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SPECIAL REPORT

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EDITOR'S DESK

Perceptions are important. And a widespread perception is that recent climactic events—from typhoons in Asia, to floods in Europe, to "superstorms" such as Sandy in the U.S. — suggest that the effects of a changing climate are already being felt. What this all may mean for debt issuers, and perhaps even for the global financial system, is the subject of one of this week's special reports. Credit analysts and experts from across McGraw Hill Financial—including research teams around the world from Standard & Poor's Ratings Services, Platts, and S&P Dow Jones Indices—have pinpointed the key themes that businesses, industries, and governments are grappling with as they try to predict the physical and financial impact of climate change.

Our special report coincides with Standard & Poor's participation in the United Nations Environment Programme's inquiry into a sustainable financial system. A U.N. goal is to support the transition to a green economy by identifying best practices and exploring financial market policy and regulatory innovations.

As we note, extreme weather events were responsible for 90% of documented natural catastrophe loss events in 2013, causing $124.5 billion of overall losses out of the $135 billion total natural catastrophe losses. Worsening financial performance as a result of climate event risk can weaken both short-term liquidity and long-term debt financing positions, leading to an increase in credit risk. We think industry regulators and investors are likely to focus more closely on climate and carbon risks as an indicator of company performance and, for the latter group, value.

In another special report, on financial companies, we look at how a strengthening U.S. economy, continued access to adequate funding, and the retreat of banks from some types of lending, is creating a very competitive environment for nonbank financial companies. Credit analyst Vikas Jhaveri says: "We expect that stiff competition for market share will be especially noticeable in auto lending, commercial business lending, and, to a lesser extent, commercial real estate lending. At the same time, because the amount of available business is expanding, albeit slowly, we expect that most finance companies will continue to turn a profit in 2014, and that we will issue few rating changes."

For companies that are involved in consumer finance, including payday lenders, money transfer companies, mortgage servicers, and student loan servicers, he says regulation continues to be a risk from a credit rating perspective. "For various reasons these sectors are facing significant scrutiny from state or federal nonbank regulators, and we can't be sure how regulatory issues might affect our ratings in these businesses."

Marguerite Nugent
Managing Editor

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SPECIAL REPORT

CLIMATE CHANGE

Preparing For The Long Term

Overview

- Increasingly, governments and corporations have left behind the question of whether climate change will affect them, and instead are focusing on when and how.
- The corporate bond market's appetite for bonds that promote environmental sustainability is growing.
- We think investors will focus more on climate and carbon risks as an indicator of company value.

From flooding in Europe, to wildfires and drought in the U.S. and Australia, to devastating typhoons in Asia, it's hard to escape the recent stories about extreme weather. Each new event adds to a growing perception that the effects of a changing climate are already being felt—concerns that are shared in many recent reports from the scientific community. The Intergovernmental Panel on Climate Change recently released its fifth assessment, finding that: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia." Similarly, this month's U.S. National Climate Assessment states: "Impacts related to climate change are already evident in many sectors and are expected to become increasingly disruptive across the nation throughout this century and beyond."

These warnings highlight the risks to societies and their economies. Without action to combat the causes of climate change, particularly the greenhouse gases that are held as a common culprit, scientists predict that average global temperatures will continue to increase, sea levels will rise, and extreme weather will become more frequent and severe. These trends will in turn affect resource and energy use, the regulatory environments governing business and finance practices, and how governments and companies measure and mitigate risk—including credit risk.

The issue of climate change is clouded by the politics of the debate. Despite emphatic warnings of the consequences of global warming, a clear consensus has yet to emerge on its source, speed, and the scope of the transformations that could affect our natural world. This creates uncertainty among voters and dilemmas for governments in developing coordinated action plans. The result can be fragmented policies globally that may miss opportunities to generate the best benefits in terms of emissions reductions, or to develop cost-effective clean energy. For both government and industry, the lack of clear signals means that risk mitigation strategies may be delayed or lose out to more immediate problems, leaving businesses and investors vulnerable to rapid policy shifts and the weather itself.

What this all may mean for debt issuers, and perhaps even for the global financial system, is the subject of this special report by analysts and experts from across McGraw Hill Financial. Research teams around the world from Standard & Poor's Ratings Services, Platts, and S&P Dow Jones Indices, have pinpointed the key themes that businesses, industries, and governments are grappling with as they try to predict the physical and financial impact of climate change.

Our special report also coincides with Standard & Poor's participation in the United Nations Environment Programme's (UNEP) inquiry into a sustainable financial system. A U.N. goal is to support the transition to a green economy by identifying best practices and exploring financial market policy and regulatory innovations. As part of the inquiry, Standard & Poor's President Neeraj Sahai will join a round-table discussion co-hosted by UNEP on May 29. Standard & Poor's is also a member of the UNEP Finance Initiative "E-RISC" project working group, which is assessing the role of environmental factors in sovereign credit risk, and is participating in the U.N.'s "Ascent" program, which aims to prepare proposals ahead of climate summits in New York this September and in Paris in November 2015.

We understand that one of the initiatives the Ascent working group is considering is a new extreme weather disclosure requirement for public companies, as has been the norm in the insurance industry. For many years, insurance groups have disclosed the likely impact of natural catastrophic losses on their balance sheets, such as by using models to predict the impact of an event with a once-in-200-year likelihood of occurrence. We understand that leading companies now take weather-related risk into consideration as part of their risk management disciplines, which in turn influences their purchases of insurance protection. Typically they draw on the modeling expertise of insurers or insurance brokers. Under the Ascent proposal, corporations might be asked to disclose the potential impact on their balance sheets, with the expectation that this might create an incentive to plan for climate change, and ultimately reduce losses and save lives. In our view, these disclosures could benefit investors, since they would provide new insights into the resilience of companies to climate change.

A connected thread in all of our reports, outlined below, is the need for deeper, more quantifiable information on both climate scenarios and the actions that businesses, industries, markets, and governments are taking to prepare for them. As the threat of climate change begins to look more acute, this need will likely become more urgent.

Climate Change Is A Global Mega-Trend For Sovereign Risk

For governments, climate change—and specifically global warming—will be the second-most important mega-trend to affect sovereign credit risk through this century, after the effects of aging populations. Key points from our report are that the impact on creditworthiness will mostly be negative and probably be felt via drags on economic growth and public finances. The impact will not be distributed evenly: poorer and lower rated sovereigns will typically be hit hardest, we think, which could contribute to rising global rating inequality.

Are Insurers Prepared For The Extreme Weather Climate Change May Bring?

The frequency of extreme weather events has increased in recent years, but insurance and reinsurance companies have coped well so far. We think the industry has been well prepared to deal with natural catastrophes of the magnitude the world has been experiencing recently, and thus the ratings impact has been limited. Many of the insurers and reinsurers (re/insurers) we rate have processes in place to monitor the potential impact of climate change. That said, while understanding of climate change is still evolving, we believe a sudden spike in the number and severity of extreme events could test the industry.

The Greening Of The Corporate Bond Market

The corporate green bond market, currently at $10.4 billion, is gaining momentum, and we estimate that, based on year-on-year growth trends, it will grow to around $20 billion globally in 2014. In our view, corporate green bond issuance is accelerating not only because it diversifies investor pools for issuers, but also because of investors' growing interest in promoting environmental, social, and governance goals. So far, corporate green bonds have mostly been issued in Europe, generally with investment-grade ratings of 'A+' or 'A', with the oversubscription of many issues to date. We believe this trend is likely to continue, as green issuance shifts from multilateral development banks toward mainstream corporations. In the future, the green project bond market could support the aggregation of environmental projects to form debt obligation

instruments and also refinance existing environmental projects.

Guest Opinion: Green Fixed-Income Indices: A Natural Outgrowth Of The Green Bond Market

According to S&P Dow Jones Indices, the nascent green bond market has reached an inflection point and is poised for take-off. This reflects a number of converging trends:

- Growing investor and public awareness of climate change, and of its potential impact on businesses, human life, and asset values;
- The recognition that a low-carbon pathway for the global economy to keep global temperatures within acceptable limits likely will require vast amounts of long-term cost-effective capital, which only institutional investors can provide via fixed-income instruments that are rated at least investment grade; and
- The development of voluntary criteria and standards for green bonds.

Corporate Carbon Risks Go Well Beyond Regulated Liabilities

Over the next five years, carbon emission regulation likely will extend to cover 40% of global greenhouse gas emissions from 21% currently. In our view, focusing solely on a company's direct liability to regulation may not accurately reflect its full carbon price risk. We believe that a comprehensive analysis of carbon price risk should incorporate both direct and indirect exposure due to the cost of a carbon liability being passed down the supply chain or changing demand for products and services. We have analyzed the impact of carbon pricing on corporate credit from four risk aspects:

- Environmental regulations,
- Emissions market pricing,
- Business risk across the value chain, and
- Financial risk to profitability, cash flow, and asset and liability valuation.

Carbon price risk management strategies that companies have adopted are also helpful in evaluating the net impact of carbon price risk on corporate creditworthiness.

Dealing With Disaster: How Companies Are Starting To Assess Their Climate Event Risks

Climate events can hurt profits, impair asset value, and constrain cash flow. This can weaken a company's liquidity and compromise its ability to raise money and service debt over both the short and long term. In Standard & Poor's opinion, corporate credit quality may suffer if companies fail to implement adequate risk management regarding climate events. We think regulators and investors will start to focus more on climate and carbon risks as an indicator of company performance and value.

Guest Opinion: Climate Policy And The Rise Of Carbon Markets

According to Platts, the world's policy response to climate change has so far been fragmented, resulting in a mix of taxes, cap-and-trade programs, environmental legislation, incentives for renewable energy, and a host of other policies and measures at the local and national level. The policy frameworks—market-based or otherwise—that may work best over the next few years are likely to provide the blueprint for managing emissions for decades to come. This could have implications for long-term investments in energy and manufacturing. In Europe, the world's largest cap-and-trade market appears to be achieving its aim of limiting CO2 emissions at a comparatively low cost. However, the true cost to Europe's economy is unclear, given state subsidies for renewables and other incentives.

Limited Visibility For Climate Change's Effects On U.S. State And Local Government's Credit Quality

In the U.S., municipal and state governments have historically been able to manage the risk of natural disasters without diminishing credit quality. With the exception of catastrophic events, such as Hurricane Katrina, the credit impact of most natural disasters has been limited. Nevertheless, increasing uncertainty caused by changing climate patterns represents a growing risk for local governments that can be difficult to quantify. This risk could result in more credit pressure for local governments if Washington were to not provide timely and sufficient financial relief. The same could be true if a local government's ability to prepare for disasters—for example, through strategies that protect infrastructure and transportation, and control flooding—comes at the cost of financial flexibility and increased leverage.

California's Water System Illustrates The Near-Term Impacts Of Long-Term Climate Change

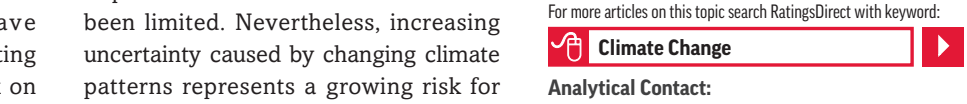
Given the length and severity of California's three-year drought, plus the potential long-term effects of climate change, the state's water agencies are trying to prepare for persistent water shortages. To meet current and future needs, they are developing capital plans whose costs they're assuming now. We expect that funding for these projects will largely come from higher water rates and, to a lesser extent, proceeds from new bonds.

Assessing The Credit Supportiveness Of Europe's Renewable Energy Frameworks

In this Credit FAQ, we address investors' questions regarding how policy frameworks for renewable energy sources have developed across the EU and rank them according to our view of their sustainability and economics. Recent announcements by the U.K. and Germany indicating lower support for some types of renewable energy have fuelled investor uncertainty, which we think could impede renewable energy investment in the EU.

At the moment, there are more uncertainties than answers about the financial and credit impact of global warming. Yet increasingly, governments and corporations have left behind the question of whether climate change will affect them, and instead are focusing on when—and how. **cw**

For more articles on this topic search RatingsDirect with keyword:



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Climate Change Is A Global Mega-Trend For Sovereign Risk

Overview

- Climate change is likely to be one of the global mega-trends impacting sovereign creditworthiness, in most cases negatively.
- The impact on creditworthiness will probably be felt through various channels, including economic growth, external performance, and public finances.
- Sovereigns will probably be unevenly affected by climate change, with poorer and lower rated sovereigns typically hit hardest, which could contribute to rising global rating inequality.

Since the turn of the century, two mega-trends have emerged to dominate public discussion on global economic risks. The first, global aging, is comparatively well-understood and the consequences relatively clear. The second, the impact of climate change, is far hazier and the potential outcomes much more challenging to predict.

For over a decade, Standard & Poor's Ratings Services has been regularly assessing the impact that demographic change is likely to have on sovereign creditworthiness. Our conclusion is that over a multi-decade time horizon the financial consequences of aging societies are likely to overshadow all other economic trends for most sovereigns *(see "Global Aging 2013: Rising To The Challenge," published March 20, 2013 on RatingsDirect)*. We also expect advanced economies will be more negatively affected than sovereigns in emerging markets. In contrast, while most sovereigns will feel the negative effects of climate change to some degree, we expect the poorest and lowest rated sovereigns will bear the brunt of the impact. This is in part due to their reliance on agricultural production and employment, which can be vulnerable to shifting climate patterns and extreme weather events, but also due to their weaker capacity to absorb the financial cost.

Another key difference is time frame. The impact of aging societies is already being felt in several advanced economies, most notably Japan, and will steadily increase through the next few decades. For most sovereigns, their demographic profile is such that the full impact of aging on economic performance and public finances will be felt from the mid-2020s or soon after (note: this is well beyond the time-horizon that can be reasonably applied to a sovereign credit rating). Our understanding of climate change, on the other hand, is still developing and we lack sufficient reliable data to make precise predictions on if and when the effects of a warming planet and changing weather patterns will overshadow other factors. This does not imply we should be complacent in developing a clearer view, however. By its very nature of complex and inter-connected ecological systems, weather is inherently unpredictable and the picture can change suddenly and dramatically for an individual country or region.

Potential Vulnerability To Climate Change

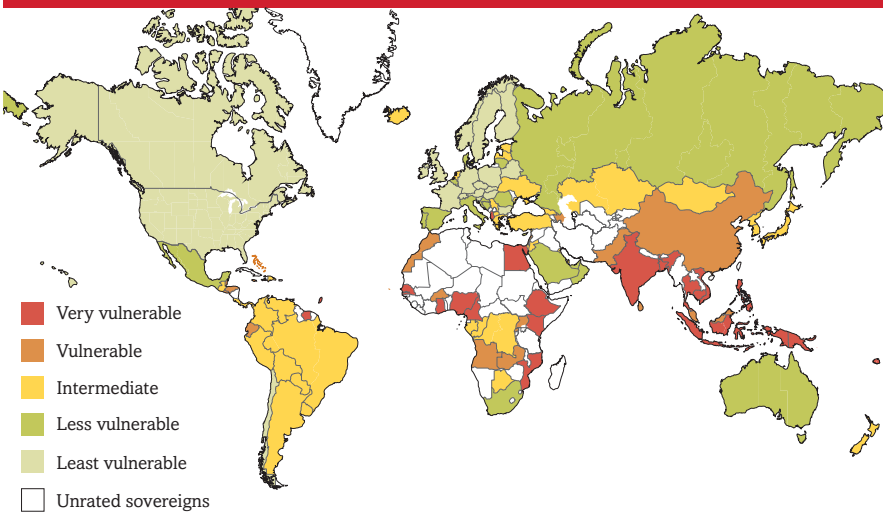


Chart 1 | Lower Rated Sovereigns Are More Vulnerable To Climate Change

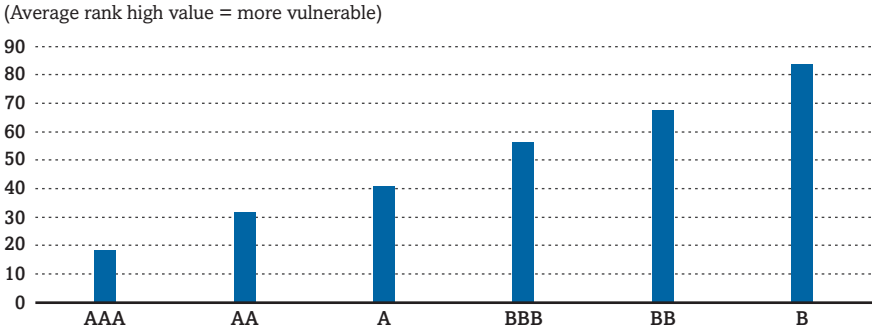
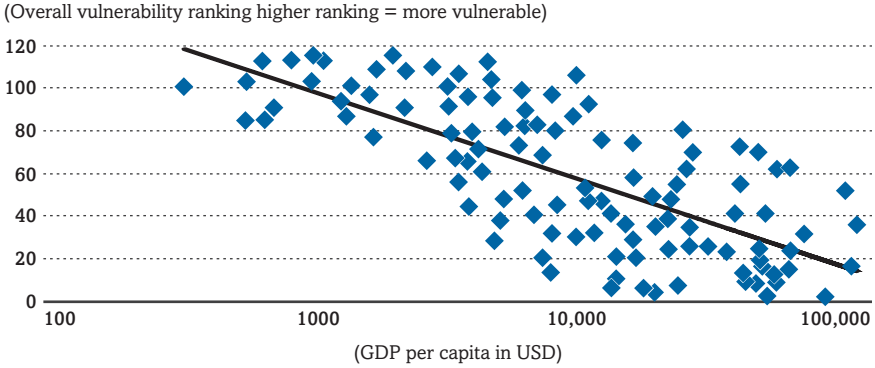


Chart 2 | Vulnerability To Climate Change Is Inversely Related To Prosperity



Climate Change Is More Difficult To Control Than Demographic Change

We believe that alongside aging, climate change, and specifically global warming, is going to be the second global mega-trend affecting sovereign credit risk. We also believe that it will put downward pressure on sovereign ratings during the remainder of this century. However, in our view there are three noteworthy differences that may

The economic and financial consequences are much less-well understood than those of aging societies.

make climate change an even more challenging problem to grasp than the world's shifting demographic.

1. The science is complex.
The economic and financial consequences are much less-well understood than those of aging societies. There remains significant uncertainty about how climate change will impact individual national territories and economies. For example, the fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC) published in 2013 estimates that the average winter temperature in Northern Europe could rise between +2°C to +7°C by 2100. But there is also a chance that the warming in winter will remain within the bounds of a standard deviation of present-day natural variability. Not so in summer, however, where the IPCC estimates that warming is all but unavoidable.

The wide array of possible outcomes can confuse politicians and voters alike and can lead to procrastination and inaction. Even in the case of aging, where financial consequences are generally well-studied and documented, we have seen that remedial action has in most countries been slow and difficult. This is usually because the benefits lie in the distant future whereas some of the unpopular consequences are being felt immediately, conspiring against robust action, especially in societies where leaders need to renew their legitimacy regularly through elections. In addition, as many of the beneficiaries do not yet have a political voice, either because they are too young to vote or they have not been born yet. While this argument can be made equally about the difficulty of enacting measures that might curb greenhouse gas emissions, the political impasse is exacerbated by the much higher uncertainty about future climatic conditions.

2. A global, collective action problem.
The degree to which individual countries and societies are going to be affected by warming and changing weather patterns depends largely on actions undertaken by other, often far-away societies. Unlike in the case of aging, individual societies cannot by themselves meaningfully reduce the impact they will feel as the climate changes. This is the global collective action problem that has been characterizing climate negotiations ever since the seminal Rio summit in 1992. A society may choose to reduce its carbon emissions unilaterally to reduce the risk of the potential consequences of global warming, but due to the global character most of the benefits of that society's sacrifice will accrue to other nations. In game theory, this is the famous prisoner's dilemma: each society would be worse off if it were to act alone to mitigate climate change: the society would have all the pain for negligible gain. On the other hand it would be better-off if it shirked an international concerted mitigation effort that all other societies undertook: the society would have to take no sacrifice while it benefits from the improvements caused by the actions of others. Typically such an incentive structure leads to uncooperative outcomes and to no effective risk mitigation. This is fundamentally different from tackling the aging challenge: a pension reform, for example, will accrue to the society that enacts it and to that society alone. The spillover benefits for other countries are negligible.

3. The impact falls disproportionately on poorer countries.
Despite the complex and sometimes controversial science underlying estimates of global warming, we believe that poorer and generally lower rated sovereigns will be disproportionately hit. In contrast, the aging problem is expected to impact highly rated sovereigns more than those with lower ratings. Our aging simulations suggest that in a no-action scenario, the net general government debt ratio of the advanced economies will rise by 150 percentage points between 2010 and 2050 to reach 216% of GDP. Emerging market sovereigns will experience an average increase of just under 120% points to reach a net general government debt ratio of 149%. In other words, the sovereigns that should be best able to address the aging challenge are hit by it more than proportionately. The opposite is likely to be true in the case of climate change. The most affected can be expected to be poorer and to have less clout in international negotiations, exacerbating the international coordination problem described above.

How Climate Change Can Impact Sovereign Ratings

Extreme weather events, such as tropical storms or floods, seem to have been on the rise since the early 1980s. Data collected by MunichRe, a reinsurer, suggest that weather-related loss-events have risen in all continents, most significantly in Asia and North America, where they increased more than fourfold. In Eastern Asia overall losses (insured and non-insured) used to be below $10 billion per year, but have regularly surpassed $20 billion during the last decade with a peak of over $50 billion (1). Typhoon Haiyan hitting The Philippines in November 2013 has been a powerful and hugely destructive reminder of this trend.

Despite the grave loss of life and the devastation caused by extreme weather events, Standard & Poor's has not revised the rating of a sovereign as a consequence. We have taken a view that the size of the devastation, while large in absolute terms, has so far not been sufficient to impact the rating overall. However, assuming that extreme weather events are on the rise in terms of frequency and destruction, how this trend could feed through to our ratings on sovereign states bears consideration.

We analyse sovereigns by applying our ratings methodology *(see "Sovereign Government Rating Methodology And Assumptions," published June 24, 2013)*. This incorporates the

specific assessment of five key factors: institutional and governance effectiveness, economic structure and growth prospects, external liquidity and international investment position, fiscal performance and flexibility, and monetary flexibility. Unless environmental disasters undermine national institutions and governance to an unprecedented degree (e.g. through massive population migration or political instability), we believe that the main factors through which climate change could feed through to sovereign creditworthiness are economic, fiscal, and external performance.

Economic performance.

There are multiple channels through which climate change can affect the growth prospects of national economies and eventually levels of prosperity. Some of the most potent may be changing patterns of rainfall that can reduce agricultural yields via repeated and prolonged droughts, heat waves and wildfires, or floods. The productivity of the broader workforce could also be negatively impacted if weather events affect sanitary conditions negatively, spreading pests or diseases, increasing morbidity. This may become a particular burden for populations living in low areas close to sea-level, where rising sea-levels in the context of global warming will not only flood agricultural and densely populated urban areas, but where a rising water table could lead to salinization of the population's water supply.

Extreme weather events, especially floods, can be expected to increasingly take a toll on a country's infrastructure and thus productivity, exacerbating weakening endowment of productive infrastructure observable in a number of countries *(see "Cracks Appear In Advanced Economies' Government Infrastructure Spending As Public Finances Weaken," Jan. 14, 2014).* The most direct and tragic economic cost is of course the loss of life, such as the more than 6,000 deaths estimated in the Philippines in the aftermath of typhoon Haiyan. In China, an average 3,000 flood-related deaths are estimated to have occurred each year since 1980. During the 1990s, flood losses oscillated to 2% of Chinese GDP per year, before dropping to below 1% as a consequence of enhanced flood management (2).

How climate change will impact GDP growth is highly uncertain. Some research estimates the annual consumption loss in 2100 as a fraction of global GDP would be around 2%, but jump to well over 5% should the annual global temperature

Vulnerability To Climate Change

		—Population living below five meters altitude (2000)—		—Agriculture as share of GDP (2012)—		—GAIN Vulnerability Index (2012)—	
Overall ranking	Sovereign	Rank	(%)	Rank	(%)	Rank	Index
116	Cambodia	90	10.6	113	35.6	106	0.500
115	Vietnam	112	42.8	103	19.7	90	0.381
114	Bangladesh	98	14.0	100	17.7	104	0.495
113	Senegal	100	14.8	96	16.7	100	0.472
112	Mozambique	71	6.5	109	30.3	109	0.513
111	Fiji	91	11.0	91	13.2	97	0.422
110	Philippines	89	10.5	87	11.8	91	0.382
109	Nigeria	46	3.0	111	33.1	108	0.503
108	Papua New Guinea	35	2.0	114	35.9	107	0.502
106	Indonesia	92	11.2	92	14.4	70	0.335
106	Suriname	116	68.2	77	9.3	61	0.306
105	Ethiopia	22	0.4	116	46.4	115	0.547
103	Albania	81	8.2	101	18.3	68	0.333
103	Kenya	29	1.4	108	29.9	113	0.530
101	Congo (Democratic Republic of)	17	0.0	115	44.9	116	0.572
101	India	51	3.8	99	17.5	98	0.427
100	Egypt	110	25.6	93	14.5	44	0.284
99	Thailand	96	13.8	88	12.3	62	0.308
97	Ghana	39	2.3	105	22.7	101	0.473
97	Grenada	105	21.7	57	5.7	83	0.355
96	Cape Verde	97	13.8	69	7.8	78	0.349
95	Belize	102	15.8	90	13.1	50	0.293
94	Pakistan	27	1.3	106	24.4	99	0.430
92	Malaysia	86	9.5	81	10.1	63	0.310
92	Morocco	50	3.8	94	14.6	86	0.365
91	Honduras	38	2.2	95	14.8	95	0.402
90	Burkina Faso	1	0.0	112	35.3	114	0.533
88	Angola	36	2.1	80	10.0	110	0.516
88	Cameroon	20	0.3	104	19.7	102	0.474
87	Lebanon	84	9.1	61	6.1	80	0.350
86	Rwanda	1	0.0	110	33.0	111	0.521
85	Uganda	1	0.0	107	25.9	112	0.522
82	China	80	8.1	82	10.1	57	0.303
82	Ecuador	76	7.3	79	9.9	64	0.316
82	Jamaica	68	5.8	66	6.7	85	0.362
80	Azerbaijan	111	29.8	56	5.5	50	0.293
80	The Bahamas	113	46.5	27	2.1	77	0.348
79	Sri Lanka	66	5.4	83	11.1	67	0.332
78	El Salvador	33	1.7	86	11.8	92	0.384

rise twice as fast as in the current scientific baseline scenario (3). The estimates for specific regions or even countries are even more variable, as the IPCC's *"Atlas of Global and Regional Climate Projections"* illustrates. But the evidence suggests that it is probably safe to expect that for most national economies, other things being equal, climate change will negatively impact national welfare and economic growth potential. Observations corroborating this expectation could lead Standard & Poor's to lower sovereign ratings on the most affected sovereigns.

Vulnerability To Climate Change (continued)

		—Population living below five meters altitude (2000)—		—Agriculture as share of GDP (2012)—		—GAIN Vulnerability Index (2012)—	
Overall ranking	Sovereign	Rank	(%)	Rank	(%)	Rank	Index
77	Zambia	1	0.0	102	19.6	105	0.497
76	Gabon	69	5.9	50	3.9	83	0.355
74	Barbados	101	15.7	17	1.5	81	0.352
74	Latvia	109	23.9	51	4.1	39	0.263
73	Dominican Republic	45	3.0	60	6.1	93	0.399
72	New Zealand	94	12.6	65	6.6	36	0.259
71	Mongolia	1	0.0	97	17.1	93	0.399
70	Iceland	95	13.1	68	7.3	27	0.236
69	Bahrain	115	66.6	3	0.0	71	0.339
68	Peru	32	1.7	67	7.0	88	0.370
67	Guatemala	21	0.3	85	11.6	78	0.349
66	Bolivia	1	0.0	89	13.0	89	0.378
65	Georgia	47	3.3	72	8.5	59	0.304
62	Korea, Rep.	64	5.0	36	2.6	76	0.347
62	Kuwait	107	22.8	4	0.1	65	0.321
62	Singapore	93	12.1	2	0.0	81	0.352
61	Paraguay	1	0.0	98	17.4	75	0.345
58	Argentina	61	4.5	75	9.1	37	0.262
58	Panama	53	4.0	49	3.9	71	0.339
58	Uruguay	62	4.7	70	8.4	41	0.274
57	Brazil	63	4.9	55	5.2	53	0.296
56	Congo (Democratic Republic of)	25	1.0	41	3.4	103	0.489
55	Japan	103	16.2	13	1.2	48	0.290
54	Malta	106	21.8	23	1.9	33	0.256
52	Qatar	108	23.1	1	0.0	52	0.294
52	Serbia	19	0.1	73	9.0	69	0.334
51	Costa Rica	24	0.8	62	6.3	74	0.343
49	Estonia	74	7.2	52	4.1	31	0.253
49	Greece	88	9.9	40	3.4	29	0.246
47	Jordan	58	4.2	39	3.1	59	0.304
47	Turkey	40	2.4	74	9.1	42	0.277
46	Venezuela	49	3.7	58	5.8	46	0.285
45	Colombia	34	2.0	64	6.5	54	0.298
44	Ukraine	37	2.1	76	9.3	37	0.262
41	Israel	82	8.3	34	2.5	33	0.256
41	Kazakhstan	52	3.9	53	4.7	44	0.284
41	Netherlands	114	61.3	22	1.7	13	0.191
40	South Africa	23	0.5	35	2.6	87	0.366
39	Oman	67	5.5	12	1.0	65	0.321

Fiscal performance.

The potential negative impact on growth will by itself weigh on public finances as tax revenues are likely to lose buoyancy if the underlying national economy falters. Government budgets could come under additional pressure as disaster recovery and emergency support for affected populations is likely to fall on the state in most cases. The same can be expected for the reconstruction of economic and social infrastructure. This can be a large burden for the public budget and, contrary to the fiscal impact from aging societies, it can hit the budget without much prior notice. An extreme example of a natural disaster (although not weather-related) overwhelming the government's financial capabilities has been the violent volcanic eruption on the small Caribbean island of Montserrat in July 1995, which rendered half of the island uninhabitable. The island, being an overseas territory of the U.K., was able to cope due to extremely significant foreign grants, which continue to contribute roughly half of its GDP for budget support and infrastructure investment *(see: "Montserrat," published Nov. 8, 2013)*. Larger economies would not be able to count on external support on the same scale, especially if climate-related fiscal pressures were to increase in many countries simultaneously. National budgets would invariably come under additional strains, potentially putting downward pressure on sovereign ratings as debts and deficits mount.

External performance.

Some nations depend on exports of agricultural products for foreign currency. With erratic weather patterns or increasingly frequent droughts or floods undermining the export base, the adequacy of foreign reserves may become threatened as trade imbalances rise. Of course

national currencies could depreciate to an extent to recalibrate imports and exports, but this would in many cases come at the price of rising inflation and falling levels of prosperity. Should episodes of bad harvests increase, emergency food imports may be required, once again putting pressure on the country's external accounts. Should global food production stagnate as climate conditions change, prices for agricultural goods would permanently increase. Terms of trade of net food importers would worsen, putting pressure on their external accounts, which in turn could increase the downside risks for sovereign ratings.

Lower-Rated Sovereigns Appear More Exposed

Great uncertainty still remains about if, how, and when various economies could be affected by climate change. Nevertheless, there are various ways through which we can attempt to gauge the vulnerability of individual sovereigns. While there is no single best measure to measure the degree to which various economies are exposed to the risks, we can use a composite of three different variables to capture different facets of potential vulnerability and arrive at a crude ranking:

1. Share of the population living in coastal areas below five meters of altitude. The livelihood and economic production of that population may be at risk should sea levels rise in the course of global warming *(World Bank, World Development Indicators)*.
2. Share of agriculture in national GDP. This measures the risk to the sector that is typically most dependent on climatic conditions. *(World Bank, World Development Indicators, Food And Agriculture Organization Of The United Nations Statistical Yearbook 2012)*
3. The vulnerability index compiled by Notre Dame University Global Adaptation Index (ND-GAIN), which measures the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change. The index includes three components: exposure, sensitivity and adaptive capacity.

For each of the three variables, we rank the 116 rated sovereigns for which all three variables are available. A rank number of 1 indicates lowest vulnerability, a rank of 116 the highest. Finally, we assign an overall rank of vulnerability

Vulnerability To Climate Change (continued)

		—Population living below five meters altitude (2000)—		—Agriculture as share of GDP (2012)—		—GAIN Vulnerability Index (2012)—	
Overall ranking	Sovereign	Rank	(%)	Rank	(%)	Rank	Index
38	Macedonia	1	0.0	84	11.5	57	0.303
36	Trinidad and Tobago	78	7.5	6	0.6	56	0.302
36	United Arab Emirates	77	7.3	9	0.7	54	0.298
35	Russian Federation	43	2.9	48	3.9	47	0.289
34	Cyprus	87	9.7	26	2.1	24	0.227
32	Botswana	1	0.0	38	2.9	96	0.421
32	Mexico	42	2.7	45	3.6	48	0.290
31	Australia	75	7.2	31	2.4	28	0.239
30	Romania	44	2.9	59	6.0	30	0.251
29	Lithuania	55	4.0	42	3.5	35	0.257
28	Bosnia and Herzegovina	18	0.1	71	8.4	40	0.272
26	Saudi Arabia	26	1.0	28	2.2	73	0.341
26	Spain	72	6.6	33	2.5	22	0.214
24	Belgium	99	14.3	10	0.7	17	0.205
24	Portugal	65	5.2	29	2.3	32	0.255
23	Italy	79	7.5	25	2.0	21	0.212
22	Denmark	104	18.5	16	1.4	2	0.145
21	Croatia	48	3.4	54	5.0	19	0.207
20	Chile	31	1.6	46	3.6	43	0.282
19	Bulgaria	30	1.5	63	6.4	23	0.223
18	Finland	59	4.4	37	2.7	12	0.189
16	Ireland	73	6.6	19	1.6	14	0.194
16	Norway	85	9.3	14	1.2	7	0.162
15	Sweden	70	6.3	18	1.6	17	0.205
14	Belarus	1	0.0	78	9.7	25	0.230
13	Canada	54	4.0	21	1.6	26	0.234
12	U.K.	83	8.6	7	0.7	8	0.165
10	Poland	41	2.5	44	3.5	3	0.150
10	U.S.	57	4.1	15	1.2	16	0.199
9	France	56	4.0	24	2.0	5	0.151
8	Germany	60	4.4	11	0.8	3	0.150
7	Slovenia	28	1.3	32	2.5	10	0.171
6	Hungary	1	0.0	43	3.5	20	0.211
5	Slovak Republic	1	0.0	47	3.9	11	0.188
4	Czech Republic	1	0.0	30	2.4	9	0.168
3	Austria	1	0.0	20	1.6	15	0.195
2	Switzerland	1	0.0	8	0.7	6	0.156
1	Luxembourg	1	0.0	5	0.3	1	0.129

GAIN–Global Adaption Index.

All of the sovereigns in the Top-20 most vulnerable nations are emerging markets, and almost all of them are in Africa or Asia.

which is derived by ranking the sum of the three ranks for each of the three indicators. For example, the average of the three variable-specific ranks of Cambodia is 103. This is the highest average rank number of any of the rated sovereigns included. Therefore, we assign Cambodia the highest possible overall rank of 116, being the most vulnerable to climate change by this measure, followed by Vietnam, Bangladesh, and Senegal.

All of the sovereigns in the Top-20 most vulnerable nations are emerging markets, and almost all of them are in Africa or Asia. In contrast, in the Bottom-20 least vulnerable advanced economies dominate, with Luxembourg, Switzerland, and Austria the least vulnerable in the whole sample *(see map for a simplified geographical representation)*.

As we can see from chart 1, lower-rated sovereigns tend on average to be more vulnerable than higher-rated sovereigns. The average vulnerability rank of 'AAA'-rated sovereigns is 18; that of the 'B'-rated sovereigns 84. This indicates that over a long time horizon, climate change could contribute to diverging ratings. Sovereign ratings could diverge further if the lowest-rated sovereigns do in fact experience the greatest impact from changing weather patterns and rising sea levels. The more vulnerable sovereigns also tend to be poorer *(see chart 2),* which makes it especially challenging for them to invest in mitigation measures that would help them to adapt to changing climate patterns.

Upcoming negotiations under the United Nations framework could alter the picture for global action on climate change. The Paris conference scheduled for the end of 2015 is aimed at achieving a legally binding and universal agreement, while a leader's summit in New York in September 2014 is likely to mark the starting point for a year of intense political manoeuvring. It's too early to say whether these forums will produce a clearer consensus on global policy or significant changes to emissions targets. Either way, we expect the significance of this mega-trend in assessing sovereign risk to only increase over coming decades, as evidence of the economic implications of climate change and extreme weather events becomes ever more visible. **cw**

NOTES

(1) MunichRe (2013): "*Severe Weather in Eastern Asia: Perils, Risks, Insurance*" (Figure 5).
(2) Cheng X. and Zhang D. (2011): "*Recent Trend of Flood Disasters and Countermeasures in China*". In Chavosian A./Takeuchi K.: "*Large Scale Floods Report,*" ICHARM, Tsukuba, Japan. (p. 192-196).
(3) Nicolas Stern (2013): "*The Structure of Economic Modelling of the Potential Impacts of Climate Change: Grafting Gross Underestimation of Risk onto Already Narrow Science Models,*" Journal of Economic Literature 51(3), p. 839-859.

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Are Insurers Prepared For The Extreme Weather Climate Change May Bring?

Overview

- Weather volatility and frequency, whether or not a direct result of climate change, are on the rise, and so are losses for insurers and reinsurers.
- The ratings impact of weather-related natural catastrophes so far has been limited, because re/insurers have comfortably absorbed the losses associated with them.
- We take a favorable view of re/insurers that are considering the additional challenge that climate change poses in modeling extreme weather events, and its implications for exposure management.
- An increase in the severity and number of extreme weather events could trigger negative rating changes, especially if they severely weaken a re/insurer's capital.

Whether or not a direct result of climate change, the number and frequency of extreme weather events have increased, but insurance and reinsurance companies have coped well so far. Standard & Poor's Ratings Services believes the industry has been, and remains, well prepared to deal with natural catastrophes of the magnitude the world has been experiencing recently. For that reason, the ratings impact of these natural catastrophes has been limited. Our view is that many of the insurers and reinsurers (re/insurers) we rate have processes in place to monitor the potential impact of climate change. That said, while the understanding of climate change is still developing, we believe a sudden spike in the frequency and severity of weather events could test the industry.

Many Insurers Are Already Watching Out For Climate Change

We've observed an increase in the occurrence as well as in the economic and insurance impact of extreme weather events in past decades. While climate change may be one factor, others are amplifying this trend: the accumulation of wealth, inflation, and the effects of population growth in higher-risk locations.

More recently, we've observed a series of unusual weather events, such as the record-breaking typhoon in the Philippines; floods in Central Europe, the U.K., and Canada; and Superstorm Sandy. Despite the major economic and social impact of these events, the insurance industry was able to comfortably absorb the losses associated with them.

Still, many re/insurers are monitoring the possible implications of climate change for their businesses as a part of their emerging risk management. According to the 2013 climate survey by the California insurance regulator of the 1,069 re/insurers responding (which includes subsidiaries of the major international groups) around 75% consider the impact of climate change on their business. However, even those that have invested the most in understanding the impact of climate change currently don't explicitly allow for it in their pricing and modeling. One reason: They expect the impact will be felt only five or 10 years or more down the road.

Industry Would Like More Climate Change Certainty

We agree with some of the views of the industry that if climate change is happening, it may have a widespread impact in the long term, but isn't likely to contribute significantly to the size of the weather-related claims the industry expects in the next few years at least. Moreover, we believe the non-life insurance business, typically based on yearly contracts, is well positioned to gradually factor in any costs related to climate change as they emerge. We consider that re/insurers have the processes in place to ensure that they can adjust premiums for any gradual increase in weather-related claims.

Some scientists believe that climate change may lead to an increase in both the size and frequency of extreme events. However, due to the complexity of climate systems, there is significant uncertainty about the exact impact. Until a consensus emerges, we don't expect the industry to directly allow for the impact of climate change. Such a consensus may be achievable if the scientific evidence becomes stronger. It is possible that the industry may incorporate it explicitly into their pricing and exposure management only after climate change clearly leads to a series of extreme events. This may nevertheless prove to be too late for some of the more weakly capitalized players or those with limited reinsurance protection against extreme events.

Our view is that climate change is another factor contributing to the challenges of modeling extreme weather events. For that reason, we take a favorable view of re/insurers that consider how climate change, despite its uncertainties, may affect extreme events in capital modeling and exposure management. Disregarding the possible impact of climate change may lead re/insurers to accept higher catastrophic risk than their risk appetite would usually allow. This could result in large losses and capital depletion if it turns out that climate change is indeed increasing the likelihood of extreme events.

Exposure Management Helps Mitigate Weather Risk

Re/insurers generally have been able to manage the impact of the extreme weather events over the past two years because of their risk diversification, as well as their effective underwriting, risk management, and risk mitigation practices. That said, while the events were extreme, they were not of historic proportions, and the related losses were well within the re/insurers' risk appetite and excess capital.

Even though variations exist, most of the re/insurers we rate are typically well diversified across several lines of business and geographies. As a result, only a part of their business, typically their

property and motor books, are likely to be exposed to extreme weather-related claims. In addition, it is highly unlikely that extreme weather events will involve a significant proportion of a geographically diversified re/insurer's business at any one time (but this may not be the case for smaller, less diversified insurers). Furthermore, the reinsurance process ensures the sharing of risk across many companies and geographies.

Through their underwriting, re/insurers select or reject risks. In that way, they can refuse to take on what they may consider to be excessive exposure to the impact of extreme weather events, for example, flood-prone properties. Depending on their jurisdiction, re/insurers may be able to apply exclusions, limits, excesses, or deductibles to control their exposure to extreme events. In addition, they can quickly adjust prices for observed and expected changes in weather patterns. That's because most of the business exposed to extreme weather is renewable annually.

Many re/insurers have sophisticated risk management systems in place. This allows them to quantify and manage their exposure to extreme weather events within their risk appetite. Typically, risk appetite depends on risk preferences, capital position, and strategic focus. The risk appetite for extreme weather events usually relates to the amount of losses a re/insurer is willing to accept at different levels of severity relative to earnings and risk-adjusted capital.

The main risk mitigation tool for re/insurers is active risk selection and reinsurance. Reinsurance helps protect their balance sheets in the event of extreme events. In addition, some insurers use reinsurers to reduce the volatility of their earnings in the event of major but less extreme catastrophic events.

Some re/insurers have a comprehensive framework for emerging risk management in place, which allows them to monitor new risks, such as those in the area of climate change. Such processes allow them to take steps to manage their risk exposure by adjusting their risk profile and pricing before fully experiencing the impact of the changes.

While the opportunity appears obvious, careful risk management is crucial for success.

Excessive risk selection and the application of exclusions can constrain the industry's ability to provide protection. We see this happening for extreme weather events, where the economic costs of extreme weather are increasing faster than insurance costs. The insurance industry may have an opportunity to close the gap through expansion into less understood geographies, taking steps to boost demand for insurance protection, and product innovation. While the opportunity appears obvious, careful risk management is crucial for success.

How We Analyze Weather Risk

Our ratings incorporate our assessments of a re/insurer's business and financial profiles. As part of the business profile assessment, we analyze the company's diversification and the inherent risk of the insurance markets where it operates, where we include an allowance for the exposure to and possible severity of extreme weather events.

Our assessment of the financial profile includes our prospective view of capital adequacy, which incorporates one-in-250-year annual catastrophe losses (that is, the amount of annual losses with a probability of 0.4% of being exceeded) in our capital model as well as our average expectations for the impact of catastrophe losses on earnings. Although climate change may affect the magnitude or frequency of such extreme weather events, there is no scientific agreement about the precise quantitative impact, which the industry could use in its natural catastrophe models. Therefore, during our rating discussions with a re/insurer, we look to understand whether and how the company may reflect that uncertainty in its capital and exposure management.

In addition, we perform an extensive catastrophic risk survey, which gives us insight into a re/insurer's exposure to extreme weather events and how the company models and manages its exposure. The analytical tools we employ include our analysis of catastrophic risk controls and modeling, benchmarking of a company's risk exposure relative to capital and earnings on a relative and absolute basis, and benchmarking of actual against modeled losses after an event. We also reflect the sensitivity of a re/insurer's capital position to major events in our risk position assessment.

Furthermore, in our ratings we incorporate our view of a re/insurer's capabilities to manage its exposure to extreme events, as we discussed above: quality of underwriting, adequacy of pricing and modeling of exposure to extreme events, quality of risk management, and effectiveness of reinsurance protection.

Extreme Events Could Trigger Rating Changes

Since 2012, we have not taken any rating actions on re/insurers as a direct result of weather events as their impact was within risk tolerances for moderate catastrophic events. Nevertheless, we have slightly raised our assumptions about expected catastrophic loss in some regions as a result of increased average annual losses from weather-related activity. For example, in the U.S., we have revised upward our expectation about the weight of natural catastrophe losses on the combined ratio in an average year to around 4 to 5 percentage points from 3 points. (The combined ratio is the industry's main profitability measure comparing claims costs to premium revenue where 100% and above indicates profitability.)

We don't expect that weather events, on a similar scale to those in the past

two years, will lead to rating changes. We believe that even a gradual increase in weather losses won't affect the ratings because most re/insurers we rate have the processes in place to factor such a change into their underwriting. However, if there is an increase in the occurrence of extreme weather events, this could trigger negative rating actions, particularly if they weaken re/insurers' capital positions.

In determining whether there is a rating impact after an event, we assess capital adequacy for the current and next two years, allowing for the prospect of typically higher natural catastrophe margins to regenerate capital. To assess the extent to which companies can benefit from rate hardening (or higher prices on policies), we consider their competitive position and ability to raise sufficient capital to take advantage of those opportunities.

So, what weather events may cause rating changes? Generally speaking, those where the capital impact for insurers goes beyond their reinsurance protection, or that result in defaults of reinsurers that provide a significant proportion of their reinsurance protection. As an insurer's reinsurance protections typically cover it against the annual impact of events as severe as those it expects to experience once every 200 to 250 years or even less frequently, we expect that only very extreme weather events can cause rating changes in and of themselves. For reinsurers, the potential for a downgrade depends on their current capital levels and any threat to their own reinsurance protection. However, widespread rating changes of global reinsurers are unlikely unless the wider industry racks up total losses that exceed those we expect to occur no more frequently than once in 250 years *(see "Earnings Tolerance Is Key To Assessing Reinsurers' Catastrophe Risk Exposure," published Sept. 10, 2013, on RatingsDirect).*

In the past decade, the biggest losses from weather events occurred in 2005 following hurricanes Katrina, Wilma, and Rita. Those losses were either the main reason or a contributing factor to our downgrades of four of more than 130 reinsurers that we rate. However, despite the severity of the losses, we affirmed our ratings on the vast majority of the affected reinsurers because the capital they raised, along with favorable pricing conditions, offset the impact of the losses on their capital. More recently, the 2011 flood in Thailand, which was a very extreme event in the region, led to rating changes on several Asia-based re/insurers.

The impact of only very severe weather events is likely to lead to rating changes in and of themselves. However, major but less severe weather events may still upset the financial markets, and subsequent financial losses, together with the direct weather losses, may weaken the capitalization of some re/insurers enough to warrant a rating change.

We consider that the re/insurance industry is well prepared to deal with possible gradual increases in extreme weather events, whether or not they're linked to climate change. As such, we don't expect climate change per se to have a ratings impact over the next three to five years, unless it causes a sudden increase in the number and magnitude of extreme events. Meanwhile, we will continue to follow developments in the field of climate change. If needed, we'll revise our base case assumptions and capital stresses for weather-related losses and reflect them in our rating process.

Under Standard & Poor's policies, only a Rating Committee can determine a Credit Rating Action (including a Credit Rating change, affirmation or withdrawal, Rating Outlook change, or CreditWatch action). This commentary and its subject matter have not been the subject of Rating Committee action and should not be interpreted as a change to, or affirmation of, a Credit Rating or Rating Outlook. **cw**

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Corporate Carbon Risks Go Well Beyond Regulated Liabilities

EDITOR'S NOTE: Please see the full version of this article, published May 22, 2014, on RatingsDirect.

Investors are paying increasing attention to the impact of carbon and climate risk on corporate credit quality, yet their focus has largely been on regulated liabilities that reflect direct risks from regulations such as emissions trading schemes and other carbon pricing mechanisms. Outside of highly polluting industries, however, few companies recognize or account for the cost of carbon on their operations. Standard & Poor's Ratings Services believes that investors can address this shortcoming with a more thorough assessment of carbon price risks—from the raw materials supply to end demand—giving management and investors greater insight on the effects of carbon price risk across the business.

Overview

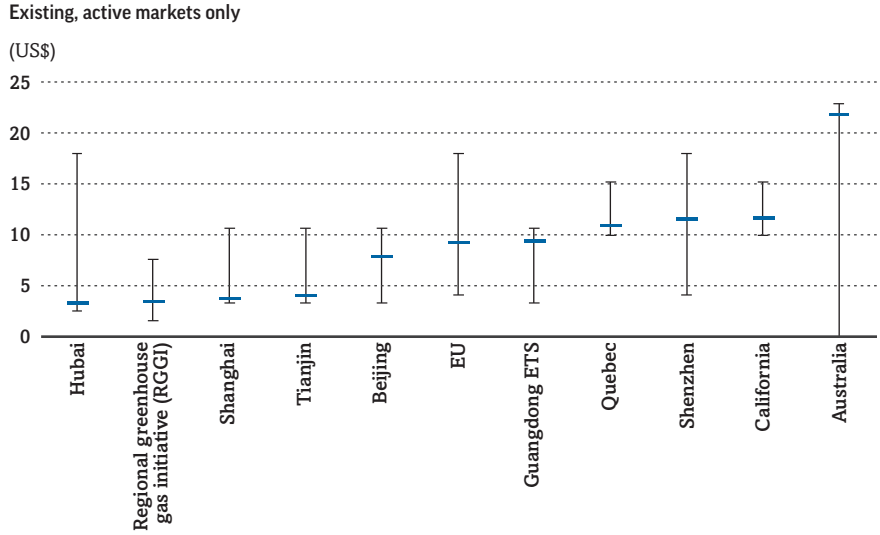
- Over the next five years, carbon emissions regulation will extend to cover 40% of global greenhouse gas emissions, from 21% currently.
- In our view, focusing solely on a company's direct liability to regulation may not accurately reflect its full carbon price risk.
- We believe that a comprehensive analysis of carbon price risk should incorporate both direct and indirect exposure due to the cost of a carbon liability being passed down the supply chain or changing end demand for products and services.
- We have analyzed the impact of carbon pricing on corporate credit from four risk aspects: environmental regulations, emissions market pricing, business risk across the value chain, and financial risk on profitability, cash flow, and asset and liability valuation.
- Carbon price risk management strategies that companies have adopted are also helpful in evaluating the net impact of carbon price risk on corporate creditworthiness.

A Comprehensive View Of Carbon Price Risk

We believe that focusing solely on a company's direct liability to emissions regulation may not fully reflect its true carbon exposure because such a narrow focus ignores the indirect carbon price risk that affects almost all companies to some degree.

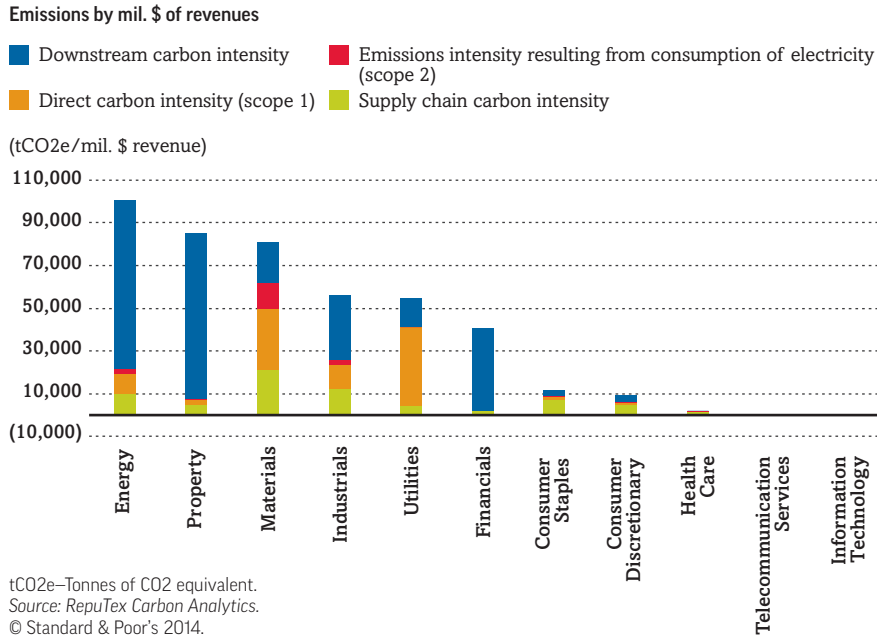
A more complete analysis assesses carbon price risk across all of a company's operations (an approach that RepuTex Carbon Analytics, an independent research firm, refers to as the value chain). This takes account of direct and indirect carbon risks, the latter covering changes in supply and demand for products and services, and potential increases in input costs due to changing market prices. It results in a more comprehensive assessment of a company's carbon exposure and can also identify potential business opportunities. The main factors influencing a company's financial exposure to carbon risk operate through regulation, supply chains (upstream emissions), and changes in demand for products and services (downstream emissions).

Chart 1 | Trading Range Of Global Carbon Prices



Source: RepuTex Carbon Analytics.

Chart 2 | Breakdown Of Carbon Intensity By Industry



tCO2e—Tonnes of CO2 equivalent.
Source: RepuTex Carbon Analytics.

Regulation Risk

Regulation across the globe

Emissions trading is the most widespread form of carbon regulation governments have applied to meet greenhouse gas (GHG) emissions reduction targets in line with their obligations under the Kyoto Protocol. So-called cap-and-trade schemes require companies to operate under a GHG emissions cap, and source permits to cover their emissions output. Companies can acquire emissions permits via free allocations from regulators, by purchasing them at auction, or by accessing secondary markets.

The European Emissions Trading Scheme (ETS) is the world's largest and most established carbon market, covering over 2 billion tonnes of GHG emissions across more than 11,000 installations in 31 countries. Since the EU ETS launched in 2005, emissions trading regulation has spread worldwide, with 17 countries currently planning or running a carbon price mechanism. According to the World Bank, emissions trading regulation currently covers approximately 10 billion tonnes of GHG emissions—equivalent to 21% of global emissions. By 2020, it estimates that emissions trading policy will cover more than 40% of global emissions, equivalent to 19 billion tonnes of GHG emissions.

Outside the EU, emissions trading operates in the U.S., China, Australia, and Canada *(see table 3)*. More markets are likely to be created by governments, for example Washington State in the U.S. just launched a new Carbon Emissions Reduction Task Force to propose legislation in 2015. Market

integration is another trend. For example, China is working to establish a nationwide emission trading scheme by 2015 following its successful operation of emissions trading market pilots in several major cities.

Emissions market trading price, pricing mechanism, and risk

While some countries favor carbon taxes on emissions output, most major jurisdictions have adopted a form of emissions trading. The current average carbon price worldwide is $10 per tonne of CO2 equivalent (CO2e), with Australia's fixed carbon price of $22 per tonne the highest and that in China's Hubei and the North American Regional Greenhouse Gas Initiative the lowest at $4 *(see chart 1, which depicts forecast trading range of carbon price by market from 2015 to 2020 based on spot price information and RepuTex forecasts. Marker represents trading price as of May 5, 2014)*.

The degree to which carbon trading and prices operate as market-based mechanisms differs by country. In established markets such as Europe and California, the price is largely free-floating, determined by supply and demand and regulatory policy. In these markets, the price of carbon is set by a defined quantity of emissions allowances (supply), which is fixed, versus company emissions (demand), which vary based on a range of factors such as weather conditions and temperature, economic conditions, industrial production, and energy prices, notably for gas and oil.

Other emissions trading markets, such as China's pilot schemes, operate in a different economic context, where political, regulatory, and financial conditions may differ from a traditional Western setting. For example, in China, capital markets have not played a large role given government restrictions on participation. Furthermore, market transparency is low, with little information on company emissions and energy usage data, which are highly sensitive. As a result, while China's pilot schemes are free-floating, they are not traditional market-based mechanisms as in Europe.

This is also the case in Australia, which has adopted a hybrid carbon tax-emissions trading scheme, where regulations fix the domestic carbon price in the initial years, rising from A$23 per tonne of CO2e in 2012 to 2013 to A$25.40 per tonne in 2014 to 2015, before converting to a floating carbon price from 2015 to 2016. That said, current government policy in Australia is to abolish this system and replace it with a direct action scheme, about which details are scant. The government is unlikely to be able to do this until July 1, 2014, when the new senate convenes.

As a result, while most global carbon prices are free-floating, many remain subject to policy settings, trading rules, and market structures. This means that, unlike traditional commodities markets, governments are more likely to control carbon prices to ensure an effective environmental outcome, which means

How Carbon Prices Cut Both Ways In The Aluminum Industry

Aluminum producers are directly exposed to emissions trading regulation, but they also face indirect carbon price exposure through the purchase of electricity and the increased cost of raw materials such as coke and caustic soda, as well as through their logistics costs. However, aluminum producers can take advantage of downstream business opportunities arising from carbon regulation, such as developing lighter, more fuel-efficient cars. This increases the demand for aluminum and supports higher margins for products that are less carbon-intensive than conventional alternatives.

Risk Or Opportunity? Carbon Cost Pass-Through In Power Generation

In the electric power sector, the carbon cost incurred in generating a megawatt hour (MWh) of electricity becomes part of the marginal cost of electricity production, much like the cost of gas or coal. The carbon cost per MWh is determined by the level of emissions: Brown coal generators have the highest emissions intensity and as such face the largest carbon cost per MWh, followed by black coal and gas generators.

Less-carbon-intensive generators will benefit as power prices rise with the increase in carbon costs per MWh, potentially resulting in a windfall profit, and the converse will happen for more carbon-intensive generators.

both market and regulation risks could affect liable entities.

Upstream And Downstream Risk

In many industries, exposure to carbon pricing is more likely to occur through a carbon liability being passed through the supply chain (upstream) or through changing demand for products and services (downstream).

Value Chain Emission Profile By Sector

Collectively, each industry's "value chain" emissions profile identifies its carbon price exposure to both upstream and downstream risks, as well as its direct carbon liabilities *(see chart 2)*.

A potential analytical approach could be to measure carbon intensity by calibrating the average GHG emissions per million dollars of revenue across a specific business activity. By measuring carbon intensity in revenue terms, such an approach can determine the business model dependence of each sector to GHGs and each sector's exposure to the rising cost of carbon.

Not surprisingly, the energy, materials, industrials, and utilities sectors have the highest direct carbon intensity, and therefore the largest regulatory exposure to emissions compliance schemes. The energy sector has the highest overall carbon intensity, with the direct and downstream combustion of oil, gas, and coal accounting for nearly 80% of the total. The property and financial services sectors also have large downstream risk profiles, due to the life cycle of buildings and the nature of financial services companies' investments (covering equity, debt, and project finance).

So, while only the energy, materials, industrials, and utilities sectors may be directly exposed to emissions regulation, all sectors are likely to be affected, albeit to varying degrees, in line with their emissions profiles.

Table 1 | **Emission Reduction Effort And Business Opportunities**

Sector: Oil and gas
Invest into renewable energy sources: Large U.S. integrated oil and gas companies such as ExxonMobil and Chevron are making modest investments in the research and development of renewable energy sources that emit significantly lower amounts of carbon in power generation than even natural gas. However, we believe these sources are still several years away from full commercial application.
Benefit in consumer demand switching from fossil fuel to gas: Natural gas burned for power generation produces half as much carbon dioxide relative to coal. With recent technological advances and exploration and production companies' ability to produce natural gas from previously unproductive shale and tight-sand formations, we believe U.S. natural gas supply will be sufficient to meet the potential growth in demand from continued fuel-switching from coal to gas in the industrial and power sectors. The potential increase in natural gas demand should improve the profitability of natural gas producers.
Auto
Improve efficiency of the internal combustion engine and vehicle weight: Many auto manufacturers have reduced engine sizes to improve fuel efficiency while maintaining performance through the use of turbochargers. Another example is using lightweight materials such as aluminum in place of steel. Ford claims this strategy has reduced the weight of its new F-150 full-size pickup by as much as 700 pounds.
Small cars gain popularity: While stable in recent years, gasoline prices remain high relative to historical averages, and this has caused a shift in consumer preference to smaller and more efficient vehicles. Small cars have recently accounted for about 20% of all light-vehicles sales, up from about 15% in 2006 and 2007.
Transportation
Replace older vehicles with more fuel-efficient ones: Airlines have the largest fuel bill, and the long-term increase in oil prices has prompted them to replace older planes with newer, more fuel-efficient ones. Buying new planes reduces operating expenses but requires a large capital commitment. Other modes of transportation similarly favor new engine technologies, but must weigh the trade-off of operating cost versus capital cost.
Trend toward fuel efficiency creates winners and losers: Aircraft manufacturers benefit if airlines order new planes. Railroads benefit at the expense of trucking companies, because they can move more weight per gallon of fuel and thus charge less to do so.
Natural resources
Enhance production energy efficiency and switch to cleaner alternative fuels: Weyerhaeuser has a goal to cut GHG emissions 40% by 2020. It is consolidating its manufacturing operations into its most efficient paper and cellulose fibers mills, and is replacing fossil fuels with carbon-neutral biomass fuels. Steelmaker Nucor recycles steel using electric arc furnace technology, which it says produces 67% less carbon equivalent emissions than making steel from iron ore. Alcoa says it has reduced emission intensity in its upstream business by 23% after repositioning to take advantage of hydroelectric power.
Chemical
Gas as a raw material to reduce emission and cost: U.S. chemical companies can reduce their carbon emissions as they are likely to switch to low cost shale gas, which is considered cleaner relative to its substitutes. For example, ammonia producers stand to benefit from low-cost natural gas because they use gas as their key raw material (and not as a secondary raw material or solely as fuel).
Capital goods
Efficiency bolsters demand: Fuel efficiency improvements, emissions reduction to meet government mandates, and other efficiency strategies (i.e. building efficiency) are creating new demand for many capital goods companies. Honeywell (building efficiency), Cummins (engine technology), and GE (wind turbines) are just some examples. Practices range from "smart grid" technology-based products, such as smart power generation, and energy-efficient electrical products, such as LED lighting, and other electrical products and fixtures that go into both new construction and renovation projects.

Risk Management And Adaptation

Risk management practices can represent both a means to mitigate carbon risk and an opportunity to generate returns, with the potential for firms to increase revenues above the cost of the initial carbon liability.

Risk management techniques will ultimately depend on geographic and policy considerations such as exposure to climate events, local regulation, and carbon market prices. The most common carbon risk management practices companies adopt are:

- Cost pass-through to customers and negotiation with suppliers, taking into account product price elasticity and competition;
- The development of permit trading and hedging strategies to minimize the impact of direct emissions liability; and
- Investment in emissions abatement, where this cost is lower than the cost of compliance with a regulatory scheme.

Carbon cost pass-through is the most common form of carbon risk management, where companies aim to recover direct and indirect carbon costs from their customers, who in turn will attempt to recover those costs from their own customers. Carbon pass-through levels are primarily determined by the emissions intensity of the product or service, supply and demand elasticity, the economics of using substitute products, and the bargaining position of each firm.

The introduction of emissions trading through spot and futures contracts has created a new source of commodity and investment risk, and

Table 2 | **Financial Effects Of Carbon Costs**

	Exposure	Profitability impacts	Asset valuation impacts	Cash flow impacts
Direct exposure	Carbon permit trading	Sale of excess permits may increase income	Excess carbon permit inventory can add value, however, the valuation may be subject to market price volatility	Operating cash flow can be affected depending on the holding position of the company and market price of carbon permits
		Purchase of carbon permits may increase the cost of production and reduce profit	Expected obligation to purchase carbon permits can be off-balance-sheet	
		Carbon permits trading and hedging affects profit in either direction		
	Risk management	Actions to abate emissions may increase expenses	Investment to protect assets may have a positive effect on asset valuations	While companies spend additional operating cash outflow to manage risk, the cash inflow from such management may not incur at the same period, causing a short-term cash balance reduction
		The pass-through of compliance costs to downstream customers may mitigate impact on profitability		
Indirect exposure	Supply-chain cost	Supply-chain cost increases could raise the cost of production, leading to gross margin decline	The costs flowing through the supply chain could increase inventory costs, which may be higher than market price, and such over-valuation can lead to inventory impairment	Cash net flow may fall if higher supply chain costs cannot be passed through suppliers and customers
			The "shadow liability" is off-balance-sheet	
		Fixed and overhead costs (transport costs, for instance) could increase and reduce net profit		

Source: RepuTex Carbon Analytics.

Incorporating Carbon Prices Into Investment And Strategic Planning

The still-evolving policies regarding carbon prices create uncertainty, particularly for industries with long asset lives such as power generation. To counter this risk, many firms incorporate a "shadow carbon price" into their calculations for investment and strategic planning.

Shadow carbon prices applied by companies differ by sector, ranging between $6 and $60 per tonne of CO2e emitted, according to the report from CDP *(see Note)*. In carbon-intensive sectors such as the energy and utilities sectors, corporates apply shadow carbon price ranging from $20 to $60 per tonne, which is generally higher than the top of the carbon price trading range and significantly higher than the average price displayed in chart 1. Such a premium on carbon prices may incorporate other direct costs such as carbon tax, costs of indirect upstream and downstream carbon exposures, policy risks from changing environmental regulation during the investment period, market risk from carbon trading price increases, and greater volatility. Examples include:

- BP Energy. When carbon costs form a significant part of a project, BP applies a carbon price of $40 per tonne to projected emissions over the life of the project.
- Xcel Energy. In its forward planning, it applies a carbon proxy cost of approximately $20 per tonne to determine the expected future costs of emissions.

therefore, risk management activity. Carbon price regulations remain the most material carbon exposure facing highly polluting companies, with each company's cost of compliance determined through the cost of carbon permits (or offsets), less the sale of excess permits and cash received from customers. In markets such as Australia, the allocation of free permits may lead to a surplus of emissions allowances, allowing companies to generate short-term returns above their emissions liability through the sale of excess permits. The banking of permits (that is, holding a carbon unit from one compliance period to sell it in a future period) enables companies to trade, hedge, and arbitrage against forward contracts with greater flexibility. Combined with other risk management strategies, such as cost-positive emissions abatement and cost pass-through to consumers, a carbon liability may therefore result in short-term revenue gains.

The increasing cost of emissions brings an added incentive to investments in emissions reduction and energy efficiency, beyond direct cost savings. Companies are starting to take measures to reduce emissions incurred from direct production, upstream, and downstream exposures. This cross-value-chain effort takes up business opportunities incurred from changes in production input, consumer preference, and competitive market dynamics *(see table 1)*.

Financial Effect Of Carbon Price Risk

Conventional financial impact analysis of carbon price risk focuses on the regulated liability and thus overlooks the "shadow liability" caused by potential carbon price obligation from indirect exposures in the upstream and downstream process.

The "shadow liability" is hard to observe due to limited availability of

Table 3 | Current Emissions Markets And Prices

Largest to smallest, established and expected schemes

Market	Market start	Type of market	Sector coverage	2013 Allowance budgets (million metric tonnes)	High (US$ per metric tonne)	Low (US$ per metric tonne)	Current price (US$ per metric tonne)
EU	2005	Mandatory cap-and trade; absolute target	Electricity, heat and steam production, and five major industrial sectors (oil, iron and steel, cement, glass, and pulp and paper). Plus, CO2 from petrochemicals, ammonia, aviation, and aluminium; N2O from acid production; and PFCs from aluminum	2,039	18.2	4.6	9.6
Guangdong ETS	2013	Mandatory cap-and-trade; intensity target	Power, iron, steeel, cement, and petrochemcial sectors. Expand to include ceramics, textiles, nonferrous metals, plastics and paper production, public buildings, and transport industries	388	11.0	3.8	9.8
Australia	2012: Tax 2015: trading	Mandatory cap-and-trade; absolute target	Cement, chemicals, energy, metals, mining, paper, and power	364	23.1	0.0	22.0
Regional Greenhouse Gas Initiative (RGGI)	2009	Mandatory cap-and-trade; absolute target	Fossil fuel-fired power plants (does not include imports)	165 (short tons)	8.0	2.0	3.9
California	2013	Mandatory cap-and-trade; absolute target	Electricity (including imports) and industry in 2013. Plus, ground transportation and heating fuels in 2015	162.8	15.5	10.3	11.9
Shanghai	2013	Mandatory cap-and-trade; intensity target	Energy-intenstive industries, airports, commercial buildings	160	11.0	3.8	4.3
Tianjin	2013	Mandatory cap-and-trade; intensity target	Electricity, iron steel, chemical, petrochemical oil and gas exploration, and large buildings	78	11.0	3.8	4.5
Beijing	2013	Mandatory cap-and-trade; intensity target	Electricity, manufacturing, and major public buildings	50	11.0	3.8	8.3
Shenzhen	2013	Mandatory cap-and-trade; intensity target	26 sectors including power, water supply, industrial manufacturing	31.7	18.2	4.6	11.9
Quebec	2013	Mandatory cap-and-trade; absolute target	Electricity (including imports) and industry in 2013; ground transportation and heating fuels in 2015	23.7	15.5	10.3	11.3
Hubei	2014	Mandatory cap-and-trade; intensity target	Electricity, iron and steel, chemical, cement, auto manufacturing, and aluminum	N/A	18.2	3.0	3.8
Chongqing	2014	Mandatory cap-and-trade; intensity target		N/A	11.0	3.8	

Pricing information is in US$/tonne. Table depicts forecast trading range of carbon price by market from 2015 to 2020 based on spot price information and RepuTex forecasts as of May 5, 2014. N/A–Not applicable.

emissions data and issues relating to the quality of data. The full obligation is also difficult to accurately quantify because applicable carbon prices are not clearly defined, and there are no widely adopted guidelines to standardize liability valuation across sectors. Also, companies are not mandated to disclose their indirect exposure and the resulting liabilities. These are among the reasons investors are starting to focus on indirect carbon price risk and its impact on corporate credit quality.

Standard & Poor's analyzes the effect of carbon price risk on a company's creditworthiness by considering the direct and indirect financial effects of exposure through the profitability, asset and liability valuation, and cash flow *(see table 2)*.

The Full Picture: Carbon Price Risk On Corporate Creditworthiness

Overall, the impact of carbon price risk on corporate credit risk is transmitted through four major risk areas: regulatory risk, market risk, business risk, and financial risk.

Regulatory risk is becoming inevitable because of the trend for governments to impose more stringent emissions controls and the uncertainty of environmental policy over the long term. Although different from conventional commodity markets, emissions markets create carbon price risk because the market price is fluctuating and governments control the total supply of carbon permits, which can decrease in the future, particularly in free-floating emissions markets. Increases in supply costs and changes in customer demand will raise business risk levels, in particular for corporates that have weak supplier and customer bargaining power. Financial risk results mainly from lower profitability and free cash flow, and by the limited visibility into "shadow liabilities."

Companies can control carbon price risk through risk management, recovering costs by passing on the cost of carbon to downstream customers via investment in emissions abatement, or through trading and hedging strategies. For many industries, we believe this may represent an opportunity to generate income in cases where cash recovered from customers, or the market, exceeds that of the initial liability.

A comprehensive risk analysis of regulation, market, business, and financial aspects across the value chain that incorporates both direct and indirect exposure, along with evaluating risk management strategies, is critical in determining the total impact of carbon risk on a firm's creditworthiness. **cw**

NOTES:

- Corporate Value Chain (Scope 3) Accounting and Reporting Standard, Greenhouse Gas Protocol, May 2013 (http://www.ghgprotocol.org/files/ghgp/public/Corporate-Value-Chain-Accounting-Reporting-Standard_041613.pdf)
- Use of internal carbon price by companies as incentive and strategic planning tool, CDP, December 2013 (https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf)
- World Bank, "Mapping Carbon Pricing Initiatives: Developments and Prospects," December 2013

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Dealing With Disaster

How Companies Are Starting To Assess Their Climate Event Risks

Overview

- Extreme weather events are responsible for 90% of documented natural catastrophe loss events, causing $124.5 billion of overall losses out of the $135 billion total natural catastrophe losses.
- Worsening financial performance as a result of climate event risk can negatively impact both short-term liquidity and long-term debt financing positions, leading to an increase in credit risk.
- Regulators and investors need to focus more closely on climate and carbon risks as an indicator of company performance and value.

While investors and issuers are beginning to recognize the impact of carbon pricing on corporate profitability, the same is less true of the effects of climate events on a company's business and financial risk profiles. Unlike exposure to emissions regulation, which trading carbon credits and investment in emissions abatement can address, the unpredictable nature of climate events constrains the planning and implementation of effective risk management strategies. The increasing frequency of extreme weather events such as flooding, intense storms, heat waves, and cold snaps is putting pressure on companies to identify, quantify, and disclose the material risks related to such events.

Climate event risk has the potential to damage profitability, impair asset value, and constrain cash flow. This can weaken a company's liquidity position and compromise its ability to raise funding and service debt over both the short term and long term. In Standard & Poor's Ratings Services' opinion, corporate credit quality may suffer if companies do not implement adequate risk management measures regarding climate events.

Extreme Weather Events Are On The Rise

According to the Intergovernmental Panel on Climate Change, "A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events."(1)

Over the past few decades, we've witnessed an increase in extreme weather events. In 2013, reinsurance group Munich Re recorded 888 loss-related natural catastrophe events worldwide *(see chart 1)*, slightly down from the 936 events recorded in 2012 but above the 10-year average of 822. Of the 888 documented loss events, 90% were weather-related, encompassing storms, floods, heat waves, cold snaps, droughts, and wildfires, while earthquakes and volcanic eruptions were responsible for the remaining 10%.

According to Munich Re, weather event-related losses have been increasing since the 1980s, and the volatility of losses has been much higher during the past decade *(see chart 2)*. In 2013, overall worldwide natural catastrophe losses from the 888 recorded events totaled $135 billion, among which $124.5 billion was weather related. In 2013, at $33 billion, weather-related insured losses represented 94% of total insured losses, 4% higher than the 10-year average percentage.

Climate event risk represents both a short- and long-term exposure for companies. Increased rainfall, flooding, and storm intensity can interrupt production, while extreme heat and fires can affect output and supply/distribution networks, potentially increasing cash flow volatility and disrupting supply chain links.

As with the impact of carbon pricing *(see "Corporate Carbon Risks Go Well Beyond Regulated Liabilities," on p. 21)*, climate event risk carries direct and indirect exposure for industry. It affects a company's value chain, covering the upstream supply chain, direct operations, and downstream supply and demand for goods and services.

Exploring Industry's Sensitivity To Climate Event Risk

Physical consequences of increased carbon in the earth's atmosphere are not yet fully understood but there is a growing understanding of the potential effects of climate change on industrial sectors. Consequently, while the actual sensitivity of these sectors to climate event risk is difficult to quantify, there is evidence that the risk is material: Extreme winter weather in North America in early January 2014, for example, had serious consequences for economic activities, ranging from industrial output to consumer spending. Significant impact arose from the load placed on electricity generators, for example PJM Interconnection, the largest U.S. grid operator, hit a record winter peak use of 141,500 megawatts (MW) during that time. Furthermore:

- Peak energy use occurred at a time when nearly 20% of the generators in PJM's territory were out of action due to the cold weather.
- At one point, nearly 40,000 MW of PJM's 190,000-MW installed capacity was offline.
- Much of the generation losses were due to natural gas pipeline constraints, which caused gas prices to spike more than 300%, resulting in the take-up of significant capacity from wind generation.
- Steam-cycle fossil fuel-fired power plants (primarily coal) made up about half of the outages in PJM's territory, with diesel generators making up the second-largest portion. In some cases, coal stacks were frozen or diesel generators simply couldn't function in such low temperatures.

Exposure to climate event risk varies by sector, depending on a company's business operations. For example, businesses dependent on biosphere services, such as forestry and agriculture, may be more vulnerable to day-by-day changes in productivity *(see table)*, while firms reliant on mineral assets and transport services may be exposed to more intermittent events. Energy infrastructure is especially at risk *(see sidebar)*.

Climate Change Threatens Energy Infrastructure

Assessments by the National Research Council and the U.S. Global Change Research Program indicate that U.S. energy infrastructure is increasingly vulnerable to a range of climate change effects, particularly in areas prone to severe weather and water shortages. Climate change can affect infrastructure throughout all major stages of the energy supply chain, thereby increasing the risk of disruptions. For example:

- Resource extraction and processing infrastructure, including oil and natural gas platforms, refineries, and processing plants, is often located near the coast, making it vulnerable to severe weather and rising sea levels.
- Fuel transportation and storage infrastructure, including pipelines, barges, railways and storage tanks, is susceptible to damage from severe weather, melting permafrost, and increased precipitation.
- Electricity generation infrastructure such as power plants is vulnerable to severe weather or water shortages, which can interrupt operations.
- Electricity transmission and distribution infrastructure, including power lines and substations, is susceptible to severe weather and may be stressed by rising demand for electricity as temperatures climb (or fall).

According to the U.S. Government Accountability Office, the rise in sea level from global warming may double the risk of coastal flood events by 2030. In the lower 48 states, nearly 300 energy facilities stand on land this would affect, including natural gas infrastructure, electric power plants, and oil and gas refineries. Oil and gas facilities in California, Florida, Louisiana, New Jersey, New York, and Texas are particularly at risk.

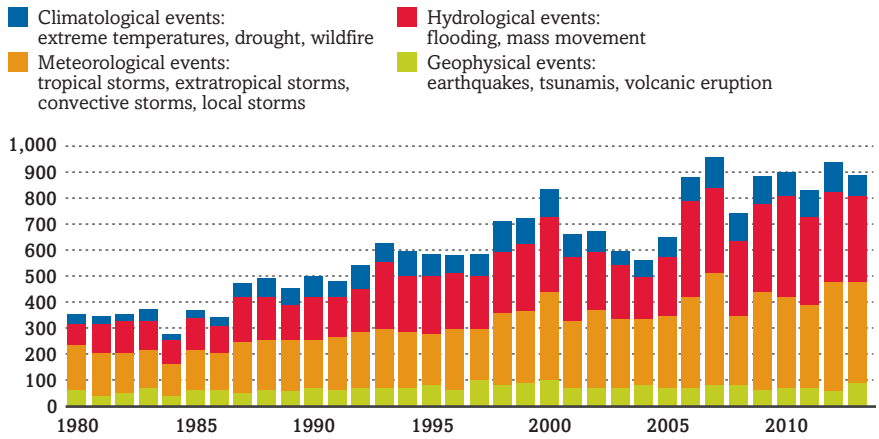
Risk Management And Adaptation Are Far From Straightforward

Because of their complex and interrelated nature, climate event risks are difficult to predict. Both short- and long-term risk management strategies need to take into account not only the gradual effects of increasing temperatures, but also the sudden and often profound effects that extreme weather events can have. What's more, implementing risk management and adaptation measures for long-life fixed assets may be difficult because of financial and technological restraints and the limited availability of viable alternatives.

Regulators And Shareholders Push For More Disclosure

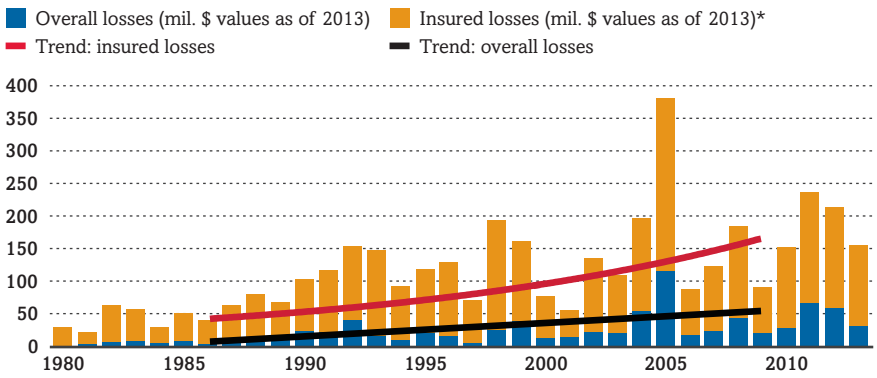
Energy-intensive companies have come under increasing pressure from regulators in recent years to inform investors of the risks that carbon pricing and extreme weather events would place on their business. In the

Chart 1 | Number Of Natural Catastrophies 1980–2013



Source: Munich Re Topics Geo, 2013.

Chart 2 | Overall Weather Related Losses And Insured Losses 1980–2013



*Values adjusted for inflation using the Consumer Price Index (CPI) of each country.
Source: Munich Re Topics Geo, 2013.

U.S., the Securities and Exchange Commission requires firms that file annual reports to disclose material climate change risk. In the U.K., effective from Oct. 1, 2013, the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 requires large listed companies to report their greenhouse gas emissions in the directors' reports for the financial year ended on or after Sept. 30, 2013, so that investors can assess the relevant climate risk. In April 2014, the European Parliament voted in favor of a new law that will require large listed firms to publish environmental and social data in their reporting to investors.

Companies are responding. Exxon Mobil recently became the first oil and gas producer to agree to publish details of its climate risk exposure from stranded assets (that is, oil and gas reserves that the company could not exploit if the regulatory regime tightened), a sign of the growing acceptance among companies and investors that climate and carbon risks are increasingly material to corporate performance and value.

Meanwhile, CDP (formerly the Carbon Disclosure Project), an international, not-for-profit organization, administers a global survey that enables companies to measure, manage, disclose, and share environmental information. It scores companies to reflect specific business risks and potential opportunities related to climate change and internal data management practices regarding greenhouse gas emissions. Companies that make their CDP survey response public and achieve a score within the top 10% of the Global 500 survey population qualify to list in the Climate Disclosure Leadership Index. The top scorers in 2013 included BASF SE, BMW AG, BNY Mellon N.A. Cisco Systems Inc., Eaton Corp., Gas Natural SDG S.A., and Nestlé S.A.

Assessing The Financial Implications

Climate event risk can have a significant impact on an economy. According to Allianz SE, weather and climate directly or indirectly affected $5.7 trillion of the

Adaptation Strategies For Industry Sectors Sensitive To Climate Event Risk

Sector	Exposure	Risk profile	Adaptation strategies
Agriculture	Potentially longer growing seasons in cooler climates	Extreme	Adjustment of planting dates and crop varieties
	Increased droughts that impair productivity		Improved land management, such as erosion control and soil protection through tree planting
	Proliferation of pests and disease		Initiation of reforestation and afforestation activities improving irrigation efficiency, and conserving soil moisture
Oil and gas	Increased storm activity disrupting asset operations and reducing production	High	Modification of assets to allow operation in line with climatic changes
	Increased costs for cooling		Remedial works to ensure fuel storage and transmission structures are secure
	The effects of rising temperature on asset performance, efficiency		
Power	Extreme demand events due to heatwaves and cold snaps are becoming less predictable	High	Design modifications such as decentralizing generation
	Unseasonal temperature changes may alter established demand profiles		Energy efficiency and demand-side management through the use of smart grid technology
	Low rainfall and high temperatures impair thermal power station cooling		Diversifying sources of energy
Property	Increased frequency and intensity of extreme weather events can affect property, notably low-lying and coastal property.	High	Improved construction practices and energy efficiency programs, along with building insulation, window glazing, and shading
	Increases in bushfire frequency may raise rates of damage to buildings and structures		Work with planning authorities
	Drier conditions may lead to increased ground movement and changes in groundwater		Better identification of at-risk locations
Water	Increased rainfall and flooding may overwhelm existing infrastructure	High	Expanded rainwater harvesting
	Temperature increases may result in a reduction of surface water availability by reducing environmental storage and increasing evaporation		Diversification of water sources—surface and groundwater, wastewater and recycling
			Water use and irrigation efficiency
Transport	Increased temperatures may stress transport infrastructure such as roads and bridges	Moderate	Long-term design considerations
	Exposure of infrastructure to flooding, water, and snow damage		Planning for roads, rail, and other infrastructure to cope with warming, drainage
Metals and mining	Extreme weather events such as site impairment due to flooding may affect production and site efficiency	Moderate	Long-term design considerations in planning stage of new assets
	Reduced availability of water may impede water-intensive metals and mining activities		Planning for roads, rail, and other infrastructure to cope with warming, drainage

Source: RepuTex Carbon Analytics.

U.S. economy in 2012, representing over 30% of GDP. Routine weather variances cost $534 billion, equivalent to 3.4% of U.S. GDP. Comparable exposures for the EU in 2012 were $5.9 trillion, equivalent to 35.8% of GDP, and routine weather variance costs of $561 billion, equivalent to 3.4% of GDP, respectively.

While weather has always been a critical business risk for many industries, an increase in the frequency of extreme events could weigh on company balance sheets. Between 1980 and 1989, the insurance industry paid out $15 billion per year for weather damage worldwide. By 2010 to 2013, this figure had risen to $70 billion per year. And physical weather events do not need to be extreme to affect financial performance, merely unseasonal or unexpected.

Variations in weather can impair a company's financial risk profile from the supply or demand side, as well operationally, with potential knock-on effects on creditworthiness arising from fluctuating revenues and capital expenses.

In the short term, climate events tend to affect profitability as a result of asset impairments and production-based events. Over the longer term, profitability and asset valuations could come under stress, leading to higher costs for insurance and risk management, asset write-downs, and reduced property values. At the same time, companies may need to adapt their business models by modifying management practices, changing asset designs, or in some instances relocating assets. Consequently, companies that fail to take account of these long-term risks may suffer significant stress and have little flexibility to manage their exposure.

The negative effects on profitability, asset values, and cash flow can weaken companies' liquidity positions, in particular for the cash conversion cycle that accounts payable days, accounts receivable days, and inventory days can affect. This is because the same climate event will impinge on the company, its suppliers, and its customers.

A deteriorating asset base could impair a company's ability to raise funds. In our view, each climate event will likely have both an immediate and prolonged effect on a company's ability to service its debt. In some extreme cases, this could lead to companies defaulting on their obligations to lenders and bondholders. Therefore, a comprehensive climate event risk analysis should take in the long-term perspective. For example, a flood can destroy a company's production facility, causing instant financial loss and triggering a reassessment by creditors. However, the flood may also lead to incremental investment for reconstruction and the loss of customers, which in turn may reduce the free cash flow available to service debt.

Managing Climate Event Exposure Is Becoming Critical

Overall, we believe that credit quality may deteriorate if a company does not implement adequate risk management measures to cope with climate events. Indeed, an effective management strategy to mitigate short- and long-term climate-related exposures is becoming a critical issue for an increasing number of nonfinancial companies. For capital market participants, greater disclosure of climate event risk and a better understanding of the financial effects of such risk should lead to improved credit analysis, in our view.

(1)Managing The Risks Of Extreme Events and Disasters to Advance Climate Change Adaptation, 2012 (Intergovernmental Panel on Climate Change). More details can be found at https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

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Credit FAQ

Assessing The Credit-Supportiveness Of Europe's Renewable Energy Frameworks

The policy risk associated with renewable energy frameworks across the EU has never been more prominent. On May 12, 2014, the U.K.'s Department for Energy and Climate Change announced that it plans to close its support scheme for solar power projects generating more than 5 megawatts (MW) from April 1, 2015, two years earlier than originally planned. This followed German Chancellor Angela Merkel's announcement on March 17, 2014, of a cut in feed-in-tariffs (FiTs; pre-set prices for energy produced from different renewable resources) across all renewable energy sources and a scaling back of the country's ambitious clean energy program. Ms. Merkel plans to cut FiTs to €0.12 per kilowatt hour (kWh), on average, by 2015 from the current €0.17 per kWh and proposes to limit the annual expansion of onshore wind and solar capacity to 2.5 gigawatts (GW) and offshore wind capacity to 6.5 GW.

Both announcements have fueled uncertainty among investors about the future of renewable energy incentives, despite rational explanations underpinning them. In the U.K., the government says it's cutting solar subsidies to ensure there is sufficient cash to support other types of renewable technology such as offshore wind, wave energy, biogas, and geothermal, and to limit further increases in consumers' bills. In Germany, the emphasis is on containing rising energy bills, which are the highest in Europe and about 3x the level of those in the U.S. However, Standard & Poor's Ratings Services believes this uncertainty can deter investors and potentially limit the growth of renewable energy investment in the EU since market participants regard some clean energy technologies as commercially unviable without government support. Moreover, government incentives often underpin the financial viability of renewable energy projects: For instance, subsidies to solar power projects in Europe can account for up to 85% of their initial revenues. This, in our view, illustrates the importance of predictable, ongoing financial support for renewable energy projects, and highlights the credit risk associated with any changes to this support.

In this Credit FAQ, we address investors' questions regarding how policy frameworks for renewable energy sources (renewables) have developed across the EU and rank them according to our view of their sustainability and economics.

Q. ***Why are EU countries investing in renewables and what have been the consequences?***

A. All countries in the EU have set goals for a percentage of energy to be produced from renewables by 2020. To encourage investment in renewables, many countries have implemented incentive schemes in the hope that this will help them achieve their 2020 targets. In March 2007, the European Council approved a set of objectives proposed by the European Commission (EC) designed to increase renewable energy production. These

Table 1 | **Factors Affecting The Creditworthiness Of Renewable Energy Incentive Schemes**

	—Effect on creditworthiness—	
Factor	**Positive**	**Negative**
Regulatory support and predictability	Stable and transparent regulatory regime. Low probability of adverse changes to tariff regimes or contracts	Weak regulatory regime. Significant potential for unfavorable changes to tariff regimes or contracts. Significant scope for the introduction of new costs that are difficult to quantify and that energy producers would likely have to bear
History (results)	Visible increase in renewable energy over the period of implementation of incentive schemes produced following the implementation of incentive schemes	Little, if any, increase in the amount of renewable energy
	Long track record	
Sustainability	Incentive schemes are sustainable over the medium-to-long term	Incentive schemes are unsustainable and/or have already been reduced or modified since their implementation
	Easy grid connection	Expensive to connect to grid
Long-term profitability	Predictable	Lack of consistency from issuer of subsidies
	Government able to keep promises	Unsustainable programs
Cost recovery	Schemes allow for full recovery of investors' costs in the near-to-medium term	Schemes do not allow for any recovery of costs in the near to medium term
	Priority grid access	Access to grid is limited to peak hours
External risks	Able to produce power independent of weather conditions (via hydroelectric, geothermal, biomass, and natural gas plant)	Power production that is highly dependent on the weather (namely wind and solar)
National economy	Growth	Declining economy
	Investor-friendly environment	Investor-unfriendly environment
	Political stability	Political instability

Note: The more factors in the positive column, the more credit-supportive the policy framework.

objectives, known as the 20-20-20 targets, entail reducing EU greenhouse gas emissions by 20% from their 1990 levels, raising the share of EU energy production from renewable resources to 20%, and striving for a 20% improvement in energy efficiency across the EU. Targets for 2030 are currently being drafted, and are to be finalized by October 2014; the initial proposal includes a 40% reduction in greenhouse gas emissions and an increase in the share of renewable energy to at least 27%.

Various EU member states have tried to improve on previous incentive schemes such as those introduced in Spain in the early 2000s, which, due to the design of Spanish utility regulation, caused tariff deficits when the government did not set electricity tariffs at levels that fully recovered costs of production. The discrepancy between the production cost and market price of electricity, coupled with a reduction in power demand following the 2008 recession, pushed the Spanish system into a tariff deficit of about €26 billion by mid-2013.

Q. ***What is Standard & Poor's view on the credit supportiveness of policy schemes?***

A. We consider certain renewable support mechanisms to be more credit supportive than others *(see table 1)*. For each country that we analyze, the more factors that are in the positive column the more credit-supportive we consider the scheme. Table 1 takes into account variables such as cost recovery, predictability, and the proven history of individual schemes. Predictability and price recovery alone are not enough, however. We've seen past examples of tariffs that have been promised to renewable energy producers and then subsequently reduced or withdrawn, leaving the producers to compete with cheaper and more carbon-intensive fossil-fuel generating plant. This has led to some market participants facing the prospect of stranded investments, due to the large amounts of capital that have been pumped into the renewables sector.

The sustainability of support schemes is one of the most important factors in our assessment of renewable energy frameworks. For example, in both the U.K. and The Netherlands we've seen large projects either reduced or scrapped completely due to a lack of clarity from governments and regulators on the amount of guaranteed returns. Earlier this year in the U.K., SSE PLC, a vertically integrated utility, abandoned plans to invest £20 billion in four major offshore wind projects due to limited subsidies and high costs. In The Netherlands, Eneco sold 50% of its Luchterduinen wind project to Mitsubishi Corp. due to political uncertainty and a lack of financial support from the state.

Q. ***How sustainable is the financial support for renewable energy in EU member states, in Standard & Poor's opinion?***

A. Incentive schemes require certain conditions to function supportively. For example, connection to the high-voltage grid network must be straightforward and affordable. Most networks have been designed to connect large centralized power plants, so they need to be reconfigured to accept small power inputs from intermittent power sources across the country. Generally, we view FiTs as supportive mechanisms that provide clear and long-term tariffs that enable investors to recover their costs. However, the supportive nature of such schemes can, as in the case of Spain, be undermined by economic and political realities. Politicians have not been willing to endorse the costs of their national energy policy though tariff increases; Spain is one of the few countries where tariff-setting power has remained in the hands of the government. Despite clear guidelines, a drop in demand post-2008 made cost recovery impossible, and exacerbated the growing tariff deficit. To reduce this burgeoning deficit, the Spanish government has reduced or, in some cases, completely cut the subsidies to renewable producers.

Q. ***Who bears the cost of renewable energy incentive mechanisms, and what are the benefits of such mechanisms?***

A. In the end, either the government or the consumer pays for renewable energy incentives. The cost of FiTs and quotas are usually fully passed through to the end consumer by the energy supplier, while the government provides tax incentives to the generator. And although the government takes the hit for tax incentives, in many cases, it can add a levy to help (state-owned) distribution networks recover the cost of these tax benefits.

If costs cannot be passed on to end consumers, the government will have to pay the difference between the market price and contracted price, leading to tariff deficits. Also, when we assess renewable support systems, we need to determine who is responsible for establishing and paying for high voltage grid access. In the U.K., this responsibility lies with the power producer, while in Germany, Sweden, and Norway it lies with the transmission operator. This means that U.K. subsidies are necessarily higher to cover connection costs. In Germany, meanwhile, there have been considerable delays in providing grid access to renewables producers due to the costs involved for the generators.

The three main incentive mechanisms are FiTs, tax incentives, and quota systems. Each has characteristics that affect the level of credit support that they offer.

Feed-in tariffs (FiTs). Generally, we view FiTs as a credit-supportive incentive for renewable energy production. FiTs provide a pre-negotiated price that the network pays for energy produced from different renewable resources. The reason we view these tariffs as credit-supportive is that they are set out in advance, detailing exactly how much will be paid, and for how long. This gives investors a degree of certainty, enabling them to reach an investment decision based on project economics. Until recently, EU member states provided generous strike prices on green energy production methods because they wanted to expand their renewables production.

The success of a FiT depends on whether market participants view it as sustainable (that is, the full extent of the cost can be passed onto the end con-

sumer by the purchasing utilities). When this is not the case, such as in Spain, network distributors have had to absorb the unrecovered costs alongside the government. This difference in production costs and electricity prices to end consumers is the cause of potentially huge tariff deficits, leading to the reduction and, in some cases, complete elimination of the subsidy.

Tax incentives. Tax incentives are another method by which governments encourage investment in renewable energy. The cost of this incentive falls more on the government than on the end consumer, although it will have indirect effects on the latter as well. That said, we do not consider tax incentives to be as credit-supportive as FiTs. This is because tax incentives do not always provide continued support for investors since renewable energy has to compete with all other energy producers in the free market. However, in an efficient incentive structure, the upfront tax relief should cover the original investment costs. As a result, renewable generators should be able to compete at a market level with other generators owing to the lower capital costs that need to be recovered.

A benefit of tax incentives is that there is no risk of causing a tariff deficit due to lack of government support, provided that pre-construction calculations were correct and the market price is high enough for the renewable sources to be able to compete after covering their investment costs fully or partially by the tax benefit.

Quota systems. Quota systems exist in many markets and have been put in place to encourage generators to produce more green energy. Quota systems require the production of a certain amount of energy from renewable resources. Unlike other schemes, generators cannot opt in or out of quotas. Standard & Poor's does not consider these systems credit-supportive: Although quotas encourage the production of renewable energy, generators are penalized if they do not comply and face a certain amount of price risk.

Quota systems exist in the U.K. and Nordic power markets. In the U.K., the system is called the Renewables Obligation (RO) scheme and requires licensed U.K. electricity suppliers to source a specified proportion of the electricity they provide to customers from eligible renewable sources. Norway and Sweden operate a combined scheme that works in a similar way. If a generator is short on Renewables Obligation Certificates (ROCs), then it must purchase the shortfall at market prices to fulfil its obligated amount of ROCs for the amount of energy it produces. This has created a market for ROCs, which are traded on the open market, with a consequent fluctuation in prices.

Q. ***Which countries have the most credit-supportive renewable energy frameworks, in Standard & Poor's opinion?***

A. We consider that the most credit-supportive renewable energy frameworks in Europe are those in Germany, the U.K., Denmark, The Netherlands, Sweden, Norway, and Spain *(see table 2)*. All of these countries have successfully provided funding for companies and incentives for investors to produce more renewable energy. As a result, most of these countries have significantly increased the percentage of electricity production generated from renewable sources.

We now present an overview of the credit-supportiveness of the renewable energy frameworks for each of these countries.

Germany. Until recently, Germany's renewable energy framework was both predictable and stable in terms of regulations and incentives. The incentives for renewables production comprise a FiT, a

Table 2 | **Ranking Of Selected EU Renewable Energy Frameworks In Terms Of Credit Supportiveness**

Country/Ranking	Renewables incentive schemes
1. Germany	Feed-in-tariff, tax incentives, and beneficial loans
2. U.K.	Renewables Obligation Certificates (quota system), Electricity Market Reform, and feed-in-tariff
3. Denmark	Feed-in-tariff funded by public service obligations, and tax incentives
4. The Netherlands	Feed-in-tariff (€3 billion limit), tax incentives, and beneficial loans
5. Sweden and Norway	Renewable quota system and tax incentives
6. Spain	Feed-in-tariffs and tax incentives

premium tariff rate, and favorable financing for renewable projects through KfW, the national development bank.

KfW provides one of the few incentive schemes where the cost of the program has no impact on the end consumer. In this case, the cost is fully borne by KfW, which offers low-interest loans, usually over 20 years and with a three-year repayment-free start-up period.

The FiT in Germany works in tandem with a premium tariff, which is the difference between the FiT for the specific renewable technology as set out in The Renewable Energy Sources Act (Erneuerbare Energien Gesetz) and the average stock market price. Plant operators are free to choose whichever tariff is more beneficial to them.

The support of the German system is under threat, however. Federal economy minister Gustav Sigmar Gabriel recently proposed a cap on renewable energy, limiting onshore wind and solar power to 2.5 GW per year and offshore wind power to 6.5 GW per year, and reducing the average FiT to approximately €105/MWh by 2015 from approximately €125/MWh today. There are also further planned cutbacks on subsidies between now and 2017, and eventually green energy will have to compete on the open market alongside nonrenewable sources.

U.K. After Germany, we consider the U.K. to be one of the most credit-supportive renewable energy regimes in Europe. It offers a range of incentives and—at least until recently—stable and predictable government support. The incentives cover the RO scheme, a small-scale FiT, and a new full-scale FiT known as Contracts for Differences (CfD), which is soon be implemented under the Electricity Market Reform.

The RO scheme, introduced in 2002, was the first program in the U.K. to encourage renewable energy production and has required a steadily increasing amount of renewables obligation certificates (ROCs) per MWh supplied. For 2014 to 2015, the amounts are 0.244 ROCs/MWh produced, up from 0.206 ROCs/MWh in 2012 to 2013. Between 2013 and 2017, the scheme sets an average of 1.4 ROCs/MWh produced, the actual amount dependent on the complexity and cost of the technology used. The small-scale FiT, for renewable energy projects of up to 5 MW capacity, has prompted investment in a number of small renewable projects, mainly solar, wind, and small hydroelectric schemes.

The CfD, which is set to come online by the third quarter of 2014, applies to all renewable power projects, regardless of size. When the CfD program is active, energy producers will be able to choose between it and the RO scheme for their renewables production until 2017. After that time, new projects will come under the FiT scheme. The evolution of the suggested strike price for CfD projects spans an average of £140/MWh in 2014 to 2015 to £134/MWh in 2018 to 2019.

The RO scheme has been active for the longest and has been relatively successful in promoting renewables production in the U.K. However, there is still a long way to go to achieve the government's target of 15% green energy production by 2020; it had reached only 4% at the end of 2012. Consequently, we believe the U.K. will continue to provide stable and predictable support for renewable energy production.

Denmark. Demark has a program similar to a FiT, in which renewable energy producers receive a bonus payment on top of the market price from Energinet.dk, a national agency that maintains security of electricity and gas supplies. The sum of the base tariff and the bonus payment is limited to a statutory maximum per kWh, which in turn depends on the source of energy used and the date of connection of a given plant. This program has led to Denmark becoming one of the largest producers of offshore wind power in the world.

Distributors pass on the cost of the aforementioned bonus payments to consumers in the form of a public service obligation (PSO). Energinet.dk pays the subsidy in three ways:

- It purchases the generated power at a guaranteed price and then sells that power on the Nord Pool Spot power exchange, the deficit being included in the PSO costs.
- It pays a subsidy that corresponds to the difference between a fixed settlement price for the renewable energy and the market price for power on the Nord Pool Spot.
- It supplements producers' income up to a guaranteed level for those companies selling their own power generation on the market. This means that they receive a monthly subsidy depending on the price of electricity. Energinet.dk assigns these subsidies on a case-by-case basis, which means that renewable energy projects can receive different terms in both tariffs and the length of support, with the latter averaging 10 to 12 years.

In our view, this FiT is stable and credit-supportive. What's more, the Danish government and energy ministry has publicly stated that they will continue to support the installation of renewables plant and subsidize research and development costs up to Danish kroner 130 million per year. An energy policy agreement of March 22, 2012, spanning 2012 to 2020, aims to develop a 100% renewables energy system by 2050. (In 2012, renewables met 26% of energy consumption.) This ambitious, long-term goal leads us to believe that Denmark will continue to provide credit-supportive incentives for renewables over the medium to long term.

The Netherlands. We consider the energy regime in The Netherlands stable and predictable. However, there is a limited amount of support available to investors. The Netherlands' FiT program, SDE+, replaced the previous SDE program in 2012. It operates in phases, the first of which allocates €3 billion each year on a first-come, first-served basis. Although later phases offer more money in terms of higher FiTs/KwH, waiting runs the risk of the annual allocation of €3 billion being exhausted. The subsidy is only open to new installations unless specifically noted otherwise. In contrast with FiTs in other EU member states, the cost of this subsidy is covered by the state budget.

The Netherlands also has tax incentives that exempt generators of renew-

able energy from the electricity and natural gas tax. Meanwhile, entrepreneurs based in The Netherlands can write off investments in renewable energy plant against taxes, and consumers that invest or put their savings in a green fund also gain a tax benefit. In addition, banks offer loans for renewable energy projects at lower interest rates.

Sweden and Norway. In our opinion, the renewables market in Sweden and Norway is stable and predictable. That said, neither Norway nor Sweden provide much financial support for renewable energy producers. Since May 1, 2003, Sweden has had a system of tradable green certificates promoting renewable energy through a government quota. Norway joined this scheme on Jan. 1, 2012. The scheme provides one green certificate per MWh of green energy produced, and requires all energy producers to produce a certain amount of green-certified energy. In 2013 and 2014, these figures stood at 0.135 and 0.142 certificates/MWh respectively. These annual targets are set to increase each year until 2020.

Following a recent large increase in the amount of renewable production in Norway and Sweden, the price of renewable certificates traded on the open market has declined sharply. This has led to talks about increasing the amount of certificates needed per MWh of electricity produced. Since 2012, the quota system has delivered 6.2 terawatt hours (TWh) of new renewable energy. With the recommended new quota, there would be an extra 8 TWh coming online each year between 2016 and 2019.

Spain. Spain is an example of a failed support scheme. When the FiT scheme was implemented in the early 2000s, the costs were too great to fully pass on to customers. At the time, there was priority dispatch for renewables without any cap, leading to renewables growing rapidly to 30% of total annual output. Then, a few years into the program, the global recession hit Europe. The combination of these factors saw the tariff deficit balloon to about €26 billion by mid-2013, forcing the Spanish government to cut back on renewable energy incentives. This greatly harmed investor confidence. As a result, we do not currently view the Spanish renewable framework as credit supportive.

Notwithstanding the tariff deficit, the renewable energy support scheme has greatly increased the amount of renewable energy that Spain produces, and the country now generates the fourth-largest amount of wind energy worldwide, meeting roughly 25% of annual electricity demand. If energy prices continue to rise, we believe these projects may become competitive on the open market in the future.

Q. ***How is policy risk in regard to EU renewable energy frameworks likely to evolve, in Standard & Poor's opinion?***

A. Overall, the ambitious 2020 renewable energy targets set by the EC remain in place and we believe that EU member states will continue to provide incentives for the production of green energy. As economies across Europe start to grow after the global recession—our economists forecast that eurozone GDP will increase by 1% in 2014 and 1.5% in 2015—the demand for power should also follow an upward trajectory. This increase in economic growth and power demand should sustain the support for renewable energy schemes in the medium-to-long term.

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The Greening Of The Corporate Bond Market

News of the successful issue of the largest-ever green bond by French power company GDF Suez last week is shining a spotlight on this emerging area of corporate finance. At €2.5 billion (US$3.4 billion), GDF Suez's issue represents close to a third of the total €7.6 billion ($10.4 billion) of corporate green issuance since November last year, and almost doubles the previous record of €1.4 billion ($1.9 billion) set by another French power company, Electricite de France. Standard & Poor's Ratings Services estimates that, based on year-on-year growth trends, the corporate green bond market in 2014 will be double the size of last year's total green bond issuance, at around $20 billion.

Overview

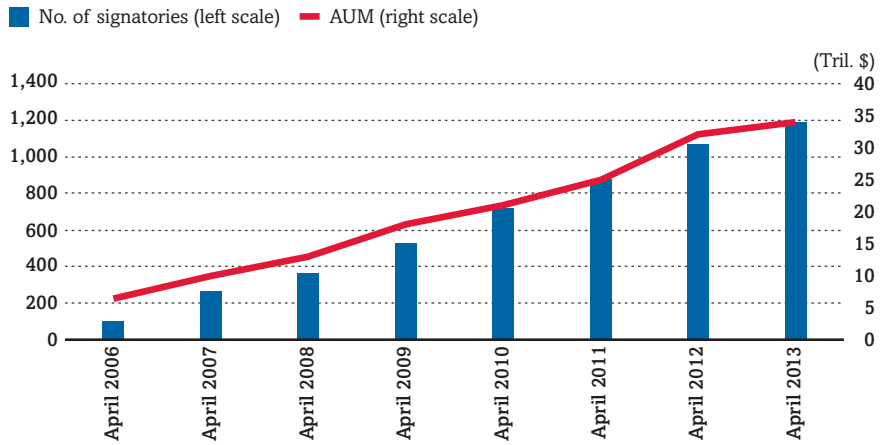
- The corporate green bond market is gathering convincing impetus, with a number of large transactions since November last year scaling the market up to $10.9 billion.
- In our view, corporate green bond issuance is likely to accelerate not only because this aids diversification of investor pools for issuers, but because of the growing intent of investors to implement environmental, social, and governance goals.
- So far, corporate green bonds have mostly been issued in Europe, with investment-grade ratings generally of 'A+', 'A' or 'A-'.

These mega deals show the rising importance of green bonds as a source of capital, driven by both the needs of corporates, as well as the desire by investors to allocate capital to socially responsible and environmentally sustainable investments. The aim for both issuers and investors alike is to develop a large and liquid market to reduce transaction and investment costs.

Corporate issuers see green bonds as an alternative financing avenue, offering access to a diversified investor base, plus a means of implementing and maintaining efficiency measures considered environmentally sustainable. A key distinction of green bonds from mainstream corporate issuance is that proceeds are ring-fenced and allotted to finance or refinance projects addressing environmental issues. So far, investors have not shown any discrimination against corporate green bonds, with oversubscription of many issues to date. Standard & Poor's believes this trend is likely to continue, as green issuance shifts away from multilateral development banks toward mainstream corporates. The future development of the green project bond market could also see the aggregation of environmental projects to form debt obligation instruments and an increased focus on the refinancing of existing environmental projects.

The Climate Bonds Initiative (CBI), a nonprofit organization that promotes investments to combat climate change, predicts total green bond issuance from all sectors will reach $40 billion in 2014. However, based on the amount of green bond issuance so far this year, we think that half this figure could easily be reached by corporate issuance alone. Entry into this expanding market is enabling corporates to tap an additional pool of investors who are committed to principles of socially responsible investing. In our view, corporate issuance is likely to accelerate not only because this aids diversification of investor pools, but because of investors' growing intention to implement environmental, social, and governance (ESG) targets initiated by the United Nations Principles for Responsible Investment (PRI). As of April 2013, the 1,188 investors who had signed up for the PRI represented approximately $34.0 trillion of assets under management (AUM), which was over 2.5x the amount five years previously *(see chart 1)*. In addition, the PRI has encouraged 30 stock exchanges to enhance ESG disclosures among their listed companies.

Chart 1 | Growth Of Principals For Responsible Investment Initiative



AUM–Assets under management.
Source: United Nations Principles for Responsible Investment (PRI).

Chart 2 | Distribution Of Green Bonds By Coupon Range

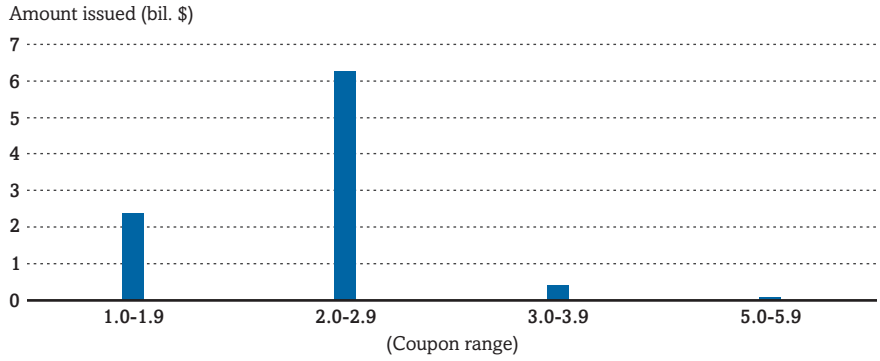
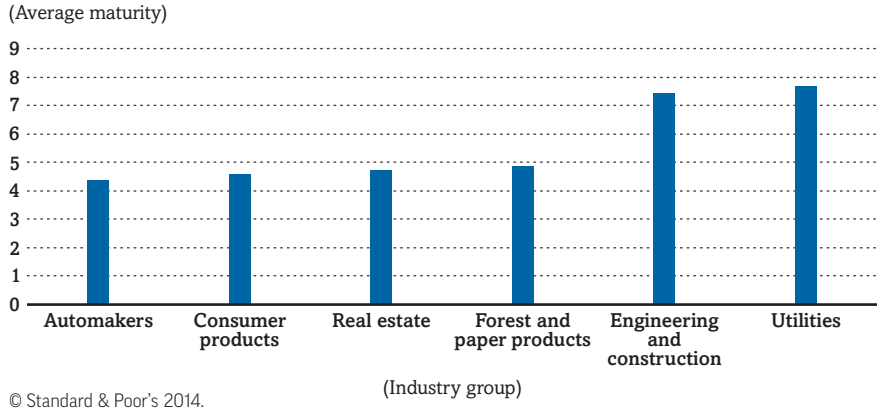


Chart 3 | Average Corporate Green Bond Maturity By Industry Group



Green Bonds Explained

Crucially for investors, the credit risk of a corporate green bond remains on the issuer's balance sheet. This means that, unlike with multilateral bank issuance, investors do not have to sacrifice yield to gain green exposure, nor significantly increase their risk profile to invest in assets that aid environmental efforts. This can satisfy investors' requirements for yield, while safeguarding their reputation for socially responsible investing. Investors are also likely to examine an issuer's environmental track record and reporting standards alongside participation in such initiatives, increasing the need for rigorous disclosure in offerings. Investors in green bonds also want assurance that the proceeds are being used to enable environmentally sustainable outcomes. In addition to this, according to a recent report by Societe Generale, investors have raised concerns regarding the lack of verification of how the proceeds of green bonds are used *(see Note 1)*. We therefore expect a revision to standards used for green bond issuance to boost investor confidence, including those governing the use of proceeds.

A group of financial institutions has created a set of green bond principles to enable issuers to categorize their bonds as "green." In all cases, the proceeds should be exclusively applied toward new or existing projects that promote climate and sustainability actions. There are currently four types:

- Green use of proceeds bond: with recourse to issuer;
- Green use of proceeds revenue bond: nonrecourse to issuer—credit exposure is to the pledged cash flows of revenue streams, fees, taxes, etc.;
- Green project bond: investor has direct exposure to the risk of the project with or without recourse to issuer; and
- Green securitized bond: collateralized by one or more projects, e.g., covered bonds or asset-backed securities.

The Market Is Growing As Corporates Issue Billion-Dollar Deals

Corporate green bonds still make up a relatively small percentage of the total green bond market, at about 30%, and are dwarfed by the size of mainstream corporate bond issuance, which according to S&P Dow Jones Indices stood at $18 trillion as of April 2013. Nevertheless, despite facing issues of volume, liquidity, and regulatory monitoring, the corporate green bond market has gathered convincing impetus since late 2013, with a number of large transactions expanding the market to $10.4 billion. In November

Credit Fundamentals Of Corporate Green Bonds

Company name	Industry group	Standard & Poor's credit rating	Amount issued ($)	Maturity date	Coupon (%)	Issue price
Acciona SA	Engineering and construction	NR	86,596,500.0	29/04/2024	5.6	100.0
Arise AB	Utilities	NR	167,087,000.0	25/04/2019	3.9	100.0
Electricite de France	Utilities	A+	1,899,840,000.0	27/04/2021	2.3	99.6
GDF Suez	Utilities	A	1,777,160,000.0	19/05/2026	2.4	98.5
GDF Suez	Utilities	A	1,640,450,000.0	19/05/2020	1.4	99.3
Iberdrola International BV	Utilities	BBB	1,036,770,000.0	24/10/2022	2.5	N/A
Regency Centers LP	Real estate	NR	250,000,000.0	15/06/2024	3.8	99.5
Rikshem AB	Real estate	NR	15,249,200.0	20/05/2016	1.1	100.0
Skanska Financial Services AB	Engineering and construction	NR	130,886,000.0	08/04/2019	1.9	100.0
Svenska Cellulosa AB SCA	Forest and paper products	A-	154,240,000.0	02/04/2019	1.6	100.0
Svenska Cellulosa AB SCA	Forest and paper products	A-	77,120,000.0	02/04/2019	2.5	100.0
Toyota	Automakers	AAA	560,000,000.0	15/08/2016	0.4	100.0
Toyota	Automakers	AAA	480,000,000.0	15/12/2017	0.7	100.0
Toyota	Automakers	AAA	165,250,000.0	17/06/2019	1.2	100.0
Toyota	Automakers	AA+	43,750,000.0	15/04/2020	0.0	N/A
Unibail-Rodamco SE	Real estate	A	1,025,360,000.0	26/02/2024	2.5	98.7
Unilever PLC	Consumer products	A+	414,200,000.0	19/12/2018	2.0	N/A
Vasakronan AB	Real estate	NR	152,272,000.0	25/05/2016	1.3	100.0
Vasakronan AB	Real estate	NR	152,158,000.0	24/10/2016	1.3	N/A
Vasakronan AB	Real estate	NR	102,283,000.0	19/03/2019	1.6	N/A
Vasakronan AB	Real estate	NR	55,075,600.0	19/03/2019	2.5	N/A
Vasakronan AB	Real estate	NR	45,681,600.0	25/05/2016	1.8	100.0

N/A–Not applicable. NR–Not rated.
Source: Bloomberg Professional.

2013, the first billion dollar issue arrived in the form of Electricite de France's (EDF) $1.9 billion 7.5-year green bond, which was twice oversubscribed. In terms of the mainstream green bond market, this was significant, not just because of its size—this was the largest to date at that time—but because it was issued by a corporate entity with a rating of 'A'. Up to then, green bonds had mostly been issued by multilateral development banks with 'AAA' ratings.

Next to break the $1 billion benchmark were Unibail-Rodamco SE with a $1 billion 10-year bond and Iberdrola International BV with a $1 billion 8.5-year bond. Unibail's green bond was 3.4x oversubscribed and illustrated the real estate company's ability to diversify its sources of funding. It met investors' green requirements as its proceeds can only be used to finance building in compliance with the Building Research Establishment Environmental Assessment Method sustainability standard. Iberdrola's bonds, which will finance wind power and smart metering environmental projects, fared even better, as it was 4x oversubscribed despite only offering a 2.50% coupon, the lowest offered by the Spanish utility to date. Most of these green bonds are issued at par or discounted by less than 1.6% *(see table)*. This month has seen the largest corporate green bond issuance so far, with GDF Suez's $3.4 billion dual-tranched green bond. It comprised a six-year 1.375% coupon and a 12-year 2.375% coupon. Orders were 3x oversubscribed, evidence of the continuing strong demand for corporate green bonds, with approximately 65% of allocations coming from investors managing socially responsible investment funds. The proceeds for this deal will be used to fund renewable energy and energy efficiency projects.

Alongside these transactions, Unilever became the first fast-moving consumer goods company to issue a corporate green bond, the proceeds of which will be used for a wide variety of environmental projects globally, and intended to aid diversification. Vasakronan, a Swedish property company, has also issued just under $1.3 billion of unrated corporate green bonds so far this year, in five smaller deals. Investors were 100% Swedish and almost all were pension funds.

While the corporate green bonds issued so far have been from well-known and higher-rated ESG names in the market, they could pave the way for other corporate entities. Furthermore, the bonds have been issued in Europe, backed by a gradually improving economic outlook. This may change if green bonds attract U.S. investors, who enjoy a larger source of liquidity in their domestic markets.

Chart 4 | Distribution Of Green Bonds-By Industry Group

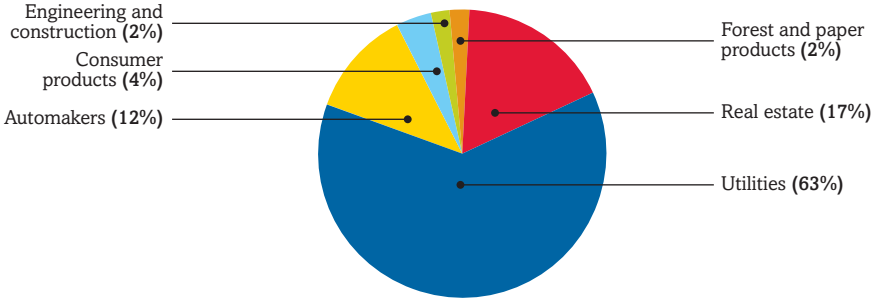
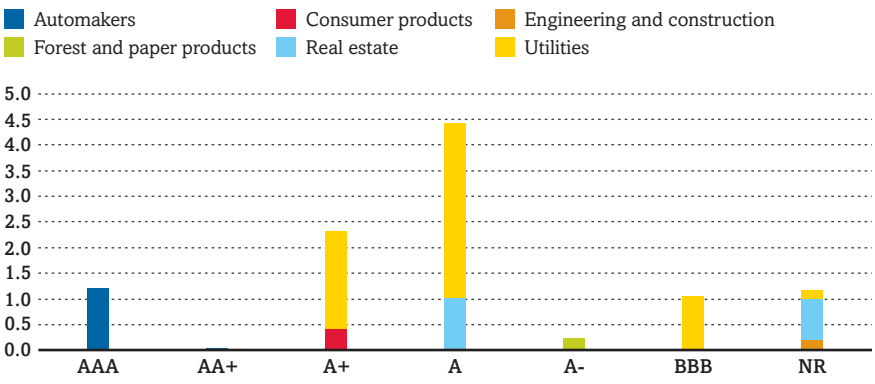


Chart 5 | Distribution Of Green Bonds-By Standard & Poor's Credit Rating



NR–Not rated.
Source: Bloomberg Professional.

The Make-Up Of The Market

Coupons for corporate green bonds tend to be about 2%, with fixed rates for nearly all issuance ranging between 0.0% and 4%, and virtually none over 4% *(see chart 2)*. This typically suggests that corporate green bonds are being marketed as low-to-moderate return investments. Such return characteristics are commensurate with their maturity profiles *(see chart 3)*. Maturities are typically between four and eight years for all industry groups, making them medium-length investments. Automakers, consumer products and real estate, and forest and paper products are at the low end of the spectrum with average maturities nearing four years, while engineering and construction and utilities are at the high end, heading toward maturities of eight years. Longer maturities increase their risk profiles, which is understandable, given that these industries have longer research and development timeframes and involve higher capital expenditure (capex) for construction.

Issuance to date has come from a number of industries, but has been led by utilities, which represent 62.5% *(see*

chart 4). In part, this is because the two largest offerings to date were from EDF and GDF Suez, totaling $5.3 billion. In the future, we expect corporate green bonds could be issued by a variety of industry groups, and will likely be concentrated in industries that are considered lower-risk, are already experiencing good growth, and where upfront costs tend to be smaller.

Unlike multilateral development banks, which are mostly rated 'AAA', ratings for corporate green bond issuers are spread over the investment-grade spectrum from 'AAA' to 'BBB', with the majority at 'A+' or 'A' *(see chart 5)*. We think this could boost confidence among prospective corporate issuers who are rated 'BBB-' or above, aiding market volume. In addition, European companies have issued a notable amount of unrated green bonds ($1.2 billion), including Vasakronan AB, Skanska Financial Services AB, and Arise AB. These have all achieved coupons under 4%, with the longest dated maturity being five years. In our view, this signals solid investor confidence, particularly in countries where these corporate entities operate, as demonstrated by 100% of Vasakronan's green bonds being bought by local investors.

Future Prospects

In the current market, a lack of economies of scale are an obstacle to speculative-grade corporates interested in issuing green bonds, or higher-rated companies with smaller funding needs. As the market continues to develop, smaller environmental projects may be able to attract financing by aggregating into larger investment offerings. This could make them more suitable to larger investors.

We think it likely that the market will begin to see structuring of bonds to enhance credit support. We have already seen evidence of this from Toyota; it used securitizations of car loans to collateralize its corporate green bonds, which were quickly oversubscribed. Notably, the underlying collateral in these transactions was not considered "green," but the proceeds will still be allocated to fund green car development.

Furthermore, we think the next stage of market evolution will involve a shift in credit risk away from corporate entities, moving financing for environmental projects off their balance sheets. With corporate green bonds, the credit risk for the investor remains linked to the issuer's general corporate creditworthiness, with bond proceeds typically being earmarked for environmental purposes. Environment-related projects tend to have high upfront capex, low maintenance costs, and, if backed by government subsidies, relatively stable revenue streams. However, mainstream investors may not yet be willing to take on project finance-style construction risk. In the short term, we expect this type of green bond will be related to the refinancing of existing projects or assets, since it tends to involve lower risk for investors. The second stage of growth may come in aggregation, where the risk to investors will depend on factors such as the type of environmental projects, how many projects are in the debt pool or portfolio, and whether construction has been completed. This method has the potential of increasing the overall credit rating on the portfolio for the combined projects, thus enhancing the likelihood of mainstream investor interest. **cw**

NOTES

(1) *Credit Themes: Green Bonds–State of Play, Societe Generale Cross Asset Research, May 15, 2014*

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Green Bond Market

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Green Fixed-Income Indices

A Natural Outgrowth Of The Green Bond Market

Overview

- While the green bond market is still in the early stages of establishing whether it can provide capital at scale for the low-carbon economy, it has reached an inflection point and is poised for growth and takeoff.
- The threat of climate change is real, and investors will begin to refocus their portfolios, investment mandates, and mission statements to address its negative effects.
- Capital needs for the development and creation of low-carbon infrastructure point to the potential of long-term debt issuance, which can provide a good fit to meet investor mandates.
- Growth of the market is building the foundation for an asset class to emerge, which is creating the need for green fixed-income indices.

EDITOR'S NOTE: The authors of this article are Anadi Jauhari, CAIA, Senior Managing Director and Founder, Emerging Energy and Environment Group and Infra Credit Alpha (1), and Julia Kochetygova, Senior Director S&P Dow Jones Indices. The thoughts expressed in this article are those of the authors and do not necessarily reflect the views of Standard & Poor's Ratings Services.

The green bond market has continued to mature since its inception in 2007, when the European Investment Bank first issued its Climate Awareness Bonds series. The first tranche took the form of a €600 million five-year bond, linked to the performance of a European corporate environmental index, designed to identify European companies building environmentally sustainable businesses.

Since then, the market has expanded in size and scope to include diverse issuers and investors, maturities, currencies, and credit ratings. The early issuers were principally highly rated multilateral development banks (MDBs or supranationals), which have a mandate to channel funds into climate and environmental projects. Because these projects tended to be small, with the attendant execution risks, they needed the credit capacity of the MDBs' strong balance sheets for raising cost-effective capital. With their high ratings, combined with a transparent mechanism established under the bond structure to assure that proceeds went solely to the targeted environmental projects, MDBs succeeded in developing an investor base that was seeking safety with some ability to satisfy its environmental mission. Our research of the market indicates that green bonds will continue their growth trajectory to create the foundation for green bonds to be treated as an asset class. This will likely pave the way for the adoption of and demand for green fixed-income indices.

Green bond issuance of about $30 billion (estimated) in 2014, compared with $11 billion in 2013, is still a very small fraction of the $157 trillion global fixed-income market (McKinsey, 2011). Yet, it has grown at a 50% plus compound annual growth rate since inception, albeit from a small base, with significant oversubscriptions, increasing issue sizes, and market liquidity.

We believe that growth in the green bond market is the result of a number of converging trends:

- The growing awareness of climate change by investors and the public, and of its potential impact on businesses, human life, and asset values;
- The recognition that a low-carbon pathway for the global economy to keep global temperatures within acceptable limits requires vast amounts of long-term cost-effective capital, which only institutional investors can provide at scale via fixed-income instruments that are rated at least investment grade; and
- The development of voluntary criteria and standards for green bonds.

Green Standards Are Crucial For Market Confidence

At its core, the "green" bond concept is a market innovation that provides for efficient capital intermediation between investors and environmental and climate projects. What's innovative is the identification and labeling of a specific bond issue as "green" based on transparent, independently verifiable qualifying criteria. The green labeling helps the issuer achieve a desired rating or credit quality and pricing level that is sufficient to clear investor demand for a bundled product of fixed-income and green attributes. Such criteria were fundamental to the establishment of Green Bond Principles (GBP) by industry participants, including major banks and nonprofits, committed to the growth of the green bond market.

Green bonds, considered a subset of the universe of climate bonds and of the even broader set of thematic bonds, are not new instruments. The Climate Bond Initiative, a nonprofit, estimates that more than $346 billion in climate bonds are currently outstanding. But we believe that's a conservative estimate. The amount of green bonds outstanding would be higher if the GBP labeling criteria and guidelines for green bonds, adopted in 2013 to 2014, were to be retroactively applied to bonds issued before then by projects and companies that produce carbon-free energy or have other climate benefits.

A bond issue is green, according to current GBP guidelines, if the issuer uses the proceeds solely for capital expenditures associated with green or climate environmental benefits, according to certain disclosure and transparent "policing" standards. This use of proceeds neither specifies the type or the nature of the project, nor mandates a certain level of climate or environmental benefits. Moreover, under current GPB criteria, a third-party provider is to ensure compliance with the use of proceeds.

Will Green Bonds Evolve As An Asset Class?

For an asset class to develop, it should achieve not only a certain critical mass in terms of size and liquidity, but also attract a wide range of investors, issuers, and intermediaries that constitute all of the

links in the market, that is, the entire green bond "ecosystem." These building blocks provide the necessary transparency, and are important in creating investment opportunities of varying risk-returns that issuers and investors can access efficiently. As a subset of the broader global fixed-income market, we expect the green bond market to develop over time to price in not only credit, interest rate, and liquidity risks, but also "green" attributes, depending on the specifics of the bond structure, to meet specific environmental mandates, or as a source of additional return or alpha.

Our analysis suggests that the green bond market will emerge as a distinct asset class, given its potential size, scale in terms of breadth and depth, and expected investor interest and demand for its fixed-income and green characteristics. By the current year-end, we estimate that the market may grow to about $40 billion to $50 billion in labeled green bonds outstanding. "Non-labeled" or "perceived green" bonds, comprising renewable energy project bonds, may amount to an additional $10 billion to $15 billion. The improved integrity of the green bond certification and verification process and standards, as well as the emergence of independent service providers, will likely further enhance information efficiency as the market matures.

Demand For Issuance May Exceed $200 Billion A Year

While estimates vary depending on the source, investments in low-carbon infrastructure could range from 1% to 3% of global GDP, or in excess of $1 trillion a year through 2050. Green investments, by definition, are intended to reduce carbon footprints or reduce the impact of climate change, and may potentially involve capital-intensive sectors such as transport, energy, and water. Even if assuming a modest fraction of total investment needs or available investor capital, the potential issuance can range easily from $50 billion to $200 billion a year.

The demand for low-carbon infrastructure capital will not come just from the developed world, which needs to replace and upgrade its aging infrastructure, but also from the developing world, which faces the daunting challenge of building new infrastructure. Institutional and retail capital, intermediated through pooled investment vehicles, banks, and

Potential Evolution Of Green Indices

Issuer type	Illustrative type of green indices	Illustrative issue/index constituent
Global issuers		
GBP-labeled green	Global labeled green bond index	Labeled issuers include International Finance Corp., European Investment Bank, International Bank for Reconstruction and Development, Financierings-Maatschappij voor Ontwikkelingslanden (FMO), African Development Bank, as well as corporate, municipal, subsovereigns (see below)
Global issuers		
GBP-labeled green Nonlabeled green but applies GBP	Global labeled green bond index Global universal green bond index	As above OFTO, Topaz, St. Clair
Corporate issuers		
	Corporate green bond index	Bank of America, EdF, Iberdrola, Arise, Skanska, EdP, Unilever, GDF Suez
U.S. municipal		
	U.S. municipal green bond index • General obligation • Revenue bonds	Hawaii, Massachusetts
Subsovereign		
	Subsovereign green bond index • OECD • Non-OECD	Île-de-France, City of Gothenburg (Sweden)
Project bonds (single asset and portfolios)		
	Green project bond index • Investment grade • Speculative grade	Topaz, Breeze, Alta Wind Holdings
Bank loans		
	Green bank loan index • Rated and nonrate • Investment grade and speculative grade	Multiple
Asset-backed securities		
	Green ABS • Solar • Energy efficiency	SolarCity, Hero Funding, Hannon Armstrong, Toyota

GBP–Green Bond Principles.

foreign or local capital markets, will likely fund the build-out, resulting in long-term asset creation. A large part of "green capital" will be in the form of debt, supported by long-lived assets.

The challenge in capital formation is the efficient aggregation of green assets to achieve a target credit quality. Alternatively, these assets could become part of larger and stronger balance sheets that could attract capital at a desired risk-return level. Green projects by their very nature not only lack scale, size, and homogeneity, but also are likely to exhibit risk and complexity profiles that might deter investors from investing in the green bond asset class, necessitating aggregation via specialized intermediaries and "derisked" vehicles.

Green Investor Mandates Are Growing

The green bond product appeals to a range of investors. Recent green bond issuances have attracted not only SRI and ESG investors (sustainable and responsible investing, and environmental, social, and governance), but also traditional institutional investors, such as pension funds, corporate pension plans, endowments, and insurance companies. This is a positive market development that has widened the traditional investor base for many issuers. While the recent green-labeled issuances have been significantly oversubscribed, investors have generally not compromised their risk-return and yield requirements while gaining exposure on the green or sustainable aspects of the issues. As issuance expands across the credit and maturity curves, with assets in varying "shades of green," investors may take a more nuanced and a differentiated view in pricing credit, liquidity, and green risks. It is unclear at this stage whether green bond issuances will price more tightly than equivalent nongreen issues at the same ratings and liquidity levels.

Given the vast potential for issuer and ratings diversity as the market grows, it is reasonable to expect that not only will green bonds likely provide an outlet to meet the growing investor environmental and sustainable mandates, but also, potentially, satisfy additional investment considerations. These might include liability and duration matching, stable and inflation-linked returns in some cases, and diversification from other asset classes such as public equities. The trend toward incorporating climate change as a long-term risk consideration into strategic asset allocation decision-making by institutional investors may also prompt a shift (or a greater allocation) to green fixed-income and other climate-sensitive asset classes such as infrastructure, farmland, and real assets, which require a longer-term perspective. Over time, green bond financing structures may begin to price in climate change-related risks, thus providing an avenue for diversification among investors.

According to TD Research, institutional investors hold 72% of long-term investments in the global fixed-income market and are therefore likely to be a vital source of long-term funding for low-carbon infrastructure. Denmark's ATP pension fund, for example, has dedicated US$1 billion toward climate change investment. Many large institutional investors, such as California State Teachers' Retirement System (CalSTRS), have integrated consideration of climate change into their asset allocation decisions and invest in investment-grade assets that provide some protection against the volatility of climate change. The development of local capital markets in larger emerging markets in Latin America and Asia, especially, as local pension funds and other institutional investors move away from government bond investing in these markets, will also likely be a source of green debt funding.

Meeting Risk-Return Demands

Over time, green projects will be aggregated in portfolios, pooled, or moved to larger corporate balance sheets and securitized, to achieve risk profiles that enable capital to be raised most efficiently. New intermediaries are entering the ecosystem. We are already seeing the emergence of "green" monolines (such as Ascending Markets Financial Guarantee Corp.), multilaterals (like the Inter-American

Development Bank), and mission-driven non-profit capital (Clean Technology Fund funded by major sovereigns) to provide credit enhancement—despite the demise of the monoline model in the aftermath of the global financial crisis.

Over time, similar to credit ratings, some form of green ratings, aimed at quantifying the environmental benefits, could come into existence to allow investors and issuers to differentiate between the shades of green and the climate change impact.

Government regulation and political support for the development of low-carbon infrastructure, as well as fiscal and tax incentives, will drive institutional and retail investor interest in the sector. The conventional wisdom is that infrastructure investment creates jobs and stimulates economic growth, and will likely create a conducive environment for long-term capital formation.

Green Indices Are The Next Phase

Indices have been an integral part of market development and maturation. They provide transparency into the characteristics of markets and the independent tracking and reporting of performance. Independent and transparent indices create the basis for a wide range of investment strategies, which can further foster liquidity in those markets.

As investors begin to allocate a share of their fixed income to green investing, it is reasonable to expect that green bonds will mainstream into the fixed-income universe, creating a strong need for green indices. Even in its current phase of growth, and despite the market's current early formative stage, our research, based on investor feedback, suggests that as investor interest and concerns over climate change continue to grow, green indices are needed to achieve transparency and simplicity, as well as the commoditization of the asset class. Over time, this will result in more debt capital committed to green assets, lowering the cost of capital. Such increased capital efficiency is key to the deployment of capital at scale in low-carbon infrastructure.

In general, we expect the development of green fixed-income indices to mirror that of the green bond market, and the indices to pattern themselves after their general fixed-income counterparts. For example, such indices may include global and regional subfamilies, as well as different types of issuers and rating levels. As the green label still remains a voluntary standard at the option of the issuer or investor, the market may continue to see labeled and nonlabeled green issuances, unless the standard allows issuers to raise debt more efficiently, while meeting investor risk-return and environmental mandate expectations. One decision for index providers, then, is whether to include only labeled green bonds in their products, or offer two different kinds of products, or include both in one product.

What follows is an indicative sketch of the likely development of green indices over time based on our reasonable expectation of market growth *(see table, where the top rows of the first column represent where issuance stands today)*. The initial indices will likely be based on green bonds that follow the current green labeling guidelines, and may expand to include other types of green assets not labeled green but that satisfy the criteria under GBP. Additionally, we believe the market will evolve to provide more granular indices as interest in the asset class grows. Depending upon growth of the segments in the green bond market, each index may be made more granular by the green asset's subsector (solar, wind, energy efficiency); asset type (mitigation versus adaptation); country of domicile for the assets; ratings; and issuer type.

(1) Based in Stamford, Connecticut, Emerging Energy and Environment Group (EEE) is an alternative investment firm focused on clean energy investments, with offices in Mexico City and Rio de Janeiro. Infrastructure Credit Alpha Group is EEE's credit research affiliate focused on innovative finance. **cw**

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Green Fixed-Income Indicies

Limited Visibility For Climate Change's Effects On U.S. State And Local Government Credit Quality

Weather-related events place local governments, which are generally the first responders to disaster, on the front lines of caring for their citizens. They must also manage budget volatility following such events, as well as repair and adapt their infrastructure to prepare for changing risks. In Standard & Poor's Ratings Services' experience, U.S. municipal and state governments have historically been able to manage the risk of natural disasters without diminishing their credit quality. The credit impact of most natural disasters has been limited. There are some exceptions, however: Hurricane Katrina, which hit an underprepared Gulf Coast at a time when the federal government was ill-equipped to respond, led to a number of negative credit actions on local communities and Louisiana, and Hurricane Ike led to a downgrade of Galveston, Texas' general obligation and water and sewer ratings. To some extent, our ratings on local governments and states incorporate the potential for disasters in high-risk areas, such as the Gulf Coast and the earthquake-prone West, by considering financial flexibility and liquidity in the context of potential losses from a major storm or quake. However, the potential for increasingly frequent climate-related disasters makes the issue more relevant for local governments all across the U.S.

Overview

- Climate-related disasters have the potential to pressure some U.S. local governments' credit quality if severity increases and the federal government isn't responsive.
- However, thus far, the impact of such disasters on affected state or local governments' credit quality has been limited to a very few severe cases.
- The major threats to credit quality are depressed economic growth, increased costs for recovery and infrastructure at a time of lower revenues, and reduced federal government support.

While the timing and severity of weather events remain unpredictable, the increasing uncertainty arising from changing climate patterns represents a difficult-to-quantify risk for local governments. This risk could result in more credit pressure for local governments if the federal government were to not provide timely and sufficient financial support for relief, or if the local government's ability to prepare for disasters—for example through improvements that reduce the impact on infrastructure of extreme weather, transportation adaptation, or flood control measures—comes at the cost of financial flexibility and increased leverage.

In our 2011 article on natural disasters and credit quality *(see "Ready for the Big One? How Natural Disasters Can Affect U.S. Local Governments' Credit Quality," published Oct. 27, 2011, on RatingsDirect)*, we noted that Standard & Poor's evaluates the impact of natural disasters in light of key credit factors—both quantitative (such as the government's financial position and the tax base's relative strength and diversity) and qualitative (including management's emergency preparedness and the adequacy of its response).

The Effects Of Weather Events On U.S. Municipal Governments

The immediate effects of extreme weather on local governments may include volatile fiscal performance, strained liquidity, increasing debt burdens, and economic loss during periods of extended extreme weather or disaster recovery. While federal disaster relief is available, increased recovery costs for local governments could result if future federal government austerity affects reimbursement levels. Even when federal relief is available, it might not completely cover the loss of taxing and revenue capacity for entities that rely on property taxes and retail sales, and distribution of federal funds can take several years. Municipalities, therefore, may be tasked with managing the immediate disaster costs—for emergency response costs, debris removal, and restoration of services—using immediately available liquid resources at a time when revenue streams, such as sales taxes and development-related fees, may temporarily decline. If future federal budgets were to limit disaster relief (from the Federal Emergency Management Agency, for instance), an increase in the magnitude and frequency of weather-related events could exacerbate this dynamic over time, forcing local governments to assume more of the recovery costs.

Perhaps most difficult to measure are the long-run economic consequences of a failure to prepare for climate change. In the past two years alone, major weather events have been severe enough to put a dent in national GDP growth for a short time. By some estimates, the deep freeze that gripped the eastern U.S. in early 2014 crimped national first quarter 2014 GDP growth by one- to two-tenths of a percentage point, and Superstorm Sandy lowered growth during the fourth quarter of 2012 although the recovery effort quickly boosted output once again. At the local and regional level, short-run economic effects may be more pronounced and are sometimes accompanied by lost taxing capacity when a portion of the property tax base is damaged. The interdependence of urban infrastructure, such as water and wastewater, power, transportation, and communications systems can magnify the downside risk, as we saw from the damage to the entire New York metropolitan region and the New Jersey coast following Superstorm Sandy.

These short-term losses may be followed by a rebound in GDP as construction and rebuilding activity ramp up following a disaster. Over the long run, however, taxing capacity at the local level may suffer if, for example, there are significant out-migrations as occurred following Hurricane Katrina, or if reconstruction and development are prohibited in high-risk areas following a disaster, as has occurred in many communities in the Gulf Coast. In other cases, such as in California's Sacramento Valley, we have observed the dampening effect of weather-related risk on private development activity in high-risk areas as insurers tighten their underwriting standards for disaster coverage, and governments place constraints on new development. This limits the tax base growth that many municipal issuers rely on to fund their recurring and disaster-related expenditures.

Responding To Climage Change Risk: Local Strategies And Their Credit Effects

State and local governments are key stakeholders in national climate change-related efforts. States create policies and programs that encourage or discourage adaptation and mitigation at all levels of government through regulation, funding, and public adoption of "clean" technologies. Currently, many state and local governments' efforts to address climate change have focused on land-use planning and incremental improvements to public facilities and infrastructure. Some state and local efforts to reduce carbon emissions have also been undertaken: most notably, in 2012, California became the first state to implement a cap-and-trade program to reduce greenhouse gas emissions, which generates a relatively small amount of revenue for the state, but which we believe has had little effect on the state's credit quality.

A growing number of state and local governments are also making adaptive improvements to reduce the effects of weather events on critical infrastructure. These include flood control improvements and water storage and delivery system upgrades, as well as storm preparedness improvements by utility and transit providers to increase infrastructure resistance to severe storms.

In California's Sacramento Valley, for instance, joint federal and local efforts are currently underway to finance levee improvements designed to achieve 200-year flood protection, according to FEMA's most recent standards, which have become stricter in the wake of Hurricane Katrina and subsequent storms. These types of financing projects increase debt burdens and cost-sharing with federal and state agencies. If shared revenues and tax-supported debt together are not sufficient to cover costs, these projects may have the potential to erode credit quality by placing strain on resources available for capital spending.

New York State's Sea Level Rise Task Force is one example of a nonfederal effort to identify and address climate change. The 2010 task force report identifies the risks associated with climate change—particularly rising sea levels—to communities and infrastructure. It also recommends actions for state and local governments to undertake to address these risks, including studying the impact of sea-level change on communities, making regulatory changes to address sea level change, implementing funding mechanisms, and seeking federal aid for adaptation and disaster-prevention measures. However, the recommendations are short on cost details.

In our view, New York's task force and the California investment highlight some of the efforts underway to understand and mitigate weather-related vulnerability. We expect continued focus on this area given the pattern of natural disaster activity over the past decade. The pace and progress of actual investments will likely be slow due to funding constraints at all levels of government.

What's Costlier, Preparing Or Doing Nothing?

Ultimately, the risk for U.S. public finance issuers of a changing climate emanate from the impact of unpredictable weather patterns on infrastructure and economic growth. While we continue to believe that local governments—in collaboration with regional, state, and federal entities—can withstand the effects of extreme weather with limited impact on credit quality, only time will tell whether an increase in the unpredictability of climate-related events will make ratings more volatile. But as evidence of climate change and related risks mounts, the costs associated with not preparing for them may continue to grow. **cw**

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How Utilities Pay For Post-Sandy "Storm-Hardening" Infrastructure Investments Could Factor Into Credit Quality

In October 2012, Superstorm Sandy knocked out electric service to 1.4 million of New York's Consolidated Edison Inc.'s approximately 3.3 million electric customers and about 920,000 of Long Island Power Authority's (LIPA) approximately 1.1. million customers. The lights also went out for about 1.7 million of New Jersey's Public Service Electric & Gas Co.'s (PSE&G) 2.2 million electric customers. For many, the outages lasted weeks, resulting in strong economic impacts that reverberated through the region as businesses closed and gasoline sales ground to a halt. Because the repercussions of the storm-related power outages were so wide, utility and government officials realized they needed strong utility responses to prevent this from happening again. Specifically, the utilities clearly needed to pursue investments in what the industry calls "storm hardening."

Overview

- After incurring substantial power restoration costs, utilities affected by Superstorm Sandy are pursuing sizable storm-hardening investments.
- The extent to which government funds are available to defray these investments or, alternatively, the presence of regulatory approvals providing for cost recovery from customers could have credit implications.

Although these utilities' solutions and their costs share common elements, the funding sources available reflect varying views among government officials as to where the financial responsibility for funding these investments lies. The availability of federal aid is also an important element of the funding solutions. Standard & Poor's Ratings Services believes that the means for funding and cost recovery can be important factors in determining credit quality.

The Storm-Hardening Programs' Common Attributes

Given the breadth of these utilities' service areas and their extensive coastal exposures, storm hardening costs will be substantial—about $1 billion per utility. Common elements of their storm hardening programs include raising key structures, such as substations, to heights that are better able to withstand storm surges. The utilities will also replace existing poles with stronger poles in those areas at risk for storm surges and they will step up activities to reduce the potential for trees and branches knocking down power lines.

FEMA Comes To LIPA's Aid

The long outages that LIPA's customers experienced triggered considerable ire among customers and politicians, leading to state legislation that imposed greater regulatory oversight. It whittled

LIPA's capacity to set rates on its own, subjecting rate adjustments to hearings if rate increase proposals exceed prescribed thresholds. In addition, the legislation transformed the utility's operations by transferring day-to-day operations to an affiliate of one of the region's investor-owned utilities and sets three days as the baseline for restoring service following a major power failure. If LIPA does not meet this target, the system operator must provide New York's Department of Public Service with an assessment of the utility's pre-event preparedness and post-event restoration efforts. The state also asked LIPA to freeze its base rates for at least one year, which it did, and the state is seeking a second year on that freeze. We believe these actions could reduce the utility's financial flexibility. We consider financial flexibility to be critical to responding to potentially volatile costs and preserving credit quality. Our negative outlook on LIPA reflects the constraints these conditions could impose on financial performance.

Against the backdrop of the state's response to the storm outages, the utility found a financing lifeline in the Federal Emergency Management Agency (FEMA). FEMA reimbursed LIPA for about 90% of its storm restoration costs. The agency reimburses these types of costs for not-for-profit utilities because they cannot take advantage of the federal tax benefits that investor-owned utilities can. Moreover, in an unusual move, the agency also agreed to finance much of LIPA's prospective storm hardening activities. This decision provides the utility with the capacity to buttress its system without incurring substantial infrastructure investment financing needs while its base rates remain frozen. The FEMA reimbursement plan helps shore up credit quality while enabling LIPA to invest in reliability as it faces ratemaking constraints.

Limits On Consolidated Edison's Options

Unlike LIPA, New York's Consolidated Edison, an investor-owned utility, will not have the benefit of FEMA resources to strengthen its system's storm resiliency. It also funded its storm recovery and restoration costs differently from LIPA, by capitalizing portions of its $363 million of spending. It recorded the uncapitalized balance as a regulatory asset for deferred recovery. In 2012, the company had no current federal income tax liability as a result of, among other things, deduction of costs incurred in connection with Sandy.

Consolidated Edison asked the state's rate regulator for cost recovery for about $1 billion of prospective after storm hardening projects. The regulator approved the projects, albeit within a framework of stable rates. We believe that the company will need to effectively control costs and avoid cost overruns in its sizable capital program to mitigate the rate freeze's impact. The costs of storm hardening also need to be considered within the context of the recent East Harlem natural gas explosion. Although the explosion's cause has yet to be determined, and we believe Consolidated Edison carries insurance that should cover a portion of potential costs if it is found liable, it is our view that such a finding could lead to penalties and higher compliance costs for the utility's aging gas distribution system. Our outlook on the company is stable, but possible penalties and additional capital investment needs could harm its financial condition and might lead to modestly lower ratings.

PSE&G Benefits From Supportive State Regulation

By comparison, neighboring PSE&G appears to operate under more beneficial state regulation. On May 1, the New Jersey Board of Public Utilities' staff recommended that the regulator allow the utility to recover from customers $1.2 billion of the $2.6 billion of the multiyear storm-hardening investments it had proposed. PSE&G ultimately plans to align its after storm hardening spending with the amounts the regulator approves. Staff's recommendation includes a 9.75% return on equity on the first $1 billion of investment and a rate of return on the balance that this utility's next rate case will determine.

We consider financial flexibility to be critical to responding to potentially volatile costs and preserving credit quality.

Vehicles For Recovering Investments Can Influence Credit Quality

Although very different avenues for funding storm hardening investments are available to these utilities, and some of the investments might weigh negatively on credit quality, the utilities and their regulators nevertheless are consistent in recognizing that investments that will help these systems better withstand storms are critical to enhancing operational predictability and improving customer satisfaction. Although we believe that these investments can contribute to greater operating stability and benefit utilities' enterprise and financial risk profiles, cost recovery—whether from customers or government reimbursements—remains an overarching consideration for credit quality. **cw**

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Post-Sandy

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New York-Area Transportation Infrastructure Providers Passed The Superstorm Sandy Credit Test

The storm surge and high winds from Superstorm Sandy in October 2012 wreaked havoc on New York Metropolitan Transportation Authority (MTA) and Port Authority of New York and New Jersey (PANYNJ) transportation facilities. However, despite the significant disruptions, most MTA services resumed relatively quickly. Similarly, all of the PANYNJ-operated facilities—including airports, bridges and tunnels, marine terminals, the World Trade Center site, and the PATH system—returned to full operation within less than a week in most cases.

As a result, the credit quality of both of these essential transportation infrastructure providers did not suffer. Standard & Poor's Ratings Services believes these operators' strong contingency plans, which allowed for quick resumption of most services, along with their good liquidity positions, ability to obtain additional interim borrowing capacity, and actions to reinforce steady financial performance, and our expectation of insurance proceeds and federal aid defraying much of the storm-related costs demonstrated effective management and mitigated our concerns about the financial fallout from the massive storm.

What We Look For In Our Ratings Analysis

Demand, leverage, and capital investments are key factors we consider when analyzing

Overview

- Superstorm Sandy's impact on transportation infrastructure providers in the New York City area was significant, but quick actions and contingency plans meant that services resumed relatively quickly.
- Management's strong contingency plans and quick response were keys to credit stability.
- As a result, despite having to absorb many of the costs associated with Sandy-related repairs, these providers maintained their credit quality.

the creditworthiness of transportation infrastructure providers. The relative importance of each depends on other factors, such as the condition of the local economy, regulations, competition, and management. Overall, Standard & Poor's expects regional economic activity in 2014 to support modest growth in demand for most transportation infrastructure providers in the U.S. Credit stress, however, could surface for some if addressing unexpected shocks (such as natural disasters or security concerns) compromises their financial flexibility. In these cases, a quick and effective management response will be critical for them to maintain the current ratings.

Sandy Didn't Hurt The MTA's Credit Standing—In Fact, It Eventually Improved

We expect the MTA to recoup most of the costs of repairing or replacing storm-damaged assets in the next several years from a combination of insurance and federal government assistance programs.

The MTA's 2010 to 2014 capital program (including bridges and tunnels) increased about $10.5 billion (to $34.8 billion) to include Sandy repair, restoration, and resiliency projects. About $4.8 billion of this is for repairing and restoring MTA assets damaged during Sandy, while the remaining $5.8 billion will go toward hardening the system against future storms or other catastrophes.

To date, the Federal Transit Administration (FTA) has given the MTA $3.79 billion in appropriated emergency relief funding. We expect the authority to submit additional requests to the FTA for funding of both repair and restoration costs and hardening costs from FTA emergency relief funds and to adjust its capital spending accordingly if it receives less federal aid or insurance proceeds than it currently assumes.

Since Sandy, MTA management has put in place three liquidity facilities that provide the authority with $950 million of interim financing capacity. To date, it has used $300 million. In response to sharp increases in insurance coverage following Sandy, the authority also decided to supplement its property insurance coverage with a capital markets-based alternative: $200 million in fully collateralized storm surge coverage for losses from storm surges that occur until July 30, 2016.

We expect the MTA to recoup most of the costs… in the next several years…

We believe the added costs did not impair the MTA's credit standing because of the authority's actions and plans to mitigate the higher expenditures. In fact, we raised our rating on the MTA one notch this year after applying our revised mass transit criteria. Although we viewed the relatively quick resumption of most MTA services positively in terms of our assessment of MTA's management other factors assessed under our revised criteria contributed to the upgrade. One of these included the MTA establishing a $350 million line of credit in January this year to bolster its liquidity position. Nevertheless, the rating could face long-term risk if the MTA's financial risk profile deteriorates or its economic fundamentals weaken significantly. Possible causes for credit stress include higher than expected increases in operating expenses and leverage, less fare and toll revenues due to lower-than-expected demand, fewer state and local subsidies, and a material erosion in liquidity.

The PANYNJ's Credit Standing Also Remains Intact

As with the MTA, we expect available insurance coverage and federal disaster relief funds will cover much of the PANYNJ's Sandy-related losses. The authority estimates that it lost $2.4 billion, although this figure could rise if officials find any latent damage from salt-water intrusion at PANYNJ facilities.

The authority's $2.9 billion 2014 operating budget includes higher insurance premium costs, which rose $18 million following Sandy. Its $4.4 billion 2014 capital budget includes a $180 million investment in the PATH's modernization and Sandy recovery programs, which includes signal replacement, station rehabilitation, and power station upgrade projects. The PANYNJ plans to invest nearly $16 billion in the first five years of its recently approved 10-year (2014 to 2023) $27.6 billion capital plan. The plan includes $1 billion of capital investment to pay for repair, mitigation, and resiliency projects, of which more than $700 million will go toward permanent repairs to the PATH system—the PANYNJ facility Sandy affected the most.

Like the MTA, the PANYNJ's credit standing did not take a hit from Sandy. We expect the authority to retain its credit standing, assuming its management continues to adjust revenues, expenses, and capital spending to sustain sound financial operations, while ensuring that the PANYNJ maintains key revenue-generating assets sufficiently. The authority's credit quality could face stress if liquidity and financial margins erode considerably from lower-than-expected demand, if leverage increases, or from added expenses from addressing unexpected shocks such as natural disasters or security concerns. In these cases, management's ability to react quickly is critical for them to maintain the ratings we have on them. In light of the PANYNJ's significant additional debt needs, we don't expect the authority's credit standing to improve.

Proactive Management Will Be Key For Credit Stability

Both the MTA and PANYNJ were able to maintain their credit quality despite the widespread Sandy-related damage. However, credit risks could loom if their management teams are unable or unwilling to implement timely adjustments to revenues, expenses, and capital spending to maintain financial profiles consistent with the ratings. **cw**

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California's Water System Illustrates The Near-Term Impacts Of Long-Term Climate Change

California is suffering a third consecutive year of drought. The state typically experiences wet, cool weather during the fall and winter, and dry, hot weather during the spring and summer. Those winter rains and snow are important buffers during the dry summers in this agriculture- and population-rich state. California's water agencies have been examining ways to meet current and future water needs. However, the severity of the current drought has highlighted operational weaknesses leading some municipalities to curtail their water consumption and requiring farmers to fallow as much as 800,000 acres of productive agricultural land with crop losses estimated at $3.65 billion.

Overview

- Given the length and severity of California's current drought and the possible long-term effects of climate change, the state's water agencies are exploring their options to mitigate supply risks from water sources with irregular performance.
- To meet their current and future water needs, water agencies are developing long-term capital plans whose costs they're assuming now.
- We expect that funding for these projects will largely come from revenue-secured debt and consumer rates.

As a result, concerns about the reliability of the state's water supply have spiked, as have worries about the possible effects of climate change. In Standard & Poor's Ratings Services' opinion, managing operational risks through demand management; increasing water storage capacity; developing new, stable water sources; and implementing water rate structures that promote stable net revenue performance are key to the future stability of the water sector in California.

California's Response To The Drought

Two major sources of surface water supply for the state are the State Water Project (SWP) operated by the California Department of Water Resources (DWR) and the Central Valley Project (CVP) operated by the U.S. Bureau of Reclamation (USBR). In response to the drought, DWR has taken the unprecedented move of lowering the water allocation percentage for SWP contractors to 0%, although subsequent modest precipitation has allowed DWR to increase those allocations to 5%, while USBR maintained a 0% allocation to CVP agricultural contractors and a 50% allocation to CVP municipal & industrial contractors. On Feb. 14, 2014, President Barack Obama visited the San Joaquin Valley and identified intensifying droughts and other weather-related disasters as examples of how climate change could affect the nation *(for Standard & Poor's view on the California Drought, see "Drought Declaration Provides Limited Relief To California Water Bond Obligors," published Jan. 21, 2014, on RatingsDirect).*

Regardless of whether the current drought is an example of climate change at work or simply another multiyear drought similar to those that struck California during the late 1970s and early 1990s, the severity of the current drought has led to a resurgence of public interest in the state's water supply reliability. For calendar year 2013, statewide average precipitation was just seven inches, the driest year on record dating back to 1895(1).

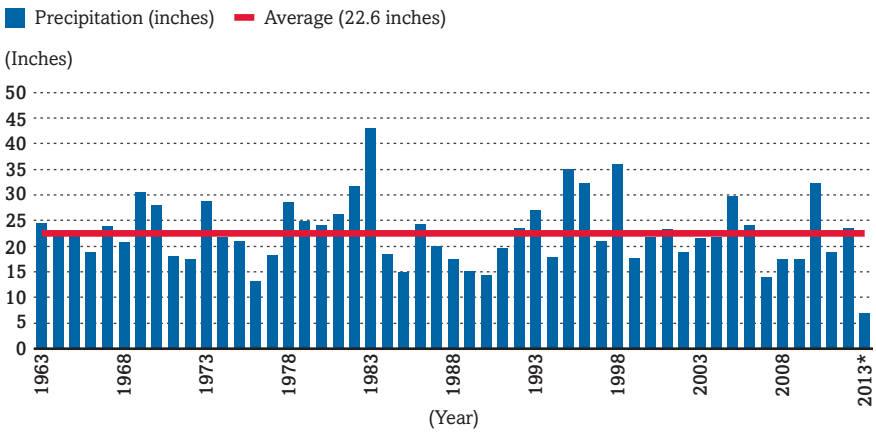
Led by DWR, the state is preparing for climate change and anticipates that it will require significant infrastructure improvements to ensure water supply reliability. Recently updated assessments from the United Nations' Intergovernmental Panel on Climate Change and the U.S. Global Change Research Program include climate change projections for the world and nation, respectively, that are largely consistent with the expectations expressed in the state's planning documents, such as DWR's Climate Change Adaptation Strategies and the California Water Plan.

Although significant uncertainty clouds the estimated range of impacts resulting from climate change and the time horizon over which they'll be felt, it is clear that DWR, USBR, and water agencies across the state are planning ahead to adapt to these forecast conditions. As a result, we anticipate that these agencies will incur significant capital costs over the near- to medium-term horizon to develop the capacity to provide reliable service under a range of scenarios. And we expect that these capital costs will affect financial performance far sooner than what might otherwise be implied by the likely time horizon for climate change.

Climate Change In California

California's climate is classified as Mediterranean, meaning that the state typically experiences wet, cool weather during the fall and winter, and dry, hot weather during the spring and summer. Precipitation occurs when moisture-laden weather systems pass across the state and over mountain ranges. Of critical importance to the state's water system is precipitation that contributes to the snowpack in

Chart 1 | California Statewide Average Precipitation



*Driest year on record, dating to 1895.
Source: Western Regional Climate Center.

California Projects

Project name	Type	Estimated cost (mil. $)	Capacity (AF)	Cost ($)/Capacity (AF)
Completed/in-progress projects				
Diamond Valley Lake	New facility	1,900	800,000	2,375
Los Vaqueros Reservoir	Expansion	120	60,000	2,000
San Vicente Reservoir	Expansion	568	152,000	3,737
Projects under consideration				
Sites Reservoir	New facility	3,600–4,100	1,900,000	1,895–2,158
Shasta Lake	Expansion	1,100	133,000	8,271
Temperance Flat Reservoir	New facility	2,500–3,400	1,200,000	2,083–2,833
San Luis Reservoir	Expansion	360	130,000	2,769
Los Vaqueros Reservoir	Expansion	850	115,000	7,391

the Sierra Nevada Mountains, typically at elevations of 5,000 feet or higher, which acts as a natural water storage mechanism. Snowpack develops during the winter and then is slowly released as watershed runoff during the spring and summer when the weather is typically dry and precipitation is rare. Notably, rain doesn't come uniformly throughout the winter, but rather through a few high-intensity weather patterns that deliver the bulk of the state's water supply. One example of this phenomenon is the well-documented "Pineapple Express," which is an atmospheric river that transports water vapor from the tropics to the Western U.S.

As reported in the U.S. National Climate Assessment, annual average temperatures in California are projected to rise by 2.5°F to 4.5°F between 2041 and 2070 and by 3.5°F to 8.5°F between 2070 and 2099 depending on which emission scenario is assumed. The expected impact of this temperature rise on California's hydrological cycle is twofold: 1) winter precipitation will more frequently take the form of rainfall and contribute less to snowpack accumulation, and 2) snowmelt will occur earlier in the spring than currently experienced. Assuming fixed reservoir capacity and that a portion of this capacity must be reserved for flood protection, a greater amount of this faster runoff is spilled in the winter during periods of lower demand, leaving less water available during hotter summer months and potentially resulting in more severe shortages.

Specifically, snow water equivalents, a measurement of the amount of water held within the snowpack, for the Southwestern states are projected to decline significantly during the coming decades, according to the assessment. For example, when using data from 1971 to 2000 as a benchmark, snow water equivalent for California is projected to decline to 84% of this level for 2006 to 2035, 66% for 2041 to 2070, and 43% for 2070 to 2099.

Climate change is also expected to contribute to a rise in sea levels, which could threaten the state's coastal regions and areas connected through the San Francisco Bay, including the Sacramento-San Joaquin River Delta. The impact in the delta is twofold: 1) The risk of levee failure would increase given that these levees were not designed to withstand significant seismic events or resist the expected rise in hydrostatic pressures, and 2) the hydrology within the delta would change as seawater and brackish water penetrate further inland. Both of these impacts reduce the reliability of water supplies that pass through the delta as a conveyance mechanism.

Plans To Address Climate Change Issues

Water agencies across the state are taking a multipronged approach to address climate change. One example that does not require new capital is implementing water conservation measures in compliance with the Water Conservation Act of 2009 (SB X7-7), which targets 20% water conservation by 2020. The state is also planning or has underway several significant water infrastructure projects to provide enhanced supply reliability in the face of climate change, such as new or expanded conveyance facilities, water storage projects, and local resource development. The largest and most expensive project is the Bay Delta Conservation Plan's (BDCP) twin tunnel conveyance facility at an estimated cost of $14.6 billion in 2012 dollars *(for our view on the BDCP, see "The High Price Of Water Supply Reliability: California's Bay Delta Conservation Plan Would Require Significant Investment," published Feb. 13, 2014).*

California currently has more than 1,300 dams and surface water reservoirs with over 43 million acre-feet(2) of storage capacity. Along with other approaches, the state is enhancing this capacity to address the shifting hydrological patterns driven by climate change. Expansions of reservoir capacity since the era of major federal dam building in the mid-20th century include the construction of Diamond Valley Lake by the Metropolitan Water District of Southern California (MWD), the expansion of Los Vaqueros Reservoir by Contra Costa Water District, and the expansion of San Vicente Reservoir by San Diego County Water Authority (SDCWA). Diamond Valley Lake is an off-stream reservoir(3) with a capacity of 800,000 acre-feet. MWD commenced construction of the facility in 1995, and it was completed in 1999 at a cost of about $1.9 billion. Los Vaqueros Reservoir is also an off-stream reservoir, and its capacity was expanded in 2012 to 160,000 acre-feet from 100,000 acre-feet at a cost of about $120 million. San Vicente Reservoir is an on-stream reservoir, and SDCWA is expanding its capacity to 242,000 acre-feet from 90,000 acre-feet by raising the dam 117 feet at a cost of about $568 million.

Several proposed reservoir projects have been studied and planned for well over a decade and are still awaiting funding before moving forward. One significant new storage facility under consideration is the Sites Reservoir project in Colusa County north of Sacramento. The project consists of an off-stream reservoir that would provide 1.9 million acre-feet of water storage capacity at an estimated cost of between $3.6 billion and $4.1 billion. Four other projects being studied by USBR are expansions of existing reservoirs. Furthest along is a project to raise the dam at Shasta Lake, a key water storage facility that was originally designed to accommodate a dam about 100 feet taller than the existing one. The current proposal is to raise that dam by 18.5 feet to enhance capacity by 133,000 acre-feet at a cost of $1.1 billion. We anticipate that USBR will release a final environmental impact statement for this project in December 2014. The Temperance Flats Reservoir Project consists of a 665-foot dam on the San Joaquin River above Millerton Lake. Management estimates the project will provide 1.2 million acre-feet of additional storage at a projected cost of between $2.5 billion and $3.4 billion. Another expansion project under consideration would raise the dam at San Luis Reservoir by 20 feet at an estimated cost of $360 million. This project would serve a dual purpose of increasing capacity by 130,000 acre-feet, while also providing funding for seismic strengthening that is necessary because a fault line crosses beneath the reservoir. A fourth project would further expand storage at Los Vaqueros Reservoir. A first phase would

boost capacity by 115,000 acre-feet at an estimated cost of $850 million, and a subsequent phase would increase capacity by 225,000 acre-feet, giving the reservoir a total capacity of 500,000 acre-feet.

Further development of groundwater storage capacity is also being explored. However, the lack of groundwater regulation constrains the potential uses for this resource. According to reports prepared by DWR, only 22 of the state's 515 groundwater basins and subbasins have been adjudicated. Estimates of total groundwater storage capacity range from 850 million acre-feet to 1.3 billion acre-feet, although usable storage capacity is estimated at a lower, but still significant, 143 million acre-feet to 450 million acre-feet. Although some groundwater basins are managed or adjudicated, thereby limiting groundwater pumping by basin users, the majority of California's groundwater storage capacity falls within basins that are unrestricted and allow entities with overlying groundwater rights to pump water without reporting usage. We anticipate that groundwater storage could be further developed in certain areas where access is regulated, which could enhance overall supply reliability, but significant expansion to take advantage of this capacity will be limited without more clear regulation.

However, additional water storage capacity is beneficial only to the extent that the total volume of annual precipitation remains about the same or increases, which may not necessarily be the case. A recent analysis that examined tree rings as an indicator of past climate patterns determined that this region has experienced very severe and prolonged droughts in its past that are well outside the range of hydrological patterns of the past century(4). In these circumstances, the development of drought-proof local water resources provides a more robust solution than an expansion of storage capacity. The most recent of these projects is the Carlsbad Desalination Project in San Diego County, which will be the largest seawater desalination plant in the Western Hemisphere when it begins delivering water in 2016 to SDCWA. Management expects the $1 billion project to produce 50 million gallons per day of drinking water.

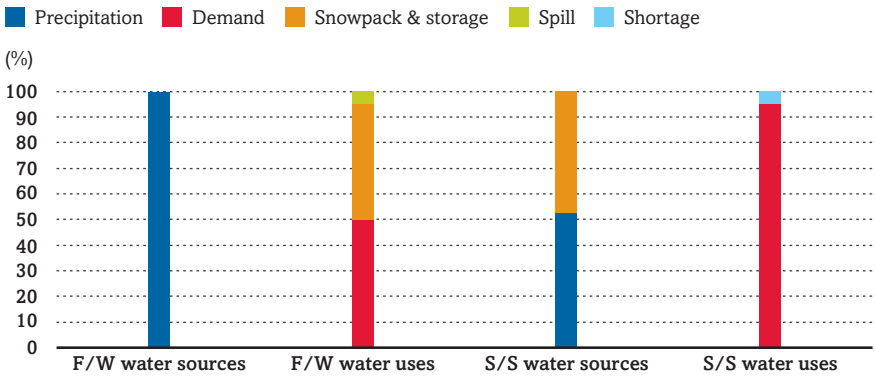
Funding Climate Change Water Projects

We expect that funding for climate change related water projects will likely follow conventional patterns in that projects will largely be funded on a "beneficiary pays" basis with some potential gaps filled with proceeds from state general obligation (GO) bonds. The challenge with funding some of the proposed projects, in our view, is determining the project's benefits and the corresponding assignment of costs, and then having the parties involved come to an agreement on a financing plan. Once a cost allocation has been formulated and agreed upon, we expect that a significant portion of these projects will be funded through revenue-secured debt.

With respect to state GO bonds for water projects, voters last approved GO bonds in 2006, and those funds have been spent or committed. An $11.1 billion state water bond is scheduled for the November 2014 ballot, although the state legislature is currently considering nine alternative proposals to change the bond amount and the scope of projects prior to the election. As it is currently written, the ballot measure includes funding for the following:

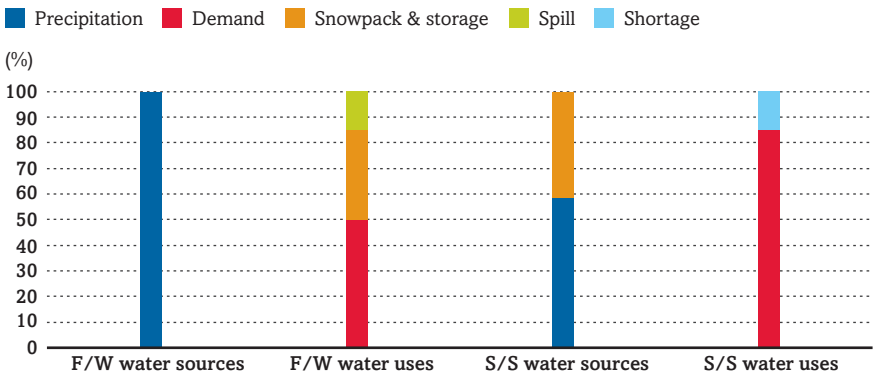
- $3 billion for water storage projects,
- $2.3 billion for delta sustainability projects,
- $1.8 billion for ecosystem and watershed protection and restoration projects,
- $1.4 billion for integrated regional water management plans,
- $1.3 billion for water recycling projects,

Chart 2a | How Climate Change Affects Water Supply Availability—Current Conditions*



*Warmer temperatures drive lower snowpack development and increased reservoir spill during the fall and winter, leading to lower water availability in the spring and summer. F/W–Fall/winter. S/S–Spring/summer.

Chart 2b | How Climate Change Affects Water Supply Availability—Projected Conditions*



*Warmer temperatures drive lower snowpack development and increased reservoir spill during the fall and winter, leading to lower water availability in the spring and summer. F/W–Fall/winter. S/S–Spring/summer.

- $1 billion for groundwater protection and water quality projects, and
- $0.5 billion for drought relief projects.

Polling conducted in March 2014 by the Public Policy Institute of California indicates that 60% of respondents and 50% of likely voters would approve the bond measure(5). Notably, the topic of water bonds has twice been delayed (from 2010 to 2012 and from 2012 to 2014), but conditions appear ripe for the measure to pass given the continued drought across the state and heightened public awareness of water issues. In our view, there does not appear to be the political will within the federal government to make direct investments in water infrastructure projects, and we anticipate that federal support of water infrastructure projects will instead take the form of grants and low-interest loan programs.

Credit Impacts From Climate Change

Given the long time horizon over which climate change occurs—largely far beyond the final maturity of debt obligations currently in the market—and the uncertainty of climate change forecasts, it may be tempting to set aside the long-term effects of climate change when evaluating today's credit fundamentals. However, water agencies, either directly or indirectly through coordination with their wholesale suppliers, are developing capital plans to meet needs far into the future when climate change may affect system operations. But those capital plans and associated costs can affect investors now.

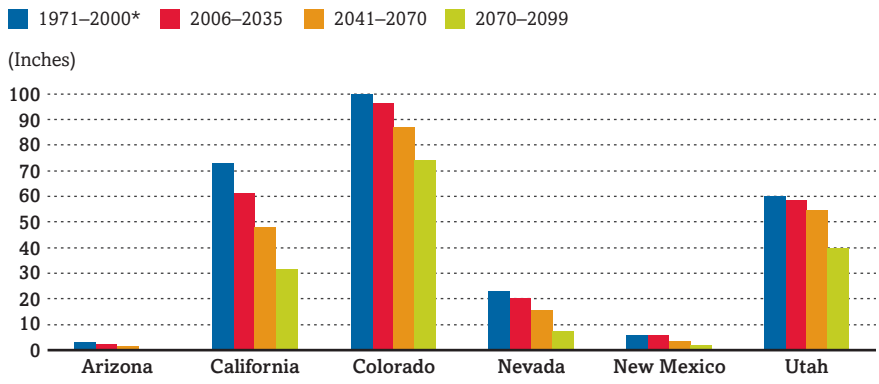
Although the BDCP is the most visible of California's upcoming water infrastructure projects, billions of dollars of other projects are also poised to move forward. Our expectation is that because of the required interagency planning and economies of scale, the majority of these projects will be managed at the wholesale level and the operating and capital costs will be passed through to retail systems, thereby raising retail system operating costs and thinning margins absent offsetting revenue-raising measures. For example, we expect that wholesale water agencies, such as MWD and its member agencies, will continue to pass through these costs to the retail systems that they supply. Partial funding through state GO bonds would provide an alternative to revenue-supported debt and would alleviate some of the burden on water agencies to otherwise raise rates to pay for these capital costs. We anticipate that retail systems will also borrow for local resource development in addition to funding typical capital needs.

Features that we identify as credit strengths in the context of climate change include:

- Water supply diversity with ample capacity to meet forecasted demand under conservative hydrology assumptions;
- Drought-proof, independent water sources;
- Significant water storage capacity, either in the form of surface reservoirs or in groundwater storage that is accessible despite drought conditions;
- Rate structures that include preapproved drought rates, which can be implemented simply through an action of the governing board; and
- Rate structures that promote conservation, such as through inclining block rates, which commensurately offset the system's need to develop expensive new sources of supply.

We also note that financial impacts could vary across sectors, particularly when evaluating agricultural water agencies as compared to municipal agencies. We are forward-looking when assessing these potential impacts, and we continually refine our analyses to incorporate specific projects as they progress and as financing mechanisms are determined. **cw**

Chart 3 | **Projected Snow Water Equivalent**



*This period represents 100% levels for each state.
Source: Scripps Institution of Oceanography.

NOTES

(1) Western Regional Climate Center. http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html
(2) One acre-foot is the volume of water required to cover one acre of land one foot deep in water. Generally, this volume of water is considered adequate to supply two families of four for one year.
(3) Reservoirs may be built either "on-stream" or "off-stream." On-stream reservoirs replenish naturally by capturing runoff from a watershed. Off-stream reservoirs have no natural source of replenishment aside from direct rainfall, and instead require active pumping to store water in the reservoir.
(4) David M. Meko, Connie A. Woodhouse, and Ramzi Touchan. Klamath/San Joaquin/Sacramento Hydroclimatic Reconstructions from Tree Rings.
(5) http://www.ppic.org/main/pressrelease.asp?i=1483

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