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CAT 360

Catastrophe Risk from Every Perspective

The CAT 360 is a quarterly newsletter that features articles developed by our Research and Development Team and covers topics that relate to Catastrophe Modeling, Natural Perils and Information Technology on a global basis. Please feel free to contact the editors if you have any questions or comments regarding any of our publications.

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Feature Stories

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New Energy Sources - Threats from Natural Hazards

The summer of 2008 saw crude oil prices peak at above $145 a barrel. At that time, there were three things at the forefront of our minds. Who would be the next president of the US, when the economy would start to recover and when the price of oil (energy) would come down. Two of these issues have been resolved - Barack Obama was elected president of the US and the price of crude oil has tumbled to around $40 per barrel (January 2009). But the economy has yet to turn.

Even though the price of oil has declined with the economy, there is still a large push to develop alternative energy sources on a global basis. There is potential for effective solar production on every continent (except Antarctica), with major photovoltaic (solar) plants and wind farms already producing power in Europe, Asia and the United States. As alternative sources of energy grow in significance, it is important to consider both their potential energy production and the new and evolving exposures they face.

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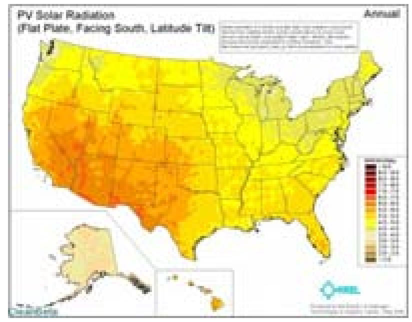
Consumer Based Rooftop Photovoltaic Systems

Rooftop solar power has gone mainstream. Over one million systems have been installed in homes and business in the US alone, according to some estimates. Advances in technology and increased efficiency in production has decreased the cost of a typical installation to about $20,000 per home. Such systems can produce the majority of electricity needs for an average family home in parts of the world that receive plenty of sunshine and daylight hours, according to academic studies. While this investment is still out of reach for most consumers, advances in technology and production will continue to lower costs weekday) is fed back into the power grid, creating energy credits for the homeowner. These credits are used at times when electricity cannot be generated by the system, such as at night or during extremely cloudy conditions. While electricity can still be produced when it is overcast, optimum production occurs during bright and sunny weather conditions.

over time. Payback for this investment is about seven to ten years based on today's electricity prices.

In urban and suburban settings, a home photovoltaic installation is now typically attached to the power grid (a requirement in many regions). Excess power generation (typically during the



Map of US annual solar energy (photovoltaic) resources-courtesy of National Renewable Energy Laboratory www.nrel.gov

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Catastrophe exposures

In the US, the top cities for solar production are in California, New Mexico, Texas, Arizona, Nevada, Wyoming, Hawaii, Colorado, Kansas and Florida (according to clean technology news site CleanBeta). Many of these states are also subject to extreme natural hazard threats. California is exposed to severe earthquake risks, Florida and Texas have been hit by multiple hurricanes in the past decade, and Texas and Kansas are prone to tornadoes and hail events every year.

Photovoltaic systems are typically installed on domestic rooftops, either as a separate series of panels attached to the roof or directly, as part of the roofing material. When mounted properly, these systems become an integrated part of the roof. They are able to withstand loads consistent with the design of the roof (according to tests conducted by the National Institute for Standards and Technology). But how well do these systems perform during an extreme natural hazard event?

Domestic rooftop photovoltaic system

One would theorize that these systems would be able to withstand hurricane-force winds, the current standard for most states along the East Coast of the US. That would provide protection

potentially decrease. If the panel is slightly elevated from the roof and remains parallel to it, then the loads will actually be reduced slightly. This is because there is a tendency for loads on the top and bottom surfaces to be similar but opposing - so they tend to cancel out. However, when a panel is installed with too much of a gap and at a different angle to the roof surface, it can cause loads to increase as a result of additional resistance to the wind flow. In these cases, loads can be up to double what they would have been.

Even if a roof's vulnerability is reduced by the correct installment of solar panels, the cost of replacement is still a lot more expensive. A typical roof without solar panels would cost around $4,000 to repair. Add solar panels into the equation and the cost of repair jumps to $25,000. Demand surge for replacement panels, and the requirement for special technicians to ensure proper installation, could also contribute to drive up restoration costs.

While photovoltaic systems are designed to be safe and low maintenance, in reality they are mini electrical generation plants on top of a house. The electricity produced by the panels is significant and improper contact can produce a potentially fatal electric shock. Great care must be taken when maintaining or repairing a system, something that should be left to a trained professional.

While solar systems can be damaged during extreme weather events, there are also important advantages to having such systems in the event of a storm or earthquake. Damaged power lines could against Category 3 hurricanes, and possibly weak tornadoes. However, it would be very difficult for a roof to withstand a microburst during a hurricane. These are localized columns of sinking air, capable of generating wind speeds above 168mph. It would also be unlikely to survive a direct hit from a strong tornado and, in such cases, it is likely the solar system would be lost in the storm.

Damage from an earthquake event would be less severe. Roofing systems do not usually totally fail when a home is built to code. The potential for loss is more likely to come from an earthquake-induced fire than from ground shaking. Shut-off switches would minimize the risk of damaged electrical systems igniting a fire, however rouge currents or extreme heat generated from the panels could potentially create a spark leading to a fire.

The damage potential does not necessarily increase if a property has had installation panels, and it could cause blackouts for days, even weeks. An undamaged home could incur loss because of an extended power outage. Whereas houses equipped with photovoltaic cells could avoid additional claims. A series of houses with solar panels could continue to generate electricity for an entire neighborhood, even during an extended power outage.

The power potential from rooftop photovoltaic cells means they are becoming an increasingly popular choice for homeowners. A fully distributed network of photovoltaic systems greatly reduces our carbon footprint, and would virtually eliminate dependence on energy generated from fossil fuels. The insurance industry has an important role to play in supporting the growth of solar-generated electricity. Because it is providing suitable and affordable cover, this will encourage more homeowners and businesses to invest in rooftop solar systems.

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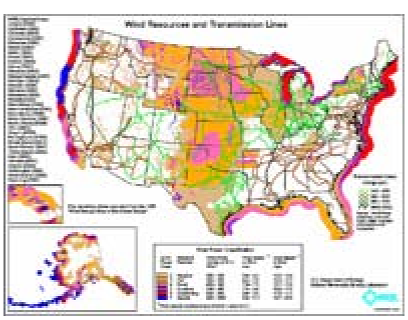
Commercial Wind Farms

During the past year, the United States has quietly become the world leader in wind power generation, able to produce 25 gigawatts of power annually. Joining the US, the other top producers of wind energy are Germany, Spain, China, India and Italy. It is estimated that wind power could save as much as 1.5 billion tons of CO_2 every year by 2020 and provide up to 30% of the world's electricity by the middle of the century. As well as its environmental credentials, wind energy also provides a sustainable answer to increasing concerns about security of energy supply and volatile fossil fuel prices, according to the Global Wind Energy Council.



Map of US wind resources - courtesy of National Renewable Energy Laboratory-www.nrel.gov

A modern wind turbine sits on top of a

- Access: Wind farm installations can occur on top of mountain ranges, where the best winds are, but it may be impossible to reach a disabled turbine during the winter months;
- Noise: Wind Turbines do generate noise and while newer models are designed to be very quiet, the public perception of noise is not favorable;
- Limited available land: Land for wind farms could compete with other uses of the land, such as housing; and
- Exposure to tornado risks: Even well built structures cannot withstand a direct hit from a tornado.

Offshore Benefits

- Consistent wind generation: Offshore winds have proven to be consistent and strong;
- Lower transportation costs: Water transportation is less costly compared to land costs;
- More suitable installation areas: Offshore locations would not compete with other uses; and
- Away from population centers:

400 foot (122 meters) tower and has blades up to 130 feet (40 meters) in length. A single wind turbine can produce enough electricity annually to power over 750 homes. Building a series of wind turbines together to create a wind farm (which can range in size from 20 to 200 turbines) can create enough power for a city of 150,000 residents.

Wind farm projects are being built throughout the world in both onshore and offshore locations. Unsurprisingly, installation on land and in the ocean comes with various benefits and disadvantages.

Land Installation Benefits

- Facilitate maintenance: Maintenance of land-based systems;
- Protection: Some wind turbines are built on towers that can pivot to the ground at the base. Lowering wind towers during a storm would minimize potential damage; and
- Proximity to transmission lines: Lines can be easily erected, able to feed the grid.

Land Disadvantages

- Higher transportation costs: Wind turbines need to be transported via trucks to their final location. This can be far more costly than water-based transportation;

Offshore locations can be erected far from population centers.

Offshore Disadvantages

- Exposure to saltwater: Maintenance and longevity would be an issue due to the corrosive nature of salt water;
- Proximity to transmission lines: Costly offshore transmission lines would need to be installed;
- Difficult maintenance issues: Maintaining wind turbines in the open sea would be a challenge compared to their onshore counterparts; and
- Exposure to tropical storm/hurricane hazards: Could offshore wind turbines withstand a direct hit from a hurricane?

For many countries, offshore wind farms make the most sense. They benefit from more consistent air currents, are away from population centers and tend not to come with the planning and land use wrangles sometimes associated with onshore wind installations. There are 25 offshore wind farms around the world situated off the coast of the UK, Germany, Netherlands, Belgium, Sweden and Denmark.

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Catastrophe exposures

Manufacturers claim that wind turbines have been designed to withstand sustained wind speeds of over 150mph. But questions remain over whether they can be engineered to withstand the force of a severe hurricane, earthquake or tornado? A popular video posted to Youtube.com shows a windmill failing during a storm in Denmark. Reports indicate the braking system had failed, causing the turbine to spin at speeds in excess of its designed capacity. News reports suggest this is an isolated instance, but hurricane events can see wind speeds of up to 200mph. Such a force is likely to test even the sturdiest of structures and future events will reveal what the true exposures are.

During Hurricane Ike, offshore oil platforms and rigs were destroyed. Not by the force of the wind, but by the 30-plus foot waves generated by the extremely large hurricane. How would an offshore wind turbine stand up to 30 foot waves? Modern engineering practices, taken from the aerospace industry, have been used in the design of wind turbines to help them withstand a direct hit from a hurricane. Given that such engineering know-how has enabled the NOAA's "Hurricane Hunter" to fly into the center of hurricanes, it seems likely that a stationary wind turbine would benefit from the same technology. But this does not mean that exposures to extreme windspeeds and storm surges do not exist.

Danish offshore windfarm- courtesy of www.wikimedia.org

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Summary

Countries around the world are actively working to reduce their daily carbon output and their reliance on fossil fuels in the process. There is growing agreement between policymakers and the scientific community on what the direct causes of global warming are. The goal, according to the UN's Intergovernmental Panel on Climate Change, is for greenhouse gas emissions to peak and then start to decline as of 2020. While the energy sector isn't the only culprit - it is currently the largest - contributing 40% of all global carbon dioxide output.

Photovoltaic systems and wind farms are just two ways of reducing these emissions - and these technologies are developing fast. Some $50 billion was invested in wind power in 2007 alone, while investment in solar technologies increased at an annual rate of 145% from 2004 to 2007 (according to the Solar Energy Industries Association). As the sector grows it is likely to require increasingly innovative solutions from the insurance industry. The more we can understand the exposures these new energy producers face, the better cover we can provide for their development and expansion.

Ultimately, the expansion of less polluting energy producers and reduction of fossil fuels could improve the world's future catastrophe prognosis. Currently, the Intergovernmental Panel on Climate Change predicts that a warming climate will lead to more hot extremes, such as the heat waves that caused the recent bush fires in Australia. It also predicts a likely increase in tropical cyclone intensity as well as increases in precipitation in high latitudes, potentially increasing flooding. Sea level rise could also cause more flooding as a result of higher storm surges and winter tides.

The development of green energy solutions could help mitigate future catastrophe events. If it does, this could prevent the cost of catastrophe-related insurance and reinsurance from escalating out of control.

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