UNLOCKING AMERICAN EFFICIENCY

THE ECONOMIC AND COMMERCIAL POWER OF INVESTING IN ENERGY EFFICIENT BUILDINGS

RHODIUM GROUP

PREPARED ON BEHALF OF

United Technologies

MAY 2013

Unlocking American Efficiency

Economic and Commercial Power of Investing in Energy Efficient Buildings

May 2013

Executive Summary

Americans spend $432 billion a year powering their homes, stores and offices, on par with what US businesses spend on employee health insurance. United Technologies Corporation, in collaboration with the Rhodium Group, analyzed the impact of a 30% improvement in US building efficiency by 2030. We find that such an improvement is possible with existing technology and design practices and would generate $65 billion dollars per year in savings, net of investment costs, for American households, businesses and governments.

THE BUSINESS CASE FOR BUILDING EFFICIENCY

In corporate finance terms, investing in a 30% improvement in building energy efficiency would have an internal rate of return (IRR) of 28.6% over a 10 year period. An IRR of 28.6% is four times better than average corporate bond yields or average equity performance and more than double the returns even high-performing venture capital firms enjoy. That's because the most attractive efficiency technology and design options cost the same or only slightly more than conventional alternatives, but deliver significant energy cost savings.

RAISING HOUSEHOLD INCOMES

Rising energy prices can take a toll on household budgets. Achieving a 30% efficiency improvement in existing residential buildings would save the average household $163 a year, net of investment costs. If residential efficiency improvements are combined with commercial efficiency improvements and the benefits are passed on to consumers, those savings would rise to $466 per year. That's more than twice as much as the average household spends on fresh vegetables, more than they spend on household appliances, furniture or clothing their children, and nearly as much as they spend on prescription and non-prescription drugs.

STREAMLINING GOVERNMENT

Federal, state and local governments spend more than $50 billion a year on energy. Achieving a 30% improvement in existing government buildings would yield $8 billion per year in net savings that could be used to balance budgets or cut taxes.

THE GLOBAL MARKET OPPORTUNITY

Globally, improving building efficiency in rapidly urbanizing emerging economies could create a $1.8 trillion market for energy efficient building design and technology. Investments in building efficiency improvements at home will help make US companies more competitive abroad.

POLICY RECOMMENDATIONS

Smart policy can serve as a catalyst for the investment in building efficiency solutions and includes such things as building labels and codes, effective standards, efficiency finance, portfolio standards and regulatory reform.

Contents

America's Efficiency Opportunity

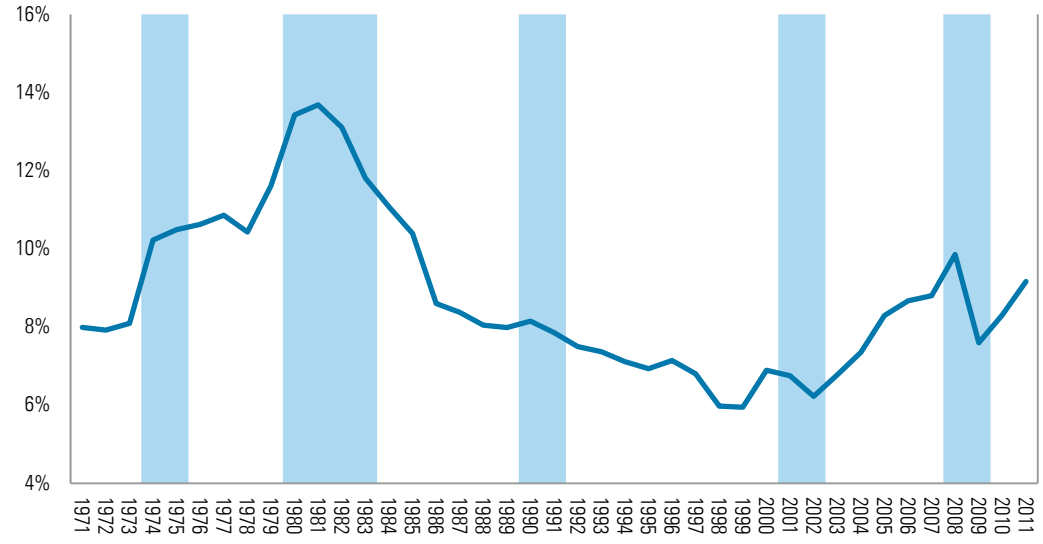
Energy, along with labor, land and capital, is a basic ingredient in any country's economic growth formula. Known as a "factor of production" to economists, energy illuminates buildings, heats homes and offices, powers factories, and moves goods and people. For advanced economies like the US, prosperity comes from finding ways to use these factors of production more efficiently, thereby increasing economic productivity. Productivity gains are responsible for roughly 60% of US economic growth since 1960 and more than 75% over the past decade.

Energy efficiency has played an important role in past American productivity improvements. Technical innovations, new design techniques, better management practices, and smart policies have enabled businesses and households to improve energy services (e.g. lighting, heating and cooling, powering appliances and machinery) while cutting the amount of coal, oil, natural gas and electricity required to deliver those services. Each dollar of additional US economic activity today requires only half as much energy as it did in 1960.

Yet unlike land, labor and capital – the other inputs into the US economy – the price of energy is highly volatile and determined by international events as much as domestic market conditions. And over the past decade, energy prices have nearly doubled thanks to growing demand in emerging economies and political turmoil in energy-rich parts of the world. So while the US economy continues to become more energy efficient, the share of national income Americans spend on energy has still increased, from 6.2% of GDP a decade ago to 9.2% in 2011 (Figure 1).

Figure 1: Energy Costs and Recessions

Energy as Share of GDP (Line) and US Recessions (Bars)

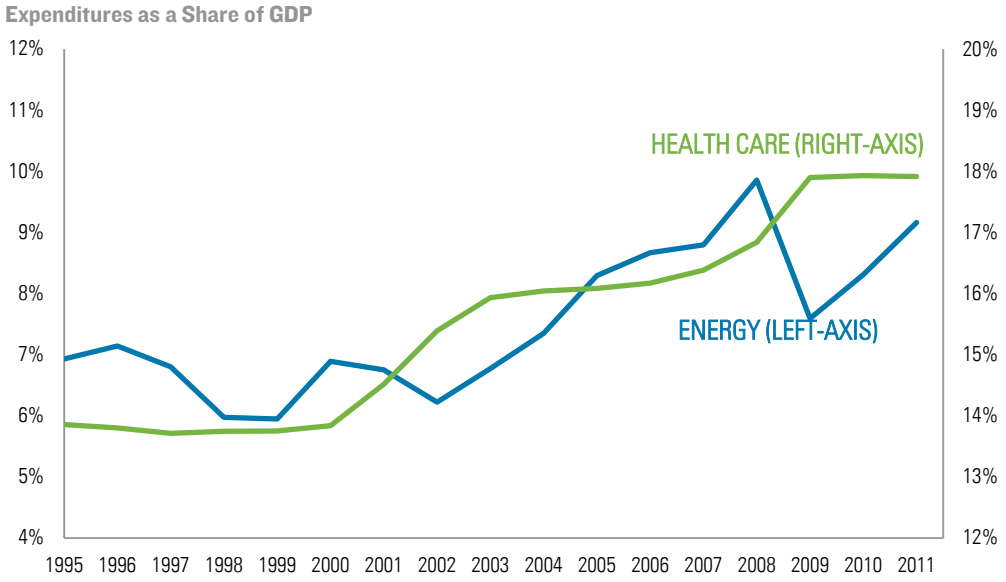


Source: Bureau of Economic Analysis, 2013; Centers for Medicare and Medicaid Services, 2013; EIA, 2012a, 2013a; NBER, 2012, Rhodium Group estimates.

Rising energy prices create business uncertainty and reduce overall investment. Indeed, four of the last five recessions in the US have been preceded by a spike in energy costs (Figure 1), and today's high energy prices threaten an already fragile economic recovery.

The economic toll of increased energy costs is similar to that of health care cost inflation. Between 2002 and 2011, American healthcare expenditures increased by $1.1 trillion (in nominal dollars), eroding household income and raising business operating costs (Figure 2). During the same period, US energy expenditures rose by $720 million. Yet unlike healthcare expenditures, much of the increase in energy expenditures was sent out of the US to energy-exporting countries. Rising energy prices have contributed more to the US trade deficit over the past decade than America's total trade with China.[1]

Figure 2: Rising Energy and Health Costs



Source: Bureau of Economic Analysis, 2013; Centers for Medicare and Medicaid Services, 2013; EIA, 2012a, 2013a; Rhodium Group estimates.

AMERICA'S FUTURE ENERGY CHALLENGE

After a multi-decade decline, US oil and gas production has begun to increase thanks to the development of unconventional resources. By combining hydraulic fracturing and horizontal drilling, American companies have been able to extract natural gas from shale and other low-permeability rock formations, leading to a 31% increase in production since 2005 (EIA, 2013b). The same techniques used to produce shale gas are also being applied to extract oil from unconventional formations. Led by the Bakken play in North Dakota, US crude oil production was 1.3 million bbl/d higher in 2012 than in 2005.

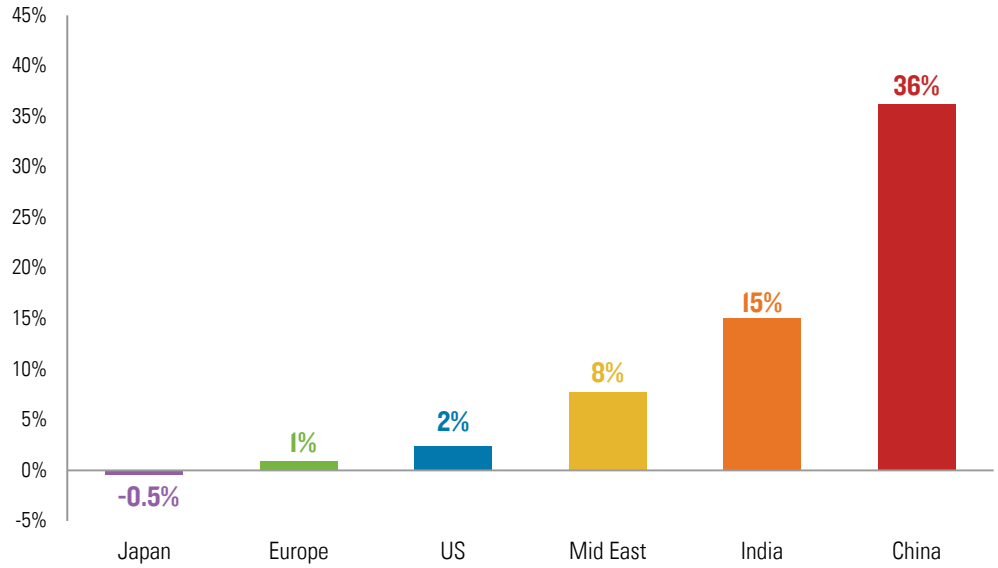
[1] Calculated using data from the US Census Bureau and US Energy Information Administration.

This domestic oil and gas boom has accelerated the US economic recovery and significantly reduced America's energy trade deficit. But high energy costs are still imposing considerable economic drag, and America remains exposed to future energy price volatility. That's because the US is, and will continue to be, integrated into global energy markets, and those markets are increasingly driven by demand in developing countries.

The developed world accounts for less than 45% of global energy demand today, down from 51% in 1990. And over the next two decades, the US will account for only 2% of global energy demand growth, while China, India and the Middle East will account for 36%, 15% and 8% respectively (Figure 3). With developing countries adding two Americas worth of additional demand between now and 2030, there are limits to how much additional US energy supply can reduce global prices. And supply disruptions abroad will continue to shape the price of energy at home.

Figure 3: Developing World Drives Demand

Share of Global Demand Growth 2010-2030



Source: IEA, 2012, and Rhodium Group estimates.

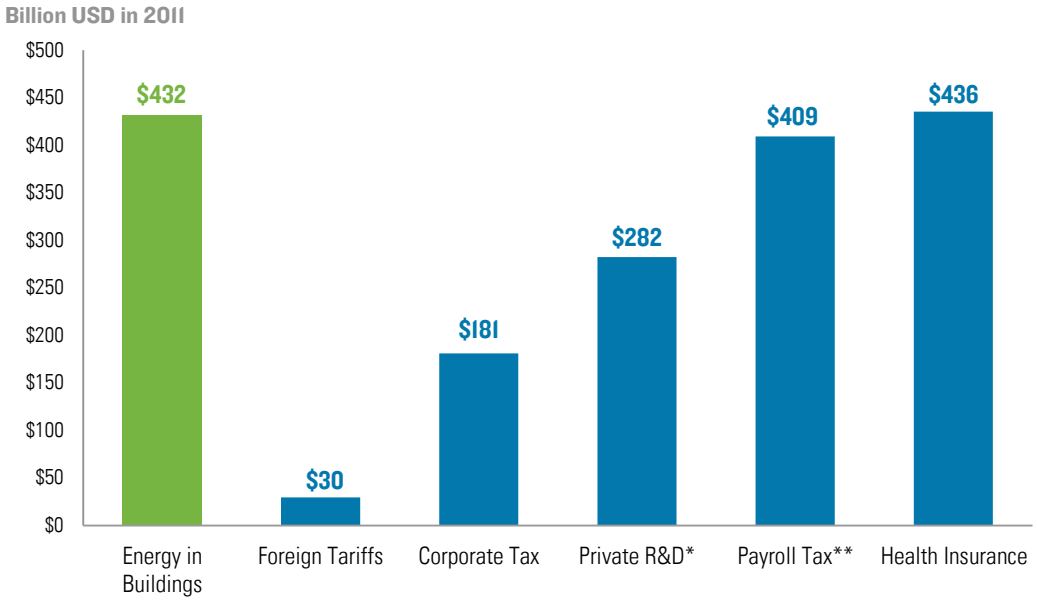
The most reliable way to reduce the drag high energy costs impose on US economic growth and safe-guard the country from future energy price volatility is to improve the efficiency with which energy is consumed. And there is no better place to do that than in buildings.

POWERING GROWTH THROUGH BUILDING EFFICIENCY

Residential and commercial buildings account for 40% of all energy consumed in the US. Americans spent an estimated $432 billion to power their homes, stores and offices in 2011. That's on par with what US businesses spend on employee health insurance and more than they pay in payroll taxes (Figure 4). The Energy

Information Administration (EIA) projects building energy expenditures will rise to $474 billion a year by 2030 (EIA, 2012b).

Figure 4: Energy Expenditures in Context



Source: CBO, 2013; EIA, 2012a, 2013a; NSF, 2012; OMB, 2013 and Rhodium Group estimates. *2009 data. **Employer contribution only.

Reducing energy expenditures makes businesses more competitive, frees up resources to invest in new production or hire new employees, lowers prices for consumers, and leaves households with more money in the bank after paying their energy bills to either save for the future or spend on other goods and services. In short, improving energy efficiency improves America's economic growth prospects.

United Technologies Corporation, in partnership with the World Business Council for Sustainable Development (WBCSD), has conducted the most comprehensive assessment available to date of the cost and technical feasibility of improving the efficiency of the global building stock, analyzing 19 million commercial and residential buildings around the world. [2] This work culminated in a landmark report, published in 2009, on transforming the way buildings use energy, which has inspired more than 100 companies around the world to launch firm-wide energy efficiency campaigns.

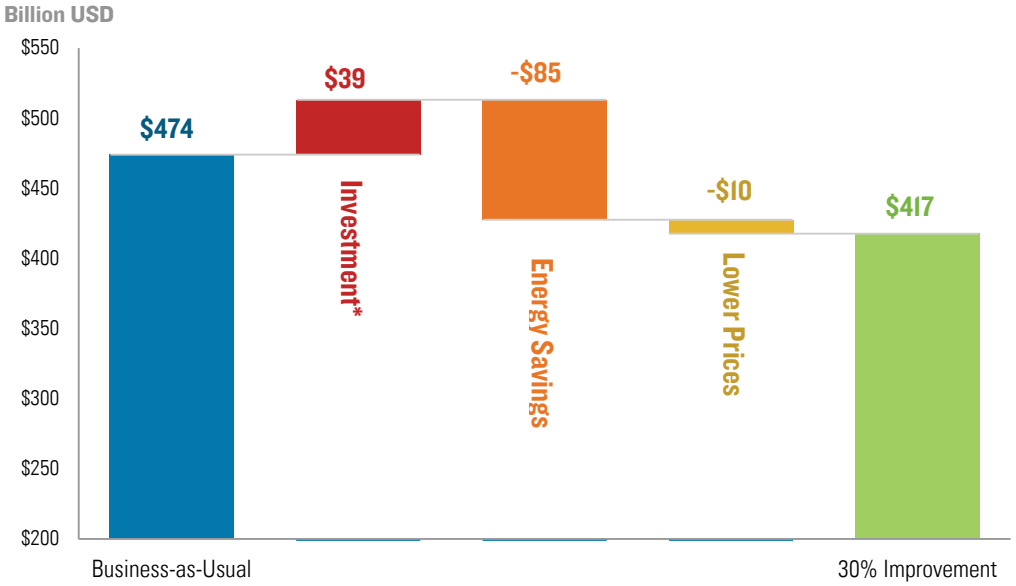
To assess the potential for cost-effective building efficiency improvements in the US, United Technologies, in collaboration with the Rhodium Group, drew on the unique buildings technology database developed for the United Technologies/WBCSD, reviewed the most recent academic, market and government research on building efficiency, and employed a suite of energy system models, including the National Energy Modeling System (NEMS), used by the US Department of Energy for official energy supply and demand forecasting. We estimate that a 30% improvement in the

[2] See http://www.wbcsd.org for more information on the Energy Efficiency in Buildings project.

efficiency of America's building stock (the amount of energy consumed per square foot in residential and commercial structures) relative to current levels is possible with existing technology and design options, profitable for the businesses and households making the efficiency improvements, and beneficial for the US economy as a whole.

Achieving a 30% efficiency improvement in today's building stock would require investing roughly $275 billion in energy efficient technology and design. Amortized over a decade at a 7% interest rate, the annual investment cost is $39 billion (Figure 5). That investment would deliver $95 billion a year in energy savings in the buildings sector alone. American households and businesses would save $85 billion a year by decreasing the amount of energy their buildings consume. That reduction in demand would lower electricity and natural gas prices by an average of 5% and 8% respectively and deliver an additional $10 billion in energy cost savings in buildings. After accounting for investment costs, the country would save $56 billion a year in the buildings sector, and an additional $9 billion a year elsewhere in the economy thanks to lower energy prices.

Figure 5: Building Efficiency Savings in 2030



* Efficiency investment is amortized over ten years at a 7% interest rate.
Source: WBCSD, EIA and Rhodium Group

American business would save $34 billion per year, net of investment expenses, that could either be passed on to consumers or used to hire more employees or invest in R&D or expanded production. Households would save an additional $23 billion per year that they could use to save for the future, invest in education, or spend on consumer goods or personal services. And federal, state and local governments would save more than $8 billion annually.

And the economic benefits of energy efficiency in buildings go beyond the direct energy cost savings. Based on National Academies of Science estimates of the economic cost of current US energy production, a 30% improvement in building efficiency would deliver multi-billion dollar public health savings and increase agricultural production (National Research Council, 2009). Researchers have found that improved lighting, ventilation and temperature control in energy efficient buildings results in significant improvements in worker productivity (Singh, Syal, Grady, & Korkmaz, 2010). And energy efficient schools often see higher test scores and lower absenteeism than their conventional counterparts (Katz, 2006).

The Business Case for Building Efficiency

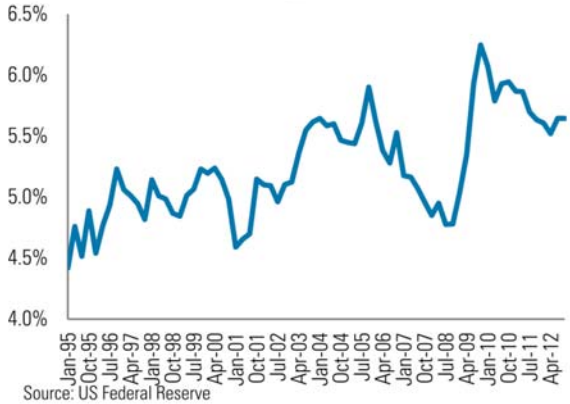
With the global economy still recovering from the Great Recession, companies are more cautious than ever in their investment planning. Businesses face an uncertain policy landscape in developed countries as Washington, Brussels and Tokyo all grapple with large fiscal deficits and a rapidly evolving competitive landscape in global markets thanks to the rise of China, India, and other emerging economies. So while corporate profits have improved in recent years, companies are careful about reinvesting those profits in new business lines or expanded production (see Figure 6, which shows record shares of US corporate assets currently being held in cash or other low-risk, low-return liquid assets).

Today's global energy prices add to the uncertainty businesses face. American businesses spent $740 billion on energy in 2011, up from $380 billion in 2000. And the rise in prices has been even more pronounced outside the US. Globally, companies now pay more than twice as much for energy than they did a decade ago. And with growing demand from emerging economies, the International Energy Agency predicts that energy prices will rise by a further 17% over the next two decades (Figure 7). While the unconventional oil and gas boom has helped soften energy prices in the US, and could potentially do so in other parts of the world, energy price volatility will not go away.

In this environment of economic uncertainty, building efficiency is an attractive corporate investment strategy. Improving the energy efficiency of a company's building portfolio increases the productivity of existing assets, guards against future energy price hikes and offers some of the most attractive rates of return available to the business community today.

Figure 6: Business Investment Uncertainty

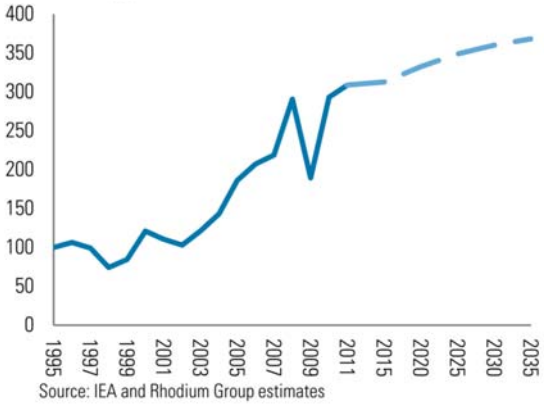
Liquid Share of Total U.S. Corporate Assets



Source: US Federal Reserve

Figure 7: Rising Energy Prices

Global Energy Price Index – 1995=100



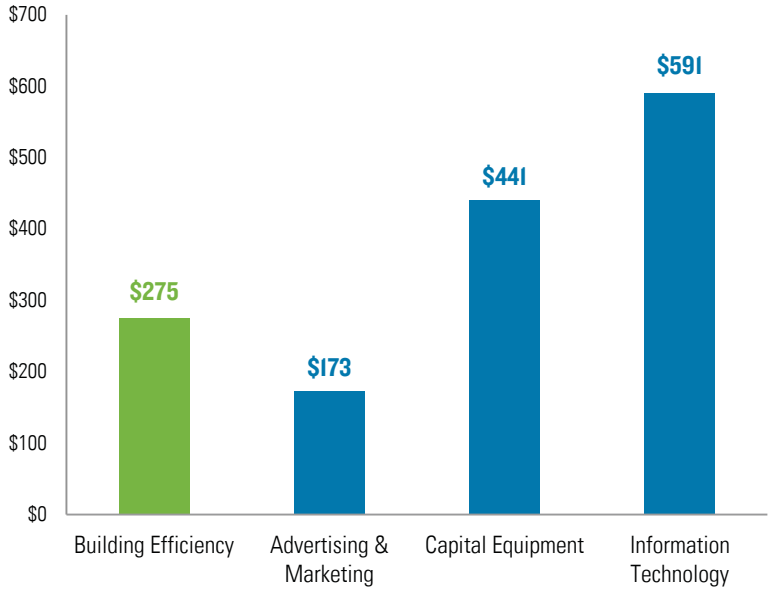
Source: IEA and Rhodium Group estimates

SIZING UP THE EFFICIENCY OPPORTUNITY

Improving energy efficiency in buildings by 30% would create a $275 billion market for advanced technology, engineering and design services, and construction activity in the US alone. That's larger than the total US advertising market, and comparable in scale to what American companies spend each year on capital equipment and information technology (Figure 8). For a corporate sector sitting on cash and unsure of where to invest, building efficiency offers a sizeable opportunity.

Figure 8: The Building Efficiency Opportunity

Building Efficiency Investment Potential Relative to Annual Business Investment in the US - $ Billion



Notes: Building Efficiency is total additional investment required for a 30% improvement in efficiency of current US stock. Other categories are 2010 U.S. investment totals.

Source: BEA, JP Morgan, Rhodium Group and WBCSD

And it's an investment opportunity that is highly profitable. We analyzed the rate of return of the highest-performing energy efficiency investments capable of delivering a 30% improvement in building efficiency using cost assumptions gathered through the United Technologies/WBCSD project's extensive market surveys and energy price forecasts from the US Department of Energy.[3] At currently projected energy prices, $275 billion in building efficiency investment would pay for itself through lower energy bills in four years or less.[4]

In corporate finance terms, these investments have an internal rate of return (IRR) of 28.6% over a 10 year period. IRR was calculated by scoring the 10 year energy cost savings resulting from the efficiency investments (at a 7% annual discount rate) against the cost premium of the energy efficient technology or design option relative to the conventional alternative. An IRR of 28.6% is four times better than average corporate bond yields or average equity performance and more than double the

[3] See http://www.eia.gov/forecasts/aeo/index.cfm for more details.

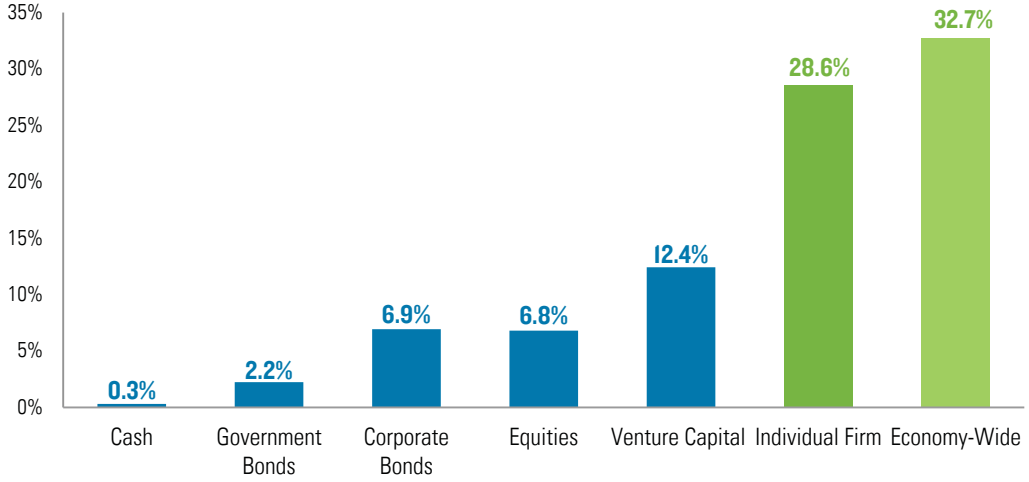
[4] Energy savings estimates in this analysis assume average, rather than perfect, use of energy efficient equipment as most buildings are not operated in a manner that achieves their full efficiency potential.

returns even high-performing venture capital firms enjoy (Figure 9). That's because the most attractive efficiency technology and design options cost the same or only slightly more than conventional alternatives, but deliver significant energy cost savings. Efficiency improvements beyond 30% are technically possible, but less profitable, as investment costs increase and energy savings decrease the closer to the technical frontier you get. But cutting energy demand in buildings by 30% – a significant start - is possible today with market-beating rates of return.

And the more companies that invest in building efficiency, the better the returns on efficiency investments become. As mentioned above, reduced energy demand through improved building efficiency leads to a decrease in energy prices. Price decreases reduce building sector energy bills by an additional $10 billion per year on top of the energy cost savings that stem from the efficiency investments directly. [5] This increases the rate of return businesses can achieve from improving building efficiency from 28.6% to 32.7% (Figure 9).

Figure 9: Building Efficiency's Rate of Return

Internal Rate of Return (IRR) of Building Efficiency vs. Traditional Investment Options



Box I: Carrier's Charlotte LEED EB Project

Carrier's Charlotte North Carolina plant manufactures a line for the high-efficiency Evergreen® 23XRV chiller, which is 40% more efficient than the industry standard. The Charlotte operation has earned the certification of Leadership in Energy and Environmental Design Existing Building (LEED® EB), one of only 11 factories worldwide at the time to receive such distinction. To earn this certification the plant had to improve the energy efficiency of its operations. The site energy team was able to identify and implement a number of energy conservation projects such as lighting efficiency improvements and building temperature controls, and install a new high efficiency heat recovery chiller and variable speed drive air compressor. The Charlotte plant invested $528,000 in these improvements and recovered that investment expense through energy cost savings in less than two years.

[5] Refers to commercial and residential building cost savings from lower energy prices, accounting for rebound effect. Industrial and transport sector energy consumers would save an additional $9 billion per year.

UNLOCKING EFFICIENCY INVESTMENT

With rates of return like this, why are companies not investing in building efficiency today? Energy efficiency research has identified a range of barriers, both market and regulatory, to profitable building efficiency investments. The most important barrier is simply a lack of good information about the opportunity at hand. Businesses are generally unable to compare the energy costs of different buildings when shopping for new floor space because that information is not made clearly available to potential buyers or tenants. Energy efficiency labeling has been extremely successful in enabling consumers to save money when shopping for appliances, and has the potential to do the same in buildings. And high-efficiency demonstration buildings can help showcase the energy cost savings potential of emerging efficiency technologies and designs.

But even when the information is available, businesses don't always have the incentive or ability to make profitable efficiency investments. In most commercial office space, the landlord or building management company makes investment decisions while the tenant or individual office unit owner pays the energy bills. These "principal-agent" problems can be overcome through smart building codes and innovative approaches to efficiency finance. And in many areas, the rules governing electricity and natural gas delivery create barriers to efficiency investments. Modernizing utility regulations can allow both energy companies and building owners to profit from improving energy efficiency.

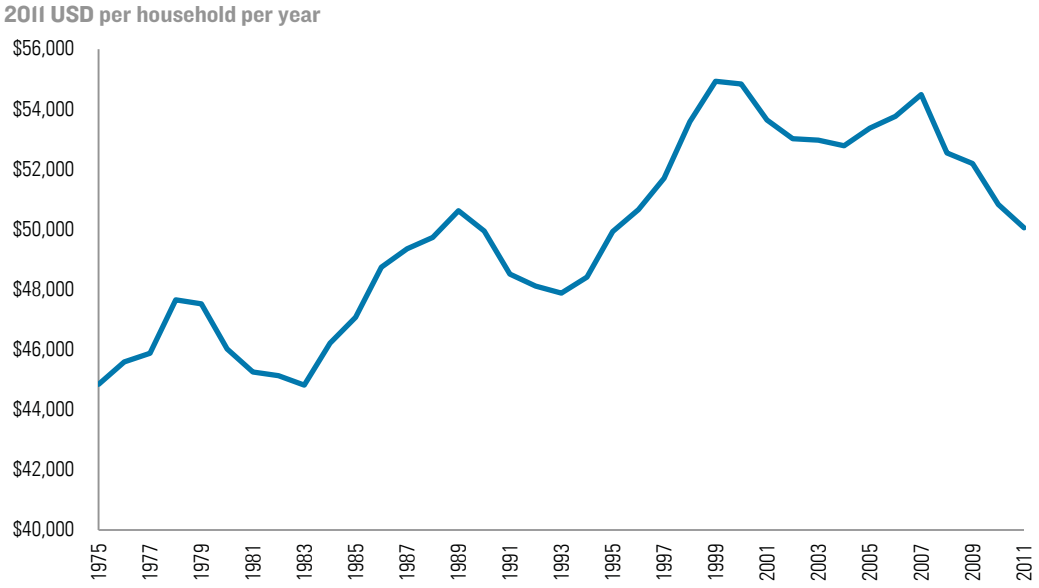
Finally, the reduction in economy-wide energy prices that can be achieved through broad-based building efficiency improvements don't factor into an individual company's investment decision-making. Labeling, standards, demonstration projects, building codes, innovative financing and regulatory reform can all help improve the profitability of efficiency investments at the company level by reducing energy costs at a national level. These policy levers are discussed in greater detail later in this report.

Raising Household Income

Median income in the United States, when adjusted for inflation, peaked in 1999 and has fallen by nearly 10% since (Figure 10). The financial crisis delivered a significant blow to American prosperity, but for several years prior most households had seen little if any increase in annual income. Wage growth has slowed from previous decades, thanks in part to increased global competition, and household expenses have increased, eroding the real value of those wages. And rising costs in particular have squeezed family budgets.

Higher energy costs have both direct and indirect impacts on household income. Rising electricity and fuel prices make it more expensive to heat and cool homes, operate appliances or drive automobiles. These direct energy expenses have nearly doubled over the past decade and now cost the average household more than $5,000 per year. And the indirect costs of higher energy prices paid by businesses that get passed through in the goods and services households consume add another couple thousand dollars to the average family's annual expenses. All told, if energy costs had remained at 2000 levels, the resulting savings would have offset most of the decline in household income over the past decade.

Figure 10: Median American Household Income



Source: Census Bureau, 2012

RAISING INCOME BY LOWERING ENERGY COSTS

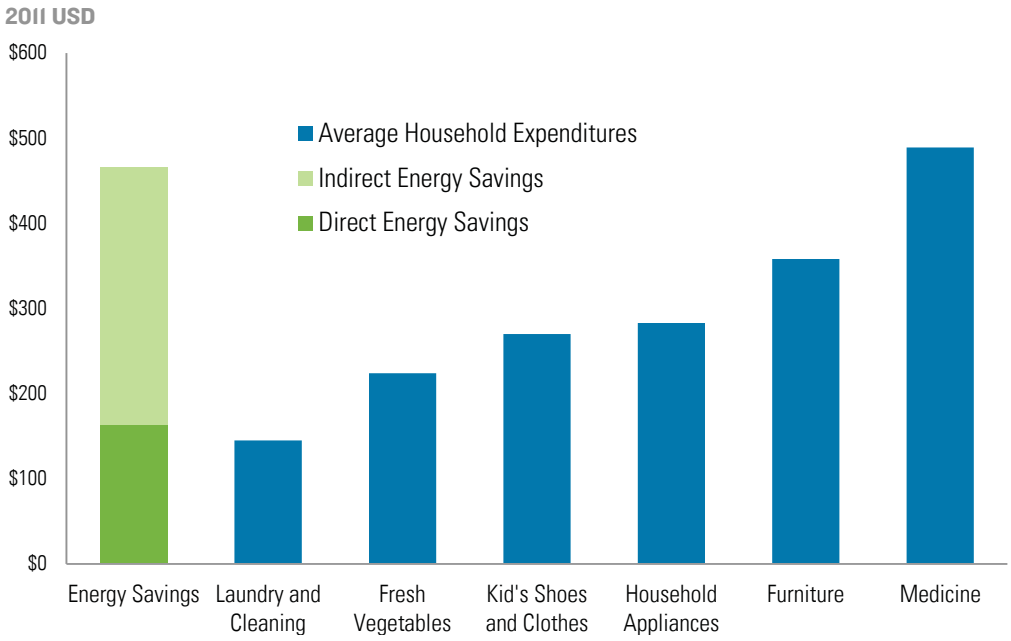
Buildings account for 40% of all energy consumed in the United States. Investing in energy efficient building technology and design can raise household income and reduce the impact of future energy price increases.

Achieving a 30% efficiency improvement in existing residential buildings would require investing $115 billion in energy efficient technology and design. But this investment would more than pay for itself in energy cost savings, providing a significant net increase in household income. Net of investment costs, the average household would save $163 a year directly in lower energy costs.

If residential efficiency improvements were combined with commercial efficiency improvements and the savings were passed on to consumers, disposable household income would rise even further. These indirect effects could put an extra $43 billion in the pockets of American families each year, or an extra $303 per household.

To put these household savings into perspective, the $466 per year in combined direct and indirect energy cost savings from a 30% improvement in building efficiency is more than twice as much as the average household spends on fresh vegetables, more than they spend on household appliances, furniture or clothing their children, and nearly as much as they spend on prescription and non-prescription drugs (Figure 11).

Figure 11: Annual Energy Savings vs. Other Household Expenditures



Source: Census, Bureau of Labor Statistics and Rhodium Group estimates

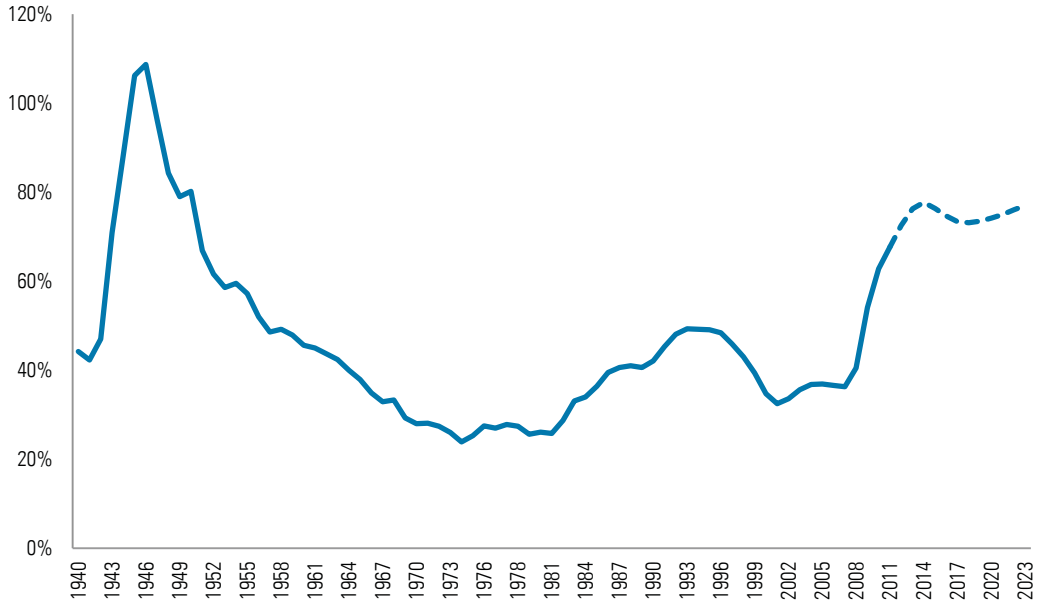
Streamlining Government

With the US federal government debt at its highest levels since World War II, fiscal policy has risen to the top of the political agenda in Washington. Standard & Poor's has taken the historic step of downgrading America's AAA credit rating in the aftermath of a contentious and high stakes debate over raising the country's debt ceiling, and the crisis unfolding in Europe highlights the risks to the US and global economy if America does not get its fiscal house in order.

Between 2002 and 2012, US federal government debt rose from 34% of GDP to 74% of GDP, making America the 35th most indebted country in the world.[6] The Congressional Budget Office estimates that under current law, federal debt as a share of GDP will fall slightly over the next few years, but then start rising again (Figure 12). And if tax cuts and spending increases currently set to expire are extended, federal debt could reach 169% of GDP a quarter century from now- far above World War II levels.[7]

Figure 12: The U.S. Fiscal Outlook

Publicly held federal debt as a share of GDP



Source: CBO, 2013. OMB, 2013

[6] https://www.cia.gov/library/publications/the-world-factbook/rankorder/2186rank.html

[7] The CBO's most recent Long-Term Budget Outlook (2012) projects the federal debt could reach 199% of GDP by 2037 if tax cuts and spending increases scheduled to expire are extended. The Center for American Progress estimates that developments since CBO's 2012 outlook reduce that number to 169%.

In the face of troubling fiscal projections, policy makers are searching for ways to balance the budget. But anemic economic recovery and persistently high unemployment make many options unattractive in the near term. Significant cuts in government services or entitlement spending risk pushing the economy back into recession. The same is true for large tax hikes or other revenue increases. Streamlining government to provide the same level of service at lower cost, however, is both an economic and fiscal policy win. And energy efficiency can play an important role in this process.

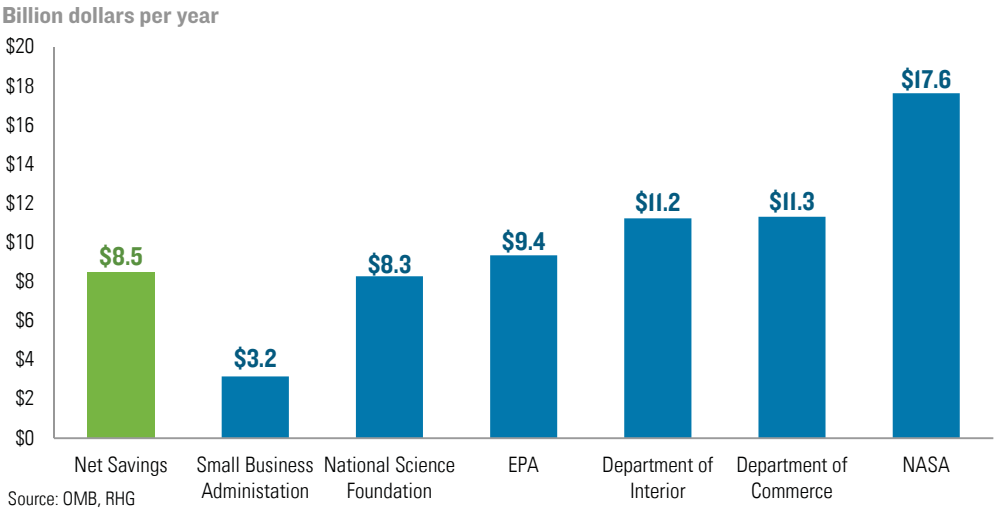
REDUCING GOVERNMENT WASTE THROUGH ENERGY EFFICIENCY IN BUILDINGS

The federal government spends roughly $20 billion each year on energy, much of which to heat, cool and light federal buildings. State and local governments spend another $30-$40 billion per year on building-related energy consumption alone. Improving the efficiency of this building stock can deliver significant government savings without impairing the services government currently provides.

Achieving a 30% improvement in existing government buildings would require investing $40 billion in energy efficient technology and design. These investments would create demand for private sector goods and services ranging from equipment sales to construction labor. But unlike past stimulus programs, the government would recoup the cost of this investment and realize more than $8 billion per year in additional savings that could be used to pay down the deficit or cut taxes.

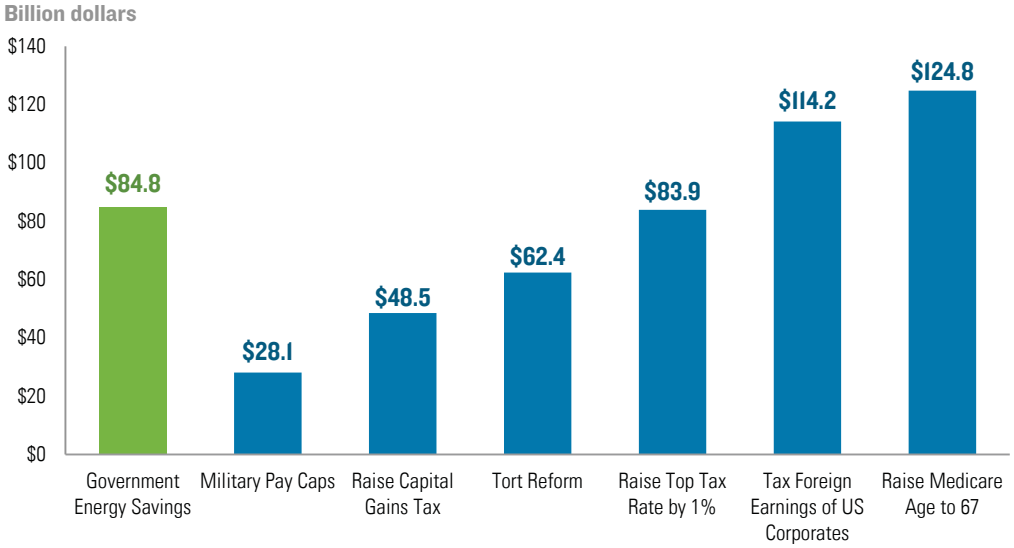
As shown in Figures 13 and 14, this is a meaningful amount of government savings, on par with eliminating the Department of Commerce or EPA. When compared to other budget options currently being considered by Congress, the savings from a 30% improvement in government building efficiency stand up well. For example, net government energy savings over a decade are close to what government would save from raising the Medicare retirement age or make by taxing foreign earnings by US corporations.

Figure 13: Government Savings from a 30% Improvement in Building Efficiency in Context



Source: OMB, RHG

Figure 14: Ten Year Government Energy Savings Relative to Other Budget Options



Source: CBO, 2011

And the energy savings would continue well beyond the 10 year budget planning window. Energy efficient building investments have a life-span of 20 years or longer, so investments made today will help streamline government for decades to come.

Recognizing this opportunity, both the federal government and state and local governments around the country have started to invest in energy efficiency. The Energy Independence and Security Act of 2007 set energy efficiency goals for federal buildings, and Executive Order 13514 (issued on October 5, 2009) tasks federal agencies with developing a game plan for achieving these and other energy and environmental performance targets. At the state and local level, myriad energy efficiency programs have arisen in recent years to improve the performance of state houses, city halls, schools, police stations and community centers while saving taxpayers money. The Center for Green Schools estimates that energy improvements in schools could save 25% or $2 billion nationally, enough to hire 35,845 new teachers.[8]

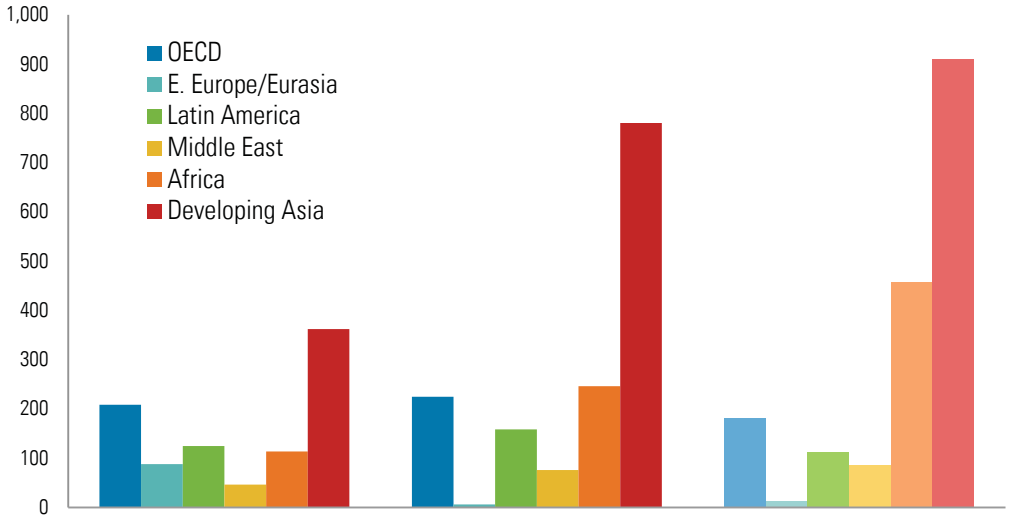
[8] http://centerforgreenschools.org/Libraries/State_of_our_Schools/USGBC_StateofSchoolsInfographic_master.sflb.ashx

The Global Market Opportunity

A decade into the 21st century, the world finds itself in the midst of the largest migration in human history. And it's happening within, rather than between, nations as rural populations in developing countries move to cities in search of new opportunities or find cities being built up around them. Between 1960 and 1985, the world's cities grew in size by an average of 39 million people per year. Over the past 25 years, that rate has increased to 60 million per year. Domestic policy reform, expanded international trade and a shift in global economic growth from developed to developing countries have enabled farmers from India to Indonesia to improve their quality of life by moving to urban centers and switching from agricultural to industrial and service sector occupations. Since 1985, developing country cities have added 1.3 billion people, sparking a global construction boom of unprecedented proportions (Figure 15).

Figure 15: An Increasingly Urban World

Million new urban residents, past and projected



Source: UN and Rhodium Group estimates

This global urbanization drive has been particularly pronounced in China. During the 1980s and 1990s, Beijing began loosening domestic restrictions on where Chinese citizens could live and what they could do for work. These reforms, along with China's integration into the global economy, created both the motive and opportunity for rural Chinese to move to the coast to work in the country's rapidly expanding manufacturing hubs. Accommodating millions of migrant workers each year required new roads, apartment blocks and commercial buildings. And as economic growth has spread throughout China, large amounts of farmland in the interior has been converted into commercial, residential and industrial real estate. All told, urban China has grown by 390 million people over the past two decades, and

more than 100 million people in the last five years alone.[9] There is currently more than 60 billion square feet of building space under construction in China – an amount equal to the total building stock of the northeast United States.[10]

And urbanization in developing countries is just getting started. The UN projects that over the next 25 years, developing country cities will expand by another 1.6 billion people (Figure 15). Most of this growth will continue to occur in Asia – China and India in particular. McKinsey estimates that urban China will continue to grow by 15-20 million people per year at least through 2025, requiring the construction of an additional 20 billion square feet of residential and commercial floor space annually (McKinsey Global Institute, 2009).[11] That's the equivalent of building four New York Cities each year between now and 2025.

While urbanization rates have so far been slower in India than in China, that's likely to change in the years ahead. The UN estimates the population of India's cities will grow by 300 million over the next twenty five years, and by 2030 will be adding more people per year than cities in China. McKinsey estimates that India will need to add 7-9 billion square feet of commercial and residential floor space over the next two decades to keep pace, the equivalent of adding the entire city of Chicago's buildings each year through 2030 (McKinsey Global Institute, 2010). And should African countries prove capable of replicating the economic success of their Asian peers, the nearly 500 million Africans the UN expects to urbanize over the coming 25 years could touch off a construction boom there as well.

THE GLOBAL BUILDING EFFICIENCY MARKET

Urbanization is dramatically improving the quality of life of some of the world's poorest residents. The World Bank estimates that the number of people living on less than $1.25 a day (their benchmark for extreme poverty, measured in purchasing power parity) has fallen from 1.9 billion in 1981 to 1.4 billion in 2005 (World Bank, 2013). And the Brookings Institution estimates this number fell to 900 million in 2010 (Gertz, 2011).

But it's also dramatically changed the world's energy outlook. Building cities requires enormous quantities of energy-intensive goods like steel, aluminum and cement. And once built, urban residents consume considerably more energy per person than their rural peers. Urbanization trends over the past decade have pushed developing country energy needs 70% higher than the International Energy Agency predicted in 2002. This has increased the cost of energy globally and threatens the sustainability of current urbanization rates going forward. Energy efficiency in both current and

[9] China's National Bureau of Statistics via CEIC.

[10] Defined as New York, New Jersey, Pennsylvania, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire and Maine.

[11] Floor space estimates adjusted for construction completed since 2005, the reference year used in the McKinsey study, as reported by China's National Bureau of Statistics.

future buildings needs to improve to accommodate the 1.6 billion additional developing country city dwellers the UN projects over the next 25 years without straining global resource availability and environmental quality.

Developing country governments are acutely aware of this reality and are increasingly focusing on building efficiency as a necessary element of their domestic economic growth strategies. China's 12th Five Year Plan (2011-2015) includes a number of building efficiency policies and targets, including retrofitting existing buildings, installing smart meters in homes, and strengthening building codes and appliance efficiency standards. And India's Action Plan for Energy Efficiency released in 2009 outlines Delhi's plans to improve existing and develop new building codes, accelerate labeling efforts and develop minimum efficiency standards.

In addition to helping countries achieve their economic development goals, building efficiency improvements represent a considerable global market opportunity. Using the United Technologies/WBCSD buildings database and projections from the International Energy Agency, we found that improving global building efficiency by 30% by 2030 would create a $1.8 trillion market for energy efficient building design and technology.

LEVERAGING AMERICA'S EFFICIENCY ADVANTAGE

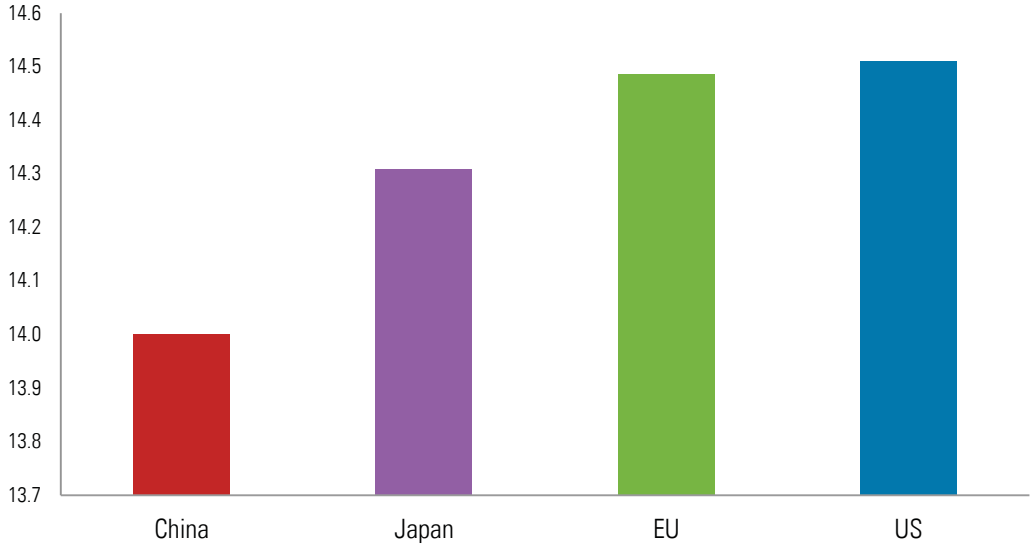
Thanks to past US energy efficiency policies, American business is in a strong position to compete in the global building efficiency market. The US has been an energy efficiency policy innovator, whether in building codes, appliance standards, labeling programs or research and development investments. By creating local demand for energy efficient building technology, these policies have given American companies a first-mover-advantage in global markets.

As shown in Figure 16, while all companies selling equipment into the US market must comply with domestic energy efficiency standards, US companies produce the most energy efficient options available (in this case commercial air conditioning systems). And when compared to the products sold in other markets with less stringent standards, American companies have an even larger efficiency edge.

The take-away for the US is this: smart building efficiency policy at home not only saves American households and businesses money, but makes US companies and workers more competitive internationally. And supporting efforts by other countries to improve their efficiency policies in the years ahead will benefit those countries directly while creating new markets for American business.

Figure 16: America's Energy Efficiency Edge

Average SEER rating for AC units sold in the US by company location*



Source: AHRI and Rhodium Group estimates. for 25,000-65,000 BTU. * Companies are grouped by the country in which the manufacturer's parent company is located, which is not necessarily where the product is manufacturered.

Policy Recommendations

This report has discussed the benefits of improving energy efficiency in buildings for American businesses, households, taxpayers and the US economy overall. Below are seven areas where smart policy can help catalyze investment in these efficiency solutions, many of which were highlighted in a recent report by the Alliance to Save Energy's bipartisan Alliance Commission on National Energy Efficiency Policy (2013).

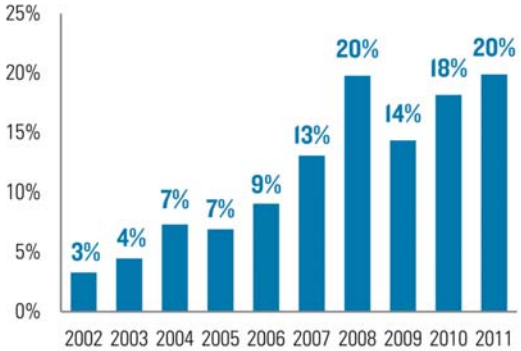
I. BUILDING LABELS

The first step in improving energy efficiency in buildings is letting building owners, tenants, and investors know the scale of the opportunity at hand. As discussed above, investments in building efficiency offer higher rates of return than many other investment options. But these benefits are often unknown to existing owners and occupants and almost always unknown to potential buyers and tenants.

In the consumer appliance industry, energy efficiency labels have provided consumers with cost-saving information about the energy performance of competing products. The Environmental Protection Agency's voluntary consumer product labeling program, ENERGY STAR®, was the primary factor in 20% of appliance purchase decisions in 2011, up from 3% in 2003 (Figure 17). The EPA estimates the labeling program has helped Americans identify and purchase over 3.5 billion energy-efficient appliances over the past 20 years (EPA, 2011), delivering $11 billion in annual savings (Figure 18).

Figure 17: Growing Market Power

Share of Appliance Purchases Driven by Labels



Source: CEE and Rhodium Group estimates

Figure 18: Annual ENERGY STAR Savings

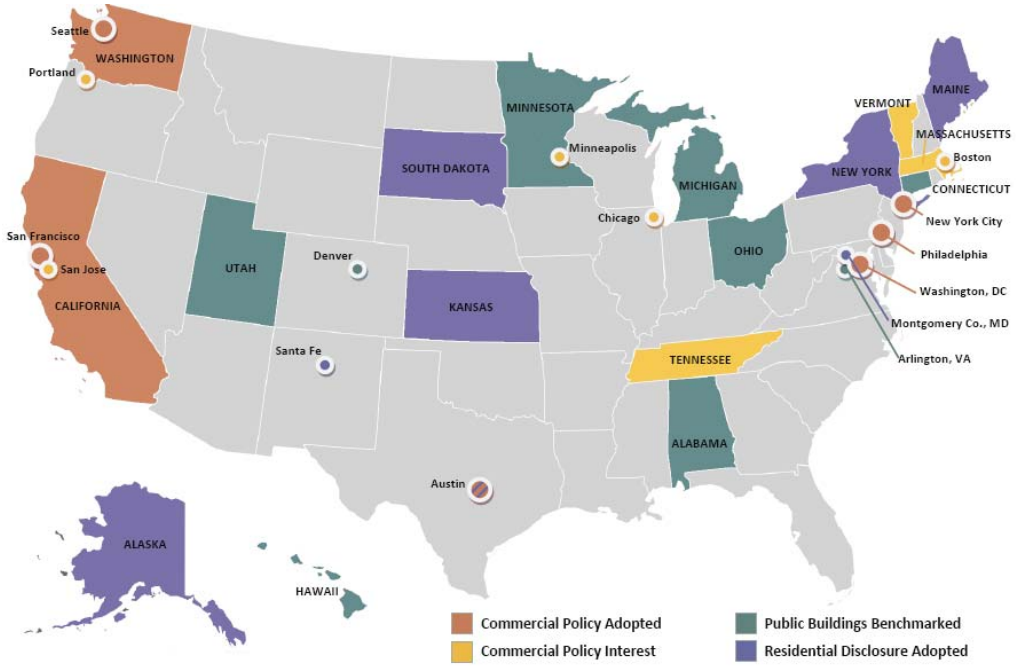
Billion USD

Source: EPA

The same strategy can deliver even bigger savings when applied to whole buildings. EPA has expanded the ENERGY STAR® program to the buildings sector, providing owners, operators and contractors with the tools they need to improve the efficiency of both new and existing residential and commercial buildings. In 2010, more than 160,000 buildings took advantage of this program, and saved $7.1 billion on energy expenses in that year alone.

In light of these benefits, two states and seven major cities have turned EPA's voluntary ENERGY STAR® program into mandatory energy rating and labeling schemes for commercial buildings (Figure 19). These regulations, which cover more than 4 billion square feet of commercial and multifamily residential floor space in California, Washington, New York City, Austin, Philadelphia, Minneapolis and the District of Columbia, require building owners to benchmark their energy consumption using EPA's Portfolio Manager tool and disclose the findings to prospective tenants, buyers and investors (Burr, Keicher, & Leipziger, 2011). This both highlights profitable efficiency investment opportunities for existing owners and occupants and allows prospective buyers and tenants to take energy costs into account when renting or buying floor space. Five states and three cities have rating and disclosure policies for residential buildings, and another seven states and two cities have policies covering public buildings.

Figure 19: U.S. Building Rating and Disclosure Policies



Source: Institute for Market Transformation
http://www.buildingrating.org/sites/default/files/documents/US_Rating_Map.pdf

These initial rating and disclosure programs will provide useful case studies for the rest of the country. Stakeholder engagement and education will be critical in their success. EPA's suite of voluntary tools may need to be modified to be effective in mandatory programs, and compliance and enforcement strategies still need to be worked out. But when done right, labeling has the potential to get the building efficiency ball rolling. The explosive growth of the US Green Buildings Council's LEED® voluntary certification program in recent years suggests the potential demand for more sustainable and efficient buildings is considerable when the market is provided with performance information.

2. BUILDING CODES

The rating and disclosure programs discussed above can help create demand for efficient buildings, but the structure of the sector can make it challenging to effectively supply the market. The patchwork of state and local building codes in the US makes it difficult for the design, engineering, and construction industries to deliver energy efficiency solutions at scale. And principle-agent problems where tenants pay energy bills but have no control over building efficiency decisions create barriers to efficiency investments.

Well-designed and uniformly implemented building energy codes can help overcome both obstacles for new buildings. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the International Code Council (ICC) develop model residential and commercial building energy codes and standards. These codes are revised every three years through a consultative process that includes industry, academic, government and advocacy stakeholder groups. The ICC's 2009 International Energy Conservation Code (IECC) for residential buildings and ASHRAE's 90.1-2007 standard for commercial buildings have the potential to reduce energy costs by up to 26% and 14% respectively (DOE, 2009a, 2009b). ICC's new 2012 and ASHRAE's new 90.1-2010 standard go even further.

The challenge is implementing and enforcing these codes at the state and local level. Only 36 states have adopted ASHRAE 90.1-2007 and only 30 states have adopted IECC 2009.[12] And even among these, enforcement of code compliance is limited. The Department of Energy's Building Energy Codes Program provides resources to state and local officials to assist with model code and standard adoption, stakeholder education and engagement, and compliance enforcement. But the rating and disclosure programs described above are also a powerful tool for ensuring newly constructed buildings perform to the levels specified in code. And rating and disclosure programs can create demand for energy efficiency retrofits, which building codes alone do not address.

3. GOVERNMENT BUILDINGS

While building labels and energy codes are primarily state and local government issues, the federal government also has an important role to play in advancing building efficiency improvements.

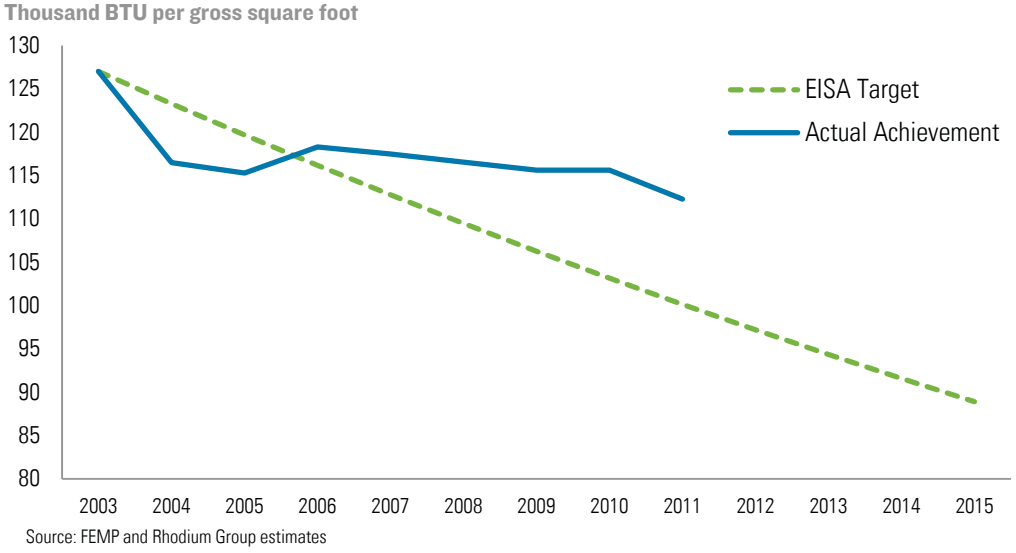
The federal government owns or operates over 500,000 buildings across the country, comprising more than 3 billion square feet of total floor space, and accounting for 2.2% of all building energy consumption in the US (DOE, 2011). And state and local government buildings account for nearly 10%. All told, American taxpayers spend more than $50 billion per year paying for the energy government consumes. As demonstrated in this report, improving the efficiency of public buildings has the potential to deliver much-needed relief to local, state and federal government budgets and reduce Americans' tax burden.

[12] See http://energycodesocean.org/code-status

Realizing this opportunity, the federal government has already begun improving the efficiency of its building stock. The Energy Independence and Security Act of 2007 (EISA) called for a 30% improvement in building energy efficiency by 2015 relative to 2003 levels, and Executive Order 13514 (issued on October 5, 2009) tasks federal agencies with developing a game plan for achieving these and other energy and environmental performance targets.[13] The Department of Defense has launched a series of building initiatives, seeing energy efficiency as a "force multiplier" (EESI, 2011). This includes the Army's goal of making 25 installations "net zero energy" by 2030. And as part of his Better Buildings Initiative, President Obama has directed federal agencies to issue at least $2 billion in performance-based energy contracts over the next two years (White House, 2011).

The federal government can also improve the energy efficiency of the nation's housing stock through its low-income housing programs. The Department of Housing and Urban Development (HUD) helps fund public housing for 1.2 million American families[14] and provides Section 8 tenant rental assistance for another 2.1 million households.[15] The low income families that HUD serves spend four times more on energy than the average American household as a share of income. And HUD itself spends $5 billion per year on energy in public and assisted housing.[16] Improving the efficiency of this housing stock will both make it more affordable for low-income families and reduce HUD expenditures.

Figure 20: Energy-Intensity of Federal Buildings – Actual vs. EISA Target



Source: FEMP and Rhodium Group estimates

[13] Major federal energy management regulations are available online from FEMP http://www1.eere.energy.gov/femp/regulations/requirements_by_reg.html

[14] http://portal.hud.gov/hudportal/HUD?src=/topics/rental_assistance/phprog

[15] http://portal.hud.gov/hudportal/documents/huddoc?id=Tenant_BR_Assis_2012.pdf

[16] http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_4321.pdf

Yet the government is falling short in meeting its own targets, let alone unlocking the full efficiency potential of public and government-supported buildings. As of 2011, the efficiency of federal buildings has only improved by 4% since EISA was signed into law (Figure 20). Much more can and needs to be done at the national level. And state and local governments are only beginning to scratch the surface of their building efficiency opportunity.

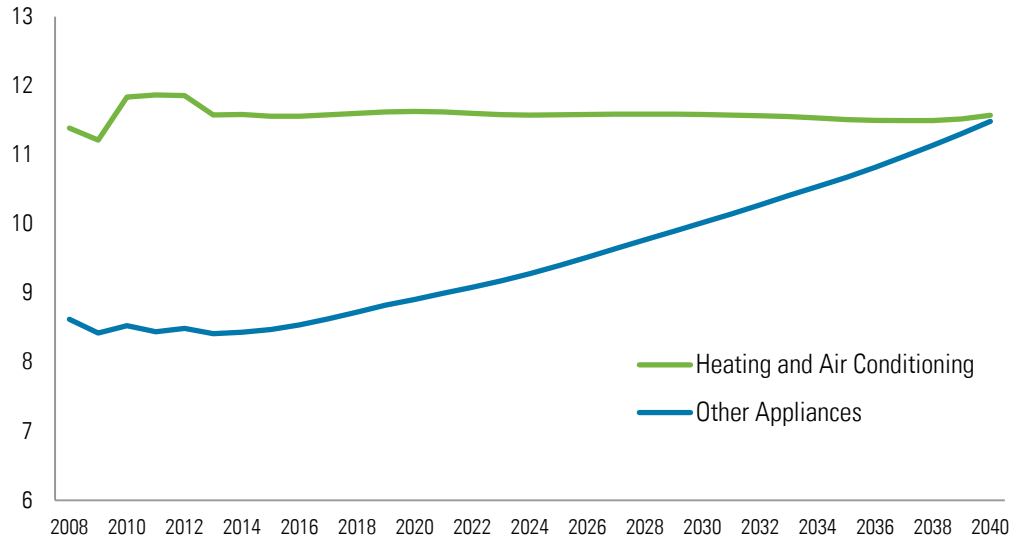
4. APPLIANCE STANDARDS

Much of the energy consumed in buildings is used to power appliances – from televisions and dishwashers to elevators and heating and cooling systems. Minimum energy efficiency standards, developed in consultation with industry, academic and civil society stakeholders and anchored in technology readiness, can provide customers with more reliable and affordable products.

As required by law, the Department of Energy has established minimum efficiency standards covering more than 50 appliance categories responsible for 90% of residential and 60% of commercial building energy demand.[17] When combined with well-designed testing procedure guidelines and effective certification and enforcement efforts, appliance standards can enable manufacturers to produce energy efficient products at scale – significantly reducing their cost – and protect consumers from low-quality and unreliable products. Existing appliance standards save American businesses and households $15 billion per year and improved standards are currently under development.

Figure 21: Projected Appliance Energy Demand

Residential and Commercial Sectors, Quadrillion BTU



Source: EIA's 2013 Annual Energy Outlook

[17] http://www1.eere.energy.gov/buildings/appliance_standards/

Standards for heating and air conditioning equipment are relatively advanced, particularly for commercial buildings. The greatest opportunities for new standards come from the proliferation of new household and business equipment, from computer systems to cable boxes to medical devices. On their current trajectory, these appliances will significantly increase energy demand in American residential and commercial buildings in the decades ahead (Figure 21).

Given the increasingly global nature of the residential appliance and commercial equipment market, harmonizing national testing procedures, minimum efficiency standards, and certification systems can create even larger economies of scale and deliver billions in additional savings to both businesses and households in the US and around the world. The Clean Energy Ministerial process, launched in December 2009, has taken up this effort by launching the Super-efficient Equipment and Appliance Deployment (SEAD) initiative.[18] Countries accounting for roughly half of global energy demand are currently participating in this effort.

5. EFFICIENCY FINANCE AND TAX INCENTIVES

Even when the value of investing in building efficiency is clear, businesses and households may not have the necessary capital available. Government can play an important role in promoting the development of financial market solutions that increase access to building efficiency opportunities.

The private sector has already begun developing innovative approaches to efficiency finance. Energy service companies (ESCOs) provide energy efficient products and services and guarantee the resulting energy cost savings, thus mitigating performance and energy price risk that has kept some building owners from making profitable efficiency investments. The ESCO industry has grown rapidly, with over $4 billion in revenue in 2008 (Satchwell, Goldman, Larsen, & Singer, 2011). Most ESCO revenue, however, comes from municipality, university, school, and hospital buildings (the "MUSH" market). Only 13% of revenue comes from commercial, industrial and residential clients.

Electrical and natural gas utilities, both public and investor-owned, have begun offering energy efficiency finance programs to their customers. Researchers at Resources for the Future (RFF) have identified over 200 major energy efficiency finance programs across the country as of 2011, roughly 100 of which were run by utilities (Palmer, Walls, & Gerarden, 2012). These programs generally use rate-payer funds to issue loans to customers for energy efficiency improvements, loans that are repaid through the customer's monthly utility bill or other payment channels. Utility efficiency programs deliver electricity demand reductions at an average cost of 5 cents per kilowatt hour, significantly below the cost of electricity supply in those service areas (Arimura, Li, Newell, & Palmer, 2011). That means the monthly energy

[18] http://superefficient.org/

cost savings generally exceed the loan payment amount, leaving households with lower utility bills as a result of the program.

State and local governments operate another 100 or so energy efficiency finance programs, using bonds, general revenue, Treasury investment funds, federal block grants, and ratepayer funds transferred to state or local government agencies for energy efficiency programs. Property-assessed clean energy (PACE) programs issue bonds specifically for energy efficiency investments, repaid through the property tax assessments on the buildings making the efficiency improvements. While most residential PACE programs were put on hold following a 2010 Federal Housing Finance Agency ruling, commercial PACE programs have continued to grow.

And the federal government provides efficiency finance through Government Sponsored Enterprises (GSEs) that either underwrite or guarantee the majority of American mortgages. Ginnie Mae, through the Federal Housing Administration (FHA), insures Energy Efficient Mortgages offered by FHA-approved lenders. These mortgages allow homebuyers to invest in energy efficient homes, either through the initial purchase decisions or subsequent renovations.[19] Fannie Mae and Freddie Mac (as well as the Department of Veteran Affairs and the Rural Development Agency) also offer energy efficiency investment financing products.

Government and utility-sponsored programs are only beginning to make a dent on the efficiency finance opportunity, reaching less than 5% of eligible businesses and households. As awareness of the benefits of building efficiency grows, these types of financing programs will need to be expanded. New approaches to efficiency finance could have a significant impact as well. The Alliance Commission on National Energy Efficiency Policy's "Energy 2030" report highlights two in particular. The first is On-bill repayment (OBR) programs administered by utilities but with capital provided by third parties, including banks and other investors. California recently adopted OBR for commercial buildings and other states are examining it closely. The second is including energy efficiency considerations in the underwriting criteria for loans backed by federal credit agencies. A recent study from the University of North Carolina and Institute for Market Transformation finds that default risk is 32% lower in energy efficient homes – something that is currently not reflected in mortgage pricing (Sadahi, Stellberg, Tian, Kaza, & Quercia, 2013). The Alliance Commission also recommends reforming federal energy efficiency tax incentives so that they focus on high efficiency technologies and measures and adjusting commercial and industrial depreciation schedules to encourage investments that can boost energy efficiency.

6. PORTFOLIO STANDARDS

Most states have adopted renewable energy production mandates known as renewable portfolio standards (RPS).[20] These standards require a certain share of

[19] http://www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages

[20] http://www.dsireusa.org/rpsdata/index.cfm

utilities' electricity production to come from qualifying "renewable" sources. A nationwide RPS is routinely proposed in Congress and President Obama called for a national clean energy standard (or CES, which includes nuclear, natural gas and coal with CCS as qualifying sources) in his 2011 State of the Union address.

Portfolio standards are generally adopted for environmental reasons, as an alternative to price-based mechanisms like cap-and-trade or a carbon tax. While price-based mechanisms allow energy efficiency to compete on a level playing field with renewables, nuclear, coal with CCS and natural gas as means of reducing air pollution or greenhouse gas (GHG) emissions, an RPS or CES limits utilities and consumers to fuel-switching solutions.

As a result, 20 states have adopted energy efficiency resource standards (EERS), either as part of or as a compliment to state-level renewable portfolio standards (Brennan, Palmer, Brennan, & Palmer, 2012). As energy efficiency is one of the most cost-effective means of reducing air pollution and GHG emissions, including it in a portfolio standard approach to environmental protection can mitigate energy price increases for businesses and households.

7. REGULATORY REFORM

Taking full advantage of the energy efficiency opportunity in buildings will require modernizing US electricity regulation. Expanding utility efficiency programs requires giving utilities as much of an incentive to sell efficiency as to sell power. There are encouraging examples of this around the country that warrant study and potential replication. In wholesale markets, energy efficiency and demand response should be allowed to compete on a level playing field with generation assets. If market participants can reduce demand through efficiency at a lower cost than electricity production they should be allowed to do so – provided reliability needs are met. And businesses looking to invest in energy efficient distributed generation like combined heat and power (CHP) should be given the back-up access to the electrical grid they need.

References

Alliance Commission on National Energy Efficiency Policy. (2013). *Energy 2030: Doubling U.S. Energy Productivity by 2030*. Washington, D.C.: Alliance to Save Energy.

Arimura, T. H., Li, S., Newell, R. G., & Palmer, K. L. (2011). Cost-Effectiveness of Electricity Energy Efficiency Programs. *SSRN Electronic Journal*. Washington, D.C. doi:10.2139/ssrn.1552133

Brennan, T. J., Palmer, K., Brennan, T. J., & Palmer, K. (2012). Energy Efficiency Resource Standards: Economics and Policy. Washington, D.C.

Bureau of Economic Analysis. (2013). National Income and Product Accounts. Washington, D.C.: US Department of Commerce. Retrieved March 1, 2013, from http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1

Burr, A. C., Keicher, C., & Leipziger, D. (2011). *Building Energy Transparency: Rating and Disclosure Policy*. Washington, D.C.: Institute for Market Transformation.

CBO. (2011). *Reducing the Deficit: Spending and Revenue Options*. Washington, D.C.: Congressional Budget Office.

CBO. (2013). *The Budget and Economic Outlook: Fiscal Years 2013 to 2023*. Washington, D.C.: Congressional Budget Office. Retrieved from http://cbo.gov/publication/43907

Census Bureau. (2012). *Income, Poverty, and Health Insurance Coverage in the United States*. Washington, D.C.: US Census Bureau.

Centers for Medicare and Medicaid Services. (2013). *National Health Expenditure Data*. Washington, D.C.: Department of Health and Human Services. Retrieved from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/index.html?redirect=/NationalHealthExpendData/

DOE. (2009a). *Impacts of the 2009 IECC for Residential Buildings at State Level*. Washington, D.C.: Department of Energy.

DOE. (2009b). *Impacts of Standard 90.1-2007 for Commercial Buildings at State Level*. Washington, D.C.: Department of Energy.

DOE. (2011). *Buildings Energy Data Book*. Washington, D.C.: Department of Energy.

EESI. (2011). *DoD's Energy Efficiency and Renewable Energy Initiatives*. Washington, D.C.: Environmental and Energy Study Institute.

EIA. (2012a). *Annual Energy Review*. Washington, D.C.: Energy Information Administration. Retrieved from http://www.eia.gov/totalenergy/data/annual/index.cfm

EIA. (2012b). *Annual Energy Outlook 2013*. Washington, D.C.: Energy Information Administration, U.S. Department of Energy.

EIA. (2013a). *Monthly Energy Review*. Washington, D.C.: Energy Information Administration, U.S. Department of Energy.

EIA. (2013b). Natural Gas Data. Retrieved September 7, 2012, from http://www.eia.gov/naturalgas/data.cfm

EPA. (2011). *ENERGY STAR® and Other Climate Protection Partnerships: Annual Report 2010*. Washington, D.C.: Environmental Protection Agency.

Gertz, L. C. and G. (2011). *Poverty in Numbers: The Changing State of Global Poverty from 2005 to 2015*. Washington, D.C.: Brookings Institution.

IEA. (2012). *World Energy Outlook*. Paris: International Energy Agency.

Katz, G. (2006). *No TiGreening America's Schools: Costs and Benefitstle*. A Capital E.

McKinsey Global Institute. (2009). *Preparing for China's Urban Billion*.

McKinsey Global Institute. (2010). *India's Urban Awakening: Building Inclusive Cities, Sustaining Economic Growth*.

National Research Council. (2009). *Hidden Costs of Energy : Unpriced Consequences of Energy Production and Use*. *Production*. Washington, D.C.

NBER. (2012). US Business Cycle Expansions and Contractions. New York: National Bureau of Economics Research. Retrieved September 4, 2012, from http://www.nber.org/cycles.html

NSF. (2012). *Business R&D Performed in the United States Cost $291 Billion in 2008 and $282 Billion in 2009*. Washington, D.C.: National Science Foundation. Retrieved from http://www.nsf.gov/statistics/infbrief/nsf12309/

OMB. (2013). *The President's Budget for Fiscal Year 2013*. Washington, D.C.: Office of Management and Budget. Retrieved from http://www.whitehouse.gov/omb/budget

Palmer, K., Walls, M., & Gerarden, T. (2012). *Borrowing to Save Energy An Assessment of Energy-Efficiency Financing Programs*. Washington, D.C.: Resources for the Future.

Sadahi, B., Stellberg, S., Tian, C. Y., Kaza, N., & Quercia, R. (2013). *Home Energy Efficiency and Mortgage Risks*. Washington, D.C.: UNC Center for Community Capital and the Intitute for Market Transformation.

Satchwell, A., Goldman, C., Larsen, P., & Singer, T. (2011). *A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011*. Berkeley: Lawrence Berkeley National Laboratory.

Singh, A., Syal, M., Grady, S. C., & Korkmaz, S. (2010). Effects of Green Buildings on Employee Health and Productivity. *American Journal of Public Health, 100*(9), 1665–1668.

White House. (2011). *President Announces Nearly $4 Billion in Public and Private Investments in Building Upgrades as Part of Better Buildings Initiative On February 3*. Washington, D.C.: White House Office of the Press Secretary.

World Bank. (2013). *World Development Indicators*.

www.utc.com
www.naturalleader.com
www.rhg.com