The Brattle Group

Whacking the Mac:
Why we should be skeptical about negative-cost carbon abatement

August 2009

Mark Sarro
Jürgen Weiss

EXECUTIVE SUMMARY

Of the dizzying array of topics crammed into the 1,428-page Waxman-Markey bill which passed the House in June 2009 by the slimmest of margins (219-212), energy efficiency is the very first topic. By comparison, the bill doesn't even mention cap-and-trade (for which it is most widely known) until six sections and 678 pages later.

The fact that energy efficiency comes first in the bill makes a lot of sense. Least-cost climate change mitigation relies on the successful implementation of a range of energy conservation measures. The potential for low or no-cost investments in conservation and energy efficiency is substantial. Investments such as commercial and residential building energy efficiency upgrades and increases in transportation fuel efficiency can generate cost savings well in excess of the costs to implement them.

But it also makes sense that most people only flipped through that section of the bill on their way to the cap-and-trade part, because, as a practical matter, the potential for low or no-cost investment in conservation and energy efficiency has never seemed to translate into reality. Instead, a confluence of market, financial, and institutional hurdles has yielded a persistent pattern of non-investment in cost-effective conservation and efficiency. The key to unlocking the potential of conservation and energy efficiency is in overcoming these hurdles. Unless we do, most of the available abatement potential will continue to go unrealized, even with the relatively high carbon price path in the Waxman-Markey bill.

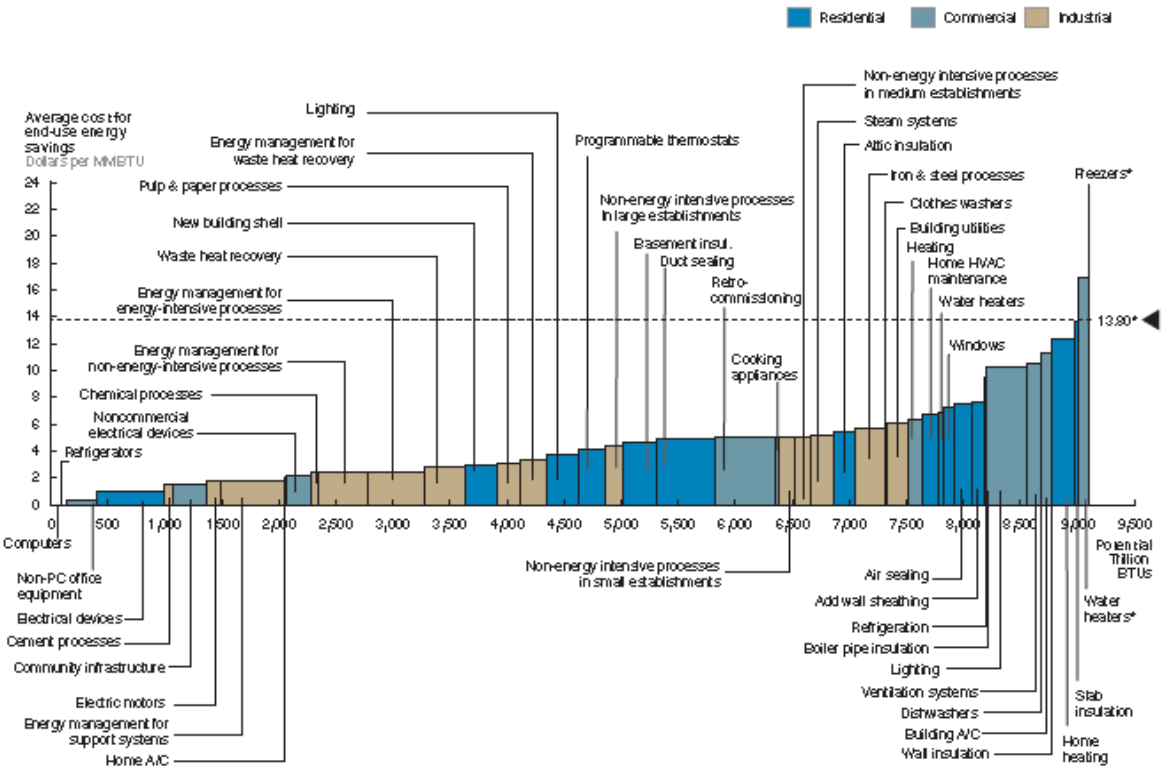
ALL YOU CAN EAT

At a May climate change conference in London and in a follow-on op/ed piece in the Times of London, U.S. Energy Secretary Steven Chu said, "The quickest and easiest way to reduce our carbon footprint is through energy efficiency. Energy efficiency is not just low-hanging fruit; it is fruit that is lying on the ground." Of course, he is right. Efficiency investments create immediate savings and reduce the need for more expensive, longer-term options to reduce greenhouse gases.

As a matter of dollars and time, increased energy efficiency is the least-cost and most expedient option for reducing carbon emissions, since many of efficiency measures (e.g., transitioning to LED lighting, updating electronic devices and appliances, better building insulation, etc.) are immediately available and far less costly than supply-side options, like getting new renewable power generation and cleaner traditional plants onto the grid.

In a cap-and-trade carbon market, companies can choose to pay the allowance price for the right to emit a ton of carbon, or they can try to emit less carbon themselves and incur an abatement cost. The ability to substitute between abatement and emissions makes abatement costs an important determinant of the ultimate cost of carbon emissions reductions. Estimates of the marginal abatement cost (MAC) for carbon show many energy efficiency investments as NPV-positive, meaning they yield net economic gains even without taking into account climate-related benefits.

The most celebrated MAC curve is the McKinsey curve. It shows the economy-wide potential for realizing reductions in carbon emissions from various activities and lists their respective abatement costs. Sequencing each abatement option from lowest to highest cost generates a curve of what McKinsey estimates is the increasing marginal cost of potential avoided emissions.



* Average price of avoided energy consumption at the industrial price; $35.60/MMBTU represents the highest regional electricity price used; new build cost based on AEO 2008 future construction costs

Source: EIA AEO 2008, McKinsey analysis

Just last week (7/29/09), McKinsey released its latest installment of the curve as part (on p. 11) of a 165-page report titled "Unlocking energy efficiency in the U.S. economy." Reading from left to right, the curve still shows potential emissions reductions in order of increasing cost, where the height of each bar shows the average annual abatement costs in dollars per million BTU. But the curve has now been redesigned. It no longer shows the "negative cost" efficiency options (i.e., net cost savings) below the horizontal axis. Instead, it shows a dashed line at the average cost of a new power plant ($14/MMBTU). According to McKinsey's math, all of the efficiency options along the curve below that line are NPV-positive.

The allure of the McKinsey MAC curve is that about one-third of the potential emissions reductions can be realized at *negative* cost (i.e., a net savings) right away, with existing technologies. This is the fruit lying on the ground in Secretary Chu's comments, essentially an all-you-can-eat buffet of conservation and energy efficiency measures. But it assumes the economy is efficient and agile enough to respond to price and profit signals.

The new McKinsey report received great fanfare for its ultimate conclusion that the U.S. can both sharply reduce emissions and realize substantial net cost savings. According to the report, implementing all of the NPV-positive options would reduce U.S. CO_2e emissions by 1.2 billion tons, or 17% of emissions in 2005, at a net savings of $700 billion. It says an investment of $520 billion in energy efficiency would produce $1.2 trillion in savings on energy bills through 2020. This happy result means efficiency gains alone would be sufficient to meet the 2020 emissions target under the Waxman-Markey bill, plus a healthy return.

McKinsey admits that assumption is clearly optimistic. Actually, it is entirely unrealistic. The New York Times reports the required $520 billion investment is 4 to 5 times more than the nation currently spends on energy efficiency. But why? If there are such obviously valuable abatement options out there, why aren't we exercising them? Why aren't efficient capital markets funding them, even without hundreds of pages and billions of dollars of energy efficiency incentives in the Waxman-Markey bill and stimulus package? Why is there so much ripe and ready fruit just lying on the ground?

If the negative cost options on the MAC curve look too good to be true, it's because they are.

NO FREE LUNCHES

Scarcity is the most fundamental principle of economics, the genesis of all economic problems. Every freshman student of economics learns, on the first day of the first semester, that economics is the study of how scarce resources are allocated to satisfy unlimited wants. In practice, economic scarcity simply means you have to give to get. Or, as University of Chicago economist and Nobel laureate Milton Friedman put it, "there's no such thing as a free lunch." But if Friedman is right, is Chu (also a Nobel laureate, in physics) wrong? Fruit lying on the ground sure sounds like a free lunch. And if Chu is wrong, then McKinsey is very wrong, because its vaunted MAC curve suggests we actually get paid to eat.

But alas, we can't, because even what look like no-cost or low-cost conservation and energy efficiency options on the surface actually involve several significant market, financial, and institutional barriers which are ignored in casual commentary and most estimates of abatement costs and likely future carbon costs. As a result, public discourse and analyses of the least-cost path and price of emissions reductions seriously overstate the likely efficiency gains and understate the likely cost of carbon in a future world where many NPV-positive efficiency options will sit rotting on the ground.

These barriers are ignored because they are frequently difficult to quantify or predict precisely. Since we mostly observe conservation and energy efficiency options *not* being used, there is no objective historical basis on which to forecast their future use or relative costs. Likewise, the likely future use and cost of abatement options depend on a dizzying array of mutual interactions with policy, technological, and market unknowns.

THE HIGHEST HURDLES

The new McKinsey report acknowledges "significant and persistent barriers" to actually achieving its estimated net cost savings. The first step toward appropriately accounting for these hurdles is to identify and understand them. They are easier to identify than they are to model, but they are impossible to model if they remain unidentified. Here, we outline only the highest hurdles to overcome and we suggest some possible approaches for doing so:

Inelastic energy demand

One very simple explanation is inertia (or inelasticity, in economic terms) in the way energy decisions are made on the demand side. Economic theory says as energy prices increase, the quantity of energy demanded will decrease, all else equal. But empirical evidence over long periods of time shows energy use changes less than proportionately to changes in price (i.e., a 1% price change results in less than a 1% change in energy use). According to one study, the

price elasticity of commercial energy demand ranges regionally from just -0.15 to -0.30 (i.e., when price changes, quantity changes by only a third as much or less) and has not changed significantly over a 20-year period. This is because energy is a relative necessity with only a limited degree of substitutability, especially in the short-run. Also, energy remains a small share of expenditure, especially relative to its critical importance, and overall energy intensity has been decreasing. The U.S. DOE reports a 10% drop in its energy intensity index over a 20-year period.

To the extent energy demand is responsive to efficiency measures, the news still isn't all good. Rebound effects may offset potential efficiency gains. Energy efficiency makes energy cheaper to use, so we use more, thus offsetting some of the efficiency gains. A recent study showed rebound effects may be significant, potentially accounting for half of all future global carbon and energy savings. It estimated global rebound effects in response to the International Energy Agency's (IEA) efficiency recommendations may be 31% by 2020 and 52% by 2030.

Capital market imperfections

A widely-discussed hurdle to conservation and energy efficiency investments are relatively large upfront costs and relatively long break-even periods for such investments. While the resulting efficiency improvements result in energy bill savings, many of which are NPV-positive under conservative discount rate assumptions, the payback periods are relatively long, many in the 10-20 year range. This payback period is longer than typical home ownership or the average life of many businesses. So far, families and business have been reluctant (at best) to commit large sums of money upfront in efficiency investments, even if they are expected to pay back over the duration of ownership.

Different financing approaches are thus needed to encourage serious efficiency investments. Most promising are approaches which require no upfront investment and tie the financing to the building itself rather than to the owner. Some financing models already exist, such as on-bill financing by utilities, pay-as-you-save approaches, and property tax financing by communities (clean energy municipal financing and outright utility ownership. But none has yet been widely used.

Information Barriers

Conservation and energy efficiency investments suffer from information barriers at both ends of the issue: information about the investment setting (e.g., a home or commercial building) and the various options to upgrade its energy infrastructure is sparse, complex and often biased.

There is very little information about the energy performance characteristics of most structures. Energy audits, while increasingly common and free of charge by local utilities, are typically unsophisticated, based on outdated models, performed by marginally skilled "professionals", and are not embedded in a system that easily allows for comparisons of structures. Information about potential solutions is often limited to "partisan" advice by equipment manufacturers, installers or industry associations interested in promoting a particular approach. As a result, there is significant uncertainty about how much of an improvement proposed efficiency measures actually would yield and whether promises made actually translate into real energy and cost savings.

Technological uncertainty

Sometimes it just makes sense to wait things out, especially in changing circumstances. The landscape for energy efficiency certainly qualifies.

This year's $800 billion stimulus package put on the table $43 billion in new money for energy investments. It extended production and investment tax credits for renewable energy investments and added a new incentive, Treasury grants in lieu of tax credits for the increasing number of investors with no profits against which to take a credit. But the on-again, off-again nature of tax incentives for renewable investments and increasingly intense competition for dollars and dominance among alternative technologies (geothermal, solar, wind, etc.) have made it difficult for renewables to gain more traction more quickly.

The stimulus package also offers freebies for energy efficiency upgrades. It extends home energy efficiency tax credits which had expired 2007. (Tough luck if you replaced all the windows in your house in 2008!) But efficiency upgrades cost very real money, typically upfront, and pay off relatively slowly over long periods of time. It is questionable whether the tax credits are sufficient to make the dollars flow. For example, the new 30% tax credit for energy-efficient doors and windows triples the old 10% tax credit. But it won't amount to anywhere near a 30% credit in most cases because it is capped at just $1,500. Solar water heaters, geothermal heat pumps and wind energy systems get a true 30% credit: 30% with no cap through 2016. But they require large cash outlays and are not well-understood by most homeowners or contractors.

Even with sufficient financial resources and incentives in place, it still may be rational to wait on big efficiency investments. After all, the fruit lying on the ground tomorrow might be tastier than what is lying there today. In a fluid environment, it is challenging to figure out exactly when to invest in efficiency upgrades. Investing in today's technologies may make it impossible or more costly to take advantage of better, lower-cost technologies in the future. Investing frequently is costly and can be risky, but waiting too long also increases cost. So energy efficiency investments become a game of optimal waiting based on the perceived gap between current and new technologies and the opportunity cost of investing now.

JUMPING THE HURDLES

We think the most important observation for policy-makers to understand right now is that simply introducing a carbon cost via a Waxman-Markey style cap-and-trade program will not be adequate to realize the potential for substantial low-cost or negative-cost efficiency gains. But finding a way to unlock the potential value of energy efficiency is critically important or we will literally pay the price. Even assuming available efficiency gains are realized, a new report (8/4/09) just released by the EIA (likely an optimistic source) projects a carbon price of $65/ton in 2030 under the Waxman-Markey bill. Without the reduced energy demand from projected conservation and efficiency investments, power prices and carbon prices will be substantially higher.

We are also skeptical of giving money to utilities in the form of free allowances to spend on efficiency. The evidence that utilities know how, and are willing, to spend that money wisely is scant at best. Utilities have little incentive to make the right energy efficiency investment decisions because their fixed cost recovery depends on the volume of electricity they sell. In

fact, increased sales (exactly the opposite of conservation and energy efficiency) results in an over-recovery of costs which goes straight to a utility's bottom line until its next rate case. Doling-out free allowances to utilities does not change their economic incentives. So we greatly prefer auctioning emissions allowances and returning the revenue directly to ratepayers or, better yet, to taxpayers, and letting them decide for themselves which energy efficiency investments make economic sense.

Simply put, it will take a lot more than a market-based carbon price and a handout of free allowances to utilities to unlock the potential of conservation and energy efficiency investments. It will take some serious innovation, a great deal of risk-taking and capital, and a coordinated effort by policy-makers, investors, and entrepreneurs to jump the significant institutional and legal hurdles currently in the way. Until then, it will continue to be a real stretch to bend over the hurdles in an effort to reach all the elusive fruit lying on the ground.

ABOUT *BRATTLE*

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. We combine in-depth industry experience and rigorous analyses to answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

We have offices in Cambridge, Massachusetts; San Francisco, California; and Washington, DC. We also have offices in Brussels, London, and Madrid.

ABOUT THE AUTHORS

Dr. Mark Sarro, a principal of *The Brattle Group*, specializes in the financial and strategic aspects of energy- and carbon-related risk analysis, investment, and business decisions. His climate change work includes project-specific financial modeling, modeling markets for conventional and renewable energy, analyzing climate policy, and advising on the availability and pricing of emissions allowances and offsets.

P: +1. 617.864.7900
E: Mark.Sarro@brattle.com

Dr. Jürgen Weiss is a principal of *The Brattle Group* and heads the firm's climate practice. He specializes in climate change and carbon market analyses, renewable energy, and electric utility economics. He advises clients on climate change policy, strategy and risk, changes in the value of existing assets, integration of renewables, market design and performance analysis, and efficient retail incentives and rate design. Dr. Weiss has consulted and written substantially on issues related to carbon pricing and the demand side of electricity markets, including topics such as efficiency, conservation, storage, retail rates, renewable power, and Renewable Portfolio Standards.

P: +1. 617.864.7900
E: Jurgen.Weiss@brattle.com