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ENERGY EFFICIENCY

Important Challenges Must Be Overcome to Realize Significant Opportunities for Energy Efficiency Improvements in Gulf Coast Reconstruction





Highlights of [GAO-07-654](#), a report to congressional addressees

Why GAO Did This Study

Following several hurricanes in 2005, the need to rebuild and repair destroyed and damaged homes and buildings in the Gulf Coast region may create opportunities for making energy efficiency improvements and realizing energy cost savings. While numerous federal agencies are involved in the recovery process, the Department of Housing and Urban Development (HUD) and the Department of Energy (DOE) interact with the states on a regular basis regarding matters of energy efficiency. This report, initiated under the authority of the Comptroller General of the United States, examines (1) the extent of opportunities for incorporating energy efficiency improvements in the Gulf Coast reconstruction, (2) potential challenges to realizing the energy cost savings during the reconstruction, and (3) the role of HUD and DOE in promoting energy efficiency in the rebuilding of the Gulf Coast.

GAO limited the scope of its work to Louisiana and Mississippi since these states experienced the majority of the hurricane damage. GAO assessed opportunities for incorporating energy efficiency measures by conducting site visits and interviewing federal, state government officials; home builders; and energy efficiency experts. GAO also worked with a DOE national laboratory to develop energy cost savings estimates. GAO is making no recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-07-654.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Mark Gaffigan at (202) 512-3841 or gaffiganm@gao.gov.

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Important Challenges Must Be Overcome to Realize Significant Opportunities for Energy Efficiency Improvements in Gulf Coast Reconstruction

What GAO Found

Reconstruction in the Gulf Coast creates a significant opportunity for incorporating energy efficiency improvements that could produce long-term energy costs savings in residential and commercial buildings. The sheer magnitude of the reconstruction effort and Louisiana's and Mississippi's recent adoption of more energy-efficient building codes makes this an opportune time for incorporating energy efficiency improvements in the rebuilding efforts. In partnership with a DOE national laboratory, GAO analyzed energy cost savings opportunities and estimated that adopting these newer building codes could reduce residential energy costs in these two states by at least \$20 to \$28 million per year, depending on the extent of the rebuilding efforts in these states. Furthermore, the analysis also showed that annual energy expenditures for commercial buildings—hospitals, schools, offices, and retail buildings—built to newer energy standards could be about 7 to 34 percent lower than buildings built to older standards. There also are opportunities for consumers to make additional energy efficiency improvements to both building types by replacing old, damaged equipment.

There are three substantial challenges to realizing the energy cost savings opportunities presented by the Gulf Coast reconstruction: (1) the shortage of a skilled construction workforce, and specifically, the shortage of workers trained to meet the newer building codes; (2) the lack of trained building code inspectors to ensure compliance with newer building codes in Louisiana and Mississippi; and (3) the difficult financial issues facing consumers, such as the sufficiency of insurance and other compensation payments, that may make decisions about energy efficiency a low priority. States have efforts under way to address many of these challenges and it will take time and sustained commitment for them to be successful.

The rebuilding of the Gulf Coast is largely a state and local matter, but HUD and DOE have played a supportive role in promoting energy efficient rebuilding. HUD and DOE have provided financial and educational resources that can encourage energy efficient rebuilding, and both agencies have broader national programs that may support energy efficiency improvements in the rebuilding of the Gulf Coast. HUD has made \$16.7 billion in funding available for general rebuilding purposes, such as restoring damaged housing, and allows states to determine how to spend these funds, including using them for energy efficient improvements. HUD also has several national initiatives that may directly improve the energy efficiency of the public housing stock in Gulf Coast states. DOE has sponsored education and training on energy efficiency issues to state and local officials, private industry, and consumers in Louisiana and Mississippi. As part of its nationwide effort to assist all states with energy efficiency initiatives, DOE provides grants to states to design and carry out their own energy efficiency programs. DOE's energy expertise as well as HUD and DOE resources may prove valuable to the states and consumers as they make decisions about energy efficient rebuilding in the Gulf Coast.

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Abbreviations

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CDBG	Community Development Block Grant
CFL	Compact Fluorescent Lighting
DOE	Department of Energy
EPACT	Energy Policy Act
FEMA	Federal Emergency Management Agency
GREAT	Gulf Rebuild, Education, Advancement, and Training Campaign
HUD	Department of Housing and Urban Development
ICC	International Codes Council
IECC	International Energy Conservation Code
IRC	International Residential Code
LEED	Leadership in Energy and Environmental Design
PATH	Partnership for Advanced Technologies in Housing
PD&R	Office of Policy Development and Research
PNNL	Pacific Northwest National Laboratory
SEP	State Energy Program

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United States Government Accountability Office
Washington, DC 20548

June 26, 2007

Congressional Addressees

Each year in the United States, consumers spend more than \$160 billion to light, cool, heat and operate homes, and about \$110 billion is spent annually in energy costs for commercial buildings, making improving the energy efficiency of homes and buildings an important aspect of any effort to reduce energy consumption and lower energy costs. Improving building efficiency to reduce energy consumption is normally a very incremental process. However, after the destruction caused by the 2005 Gulf Coast hurricanes¹ the need to rebuild and repair hundreds of thousands of destroyed and damaged buildings in the Gulf Coast region creates unique opportunities to address energy efficiency issues on a large scale.²

The Gulf Coast hurricanes battered the Gulf Coast region causing over \$150 billion in estimated damage.³ Louisiana and Mississippi were the states hit the hardest by the hurricanes, sustaining extensive destruction and damage to residential and commercial buildings. For example, the hurricanes are estimated to have destroyed or caused severe or major damage to nearly 270,000 single-family homes in Louisiana and Mississippi. In all, the Gulf Coast hurricanes caused more than 1,500 deaths; left hundreds of thousands of people displaced without shelter or employment and had a disproportionate impact on certain populations, especially the poor, elderly, and minorities. In response to the Gulf Coast devastation the federal government has committed a historically high level of resources—over \$110 billion—through an array of grants, loan subsidies, and tax relief and incentives. A substantial portion of this assistance was directed toward providing emergency assistance and meeting short-term needs arising from the hurricanes. A relatively small portion of federal assistance

¹In this report, we refer to Hurricanes Katrina, Rita, and Wilma collectively as the “Gulf Coast hurricanes.”

²For purposes of this report, the term “building codes” refers to state and local government requirements for design and construction of residential and commercial buildings that are based on industry standards including those related to energy efficiency.

³Cost estimates for damages due to these storms have varied and a definitive cost estimate may never be known. See *Gulf Coast Rebuilding: Preliminary Observations on Progress to Date and Challenges for the Future* [GAO-07-574T](#) (Washington, D.C., April 12, 2007).

is available for longer-term rebuilding activities, such as the restoration of the regions housing and infrastructure.

In Louisiana and Mississippi, housing and infrastructure restoration is taking place in the context of broader regional planning and coordination activities. The Louisiana Recovery Authority is the planning and coordinating body created by the governor to assist in implementing the state's vision for the recovery of Louisiana. Working in collaboration with local, state, and federal agencies, the authority serves to address short-term recovery needs and guide the long-term planning process. In Mississippi, the Governor's Commission on Recovery, Rebuilding, and Renewal was formed to develop a strategy for rebuilding the affected areas of Mississippi. In early January 2006, the commission released a report with numerous recommendations intended to guide Mississippi's post-hurricane rebuilding. Current Gulf Coast rebuilding activities, including the bulk of the federal rebuilding assistance, are directed primarily toward restoring the region's stock of livable housing and essential infrastructure.

States and their subdivisions, such as counties and cities, adopt codes and standards that establish minimum requirements for energy-efficient design and the construction of residential and commercial buildings. Building codes and standards regulate components that affect the amount of energy that a building will use, such as the building envelope,⁴ electrical power, and lighting. These codes and standards vary from one state to another and sometimes within a state. States and local jurisdictions may choose to adopt model codes developed and published by nonprofit organizations, such as the International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

Louisiana and Mississippi adopted statewide residential building codes created by the ICC to guide the reconstruction of housing after the hurricanes. Louisiana adopted the 2006 version of the ICC's code as its mandatory statewide residential building code, while Mississippi adopted the 2003 version of this code as its voluntary statewide residential building

⁴The building envelope is the structural elements (walls, roof, floor, and foundation) of a building that encloses conditioned space—the building shell.

code—except for five coastal counties where it is mandatory.⁵ In addition, both of these states were already using ASHRAE’s commercial energy standards prior to the Gulf Coast hurricanes. Louisiana used ASHRAE’s 2001 standard and Mississippi employed ASHRAE’s 1975 standard.⁶

While numerous federal agencies, including the Department of Housing and Urban Development (HUD) and Department of Energy (DOE), are involved in providing emergency assistance as part of the recovery process, HUD and DOE have also been working with states regarding matters of energy efficiency. HUD works to increase homeownership, support community development, and increase access to affordable housing. DOE is the nation’s lead agency on energy use and energy efficiency issues. DOE provides education and training through a diverse set of national, state, and local programs that promote energy efficiency, such as its Building America, Building Energy Codes, and High Performance Building Programs. DOE sponsors research in partnership with industry and academia to advance building science and improve technologies and practices that make both residential and commercial buildings more energy efficient.

In light of the widespread congressional and public interest in rebuilding the Gulf Coast, we have prepared this report under the authority of the Comptroller General of the United States as part of an effort to assist the Congress in reviewing opportunities and challenges related to incorporating improved energy efficiency practices into the reconstruction of residential and commercial buildings in the affected Gulf Coast states. This report (1) analyzes the extent of opportunities for incorporating energy efficiency improvements and realizing energy cost savings in the Gulf Coast reconstruction, (2) discusses potential challenges to realizing energy cost savings during the reconstruction, and (3) describes the roles of HUD and DOE in promoting energy efficiency in the rebuilding of the Gulf Coast. We limited the scope of our work to Louisiana and Mississippi because these states experienced the majority of the damage from the Gulf Coast hurricanes and their building stock is generally similar to the

⁵Mississippi requires the counties of Jackson, Harrison, Hancock, Stone and Pearl River to enforce, on an emergency basis, all the wind and flood mitigation requirements of the code. According to state officials, although the energy provisions are optional, some counties are considering making the provisions mandatory.

⁶ASHRAE’s 1975 standard and ASHRAE’s 2001 standard refer to ASHRAE standards 90-75 and 90.1-2001, respectively.

residential and commercial buildings found in the other Gulf Coast states, according to the data we that analyzed.

We assessed the opportunities for incorporating improved energy efficiency measures in the reconstruction efforts in Louisiana and Mississippi by soliciting the views of federal and state government officials, home builders, and energy efficiency practitioners and by conducting site visits to these states. In addition, we worked with DOE's Pacific Northwest National Laboratory (PNNL) to develop energy cost savings estimates for residential and commercial buildings in the Gulf Coast. PNNL used energy simulation programs to develop these estimates under several scenarios. PNNL calculated energy consumption and energy expenditures for these building types assuming they were constructed to meet newer building codes and standards and compared these data with a baseline that approximately reflected the energy consumption and expenditures of buildings prior to the hurricanes. To aggregate potential residential energy cost savings to the Gulf Coast region, we made estimates of annual savings that could occur as the result of reconstruction efforts. A more in-depth description of the methodology that DOE's PNNL used to develop energy cost savings for residential and commercial buildings can be obtained from their January 2007 and December 2006 reports.⁷ These reports can be found at <http://www.energycodes.gov/impacts.stm>.

To understand the potential challenges that may limit energy cost savings from being realized, we relied on site visits to Louisiana and Mississippi, interviews with state and local government officials, and attendance at local building conferences and housing summits. Furthermore, we interviewed energy efficiency practitioners, building industry representatives, and non-profit organizations as well as HUD and DOE officials to solicit their views on the challenges of incorporating energy efficiency measures in the rebuilding and repairing of destroyed and damaged buildings.

To describe the roles of HUD and DOE in promoting energy efficiency in the rebuilding of the Gulf Coast, we interviewed agency officials and obtained and reviewed documentation describing the actions that these

⁷R.G. Lucas, *Analysis of Energy Savings Impacts of New Residential Energy Codes for the Gulf Coast*, PNNL-16265, (January 2007); and M.A. Halverson, K. Gowri, E.E. Richman, *Analysis of Energy Savings Impacts of New Commercial Energy Codes for the Gulf Coast*, PNNL-16282, (December 2006).

agencies have taken to assist Louisiana and Mississippi. We also conducted site visits to these states to obtain firsthand knowledge from state government officials, non-profit organizations, home builders, and energy efficiency practitioners about their views on HUD's and DOE's efforts to promote or work with various stakeholders to consider energy efficiency in the rebuilding process. A more detailed discussion of our methodology is provided in appendix I. We conducted our work from March 2006 through May 2007 in accordance with generally accepted government auditing standards, which included an assessment of data reliability.

Results in Brief

The anticipated reconstruction in the Gulf Coast creates a significant opportunity for incorporating energy efficiency improvements that could produce long-term energy cost savings. First, the sheer magnitude of the reconstruction effort creates a tremendous opportunity for incorporating energy efficiency improvements during the rebuilding and repairing of residential and commercial buildings. Second, state and local governments in Louisiana and Mississippi are still engaged in short and long term planning efforts to recover from the hurricanes. Since these planning efforts are evolving, now is an opportune time to consider fully incorporating energy efficiency improvements in the reconstruction. Third, Louisiana's and Mississippi's recent adoption of newer and more energy efficient building codes and standards creates a unique opportunity for energy efficient rebuilding. In partnership with DOE's PNNL, we analyzed energy cost savings opportunities and estimated that these newer building codes could reduce energy expenditures for residential buildings in Louisiana and Mississippi by at least \$20 to \$28 million per year, depending on the scale of rebuilding in these states. For example, the annual energy expenditures for heating and cooling a typical home in Louisiana and Mississippi built to newer codes could be reduced by \$167 to \$233, a range of savings of 24 to 28 percent, depending on the type of foundation upon which the home is built and the specific code to which it is built. Furthermore, our results showed that annual energy expenditures for commercial buildings—hospitals, schools, offices, and retail—built to newer commercial energy standards could be about 7 to 34 percent lower than buildings built to older standards, depending on the building type. Fourth, our analysis showed that even greater energy cost savings could be obtained for both residential and commercial buildings if consumers and builders voluntarily embrace energy efficiency measures that exceed minimum building code and standard requirements. Finally, in addition to rebuilding homes and commercial buildings, there are opportunities for consumers to make energy efficiency improvements as they replace

damaged equipment with more energy efficient air conditioners, appliances, lighting, and windows.

There are three primary challenges to realizing energy cost savings opportunities presented by the Gulf Coast reconstruction. First, home builders, state officials, and energy efficiency practitioners told us that there is a shortage of construction workers and more specifically a shortage of skilled labor trained to meet the newer building codes and standards—including wind, flood, and energy provisions. These shortages are of particular concern given the number of homes and buildings that may need to be rebuilt or repaired in accordance with newer building codes and standards. Second, states will confront substantial challenges to ensuring compliance with new building codes and standards because of a lack of trained building code inspectors. State compliance and enforcement programs are essential for ensuring that buildings are constructed to the mandatory building codes and standards. Despite states' efforts to improve their compliance and enforcement programs, state and local officials as well as building industry representatives repeatedly told us that they do not have enough trained staff and will have to create building inspection offices, hire additional code officials, and train them in the application of the new codes. Third, consumers considering rebuilding and repairing their homes are faced with making other decisions that may make energy efficiency a low priority. Because of the catastrophic losses caused by the hurricanes, many residents must determine whether they have the financial resources to rebuild or repair their homes at all and whether existing employment opportunities make returning to their homes feasible. Once consumers address these issues, they will have to decide whether it is in their best financial interest to pay the additional costs to make their homes more energy efficient through purchases, such as energy efficient appliances, or to use their money for other purposes. For consumers, especially poor and low-income consumers, this decision will be further compounded by their loss of income, assets, and other financial needs that must be met. Indeed, for some, these short-term financial needs may be so pressing that they preclude long-term thinking about the future financial savings that might be gained by making energy efficiency improvements.

Because the rebuilding of the Gulf Coast is largely a state and local matter, HUD and DOE have played a supportive role in promoting energy efficient rebuilding. More specifically, HUD and DOE have provided financial and educational resources that can encourage the incorporation of energy efficiency in the reconstruction of the Gulf Coast. In addition, both agencies have broader national programs that may assist Louisiana and

Mississippi in incorporating energy efficiency improvements during their rebuilding efforts. HUD has made \$16.7 billion in funding available for general rebuilding purposes, such as damaged housing and infrastructure, and allows states to determine how to spend these funds, including using them for energy efficient improvements. In addition, HUD had several national initiatives that were either planned or under way prior to the hurricanes, and that may directly improve the energy efficiency of the public housing stock in Gulf Coast states. For example, HUD developed an energy strategy for public and assisted housing that includes actions to, among other things, provide incentives for energy efficiency in housing financed through HUD's competitive grant programs and to promote the use of energy efficient appliances and equipment through a HUD partnership with DOE. In its capacity as the nation's lead agency on energy use and energy efficiency issues, DOE's primary role in the Gulf Coast reconstruction has been to provide education and training to state and local officials, private industry, and consumers. In direct response to the Gulf Coast hurricanes, DOE partnered with several entities, including state energy offices, to conduct training workshops for home builders, contractors, and consumers on rebuilding with energy efficiency and storm resistance practices. The department also developed a Disaster Recovery and Building Reconstruction Web site to provide information to state and local officials, builders and contractors, and consumers to promote cost-effective and energy-efficient reconstruction. As part of its ongoing nationwide effort to encourage state energy efficiency initiatives, DOE provides grants to state energy offices to design and carry out their own energy efficiency programs. For example, DOE recently awarded \$6 million to fund 22 federal-state partnerships, 4 of which involve Gulf Coast states, with the aim of creating initiatives to increase energy and cost savings in residential and commercial buildings.

Significant Opportunities Exist for Incorporating Energy Efficiency Measures into Gulf Coast Reconstruction Efforts, Which Could Reduce Energy Expenditures

The anticipated rebuilding and repairing of residential and commercial structures in the Gulf Coast creates an important opportunity for incorporating energy efficiency improvements that could produce long-term energy cost savings. We estimated that newer building codes and standards could significantly reduce energy expenditures for residential and commercial buildings in Louisiana and Mississippi, depending on the rebuilding efforts in these states.

The Scope and Status of the Reconstruction Efforts Create Significant Opportunities to Reduce Energy Expenditures through New Building Codes and Standards

The sheer magnitude of the reconstruction effort creates a tremendous opportunity for incorporating energy efficiency improvements into rebuilt homes and buildings. Many Gulf Coast neighborhoods and communities need to be rebuilt—some from the ground up—especially since an estimated 122,261 homes in Louisiana and Mississippi were destroyed or severely damaged. This rebuilding creates an opportunity for these states to make wide-scale improvements to their building stock, especially the older vintage housing in the areas.⁸ In addition, state and local governments in Louisiana and Mississippi are still engaged in short- and long-term planning efforts to recover from the hurricanes. Since these planning efforts are evolving, now is an opportune time to consider fully incorporating energy efficiency improvements in the reconstruction efforts. Furthermore, Louisiana's and Mississippi's recent adoption of newer and more energy efficient building codes creates a unique opportunity for rebuilding all of the destroyed and severely damaged homes in a manner that could result in significant energy cost savings for these two states.

In partnership with DOE's PNNL, we analyzed a range of energy efficiency levels to determine the potential energy cost savings that could be achieved if single-family homes and commercial buildings in Louisiana and Mississippi were constructed in accordance with various residential

⁸The Energy Information Administration estimates that 38 percent of housing in the South Census Region was built prior to 1970; 58 percent was built before 1980; and 81 percent was built before 1989.

building codes and commercial energy standards. For residential buildings, we examined four energy efficiency levels associated with building in accordance with various codes—a “baseline” level,⁹ a “code” level, and two “above- code” levels. The baseline level we used represents the estimated energy efficiency associated with construction practices in areas of the Gulf Coast that do not have building codes or where the codes may not be enforced. The code level represents the energy efficiency associated with building in accordance with the energy provisions of the ICC’s 2006 residential code.¹⁰ The third level represents the energy efficiency associated with building to meet the Energy Star New Homes Guidelines, which requires a 15 percent improvement over the ICC’s code for all energy used in a house. The fourth level represents the energy efficiency necessary to qualify for the \$2000 home builders’ federal tax credit for energy efficient new homes, which requires a 50 percent reduction in space heating and air conditioning energy use compared with the ICC’s code.¹¹

We estimated that homes built to meet the ICC’s 2006 residential code could reduce energy costs between 24 to 28 percent, resulting in an aggregate annual savings ranging from \$20 to \$28 million, depending on the type of foundation used, the energy efficiency measures to which the homes are built, and the number of homes being rebuilt.¹² More

⁹PNNL modeled two baselines. The first baseline is an approximation of measures in typical existing housing in the rebuilding region. The second baseline represents the estimated energy efficiency associated with construction practices in areas of the Gulf Coast that do not have building codes or where the codes may not be enforced.

¹⁰We use the term “ICC’s residential code” in this report to refer to the ICC’s International Residential Code (IRC), which is a comprehensive, stand-alone residential code that creates minimum regulations for one- and two-family dwellings of three stories or fewer and brings together all building, plumbing, mechanical, fuel gas, energy, and electrical provisions for one- and two-family residences. In terms of energy efficiency, the energy provisions of the IRC references the International Energy Conservation Code (IECC), which requires energy conservation through efficiency in areas, such as, envelope design and mechanical systems. We technically analyzed the energy efficiency requirements of the IECC 2006, which is similar in stringency to the energy provisions of the 2003 and 2006 versions of the IRC.

¹¹This tax credit is provided by section 1332 of the Energy Policy Act of 2005, Pub. L. No. 109-58 (Aug. 8, 2005).

¹²The amount of rebuilding can vary. The aggregated and individual ranges of energy cost savings depend on the type of foundation used, the energy efficiency measure to which the houses are built, and the number of homes being rebuilt. Our aggregate range of energy cost savings is based on the assumption that an estimated 122,261 severely damaged/destroyed homes are rebuilt with either a slab-on-grade or elevated foundation. See appendix II of this report for more information.

specifically, our analysis showed that, depending on the parameters of individual homes, an estimated annual per house energy cost savings ranging from \$167 to \$233 could be achieved if new homes were built in accordance with the ICC's 2006 residential code, rather than current construction practices in the Gulf Coast region where there are no building codes or where codes are not enforced. Furthermore, greater home energy cost savings could be obtained if consumers rebuild their homes to meet Energy Star New Home Guidelines or if home builders take advantage of the energy efficient home tax credit provisions of the Energy Policy Act of 2005 (EPACT) by building homes that use 50 percent less energy for heating and cooling than those built to meet the ICC's code. For example, annual per house energy cost savings of \$310 to \$364 over baseline levels could be achieved by meeting Energy Star Home specifications, while \$371 to \$447 in savings can be realized by building to meet the tax credit criteria in EPACT. The potential for Louisiana and Mississippi to achieve significant energy cost savings if the estimated 122,261 homes that were destroyed or severely damaged are rebuilt in accordance with various energy efficiency measures is shown in more detail in appendix II, table 1.¹³

In general, the improved energy efficiency features that are part of the ICC's 2006 residential code, Energy Star New Home Guidelines, and the EPACT tax credit include more efficient windows and heating and cooling equipment, improved building envelope and duct sealing, and increased insulation. While building homes in accordance with the newer building codes and above code measures will improve a home's energy efficiency, it will also increase home construction costs because more expensive and efficient energy features are required. However, these additional costs can generally be recovered within several years. Details on the cost recovery period for several key energy efficiency features can be found in appendix II, table 2.

For commercial buildings—offices, hospitals, schools, and retail—we used the current commercial energy standards for Louisiana and Mississippi as baselines: the ASHRAE 2001 standard for Louisiana and the ASHRAE 1975 standard for Mississippi. We then estimated the potential energy cost

¹³On the basis of our review of HUD's report entitled *Promoting Energy Efficiency at HUD in a Time of Change: Report to Congress* (Washington DC: August 8, 2006), it appears that the department could similarly reduce its utility-related energy expenditures for its public and assisted housing programs in the Gulf Coast region by implementing energy efficiency practices similar to those that we identified for single-family homes.

savings associated with rebuilding commercial structures in Louisiana in accordance with the ASHRAE 2004 standard¹⁴ and in Mississippi in accordance with ASHRAE's 2001 standard. We also estimated the potential savings that could be achieved by constructing buildings to meet "above code" levels, such as the requirements of the Leadership in Energy and Environmental Design (LEED) green building program and the EPACT commercial tax credit level, requiring 50 percent less energy use than the ASHRAE 2001 standard.¹⁵

The results of our commercial building analysis showed that an estimated annual energy cost savings for commercial buildings between 7 and 34 percent could be achieved in Mississippi if commercial structures were rebuilt in accordance with the ASHRAE 2001 standard and a savings of between 7 and 13 percent could be achieved in Louisiana if commercial structures were rebuilt in accordance with the ASHRAE 2004 standard. More detailed information on these potential savings is presented in appendix III, table 5. The primary reason for this significant savings is that the newer energy standards call for the use of less lighting power, which directly saves energy and indirectly reduces cooling needs because less heat is given off from lighting fixtures. Overall, adopting newer and more efficient commercial energy standards in the Gulf Coast would reduce energy operating costs as well as construction costs because the newer standards can be met with fewer, more efficient lighting fixtures resulting in immediate cost recovery.

Our analysis also shows that greater energy cost savings could be obtained for commercial buildings if they were constructed in accordance with even higher energy efficiency measures. These efficiency measures include the LEED rating system,¹⁶ which awards points for buildings that

¹⁴Technically, the ASHRAE standards referred to in this report are the ANSI/ASHRAE/IESNA Standard 90-75, ANSI/ASHRAE/IESNA Standard 90.1-2001, and the ANSI/ASHRAE/IESNA Standard 90.1-2004.

¹⁵The LEED Green Building Rating System is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings and is operated by the U.S. Green Building Council. EPACT created certain requirement and incentives to help improve energy efficiency, including residential and commercial buildings.

¹⁶The U.S. Green Building Council has developed a national rating system—LEED—for constructing high-performance, sustainable buildings. The LEED system awards points for various building parameters, including energy. For example, the LEED system awards 1 point for a building that uses 10.5 percent less energy than required using the ASHRAE 2004 standard and 10 points for a building that uses 42 percent less energy than required using the ASHRAE 2004 standard.

use less energy than required by the ASHRAE 2004 standard and the federal tax credit level for commercial buildings.¹⁷ The energy cost savings associated with these two “above code” energy efficiency approaches could range from \$17,263 to \$286,285 per building, depending on the building type and size. Additional information about these potential savings are presented in appendix III, table 6.

Making Energy Efficient Improvements to Residential and Commercial Buildings by Replacing Damaged Equipment and Appliances Could Further Decrease Future Energy Expenditures

Some residential and commercial buildings damaged by the Gulf Coast hurricanes will not need to be replaced completely, but they will require repairs. Consumers who decide to repair homes or commercial structures can reduce their energy expenditures by replacing older and less efficient energy consuming equipment that may have been destroyed or damaged with more energy efficient products. We identified several common energy efficiency improvements that can be made to both residential and commercial buildings. For some items, such as cooling systems, minimum federal standards set by DOE require the manufacture of more efficient units than would have been used prior to the Gulf Coast hurricanes. Therefore, energy cost savings from these kinds of equipment could be achieved by simply replacing older equipment with a standard newer model. Some of the more common energy efficiency improvements include more efficient air conditioning systems, better insulating windows,¹⁸ and improved duct sealing.¹⁹ Although these systems are generally more costly than older, less efficient units, with the exception of window replacements, the additional costs can usually be recovered in a

¹⁷A tax deduction of up to \$1.80 per square foot is available to owners or designers of new or existing commercial buildings that save at least 50 percent of the heating and cooling energy of a building that meets ASHRAE standard 90.1-2001. Partial deductions of up to \$0.60 per square foot can be taken for measures affecting any one of three building systems: the building envelope, lighting, or heating and cooling systems.

¹⁸The cost recovery period for the windows that we previously mentioned may not appear attractive. However, if the existing building has single-pane windows, these windows can have substantial disadvantages that are not accounted for in an energy cost analysis. For example, the inner surface temperature of a single-pane aluminum window will become quite low during the coldest winter conditions. This low temperature can result in an unpleasant drafty feeling for occupants in the vicinity of the windows. Also, the cold surface can lead to possible water condensation, which could eventually result in water damage to the windows or walls over an extended period of time.

¹⁹Tax credits are available for many types of home improvements including adding insulation, replacing windows, and purchasing certain high efficiency heating and cooling equipment. The maximum amount of homeowner credit for all improvements combined is \$500 during the 2-year period of the tax credit.

few years. Additional information on the estimated energy cost savings that these improvements could bring to both Louisiana and Mississippi is presented in appendix II, table 3.

Residential consumers can also reduce their energy costs by replacing damaged incandescent lighting and appliances with compact fluorescent lighting (CFL) and Energy Star appliances. On a per house basis, switching to CFLs can save consumers an estimated \$48 a year in electricity costs for lighting.²⁰ Installing Energy Star appliances can produce modest annual dollar savings compared with appliances that simply meet the current minimum federal manufacturing standards. However, according to PNNL, if these appliances are used to replace older appliances that may be much less efficient, the costs savings can be considerable. According to Energy Star data, an Energy Star refrigerator is at least 15 percent more efficient than federal minimum manufacturing standards, meaning that it would save an estimated \$9 a year over a new conventional refrigerator. Savings from replacing an older refrigerator could be much higher, for example \$65 a year over a pre-1993 refrigerator. The additional costs and the energy cost savings that may be achieved if these lighting and appliance upgrades are made in the estimated 143,862 homes that received major damage is outlined in appendix II, table 4.

Our analysis demonstrated that lighting upgrades are the primary area where energy cost savings can be achieved from renovating damaged commercial buildings in the Gulf Coast region. For example, if commercial buildings—offices, schools, hospitals, and retail—in Mississippi were renovated to meet the ASHRAE 2004 standard, rather than the state’s current standard (the ASHRAE 1975 standard), the cumulative savings per building would be \$18,689 to \$150,538 per year depending on the building type. In contrast, renovating these same building types in Louisiana so that they go beyond the state’s current ASHRAE 2001 standard to meet the ASHRAE 2004 standard would result in \$5,704 to \$30,537 in annual savings per building. According to PNNL officials, all other building renovations pale in comparison to the impact that lighting changes would have in terms of producing energy cost savings for commercial buildings. Additional information about the potential energy cost savings associated with lighting in commercial buildings is presented in appendix III, table 7.

²⁰On the basis of a house with 20 light fixtures, the Energy Star Advance Lighting Package’s minimum requirements would save \$48 a year in electricity costs for lighting.

Home Builder, State, and Consumer Challenges Are Substantial and May Limit Energy Cost Savings Opportunities from Being Realized

Three substantial challenges may limit the energy cost savings opportunities presented by the Gulf Coast reconstruction from being realized. First, a general shortage of a skilled construction workforce and, specifically, the shortage of construction workers trained to meet newer building codes may limit energy cost savings. Second, states will face serious challenges ensuring compliance with newer building codes, thereby potentially limiting energy cost savings opportunities from being realized. Third, consumers who consider rebuilding and repairing their homes are faced with making other decisions that may make energy efficiency a low priority.

Availability of a Skilled Construction Workforce Trained to Meet Newer Building Codes and Standards May Limit Energy Cost Savings

The shortage of a skilled construction workforce capable of sustaining the rebuilding and repairing of destroyed and damaged homes in Louisiana and Mississippi may limit the energy cost savings that can be achieved by rebuilding to the newly adopted building codes. The construction workforce shortage is twofold—that is, there is a general shortage of construction workers and, more specifically, a shortage of skilled construction workers trained in the application of the newer building codes.

A 2004 Department of Labor report cited an industry study that said in the year prior to the Gulf Coast hurricanes, nearly 75 percent of contractors nationwide reported experiencing skilled construction labor shortages.²¹ Louisiana and Mississippi builders told us that the labor shortage worsened when the hurricanes displaced some of their construction workforce to other states and caused an overwhelming demand for rebuilding and repairing destroyed and damaged residential and commercial buildings. Consequently, the demand for construction in the Gulf Coast region far exceeds the capacity of the local construction workforce. For example, a study conducted by the RAND Corporation reported that to sustain the rebuilding efforts in New Orleans, the city would have to expand its number of construction firms, labor force, and building supply networks.²²

²¹U.S. Department of Labor, *Americas Construction Industry: Identifying and Addressing Workforce Challenges* (December 2004).

²²Kevin McCarthy, D.J. Peterson, Narayan Sastry, and Michael Pollard, *The Repopulation of New Orleans After Hurricane Katrina*, a technical report prepared by the RAND Gulf States Policy Institute (January 2006).

In addition, there is currently a lack of skilled construction workers trained to meet the states' new building codes and standards. According to many different stakeholders with whom we spoke, building code training is an important part of ensuring that buildings are properly constructed to meet the newer building codes, including the energy provisions. Training the construction workforce will require time and involve a learning curve, which may delay or even limit the energy cost savings achieved during the Gulf Coast reconstruction. According to state officials and home builders that we spoke to, prior to the Gulf Coast hurricanes the general construction workforce in Louisiana and Mississippi did not have to comply with any particular statewide building codes, and some parishes and counties had no residential building codes to guide home construction. As a result, there was not an overwhelming need for the general construction workforce to be familiar with the building codes developed by the ICC. However, the construction workforce in Louisiana and the five coastal counties in Mississippi will now need training on the application of the newer building codes that include wind, flood, and energy provisions. This is especially true for Louisiana, since it adopted mandatory statewide building codes. Home builders, energy efficiency practitioners, state officials, and non-profit organizations with whom we spoke acknowledged that fully implementing newer building codes will take time and will involve a learning curve before construction workers understand and are able to comply with the requirements. State officials and home builders told us that it will be difficult for local home builders—consisting of small volume builders—to make the transition from not building according to a building code to now constructing buildings to meet the requirements of the most recent residential codes. In addition, according to the National Association of Home Builders, the ICC's energy code has caused problems for home builders because they have trouble finding the lowest cost solution that also complies with the code. All of these challenges may delay or even limit the energy cost savings.

In an effort to address the skilled construction workforce shortage, the Business Roundtable—an association of chief executive officers of leading U.S. companies with \$4.5 trillion in annual revenues and more than 10 million employees—in partnership with federal, state, and local government agencies, construction trade groups, businesses, and non-profit organizations, created the Gulf Coast Workforce Development Initiative as an effort to recruit and train up to 20,000 skilled construction laborers for the Gulf Coast region by the end of 2009. Recruitment efforts for this initiative are under way through the Gulf Rebuild, Education, Advancement, and Training (GREAT) Campaign. Under this campaign, participants enroll in a 4-week course to gain entry-level skills in

preparation for jobs in the construction industry. In addition to the GREAT Campaign, there are other efforts under way to build a skilled construction workforce in the Gulf Coast states, including courses and related workshops at local colleges and universities and construction and building summits/expos being offered throughout the Gulf Coast states.

States Will Be Challenged to Ensure That New Construction Meets the Recently Adopted Building Codes and Standards

Having an adequate number of trained code officials to inspect buildings is vital to ensuring that rebuilding the hundreds of thousands of destroyed and damaged structures is done in accordance with the newly adopted building codes so that energy cost saving opportunities are actualized. However, building industry representatives and state officials told us that Louisiana and Mississippi lack code offices, lack an adequate number of code officials,²³ and may find it difficult to secure the resources to hire a sufficient number of adequately trained staff. Despite these challenges, however, efforts to enforce the new codes and standards in Louisiana and Mississippi are currently under way.

Louisiana and Mississippi may not have adequate resources to open additional code offices and may not currently have adequate numbers of trained staff. For example, only a few Louisiana parishes and Mississippi counties have code compliance and enforcement programs, and implementing the new building codes will require more building code offices to be established. According to one Louisiana code official, because 57 of the state's 64 parishes did not have to comply with any mandatory statewide building codes before the Gulf Coast hurricanes, there was no need for building code offices in those particular parishes. In Mississippi, only those five coastal counties affected by the hurricanes are required to meet the new statewide building codes. According to Mississippi officials, despite the fact that three of the five counties had building codes and offices in place prior to the hurricanes, these counties will still need to hire and train additional code officials because of the overwhelming amount of rebuilding that remains and the new building codes. In addition, there was a consensus among the groups we interviewed that building code offices are currently overburdened, because there are too few officials and too many inspections.

²³The terms "code officials" or "inspectors", in this report, refer to building officials, inspectors, plans examiners, and others in the position of regulating building codes and standards.

Furthermore, Louisiana and Mississippi will face serious challenges in securing the adequate staff and resources to support code enforcement. Both states reported that the local governments in the most severely affected parishes and counties have limited financial resources to provide staff to implement the newer building codes. State officials, home builders, and non-profit organizations pointed out that code officials are taking other jobs in the private sector, which means code offices will have to fill those vacated positions as well as hire and train additional code officials. According to 1 state official in Louisiana, there were only 35 code inspectors statewide, only 7 of whom were certified to enforce the ICC building code recently adopted by the state that includes energy provisions.

Furthermore, local governments will face challenges in training code officials and code users²⁴ in the application of the new building codes. Building codes are inherently complex and technical, thereby potentially affecting compliance and enforcement, especially for larger commercial buildings. One study on compliance and enforcement methods reported that enforcing energy codes may require a higher level of expertise, and found that some local governments hire multiple code officials with specialized areas of expertise.²⁵ Another study suggests that the complexities of energy codes make them impossible to enforce without a labor-intensive review of energy plans and documentation supported by extensive investments in hardware, software, training, and other resources. Energy efficiency practitioners suggest that education and training are critical during implementation, and that adopting jurisdictions must prepare code officials to enforce the energy code and prepare the building industry to comply with the code. According to one study, the inability to ensure compliance with energy codes will risk failing to capture the energy efficiency and cost savings they are designed to achieve.²⁶

²⁴The term “code users,” as used in this report, refers to builders and contractors, architects, designers, and others in the position of compliance with building codes and standards.

²⁵Maine Public Utilities Commission, *“Building Code Compliance and Enforcement Methods Investigation”* (presented to the Utilities and Energy Commission, December 2004).

²⁶D.L. Smith and J.J. McCullough, *Alternative Code Implementation Strategies for States*, A report prepared for the U.S. Department of Energy (May 2001).

Despite the challenges, efforts to implement the new codes and standards in Louisiana and Mississippi are currently under way. For example, according to Louisiana Code Council officials, to some extent parishes have been enforcing the new building code since February 2006. The 11 most affected parishes have collaborated with surrounding governmental bodies to expand their existing offices or hired third-party service providers. One official estimated that the number of code officials in the state has increased from about 35 to 100, mainly because the Louisiana Code Council is giving existing code officials, who are not certified to enforce the new code, up to 3 years to acquire their certification as they continue to conduct building inspections. Moreover, as of December 2006, the state had allocated \$8 million for those parishes that did not previously have building code offices. Furthermore, Louisiana has a \$14 million program, funded by Federal Emergency Management Agency (FEMA) funds,²⁷ to provide assistance to local governments as they implement the new statewide building codes. The Mississippi Development Authority is using HUD funding to administer a \$5 million grant program to coastal county governments to hire additional building code officials and inspectors to ensure compliance with the new building codes. The program also intends to help to fund salaries, fringe benefits, travel, and training for building code enforcement officials for 1 year.

Finally, Louisiana and Mississippi state energy office officials are providing education and training to code users to encourage the incorporation of energy efficiency and sustainable practices into the rebuilding of the state. According to Louisiana officials, they will continue to provide training on energy codes and compliance methods, sponsor energy efficiency projects, and work with experts and universities to host forums to provide hands-on, project-specific, one-on-one assistance to those rebuilding and repairing destroyed and damaged structures. Officials from the Mississippi state energy office said that they are conducting similar efforts in their state.

²⁷FEMA is tasked with responding to, planning for, recovering from, and mitigating against disasters. Its Hazard Mitigation Grant Program provides grants to states, to implement long-term hazard mitigation measures after a major disaster declaration.

Energy Efficiency May Be a Low Priority When Consumers Consider Rebuilding or Repairing Destroyed and Damaged Homes

According to state officials, home builders, and non-profit organizations in Louisiana and Mississippi, consumers who desire to return to their homes face difficult financial questions regarding compensation payments, the higher costs of construction and insurance, and the availability of employment, which may make decisions about energy efficiency a low priority. Some state officials and non-profit organizations believe that compensation payments awarded to homeowners may not be enough to cover their mortgage balances or rebuilding costs. Qualified Louisiana and Mississippi homeowners may receive up to \$150,000 in financial assistance from their state's homeowner's assistance program, which is funded by the federal government. However, the most recent available data show that the average amount received by residents in Louisiana and Mississippi is about \$75,177 and \$70,045, respectively. Representatives from non-profit organizations with whom we spoke told us that in some cases, homeowner mortgage balances and rebuilding costs exceed the payment amounts, leaving a funding gap that homeowners will have to fill. In addition, state officials whom we spoke with told us that the housing program does not provide additional funds to use for energy efficiency, thus homeowners will have to pay any additional costs associated with making their homes more energy efficient.

According to home builders, non-profit organizations, and energy efficiency practitioners, homeowners may also have to consider the additional construction costs associated with new elevation requirements. That is, some consumers will have to consider the additional costs to elevate their homes. Although FEMA provides \$30,000 to cover the costs for building to higher elevations, it may cost more than that to build in some neighborhoods, based on FEMA's advisory base flood elevations and local parish and county community decisions to implement higher elevation requirements, according to some home builders. Representatives of a state home builders association told us that it can cost as much as \$40,000 to more than \$100,000 depending upon the house.

According to state officials, home builders, and non-profit organizations, homeowners continue to deal with insurance claims and face difficult decisions about future coverage in light of higher insurance costs, if any coverage is available at all. By some news reports, insurance premiums have doubled or tripled in some areas. Increasing insurance costs may affect consumers purchasing decisions regarding energy efficiency, thus limiting energy cost savings opportunities presented by the Gulf Coast reconstruction from being realized.

State officials and non-profit organizations told us that homeowners also will have to decide whether existing employment opportunities make returning to their homes feasible. Many residents lost their jobs when infrastructure was destroyed and employees and customers were displaced. The employment level statewide in Mississippi returned to their pre-hurricane levels, while levels in the hardest hit area remained down, as did the rate in Louisiana. In the absence of employment opportunities, many residents will likely not return to their homes. Without adequate employment opportunities, even those residents who do return are likely to face financial hardships that will make decisions about repairing or rebuilding their homes in an energy efficient manner a low priority.

Even after addressing these issues, homeowners will have to decide whether it is in their best financial interest to pay the additional costs to make their homes more energy efficient through purchases, such as energy efficient appliances, or to use their money for other purposes. For consumers, especially poor and low-income consumers, this decision may be compounded by their loss of income, assets, and other financial needs that will have to be met. One study we reviewed suggest that among the most important barriers generally affecting consumers and their purchasing decisions are limited information, limited awareness and interest in energy costs and reducing energy expenses; and limited capital and rapid payback requirements. Consumers are less likely to voluntarily adopt energy efficiency measures without financial incentives and education on the costs and benefits.

HUD and DOE Are Providing Funding and Educational Resources to Encourage Gulf Coast States to Incorporate Energy Efficiency in Rebuilding

Because the rebuilding of the Gulf Coast is largely a state and local matter, HUD and DOE have played a supportive role in promoting energy efficient rebuilding. More specifically, HUD and DOE have provided financial and educational resources that can encourage the incorporation of energy efficiency in the reconstruction of the Gulf Coast. In addition both agencies have broader national programs that may assist Louisiana and Mississippi in incorporating energy efficiency improvements during their rebuilding.

HUD Is Making Funding Available to Gulf Coast States for Rebuilding and Repairing Residential Buildings

HUD officials told us that they provided the affected Gulf Coast states with funding that can be used for, among other things, rebuilding in an energy efficient manner. Congress has appropriated a total of \$16.7 billion in Community Development Block Grants (CDBG) supplemental funding that has been allocated for use in the five affected Gulf Coast states for general rebuilding. These grants afford states a great deal of discretion in designing, rebuilding, and repairing housing; in neighborhood revitalization; and in economic development activities. The federal coordinator for Gulf Coast rebuilding has said that the CDBG program allows state leaders “who are closest to the issues” to make decisions regarding how the money should be spent.²⁸ In Louisiana and Mississippi, these funds are mostly being used for restoring housing infrastructure. To receive CDBG funding, Louisiana and Mississippi as well as the other affected Gulf Coast states were required to submit a Disaster Action Plan—an overall plan for short-and long-term disaster recovery—to HUD for review and approval. States were required to describe, among other things, how their Disaster Action Plan would encourage construction methods that emphasize energy efficiency and promote the enactment and enforcement of modern building codes as part of their rebuilding process. HUD officials said they also have been working with Louisiana and Mississippi homeowner assistance programs to target CDBG funds to better assist states and consumers in rebuilding homes that are more energy efficient, safer, and storm resistant. In addition, HUD officials told us that they encourage public housing authorities to use energy efficient construction practices, appliances, and equipment. According to HUD, this was the case when the department approved and funded a \$22 million grant to the Housing Authority of New Orleans and \$7 million in grants to the Biloxi Mississippi Housing Authority from its Capital Fund Reserve for Emergencies and Natural Disasters to rebuild, repair, modernize, and improve the energy efficiency of damaged public housing units.

HUD officials told us that they also have disseminated information on energy efficiency to public housing authorities and participated in educational and training activities to assist state and local offices, consumers, and builders with considering energy efficient rebuilding. For example, the department distributed a special disaster recovery edition of its Public Housing Energy Conservation Clearinghouse e-newsletter,

²⁸Statement made by Donald Powell, the Federal Coordinator for Gulf Coast Rebuilding; on January 25, 2006, when he announced the distribution of CDBG funds to the five Gulf Coast states impacted by hurricanes.

outlining energy efficiency measures that public housing authorities and residents can take to save energy and reduce utility costs. In addition, HUD was involved in several reconstruction activities that while focused on hurricane preparedness and reconstruction, also provided information on energy efficiency. These activities included the Mississippi Governors Reconstruction “Expo” where HUD disseminated extensive materials on its Partnership for Advanced Technologies in Housing (PATH) program, and the release of HUD “Tech Sets” on storm-resistant roofing and wind resistant openings for use by homeowners, builders, and community officials in the affected Gulf Coast states.

HUD also has actions that were planned or under way prior to the Gulf Coast hurricanes that are designed to improve the energy efficiency of the nation’s public housing stock and that could potentially benefit the Gulf Coast states.²⁹ These actions included the following:

- HUD’s Energy Task Force developing standard training program modules to promote energy efficiency in both new and existing HUD-assisted and financed housing. HUD also will develop materials on ways to improve household energy efficiency for housing authorities to disseminate to public housing residents.
- HUD, through its new Partnership for Home Energy Efficiency with DOE and the Environmental Protection Agency, working to ensure that information on Energy Star products and appliances, Energy Star Qualified New Homes, and Home Performance with Energy Star for existing homes is available for distribution to public housing authorities, grant recipients, property managers, and new Federal Housing Administration (FHA) homebuyers.³⁰
- HUD improving its tracking and monitoring of energy efficiency in public housing with an automated system to provide public housing authorities with data that serves as an indicator of the relative efficiency of individual properties and their potential for energy savings.

²⁹Section 154 of EPACT requires HUD to develop and implement an integrated strategy to reduce utility expenses through cost-effective energy conservation and efficiency measures and energy-efficient design and construction of public and assisted housing. HUD also is required to monitor the energy use of public housing agencies and submit a report update every 2 years on its progress in implementing the strategy.

³⁰Home Performance with Energy Star is a whole-house Energy Star retrofit initiative aimed at existing homes.

DOE Is Providing Energy Efficiency Training and Education to Consumers and State and Local Officials

In its capacity as the nation's lead agency on energy efficiency issues, DOE's primary role in the Gulf Coast reconstruction has been to support states by provide training and education to state and local officials, private industry, and consumers. In direct response to the Gulf Coast hurricanes, DOE partnered with several entities, including state energy offices, to conduct training workshops on rebuilding with energy efficiency and storm-resistance practices for home builders, contractors, and consumers. For example, DOE, in partnership with HUD's PATH program, Home Depot, and Entergy Corporation, sponsored free home repair workshops in Louisiana and Mississippi that highlighted energy efficiency.³¹ Attendees had the opportunity to receive hands-on instructions on repairing storm damaged roofs, ceilings, walls, and floors; installing windows, doors, and hurricane shutters; and improving a home's energy efficiency and durability. DOE also responded to a request from the Louisiana State Energy Office to provide Web-based code training sessions to architects, engineers, and code officials to train them on how to comply with the 2005 Louisiana ASHRAE Commercial Energy Building Code as they renovate and replace commercial buildings.

DOE also made educational resources available to all parties involved in the rebuilding efforts by developing a Disaster Recovery and Building Reconstruction Web site (www.eere.energy.gov/buildings) to (1) provide various educational resources to state and local officials, builders and contractors, and consumers and (2) promote cost-effective and energy-efficient reconstruction. This Web site includes information on energy efficiency and rebuilding training opportunities and a wide range of guidelines, fact sheets, and case studies developed by DOE, HUD, FEMA, the National Association of Home Builders, and other organizations.

DOE has taken other actions to encourage parties involved in the rebuilding process to consider energy efficiency. For example, it awarded a \$100,000 grant to Louisiana, Mississippi, and other affected Gulf Coast states to incorporate energy efficiency and sustainable design practices into their rebuilding strategy. DOE also partnered with state energy offices to encourage the regional exchange of information and best practices. As part of its partnership with states, DOE hosted the Katrina Green Informal

³¹PATH is a voluntary partnership between leaders of the homebuilding, product manufacturing, insurance, and financial industries and representatives of federal agencies concerned with housing. HUD's Office of Policy Development and Research (PD&R) coordinates all PATH activities. PD&R manages PATH's budget, strategy, and daily operations.

Working Group, a biweekly conference call with various federal and state officials, industry associations, builders, nonprofit organizations, and energy efficiency and housing experts, aimed at networking and sharing information about the rebuilding efforts in Gulf Coast states. DOE officials said that the agency plans to continue its efforts to encourage Louisiana and Mississippi and other affected states to rebuild more energy efficiently.

Finally, DOE also has ongoing nationwide energy efficiency initiatives to assist all states with their own energy efficiency initiatives through several national programs and projects including the following:

- *Federal-State Partnership Projects*: DOE recently awarded \$6 million to fund 22 federal-state partnerships that will help implement training programs and provide technical assistance and education that is intended to ultimately result in the construction of more energy efficient buildings. Louisiana and Mississippi were among the states that were awarded partnership grants. Louisiana's project proposal, entitled *Gulf Region High Performance Homes Program*, is intended to spur market transformation in Louisiana and the Gulf Coast region through educational outreach, demonstration, technical assistance, and training on locally appropriate, hazard-resistant, energy-efficient, and healthy-building science and technologies. The goal of Mississippi's proposal, entitled *Promoting Energy Codes and "Beyond Code" Programs through EPACT Tax Incentives*, is to integrate building energy codes and "better than code" programs using the tax incentives of EPACT as a coordinating framework, and to promote building energy codes, DOE Building America approaches, and Energy Star Home procedures as avenues for qualifying for the buildings-related tax incentives in EPACT.
- *State Energy Program (SEP)*: DOE's SEP provides grants to the states to design and carry out their own renewable energy and energy efficiency programs. Funding from SEP goes to state energy offices in all states and U.S. territories. States use these grants to address their energy priorities and to adopt emerging renewable energy and energy efficiency technologies. SEP projects are managed by state energy offices, not by DOE directly. In 2006, DOE provided over \$650,000 in SEP grants to Louisiana and about \$400,000 to Mississippi.
- *Weatherization Assistance Program*: This program enables low-income families to permanently reduce their energy bills by making their homes more energy efficient. According to DOE, it is this country's longest running and perhaps most successful energy efficiency program. During the last 30 years, DOE's Weatherization Assistance Program has provided

weatherization services to more than 5.5 million low-income families. DOE reported that, on average, weatherization reduces overall energy bills by \$358 per year at current prices. In 2006, about \$2 million in weatherization funds were provided to Louisiana and about \$1.9 million went to Mississippi.

Concluding Observations

While the current level of reconstruction and the difficulties surrounding the return of residents is unsettling for both individuals and communities, the nature and status of rebuilding actually creates significant opportunities for incorporating energy efficiency measures into reconstruction and rebuilding efforts. Nonetheless, as great as the potential opportunities are, the challenges that must be overcome to capitalize on these opportunities and actually achieve energy cost savings are equally significant. Since most of the reconstruction in Louisiana and Mississippi is still in the planning phase, there is still time to address the challenges of incorporating energy efficiency in the rebuilding of the Gulf Coast. Meeting these challenges will undoubtedly benefit consumers, the Gulf Coast region, and the nation.

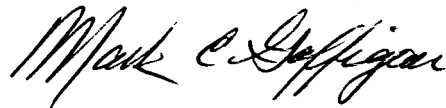
While the rebuilding of the Gulf Coast is largely a state and local matter, HUD and DOE have provided states and consumers with funding and educational resources to assist in the largest reconstruction effort in the nation's history. Going forward, there will be a growing opportunity to incorporate energy efficiency measures during the rebuilding process—as states and local governments decide on how and to what extent to implement and enforce new building codes, and consumers begin to make decisions about whether making energy efficient choices is in their best financial interest. Given that improved energy efficiency measures, such as updated building codes and energy efficient building materials are new to the Gulf Coast region, states and consumers can greatly benefit from DOE expertise in these areas. DOE expertise as well as HUD and DOE resources may prove invaluable to states and consumers as they make decisions about building code training and enforcement, energy efficiency construction practices, and purchasing energy efficient appliances and equipment.

Agency Comments

We provided a draft of this report to DOE and HUD for their review and comment. DOE provided technical and clarifying comments, which we incorporated as appropriate. HUD had no comments on the report.

We are sending copies of this report to interested congressional committees, the Secretary of Energy, the Secretary of Housing and Urban Development, and other interested parties. We will also make copies available to others on request. In addition, the report will be available at no charge on GAO's Web site at <http://www.gao.gov>.

If you or your staffs have any questions regarding this report, please contact me at (202) 512-3841 or gaffiganm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IV.



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Appendix I: Objectives, Scope, and Methodology

During our review, our objectives were to (1) analyze the extent of opportunities for incorporating energy efficiency improvements and realizing energy cost savings in the Gulf Coast reconstruction, (2) discuss potential challenges to realizing energy cost savings during the reconstruction, and (3) describe the role of Department of Housing and Urban Development (HUD) and the Department of Energy (DOE) in promoting energy efficiency in the rebuilding of the Gulf Coast.

To estimate potential energy cost savings from rebuilding and repairing residential and commercial structures on the Gulf Coast, we worked with DOE's Pacific Northwest National Laboratory (PNNL). PNNL modeled the levels of energy efficiency that could be achieved if the buildings were rebuilt or repaired to meet newer building codes and standards or "above code" levels, and compared these measures with a baseline that approximately reflected the energy efficiency of these buildings prior to the Gulf Coast hurricanes. Separate analyses were conducted for representative residential and commercial building types. We worked with PNNL in developing the model assumptions, including the size and characteristics of representative residential and commercial buildings, the building codes and standards that were used, the future costs of fuels, the heating and cooling climate of the area, the discount rate used for consumers' valuation of future fuel cost savings from more energy efficient equipment and materials. We found PNNL's models and assumptions reasonable and sufficiently reliable for the purposes of this report.

For a representative residential Gulf Coast home, PNNL modeled several energy efficiency scenarios—two baseline measures,¹ an energy code level, and two "above code" levels. PNNL used an energy simulation tool developed at the Florida Solar Energy Center and DOE's Energy Information Administration forecasts of natural gas and electricity prices. PNNL also modeled the efficiency gains that could be achieved by bringing Gulf Coast commercial buildings into compliance with current, more efficient, energy standards for four prototypical buildings—offices, schools, hospitals and retail. PNNL estimated the annual energy cost savings associated with three levels of energy standards—baseline

¹PNNL modeled two baselines. The first baseline is an approximation of measures in typical existing housing in the rebuilding region. The second baseline represents the estimated energy efficiency associated with construction practices in areas of the Gulf Coast that do not have building codes or where the codes may not be enforced.

efficiency, the current code's higher-efficiency, and "above code" building standards.

To aggregate potential residential energy cost savings from rebuilding or repairing destroyed and damaged homes in the Gulf Coast region, we used PNNL's estimates of annual energy cost savings for a representative home built to different levels of energy efficiency and federal estimates of the aggregate number of these homes to estimate the scope for savings. We reviewed the methodology used to estimate the damaged and destroyed homes, including the steps that were taken to ensure the reliability of these data and were satisfied that the estimates were satisfactory for our purposes.

To understand the potential challenges that may limit energy cost savings from being realized, we relied on site visits to Louisiana and Mississippi, interviews with state government officials, and attendance at local building conferences and housing summits. Furthermore, we interviewed energy efficiency practitioners, building industry representatives, and non-profit organizations as well as HUD and DOE officials to solicit their views on the challenges of incorporating energy efficiency measures in the rebuilding and repairing of destroyed and damaged buildings.

To describe the role of HUD and DOE in promoting energy efficiency in the rebuilding of the Gulf Coast, we interviewed agency officials and obtained and reviewed documentation describing the actions that these agencies have taken to assist Louisiana and Mississippi. We also conducted site visits to these states to obtain firsthand knowledge from state government officials, non-profit organizations, home builders, and energy efficiency practitioners about their views on HUD's and DOE's efforts to promote or work with various stakeholders to consider energy efficiency in the rebuilding process. We conducted our work from March 2006 through May 2007 in accordance with generally accepted government auditing standards, which included an assessment of data reliability.

Appendix II: Energy Cost Savings Estimates for Residential Buildings

Tables 1 through 4 contain energy cost savings estimates for homes built in accordance with various energy efficiency standards and for homes repaired with selected energy efficiency-related improvements.

Table 1: Annual Energy Cost Savings for Heating and Cooling Homes Built in Accordance with Various Energy Efficiency Codes and Standards with Slab-on-Grade and Elevated Foundations

Energy efficiency alternative	Per house dollar savings over new housing baseline		Percentage savings over new housing baseline		Aggregate savings over new housing baseline for 122,261 homes (dollars in millions)	
	Slab-on grade	Elevated	Slab-on grade	Elevated	Slab-on grade	Elevated
International Residential Code (IRC) 2006	\$167	\$233	24%	28%	\$20	\$28
Energy Star	\$310	\$364	45%	44%	\$38	\$45
Tax credit	\$371	\$447	54%	54%	\$45	\$55

Source: GAO analysis of Pacific Northwest National Laboratory data.

Notes:

New housing baseline: estimated current practice for new construction in areas of the Gulf Coast region that does not have building codes. There will be a variation of energy efficiency in both new and existing buildings. Some buildings may be more energy efficient than the baseline assumed here, some will be less.

IRC 2006: For this analysis, we analyzed the energy efficiency requirements of the International Energy Conservation Code (IECC) 2006, which is similar in stringency to the energy provisions of the IRC 2006 as well as the IECC 2003.

Energy Star Homes Guideline: Energy Star requires a 15 percent improvement over the IECC for all energy used in a house.

Tax Credit: Qualification for the \$2,000 tax credit requires a 50 percent reduction in space heating and air conditioning energy use compared with the IECC 2003, including supplements.

**Appendix II: Energy Cost Savings Estimates
for Residential Buildings**

Table 2: Estimated Construction Cost Increases and Cost Recovery Periods for Building Homes in Accordance with Various Energy Efficiency Codes and Standards

Energy efficiency alternative	Per house dollar cost increase above new housing baseline	Cost recovery period		Aggregate cost increase above new housing baseline for 122,261 homes (dollars in millions)
		House with slab-on-grade foundation (years)	House with an elevated foundation (years)	
IRC 2006	\$618	3.7	2.7	\$76
Energy Star	\$2,198	7.1	6.0	\$269
Tax Credit	\$1,354	3.6	3.0	\$166

Source: GAO analysis of Pacific Northwest National Laboratory data.

Note: For this analysis, we analyzed the energy efficiency requirements of the IECC 2006, which is similar in stringency to the energy provisions of the IRC 2006.

Table 3: Annual Energy Cost Savings for Selected Home Energy Efficiency Improvements

From: estimated existing home energy features (prehurricane)	To: more energy efficient home features	Incremental cost (per house)	Annual per house energy cost savings	Cost recovery period (years)	Aggregate energy cost savings for 143,862 homes (dollars in millions)
SEER-10 Cooling equipment	SEER-13 cooling equipment	\$335	\$127	2.6	\$18
Manual thermostat	Programmable thermostat	\$65	Unknown	Unknown	Unknown
Standard duct sealing	Improved duct sealing	\$235	\$63	3.7	\$9
Single pane, aluminum window	Double pane vinyl low-E window	\$3,506.00 (\$10.56 sq. ft.)	\$202	17.4	\$29

Source: GAO analysis of Pacific Northwest National Laboratory data.

Note: Studies have been unable to verify any energy savings from programmable thermostats. In addition, EPA recently decided to cease crediting any thermostats as Energy Star. Inherently, these thermostats save no energy but allow the consumers to set a temperature schedule that could reduce energy.

**Appendix II: Energy Cost Savings Estimates
for Residential Buildings**

Table 4: Annual Energy Cost Savings for Home Lighting and Appliance Upgrades

From: standard lighting and appliances	To: more energy efficient lighting and appliances	Incremental cost (per house)	Annual per house energy cost savings	Cost recovery period (years)	Aggregate energy cost savings for 143,862 homes (dollars in millions)
Incandescent lighting	Compact fluorescent lighting	\$99	\$48	2	\$7
New conventional refrigerator	Energy Star labeled	\$65	\$9	7	\$1
New conventional clothes washer	Energy Star labeled	\$440	\$59	7.5	\$8
New conventional dish washer	Energy Star labeled	\$45	\$13	3.5	\$2

Source: GAO analysis of Pacific Northwest National Laboratory data.

Appendix III: Energy Cost Savings Estimates for Commercial Buildings

Tables 5 through 7 contain energy cost savings estimates for commercial buildings— office, school, hospital, and retail buildings—constructed in accordance with various commercial building energy standards, to “above code” levels, and with more efficient lighting requirements.

Table 5: Annual Incremental Energy Cost Savings per Building for Various Commercial Buildings Constructed in Accordance with a Newer ASHRAE Standard

Incremental savings from moving to a newer ASHRAE standard	Office	School	Hospital	Retail
1975 standard (Mississippi’s current standard) to 2001 standard	\$13,311 (\$0.18 sq. ft.) (12%)	\$28,060 (\$0.23 sq. ft.) (18%)	\$37,822 (\$0.16 sq. ft.) (7%)	\$145,404 (\$0.61 sq. ft.) (34%)
2001 standard (Louisiana’s current standard) to 2004 standard	\$7,608 (\$0.10 sq. ft.) (8%)	\$10,524 (\$0.09 sq. ft.) (8%)	\$32,567 (\$0.14 sq. ft.) (7%)	\$37,649 (\$0.16 sq. ft.) (13%)

Source: GAO analysis of Pacific Northwest National Laboratory data.

On a per building basis, we estimated the energy cost savings that could be achieved in Mississippi and Louisiana by moving from their current energy standards to the LEED 1- point and 10-point levels as well as the federal tax credit level, as shown in tables 6 and 7.¹

¹We did not evaluate the total cost-effectiveness of these options because the methods that designers might use to achieve these savings are highly variable.

Table 6: Estimated Energy Cost Savings from Commercial Buildings in Accordance with Selected “Above Code” Levels

Location	Estimated annual energy cost savings, per building type, by amount total and square feet			
	Office	School	Hospital	Retail
Louisiana - Current standard (ASHRAE 2001 standard)				
LEED 1-point level	\$17,263 (\$0.23)	\$22,093 (\$0.18)	\$77,259 (\$0.32)	\$62,028 (\$0.26)
LEED 10-point level	\$45,785 (\$0.61)	\$60,139 (\$0.49)	\$219,706 (\$0.91)	\$140,757 (\$0.59)
Tax credit level	\$49,538 (\$0.66)	\$63,821 (\$0.52)	\$239,021 (\$0.99)	\$140,757 (\$0.59)
Mississippi – Current standard (ASHRAE 1975 standard)				
LEED 1-point level	\$30,773 (\$0.41)	\$50,320 (\$0.41)	\$115,889 (\$0.48)	\$207,557 (\$0.87)
LEED 10-point level	\$59,295 (\$0.79)	\$88,367 (\$0.72)	\$258,335 (\$1.07)	\$286,285 (\$1.20)
Tax credit level	\$63,048 (\$0.84)	\$92,049 (\$0.75)	\$277,650 (\$1.15)	\$286,285 (\$1.20)

Source: GAO analysis of Pacific Northwest National Laboratory data.

Table 7: Annual Lighting Cost Savings for Commercial Buildings in Louisiana and Mississippi

Location/Building type	ASHRAE standard		Cumulative savings (1975 standard to 2004 standard)
	1975 standard to 2001 standard	2001 standard to 2004 standard	
Louisiana			
Office	\$11,334 (\$0.15 sq. ft.)	\$5,704 (\$0.08 sq. ft.)	\$17,038 (\$0.23 sq. ft.)
School	\$13,746 (\$0.11 sq. ft.)	\$8,223 (\$0.07 sq. ft.)	\$21,969 (\$0.18 sq. ft.)
Hospital	\$26,075 (\$0.11 sq. ft.)	\$26,075 (\$0.11 sq. ft.)	\$52,150 (\$0.22 sq. ft.)
Retail	\$107,118 (\$0.45 sq. ft.)	\$30,537 (\$0.13 sq. ft.)	\$137,655 (\$0.58 sq. ft.)
Mississippi			
Office	\$12,459 (\$0.17 sq. ft.)	\$6,230 (\$0.08 sq. ft.)	\$18,689 (\$0.25 sq. ft.)
School	\$14,973 (\$0.12 sq. ft.)	\$8,959 (\$0.07 sq. ft.)	\$23,932 (\$0.19 sq. ft.)
Hospital	\$28,489 (\$0.12 sq. ft.)	\$28,489 (\$0.12 sq. ft.)	\$56,978 (\$0.24 sq. ft.)
Retail	\$117,138 (\$0.49 sq. ft.)	\$33,400 (\$0.14 sq. ft.)	\$150,538 (\$0.63 sq. ft.)

Source: GAO analysis of Pacific Northwest National Laboratory data.

Note: The lighting cost saving reflect the typical building sizes used in our analysis, as well as the electricity prices used for Louisiana and Mississippi, which were 8.81 cents per kilowatt hour (kWh) and 9.64 cents per kWh respectively.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

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