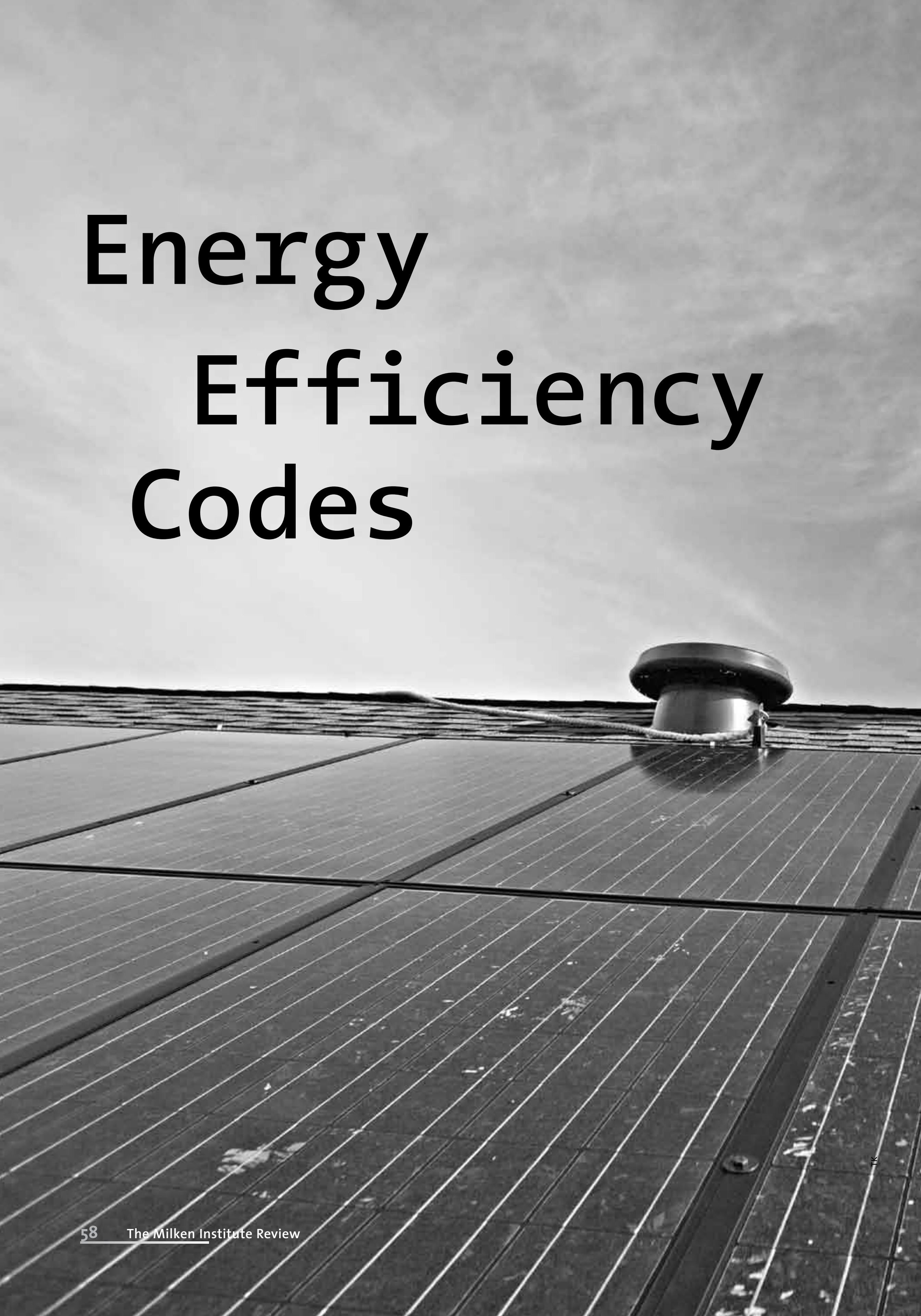
Energy Efficiency Codes



Plan B for Climate Change?

BY MATTHEW J. KOTCHEN

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Even as governments and entrepreneurs scramble to find sources of energy that are both climate friendly and secure, it's worth remembering that one major source of green energy is conservation. And much of the low-hanging fruit in curbing the waste of fossil fuels can be found in buildings, which account for 40 percent of U.S. energy consumption and a whopping 73 percent of electricity use.

This is hardly a secret. Federal and state governments already encourage building efficiency with a host of programs ranging from appliance standards to tax incentives to mandated utility rebates. But the policy levers with more potential to influence energy efficiency in new and renovated structures are building codes. Most states long ago added energy efficiency provisions to these codes. And in my view, Washington would do well to consider national building standards as interim measures to bridge the gap to a more comprehensive, market-based approach to curtailing greenhouse emissions.

That said, it makes sense to consider what we know – and don't know – about building codes and energy efficiency. Is there hard evidence that energy codes save energy and, if so, at what cost? Are there lessons here for those seeking to toughen energy codes in the near future?

WHERE WE STAND NOW

Building codes have been around since the mid-19th century, with provisions largely aimed at ensuring health and safety. Energy efficiency entered the picture only in the early 1970s, in the wake of the Arab oil embargo. Spurred by federal incentives, 31 states adopted energy codes for structures by 1980. All the others – with the exceptions of Alabama, Missouri, Mississippi, North Dakota and Wyoming – eventually followed suit.

But the state codes vary greatly. The nonprofit American Council for an Energy-Efficient Economy ranks them for stringency on a scale of one to five. Stringency does not tell the whole story, though, since their actual impact also turns on efforts to enforce compliance – hence the importance of the ACEEE's "compliance effort" scores, which are based on a survey of professionals. Some states with stringent codes – notably California and Massachusetts – also have high compliance effort scores, but the two don't always go together. (Indeed, it is hard to know what to make of the eight states with the highest scores on stringency and virtually no follow-through on enforcement.)

The energy codes themselves often combine prescriptive requirements with performance-based rules. These requirements mandate that buildings meet a particular specification – say the "R-value" of the insulation. The newer, increasingly common, performance-based approach sets minimum efficiency goals without dictating the way they are achieved.

With performance rules, construction specifications are compared with a model structure that establishes the minimum standard, sometimes referred to as an "energy budget." While some components of new construction may be less efficient than the model – say, because windows are double-

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glazed rather than triple-glazed – the overall efficiency rating (based on points for different components) must meet a minimum standard. In other words, new construction must stay within an energy budget. So the specs of the model structure determine the stringency of an energy code without dictating the technology used to get there.

It follows that one way for the federal government to increase energy efficiency is to mandate tougher state codes. And though Congress has shelved proposals for an ambitious, market-based energy/climate policy, energy codes were at the heart of two bills that received serious consideration in 2010 and are likely to shape the terms of debate in the future.

The Waxman-Markey cap-and-trade bill, which passed the House while the Democrats still held a majority of seats, would have required all states to enact building energy codes by 2014 that were 30 percent more

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stringent than a 2006 benchmark; in the three following years, the codes would have been toughened enough to beat the 2006 standard by 50 percent. Thereafter, the bill called for a 5 percent increase every three years until 2029. Its Senate counterpart (the Boxer-Kerry bill) was less explicit, calling only for the Department of Energy to promulgate energy-code targets by 2014, while also including provisions for state adoption of a national building code standard.

THE ECONOMIC RATIONALE

For old-school environmentalists, government mandates for conservation need no justification. But for economists, "command-and-control" regulation is a tougher sell. If energy conservation is worthwhile, they ask, why aren't market forces alone sufficient to generate the optimal level of conservation?

One reason that markets can fail to equate cost with value is the presence of "externalities" – circumstances in which some of the costs and benefits generated by a transaction are experienced by third parties. Where the externalities are positive – say, if I shovel the snow on the sidewalk in front of my house, thereby making it safer for you to walk, too – free market incentives are apt to produce too little of the activity. If the externalities are negative – say, when I play loud music on my porch at midnight – "markets" produce too much. And there is no behavior more commonly associated with negative externalities than energy consumption, as energy use typically generates pollution of one form or another that is harmful to human health and the environment. Hence, the economic rationale for regulation – provided, that is, the benefits of the intervention exceed the costs.

But quantifying the impact of pollution is not straightforward, as the harm is rarely observable directly. Economists have still managed by focusing on how pollution affects other market behavior. A partial estimate of the cost of air pollution, for example, can be

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derived by looking at the statistical relationship between pollution levels and health-care expenditures between localities.

Using this approach, Grant Jacobsen of the University of Oregon and I estimated that electricity use by a typical Florida household imposed an external health cost on society in the form of pollution of somewhere between $14 and $85 per year. And that, at least in principle, justifies building codes designed to promote energy efficiency.

A separate justification for intervention is linked to findings in behavioral economics, a rather new field that uses psychology to explain seemingly irrational economic behavior. Investments in energy efficiency usually require upfront outlays to save money in the future – sometimes far in the future. And anyone who has been on a diet knows how difficult such decisions can be. The fact is, most people have a tough time making decisions that involve costs now (the pain of eating less) for future benefits (the pleasure of looking better and living longer). But when the future eventually becomes the present, people often regret their failure to delay gratification.

In the context of energy efficiency, the failure to take proper account of future benefits often leads home buyers (or housing developers responding to what they perceive as buyers' preferences) to decline the option of spending the extra money for, say, additional insulation or a more efficient air-conditioning system, in spite of the fact that the return to the investment in terms of lower utility bills is very high. Of course, not all energy efficiency investments justify the costs. But proponents of tougher energy codes argue that plenty of high-return opportunities are neglected in building construction.

Moreover, even where consumers are willing to invest now to save later on utility bills, they often lack the necessary information to make an informed decision. Research by Shahzeen Attari of Columbia, along with Michael DeKay, Cliff Davidson and Wändi Bruine de Bruin of Carnegie Mellon, suggests that ignorance is greatest where information would make the biggest difference. For example, people are better at evaluating the energy savings associated with small changes like choosing a light bulb than about more significant choices like purchasing a central air conditioning system. And while the evidence is skimpy, it's not a big leap to assume that people know far less – if anything at all – about the ways esoteric building specifications affect energy efficiency.

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Buildings are quite similar to cars and appliances in the sense that most people buy them infrequently, and thus must rely on expert analysis to make sensible choices. After all, you can't tell much about the fuel efficiency of a car by kicking the tires or taking a test drive. And the cost of doing the research yourself is high, at least compared with the cost to the manufacturer. That's why fuel efficiency labeling – the so-called Monroney stickers on the windows of new cars and the yellow tags on new appliances – is easily justified in purely economic terms.

While buildings could be labeled in similar ways, the idea has not taken hold. Instead, we have chosen to mandate standards for energy efficiency (along with health and safety) as a way to compensate for the market failure linked to incomplete information when people purchase or rent buildings.

DO ENERGY CODES WORK?

Given the widespread use of energy codes in the United States, and proposals to increase their stringency, one might assume there is plenty of evidence to show that they do save energy – and in ways that generate more benefits than costs. But surprisingly little is actually known about the relationship between energy codes and energy consumption.

The evidence that does exist comes primarily from engineering simulations. While the engineering approach is useful, it has limitations. The economist Paul Joskow, the president of the Sloan Foundation, argues that such studies "are not very meaningful because they don't even purport to measure actual behavior and performance of real institutions."

Joskow's critique is sound. For one thing, changes in energy codes may not affect building practices if the codes are not enforced or if they are not stringent enough to mandate changes in the way that things are actually done. To the point, Adam Jaffe of Brandeis and Robert Stavins of Harvard found that energy codes for insulation had no net effect on construction practices. But even when codes are apparently tough enough to make a difference, engineering simulations may overestimate the energy savings because they take no account of responses that tend to offset them. It shouldn't, for example, be surprising that since improvements in energy efficiency decrease the effective cost of consumption – think of the cases of cars and air-conditioning – they create a rebound effect in which people drive more or set their thermostats to lower temperatures.

Finally, if the engineering assumptions are not accurate, realized savings will differ from predictions – sometimes wildly – even without a behavioral rebound. One study on attic insulation by Gilbert Metcalf of Tufts and Kevin Hassett of the American Enterprise Institute found that actual energy savings were less than one-fifth the predicted savings!


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Hence, the importance of two recent analyses that tested energy-code effectiveness by measuring energy consumption.

In the first, researchers at the University of California (Berkeley) used state data from 1970 through 2006 to test the impact of building codes on residential electricity use. Controlling for the effect of energy prices, household income and weather, they found that when a state adopts a building energy code during a period of substantial construction activity, electricity consumption falls significantly. Overall savings amounted to 3 to 5 percent in 2006. What's more, the measured effect is, indeed, larger in states with more stringent codes and better enforcement, as measured by the aforementioned ratings by the American Council for an Energy-Efficient Economy.

In the other study, Grant Jacobsen and I used monthly billing data for electricity and natural gas to assay the impact of a specific change to Florida's building code on energy use by households. Our data from the city of Gainesville compared 1,293 homes built in the three years before the energy-code change with 946 homes built in the three years after the change.

Controlling for other relevant variables such as floor area, we found that houses built after the code change consumed 4 percent less electricity and 6 percent less natural gas. Moreover, as we expected, the results showed reduced consumption of electricity (for air-conditioning) in the summer and reduced consumption of gas (for heating) in the winter. Our estimates, incidentally, were comparable to those derived from engineering simulations.

DO ENERGY CODES PAY?

The fact that energy codes do, in fact, reduce energy consumption does not necessarily mean they also increase economic efficiency. Compliance with stricter codes is costly and is thus efficient in economic terms only if the benefits (to the utility bill payers and pollution sufferers) exceed the costs.

Fortunately, this calculation is relatively straightforward for our study in Gainesville. An especially important part of the energy-code change in Florida was the requirement to use low-emissive ("low-E") windows, which reduce the amount of solar heat penetrating the glass. We found that the resulting savings on electricity and natural gas paid back the investment in 6-10 years – an impressive return by any rational standard.

But this payback calculation does not account for the social benefits of reduced pollution emissions because less electricity and natural gas is consumed. Using the high estimate of avoided pollution damages ($85), the payback period shrinks to just 3.5 years.

Another way to test the impact of energy codes is to see whether the associated investments are capitalized in property values. Our research in Gainesville did not employ this approach, but there is evidence from other studies that energy efficiency is capitalized in the value of commercial real estate. A recent paper in the *American Economic Review* found that "green-certified" commercial buildings commanded substantially higher rents and selling prices than non-certified buildings. Controlling for other structural and location characteristics, office space in green-certified buildings rents for a premium of 3 percent. And after adjusting for higher average occupancy rates in green buildings, the effective rental premium is closer to 6 percent. Green certification raised the market value of buildings by roughly the same percentage.

WHAT'S IT ALL MEAN?

Generalizing from the evidence of savings in one city can be problematic. But the fact that

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the numbers come from Florida is reassuring. For one thing, the state falls near the middle of the pack with respect to both the stringency of its energy code and the compliance effort. For another, one-fifth of all U.S. residences cope with roughly the same climate as Gainesville, suggesting that the research results should apply to a broad swath of the country, including much of the South and Southwest.

It's important, though, not to lose sight of the reality that energy codes are at best a supplement to a comprehensive approach to reducing energy use and carbon emissions. Economic theory (and considerable experience) suggests that market-based mechanisms like cap-and-trade systems are likely to be more efficient than mandated conservation because they allow consumers and producers to exploit a much broader range of possibilities for emissions reductions – including, in particular, switching away from coal in the power sector.

But for the moment anyway, market-

friendly fixes are off the table. And in this political climate, energy codes offer a palatable, cost-effective way to move forward. Moreover, even if Washington sees the light on pricing energy to reflect its societal costs, building codes may still be a worthwhile component of national energy policy. Indeed, the evidence suggests that simply getting fuel prices to reflect true social costs isn't sufficient to induce myopic consumers to make efficient choices. Energy codes, it seems, are a good idea as well as an expedient one. M

STRINGENCY AND COMPLIANCE OF STATE ENERGY CODES FOR BUILDINGS

	ENERGY CODE STRINGENCY SCORE			COMPLIANCE EFFORT SCORE
STATE	RESIDENTIAL	COMMERCIAL	AVG.	
California	5	5	5	4
Massachusetts	5	5	5	4
New York	5	5	5	3
Virginia	5	5	5	3
District of Columbia	5	5	5	2
Iowa	5	5	5	2
Maine	5	5	5	2
Montana	5	5	5	2
Pennsylvania	5	5	5	2
Delaware	5	5	5	1
Illinois	5	5	5	1
Indiana	5	5	5	1
Maryland	5	5	5	1
New Hampshire	5	5	5	1
New Jersey	5	5	5	1
New Mexico	5	5	5	1
Rhode Island	5	5	5	1
Oregon	4	5	4.5	4
Florida	4	5	4.5	2
Washington	4	4	4	4
North Carolina	4	4	4	2
Utah	3	5	4	2
Georgia	4	4	4	1
Michigan	4	4	4	1
Idaho	3	3	3	4
Connecticut	3	3	3	2
Hawaii	3	3	3	2
Kentucky	3	3	3	2
Louisiana	3	3	3	2
Minnesota	3	3	3	2
Nevada	3	3	3	2
Wisconsin	3	3	3	2
Ohio	3	3	3	1
South Carolina	3	3	3	0
Vermont	2	3	2.5	2
Arkansas	2	2	2	2
Arizona	2	2	2	2
Texas	2	2	2	2
West Virginia	2	2	2	2
Nebraska	2	2	2	1
Alaska	4	0	2	0
Kansas	0	3	1.5	1
Tennessee	3	0	1.5	1
Colorado	1	1	1	2
Oklahoma	1	1	1	1
South Dakota	0	1	0.5	0
Alabama	0	0	0	0
Missouri	0	0	0	0
Mississippi	0	0	0	0
North Dakota	0	0	0	0
Wyoming	0	0	0	0

SOURCE: American Council for an Energy-Efficient Economy. Stringency scores range from 0 for no code to 5 for the most stringent code; compliance effort scores range from 0 for lowest effort to 4 for highest effort.