

# Energy finance must account for extreme weather risk

Despite increased awareness among investors, physical climate risk from extreme weather remains surprisingly unaccounted for in financial markets. Without better knowledge of this risk, the average energy investor can only hope that the next extreme event will not trigger a sudden correction to the market values of energy firms.

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This past summer, the United States and Europe experienced record-breaking heat. Now linked reliably to climate change<sup>1</sup>, excessive high temperature is among the deadliest of weather extremes<sup>2</sup>. Not only can it disrupt agriculture<sup>3</sup>, harm human health<sup>4</sup> and stunt economic growth<sup>5</sup>, it can also overwhelm — and temporarily shut down — large parts of a state's or a nation's energy system<sup>6-8</sup>, as in the case of the Pacific Gas and Electric Company (PG&E) in California. Extreme heat events can create uncertain and longer duration power outages, threaten critical infrastructure, exacerbate energy supply and demand imbalances, and trigger significant legal liability for energy firms. Newer reports<sup>9</sup> of an increase in the frequency and severity of extreme weather events, moreover, amplify those risks for energy firms.

Despite these obvious risks, investors and asset managers have been conspicuously slow to connect physical climate risk from extreme weather events to company market valuations. One reason is that limited data based on past events are available to investors and asset managers making it hard for them to understand how physical climate risk at the local level might affect individual companies' assets and liabilities. National weather services have traditionally focused on short-term weather forecasts and not longer-term climate risk predictions useful for financial planning. Efforts to develop the latter have often been stymied for lack of public funding<sup>10</sup> or have produced scientific data that is hard for financial players to absorb. Proprietary risk prediction services such as Jupiter Intelligence and Four Twenty Seven are, however, fast filling the void in what has been recently described as a "climate intelligence arms race"<sup>11</sup>, and non-governmental organizations such as the Climate Disclosure Project are publishing data that chronicles lost revenue from climatic events. So far, though, research indicates that markets are not fully assessing the impact of physical climate risk in the



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calculation of company stock prices<sup>12</sup>. Hence, it is reasonable to conclude that stock prices could sink precipitously should new bouts of even more extreme weather occur.

Research shows that there has been some fleeting market response to extreme weather events. For example, the average firm's market capitalization drops by about one-half of one percent in the month following an extreme heat event<sup>13</sup>. However, for energy firms, the short- and long-term effects on shareholder value of corrections to physical climate risk underpricing from extreme weather will be much greater.

## Stringent climate policy

Higher energy production and demand — now at record levels in part as a direct result of extreme weather events — make it less likely that the Paris targets for global emissions reductions will be met within the

necessary timetable<sup>14</sup>. The harder it is for countries to meet their Paris targets (and the possibility that even meeting them will not achieve sufficient temperature reduction), the more the potential for reputational harm will build up for carbon-intensive energy firms. Similarly, the expectations for carbon regulations going forward will be stronger. Markets may eventually reflect this as a sudden loss of firm value.

Without innovation and backstop technologies for ample supplies of low or zero-carbon energy, future binding restrictions on high-carbon energy production would seem inevitable<sup>15</sup>. And if pressure rises to reduce carbon emissions, investment in low-carbon technologies will likely accelerate. This will further increase energy transition risk for traditional fossil-fuel firms whose market share will decline accordingly. Already, in the United States,

fossil-fuel companies have produced the lowest annualized returns of any Standard & Poor's stock market sector in the past one and three years. Additionally, as markets adjust to the lower need for fossil-fuel energy, a sell-off could take place that spills into other sectors. Given that the use and price of energy is intertwined with almost all economic activity in today's world, the Federal Reserve and other central banks have expressed deep concern for global financial stability should a series of climate-related extreme events like this unfold<sup>16</sup>.

Stringent policies to decarbonize could also be costly to individual fossil-fuel firms because new research is demonstrating an ability to trace higher carbon emissions to a particular energy producer<sup>17</sup>. This means that it will be increasingly possible to pinpoint the cause of loss from emissions in litigation involving the energy sector. Satellite imagery has also been able to trace the specific source and amount of methane gas emissions, a significant portion of which originates with energy firms<sup>18</sup>. More precision on what energy firms emit and when will raise firm liabilities, creating a further drag on energy stock prices.

### Damage from extreme weather events

Energy firms will suffer more than others from investors' assessments of extreme weather risk because they have substantial production infrastructure in climate-vulnerable locations. For example, a high percentage of US refining capacity is located on the Gulf Coast (for example, in the Houston Ship Channel and Galveston Bay), which is an area exposed to accelerating sea-level rise and higher frequency of more intense storms. In Northern California, the Benicia and Richmond oil refining complexes are exposed to coastal flooding. Additionally, in some western states (for example, California), energy suppliers have located their transmission infrastructure in increasingly arid areas, exposing those energy suppliers to wildfire risk, as the lines themselves can cause the fires. Not only is extreme weather risk underestimated by investors<sup>12,13</sup>, that risk is also amplified for energy firms because of limitations and uncertainties in the ability of these firms to insure themselves against it or recover resulting losses from investors or ratepayers. In fact, in many cases it is not clear whether insurance coverage will be available at all, further adding to this risk.

Prior research may also have underestimated the market impact of stranded assets on energy firm market values. For one, earlier studies of energy firms did not consider the impact of increasingly frequent and severe extreme

weather events, perhaps because they were less extreme at that time. While energy company stocks did drop by a small amount in response to the first news in 2009 of limits to the carbon budget if global temperature rise were to be held to 2 °C<sup>19</sup>, today's evidence suggests that carbon levies would have to swell to well over US\$100 per CO<sub>2</sub> ton for each of the next 80 years for a smooth transition to a low-carbon economy without economic disruptions "comparable to a severe global depression"<sup>20</sup>. During that transition, smooth or otherwise, trillions of energy company assets would have to be written off as stranded, as would the assets of companies in other sectors linked to energy<sup>21</sup>. This risk has yet to be fully priced by the market.

### Looming litigation liability

Beyond operating risks, energy firms currently face legal challenges on many fronts: from state attorneys general seeking damages from lack of disclosure, to cities hoping to recover mitigation and abatement costs from emissions-attributed weather events, to young people alleging emissions-related damages to the natural environment in violation of the common law public trust doctrine. So far, though, the US courts have mostly sided with the energy industry on climate cases. According to data compiled by the Sabin Center for Climate Change Law, only two of hundreds of US climate cases brought against emission emitters have reached the trial stage<sup>22</sup>. The first in 2007 was directed at the automobile industry and the US Environmental Protection Agency and related to emissions standards for cars<sup>23</sup>. The second in 2019 was a bench trial brought by the State of New York against ExxonMobil alleging that the company violated the state's Martin Act by misleading investors about the cost of carbon used for investment decision making. However, on dismissing the case, the New York court sided with ExxonMobil, agreeing that the company did not mislead investors in a material way and, as such, there were no damages<sup>24</sup>.

This doesn't mean energy investors are entirely naive to court decisions on environmental damage. Exxon's stock price dropped nine percent over 15 days following the jury verdict in 1994 to award US\$5 billion in punitive damages regarding the Exxon Valdez oil spill<sup>25</sup>. Nonetheless, whether it be climate-related litigation against ExxonMobil or any other large energy firm alleging improper disclosure of carbon costs, a major obstacle can arise for plaintiffs because a stock purchased at the current market price could well already reflect a higher implicit future cost of carbon regardless of what the firm used for

internal decision making, thus effectively nullifying the price effect of the alleged misrepresentation.

Notwithstanding the New York decision favouring ExxonMobil, several other climate cases against the energy industry are pending, and any one that is successful for the plaintiffs could set off a flood of new litigation against the industry. Should this happen, the climate litigation risk already priced into energy stocks through successful defences in the past could prove highly insufficient.

Any legal decision for plaintiffs against fossil-fuel firms would also strengthen regulators' calls for more disclosure to ensure adequate availability of material information for the public. However, calls by regulators for more detail on the location of facilities and their exposure to physical climate risk would face stiff opposition from energy companies and others. Not only would detailed location and exposure disclosure be costly to implement, but many firms would fear that once implemented the disclosures would reveal company trade secrets and the cost advantages of particular locations to future competitors and rivals. Required location disclosures by energy firms to address extreme weather risk could, therefore, have unintended negative impacts on stock price.

Location disclosures may also help financial markets understand the Green Paradox theory<sup>26</sup>, a notion where anticipation of greater future restrictions on the extraction of fossil fuel in certain (for example, high-carbon intensity) locations combined with the low availability of low-carbon alternatives prompt energy firms to sell as much fossil-fuel energy as possible now before it becomes uneconomic. For example, several major oil and gas companies recently sanctioned US\$50 billion in fossil-fuel investments deployed over 2019–2030 that arguably would not pay for themselves if required to include the full cost of emissions to meet a low carbon scenario in their projections<sup>14</sup>. The recent announcements by Norway's Government Pension Fund Global to divest some of its fossil-fuel holdings and by the Saudi Aramco corporation to offer a small slice of the company's shares to the public are also consistent with the Green Paradox theory. Moreover, such actions support the belief that the market value of fossil-fuel assets is significantly greater today than it will be in the future. That is, for investors and asset managers, the Norwegian and Saudi actions are a further sign of climate risk underpricing. The finding that firms tend to sell equity when they believe their shares are overvalued in the market is well established

in the finance literature more generally. Consistent with market risk underpricing, firms that sell shares to the public also tend to underperform.

### History as guidance

While proprietary climate risk models may help some firms and organizations better understand future conditions attributable to climate change, extreme weather risk is still highly problematic from a risk-estimation standpoint. This is because with climate change the patterns of the past are no guide to the future, whether it be one year, five years, or 20 years out. Investors may also normalize extreme weather impacts over time, discounting their future importance.

Nonetheless, additional disclosure of information in regulatory filings such as the location and exposure of vulnerable energy infrastructure to different kinds of extreme weather risk would be a step in the right direction. Decisions by the courts regarding the liability or otherwise of energy firms as a result of producing and marketing products that contribute to extreme weather would also be a positive step for investors, in that the courts would resolve some of the litigation uncertainty, which would then enable markets to impound extreme weather risk into energy firm stock prices in a more orderly way.

New weather services to generate longer term climate risk forecasts might further ensure more orderly pricing of those risks by investors.

However, one cannot forget a key message of the Stern Report<sup>27</sup>, that investors' obliviousness to the negative externalities of greenhouse gases — much due to human activity — represents "... the biggest market failure the world has seen." So far, energy company shares still shoulder much of that unpriced risk. This means that the market could at some point witness an extreme correction. □

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### Competing interests

The author declares no competing interests.