creates economies of scale, growing markets for energy efficient technologies and thereby encouraging industry to produce more of them at competitive prices. The role of energy efficiency technical assistance in this case primarily supports technical criteria to identify qualified products and support certification.

TECHNICAL ASSISTANCE TOOLKIT

Technical assistance for bulk procurement include:

- ***Technical Specifications for Qualified Products*** – Metrics and testing procedures for equipment are the technical basis for assuring the energy performance of models eligible for purchase within the program.
- ***Product Registry and Procurement Handbook*** – Product registries list qualifying product models available on the market and define a process for keeping them up to date. Procurement handbooks cover multiple programs and describe best practices for acquiring high-efficiency equipment.

Incentive Programs

In an incentive program, consumers receive a rebate in order to offset potentially higher retail prices or construction costs associated with energy efficiency measures. For example, a consumer might receive a rebate after purchasing a high-efficiency refrigerator that has a higher upfront cost than less efficient appliances on the market. An ideal incentive program provides the minimum incentive needed to drive adoption, and should not greatly exceed the amount needed to guarantee net benefits. Incentive programs lower financial hurdles in order to grow the market for very high-efficiency equipment or building efficiency measures and encourage economies of scale. Care must also be taken to minimize "free-ridership" associated with incentive programs, meaning a significant incidence of participation by consumers who would buy high-efficiency equipment in the absence of incentives. Multiple options exist for administration of incentive programs. Incentives can be paid directly to consumers or "up stream" at the point of production. They can be managed through retailers or directly from manufacturers with cash rebates, payments through utility bills, tax incentives, or green mortgages.

As in the case of bulk procurement, incentive programs require clear and consistent criteria to identify qualified products, and the technical parameters and procedures needed to establish these are an important role for technical assistance. Other important objectives for technical assistance include optimization of the incentive to be offered, assessment of impacts, and design of public awareness campaigns to encourage program participation.

TECHNICAL ASSISTANCE TOOLKIT

Incentive programs share elements with those for equipment performance standards but include financing elements and public awareness. These programs should include:

- ***Technical Specifications for Qualified Products*** – Incentive programs should target high efficiency products that are not cost-effective in the absence of subsidies, and for which market transformation is feasible given a sufficient market impulse.
- ***Rebate Amount and Financing Mechanism*** – Rebates must be designed to be large enough to encourage mass adoption but still provide net benefits at the societal level in terms of reduced energy infrastructure and environmental costs.
- ***Public Awareness Campaigns*** – Because incentivized purchases are voluntary, well-designed public awareness campaigns can greatly increase adoption.

Energy Efficiency Funds and Low-Income and Small Business Programs

Government efficiency funds provide financial resources to projects at an ad-hoc level to projects implemented by various actors. Funds are typically provided through the energy ministry and applied for and granted through a rigorous procedure of proposals and evaluations in order to minimize the risk of corruption. The management and evaluation of fund dispersal can be cumbersome and stretch the capacity of ministry staff. Therefore, a role for technical assistance exists in not only building the capacity of staff and providing evaluation of specific proposals, but also is providing more general guidance about the most effective themes for fund activities and methodologies for efficient and effective monitoring.

TECHNICAL ASSISTANCE TOOLKIT

Energy efficiency funds support effective program design and implementation and build capacity within the fund. They should include:

- ***Technical Capacity Building of Fund Administrators*** – International best practices and experience around energy efficiency technologies and sectoral opportunities as well as monitoring and evaluation.
- ***Program Design*** – Identification and prioritization of opportunities in terms of energy technologies and end users, particularly for small businesses.
- ***Awareness Raising / Stakeholder Outreach*** – Targeted outreach via webinars, workshops, and publications to communicate fund program opportunities and criteria.

Developing country governments have a strong inclination to use public funds to support their most disadvantaged citizens and make tangible contributions to poverty alleviation. In fact, many programs stipulate targeting government resources and subsidies to low-income households. For energy efficiency policies and programs, this requires developing a knowledge base of not only the way in which low-income households use energy, but how energy efficiency subsidies and regulations increase access to energy services and free up income currently spent on energy. Technical assistance can provide such insights, and also advise program managers on how to best reach low-income consumers through information campaigns and direct outreach. Similarly, a typical priority concerns small- and medium-sized enterprises that generally suffer from a lack of awareness of energy efficiency and access to information about government assistance programs.

STANDARDS IN ACTION

SPACE COOLING ENERGY EFFICIENCY – A CRITICAL DEVELOPMENT TOOL

Space cooling – the use of air conditioners and fans – holds a unique place in the strategies for developing countries at this point in history. As economic development advances and manufacturers innovate, room-sized air conditioners are becoming available to large portions of growing economies and uptake is strong, particularly in hot and humid climates, where it is increasingly seen as necessary for adequate living conditions. In addition to being extremely energy intensive, air conditioners often operate at the peak of grid consumption, driving the need for power plant investments and exacerbating the climate impacts of the power sector. Fortunately, there are a variety of policies that promote energy efficient air conditioning, including standards, building codes, government financing and bulk procurement programs. Air conditioners not only use energy, but refrigerants with high global warming potential, providing the opportunity to mitigate climate change in two ways with one set of technologies. In 2018, the United States Agency for International Development (USAID) held a *Cooling Summit* in Mexico. This in turn launched the Mexico Cooling Initiative,[18] which serves as a model for integrated action on climate change. Technical assistance actions following this model include:

- **Stakeholder Summit** – A meeting of government, industry and civil society members to lay the groundwork for a range of policies, such as minimum efficiency standards, building codes, incentive programs, bulk procurement and solar-reflective surfaces (cool roofs), etc.
- **Assessment and Expansion of Regulations** – Regulations are usually a first step toward scaled energy efficiency. An assessment determines whether new regulations are needed, or if existing ones can be strengthened, or expanded.
- **Regional Harmonization and Donor Collaboration** – Because space cooling technology is similar across countries, it makes sense to consider alignment (harmonization) of regulations and programs throughout several neighboring countries, especially through trade agreements. In addition, since multiple donors act in the cooling area, it makes sense to coordinate actions.

[18] See https://mexico-cooling.lbl.gov.

BUILDING BLOCK: STRATEGIC PLANNING

POLICY PLANNING

Energy efficiency programs can show concrete benefits that are significant in terms of reducing overall energy demand and meeting national goals for energy security and environmental protection. Further, most governments actively plan for energy demand growth and mitigating the effects of climate. Unfortunately, there is often a disconnect between plans for energy demand and supply: energy planners lack awareness of energy efficiency policy, and energy efficiency implementation is not well-integrated with greater national goals. Addressing this gap through development of comprehensive energy efficiency planning models and building capacity within the planning agencies to model and interpret the impacts of energy efficiency policy builds political will and empowers action. Technical assistance is needed when power sector and environmental ministries lack a deep understanding of the dynamics of energy efficiency policy and the root drivers of energy demand. It helps integrate energy efficiency into national power development and integrated resource plans, enabling targets and strategies for low emissions development strategies (LEDS), and implementation of Nationally Determined Contributions (NDCs).[19]

Energy Efficiency Policy Prioritization and Road Mapping

Policy prioritization refers to the selection, resource allocation, and time-ordering of specific policy actions to reduce energy demand according to existing national targets. While energy demand is often forecast according to macroeconomic trends (e.g., population and GDP), development of effective policies requires a more detailed picture that includes use patterns in households, services, industry, and transport as well as growth trends in specific energy end uses (e.g., air conditioners and electric vehicles). A meaningful model of energy use is based on detailed base year data and projects energy consumption, related emissions, and peak electricity demand. Once these are in place, sensible plans or roadmaps can be developed detailing how the energy efficiency policies listed above can contribute to national goals. Technical assistance in this area involves providing modeling expertise to develop the aforementioned results, but more importantly builds local capacity within the appropriate ministries to continue this work and also helps communicate the value of energy efficiency policy to political leaders.

TECHNICAL ASSISTANCE TOOLKIT

Technical assistance objectives for energy efficiency policy prioritization and road mapping build modeling and planning capacity in order to bring energy efficiency together with planning. They should include:

- ***Bottom-Up Energy Demand Forecasting*** – Comprehensive and detailed models of energy consumption by sector and end use, with projections of growth according to economic and technological trends.
- ***Planning Department Capacity Building*** – Training of planning staff on the incorporation of bottom-up modeling and integration of energy efficiency policy planning into national planning strategies.
- ***National Plan Roadmapping*** – Adaptation of policy prioritization into actions and timelines by specific government entities according to well-specified targets.

[19] NDCs are specific post-2010 actions to reduce greenhouse gas mitigation in advance of signing the 2015 Paris Climate Accord.

Energy Efficiency Utility Resource Planning

Energy efficiency can represent a particular opportunity for regulated and/or public energy utilities. In this context, energy efficiency programs can be seen as sources of benefit in three distinct areas: 1) reduction of energy input costs, 2) leveling of loads to better match demand with supply, and 3) meeting the requirements of energy savings targets or renewable energy portfolio goals. Several steps are necessary in order to optimize efforts and ensure capture of this resource. First, the savings potential and resulting avoided energy costs must be broadly evaluated. Next, specific energy efficiency measures and cost-effectiveness of implementation must be evaluated. Finally, a plan for implementation must be developed and followed, and impacts must be measured through robust evaluation protocols.[20] Each of these steps is an appropriate subject for technical assistance, especially in situations in which utilities are unaccustomed to promoting energy efficiency.

TECHNICAL ASSISTANCE TOOLKIT

Energy Efficiency Utility Resource Planning should include:

- ***Utility Perspective Energy Efficiency Cost-Benefit Analysis*** – Expansion/modification of traditional consumer-focused analysis to include avoided capital costs, renewable resource availability, and time-dependent cost of production.
- ***Program Design*** – Identification and rank ordering of most high-impact and lowest cost energy efficiency programs from the utility financial perspective.
- ***Awareness Raising / Stakeholder Outreach*** – Training on concepts of energy efficiency programs as a utility financial tool and program design best practices

[20] Details of these steps may be found in NAPEE 2007.

IV. ENSURING SUCCESS

As noted above, despite the benefits to developing countries that energy efficiency policies provide, these policies are perceived to be complex and difficult to implement. While this perception can be moderated, it is true that multiple policies with distinct stakeholders are required to fully capture benefits. Regulations in particular require detailed, deliberate, and transparent processes for each separate technology or sector. For these reasons, technical assistance is most effective when it clearly identifies key barriers in each specific case, and provides tools for governments to lower them. While in developed countries, governments have the resources to pay for consultants to analyze all of the details about energy efficiency regulations,[21] internal resources are often scarce or absent for developing country governments. The basic elements of technical assistance increase understanding of methodologies for data collection and analysis applied to specific questions needed by a program or policy (e.g., cost-benefit analysis).

To fill this need, international organizations and donors have provided guides and technical aids to give step-by-step instructions to developing country governments.[22] While these technical resources are indispensable, there is no one-size-fits-all approach to implementing good policy, as each country has unique priorities and limitations given its: 1) climate, 2) level of development and domestic industry, 3) trade patterns, and 4) national priorities and political landscape.

COMMUNICATE BENEFITS EFFECTIVELY

An important role for technical assistance exists in raising awareness about the benefits of policy implementation and the need for robust technical analysis to support them. While the case for energy efficiency policy seems clear enough, the devil is in the details, and while national political leaders of large developing countries usually have some understanding of the main energy efficiency policies, they may not see them as core to government's mission and broader national goals such as energy security and climate mitigation. At the level of states and cities, the awareness of these policies drops significantly, as it does in small and very low-income countries. International development aid often focuses on training and workshops, which raises awareness, but can fall short of guaranteeing sustainability. Progress is generally made only when there is complete and widespread buy-in about policies and dedicated staff in ministries to implement and enforce them. A main way of thinking about the benefits of energy efficiency is in terms of the cost of energy inputs and climate mitigation goals as defined by NDCs. At the highest level of government and within energy ministries, however, climate change mitigation may not be the highest priority. Instead, developing country governments may be most concerned about economic development, poverty alleviation, energy security, trade relations, air pollution, etc. Energy efficiency's role in these areas is often not well-understood by finance, industry, economy, foreign affairs, and trade agencies who may play an important role in providing political support and resources, for example.[23] Some of the most effective messages linking energy efficiency to non-climate priorities are:

- ***Economic Development*** – Cost-effective energy efficiency measures provide a positive return on investment in the form of energy bill savings. More broadly, however, energy cost reductions shift spending to more productive sectors like services and durable goods, and may enhance access to energy services in low-income communities.

[21] In the U.S., a major portion of this function is served by its national laboratory system.

[22] An early and outstanding example of this is CLASP's Guidebook (CLASP 2005).

[23] A concise way of looking at the various interrelated benefits of energy efficiency was provided by IEA (IEA 2014). In this picture, all of the positive outcomes of energy efficiency policy are considered, and the emphasis is tailored to audiences that may have the authority and political power to act.

- ***Job Creation*** – It is increasingly understood in the international community that investment in energy efficiency, either through manufacturing of high-performance equipment or through construction projects like building retrofits, create jobs at a high rate, especially compared to other capital-intensive energy sector investments.
- ***Energy Security*** – In many cases, the reduction of energy demand translates directly into increased resilience and independence from volatile international trade relationships.[24] These issues may be the highest priority by political leadership.
- ***Reduced Need for Capital*** – Most developing countries will require large capital investment in the energy sector in order to meet growing demand. Mitigation of these expenses, including debt servicing, may be the most valuable payoff of energy efficiency.
- ***Net Subsidy Reduction*** – In countries that subsidize energy, government investment in energy efficiency may provide a net benefit to government coffers and support more politically attractive goals such as reducing burdens on taxpayers and shifting investment to social programs.

DESIGN INTEGRATED PROGRAMS

Integrated Policy Planning refers to the design of a set of policy tools with the long-term goal of reaching mass adoption of a high-efficiency technology. Examples of disruptive energy efficiency technologies are LED lamps, variable speed (inverter) air conditioners, or heat pump water heaters, etc. These are technologies that are available in most markets, have very high efficiency compared to the baseline (e.g., 50 percent improvement or more), and generally are significantly more expensive than baseline equipment, creating a barrier to mass adoption.

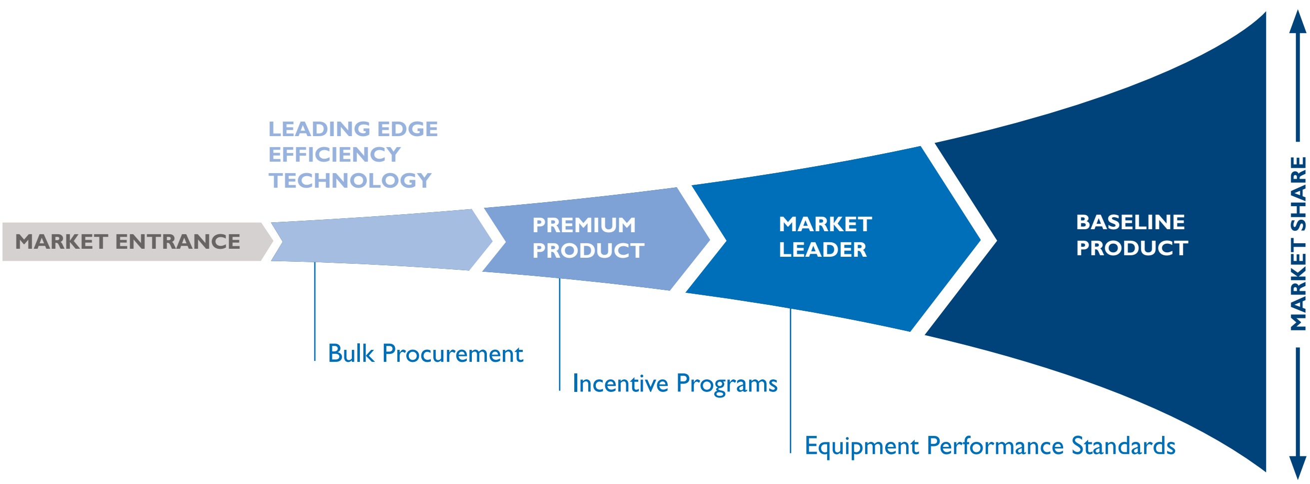


FIGURE 8: BUILDING BLOCKS WORK TOGETHER TO TRANSFORM MARKETS FOR ENERGY EFFICIENCY

The *Integrated Policy Planning* approach can be illustrated with an example from energy-efficiency equipment, but is generally applicable to other efficiency technologies (Figure 8). In each step, production goes up, costs go down, and cost-effectiveness increases.

Research, Development, and Deployment Phase – This phase results in *technology readiness,* which is often described as the end point of government-sponsored programs to boost an industry. Technology readiness means that products are beyond prototype and ready for commercialization and mass production. Energy efficiency policy begins where this phase ends, targeting products that have a small but non-negligible market, or are widely available in other economies. These can be niche products that don't have a wide appeal due to their high cost.

[24] A lack of local resources and energy independence is often cited as one of the drivers of Japan's highly energy efficient economy.

Hi-Tech Phase – In this phase, the product is commercialized but not mainstreamed. The market is limited to high-income "first-adopters" who voluntarily pay a premium because of environmental consciousness, status, or other considerations. Purchase of these technologies does not necessarily pay off in terms of energy bill savings at this stage, but in many cases the technology is recognized as the "wave of the future." Consumer awareness of these products can be raised through awards and other recognition programs.

Premium Product Phase – In this phase, the technology enjoys significant, but moderate market shares. Technologies in this phase often exist in a two-tier market. Examples of this are Energy Star products in the United States, and inverter air conditioners throughout the world. High-efficiency products at this stage are marketed as higher-quality products and are purchased typically by higher-income consumers. The investment in energy efficiency may or may not pay off over the life of the product. Products in this phase are good candidates for incentives and endorsement labeling.

Mass Adoption – In the final phase, the technology reaches 100 percent or near-100 percent market penetration, often as a result of a minimum energy performance standard. This condition usually requires cost effectiveness, industry capability for mass production, and broad consumer acceptance. Economies of scale are maximized at this stage and the price drops, in some cases to the pre-regulation baseline.

In general, the innovation process is cyclical. As in all industries, the manufacturers of energy-consuming products are constantly seeking ways in which to differentiate between their competitors and/or between product lines. For this reason, it is common that once a certain technology reaches high market share, they will introduce newer, better, and more expensive models.[25]

SET GOALS AND INTEGRATE ENERGY EFFICIENCY IN NATIONAL PLANS

Increasingly, developing country governments are setting forth long-term national goals related to energy efficiency. Most obviously, the Paris Climate Accord process requires each country to make greenhouse gas mitigation commitments. Fulfillment of these commitments is supported by a national climate change plan, often implemented by the Ministry of the Environment. Energy Ministries also have a key role in the implementation of these plans, and may have their own separate plans around energy security, increased penetration of renewable energy sources, or energy efficiency itself. In order to maximize and sustain political will to take action and spend required resources on energy efficiency, technical assistance should strongly link its activities to already stated national goals, including through modeling and analysis of program impacts (see Policy Planning above). In doing so, technical assistance can address long-term strategic goals of increasing the awareness and priority of energy efficiency as a tool for achieving development goals. Goals should be quantified in terms of well-defined metrics. Furthermore, these should include both short- and long- time periods due to the nature of policies like regulations for equipment production and building construction that are implemented once but continue to have growing cumulative effects long into the future. Like any program, support for energy efficiency benefits from rigorous monitoring and evaluation. Specific metrics to measure progress are:

- ***Energy Savings and Emissions Mitigation*** – Projected savings from the program, which generally continues well into the future. For example, a minimum energy performance standard on appliances can reduce electricity consumption of products sold a decade or more after standard implementation, relative to business-as-usual. Energy savings is measured in terawatt-hours (electricity) or gigajoules (fuel). Megatons of carbon dioxide emissions mitigated are generally related directly to avoided energy use through constant or time-dependent factors.

[25] Of course, energy efficiency is not the only feature considered, and differentiation is often through other high-tech or "luxury" product features.

- ***Financial Benefits*** – Like energy savings, financial returns on energy efficiency investments continue well into the future. Several distinct financial flows over the full time horizon should be considered: 1) energy bill savings, 2) net financial flows to manufacturers and builders, 3) utility financial flows, and 4) net subsidy flows.
- ***Development Impacts*** – A wide range of positive impacts on development are provided by energy efficiency. Analysis and reporting of these should be tailored by specific country contexts and priorities. Some examples include job creation, net GDP impacts, air pollution alleviation, and increased access to energy services.
- ***Increased Technical Capacity*** – In addition to training government staff on specific tools and analysis methods, bolstering the long-term capacity of institutions inside and outside of government ensures sustainable and effective actions around energy efficiency.

V. REFERENCES

1. Meyers, S., A. Williams, P. Chan, and S. Price. "Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted from 1987 through 2015." LBNL-1004328. (2016).
2. Steven Nadel, Neal Ellliot and Therese Langer. "Energy Efficiency in the United States - 35 Years and Counting. American Council for an Energy Efficiency Economy. (2015).
3. Alliance to Save Energy. "The History of Energy Efficiency," (2013). .
4. National Academy of Sciences. "Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000." (2001).
5. International Energy Agency. "Energy Efficient Prosperity: The "first fuel" of economic development." (2016).
6. National Action Plan for Energy Efficiency Leadership Group. "Guide to Resource Planning with Energy Efficiency." (2007).
7. Collaborative Labeling and Appliance Standards Program. "CLASP Standards and Labeling Guidebook, Second Edition." (2005).
8. International Energy Agency. "Capturing the Multiple Benefits of Energy Efficiency." (2015).
9. McNeil, M.A., V. Letschert, S.A. de la Rue du Can, P. Kalavese, N. Bojda, M. Zhou, N. Kearny, A. Carreño, and J. Corry. "SEAD Member Economy Recent Achievements: Projected Savings from Energy Performance Standards since 2010." (2016).

U.S. Agency for International Development

1300 Pennsylvania Avenue, NW
Washington, DC 20523

Tel. 202–712–0000
Fax. 202–216–3524
www.usaid.gov