In advance of Hurricane Sandy, New York warned on vulnerable infrastructure

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In the aftermath of Hurricane Sandy, a common refrain from politicians, responders and victims alike was that the effects of the storm were like nothing they had ever seen before. The extent of damage, indeed, far exceeds any other recent storm in the New York area.

This, however, does not mean that the scale of the storm's impact was unforeseeable. In fact, the opposite is the case for those in positions of power and authority. The scope of devastation wrought by Sandy actually *was* predicted by numerous scientific studies commissioned by government agencies over the past decade.

Warming oceans and melting ice have already led to significant sea level rise over the past century. The Battery in lower Manhattan has recorded a twelve-inch rise in sea level since 1900.

Climate scientists project that in the coming decades the rate of this rise will accelerate. This is particularly important for the New York region, where ocean currents and land subsidence result in a higher than average rise.

One recent assessment for New York determined the need to plan for up to 5 additional feet of sea level rise by 2080. The scientific community, as well as all levels of government, has recognized the increasingly likely danger of a severe storm such as Sandy generating never-before-seen flooding.

The US Global Change Research Program, a federally funded research body that published its most recent major assessment of climate change impacts in 2009, warned: "The densely populated coasts of the Northeast face substantial increases in the extent and frequency of storm surge, coastal flooding, erosion, property damage, and loss of wetlands. New York State alone has more than $2.3 trillion in insured coastal property. Much of this coastline is exceptionally vulnerable to sea-level rise and related impacts."

Detailed studies specific to the region began more than a decade ago. The Metropolitan East Coast Assessment examined the potential impacts of climate change on the transportation infrastructure of the New York metro area in 2001. The report noted the vulnerability of many critical facilities, which, at between 6 and 20 feet above the current sea level, lie well within the range of storm surges from hurricanes and nor'easters.

However, it doesn't take the threat of a hurricane to expose New York's vulnerabilities. A Transportation Research Board special report from four years ago noted: "The New York metropolitan area is no stranger to the devastating impacts of flooding. For example, the nor'easter of December 1992 produced some of the worst flooding in the area in 40 years, resulting in an almost complete shutdown of the regional transportation system and evacuation of many seaside communities. More recently, heavy rainstorms in September 2004 and August 2007 crippled the New York City transit system."

Hurricane Irene, which made landfall in the city as a tropical storm last year, came within a foot of paralyzing the transportation system, according to Columbia University scientist Klaus Jacob. In 2011, Jacob and a team of researchers completed the most comprehensive assessment of climate change vulnerabilities in New York to date. ClimAID, as it was known, included a case study that modeled the impacts of a storm surge very similar to Sandy.

The study projected extensive flooding within an hour to most subway, rail and vehicle tunnels linking Manhattan to the rest of New York and New Jersey. It estimated that complete restoration of transit service could take weeks, and the economic damages reach

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near $50 billion, even without further sea level rise. A similar storm after 70 years of sea level rise could increase costs by 75 percent.

The report recommended a number of short, medium, and long-term measures to reduce vulnerability. "Raise or relocate to higher ground… critical infrastructure to avoid current and future flood zones," was one. Another suggested looking at "constructing levees, sea walls, barriers, and pumping facilities, and… designing innovative gates at subway-, rail- and road-tunnel entrances."

Just a little more than a month prior to Sandy hitting the East Coast, the *New York Times* quoted Jacob on the city's preparedness for potential flooding. “We’ve been extremely lucky. I’m disappointed that the political process hasn’t recognized that we’re playing Russian roulette,” he said.

Of course, transportation was not the only critical infrastructure impacted by the flooding. Over 8.5 million homes lost electricity immediately following the storm, as substations, transformers and power lines throughout the region collapsed.

Gasoline shortages still persist, as petroleum terminals and major refineries in New York and New Jersey were damaged and remain shuttered.

Wastewater treatment plants were overwhelmed during the storm, leading a dozen drinking water systems to issue boil water advisories and hundreds of millions of gallons of untreated sewage to spill into waterways during the week following the storm.

These impacts were also not unforeseen. The ClimAID report notes that a majority of the city's largest power plants are located at an elevation less than 16 feet above sea level, vulnerable to hurricane storm surges. Much of the city's critical transmission infrastructure is also extremely vulnerable, the report found.

As utilities have cut workforces and under-funded investment, their resiliency to storms has deteriorated drastically. The US Global Change Research Program explained: "The number of [weather-related electric grid] incidents caused by extreme weather has increased tenfold since 1992. The portion of all events that are caused by weather-related phenomena has more than tripled from about 20 percent in the early 1990s to about 65 percent in recent years. The weather-related events are more severe, with an average of about 180,000 customers affected per event compared to about 100,000 for non-weather-related events."

With the known threats from rising seas, warming temperatures and other climate change impacts growing, the complete inability and/or refusal to implement protective measures has exposed the irrationality of development in the country's largest city, whose gross metropolitan product approaches $4 billion per day.

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