From Katrina to Harvey: Storm Resilience in the Age of Shale

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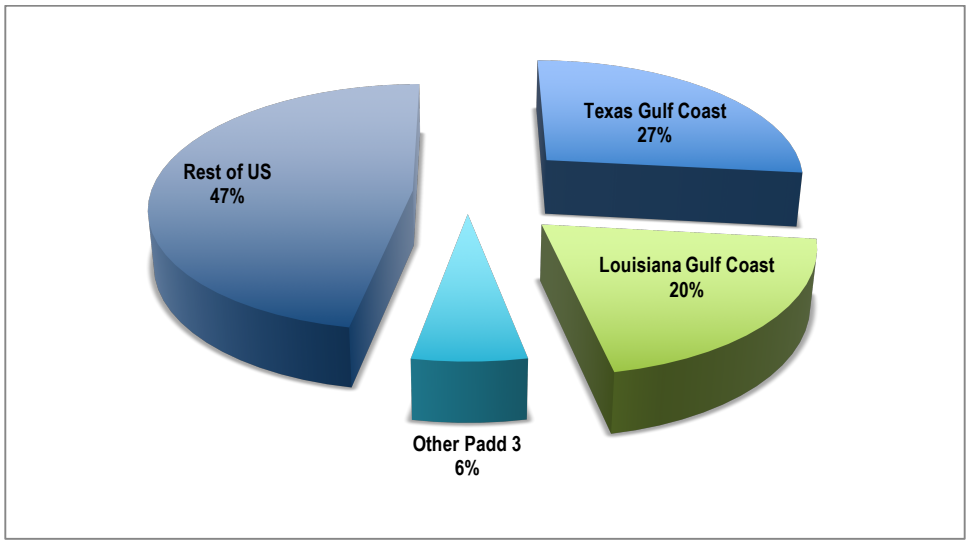
Three days after Hurricane Harvey made landfall near Houston, rains continue to lash the region, unleashing catastrophic flooding. Apart from the human suffering, the storm's devastating impact should also serve as a powerful reminder that no country, no matter how large its oil and gas production may be, is fully insulated from the risk of an energy supply disruption. Indeed, the larger a country's production volumes, the greater its risk exposure. The flipside of US energy 'dominance,' and more specifically of the phenomenal US ramp-up in oil and gas production, refining activity and petrochemical output unleashed by the shale miracle in the last few years, may thus paradoxically be, in some ways, heightened energy vulnerability. As such, when the water finally recedes, energy companies and policy makers will no doubt have to evaluate not only newly exposed risks but also the effectiveness of existing response measures and tools such as the US Strategic Petroleum Reserves.

At the time of writing, it is too early to assess the full scope of the damage to oil and gas facilities in the Gulf Coast, home to significant proportion of the nation's production and refining capacity. As of Monday, the U.S. Department of the Interior's Bureau of Safety and Environmental Enforcement (BSEE) reported that just over 330,000 barrels per day (bpd) of oil production, or 19 percent of U.S. Gulf of Mexico oil output, had been taken offline due to Harvey, down slightly from 22 percent on Sunday. About 18 percent of Gulf natural gas production, or 583 million cubic feet per day, was offline. Meanwhile, the US Department of Energy's Energy Information Administration (EIA) reported that 10 refineries, totaling roughly 1.8 million bpd of processing capacity, had been idled as a precaution. But the worst has yet to come. Flooding in Houston already appears of an unprecedented scale. Harvey is expected to stall and linger and continue to unleash a deluge, and flood damage is likely to worsen and spread further out in the region in the next few days. The Army Corps of Engineers has already started releasing water from two Houston-area reservoirs, the Addicks and Barker, into Buffalo Bayou, the primary body of water running through Houston, to prevent uncontrolled water flowing from the dams. The dams are said to be in very bad physical condition, raising the specter of a possible catastrophic failure. Releasing water might prevent the worst, but will further raise water levels in at least parts of greater Houston in any event.

Figure 1: Distribution of US Crude Oil Distillation Capacity



Source: US Energy Information Administration.

Lingering water damage is in fact a bigger threat to oil and gas than the wind associated with Harvey. When Hurricane Katrina hit New Orleans in 2005, most of the damage inflicted on oil and gas facilities, particularly on refineries, came as a result of flooding, rather than direct hit by the storm. Protracted downtime was also inflicted on refineries by uncoordinated precautionary outages at electric co-generation facilities that supplied the plants, the operation of which had previously been outsourced to local electric utilities in an effort to save costs and optimize operations. The gigantic Texas City refinery then owned by BP was particularly hard hit and remained out of commission for months.

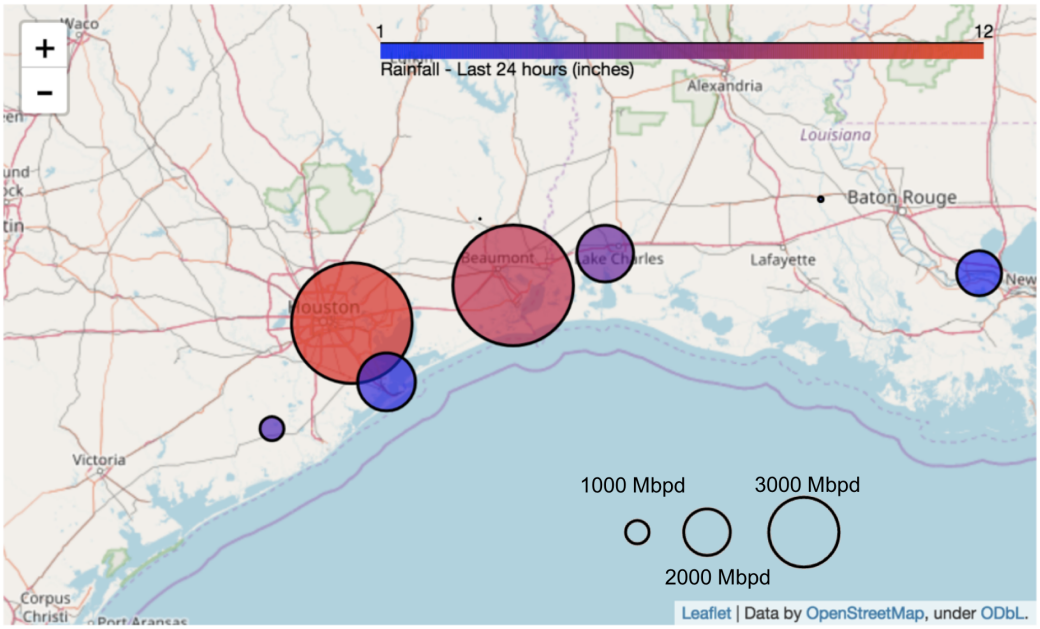
Refiners learned the lessons of Katrina and considerably beefed up their flood readiness in the aftermath of the storm. They did such a good job of it that by the time Hurricane Ike hit the Gulf Coast in 2008, refining downtime and damage to oil and gas facilities was remarkably limited, indeed minimal. That was a truly remarkable achievement, given the considerable storm surge and rainfall caused by Ike.

These efforts at storm readiness are now being tested anew. There are three main reasons to suspect that past preparations may prove insufficient.

First, the rainfall appears to have already hit a new record. The National Weather Service forecast that some parts of the greater Houston area could receive as much as 50 inches (1.3 meters) of rain -- the highest amount ever recorded in Texas -- before the storm is gone. Some areas have already halfway there. Since Thursday, South Houston was reported to have gotten nearly 25 inches (63 centimeters), and the suburbs of Santa Fe and Dayton even more. In a statement, the National Weather Service said: "The breadth and intensity of this rainfall is beyond anything experienced

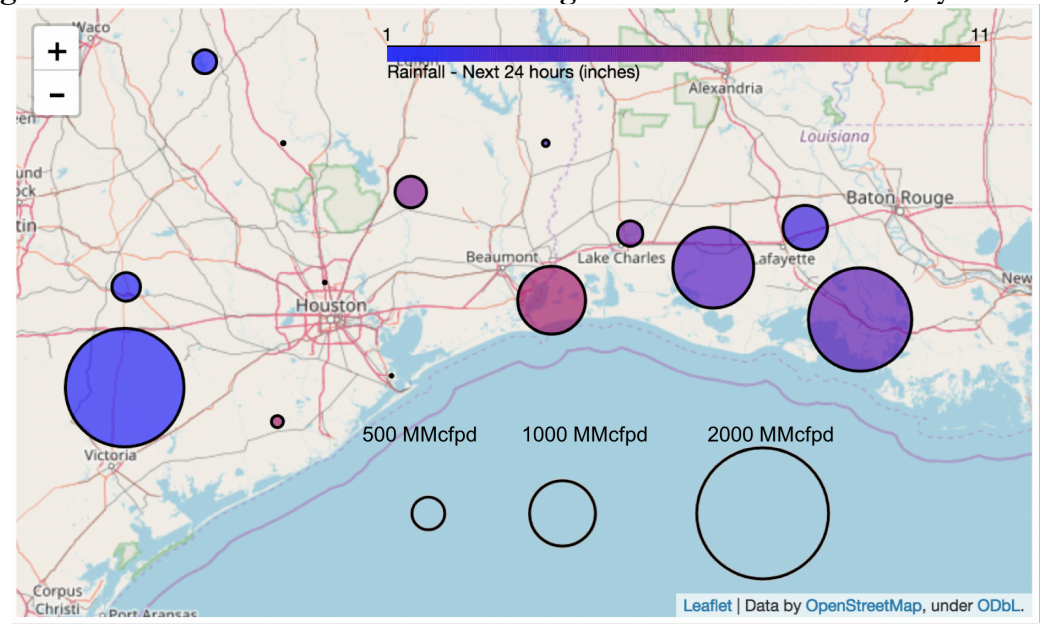
before." It is unclear that when oil and gas operators ramped up their storm readiness post-Katrina, they had that kind of catastrophic rainfall in mind.

Figure 2: Rainfall on Refineries in Past 24 Hours, by Location



*Source: Kayrros, Aug. 28, 2017.**

Figure 3: Rainfall on Natural Gas Processing Plants in Past 24 Hours, by Location

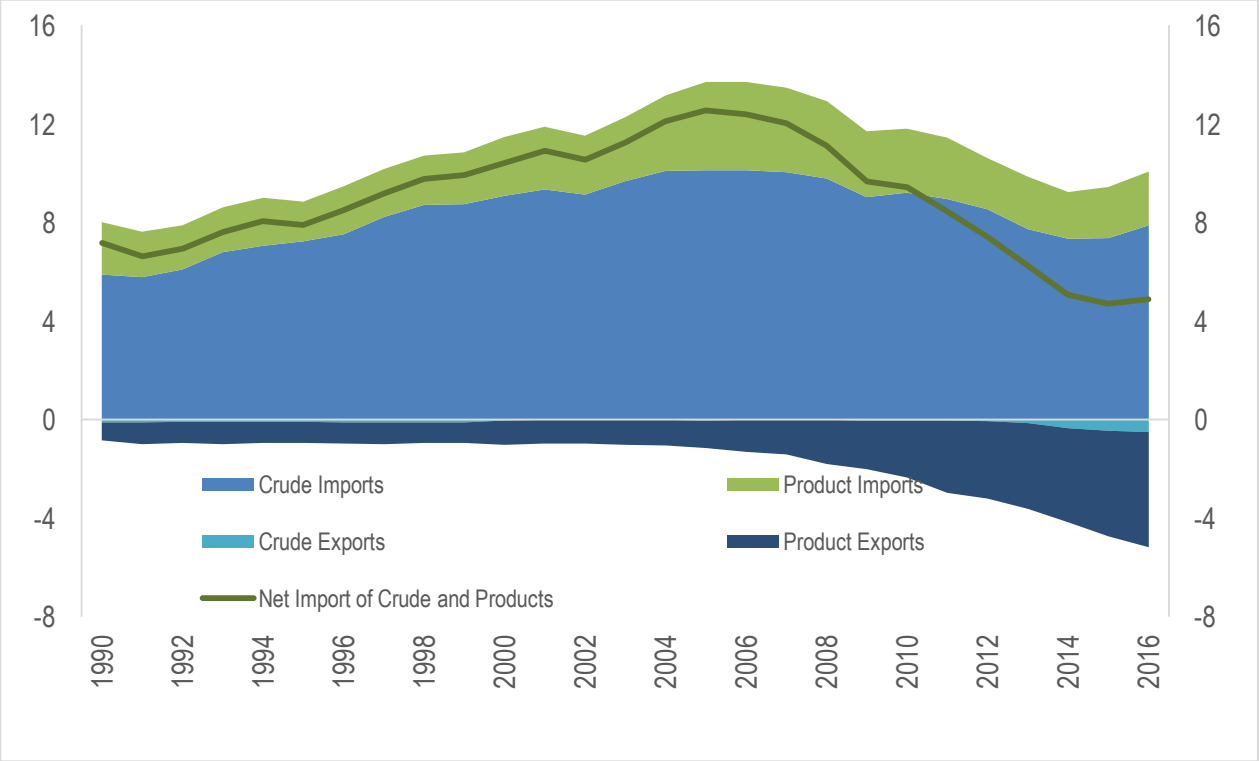


Source: Kayrros, Aug. 28, 2017.

Second, since 2005 the shale boom has fueled a considerable buildup of oil and gas facilities in the Gulf Coast region (and beyond). This not only includes thousands of producing oil and gas wells more or less directly exposed to storm damage in South Texas, notably in the Eagle Ford. In addition, the shale boom was accompanied by a build out of a great number of oil and gas processing facilities, new pipelines and compressor stations, condensate splitters, crude and product tank farms and storage units, railcar loading and unloading facilities and coastal export terminals. The storm readiness of these facilities is unclear.

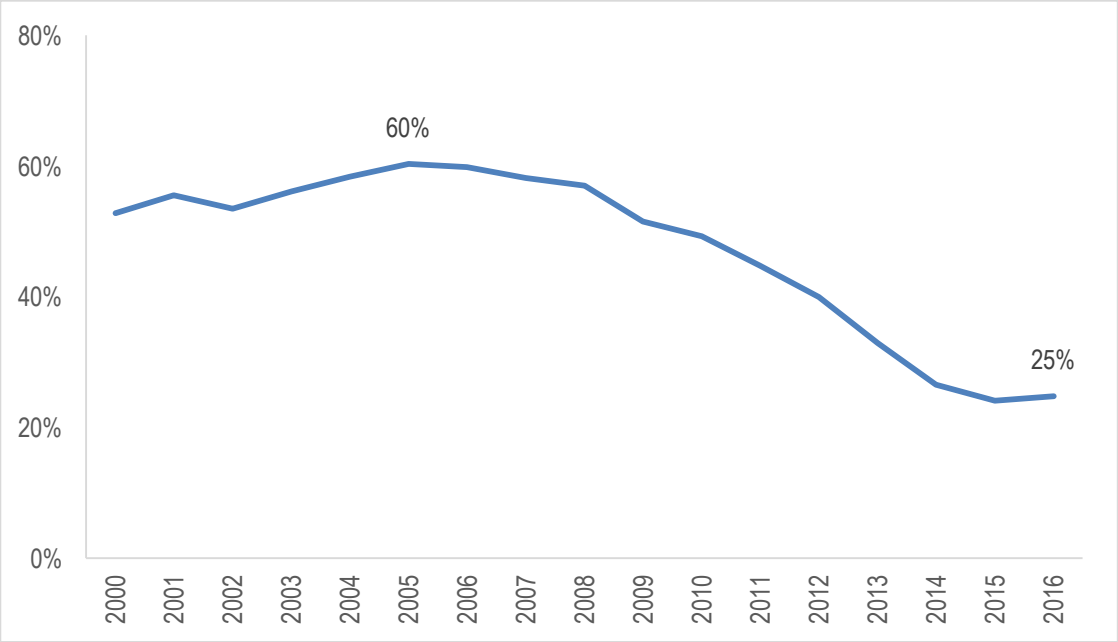
Figure 4: US Trade in Crude Oil and Petroleum Products

Million barrels per day



Source: US Energy Information Administration.

Figure 5: US Net Oil Import Dependence
% share of net imports in total consumption



Source: US Energy Information Administration.

Industry has in general invested a lot in hardening infrastructure in the last decade. But whether all the plants and facilities erected in the infrastructure boom triggered by the unlocking of the shale oil and gas reserves were built to the highest water-protection standards is at best untested. While 'survivors' of Katrina may have beefed up their flood preparedness, new facilities may not prove as resilient.

Finally, the expansion the oil and gas infrastructure and the increase in US production volumes of the last 10 years has turned the United States into a considerably more complex and integrated energy system than was previously the case. That means that indirect effects from the storm may be as considerable, if not even larger, than direct ones. Protracted shutdowns at export facilities in the Gulf Coast or at refineries and chemical plants could have far-flung ripple effects on producing assets that depend on them for market access. Oil and gas wells located in areas far away from the storm may have to be temporarily idled or to ramp down if their market access (including access to both domestic downstream facilities such as refineries or petrochemical plants and to export markets) is cut off by lingering storm damage. Output from the Permian, which has been the shale industry's star performer despite issues such as rising gas oil ratios, logistical congestion, labor shortages and cost re-inflation, may face new and more severe obstacles if takeaway and export facilities in Corpus Christi or elsewhere are affected by the storm.

As of this writing, the oil market response to the news, with North Sea Brent prices up but those of US WTI crude down, suggests expectations that there will be reduced refinery demand for US crude.

Decreased domestic processing of US domestic crude grades could indeed depress their price, especially if the storms also shutters export facilities. But that assumes that the US upstream sector, crude oil and natural gas production, will not be as badly affected as downstream activities (refining and petrochemicals). In a note released today, Goldman Sachs thus estimates that if current levels of outages remain in place, "and using past hurricanes as proxies for the impact on oil demand," Harvey would "increase domestic crude availability by 1.4 million bpd while removing 615,000-785,000 bpd of gasoline and 700,000 bpd of distillate supplies. Larger refinery outages would increase these long crude and short product impacts." Past hurricanes may not be a reliable guide to gauge upstream production impacts, however, given the large-scale inland migration of US crude production into highly fragmented onshore facilities, presumably much more vulnerable to flooding and more dependent on onshore midstream infrastructure, over the last decade.

Another change since the last hurricanes is that the US has turned from the world's largest importer of refined products to the largest exporter. That means that US product export outlets such as Mexico and other Latin American countries may have become much more vulnerable than in the past to a disruption in US refining activities and a drop in US product exports.

A measure of Harvey's novelty may be provided by the fact that while the US government is well prepared to monitor storm-related outages at traditional oil and gas facilities, such as were affected by past storms, it is unclear that there is a process in place to track impacts on some of the new facilities. The BSEE is tracking oil and gas production outages in the Gulf of Mexico and the EIA is doing daily reports on refineries, ports and power plants. Nothing so far on condensate splitters, onshore production, etc.

The storm in the US Gulf Coast is striking even as a storm of another nature – political, economic, humanitarian – is wreaking havoc across the Caribbean Sea in Venezuela, still a major supplier of heavy, high-sulfur oil to several large Texas and Louisiana refineries. The meltdown of "Bolivarian socialism" already has caused a steep reduction in the country's oil production volumes and, as a result those, exports to the United States. While an embargo on US imports of Venezuelan oil was reported to have been recently considered but ruled out for now by Washington, due in part to concerns over its adverse impact on US refineries and fears of a gasoline price hike, Harvey may end up doing what the Trump administration preferred to avoid: reduce US market access to Venezuela. In other words, the storm could impose financial pain on Venezuela without the United States actually sanctioning it, since US demand for the country's crude will fall, at least for as log as the refineries are down, thus forcing Caracas to find other outlets, and likely agree to significant discounts, for its oil. That would add to the Maduro regime's struggle to meet debt payments.

Generally speaking, though, the broader market background of Harvey could not be more different from Katrina's. Back in 2005, the hurricane struck amid rising oil prices, in a market atmosphere heavy with concerns over "peak oil supply" and perceptions of runaway demand from China and other emerging economies. In contrast, the shale revolution has replaced fears of oil scarcity with a new perception of abundance; plummeting renewable-energy costs are fuelling expectations of displacement of oil demand with clean electricity, notably in road transport; oil inventories, despite eight months of OPEC and non-OPEC production cuts, remain extraordinarily elevated; oil's place

in the fuel mix is threatened by rising inter-fuel competition amid surging natural gas supply and plummeting renewable energy costs; already natural gas production gains have displaced coal in US power generation and helped fuel a fast-expanding global LNG market; electric vehicles now threaten oil vehicles; fears of peak oil supply have been replaced by expectations of peak oil demand. Despite some draws, US total stocks of crude oil and petroleum products remain extraordinarily elevated and were last reported at nearly 2 billion barrels as of mid-August (specifically 1,983 million barrels), up by 200 million barrels from 1,781 million barrels three years ago, at the beginning of the shale-induced downturn in global oil prices. While market turbulence from Katrina had been contained with remarkable efficiency by a speedy, impeccably choreographed, well-advertised release of emergency stocks by the International Energy Agency, at the time of writing the IEA had yet to issue a statement about Harvey or give any public sign that Harvey was on its radar screen. The difference reflects not only the speed with which Harvey has materialized as a threat, but also the profoundly different market context, both in terms of oil and gas balances in general, and perhaps also the political context in Washington.

Yet the storm shows that no country, no matter how mighty an oil and gas producer it may be, is beyond the threat of catastrophic damage. Indeed, the greater a country's oil and gas production, the more is at stake and the larger the volumes that may be as risk of disruption – whether from an act of God such as Harvey or a man-made disaster such as Venezuela's Chavismo. Hopefully, the damage this time around will be contained and the downtime at oil and gas facilities and downstream plants will be relatively brief. Clearly, though, no country is an energy island. As far as oil and gas are concerned, we are all in it together.

There may thus be a lesson in the storm about the enduring insurance value of Strategic Petroleum Reserves, which some have suggested should be cut as a result of rising domestic supply. In the case of flooding-related disruptions in Gulf Coast production, the US SPR may not be of much direct help: after Katrina, the US depended on imports to make up for the disruption rather than on drawdowns of domestic emergency stocks, at the SPR itself was out of commission, as were the refineries that could have processed its oil. The value of the SPR however is not just as a tool of self-sufficiency, but also as a premium paid for membership in a collective insurance scheme, whereby IEA member countries are bound together by a pledge of mutual assistance. High precautionary stocks can also translate into a form of soft power in the event of catastrophic events striking other producer or consumer countries. While the benefits of IEA membership can be maintained with just 90 days of cover, there may be value in holding stocks above that minimum requirement, especially against the background of global warming and an elevated risk of catastrophic weather events. As winds and rainfall rage in Houston and the region, the need for caution and a thorough rethink of our collective energy insurance policy comes into sharp focus.

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