Disaster!

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Reduce the Risk of Insurance Loss with Renewable Energy Technologies

The U.S. insurance and financial communities are becoming increasingly attentive to mounting property loss claims resulting from floods, hurricanes, tornadoes, and other events resulting from extremes in weather conditions. Property loss claims in the United States from windstorms alone have grown from half a billion dollars in the 1960s to more than $14 billion in just the first half of the 1990s. Many U.S. climatologists and others believe the recent increase in wide-ranging weather-induced events such as Hurricanes Andrew and Opal are directly related to global climate change[1]. One solution to alleviate the immediate and long-term impact of disasters and huge property loss claims may be found in renewable energy and energy-efficient products and designs. These technologies not only reduce the CO_2, NO_X, and other emissions believed to accelerate climate change, but they also mitigate losses generated by harsh weather.

For many years, the U.S. Department of Energy (DOE) and its National Renewable Energy Laboratory (NREL) have supported and conducted research in renewable energy and energy-efficiency technologies. These technologies have a demonstrated capacity to serve an important role in speeding recovery time and limiting the consequences of the initial impact of climatic disasters. Two excellent examples of the potential of such applications can be shown with passive solar building designs and photovoltaic power systems.

[1]*Climate Change and the Financial Sector—the emerging threat—the solar solution*, J. Leggett, ed., Munich: Gerling Akadamie Verlag, 1966.

Disaster-Resistant Passive Solar Buildings

In the most narrow sense, a passive system is defined as one that can provide heating, cooling, or lighting with minimal need for mechanical devices or purchased energy. In a more practical sense, passive solar buildings are designed to be well adapted to the climates in which they are constructed. In cold climates, the emphasis is on insulation and on keeping heat and light inside the building by collecting and storing solar energy. In hot climates, the emphasis is on keeping the interior cool by avoiding solar load and using non-mechanical methods of heat dissipation. Moderate or mixed climates require systems engineered to admit solar energy during the cold season and reject solar heat gain during the summer.

Tierra Concrete Homes-NREL / PIX 04464

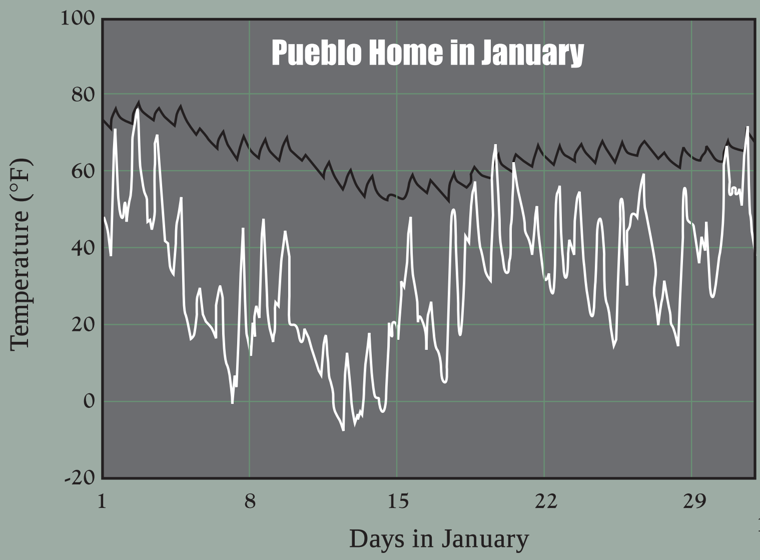
Passive solar buildings are inherently disaster resistant because, in the event of a power failure, they will neither freeze nor become seriously overheated. During periods of extreme heat or cold, temperatures in a well-designed passive solar building will remain well within the limits for comfortable habitation. An example of such a home is shown here. NREL researchers have teamed with Tierra Concrete Homes of Pueblo, Colorado, to engineer and construct a home incorporating the optimum in passive solar building technology. With all house systems off during seasonal temperature extremes from -10°F to 100°F, the indoor temperature avoids dropping below 55°F in the winter, nor does it exceed 80°F in the summer.

Using the same computer software developed by NREL to design the Pueblo house, similar simulations were performed for the more extreme climates of Minneapolis, Minnesota, and Las Vegas, Nevada. With all systems off in January, the Minneapolis house took almost two weeks to drop to 40°F, while outside temperatures dropped to -25°F and averaged around 0°F. The house temperature then leveled off, hovering around 40°F for the remainder of the month. The house in Las Vegas, with the air conditioning off, was tested for the month of August when outdoor temperatures exceeded 100°F for 19 days and 105°F for 10 days. Indoor temperatures leveled off in the mid to high eighties. This performance cannot be achieved with nominal energy conservation and efficiency measures alone. A house with very high insulation levels will freeze during a protract-

Tierra Concrete Homes-NREL / PIX 04465

Exterior and interior of an attractive and comfortable Tierra Concrete home in Pueblo, Colorado.

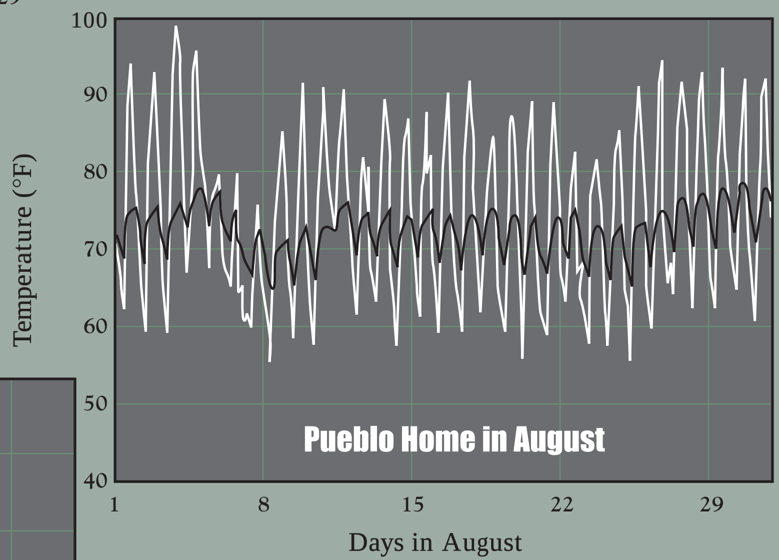
Cover Photo: Bob Parsons

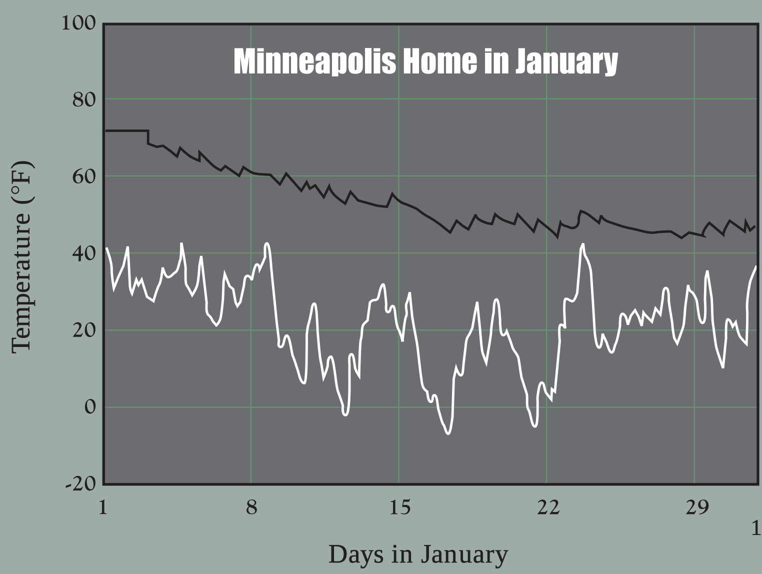


Temperature Outside
Temperature Inside

Time/temperature performance of the Pueblo home with the heating system turned off during January.

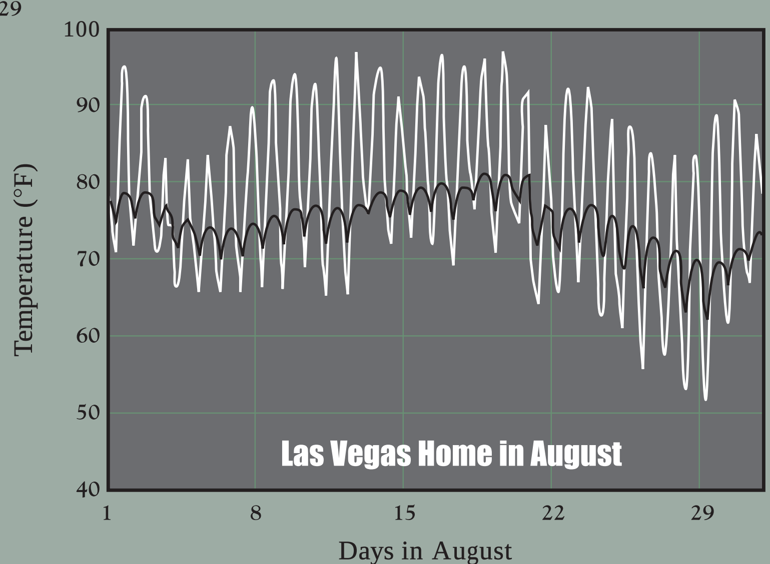
Time/temperature performance of the Pueblo home with the cooling system turned off during August.





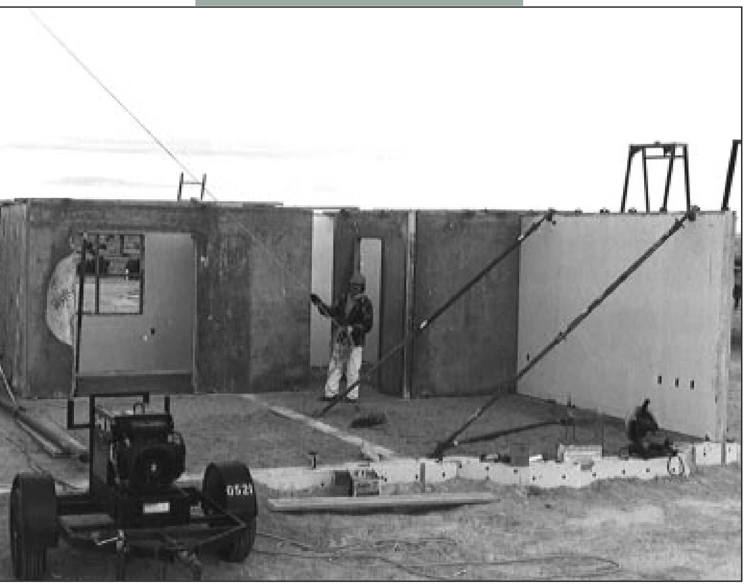
Estimated performance of the simulated house during January in Minneapolis.

Estimated performance of the simulated house during August in Las Vegas.



Because all exterior and interior walls are concrete, flooding will only damage contents, not the structure itself.

ed winter power outage if it lacks properly designed solar collection and storage elements.



Tierra Concrete Homes-NREL / PIX 04463

In addition to their passive solar design qualities, the Tierra homes are also flood resistant because of their concrete exterior and interior walls. They are also extremely resistant to high winds and fire, and have an earthquake seismic Zone-4 rating. All of these advantages are inherent and at a cost comparable to conventional homes, averaging $75/sq ft.

The Tierra homes are ideal for passive solar design because of their concrete construction. Concrete and other dense building materials naturally provide the thermal storage capacity to maintain cool and warm temperatures over extended periods. However, much conventional construction also contains potentially free thermal storage capability in floor slabs, south-facing walk-out basements, and interior decorative masonry components. With proper passive design, these elements can be used for solar storage at little or no additional cost.

Passive solar buildings represent only part of an entire spectrum of conservation and solar strategies that can increase the disaster resistance of otherwise conventional home designs. There is a statistically determinate value in avoided insurance claim costs for each strategy and combination of strategies. Determination of these values would provide the insurance industry with a powerful tool for decreasing claim costs through incentive programs.

Other Building Types

All building types can be optimized to be minimally dependent on external power sources. Schools, offices, and businesses can be designed to use daylighting even in hazy environments. There is some evidence that daylit environments increase productivity, reduce illness, and increase student test scores. There are multiple benefits from such buildings for the insurance industry. First, the buildings themselves are more disaster resistant. Second, these buildings require less energy during peak demand periods. In aggregate, they reduce power demand peaks and therefore can reduce the frequency of costly brownouts and blackouts. Finally, such buildings provide a healthier indoor environment and can potentially reduce health-care costs.

One of the primary goals of NREL's research has been to develop simulation-based design tools that are quick and easy for architects and engineers to use for optimization of heating, cooling, lighting, and comfort during the building design process. One of these tools, the *Energy-10* computer program, recently received the Progressive Architecture Research Award. With appropriate data, such a tool could be modified to run economic analyses on how solar and energy-efficient strategies can reduce insurance costs.

Photovoltaics in Disaster Mitigation and Recovery

PV is used to monitor the flow of the river through Ft. Collins to warn of upstream flooding.

John Thornton-NREL / PIX 03543

Photovoltaic (PV) technology plays several important roles in mitigating disasters and speeding recovery after they occur. Simply defined, PV systems are typically stand-alone, utility-independent, electrical generators. They offer a high degree of reliability for powering critical climate and environmental sensing and monitoring instruments, lighting and traffic control equipment, water pumps and purifiers, and communications systems. PV can be connected to the utility grid to augment local power, but should disaster strike and the conventional utility grid fail, a PV system can continue to deliver power.

PV systems have several inherent characteristics that make them ideal candidates for disaster mitigation. Because they are modular, they can be tailored to a wide range of electrical loads, sites, and applications. The systems are relatively lightweight, which allows them to be mounted on mobile units that can be deployed rapidly and moved easily to meet changing situations. PV systems are highly cost-effective, low maintenance, silent, and emit no radio-frequency interference that can block or garble critical communications connections.

John Thornton-NREL / PIX 04462

A PV-powered watergate is used to divert excess run-off and prevent flooding.

PV can play an important role in minimizing the consequences of disasters through remedial action or by providing early warning. There are thousands of small PV sensing and warning systems installed throughout the United States and its territories for these express purposes. Examples of both types of disaster prevention units can be found in Colorado. Water levels in the Cache la Poudre River are monitored continuously by a remote, PV-powered, water-level sensing system located near downtown Fort Collins, Colorado. Any abnormalities can be quickly identified from information telemetered to the city center. Government officials can then get advance flood warnings to area residents in case of heavy rain or runoff from the mountains.

Similar flood disaster prevention is provided by several PV-powered water sensing gates located throughout the town of Steamboat Springs, Colorado. Water run-off levels are continuously monitored by these units. If levels rise too high and the town is threatened with flooding, the water gates automatically open to direct excess flow to storm sewers. The Steamboat Springs systems were installed at a cost of $850 each. Just one of these units alone can prevent millions of dollars worth of damage.

A PV-powered early warning siren can be found in Lakewood, Colorado, a suburb of Denver. The system is one of eight PV-powered units in Lakewood that signals early warning of tornados and other emergency situations to residents. The city planners chose a PV system to avoid the risk of having no warning should power lines fail. The cost of the installed PV system was a fraction of the cost to connect the siren into the utility grid.

Should disaster strike and the utility grid be disabled, a PV system can prove to be invaluable for community safety. Hurricane Andrew provides some of the most dramatic examples. Prior to the hurricane, Solar Outdoor Lighting, Inc., of Stuart, Florida, had mounted several of its Solarpal Safety Streetlights in a Miami suburb. After the hurricane had passed through the area, only the solar streetlights remained standing. They continued to operate for several weeks while the local utility was struggling to restore grid power. Urban streets often fall prey to looters and other vandals during these times. Reliable street lighting can help prevent criminal activity and reduce property loss.

All of these examples of renewable energy and energy-efficient technologies can produce varying degrees of cost savings for both the insured and their insurance providers. However, the greatest potential savings for the insurance industry will be found in distributed, large-scale power production. The massive summer blackout in the summer of 1996, which affected a large number of western states, underscored the advantages that renewable-energy technologies could contribute.

Solar Outdoor Lighting Company / PIX 03535

Solar Outdoor Lighting Company / PIX 03529

A Miami street lit by solar power before and after Hurricane Andrew. The solar street light is still operating when utility grid power is down.

This PV-powered emergency siren is one of eight in the Lakewood suburb of Denver used to warn against tornados.

John Thornton-NREL / PIX 04461

Thousands of businesses and millions of people in 17 states were suddenly without power on July 2, many of them for several days. Businesses, individuals, transportation, health care, and communications depend on a reliable source of electric power. When a centralized power grid is disabled, millions of dollars are lost in every sector of the community, the insurance industry being among the hardest hit.

Because they are modular in configuration, PV power plants can operate as decentralized energy sources. Although there is still some work to be done to bring delivered energy prices down to conventional power costs for certain areas of the United States, many PV and other renewable-energy applications such as wind turbines are cost-effective and well-proven today. Electricity from large, modularly configured wind turbines can cost less than 5¢ per kilowatt-hour, below the average rates for conventional power in many parts of the United States. More than 35 electric utilities in 20 states now operate cost-effective solar and wind energy systems. More and larger systems like these can provide security and safety in case of a disaster and save millions of dollars.

Top Ten Climatic Losses

1992	Hurricane Andrew	$16.0 billion
1991	Typhoon Mireille	$5.7 billion
1990	Winter storm Darla	$4.9 billion
1989	Hurricane Hugo	$4.7 billion
1990	Winter storm Vivian	$3.4 billion
1987	UK October storms	$2.5 billion
1995	Hurricane Opal	$1.9 billion
1993	USA East Coast snows	$1.7 billion
1992	Cyclone Iniki	$1.6 billion
1996	Hurricane Fran	$1.6 billion

(source: Swiss Re, 1996)

Claims for property damage losses from weather-induced disasters have soared in the past decade, running at nearly three times the level of the previous decade. Many insurance companies fear this trend will continue. Governments are also concerned because of the need to provide resources to cover uninsured losses in times of disaster.

The reinsurance giants Swiss Re and Munich Re were among the first insurance businesses to take global warming seriously and are actively encouraging governments to adopt tough new targets to reduce carbon dioxide levels and increase the use of solar power.

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Produced by the
National Renewable Energy Laboratory,
a DOE national laboratory

NREL/BR336-22820
Revised May 1997

Printed with a renewable source ink on paper containing at least 50 percent wastepaper, including 20 percent postconsumer waste