NATIONAL RENEWABLE ENERGY LABORATORY

Green Building Policy Options for New Orleans

Elizabeth Doris

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Technical Report
NREL/TP-7A30-52576
September 2011

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Purpose

This document is adapted from a memo and report delivered to the City Council of New Orleans, the office of the Mayor of New Orleans, the Chairperson of the Citizen Stakeholders Group (New Orleans Energy Task Force) and the U.S. Department of Energy (DOE) Project Officer in 2008. The purpose of the report is to outline ideas for and potential impacts of various green building policies in New Orleans in the years following Hurricane Katrina.

This report is one in a subset of documents created to assist the City of New Orleans to rebuild in a more energy-efficient way through policy and program development. The broader project included a wide variety of technical assistance in addition to the policy and program assistance, which was implemented by the National Renewable Energy Laboratory on behalf of DOE from 2006 to 2008. For more information, see the DOE website at: www.eere.energy.gov/deployment/new_orleans.html

Acronyms and Abbreviations

ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
DOE	U.S. Department of Energy
GWh	gigawatt hour
IECC	International Energy Conservation Code
kWh	kilowatt hour
LEED	Leadership in Energy and Environmental Design
LEED-H	Leadership in Energy Environmental Design for Homes
NAHBGHG	National Association of Home Builders Green Home Guidelines
NREL	National Renewable Energy Laboratory
PNNL	Pacific Northwest Laboratory

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1 Summary

The purpose of this report is to outline ideas for and potential impacts of various green building policies in New Orleans in the years following Hurricane Katrina. This report represents a compilation of analyses presented to various stakeholders throughout that effort, including the Office of the Mayor, the City Council, the citizen stakeholder group, "the Energy Policy Task Force" or "Task Force," and the subset of the City Council utility regulatory committee.

1.1 Summary of Analyses Presented

From 2006 to 2008, the National Renewable Energy Laboratory (NREL) team completed various evaluations and impact analyses of the policy and program suggestions from various parties, as described in Table 1.

Table 1. Analyses Presented on Program and Policy Suggestions

<table>
<tr><th>Program or Policy Suggestion</th><th>Analyses Presented</th></tr>
<tr><td>Greening City Government: "Require all new City-owned nonresidential buildings larger than 5,000 square feet be designed, constructed, and certified at a minimum LEED new construction Silver rating or its equivalent at minimum 30% above code."</td><td rowspan="2">1. An overview of the impact of greening all public and private new construction in the commercial and residential sectors in the city of New Orleans.
2. Estimates, based on the experience of other cities (as a result of limited data on the costs of green building for the city of New Orleans), of the impact of policies that encourage voluntary green building practices.</td></tr>
<tr><td>Establish incentives for all commercial and residential construction that achieves a life cycle cost neutral minimum 30% above code.</td></tr>
<tr><td>Non-financial incentives could include waiving building permit fees, relaxing certain building restrictions and set-back requirements, approving a 30-day guaranteed building permit-plan-check process, and waiving city sales tax for green building products</td><td rowspan="3">Discussion of a range of different policies that encourage voluntary adoption of green building practices, as well as current and future applicability and feasibility in the city.</td></tr>
<tr><td>Develop a coherent incentives process/program for above-code construction that relies on rigorous analysis.</td></tr>
<tr><td>Streamlined permitting for green buildings.</td></tr>
</table>

1.2 Primary Findings

NREL's analysis estimates that if all new commercial and residential construction is built above code, the energy savings relative to building to current code requirements would be 155 to 281 Gigawatt hours (GWh) annually. Because adoption of beyond-code building activities will be voluntary, the extent to their uptake is determined by the cost of green building attributes and the incentives offered for their inclusion. Based on other municipalities' experiences, incentive programs tailored to the specific city can lead to about 20% of new construction built green. This would result in the following impacts:

- Commercial sector savings of 16 to 33 GWh (GWh=10^6 kilowatt hours (kWh)) of electricity (over code). This translates into a reduction of costs to the rebuilt commercial sector of between $1 to $4 million dollars in annual energy savings over an equivalent rebuild to code standards, and an electricity use per square foot reduction from 15 to 21 kWh to 12 to17 kWh.
- Residential sector savings (in heating and cooling systems alone) of $150 annually for green-built homeowners—over International Energy Conservation Code (IECC) 2006)—an overall sector savings of 15 to 22 GWh annually, and a per household reduction of 30%.

Common incentives include expedited permitting, floor-to-area ratio incentives, direct capital cost reduction incentives, increasing the availability of energy-efficient mortgages, and education and outreach programs.

In the city of New Orleans, many of these incentives will prove challenging as a result of lack of infrastructure or funding opportunities. In the current environment, the most feasible incentives appear to be increasing floor-to-area ratio incentives, as these promote economic growth, account for little cost to the city, and do not stress city infrastructure.

Further research is required to move beyond this preliminary analysis and begin implementation of a feasible and useful program for the city. That research includes increased data collection both in terms of the amount of new construction expected in the city as well as the costs of green building. The latter could be estimated by implementation of a pilot program in which data on builder's choices for green attributes, as well as the cost of those energy improvements, is tracked. Increased data collection in both areas would lead to more accurate savings estimates. These estimates would then be compared to the relative cost to the city for implementing policies and programs that support green building. Determining these costs more accurately will require more detailed policy outlines as well as a compilation of other city experiences.

2 Estimating the Impacts of Encouraging Green Building: Commercial and Residential

The analysis presented in this section estimates the energy impacts of encouraging green building, as well as the likely savings to end-users (consumers, building owners, or government agencies). The analysis was split into two primary sectors, based on building size and use:

- Commercial, multi-family, office, and public buildings ("commercial" from here on). These buildings are all larger scale and have different costs and energy needs than individual housing units.
- Small-scale residential. This category includes single-family homes, duplexes, and town homes.

For each building category, the analysis is divided into sections:

1) Analysis Overview. Provides a brief overview of the analysis and an overview of the challenges and assumptions required.
2) Methodology and Results. Provides a detailed outline of the assumptions made, as well as the method for developing a wide range of estimates on impact. Included in this section are possible methodological improvements and additional data needs to improve the preliminary analysis.
3) Policy options for encouraging green building in the sector. Lays out possible policy options for encouraging the adoption of green building in the sector (commercial or small-scale residential buildings). This section also outlines the challenges and opportunities for each policy option given the context of New Orleans' current situation.

The baseline and critical assumption for both analyses is that the required building codes in the city for both commercial and residential buildings are enforced. The distributed nature of buildings in addition to perceived and real permitting costs and time requirements for developers make it an especially hard sector to regulate; if the city of New Orleans has challenges enforcing building codes and permitting, it is not alone. However, enforcement of building codes is critical to achieving optimal energy use in the city. Without it, there is no way to estimate the impact of the optional green building code nor to assure that the incentives offered by the city are leading to optimized energy use and the public benefits associated with it.

Finally, a note on the complications of encouraging green buildings: Allowing for multiple certification programs creates both implementation and achievement challenges. The city must be able to certify and process incentives (or enforcements, depending on the voluntary or required nature of the program), and builders must be able to understand and implement specifications to multiple certification styles. This increased transaction cost may decrease participation in the program overall. While no specific certification program is recommended in this report—although Leadership in Energy and Environmental Design (LEED) certification has the largest library of impact analysis, and is therefore relied heavily upon— the city may be best served by streamlining and using a single certification program for each sector.

2.1 Category 1: Commercial Buildings

2.1.1 Analysis Overview

The policy recommendations identified for this analysis include:

- Greening City Government: Require all new city-owned nonresidential buildings larger than 5,000 square feet be designed, and constructed at minimum 30% above code
- Establish incentives for all commercial and residential construction that achieves a minimum 30% above code.

These policy recommendations are analyzed in this section, with the following clarifications based on the intention that this work presents the impacts of a broad range of options to inform decision makers.

1) Impacts over a range of 10% to 50% above code are reviewed. The current code for commercial construction in New Orleans is the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 90 (2004), for which the LEED 21% above code rating is equal to the 30% improvement that most cities use, as a result of an older baseline code in those locations.
2) The 5,000 square foot cut-off was suggested by multiple policymaking parties, but was not analyzed due to data limitations. However, because the program is voluntary, there may be no reason to have such an arbitrary cutoff, as it may discourage smaller builders' participation.
3) New Orleans Specific Green Building Costs are NOT estimated here. The choice of credits for achieving certification impacts the incremental cost of green buildings, and therefore impacts the builder's choices. The cost of the building is a major component of the decision of whether or not to achieve the rating in a voluntary program. In addition, knowing the incremental cost of certification is critical for creating an incentive that adequately encourages builders to build green buildings.[1] The incremental cost of achieving a certification depends on the change required from the typical building construction guidelines, location-specific impacts (e.g. supply procurement costs), other building codes (e.g. plumbing codes), and which credits are selected by builders, among other variables. This specific data is not currently available for New Orleans, but a pilot program could be used to collect it. For the purposes of this analysis, several case studies and reports were reviewed

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[1] There are multiple non-direct cost reasons that a builder may be interested in green building. In this preliminary analysis, these are not addressed.

that estimate the incremental cost of LEED-certified buildings and those are assumed to be reasonable estimates for green building certification.[2]

As building efficiency targets and incentive levels are narrowed down, more detailed analysis can refine the assumptions used here and reduce the range of possible outcomes and results.

The LEED Certification System for New Commercial Construction
LEED certification is a green building rating system designed by the U.S. Green Building Council. The builder is awarded "points" for improvements to buildings covering a broad range of interested. These include water efficiency, sustainable siting, efficient use of materials and resources, indoor air quality, and innovation in the building process, in addition to energy and atmospheric improvements. In order to be LEED certified, a project must achieve 26 of a total of 69 points; 33 to gain a Silver rating; 39 for a Gold rating, and 52 for Platinum. Because of the large number of possible points, it is possible for a building to achieve basic LEED certification without being awarded any points in the Energy and Atmospheric category. In short, this means that there is the potential for no energy impact through a policy that encourages LEED certification. In order for energy savings to be realized within the City of New Orleans through encouragement of LEED Certification, the policy must also encourage achievement specifically of Energy and Atmospheric points within the certification system.

2.1.2 Methodology and Results
This analysis is largely based on work completed by the Pacific Northwest National Laboratory (PNNL) on improving the commercial building codes in the Gulf Coast area.[3] That report contains a simulation of energy improvements from possible green building codes on four different buildings types in the climate area of New Orleans. These building types were estimated to be average in size, makeup, and use for office, retail, hospital, and school buildings.

Acknowledging that predicting the choices of the builder in terms of meeting the LEED certification requirements was challenging, the analysts ran two scenarios using specific improvements.

The first scenario, called Level 1, included three likely improvements for increasing energy efficiency beyond ASHRAE 90.1 (2004) code: a 10% reduction in lighting power density, a reduction in glazing solar heat gain coefficient to 0.2, and the addition of one inch of insulation around the outside of the building. Level 2 included these improvements and an increase in cooling efficiency to a 6.1 coefficient of performance. [5] Results for cost-per-square-foot savings and energy improvements over the ASHRAE 2004 baseline are re-created below for office buildings and hospitals.

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[2] http://www.wbdg.org/ccb/GSAMAN/gsaleed.pdf, www.cleanair-coolplanet.org/for_communities/LEED_links/AnalyzingtheCostofLEED.pdf.
[3] Halverson, M.A.;Gowri, K.; Richman, EE. *Analysis of Energy Savings Impacts of New Commercial Energy Codes for the Gulf Coast*. PNNL - 16282. Richland, WA: Pacific Northwest National Laboratory. 2006.

The results of these scenarios provide detailed simulation estimates for savings in average building types along the Gulf Coast. To determine the overall energy benefit for the city of New Orleans would require estimating the amount of square footage likely to be built in the city in coming years. No current estimate of the square footage was discovered in the literature search for this analysis.[4] To estimate the square footage, electricity use per square foot in high-energy use and lower energy use buildings[5] was divided by total electricity sold to the electricity sector in New Orleans in 2004 and 2006.[6] This resulted in a differential in square footage between 2004 and 2006. Assuming that the loss of square footage was the result of the hurricane, and that all square footage would be rebuilt, this calculation estimated between 26 and 38 million square feet of new commercial construction, depending on the mix of building types.[7]

To create a baseline for estimating the energy use in rebuilt commercial construction, the total square footage (26 to 38 million) was multiplied by the calculated improvement between the original code and current code as estimated by Halverson. [5] That improvement ranges from 13% to 18% depending on building type energy intensity. To bound the baseline, it is assumed that the improvement between the old construction and rebuilding to the current code would be the average improvement, or 15 %.[8] Rebuilding to the current code would result in annual energy use of 15 kWh to 21 kWh per square foot of 384 kWh to794 million kWh for the commercial sector. These results, and the results for the scenarios described below are summarized in Table 2.

Three scenarios were modeled to estimate the impact of increasing the energy efficiency of commercial buildings: 10%, 21%, and 50% improvements over code. A 10% improvement represents a basic LEED certification level (in coordination with other non-energy green building points). The 21% level reflects either LEED certification gaining two Energy and Atmospheric points or a 30% improvement over ASHRAE 90.1 (2001). This improvement over ASHRAE 2001 standards is included because it is a common goal for other cities and because there are available guidebooks for prescriptive measures to meet it available to builders, reducing the potential increased capital cost of optimizing energy use. The upper bound energy improvement scenario, 50% over code is to identify the level of savings at which the federal incentive for green buildings is available.[9]

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[4] Area for analytic improvement that will have a large impact on accuracy of estimates.

[5] Halverson et al (see note 3 for full reference) estimated for the four average type commercial buildings, typical energy use ranged from 17 kWh to 25 kWh per square foot (sf), assuming that most buildings damaged or destroyed by the hurricane were built previous to 1992, when the building code was ASHRAE 75.

[6] 2006 Entergy Annual Report. 2007. URL: http://www.google.com/url?sa=t&source=web&cd=2&ved=0CBwQFjAB&url=http%3A%2F%2Fwww.entergy.com%2Fcontent%2Finvestor_relations%2Fhtml%2F2006_ar%2Fletter_main.html&ei=tSlUTtvwJqmusQK93eWoBw&usg=AFQjCNGlQKvkidEccnQvrcMSs2JKHwSBrw

[7] Note that this calculation depends on the type of buildings rebuilt in terms of their energy intensity, kWh/sf.

[8] This is a rough estimation and would be improved if the building use improvements were weighted against the possible improvements. However, at this high level, the impact of this estimation is negligible.

[9] EPACT 2005. Energy Policy Act of 2005.

Reductions in energy use for each of the scenarios (Table 2) stem directly from the goals posed. The total energy use in the commercial sector is a multiplier of the square footage to be rebuilt and the range of energy intensities listed. Decreased utility revenue applies only to decreases in income to the utility resulting from the reduced sales of energy to the commercial sector. There is a possibility that supply costs will be reduced, lessening the net impact on the utility, but more detailed analysis is necessary to determine those potential reductions. The benefit to the end user is measured in reductions of utility payments per square foot. If cost estimates were more certain (see following discussion) they could be used to estimate payback for increasing energy efficiency.

Table 2. Summary of Commercial Building Code and Above Code Impacts

	Code	Improvement over Code		
		10%	21%	50%
Square Footage Replaced	26-37 million square feet			
Annual Energy Use (kwh/sf)	15-21	13-19	12-17	7-11
Annual Energy Use Total Rebuild (GWHhyear)	384-794	346-714	304-627	192-397
Decreased Utility Revenue (%)[1]	0%	2-5%	4-11%	9-25%
Annual Commercial End User Savings ($M)	0	3-8	6-18	15-43
End User Energy Savings (cents/sf)	---	$0.12-0.23	$0.25-0.49	$0.59-1.16
Incremental Cost Increase	0%	-0.4-11% over code, see text		

[1]Revenue loss relative entire commercial rebuild (NOT ENTIRE SECTOR) at ASHRAE 90.1(2004)

Estimates of the additional costs of building an above-code building vary widely. The range is large because the methods for achieving above-code energy savings are not prescriptive. While this allows for maximum flexibility in determining the best energy saving practices for the specific building, it creates a challenge for generalizing the incremental cost of improvement. For this analysis, the literature was reviewed with respect to incremental cost of energy improvements, primarily related to LEED minimum certification, as most of the cost literature surrounds those guidelines. Note that LEED certification includes a large range of energy and non-energy related improvements to buildings, and that no study found directly answers the questions of how much achieving a certain percentage improvement would cost.

The American Chemistry Council determined LEED certification costs to be 4% to 11% over standard practice.[10] On the opposite side of the spectrum, the General Services Administration ranked possible LEED credits for new construction from “no cost” to “high cost” and, assuming builders will prioritize lower cost items, estimated the following percentages over standard government practice:

[10] Northbridge Environmental Management Consultants. 2003. *Analyzing the Cost of Obtaining LEED Certification*. Prepared for the American Chemistry Council. Arlington, VA.

- LEED certification could cost between -0.4% and 1% (a possible decrease in project cost)
- LEED Silver certification could cost between -0.03% and 4.4%
- LEED Gold certification could cost between 1.4% and 8.1%.

These two studies represent the range of likely costs for varying levels of certification. Because of the variation in builder choice for meeting percentage improvements and other challenges in estimating costs, only the range of -0.4% to 11% cost change are estimated for this analysis. Because of the large uncertainty associated with cost estimates, no further analysis is done on cost impacts on builders or cost benefit of increasing energy efficiency in new construction. In order to improve these estimates, a better understanding of the likely improvements builders would choose in New Orleans, as well as the costs of those improvements (also specific to New Orleans), would be required.

Critical assumptions associated with this commercial buildings analysis include:

1) All damaged and destroyed energy demand (in the form of square footage) will be rebuilt as new construction
2) Baseline energy use of new buildings assumes that all buildings will be built to current code of ASHRAE 90.1 (2004)
3) Commercial electricity costs range between \$0.08 and \$0.11 per kilowatt hour.

2.1.3 Encouraging Energy Efficiency in Building through Public Policy in New Orleans

This section provides a review of possible policy options and the levels of effort and investment required by the city to implement them.

This analysis of commercial building rebuilds indicates that at the lowest level of improvement there is an energy savings of minimum 40 GWh per year for the business owners of New Orleans, or a cost savings of over \$3 million annually. There is evidence that this improvement could occur at little or no additional cost to the builder, indicating that an education program offered by the city on the costs and benefits of increasing building energy efficiency through low- and no-cost efforts may be adequate to encourage builders to take advantage of possible savings. Training a staff member on opportunities for builders or developing a centralized information dissemination station is a basic and inexpensive step that can encourage the implementation of low- and no-cost improvements. Furthermore, the city could offer expedited permitting for builders that increase the efficiency of their buildings. At the higher end of energy savings, a financial incentive may be required to offset potentially high initial costs of the technology. These policy types have been applied successfully in other cities.

The extent of public policy in encouraging green building depends largely on the incremental costs of green building for the builder, the ancillary motivations of the builder to build green, and the ability of the city to develop an incentive that is fiscally sustainable. Cities across the United States have implemented programs to encourage green building. Those models are used in this analysis to estimate the potential impact of incentives in New Orleans.

- The primary incentive offered to builders for green building in these cities is expedited permitting. The incentive is favored because it is revenue-neutral for the city and a benefit to the builders, who may reduce permitting time by weeks or, in some cases, months. However, limited permitting infrastructure in the city of New Orleans limits the immediate implementation of this policy type.
- Financial incentives are also applied in the form of permit fee reductions and direct grants. In the city of New Orleans, the use of permit fee reductions is unlikely, as the fees generally represent approximately 40% of revenue.[11] This is a more aggressive approach. This program type attempts to ensure compliance by requiring that builders present the approved building permit and/or LEED registration and checklist before delivery of the grant monies. The money is still delivered in time to help defray some of the incremental costs of green buildings. Although some cities acquire the grant funding out of tax revenue, there are some innovative programs under pilot study that incorporate a nominal per-square-foot charge to builders that do not build green buildings in the area and use that funding to support a grant or education program (e.g. Marin County, California).
- A third incentive includes increasing the floor-to-area ratio for efficient buildings.
- Finally, many cities implement multiple programs to capture a larger portion of the market and drive economically sound green building development. The city of Santa Monica, California, for instance, offers both expedited permitting for buildings with proof of LEED registration and submittal of the LEED checklist, as well as a $20,000 grant program for green buildings (distributed after the city building permit is issued).[12]

Measuring the impact of policies on the market uptake of green building codes is challenging as well, as it involves estimating the importance of time to builders. Anecdotal evidence suggests that offering incentives, such as expedited permitting services, is of high value to builders, but program implementers report that uptake of the option is as low as 10%.[13] This analysis would benefit from determining the value of an incentive program for those builders in the New Orleans area.

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[11] Nance, Fisher personal communication.
[12] http://greenbuildings.santa-monica.org/mainpages/whatsnew.htm.
[13] Note that Susan Munves with the Santa Monica incentive program suggests based on anecdotal evidence that their incentive program triggers around 10% of planned square footage to be built green.

To develop a range of estimates, this analysis provides a range of possible values for builders that participate in green building. The analysis uses the mid range above code goal of 21% improvement over code and estimates the energy benefits if 10%, 20%, 50%, and 70% of buildings were built green as the result of the incentives. Table 3 summarizes the results.

Table 3. Range of Possible Benefits for Incentives to Promote Green Building

Percent of square footage built to 21% beyond code resulting from incentives	Energy Savings for Total Commercial Rebuild (GWh)
10%	30-87
20%	61-126
50%	152-314
70%	213-439

2.2 Category 2: Residential Buildings

2.2.1 Analysis Overview

Another option is to implement incentives for increasing the efficiency of new home development over the current IECC 2006 code requirement in the city.[14] Efficiency targets available for the residential sector include LEED for Homes (LEED-H) and the National Association of Home Builders Green Home Guidelines (NAHBGHG). This section briefly describes the two systems and outlines the analytic assumptions for estimating the energy benefits to encourage these goals for implementation into New Orleans public policy. As in the introduction, it is noted that the improvements above code may be better served by a single ratings system to reduce the burden on the developer, or that specific levels of a given guideline and its certification are chosen to ease measurement and verification burdens on the city.

LEED-H was released in January 2008.[15] Like the current LEED for New Commercial Construction guidelines, the inclusion of energy efficiency improvements is not required to meet certification levels for homes. However, a typical home will require 40 points out of 130 to be certified, and with 38 of those possible points energy efficiency related, homes builders may find it more cost effective to pursue some or all of the energy options.

There are two ways to achieve energy points in the LEED-H system. The first is to use a prescriptive method throughout the house as described in the LEED-H guidebook. The alternative method is to achieve an ENERGY STAR® Homes rating. ENERGY STAR Homes require a 15% energy improvement over 2006 IECC guidelines. In this analysis, it is assumed that those two methods create similar results, and the 15% above code goal can be assumed, with minimum other non-energy related points, to meet LEED-H lowest level of certification.

[14] http://bcap-energy.org/state_status.php?state_ab=LA.
[15] Note that the LEED-H system was not available at the original time of delivery to the city of New Orleans, but the pilot was referenced in this part of the report.

The NAHBGHG is a voluntary use guidebook that is used by many local homebuilder associations across the United States. There is a rating system associated with the guidebook. For the energy efficiency section the improvements are 15% (bronze), 30% (silver) and 40% (gold) over IECC 2003 energy efficiency standards. This analysis assumes IECC 2003 and 2006 to be approximately equivalent. [16]

The upper end of the possible energy savings in this analysis is associated with the 2005 Energy Policy Act federal incentive. This incentive is $2,000 for homes that reach 50% over IECC 2003. Table 4 presents an overview of the improvements over the current code and their relation to different green home building guidelines and provides the percentage improvements used in this analysis to estimate the energy and cost impacts of building beyond code. The estimates made here are in no way recommending a particular method for certification. The table is intended as a reference guideline only.

Table 4. Summary of Possible Energy Efficiency Goals for Housing

Percentage Improvement over IECC 2006	Rating System Equivalency
0%	IECC 2006
15%	ENERGY STAR Homes, LEED-H certification*, NAHBGHG Bronze
30%	NAHBGHG Silver
40%	NAHBGHG Gold
50%	EPAct Tax Credit

2.2.2 Estimating the Impact of Green Home Building in New Orleans

Housing energy data is limited for New Orleans. A PNNL study found that for electricity use in space conditioning only in IECC 2006 housing in the city, about 4,000 kWh is used annually.[17] Because space conditioning is the primary energy use in a home, this analysis uses that estimate as baseline energy use for homes. Future analysis could benefit from more detailed energy data for IECC 2006 homes in New Orleans, including expansion to understand natural gas use, rebuilt house sizes, and dweller energy use habits.

Estimates of the number of homes damaged by the hurricane and ensuing floods in the city of New Orleans are challenging to acquire because of the definitions of damage ("at what point does a home need to be rebuilt?"), lack of information dissemination, and inaccurate or non-existent census information on the current situation. Although several estimates were found in a literature search, none were specific to the city and the extensive level of damage. One report from Brown University used data from the Greater

[16] The PNNL study states that for energy purposes there is no significant difference between IECC 2003 and IECC 2006. That assumption is used here as well.

[17] Lucas, R.G. *New Residential Energy Codes for the Gulf Coast, Summary*. PNNL – 16265. Richland, WA: Pacific Northwest National Laboratory. 2007.

New Orleans Central Data Center (http://www.gnocdc.org) to estimate that 73% of the populations in neighborhoods in New Orleans suffered moderate or catastrophic damage to their homes.[18]

In the 2005 American Community Survey, there were approximately 163,000 occupied housing units in the city of New Orleans. Because over 75% of those were duplex or single-family occupancy, this analysis assumes that most rebuilt housing will be duplex or single-family. Combined with the Brown University estimate, this results in 122,000 homes damaged moderately or catastrophically. Because of the economic and social complexities of determining the number of houses that will be rebuilt, we assume that between 50% and 75% of the moderately and catastrophically destroyed homes will be rebuilt. Therefore, this analysis estimates that between 60,000 and 90,000 homes will be rebuilt in the city to the minimum IECC 2006 standard.

Combining these housing estimates with the energy use estimates described above and the improvements over code leads to the possible energy impacts of green building described in Table 5. These ranged estimates provide the maximum amount of energy saved if all homes were built to the assumed improvement over current code.

Table 5. Results from Residential Rebuild Electricity Use Analysis

	IECC 2006	**Code Improved by**			
		15%	30%	40%	50%
Homes Built	60,000-90,000				
Average Annual Electricity Use (kWh)	4,153	3,534	2,911	2,287	1,663
End User Annual Electricity Cost (space heating and cooling)	$499	$424	$349	$274	$200
Total City savings (GWh)	0	37-56	75-112	112-168	150-225
Increased Energy Use (GWh)	249-374	212-318	175-262	137-206	100-150
For Sources and Assumptions, See Text.					

Data for estimating the costs of increasing the efficiency of new construction homes is limited. Because of the wide range of options for improvement (e.g. efficient windows, increased insulation) the range of incremental costs could be large. No studies were found estimating the incremental cost of building green in New Orleans or similar economic and environmental climates. These types of studies have been carried out elsewhere however, such as one completed in the city of Denver, Colorado.[19] This study found that the selling price of $150,000 home would be increased to $163,000 with the inclusion of energy-saving measures during the building. This $13,000 investment would save the dwellers within the building $70 to $100 per year. Since the primary focus of the study was to estimate the impact of low-income homeowners being capable of purchasing affordable housing, the study also found that a home with these features would qualify

[18] Logan, J.R. 2007. *The Impact of Katrina: Race and Class in Storm-Damaged Neighborhoods*. Brown University. Providence, RI.
[19] Johnston, D. 2000. *Building Green in a Black and White World*.

for an energy-efficient mortgage (available in Colorado) that would allow for the same family to acquire an 8% fixed rate mortgage to purchase the house.[20]

The lack of city-specific data surrounding the choices that homebuilders would make when building green as well as the incremental costs of those choices makes the quality of cost estimates to builders too low for this effort. It should be noted, however, that the ENERGY STAR Homes program touts a number of non-quantified green building benefits for builders, including increased purchase power of consumers with reduced energy costs and advantageous marketing in an increasingly energy-efficient consumer market.[21]

Uncertainties in this preliminary housing energy potential could be minimized with improved data in the following areas (in rough order of largest to smallest reduction):

- Housing expected to be rebuilt and in what form (e.g. single family, townhouse, etc.)
- Energy use (expanding to total household energy use in IECC 2006 housing in New Orleans)
- Incremental cost to builders of building green in New Orleans
- Expected energy costs.

2.2.3 Creating Incentives for Green Home Building in New Orleans

Policy options for encouraging green residential building include:

1) Floor area ratio improvements (also known as density bonuses). Would allow for a builder to increase the number of units in a given area if the units were energy efficient.
2) A waiver of property tax over 5 years for efficient homes. Could offset in the first cost of any incremental costs that increase the cost of the home. This type of incentive is intended to drive demand for more efficient housing and is therefore considered an indirect builder incentive as well.
3) Expedited permitting. A low incremental cost to the city program, and may provide enough of an incentive to builders to speed projects to market.
4) Encouragement of energy-efficient mortgages may increase supply and demand of higher efficiency homes.

These four incentives are discussed in more detail below, but because the incremental cost of building green homes is not estimated, analysis on the cost effectiveness of these

[20] This energy-efficient mortgage program allow a buyer to increase the debt-to-income ratio by 2% (offsetting the cost of the energy savings). Further discussion of this option in section 2.2.3: Creating Incentives for Green Home Building.
[21]http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_features.

policy options was not performed.[22] Further information, such as the incremental costs and detailed property tax information, and the importance of permit expedition to local builders, is critical to the development of policy impacts. These policies are also preliminarily evaluated for feasibility in the current New Orleans context.

Increased floor area ratio incentive. This no-cost-to-the-city (and possible tax revenue increase) policy would deliver a bonus to builders of green homes allowing them to recoup the investment in energy efficiency by increasing the number of residential units that can be built and sold. These density bonus programs are used extensively in cities and counties nationwide for a variety of reasons, most commonly, the integration of increased green space into a development. Anecdotal evidence from builders and program implementers indicates that these policies have a large impact on builder and design decisions, increasingly so as energy efficiency becomes a primary selling point for home purchasers. A quantitative analysis could be done by collecting data from builders in the area to determine how much of an impact this policy would have on their decision-making. Due to a lack of permitting infrastructure in the city, the feasibility of this policy in the near term is low.

Property tax exemption. This incentive would apply to homeowners that purchase energy-efficient homes. The rate of this incentive depends on many factors, including the scale of property tax in relation to owner income and the ability of the homeowner to invest in possible up-front increased cost. The cost of the program to the city is also important. If homeowner property tax is a large portion of the annual city revenue, developing a program that would reduce revenue may not be fiscally sustainable. Especially during the recovery phase, New Orleans tax income could be low and stretched over a wide variety of programs, leading to the delay of this type of program. In addition, displaced homeowners may not be in a position to offset the first cost of the efficiency improvements, so uptake of the program could be low. However, if property tax is a small portion of city revenue, and a high proportion of the costs of home ownership, this type of incentive could create a large market for efficient homes.

Expedited permitting for green homes. Measuring the impact of expedited permitting on the market uptake of green building codes is challenging because it involves estimating the importance of time for builders. If expedited permitting is valuable to builders in New Orleans, then the program could be popular and lead to significant energy savings. If there is no way to implement expedited permitting, however, the program will not create the time savings of value to builders. In addition, this type of program has a challenge of diminishing returns: the more people apply for expedited permitting, the less expedited the permitting becomes. This is an area of extensive continued research, however, as there is little–to-no quantitative evidence of the success of these programs due largely to the interconnectedness of incentives and other factors in building decision-making.

[22] Note that there are a number of resources for assisting builders in no- and low-cost building. While no specific guidelines for New Orleans are found in this analysis, completing such analysis with relatively little data collection and builder interviews would be largely feasible.

Encouraging mortgage companies to offer energy-efficient mortgages. Energy-efficient mortgages allow homebuyers to offset the first cost of an energy-efficient home by leveraging the potential annual savings to home upkeep. In addition to principal, interest, taxes, and insurance, the mortgage incorporates energy bills. This allows buyers to increase their debt-to-income ratio by a certain percentage that will allow them to attain a slightly larger mortgage—enough to cover the first capital costs of the building. In terms of public policy, recommending or requiring that mortgage offerers in the city have an energy-efficient mortgage available would ease builder concerns that the costs of green building would decrease sales, and would increase the ratio of affordable green home ownership in the city.

3 Conclusion

This document provides a preliminary analysis of the impact of potential policies and programs targeting green redevelopment of building in New Orleans. Rebuilding 26-37 million square feet of buildings provides the opportunity to save between $0.12-$1.16 per square foot to the end user. Finding that there is a large potential for savings over the lifetime of buildings constructed beyond code, several policies are evaluated, including no- and low- cost voluntary efforts and higher cost higher impact mandatory efforts, including voluntary beyond code programs, certification programs, and non-financial incentives for encouraging developers to build more energy efficient buildings. While each of these types presents challenges and opportunities, this analysis is meant to provide the stakeholders and decision makers in New Orleans with a menu of options and their relative impacts.