Rebuilding After the Gulf Coast Hurricanes: Energy Efficiency Opportunities and Challenges

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ABSTRACT

On August 29, 2005, a Category 4 hurricane made landfall near Buras, Louisiana, bringing 145 mph winds, inundating New Orleans and creating a path of destruction the size of the United Kingdom. In four short hours, a city fondly dubbed "the Big Easy" became a site of vast difficulty as the tragedy compounded. An estimated 310,353 new single-family homes will need to be built in Louisiana, Mississippi, and Alabama during coming months. Six of those homes are being piloted in Pass Christian, Mississippi.

This paper proposes energy efficiency as the minimum requirement for all new residential housing in the Gulf Coast region, makes the financial case for doing so, and presents a snapshot of reconstruction using "smart energy choices" in one current pilot program.

Recent changes in building policies (2005 Energy Policy Act, upgraded IECC 2006 codes, and 2006 Energy Star® for New Homes Guidelines) were modeled for funding leverage and potential for residential energy efficiency mass deployment. Supported by DOE-2 modeling analyses, this research compares the consequences of rebuilding baseline (inefficient) homes to other energy-efficient scenarios in both "theoretical" and "real world" situations.

The paper concludes with recommendations for energy efficient rebuilding in the Gulf Coast region.

The Hurricane Hits

On August 29, 2005, at 6:10 a.m., a Category 4 hurricane made landfall near Buras, Louisiana, with 145 mph winds. By 9:00 a.m., New Orleans' Lower Ninth District was under 8 feet of water and a path of destruction the size of the United Kingdom had been created, leaving 1.5 million people without power. Thirty-one parishes in Louisiana were affected, 47 counties in Mississippi were affected, and 8 counties in Alabama saw damage to their single-family housing units of 2.1 million. Of the total population of 6 million people in the affected areas, an estimated 1.5 million were evacuated from Louisiana alone and hundreds of thousands had set out on the largest transmigration across America since the Dust Bowl of the 1930s. By October 2005, an estimated 2.2 million people had registered for aid from the Federal Energy Management Agency (FEMA) and 416,852 people were still without power in Texas and Louisiana. In four short hours, a city fondly called "the Big Easy" by Americans became a site of vast difficulty as events compounded the tragedy. In weeks, the consequences of Katrina created a death toll of nearly 1,281.

Many who perished were among America's most economically-challenged (the average per capita income of those affected by the hurricane was around $17,000). The scope and scale of the healing process and the rebuild is monumental. An estimated 160,000 new single-family homes will need to be built in the coming months in New Orleans alone, with a grand total of 310,353 single-family homes needing to be built in the three states.

In Pass Christian, Mississippi, the storm surge was prevented from returning to the sea by a barrier island that held the flood waters longer than other coastal regions experienced. This storm surge and subsequent high water destroyed 138 of the 150 pre-Civil War mansions that graced this coastal town and which had historically brought tourism dollars to this seaside village. Of the 3,000 single-family homes in Pass Christian, none remained habitable after the storm subsided.

Gulf Coast Single-Family Housing Rebuilding

In the 140 years since the Civil War, an estimated 2 million single-family homes had been built in the Gulf Coast region affected by Hurricane Katrina. By 2000, the average cost of those homes was $71,685, nearly $48,000 less than the average single-family home in America.

Like those along the Gulf Coast areas affected by Hurricane Katrina, the populace of Pass Christian was more vulnerable than average Americans. The percent of the population living on incomes at or below the poverty line in the parishes and counties affected by the hurricane was 19% of the population—in Pass Christian, that percentage was much higher. The average age of the total 310,353 homes along the Gulf Coast destroyed was three decades and the relative energy efficiency (as compared the national average) was lower than the norm. In Pass Christian, the average home age was 80 years, with an efficiency that was lower than the norm. The Gulf Coast region hit by Hurricane Katrina had a history of lagging behind the rest of the country in terms of infrastructure, housing quality, and economic robustness. In short, the region was ripe for the kind of disaster the hurricane wrought.

Since the hurricane, some entities have stepped forward to take an active stewardship role in the reconstruction of the Gulf Coast region. For example, The Home Depot and its suppliers have partnered to donate nearly $1.2 million of products to those areas in need, along with $4 million in donations from the Home Depot Foundation. Meanwhile, Congress is seeking to pass bills to shield contractors from litigation that might result from workers in this polluted, dangerous area that is today's Gulf Coast.

In January 2006, the Bring New Orleans Back Commission proposed greater flood protection, storm water protection, increased use of canals, introduction of a light rail system, improved neighborhood infrastructure, schools, and health facilities. Hospitals along the Gulf Coast, like MD Anderson Cancer Hospital in Houston, Texas, have begun relocating their mechanical rooms to higher floors and installing flood gates that automatically drop into place should a flooding event occur. By February, the Bush Administration had released a review of the Federal response to Katrina, citing 17 "lessons learned," 125 "special recommendations to the President," and 11 "critical actions" to be taken before June 1, 2006 (when the hurricane season begins anew). It is clear that greater leadership and harmonization of programs and projects is needed.

ICF International modeled rebuilding those 310,353 single-family homes along the Gulf Coast region as a way to establish a minimum threshold for any potential rebuilding and inform policymakers. That initial modeling is characterized as the "theoretical" rebuilding scenarios proposed herein. Subsequent to this initial modeling, a "real world" pilot program is being undertaken in Pass Christian, Mississippi—one of the hardest-hit areas—under project "Home Again." Those "real world" rebuilding scenarios are also shown herein. In the Pass Christian pilot, a community housing development organization has selected six home sites for which to provide modern housing at a reasonable cost to serve these "low" and "very low" income clients of this devastated community.

The "Home Again" pilot project in Pass Christian is sponsored by the Enterprise Foundation, The Home Depot Foundation, Oak Hill Fund, John and Renee Grishom Foundation, with a team that includes Southface (Atlanta), Hope Credit Union, and local architects. In Pass Christian, the Mercy Housing Human Development, Inc. is leading this effort to rebuild using modular homes on six home-sites (that previously had a housing type known as "shotgun" style). ICF International modeled various scenarios using data from a major manufacturer of energy efficient modular homes to illustrate the modular type of housing possible for use in the Pass Christian rebuild and quantify its financial benefits.

It bears noting that along the entire Gulf Coast rebuilding efforts are often confounded by a situation common in Pass Christian—that is, lack of "clear title" to the land. In Pass Christian, of the 150 family home sites proposed for the pilot, only six could prove clear title and actual survey of their land. The reasons for this are myriad, however, in the case of Pass Christian, many families were tenanted on land passed through many generations, sometimes over 200 years. Some had been gifted the land, others had not paid property taxes (since the homes were long ago paid for) and had actually "lost" the land rights but had never been told they were tenants on someone else's land. Still others had lost access to their land titles in a fire that occurred at the Court House in the 1920s. But virtually all citizens of this small town had "agreed" to land demarcations (such as fences and trees) which were swept away by the storm surge.

Modeling Datasets and Housing Types

For the "theoretical" modeling, the housing characteristics, including construction type, architectural characteristics, and quantity of construction from the 86 counties and parishes in the three hardest-hit states (Louisiana, Mississippi, and Alabama) were gleaned from 2000 U.S. Census Bureau data. Modelers established a baseline of what existed pre-Katrina using DOE-2 modeling software to compare the economic and environmental benefits of rebuilding in an energy efficient manner. For the ease of modeling a representative sample, only single-family homes units were considered since 67% of the homes destroyed were this housing type. Means Cost Data aided in modeling the "per unit cost to rebuild" each home for each scenario. National Association of Home Builders (NAHB) data described the housing starts projections for 2005-2010 while additional economic characteristics for the region were gathered from the 2000 U.S. Census.

Prior to modeling the "real world" pilot project in Pass Christian, a design symposium was held in which citizens of Pass Christian and representatives of the pilot program were asked their preferences for the style, character, and function of the houses to be built in Pass Christian. Since the original homes were "single shotgun" and "double shotgun" style homes, these were the stated preference by the community for the rebuild. (Shotgun style homes were developed after the Civil War in many southern states due to the long, narrow plots of land given to new land-owners after the war. Typically, these plots were 35' wide and very long. Thus, the shotgun style developed to accommodate these unusual sites). For the ease of modeling a representative sample, only single and double shotgun style homes units were modeled since that was the predominant style of home in Pass Christian prior to the hurricane.

Figures 1 and 2 illustrate the plans of single and double shotgun style homes. As Figure 1 shows, the double shotgun style home has rooms without a central corridor, but in which all rooms have three doors, 12’-0” ceilings, tall windows with transoms above all internal doors, and the ability to have natural ventilation—which occupants expressed a desire to have six months of each year. Single shotgun style homes were similar, but had only two doors per room, and did not have a double bank of rooms. This particular style can be found along the Gulf Coast region, but was the hallmark of Pass Christian. Photos A and B illustrate the charm of these homes with their “gingerbread” styling.

Figure 1. Double Shotgun House

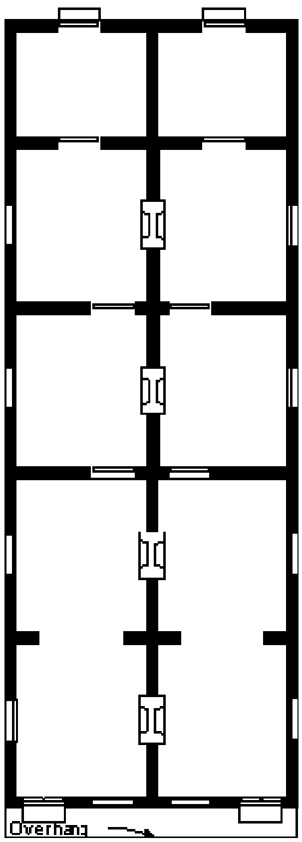

Figure 2. Single Shotgun House

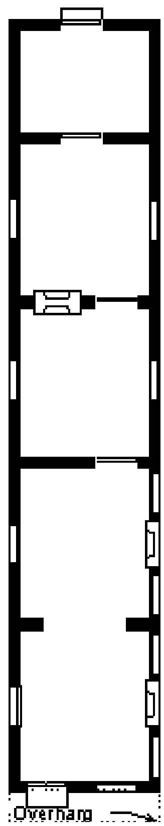

Photo A. Single Shotgun House

Source: Bywater Neighborhood Association

Photo B. Double Shotgun House

Source: Bywater Neighborhood Association

For the "real world" pilot project modeling, the housing characteristics of Pass Christian, including construction type, architectural characteristics, and quantity of construction from this town in Mississippi was used. Using 2000 Census Bureau data along with actual accounts from residents, ICF International's modelers established a baseline of what existed pre-Katrina using DOE-2 modeling software to compare the economic and environmental benefits of rebuilding Pass Christian in an energy efficient manner—but with the additional recommendations to formulate a housing style using modular construction but with the size and footprint of shotgun style homes.

The codes climate in the Gulf Coast states gave a snapshot of what would be practical to expect during the "theoretical" rebuild. As of August 29, 2005, the local codes for energy efficiency in the three states were based on standards as recent as the year 2000 and as old as 1975. However, recent code revisions have made an energy efficient rebuild possible. For example, the newly-revised IECC 2006 of the International Codes Council was considered in one scenario for the theoretical rebuild. And since the government-sponsored Energy Star® program of the EPA amended its New Homes Guidelines in October 2005, and those guidelines are effective beginning January 1, 2006, those guidelines were considered as another scenario in both the "theoretical" and "real world" rebuilding scenarios.

Scenarios for the Theoretical and Real World Gulf Coast Rebuild

Four scenarios were selected for the "theoretical" modeling, against a baseline set at the Model Energy Code 1993 (MEC 93). MEC 93 was used as the baseline because upon review of the actual build-dates of the 310,383 homes destroyed it was found that most had not been built to any code. MEC 93 assumes that all houses destroyed had indeed been constructed to a code standard that was only a decade old. The baseline was established as if the home had a window solar heat gain coefficient (SHGC) of 0.58, a wall R-value of 13, an attic R-value of 23, an air conditioner Seasonal Energy Efficiency Rating (SEER) of 10, and an estimated size of 2,000 s.f. The four "theoretical" scenarios are shown in Table 1.

Table 1. Comparison of the Baseline and Four Theoretical Scenarios

	Baseline MEC 93	**Scenario 1 Quick Payback**	**Scenario 2 IECC 2006**	**Scenario 3 Energy Star® 2006**	**Scenario 4 Best Practices**
Window SHGC	0.58	0.58	0.40	0.40	0.30
Appliances and Lighting	Standard	Energy Star® Labeled	Standard	Energy Star® Labeled	Energy Star® Labeled
Duct Leakage	~13%	~6%	~13%	~6%	~6%
Wall R-Value	13	13	13	13	19+
Attic R-Value	23	~23	30	30	44
AC SEER	10	Upgrade from 13 to 14	13	14	17
Square Footage	2,000 s.f.	2,000 s.f.	2,000 s.f.	2,000 s.f.	2,000 s.f.

Using datasets of several thousand factors and applying those factors to the four basic upgrades in energy efficiency as seen in Table 1, researchers modeled 72,000 DOE-2 runs to characterize the impacts in two climate zones, and eight cities in the Gulf Coast region affected.

This modeling provided the baseline for a "plain vanilla" single-family housing unit in the three states on August 29, 2005, for comparison with four scenarios.

For the "real world" example in Pass Christian, four scenarios were selected for modeling, against a baseline set at the Model Energy Code 1993 (MEC 93). As in the theoretical modeling, it was assumed that all six houses destroyed had indeed been constructed to a code standard that was approximately a decade old. In Pass Christian, these homes were not built to any code. Nonetheless, the baseline was established as if the home had a window solar heat gain coefficient (SHGC) of 0.58, a wall R-value of 13, an attic R-value of 23, an air conditioner Seasonal Energy Efficiency Rating (SEER) of 10, and an estimated size of 980 s.f. for the single shotgun style, and 1,960 s.f. for the double shotgun style home. The six scenarios are shown in Table 2.

Table 2. Comparison of the Six Scenarios for Pass Christian

	Scenario A Single Shotgun MEC 93	**Scenario B** Double Shotgun MEC 93	**Scenario C** Modular Medium Size Energy Star®	**Scenario D** Modular Large Size Energy Star®	**Scenario E** Single Shotgun Energy Star®	**Scenario F** Double Shotgun Energy Star®
Window SHGC	0.58	0.58	0.40	0.40	0.30	0.30
Appliances and Lighting	Standard	Standard	Energy Star® Labeled	Energy Star® Labeled	Energy Star® Labeled	Energy Star® Labeled
Duct Leakage	~13%	~13%	~3%	~3%	~6%	~6%
Wall R-Value	13	13	18	18	13	13
Attic R-Value	23	23	33	33	30	30
AC SEER	10	10	13	13	14	14
Size and Ceiling Ht.	980 s.f. 12'-0" (clg.)	1,960 s.f. 12'-0" (clg.)	1,291 s.f. 9'-0" (clg.)	1,916 s.f. 9'-0" (clg.)	980 s.f. 12'-0" (clg.)	1,960 s.f. 12'-0" (clg.)

Using datasets of several thousand factors and applying those factors to the four basic upgrades in energy efficiency as seen in Table 2, researchers performed 192 DOE-2 runs to characterize the impacts in this climate zone in the town of Pass Christian, Mississippi. This modeling provided interesting results on the potential for making "smart energy choices" particularly, in economically-challenged communities like Pass Christian.

Results of the Modeling

The estimated number of homes requiring demolition and rebuild has been estimated to be as many as 2.1 million single-family homes. As mentioned, the theoretical modeling studied only those homes utterly obliterated. It bears mentioning that the cost estimates for constructing new homes with these upgrades must be considered estimates only. The cost of materials, regional labor cost differences, the value of money, the cost of electricity or gas, and many other factors might affect these building costs and therefore, the simple payback period estimates. Given that disclaimer, in terms of the "cost to upgrade," Scenario 4 proved to be the most expensive initial investment at $6,003 per home, with a simple payback period of 12.5 years. Yet when this payback period is considered within the context of a 30-year mortgage, that return-on-investment appears more favorable. The next most costly upgrade was Scenario 3 (Energy Star®)

at $2,754 per home. Yet the Energy Star® scenario had a much quicker payback than Scenario 4 (Best Practices) or the less expensive option, Scenario 2 (IECC 2006). The simple payback period for Scenario 3 (Energy Star®) was just 7.5 years. The initial investment per home may be seen in Table 3 while the annual utility bills savings per home are seen in Table 4.

Table 3. Incremental Cost to Upgrade (Per Home)

		Per Unit ($)			
Total Units		Scenario			
		1	2	3	4
	Yr	Quick Payback	2006 IECC	2006 Energy Star®	"Best" Practices
Incremental Upgrade Cost *	-	$527	$1,511	$2,754	$6,003

*Upgrade costs consider cost of materials and labor at present day prices for purposes of establishing simple payback

Table 4. Incremental Annual Utility Bill Savings (Per Home)

		Per Unit ($)			
Total Units		Scenario			
		1	2	3	4
	Yr	Quick Payback	2006 IECC	2006 Energy Star®	"Best" Practices
Incremental Annual Utility Bill Savings*	1	$254	$179	$365	$485
	5	$1,268	$894	$1,777	$2,427
	10	$2,536	$1,788	$3,555	$4,853
	15	$3,804	$2,683	$5,332	$7,280
	20	$5,072	$3,577	$7,110	$9,706
	25	$6,340	$4,471	$8,887	$12,133
	30	$7,609	$5,365	$10,665	$14,559

*Utility costs at present day prices without adding cost increases that may occur

"We want to avoid having folks drive down the road ten years from now and be able to point and say, 'That's a Katrina-house' and 'There's another Katrina-house.' Instead, we want people to have nice-looking homes, in the style they had before the storm, so the character of Pass Christian remains constant even if everything else has changed."

- Mercy Housing Human Development, Inc.

In Pass Christian, approximately 3,000 homes will need to be rebuilt. As in the theoretical modeling, the cost estimates for constructing these new homes must be considered estimates only. The cost of modular homes complete, labor cost differences, the value of money, changes in the cost of electricity or gas, and other factors might affect these building costs and therefore, the simple payback period estimates. (In discussions with a major manufacturer of modular homes, they said they typically train local foundation crews, absorbing that training cost with only one unacceptable foundation in 3 years). Since the modular home size that most closely fit the shotgun styling was the larger modular unit, only three scenarios may be closely compared: Scenario A (Double Shotgun MEC 93), Scenario D (Modular Large Energy Star®), and Scenario F (Double Shotgun Energy Star®). In terms of the "cost to upgrade", Scenario B (Double Shotgun at 1,960 s.f.) was the baseline. Scenario D proved more costly to build than the baseline by $1.75 per square foot, while Scenario F cost $0.81 per s.f. more.

Table 5. Incremental Cost to Upgrade (Per Home)

			Per Square Foot	
			($)	
Scenario			**Scenario**	
		A	**D**	**F**
	Yr	**Double Shotgun Style MEC 93** 12'-0" (clg. ht)	**Modular Home Large Size Energy Star®** 9'-0" (clg. ht)	**Double Shotgun Site-Built Energy Star®** 12'-0" (clg. ht)
Incremental Upgrade Cost*	-	----	**$1.75 s.f.**	**$0.81 s.f.**

*Upgrade costs consider cost of materials, labor, and foundations at present day prices to establish simple payback

Table 6. Annual Utility Bill Savings (Per Home)

		Per Unit		
		($)		
Scenario		**Scenario**		
		A	**D**	**F**
	Yr	**Double Shotgun Style MEC 93** 12'-0" (clg. ht)	**Modular Home Large Size Energy Star®** 9'-0" (clg. ht)	**Double Shotgun Site-Built Energy Star®** 12'-0" (clg. ht)
Annual Utility Bills*	**1**	$710	$591	$552
	5	$2,840	$2,364	$2,208
	10	$3,550	$2,955	$2,760
	15	$7,100	$5,910	$5,520
	20	$10,650	$8,865	$8,280
	25	$14,200	$11,820	$11,040
	30	$17,750	$14,775	$13,800

*Utility costs at present day prices without adding cost increases that may occur

"The typical Mississippi family spends $1,300 annually on their homes' utility bills. Home energy costs are often the second-highest expense, after the mortgage payment."

- Mississippi Development Authority

Other Benefits of Smart Energy Choices

The simple payback period for both the theoretical and the real world rebuild scenarios was calculated without considering rising costs of electricity (which increased 3.3% in this region in the past year) or rises in crude oil prices (which rose 64% in the past year). In the recommended scenario (Energy Star®), an estimated 713 MW annually would be avoided, roughly equal to one nuclear power plant. The increased benefits in savings for local power plants, and environmental benefits (in an already-challenged region) would be reduced greenhouse gas (CO_2) equivalent to removing 51,221 cars from the roads. For every 1 MW avoided, an estimated $1 million is saved, and similar savings are achievable in reduced distribution costs. In Pass Christian, the numbers are much smaller, but still impressive. The larger modular homes appear to more expensive to build at the outset but would return $119 to each homeowner every year. (Yet site-built homes with non-standard 12'-0" ceilings as modeled may prove more costly than the modular.) In 30 years, modular homes energy savings would amount to $21,420 (potentially more if natural ventilation was used an additional two months annually). The Pass Christian savings would amount to 234 kW in 30 years, and reduce CO_2 equal to removing 30 cars from the road.

As the rebuilding of the Gulf Coast continues, building energy efficient homes through the 2006 Energy Star® for New Homes Guidelines (along with the Indoor Air Quality guidelines being piloted) ensure that occupants of these new homes will spend less on medical-related problems and mold-remediation costs long associated with poor construction techniques in hot, humid climates. When considering that indoor air pollution is responsible for one death every 20 seconds, and that the economic impacts of indoor pollution have been estimated at billions of dollars a year, spending a little more on each home to avoid these costs is money well-spent. (It bears noting that the modular homes being produced for Pass Christian are Energy Star® qualified, and that similar savings may not be achievable in less efficient modular homes.)

For the citizens of Pass Christian, the first criterion was to recapture a sense of belonging to a community. That is why the rebuilding for Pass Christian ought to facilitate community interaction that operates the way the town historically has operated—that is, according to "front porch" communication that the shotgun style homes allowed. Citizens also cited walk-ability, the need for human-scale elements, and replacement of all the lost trees as other features deemed critical. They also proposed using the dry bayous that criss-cross the town as bike and walking paths to promote greater passage as the rebuilding continues. Since the townspeople made use of natural ventilation half the year, owing in part to the prevalence of mature shade trees, they also requested transplantation to continue using energy efficient micro-climates around each home.

Recommendations

For the Gulf Coast rebuild, the opportunity to build energy efficient single-family homes is clear: a **"right rebuild"** will have long-term benefits to the homeowners, the local utilities, the region, and the nation. For homeowners, building homes that have tight envelopes, good insulation, proper windows, and energy efficient equipment will reduce their monthly energy bills and increase the comfort and health of the occupants. The benefit of reduced energy bills cannot be understated. In present-day Mississippi, 34% of the household income pays the mortgage. The second-highest cost is energy bills. As consumer energy bills rise, some regions are more challenged than others. For example, a study in North Carolina found that of every 100 trailers sold, 20 were repossessed. The problem was not mortgage costs that were too high; rather, the problem was that the monthly energy costs were more than the mortgage. With utility bills as high as $230 a month, the 30-year mortgage on a $25,000 mobile home was minor in comparison. The fragility of the household incomes in the Gulf Coast region certainly plays a part in determining what ***ought to*** be re-built there. The average annual energy bills for the region were around $1,200. Scenario 3 (Energy Star®) returns a higher amount than the "Quick Payback" scenario, for example. **For that, and other reasons, Energy Star® 2006 is the recommended threshold for the theoretical rebuild along the Gulf Coast states of Mississippi, Louisiana, and Alabama.**

For the population of Pass Christian, the pilot program using modular homes has a multitude of benefits. The ability of the manufacturers to control the quality of the homes and test those homes for air tightness and insulation levels at the factory cannot be understated. The same care and quality is unlikely to be taken at site-built homes in this region (unless they are Energy Star®) given the rapid turnover of crews, speed of construction, and the unusually high competition for skilled labor along the Gulf Coast. Additionally, the cost of materials has skyrocketed. The opportunity for a large modular homes manufacturer to create "style differentiators" for communities like Pass Christian will make each modular home distinctive—as residents greatly desire. Presently, this manufacturer has agreed to incorporate stylistic options for the Pass Christian rebuild. Similarly, the ***consumer pull*** to have the ability to use natural ventilation two more months of the year has already engendered the re-tooling needed to create higher ceilings and taller windows that must accompany this consumer stipulation. At least one major manufacturer of modular homes has raised their standard ceiling height from 8'-0" to 9'-0" and discussions are underway to increase that to 10'-0". As to window re-design, this manufacturer has also agreed to use 72" tall windows for the Pass Christian pilot, an increase of 14" from their previous standard. While the modular homes modeling in Table 6 reflects natural ventilation four months of the year, were the larger modular homes to have taller than standard windows and ceiling heights of 10'-0" along with long open spaces in the homes, these homes might be expected to realize additional energy savings due to natural ventilation two more months. **For that, and other reasons, Energy Star® 2006 modular homes are the recommended threshold for the real world rebuilding of Pass Christian (and similar areas with special needs in Mississippi, Louisiana, and Alabama).**

- The 2006 Energy Star® for New Homes Guidelines are the recommended threshold for all new single-family site-built homes construction undertaken during the rebuilding of Mississippi, Alabama, and Louisiana.
- Energy efficient Energy Star® qualified modular homes with the design characteristics and training of local builders are the recommended solution for communities like Pass Christian.
- State and local incentives should be leveraged for all new homes construction during the rebuild; and federal tax credits and federal funding should be leveraged for all new homes construction during the rebuild to multiply the impacts.
- Energy Efficient Mortgage programs (and other similar initiatives) should be extended to include new homes construction needed for the rebuild and should be available for purchasing energy efficient modular homes.

- The financial benefits that accrue due to "smart energy choices" taken during the rebuild should be tracked to build a larger case for energy efficient development and subsequent mass deployment of energy efficient practices.
- For Pass Christian and similar communities, "smart energy choices" must include consideration of the human aspects homeowners demand; and manufacturers of modular homes should be included in the design process so they can revise their standards to suit.
- The difficulties of working in a storm-ravaged area must be considered in terms of scarcity of skilled labor to provide for site-built homes, the enormous demand for supplies such as roofing materials and drywall, as well as the sheer quantity of debris to be taken away before rebuilding can progress.
- Manufacturers who undertake training of local crews and re-tooling to accommodate special design needs should be allowed to access state or federal funding to make modular homes more cost-competitive with site-built.
- In Pass Christian and other communities similarly disadvantaged, care must be taken to provide new homes that can be operated as frugally as occupants choose as well as keep future energy costs to a minimum.
- Unforeseen barriers, such as the lack of clear title to land and all demarcations of boundaries, must be assumed when planning rebuilding timelines.
- Greater linkage between programs and projects must be undertaken; and all rebuilding efforts ought to be harmonized under a comprehensive rebuilding program.

Conclusion

This research demonstrates that the decisions made in the coming months will impact the economics and resources of households, utilities, the region, and the nation for several decades to come. As power suppliers struggle to rebuild damaged infrastructure like power distribution systems and every local provider of materials and manpower is stretched to its limits, there is no better time to reduce the eventual load on manpower and infrastructure than now. Homeowners will benefit from reduced energy bills while area builders will find a whole new business model in setting themselves apart from "plain vanilla" builders as they position themselves as Energy Star® builders. Manufacturers of energy efficient modular homes can find new market niches providing truly customized homes at reasonable costs.

Yet rebuilding an area this large will not be easy. But as these studies prove, rebuilding single-family housing to an energy efficiency standard that is higher than what it was makes sound economic sense and forms the most coherent strategy for creating a sustainable re-construction. The incentives under the new tax credits bill, energy efficient mortgages, and state-centered incentives and financing--when supplemented with federal funds for the rebuild—only add to the financial benefits of making smart energy choices in the Gulf Coast rebuild. Even without these benefits, rebuilding the 310,353 homes to Energy Star® standards would be an investment that pays for itself quickly, and returns another $3.2 billion dollars into the local economy in just 30 years.

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