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**Sustainable Real Estate Development: An Early Inquiry into Costs
and Possible Outcomes**

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Opening Themes:

Environmental or green issues have become policy important with an uncertain degree of current political and popular momentum (Barringer 2008; Friess 2008; Nelson 2008; Peters 2009; Broder 2009a). The development of green or sustainable buildings, as one component of the sustainability dynamic, has also become increasingly feasible and relatively more popular among both for-profit and not-for-profit developers (Freeman 2008). This popularity has been both facilitated and partially captured by a variety of green measurement tools established in the United States over roughly the last decade that have defined what it means to build sustainably. We introduce differing views of developers about the value of building green to contrast with current debate among researchers about a select set of economic outcomes of green buildings.

This paper explores a number of the social science and policy complexities and limitations associated with deciding what “green building” should mean, how we should measure it, including its costs and impacts. The purpose of this paper is to explore newly emerging evidence and debate about green building’s cost and effects, and to raise questions about what we know, how much more we should learn, and any caveats about any quick, wholesale movement to promote fully green building technologies and rating systems.

The analysis begins with short case studies of several for-profit and non-for-profit developers located within the New York City area to highlight the varying views of what it means to build green and to illustrate how well or poorly social science research evidence is currently related to developer’s intentions. We include a brief discussion of the differences between commercial development and affordable housing development as illustrations of potential equity gaps in the emerging world of green building.

These cases highlight the complexity and financial costs associated with building green for differing types of developers and the fact that developers can have multiple, differing motivations for selecting a green format for their buildings that have nothing to do with research evidence. What they have in common is a desire to lower energy costs.

We then use a meta-analysis of recent, mostly unpublished social science research assessing the cost, economic returns, and social benefits of green building. As would be expected of any new field of analysis, we find limited data on core issues of concern, as well as confusion as to the applicability of research to policy debates over large-scale, city or metropolitan wide plans for managing energy savings and global warming (Weisman and Hughes 2009; Broder 2009). The limitations of recent research evidence are noted. Given how late, mixed, and even conflicting the

research results have been, developers are unlikely to rely on research to guide their choices and planning for some years to come. We conclude with a set of cross-cutting constraints and options that appear relevant to the future of green development.

Why Study Green Buildings?

The basic canons of social science perpetually caution us against readily validating popular support and enthusiasm before there is evidence on the costs, benefits, and outcomes of the various policies and programs, including an assessment of winners and losers. This caveat applies to evaluating various formats for developing green buildings, whether commercial or residential.ⁱ Given the apparent current higher cost for building or rehabilitating new buildings in American cities, and the long-term durability of these structures, there needs to be care in assessing who are the winners and losers in any drive to establish new sustainable building code requirements upon office and residential markets, most especially at a time when their financing sources are either unclear or have become critically limited. (Langdon 2007).

As in any new arena of policy analysis, there are a range of reasons why the study of green buildings is beneficial to policy makers and social scientists. The simplest is that new ideas and policy emphases are seldom born in a perfected state and require constant monitoring, evaluation, and management for their improvement and scaling up to encompass increased shares of the development process. We may also learn much about how human behavior adapts to, and in the longer term benefits from, such innovations. Finally, because fashionable or trendy ideas can trigger selectivity problems or biases, the issue of carefully controlling how research evidence is gathered and analyzed becomes central.

The evaluation of how well new standards for building green help in achieving benefits for more people at comparable or lower costs is central for both commercial and not-for-profit builders. There has, however, to date been very little data assembled on the costs associated with the design, construction and operation of new or remodeled office or residential buildings using differing green certification requirements, such as LEED, Energy Star, or competing formats (see Langdon 2007).

Beginning with the question, or assumption, that building green typically costs more than building traditionally, the issue of the costs and benefits of sustainable development become central to any sensible long-term planning, research and evaluation agenda most especially one that aims to focus on the transferability of development standards to low-income housing and community development.ⁱⁱ A central policy goal therefore should be to adapt costly technologies into more usable and affordable techniques for addressing large scale environmental risks. The issue of environmental equity becomes, therefore, a concluding concern.

Measuring 'Green'

As analysts of US green building technologies are aware, there are now several formats or program standards used in this country for defining what is meant by building sustainably (Miller, Spivey and Florance 2008). There are currently four major national certification formats for defining what green building means in the US, all of which are currently voluntary although some local jurisdictions are moving to incorporate sustainable building techniques into their building codes.ⁱⁱⁱ New York City, for example, has had a large task force examining the issues in this area for over one year, with a report expected in summer 2009.^{iv}

The earliest green rating system, the Energy Star system, was developed by the US Environmental Protection Agency or EPA in 1992 as a voluntary labeling program for new sustainable products. With the exception of Energy Star ratings, the alternative rating formats have been developed by groupings of industry sponsors working with various coalitions of interested organizations and agencies. Some have included non-profit organizations as part of their network of sponsors or stakeholders. They are all, including Energy Star ratings, voluntary and most entail some cost to an applicant for applying for certification as a “green” building. Leadership for Energy and Environmental Design or LEED is by most accounts the most complex and time consuming to apply for, as well as the best known.

Below, in table 1, we list the major systems currently used for defining the component parts of what is a green building. Some of these standards may in turn become potential measures of green energy and water savings for individual consumers or to building developers and managers. We list them in rough order of their chronological development although there has been an almost continual process of adapting and changing the standards to address the concerns of “stakeholders”. LEED building standards, for example, continue to evolve but have nonetheless become the most used and discussed. They may range from basic approval to the top platinum rating.^v

Green building systems in the United States are, then, relatively new with all evolving since 1990, with the latest from the National Association of Home Builders being copyrighted in 2006. We include in the table a fifth category of ad hoc implementation to capture those building and non-profit building sponsors who decide they cannot, for example, take advantage of LEED because that system’s certification requirements are cumbersome and costly. This final category captures interest in non-certified forms of sustainable building practices that are also evolving in tandem with formalized systems for accreditation and certification of greenness.^{vi} This includes firms such as Time Equities Inc, profiled in our case studies below, which has focused on the net greenhouse gas emissions from their national portfolio of buildings as the centerpiece of their evolving plans to convert their existing building inventory into a more energy efficient status. They view LEED certification as largely a tool for the marketing of their assets.

Table 1: US Systems for Defining & Measuring

Green Building Inputs	
LEED	1998 (evolving)
Energy Star	1992
Green Globes (Global Environmental Method)	2000 (initially UK & Canada)
NAHB Model Green Home Building Guidelines	2005-6
Ad Hoc	No-rating; individual projects

It is essential to note at this point out that many of the construction and building technologies that are referenced in the above standards apply most directly and readily to the development of new buildings. The bulk of commercial and residential buildings in the US as elsewhere are, however, pre-existing and the technologies for modifying older existing buildings are both more complex, case specific, and even more costly. Among the complexities in adapting older buildings is that they may have asbestos, lead based paint, or other environmental hazards which must be abated at the same time that energy saving and sustainable systems are installed.

LEED and Green Globes in Canada have been adapting their requirements for existing building approvals or certification over the last few years (Moore 2008; Miller, Spivey and Florance 2008). The current uncertainty about these standards has resulted in some building owners have elected to develop their own sustainable building practices due to the high degree of variability in the age and cost of adapting their buildings.

It is also important to note that these rating systems have focused on the front-end of the design and development process in the US. These are front-loaded rating systems with much less focus upon the methods for sustaining energy savings and for training staff to manage new technologies optimally. Energy Star and LEED for Existing Buildings are focused on the on-going performance of the buildings or homes after construction (Jones and Vyas 2008: 66). There is early but limited data that suggest that there is some loss or atrophy of energy savings over time (Jones and Vyas 2008).

As of fall 2008, a total of only roughly 1,700 building in the US had achieved some level of LEED certification. There were, at the same time, 5,700 buildings which were rated using Energy Star (Eichholtz, Kok and Quigley 2009: 9). In all of New York City there are only 41 LEED rated buildings out of a total of 3,565 office building as of April 2009 (Center for an Urban Future 2009; CoStar Office Market Report, New York City; 1st quarter 2009). Roughly 50 cities in 15 states have incorporated LEED standards into legislation and building codes. In addition, initiatives in federal agencies have been adopted, including at the Environmental

Protection Agency, US HUD, the Department of Energy and the Department of Defense. Roughly two dozen countries have also developed projects that are registered by LEED using green building standards. The future evolution of government regulation in this area is currently uncertain due to the downturn in construction but also due to the inability to develop needed incentives or financing techniques that could help subsidize and encourage the development of affordable green projects.

Case Studies and Cost/Income Impacts Data:

This paper makes use of two types of data regarding green buildings. The first, which serves to highlight complexities, are three short, simple case descriptions of developers using various forms of green design to build and operate either office or residential properties. The three cases are taken from New York City.

The first case, of One Bryant Park, illustrates the intentions and expectations of a major New York area development company as they approached the question of how to build the best quality green Class A office building in Manhattan. The developer, the Durst Organization, provides a clear set of performance expectations for their new building which is currently almost completed construction.

The second case is of a large scale national and international developer and building operator, Time Equities Inc, which owns and manages office and residential buildings in the US, Germany, and Canada. They created a new office of sustainability in 2007 for the corporation and have begun a careful process of planning how to cost effectively retrofit their existing inventory of buildings into more energy efficient operation.

The last case is of two builders of affordable rental housing. The companies cited operate in lower cost areas, mainly in the South Bronx section of the city. This case highlights the interaction of the cost for building any affordable project in a high cost city like New York, and the manner in which they promote sustainable energy conservation initiatives.

The bulk of research on the economic effects of green building standards in the US has mainly occurred within the last two years. Industry based and some academic research has made use of a national data base on key parts of the office market to study effects. Major attention in most research has been allocated to measuring the energy cost savings from the operation of buildings using differing sustainability platforms and to evaluating the vacancy rates, rents, and sales prices of green buildings to learn if the ‘market’ places some economic value upon these structures (Jones and Vyas 2008). The major studies in this area only compare rent levels, occupancy, and sale values of a range of office buildings whose information has been captured by a private sector data firm, CoStar.^{vii} I examine conflicting results from the few central, recent research papers noting the limitations of the data sets available in this area, following the discussion of cases in the next section of this paper.

Case Study: One Bryant Park New York City

The Durst Organization, founded in 1915, has been at the forefront of the environmental movement in New York. According to key leaders in the firm, they initially began to focus on green technology as a tool to reduce energy cost but soon made use of more costly sustainable systems as they both improved the marketability of their properties and added to the history of the company's public sector commitments. In 1999 they completed 4 Times Square that was recognized as the first "green" high-rise office building in the United States. They now have four buildings that are counted as 'green.'

Most recently, they have built the Bank of America Tower at One Bryant Park. The building was co-financed and is co-owned with the Bank of America. The bank was a founding sponsor of the United States Green Building Council and they occupy roughly 50 percent of the total 2.1 million square foot building. The new building incorporates innovative, high-performance environmental technologies that the Durst Corporation states will promote the health and productivity of tenants, reduce waste, and assure environmental sustainability. They identify it as the world's most environmentally responsible high-rise office building, focusing on sustainable sites, water efficiency, indoor environmental quality, and energy and atmosphere and the first high-rise to obtain LEED Platinum designation.

The specific goals stated by the developers for the building were to: reduce energy consumption by a minimum of 50%; reduce potable water consumption by 50%; reduce storm water contribution by 95%; use 50% recycled material in building construction; and obtain 50% of building material within 500 miles of site. They also argue that the building's improved lighting and air flow will improve worker productivity.

The newness of the building means we only know that it is now over 90 percent leased up, with posted rental rates that are among the highest in the United States. Its LEED Platinum rating was partly the basis for former Vice President Al Gore's offices to move there. Their co-generation plant is fully operational as is their rain water capture system. There are no reported building performance data available or any current measures of worker productivity.

Case Study 2: Alternative and Complementary Standards for Existing Buildings

One firm which has elected to develop its own format for promoting sustainability within its existing building inventory is Time Equities Inc. The firm, founded in the mid 1960s by Francis Greenburger, has established the reduction of green house gases as its leading operational indicator for measuring the effectiveness of its program to support sustainability. Unlike a pure LEED-first and only method, their sustainability office has spent the last several years focused on learning how to best

measure green house gas emissions from their inventory and then reducing it as cost effectively as possible^{viii}

They state their goals:

“As a real estate owner with significant size and presence, we... recognize that climate change is a major economic, social and environmental challenge globally, and as a company we are taking voluntary action to address it. From the business perspective, we are striving to hedge climate-related risks, prepare for regulatory change, and address financial opportunities associated with green market trends.”

They were among the first commercial firms to create their own sustainability department, in 2007, to manage their sustainability programs, training and funding. The goals of this new department of sustainability are to: “...create healthier, more sustainable environments for the occupants of our buildings while lowering operating costs. Our experience has shown us that the cost of reducing our environmental impact is low and often aligns with cost savings.”

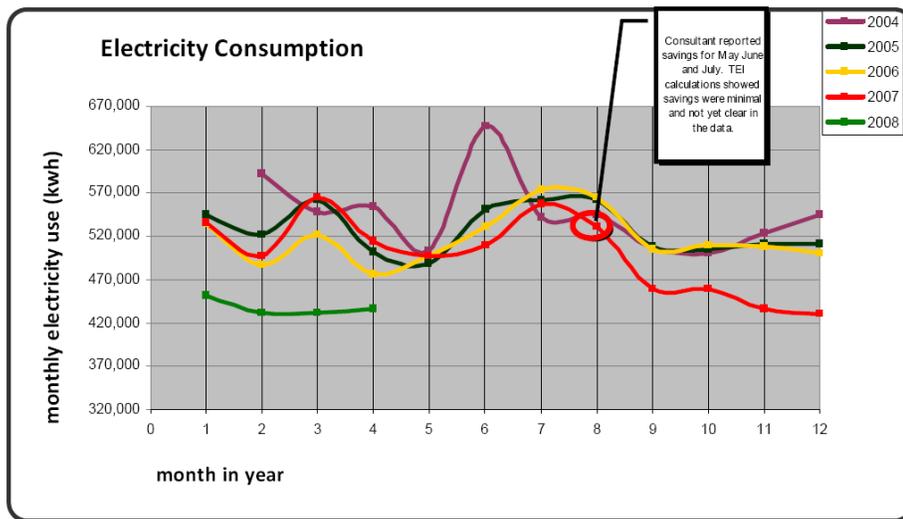
The energy saving or cost side of the real estate business appears a paramount metric within their goal of reducing the corporations’ total carbon footprint. They assert low costs to build green and some reduction in energy costs. They intend to seek LEED certification as, and after, they adapt their existing building portfolio of 20 million square feet. Again, their target measuring tool is to measure the aggregate carbon footprint of all of the properties using utility resource accounting techniques.^{ix}

In comparison to the Durst Organizations’ shorter public statement, Times Equities has made a more formal public announcement of its goals and plans for all of its buildings. The Durst group has remained silent on the conversion of the balance of their building portfolio into green operation.

Time Equities major strategy for adapting their 20 million square feet of office and residential space is to first learn what the bench-line energy uses of their buildings are, and then to use outside experts to estimate what would be required to reduce those costs. The core goal is to learn what are the carbon footprint, or greenhouse gas emissions, of their entire portfolio, and then to finance those retrofits. They obtain and then track energy and often water use using utility resource accounting software now commercially available. These “phase 1 and 2 audits”, as they are called, are in the process of being completed.

In one case for which we have some data, a building located on West 10th Street in New York, would have required roughly \$340,000 in repairs to create an annual energy savings of \$65,000. The firm proposed to obtain \$55,000 in state agency rebates and savings for a net cost to them of \$324,000. They initially estimated that they could recover those costs in less than 5 years of building operation at the current rate of energy costs. Because of financing limitations, these retrofits were not completed.

The major completed project for Time Equities is located in Montreal, Canada (4200 St. Laurent St.). They spent \$538,000 for this 321,000 square foot office building to add a systematic set of building controls addressing energy use, retrofitted the building's lighting, and added heat exhaust recovery equipment. They received roughly \$100,000 in governmental incentives and calculate energy savings of \$114,000 a year. From their perspective, the crucial calculation was that they could expect payback of their net costs on a little over three years. The chart below, prepared by Time Equities, illustrates the substantial energy cost savings displayed in the lowest line in the chart.



Downward trend in electricity use is obvious. See green line for 2008 and red line for 2007.

They estimate that it may require seven to ten years before they are able to achieve a substantial reduction in the energy use and to train their management staffs for their entire portfolio to operate them as efficiently as possible. They think of LEED certification, which they plan to achieve in gradually increasing steps, as largely a marketing or positioning tool. They view LEED as one useful tool for brokering vacant space to tenants but do not view this measurement tool as the core of their corporate sustainability strategy.

Case 3: Building Green & Affordable?

Being able to afford to become green has been a modest focus of policy makers in recent years. There is at this point in time an uncertain policy link between building affordable housing and sustainability. The linkages may well evolve and grow to a larger scale especially if it is proven to funders, sponsors, and insurers that sustainable building technologies require no additional construction costs and lower on-going building operational costs close to zero compared to other building methods.

To date, non-for-profit and for-profit developers of affordable housing are fully absorbed in arranging complex financing packages, with little encouragement and no additional margin of funding of non-essentials when all unit amenities have already been cut to the bone. For such developers, finding multiple sources of funding for a project to become affordable is hard and stressful enough given the collapse of many traditional forms of financing. Finding willing sources of sustainable and affordable rental housing is still an uphill fight. It is, for example, only recently that state housing finance agencies have begun to include green factors in their scoring of application for annual Low Income Housing Tax Credit financing.^x

For New York, we focus on the green developments of Jonathan Rose Associates and Nancy Biberman's Women's Housing and Economic Development Corporation.^{xi} The Jonathan Rose companies began operation as a for-profit builder, planner and investor in affordable and environmentally responsible projects. They have a national scope rather than the New York only focus of WHEDCo.

The Rose companies' mission, more social than business oriented, states that they "plan and develop diverse, mixed-use, transit-accessible, mixed-income communities ... where the result is equitable, and supports the cultural, environmental and biological health of the bioregions we work in." Unlike the private sector developers they begin with ecologically framed site selection. As they state:

"... environmentally responsible development begins by choosing the right place to build and only then proceeds by being thoughtful about how we build. No single act has a greater positive or negative impact on the environment, on community and on the quality of the resident's lives than the selection of where one chooses to build. "

In December 2008, they acquired nearly 200 units of affordable housing in Harlem and will make use of a range of incentive programs to create a "more energy efficient and healthier community." Their projects typically report high levels of energy savings up to nearly a 40% cost reduction as a centerpiece of the efficacy of their programs. For a major planned development in the South Bronx, the 139 affordable rental unit and 63 unit cooperative Via Verde, they state an expected 37.3% energy savings. This project, to be completed in 2010, draws on a wide ranging of sources for its financing.^{xii} Their plans for this project include the following LEED goal oriented innovations:

"Passive, low-tech strategies include cross ventilation in all apartments, solar shading, and planted green roofs to provide insulation and control storm water. High-efficiency mechanical systems, energy-conserving appliances, and renewable energy strategies, including solar voltaic canopies Smart material choices, including non-toxic paints and rapidly renewable wood products. "^{xiii}

One of the most innovative aspects of this affordable housing developer is their added programs and commitment to broad scale planning initiatives aimed at more

comprehensive approaches to sustainability. They have established for this purpose a “City Climate Change Collaborative”. This effort is aimed at delivering “a comprehensive planning and integrated implementation approach to local governments committed to reducing their climate change impacts.” As they tell us, this initiatives uses “innovators in the fields of land use, transportation, housing, green building, open space and parks, renewable energy, stakeholder engagement, capacity building, and financing strategies.” No other non-profit developer has the capacity or resources to offer such a wide ranging set of services aimed at a wider agenda of planning and programs.

Nancy Biberman created her women’s collective in 1991 with simple but major goals:

“WHEDCo offers interconnected, innovative, and high quality solutions – including the building of healthy, affordable homes – and because of this, the Bronx is a more beautiful, more equitable, and more economically vibrant place to live and raise a family.”

They have completed a green retrofit for an affordable rate residential building with 132 units, labeled Urban Horizons. Their major operational goal was to lower escalating energy costs for themselves, as property managers, and the utility cost for their tenants. The building opened in 1997 and has offered apartment to 32 families from the homeless shelter system. They report impressive, roughly thirty percent savings, in their energy costs but have not found financing for other aspects of their sustainability plans. The later non-profit offers a more modest scale of projects compared to the Rose Companies, limited largely by the lack of funding initiatives that can help finance a more ambitious rebuilding agenda.

Research Analyses of Green Buildings: The Hammer of CoStar data:

In methodology classes, students are cautioned about allowing the ready availability of a methodological or statistical tool, or hammer, to blind the analyst to important alternative hypotheses and research directions. The ready availability of a single research data set, for instance, can result in having core research curiosities limited by that data rather than the full reach of outstanding research and evaluation questions.

There have been very limited sources of US wide quantitative data available to sensibly evaluate the costs and impacts of various green building rating systems. The central source so far has been the CoStar Corporation. CoStar states that it gathers data on over 66 billion square feet of office space as well as 1.2 million for sale or lease property listings. Beginning in 2006 they began to add data on the properties in their system that had made use of either LEED or Energy Star ratings. In 2008 CoStar, writing with one academic co-author, issued several closely related reports describing substantial economic benefits from building green that were promptly criticized by industry sources for their methodological shortcomings and overstatement (Miller, Spivey, and Florance 2008; Muldavin 2008).^{xiv}

The basic CoStar report, labeled the first systemic study of the economic benefits of green building, created a relatively major impact when they reported that there was a 36% improvement in rents for LEED buildings compared with a comparison sample and a 9% improvement in rents for Energy Star buildings.^{xv} They also reported a striking increase in sale prices with prices reportedly \$171 or 64% higher for LEED buildings. The selling price advantage for Energy Star buildings was \$61 a square foot or 27% price advantage over comparables (CoStar 2007; 2008).^{xvi} Without much explanation, they also presented regression results which revealed much lower returns.^{xvii} The level of explained variance was .48

Also, in 2008 an analyst for the firm, Good Energies, released a report which they self-identified as “the largest international study of its kind” based upon an analysis of data on 150 to 160 buildings in the US and in foreign countries. They reportedly found that the cost of building a green building on average added only an additional 2 percent to total development costs. The energy savings they reported from the operation of “green vs. conventional buildings” was roughly 33 percent. They also suggested that there were major health and social benefits from such buildings^{xviii} The full details of the study are expected to be released in book form later in 2009.

These studies were first released in on-line format, with a revised version of the initial Costar report by Miller, Spivey and Florance (2008) appearing later in 2008 in journal format. In this and earlier reports they released the results of a regression based, hedonic analysis that lowered the sale price advantage from \$171 to \$24 a square foot or a decline from a 64% to 9% advantage. This is a huge negative differential that has attracted major concern from analysts and appraisers. Among the first criticisms was an on-line report issued by the US Green Building Finance Corporation (Muldivin 2008).

The report’s author usefully gathered additional methodological details from CoStar about their study.^{xix} They then identified a number of major limitations for the CoStar report that undercuts its ability to serve as a convincing guide to potential price advantages of building green. The major issues, in brief, were:

1. Small sample sizes: Although CoStar had a potential universe of over 1,300 LEED certified buildings, they limited the study to only office buildings constructed after 1990. This left them with a population of only 218 structures. They were, however, unable to find sensible ‘peer’ comparables for this entire group and could match only 77 buildings within the local sub-market of the base office buildings. They then expanded the market area for the selection of comparable properties to five miles, thereby adding another 89 LEED buildings for a final sample size of only 166 LEED buildings. Of this group there were only 15 to a maximum of 20 sales from which to calculate values at sale.

2. Variability of sales prices at a market peak: The sales price data provided were a potentially volatile set of sales at the high point of property valuations; 2007 office prices were at their market peak after which rents, occupancy levels, and values have declined in most major US markets. They were also compared with a heterogeneous and variable set of comparables. Using a five mile radius for selecting comparable sales properties for either the New York or San Francisco office markets would, for example, place those properties far into either New Jersey or Oakland suburbs; markets distinctly non-comparable for a host of reasons.
3. The validity of the hedonic results is, as a result, limited. The low level of explained variance in their study (an R-squared of roughly 48%) means that many additional unexamined variables are likely causing the level and dispersion of values.

The limited sample sizes of the first two web-based studies therefore limit anyone's ability to be able to firmly assess social and economic costs and benefits.

The final study we present, also not yet formally published, is a 2009 working paper by economists at the University of California (Eichholtz, Kok, and Quigley 2009). They assert that their analysis is the "first systematic analysis of the impact of environmentally sustainable building practices upon economic outcomes measured in the market place." It is to date the most statistically careful, with estimates that suggest marginal economic benefits of Energy Star rated buildings compared with the initial CoStar data. They report no statistically significant effects for LEED certified buildings although their samples here were also smaller than ideal.

They report a statistically significant increase in rental rates and in final sales prices for the sample of 694 buildings for which they were able to gather rent and sales data from CoStar.^{xx} Of the nearly 700 buildings in their study, there were sales data for only 200 buildings (199). Unlike the CoStar report which selected comparable buildings from up to 5 miles away, this analysis limited their comparables to within 1,300 feet or one-quarter of a mile. However, even by narrowing their geospatial net for finding comparable office buildings they wound up with a sample of Energy Star and LEED certified buildings which were larger in square footage, newer, more likely to be rated A class buildings, with more building amenities than those they classified as comparable.^{xxi}

After controlling for a range of variables they find a positive 3.3 percent increase in rents for Energy Star buildings, and 16% improvement in sales prices for buildings sold between 2004 and 2007. The best returns, they note, are for larger and better quality buildings. The statistical models they use explain, however, only roughly 40 percent of the variance on key metrics leaving a good deal more to be done to improve explained variance.

Table 2: Research Studies on Economic Impacts of LEED and Energy Star Rated US Office Buildings			
Miller, Spivey, Florance (2008)		Eichholtz, Kok and Quigley (2009)	
	Descriptive	Regression	Hedonic Regression
LEED			
Rent gain	36% (\$11.33 sq ft per yr)		NS
Sales price gain	64% (\$171)	9.94%	NS
Energy Star			
Rent gain	9% (\$2.40 sq ft per yr)		3.3%
Sales price gain	27% (\$61)	5.3%	19%

NS=not statistically significant

They then offer a major caveat by telling the reader that the strongest effects are localized in smaller markets, at the periphery of larger metropolitan areas, and where rents in general are set lower. Prime locations and cities, like New York, would benefit less (p.19). This constraint suggest that the newer buildings constructed using Energy Star ratings command better rents and sale prices but only in second tier and marginal markets; it offers little (statistically significant) impact in the areas where Time Equities and the Durst's are building – based upon their still-small sample of properties.

The absence of any effect for LEED buildings can be attributed to any number of market or sampling issues; it is simply not clear which bears greater weight. Also, sales price effects they report are an artifact of an exceptional market upturn that has since dissipated. A longer period of performance is essential before reaching a clear conclusion that investors value green buildings under all market circumstances. This caveat is especially important because of the limited nature of the comparables they used, many simply are not in fact comparable, and to the fact that there strongest effects are for small, less major markets. A finding that suggests that green building has little sustained economic value in the country's major markets would be a considerable set-back from the perspective of those financing green development.

It is important to point out that this last study found that the degree of energy improvements made by the building owners translated into proportionately higher rents. That is, tenants do discriminate in rental prices when it comes to key features associated with energy savings (Eichholtz, Kok and Quigley 2009: 24).

The lack of attention to the measurement of the human or personal impacts or outcomes of sustainability performance systems also appears to be one of the critical shortcomings in this area of policy analysis. For example, while local developers are confident that their buildings can have important, positive impacts on the productivity and health of the employees working in their buildings, to date there have been very few formal, carefully controlled studies of the longer-term health and productivity impacts of new building systems built to US green rating standards (Loftness et. al. 2006; 2007; 2008).^{xxiii} For example, it was only in 2002 that a major report recommended a process for providing better advice about building technologies as they relate to and affect worker productivity (Kumar and Fisk 2002). In no small part this is due to the recency of the entire field of sustainability measurement and standardization. It is no doubt also due to the complexity of arranging to have corporations agree to have their employees studied if the results of the analysis might imply liability for some degree of prior unhealthy working conditions.^{xxiii}

The process of carefully measuring the impacts of green building is then only in its infancy with only one hammer, CoStar data, currently available to nail down costs and returns. Given that green measurement tools, like LEED, are also in the early years we are watching an important and interesting policy research experiment slowly improve.

Evolving Constraints and Contexts

The process of evaluating how well or poorly the sustainable development movement for commercial and residential buildings is complicated by any number of factors. The simplest complication is that there has been only a recent surge in establishing what building green means and how to measure it. These green measurement tools have outpaced the development of funding systems to enable ready access to the huge pool of potential applicants to get the advice and training needed to both apply for and then maintain green buildings, whether they are run at affordable or at market rates.

There are a number of other factors that help condition or constrain how well or poorly sustainable building will advance in the US. These of course include the complexities imposed by the world economic recession and budget problems at the national to local levels. It has however been announced in Washington DC, that the US housing and energy agencies will collaborate over the next several years in developing synchronized programs that can assist green growth strategies at the municipal and neighborhood level. It is as of this writing uncertain the level of funding that these initiatives will command and how much more than small scale demonstrations will be implemented in the next several years.

The following is a preliminary sketch of probable influences on the future trajectory of green building and any in-tandem evaluation research. There appears no means to assess their probable interaction or complicity in affecting the trajectory of green and

affordable building. There is also no means also for predicting the rate of transformation of US commercial and residential markets into something approaching full sustainability.

1. Evidence is Limited:

As we noted above in our review of research evidence, there has been no credible data gathered on the full set of social, economic and health benefits ascribed to green building systems in the US. There is currently only anecdotal evidence as well as some summaries of evidence drawn mostly from non-US sources. The evidence on economic benefits is being currently debated but is certainly lower than estimates made only in 2008 by industry analysts.

Until there are better data and results on the improved productivity and health of tenants which derive from building green, to complement clear regression based assessments of economic outcomes, there is little likelihood that evidence alone will impel a stronger movement into green building. Progress may well then depend on the public spirited commitments of developers like the Durst's or Jonathan Rose or upon the evolving, if thin popular sentiment in support of sustainability.

Central to the future research in this area will have to be longer term studies of the health, social, and productivity impacts on workers, and tenants, who are exposed to varying levels of new sustainability protocols. Only time and better research plans can accomplish this. Another part of this future agenda will be to gather a clearer assessment of the actual costs of varying green requirements, and a system for reporting technological improvements that can result in lowering existing costs. Innovations in building technologies, mentioned below, may well offer substantial cost savings especially for the inventory of old, subsidized, and affordable housing.

xxiv

2. Uncertain Popular Support for Sustainability Initiatives and the Willingness to pay (something) for it:

There are a variety of survey data and opinion polls which document increased popular support for varying green initiatives, most especially those easier to comprehend and implement. This evolution of views and support has of course been heavily affected by the relatively recent sudden rise of energy costs.

There is also evidence of the volatility of public enthusiasm especially when they are juxtaposed against other pressing political or economic choices. Survey results released in spring 2009, for example, reveal that the US public considers the economy its top concern with only two percent rating energy issues as the “most important problem facing the country today” (Stolberg and Connelly 2009). Despite such lower positioning of energy issues in the public frame of current anxieties, environmental issues have nonetheless become a more abiding source of concern in the US and globally.

An opinion that most publics throughout the world share is that they know of the issue of global warming. This abstract information question conceals a wide range of knowledge about and evolving, even mercurial, support for green policy issues. The public's average views change. From 2004 to 2008, for example, there were large percentage point increases in public support for "dealing with global climate change (+7) and for 'reducing energy dependence (+13, Pew 2008)). By 2009 however, under the pressure of a worldwide economic slowdown, this had translated into lower rankings for energy issues. A Pew Center poll released in 2009 revealed that global warming ranked last for the American public out of 20 items and "energy" issues ranked only 6th (Pew 2009). Moreover from January 2008 to January 2009, there was a major 15 percentage point decline in the number of people rating environmental protection as a top priority. Such shifts in support have occurred before and may well happen again, raising questions about how well elected officials will prioritize needed legislation and funding for reforms in this area.

There are also persuasive arguments that there is no simple or direct correlation between the in-principle support for green policies and actual changes in behavior or in action in support of environmental causes (Kollmuss and Agyeman 2002). There needs to be some care as policy makers and advocates attempt to leverage public engagement with specific actions so that any social marketing program is geared towards a sensible set of action targets.

If green initiatives are considered cost or tax free, for example, there may be a different level of popular commitment than when the budgetary and tax consequences are spelled out for individuals and corporations. By pricing the cost of various green policy adaptations in survey questions, it might be possible to tap into a clearer sense of the degree of tangible popular support for specific green programs. How much would better health outcomes be worth for an office tenant if they were asked to pay part of the installation costs? How many employees would insist upon sustainable building technologies as a condition for employment at a firm? What would owners pay for better worker productivity? How much would governmental agencies pay to lower health care costs for their citizens or reduce their own energy bills? How much can low income renters value sustainability given the other constraints on their choices and resources? This is of course an on-going, slowly evolving story (Friedman 2008: 205-209).

One recent example of how the value of green buildings has not yet been firmly established or proven is a current effort by a Long Island real estate broker who is paying tenants to adapt their building's interiors to a sustainable standard (LEED CI). This broker will provide up to \$30,000 in matching funds if a firm signs a 10-year lease for roughly 10,000 square feet of space and agrees to include green interior finishes. This form of a tenant improvement allowance may be used for green finishes and to apply for LEED certification (Burr 2009). But it means the tenants must be paid to turn green.

Building owners too have been surveyed and report that they are heavily likely (69%) to support some form of sustainable building construction and maintenance. This study however points out that in 2008 fewer corporate executives were willing to pay a premium to retrofit a property “to gain sustainability benefits.” Also, while in 2007, during a boom period, 77% stated their support for retrofitting cost this number plunged to 53% in the next, down cycle year (Krieger 2009). This evidence might suggest that sustainability might be among those great ideas that are widely espoused but weakly held and therefore thinly funded. There is however, little data that can be used to estimate the demand, at varying rent levels, for specific forms of sustainable building designs and operations. It is very much a central black-box in estimating future trends and policy choices for the private and governmental sectors.

3. Growing to Full Scale:

There are a number of important contexts or settings for appreciating the viability and effectiveness of green building technologies including the issue of how to bring the “program” to full-scale. Because of the recency of green building standards the bulk of buildings in the US are not energy efficient or sustainable. There are roughly 72 million owner occupied buildings in the US, another 7.6 million attached homes, and then 6.9 million mobile or manufactured homes very few of which were constructed using a sustainable set of guidelines or building technologies. And of the nearly 5 million commercial building, including over 70 million square feet of space, most have not been adapted to or built with energy or environmental issues in mind. ^{xxv}

Recent research indicates that for a number of larger real estate developers in the US, none have built or adapted more than 20% of their total inventory and most have built out less than two percent of their owned stock (Miller, Spivey and Florance 2008: 394). In part this may be due to the costs associated with the development of new buildings and the retrofitting of older ones. The flip side of this is that owners may not feel certain that tenants will pay more for a green space when faced with ample vacant space at lower rents. In addition, some owners who have used some green building systems may not wish to be bothered with the time and paperwork seeking certification. It is then not feasible to get an accurate count of all sustainable building adaptations, either using a certification system or not. As one analyst notes, “Meaningful building counts are ...elusive because most green certification programs have been adopted only in the last few years – well after the industry began constructing more sustainable projects, and many owners resist the expense of seeking certifications retroactively.” ^{xxvi}

For new buildings, the issue can be cost or financing options. The Bank of America building in New York, for example, cost roughly \$900 a square foot or \$1.9 billion to construct a 2.1 million square feet LEED Platinum standard office building. In turn, rents prior to the recent office market downturn were \$175.00 a square foot. ^{xxvii} Such high costs and high rents may be an anomaly in many urban markets for a number of years due to downward pressure on rents and occupancy levels.

A final concern is that for investors there is a multiplicity of green building standards and certification programs none of which have shown clear links to assessed and longer term property values. As Nelson (2008: 14) comments: “Without a common standard, “compiling assets for a green building fund is daunting.” Increasing the pool of investors, nationally and globally, will then require new strategies to standardize and solidify the meaning and potential benefits for building or investing in green. Until this occurs, green building systems are in a small scale, unsecuritizable niche.

Local building and zoning codes appear likely to continue to play a major part in determining what types of building standards are feasible and what costs are imperative rather than the new, voluntary green building codes. This potential melding of green with pre-green codes has already begun although it is unclear how fast the pace of code integration will be. It is even unclear what the propulsion behind such integration may be.

One key to the improved scalability of green building is the ready availability of the appropriate technological choices provided for varying for-profit and non-for-profit building options. There is a circular path here of note: with increased demand, costs for building materials and systems will decline, and as the technology improves its efficiency and prices may decline. Demand might also increase to the point that the public and developers accept that building green adds few additional new costs and almost certain clear returns.

4. Evolving Technology:

The rate and components of technological innovation and pricing are unknown, most especially in the comparatively recent field of LEED and Energy Star rated building systems. Two examples help illustrate this complex issue.

In 2009, the New York City Housing Authority was in the final stages of selecting a contractor for the installation of green roofs for a number of their project buildings. At virtually the last minute, a new bidder submitted information about the lower cost and weight of installing green roofs using an artificial, lighter weight alternative to the required earth roofing the Authority had previously believed was their only choice. This improvement in technology would reduce considerably the worries NYCHA staff had over the weight of any new green roofs on buildings whose average age was 47, and whose roofing had never been installed with an expectation of installing hundreds of pounds of additional weight (Piscopia interview 2009).

Years earlier, when the private developer Douglas Durst sought technology for the installation of major banks of solar paneling for a new building they were planning in Times Square, the only builder of these systems they could identify used a small garage in New Jersey as his construction site (Durst interview 2008). Since that time in the early 1990s, solar technologies have evolved significantly, lowering costs and their potential utility for residential and commercial projects (Gold 2009; Sweet

2009). It is however unclear, and outside the scope of this paper, to evaluate the rate at which the costs for various green building features and technology can drop as a result of market demand or as a result of various governmental research subsidies or tax benefits.

This paper is not the correct setting to assess the evolution of green building technologies except to note that any reduction in the cost of production and operation of major green systems, such as cooling, air filtration, water treatment, and heating, may significantly assist in reducing the negative equity impacts of technologies currently too costly to afford for either existing office buildings or for most low-income residential developments (Friedman 2008: 187-190; Eisenberg 2009; Lohr 2009). Presumably the inclusion of solar panels, green roofing, and even wind power can become increasingly mainstreamed for all general contractors and architects as buildings are designed, costed, and built.

Indeed as technology improves, it will likely affect the ways in which rating systems, like LEED, evaluate building conversion plans. Should rating systems stress lower cost technologies, and should government programs help support cost reductions, then the spread of green buildings will be vastly faster and easier.

5. Problems with rating systems:

The relevance of LEED in establishing a credible, widely usable, and sustainable sensible set of building standards has not been comprehensively or carefully evaluated. That is, there are no independent evaluations of the mechanics and costs to builders of implementation or a careful assessment of a full range costs and benefits of various levels of LEED approval. There is then no sense of whether all of the required components of LEED capture essential elements of sustainability or which are most central, say, to the health of tenants.

There have been though, as context for any evaluation, a relatively constant set of criticisms. This includes concerns that LEED is a moving target, with an on-going set of adaptations of standards by the USGBC. While it is clear that standards have been changed to enable and encourage greater inclusiveness (Friess 2008), the effect means that LEED certification can vary in its content over any specific time period.

There are also frequent comments that the certification process is time consuming and costly as well as rigid and cumbersome to some. One commentator, for example, stated: “You’re happy when you’re released from the US Green Building Council’s Abu Ghraib – you typically end up with a delightful building” (Barringer 2008: A1).

Energy Star ratings also have often noted limitations. Since Energy Star ratings in an area only award a rating to the top 25% of buildings that are being evaluated, they necessarily create a relative ranking system with the remaining buildings left out in the cold (perhaps literally).^{xxviii} Without any system of incentives or subsidies to encourage the lowest performing buildings to adapt more efficient technologies, the

ES rating has an in-built disincentive against the bottom tiers making an effort to fight their way into the top quarter. They would have no assurance that their efforts might feasibly pay off.^{xxix}

The final concern is an equity issue. While not necessarily a formal obligation of LEED administrators, there is a contextual issue of how the benefits of green building certification can be applied to the work on affordable housing developers who have little time or funding to seek such certificates when they have no apparent benefit in their search for financing sources. Absent some form of a mandate to build more sustainably, or increased willingness of state and federal housing finance agencies to support any additional costs, it would appear unlikely that green building standards will become ubiquitous for lower-income communities.

6. Weak Links to 'smart growth' planning:

The consensus among most experts focused on green building technologies is that building by building adaptations are ultimately doomed to limited impacts unless that is a concurrent alteration in the planning of future larger scale developments to be more sensitive to issue of transportation and traffic congestion and urban sprawl (Loftness et. al. 2007). This is another large, important issue outside the scope of this short paper but is, nonetheless, central to being able to incorporate mass transit facility accessibility as one of the features for building green and sensibly. The US green building movement and its rating systems need to become fully integrated into the planning momentum for smarter, more compact and energy efficient cities.

Sweden's Sewco sustainable city and Shanghai's Dongtan Island "eco-city" help illustrate the planning and policy advantages of building-in sustainable design components from the first stages of planning the allocation of transit, commercial and residential land uses.^{xxx} Dongtan's 20,000 acre site, for example, has been planned to incorporate urban design and sustainable initiatives that make their construction more effective than the retrofitting which is occurring in cities like New York.

7. Social Equity or Affordability:

One short-end of the environmental building green movement is the impetus to stress sustainable *and affordable* processes and products. The question of whether sustainable building technologies and practices can be made inclusive and affordable, rather than costly and exclusive, is among the central issues affecting the longer term policy viability and impacts of this component of the green movement. If policies and codes are developed that require sustainable building techniques then the issue of opting into or out of green building format becomes moot.

Given the comparatively high cost of building any affordable rental product within larger cities in the US, adding additional costs for an "elective amenity" such as green appears more optional rather than necessary. It is unclear when green building practices would be included as a mandatory feature for all HUD, CDBG, HOME, or

tax credit financed affordable housing, when leases would include green building issues for residents, when building managers would be trained to operate their buildings with an eye focused on energy, water and other forms of conservation. Given the inertness of US rental housing policy over the last couple decades (Schwartz 2006; Glaeser and Gyourko 2008; Retsinas and Belsky 2008), it appears timely to rebuild affordable rental housing with the building code features and funding incentives that can ensure sustainability and reduced costs for tenants and managers.

The issue then of the degree to which building green saves money for non-profit building operators and lower-income residents figures prominently in the analysis of the viability of sustainable development practices. It is also a critical test for the inclusivity of the green movement.

This issue has received some recent attention. Hammer (2009), for example, argues that social equity developments need to include the participation of tenant beneficiaries in the planning and implementation of such projects. She argues that, “Engagement with community members is appropriate to the type and scale of the project and fosters productive participation by diverse stakeholders, including people traditionally marginalized by imbalances in access to power and capital” ((Hammer 2009: 3). Community participation has for decades been a marginal goal for most urban planning choices but becomes more critical should non-profit developers expect to pass on electrical and water costs to tenants before they have become accommodated to the management of those extra costs.

The processes by which green building can become ubiquitous rather than a costly experiment of the well-off has just begun. The US has not, so far, proven adept at reducing income and other forms of inequality; perhaps building sustainably will be an exception (Massey 2007).

Conclusions:

For the US, we are in the infancy of efforts to both define green building and to study its costs and effects. We are only beginning to formulate a coherent agenda of research that can sensibly measure and track human and economic outcomes for residential and office properties in a rigorous and long term manner.

It also appears that there are some notable disconnects between what for-profit and non-for-profit developers see as the critical benefits of green building and what researchers have so far been able to document. There is most importantly a lack of clear evidence about the cost and benefits of various green building rating systems and their long term effectiveness in lowering costs and improving the lives of tenants. Some of this is solely due to the newness of the rating formats themselves and to the absence, until quite recently, of any reasonable data source for measuring green building outcomes.

Only within the last three years have industry and academic analysts been generating on-line and published reports describing a limited set of economic outcomes from building green. While a widely quoted industry analysis asserts major rent and sales value impacts, a more recent regression based analysis finds only small effects and only for those buildings rated Energy Star. While there is currently no comparable alternative data source, this initial set of studies makes use of an industry based, proprietary data set that does not have full coverage of all office, rental or others buildings throughout the US. CoStar data also only report a limited set of economic outcome measures. The data and these studies have been then a necessary but hardly sufficient basis for judging benefits and costs. ^{xxxi}

The errors in these initial analyses suggest, then, the need for caution in drawing any firm conclusions about net social benefits of green building. It is simply too early to tell; too early in the life cycle of green building measurement and much too early in measuring a comprehensive set of outcomes of green building. None of the studies has, for example, presented clear or convincing empirical evidence on the health and productivity benefits from green development, although they have asserted that such effects can be shown. Developers, such as the Dursts', make the case that there are such impacts. There is then a clear imbalance in what research reports have found and what for-profit and not-for profit firms stress as critical.

There has then only been a short time period for construction according to green codes and an even shorter period for occupancy. The Dursts' Platinum LEED building is not yet fully occupied. It is also among the few such building seeking a top ranking. There are therefore very few building upon which to seek sales and performance data to determine market value and long term returns; this applies to Platinum and other LEED scales. It is also central to recall that the substantial decline in demand for office space has resulted in lowering of rents, more rent concessions, and lower sales prices for the few buildings that have managed to be sold. The evaluation of LEED performance in a major down-market, when tenants are seeking lower rents and possibly little else, will test the utility of sustainably developed buildings in a way not previously possible. A final issue of concern is that while a building may be built to a full sustainability standard, office or residential tenants need not use green methods for the operation or maintenance of their units or apartments. Building tenants have the option to not fit out their space in green (LEED IB) so the cumulative net building effect will be harder to evaluate and price.

The clearest place where there is agreement between most data-based reports and developers is that there is a considerable savings on the cost of energy for both building operators and residents or tenants as a result of many forms of sustainable development. Even though there are still relatively few buildings from which data can be drawn, there appears to be a rough consensus that energy savings range from a 25 to 33% reduction in annual energy costs as a result of building in differing green formats. The savings for example of Time Equities from their conversion are quite pronounced after a non-LEED set of building adaptations that were not made to fit any code requirements. The energy savings reported by the Bronx affordable housing

developer WHEDCo are in this range as well (Turner and Frankel 2008). The Jonathan Rose companies reports an expected 37.3% energy savings on their planned South Bronx development. Indeed this is the sole variable they use to demonstrate the effectiveness of their green and affordable strategy.

The short to medium term advantages to green building may then simply boil down to the fact that it saves tenants and landlords money on their costly utility bills. It's the energy savings that matter. This appears quite convincing enough pending further research. Central to an appreciation of how effective green building strategies have been is an assessment of their costs and their net economic, social and health related outcomes. Such an assessment has barely begun for green buildings.

In answer to the question posed at the beginning of this paper, of why study green buildings, it is because they offer one of the few new, unique experiments combining building technologies with major human outcomes. It is important because we can uniquely observe the complex interactions between human and corporate decisions and adaptations to green technological formats. We will hopefully be able to soon see long term research on such decisions, their impacts, and human adaptations to both the costs and the benefits of living and working in green spaces.

What is most embryonic is governmental commitments to reinforcing or directing current voluntary schemes for providing sustainability in office and residential complexes. Until governmental incentives, tax policy, and regulations act to coherently support both innovation and technological improvements it appears certain that social equity gaps will remain, and green building will remain more fashion than necessity for far longer than is necessary. Federal efforts to initiate a large-scale demonstration aimed at fostering major technological and training breakthroughs in affordable green building appear one logical next step (Friedman 2008: 175-176).

If we follow the encouragement of those who wish to push the envelope of sustainable planning to incorporate more than individual properties we then encounter a useful dynamic for causing a potential reevaluation of long-standing methods of building American communities; sprawled and costly. We may be at the forefront of testing the linkages among our environmental commitments, human community planning, social equity, and technological innovations in reshaping the viability, health and long term competitiveness of cities in the US (Friedman 2008; Price Waterhouse 2009).^{xxxii}

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- Pew Center for Global Climate Change: Building Sector: http://www.pewclimate.org/what_s_being_done/in_the_states/leed_state_buildings.cfm

ENDNOTES

ⁱ "The current information stream has become polluted with advocacy and lobbying rather than useful metrics" (Vyas and Cannon. 2008: 4).

ⁱⁱ In the 1970's US HUD initiated a major demonstration aimed at improving affordable building technologies in "Operation Breakthrough". A comparable although fully completed level of engineering and technological innovation appear appropriate for sustainable and affordable rental and ownership housing modules. <http://www.gao.gov/products/PSAD-76-173>

ⁱⁱⁱ It is critical to recall that there have been prior guidelines aimed at improving building occupants health and productivity such as the National Construction Goals issued by the National Science and Technology Council (see Hodgson et. al. 2000).

^{iv} <http://usgbcny.org/initiatives/green-codes-task-force.html>

^v “The LEED System is a point based system. The building projects earn points based on their satisfying [Green building](#) criteria. They must satisfy certain prerequisites and earn credit points based on six different categories. The six categories are: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design processes. Depending on the number of points the building project earns, it is awarded a certification level. There are four LEED certification levels – Certified, Silver Gold and Platinum “ (Copperwiki, May 2009).

^{vi} Other countries maintain their own green building rating systems, including Japan’s more developed CASBEE format. http://www.ibec.or.jp/CASBEE/english/document/CASBEE_brochure.pdf

^{vii} Costar is the US largest provider of commercial and multifamily information covering 66.6 billion square feet of space and 1.2 million for sale and lease property listings (as of April 2009). http://www.costar.com/?src=ppcg&s_kwcid=costar12987601259

^{viii} See their website: <http://www.timeequities.com/about-environment.cfm>

^{ix} One illustration is the following company: <http://www.utilityaccounting.com/>

^x “CHFA Tops in Green QAPs”. 2009. *Affordable Housing Finance*. (April/May): 6.

^{xi} Jonathan Rose’s company can be found at: <http://www.rose-network.com/> and WHEDCo at: http://www.whedco.org/message_nancy.php

^{xii} They include Federal Low Income Housing Credits; NYS Low Income Housing Credits; NYC Housing Development Corporation Affordable Cooperative Program; the NYS Affordable Housing Corporation; New Market Tax Credits; an Enterprise Green Community Grant; as well as funding from NYSERDA and a Home Depot Grant.

^{xiii} See: http://www.rose-network.com/projects/index.html?cat_toc.html&top.html&studio_investment.html

^{xiv} Fuerst and McAllister (2008) also made use of CoStar data in their unpublished “preliminary” regression study of the effects of LEED and Energy Star. They used a non-comparable set of comparison properties with no attempt to locate comparables within the same micro market; they selected their comparables throughout the metro area. As they only identified 4-5 platinum rated buildings, they apparently excluded them from their analysis. They apparently compared newer class A rated buildings with older A and B buildings further limiting their results. They report a roughly 12% positive rent improvement combining both LEED and ES rated office buildings, with a number of the cities for which they have data reporting negative rents. They too find that the bulk of the rent improvement is found for ES rated buildings. They report a 31% price premium for LEED buildings and a 10% premium for ES buildings.

^{xv} McCormick (2008) reports 2.6% to 3% higher rents. A central issue will be as LEED ratings become more popular and common, will this ‘exclusivity’ rent benefit decline.

^{xvi} McCormick (2008: 35) also reports a 3.5% higher occupancy, but such a small differential could be the result of sampling and selectivity issues.

^{xvii} Among the well known problems associated with using asking rent data is that there are often differences in the final or effective rent. Also rent concessions are often used to attract tenants which are seldom revealed in the initial asking rent. Vacancy rate data also may not capture shadow rental or sub-lease space offered for rent for current tenants seeking to lease out part of the floor space.

^{xviii} Greg Kats. 2008. “Greening Buildings and Communities: Cost and Benefits.” (November). Good Energies: http://www.goodenergies.com/news/-pdfs/Green%20Buildings%20Study%20Press%20Release%20FINAL_5.pdf

In a telephone interview on May 4, 2009, Mr. Kats confirmed the study sample was only roughly 160 buildings and that the full methodology and findings from this study will be published by Island Press in some month’s time.

^{xix} CoStar generated a 61 page report in which more details of their sampling and analysis strategy were presented CoStar 2008(a).

^{xx} They began with a potential pool of 5,709 Energy Star rated buildings and 1,703 LEED certified. As on 2008. n A matching process for rent and sales values reduced that pool to only a total of 286 LEED and 1045 Energy Star buildings. . They make note of the fact that the CoStar data series fails to include much data on older and smaller buildings in the US (p.11, note 3).

^{xxi} The comparative analysis they conducted did not include the types of variables which would be used by a professional appraiser to establish clear set of similar properties. They did not for example have data on tenant mix in the buildings, the size of space leased which often affects price/rents, how close the buildings were to mass transit, nor did they take into account that rental prices can vary as much as 2 percent a month in an up or down market thus making their year dummies a crude proxy for time sensitive returns. Telephone interview with Scott Muldavin, May 5, 2009.

^{xxii} Loftness (2006) for example summarizes ten case studies that suggest productivity improvements of 18%; reductions of absenteeism up to 71%. The studies are not tied to specific rating systems.

^{xxiii} It will be difficult to establish long-term data on health impacts and tenant retention information that will separate on-going tenant health issues and medical care from the independent, immediate impacts of spending roughly 8 hours and day, 5 days a week in a different, “healthier” environment. Also, some tenants will likely refuse to allow surveys of employee health and performance in green environment because of risk of liability that their prior space was unhealthy and therefore damaging.

^{xxiv} Matthiessen and Morris (2007): no major difference in building costs (0-3%; platinum costs more); others: 2-5%.

^{xxv} Residential and commercial building data are available from the Energy Information Administration of the US Department of Energy and from the US Census. <http://www.eia.doe.gov/emeu/consumption/index.html>

^{xxvi} Nelson 2008: 4.

^{xxvii} According to the developer, this sum does not include the land costs as the Durst Corporation had acquired the land many years earlier at a far from then peak market acquisition price.

^{xxviii} The US EPA states: “Projects must achieve an EPA energy performance rating of 75 or higher. A rating of 75 means that the proposed design is intended to perform in the top 25 percent of similar operating buildings.” http://www.energystar.gov/ia/business/tools_resources/new_bldg_design/App_Instructions.doc For criticism of the ES system see Aston (2008).

^{xxix} I am indebted to Michael Bobker, director of CUNY’s Building Performance Laboratory, for pointing this out to me.

^{xxx} On SWECO see: <http://www.swecogroup.com/en/enswecose/>

http://unfccc.int/files/methods_and_science/mitigation/application/pdf/berg_von_linde_sweden_the_sustainable_city.pdf. A source on the Dongtan Island Eco-city is:
<http://www.arup.com/eastasia/project.cfm?pageid=7047>

^{xxxi} Adding a battery of additional variables onto the CoStar data base could, for example, be one simple beginning in tracking a wider range of important outcomes.

^{xxxii} There is an in tandem need for international action in this area as well, including international measurement (Investment Property DataBank: Lim, McGreal and Webb 2008)