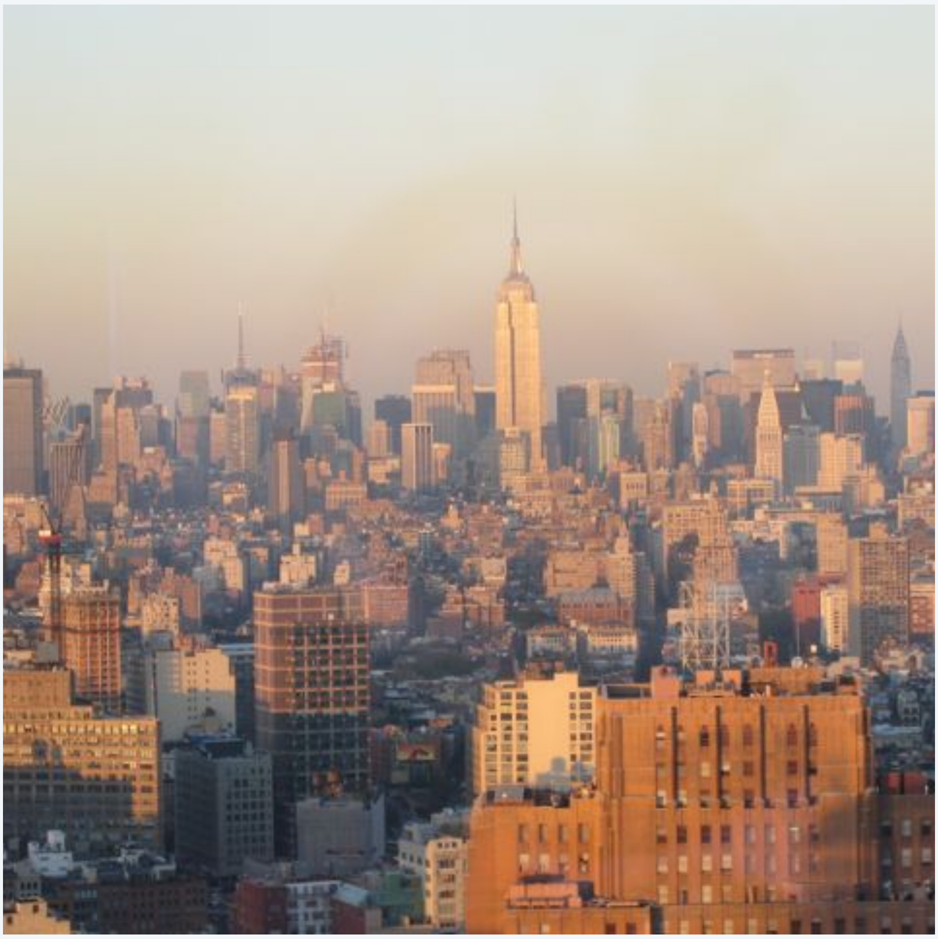
GBPN
Global Buildings Performance Network

Building Policies for a Better World

Executive Summaries

BUILDING ENERGY EFFICIENCY: BEST PRACTICE POLICIES AND POLICY PACKAGES

October 2012



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FOREWORD

The Global Buildings Performance Network was established to support the building sector in achieving significant reductions in greenhouse gas emissions associated with building energy use. By working closely with our hubs and partners in the USA, EU, China and India we harvest best practices in building energy policy and share them globally. The first task for GBPN in pursuing this mission is therefore to define what we mean by 'best-practice' policies.

To help address this question we commissioned this research led by Professor Mark Levine at Lawrence Berkeley National Labs, to investigate building energy policies that have been implemented in our four focus regions and to determine those that have been most effectively delivering energy savings and reducing GHG emissions. As this report reminds us, the building sector provides the greatest cost-effective mitigation potential compared with other industries, and has therefore been an increasing priority for policy makers in tackling climate change. It also provides an important insight into the features of policy regimes that have been qualitatively influential and, where data was available, those that have made a quantitative impact on reducing GHG emissions from the built environment.

The review of policies being implemented in China, the EU, India and the US presented in this report has also identified some key challenges that we must address if we are going to realize the mitigation potential of the building sector. Chief among these is the need to improve our monitoring of the impact that our policies are having. Lack of measured and verifiable data on the influence of policies on building energy performance currently hampers our ability to assess and continuously improve their effectiveness. Development of energy performance requirements for existing building renovation is also necessary.

The report also shows that despite effective 'best-practice' policies being implemented in each region, we are yet to achieve a mainstream adoption. Today's best-practice policies are also not necessarily ambitious enough in setting energy performance targets necessary to reduce energy demands and associated GHG emissions at the rate and magnitude necessary to reduce our sector's overall impact on climate change.

However, this review of best practices yields important recommendations for change. Our building energy policies should encourage integrated building design, and they should be combined into packages of regulations, incentives, labels and voluntary schemes that encourage the market to achieve beyond minimum performance standards. Finally, there is a clear need for continued documentation and sharing of policy experiences globally – a role for which GBPN was established. It is with this intention that I commend this report to you.

Dr. Peter Graham, GBPN Executive Director

Paris, October 2013

EXECUTIVE SUMMARY

This report addresses the single largest source of greenhouse gas emissions and the greatest opportunity to reduce these emissions. Fully 35% to 40% of all energy-related CO2 emissions result from energy use in buildings. Emissions reductions from a combination of energy efficiency and conservation (using less energy) in buildings have the potential to cut emissions more than all other energy-using sectors combined. In short, buildings constitute the largest opportunity to mitigate climate change.

At the same time, the buildings sector has been particularly resistant to achieving this potential. Technology in other sectors has advanced more rapidly than in buildings. In the recent past, automobile companies have made large investments are made in designing, engineering, and marketing energy efficient and alternative fuel vehicles that reduce greenhouse gas emissions. Energy price increases, the likelihood of their continuing, and the recognition that climate change will drive them even higher over time has caused industry to make large investments in energy efficient equipment and processes. At the same time, the buildings sector – dependent on millions and millions of decisions by consumers and homeowners – face a large variety of market barriers that cause very substantial underinvestment in energy efficiency.

How can the trajectory of energy use in buildings be changed to reduce the associated CO2 emissions? Is it possible to greatly accelerate this change? The answer to these questions depends on policy, technology, and behavior. Can policies be crafted and implemented to drive the trajectory down? Can the use of existing energy efficiency technologies be increased greatly and new technologies developed and brought to market? And what is the role of behavior in reducing or increasing energy use in buildings?

These are the three overarching issues. The information assembled in this study and the knowledge derived from it needs to be brought bear on these three questions. And thus we turn to some of the insights from the study, presented in the form of findings and recommendation.

1. Findings: Policy

1.1. Building Energy Standards

Building energy standards are ubiquitous in the United States, the European Union, and China. They are the most potent of all policies in reducing energy use from heating and cooling of buildings. Almost all of the standards thus far promulgated in three regions have been cost-effective. There is a long (multi-decade) tradition of building standards in all of the regions. This is especially true of the north of Europe with extreme cold weather and countries wealthy enough to invest in energy efficiency.

To date, most standards have been applied only to new buildings. The problem of high energy use of existing buildings – of great importance in the two regions (the United States and the E.U.) in which the building stock is growing slowly – has not been well addressed and standards have played little role. There is increasing activity in applying standards at point of sale.

The most important issues in making standards more effective are (1) increased training (of code officials, builders, and other building professionals) and (2) the rigorous updating of the standards to promote the development and use of new, efficient technology (3) announcing code early on so that the industry can prepare for more stringent code (4) demonstrate the feasibility of constructing more efficient building that are cost effective manner.

1.2. Building Energy Labels

Whole building energy labels have been particularly effective in three ways. They provide the necessary knowledge to the building owner or occupant to motivate decisions to invest in energy efficiency (for buildings receiving low ratings). Some of the labels recommend measures for reducing energy use (e.g., the EU). This effectiveness of this application of labels is strongly dependent on consumers' view of their trustworthiness.

A second application of labels is to provide information about the building energy-efficiency or energy use at the point of transaction (e.g., as required for example by France). The premise is that such knowledge is likely to be useful and used when the building is sold or rented.

The third use of labels is in our judgment the most important. The combination of standards (setting a floor on efficiency or energy use), a label (serving as a measuring stick), and incentives for performance or building characteristics better than the standards) is an extremely powerful means of increasing energy efficiency. If all three policies are well integrated with each other (e.g., California), they can drive efficiency aggressively and over a long period of time. The incentive and labeling policies will promote state of the art energy efficiency on which updates to standards can be based. This is an effective as a policy design for new buildings but also can be applied to retrofits of existing buildings.

1.3. Building Energy Financial Incentives

The fundamental issue of incentive programs is how to maintain funding, particularly if the funds come from governments. There are many innovative approaches to the problem that have potential for success. There are at least two approaches that have been successful on a large scale: utility DSM in the United States (funds from ratepayers who in turn are the beneficiaries of the incentives) and in Germany (the KfW program where the increased taxes resulting from the program cover the for the costs of the administering the program plus the cost of the incentives}.

As noted in section 8.3, combining incentives with labels and standards produces a particularly effective means of reducing energy use in buildings as well as encouraging the development and use of advanced energy-efficiency technologies.

1.4. Building Energy Policy Packages

The packages discussed in section 1.2 (labels), combining incentives with labels and standards produces a particularly effective means of reducing energy use in buildings as well as encouraging the development and use of advanced energy-efficiency technologies. California is the prime example of the strong synergy among the three policies but there are other examples (described in the case studies). Packaging the three policies together can be implemented in many different configurations (levels of standards and incentives; ways of expressing ratings; agent responsible for implementation; form and identify of beneficiary of the incentive' etc).

2. Findings: Technology

2.1 Opportunities with Existing Technologies and Systems

The biggest opportunity for saving energy with existing technologies is for them to be purchased and utilized. The existence of many underutilized energy efficiency technologies and the associated market barriers that cause this underutilization provides a strong justification for designing and implementing governmental policies.

Systems rather than technologies offer the greatest promise of energy savings. They typically underperform and in the process use excessive amounts of energy. This is particularly the case for space conditioning systems in large buildings. Thus, improving system performance has large potential for energy saving in the near time.

For those developing countries with large numbers of poor people in cold regions, the single most important means for reducing CO_2 emissions heating (for cooking and water heating in all climates) is the replacement of inefficient biomass and/or coal burning stoves with modern fuels and equipment.

2.2 Creating Future Technologies

In spite of the plethora of underutilized technology today, R&D is needed to achieve technologies and systems with lower costs or better performance. There are numerous R&D opportunities to achieve these goals.

Current R&D programs unfortunately give very little emphasis to systems as distinct from technologies. Passive solar houses, with a combination of many technologies, illustrate the importance of systems in reducing energy use. Integrated design (see endnote[i]) is arguably the most important system (in reality, a "system of systems) for designing large buildings with very low energy use.

Thus R&D needs to focus much more strongly than it does today on designing, creating, testing, and producing techniques to assure effective performance of systems.

3. Findings: Behavior, Comfort Preferences, and the Operation of Buildings

A body of research going back to the 1970's has shown that large variations in energy use per square meter (by factors of 3 or higher) are often found for the similar buildings in the same climate. This research demonstrated that effect of behavior on energy use in buildings can be greater than that of technology.

This fact is poorly known or understood by policy makers (and many others). A miniscule portion of research on energy efficiency addresses behavior, the largest source of variation in energy use in buildings.

4. Policy Research Needs

There is a need for experimentation, demonstrations, policy research, data and/or analysis on:

- Impacts of policies on heating and cooling energy use and costs (treated broadly[1]) based on quantitative and reproducible research
- The effects of behavior on energy use in buildings and policies that encourage energy-conserving behavior
- Well-documented costs and energy savings of buildings with very low heating and cooling energy
- Quantitative effects of employing multiple policies (policy packages) to reduce building energy use
- Transferring policy experience on building energy efficiency policies in actionable forms to developing countries
- Effective methods to communicate information not widely known or understood to policy makers and the public

5. Recommendations

The third paragraph of this chapter posed several questions of highest importance to this enquiry.

> *How can the trajectory of energy use in buildings be changed to reduce the associated CO2 emissions? Is it possible to greatly accelerate this change? The answer to these questions depends on policy, technology, and behavior. Can policies be crafted and implemented to drive the trajectory down? Can the use of existing energy efficiency technologies be increased greatly and new technologies developed and brought to market? And what is the role of behavior in reducing or increasing energy use in buildings?*

1 Includes costs to consumers, energy suppliers, builders, the environment, etc.

The recommendations below taken together are intended to address these questions.

To increase the effectiveness and energy savings of building energy standards, we recommend that governmental organizations with authority over energy use in buildings should

- As a matter of highest priority create (if they do not already exist) or strengthen the energy standards and their enforcement in measureable ways.
- Regularly update the standards as new technology or practices are demonstrated to cost-effectively save energy for space conditioning in buildings
- Provide sufficient advance notice of the specifics and timing of the updates so that industry can prepare for the updates
- Assure that demonstrations of improved practices and advanced systems and technology take place frequently and of sufficient quality to support standards updates

To increase effectiveness of labels, organizations responsible for them should

- Assure that they are designed and promulgated to be easy to use
- Are as consistent with actual energy use or efficiency of the building to which it is applied
- Are communicated to consumers, builders, and other building professionals in a manner to assure their trustworthiness

The most important action to enable financial incentives to have large and sustaining impacts, methods need to be developed that are suitable for their institutional environment to assure that the incentive programs are long-lasting at levels that are not reduced over time.

Packages of policies, particularly different configurations of standards, labels and financial incentives,[2] should be implemented whenever possible.

Much greater emphasis is needed on research, development and demonstration of systems (as distinct from technologies), systems of systems (e.g., integrated design), and effects of behavior on energy use for heating and cooling of buildings.

Increased support should be provided for policy research, with particular emphasis on research whose results are reproducible and can be used for buildings in many locations to increase energy savings. Areas that should receive increased attention and funding include quantitative assessment of impacts and costs of policies; effects of behavior on heating and cooling energy use; means to achieve very low energy use in buildings; effects of packages of standards, labels, and incentives; and means of supporting developing countries in reducing energy use in buildings while not reducing amenity of building occupants.

[2] and potentially combined with popular and enduring social policies

Endnotes:
Explanation of Integrated Design

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[i] The integrated design process may be defined as one in which the design variables that interact with one another are treated together (i.e., iteratively), producing a design that comes close to achieving the objectives established for the design ("optimal"). The sequence of steps that is typically followed today often leads to solutions that are far from optimal. For example, HVAC capacity and equipment are often decided before the major contributors to the internal loads of a building are known.

Significant interactions take place among all design elements of a building affect heating and cooling loads (e.g., window size, placement, and thermal characteristics; window shading types and placement; lighting locations, efficacy and local controls; building orientation; number and wattage of plug loads; and the volume of outside air that is circulated into a building).

Advanced technology options (e.g., on- site generation, passive ventilation, thermal mass with night ventilation, chilled ceiling displacement ventilation, dehumidification and day-lighting) need to be taken into consideration. Control strategies and operating conditions of the equipment in the building strongly affect the effectiveness of the design and technology choices for the building.

Finally, all of these complex design and engineering issues must themselves be integrated with decisions on structural issues, space planning, site context, materials selection and other issues, all within the context of tight budgets and schedules.

To address these interactions among the different components of a building, integrated design and operation requires cooperation among the major decision makers in a building project—architects, engineers, and builders—to evaluate the projected energy consumption for a variety of designs. Building professionals must also enjoy a comfort level in using results of computer tools to underpin important design decisions. Software that is understandable to everyone involved is needed, so that the group's collective knowledge is codified and used as different problems and solutions are addressed in the design, construction, and eventually the operation of the building.

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About GBPN

The Global Buildings Performance Network (GBPN) is a globally organised and regionally focused network whose mission is to advance best practice policies that can significantly reduce energy consumption and associated CO_2 emissions from buildings.