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Rebuilding Infrastructure: The Need for Sustainable and Resilient Solutions

Foreword

Paul Horgan

Head of North America Commercial Insurance

Zurich North America

It's been more than six months since Hurricanes Irma and Maria devastated Puerto Rico in September 2017. And today Puerto Rico continues to suffer from the after-effects of the hurricanes. The combined losses from the storms make them among the most severe weather events in U.S. history. In addition to the loss of life, countless homes and businesses have been severely impacted.

Insured losses in Puerto Rico have been estimated at $25 billion to $43 billion,[1] but this figure doesn't take into account the damage to the 40 percent of the island that was uninsured.

Leading up to the 2017 hurricane season, Puerto Rico's infrastructure was in need of updating and upgrading. The condition of Puerto Rico's infrastructure before the storm exacerbated the devastation caused by Maria when it slammed into the island with 150+ mph winds. Addressing the vulnerability of critical infrastructure needs to play a more prominent role in disaster planning.

Unfortunately, in the aftermath of a disaster, there is rarely the time to think beyond recovery. In other words, the immediate focus after a disaster is to get the lights back on. In reality, we should be taking the time – in advance – to make sure the lights will stay on when the next disaster strikes. The existing incentives to build back better are proving to be inadequate, which is unsettling, especially when recent studies have indicated that every dollar spent rebuilding or improving buildings to meet stronger building codes saves four dollars in damages.[2] This paper explores some of the incentives available today, but which need to be strengthened so we do not continue to build back to the same standards that failed.

Zurich is focused on rebuilding infrastructure across the country. We are a global commercial insurance company trusted by 90 percent of the Fortune 500 and other leading businesses, all of which depend on a strong, reliable infrastructure. Our customers include some of the world's largest construction companies and industries that design and build infrastructure components. We also provide surety bonds for infrastructure construction projects around the world, including hundreds of surety bonds for projects in Puerto Rico. But we work together with our customers beyond the four corners of the policy forms to also help them improve their own resilience and sustainability. Improving our crumbling infrastructure will have a major economic impact on the day-to-day operations of businesses while preventing the cascading failures which send shock waves through people's lives.

The reality is that severe storms of all varieties are predicted to become both more frequent and more severe.[3] When combined with the critical state of our infrastructure, everyone is vulnerable to future disruptions. It is not enough to understand the dynamics behind what is needed to address these shortcomings. It's time for action.

Sincerely,

Paul Horgan
Head of North America Commercial Insurance
Zurich North America

[1] "AIR Worldwide Updates Hurricane Maria Loss Estimate," Insurance Journal, December 7, 2017

[2] National Institute of Building Sciences, "Natural Hazard Mitigation Saves: 2017 Interim Report"

[3] Climate Change Impacts in the United States, National Climate Assessment, 2014

Introduction

In this paper, we look at how Puerto Rico's infrastructure has suffered and how its damaged and deteriorated state serves as a somber backdrop for the work that lies ahead. It's a warning of the costs that come with failing to address the immense infrastructure needs all across the United States. The solution starts with building back better – which can be far more cost effective and provide greater protection for people and businesses.

LACK OF INVESTMENT

During the years leading up to Hurricane Maria, Puerto Rico's infrastructure had been in increasing need of routine maintenance. A prime example is the electrical distribution system on the islands. An audit of the Puerto Rico Electric Power Authority (PREPA) revealed that power lines were "cracking, corroding and collapsing."[4] PREPA had undergone a rapid industrialization during the 1970s, as U.S. tax law provided incentives for mainland firms to locate manufacturing and other operations on the islands. This gave PREPA an abundance of industrial customers and the islands a growing middle class. Unfortunately, subsequent changes to U.S. tax law eliminated some of those incentives, resulting in fewer jobs and a lower tax base, and hollowing out PREPA's customer base. These events combined with of a lack of regulatory oversight, alleged corruption, political patronage, and other factors, caused PREPA's debt to increase to the point where it accounted for approximately $9 billion of Puerto Rico's $73 billion debt by early 2017. In addition to cutting back on basic maintenance, the Commonwealth's austerity measures prompted hundreds of experienced PREPA employees to retire to preserve their pension benefits before the cuts kicked in. Those employees were never replaced.[5] Eventually, Puerto Rico was forced to file for a form of bankruptcy, which is pending before the federal courts.[6]

FIRST CAME IRMA AND THEN CAME MARIA

On September 7, 2017, the eye of Hurricane Irma, a category 5 hurricane, passed approximately 50 miles north of the north coast of Puerto Rico. The combination of 74 mph winds and 10 to 15 inches of rain caused widespread power outages, including a near-total loss of electricity and water supplies for several days.[7]

Then, on September 20, 2017, Hurricane Maria, the island's worst storm in 80 years, made landfall in Yabucoa, Puerto Rico as a Category 4 hurricane with sustained winds of 155 mph, and produced localized rainfall totals from nine to 30 inches. Compounding the damage from Irma, Maria caused more major flooding, mudslides and washed out roads. Power, which had not been fully restored, was again cut throughout the island, and still has not been restored for consistent use in many areas. Communication towers and facilities were damaged or destroyed.[8]

RESILIENCY MATTERS

It is estimated that as much as 40 percent of Puerto Rico's structures were uninsured. Those sent to measure damage on the island have reported that the scope of damage to buildings can largely be divided according to when they were constructed. Puerto Rico adopted the 2009 building codes advanced by the International Code Council, as well as the 2016 update. However, the codes only applied to new buildings. The effect of these new building codes can be seen throughout Puerto Rico. Older buildings, mostly in older neighborhoods and constructed before the implementation of building codes in the mid-2000s, suffered greater damage. Neighborhoods built to higher standards, many using concrete walls and flat roofs, sustained less damage.[9]

[4] The Economist, "The Story of Puerto Rico's Power Grid is the Story of Puerto Rico," October 19, 2017

[5] The Economist, "The Story of Puerto Rico's Power Grid is the Story of Puerto Rico," October 19, 2017

[6] In re: The Financial Oversight and Management Board for Puerto Rico, U.S. Dist. Ct., Dist. Of Puerto Rico, 17 BK 3283

[7] National Hurricane Center Tropical Cyclone Report, Hurricane Irma, March 9, 2018.

[8] Major Hurricane Maria – September 20, 2017, National Weather Service

[9] Hurricane Maria: The Importance of Local Knowledge, The RMS Blog, November 14, 2017

Puerto Rico serves as a warning to the mainland U.S. for failing to rebuild existing infrastructure to a more resilient standard

The effects of Irma and Maria on the infrastructure in Puerto Rico are readily apparent. And given the ragged state of Puerto Rico's infrastructure before the storms, Maria has provided the Commonwealth an opportunity to address the situation on a comprehensive scale by building it back better rather than continuing to cover it with bandages. In fact, the governor of Puerto Rico has asked Washington for almost $95 billion in federal disaster related recovery funds to address the problem.[10] However, given the state of Puerto Rico's economy, it will require additional resources from both inside and outside the island, including financial investments and investments of ingenuity, to truly recover and move forward sustainably.

The condition of the Puerto Rican infrastructure can be instructive for the rest of the U.S. and Canada. Puerto Rico's infrastructure, especially its electrical system, suffered from neglect – its further decay and eventual collapse was expedited by Irma and Maria. The U.S. mainland infrastructure may not be in imminent danger of a comparable catastrophe, but with increased frequency and severity of extreme weather events such as the recent Hurricane Harvey, multiple Nor'easters, wildfires, and flooding in the Midwest, it cannot continue to be ignored. It's time to rip the bandages off and start working on making the infrastructure of the United States and its territories more resilient and sustainable.

THE U.S. MAINLAND'S INFRASTRUCTURE SUFFERS FROM SIMILAR NEGLECT

In 2017, The American Society of Civil Engineers (ASCE) gave the U.S. infrastructure a D+.

TRANSPORTATION - Most of the U.S. interstate highway system is more than 50 years old. One in nine of its bridges, most of which are more than 40 years old, are considered to be structurally deficient. Many of its waterways have not been updated since the 1950s.[11] The locks, such as those on the Mississippi River, are well past their designed life expectancy and their replacements would need to be built to accommodate the size of barge flotillas used today.[12]

WATER – Many urban areas are experiencing major water main breaks to pipes that have been in place for many years. Chicago,[13] Los Angeles[14], Atlanta, Baltimore, Boston, Detroit and Tampa have all experienced major water main breaks within the past year due to a combination of age and/or unusual weather conditions. The water system in Flint, Michigan is still in dire need of repair after a poorly planned decision to change water sources caused major corrosion to its lead water mains and a staggering increase in the amount of lead throughout the city's water supply.

America's dams have also been neglected, with an average age of 56 years. As of 2017, approximately 15,500 of these were deemed as high-hazard risks, about a third more than in 2005. And older dams were not built to safely withstand current predictions regarding large floods and earthquakes.[15] Additionally, most U.S. levees, which protect over $1 trillion in property value from riverine flooding, are more than 50 years old.[16]

[10] Request for Federal Assistance for Disaster Recovery, Build Back Better Puerto Rico, November 2017

[11] American Society of Civil Engineers, "2017 Infrastructure Report Card: A Comprehensive Assessment of America's Infrastructure."

[12] The Washington Post, "Taming the Mighty Mississippi," Todd C. Frankel, March 14, 2018

[13] City of Chicago, Department of Water Management.

[14] Los Angeles Times, "L.A.'s aging water pipes; a $1 billion dilemma," Ben Poston and Matt Stevens, February 16, 2015

[15] American Society of Civil Engineers, "2017 Infrastructure Report Card: A Comprehensive Assessment of America's Infrastructure."

[16] American Society of Civil Engineers, "2017 Infrastructure Report Card: A Comprehensive Assessment of America's Infrastructure."

Effects of a crumbling infrastructure

It is vitally important to plan funding for potential disasters before one strikes. And that includes improving the infrastructure.

POWER – As with the other areas of infrastructure, much of America's electrical grid was constructed in the 1950s and 1960s with a 50-year life expectancy, and not engineered to meet today's demand or weather events. A snowstorm in early 2013 knocked out power to hundreds of thousands of customers throughout New England, and even caused a nuclear power plant to shut down.[17] The power grids are at full capacity, leading to cost and reliability issues. Loss of production from the closing of nuclear and coal fired plants has been somewhat offset by increases in natural gas and renewables such as wind and solar power, but new delivery systems need to be integrated into the existing grids. Recent cyber-attacks on electrical systems in the U.S. and around the world have demonstrated yet another vulnerability to be mitigated against.[18]

Consumption of oil and gas continues to rise, and many oil refineries have been upgraded to keep up with demand. However, their concentration on the coasts makes them vulnerable to storms and rising tides. Continued new pipeline construction to allow for increased capacity has helped, but failures of existing pipelines have demonstrated a need for increased monitoring and maintenance spending.[19]

COMMUNICATIONS – In many ways, communications are dependent upon a similar transmission infrastructure as the electrical system. However, with the use of cellular and satellite technology, businesses are dependent upon the resilience of these systems, which are themselves reliant upon the electrical system.

EFFECTS OF CRUMBLING INFRASTRUCTURE

If the infrastructure is allowed to continue its downward trend, the American Society of Civil Engineers (ASCE) estimates that could cost the U.S. economy $3.9 trillion by 2025.[20] Businesses run the risk of supply chain disruptions caused by an inability to obtain sufficient raw materials or to ship products due to road or bridge failure, and productivity interruptions due to network disruptions, power outages and cyber-attacks.

THE VALUE OF HIGHER STANDARDS

Recent studies have indicated that every dollar spent building or improving buildings to comply with the newer codes saves four dollars in damages.[21] But while building codes don't necessarily directly translate to infrastructure, the return on investment in building to the upgraded codes parallels similar investment in efforts to create a more resilient infrastructure. Studies have indicated that it's possible to receive a 6:1 rate of return on federal grants that have been provided for in mitigation efforts, including enhancing the infrastructure.[22] However, FEMA repayments following a disaster may not account for infrastructure improvements, especially when restoring service is the priority. For example, during the recovery from Superstorm Sandy, utilities were rapidly restoring power to affected areas, but not enough "quick disconnect" devices were available to incorporate into the entire system. When they subsequently became available, the utilities were told that Stafford Act (FEMA) funds would not be available because the repairs had already been made.[23] Therefore, it is vitally important to plan funding for potential disasters before one strikes. And that includes improving the infrastructure.

RESILIENCE AND SUSTAINABILITY

Resilience and sustainability require considerable planning and preparation in all aspects of a project. Correctly assessing the problem to be addressed, determining the best solution, foreseeing changes to the situation and being prepared to address them are all essential elements.

According to a Presidential Policy Directive, the word "resilience" means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

[17] "Mass. Nuclear power plant loses power, shuts down during snowstorm; NRC monitoring," Fox News, February 9, 2013.

[18] "Cyber Threat and Vulnerability Analysis of the U.S. Electric Sector," Mission Support Center, Idaho National Laboratory, August 2016

[19] American Society of Civil Engineers, "2017 Infrastructure Report Card: A Comprehensive Assessment of America's Infrastructure."

[20] "Failure to Act: Closing the Infrastructure Investment Gap for America's Economic Future," American Society of Civil Engineers.

[21] National Institute of Building Sciences, "Natural Hazard Mitigation Saves: 2017 Interim Report"

[22] National Institute of Building Sciences, "Natural Hazard Mitigation Saves: 2017 Interim Report"

[23] Bolstering Critical Infrastructure Resilience after Superstorm Sandy: Lessons for New York and the Nation, Stephen E. Flynn, Northeastern University Center for Resilience Studies and George J. Kostas Research Institute for Homeland Security at Northeastern University, LLC

Plan the rebuild before a disaster

Over the past few years, use of reinsurance and catastrophe bonds by governments and government agencies have been increasing.

The ASCE defines "sustainability" as a set of environmental, economic, and social conditions – the "Triple Bottom Line" – in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely, without degrading the quantity, quality or the availability of natural, economic, and social resources.

ADDRESS LIFE CYCLE COSTS

Planning for resilience and sustainability begins with ensuring that the project selected is the right one for the situation – addressing the needs of the present and foreseeing those needs in the future. This includes making sure that the solution is cost-effective over its life cycle.

For example, in 1997 the New York watershed needed improvement because it was not supplying as much water as in the past. Under the Safe Drinking Water Act of 1974, water drawn from the reservoirs requires microfiltering unless the source could be protected from microbial agents and chemical pollutants through watershed management. The "bricks and mortar" response, building a filtration system and pump station at an estimated cost of $4-6 billion, would have a limited lifetime before the structures would need to be replaced. Instead, the U.S. Environmental Protection Agency, the state and 46 watershed towns agreed to a plan to bring the degraded watershed back to its natural state at a cost of $1 billion over the first ten years.[24]

This solution worked well enough to be extended an additional ten years. Doing the right project cost less up front and has been more sustainable over the long run.

PLAN THE REBUILD BEFORE A DISASTER

Having insurance for the potential failure of public infrastructure is essential, whether due to a natural catastrophe or other cause. Its benefits are only apparent after a failure occurs. And once a failure occurs, especially a weather-related failure, it's likely that the cost of insuring against the risk of a repeat event will increase prohibitively. New York's Metropolitan Transit Authority addressed such an issue after Superstorm Sandy flooded its subway system. It used the funding it received from insurers to rebuild its system with resilience in mind to lessen the likelihood of damage from a repeat event. But going forward, the insurance cost for even half the coverage would have doubled. Instead, it used a $200 million catastrophe bond tied to certain parameters established by independent modelling. If the trigger conditions were met, the $200 million would be immediately available to fund repairs. If not, the investors would receive a 13.5 percent return on their investment.[25]

Over the past few years, use of reinsurance and catastrophe bonds by governments and government agencies have been increasing. Several South American and Central American countries have obtained bonds that would pay for damage caused by earthquakes[26] and FEMA has begun obtaining reinsurance for its National Flood Insurance Program.[27]

[24] New York City Watershed Management, American Society of Civil Engineers

[25] NYC MTA Storm Surge Protection via Catastrophe Bond Market, Adaptation Clearinghouse, July 31, 2013

[26] "Pacific Alliance cat bond to settle at $1.36 billion," www.Artemis.bm, February 6, 2018

[27] "FEMA secures 40% more NFIP flood reinsurance in $1.46 billion renewal", www.Aretmis.bm, January 8, 2018

Build back better

Building back better can reduce the scope of damage from future storms, allow for less extensive efforts for the Puerto Rican people and businesses, and give them a fighting chance to establish economic sustainability going forward.

PUBLIC-PRIVATE PARTNERSHIPS (P3)

Public-Private partnerships are another way to build a sustainable infrastructure. Private investors fund infrastructure improvements in exchange for a share of any proceeds derived from users of the infrastructure. A prominent example is the leasing of the Chicago Skyway, where the investors that paid the City of Chicago $1.5 billion replaced the 60-year-old bridge and made roadway improvements in exchange for the tolls that would be collected over a 99-year period. Similar arrangements have been suggested for replacing and improving the locks on the Mississippi River,[28] as well as a variety of services and facilities in a number of states. Puerto Rico is no stranger to P3s, having created a Public-Private Partnership Authority in 2010, which successfully built toll roads and made airport improvements. And since Maria, it has been soliciting proposals relating to disaster recovery services and evaluating unsolicited proposals addressing its energy needs.[29]

BUILD BACK BETTER

There is always a cost to build back better. Some insurers offer a "build back better" type of coverage to their policyholders. For an additional premium, an insurer will provide two types of coverages: 1) ensure that a structure will be "hardened" against future events, and 2) enable an upgrade using sustainable and green products. Investors in future projects can require the purchase of this type of coverage as a condition for their funding.

INSURERS ARE IN A UNIQUE POSITION TO PROMOTE INVESTMENT IN A RESILIENT INFRASTRUCTURE

Insurers can provide investment in resilient infrastructure directly through investment in bonds promoting individual infrastructure projects, green or municipal bonds. They can also have a less direct, although important role in infrastructure investment. For example, insurers can:

- Create insurance pricing incentives for infrastructure owners to make needed improvements, and help inform them of how to build back better.[30]
- Educate policymakers on ways to distribute the risk of infrastructure failure, as well as the benefits of infrastructure improvements.
- Guide policymakers in tailoring resilient infrastructure improvements and projects to be regionally compatible.
- Encourage creation of public policy incentives for rebuilding sustainable infrastructure.
- Share lessons learned from other projects.

But it's not limited only to insurers. Experts from the public and private sectors can contribute unique insights and generate new ideas to help resolve the complex challenges all of us are facing as we strive to rebuild infrastructure in Puerto Rico and throughout the nation with resilience and sustainability in mind.

CONCLUSION

Hurricanes and extreme weather events will continue to impact Puerto Rico and other parts of the United States. The risk of allowing existing infrastructure to further deteriorate is unacceptable. They continually remind us of the need for public and private entities to work together in crafting solutions and undertaking the work needed to move forward. Building back better can reduce the scope of damage from future storms, allow for a faster recovery for the Puerto Rican people and businesses, and give all of us a more resilient future.

[28] The Washington Post, "Taming the Mighty Mississippi," Todd C. Frankel, March 14, 2018

[29] Puerto Rico Public-Private Partnerships Authority Public Notices

[30] "Informed Decisions on Catastrophe Risk," Current Flood Insurance Policy and Potential Improvements, Wharton Risk Center Issue Brief, Spring 2016

Zurich
1299 Zurich Way, Schaumburg, Illinois 60196-1056
800 382 2150 www.zurichna.com

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