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Carbon Markets: A Hidden Value Source for Commercial Real Estate?

Aaron Binkley & Brian Ciochetti

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Authors Aaron G. Binkley and Brian A. Ciochetti

Abstract Real estate is one of the largest contributors to CO_2 emissions yet the industry knows very little about this topic. This paper provides a background on carbon markets and their potential role in a proposed strategy for energy efficiency improvements (EEI). It compares the relationship between an investment decision based solely on electricity prices to one that incorporates the monetary benefit associated with carbon offsets. The findings suggest that a regulated carbon 'cap and trade' system could provide additional value to property owners who pursue EEI strategies. Moreover, carbon offset value differs significantly by geographic location and method by which electrical energy is produced. EEI strategies that take into account carbon offset value could significantly reduce the impact that commercial real estate has on the environment.

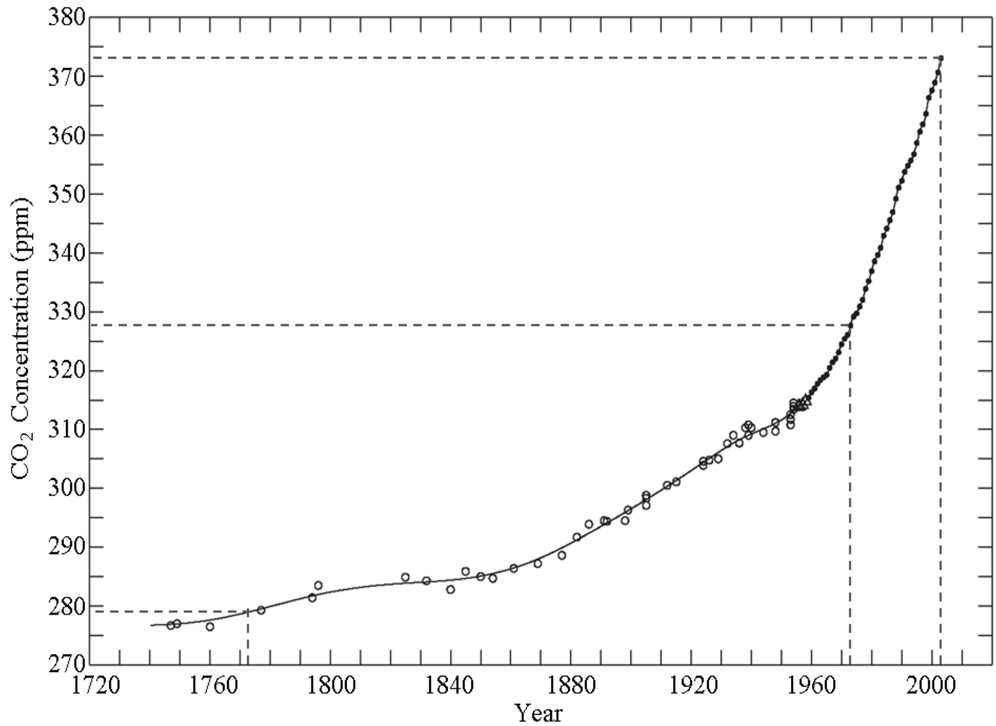
Momentum is growing within the United States to better understand the causes and consequences of climate change, commonly referred to as ''global warming.'' While debate continues as to what the best course of action may be to deal with this phenomenon, one fact remains clear: activities that consume fossil fuels such as manufacturing, transportation, energy production, building operations, and food production are contributing to a rapid rise in carbon emissions (IPCC, 2007; Harvey, 2010). Continued reliance on fossil fuels as a primary source of energy will have dire environmental consequences. Atmospheric CO_2 levels have increased as much in the past 30 years as they have in the prior 200 years. This rate of increase has been especially pronounced in recent years (Exhibit 1).

In a seminal research report, *The Stern Review* has argued that the financial implication of attempting to stabilize global greenhouse gas emissions could be approximately 1% of global GDP, and this figure is expected to grow over time (Stern, 2006).

In the U.S., major industrial sectors are increasingly facing questions about their role in global warming, and it is likely that regulation associated with carbon emissions will be adopted in the near future. At present, the commercial real estate industry does not have a clear understanding of the magnitude or potential value of carbon emissions—either as a liability or as an opportunity (Llewellyn, 2007). This in turn may impact investment decisions and operational strategies of commercial real estate owners and investors.

This paper provides an introduction to carbon emissions and the commercial real estate sector's current level of awareness of its emissions footprint. It identifies

Exhibit 1 | Trend in Atmospheric CO_2 Concentration over the Industrial Era



Source: Scripps CO_2 Program, 2004.

the operational carbon footprint of investable U.S. commercial real estate and estimates the emissions reduction potential within the industry to be nearly $3 billion on an annual basis. A scenario is proposed where carbon emission reductions from investments in energy efficiency improvements (EEI) in both existing and new construction can be monetized in a regulated carbon market.[1] This creates a new revenue stream that justifies greater investment in energy conservation projects, which in turn, reduce carbon emissions. A geographical comparison of the relative value of emission reductions is made that allows for a location-based model of emission reducing EEI investment. The paper concludes with a discussion of major opportunities and barriers to realizing carbon emissions value given current industry practices and lack of regulatory certainty.

The academic literature linking carbon emissions to commercial real estate operations has been limited to a discussion of potential emission reductions (Binkley, 2007; Nauclér and Enkvist, 2009). There is however a growing body of research and policy documents that identify and address energy efficiency potential, building performance, and energy conservation in the commercial building sector (e.g., Ashford, 1999; Huovila, Ala-Juusela, Melchert, and Pouffary, 2007; Llewellyn and Chaix, 2007; Nelson, 2007; DiBona, 2008; Fuerst, 2008;

Miller, Jay, and Florance, 2008; Eichholtz, Kok, and Quigley, 2009). Research conducted by organizations have also examined this topic (United Nations Foundation, 2007; World Business Council on Sustainable Development, 2009), and policy implications to support energy efficiency investments have also been discussed (Reed, Johnson, Riggert, and Oh, 2004).

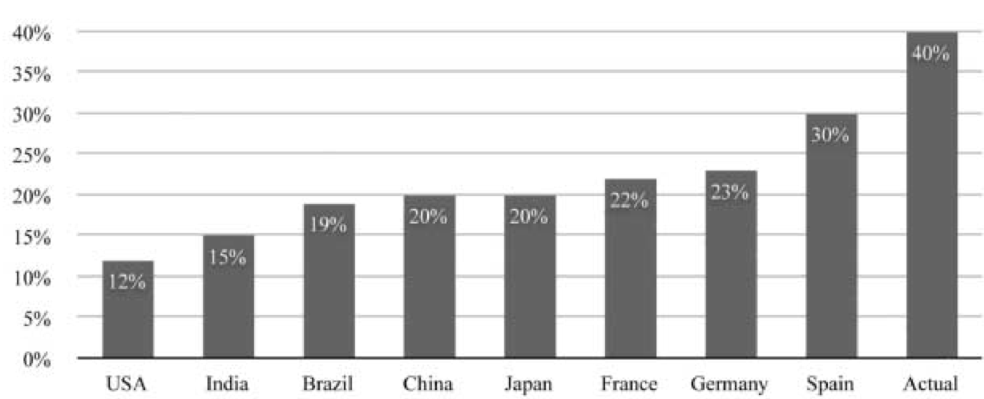
Carbon Emissions: Perception and Reality

Many real estate professionals believe that carbon emissions come primarily from vehicles and power plants; yet few recognize the magnitude of the contributions from real estate. A survey of building industry professionals globally shows that when asked the question: ''What percentage of CO_2 emissions do you think buildings give rise to—directly and indirectly?'' respondents reported a range of 12% to 30% depending on country of origin (Exhibit 2). Respondents in the U.S. reported the lowest estimates of all countries surveyed, at 12%, less than one-third the actual level of approximately 34% globally and 40% in developed economies (Price et al., 2006; World Business Council on Sustainable Development, 2009).

In the U.S., residential and commercial buildings account for more than 39% of all carbon emissions, more than either the transportation or industrial sectors. Commercial buildings account for 18% of total carbon emissions, whereas residential structures account for 21% (Exhibit 3). While carbon emissions for the economy as a whole are expected to grow at 1.2% annually, emissions from commercial real estate are expected to rise at nearly double that rate (McKinsey and Company, 2007). This is despite the recent awareness and increase in construction of ''green'' buildings in many countries throughout the world.

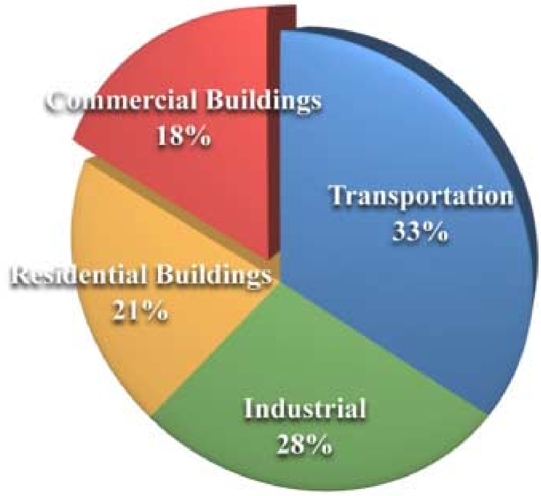
Fortunately, building energy conservation projects (EEI) represent some of the lowest cost, highest return investments available to reduce energy use and

Exhibit 2 | Perceived Emissions Generated by Real Estate



Source: World Business Council for Sustainable Development (2009).

Exhibit 3 | CO_2 Emissions by End Use



Source: Energy Information Administration (2007).

simultaneously reduce carbon emissions. The commercial real estate industry has a valuable opportunity to monetize emission reductions while simultaneously reducing operating expenses and modernizing their property portfolios.

Background on Greenhouse Gases and Carbon Emissions

Carbon emissions are greenhouse gases, produced largely by the burning of fossil fuels. They are generated either directly by the conversion of fuel such as natural gas into energy and heat in a building's central plant, or indirectly by a power company burning coal to generate electricity for building use. In either case, the exhaust gases released into the atmosphere—primarily carbon dioxide (CO_2) and nitrogen oxides—trap heat from the sun.[2] The accumulation of these gases in the atmosphere is believed to alter global climate patterns, leading to extreme weather events and changes to regional climates.[3] This is what is commonly referred to as 'global warming.' These events and changes negatively impact global gross domestic product, as well as affecting mankind's health and safety (CIER, 2007). Commercial real estate can also be affected through business interruption, higher insurance costs, and increased regulation that leads to higher construction costs or prohibits development in certain areas. Long-term shifts in customer demand to less risk-prone markets are also possible.[4]

The standard measure of greenhouse gas emissions is one metric ton of carbon dioxide equivalent (CO_2e), the global warming impact of one metric ton of atmospheric carbon dioxide. The "e" is an equivalent measure by which certain gases other than CO_2 are converted to a common unit of measure. This is referred to as the global warming potential (GWP) of a gas. Exhibit 4 lists several greenhouse gases and their relative GWP compared to CO_2.

When the global warming CO_2e of these gases is compared, fluorocarbons have a very high CO_2e; however, they are produced in much smaller quantities than CO_2. For example, fluorocarbons studied by the U.S. EPA account for only 2.2% of the total annual CO_2e emissions in the U.S.

Fossil fuel combustion produces several greenhouse gases including carbon dioxide, nitrogen oxides (NOx), sulfur oxides, and carbon monoxide. Utility-based power production is responsible for 27% of total NOx emissions in the U.S., second only to motor vehicles, which produce 49% of all NOx emissions (EPA, 1998). Avoiding the emission of one ton of N_2O (a common oxide of nitrogen) from fossil fuel combustion is equivalent to avoiding the emission of 310 tons of CO_2.

Carbon emissions from buildings accounted for more than 39% of all U.S. carbon emissions. The U.S. building sector was found to be responsible for direct and indirect emissions of 2.2 gigatons of CO_2e per year (U.S. EPA, 2010; author's calculation). Globally, buildings have been estimated to contribute to 34% of CO_2 emissions, which is somewhat higher for developed countries at approximately 40% (Price, et. al., 2006; World Business Council on Sustainable Development, 2009).

Efforts to Reduce Carbon Emissions

Over the past 15 years, there has been a global call to slow the impact of mankind's contribution to climate change. Meetings in Kyoto, Japan in 1997 provided the first significant recognition of the global impact of carbon emissions and globally warming. The Kyoto Protocol, adopted by 187 countries, established a framework for several non-U.S. carbon emission trading systems currently in operation. One of the most comprehensive programs is represented by the European Union Emission Trading Scheme (EU ETS), which was created in 2003 and took effect in January 2005. This multi-country, multi-sector Greenhouse Gas

Exhibit 4 | Global Warming Potential of Various Gases

Gas	Global Warming Potential	% of U.S. Emissions[a]
Carbon Dioxide (CO_2)	1	85.1%
Methane (CH_4)	21	8.2%
Nitrous Oxide (N_2O)	310	4.6%
Fluorocarbons (HFCs, PFCs, SF6)	11,700	2.2%

Note: The source is U.S. EPA (2010).
[a] mmtCO_2e.

(GHG) emission trading scheme is intended to allow member countries to meet their carbon emission reduction goals set forth by the Kyoto Protocol.[5]

In this program, emissions are capped on a country-by-country basis, and each country then allocates their allowances to large emitters across the range of regulated industries. Large emitters are assigned emissions allowances by their national government's National Allocation Plan (NAP). This allocation is accomplished through study of industry efficiency, economic development levels, anticipated growth, and industry input. These companies are required to reduce their emissions to meet their allocated cap within the compliance period. There are over 10,000 such facilities throughout the European Union and include such industries as electrical generation, pulp and paper, smelting and refining, and the production of iron and steel, cement, and chemicals.

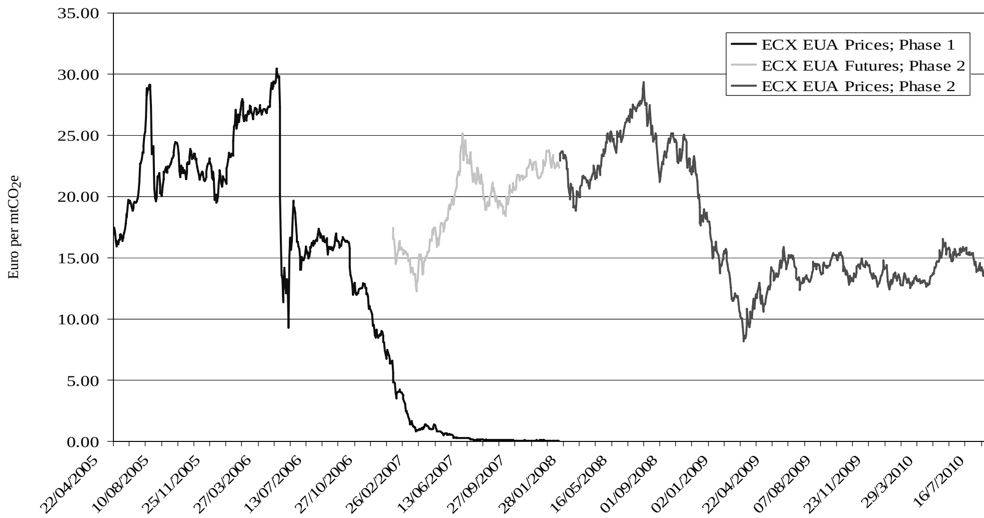
Large emitters are required to reduce their emissions to meet their cap within a series of compliance periods.[6] This activity provides the basis for what is known as a 'cap and trade' system, and can be illustrated through a generic example: Let's look at two power companies in Europe. A coal-fired power generating utility in Germany is required to reduce greenhouse gas emissions from 120 units to 100 units. In Spain, a power producer generates electricity from wind turbines, and has an allowance of 80 units but only uses 60 units because of the non-polluting wind energy. The Spanish company has excess offsets and can sell them via the cap and trade market to the German company to meet their emission reduction obligations.

Cap and trade markets work by setting a ceiling, or 'cap' on total emissions and allowing market forces to determine the price of emission reductions to comply with the cap. Entities participating in the cap and trade system can choose to reduce emissions internally or they can go to the market to buy or sell emission reductions to manage their obligations at a lower cost. Costly fines are levied for non-compliance, and emission reductions are required even if fines are levied.

One can gain a sense of the economics of a cap and trade system by looking at historical prices from the EU ETS market. The prices at which carbon offsets trade on the EU ETS index have ranged from €8.5 ($12.23) to €29 ($41.80) per metric ton in the 2008–2012 compliance period (Exhibit 5).[7] The EU ETS accounts for nearly 70% of all global carbon trading, with nearly 8.2 gigatons of CO_2e traded in 2009 (Mouawad, 2010).

While the U.S. has not ratified the Kyoto Protocol and does not have a national carbon emission market, regulated markets have been created on a regional level. The Regional Greenhouse Gas Initiative (RGGI), a coalition of ten New England and Mid-Atlantic states, established a regional cap and trade system with similarities to the EU ETS.[8] This market regulates only power sector emissions and quarterly emission allowance auction proceeds have totaled $662.8 million across eight auctions since September 2008.[9] Prices have ranged from $2.00 to $3.50 per ton since initiation, and reflect an over-allocation of emission allowances to utilities and a weak economy in the U.S., which has resulted in lower-than-anticipated demand for electricity.

Exhibit 5 | EU ETS Price History: 2005–2010



Source: http://www.ecx.eu/market-data/ecx-historical-data; author's chart.

California, along with ten other Western states and four Canadian provinces have created a similar cap and trade system, with stringent emissions reductions goals known as the Western Climate Initiative (WCI). The WCI applies to many sectors of the economy, not only power generation. The WCI is planned for full implementation by 2015 when it will cover 90% of all regional carbon emissions.[10] The Midwestern Greenhouse Gas Reduction Accord (MGGRA) is another example of an emerging multi-state emission reduction plan.[11]

The federal government has been debating various cap and trade systems to regulate greenhouse gases, although legislation has yet to be enacted. In February 2009, the Obama Administration released its proposal for the first nationwide carbon cap and trade market. Initial targets sought to reduce overall carbon emissions by 14% below 2005 levels by the year 2020 and 83% by 2050.[12]

In 2010, further federal progress appears to have slowed due to a lack of bipartisan political support in the U.S. Congress for a comprehensive climate and energy legislation. In response, the Clean Energy Jobs and American Power Act (Senate bill S.1733) was proposed in July 2010. This legislation would create a limited cap and trade program that applies only to the electric power sector and proposed to take effect in the year 2013. If a national cap and trade market is enacted in the U.S., it is not unreasonable to assume that over time, as caps are lowered, the price for emission reductions in the U.S. will rise toward levels seen in the EU ETS. This will likely accelerate if a functional global carbon cap and trade system is agreed-upon by the U.S., the European Union, and other major carbon-emitting countries.

Voluntary carbon markets also exist in the U.S. One example is the Chicago Climate Exchange. Compared to a regulated market, the voluntary market is small and carbon offset prices are considerably lower. Historic prices in the $2 to $3 per metric ton range have fallen to under $0.50 per emission reduction allowance in 2009 and 2010, due in large part to the recent global economic slowdown.

Thus far in the U.S., regional efforts to regulate carbon emissions have utilized a cap and trade approach. It is likely that a cap and trade solution will continue to be preferred over other options such as a carbon tax. Cap and trade programs that are currently operating or planned are constrained by limited geographic reach and also by a focus on only certain sectors of the economy. Until there is a comprehensive national carbon reduction program that encompasses all major sources of carbon emissions, it is unlikely that EU ETS-level pricing for carbon emissions will occur in the U.S.

Carbon Offset Additionality

In order to understand the impact of carbon-related improvements in commercial real estate, one needs to identify the level of activity that could occur, and which would qualify for inclusion in a functioning cap and trade market. This is referred to as *additionality*, and it is a complex term that pervades the carbon markets.[13] It refers to a specific, prescribed activity or investment that must take place in order to prove that emission reductions are a result of a conscious activity, and one that would have *not* occurred through business-as-usual practices. The retrofit of a functionally obsolete 30-year-old boiler in a commercial building illustrates the concept of additionality. Due to advancements in boiler technology over the past 30 years, all new boilers will likely be more efficient than the one being replaced. Because of this improvement, carbon emission reductions associated with this boiler retrofit that bring it up to current standards would be considered business-as-usual and therefore *would not* have additionality. If, on the other hand, the new boiler was one of the most efficient models available and perhaps utilized other systems to further boost its efficiency (e.g., co-generation), many of the emission reductions for the level of efficiency beyond the business-as-usual case would have additionality. This concept can be thought of like a sales quota plan in marketing. Only by exceeding the quota will a salesperson receive a bonus. Carbon offsets work in a similar manner. Investments in buildings that do not exceed a carbon market-recognized threshold of emission reductions (i.e., have additionality) will not receive a bonus—they will not be able to monetize the carbon offsets that could result from such activity. As a result of this concept of additionality, it is likely that a limited number of larger and highly energy-efficient properties will capture a disproportionate level of carbon offsets relative to their peers.

Emission Reduction Potential in Commercial Real Estate

Commercial real estate electricity use accounts for three quarters of all electricity consumption in the U.S. A conservative approximation of the level of carbon emissions from commercial real estate activity can be made by using federal electricity consumption information for commercial real estate and multiplying it by the U.S. average carbon emissions rates per unit of electricity production (pounds of CO_2 equivalent emissions per kilowatt-hour). Other forms of energy use in buildings, such as natural gas, also present carbon emission reduction opportunities. However, natural gas use in commercial buildings comprises only 8.2% of all natural gas use in the U.S. By comparison, natural gas used in residential buildings accounts for 21% of total yearly U.S. natural gas consumption (EIA, 2009). Due to the lower percentage consumption, as well as for clarity and simplicity, only emission reductions associated with electricity consumption are considered in our discussion.

Secondary carbon reductions that are a by-product of energy conservation measures are also excluded. An example of this would be more efficient lighting that, as a by-product, also reduces indoor heating loads, thereby reducing air-conditioning power consumption. In this case, secondary savings from the air-conditioning have been ignored even though they may be quantifiable and additional in a real world carbon emission reduction project. Excluding secondary sources of emission reductions also provides for more conservative assessment of economic value.[14]

Investable commercial buildings in the U.S. consume approximately 1.7 trillion kWh of primary electricity per year.[15] The average U.S. carbon emissions rate from the production of primary energy average 2.06 pounds per kilowatt-hour of electricity. Multiplying primary energy consumption and the average carbon emission rate and dividing by 2,204.6 (the number of pounds of CO_2 per metric ton) yields 1.6 billion metric tons. This is a gross (and conservative) approximation of the carbon emissions generated from U.S. investable commercial real estate on an annual basis.

In order to arrive at the net monetizable emission reduction potential, carbon offset additionality must be considered. As discussed, most emission reduction investments will not meet additionality requirements, although they will still generate significant operating cost reductions. For purposes of this research, it is assumed that industry-wide, commercial real estate emissions can be reduced by 30%.[16]

Of this 30% reduction, the assumption is that only a relatively small subset would be classified as having additionality. The actual percentage will be a result of many factors including regulations and energy codes, emission reduction schedules, incentive levels, and the rate of adoption of new technology. For purposes of the current discussion, approximately 1/6 of these reductions (or 5% of total carbon emissions) will qualify as having additionality.[17] This results in an annual level of tradable carbon emissions of approximately 79.8 million metric tons (Exhibit 6).

While the choice of additionality level may appear to be somewhat vague, there are some guidelines as to how it may be interpreted. In the U.S., there is a voluntary carbon market, which operates on the Chicago Climate Exchange (CCX). The CCX uses the EPA ENERGY STAR rating system to determine additionality, and an ENERGY STAR rating of 75 has been set as the threshold

Exhibit 6 | Emission Reduction Potential for Commercial Real Estate

CO_2 Emissions Generated by Electricity Consumption	Million Metric Tons of CO_2e
All commercial buildings	3,754
Investable commercial buildings	1,596
5% of investable commercial buildings emissions	79

Note: The source is EIA 2008; author's estimates.

for what constitutes additionality. Emission reductions that result from efforts required to bring a building up to an ENERGY STAR 75 rating cannot be monetized, while those associated with exceeding the ENERGY STAR 75 rating pass the CCX prescribed additionality test.

Value of Carbon Emission Reductions

To determine the value of potential carbon savings, a range of carbon prices is assigned to the quantity of offsets generated in Exhibit 6. The range of offset prices is shown in Exhibit 7. The range of prices for carbon offsets are derived from a low of \$3 per ton (RGGI market prices) to a high of \$35 per ton (EU ETS prices). As shown, the annual value of emission reductions ranges from a low of \$240 million to a high of \$2.80 billion. Assuming no growth in this market, the total capitalized value of carbon offsets for U.S. investable commercial real estate would range from approximately \$3.43 billion to \$40.0 billion.

While many emission reduction projects will not exceed the additionality threshold, a subset of assets will thus constitute the universe of properties that represent the values shown in Exhibit 7. The average impact of carbon offsets for these buildings could reasonably fall between \$0.01 and \$0.08 per square foot per year, assuming monetizable energy savings of 2.5 kWh per square foot per year.

Exhibit 7 | Value of Carbon Offsets for Commercial Real Estate

Price per Ton of CO_2	Annual Market Value of Emission Reductions (\$ billion)	Capitalized Value at 7% (\$ billion)
\$3	\$0.24	\$3.43
\$15	\$1.20	\$17.1
\$35	\$2.80	\$40.0

Note: The source is author's estimates.

In the case of a 1 million square foot building, this would represent an annual monitized value of between \$7,000 and \$82,000.[18] In low carbon price scenarios, carbon offsets are unlikely to be monetized, as even modest transaction costs would likely consume any marginal revenue. Yet as shown in this example, higher carbon prices (such as those experienced in the EU ETS market) could result in a value enhancement of \$1.2 million.[19] In a high carbon price scenario, this revenue should become a consideration when underwriting the scope and energy savings level to be attained by EEI investments. Note, this value is in *addition* to the value created through the reduction of electricity costs achieved by making EEI investments to the building.

Carbon Emissions, Physical Location, and Fuel Source

Property location will have a significant effect on emission reduction potential for EEI investments. Within the U.S., carbon emissions vary between electric utilities due to their power generation fuel sources and generation efficiencies. Carbon emissions per kilowatt-hour (kWh) of electricity vary by more than 550% from highest to lowest emitting states (Exhibit 8). North Dakota and Wyoming lead the nation in emissions, while Vermont and Idaho have the lowest. This suggests, ceteris paribus, investing in states with high levels of emissions will maximize the monetary impact of carbon offsets. This is evidenced by the fact that North Dakota has 55 times greater effective emissions (per kWh) than Vermont.

In the prior 1 million square foot building example, the carbon offset value was based on a carbon emissions rate equal to the U.S. *average* of 2.06 pounds of CO_2e per kWh of electricity. If the same EEI investment were implemented in North Dakota with its much higher emissions rate, annual revenue would exceed \$153,000 and the capitalized value would approach \$2.2 million, which is nearly double the prior example.

Price of Carbon

Given the level of average carbon emissions per kWh by states, the monetary value of savings associated with the offset of these emissions can be derived on a kWh basis. These results are shown in Exhibit 9.[20] In the exhibit, there are two values: one based on a carbon offset price of \$3 (RGGI market) and the other at \$35 (EU ETS market). The dollar value of CO_2 emissions at a \$3 price ranges from a low of nearly zero per kWh in Vermont, where the average level of emissions is very low, to a high of \$0.005 kWh in North Dakota, where a higher level of emissions has marginal value at this offset price.[21] As discussed earlier, transaction costs would likely preclude the decision to undertake a carbon-motivated improvement by itself at these price levels. However, at an offset price of \$35 per ton, the savings become more significant, ranging from \$0.001 per kWh in Vermont to \$0.061 per kWh in North Dakota. While these values may seem low, recall that they are based on a single kWh, and when scaled up for actual carbon savings associated with the operations of commercial real estate, could offer monetary benefit to a well-planned EEI investment strategy.

Exhibit 8 | Comparison of CO_2 Emissions by State

State	Effective CO_2 Emissions[a]	State	Effective CO_2 Emissions[a]
VT	0.070	U.S. AVERAGE	2.056
ID	0.188	MI	2.057
WA	0.491	MS	2.155
OR	0.612	AK	2.195
CA	0.802	NV	2.317
CT	0.968	NE	2.411
NJ	1.008	MT	2.415
ME	1.057	WI	2.510
NH	1.070	OK	2.537
RI	1.166	MN	2.609
NY	1.221	SD	2.628
SC	1.335	DE	2.698
IL	1.611	MO	2.756
MA	1.616	HI	2.767
LA	1.694	OH	2.871
AZ	1.743	CO	2.875
PA	1.776	KS	3.053
AR	1.791	IA	3.067
VA	1.799	KY	3.091
TX	1.809	WV	3.148
NC	1.811	IN	3.168
GA	1.893	UT	3.253
AL	1.920	NM	3.338
TN	1.953	WY	3.527
MD	2.026	ND	3.865
FL	2.038		

Notes: The sources are EPA (2007) and author's calculations.
[a] lbs / kWh.

Price of Electricity

Traditionally, the investment decision for energy conservation measures has been based on energy cost reductions and their relation to the capital cost of implementation. Investment is made when an acceptable return on investment is expected. Notwithstanding the value of carbon offsets, the cost of electricity significantly impacts the attractiveness of EEI investments in certain markets. For

Exhibit 9 | \$ Value of CO_2 Emissions per kWh at \$3 and \$35 per Ton Carbon Prices

State	\$ Value of Carbon Emissions per kWh at \$3	\$ Value of Carbon Emissions per kWh at \$35	State	\$ Value of Carbon Emissions per kWh at \$3	\$ Value of Carbon Emissions per kWh at \$35
VT	0.000	0.001	FL	0.003	0.032
ID	0.000	0.003	MI	0.003	0.033
WA	0.001	0.008	MS	0.003	0.034
OR	0.001	0.010	AK	0.003	0.035
CA	0.001	0.013	NV	0.003	0.037
CT	0.001	0.015	NE	0.003	0.038
NJ	0.001	0.016	MT	0.003	0.038
ME	0.001	0.017	WI	0.003	0.040
NH	0.001	0.017	OK	0.003	0.040
RI	0.002	0.019	MN	0.004	0.041
NY	0.002	0.019	SD	0.004	0.042
SC	0.002	0.021	DE	0.004	0.043
IL	0.002	0.026	MO	0.004	0.044
MA	0.002	0.026	HI	0.004	0.044
LA	0.002	0.027	OH	0.004	0.046
AZ	0.002	0.028	CO	0.004	0.046
PA	0.002	0.028	KS	0.004	0.048
AR	0.002	0.028	IA	0.004	0.049
VA	0.002	0.029	KY	0.004	0.049
TX	0.002	0.029	WV	0.004	0.050
NC	0.002	0.029	IN	0.004	0.050
GA	0.003	0.030	UT	0.004	0.052
AL	0.003	0.030	NM	0.005	0.053
TN	0.003	0.031	WY	0.005	0.056
MD	0.003	0.032	ND	0.005	0.061

those who have performed energy audits of their properties in several markets, this will not come as a great surprise, and countless energy conservation businesses exploit this to target customers in high energy cost markets.

What is rather surprising is the lack of awareness by many (if not most) real estate investors about the variation in commercial electricity prices from one market to another. For example, average commercial electricity prices per kWh in 2006 range from a low of \$0.052 in Idaho to a high of \$0.214 in Hawaii, with a U.S. average of \$0.095 (Exhibit 10). Put another way, base electricity prices vary 415% from lowest to highest cost states.[22]

Exhibit 10 | Commercial Electricity Price by State

State	Electricity Price[a]	State	Electricity Price[a]
ID	$0.051	TN	$0.080
WV	$0.056	AL	$0.081
MO	$0.061	WI	$0.084
UT	$0.061	OH	$0.085
VA	$0.062	MI	$0.088
NE	$0.062	PA	$0.089
WY	$0.062	LA	$0.090
ND	$0.063	MS	$0.091
SD	$0.064	U.S. AVERAGE	$0.094
KY	$0.065	TX	$0.097
WA	$0.066	FL	$0.099
AR	$0.068	NV	$0.101
KS	$0.069	MD	$0.103
OR	$0.070	DE	$0.109
MN	$0.070	VT	$0.117
NC	$0.072	AK	$0.117
IN	$0.072	NJ	$0.118
OK	$0.072	ME	$0.124
IA	$0.073	CA	$0.131
CO	$0.075	RI	$0.135
MT	$0.075	NY	$0.136
NM	$0.077	NH	$0.138
SC	$0.077	CT	$0.138
AZ	$0.079	MA	$0.158
GA	$0.079	HI	$0.214
IL	$0.080		

Notes: The source is EIA (2007).
[a] $ per kWh.

Electricity Prices and Carbon Emissions

If one considers the value of carbon emissions in *addition* to the value of energy cost reductions when making an EEI investment decision, alternative outcomes from an energy-cost-only perspective may be warranted. Carbon offset value could make EEI investment in low-cost power states *more* attractive while spurring greater conservation efforts in virtually all locations.

Electricity prices and carbon emissions exhibit negative cross-correlation. This suggests that states with higher CO_2 emissions are associated with lower electricity cost (Exhibit 11). For example, Utah has the fourth *highest* level of emissions per kWh (Exhibit 8) while its electricity prices are the fourth *lowest* (Exhibit 10). This is driven in part by the fact that places with lower electricity costs are likely to have power created by coal-fired electricity plants, which are typically a cheaper source of power, but associated with higher levels of carbon emission.

Until there is a national policy for dealing with carbon emissions, EEI investment will likely remain concentrated in higher electricity price regions; regions that correlate to lower carbon emissions.[23] In this case, energy use reductions will be achieved, but industry-wide emission reductions will *not* be maximized. As a result, the role that commercial real estate investment (and corresponding EEI) will play in the reduction of greenhouse gases may be limited.

One can examine the *relative* economics of carbon value with electricity value in EEI investments by comparing the ratio of carbon emission value per kWh divided by electricity value per kWh. The ratio indicates the relative attractiveness of EEI investment value when considering a given carbon offset price and electricity price. For a ratio less than 1, this means the value of electricity reductions is greater than the value of emission reductions. From a relative *economic* perspective, the closer the ratio is to zero suggests that EEI investment will be driven more by electricity costs than carbon offset value. However, even with a ratio less than one, some level of carbon offset value will be generated, depending on the state location of the property. Exhibit 12 presents this ratio for a carbon offset price of $3 per ton.

In Utah, for example, at a $3 per ton offset price, the ratio of carbon savings to energy savings is 0.066. Subject to the earlier discussion on additionality, this can be interpreted as follows: for every dollar of electricity savings per kWh on commercial real estate in Utah due to EEI, there will also be 6.6 cents of savings from carbon offsets. While these numbers are not large, they come in addition to the electricity savings already being received, and can thus be thought of as an additional value that is associated with EEI investment. While there is carbon offset value in nearly all states at the offset price of $3 per ton, in most locations it is relatively small and unlikely to shift investments away from higher electricity price markets. This implies that carbon offsets priced at levels observed in the

Exhibit 11 | Correlation between CO_2 Emissions and Electricity Cost

	CO_2 Emissions by State (Lb/kWh)	Electricity Cost ($/kWh)
CO_2 Emissions by State (Lb/kWh)	1.00	
Electricity cost ($/kWh)	−0.32	1.00

Exhibit 12 | Ratio of \$3 / ton CO_2 Emissions Value to Electricity Value per kWh

State	Ratio of Emission Value to Electricity Value	State	Ratio of Emission Value to Electricity Value
VT	0.000	VA	0.032
ID	0.000	MS	0.033
CT	0.007	MI	0.034
NH	0.007	WI	0.036
CA	0.008	DE	0.037
ME	0.008	AL	0.037
NJ	0.008	TN	0.038
MA	0.013	GA	0.038
OR	0.014	MT	0.040
NY	0.015	OK	0.042
RI	0.015	OH	0.047
WA	0.015	NE	0.048
HI	0.019	CO	0.053
TX	0.021	IA	0.055
LA	0.022	IN	0.056
PA	0.022	MN	0.057
IL	0.025	KS	0.058
AZ	0.025	KY	0.062
AK	0.026	SD	0.063
SC	0.026	NM	0.065
NC	0.028	MO	0.066
MD	0.029	UT	0.066
AR	0.029	WV	0.071
NV	0.030	ND	0.079
FL	0.030	WY	0.081
U.S. AVERAGE	0.032		

U.S. RGGI market are unlikely to become a major factor affecting EEI investment decisions in most states.

If, however, market pricing as observed in the regulated markets in Europe (EU ETS) are assumed, the results change significantly. Exhibit 13 presents the ratio of carbon offset value to electricity price at an offset value of \$35 per ton. At \$35 per ton, not only do the carbon offset values become significant, but they can re-order the priority list of most financially attractive markets for EEI investment. This can be illustrated by examining state of Vermont. Vermont has the 11th highest electricity price among all U.S. states at a cost of \$ 0.117 per kWh (Exhibit

Exhibit 13 | Ratio of $35/ton CO_2 Emissions Value to Electricity Value per kWh

State	Ratio of Emission Value to Electricity Value	State	Ratio of Emission Value to Electricity Value
VT	0.009	MI	0.375
ID	0.059	GA	0.380
CA	0.099	TN	0.388
CT	0.109	DE	0.394
WA	0.121	NC	0.403
NH	0.123	AR	0.412
NJ	0.136	VA	0.468
ME	0.137	WI	0.476
NY	0.140	MT	0.507
RI	0.141	OH	0.541
OR	0.143	OK	0.556
MA	0.165	MN	0.586
HI	0.206	NE	0.613
SC	0.273	CO	0.613
TX	0.299	SD	0.656
AK	0.299	IA	0.671
LA	0.300	NM	0.688
MD	0.311	IN	0.694
PA	0.315	KS	0.696
FL	0.323	MO	0.721
IL	0.325	KY	0.754
U.S. AVERAGE	0.351	UT	0.852
AZ	0.354	WV	0.893
NV	0.366	WY	0.903
AL	0.370	ND	0.968
MS	0.374		

10), making it a strong candidate for EEI investment today—when carbon has no value. When carbon offset value is considered at $35 per ton, Vermont falls to 50th on the list (Exhibit 13). Vermont is one of only two states that do not operate coal-fired power plants; almost three quarters of its energy comes from a nuclear power plant and much of the rest from hydroelectric sources that do not produce carbon emissions (U.S. Energy Information Administration, 2010).

Perhaps a more relevant comparison to illustrate the value of carbon offsets can be made through a comparison between states. For example, electricity prices are 5.3% higher in Arizona ($0.079 per kWh) than Colorado ($0.075 per kWh).

Referring back to Exhibit 13, note that the ratio of emission value to electricity price (at a $35 offset price) is higher in Colorado (0.613) than Arizona (0.354). In other words, the relative value of carbon emission reductions is greater in Colorado than in Arizona. For every $1 of electricity savings in Colorado, there is an additional $0.613 in carbon offset value, whereas in Arizona, the additional carbon savings are $0.354, a difference of 42%. Despite the higher electricity costs in Arizona, and hence greater savings from EEI investments, greater carbon offset values make an identical EEI project in Colorado more financially attractive than one in Arizona (Exhibit 14). This illustrates the potential value of carbon offsets in locations where emissions from the production of electricity are high. In most states, carbon offset values add between $0.10 and $0.70 in value for every $1.00 of electricity value saved.

As these examples illustrate, the decision of where to prioritize EEI investment becomes more than simply identifying the highest electricity prices—when carbon emission reductions have sufficient value. At higher carbon offset prices, there is likely to be significant interest in the monetization of commercial real estate carbon emission reductions associated with EEI investment.

Additional Considerations

Given the undefined nature of real estate participation in carbon markets in the U.S., a series of assumptions have been made to arrive at the conclusions. There are a number of additional considerations that are likely to have an effect on the eventual structure, value, and attractiveness of carbon offset generation by commercial real estate EEI investment. These are summarized below to highlight areas of uncertainty, as well as relevant efforts already underway.

Unequal Offset Generation. Carbon offset generation will likely be unevenly distributed throughout the commercial real estate industry. Although significant cost-effective energy conservation is possible for all asset types, some will likely see more retrofit activity than others. For example, EEI investment may occur in the office sector before the multifamily residential sector due to centralization of building systems and improved economies of scale. Additionally, large portfolios are in a better position to identify and implement the most attractive offset-producing projects at scale and with lower transaction costs across multiple

Exhibit 14 | Comparison of EEI Investment in Arizona and Colorado

($ per kWh)	Arizona	Colorado
Electricity Price	$0.079	$0.075
Carbon Offset Value ($35)	$0.028	$0.046
Total	$0.107	$0.121
Difference		+13%

markets. Triple-net lease structures will remain a split incentive barrier throughout the industry. While value from both carbon offsets and electricity savings may be recognized, the ability to assign or share these benefits between owner and tenant will continue to create challenges. Tenants with long-term leases may have more incentive to push for EEI efforts, while those with shorter leases may have more incentive to resist capital expenditures by the owner to achieve these benefits.

Additionality Threshold. Considerable debate will precede the adoption of an additionality standard. Regulators and industry participants will need to work collaboratively to set an appropriate threshold. Utility companies and others are also likely to have a voice in the discussion. Evolving technologies and market demand for exceptionally energy-efficient buildings will allow some developers and owners to surpass the additionality threshold, even as it rises over time. A methodology for effective real estate participation in carbon markets should account for this complexity with a robust mechanism that adjusts in a predictable, consistent way to changes over time, while meeting the goals of regulators and the realities of the real estate industry.

Current Carbon Market Methodologies. Several standards exist today for commercial real estate participation in carbon markets. These have yet to see widespread adoption, due in part to high transaction costs, low carbon offset value, proprietary information, and limited scalability. The Chicago Climate Exchange (CCX) has established a methodology available to CCX-member companies for quantifying and certifying energy efficiency-based emission reductions.

Methodologies also exist in the European Union Emissions Trading Scheme (EU ETS). But of more than 1,400 registered Clean Development Mechanism (CDM) projects, only 18 projects deal with energy demand reduction, and only four deal with real estate.[24] The administrative burden under the CDM is a particular challenge. This is beginning to receive attention, but is unlikely to be fully restructured soon. CDM projects also must be implemented in non-Annex B countries (more commonly referred to as developing countries). U.S.-based emission reduction projects are therefore prohibited from entering the CDM pool.

White Tags. White tags, or energy efficiency certificates, allow businesses and utilities to meet conservation and renewable portfolio standard requirements by purchasing certificates generated by third parties. Connecticut is one of a few states that have implemented such a system. The market acceptance of white tags has been somewhat limited. Also, due to a lack of a nationally accepted standard or market for white tags, the additionality criteria are subject to scrutiny and in some cases skepticism.

First Mover Advantage. Those companies that choose to take advantage of carbon offset savings may enjoy a first mover advantage. While the costs to a first mover include a steeper learning curve and perhaps less efficiencies in the market, they will enjoy the marketing advantages that come with ‘greening’ their property portfolio. These can add value for those wishing to pursue an SRI (socially responsible investment) initiative or use such initiatives to send behavior signals to the marketplace.

Utility Incentives and Rights to Benefits. Utility incentives are available in many markets to subsidize the cost of energy efficiency improvements. By claiming the resulting kilowatt-hour reductions, utilities meet their regulated quotas (as discussed in *White Tags* above). When utilities are regulated in a carbon market, they will continue to count energy reductions and associated emission reductions for their own requirements. Building owners will not be allowed to claim the same emission reductions. In this scenario, EEI investors will need to decide at the outset if they are going to accept utility incentives and forego title to the carbon offsets, or if they will decline utility incentives and seek to monetize emission reductions themselves. This decision will depend largely on how cost-effective it is to monetize offsets, as well as the perceived risk of successfully monetizing them. For many, utility incentives may be the faster, simpler solution.

Securitization. Once a sufficient pipeline volume of carbon offsets from EEI investment is flowing, financial products that enable better risk management can be created. One example is the securitization of bundles of carbon offsets aggregated from portfolios of EEI projects. This may reduce uncertainty of offset delivery among those who invest in securitized carbon offset bundles. This ''carbon offset-backed security'' will likely carry with it the current stigma from the mortgage-backed security market failures over the recent past. If and when market confidence returns, securitization may be a viable tool for risk reduction, along with potentially more efficient pricing in the marketplace.

Conclusion

This paper describes a scenario where the U.S. commercial real estate industry, through participation in emerging carbon emission markets, can create up to $2.8 billion in revenue with a capitalized value of $40.0 billion. This can be accomplished by implementing energy conservation projects and developing highly energy-efficient buildings that reduce operating costs from electricity use while also reducing carbon emissions.

The value of emission reductions in real estate is dependent on a number of factors. These include achieving sufficient emission reductions to meet additionality requirements, scalability to reduce transaction costs, and the market price of carbon offsets. This research addresses this uncertainty by assuming that gross emission reductions for commercial real estate will reach 30% industry-wide, but that only 5% of gross emission reductions will be monetized in the carbon market after meeting additionality requirements and overcoming transaction cost barriers. This equates to 79.8 million metric tons of CO_2e emission reductions per year.

At a low offset price scenario of $3 per metric ton CO_2e, it is unlikely that investors in commercial real estate will seek to monetize emission reductions, due in large part to an inability to overcome transaction costs. In a high price carbon offset scenario of $35 per metric ton CO_2e, there is likely to be significant interest in monetizing emission reductions. In fact, in some states the value of carbon offsets nearly equals the value of electricity savings at these prices. When the value of carbon offsets is considered, they can re-prioritize which states are most attractive for EEI investment. This is most notable in states that have relatively low energy prices combined with high carbon emissions per kWh of electricity produced.

The value of carbon emissions reductions is dependent upon three major factors: electricity price, carbon emissions offset price, and carbon emissions rate per kWh. Electricity prices vary more than four times across all 50 states and carbon emissions per kWh vary in excess of 55 times. Both factors should be considered to monetize emission reductions effectively. Recognizing these factors will spur EEI investment in markets that have high carbon emissions rates but moderate-to-low electricity prices. This can lead to greater adoption of energy conservation measures that both reduce electricity costs and also maximize carbon emission reductions from the commercial real estate industry.

There is uncertainty in the exact value of emission reductions from EEI investment in commercial real estate. Despite the limitations discussed, there is potential for EEI investments to access a new source of revenue to incentivize greater energy conservation investment. This incentive can help maximize industry-wide carbon emission reductions. This will help meet the objective of the carbon markets: to spur meaningful and additional carbon emission reductions efficiently and at the lowest cost in order to lower the carbon footprint in an increasingly challenged environment.

An efficient carbon market will present significant opportunities to support greater investments in energy conservation that lower carbon emissions in the commercial real estate industry. This will not only help modernize buildings and reduce operating costs, but also reduce the impact of commercial buildings on the environment. This benefits owners, occupants, and society while reducing the impact of building operation on the natural environment.

Endnotes

1 EEI is construed to represent any capital expenditure undertaken in an effort to lower energy consumption in the ownership and operations of real estate. Examples could include upgrades in lighting, heating and cooling systems, control systems, and roofing upgrades.

2 Nitrogen oxides are often referenced as NO_x and are measured alongside CO_2 when measuring greenhouse gas emissions.

3 Extreme weather events include increased frequency and severity of hurricanes, cyclones, tornadoes, and the like. Examples of climate change could include water shortages and desertification.

4 Examples could include the reluctance by some companies to move back into New Orleans in the aftermath of Hurricane Katrina.

5 See http://ec.europa.eu/environment/climat/emission/index_en.htm.

6 The first compliance period, Phase I, was 2005–2007. Phase *2* runs from 2008–2012, with discussions currently underway to establish a successor phase.

[7] As of July 2010, prices were generally in the \$20–\$23 U.S. dollar range. Pricing data are available from http://www.ecx.eu/ECX-EUA-Indices.

[8] See http://www.rggi.org/home.

[9] See http://www.rggi.org/co2-auctions/results.

[10] See http://www.westernclimateinitiative.org/designing-the-program.

[11] See http://www.midwesternaccord.org/.

[12] The cost of emissions certificates were projected to be in the \$13–\$20 per ton range (Carey, 2009).

[13] The term ‘additionality’ is widely recognized globally and pertains to carbon emission reduction projects. A technical definition for additionality, based on the United Nations Framework Convention on Climate Change (UNFCCC), enacted in 1994 and supported by 165 signatory countries, may be found at: http://www.cdmrulebook.org/84.

[14] The impact of natural gas use and secondary carbon reductions could improve the results reported in this study by approximately 10%–15%.

[15] First, for purposes of discussion, it is assumed that ‘investable’ real estate comprises approximately 60% of the overall commercial real estate market. This statistic was derived from the 2003 Energy Information Administration-Commercial Buildings Energy Consumption Survey, Table IA. From the total square footage of all buildings listed, we deducted those classified as education, museums, places of worship, and other categories not deemed to relevant for commercial ‘investment.’ Second, primary electricity is the electricity generated at the generation source before accounting for transmission and distribution losses.

[16] A number of studies and reports suggest that 30% is a reasonable target to achieve. Deutsche Bank’s real estate group, RREEF, has committed to reducing energy consumption of its global portfolio by 30% by 2012 (Carpenter and Wyman, 2009). Research into the performance of LEED certified buildings found that on average the green buildings studied used 30% less energy than regular buildings (Kats, 2003). The McKinsey greenhouse gas abatement cost curve study assumed a carbon emissions abatement potential of 30% for real estate in the U.S. and 25% for China (Nauclér and Enkvist, 2009).

[17] For example, if total emissions were 100 units, and EEI measures reduced emissions by 30 units, only 5 units (1/6th of the 30 units reduced) are assumed to have additionality.

[18] Assume an EEI project results in 2.5 kWh/SF energy savings that can be monetized via emission reductions: 2.5kWh $\times$ 2.06 Lb/kWh /2204.6 metric tons $\times$ 1,000,000 SF $\times$ carbon offset price (at \$3 and \$35) = \$7,008 and \$81,761 respectively.

[19] Using a 7% capitalization rate on offset value.

[20] These figures are derived by taking the average level of carbon emissions by state times the carbon offset price and dividing this product by 2,204.6 (the number of pounds in a metric ton).

[21] Vermont has a positive value for this statistic, but due to rounding, the result shows up as zero.

[22] Billed electricity costs will vary due to time-of-use, demand charges, as well as additional fees and taxes.

[23] Here and throughout this paper, the effect of utility and/or government involvement (incentives, rebates, regulations, etc.) in energy efficiency programs has been excluded due to inconsistencies from market to market and because they tend to distort price signals for EEI investment decisions.

[24] See: http://cdm.unfccc.int/Projects/projsearch.html.

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Aaron G. Binkley, AMB Property Corporation, San Francisco, CA 94108 or abinkley@alum.mit.edu.

Brian A. Ciochetti, Massachusetts Institute of Technology, Cambridge, MA, 02139 or tc@mit.edu.