

Carbon Markets: A New Revenue Source for Commercial Real Estate?

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Abstract

Global warming is one of the most pressing environmental issues facing our society today. As we continue to consume more fossil fuels, greenhouse gasses are increasing at alarming rates. Real estate is one of the largest contributors to the emission of CO₂ gasses and yet our industry knows very little about this topic. In this paper, we provide a background on carbon markets and their potential role in a proposed strategy for energy efficiency improvements (EEI). We examine the relationship between investment decisions based solely on electricity prices, as compared to one that incorporates the monetary benefit associated with carbon offsets. Results suggest that significant value can be created through carbon offset value, and that such a strategy for EEI can also provide a significant improvement in the carbon footprint of commercial real estate.

Introduction

Momentum is growing within the United States to better understand the causes and consequences of “global warming”. While debate continues as to what the best course of action may be to deal with this phenomenon, one fact remains clear. Our continued reliance on fossil fuels as a primary source of energy will have dire consequences to our environment. As the world continues to develop at unprecedented speed, the impact on global warming is increasing at an increasing rate (The Economist [2009]). In the US, major industrial sectors of the economy 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 foreseeable 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 (see 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. We identify the operational carbon footprint of investable US commercial real estate and estimate the emissions reduction potential within the industry. We also estimate a range of carbon offset prices to determine the value of carbon emission reductions for commercial real estate. A geographical comparison of the relative value of emission reductions is made which allows for a location-based model of emission reduction investment. We conclude the paper with a discussion of major opportunities and barriers to realizing carbon emissions value given current industry practices and lack of regulatory certainty.

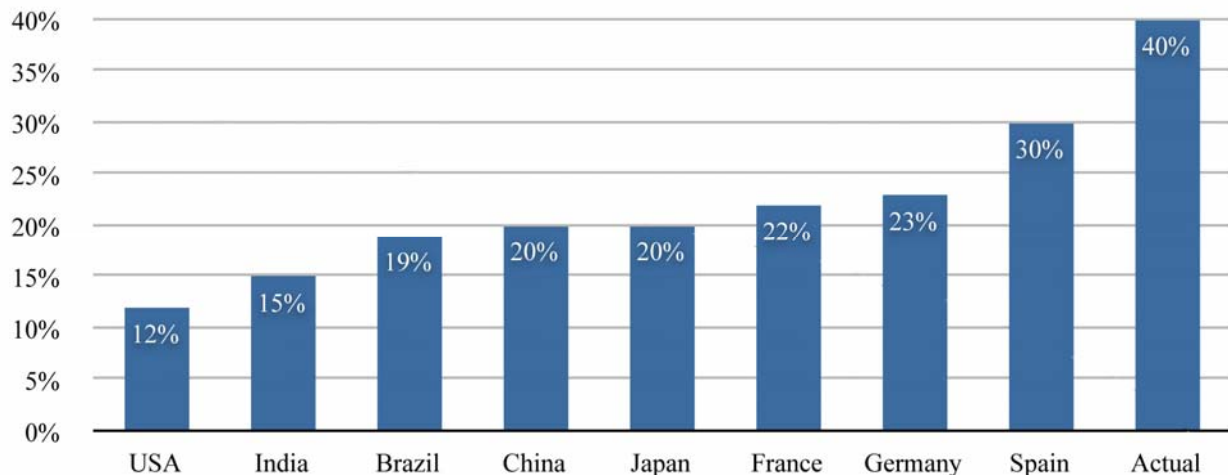
In this paper, we propose a scenario where carbon emission reductions from investments in *energy efficiency improvements* (EEI) in both existing and new construction can be monetized in a regulated carbon market. We construe EEI to represent any capital expenditures undertaken in an effort to lower energy consumption in the ownership and

operations of commercial real estate.¹ This creates a new revenue stream that justifies greater investment in energy conservation projects, which in turn, reduce carbon emissions. Projected revenue from emission reductions are estimated at up to \$2.86 billion annually in the US commercial real estate industry; a capitalized value of \$35.75 billion.²

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 CO₂ emissions do you think buildings give rise to - directly and indirectly?” respondents reported a range of 12% to 30% depending on country of origin (*Figure 1*). Respondents in the US reported the lowest estimates of all countries surveyed, at 12%, less than one third the actual level of 40% on a global basis.

Figure 1: Perceived Emissions Generated by Real Estate



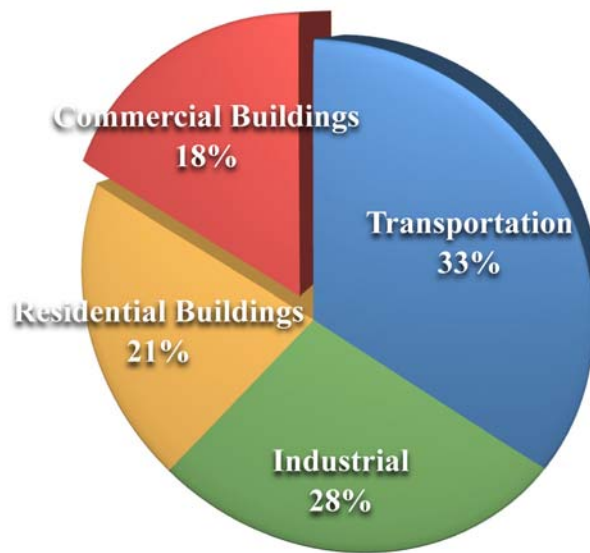
Source: World Business Council for Sustainable Development, 2007

¹ Examples could include upgrades in lighting, heating and cooling systems, control system and roofing upgrades.

² See World Business Council for Sustainable Development [2009].

In the United States, residential and commercial buildings account for over 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% (*Figure 2*). 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 at nearly double that rate, or 2% per year (Creys, et. al. [2007]). This is in spite of the recent awareness and increase in construction of “green” buildings in many countries throughout the world.

Figure 2: Carbon Dioxide Emissions by End Use



Source: Energy Information Administration, 2007

Fortunately, building energy conservation projects (EEI) represent some of the lowest cost, highest return investments available to reduce energy use and 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 (CO₂) and nitrogen oxides (N_x) - trap heat from the sun. 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 we commonly refer 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 interest in carbon emission reductions is the result of a global call to slow the impact of mankind's contribution to climate change. This is being implemented directly through market-based regulatory mechanisms that put a price on carbon emissions, or indirectly through the taxation of fossil fuels. The regulated markets are commonly referred to by their "cap and trade" structure. The Kyoto Protocol established a framework for several non-US carbon emission trading systems currently in operation, with the European Union Emission Trading Scheme (EU-ETS) as the best-recognized market. The US is neither signatory to the Kyoto Protocol nor currently affiliated with the EU-ETS (UNFCC [1997]).

The EU-ETS began operation in 2006 with emission regulations for major carbon-emitting economic sectors including heavy manufacturing, utilities and cement

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.

production. The regulations are set in two phases up through 2012, at which time ratification of a successor agreement by Kyoto member countries is expected. It is widely believed that a regulated US carbon market would be compatible with this extension, if not a party to it.

There have been several recent regional efforts to reduce carbon emissions in North America through cap and trade mechanisms. The two most prominent are the *Regional Greenhouse Gas Initiative* (RGGI) and the *Western Climate Initiative* (WCI). These two, non-interlinked cap and trade programs cover seventeen states and four Canadian provinces. RGGI regulates emissions only from the power sector and there has been trading activity since September 2008 when the first of three allowance auctions took place. The WCI proposal is more comprehensive in scope and regulates sectors responsible for 90% of all carbon emissions in this region. Included are not only the heavy industries and the power sector (as in the EU-ETS), but also transportation and real estate fuel use. However, the WCI is still in the development phase and emission trading for this program is projected to begin in 2012.⁵

There are significant efforts underway in the US to develop and implement economy-wide, market-based, carbon cap and trade markets. In February 2009, the White House administration, released its proposal for the first nationwide carbon cap and trade market, slated to start in 2009.⁶ Initial targets are to reduce overall carbon emissions by 14% below 2005 levels by 2020 and 83% by 2050. Estimated revenue of \$646 billion from 2012 to 2019 would come from auctioning the rights to produce carbon emissions. The estimated cost associated with the right to produce these emissions is projected to be in the \$13 to \$20 per ton range (Carey [2009]).

Other plans are being discussed and while the details may differ, most plans are fundamentally similar to the EU-ETS in approaches to regulating carbon emissions. It is reasonable to assume that over time, as caps are lowered, the price for emission

⁵ Additional information on RGGI and WCI may be sourced at www.rggi.org and www.westernclimateinitiative.org, respectively.

⁶ For more information on the proposed cap and trade system see The Economist [2009].

reductions in the US will rise to levels comparable to those seen in the EU-ETS. This will likely accelerate if a functional global carbon cap and trade system is agreed-upon by the US, the EU and other major carbon emitting countries.

The carbon cap and trade system is driven by the desire to limit the amount of greenhouse gasses emitted into the atmosphere. But how are these gasses categorized? The standard measure of greenhouse gas emissions is one metric ton of carbon dioxide equivalent (tCO₂e), the global warming impact of one metric ton of atmospheric carbon dioxide. The “e” is an *equivalent* measure by which certain gases other than carbon dioxide are converted to a common unit of measure. This is referred to as the *global warming potential* (GWP) of a gas. *Figure 3* lists several greenhouse gases and their relative GWP compared to carbon dioxide.

Figure 3: Global Warming Potential of Various Gases.

Gas	Global Warming Potential
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous Oxide (N ₂ O)	310
Trifluoromethane (HFC-23)	11,700

Source: University of Washington, 2008

Fossil fuel combustion produces several greenhouse gases including carbon dioxide, nitrogen oxides, sulphur oxides, and carbon monoxide. Avoiding the emission of one ton of N₂O from fossil fuel combustion is equivalent to avoiding the emission of 310 tons of CO₂.⁷ Utility-based power production is responsible for 27% of total NO_x emissions in

⁷ The combination of N₂O and NO are commonly referred to as NO_x and are measured alongside CO₂ when measuring greenhouse gas emissions.

the US, second only motor vehicles which produce 49% of all NOx emissions (EPA [1998]).⁸

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. 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 thirty year old boiler in a commercial building illustrates the concept of additionality. Due to advancements in boiler technology over the past thirty 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 replacement 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 the most efficient model available and perhaps utilized other systems to further boost its efficiency (for example 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 salesman receive his or her 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 highly energy efficient properties will capture a disproportionate level of carbon offsets relative to their peers.

⁸ HFC-23 is used in the manufacture of the refrigerant commonly known as 'R-22'. R-22 is found in commercial real estate in packaged air conditioners, heat pumps, chillers, retail food refrigeration and cold storage warehouses. Reductions in the demand for R-22 reduce the demand and production of HFC-23.

Size of the Global Carbon Market

An efficient carbon emission market harnesses market dynamics to produce the greatest amount of emission reductions at lowest costs across regions and industries. Carbon taxes have also been discussed as a way to place a price on carbon emissions, but thus far market-based mechanisms have been preferred by most regulators and within industry. A global carbon market, to which a regulated US market could be linked, will likely be established in the next several years.

The value of a comprehensive global carbon market is the subject of not only considerable speculation, but also considerable size. Studies estimate the global economic value of mitigating carbon emissions from all sources at 0.6% to 1.4% of Global GDP by the year 2030, or between \$675 billion and \$1.48 trillion (Enqvist, et. al. [2007]).

In 2006, the actual global carbon market was valued at \$32 billion, and doubled to \$64 billion in 2007. By 2008 the total carbon market value exceeded \$118 billion, a growth of over 84% from 2007 (World Business Council on Sustainable Development [2009]). Continued growth in the market is expected as more countries, in particular the US, regulate carbon emissions.⁹

Emission Reduction Potential in Commercial Real Estate

Commercial real estate electricity use accounts for three quarters of all electricity consumption in the US. 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 US average

⁹ On a per capita basis, the US has the highest energy consumption of any country in the world, at 91,000 kWh per year. This is twice the level of Europe and seven times the level of China.

carbon emissions rates per unit of electricity production (referred to as kilowatt-hour (kWh)). 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 US (EIA [2009]). By comparison, natural gas used in residential buildings accounts for 21% of total yearly US natural gas consumption. 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.

We have also excluded secondary carbon reductions that are a by product of energy conservation measures. 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.¹⁰

Investable commercial buildings in the US consume 1.76 trillion kWh of primary electricity per year.¹¹ Carbon emissions from the production of primary energy average 2.06 pounds per kilowatt-hour of electricity nationally. Multiplying the two and dividing by 2,204.6 (the number of pounds of CO₂ per metric ton) yields 1.64 billion metric tons. This is a gross (and conservative) approximation of the carbon emissions generated from US investment grade commercial real estate.

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, we assume that industry-wide,

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

¹¹ For purposes of discussion, we assume that 'investable' real estate comprises 60% of the overall commercial real estate market.

commercial real estate emissions can be reduced by 30%. Of this 30% reduction, we assume 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 our current discussion, we assume that approximately 1/6 of these reductions (or 5% of total carbon emissions) will qualify as having additionality. This results in an annual level of tradable carbon emissions of approximately 81.9 million metric tons.

While the definition of additionality may appear to be somewhat vague, we do have some guidelines as to how it may be interpreted. In the US, we have 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 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.

Figure 4: Emission Reduction Potential for Commercial Real Estate.

CO₂ emissions generated by electricity consumption	Million metric tons of CO₂e
All commercial buildings	2,711
Investable commercial buildings (60% of total)	1,637
5% of investable commercial buildings emissions	81.9

Source: Enkvist, et. al. (2007)

Value of Carbon Emission Reductions

To determine the value of potential carbon savings, we assign a range of carbon prices to the quantity of offsets generated in *Figure 4* above. Our range of offset prices is shown in *Figure 5*. The range of prices for carbon offsets are derived from a low of \$3 per ton

(CCX voluntary market prices) to a high of \$35 per ton (recent EU-ETS prices). As shown, the annual value of emission reductions range from a low of \$250 million to a high of \$2.86 billion. Assuming no growth in this market, the total value of carbon offsets would range from approximately \$3.5 to nearly \$36 billion dollars.

Figure 5: Value of Carbon Offsets for Commercial Real Estate.

Price per ton of CO₂	Annual Market Value of Emission Reductions (\$ billion)	Capitalized Value at 8% (\$billion)
\$3	\$0.25	\$3.50
\$15	\$1.23	\$15.38
\$35	\$2.86	\$35.75

Source: Authors

Many emission reduction projects will not exceed the additionality threshold. It is therefore likely that a subset of assets will thus constitute the universe of properties that represent the values shown in *Figure 5*. Anecdotal evidence suggests that the average impact of carbon offsets for individual buildings would fall between \$0.01 and \$0.08 per square foot per year. In the case of a 1 million square foot building, this would represent an annual monetized value of between \$7,000 and \$81,000.¹² Capitalized at 8%, this has a value of up to \$1.0 million. However, in low carbon price scenarios, carbon offsets are unlikely to be monetized, as even modest transaction costs would likely consume any marginal revenue. In a high carbon price scenario there may be greater interest in the revenue and we believe that 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 achieve by making EEI investments to the building.

¹² Assume an EEI project results in 2.5 kWh/SF energy savings that can be monetized via emission reductions: 2.5kWh x 2.06 Lb/kWh /2204.6 metric tons x 1,000,000 SF x carbon offset price (at \$3 and \$35) = \$7,008 and \$81,761 respectively.

Carbon Emissions, Physical Location and Fuel Source

Property location will have a significant effect on emission reduction potential for EEI investments. Within the US, 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. 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.

Figure 6: Comparison of CO₂ Emissions by State.

State	Effective CO2 Emissions (Lbs/kWh)		State	Effective CO2 Emissions (Lbs/kWh)
VT	0.070		US 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		DC	N/A

Source: EPA (2007)

In our prior 1 million square foot building example, the carbon offset value was based on a carbon emissions rate equal to the US *average* of 2.06 pounds of CO₂e per kilowatt-hour 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 exceed \$1.9 million; nearly double the prior example.

Price of carbon

Given the level of average carbon emissions per kWh by states, we can derive the monetary value of savings associated with the offset of these emissions. These results are shown in *Figure 7*. In *Figure 7* we show two values; one based on a carbon offset price of \$3 (US voluntary market) and the other at \$35 (EU-ETS regulated market).¹³ The dollar value of CO₂ 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 and the offset value is essentially zero, to a high of \$0.005 kWh in North Dakota, where a higher level of emissions has marginal value at this offset price.¹⁴ 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 in real estate, could offer monetary benefit to a well planned EEI investment strategy.

¹³ These figures are derived by taking the average level of carbon emission by state times the carbon offset price and dividing this product by 2,204.6 (the number of pounds in a metric ton).

¹⁴ Vermont has a positive value for this statistic, but due to rounding, the result shows up as zero.

Figure 7: \$ Value of CO₂ 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

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 those in operations 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 2006 commercial electricity prices per kilowatt-hour (kWh) range from a low of \$0.052 in Idaho to a high of \$0.214 in Hawaii, with a US average of \$0.095 (see *Figure 8*). Put another way, base electricity prices vary 415% from lowest to highest cost states.¹⁵

¹⁵ Billed electricity costs may be higher than these base rates due to time-of-use, or demand, charges, as well as additional fees and taxes. Due to the variability of these costs, our research used the base rates for comparison and analysis purposes.

Figure 8: Commercial Electricity Price by State

State	Electricity Price (\$/kWh)		State	Electricity Price (\$/kWh)
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		US 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		DC	\$0.110
NC	\$0.072		VT	\$0.117
IN	\$0.072		AK	\$0.117
OK	\$0.072		NJ	\$0.118
IA	\$0.073		ME	\$0.124
CO	\$0.075		CA	\$0.131
MT	\$0.075		RI	\$0.135
NM	\$0.077		NY	\$0.136
SC	\$0.077		NH	\$0.138
AZ	\$0.079		CT	\$0.138
GA	\$0.079		MA	\$0.158
IL	\$0.080		HI	\$0.214

Source: EIA (2007)

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 CO₂ emissions are associated with lower electricity cost (*Figure 9*). For example, Utah has the fourth *highest* level of emissions per kilowatt-hour (*Figure 6*) while its electricity prices are the fourth *lowest* (*Figure 8*). This is mostly driven 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.

Figure 9: Correlation between CO₂ 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

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.¹⁶ In this case, energy use reductions will be achieved, but

¹⁶ Here and throughout this paper, the effect of utility and/or government involvement (incentives, rebates, regulations, etc) in energy efficiency programs has been excluded because due to inconsistencies from market to market and because they tend to distort price signals for EEI investment decisions.

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 gasses 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 kilowatt-hour divided by electricity value per kilowatt-hour. The ratio indicates the relative attractiveness of EEI investment value when considering a given carbon offset price and electricity price. When the ratio is less than 1, this means the value of electricity reductions is greater than the value of emission reductions, and from a relative *economic* perspective, suggests EEI investment may be driven more by electricity costs than carbon offset values. However, even with a ratio less than one, some level of carbon offset value may be generated, depending on the state location of the property. In *Figure 10* we present this ratio for a carbon offset price of \$3 per ton, which is the current level in the unregulated US market (CCX).

Figure 10: Ratio of \$3/ton CO₂ Emissions Value to Electricity Value per kWh.

State	Ratio of Emission Value to Electricity Value	State	Ratio of Emission Value to Electricity Value
VT	0.00	MS	0.04
ID	0.01	GA	0.04
CA	0.01	TN	0.04
CT	0.01	DE	0.05
WA	0.01	NC	0.05
NH	0.01	AR	0.05
NJ	0.02	VA	0.05
ME	0.02	WI	0.05
RI	0.02	MT	0.06
OR	0.02	OH	0.06
NY	0.02	OK	0.06
MA	0.02	MN	0.07
HI	0.02	CO	0.07
SC	0.03	NE	0.07
TX	0.03	SD	0.07
AK	0.03	IA	0.08
LA	0.03	NM	0.08
MD	0.04	IN	0.08
PA	0.04	KS	0.08
IL	0.04	MO	0.08
FL	0.04	KY	0.09
AZ	0.04	UT	0.10
NV	0.04	WV	0.10
MI	0.04	WY	0.10
AL	0.04	ND	0.11

We can use the state of Utah as an example. In Utah, at a \$3 per ton offset price, the ratio of carbon savings to energy savings is \$0.10. Subject to our 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, you will also receive 10 cents of savings from carbon offsets. While these numbers are not large, we should note that they come in addition to the electricity savings already being received. 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 US voluntary market are unlikely to become a major factor affecting EEI investment decisions in most states.

If however, we assume market pricing as observed in the regulated markets in Europe, our results change significantly. In *Figure 11* we present the ratio of carbon offset value to electricity price at an offset value of \$35 per ton (current EU-ETS regulated market).

Figure 11: Ratio of \$35/ton CO₂ Emissions Value to Electricity Value per kWh.

State	Ratio of Emission Value to Electricity Value	State	Ratio of Emission Value to Electricity Value
VT	0.01	MS	0.51
ID	0.08	GA	0.51
CA	0.13	TN	0.52
CT	0.15	DE	0.53
WA	0.16	NC	0.54
NH	0.17	AR	0.56
NJ	0.18	VA	0.62
ME	0.18	WI	0.64
RI	0.18	MT	0.69
OR	0.19	OH	0.72
NY	0.19	OK	0.75
MA	0.22	MN	0.79
HI	0.28	CO	0.82
SC	0.37	NE	0.83
TX	0.40	SD	0.87
AK	0.40	IA	0.89
LA	0.40	NM	0.93
MD	0.42	IN	0.94
PA	0.43	KS	0.94
IL	0.43	MO	0.96
FL	0.44	KY	1.02
AZ	0.47	UT	1.13
NV	0.49	WV	1.20
MI	0.50	WY	1.20
AL	0.50	ND	1.31

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 US states at a cost of \$ 0.117 per kWh (refer to *Figure8*), 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 (refer to *Figure*

11). In this scenario, carbon offset value could help redefine the EEI investment strategy. We can also use this table to make relative comparisons between states. For example, electricity prices are higher in Arizona (\$0.079 per kWh) than in Colorado (\$0.075 per kWh), a difference of 5.3%. Referring back to *Figure 11*, note that the ratio of emission value to electricity price (at a \$35 offset price) is higher in Colorado (0.82) than in Arizona (0.47). 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, one receives an additional \$0.82 in carbon offset value, whereas in Arizona, the additional carbon savings are \$0.47, a value enhancement of 43%. In spite of 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. A quick scan of *Figure 11* suggests that in most states, carbon offset values add between \$0.20 and \$1.00 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 US, we have made a series of assumptions to arrive at our 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. These are summarized in this section 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 markets. Triple-net lease structures will remain a split incentive barrier throughout the industry. While savings from both carbon offsets and electricity savings may be recognized, the ability assign or share these benefits between owner and tenant will continue to create challenges. For example, 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

There are several standards existing 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 nature 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 all but three deal with industrial processes, not real estate. The cost and 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. US-based emission reductions 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 has 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 the environment’. 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.¹⁷

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 may be created. One example is the securitization of bundles of carbon offsets aggregated from

¹⁷ We are beginning to see examples of this in the areas of ‘green’ and ‘sustainable’ investment and development.

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 a 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, and potentially more efficient pricing in the marketplace.

Summary

This paper describes a scenario where the US commercial real estate industry, through participation in emerging carbon emission markets, can create up to \$2.86 billion in revenue with a capitalized value of \$35.75 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 monetizable in the carbon market after meeting additionality requirements and overcoming transaction cost barriers. This equates to 81.9 million metric tons of carbon dioxide-equivalent emission reductions per year.

At a low offset price scenario of \$3 per metric ton CO₂e, 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 CO₂e there is likely to be significant interest in monetizing emission reductions. In fact in some states the value of carbon offsets outstrips the value of electricity savings at these prices.

The value of carbon emissions reductions is dependent upon three major factors: Electricity price, carbon emissions offset price, and carbon emissions rate per kilowatt-hour. Electricity prices vary more than 4X across all fifty states. Carbon emissions per kWh vary in excess of 55X. Both factors should be considered in order 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. In spite of the limitations discussed, we believe that 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 lowest costs in order to lower our 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.

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