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TITLE:

Energy Efficiency in Residential Buildings and Transferable Development Rights: An Exploratory Analysis

ABSTRACT

New York City hopes to reduce Green House Gas emissions from buildings by 3.4 million metric tons by 2025. Since the vast majority of buildings in New York City already exist, a crucial objective is improving the energy efficiency of the existing building stock. The slow implementation of energy efficient technologies in buildings can be explained by a lack of funding. This study explores methods for targeting deeper energy efficiency retrofits, as well as financing these improvements through reforming the City's zoning ordinance, specifically the governance of Transfer of Development Rights (TDR) transactions. Developments with transferred development rights create increased density that impose costs that need to be accounted for; with more building density there will be more energy usage at one point in space. Based on research and reasonable assumptions, this study of Manhattan alone demonstrates that placing a value capture tax on TDR transactions at a hypothetical 6% tax rate could raise between $46 million and $72.5 million. Similarly placing a flat $18 per square foot (PSF) charge could raise from $47 million to $67 million. The revenues generated by this transfer charge could be earmarked for energy improvements in residential buildings. Using existing technologies, it is estimated that this money could possibly reduce GHG emissions in the City of New York between 282,337 and 433,782 Metric Tons of CO2 equivalents- depending upon the approach adopted. Further consideration should be given to the benefits of energy efficiency grants as opposed to loans.

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1. Introduction

This research makes a case for suitable strategies to improve energy efficiency in existing residential buildings in New York City. It will focus on existing residential buildings because they hold the greatest potential for an immediate impact on reducing GHG emissions. New construction alone will not make a measurable impact on building related GHG emission because such construction represents less than 1.5% of the entire stock of commercial buildings in the U.S. (Ciochetti & McGowan, 2010). Furthermore, New York City's Pathways to Deep Carbon Reductions study show that multifamily buildings represents the greatest potential opportunity for building-based GHG reductions due to their relative size and distribution of energy use. Many studies suggest that improving the energy efficiency of existing buildings can be an important strategy to achieve a carbon free future. Lacking however, are strategies for creating the needed alternative funding platform to bring these approaches to fruition.

Local governments already have policy tools that with slight adaptation could be used to increase the energy efficiency of existing buildings. The most effective policy tools are those that enforce energy codes and provide energy efficiency incentives or subsidies to building owner. However, reports created by the city planning departments suggest that to reach carbon emission reduction goals more innovative policy tools are needed. This paper will discuss the barriers to implementing energy efficiency improvements in residential buildings- specifically lack of information, split incentives between landlords and tenants and financial barriers- and a strategy to overcome these barriers.

In New York City, leveraging the market for Transfer of Development Rights (TDR) through the zoning resolution can create a local fund dedicated to energy improvements. A modification to TDR regulations can possibly target old buildings for energy retrofits and imposing a value capture tax can raise funds to finance energy efficiency retrofits. An important public rationale for this is that added FAR does impose costs on the environment and the beneficiaries should share in the cost. These policies will help the city achieve its goals in reducing carbon emissions.

2. Research Design

To understand New York City's energy landscape and programs for energy efficiency of residential buildings, research articles were collected via the department of city planning's website, as well as through google, and Columbia University's library catalog. To recognize the most effective policy tools, different policy tools for energy efficiency in other cities were researched as well. The barriers to energy efficiency were researched on the internet and also from speaking with multi-family developers. After an analysis of the programs offered by the city and of the impediments, it was determined that securing affordable financing is a major issue concerning energy efficiency investments.

Value capture seeks to create public revenues from transactions that benefit from publically induced changes in land use. To capture the increase land value from TDR regulations, taxing air rights transactions were investigated as a method to create revenue for an energy efficiency improvement fund. To justify the tax, data was collected and analyzed to ensure the tax could raise sufficient revenue to meet the city's carbon reduction goals. Data was only readily available for Manhattan, therefore analysis and results only reflect possibilities from Manhattan.Data on Manhattan air rights were investigated, as well as data from the Furman Center on recent TDR transactions to determine a tax rate. The data on TDR transactions was also used to project potential savings and reductions in carbon emissions.

3. Background

3.1 Energy Efficiency – Implications in New York City

Cities everywhere are aiming to reduce the amount of energy they consume in order to slow down climate change caused by Green House Gas (GHG) emissions (Riffle et al., 2013). The City of New York's Green House Gas (GHG) emissions accounted for 0.5% of total global emissions in 2013 (City of New York, 2013). The most economical path to ensure lower carbon emissions in the future is not by expanding renewable energy production, but by improving the energy efficiency of our infrastructure. Energy efficiency is defined as the ratio of the useful energy to the total energy consumed (American Physical Society 2008). Improving the energy efficiency of cities will only be possible if governments expand their use of policy tools, pushing markets in favor of energy efficient design and technology.

In New York City, 80% of the energy consumed must be produced within the five boroughs by law; therefore, emissions from the burning of fossil fuels for energy production can directly negatively affect the city's citizens. All power generation projects in New York City burn gas to generate power for the grid (EIA, 2014) and nearly 70% is lost as heat during generation and transmission (Urban Green Council 2010). Power generation is New York City creates local air pollution and also creates excess urban heat. The only way to resolve these consequences is through decentralization of electricity production (i.e. renewables), or to lessen the burden with energy efficiency measures (Portney, 2013).

Since 2002, New York City's tenants have experienced an increase in utility costs of 20% percent and fuel oil costs more than doubled in the same period; bear in mind, these costs disproportionately impact low-income residents, who typically pay a higher proportion of their rent on energy and utilities (HUD, 2011; NYC Mayor's Office, 2014). Mayor Bill De Blasio is especially focused on green building and affordable housing. One of the main components on providing affordable housing in the city is maintaining the affordable units that already exist. Many affordable housing and public housing developments are financially burdened with high energy costs because they were built without energy efficiency in mind (Columbia University, 2009). Coming up with new funding strategies to implement energy efficiency measures in affordable housing developments will be crucial for their future viability.

Energy Efficiency and Social Justice

In New York City, it is estimated that the least efficient buildings use 3 to 5 times more energy than the most efficient buildings (Urban Green Council, 2010). Mainly expensive, high-end buildings have been built “green”- that is with efficiency in mind- thus, middle and low income New Yorkers have a lower chance of experiencing the benefits of a green building (Urban Green Council, 2010). Even more, green buildings go even deeper in issues of environmental justice as climate change and environmental issues have serious, long-term impacts on the general public’s health and safety, including the very habitability of New York City. We need to be conscious of marginalized populations in low-lying coastal neighborhoods; low-income populations usually suffer disproportionately from the impacts of climate change, as witnessed in the aftermath of Hurricane Sandy. Also, deaths and hospitalizations from heat waves are 50% more likely in high poverty neighborhoods (NYC Mayor’s Office, 2014). For city-planners and real-estate developers, green building can be a solution to environmental challenges.

Considering the urban context, a city’s sustainability is measured within balance of the three “Es”; economy, ecology, and equity (Fitzgerald, 2010). To ensure a city is sustainable there needs to be a vibrant economy that is constantly producing more opportunity for jobs and economic exchange. The ecology of the city needs to be healthy to build on the city’s natural assets and ensure the well-being of the residence. Even more, for a city to be truly optimistic and sustainable, there needs to be access and opportunity for all classes of society (Fitzgerald, 2010). Energy efficiency in the building sector advances all three tenants- it pushes for innovation in green technology thereby creating more employment opportunities, green buildings reduces pollution and by applying the right policies, energy efficiency can be accessible to all classes of society.

3.2 Environmental Planning and Economic Development

First and foremost, economic growth and development need to be consistent with visions of the community and a greater quality of life. “Smart growth” ensures economic growth is tied to the quality of life in the community (Portney, 2013). Development left unmanaged and unquestioned can lead to undesirable consequences- smart growth leverages new growth to improve the community. Private economic development decisions that are likely to produce a tragedy of the commons scenario can undermine the quality of life pursuits for the community as a whole (Portney, 2013). The tragedy of the commons is Garrett Hardin's theory which proposes that individuals proceeding rationally and according to individual self-interest deplete a common resource, thereby behaving contrary to the best interests of the community. In the case of economic development, new and denser neighborhoods reduce the supply of clean air in the city, especially in New York City where 80% of power generation must be produced within the city. Cities need to ensure that buildings consistently incorporate energy efficiency measures that decrease pollution and local energy demand.

Strengthening policies to encourage green retrofits can also invigorate the local economy- it will also shift local markets in favor of green technologies. From green building retrofits cities can benefit from increases in local employment, and especially an increase in jobs for those without a college degree (NYC Mayor's Office, 2014). A community is made more sustainable when residents' money circulates within the community, thereby eliminating the need for outsourcing building services and importing products. In fact, when retrofitting buildings, every one million invested in energy efficiency in buildings creates around 12 to 15 direct and indirect jobs (Fitzgerald, 2010). City governments should pursue "linking strategies" to connect sustainability or climate change initiatives to economic development goals such as creating workforce development programs to train residents for green jobs (Fitzgerald, 2010). Outsourcing energy service and non-renewable products sends money out of state; while, dollars saved from efficiency tend to be re-spent locally. Construction and installation jobs employ local people and going green also means using local products. Job creation from energy efficiency can also be seen in NYC, where the city expects to train and create opportunities for about 7,000 people for jobs such as high performing building operators (NYC Mayor's Office, 2014). Furthermore, Fitzgerald (2010) defines "transformational strategies" as ways existing businesses can expand into green markets or services; in this case, a producer of windows becomes a producer of thermal shades (Fitzgerald, 2010).

3.3 Energy Efficiency in Buildings

In buildings much energy is lost as heat escapes due to poor insulation, air leakage or improper maintenance and operation of mechanical equipment. The largest source of GHG emissions in New York City is from the generation of electricity used in buildings (City of New York, 2013). In 2013 New York City conducted a study that found two-thirds of the GHG reductions that are needed to achieve an 80% reduction from 2005 levels by the year 2050 based on current technologies must come from more efficient buildings (City of New York, 2013).

Today, people are able to achieve the same quality of life and use less energy thanks to improvements in energy efficient technologies; these include better insulation to lower heating and cooling loads, shading devices and new mechanical equipment and lighting. Although there are new advances in efficiency, energy consumption has been rising because of population growth, increased standards of living, and an abundance of ways to use energy (American Physical Society, 2008). For New York City, focusing on improving energy efficiency in buildings can have a large impact on the city's sustainability; about $15 billion is spent each year to heat and power buildings in the city (NYC Mayor's Office, 2014). The residential apartments of New York City are suitable targets for improving energy efficiency, because residential buildings represent 92% of total buildings in New York City and 70% of the built area. More importantly, about a third of GHG emissions come from buildings, with residential buildings accounting for 48% (City of New York, 2013). Furthermore, New York City is estimated to grow to 9.1 million people by 2030 (NYC Mayor's office, 2014) and about 75% of the buildings that New Yorkers will occupy in 2030 exist today (City of New York, 2013). With an increase in population there will be an increase in energy demand. Therefore, the sustainability of the city will depend on reducing the energy demand from buildings.

New York City has recognized the large amount of greenhouse gases that are emitted by the building sector and in 2010, initiated the benchmarking program, Local Law 84 (LL84). Local Law 84 was created as part of the Greener, Greater Buildings Plan and mandates that buildings over 50,000 gross square feet submit to periodic energy audit and retro-commissioning measures. Shortly, this law will effect buildings over 25,000 square feet. More than 2.1 billion square feet of floor area in New York City has been benchmarked since 2010, and after analyzing the data, reports found that multi-family residential buildings could have the greatest potential for energy savings due to their size and distribution of energy use (City of New York, 2013). Most of the bulk end use of energy for residential buildings is for heating- reducing energy consumption from heating can be achieved from current design and technology such as improved insulation.

3.5 Policy Tools For Energy Efficient Up-Grades

Tools that are already recognized by local governments include, regulations to meet certain energy codes or standards, programs that offer financial support or incentives, programs that provide technological or administrative support, and finally maintenance support to ensure buildings are actually operating as efficiently as intended (Fitzgerald, 2010; Simons et al., 2010; Retzlaff, 2009). With the right mix of such tools, building owners will be encouraged to increase the efficiencies in their buildings. For example, after Chicago introduced a plan that encouraged green building by providing technical assistance, expedited permitting, density incentives, and green roof grants, the city saw a sharp increase in green construction and renovation (Simons et al., 2010).

The most effective tools for increasing energy efficiency in buildings are building energy codes and financial subsidies or incentives (American Physical Society, 2008). For example, through the use of appliance standards, building energy codes, and utility programs, Californians use about 5,000 kWh per person per year less than the average (American Physical Society, 2008). California has been a leader in building energy standards that it develops itself – energy codes adopted since 1975 reduced peak power demand by 30 billion USD or more in energy savings in 2003; furthermore, California has experienced a 10-15% cut in energy use each time the state has revised its energy code (American Physical Society, 2008). Another policy tool that has proved successful is the requirement to retrofit to meet energy code at time of sale for commercial and residential properties (American Physical Society, 2008).

I. Regulating Buildings - Set a Code or Standard

Cities can use certain standards or codes in regulating building energy efficiency. A standard is an established rule or basis for comparison to benchmark and judge a quality such as energy efficiency. Standards can be mandatory or voluntary, and when they are used to benchmark energy efficiency they can potentially remove trade barriers and promote competition. On the other hand, a code is a body of laws that ensure public safety and sustainability- local amendments are usually applied to codes to tailor them to the unique needs of the locality.

The most popular standard is LEED (Leadership in Energy and Environmental Design). LEED was created in1998 by the United State Green Building Council and was established as a non-profit entity. LEED has four different levels of certification: certified, silver, gold and platinum (International Code Council, 2012). Certification is by point basis and points are awarded based on design, construction, and projected energy use of operation- most points can be awarded based on energy efficiency. LEED standards began to be mandated in cities by requiring all public buildings to become LEED certified; the idea was that local governments should "LEED by example" (Simons et al., 2010; Retzleff, 2009). Currently some localities are mandating requirements for LEED certification for renovated buildings that meet a certain size or value requirement (Simons et al. 2010).However, according to the Urban Green Council's Green Codes Taskforce, "greening the codes" can prove more beneficial than mandating LEED standards for the private sector; codes are enforceable and therefore create economies of scale in both expertise and materials, and result in lower costs.

The code adopted by the U.S. Department of Energy is the International Energy Conservation Code (IECC), with content based on ASHREA 90.1-2010. The new code was adopted in 2012 and is expected to impact commercial property owners with the aim to increase energy savings by 30% from the previous code (International Code Council, 2012). Codes are constantly changing to keep up with technological innovations, the IECC up-dates every three years; interested and qualified parties may submit requests for changes to the code; the requests for changes to codes are reviewed by an expert committee- the process is also democratic as there are public hearings to review changes to codes (International Code Council, 2012). The function of the IECC is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building". Furthermore, in existing buildings, any new work requiring a permit must meet IECC provisions. The code should provide building owners guidance in order to comply with the law. As of 1978 California became the first state to include energy requirements in its code and today 40 states use the ASHREA or IECC; however, only 19 states use the most recent version of efficiency codes (EPA, undated). Building energy codes are estimated to produce a financial benefit to owners of nearly 2 billion dollars annually by 2015, rising to over 15 billion dollars annually by 2030 (U.S. Department of Energy, 2011).

In 2009, New York developed the city's own local energy code (Local Law 85) that is revised on 3 year basis. This is in line with the International Code Council code revision process. The major change from LL85 was the exemption for most renovations from being required to meet code was removed. Presently, all buildings renovations must meet energy code. The Department of Buildings is responsible for enforcing the Energy code; however, the enforcement program is limited in scope and lacks appropriate human resources. Almost every renovation project that has been audited has been out of compliance. The only way this tool can work is with proper monitoring and enforcement. The City and the Urban Green Council also brought together city officials and industry leaders in the building and construction industry to create the "Green Code Taskforce" with the goal of creating new codes or changes to codes that would promote environmental responsibility and sustainability.

II. Financial Incentives- Zero or Low Interest Loans and Subsidies

There is a reasonable case for providing subsidies for energy efficiency initiatives since these retrofits could in fact be profitable in the long term and property owners and businesses could realize savings on investments. However, the up-front costs to energy efficiency up-grades are high and bank loans could be difficult to obtain. Referring to literature on urban offices, financial incentives have not worked as a tool for "green building" development for commercial office buildings (Choi, 2010). Especially, in California the existing financial incentives were hardly taken advantage of by private developers (Choi, 2010).

Research conducted by Walls (2014) also found that there was low participation in loan programs for energy efficiency retrofits. Consumers were found to be more responsive to subsidies (in the form of tax credits, rebates, or grants) and therefore, greater energy and CO_2 reductions are achieved with subsidy policies. In fact, subsidy policies were found to be 7 times more effective at reducing CO_2 levels than loan programs (Walls, 2014). On the other hand, subsidy programs are subject to a greater policy trade off as they have greater welfare costs. Welfare costs are the opportunity costs imposed on society when resources are diverted toward energy efficiency up-grades instead of other sectors of the economy. Loans do not have great welfare costs since they are eventually paid off, but they are substantially less effective in achieving their goals than direct subsidies. Walls (2014) study also found subsidy policies to be more effective than policies regulating efficiency standards; efficiency standards lead to purchases of equipment that just meet the minimum standards instead of the most innovative and efficient equipment.

Another innovative policy tool that was developed in Austin, Texas has been to defer increases in property taxes or waive permitting fees. A panel of city officials and developers' representatives assess development proposals and assign points- these points earned by the project determine the size of the permitting fees waived or if the project is permissible to have ten years of incremental increase in property taxes waived (Portney, 2013). A further financial incentive used is expedited permitting- Chicago is an example city that uses this policy. Expedited permitting can reduce costs since it reduces construction time for new construction and renovations.

4. **Looking Forward - Energy Efficiency in New York City**

Programs that exist in New York City are New York States Energy Research and Development Authority's (NYSERDA) Multifamily Performance Program (MPP) and soon to be launched is by city planning is a retrofit accelerator for creating energy efficient and resilient neighborhoods.

The MPP is available for multi-family buildings with 5 or more units or 4 or more floors and can be market-rate or affordable – the program provides property owners with expertise, technology and incentives as per unit loan payments to improve their building's energy performance (see Appendix for more information). According to NYC PLUTO data, there are 25,240 multi-family buildings in Manhattan alone. NYSERDA's MPP program has only covered 256 buildings, which is about 1% of all Manhattan's buildings.

The retrofit accelerator will focus primarily on neighborhoods that are inundated with issues of housing affordability and grid reliability but also on other neighborhoods. The idea is to complement utility cost reduction programs under development by the city's Housing and Preservation Department. The success of this program should result in energy retrofits completed in 1000 buildings (NYC DCP, 2015).

These programs are not enough to ensure energy efficiency in all of New York City's residential building stock. Most of New York City's buildings are small- and mid-sized buildings that are less than 50,000 square feet. Smaller residential buildings are the core of the city's neighborhoods and are in precarious situations due to affordability issues and rising operating and utility costs (NYC DCP, 2015). However, many building owners are faced with financing constraints and limited time and capacity to deal with administrative and technical complexities.

5. Barriers to Energy Efficiency Retrofits

If energy efficiency measures are cost-effective then why have they not been adopted? Reasons include lack of information and also a lack of time to fully comprehend energy efficiency technology and energy savings. To finance energy retrofits, it is crucial to understand retrofit cost, energy savings, and whether they are cost-effective (Markowski et al., 2014). Other barriers to energy efficiency include difficulties renovating when tenants are occupying dwellings, access to investment loans for small landlords, consumer education, targeting large residential buildings since they are so numerous in large cities, and an inability to recoup the investments in the short term in the event of a property sale (Volker & Johnson, 2008). Energy is also a small cost compared to other expenditure, only representing 30% of total operating costs (Hammersmith Group, 2010), while opportunity costs of undertaking retrofit projects are high due to limited time and capital. Also, there is the split incentive problem; landlords who do not pay for utilities are unlikely to invest in energy efficient technologies since the energy savings end up accruing to the tenant.

Barriers in terms of uncertainties have been defined as the transaction costs associated with building efficiencies (Qian et al., 2012). Transactions costs are the invisible or hidden costs and include the uncertainties of capital costs, new information, new technology, and financial risk. Market failures are hypothesized to inhibit exchange, production and economic growth which all contribute to higher transaction costs (Qian et al., 2012). To lower transaction costs in promoting energy efficiency, governments should have long-term strategies and clear policy signals.

Split Incentives

Split incentives occur due to the different incentives for lessors and lessees concerning the efficient use of the building in different lease structures. In gross leases that include utilities, lessors directly benefit from energy savings and thus have an incentive to implement energy efficiency measures. Meanwhile, in gross leases, there is no incentive for lessees to use the space efficiently. Daily energy use is likely to be higher in gross leases as tenants have less incentive to shut off air-conditioning during low operation hours (Dolnick, 2010). On the other hand, in the net lease structure, renters pay the costs of their utilities so they are assumed to conserve energy; however, since they pay utility costs, building owners are not incentivized to up-grade for energy efficiency. Maruejols and Young (2011) found that total energy consumption was significantly higher for households that do not pay their own utility bills. When tenants do not see their bill they have a vague idea of the costs associated with energy consumption habits.

Dwellings where occupants do not pay directly for heat might be especially targeted for improvements related to the energy-efficiency of heating technologies and building's thermal envelope in order to counter-act temperature setting behaviors. Another strategy to reduce tenant temperature setting behaviors is to bill them for energy use by installing sub-meters in buildings. When buildings are sub-metered, the building owner is charged by the utility provider based on the building's master meter, but the owner can charge tenants for electricity in proportion to their individual use from sub-meter information. A counter argument to this is that landlords would design their buildings to be better insulated and ensure use of efficient equipment if they are burdened with paying utility bills. On the contrary, the share of buildings that have undergone renovations is higher when tenant pays the utility bills than when landlord pays (Maruejols & Young, 2011).

New York City should concentrate on finding effective ways to promote programs that help building owners install sub-metering. Con Edison counts about 250,000 apartments across the city, not including public housing projects, that do not have direct meters or sub-meters tracking electric and gas consumption, compared with roughly 1.75 million that do (Dolnick, 2010). Cooper Square Management Company estimates that these units expend at least 30 percent more energy year-round than their counterparts (Dolnick, 2010). New York State studies have shown that metering tenant energy use in a multi-family building can reduce apartment energy consumption by approximately 17%-27% (Urban Green Council, 2010). Furthermore, converting to sub-meters is more advantageous than converting to direct metering (where the utility provider bills the tenant directly) since it is less costly, and also technologies like Combined Heat and Power are only available for master-metered buildings.

Financial Barriers

Subsidies and incentives from government are not enough to cover the amount of the energy efficiency investments so building owners will need to seek additional financing sources. Due to the uncertainty of savings created from energy efficiency investments, private lenders have difficulty determining value and incorporating energy savings into underwriting processes, proforma analysis or property appraisals (HUD, 2011). The unpredictability of the energy market also causes uncertainty in energy savings from energy efficiency investments since they depend on the price of energy. Multifamily building owners need access to financing for energy efficiency improvements and usually only come across sufficient capital when they refinance, so that the cost of the improvement can be incorporated into the new loan (Markowski et al., 2014). Even so, most lenders do not take into account the energy savings into their projections and this could prevent owners from investing in the retrofit (Markowski et al., 2014).

Furthermore, properties may not be able to access loans because loan programs typically secure a retrofit loan by recording a lien against the property (Markowski et al., 2014). Owners must get the permission of senior lenders to add a subordinate lien against the property and this is an onerous task. Other liens tied to mortgages will cause the retrofit loan to take a subordinate position. Most private lenders do not consider a subordinate lien a secure investment, and this deters them to finance smaller retrofit loans (Markowski et al., 2014). Lack of access to capital is a major issue for energy efficiency improvements in multifamily buildings.

6. Energy Efficiency Funding – A Normative Proposition

New York City has been successful in recognizing what needs to improve, but how can old buildings be targeted for deeper energy efficiency retrofits and how can these retrofits be financed? Since the vast majority of New York City's buildings already exist, the most effective ways to improve the energy efficiency of the city is to focus on the existing building stock. There is a need for further research on strategies to target existing buildings, especially smaller and medium sized buildings, for deep energy efficiency retrofits.

A policy tool that has proved successful is the requirement to retrofit for energy efficiency and meet energy code at time of sale for commercial and residential properties (American Physical Society, 2008). Even more, air infiltration tests should be performed to limit air leakage to levels determined by the 2012 IECC. Building alterations commonly manifest during a sale event. The city should include requirements in real estate transactions that support the city's sustainability goals. A scenario where existing buildings acquire capital that could be used towards improvements and thus targeted for regulation is during a transfer of developments rights event, also known as an air rights transfer. Buildings selling their excess air rights should also be required to meet the current energy code.

The city also needs to increase funds dedicated to energy efficiency programs. The government programs already in place are not sufficient to reach the Mayor's carbon reduction goals, also barriers to accessing private loans are an impediment. The city should create its own revolving low interest loan fund for energy efficiency improvements. Ideally, loan proceeds would be distributed similarly to NYSERDA's MPP program (see Appendix). To raise funds for energy efficiency improvements the city can collect revenues from a tax on air right transactions.

6.1 Transfer of Developments Value Capture

Increases in land value are made by privately funded improvements, but also by local population growth, neighborhood economic activity, public investments in infrastructure, public service provision, and planning and land use regulations. Value capture is the process of retaining as public revenue some portion of the increase in land value induced by changes from the public sector (Ingram & Hung 2012). Since Transfer of Development rights can increase the value of land by increasing the amount of build area, the city could potentially capture a portion of the created value by taxing the transaction.

Types of Air Right Transfers

Transfer of Development Rights (TDR) occur between entities whose buildings do not comprise the total FAR (Floor Area Ratio) allowance; these entities can transfer their excess allowable building floor area as air rights to another entity who wishes to build a building that exceeds the permissible FAR. In New York City, a Transfer of Development Rights can occur only between buildings that are located in the same zoning block; this is called an Arm's Length transfer. Another type of TDR that is widely used is a Zoning Lot Merger. In a Zoning Lot Merger, developers offer building owners of contiguous lots money in exchange to merge their lots in order to aggregate the total FAR of all lots involved in the transaction; thus, the developer can use the excess of the aggregated FAR to build higher on the lot they intend to build on (Augspach, 2009). The lots are merged into one zoning lot, only for zoning purposes. This type of transfer prevails “as-of-right” as the developer does not need documented approval from the city. One limitation of a Zoning Lot Merger is that building rights can only be transferred in an area as small as the block, so the opportunity to build a new building in the same block has to be presented.

On the other hand, a landmark transfer allows a building owner of a landmarked building to transfer their development rights to an adjacent lot or a lot directly across the street (Landis et al., 2008). Additionally, the city has implemented special purpose districts in the zoning resolution, where any lot within the district can transfer development rights to any other lot in the same district (Landis et al., 2008). For example, in the special midtown theatre district, theatres have had the ability to transfer their development rights to other buildings within the special zoning bounds-receiving sites for TDRs owned by certain “listed” theaters are anywhere between West 40th and West 57th Streets and between Sixth and Eighth Avenues (NYC DCP, 2015). In the special midtown theatre district, in addition to purchasing developments rights, developers must also contribute about $18 per square foot (psf) to a fund that is dedicated to preserving Broadway’s Theatre industry (The Furman Center, 2013; Renzel, 2014).

New York City has also proposed to allow additional density in Qualifying Sites around Grand Central- Qualifying Sites could exceed the base FAR if developers contribute $250 a square foot to a proposed district improvement fund (NYCDCP, 2014). Interestingly, there is also a sustainability requirement: to qualify for additional FAR, the new development must exceed Energy Efficiency requirement by 15% based on the New York City Energy Conservation Code.

Leveraging the market for TDR through the zoning resolution to create funds dedicated to energy improvements.

Currently New York City applies the state and city real property transfer tax on the TDR sales price, but only when the sale is more than 25,000 SF; the transfer tax is 1.425% on transactions $500,000 or less, or 2.625% on transactions greater than $500,000 (NYCDCP, 2015). However, in other cities TDR is strictly used as a tool to generate revenues for public benefit. For example, in Los Angeles, the city uses their TDR program (referred to a Transfer of Floor Area Rights "TFAR") to generate revenues- revenues from TFAR sales are stored in a TFAR fund to be used for social benefits. Los Angeles also charges a Public Benefit Transfer fee on all publicly and privately transacted TFAR, and these funds are deposited into the TFAR fund as well (Seifel, 2013). The following describes how the fee is calculated:

"The Public Benefit Payment under any Transfer Plan shall equal: (1) the sale price of the Receiver Site, if it has been purchased through an unrelated third-party transaction within 18 months of the date of submission of the request for approval of the Transfer, or an Appraisal, if it has not; (2) divided by the Lot Area (prior to any dedications) of the Receiver Site; (3) further divided by the High-Density Floor Area Ratio Factor; (4) multiplied by 40%; and (5) further multiplied by the number of square feet of Floor Area Rights to be transferred to the Receiver Site." (Los Angeles Municipal Code Ord. No. 178,592, Eff. 5-20-07.)

In comparison to the Public Benefit Payment charged by Los Angeles, the transfer tax applied by New York City does appear meager. New York City should intervene in transfer of development transactions to create greater benefits to the society, since externalities do ensue from such transactions. The city should tax TDR transactions to capture the value added from the increase of development rights in the receiving site.

Even more, as described previously, New York City has also created Special Zoning District programs where a dollar amount per square foot contribution is charged on transfer of developments transactions to make improvements within the district. As mentioned previously, the special theatre sub-district charges $18 psf and this amount is adjusted over time (Renzel, 2014). Other areas like the West Chelsea District charged $50.00 psf to make improvements around the High Line (NYC DCP,2015). If the city created revenue funds from TDR transactions in all areas of the city, the city could accumulate more revenue for programs that are essential to the city's sustainability.

The market for TDR

The Average price a square foot for air rights in Manhattan was $305 in 2013 (Morris, 2014). About 40% of the 34 air rights deals in 2013 in Manhattan were for residential condominiums, 36% for hotels and 16% for residential rentals (Morris, 2014). Recently air rights transactions have been more common than before- this is because they can make the difference between a “marginal and profitable project” (Finn 2013). From 2011-2013 17% occurred in residential only districts and they were all arm’s length zoning lot mergers (The Furman Center, 2013).

3.2 Reforming TDR for an Energy Efficiency Requirement

Since there is already an active TDR market in New York City and funds being created to take advantage of this market, the city should create a fund dedicated to improving the energy efficiency of old buildings through value capture of air rights transactions. The fund could potentially help finance energy efficiency improvements of the most polluting buildings or buildings in low-income communities. Especially since it is the oldest buildings that are usually the most energy inefficient, and TDR is intended to preserve old buildings, there should be an extra layer of regulation to make sure older buildings are getting renovated to be more efficient. As well as making sure the buildings acquiring the development rights are being constructed to be efficient. This idea would be in line with “Smart Growth” since the city can leverage capital for sustainability goals from new development that would be impossible without TDR.

To ensure a sustainable urban future, the city must decide important requirements to include in development programs like TDR’s. From 2003 to 2011, almost one third of new construction in the area of Manhattan below Central Park used TDRs to increase their development rights (MAS, 2013). Many of the new buildings being constructed will be some of the tallest residential buildings in New York City, and none of them are planned to maximize energy efficiency; they are being designed to be luxurious, and not necessarily sustainable (Barbanel, 2014). Many of these new buildings have glass facades that perform inefficiently in terms of energy due to heat gain, and poor insulation. The receiving building in a TDR transaction, if over a certain size should be LEED certified or have some high-energy performance standard requirement. If these developers do not want to constrain their own design, they should contribute to a fund that can be used to make energy efficiency improvements on other residential buildings in the city. The fund could be targeted to buildings with lower income residents, or buildings with the worst energy performance.

Reforming the Landmark Transfer Program

Today there are 33,000 buildings that have been landmarked in New York City (LPC, 2014). Landmarked buildings do not have to follow energy code, so as more buildings become designated as landmarks, the city must look into the energy efficiency of these building to meet a 80% reduction in carbon emissions by 2050.The Landmark Transfer program has been under-utilized in the past due to restrictions on the size of allowable transfer, the requirement for public review, and other transaction costs (The Furman Center, 2013). In fact, from 2003 to 2011 there were only two landmark transfers recorded (The Furman Center, 2013). Developers prefer methods, such as zoning lot mergers and lot assemblies, which involve fewer regulatory compliance requirements, less uncertainty, less time, and less administrative costs. If the Landmark Transfer program can be designed to happen as-of-right, as long as there is an energy efficiency requirement, developers can take advantage of the improved development opportunities and at the same time help to further environmental goals. For the Landmark Transfer to happen as-of-right, the purchaser could make a cash contribution to a fund that would help finance energy retrofits to multi-family buildings most in need. Furthermore, receiving sites should be required to build buildings that are a certain percentage above the current energy code. This contribution would be of great importance to counter the lack of energy efficiency in land-marked buildings, since land-marked buildings do not need to meet energy code.

7. Analysis and Discussion

To justify the case for a tax on TDR transactions for an energy efficiency fund, data from the Municipal Arts Society on available air rights and data on TDR transactions were collected online to determine the amount of remaining air rights in New York City. Data show that there are enough buildings with excess FAR available for TDR transactions. Just from the residential buildings in Manhattan alone, there remain 373,183,995 square feet of available transferable development rights (MAS 2013, PLUTO).

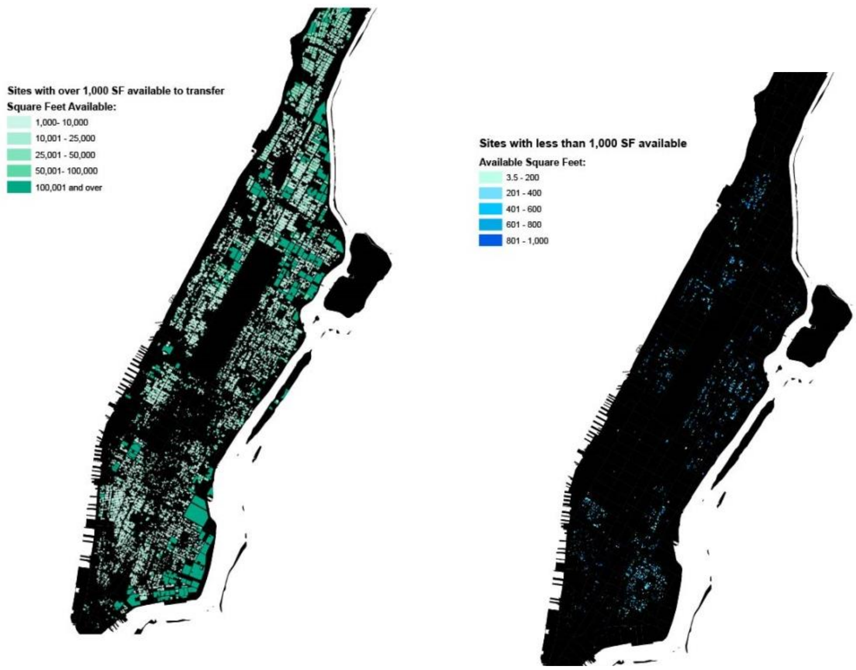

Figure 1. Maps showing available air rights for Manhattan's residential buildings.

Determining the TDR Taxation Rate

When forecasting the future market for development rights we must account for either of the followings events happening in the future: the rise and fall of the price associated with development rights. The amount of square feet involved in TDR transactions will go down with time as there is only a finite amount, unless there is an re-zoning, and as the supply per square foot decreases, the price per square foot will rise. However, if there is a depression in the market prices may fall even as the supply of transferable development rights fall. To account for unpredictable fluctuations in the future, five different scenarios were projected (see Table 1). Projections estimate the amount that could be raised from a tax on TDRs, and also present an idea of how much Metric Tons of CO2 equivalents could be saved each year.

Table 1. Scenarios of the future amount and price of air rights available in Manhattan.

Scenario	1	2	3	4	5
Decline in SF	5%	5%	0%	5%	10%
Growth $PSF	-5%	0%	0%	5%	10%

While analyzing the impacts of taxing development rights for energy efficiency up-grades, a 6% tax and $18 psf charge were assumed. Charging a dollar amount per square foot hedges against losing money, in the event that the price per square foot goes down; however, if the price does go down, the constant charge may deter developers from acquiring development rights. The percentage tax responds to the market and leverages the increase in funding from a heated market. This also responds to the negative externalities the market imposes. Losses from the constant charge can be mitigated if we raise the charge further out.

When choosing a tax amount consideration was given to the conventional supply and demand model of price determination (Rosen, 2004). If consumers of development rights purchase the same amount regardless of price, the whole burden can be shifted to them; however, if the demand of development rights is more responsive to price, the suppliers will find it difficult to sell their excess development rights and the city might not achieve further density. Generally, since the intent of the tax is to raise funds for social benefit without reducing market demand, the tax price must be set low enough so that the overall price does not to deter consumers from partaking in the market. However, the behavioral response is not well understood and will need more research.

In determining the rate of taxation, a 6% rate was considered reasonable and conservative; a tax rate set too low would not generate enough funds for the reform to be feasible, on the other hand a tax rate set too high might deter demand. Comparing different tax rates (see Table 2), 6% was the lowest rate that would achieve a contribution amount higher than NYSERDA's 2012-2015 allocation for Manhattan (see discussion below). The charge amount was assumed as $18 psf since this is the charge for the theatre sub-district (Renzel, 2014); this is considered a reasonable charge since developers have continued to demand development rights at this price (The Furman Center, 2013).

Table 2. Comparison of the potential revenue collected from different tax amounts.

		Contribution Tax Amount 4%	5%	6%	7%	8%
0% Decline in Square Feet						
Growth $/PSF	-5%	$ 36,279,226.56	$ 45,349,033.20	$ 54,418,839.84	$ 63,488,646.47	$ 72,558,453.11
	0%	$ 45,523,622.22	$ 56,904,527.78	$ 68,285,433.33	$ 79,666,338.89	$ 91,047,244.44
	5%	$ 56,897,766.58	$ 71,122,208.22	$ 85,346,649.87	$ 99,571,091.51	$ 113,795,533.15
	10%	$ 70,833,907.16	$ 88,542,383.95	$ 106,250,860.74	$ 123,959,337.53	$ 141,667,814.32
5% Decline in Square Feet						
Growth $/PSF	-5%	$ 30,666,872.93	$ 38,333,591.16	$ 46,000,309.39	$ 53,667,027.62	$ 61,333,745.85
	0%	$ 38,188,659.53	$ 47,735,824.42	$ 57,282,989.30	$ 66,830,154.18	$ 76,377,319.07
	5%	$ 47,383,293.41	$ 59,229,116.76	$ 71,074,940.11	$ 82,920,763.46	$ 94,766,586.81
	10%	$ 58,581,822.63	$ 73,227,278.28	$ 87,872,733.94	$ 102,518,189.60	$ 117,163,645.25
10% Decline in Square Feet						
Growth $/PSF	-5%	$ 25,898,130.42	$ 32,372,663.02	$ 38,847,195.63	$ 45,321,728.23	$ 51,796,260.84
	0%	$ 31,995,754.36	$ 39,994,692.95	$ 47,993,631.54	$ 55,992,570.13	$ 63,991,508.71
	5%	$ 39,396,920.90	$ 49,246,151.12	$ 59,095,381.35	$ 68,944,611.57	$ 78,793,841.79
	10%	$ 48,352,245.62	$ 60,440,307.02	$ 72,528,368.43	$ 84,616,429.83	$ 96,704,491.23

Projections: Contribution Amount and Reduction in GHG Emissions

The scenarios were projected only for Manhattan due to data availability. Based on the five scenarios, the range of estimates for the amount raised with a 6% contribution is $46,000,309 to $72,528,368 and for the $18PSF charge, the total amount raised ranged from $47,206,850 to $67,166,000 (see table 3). This translates into GHG emission reduction ranging from 323,641 to 433,782 Metric Tons of CO2 equivalents at the 6% tax or reductions ranging from 282,337 to 401,710 Metric Tons of CO2 equivalents at the $18PSF tax charge. The Mayor's office hopes to reduce GHG emissions from buildings by 3.4 million metric tons by 2025. This program would potentially already reach about 12% of this target by 2020, and remember this projection is only for Manhattan so there is greater potential when the other boroughs are included.

Furthermore, it is important to note that these calculations were done with conservative estimates- to estimate the total CO2 emission reduction, an estimate of 15% return on energy saving investment was assumed. This return was assumed since

NYSERDA's MPP Program stated that building owners who go through with the program have the potential to save at least 15% on annual energy bills. This is just the minimum amount so there is potential for further reductions in CO2 emission reductions with greater returns on energy investments. Also, there is greater potential for CO2 emission reductions since reductions in CO2 emissions were calculated under the assumption that all buildings use Natural gas. Natural gas is more efficient than petroleum and other fuel sources.

Greater reductions in CO2 emission can also be realized if the tax or charge for transactions involving landmarked buildings is higher. The tax should be higher for transactions involving landmarked buildings since these buildings do not have to follow energy code.

Table 3. Results of projections based on 6% tax or $18psf contribution for different scenarios.

	Total 2015 - 2020				
Decline in SF	5%	5%	0%	5%	10%
Growth $PSF	-5%	0%	0%	5%	10%
Contribution 6% of Total Cost	$ 46,000,309.39	$ 57,282,989.30	$ 68,285,433.33	$ 71,074,940.11	$ 72,528,368.43
$ Savings per year	$ 6,900,046.41	$ 8,592,448.40	$ 10,242,815.00	$ 10,661,241.02	$ 10,879,255.26
GGH Metric Tons of CO2 e	323,641.95	342,601.61	408,405.70	425,089.35	433,782.11
Total Cotribution $18 psf	56,343,924	56,343,924	67,166,000	56,343,924	47,206,851
$ Savings per year	$ 8,451,588.59	$ 8,451,588.59	$ 10,074,900.00	$ 8,451,588.59	$ 7,081,027.60
GGH Metric Tons of CO2 e	336,985.19	336,985.19	401,710.53	336,985.19	282,337.62

To get a sense of scale, the annual contributions collected from the TDR tax were compared to NYSERDA's annual combined MPP electric and gas budgets (see Appendix for a description of NYSERDA's MPP program). NYSERDA's aggregated budget for the entire state in years 2012 through 2015 was a total of $137,452,940, with each year having annual budgets of $34,363,235. To get a sense of Manhattan's allocation of this budget, the total amount of buildings in Manhattan receiving the Incentive was compared to the total number of buildings receiving an incentive in the state (2012). This came out to 27%; this was subsequently factored into the state's budget to find a $37,594,809.86 budget allocation from 2012-2015, or an annual budget allocation of $9,278,073.

Manhattan	Total Buildings	% of Total
381	1393	27%

Figure 2. Total Number of Buildings Receiving NYSERDA's MPP incentives (2012)

Now if we compare Manhattan's budget allocation from NYSERDA to the total amount collected from a TDR tax, we see there is not much difference in the scenarios (see Table 4). The table below shows that a fund created with the 6% tax would have not only matched NYSERDA's allocation, with an extra 5.24% to 15% raised. A fund created with a $18PSF charge would have also matched NYSERDA's allocation with an extra 15% to 20% increase. This is even more interesting because on NYSERDA's existing multi-family building program webpage, in April 2015 the NYSERDA base incentives are expected to go down by $50 per unit for electrically heated and by $200 a units for fuel heated (for both market rate and affordable).

Table 4. Comparison of the revenue from the TDR tax to NYSERDA's MPP program.

	Missed out 2012 -2015 %					
Decline in SF	5%	5%	0%	5%	10%	NYSERDA
Growth $PSF	-5%	0%	0%	5%	10%	Total 2012 - 2015
Total Contribution 6% of TC	$ 39,674,559.73	$ 41,297,761.39	$ 41,866,806.67	$ 42,975,022.35	$ 44,017,797.82	$ 37,594,809.86
$ Savings per year	$ 5,951,183.96	$ 6,194,664.21	$ 6,280,021.00	$ 6,446,253.35	$ 6,602,669.67	$ 5,639,221.48
GGH Metric Tons of CO2 e	279,136.21	249,140.47	249,140.47	255,768.55	$ 262,005.25	264,503.82
% Difference in funds from NYSERDA	5.24%	8.97%	10.20%	12.52%	14.59%	
Total Cotribution $18 psf	$ 44,217,616.67	$ 44,217,616.67	$ 44,777,333.33	$ 44,217,616.67	$ 47,206,850.69	$ 37,594,809.86
$ Savings per year	$ 6,632,642.50	$ 6,632,642.50	$ 6,716,600.00	$ 6,632,642.50	$ 6,548,685.00	$ 5,639,221.48
GGH Metric Tons of CO2 e	262,507.77	$ 262,507.77	265,855.36	262,507.77	$ 259,160.18	264,503.82

8. Conclusions

Complexities of Loan Programs

The success of the loan program will depend on the amount of participation among building owners. Loan programs have had low participation in the past, one reason being because loans must be paid back. Strategies to urge owners to participate in energy efficiency loan programs must be explored.

Furthermore, subordinate agreements in mortgage loans cause complexities in acquiring energy retrofit loans. Seeking approval from multiple lien holders with buildings that have multiple layers of financing could limit access to energy efficiency loans. For example, mortgages financed through programs such as Fannie Mae, Freddie Mac and the Federal Housing Administration prohibit buildings to add subordinate liens (Markowski et al., 2014). Also, energy efficiency loans are difficult to finance because they are smaller compared to the mortgage; therefore underwriting costs will be larger (Markowski et al., 2014). Furthermore, due to the split incentive problem, owners of buildings with direct metered units do not capture savings from retrofits.

A grant program put in place instead of a loan program could relieve these complexities. Grants do not require the consent of mortgage providers and they are easier to administer. Grants will also be more attractive to owners since they do not have to pay them back. Unlike loans, grants allow for greater experimentation in energy efficient building design. The distribution of grants will also need to be determined, based on multiple factors such as energy intensity, affordability and building design. Government could use preservation as a pathway for affordability.

Unfortunately, grants do not allow funds to be recovered like a loan. However, if information on the energy savings generated from grants is recorded over time, in the future there is possibility that private lenders will be assured of the security of energy efficient loans.

Concluding Remarks

This research is intended to make a case for suitable strategies to improve energy efficiency in existing residential buildings. With an energy efficiency fund created from a value capture tax on transfer of development rights transactions, carbon emissions from residential buildings in Manhattan can be reduced by about 400,000 Metric Tons of CO2 equivalents in 5 years. This is important since New York City's population and energy demand is growing. Reductions in energy consumption and carbon emissions make the city more affordable and habitable.

Significant barriers to energy retrofits have been the split incentive problem and limited access to affordable energy efficiency loans- these barriers could be overcome if the city set up a revolving fund for 0 to low-rate energy efficiency loans. With this fund, the city could meet its goal in reducing energy consumption and ultimately lowering carbon emissions. Taxes on transfer of development rights have been used to create funds for social benefit in the past, and since these transactions increase building density and energy usage at one point in space these there is reason to create a fund for energy efficiency improvements in buildings. In New York City, a modification to TDR regulations can possibly target old buildings for energy retrofits and imposing a tax can raise funds to finance energy efficiency retrofits.

However, when placing further regulations on development rights and building codes the local government needs to consider the repercussion for development and investment in the city. Since these regulations do levy extra costs to developers, is there a point where this becomes a disincentive to invest and develop in the city? The city government needs to consider that increased regulation may cause developers to develop outside city borders where there is less limitation and cost.

This data may not be the most accurate, but it gives a general estimate of the amount of funding that could be accumulated by imposing a tax on Transferable Development Rights. This research is meant to present a new concept for regulating transferable development right transactions with the goal of improving the sustainability of the city. Increased density imposes costs that need to be accounted for; with more building density there will be more energy usage at one point in space. Steps for further research would be to acquire accurate numbers to base budget projections on and determining the feasibility of implementing this tax in the market and the economics of development. Further consideration should also be given to energy efficiency and air rights transfers of landmark buildings, since landmarked buildings do not have to follow the energy code.

9. <u>Methodology</u>

Basic Assumptions

The average annual return on investment was assumed to be 15%, since this is the minimum target that NYSERDA's Multifamily Performance Partner program reaches. Projects can usually achieve higher levels of energy savings, but 15% was used to take on a more conservative estimate. To get an estimate of the number of units improved, the total contribution amount was divided by $3750- Markowski et al. (2014) suggest that most retrofits cost $2500 to $5000 per unit.

Table 5. NYSERDA MPP Incentive program

NYSERDA MPP Program Base Incentives (2015)			
Affordable (per unit)		Market Rate (per unit)	
Electrically - Heated $950	Fuel - Heated $750	Electrically - Heated $650	Fuel - Heated $300
Average Base Incentive: $663			

source: nyserda.gov

Pre 2012 Assumptions

Data on air rights transactions were collected from Buying Sky, Furman Center 2013. The average size of TDR transaction pre 2012 was about 20,000 (Furman Center 2013). This was multiplied by the amount of arm's length transfers per year to get the total amount of purchased air rights each year. This was subsequently multiplied by the Average $PSF for each year and the tax rate or charge to achieve the total contribution amount.

2012-2020 Assumptions

The average annual market for air rights, beginning in 2012 was assumed to be 621,907 SF, as reported in the market (Morris, 2014). The average price per square foot beginning in 2013 was assumed to be $305, as reported in the market (Morris, 2014).

Cost Savings and GHG Calculation

To find the total amount of GHG that would be saved, a conversion from total Therms of natural gas was used. Not all buildings use natural gas for heating, but most do (NYC Mayor's Office, 2013), and an increasing amount will switch to natural gas as Local Law 88 reaches its goal. The dollar amount saved was calculated as a percentage of the dollar amount invested in energy retrofits from available MPP data on New York City. On average, projects realized a 15% cost savings on total investments. The total annual contribution from the TDR tax was multiplied by 15% to get an estimate of cost savings, and this was divided by the price of Natural Gas (EIA, 2014). The price of Natural Gas was assumed to stay at 2014 level, from 2014 onward. Finally, the Therms saved were converted into Metric Tons of CO2 equivalents; 1 Therm is equal to 0.005 MT CO2e. Table 6 and 7 display the basic projection calculations.

Table 6. 0% growth in Price PSF and 0% decline of SF in TDR transactions - 2003 to 2014 estimates

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Growth in Price psf		67%	28%	25%	23%	-8%	-44%	92%	-17%	4%	47%	0%
TDR Square Feet	360,000	780,000	1,220,000	1,500,000	1,600,000	980,000	260,000	240,000	300,000	621,907	621,907	621,907
Decline in SF												621,907.41
$/sf	$ 75.00	$ 125.00	$ 160.00	$ 200.00	$ 245.00	$ 225.00	$ 125.00	$ 240.00	$ 200.00	$ 207.00	$ 305.00	$ 305.00
	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Contribution %	$ 1,620,000.00	$ 5,850,000.00	$ 11,712,000.00	$ 18,000,000.00	$ 23,520,000.00	$ 13,230,000.00	$ 1,950,000.00	$ 3,456,000.00	$ 3,600,000.00	$ 7,724,090.00	$ 11,380,905.56	$ 11,380,905.56
# Units Improved	432	1,560	3,123	4,800	6,272	3,528	520	922	960	2,060	3,035	3,035
Energy Savings	$ 243,000.00	$ 877,500.00	$ 1,756,800.00	$ 2,700,000.00	$ 3,528,000.00	$ 1,984,500.00	$ 292,500.00	$ 518,400.00	$ 540,000.00	$ 1,158,613.50	$ 1,707,135.83	$ 1,707,135.83
Therm (Natural Gas)	2,096,635.03	7,020,000.00	11,798,522.50	17,589,576.55	22,428,480.61	11,826,579.26	1,943,521.59	3,692,307.69	3,938,730.85	8,933,026.21	13,668,021.08	13,613,523.39
Metric Tons CO2 e	10,483.18	35,100.00	58,992.61	87,947.88	112,142.40	59,132.90	9,717.61	18,461.54	19,693.65	44,665.13	68,340.11	68,067.62
Contribution $	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00
	$ 6,480,000.00	$ 14,040,000.00	$ 21,960,000.00	$ 27,000,000.00	$ 28,800,000.00	$ 17,640,000.00	$ 4,680,000.00	$ 4,320,000.00	$ 5,400,000.00	$ 11,194,333.33	$ 11,194,333.33	$ 11,194,333.33
# Units Improved	1,728	3,744	5,856	7,200	7,680	4,704	1,248	1,152	1,440	2,985	2,985	2,985
Energy Savings	$ 972,000.00	$ 2,106,000.00	$ 3,294,000.00	$ 4,050,000.00	$ 4,320,000.00	$ 2,646,000.00	$ 702,000.00	$ 648,000.00	$ 810,000.00	$ 1,679,150.00	$ 1,679,150.00	$ 1,679,150.00
Therm (Natural Gas)	8,386,540.12	16,848,000.00	22,122,229.68	26,384,364.82	27,463,445.65	15,768,772.35	4,664,451.83	4,615,384.62	5,908,096.28	12,946,414.80	13,443,955.16	13,390,350.88
Metric Tons CO2 e	41,932.70	84,240.00	110,611.15	131,921.82	137,317.23	78,843.86	23,322.26	23,076.92	29,540.48	64,732.07	67,219.78	66,951.75

Table 7. 0% growth in Price PSF and 0% decline of SF in TDR transactions - 2015 to 2020 projections

	2015	2016	2017	2018	2019	2020		
Growth in Price psf	0%	0%	0%	0%	0%	0%		
TDR Square Feet	621,907	621,907	621,907	621,907	621,907	621,907		
Decline in SF	621,907.41	621,907.41	621,907.41	621,907.41	621,907.41	621,907.41		
$/sf	$ 305.00	$ 305.00	$ 305.00	$ 305.00	$ 305.00	$ 305.00		
	6%	6%	6%	6%	6%	6%	Total 2015 - 2020	
Contribution %	$ 11,380,905.56	$ 11,380,905.56	$ 11,380,905.56	$ 11,380,905.56	$ 11,380,905.56	$ 11,380,905.56	$ 68,285,433.33	
# Units Improved	3,035	3,035	3,035	3,035	3,035	3,035	18,209	Units
Energy Savings	$ 1,707,135.83	$ 1,707,135.83	$ 1,707,135.83	$ 1,707,135.83	$ 1,707,135.83	$ 1,707,135.83	$ 10,242,815.00	
Therm (Natural Gas)	13,613,523.39	13,613,523.39	13,613,523.39	13,613,523.39	13,613,523.39	13,613,523.39	81,681,140.35	
Metric Tons CO2 e	68,067.62	68,067.62	68,067.62	68,067.62	68,067.62	68,067.62	408,405.70	
Contribution $	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	$ 18.00	Total 2015 - 2020	
	$ 11,194,333.33	$ 11,194,333.33	$ 11,194,333.33	$ 11,194,333.33	$ 11,194,333.33	$ 11,194,333.33	$ 67,166,000.00	
# Units Improved	2,985	2,985	2,985	2,985	2,985	2,985	17,911	Units
Energy Savings	$ 1,679,150.00	$ 1,679,150.00	$ 1,679,150.00	$ 1,679,150.00	$ 1,679,150.00	$ 1,679,150.00	$ 10,074,900.00	
Therm (Natural Gas)	13,390,350.88	13,390,350.88	13,390,350.88	13,390,350.88	13,390,350.88	13,390,350.88	80,342,105.26	
Metric Tons CO2 e	66,951.75	66,951.75	66,951.75	66,951.75	66,951.75	66,951.75	401,710.53	

10. Appendix

CASE STUDY: NYSERDA's Multifamily Performance Program (nyserda.gov)

The Multifamily Performance Program (MPP) is available for multi-family buildings with 5 or more units or 4 or more floors and can be market-rate or affordable–

the program provides property owners with expertise, technology and incentives to improve their building's energy performance. Incentives come as per unit payments. Property owners have the potential to save at least 15% on annual energy bills, increase long-term property value, reduce operating costs in the long term, and take advantage of low-interest loans to finance the up-front costs. The program is separated into two lines; one for new construction and one for existing buildings.

Furthermore, the program offers the opportunity for building owners to obtain low-interest financing on energy-saving building and renovation projects through private commercial lenders. Property owners can access the available funding through the Green Jobs – Green New York website. The program works by NYSERDA providers lending up to 50% of the principal borrowed, to a maximum of $5,000 per unit or $500,000 per energy saving project, at a 2% rate. This financing option is available for existing buildings undergoing renovation or for "gut-rehab" projects; this is defined as change in use, construction work requiring the space to be out of service for 30 consecutive days, or reconstruction of a vacant structure. To qualify for the low-interest loan, a property owner needs to partner with a qualified NYSERDA MPP contractor to develop an energy efficiency plan.

The program involves a whole building assessment that identifies energy-saving potentials. The property owner works with certified contractors to determine the best rehabilitation options and determine cost savings. Apartment building owners can usually only chose one subsidy program for efficiency upgrades- owner's need to evaluate the benefits and costs of the NYSERDA program compared to incentives offered by local authorities and utility companies. For example, ConEdison offers a program, but only offers a program for 5-75 unit residential building. Another plan that involves heating oils and managed by the independent, non-profit, NYC Energy Efficiency Corporation (NYCEEC) is the provision of low interest loans to eliminate the use of number 4 and 6 heating fuels. Through partnerships with banks and financial GJGY New York institutions, the corporation's goal is to advance the energy efficiency and clean heat retrofit financing market for private building owners. The cost to heat and power all buildings in New York City each year is $15 billion and buildings which use 4 and 6 fuels emit 80% of the CO_2.

11. References

Alcott, A & Mullainathan, S. 2014. Behavior and Energy Policy. *Science, 327:*5970, pp. 1204-5.

American Physical Society.2008, September. Chapter 3 in *Energy Future: Think efficiency.* American Physical Society

Augspach, F. 2009. Development Rights Purchases by Zoning Lot Merger in New York City. *NYSBA, 37*:3.

Barbanel, J. 2014, July 11. Trying to put more green in glass towers. *The Wall Street Journal.* Retrieved April 25, 2015 from http://www.wsj.com/articles/trying-to-put more-green-inglass-towers-1405129234

Choi, E. 2010. Green on Buildings: The Effects of Municipal Policy on Green Building Designation in America's Central Cities. *JOSRE, 2*:1

Ciochetti, B. A. & McGowan, M. D. 2010. Energy Efficiency Improvements: Do they Pay? *JOSRE 2*:1

City of New York. 2013. New York City's Pathway to Deep Carbon Reductions. New York, NY: Mayor's Office of Long-Term Planning and Sustainability.

Columbia University. 2009. Energy Management in New York City Public Housing. Retrieved April 27, 2015 from http://mpaenvironment.ei.columbia.edu/files/2014/06/EneManNYCPubHousRep rt.pdf

Datta, S & Mullainathan, S. 2014. Behavioral design: a new approach to development policy*. Review of Income and Wealth, 60*:1.

Dolnick, S. August 15, 2010. Air conditioners that run when nobody is home. The New York Times. Retrieved April 25, 2015 from http://www.nytimes.com/2010/08/16/nyregion/16chill.html?pagewanted=all&_r=0

Energy Information Administration (EIA). Natural Gas Prices (New York 2014). Retrieved April 25, 2015 from http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_sny_a.htm

Energy Information Administration (EAI). 2014. New York State Profile and Energy Estimate. Retrieved April 25, 2015 from http://www.eia.gov/state/data.cfm?sid=NY

Environmental Protection Agency (EPA). Building Codes Fact Sheet. Retrieved from www.epa.gov/cleanenergy/documents/suca/buildingcodesfactsheet.pdf] on April 25, 2015

Fitzgerald, J. 2010. *Emerald cities - urban sustainability and economic development.* Oxford University Press

Finn, R. 2013, February 22. The Great Air Race. *The New York Times, Real Estate.*

The Furman Center. 2013. Buying Sky: The Market for Transferable Development Rights in New York City. New York, NY: Furman Center for Real Estate and Urban Policy.

Been, V., Infrance, J., Madar, J., & Yager, J. 2014. Unlocking the Right to Build: Designing a More Flexible System for Transferring Development Rights. New York, NY: Furman Center for Real Estate and Urban Policy.

The Hammersmith Group. 2010. Clicks & Mortar, "The Costs And Benefits Of Intelligent Buildings", The hammer smith group research report.

U.S. Department of Housing and Urban Development (HUD). 2011. Quantifying Energy Efficiency in Multifamily Rental Housing, Evidence Matters Periodicals. Retrieved April 25, 2015 from http://www.huduser.org/portal/periodicals/em/summer11/highlight1.html

Ingram, G. K. and Hong, Y. 2012. *Land Policy Series: Value Capture and Land Policies.* Lincoln Institute of Land Policy

International Code Council. 2012. Building Code Basics: Energy: Based on the 2012 International Energy Conservation Code in *the Building Energy Codes Resource Guide.* International Code Council

Landis, M. A., McGrath, K. B. & Smith, L. L. sept 29 2008. Transferring Development Rights in New York City. *New York Law Journal, Real Estate Trends.*

Landmarks Preservation Commission (LPC). 2015. Building History. Retrieved April 25, 2015 from www.landmarks.nyc

Luoma, J. R. 2011, February 7. Why does energy efficiency's promise remain unfulfilled? *Yale Environment 360*. Retrieved April 19, 2015, from http://e360.yale.edu/feature/why_does_energy_efficiencys_promise_remain_unfulfilled/2367/

Maruejols, L. & Young, D. 2011. Split incentives and energy efficiency in Canadian multi-family dwellings. *Energy Policy, 39*, 3655-3998

Markowski, J., Evens A. & Schwartz, M. 2014. Financing Energy Efficiency Retrofits of Affordable Multifamily Buildings. Community Development Investment Review for the Federal Reserve Bank of San Francisco.

The Municipal Arts Society of New York (MAS). 2013. Accidental Skyline. New York, NY: Author.

New York City Department of City Planning (NYCDCP). 2014. East Midtown Rezoning. Retrieved on April 25, 2015 from http://www.nyc.gov/html/dcp/html/east_midtown/index.shtml

NYC Mayor's Office. 2013. New York City Local Law 84 Benchmarking Report. New York, NY: Mayor's Office of Long Term Planning and Sustainability.

NYC Mayor's Office. 2014. Once City Built to Last. New York, NY: Mayor's Office of Long Term Planning and Sustainability.

Moavenzadeh, F. & Liddle, B. 2007. Sustainability of the urban environment: A case for energy efficiency in the building sector. *Journal of Urban Technology*. 4:2, 5-26.

Morris, K. April 24, 2014. Sky is Limit For Air Rights in Manhattan. The Wall Street Journal.

Portney, K. E. 2013. *Taking sustainable cities seriously: Economic development, the environment, and quality.* Cambridge, Mass: MIT Press.

Qian, Queena K., Chan, Edwin H.W., & Choy, Lennon H.T. 2012. Real Estate Developers' Concerns About Uncertainty in Building Energy Efficiency (BEE) Investment – a Transaction Costs (TCS) Perspective. *Journal of Green Building, 7*:4.

Research into Action. 2014. Multifamily Performance Program Process Evaluation and Market Characterization. Prepared for NYSERDA

Retzlaff, R. C. 2009. The Use of LEED in Planning and Development Regulation: An Exploratory Analysis. *Journal of Planning Education and Research, 29*:67

Riffle, C., Appleby, L., Martin, P. 2013. CDP CITIES 2013 Summary report on 110 global cities. London, UK: CDP

Rosen, H. S. 2004. Public Finance *in The encyclopedia of public choice (volume 1). Edds Friedrich Schneider and Charles K. Rowley*. Kluwer Academic Publishers: New York

Simons, R. A., Choi, E. and Simons, Donna M. 2009. The Effect of State and City Green Policies on the Market Penetration of Green Commercial Buildings. *JOSRE 1*:1.139-166.

Siefel Consulting Inc. 2013. TDR Study San Francisco's Transfer of Development Rights Program. Prepared for San Francisco Planning Department.

Urban Green Council. 2010. NYC Green Code Task Force Executive Summary. A report to Mayor Michael R. Bloomberg & Speaker Christine C. Quinn.

U.S. Department of Energy. 2011. Building Energy Code Resource Guide For Policymakers.

Walls, M. 2014. Comparing Subsidies, Loans, and Standards for Improving Home Energy Efficiency. *Cityscape, 16*:1, 253-278.

Wenzel, Robert. 2014. The "There Is No Inflation" Report: Air Rights Edition. Retrieved April 25, 2015 from http://www.economicpolicyjournal.com/2014/05/the-there is-no-inflation-report-air.html