CLIMATE RISK: RISING TIDES RAISE THE STAKES

STANDARD & POOR'S
RATINGS SERVICES

McGRAW HILL FINANCIAL

STANDARD & POOR'S
RATINGS SERVICES
McGRAW HILL FINANCIAL

Table of Contents

RatingsDirect®

The Heat Is On: How Climate Change Can Impact Sovereign Ratings

Primary Credit Analyst:
Marko Mrsnik, Madrid (34) 91-389-6953; marko.mrsnik@standardandpoors.com

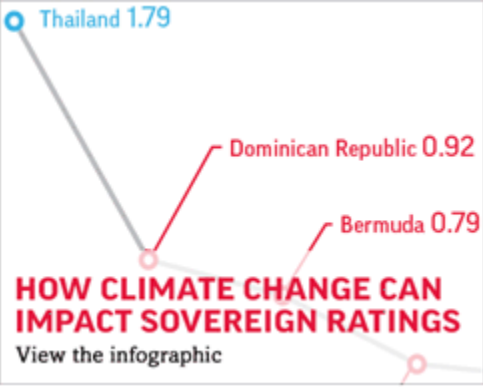
Secondary Credit Analysts:
Moritz Kraemer, Frankfurt (49) 69-33-999-249; moritz.kraemer@standardandpoors.com
Alexander Petrov, London (44) 20-7176-7115; alexander.petrov@standardandpoors.com

Senior Economist:
Boris S Glass, London +44-207-176-8420; boris.glass@standardandpoors.com

Table Of Contents

The Heat Is On: How Climate Change Can Impact Sovereign Ratings

Record-beating warm weather worldwide so far in 2015 could make it the hottest year on record. This is fitting climatic context ahead of the 2015 U.N. Climate Change Conference taking place in Paris over next two weeks. Earth is warmer now than it has been for over 90% of its 4.6 billion year history, and there's no sign of any slowdown (McGuire, 2014). The British Met Office estimates that global temperatures between January and September of this year were just over 1 degree Celsius above the 1850-1900 average--halfway to the 2 degrees Celsius increase from that time that many governments have committed to as a benchmark limit to avoid catastrophic levels of warming. (Watch the related CreditMatters TV segment titled "The Rating Impact Of Natural Catastrophes Due To Climate Change," dated Nov. 26, 2015.)



View the infographic at www.spratings.com/climatechange.

That raises a very relevant question from Standard & Poor's Ratings Services' view: As the planet as a whole gets hotter, what are the potential consequences of climate change on particular nations' sovereign creditworthiness? It's a fairly complicated exercise, and to make our first-ever informed estimates requires us to assess climate change's impact on economic and individual sovereign ratings factors.

Overview

- Based on a sample of 38 sovereigns and 44 natural catastrophe events, our simulations show that climate change impact, triggered by tropical cyclones and floods that can be expected once in every 250 years, would exacerbate the current negative sovereign rating impact of a natural catastrophe on average by about 20%.
- The calculated impact is, however, only partial because it doesn't reflect all the risks that come with climate change and stops in 2050. The actual ratings impact of climate change could, therefore, be larger still.
- While the climate change risks to sovereign ratings of advanced economies appear on average negligible, the ratings of many emerging sovereigns (specifically in the Caribbean or Southeast Asia) would likely come under additional significant pressure.
- We find that catastrophe insurance can partly mitigate the rating impact of climate change disasters. The extent to which this can be effective, however, depends to a large degree on the strength of the fundamentals that factor into the rating, especially when the damage is large.

Extreme weather conditions that likely lead to a radical rise in meteorological disasters, and their magnitude, are increasingly becoming part of everyday lives. According to the World Meteorological Organization, more than 370,000 people died in extreme weather incidents between 2001 and 2010--a 20% rise over the previous decade. Our planet is expected to become even more lethal, e.g. given the future trends in coastal urbanization, with rising sea temperatures and levels resulting in more frequent and more devastating storms, particularly in the tropical regions. In fact, extreme precipitation events have increased significantly at high and middle latitudes in the second half of the 20th century, and tropical cyclones worldwide are becoming stronger, with a 250% increase with sustained wind speeds exceeding 175 km per hour (McGuire, 2015). For small island nations, such as Maldives in the Indian Ocean and the Marshall islands in the Pacific, a one-meter rise in sea level would flood up to 75% of their dry land, making the islands uninhabitable. Other major concentrations of population at risk from such events are those living by river deltas, including in Bangladesh and Thailand.

Public awareness of these risks is growing. Indeed, the Global Risks 2015 report by the World Economic Forum (World Economic Forum, 2015) shows that survey respondents mostly consider environmental risks will grow faster over the next decade than any other risk category. Another recent global survey, with respondents from 40 countries, confirms this. Its respondents cited climate change as their biggest global concern, even ahead of global economic instability and specific regions' security concerns (Pew Research Center, 2015).

The consequences of climate change will become even more tangible in coming decades, with more frequent and more destructive storms and floods as well as shifts in weather patterns due to rising average global temperatures.

Climate Change And Our Sovereign Ratings Methodology

Standard & Poor's sovereign credit rating methodology doesn't specifically refer to risk of climate change impact. However, it makes reference to natural peril as an "event risk" and a situation where a sovereign would be subject to "constant exposure to natural disasters or adverse weather conditions." While not explicit, the latter is very much in line with the description of potential consequences of climate change (see "Sovereign Rating Methodology," published Dec. 23, 2014, on RatingsDirect). In general, however, the most likely effect of climate change via natural catastrophes on sovereign ratings would be indirect rather than direct, through a weakening of the fundamental factors that determine a sovereign's rating, such as our economic, external, fiscal, monetary, and institutional assessments. Similar to the ratings implications of aging societies (see "Global Aging 2013: Rising To The Challenge," published March 20, 2013), our criteria implicitly capture the effect of climate change and natural disasters on the sovereigns we rate.

Quantifying The Impact Of Climate Change

This is our initial attempt to quantify the severity of the economic and ratings impact of climate change, and we're focusing on two perils: tropical cyclones (and their associated storm surges) and floods. Of course, climate change can exacerbate other, non-meteorological natural hazards. Due to limited data availability, we had to omit drought and some other hazards related to climate change, but we recognize that they, too, can affect lives and economic activity, especially in low-income developing sovereigns with important agricultural sectors. Our results presented here should

therefore be understood as merely a partial analysis of how climate change would affect sovereign ratings.

To quantify climate change impact for each country, we start by simulating direct damage to property and infrastructure resulting from a disaster whose severity would be expected to occur once every 250 years. It's important to note that our analysis isn't aimed at quantifying the impact of climate change in totality. We're just looking at the implications climate change will have on a once-in-every-250-year catastrophe event. We're not including all other gradual and accumulating impacts. As a starting point, we use estimates of property damage-to-value that could result from natural disasters under climatic conditions prevailing today (for a more detailed discussion of our assumptions, see "Storm Alert: Natural Disasters Can Damage Sovereign Creditworthiness: Methodological Supplement," published on Sept. 24, 2015). We then reassessed this impact by modifying the model's hazard component to reflect climate change, which will lead to higher potential damages (see Appendix). The result: Once-in-250-years disasters become more damaging as climate change increases.

The mainstream in climate science takes the view that global warming will make meteorological natural catastrophes more frequent and more severe than at present. That assumption also underlies our analysis here. It also means given the forecasts for increased frequency of extreme events, what is now considered a once-in-250-years event could become, say, a once-in-50-years event. Depending on emissions scenarios, warming might not be stopped by 2050 and could go on beyond 2100. In the very long term, therefore, our estimates may well underestimate climate change risks to sovereign creditworthiness (see Appendix). It's important to reiterate that our simulation's aim isn't to incorporate all climate change effects for an individual sovereign. Instead, the key is to analyze how the impact of climate change through 2050 affects the severity of a 250-year event (tropical cyclone or flood) and its implication on the sovereign's economy and creditworthiness.

The direct damage data we use were compiled and provided by reinsurance company Swiss Re. The data estimation is based on the open-source climada model (Bresch, 2015) and further proprietary information provided by Swiss Re (see Appendix). The data set contains 30 estimates of 250-year tropical cyclone events and 14 estimates for 250-year flood events.

Compared to our recent report on natural catastrophes, here we're extending our analysis to Africa (previously not covered) and notably the Caribbean region (increasing the number of sovereigns analyzed). It's worth recalling that the direct damage data include only the estimated value of the physical destruction of private and public property, including infrastructure. It doesn't include the knock-on effects on economic growth because of the concomitant impact on productive capacity or disrupted supply chains. We model these secondary impacts separately. A comprehensive assessment should include a projection of economic development in the future. This can encompass more densely populated cities, newly constructed infrastructure and enlarged industrial and settlement areas, which may increase the future potential damage following a natural disaster.

The economic and sovereign rating impact is expressed in relative GDP terms. Under the reasonable assumptions that absolute property damage (in constant-dollar terms) grows proportionally with absolute property values (equally measured) and that property values move proportionately with real GDP, we quantify the impact of climate change by solely increasing the damage-to-value ratio of a natural catastrophe.

The sample analyzed is limited by data availability. Many of the 130 sovereigns we currently rate aren't in the sample because data were unavailable or we considered damage estimates to be too low to have any ratings impact. Our simulations take into account existing insurance coverage for the sovereigns concerned, as made available by Swiss Re. The impact of climate change could, therefore, still be ratings-relevant for sovereigns left out of this report. We recognize that alternative reasonable specifications and modeling could lead to equally valid but differing damage estimates. Nevertheless, and in full recognition of those caveats, we consider the Swiss Re dataset to be the most comprehensive and cross-country comparable available to us.

We simulated the macroeconomic impact and sovereign rating outcomes as described in our September 2015 "Storm Alert" report and methodological supplement. For the purpose of this analysis we assume that, all things being equal, the ratings distribution will remain broadly unchanged in 2050. In fact, sovereign default probabilities have on average empirically not changed significantly over a time period of 35 years, like we're covering here. Indeed, our historical ratings transition data suggest that the relative rank ordering is likely to remain broadly unchanged in the future (see "2014 Annual Sovereign Default Study And Rating Transitions," published on May 18, 2015). Finally, it's also worth recalling that the hypothetical rating changes this simplified model generates are not to be misunderstood as Standard & Poor's definitive view on likely future ratings trajectories.

What The Simulations Show

In the following sections, we analyze the results of our simulations of the impact of climate change on sovereigns. As in our September 2015 "Storm Alert" report, the benchmark is an event that occurs once every 250 years on average. But here we're including the corresponding damage assumptions from climate change. Differences between individual perils are recognized in the direct damage estimates, which is the main factor behind the macroeconomic and ratings impact. The simulations of economic, external, and budgetary variables are uniformly applied across the sample and do not discriminate among the two perils, tropical cyclones and floods.

Overall, in 44 natural catastrophes in 38 countries, climate change increases the expected once-in-250-years damage-to-value ratio significantly, on average by about 25%. The negative rating impact of the catastrophes due to climate change increases accordingly on average by about 20% compared to a scenario not including climate change.

However, important differences exist among the sovereigns covered in this report. The impact of climate change is far more important for emerging and developing sovereigns than the advanced economies. In terms of average impact, our simulations show that tropical cyclones are more damaging than floods. Most notable climate change risk increases include tropical cyclones in the Bahamas, Barbados, Dominican Republic, Jamaica, and Vietnam, and floods in Thailand. Regarding Thailand, the impact is particularly severe: It doubles the potential flood damage compared to a status-quo scenario without climate change.

Nevertheless, we expect advanced sovereigns to also see significantly raised potential direct damage from climate change. For example, that from tropical cyclones in the U.S., New Zealand, or Japan would be higher by 45%, 50%, and 64%, respectively, albeit from a relatively lower base than for Caribbean economies. The impact of floods in Europe appears quite small according to our simulations.

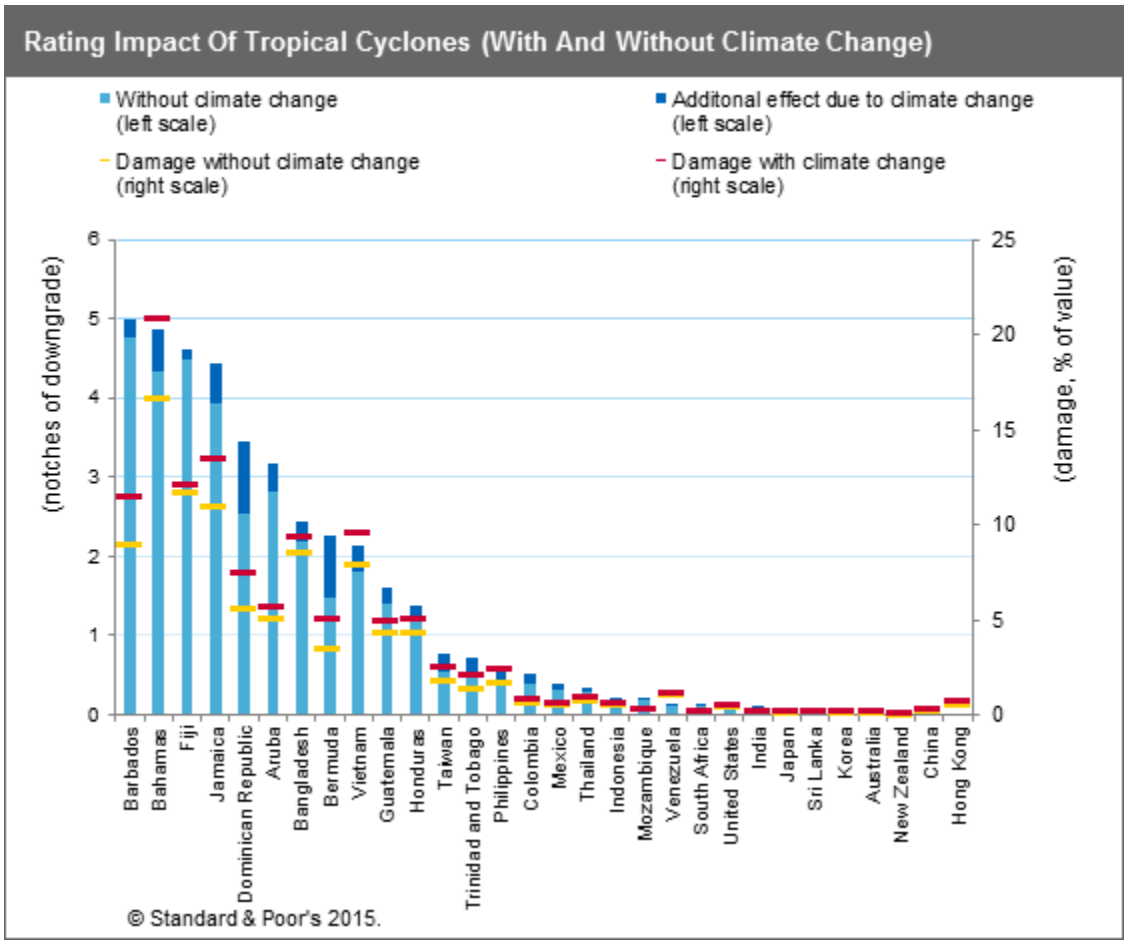
In our view, some countries will be able to adapt to the challenges associated with climate change. But the speed of change could be so rapid as to make this all but impossible for the most vulnerable nations in Asia, Africa, the Caribbean, and elsewhere in the developing world.

Climate Change Could Lead To More Destructive Floods And Tropical Cyclones

The Swiss Re direct damage data assessing the impact of climate change on tropical cyclones and floods indicate a particularly large increase in potential direct economic damage (of more than a 1 percentage point increase in value compared to the no-climate-change scenario) for the Caribbean sovereigns like Bahamas, Barbados, Bermuda, Dominican Republic, Jamaica, Vietnam (all tropical cyclones; see chart 1) and Thailand (floods; see chart 2 and tables 2-9 for detailed data on damage caused as well as key results of our economic simulations). In some other sovereigns that are geographically exposed to tropical cyclones, for example Bangladesh and Fiji, the increase in direct damage is not so significant. But this needs to be viewed in the context that a natural catastrophe would already be extremely devastating under current climatic conditions (8.6% and 11.7% of value in Bangladesh and Fiji, respectively). Climate change would only be aggravating an already very vulnerable position.

Conversely, the impact of climate change is likely to reduce potential direct damage from floods in Poland and the Czech Republic, although ever so marginally. This is due to the likely decline in floods usually caused by the combination of heavy rains and snow melting. With warmer temperatures, snowfall will be lower and so will be meltwater.

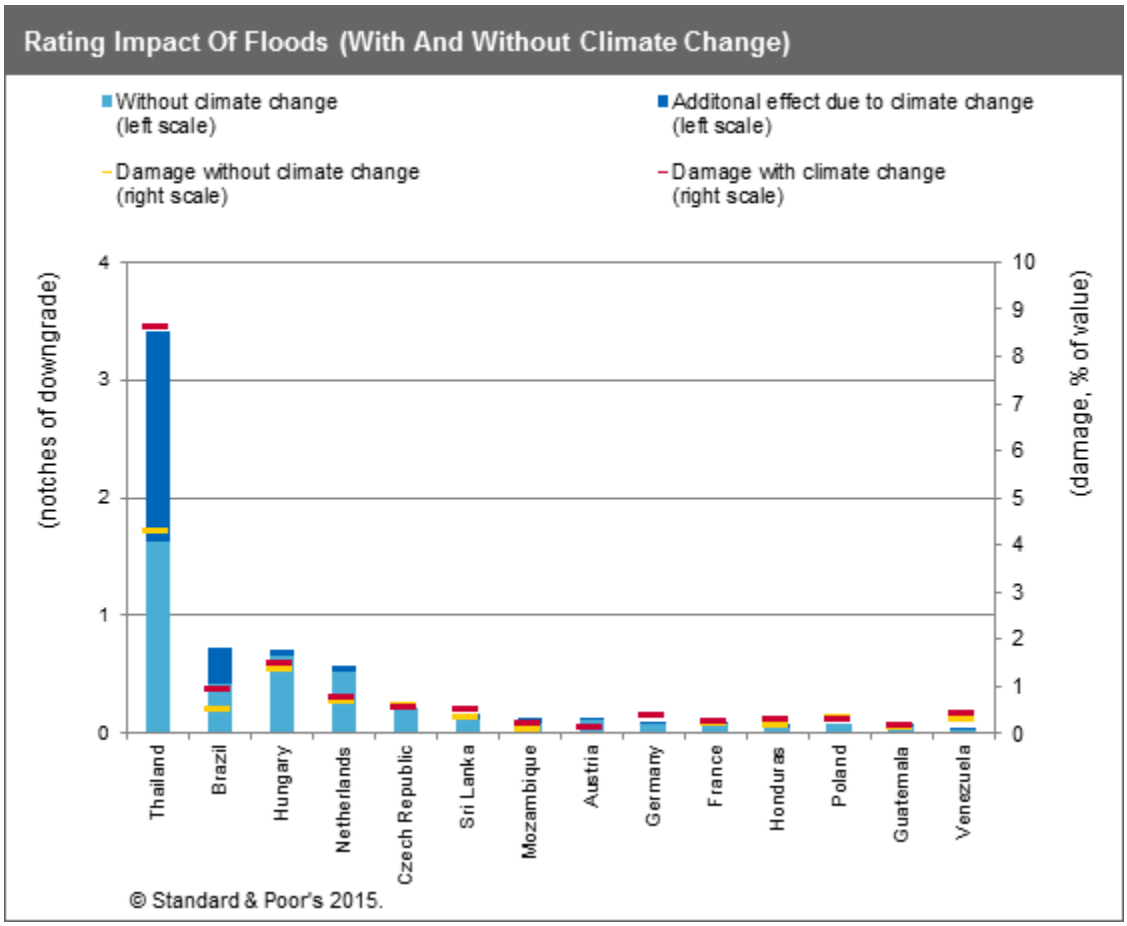
Chart 1



Economic impact: For each of the sovereigns analyzed, our damage estimates represent an immediate severe negative economic shock, and our simulations of macroeconomic impact show worsening GDP per capita losses (in cumulative U.S. dollars) due to climate change. In the most affected sovereigns, the per-capita income losses range from about 1.6% (Bermuda) to 8.5% (Thailand), compared to a simulation with no climate change.

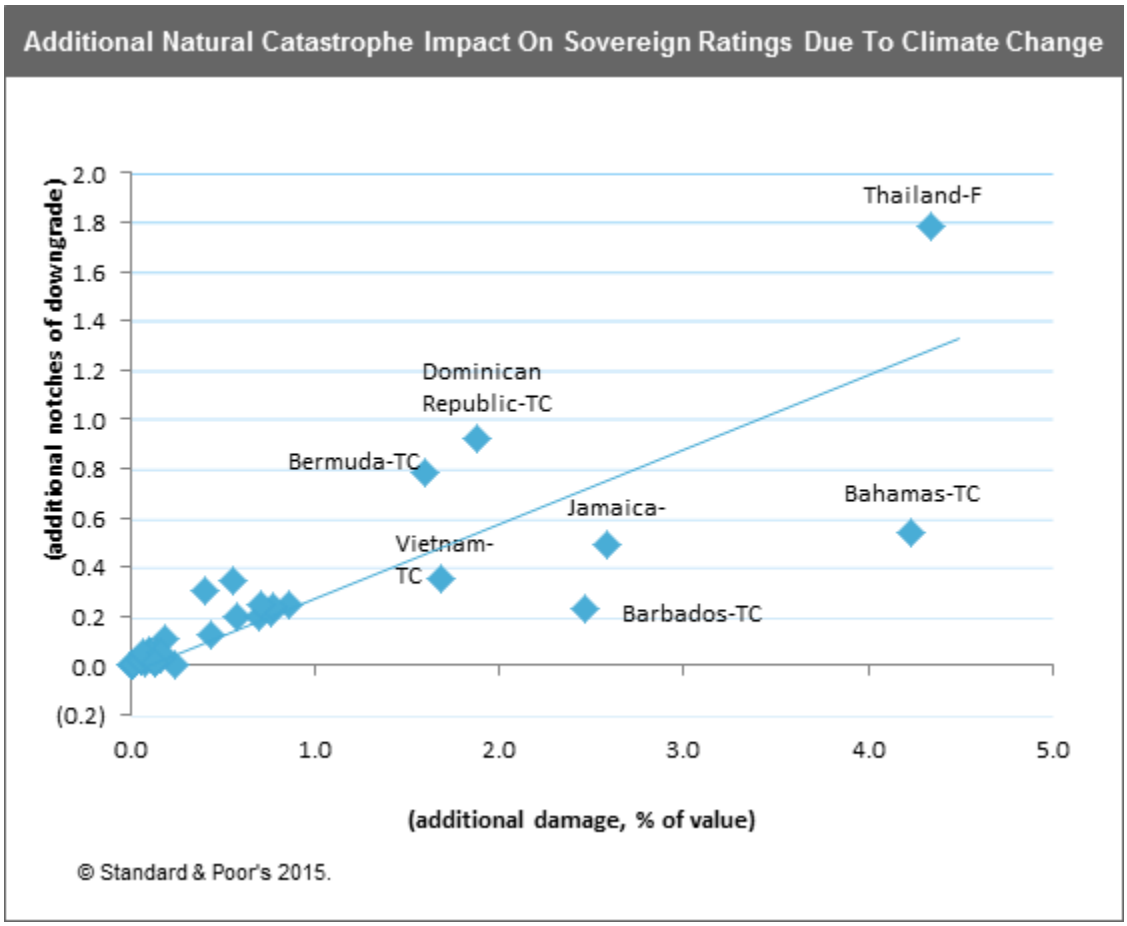
Fiscal impact: As a result of the economic shock, we would expect government finances to deteriorate due to the necessary public spending on reconstruction following the disaster, as well as the negative cyclical effect of the resulting economic downturn. Climate change alone would increase government debt in the affected sovereigns by between slightly more than 4% of GDP in Vietnam and 42% of GDP in the Bahamas, compared to a no-climate-change scenario (see table 9).

Chart 2



External impact: Adding the adverse impact of climate change to the devastation of a tropical cyclone or flood would likely further depress exports and increase imports, such as food, medical supplies, and reconstruction-related materials. As a result, the external position of the affected sovereigns would worsen compared with a no-climate change scenario. We expect the projected weakening of current account balances, in particularly the decline in current account receipts, to contribute to a significant deterioration in the external debt position of several sovereigns, especially in Bahamas, Bermuda, Dominican Republic, Jamaica, and Thailand.

Chart 3



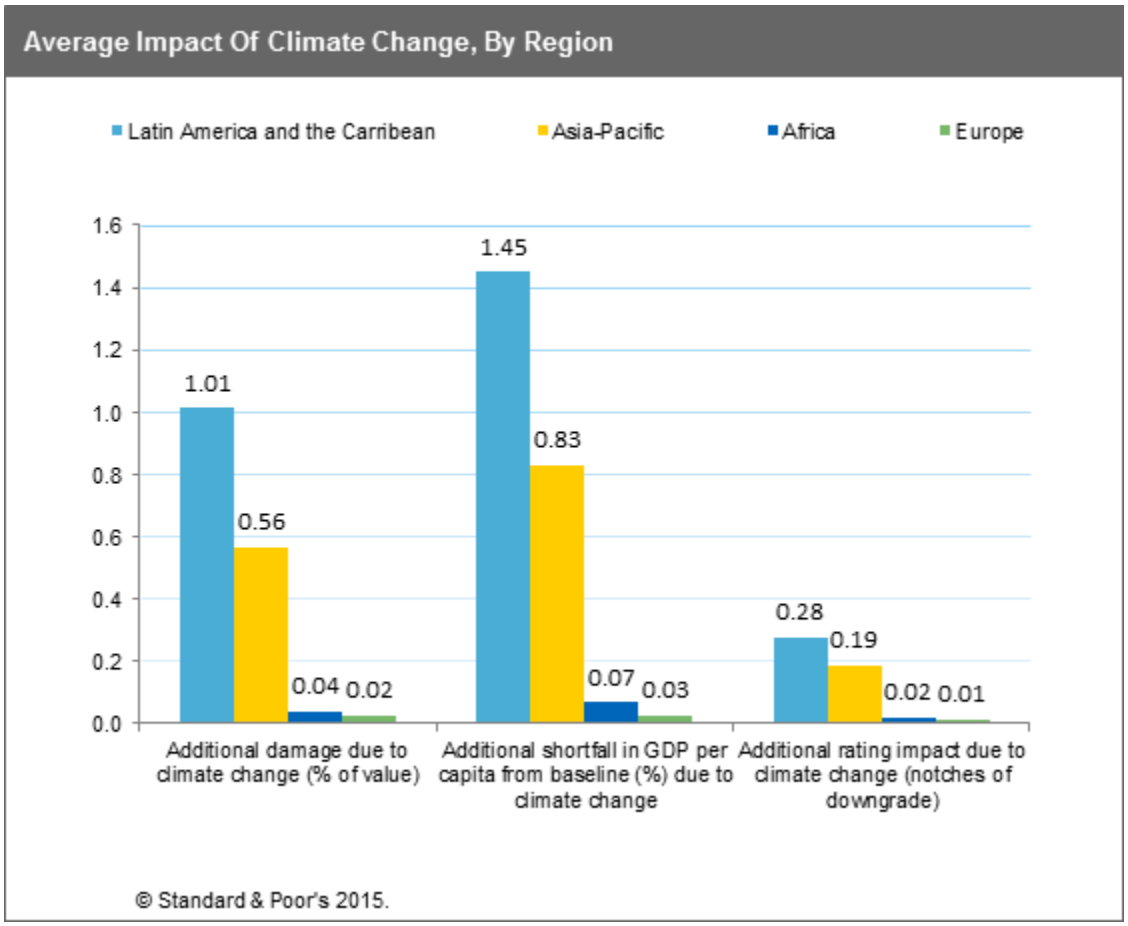
Ratings impact: The projected economic consequences translate into an adverse impact on sovereign creditworthiness as a consequence of more damaging one-in-250-year catastrophes. We estimate that on average and across the sovereigns in our sample, the simulated sovereign ratings would decline by about a fifth of a notch, compared with our baseline rating in the absence of climate change. However, the sovereigns concerned show wide differences. For example, for the most affected sovereigns listed above, the hypothetical ratings would decline by at least half a notch and almost two notches for Thailand. Regarding that country, while the hypothetical rating impact is very large, the risk of the event happening is remote (once in only 250 years), and the likelihood that it will happen in our ratings horizon (5-10 years) is small. Therefore, the analysis here doesn't indicate structural weakness that the rating should reflect, but rather a possible ratings cliff in a rare but not impossible event.

The deterioration in the Caribbean sovereigns would mainly result from the deterioration in our assessment of economic risks (Bahamas) or fiscal risk (Bermuda, Jamaica) accompanied by external risk (Dominican Republic). In the case of Thailand floods, the deterioration would likely be broad based, led by fiscal and external risk deterioration, followed by increases in economic and debt risks (see tables 3 and 7).

Wealthier Nations Should Better Withstand Climate Change Impacts

The results of our climate change simulations are in line with our findings from the September 2015 "Storm Alert" report on the impact of natural disasters in the absence of climate change. There we observed that richer sovereigns' ratings feel less impact from a natural disaster. We believe this is due to existing economic and financial resilience, but also a more developed insurance market. Moreover, an equally adverse climate change impact will comparatively have more significance for the ratings of emerging and developing sovereigns than for the wealthier ones.

Chart 4

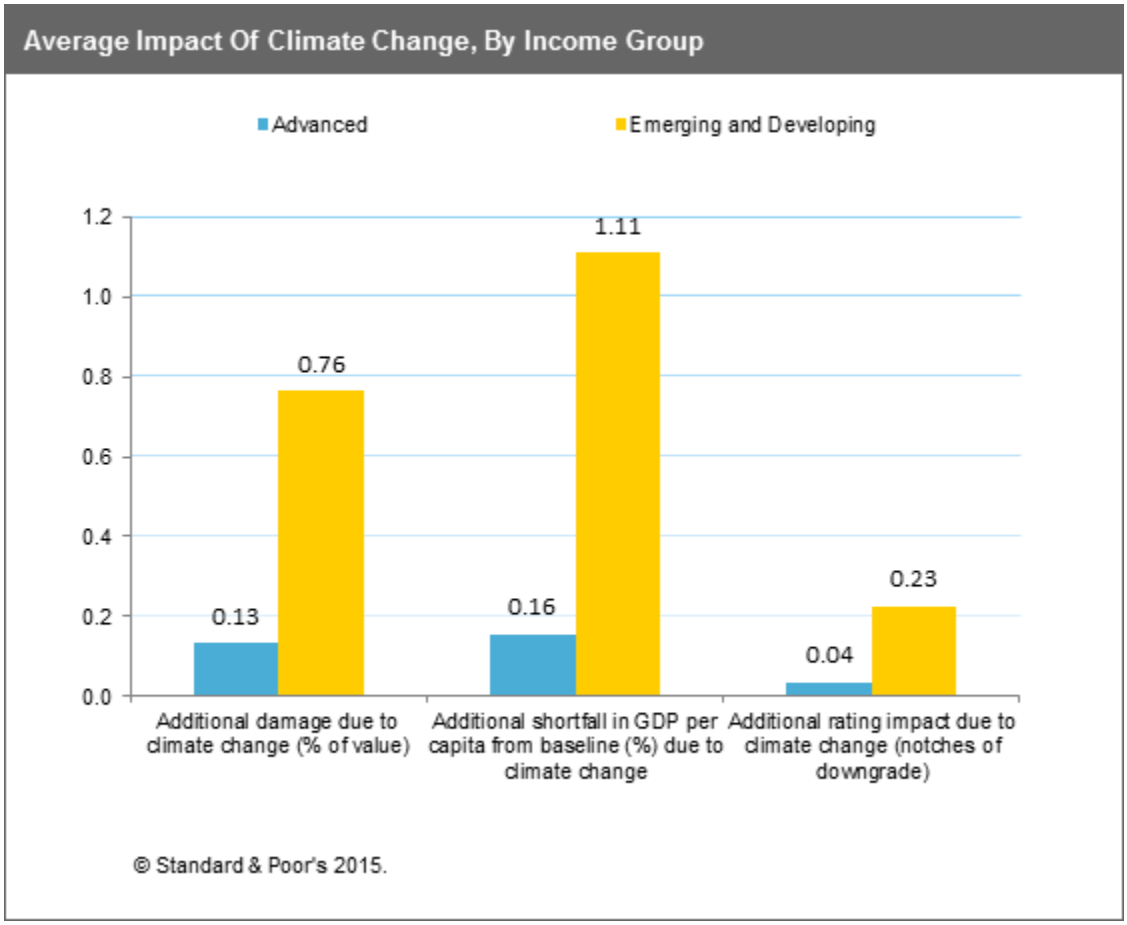


In terms of the impact on economic growth trajectories, again emerging and developing sovereigns would be the most affected, with an estimated average decline in income per capita of about 1.1 percentage points, compared with the no-climate-change scenario (see chart 4). The advanced sovereigns display much more resilience, with less than a 0.2 percentage point decline. As a result, the rating impact is on average the highest for emerging and developing sovereigns, with practically no impact for advanced sovereigns' ratings, reflecting the smaller expected damage and their relatively higher resilience.

The Caribbean And Asia-Pacific Are Most At Risk

In terms of geographic impact, the average potential direct damage for all the perils considered in this study is the highest for sovereigns in Latin America and the Caribbean (more than 1 percentage point of value increase compared to no-climate-change scenario), followed by Asia-Pacific (more than 0.5 percentage points higher). This reflects their increased exposure to tropical cyclones and floods compared to the rest of the world (see chart 5). The average potential additional direct damage from climate change for sovereigns in Europe and Africa is much lower in relative terms, at well below 0.1% of value. The additional average rating decline compared to the no-climate-change scenario for the Latin America and Caribbean sovereigns in this report would be almost 0.3 notches, followed by Asia-Pacific with about 0.2 notches.

Chart 5



Insurance Coverage Helps, But Preparedness Is Key

We have shown in our previous September 2015 "Storm Alert" report how larger insurance coverage of the assets damaged or destroyed by a natural catastrophe can, to some extent, mitigate the medium-term economic impact.

Insurance coverage cushions the negative effect on the private sector, and insurance payouts help accelerate the restoration of damaged productive assets of the private sector. This boosts economic growth and raises the tax base. As a result, higher insurance coverage will also mitigate the ratings impact of natural catastrophes. This holds true if we account for changes in magnitude of disasters due to climate change, as we do in this report.

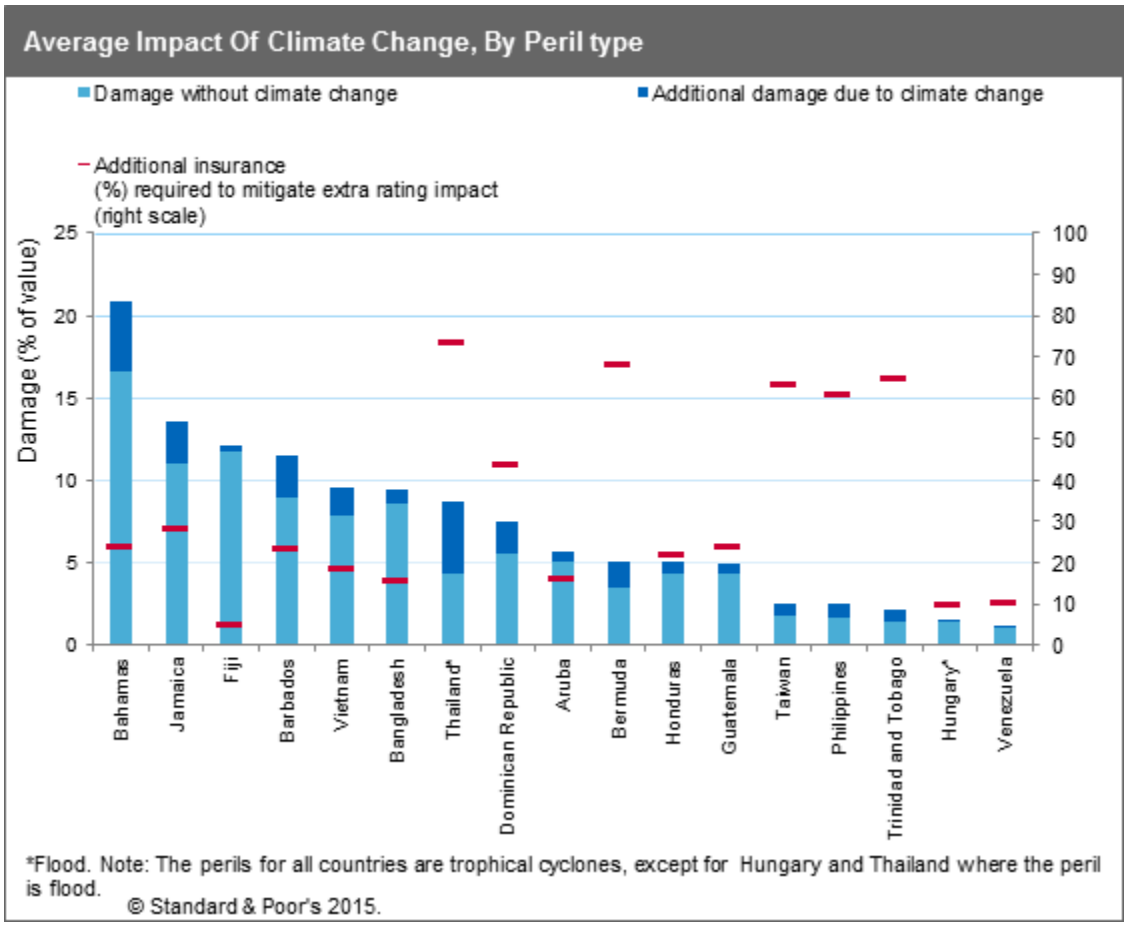
But here, we're shifting the angle at which we look at insurance. We use insurance coverage as a measure to quantify the cost of the ratings impact due to climate change. More precisely, we ask: What incremental insurance coverage would an economy need to fully offset the ratings impact due to climate change? To answer this question, we compute the additional insurance coverage ratio that would result in the same rating impact under a 250-year event under climate change would yield as under a 250-year event without climate change (taking as given actual insurance coverage ratios).

We caution that insurance can't offset all of the economic and ratings impact of a natural disaster. Even with insurance coverage at 100%, it will take time to rebuild infrastructure and other capital. During that time, government spending is likely to be at least as high as in the absence of a natural disaster while tax receipts will fall comparatively short, leading to a deterioration of the fiscal position. In our exercise, our measure of additional insurance coverage also aims to account for this loss in terms of the ratings impact.

The amount of additional insurance that would offset climate change impacts will, of course, not only depend on the additional direct damage likely to be caused, but also on the specific economic and fiscal circumstances of the economy in question. These factors determine the country's vulnerability to ratings downgrades. In Thailand, for example, when accounting for climate change, a 250-year event will wreak double the damage of the same event when assuming no climate change. But it will take an additional 74% insurance coverage, more than seven times the actual coverage ratio, to offset the impact due to climate change (see chart 6). This is because insurance cannot fully mitigate the higher fiscal costs of larger damage and the larger initial economic disruption. Therefore, to cut the rating impact from 3.4 notches (with climate change) to 1.6 notches (without climate change and with actual insurance coverage levels) with a much larger damage, insurance needs to overmitigate the negative economic and external assessments (while the fiscal impact is still larger with climate change than without it). In other words, an 8.6% damage-to-value ratio with 83% insurance coverage leads to the same 1.6-notch rating impact as a 4.3% damage-to-value ratio and 10% insurance coverage. But in the latter case, the role of fiscal factors in the downgrade is much higher than in the former.

Similarly, in case of a tropical cyclone in Jamaica, the damage under a climate change scenario increases to 13.5% from 11%, and the rating impact goes to 4.4 notches from 3.9 notches. Because the additional impact is smaller, it can be compensated with only 29% additional insurance coverage (up from 10% estimated currently). Like in the case of Thailand, the additional insurance would need to overmitigate the economic impact to offset the unavoidable negative fiscal implications. It's important to note, however, that while the required additional insurance is smaller, both the damage and the rating impact without climate change are already very significant, higher than in the Thailand example.

Chart 6



It is worth noting that smaller sovereigns and regionally close sovereigns with similar natural disaster exposure have been effectively sharing and hence diversifying risk through multilateral risk-pooling institutions. Both the Caribbean Cat Risk Insurance Facility (CCRIF, www.ccrif.org) and the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI, pcrafi.sopac.org) provide their member states with disaster risk-modeling and -assessment capabilities as well as risk-bearing capacity. In a similar fashion, the African Risk Capacity (ARC, africanriskcapacity.org) uses modern finance mechanisms such as risk-pooling and risk transfer to create pan-African climate-response systems that have been helping African countries meet the needs of people harmed by natural disasters.

Still, given that insurance alone is unable to fully offset the impact of climate change, for the most adversely affected sovereigns, studies have shown that they would benefit from strengthened local resilience. Depending on the region, up to 80% of the increase in damage results from economic development in hazard-prone areas, such as megacities in coastal regions. Studies in more than 20 countries around the world suggest that up to 60% of the damage can be cost-effectively averted (ECA, 2009; swissre.com/eca). Consider the Netherlands, with about a quarter of its surface below sea level, countless man-made canals, and large areas of reclaimed land. This makes the country highly exposed to both saltwater and freshwater floods, which materialized in a devastating storm surge in 1953, the country's worst

natural disaster so far. Since then, however, successive Dutch governments have been building protection measures, allocating large amounts of their annual budget to keep up safety levels. As a result, a network of dike rings and river embankments is designed to withstand up to once-in-10,000-year events, which makes additional insurance coverage less necessary. This also explains the surprising absence of flood insurance in the Netherlands (see tables below for insurance coverage of individual sovereigns). Therefore, the extent to which insurance coverage can be effective depends to a large degree on the strength of the fundamentals supporting the rating, especially when the damage caused by the disaster is large.

High Stakes At The 2015 U.N. Climate Change Conference

Our simulations indicate that climate change-related natural hazards can harm sovereign ratings. In terms of average impact of climate change by peril, our simulations show that tropical cyclones and associated storm surges will be more damaging than floods as the earth's temperature rises. Geographically, ratings of sovereigns in the Caribbean and Southeast Asia appear to be most at risk. The additional climate change damage caused in richer countries is on average more moderate. Their higher level of preparedness, including insurance coverage, further reduces the economic and rating impacts for that prosperous group. Finally, our results confirm that a larger insurance coverage against natural hazards is on average associated with more likely mitigation of adverse economic implications of any climate change impact. The extent to which this can be effective, however, depends to a large degree on the strength of the fundamentals that support the rating, especially when the damage caused by the disaster is large.

The 2015 U.N. Climate Change Conference in Paris aims to achieve a legally binding and universal agreement to limit global warming. It's too early to say whether the conference will produce a clear-cut consensus on global policy or significant changes to emissions targets. Either way, if insufficiently addressed, we expect the significance of the climate change megatrend 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 concrete, sovereign ratings could gradually become more at risk as well.

Table 1

Macroeconomic Snapshot (2015 Data)

Country	Foreign Currency Rating	GDP per capita (USD)	Real GDP growth (%)	General Government Balance / GDP (%)	Net General Government Debt / GDP (%)	Current Account Balance / GDP (%)	Narrow Net External Debt / CAR (%)
Aruba	BBB+	25,446.9	2.3	-2.59	23.5	-4.83	24.03
Australia	AAA	56,244.6	2.42	-2.88	18.44	-3.55	269.15
Austria	AA+	43,347.3	0.6	-2.2	81.19	1.72	124.01
Bahamas	BBB-	23,316.1	1.3	-2.16	50.96	-18.99	47.61
Bangladesh	BB-	1,253.7	6.4	-3.4	24.02	0.6	8.5
Barbados	B	15,510.9	1.2	-4.73	86.47	-2.96	33.96
Bermuda	A+	93,172.4	0.25	-3.82	-3.82	17.32	-211.04
Brazil	BB+	8,551.6	-2.5	-8.06	53.52	-3.72	27.01
China	AA-	7,879.7	6.82	-1.6	19.64	4.48	-125.7
Colombia	BBB	6,225.3	2.5	-2.7	33.66	-6.18	71.61

Table 1

Macroeconomic Snapshot (2015 Data) (cont.)

Czech Republic	AA-	17,512.3	3.6	-2	38.51	0.96	21.07
Dominican Republic	BB-	6,766.9	5	-4.24	41.76	-0.89	81.11
Fiji	B+	4,934.6	2.5	-2.7	43.95	-9.25	14.43
France	AA	36,339.7	1.1	-3.8	88.53	-1.22	195.94
Germany	AAA	41,223.8	1.7	-0.05	67.99	7.31	66.79
Guatemala	BB	3,888.9	3.7	-1.97	17.28	-1.84	31.37
Honduras	B+	2,227.6	3.4	-4.21	34.46	-7.04	20.28
Hong Kong	AAA	42,349.2	2.47	1.5	-34.6	3.15	-51.37
Hungary	BB+	12,329.4	3	-2.6	71.63	4.59	42.05
India	BBB-	1,684.6	7.4	-7.1	66.83	-1.39	20.09
Indonesia	BB+	3,406.4	4.9	-2.3	22.93	-2.6	64.22
Jamaica	B	4,961.8	1.2	-0.34	115.49	-2.99	131.5
Japan	A+	33,077.9	1.21	-5.8	127.93	2.68	19.4
Korea	AA-	27,346.0	2.69	0.1	20.41	7.78	-34.62
Mexico	BBB+	9,349.1	2.3	-2.7	42.49	-1.8	39.8
Mozambique	B-	576.4	7	-7	44.14	-35.69	173.46
Netherlands	AA+	44,570.7	1.87	-2.1	64.27	10.5	211.05
New Zealand	AA	40,827.8	2.95	-1.94	21.75	-3.45	163.94
Philippines	BBB	2,942.3	5.57	-0.8	25.82	5	-25.88
Poland	A-	13,216.6	3.5	-2.97	47.44	-0.91	55.37
South Africa	BBB-	5,902.0	1.63	-3.6	42.69	-4.32	28.35
Sri Lanka	B+	4,151.7	5.5	-5.9	72.57	-2	121.7
Taiwan	AA-	22,210.4	1.54	-1.6	41.26	12.71	-92.67
Thailand	BBB+	5,945.3	3.1	-0.6	22.65	2.9	-17.12
Trinidad and Tobago	A	19,432.8	0.8	-3.28	18.66	2.21	-133.49
United States	AA+	56,008.4	2.53	-4.16	79.11	-2.28	330.63
Venezuela	CCC	21,949.2	-7	-4.49	20.47	-0.84	125.38
Vietnam	BB-	2,220.9	6.2	-4.1	46.43	5.59	-0.32

Ratings data as of Nov. 19, 2015. CAR--Current account receipts.

Table 2

250-Year Tropical Cyclone, Net Rating Impact, And Contribution By Assessment (Without Climate Change)

					Contribution by assessment			
	Foreign currency long-term rating	Damage (% of value)	Insurance coverage (% of assets)	Net rating impact	Economic	External	Fiscal	Debt
Aruba	BBB+	5.10	10.00	2.86	0.40	0.93	1.06	0.48
Australia	AAA	0.14	70.00	0.05	0.00	0.01	0.03	0.01
Bahamas	BBB-	16.63	10.00	4.41	1.55	0.00	1.76	1.10
Bangladesh	BB-	8.57	5.00	2.19	0.31	0.96	0.48	0.44
Barbados	B	9.00	10.00	4.77	0.67	1.67	1.80	0.63
Bermuda	A+	3.44	10.00	1.48	0.36	0.00	0.70	0.42

Table 2

250-Year Tropical Cyclone, Net Rating Impact, And Contribution By Assessment (Without Climate Change) (cont.)

China	AA-	0.19	8.00	0.02	0.01	0.00	0.00	0.01
Colombia	BBB-	0.66	0.00	0.40	0.04	0.19	0.11	0.06
Dominican Republic	BB-	5.59	5.00	2.53	0.38	0.97	0.67	0.51
Fiji	B+	11.72	10.00	4.48	0.53	1.41	1.65	0.90
Guatemala	BB	4.32	7.00	1.40	0.16	0.55	0.37	0.32
Honduras	B+	4.31	7.00	1.17	0.15	0.42	0.38	0.23
Hong Kong	AAA	0.54	15.00	0.00	0.00	0.00	0.00	0.00
India	BBB-	0.21	5.00	0.09	0.01	0.05	0.02	0.01
Indonesia	BB+	0.54	0.00	0.20	0.02	0.10	0.04	0.03
Jamaica	B	10.96	10.00	3.94	0.50	1.43	1.87	0.14
Japan	A+	0.14	60.00	0.06	0.01	0.01	0.03	0.01
Korea	AA-	0.15	30.00	0.04	0.01	0.00	0.02	0.01
Mexico	BBB+	0.53	15.00	0.33	0.03	0.18	0.07	0.04
Mozambique	B-	0.32	5.00	0.18	0.01	0.16	0.00	0.01
New Zealand	AA	0.04	70.00	0.03	0.00	0.01	0.01	0.00
Philippines	BBB	1.70	5.00	0.41	0.06	0.18	0.09	0.09
South Africa	BBB-	0.23	0.00	0.12	0.01	0.05	0.04	0.02
Sri Lanka	B+	0.16	5.00	0.06	0.01	0.04	0.01	0.01
Taiwan	AA-	1.80	15.00	0.54	0.15	0.00	0.27	0.12
Thailand	BBB+	0.77	5.00	0.29	0.05	0.11	0.09	0.04
Trinidad and Tobago	A	1.41	10.00	0.48	0.12	0.00	0.25	0.10
United States	AA+	0.38	70.00	0.08	0.00	0.00	0.05	0.02
Venezuela	CCC	1.07	15.00	0.12	0.04	0.00	0.06	0.02
Vietnam	BB-	7.87	5.00	1.80	0.29	0.55	0.61	0.34

Table 3

250-Year Tropical Cyclone, Additional Rating Impact Due To Climate Change And Contribution By Assessment

					Additional contribution by assessment			
	Foreign currency long-term rating	**Additional damage (% of value)**	**Insurance coverage (% of assets)**	**Additional rating impact**	**Economic**	**External**	**Fiscal**	**Debt**
Aruba	BBB+	0.56	10	0.35	0.05	0.11	0.13	0.06
Australia	AAA	0.02	70	0.00	0.00	0.00	0.00	0.00
Bahamas	BBB-	4.23	10	0.54	0.54	0.00	0.00	0.00
Bangladesh	BB-	0.86	5	0.25	0.04	0.10	0.06	0.05
Barbados	B	2.47	10	0.23	0.23	0.00	0.00	0.00
Bermuda	A+	1.60	10	0.79	0.19	0.03	0.35	0.21
China	AA-	0.08	8	0.01	0.01	0.00	0.00	0.00
Colombia	BBB-	0.19	0	0.11	0.01	0.05	0.03	0.02
Dominican Republic	BB-	1.88	5	0.92	0.15	0.32	0.26	0.20

Table 3

250-Year Tropical Cyclone, Additional Rating Impact Due To Climate Change And Contribution By Assessment (cont.)

Fiji	B+	0.44	10	0.13	0.02	0.05	0.01	0.04
Guatemala	BB	0.58	7	0.20	0.02	0.07	0.05	0.05
Honduras	B+	0.70	7	0.20	0.03	0.06	0.07	0.04
Hong Kong	AAA	0.24	15	0.00	0.00	0.00	0.00	0.00
India	BBB-	0.02	5	0.01	0.00	0.00	0.00	0.00
Indonesia	BB+	0.08	0	0.03	0.00	0.01	0.01	0.00
Jamaica	B	2.58	10	0.49	0.14	0.00	0.35	0.00
Japan	A+	0.09	60	0.03	0.01	0.00	0.02	0.01
Korea	AA-	0.06	30	0.02	0.01	0.00	0.01	0.00
Mexico	BBB+	0.10	15	0.06	0.01	0.03	0.01	0.01
Mozambique	B-	0.00	5	0.00	0.00	0.00	0.00	0.00
New Zealand	AA	0.02	70	0.01	0.00	0.00	0.00	0.00
Philippines	BBB	0.76	5	0.21	0.03	0.08	0.07	0.04
South Africa	BBB-	0.01	0	0.01	0.00	0.00	0.00	0.00
Sri Lanka	B+	0.01	5	0.00	0.00	0.00	0.00	0.00
Taiwan	AA-	0.77	15	0.24	0.07	0.00	0.12	0.05
Thailand	BBB+	0.15	5	0.05	0.01	0.02	0.02	0.01
Trinidad and Tobago	A	0.71	10	0.25	0.06	0.00	0.13	0.05
United States	AA+	0.17	70	0.03	0.00	0.00	0.02	0.01
Venezuela	CCC	0.13	15	0.01	0.01	0.00	0.01	0.00
Vietnam	BB-	1.68	5	0.35	0.07	0.04	0.17	0.08

Table 4

250-Year Tropical Cyclone, Economic Impact (Without Climate Change)

				Deviation from baseline				
	Foreign currency long-term rating	**Damage (% of value)**	**Insurance coverage (% of assets)**	**GDP per capita (USD)**	**Net General Government Debt**	**General government balance (5-yr average)**	**Narrow Net External Debt**	**Current Account Balance (5-yr average)**
Aruba	BBB+	5.10	10	-4.7	23.88	-4.9	73.3	-11.4
Australia	AAA	0.14	70	-0.1	0.64	-0.1	1.2	-0.1
Bahamas	BBB-	16.63	10	-19.1	109.02	-20.3	421.4	-23.9
Bangladesh	BB-	8.57	5	-11.6	11.84	-2.5	78.6	-3.6
Barbados	B	9.00	10	-9.0	54.03	-10.1	162.9	-14.1
Bermuda	A+	3.44	10	-3.1	16.02	-3.4	2.8	-2.1
China	AA-	0.19	8	-0.3	0.50	-0.1	3.7	-0.2
Colombia	BBB-	0.66	0	-1.1	2.71	-0.6	16.6	-0.5
Dominican Republic	BB-	5.59	5	-8.7	18.06	-3.6	73.4	-3.9
Fiji	B+	11.72	10	-18.5	41.75	-8.1	119.2	-10.2
Guatemala	BB	4.32	7	-6.3	8.85	-1.8	44.8	-2.7
Honduras	B+	4.31	7	-6.6	10.71	-2.2	37.0	-3.7

Table 4

250-Year Tropical Cyclone, Economic Impact (Without Climate Change) (cont.)								
Hong Kong	AAA	0.54	15	-0.4	1.70	-0.4	6.3	-3.0
India	BBB-	0.21	5	-0.3	0.46	-0.1	4.1	-0.2
Indonesia	BB+	0.54	0	-0.8	1.10	-0.2	10.5	-0.4
Jamaica	B	10.96	10	-19.0	57.47	-9.4	122.6	-10.2
Japan	A+	0.14	60	-0.1	0.77	-0.1	1.2	-0.2
Korea	AA-	0.15	30	-0.2	0.56	-0.1	1.9	-0.3
Mexico	BBB+	0.53	15	-0.9	1.82	-0.4	8.1	-0.7
Mozambique	B-	0.32	5	-0.5	0.55	-0.1	13.1	-0.5
New Zealand	AA	0.04	70	0.0	0.18	0.0	1.4	-0.1
Philippines	BBB	1.70	5	-2.5	3.71	-0.8	14.7	-1.2
South Africa	BBB-	0.23	0	-0.4	0.90	-0.2	5.1	-0.3
Sri Lanka	B+	0.16	5	-0.2	0.30	-0.1	3.1	-0.2
Taiwan	AA-	1.80	15	-2.8	7.11	-1.4	8.6	-2.1
Thailand	BBB+	0.77	5	-1.7	2.32	-0.5	8.1	-1.3
Trinidad and Tobago	A	1.41	10	-2.4	6.32	-1.3	10.9	-1.4
United States	AA+	0.38	70	-0.1	1.39	-0.3	0.4	-0.2
Venezuela	CCC	1.07	15	-1.0	0.71	-0.3	25.4	-0.1
Vietnam	BB-	7.87	5	-8.7	18.43	-4.3	43.6	-7.0

Table 5

250-Year Tropical Cyclone, Additional Economic Impact Due To Climate Change								
				Additional impact (%)				
	Foreign currency long-term rating	**Additional Damage (% of value)**	**Insurance coverage (% of assets)**	**GDP per capita (USD)**	**Net General Government Debt**	**General government balance (5-yr average)**	**Narrow Net External Debt**	**Current Account Balance (5-yr average)**
Aruba	BBB+	0.56	10	-0.6	2.9	-0.6	8.7	-1.3
Australia	AAA	0.02	70	0.0	0.1	0.0	0.0	0.0
Bahamas	BBB-	4.23	10	-6.2	42.3	-7.5	158.8	-7.6
Bangladesh	BB-	0.86	5	-1.3	1.5	-0.3	8.4	-0.4
Barbados	B	2.47	10	-3.0	18.7	-3.4	53.8	-4.2
Bermuda	A+	1.60	10	-1.6	8.0	-1.7	0.8	-1.0
China	AA-	0.08	8	-0.1	0.2	0.0	0.9	-0.1
Colombia	BBB-	0.19	0	-0.3	0.8	-0.2	4.3	-0.1
Dominican Republic	BB-	1.88	5	-3.2	7.1	-1.4	26.2	-1.4
Fiji	B+	0.44	10	-0.6	2.0	-0.4	4.2	-0.3
Guatemala	BB	0.58	7	-0.9	1.3	-0.3	5.9	-0.4
Honduras	B+	0.70	7	-1.1	1.9	-0.4	5.6	-0.5
Hong Kong	AAA	0.24	15	-0.2	0.8	-0.2	2.2	-1.0
India	BBB-	0.02	5	0.0	0.0	0.0	0.3	0.0
Indonesia	BB+	0.08	0	-0.1	0.2	0.0	1.3	0.0
Jamaica	B	2.58	10	-4.4	18.0	-2.9	26.7	-2.3

Table 5

250-Year Tropical Cyclone, Additional Economic Impact Due To Climate Change (cont.)

Japan	A+	0.09	60	-0.1	0.5	-0.1	-0.1	-0.1
Korea	AA-	0.06	30	-0.1	0.2	0.0	0.3	-0.1
Mexico	BBB+	0.10	15	-0.2	0.3	-0.1	1.3	-0.1
Mozambique	B-	0.00	5	0.0	0.0	0.0	0.0	0.0
New Zealand	AA	0.02	70	0.0	0.1	0.0	0.1	0.0
Philippines	BBB	0.76	5	-1.1	1.7	-0.4	6.1	-0.5
South Africa	BBB-	0.01	0	0.0	0.1	0.0	0.2	0.0
Sri Lanka	B+	0.01	5	0.0	0.0	0.0	0.1	0.0
Taiwan	AA-	0.77	15	-1.2	3.2	-0.6	3.0	-0.8
Thailand	BBB+	0.15	5	-0.3	0.5	-0.1	1.3	-0.2
Trinidad and Tobago	A	0.71	10	-1.2	3.3	-0.7	5.0	-0.7
United States	AA+	0.17	70	0.0	0.6	-0.1	-0.3	0.0
Venezuela	CCC	0.13	15	-0.1	0.1	0.0	2.9	0.0
Vietnam	BB-	1.68	5	-0.4	4.3	-1.1	4.0	-0.7

Table 6

250-Year Flood, Net Rating Impact, And Contribution By Assessment (Without Climate Change)

					Contribution by assessment			
	Foreign currency long-term rating	**Damage (% of value)**	**Insurance coverage (% of assets)**	**Net rating impact**	**Economic**	**External**	**Fiscal**	**Debt**
Austria	AA+	0.14	35	0.11	0.01	0.06	0.03	0.01
Brazil	BB+	0.53	10	0.41	0.03	0.18	0.13	0.07
Czech Republic	AA-	0.60	50	0.22	0.02	0.05	0.10	0.04
France	AA	0.24	80	0.08	0.01	0.01	0.05	0.02
Germany	AAA	0.39	25	0.08	0.01	0.03	0.03	0.01
Guatemala	BB	0.13	7	0.06	0.00	0.03	0.01	0.01
Honduras	B+	0.20	7	0.06	0.01	0.03	0.01	0.01
Hungary	BB+	1.39	10	0.67	0.10	0.17	0.27	0.14
Mozambique	B-	0.11	3	0.08	0.00	0.08	0.00	0.00
Netherlands	AA+	0.70	0	0.52	0.11	0.18	0.17	0.06
Poland	A+	0.34	60	0.09	0.01	0.04	0.01	0.02
Sri Lanka	B+	0.36	5	0.12	0.01	0.06	0.02	0.02
Thailand	BBB+	4.31	10	1.62	0.28	0.53	0.55	0.25
Venezuela	CCC	0.32	15	0.03	0.01	0.00	0.02	0.00

Ratings data as of Nov. 19, 2015.

Table 7

250-Year Flood, Additional Rating Impact Due To Climate Change, And Contribution By Assessment

					Additional contribution by assessment			
	Foreign currency long-term rating	Additional Damage (% of value)	Insurance coverage (% of assets)	Additional rating impact	Economic	External	Fiscal	Debt
Austria	AA+	0.00	35	0.00	0.00	0.00	0.00	0.00
Brazil	BB+	0.41	10	0.31	0.02	0.13	0.10	0.06
Czech Republic	AA-	(0.03)	50	-0.01	0.00	0.00	-0.01	0.00
France	AA	0.03	80	0.01	0.00	0.00	0.01	0.00
Germany	AAA	0.01	25	0.01	0.00	0.00	0.00	0.00
Guatemala	BB	0.06	7	0.02	0.00	0.01	0.00	0.00
Honduras	B+	0.12	7	0.03	0.00	0.01	0.01	0.01
Hungary	BB+	0.10	10	0.05	0.01	0.01	0.02	0.01
Mozambique	B-	0.11	3	0.05	0.00	0.04	0.00	0.00
Netherlands	AA+	0.07	0	0.05	0.01	0.02	0.02	0.01
Poland	A+	(0.01)	60	0.00	0.00	0.00	0.00	0.00
Sri Lanka	B+	0.17	5	0.05	0.01	0.02	0.01	0.01
Thailand	BBB+	4.34	10	1.79	0.33	0.49	0.66	0.30
Venezuela	CCC	0.13	15	0.01	0.01	0.00	0.01	0.00

Ratings data as of Nov. 19, 2015.

Table 8

250-Year Flood, Economic Impact (Without Climate Change)

				Deviation from baseline				
	Foreign currency long-term rating	Damage (% of value)	Insurance coverage (% of assets)	GDP per capita (USD)	Net General Government Debt	General government balance (5-yr average)	Narrow Net External Debt	Current Account Balance (5-yr average)
Austria	AA+	0.14	35	-0.1	0.84	-0.2	2.8	-0.4
Brazil	BB+	0.53	10	-0.4	2.72	-0.6	18.4	-0.4
Czech Republic	AA-	0.60	50	-0.4	2.78	-0.6	3.1	-0.8
France	AA	0.24	80	0.0	1.15	-0.2	1.1	-0.3
Germany	AAA	0.39	25	-0.3	2.22	-0.4	4.3	-0.6
Guatemala	BB	0.13	7	-0.2	0.25	-0.1	2.7	-0.2
Honduras	B+	0.20	7	-0.2	0.43	-0.1	2.8	-0.3
Hungary	BB+	1.39	10	-2.1	8.15	-1.6	11.6	-2.1
Mozambique	B-	0.11	3	-0.2	0.18	0.0	6.6	-0.4
Netherlands	AA+	0.70	0	-0.7	4.47	-0.9	8.3	-1.6
Poland	A+	0.34	60	-0.4	1.33	-0.3	3.4	-0.5
Sri Lanka	B+	0.36	5	-0.5	0.68	-0.1	5.3	-0.3
Thailand	BBB+	4.31	10	-9.2	13.72	-3.0	39.0	-6.5
Venezuela	CCC	0.32	15	-0.3	0.21	-0.1	8.7	-0.1

Ratings data as of Nov. 19, 2015.

Table 9

250-Year Flood, Additional Economic Impact Due To Climate Change

				Additional impact (%)				
	Foreign currency long-term rating	**Additional Damage (% of value)**	**Insurance coverage (% of assets)**	**GDP per capita (USD)**	**Net General Government Debt**	**General government balance (5-yr average)**	**Narrow Net External Debt**	**Current Account Balance (5-yr average)**
Austria	AA+	0.00	35	0.0	0.0	0.0	0.0	0.0
Brazil	BB+	0.41	10	-0.4	2.1	-0.5	12.6	-0.3
Czech Republic	AA-	(0.03)	50	0.0	-0.1	0.0	-0.1	0.0
France	AA	0.03	80	0.0	0.1	0.0	0.0	0.0
Germany	AAA	0.01	25	0.0	0.1	0.0	0.1	0.0
Guatemala	BB	0.06	7	-0.1	0.1	0.0	0.6	0.0
Honduras	B+	0.12	7	-0.2	0.3	-0.1	1.0	-0.1
Hungary	BB+	0.10	10	-0.2	0.6	-0.1	0.8	-0.1
Mozambique	B-	0.11	3	-0.2	0.2	0.0	3.4	-0.1
Netherlands	AA+	0.07	0	-0.1	0.4	-0.1	0.7	-0.1
Poland	A+	(0.01)	60	0.0	-0.1	0.0	0.0	0.0
Sri Lanka	B+	0.17	5	-0.2	0.3	-0.1	1.9	-0.1
Thailand	BBB+	4.34	10	-8.5	16.5	-3.5	37.1	-6.2
Venezuela	CCC	0.13	15	-0.1	0.1	0.0	2.9	0.0

Ratings data as of Nov. 19, 2015.

Appendix: Climate Change Impact Scenarios

Storms and floods are major natural hazards. Over the last decade they have been responsible for three-quarters of global insured losses and over half the fatalities and economic losses from all natural catastrophes. Most climate models suggest that the proportion of rainfall classified as heavy will continue to increase, raising the frequency and magnitude of flooding events. Over the last three decades, the number and intensity of hurricanes have increased in the North Atlantic and Western Pacific Oceans, thanks to rising sea-surface temperatures (Maslin, 2014).

Tropical cyclones

Tropical cyclones form in six basins worldwide, the East Pacific, North Atlantic, South Indian Ocean, North Indian Ocean, West Pacific, and South Pacific. An increase of maximum wind speed in the basins between 1% and 5% and stable cyclone frequencies is used, based on the IPCC Fifth Assessment Report (2014), Emanuel (2013), and Knutson et al. (2010; see table 10). Model simulations show robust results for increased precipitation associated with cyclones. As the water vapor content of the tropical atmosphere increases, the rainfall rates in tropical cyclones increase as well. The storm surge associated with tropical cyclones increases due to sea level rises in the different basins. For the purpose of the simulation, sea level rise data from the IPCC AR5 based on the high greenhouse gas emission scenario Representative Concentration Pathway 8.5 are used. In an extreme climate change scenario, storm surge increases due to rising sea levels until 2050 range between +25 cm and +40 cm for the different basins (see table 10).

Table 10

Impacts On Tropical Cyclone Frequency, Cyclone-Induced Rainfall, And Sea Level Rises In An Extreme Climate Change Scenario

	Change in cyclone intensity (including rainfall) until 2050	Change in cyclone surge, due to sea level rise until 2050 (meters)
North Atlantic	5.00	0.4
East Pacific	3.50	0.3
West Pacific	3.50	0.35
South Pacific and South Indian Ocean	1.00	0.35
North Indian Ocean	1.00	0.25

Source: Knutson (2010).

Floods

Climate change is projected to have different impacts on precipitation patterns in different parts of the world. Where climate change leads to higher precipitation events, river inundation zones will extend. In some regions, severe flood events can occur more often, for example, an event that on average occurs every 100 years could occur every 50 years in the future. As warmer air can take up more moisture, and therefore more water is available for precipitation and subsequent flooding, the global water cycle intensifies. An opposing phenomenon may lead to fewer peak flood events: With warmer temperatures, snowfall will be lower and so will be meltwater.

In an extensive research study conducted by the University of Tokyo, Hirabayashi et al. (2013), calculated the changing return period of a 100-year flood event on a global scale. This change of return period was applied for all evaluated countries, downscaled to a time horizon until 2050 and modified by a country-based natural hazard management resilience factor that is published and evaluated by the insurance company FM Global on a yearly basis. The FM Global resilience index reflects the capability of a country to prevent and manage natural disasters. In simple words, it refers to "preparedness." While economically well-developed countries like Germany, the Netherlands, and the Czech Republic already have strong natural hazard prevention measures in place, countries like Honduras or Venezuela do not appear that well prepared.

Estimating climate change's effect on precipitation in Europe, Rajczak et al. (2013) find two different patterns. While Southern Europe will see less precipitation, the north will have a substantial increase, defining a zone that moves south/northwards with seasonal patterns. This pattern includes countries like Austria, Czech Republic, France, Germany, Hungary, Netherlands, and Poland. Even while mean rainfall decreases for Southern Europe, strong events--like a five-year return period precipitation event leading to inundation--will in general increase across most of Europe.

Overall, most countries will see a moderate increase in climate change-related flood risk. However, countries like Mozambique and Thailand will see a strong increase in flood damage. On the other hand, Eastern European countries like Poland and Czech Republic will even see a small decrease in flood-related damages (only considering climate change and not taking economic growth into account). It should be mentioned, that economic growth will have a strong influence on future flood damages, too.

Related Criteria And Research

Related Criteria

Sovereign Rating Methodology, Dec. 23, 2014

Related Research

Standard & Poor's

- Storm Alert: Natural Disasters Can Damage Sovereign Creditworthiness: Methodological Supplement, Sept. 24, 2015
- Storm Alert: Natural Disasters Can Damage Sovereign Creditworthiness, Sept. 10, 2015
- Assessing The Impact Of Natural Disasters On Sovereign Credit Ratings, June 14, 2010.
- 2014 Annual Sovereign Default Study And Rating Transitions, May 18, 2015
- Climate Change Is A Global Mega-Trend For Sovereign Risk, May 15, 2014
- Global Aging 2013: Rising To The Challenge, March 20, 2013

Other

- Bresch, D.: climada, the open source Nat Cat model: https://github.com/davidnbresch/climada, 2015
- ECA, 2009: Shaping Climate Resilient Development – A Framework For Decision-Making, www.swissre.com/eca
- Emanuel, 2013: Downscaling CMIP5 climate models shows increased tropical cyclone activity over the 21st century
- Hirabayashi et al. (2013): Global flood risk under climate change, Nature Climate Change
- International Monetary Fund: World Economic Outlook; Statistical Appendix, October 2015
- IPCC (2014): Fifth Assessment Report, 2014, Working Group 1
- Knutson et al., 2010: Tropical cyclones and climate change
- Maslin, M.: Climate Change: A Very Short Introduction; Oxford University Press, 2014
- McGuire, B.: Global Catastrophes: A Very Short Introduction; Oxford University Press, 2014
- Pew Research Centre: Climate Change Seen as Top Global Threat; July 14, 2015
- Rajczak et al. (2013): Projections of extreme precipitation events in regional climate simulations for Europe and the Alpine Region, Journal of Geophysical Research
- World Economic Forum: Global Risks 2015; 10th Edition, Insights Report, 2015

We have determined, based solely on the developments described herein, that no rating actions are currently warranted. Only a rating committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

•

Additional Contact:
SovereignEurope; SovereignEurope@standardandpoors.com

STANDARD & POOR'S
RATINGS SERVICES
McGRAW HILL FINANCIAL

RatingsDirect®

Climate Change: Building A Framework For The Future

Primary Credit Analyst:
Michael Wilkins, London (44) 20-7176-3528; mike.wilkins@standardandpoors.com

Research Contributor:
Xenia Xie, London; xenia.xie@standardandpoors.com

Table Of Contents

Climate Change: Building A Framework For The Future

With the Group of Seven nations pledging earlier this year to decarbonize their economies by 2100, expectations are high that the UN Climate Change Conference in Paris from Nov. 30-Dec. 11, 2015, will produce a global treaty. Yet our memories are littered with failed climate change negotiations of the past, and many remain skeptical whether the forthcoming fortnight of talks in the French capital will be any different. So what would constitute a success and what would failure look like? And what should the world of business and finance expect from an agreement in Paris, at the 21st Conference of the Parties (COP21) to the UN Framework Convention on Climate Change? (Watch the related CreditMatters TV segment titled "Financing To Be Key Issue For Climate Change Agreement," dated Nov. 13, 2015.)

Overview

- The aim of COP21 is to reach a global agreement that will combat climate change effectively and boost the transition toward a resilient and low-carbon global economy.
- A successful agreement would limit greenhouse gas emissions, forestalling a rise in the average global temperature by no more than 2 degrees Celsius.
- National and international regulations arising from such an agreement would have major repercussions for carbon-intensive sectors, in particular power generation and coal mining.
- Financing the transition will need to rely on private investment aimed at low-carbon technologies such as renewables and energy efficiency as well as carbon-pricing mechanisms to provide the necessary incentives.

Some have argued that success at COP21 won't be and shouldn't be a legally binding treaty to curb global emissions. Instead, they argue, success would be a flexible, high-level political framework that allows for bottom-up national pledges (the so-called intended nationally determined contributions or INDCs). Countries would then translate their pledges into national policies to decarbonize their global economies by 2100 (source: Carbon Tracker Initiative, "What will success for Paris, COP 21 look like?").

Many countries have made commitments to date, creating optimism about the chances for an agreement. However, as many commentators have noted, the sum of these commitments doesn't bring down carbon emissions enough to limit the average global temperature rise to 2 degrees Celsius, relative to pre-industrial levels.

As a mechanism to address this, the proposed agreement contemplates periodic revisions to the national commitments, say every five years, akin to those in recent EU environment and energy legislation. The rationale behind this mechanism is that in the meantime, developments in science, technology, and funding will allow for more ambitious commitments in the future.

Global Warming By Numbers

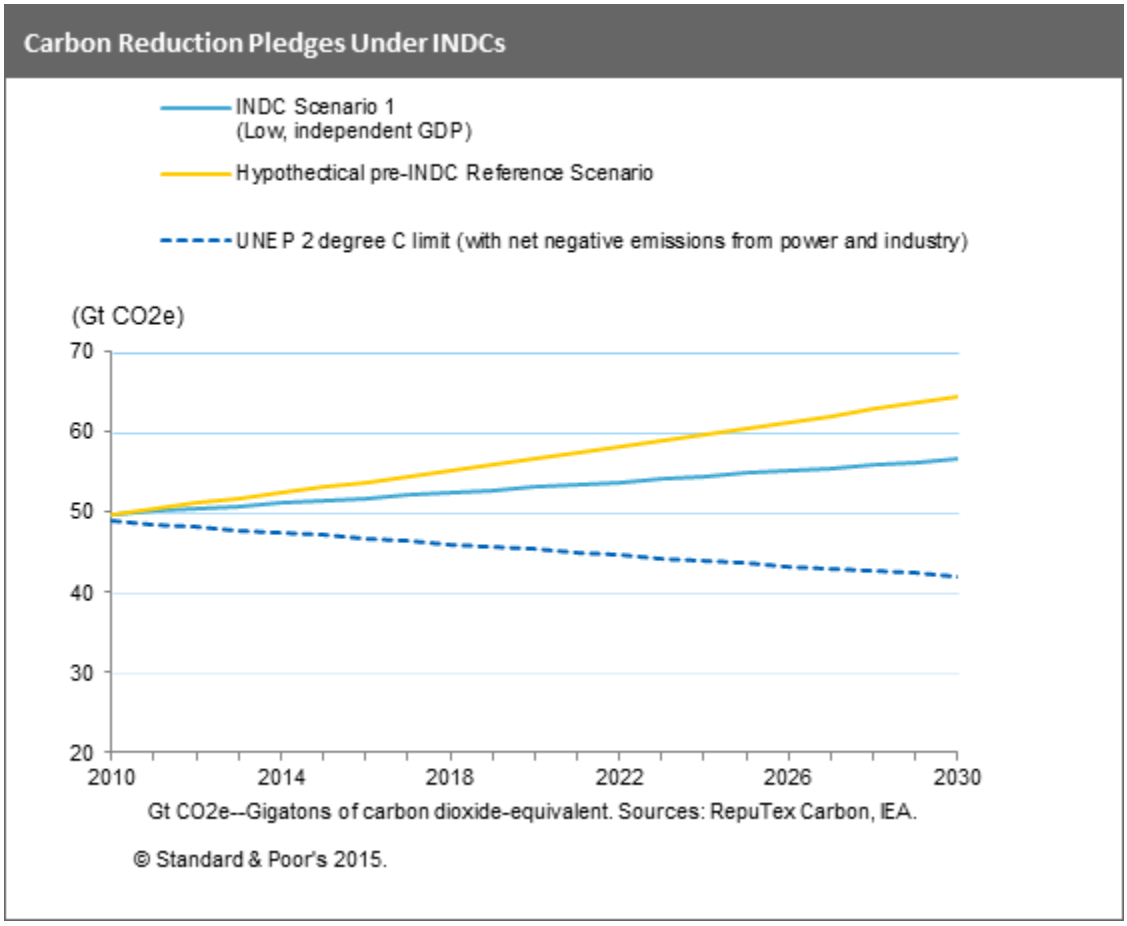
As of Oct. 30, 2015, a month before the start of the Paris talks, more than 150 countries, led by China, the U.S., and the

EU, had released their INDCs accounting for 90% of global energy-related emissions. The UN estimates these pledges, which are to be set in stone by world leaders attending the climate change summit, could limit the average global temperature rise to around 2.7 degrees by 2100. While the scientific consensus argues this is by no means enough, such a reduction nonetheless is a lot lower than the estimated 4, 5, or more degrees of warming that many previously projected (source: "Synthesis report on the aggregate effect of the intended nationally determined contributions," UNFCCC, Oct. 30, 2015).

Global temperatures have already risen by nearly 1 degree since the industrial revolution amid increasing greenhouse gas (GHG) emissions that mostly come from burning fossil fuels such as coal, oil, and gas. The UN has been holding climate negotiations for more than 20 years to try to curb a steady rise in emissions that reached the equivalent of 49 billion tons of carbon dioxide in 2010.

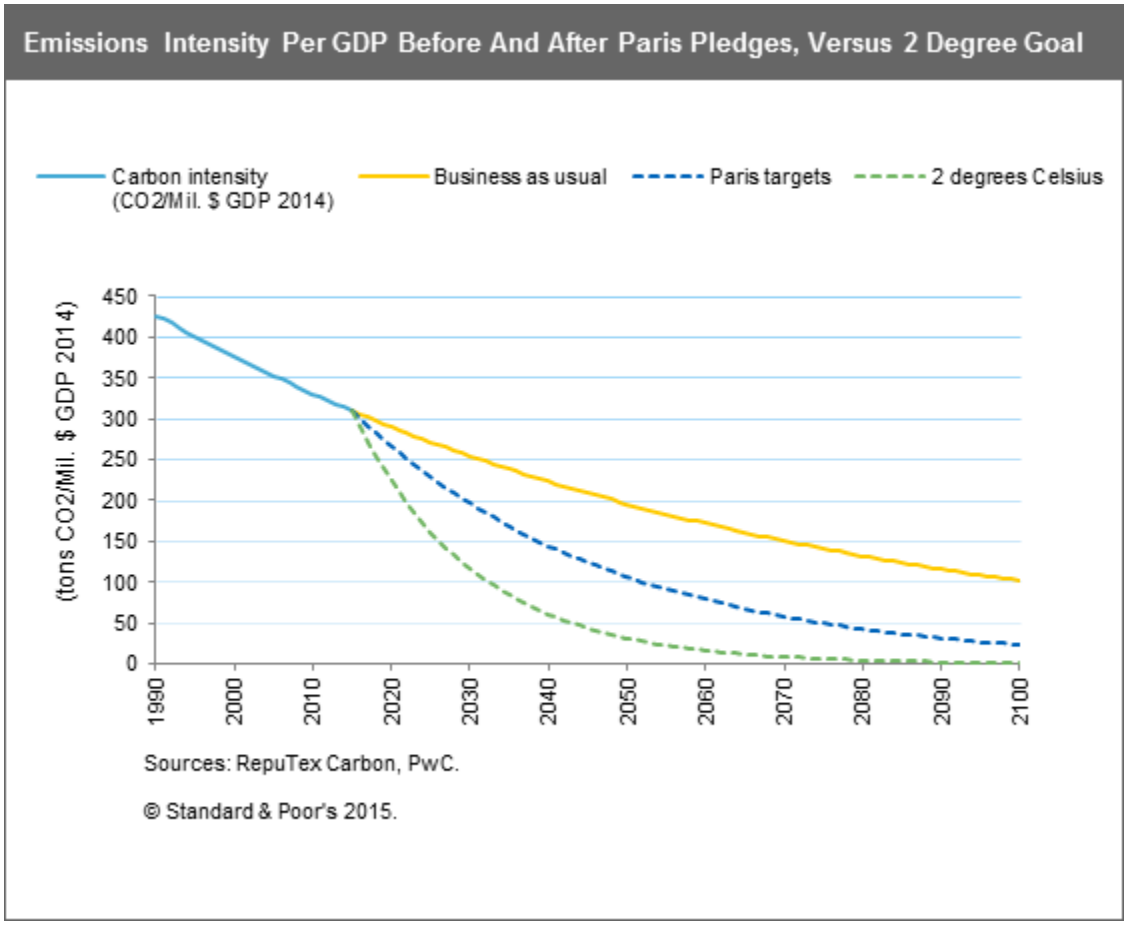
The pledges so far imply emissions rising to 56.7 gigatons of CO2-equivalent by 2030. That's nearly 4 billion tons less than without the INDCs, but still about 15 billion tons more than what the latest scientific report from the UN's Intergovernmental Panel on Climate Change suggests is needed to have a reasonable chance of avoiding 2 degrees of warming (see chart 1). To be sure, INDCs are a measurable improvement and may help global emissions peak sometime after 2030. However, reaching the 2 degree goal requires emissions to peak earlier than that.

Chart 1



Another way to portray emissions growth is the amount of energy consumed per unit of GDP, or emissions intensity, which has been reducing by about 1.3% a year over the past 15 years. It is argued that the rapid decoupling of emissions from economic growth is essential to avoid the worst impacts of climate change. The Paris pledges should further this reduction to about an annual 3%, whereas a carbon-neutral pathway by the end of the century would necessitate an annual 6% to 7% reduction (source: PwC, "Low Carbon Economy Index 2015: Conscious uncoupling?"; see chart 2).

Chart 2



The Drive Toward Decarbonization: The Implications

If we look at the 2020 emissions reductions pledges that China, the U.S., and the EU have made so far, China's don't go beyond the "business as usual" projections that the International Energy Agency has made (what it calls its "Central Scenario"). Although the EU doesn't need to take additional action to reach its 2020 target, the projections do show a significant gap against its 2030 target. The EU nevertheless plans to adopt more policies to comply with its Energy Efficiency Directive, implement structural reforms to the cap-and-trade program to revive the carbon dioxide (CO2) market price, and decide on a post-2020 CO2 target for carmakers. Europe's finance ministers have recently endorsed the EU's stance on climate finance ahead of COP21, reiterating the region's ambition to push for a strong signal to the

private sector to decarbonize investment as part of a COP21 agreement.

The U.S. has set the most ambitious 2020 target of the four main global emitters—which also include China, the EU-28, and India. However, the U.S. has not yet implemented policies to reach that target, including the Clean Power Plan that was finalized just last month as well as methane reduction targets. Beyond 2020, regulations issued by the government's Environmental Protection Agency (EPA) may not be enough, and the strong Republican majority currently in Congress makes any bold move on carbon-cutting policies very unlikely.

What's the possibility that some governments will up the ante? Some parties have said that they would set tougher targets, with the EU moving to -30% by 2020, instead of -20%, if COP21 reaches a binding and ambitious agreement. However, we believe that this is highly unlikely, considering that current 2020 targets are far below the levels needed to meet the 2 degree objective.

Energy production and use account for two-thirds of the world's GHG emissions, according to the IEA, meaning that the pledges made at COP21 must bring deep cuts in these areas, while sustaining growth of the world economy (source: the IEA's "World Energy Outlook Special Report," 2015). The use of low-carbon energy sources is already expanding rapidly, and signs point to a gradual decoupling of energy-related emissions and GDP growth. The IEA predicts the share of global low-carbon power generation will grow to almost 45% in 2030, resulting in a flattening out of power emissions--despite an increase in electricity demand by more than 40%.

What's becoming clearer is that many INDCs target fossil fuel producers--especially coal companies. Coal-fired power generation is coming under increasing scrutiny, as countries try to decarbonize, with many INDCs putting regulation of coal front and center—like China's. The country's stall in coal consumption is the main reason their emissions growth slowed in 2014, although recent reports suggest that coal-related carbon emission reductions may have been somewhat exaggerated. Nonetheless, the economic slowdown in China and the country's explicit policies to restrict coal use mean that the massive growth in coal demand that had been assumed until as recently as last year has all but evaporated from outlooks. As a result, China's emissions may reach its highest point well before their goal of 2030, which would help global emissions peak sooner rather than later. Although it is far too early to tell, some even hope that China's coal use may have already peaked, despite annual GDP growth of more than 7%. Although economic and emissions data must be treated with caution in China, it does appear that in 2014 at least, the country was able to decouple emissions from growth.

The IEA has recently laid out a Bridge Scenario for a peak in global energy-related emissions by 2020 that could provide the best chance to keep global warming below 2 degrees. It relies solely on proven technologies and policies, without changing the economic and development prospects of any region. The catch is that immediate action is required to 1) increase energy efficiency; 2) reduce the least-efficient coal-fired power plants and ban new construction; 3) increase renewable investment; 4) phase out fossil-fuel subsidies, and 5) reduce methane emissions. For such a scenario to work, coal use would peak before 2020 and then decline, with oil demand rising to 2020 and then plateauing. Importantly, China would decouple its GDP from emissions growth by around 2020, much earlier than expected. Others, like the U.S., would significantly accelerate the decoupling of economic growth and emissions under this scenario.

Financing The Transition

In its latest World Energy Outlook released this week, the IEA estimates investment of $13.5 trillion in low-carbon technologies and efficiency is required to 2030 just to meet the COP21 pledges to keep below 2.7 degrees of warming. A key question to be hammered out in Paris is the amount of financing that developed-country parties to the negotiations may be willing to provide to developing-country parties, and under what kind of terms. While no amounts have been floated in the run-up to COP21, the figure of US$100 billion a year from 2020 was proposed at COP15 in Copenhagen in 2009. While some commentators argue that this figure may be insufficient to cap the rise in the average global temperature to 2 degrees, it is promoted as essential in helping bridge the gap. As a way to decarbonize the global economy, the negotiators will also consider how big a role energy efficiency programs can play, how to lower the cost of capital for renewables and infrastructure (such as transport), and how to develop effective carbon-pricing mechanisms.

Several countries state in their INDCs that their level of commitment is conditional upon having access to an international carbon market, under negotiation for the immediate post-Paris era. Overall, nearly 80 INDCs mention the use of carbon markets, while over half submitted to date plan to use or are considering the use of market mechanisms.

An increasing number of jurisdictions are implementing domestic climate policies and, more specifically, are pricing GHG emissions. In most cases, carbon pricing policies take the form of an emissions trading system (ETS), but some jurisdictions have also implemented carbon taxes. To date, 55 jurisdictions, including 35 national and 20 subnational jurisdictions, have implemented an ETS as a way to put a price on carbon. By early 2015, jurisdictions accounting for 40% of global GDP had introduced an ETS (source: International Emissions Trading Association, "The 2015 Paris Agreement, Carbon Pricing and Markets: Connecting the Dots," November 2015).

Renewable energy, meanwhile, accounted for nearly half of all new power generation capacity in 2014, led by growth in China, the U.S., Japan, and Germany, with investment remaining strong (at $270 billion) and costs continuing to fall. Since 2009, the levelized cost of electricity from solar photovoltaic (PV) has come down by more than 60%, while that of onshore wind has fallen 15%.

Private-sector investors will, in our view, require strong incentives to finance the transition to a low-carbon economy. Among other things, this involves a carbon price that is high enough to re-orient funds from fossil-fuel heavy industries to low-carbon technologies and the clean energy sector. For this to happen, policies and regulation geared toward decarbonization would have to ensure that carbon-intensive assets effectively become regarded as "stranded," that is, have no future economic value.

The recognition of carbon as a significant risk and an integral part of financial investment planning has been acknowledged by the Bank of England and other organizations for some time. The negotiations in Paris will be followed very closely. It is an opportunity for political leaders to provide a vibrant sign of exactly how much and in what ways they expect the world's governments and economies to tackle the risk.

No Going Back

It has been argued that an agreement in Paris this December will mark a critical turning point in the effort to tackle climate change, where most countries in the world will accept the need to take action regardless of whether or not some other group or block of countries acts first. The expectation is that they will seal this consensus with a global political agreement.

If governments are to send strong signals in support of long-term strategies and priorities to support movement toward low carbon and resilience, then financing will be a key issue that must be unblocked for there to be agreement in Paris.

Commitments within an internationally agreed framework could provide the common norms that will allow actions by sovereign states to link up and unlock the finance necessary to decarbonize the world's economy. This could be through the promotion of linkages between established carbon pricing mechanisms and markets. Carbon market linkages allow for efficiencies in emission reduction activities to be identified beyond borders and can attract investment where emissions reductions occur at the lowest cost. This could accelerate clean energy investment at the scale needed to meet the world's ambitious decarbonization goals.

Paris may well usher in the necessary policy and regulatory infrastructure for action. While COP21 may not achieve a 2 degree outcome, the necessary impetus to get there is gaining momentum. That should be considered a success, of sorts.

Appendix: The UNFCCC and the Kyoto Protocol

Established in 1992, the UN Framework Convention on Climate Change provided a platform for sovereign states to consider how they could limit average global temperature increases. This was followed by the Kyoto Protocol, a separate international agreement adopted 18 years ago, which attempted to bind developed countries to emission reduction targets. The Protocol, which covered around 10% of global emissions, was neither universal in application nor ratified by the U.S. The Protocol's first commitment period started in 2008 and ended in 2012. The second commitment period began on Jan. 1, 2013, and will end in 2020.

Related Criteria And Research

- How Environmental And Climate Risks Factor Into Global Corporate Ratings, Oct. 21, 2015
- Climate Change Will Likely Test The Resilience Of Corporates' Creditworthiness To Natural Catastrophes, April 20, 2015
- For The U.S. Economy, Climate Change Is A Case Of Pay Now--Or Pay More Later, Sept. 18, 2014
- Climate Change Could Sting Reinsurers That Underestimate Its Impact, Sept. 3, 2014
- Dealing With Disaster: How Companies Are Starting To Assess Their Climate Event Risks, May 21, 2014
- Climate Policy And The Rise Of Carbon Markets, May 19, 2014
- Environmental Regulation Starts To Squeeze Utilities' Credit Quality, Nov. 14, 2012
- Credit FAQ: What The Durban Climate Change Talks Could Mean For Clean Energy Investment And Carbon-Intensive Industries, Dec. 21, 2011

- Q&A: Did The Cancun Summit Bring Global Action On Climate Change A Step Closer? Dec. 20, 2010
- Q&A: Successes And Shortcomings From Copenhagen's Climate-Change Conference, Jan. 12, 2010

We have determined, based solely on the developments described herein, that no rating actions are currently warranted. Only a rating committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

RatingsDirect®

Economic Research:

Reversing Global Warming Requires Nothing Less Than A Global Effort

Credit Market Services:
Satyam Panday, U.S. Economist, New York (212) 438-6009; satyam.panday@standardandpoors.com
Beth Ann Bovino, U.S. Chief Economist, New York (1) 212-438-1652;
bethann.bovino@standardandpoors.com

Table Of Contents

Economic Research:

Reversing Global Warming Requires Nothing Less Than A Global Effort

Although the existence of climate change is all but a settled matter--few scientists dispute anymore that the earth is heating up--far less consensus exists on how to ameliorate the damaging effects. Evidence continues to mount that glaciers and ice caps are melting, sea levels are on the rise, and hurricanes, tornadoes, blizzards, floods, and droughts are happening with more intensity, more frequency, or both. As the earth continues to warm and climate change accelerates, the global economy is likely to take a hit. And while global warming will ultimately affect everyone, it appears that the largest economic blocs on the planet, the U.S., Europe, and China, may be the ones that point the way to ensure that climate change doesn't seriously erode the potential for global economic prosperity.

Standard & Poor's Economics is among those believing the scientific consensus that the economic costs of marginal warming will be small up to a two-degree Celsius rise in the earth's overall temperature, but that damages will begin to climb at an accelerated pace past that threshold, becoming substantial if the temperature rises four degrees Celsius or more. Those temperature changes may sound insignificant, but prominent studies predict that by the time the four degrees of warming is reached in 2100, absent any mitigating action, global losses could range from 4% to 9% of economic output relative to an economy without global warming. No one can predict future temperatures with absolute certainty, but the reports produced for the World Bank by the Potsdam Institute for Climate Impact Research estimate a 40% chance of a four-degree temperature rise by 2100 if emissions follow a moderate, "business-as-usual" path, i.e., as if the world's governments don't implement their pledges to reduce emissions.

Overview

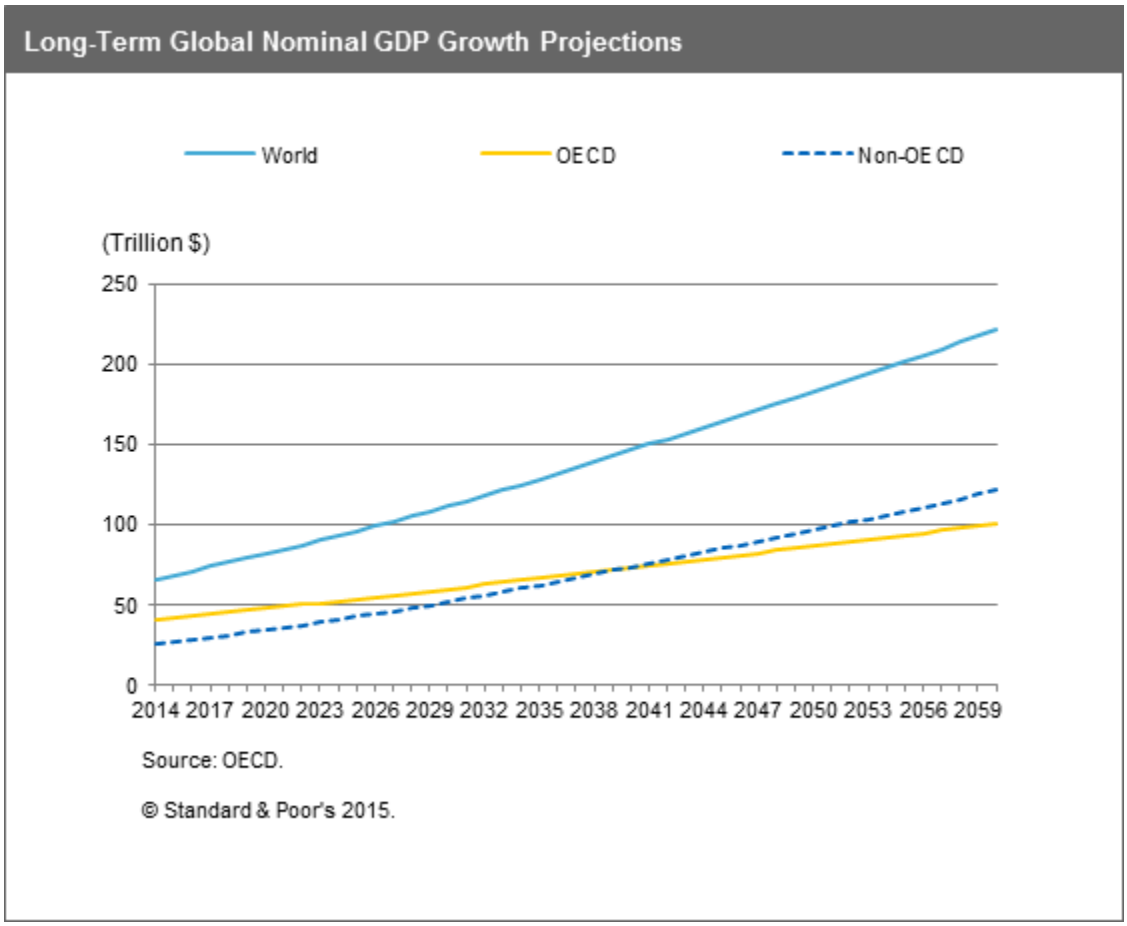
- Some economic forecasts predict that if climate change causes the earth's temperature to rise by another four degrees Celsius by 2100, global economic output will be 4% to 9% lower relative to an economy with no warming effect.
- The upcoming Paris Climate Conference in December 2015 aims for more effective national targets to keep global temperature from increasing more than two degrees Celsius over pre-industrial temperatures, which should avoid the worst effects of climate change.
- An agreement for collective, global action won't be easy since it requires high levels of trust and cooperation between advanced economies and developing ones--two blocs at different stages of development.
- While Europe and the U.S. already have some plans to combat global warming, China recently announced a cap-and-trade system and new goals for cutting GHGs.
- With the world's three leading economic regions ready to combat global warming, more of the developing world may be ready to join the fight.

Two Degrees Of Separation?

So, how does the world turn down the thermostat? The U.N. will once again seek answers in December at the 2015 Paris Climate Conference (COP21; starts Nov. 30), which its French hosts call, "A Conference of the Parties with higher stakes than ever before." The UN COP21 aims for more effective national targets to keep global temperature increases to less than two-degree Celsius over pre-industrial age temperatures, which should avoid the worst effects of climate change.

But it won't be easy, because it requires collective, global action. The difficulty comes from the fact that costs to mitigate global warming need to be borne today, while the benefits won't be apparent until the future. In addition, while most parties can see the dangers in unabated global warming, their long-term and short-term goals may be different. That's especially true in the difference between the advanced economies, which have more money to spend and have been the source of most emissions of greenhouse gases (GHG) until now, and some developing nations, which are striving to achieve strong near-term economic growth without adding to the atmospheric damage generated by intense urbanization and industrialization.

Chart 1

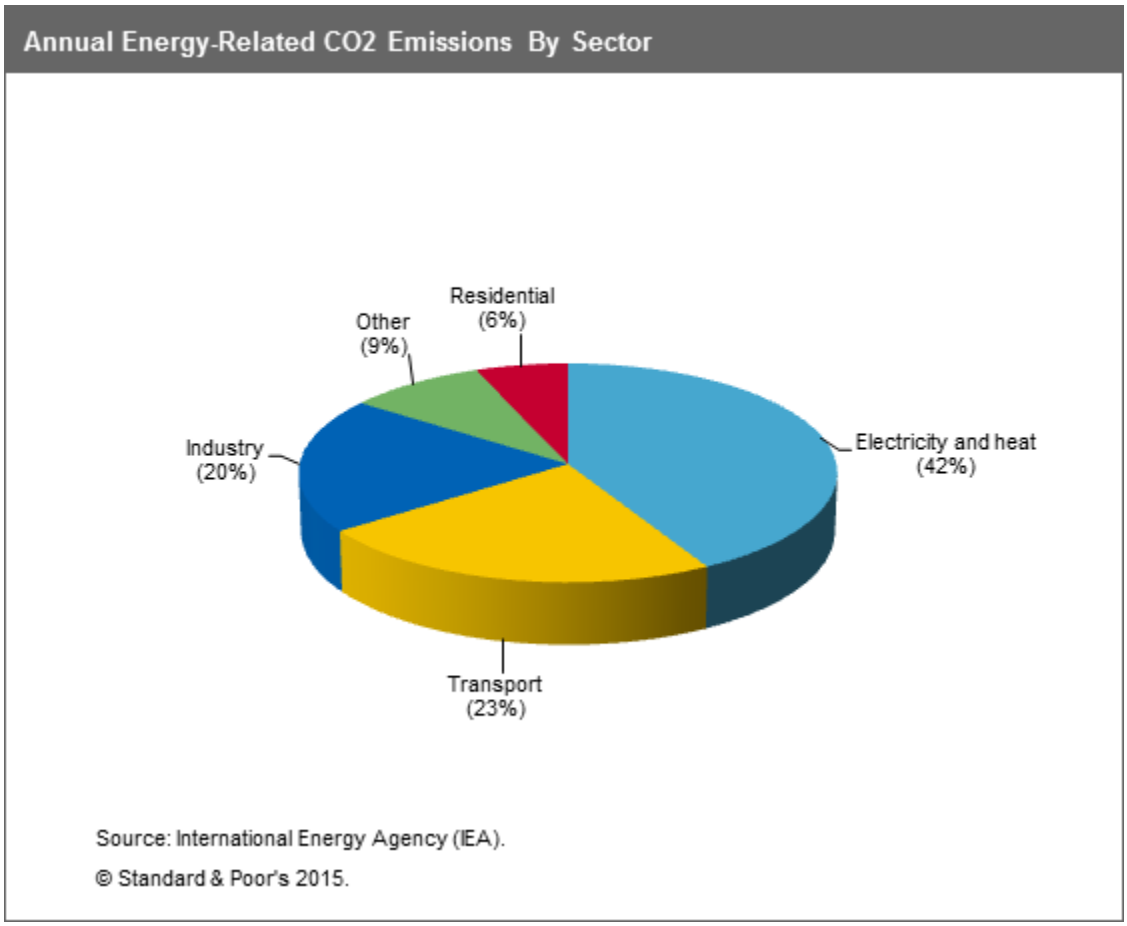


According to OECD's long-term projections, global GDP is expected to almost treble by 2060, with almost two-thirds of global growth (at current prices) set to come from non-OECD countries (see chart 1). Given their energy-intensive stage of development, the non-OECD countries will require disproportionate amounts of energy to achieve that growth. But just as equity demands that developed countries act first in reducing GHG emissions, the physical workings of our planet demand that developing countries also limit and, in time, reduce their emissions. This will require high levels of trust and co-operation among the nations attending the Paris summit, if they are to come up with the action necessary to put the world on a trajectory below two-degree Celsius global warming.

A Hotter Earth And A Cooler Economy

To keep the earth from reaching those critical extra degrees in overall heat--one of the prime goals of COP21--scientists know what's needed is to cut emissions of GHGs, such as carbon dioxide (CO2), methane, nitrous oxide, and fluorinated gases that trap the sun's heat and promote global warming. In large part, GHGs such as CO2 result from burning fossil fuels. The less wood, coal, oil, and natural gas that's used, the better it will be for the planet. Economies have several ways to use less fossil fuel, but all of them exert a cost somewhere along the line. Whether it is individual consumers, sovereign governments, or businesses, someone has to pay for phasing out fossil fuels while developing and installing replacement power sources for transportation, power, and manufacturing--the sectors that use the most fossil fuels (see chart 2). Conversely, some or all of those same parties might also gain direct and indirect economic benefits in terms of new construction and new industries, the reduced likelihood of serious crop failures and coastal flooding, lower health care costs, and less property damage from natural disasters.

Chart 2



Determining the costs of action versus inaction to avoid even a two-degree Celsius increase is an inexact science. First, although consensus exists that temperatures will rise, there is still uncertainty on how much temperatures will rise under current conditions, and what the damage function looks like, which is the uncertainty regarding the timing of cascading effects. And just as important, all potential costs of global warming must be discounted over future years--and economists can disagree widely on what the discount rate will be. Many argue that traditional methods using the cost of capital may not be appropriate to discount the welfare of future generations and therefore a lower discount rate should be used to calculate the present value of future climate damages.

In a recent report, Citibank GPS economists estimated future losses using different discount rates. They also estimated the costs of action to mitigate GHG emissions through a combination of increased energy efficiency and reduced fossil-fuel use for power production and transportation. They found the $190.2 trillion expenditure through 2060 on mitigating actions for energy (capital costs and fuel) are nearly the same as the expenditure of conducting business as usual), at $192 trillion. In the mitigating scenario, costs are incurred mostly on development of renewables and energy efficiency, resulting in lower use of fossil fuels, which in turn lowers the total cost in later years.

But the real difference lies in their estimated cumulative losses. The central estimate of cumulative losses from inaction from 2015 to 2060 is as high as $44 trillion (assuming a 2.5-degree Celsius rise by 2060), with a 0% discount rate (see

table 1). A low discount rate encourages early action primarily because future damages count for so much. Using a higher discount rate--that values costs in the future less than costs incurred presently--shows somewhat lower losses (see table 1). In fact, when viewed through a typical discount rate schedule of 5% to 7%, global losses amount to 6.25% to 10% of current GDP.

Table 1

Potential Costs Of Climate Change Damage

(Assuming a 2.5 degree Celsius rise by 2060)

Discount rate	Net present value lost (trillion $)
0%	(44)
1%	(31)
3%	(16)
5%	(8)
7%	(5)

Notes: (1) Global GDP currently amounts to about $80 trillion in nominal terms. (2) A typical equity discount rate is 6.5%, which assumes a combined real risk-free rate of 1% and an equity risk premium of 5.5% to give a cost of equity capital of 6.5%. Source: Citi Research.

And this is in line with what most studies that estimate impact on global GDP growth. Climate scientists use so-called "Integrated Assessment Models" to estimate how inaction affects global GDP. The inaction estimates range from 0.7% to 2.5% of GDP loss for a temperature of 2.5 degrees Celsius expected to be reached in 2060. Damages will begin to climb at an accelerated pace past that threshold, becoming substantial if the temperature rises four degrees Celsius or more. Damage assessments using two prominent studies--one by Professor William Nordhaus of Yale University and another by Professor Martin Weitzman of Harvard University--suggest that the GDP loss to be 4% and 9% relative to the base with no-warming effect, respectively (see table 2).

Table 2

The Damage To Global GDP From Global Warming By 2100

Temperature rise (degree Celsius)	Weitzman damages (%)	Nordhaus damages (%)
1 degree	0	0
2 degree	1	1
3 degree	3	2
4 degree	9	4
5 degree	25	7

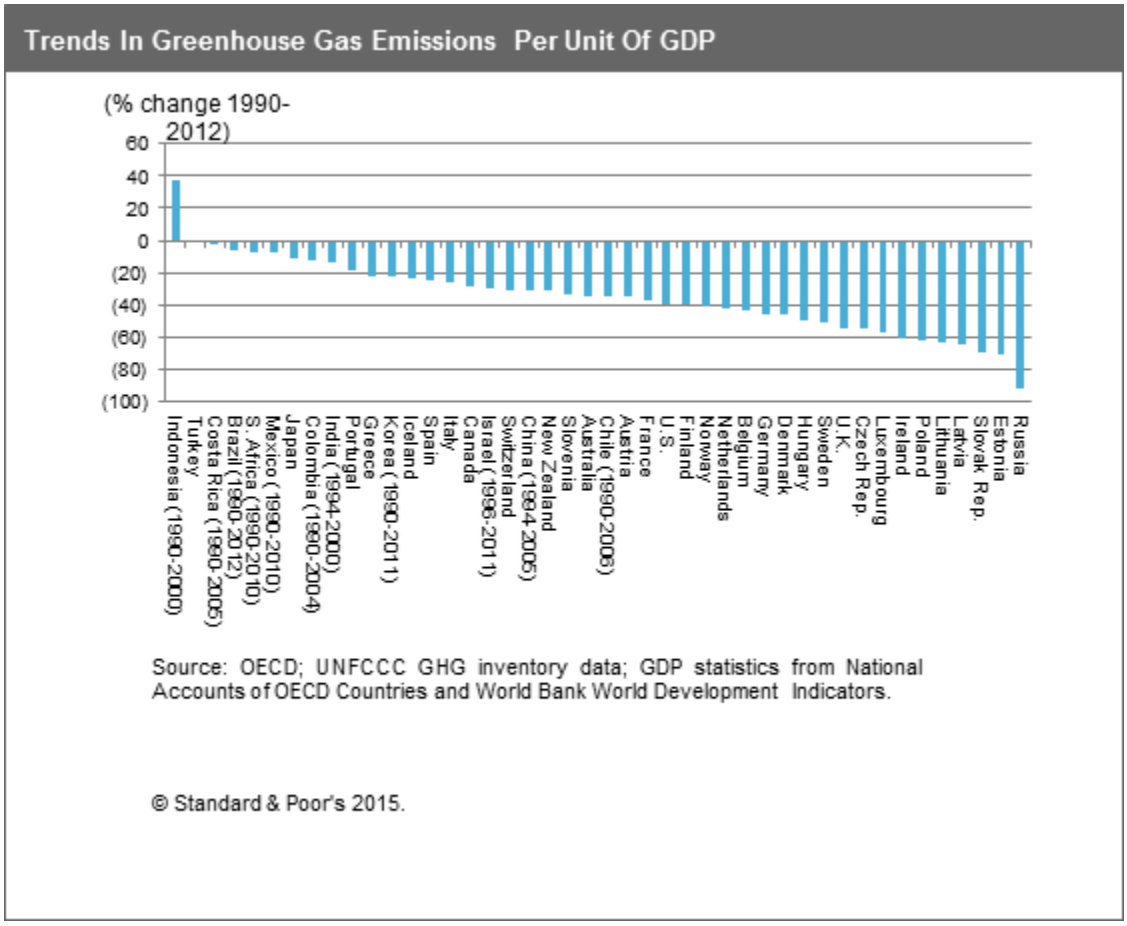
Notes: (1) Nordhaus damages are based on Nordhaus, W. (2013) "The Climate Casino." (2) Weitzman damages are based on Weitzman, M. (2012) "GHG Targets as Insurance against Catastrophic Climate Damages." Source: Covington and Thamotheram (2015) " The Case for Forceful Stewardship: The Financial Risk from Global Warming,"

While the cost of fighting global warming will continue to be debated, little dissuades us from the reality that what the world's major economies do to fight it will be critical. Because the amount of CO2 and other GHGs that a nation generates are generally a function of industrial activity, transportation, and power generation (see chart 2)--all linked to GDP--advanced economies and fast-growing developing ones will have a big part to play.

That said, in a sign that potentially marks delinking between CO2 and GDP, CO2 emissions were flat according to the International Energy Agency, despite the global economy increasing by about 3%. In fact, a recent OECD study

reviewing 34 OECD countries and 10 non-OECD partner countries (including Brazil, China, India, Indonesia, and Russia, to name a few)--which together account for 80% of global GHG emissions--shows that most countries are already turning their economies toward a more emission-sustainable direction, with all countries except Indonesia seeing GHG emissions per unit of GDP trend down going from 1990 to 2012. To be sure, they still need to achieve greater reductions to meet their own national, politically feasible targets, let alone the reductions needed to keep climate disaster at bay.

Chart 3



Over future decades, national economies will certainly vary according to war, recession, or other factors. But examining how the world's leading economic regions are dealing with climate change will hopefully demonstrate how national interests and global ones can reinforce each other.

Europe's Global Warming Weapon

One widespread method of reducing GHG--generally CO2--in a cost-effective manner is to establish a carefully designed cap-and-trade system. In such a system, governments gradually tighten limits on emissions by issuing or selling allowances consistent with those limits to power producers, transportation companies, or manufacturing

companies. Producers can then sell or buy allowances from other producers depending on how little or how much CO2 they produce. In this system, governments set initial prices for the allowances and caps for each producer, but let the market take subsequent control, with businesses deciding how much they're willing to pay to exceed their capped greenhouse output. This market-based system thus gives businesses an incentive to minimize their CO2 output.

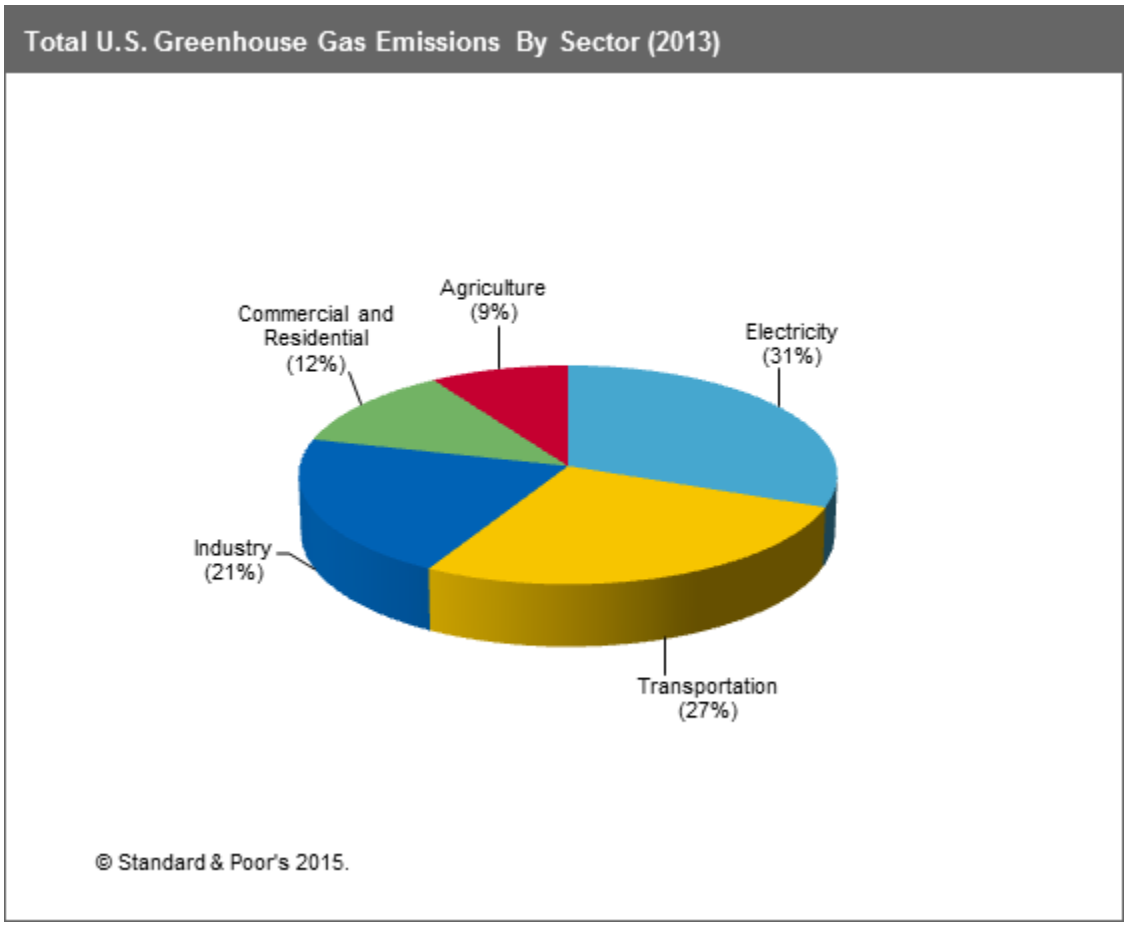
Europe began its cap-and-trade system, the Emissions Trading System (ETS), in 2005, and it's now in its third iteration, covering 45% of 28 EU member states as well as Norway, Iceland, and Liechtenstein's GHG emissions. The reduction in GHGs has been fast, but not yet fast enough to meet ETS goals of emissions 40% below 1990 levels by 2030. The EU has said emissions are currently falling at a rate of 1.74% per year compared with the needed rate of 2.2% per year (starting in 2021) to meet its 2030 goal.

The U.S. Joins The Fight

The U.S. government has never passed a comprehensive, national cap-and-trade system, largely due to objections by fossil-fuel producers that their profitability would suffer if end-users materially cut back on some fossil fuels, especially coal. The state of California however, enacted a cap-and-trade system (which is also linked to the Canadian province of Quebec) that took effect in 2013 and applies to large electric power generators, industrial plants, and fuel distributors, which together generate roughly 85% of GHG emissions in what is the world's ninth-largest economy. The system is part of a strategy to reduce California's GHG emissions to 1990 levels by the year 2020. Because California's economy is big, its cap-and-trade scheme is being watched closely and could prove a template for a future national system. (A cap-and-trade system solely for power plants, the Regional Greenhouse Gas Initiative, has operated in the U.S. Northeast since 2008.)

Global warming will certainly affect the U.S. economy if nothing is done about it. Standard & Poor's estimates that unabated global warming will cost the domestic economy between 2.2% and 5.2% of GDP by 2100 (see "For the U.S. Economy, Climate Change Is A Case of Pay Now--Or Pay Later," published Sept. 18, 2014, on RatingsDirect). To fight global warming without a national cap-and-trade mechanism, the Obama Administration sidestepped Congress in August by issuing regulatory rules from the Environmental Protection Agency (EPA), dubbed the Clean Power Plan (CPP). Those rules apply to power plants and aim to reduce CO2 in the power sector 32% below 2005 levels by 2030. The U.S. is also proposing to further reduce GHG by boosting fuel efficiency in light cars and trucks starting with 2017 models. The transportation and power generation sectors each account for a little less than one-third of all GHG emissions in the U.S. (see chart 4).

Chart 4


Total U.S. Greenhouse Gas Emissions By Sector (2013)
Agriculture (9%)
Commercial and Residential (12%)
Electricity (31%)
Industry (21%)
Transportation (27%)
© Standard & Poor's 2015.

New Emission Reduction Initiatives In The U.S.

The CPP is an executive rather than a legislative action, so it can be reversed by a subsequent Administration. We also expect the CPP will face many administrative and legal challenges, especially from states that produce coal or get much of their electricity from coal-fired plants. However, the CPP is flexible. Instead of a straight federal mandate about how to cut CO2, it establishes goals and then allows states latitude about how to achieve them. States can use direct carbon taxes, a cap-and-trade system, the production of renewable energy, or other methods that meet specified statewide goals. While slowing climate change, the CPP's economic benefits by 2030, says the Administration, would also be substantial:

- By 2030, when the CPP is fully in place, carbon pollution from the power sector will be 32% below 2005 levels;
- The CPP's public health and climate benefits will total an estimated $34 billion to $54 billion per year in 2030, versus a cost of $8.4 billion;
- Just from soot and smog reduction, U.S. families will see up to $4 in health benefits for every dollar invested through the CPP; and
- The lower exposure to particle pollution and ozone in 2030 will avoid a projected 1,500 to 3,600 premature deaths, 90,000 asthma attacks in children, and 300,000 missed school and work days.

CPP opponents, however, claim the costs will far outweigh any economic benefits over the next 15 years. The Beacon Hill Institute, a right-leaning think tank in Boston, calculated the CPP's total costs at $46.5 billion (using a 3% discount rate) during that period, while NERA Economic Consulting, in a study that the coal industry partially funded, set annual CPP compliance costs between $41 billion and $73 billion from 2001 to 2031.

The assumptions, discount rates, and specific factors behind any cost estimates for fighting global warming can and will be debated, even as politicians gear up to began fighting on behalf of the stakeholders they believe have much to gain or lose under the CPP. It will unquestionably cost something to keep America's air clean and prevent it from heating up. How large that cost turns out to be and who will ultimately bear it remain open questions.

The U.S. is also attacking climate change in the transportation sector with calls for higher fuel efficiency for autos. Although the Corporate Average Fuel Economy (CAFE) standards were first instituted in 1975 as a way to reduce oil imports in the wake of the 1973-1974 Arab oil embargo, they're now also widely seen as a way to help cut GHG emissions. The EPA and the National Highway Traffic Safety Administration are proposing to increase automotive fuel efficiency in new cars, light-duty trucks, and medium-duty passenger vehicles, starting in 2017. The final standards are projected to result in an average fleetwide level in model-year 2025 of 54.5 miles per gallon if they're achieved exclusively through fuel economy improvements. Light-duty vehicles currently account for nearly 60% of U.S. transportation-related petroleum use and GHG emissions.

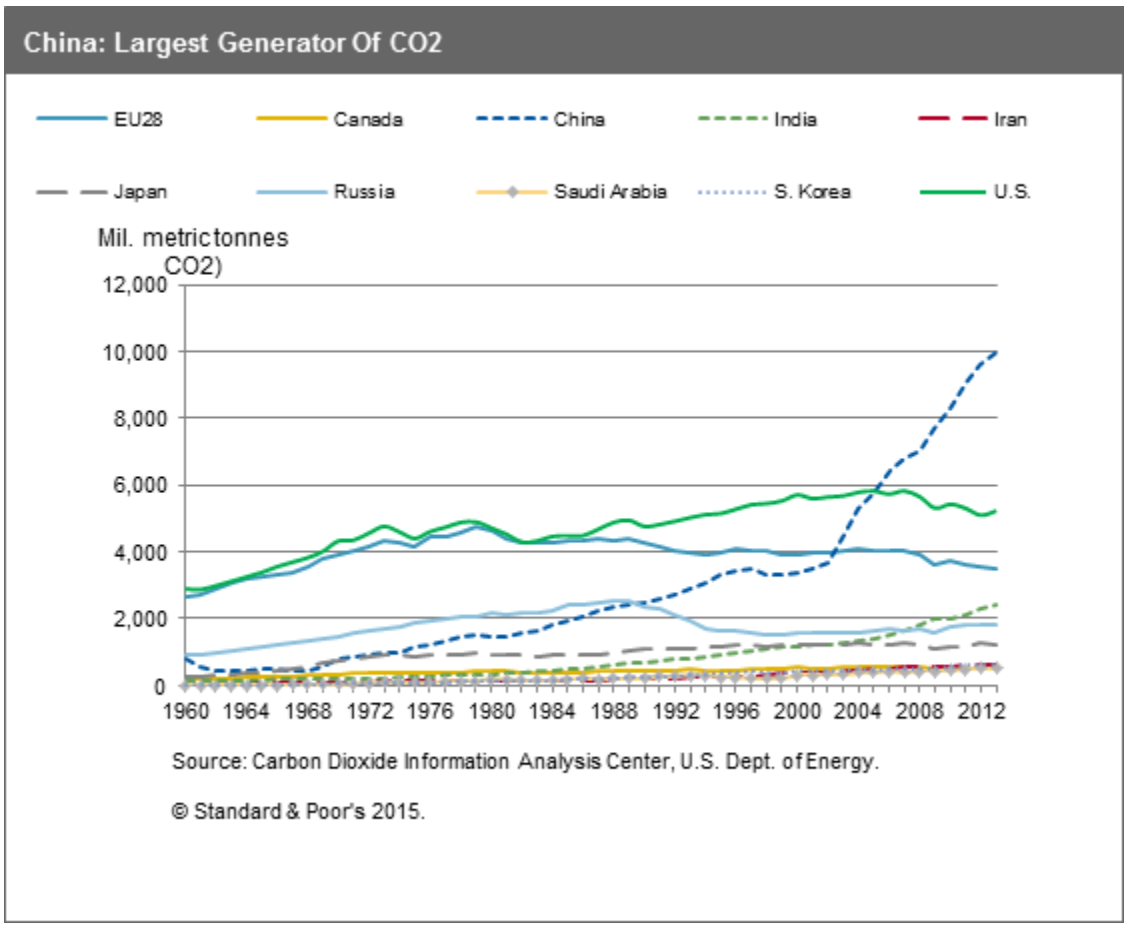
And China Makes Three

While Europe and the U.S. have been ramping up efforts to combat climate change, progress had been somewhat slower in China, now the world's second-largest economy, and largest on the basis of purchasing power parity. The Chinese government is acutely aware of the potential damages to the nation from global warming, even as its economy boomed. Much of the population is in coastal areas that could be hurt by rising sea levels, while disappearing glaciers that feed some major rivers could hurt agricultural production if those rivers eventually lack the necessary water for regular irrigation. And beyond that, of course, is the cost to day-to-day life in China's big cities from the

nation's infamous smog, a direct result of GHG emissions from factories and cars.

Along with China's rapid economic growth it has also become the largest generator of CO2 from power plants in the world, with a 27% share of that gas worldwide. (The U.S. produced 14% and the EU 9%). On a per capita basis, however, China doesn't even come close to being the leading CO2 generator. While Chinese per capita emissions and total emissions (see chart 5) have more than doubled since 1995, consumption-based per capita emissions--the emissions embodied in the final goods and services consumed regardless of country of production--in the U.S are still almost four times larger. Much of China's power still comes from coal (and in the developing world in general, 70% of power is now coal-generated). China has rapidly urbanized, and with people flocking to its cities from rural areas, the need for power is likely to increase.

Chart 5



Therefore, China's pronouncements in November 2014 that it will set limits on CO2 emissions are, in our view, something of a landmark in the fight against global warming. China announced goals to achieve 20% of its power by 2030 from zero-emission sources, such as nuclear, wind, hydroelectric, and solar. The nation also said it intends for CO2 emissions to peak by 2030, making best efforts to reach a peak earlier than that. Its aim is to reduce CO2 emissions per unit of GDP by 60% to 65% by then. And to help it do so, China is also committed to a major reforestation project.

Nearly a year later in October, 2015, Chinese President Xi Jinping further strengthened the country's efforts to combat global warming when he said China would begin a national emission trading system in 2017--a cap-and-trade mechanism--to lower GHGs. The system would cover power plants and several major industrial sectors, including steel, chemicals, and paper manufacturing. That initiative was announced at the U.S. White House with President Obama. No one can say with certainty how effective China's new environmental policies will be--especially after early November 2015, when it revealed that it had been burning much more coal than it previously acknowledged.

Nevertheless, China has agreed to cooperate with the U.S. on a number of initiatives to increase energy efficiency and reduce global warming, including work on carbon capture and sequestration projects that could cut greenhouse emissions at coal-burning plants, a joint clean energy research and development center, enhanced bilateral cooperation on the phase-out of hydrofluorocarbons (GHGs used in refrigeration and air conditioning), and the promotion of trade in green infrastructure, power, and construction goods.

Protecting The Commons

We expect a new seriousness about combating climate change is likely to emerge at COP21 now that the three largest economies in the world, the U.S, the EU, and China, have laid out detailed plans for GHG reduction. A strong Chinese commitment could signal to other nations that they can undertake the expense of ameliorating climate change without putting themselves at a disadvantage vis-à-vis their economic competitors on the world stage.

In 1832, William Forster Lloyd, an economist at Oxford, first enunciated the theory known as the Tragedy of the Commons: When stakeholders take free and full advantage of a common good, that good eventually becomes so depleted as to be economically useless to everyone. Civilization is in a similar position today with the atmosphere. For most of human history it has been seen as an endless commodity that all can use as they wish, without consequence. But it's clear now that without significant investment and cooperation on the part of humanity, the economic utility of this common good will begin to be depleted in a matter of decades and that living with the damage will surely prove to be far more expensive than preventing it.

Writer: Robert McNatt

Related Criteria And Research

For the U.S. Economy, Climate Change Is A Case of Pay Now--Or Pay Later, Sept. 18, 2014,

RatingsDirect®

Guest Opinion:

As Carbon Risks Mount, Investors Eye Tools To Manage Their Impact

Contributor:
Frank Watson, London (44) 20-7176-6275; Frank.Watson@platts.com

Table Of Contents

Guest Opinion:

As Carbon Risks Mount, Investors Eye Tools To Manage Their Impact

*(**Editor's Note:** The author of this article is Frank Watson, managing editor for European carbon emissions markets at Platts. Platts, like Standard & Poor's Ratings Services, is a subsidiary of McGraw-Hill Financial. The thoughts expressed in this article are those of the author and do not necessarily reflect the views of Standard & Poor's.)*

As scientists continue to warn governments and wider society about the growing dangers of climate change, pressure to act has been building--particularly following the Intergovernmental Panel on Climate Change's (IPCC) fourth and fifth assessment reports released in 2007 and 2014. In its 2014 synthesis report, the IPCC stated that:

- The evidence of atmospheric and ocean warming is unequivocal;
- Many of the associated impacts, such as rising sea levels, have been occurring since 1950 at rates unprecedented in the historical record;
- There is clear human influence on climate; and
- It is "extremely likely" that human influence has been the dominant cause of the observed warming since 1950.

Although not all parties agree with all of the IPCC's statements, few governments now reject the climate science as a whole, and these sobering findings will place an increasing focus on curbing carbon emissions. Companies exposed to the related carbon risk are already taking steps to ensure that climate policy actions will not compromise their future profitability. And for investors looking to protect their assets, the important question is becoming whether the transition to a low-carbon economy will be orderly or disruptive. Importantly, the IPCC also warned that "delays in additional mitigation or constraints on technological options increase the longer-term mitigation costs to hold climate change risks at a given level." In other words, the longer the world waits to curb emissions, the higher the eventual cost will be.

Overview

- Carbon markets are a big part of the transition to a lower-carbon global economy.
- The big question for investors is whether the transition to a low-carbon economy will be orderly or disruptive.
- Well-designed and timely policy measures by governments and companies could help mitigate climate change's economic and financial impact.

Since the private sector hasn't taken adequate action to cut emissions to rates that will hold global warming at levels scientists consider safe, the push for governments to act has intensified. With a U.N.-brokered global climate deal in the offing this December at the United Nations Climate Change Conference (or COP21) in Paris, climate policy options are coming into sharper relief. The underlying economics governing fossil fuel markets would themselves eventually force a transition to clean energy. Since fossil fuel resources are finite, supply will eventually decline, sending prices higher, while at the same time, the cost of renewable energy is falling as production is scaled up. However, this will

almost certainly not happen within a timeframe that avoids the dangerous effects of climate change. That means governments will play a critical role in shaping the frameworks that guide industry onto a cleaner track. The choice for policymakers is stark: either put a price on carbon, or use direct regulation to curb emissions. Policymakers have generally done one of four things: nothing; regulate emissions directly; put a tax on carbon; or use carbon markets.

Interest has been building among policymakers, economists, and industry groups alike in using carbon pricing--charging those who emit carbon dioxide (CO2) for their emissions--to enable an orderly and affordable transition to a cleaner, lower-carbon economy, allowing for more efficient use of fossil fuels during the process. International climate talks in Copenhagen in 2009 failed, in that countries were not ready to take on binding emissions-reduction targets under a second commitment period under the Kyoto Protocol for 2013-2020, covering about 14% of global greenhouse gas emissions. The focus in Copenhagen was to agree to a renewal of the Kyoto Protocol for the period after 2012, i.e., a second commitment period. It failed because of a deep divide between rich and poor countries over who was to blame for global warming and who should act and when. It didn't impose emissions cuts on fast developing economies like China, and many industrialized countries could not accept this. So, although it failed to bring more countries on board Kyoto, it did succeed for the first time in uniting the U.S., China, and other big developing economies to go beyond Kyoto to find a more inclusive global deal in which all countries would take action. So in this regard, Copenhagen helped lay the ground for a deal in Paris.

The Kyoto Protocol was clearly only a first step toward a much more comprehensive global agreement. The potential new global deal to be agreed upon at the December COP21 talks is widely expected to include actions by more than 150 countries that account for about 90% of global greenhouse gas emissions. The new global deal looks set to include voluntary action instead of top-down legally binding targets, giving governments the flexibility to increase their climate ambition by tailoring actions to their individual circumstances and capabilities. Each country's action plan (INDC) is submitted voluntarily, but they are expected to become legally binding under the main agreement in Paris. There is no punitive enforcement mechanism at this stage, but it is expected that all the INDCs will be subject to international scrutiny and countries are expected not to backslide on their minimum commitments. On the contrary, many countries are expected to build on their original INDCs by showing further ambition, circumstances allowing.

The Problem

According to the IPCC, under a business-as-usual scenario, ongoing unabated combustion of fossil fuels will ultimately cause the build-up of atmospheric greenhouse gases to reach levels that could destabilize the global climate system. This could include:

- Significant sea-level rise, causing widespread coastal flooding;
- More severe and frequent storms, causing deaths, flooding of populated areas and farmland, and damage to property and economic activity; and
- Drought, causing disruptions in fresh water availability and crop failures.

Taken together, these factors increase the risk of famine, civil unrest, increased global conflict, failure of already fragile states, and mass migrations. For these reasons, and based on the available science, climate change is increasingly likely to become a national security issue for governments as time passes.

Moreover, Bank of England Governor Mark Carney warned in September 2015 that climate change, if left unaddressed, could destabilize the global financial system. This could stem from a combination of direct physical impacts that affect populations and disrupt trade or by a sudden reassessment of the value of fossil-fuel assets in light of global action to keep global warming within safe limits.

More than 190 countries have agreed to limit global warming to no more than 2 degrees Celsius above preindustrial levels. This target is not arbitrary: Scientists believe a 2-degree rise is the level of warming beyond which changes to the climate are likely to become dangerous and potentially irreversible.

This temperature target means limiting the atmospheric concentration of carbon dioxide to no more than 450 parts per million (ppm), according to the U.N. In preindustrial times, the atmospheric CO2 concentration stood at roughly 280 ppm, according to the IPCC. The CO2 level had risen to about 399 ppm in 2015, based on data from the U.S. National Oceanic and Atmospheric Administration.

This discussion has raised the concept of a global carbon budget, or the volume of emissions that can be added to the existing atmospheric build-up before exceeding the 2-degree threshold. The reason this matters for the energy markets is clear: Much of the world's proven fossil-fuel reserves will have to remain dormant or be separated from their carbon content in order to stay within the global cap, a point that the World Bank, the International Monetary Fund, the Bank of England, and others now acknowledge.

If the global warming science is even approximately correct, this suggests that the industrialized world's economic model--which is based largely on unabated emissions from fossil-fuel combustion--is flawed and will have to be altered or replaced. The question for investors is over what time period this process will unfold, and whether the transition to a low-carbon economy will be managed and orderly, or sudden and disruptive.

Various financial, economic, and physical risks loom as the concentration of CO2 increases from year to year. Aside from the direct risks, including harm to people and property and disruptions in trade arising from storms, floods, and droughts, climate change also raises litigation risk for carbon-intensive companies and resulting financial risks for those that invest in them. Individuals or civil society groups may seek compensation through the courts for climate change-related damage from those they hold accountable. We can expect lawsuits against companies--or governments--accused of not taking reasonable action to reduce greenhouse gas emissions or, potentially, those accused of deliberately misleading the public about climate dangers.

Well-designed policy measures could help mitigate many of these risks both by curbing greenhouse gas emissions and demonstrating that governments and companies are taking appropriate action in response to the climate science.

The Solutions

Fossil fuels are not, in themselves, the problem: greenhouse gas emissions are. And there is no inherent reason why the two cannot be separated. The ability to strip out greenhouse gas emissions from combustion energy may provide a long-term lifeline to coal, oil, and natural gas. However, the cost of removing carbon from traditional fuels may undermine their underlying economics, just as renewable energy is nearing grid parity with fossil-fuel power

generation.

The economics have not stacked up well for carbon capture and storage thus far, and one risk for the fossil-fuel industry is that if further delays occur in developing capture/storage technologies, the traditional energy markets could be undercut by cost-competitive wind and solar power generation and new technological solutions. High-efficiency renewable energy coupled with commercially viable energy storage is just one example.

Attempts at a managed transition to clean energy are already underway in some areas, with help in many cases from government subsidies, but the falling cost of renewable energy and an eventual rise in the cost of fossil fuels will eventually drive the transition to a low-carbon economy, irrespective of climate change and related policy choices. However, without a strong global climate deal thus far, this effort has been disorderly and fragmented as governments try to balance the need to curb emissions while supporting economic growth and protecting their industrial competitiveness.

As the urgency to act increases, these two inescapable fundamentals--that global greenhouse gas emissions must be reduced to keep temperatures at safe levels, and that basic economics dictate that this must be done in the cheapest way possible--have generated interest in market-based approaches and spurred the effort to put a price tag on industrial CO2 emissions. Together, these objectives suggest that carbon markets--under which entities may trade allotments of CO2 emissions within a broad cap on total emissions--will continue to expand, but with political opposition continuing in some jurisdictions.

While some countries are exploring options for curbing emissions through policy mandates using powers provided under existing legislation, others are implementing carbon markets on a piecemeal basis, with Europe, China, the U.S., and other nations continuing to move forward with market-based approaches to controlling greenhouse gas emissions under unilateral or multilateral agreements.

A range of approaches to curb emissions are therefore already in play, and as this patchwork of policy actions moves forward, it will likely enable comparisons that show which approaches are the most environmentally effective and economically efficient--particularly under the umbrella of a global climate agreement that promotes increasing scrutiny of national actions.

Global Carbon Pricing Instruments Are Worth $50 Billion

The World Bank has offered some compelling testimony of the move toward carbon pricing. A September 2015 World Bank report noted "clear evidence of growing momentum to put a price on carbon," stating that the number of carbon-pricing instruments already in place or scheduled for implementation has almost doubled since January 2012, to 38 from 20. The EU has used a carbon market approach for the past 10 years, whereby a cap is set on industry's CO2 emissions and allowances to emit CO2 are distributed between companies, up to the level of the cap. The cap ensures that emissions are reduced, while the trading of allowances allows the price to fall naturally to its lowest possible level, so long as the cap is being met, reducing the overall cost to the economy. By contrast, other countries are using a tax on CO2, including the U.K., Japan, Mexico, Switzerland, Sweden, Denmark, Finland, Norway, France, Portugal, Poland, South Africa, and Chile. The bank also noted a threefold increase in the share of emissions covered

by carbon pricing over the past decade, stating that roughly 40 national jurisdictions and more than 20 cities, states, and regions--accounting for nearly one-quarter of global greenhouse gas emissions--are putting a price on carbon. "Together, carbon pricing instruments cover about half of the emissions in these jurisdictions, which translates to about 7 gigatons of carbon dioxide equivalent, or about 12% of global emissions," the bank said.

The World Bank estimates that the global value of the regional, national, and subnational carbon pricing instruments in 2015 is estimated at just under $50 billion. The bank values these instruments by using the annual revenue from carbon taxes, or in the case of carbon markets, the value of all allowances in a given year, multiplied by the average traded price.

Europe's flagship climate policy tool, the EU Emissions Trading System, has successfully priced CO2 emissions since 2005, and although the system has faced various criticisms (including overallocation of carbon allowances, lower-than-expected carbon prices, windfall profits for emitting companies, VAT fraud, and cybercrime), the underlying principle has worked: Europe's greenhouse gas emissions fell by 23% between 1990 and 2014, while GDP grew by 46% over the same period, according to the European Commission. This seriously undermines the claim that continued expansion of fossil-fuel consumption is necessary to achieve economic growth.

In the U.S., the Regional Greenhouse Gas Initiative (RGGI) has reduced CO2 emissions from power generation in nine Northeast states using a market-based approach since 2009. RGGI has already invested more than $1 billion, or more than 70% of its 2009-2013 revenue, in projects for energy efficiency, renewable energy, and greenhouse gas abatement and support for household energy bills.

On America's opposite coast, California started an internal carbon market in 2012, and has announced a goal of reducing greenhouse gas emissions by 40% by 2030, in line with Europe's target. Furthermore, California's carbon market officially linked up with Quebec's in January 2014, highlighting the potential for international linkage of carbon markets to allow for more efficient emissions reductions.

The success of these systems, despite some design flaws, has inspired other jurisdictions to move ahead with their own. China has developed seven pilot cap-and-trade systems since 2013, with a view to launching a nationwide carbon market in 2017. The country expects this to be a key part of its plan to have its CO2 emissions peak by 2030 at the latest; reduce its CO2 intensity (emissions per unit of GDP) by 60%-65% from 2005 levels by 2030 and increase the share of non-fossil fuels in primary energy consumption to about 20% by 2030.

Other countries making use of carbon pricing instruments include Brazil, Chile, Japan, Kazakhstan, Mexico, New Zealand, South Africa, South Korea, Thailand, Turkey, and Ukraine, according to the World Bank's September 2015 report.

But carbon markets are not the only game in town. Companies, cities, governments, and regions are taking a range of actions to reduce greenhouse gas emissions, including carbon pricing instruments, direct regulations, and incentives for energy efficiency and clean energy, cleaner transport, and lower-carbon buildings and agricultural processes.

Companies Are Using Internal Carbon Prices

In sum, these policy actions suggest that carbon risks are rising, and companies are increasingly looking to mitigate their exposure to carbon costs and potential stranded assets by using internal carbon prices in their business planning.

A total of 435 companies globally reported using an internal carbon price in 2015, up from 150 in 2014, according to nonprofit group CDP (formerly known as the Carbon Disclosure Project). Among the energy companies, this includes Canadian Oil Sands Ltd., ConocoPhillips, Eni SpA, Exxon Mobil Corp., Imperial Oil Ltd., Royal Dutch Shell PLC, and Statoil ASA, among others. The CDP noted in a report that "a variety of drivers are cited, including incentivizing investments in clean energy and emissions reductions, to mitigating risks from future regulation and global carbon pricing frameworks."

Broadly speaking, companies are choosing to use internal carbon prices to ensure that the investments they make now will continue to generate profits in an increasingly carbon-constrained regulatory future. Arguably, these company actions say more about where industry thinks the future lies than do world leaders' statements of intent.

Better Tools Will Cut Risk

The U.N.'s December climate summit will likely lead to a new global climate-protection agreement. In the short term, this may not materially affect the underlying economics of fuels for power generation, for example. But in the long run, the Paris summit could be a decisive turning point toward globally coordinated action to reduce greenhouse gas emissions.

In light of such an agreement, fossil fuels will be part of the energy and industrial sectors for many decades to come even as renewable energy gains market share. With the right, timely policy signals, the markets can cope with risk and deal with the transition in an orderly fashion, making the nature of this change more of an evolution than a revolution. But if action is too slow, it would raise the risk that new technology emerges with a sudden and disruptive impact on the energy- and emissions-intensive industrials sectors.

For both industry and the financial sector, what matters perhaps more than anything else is that transparency about carbon risk is increasing. This means investors will have better access to tools that enable them to make sound investment decisions and protect their profitability while the transition to a low-carbon economy moves forward.

We have determined, based solely on the developments described herein, that no rating actions are currently warranted. Only a rating committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

STANDARD & POOR'S RATINGS SERVICES
McGRAW HILL FINANCIAL

RatingsDirect®

How Environmental And Climate Risks Factor Into Global Corporate Ratings

Primary Credit Analysts:
Michael Wilkins, London (44) 20-7176-3528; mike.wilkins@standardandpoors.com
Miroslav Petkov, London (44) 20-7176-7043; miroslav.petkov@standardandpoors.com
Trevor J D'Olier-Lees, New York (1) 212-438-7985; trevor.dolier-lees@standardandpoors.com

Governance Analysts:
Imre Guba, London +442071763849; imre.guba@standardandpoors.com
Laurence P Hazell, New York (1) 212-438-1864; laurence.hazell@standardandpoors.com

European Corporate Ratings Criteria Officer:
Peter Kernan, London (44) 20-7176-3618; peter.kernan@standardandpoors.com

Research Contributors:
Xenia Xie, London; xenia.xie@standardandpoors.com
Karoliina Hienonen, London; karoliina.hienonen@standardandpoors.com

Table Of Contents

How Environmental And Climate Risks Factor Into Global Corporate Ratings

With climate change and severe weather events garnering rising numbers of headlines, lenders and institutional investors have become more interested in how Standard & Poor's Ratings Services incorporates environmental and climate (E&C) risks into its corporate credit ratings, and the impact these risks have had on our ratings of late. To provide some clarity, we conducted a lookback review of all of our global corporate rating actions and published surveillance reports since Nov. 19, 2013 (the launch date of our updated corporate ratings methodology, which provides increased transparency into our ratings process) to discern the impact of extreme weather events and E&C risks. (Watch related CMTV segment "How Environmental And Climate Risks Impact Global Corporate Ratings".)

Altogether, in our review of all 38 corporate subsectors, we identified 299 cases in which these risks have either resulted in or contributed to a corporate rating revision or have been a significant factor in our rating analysis. In 56 of these cases, E&C risks have had a direct and material impact on credit quality, resulting in a rating, outlook, or CreditWatch action or notching of the rating--nearly 80% of which were negative in direction. The lion's share of these ratings were in the oil refining and marketing, regulated utilities, and unregulated power and gas subsectors. As the severity and frequency of E&C risks continue to rise, we believe related rating actions could also accelerate in coming years.

A recent high profile rating action was the downgrade of the German automaker Volkswagen AG (VW) on Oct. 12 2015 and continued CreditWatch placement. The action reflects our view that VW continues to face wide-ranging negative credit consequences following its admission that it installed software designed to manipulate diesel engine exhaust emissions in 11 million passenger cars and commercial vehicles and the related global recall of these vehicles.

Overview

- To provide some clarity into how Standard & Poor's incorporates environmental and climate (E&C) risks into its corporate credit ratings, and the impact these risks have had on our ratings, we conducted a lookback review of corporate rating actions and surveillance reports over the past two years. Our research identified 299 cases in which these factors either contributed to a rating revision or were a significant factor in our rating analysis.
- Fifty-six of these cases resulted in a rating action, CreditWatch placement, or outlook revision, 44 of which (close to 80%) were negative in direction.
- The subsectors with the greatest exposure to E&C risk thus far have been the oil refining and marketing, regulated utilities, and unregulated power and gas subsectors, and the greater focus on E&C risk in our criteria for these segments reflects this.
- As the severity and frequency of E&C risks continue to rise, we expect the numbers of E&C-related corporate rating actions to accelerate in coming years.

The Rating Impact Of E&C Risks

To date, a relatively small proportion of overall corporate rating actions have resulted directly from environmental and climate risks, but their number is increasing. Fifty-six of the close to 300 instances over the lookback period in which E&C risk was a corporate credit factor resulted in rating actions that could be directly linked to E&C risk and traced to our criteria for that specific sector. Of these, 44 were negative actions (downgrades, negative outlook revisions, or CreditWatch negative placements) and 12 were positive actions (upgrades, or outlook revisions to positive or to stable from negative). In the remaining 243 cases identified in our review, we considered E&C risk factors significant to the credit analysis but they did not lead to a specific rating action (see table 1 and chart 1).

Chart 1

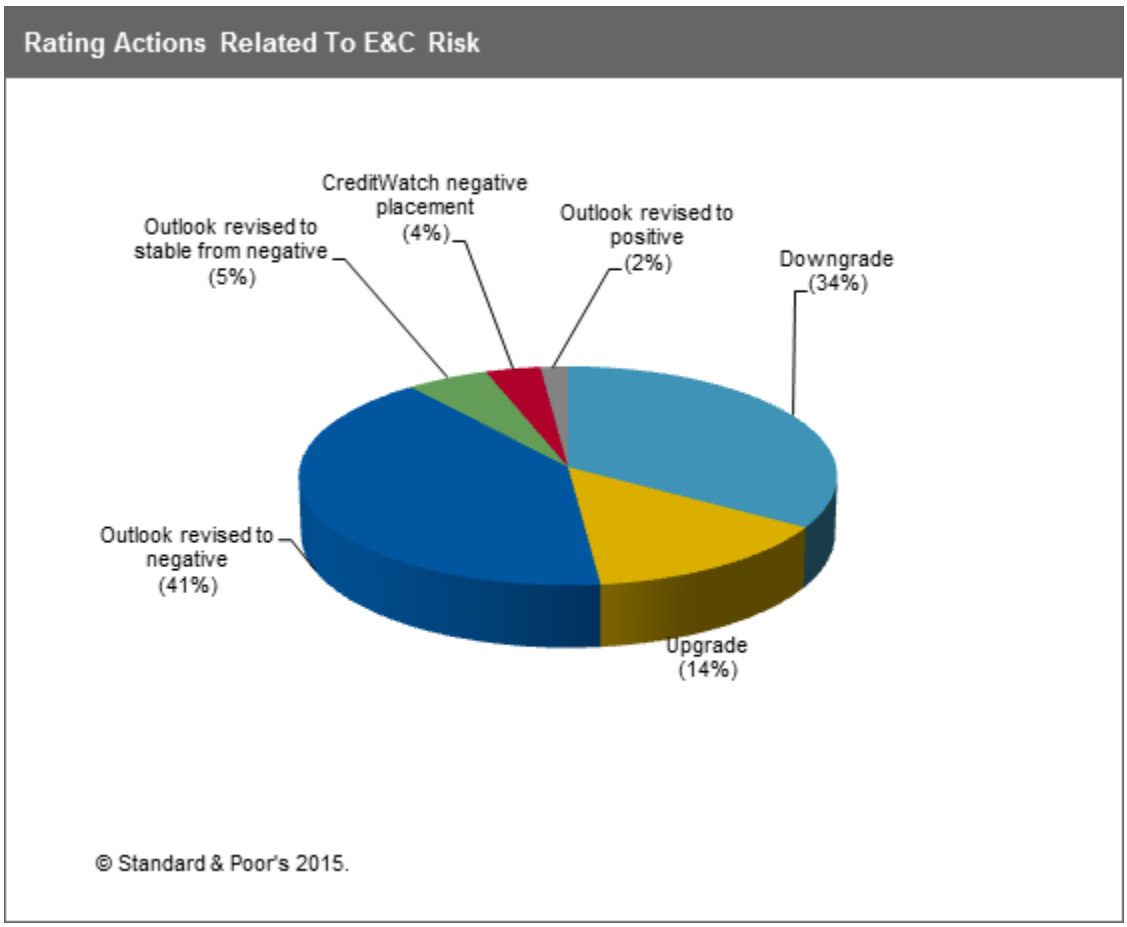


Table 1

E&C Risk Impact On Credit Analysis And Ratings	
Outlook revised to negative	23
Downgrade	19
CreditWatch Negative placement	2
Upgrade	8
Outlook revised to stable from negative	3

Table 1

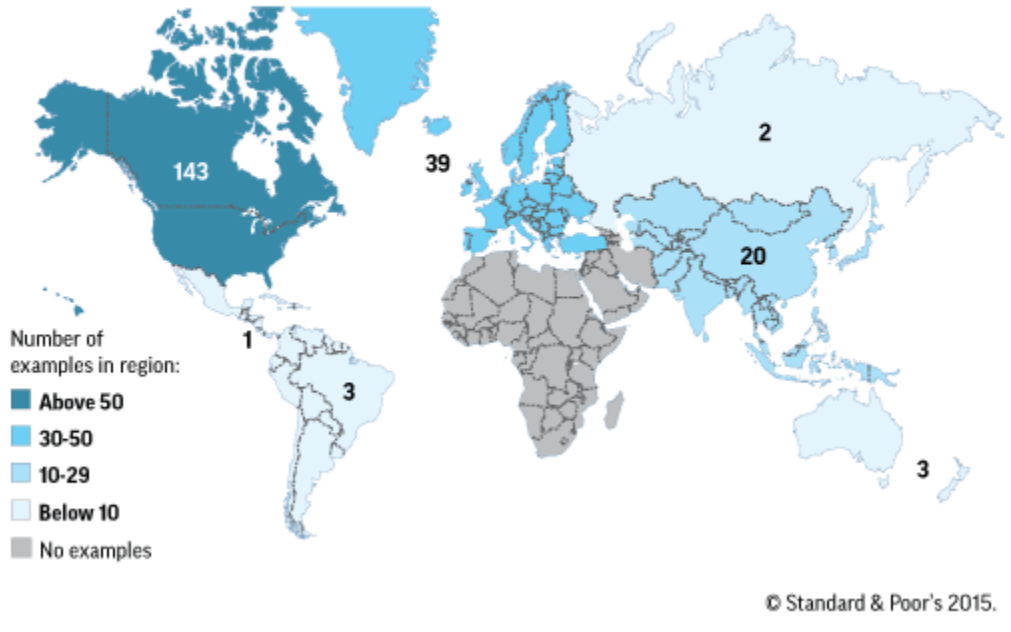
E&C Risk Impact On Credit Analysis And Ratings (cont.)	
Outlook revised to positive	1
Contributed to general analysis	243

In some instances, a company's exposure to environmental regulations (such as emissions controls) and how the company complies with them has been a key consideration in our business risk profile assessments. Our October 2014 downgrade of GenOn Energy to 'B-' from 'B', for instance, resulted in large part from increasingly stringent environmental regulations on nitrogen oxide (NOx) emissions in Maryland, which could force the retirement of power plants over the next few years. Such closures would significantly hinder the company's ability to service its lease obligations. However, E&C risk considerations can also benefit corporate entities that diversify away from certain regulated business segments or which create a niche for successfully serving regulated areas in ways that other companies don't (see sidebar on Tenneco below).

North America has seen the greatest number of cases in which E&C risk has either affected ratings or contributed significantly to the credit analysis (48%), followed by Europe (10%) and Asia-Pacific (8%) (see chart 2). Among other factors, this largely reflects the increasing number of environmental regulations introduced in the U.S., as well as the concentration of corporate ratings there.

Chart 2

Geographical Distribution Of E&C Risks' Impact On Corporate Credit Analysis And Rating Actions



Case Studies

Volkswagen AG:

- Date: Oct. 12, 2015
- Action: Downgrade of long-term ratings to 'A-' from 'A'
- Key rationale: Violation of environmental laws and regulations and €6.5 billion charge, indicating material deficiencies in management & governance.

We downgraded our ratings on Volkswagen AG in October 2015 following its admission that the German auto manufacturer had manipulated diesel engine emissions, and would incur recall costs of €6.5 billion during the third quarter of 2015. We had placed our ratings on VW on CreditWatch negative the prior month at the time of the company's announcement. Alleged illegal behaviour in the U.S., the inadequacy of internal controls, and the management of environmental and social risks were factors in our revised assessment of VW's management and governance, which was the reason for the downgrade. Furthermore, because the full impact of these developments has yet to unfold, and the resulting reputational damage to the company could weaken its operational performance and credit metrics, we are keeping our long-term ratings on VW on CreditWatch negative to indicate the possibility that we may lower them further by up to two more notches.

Tenneco Inc.

- Date: April 30, 2014
- Action: Upgrade to 'BB+' from 'BB'
- Key rationale: The company's focus on clean products benefits from increased regulation

We upgraded Tenneco Inc., a U.S.-based auto components manufacturer, in large part because of its leadership position in clear-air products, an area that stands to benefit from stricter vehicle-emissions regulation and accounts for two-thirds of the company's revenues. We believe Tenneco is in a strong position to answer the increased demand for clean-air products amid tightening regulation worldwide, which gives them a competitive advantage over more traditional auto suppliers and will likely boost their profitability. Currently Tenneco is the No. 1 supplier of emissions control products and is No. 2 in ride control equipment in North America and Europe, both markets that are likely to see increased regulation. Moreover, we believe the current management's well-timed leveraging of technology to provide emissions-related solutions to customers has bolstered the company's strategic standing.

Energy XXI:

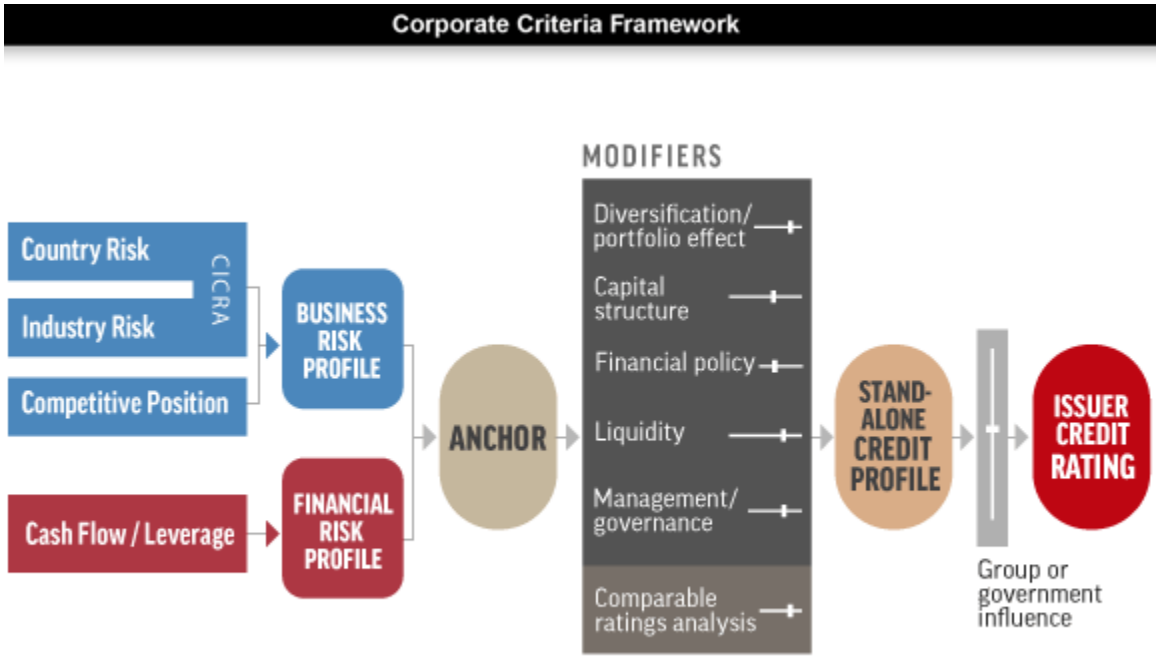
- Date: March 3, 2015
- Action: Downgrade to 'B-' from 'B'
- Key rationale: Concentration in the U.S. Gulf Coast, where disruptions due to hurricanes and other weather events are probable

We downgraded Energy XXI, an oil and gas operator in the southeastern U.S. coast, and maintained our negative outlook in light of its geographical concentration in the Gulf of Mexico, where the risk of well damage and operational disruptions resulting from hurricanes and other environmental factors is high. The company already experienced weather-related operational difficulties in 2014, and we expect this risk to keep growing. Furthermore, we believe significant reinvestment will be necessary to maintain current production levels following these difficulties. Falling crude oil prices, which increase the risk of offshore operations even further, were another key factor in our analysis.

Where E&C Risk Comes Into Our Corporate Rating Methodology And Key Credit Factors

Our corporate analytical methodology incorporates various elements that, taken together, yield our rating on a given company (see chart 3). Our assessment of a corporate issuer's business risk profile combines our individual assessments of the company's industry risk, country risk, and competitive position, while our financial risk profile assessment reflects our cash flow/leverage analysis. We combine the issuer's business and financial risk profile assessments to determine its anchor. We apply additional factors--namely, diversification/portfolio effect, capital structure, financial policy, liquidity, management and governance, and the comparable ratings analysis--to modify the anchor.

Chart 3

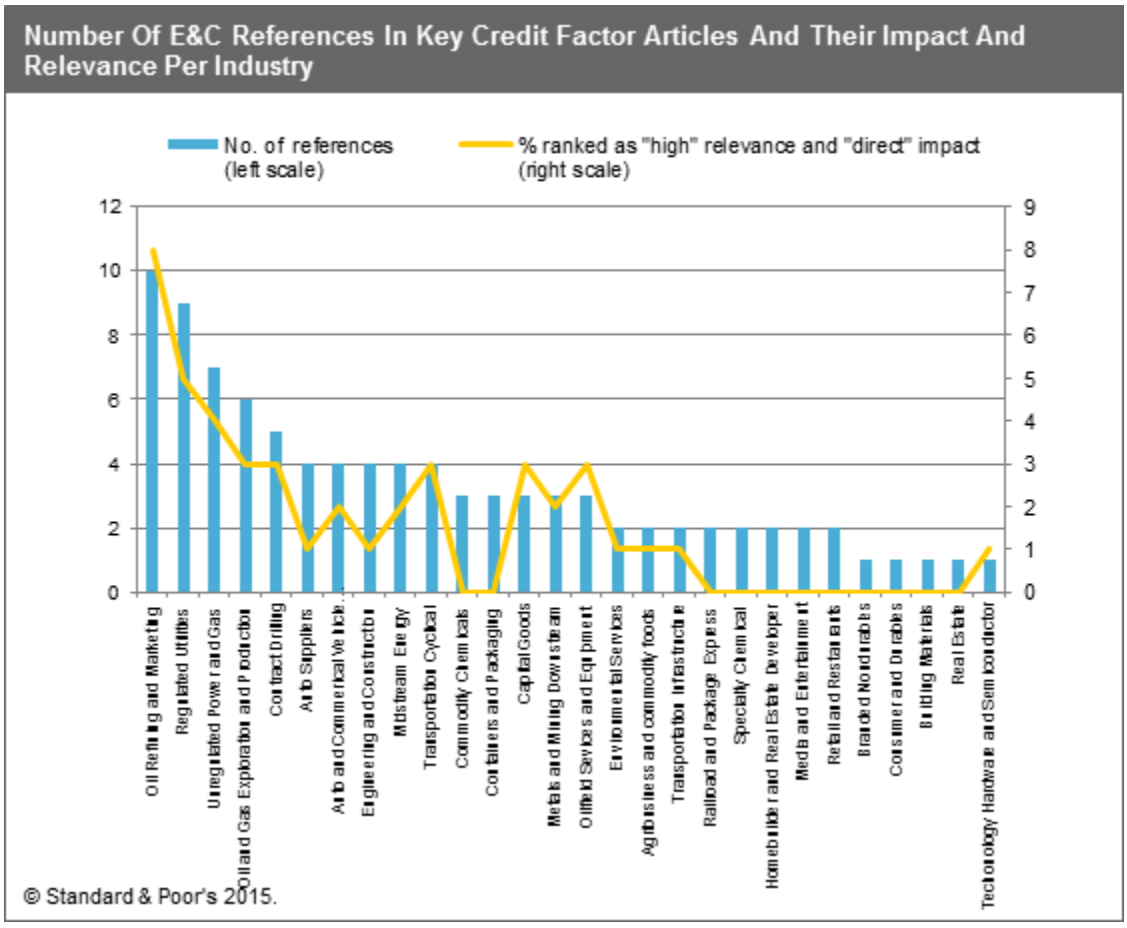


We also apply industry-specific criteria, which we refer to as key credit factors (KCFs), to complement our corporate methodology. The KCFs in rare circumstances may supersede certain sections of our broader corporate methodology. The KCFs provide complementary detail as regards how for example industry risk factors are assessed for a given industry and are where E&C risk references predominantly appear, most often within the industry risk and competitive position portions of the business risk profile assessment and in the "management and governance" modifier.

E&C risks factor most heavily into our criteria for the oil refining and marketing, regulated utilities, and unregulated power and gas industries, where environmental regulations and weather events tend to have a more direct impact on credit quality than in other sectors, although E&C risks factor into our criteria for most industries to some degree (see

chart 4).

Chart 4



E&C risk in our management and governance criteria

Our assessment of management and governance (M&G) acts as a modifier in our corporate rating methodology and therefore can directly influence an issuer's credit rating. The modifier is an aggregation of our analysis of eight management and seven governance subfactors.

We incorporate our view of how a company's management deals with environmental and social risks into the "comprehensiveness of risk management standards and tolerances" subfactor, which is part of our general risk management analysis. That is because we believe that material unmanaged environmental and social risks can hurt a company's creditworthiness over the rating horizon.

During our review, we identified that analysts had taken either a positive or negative view of environmental or social risk management for 117 corporate issuers, although the resulting impact on the overall M&G modifier has resulted in just one rating action to date (the downgrade of Volkswagen AG).

Accounting for extreme weather and natural catastrophes

Our corporate criteria consider the impact of unfavorable weather on the rating profiles in many industries. The impact of weather includes extreme weather events, such as storms and floods, and unseasonal weather, including cold spells and heat waves.

Although unfavorable weather can result in property losses and production and market disruptions for companies, such events have not been frequent contributors to rating actions over the past decade (see "Climate Change Will Likely Test The Resilience Of Corporates' Creditworthiness To Natural Catastrophes," April 15, 2015). Overall, we have found that companies' liquidity management, insurance protection, natural disaster risk management, and post-event recovery measures have been adequate to mitigate the impact of natural catastrophes on their rating profiles during the period. Looking ahead, however, the picture is less certain. Climate change may increase the frequency and severity of weather events. And indeed, scientific evidence, as summarized in the 2014 Intergovernmental Panel on Climate Change (IPCC) report, points in that direction.

Our criteria consider the impact of unfavorable weather through direct property and production losses, as well as supply-chain and market disruptions:

Direct impact. Extreme weather events can directly damage a company's production facilities, leading to disruptions in its operations. This is of particular concern for companies with limited geographical diversification, which are less able to offset the impact of a weather event by ramping up production elsewhere, and thus could face major production disruptions or shutdowns and significant financial damage.

Supply chain disruptions. Natural catastrophes can cause major supply-chain disruptions, as we saw in 2011 following the Tohoku earthquake and tsunami in Japan and floods in Thailand. Again, suppliers' level of geographical diversification is an important factor in determining the extent of the impact. In the future, the increasing integration of the world economy through complex global supply chains may exacerbate the impact of natural catastrophes.

While insurance can provide some protection against weather-related losses, companies may find it harder to insure against these risks following a major event. For instance, following the large insurance losses from contingent business interruption resulting from the Japan earthquake and the Thai floods in 2011, insurers tightened up their policy conditions, increased rates, and, in some cases, reduced the insurance coverage for certain companies.

Market impact. Market conditions in certain industries may deteriorate following severe weather. For instance, supply and demand disruptions could lead to abrupt price movements and volatility. A major event affecting an important link in the economy, such as power and energy distribution, is likely to have a widespread and long-lasting impact on supply and demand and lead to price volatility.

In particular, a number of our industry-specific criteria consider exposure to volatility in raw materials prices. Natural catastrophes can have a considerable impact on the cost of raw materials, particularly when they hurt harvests or damage production facilities (e.g., when hurricanes force the shutdown of oil refineries).

For some segments, such as oil refining and marketing and the midstream energy industry, the adequacy and cost of insurance can be important risk factors. Therefore, a major market and price disruption in the insurance industry could have an impact on a company's cost of insurance. Because the cost and availability of insurance depends on the expected impact of extreme weather events, the potential negative impact of climate change on the impact of extreme

events may increase the cost of insurance or restrict its availability.

E&C Risks Vary By Sector

Government regulations regarding emissions and environmental remedies could present material barriers to entry in a given industry, which can help incumbents that have already invested in meeting these standards. For example, in the oil refining and marketing industry, the government regulates refinery emissions (into the air and water) and environmental remediation of spills. However, restrictions on refinery emissions, along with standards for gasoline and diesel fuel and blending mandates to produce cleaner-burning fossil fuels, can also add significant costs and investment requirements to refiners, thereby constraining refining margins.

Environmental standards play an important role in assessing an affected company's operating efficiency. For example, in the regulated utilities industry, we analyze how successfully a utility's management achieves compliance with environmental standards while preserving cash flow stability. We also consider how management of these factors reduces the prospect of penalties for noncompliance.

Increased political and social emphasis on demand management and energy efficiency effectively represent, in economic terms, substitution risk (the risk that cleaner resources will take share from existing "dirtier" technologies) that could affect demand, rather than complete displacement. In the unregulated power and gas industry, we observe a modest trend in more affluent markets for a small but increasingly material number of residential consumers and small and midsize enterprises to migrate to on- and off-grid energy supplements (i.e., distributed or self-generation). Government mandates can accelerate this trend (and are already doing so in many areas, especially the U.S.), and subsidies to promote certain environmental policies can bolster demand for specific asset types (including gas-fired resources, renewables such as wind and solar, and distributed generation through rooftop solar panels, for example) while harming others (like traditional coal-fired generation).

Environmental and climate issues can also influence a company's competitive advantage in various ways. Take the unregulated power and gas industry, for example, where the markets in which a given company operates have a profound impact on risk. Specifically, we assess how public policies (including energy and environmental policies) affect an unregulated power and gas company's operating stability. The relative supportiveness and effectiveness of public policies and the likelihood of weather volatility influence our view of a market's attractiveness. For example, many European markets have been fully liberalized (with the breakup of monopolies and an opening to competition and cross-border trading) and are influenced not only by national energy policies (such as the hard turn by Germany away from nuclear energy), but also by EU-wide initiatives. The EU's "20-20-20" targets (for a 20% reduction in greenhouse gas emissions compared with 1990 levels, an increase in energy consumption produced from renewable resources to 20%, and a 20% improvement in energy efficiency by 2020), for instance, have dramatically reduced profitability for Europe's traditional power and gas companies.

E&C Risks Will Likely Grow

Corporate exposure to E&C and extreme weather risk has generally been relatively modest to date, but is increasing. We believe the future could usher in significantly more devastating events than we've seen recently. Likewise, we believe that environmental regulations and the impact of climate change-related policies could lead to a more widespread weakening of corporate credit profiles and subsequently to more downgrades than in the past. As demonstrated by the past two years of rating actions, our corporate ratings methodology, whether through the KCF criteria or the application of the M&G modifier, is well equipped to pick up on these risks as they emerge and pose a threat to credit quality.

Appendix: Criteria Review Methodology And Findings

Our industry-specific criteria (or KCFs) cover 38 corporate subsectors and contain numerous E&C risk-related references, such as those related to weather, emissions, natural disasters, etc. Out of these references, we identified 94 as directly relevant to the way we consider E&C risk in our analysis.

For illustrative purposes, we further subdivided the 94 analytically pertinent references in our criteria in order to rank their credit relevance (whether high, medium, or low) and their impact (direct or indirect).

We based our assessment of the relevance of a given E&C-related criteria reference on whether it would have a significant effect on a company's business or financial profile. For instance, references related to industries subject to environmental regulations and standards would likely have greater credit relevance than those related to companies and business lines that would only face disruptions to their business due weather volatility.

The assessment of impact reflects whether environmental and climate risks have had a direct effect on a company's operations and profitability or an indirect effect through its upstream or downstream activities.

After assessing the relevance and impact of the 94 references in our KFCs, we ranked nearly two-thirds in the "high" relevance and "direct" impact categories (62 and 60 of the references, respectively), with the greatest numbers of "high" relevance and "direct" impact references related to the regulated utilities, oil refining and marketing, and unregulated power and gas industries.

We incorporate E&C risks primarily into our assessments of companies' business risk profiles, and they have the biggest influence on the industry risk and competitive factors portions of this analysis (see appendix charts 1 and 2 below).

Appendix

Appendix Chart 1

Mapping Of E&C Risk Factors To Corporate Ratings Methodology

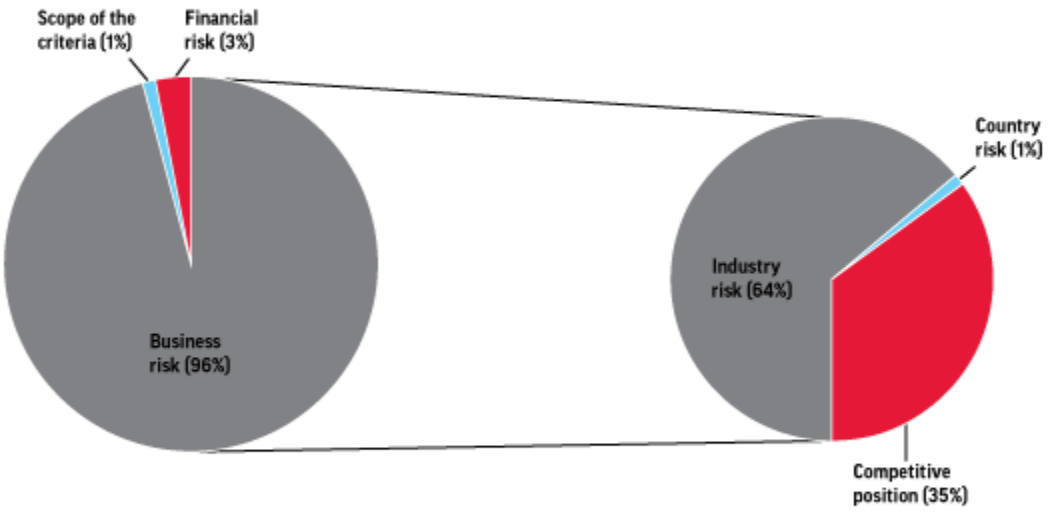
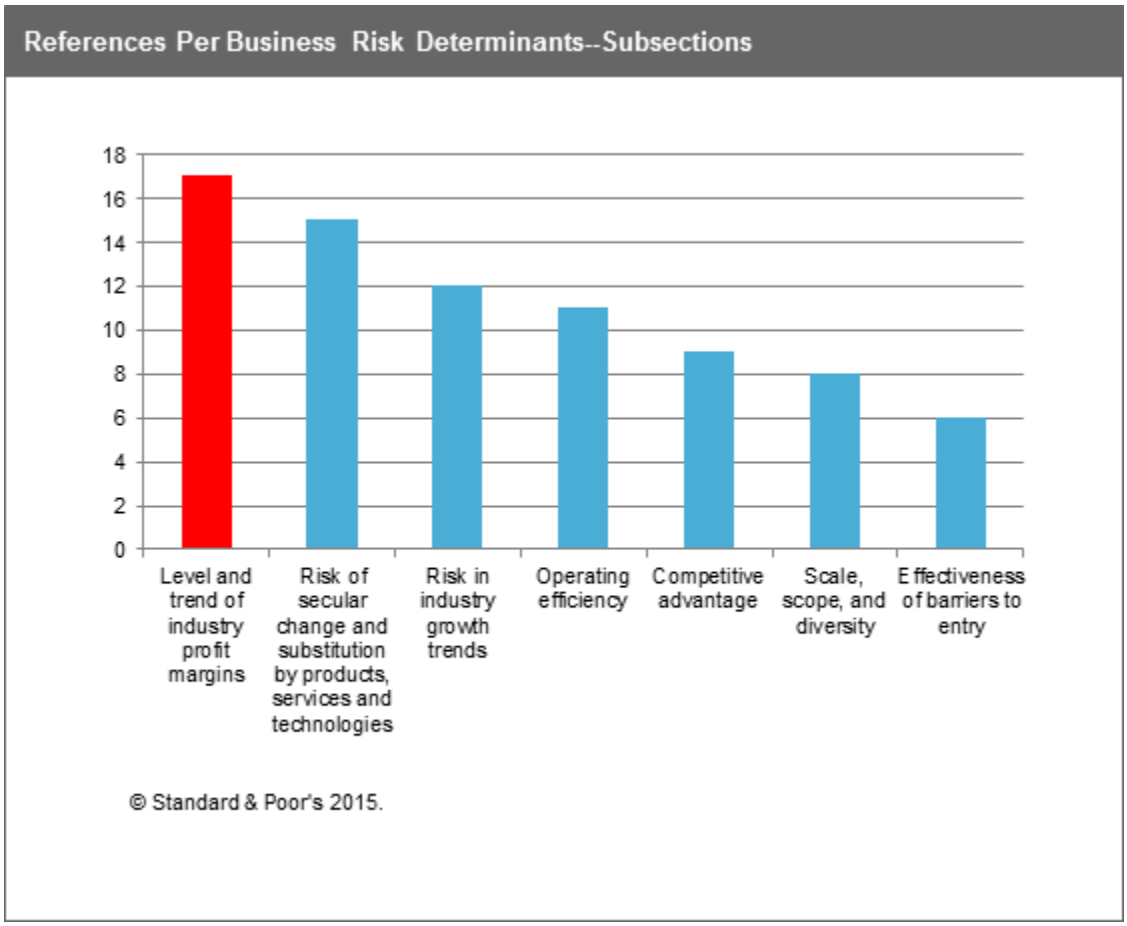


Chart 2



Related Criteria And Research

Related criteria:

- Corporate Methodology, Nov. 19, 2013
- Management And Governance Credit Factors For Corporate Entities And Insurers, Nov. 13, 2012

Related research:

- Climate Change Will Likely Test The Resilience Of Corporates' Creditworthiness To Natural Catastrophes, April 20, 2015
- For The U.S. Economy, Climate Change Is A Case Of Pay Now--Or Pay More Later, Sept. 18, 2014
- Climate Change Could Sting Reinsurers That Underestimate Its Impact, Sept. 3, 2014
- Working With Governments To Increase Disaster Resilience Can Open New Doors For Reinsurers, Aug. 27, 2014
- Dealing With Disaster: How Companies Are Starting To Assess Their Climate Event Risks, May 21, 2014
- Are Insurers Prepared For The Extreme Weather Climate Change May Bring?, May 19, 2014

The authors would like to acknowledge the contribution of Adele Bertolino of Bocconi University, Milan, to this research.

committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

STANDARD & POOR'S RATINGS SERVICES
McGRAW HILL FINANCIAL

RatingsDirect®

ESG Risks In Corporate Credit Ratings--An Overview

Governance Analyst:
Laurence P Hazell, New York (1) 212-438-1864; laurence.hazell@standardandpoors.com

Head of Investor Communications, Americas:
Steven J Dreyer, Washington D.C. (1) 202-383-2487; steven.dreyer@standardandpoors.com

Table Of Contents

ESG Risks In Corporate Credit Ratings--An Overview

Among the many categories of risk Standard & Poor's Ratings Services examines within its ratings framework are environmental, social, and governance (ESG) risks. Since all rated entities operate in the natural and social worlds, we regard these risks as ubiquitous across the ratings spectrum.

Our "Management And Governance Credit Factors For Corporate Entities And Insurers," (M&G; published Nov. 13, 2012) includes our assessment of managements' and directors' oversight of environmental and social factors at the companies they lead. This includes the impact of--and their contribution to--matters like climate change, pollution, and resource depletion; their effectiveness in terms of maintaining employee and community relations; and their adherence to legal and regulatory requirements. In our ratings methodology, we allow for positive, neutral, and negative evaluations of management's capabilities in those areas.

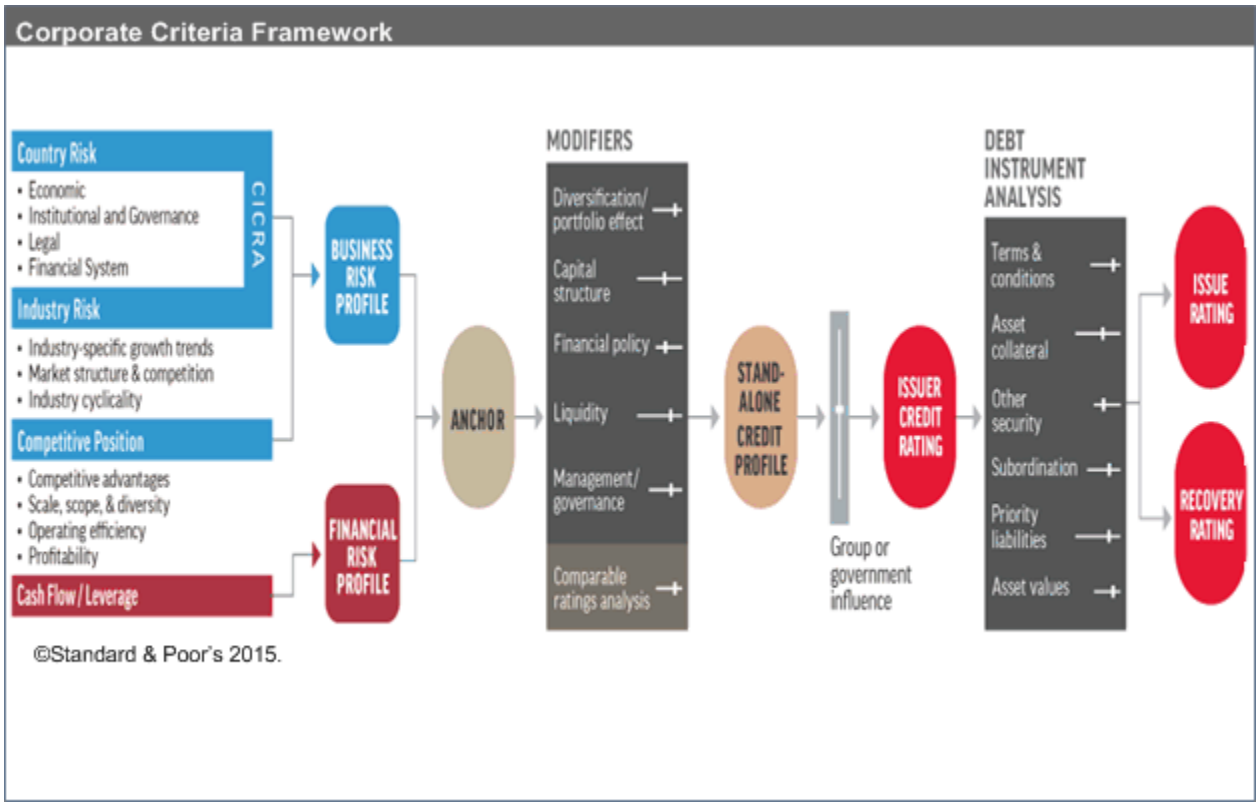
However, regarding governance, our M&G criteria only permit neutral or negative evaluations. Positive or "good governance"--however that might be defined--does not in and of itself constitute credit enhancement in our view. For investors, ESG risk and measures are now a key focus for their investment decisions (see note 1). In our corporate ratings framework we differentiate between the incidence of environmental and social impacts associated with all entrepreneurial activities, and their management and oversight--the "G" in ESG.

Overview

- Examining environmental, social, and governance (ESG) risks is an essential element of our credit analysis.
- We assess rating impacts of matters like climate change, pollution, resource depletion, employee and customer and community relations, and adherence to legal and regulatory requirements.
- Our analysis identifies downside risk to credit ratings and any favorable initiatives or conditions that lend support to a credit rating, or provide evidence for a higher one.
- Credit ratings are time-dependent; credit is present value given in exchange for the promise of future repayment. For example, rising sea levels are a long-term, macroeconomic credit risk, but one that is unlikely to be a significant ratings factor in the next five years (see note 2).

Introducing The Corporate Criteria Framework And Key Credit Factors

Standard & Poor's analytical framework identifies downside risks to creditworthiness, which may indicate a lower rating, and any favorable conditions that lend support to a credit rating or provide evidence for a higher one. We analyze these risk factors and positive indicia using our General Corporate Methodology, set out in our Corporate Criteria Framework (see chart).



We supplement this general framework with industry-specific criteria, which we call Key Credit Factors (KCF) that focus on particular industry risks, for example, the impact of carbon-reduction programs on the the power and natural gas industries. These sector-specific criteria complement and modify our general criteria framework.

To illustrate: For some KCF, the Liquidity modifier can specify different standards for rated enterprises that are part of either exceptionally stable or, alternatively, exceptionally volatile industries. In others, an enterprise's Competitive Position (which constitutes part of the issuer's business risk profile for the anchor rating) will vary--the KCF for regulated utilities are markedly different when compared with our KCF for auto suppliers.

Although this ratings framework clearly illustrates that we consider business and financial risk profile elements separately, they combine with one another to produce a current credit rating and outlook for a corporate enterprise. Similarly, we evaluate ESG risks within different parts of our analytical framework, but these ESG risks are united in the overall rating analysis to provide a view of a rated issuer's ESG profile from a credit rating perspective. Consequently, we do not provide stand-alone ESG assessments. For credit ratings, these risks are best understood in the context of all the components that together constitute the issuer credit rating.

This framework and associated KCFs allow Standard & Poor's to factor ESG considerations as essential elements of our ratings analysis, when we assess them as material to the rating or the outlook on a corporate issuer. But where, in our opinion, they are not material to the credit rating, they can still be disclosed to market participants, so that investors, issuers, and others can make their own decisions about their relevance in terms of investment priorities, entrepreneurial activities, counterparty assessments, purchase and sales activities, and so forth (see note 3).

Detailing ESG Factors In The Corporate Criteria Framework

Country risk

Country risk includes economic, institutional, financial system, payment culture, and rule-of-law considerations in the country or countries where the rated entity operates. Collectively, we use this country-level "governance profile" to illuminate the constituent elements of a country risk profile for the industry, which we call the Corporate Industry Country Risk Assessment (CICRA--the vertical bar between country and industry risk in the chart).

These will include any specific social and political conditions that either support or impair a corporate entity's credit quality. From a ratings perspective, relevant social and political considerations include matters as diverse as the use of child labor to produce clothing, forms of political repression fomenting unrest that drain a country's skill base, and its knock-on effects for domestic corporations (see note 4).

One way these issues surface at the entities we rate is in terms of supply-chain risk, e.g., in the retail sector. Although the broadening of supply chain sourcing can benefit developing countries and the markets they serve, there are risks such as:

- Weaker monitoring, law enforcement, and regulation that create labor issues;
- A potential for manufacturing defects; or
- Concerns about workplace safety.

Reputational risk for the manufacturer, suppliers, and retailers can become acute, particularly where the emergence of facts connected with those issues contradict a retailer's corporate social responsibility statements.

From a credit rating perspective, the failure to adequately monitor suppliers and intermediaries would also weigh on our assessment of a retailer's management and governance. That alone, depending on the rating level, could lead to a lower credit rating or outlook change, depending on the specific circumstances and our assessment of the degree of harm caused. An expose of poor working conditions by investigative journalism and a company's prompt remediation of them would likely have a different rating outcome than, say, the occurrence of a factory fire due to negligence and neglect, where loss of life occurs.

Industry risk

Industry risk includes specific growth trends, salient elements of the sector's market structure and competition, and the industry cycles that can markedly affect a rated issuer's ability to service its debt (see note 5).

More specifically, general conditions can affect an industry and its operating environment (whether these changes are deemed to be natural or man-made). Where such changes have a general impact there may be no specific rating implications, precisely because of that general impact--given that every rated entity is affected similarly (of course, broader downgrades or upgrades may result for the industry sector over time).

However, where other credit-relevant deficiencies exist--it can have a ratings impact, as the case of China Fishery Group Ltd. illustrates. Our Oct. 19, 2015, rating action on the company centered on the material deterioration of its liquidity position. Although strong liquidity is generally immaterial in terms of credit enhancement for higher-rated

enterprises, it is a significant ratings factor at the single 'B' level and below, with attendant and imminent risks for refinancing and/or the potential for a covenant breach or breaches.

In our June 12, 2015, ratings rationale on China Fishery we discussed the cancellation of the second Peruvian fishing season due to environmental issues (i.e., El Nino) and the impact that would have on cash flow generation. Our "weak" management and governance assessment (resulting in a one-notch rating downgrade) reflected our view that the company stretches its capabilities to achieve its growth aspirations and rapidly shifts its strategic focus across geographic regions, requiring a level of management expertise that is not always evidenced in corporate actions. We note that China Fishery has initiated communication with major lending banks for temporary support for its short-term liquidity needs, but as of Oct. 19, 2015, the timing and amount of that support were uncertain (see "China Fishery Group Ltd. Rating Lowered to CCC+ On Vulnerable Liquidity Position, Placed On Credit Watch Negative," Oct 19, 2015. We acknowledge the support may be there, given the company's long-term banking relationships, and that operations could recover if weather conditions change.

The China Fishery case illustrates how environmental factors are interwoven into this issuer's credit rating. It also highlights the dynamic nature of credit ratings--when circumstances such as the issuer's financial condition require a nimble change in rating and outlook.

Competitive position

Competitive position includes a number of factors that can markedly affect a rated issuer's credit strength, including inherent competitive advantages, e.g., with the ability to easily source key raw materials, the scale of operations, their scope and diversity, the issuer's operating efficiency compared with peers, and how much profit can be extracted from the company's operations.

However, the path to competitive advantage is strewn with danger, and if mismanaged, its pursuit can have a negative ratings impact. On Sept. 18, 2015, we revised the outlook on Sysco Corp. to negative from stable after it announced it would likely issue $2 billion in new debt in the first quarter of fiscal 2016. The proceeds would fund a $1.5 billion accelerated share repurchase and repay $500 million in commercial paper borrowings.

While this marketer and distributor of food and related products to the food-service industry has several competitive strengths, including greater route density than most competitors and a more profitable private-label and street business, it is in an intensely competitive and low-value-added sector. Our ratings on Sysco incorporate the company's industry-leading operating efficiencies, good customer and geographic diversification, and its status as the sector's largest player. The industry's relatively low customer-switching costs were highlighted by lost business at US Foods Inc. following its planned merger into Sysco, which regulators ultimately blocked for antitrust reasons.

But, in attempting to further consolidate its leadership status, Sysco, in our opinion, made several strategic mistakes, including the $600 million spent on the failed acquisition of US Foods and the investment of more than $1.5 billion in a business transformation program that has fallen short of desired results. The company's "satisfactory" management and governance assessment remains unchanged for now, but the July 1, 2015 research update "Sysco Corp. Downgraded to 'A-/A-2'" indicated that any further missteps in terms of management execution or board oversight could lead to a reassessment and a lower rating. This is because at the company's rating level, a "fair" overall management and governance score would have a rating impact (see table).

Impact Of Management & Governance On The Anchor

	--Anchor range--			
Factor/ranking	**'a-' and higher**	**'bbb+' to 'bbb-'**	**'bb+' to 'bb-'**	**'b+' and lower**
Management and governance (M&G)				
1. Strong	0 notches (see positive FP)	0 notches (see positive FP)	0 or +1 notch*	0 or +1 notch*
2. Satisfactory	0 notches (see positive FP)	0 notches (see positive FP)	0 notches (see positive FP)	0 notches
3. Fair	-1 notch	0 notches	0 notches	0 notches
4. Weak	-2 or more notches**	-2 or more notches**	-1 or more notches**	-1 or more notches**

*This adjustment is one notch if we have not already captured benefits of strong management and governance in the analysis of the issuer's competitive position. **Number of notches depends on the degree of negative effect on the enterprise's risk profile.

In Sysco's case the continuance of the company's "satisfactory" management and governance score really speaks to middle management's execution capabilities. These strengths maintain our M&G criteria assessment, despite those identified missteps.

It is also worth noting (given some who view activist investor engagement as invariably credit negative) that Nelson Peltz's Trian Partners gained two board seats in August, after it purchased a 7% ownership stake. However, that investment and presence on the board did not itself trigger a reassessment (positive or negative) of Sysco's management and governance profile (see note 6).

Not all of the elements that constitute the Business Risk Profile will be equally pertinent from an ESG perspective. ESG considerations will more rarely apply when considering an entity's scale, scope, and diversity, or industry-specific growth trends. However, it is important to bear in mind that matters of "scale and scope" or "growth trends" still might--where, for example, they are helped or harmed by labor shortages or barriers to entry imposed by high costs or legal and regulatory hurdles.

Management and governance

Management and governance, a modifier in our ratings framework (see chart), has proven on several occasions to be a leading indicator of changes to creditworthiness. This part of our ratings analysis encompasses the broad range of oversight and direction conducted by an enterprises owners, board representatives, executives, and functional managers. Their strategic competence, operational effectiveness, and ability to manage risks shape an enterprise's competitiveness in the marketplace and credit profile.

If an enterprise can manage important strategic and operating risks, then its management plays a positive role in determining its operational success. Alternatively, weak management with a flawed operating strategy or an inability to execute its business plan effectively is likely to substantially weaken an enterprise's credit profile. So, as noted earlier, by this juncture in our analytical framework, this modifier speaks to the management of risks, not their prevalence or occurrence in a country, industry, or competitive landscape.

Managing environmental and social risk is included in the enterprise risk management (ERM) subfactor for corporate ratings. ERM is a core consideration for all of our ratings practices, as evidenced by the different articulation it receives for corporate, insurance, and more recently, nonbank financial institution credit ratings.

There are four overall scoring outcomes for our assessments of management and governance: "strong," "satisfactory," "fair," and "weak" (see table). These originate from the six-point scale that we use for determining the Business Risk Profile in Corporate Ratings consisting of the middle four of the six available rankings (i.e., except for "excellent" and "vulnerable").

For corporate ratings, a "strong" score requires five or more positive assessments among the eight management subfactors, with three "positives" for a "satisfactory" score. Critically, the achievement of either of these scores requires that none of the management subfactors, or any of the governance subfactors, receives a negative assessment.

A "weak" score would result from five or more of the management subfactors receiving a negative assessment, or in the analyst's judgment and confirmed by a rating committee, where any one or more identified deficiencies in the management and governance subfactors are so severe, that singly or in combination, they warrant a "weak" overall score.

"Fair" scores have a constraining effect on investment-grade ratings in the single 'A' rating category and above, and result from all other combinations of scores. That can be summarized as having either insufficient positive management subscores or the presence of any management or governance negative assessment.

Conversely, "strong" M&G scores can positively affect single and double 'B' ratings, and these scores could include situations where a company effectively manages its environmental and social impacts. In sum, our management assessments drive the M&G score, while our governance assessments constrain the overall score.

An illustration of the mismanagement of environmental risk, which includes additional management and governance deficiencies, is the case of Volkswagen AG. The company's acknowledgement that it deliberately falsified emissions testing led to a revision of our overall M&G assessment to "fair" from "satisfactory." This had an immediate ratings impact (see table), and the company remains on CreditWatch with negative implications, including the potential for a further downward revision of our M&G assessment and attendant consequences for the rating (see note 7).

More recently we lowered our management and governance assessment to "weak" from "fair" (which in turn lowered the rating) on Valeant Pharmaceuticals International Inc. to 'B+' from 'BB-' (with a negative outlook), noting weakened management credibility, a significantly tarnished corporate reputation, and exacerbation of legal and regulatory headwinds for Valeant, following the severing of ties with its affiliate, specialty pharmacy Philidor RX Services (see note 8).

Some Questions And Answers

In view of our recognition that ESG is very much a work in progress for all of us, we'll conclude by answering some questions that millennial members of the NYU Stern School of Business Net Impact Club posed to Standard & Poor's at their lunchtime speaker event on Oct. 22, 2015.

Could a company's commitment to ESG issues and concerns hurt credit ratings?

Yes. A company may decide to try a new production method to lower or eliminate climate-changing or toxic emissions. This may be either voluntary or in response to regulatory requirements or a legal challenge. The initiative in

most cases will be costly--new plant and working methods--with corresponding effects, like workforce retraining, updating safety standards and pricing challenges, particularly if the product is in a competitive market.

If the transition is costly enough, the company's credit measures can worsen to a point where we could lower the rating. So, a negative rating action could occur unless we determined that the capital and operating spending had remained within the expected range for the existing rating.

However, Standard & Poor's analysts would also be considering the potential advantages of the company being an "early adopter" and the marketing opportunities for the product that may be realized if the company can position itself, for example, as a "clean" supplier. As you would expect, the skills of management in terms of how they used equity and debt to achieve the transformation would be key elements in terms of making our credit assessment.

ESG risks for different companies are diverse. How do you ensure that you apply effectively comparable standards of assessment?

A key challenge for a credit rating agency is that it has to strive to provide equivalent assessments of credit risk, irrespective of geography, jurisdiction, or sector. We have considerable experience in navigating these differences as set out in our ratings framework. The work we have done on our M&G assessments has augmented our skills and abilities in assessing ESG risk. These kinds of comparisons are at the heart of the credit rating exercise.

Currently, what are the most common reasons for rating changes due to ESG risks?

Currently, governance is the most common factor cited for rating changes. This reflects the introduction of our M&G credit factors criteria in 2012 and prior work we had done in this area, but looking forward, we expect environmental and social factors to receive greater prominence.

Could any emerging ESG risks lead to ratings being changed in the future?

Yes. An environment that so many now inhabit in addition to the natural environment is the cyber-environment. While different in so many important respects from the issues regarding the natural environment, we are beginning to make inroads to the assessment credit impacts from cyber-crime and cyber-breaches and earlier this year published our initial thinking on this fast-evolving and increasingly significant area of potential credit risk (see note 9).

Do you have to believe that climate change is true to be able to analyze it from a credit rating perspective?

No. This question reflects a debate, a particularly lively one in the U.S., about whether climate change is actually occurring and, if it is, whether it is man-made. From a credit rating perspective, how we assess climate change impacts on rated entities does not require any kind of prior commitment to the truth or falsity of climate change--or its causes. But questions about belief and the nature of truth are extremely important and deal with deeper issues than our routine analytical work in credit ratings.

A comparison with another profession may help here. A lawyer can defend someone on a charge of theft or murder, without "believing" in the veracity of their client's claim of innocence. Credit analysts assess credit-relevant impacts of business and financial risk along with their assessment of any ESG indicia that have or could affect a rating, historically, contemporaneously, and prospectively. They do this in terms of the reasonably foreseeable developments that evidence and inference can supply in terms of the ratings impacts of these phenomena.

Why aren't matters like rising sea levels and other long- and longer-term phenomena factored into Standard & Poor's ratings today?

At the most fundamental level, this is a question about time and the confidence one can have about assumptions going years out into the future. That individual issue ratings can change over their life from issuance to maturity reflects not only changing fundamentals of the rated issuer but our evolving views of that issuer's future fundamentals. In our experience a foreseeable horizon is less than two years for a speculative-grade credit (rated 'BB+' and below) and no more than five years for an investment-grade credit ('BBB-' and above), reflecting the fact that investment- and speculative-grade credits are differentially vulnerable to the many factors in the business, financial, natural, and social environments.

Complicating the time horizon question is that any two investors buying the same security at the same time may experience vastly different holding period expectations. Those buying a bond to trade it during the coming year have a different horizon than the so-called "buy-and-hold" institutional investor and even the latter often dispose of bonds before maturity for a variety of reasons.

We do believe (see the last question, but note that this belief is not a prerequisite for our analytical conclusions) that rising sea levels is a long-term, macro credit risk, but one, nevertheless unlikely to be a significant ratings factor in the next five years. But we are reviewing the preparedness of rated entities over that longer time horizon precisely because time is an essential factor in credit analysis--credit is value given in the present in exchange for the promise of future repayment (see note 2).

Notes

(1)"Stock Exchange Group Sets Guidelines for Sustainability Disclosures," Wall Street Journal, Nov. 5, 2015.

(2) "Climate Resilience Can Protect Ratings From Sea-Level Rise And Threats To U.S. Coastal Infrastructure," RatingsDirect, Oct. 22, 2015.

(3)"How Environmental And Climate Risks Factor Into Global Corporate Ratings," RatingsDirect, Oct. 21, 2015.

(4) "Why Politics Matters To Sovereign Ratings" RatingsDirect, Nov. 6, 2015

(5) "Rating Actions Taken On 25 U.S. Oil and Gas Exploration And Production Companies After S&P Revises Price Assumptions," RatingsDirect, Oct. 14, 2015.

(6) "Assessing Management And Governance Quality In U.S. Corporates When Activist Investors Engage," RatingsDirect, July 2, 2013.

(7) "Research Update: German Automaker Volkswagen Ratings Lowered To 'A-' On Governance," RatingsDirect, Oct. 12, 2015.

(8)"Research Update: Valeant Pharmaceuticals International Inc. Downgraded to 'B+' from 'BB-'; Outlook Negative," Ratings Direct, Oct. 30, 2015.

(9) "Cyber Risk And Corporate Credit," "U.S. Financial Services Credit Ratings Are Resilient to Cyber Risk--For Now,"

"Looking Before They Leap: U.S. Insurers Dip Their Toes In The Cyber Risk Pool," all published June 9, 2015 on Ratings Direct.

We have determined, based solely on the developments described herein, that no rating actions are currently warranted. Only a rating committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

RatingsDirect®

How National Commitments To Lower Carbon Emissions Will Alter Global Power Generation

Primary Credit Analyst:
Michael T Ferguson, CFA, CPA, New York (1) 212-438-7670;
michael.ferguson@standardandpoors.com

Secondary Contacts:
Aneesh Prabhu, CFA, FRM, New York (1) 212-438-1285; aneesh.prabhu@standardandpoors.com
Michael Wilkins, London (44) 20-7176-3528; mike.wilkins@standardandpoors.com
Pierre Georges, Paris (33) 1-4420-6735; pierre.georges@standardandpoors.com
Julyana Yokota, Sao Paulo +55 11 3039 9731; julyana.yokota@standardandpoors.com
Nicole D Martin, Toronto (1) 416-507-2560; nicole.martin@standardandpoors.com

Table Of Contents

How National Commitments To Lower Carbon Emissions Will Alter Global Power Generation

In less than a month, world leaders will descend on Paris for the U.N. Climate Change Conference. The meeting's goal is to put in place mechanisms to curb global temperature increases to two degrees Celsius over the pre-industrial period. Although the U.S. has long been a laggard in climate change policy globally, the Obama Administration has been adamant that this time will be different, and Standard & Poor's Ratings Services expects that the U.S. will not only explain the details of its own, ambitious carbon reduction goal but will provide leadership in compelling other large emitters to pursue similarly ambitious targets.

This meeting could allay one of the key concerns of opponents of the U.S. Environmental Protection Agency's (EPA) Clean Power Plan is that without similar efforts from other large emitters, the plan would ultimately fail to address the climate change problem. Already, other nations have begun to unveil plans that rival the U.S. goal of a 26% to 28% reduction by 2025, and we expect all of the globe's key carbon emitters to contribute to the Paris talks in some manner.

If the participating nations do in fact reach an accord on how to reduce carbon emissions, we expect that the agreement would precipitate a major change in how electricity is produced around the world and that the effects would ripple through several industries over the next two decades. We expect the long-term credit impacts to be significant for a variety of players in the energy industry.

Of course, in a nation with the sheer size of the U.S., attaining dramatic carbon reduction requires significant initiative. So, in August 2015, the EPA announced the final Clean Power Plan (the first draft came in 2014), which will help push toward the reduction goal by leveraging work already done in certain parts of the country and taking advantage of currently low commodity prices.

Table 1

Top Carbon Emitters 2013

(Kilotons CO2/year)	
China	10,281,178
U.S.	5,297,581
India	2,071,514
Russian Fed.	1,803,249
Japan	1,360,570
Germany	844,981
South Korea	626,648
Int'l shipping	610,965
Canada	551,247
Brazil	511,982
Indonesia	487,283
Saudi Arabia	478,637
U.K.	475,119
Mexico	474,583

Table 1

Top Carbon Emitters 2013 (cont.)	
Int'l aviation	463,824
World	35,274,106

Source: European Commission, Joint Research Centre; BP Statistical Review of World Energy 2011-2014.

Overview

- Countries around the world are formulating strategies to deal with climate risk
- Credit impacts due to climate change remediation plans over the long term should be significant.
- Power generators may be the sector most directly affected by these commitments to cut carbon emissions, but other participants in the energy industry will likely see effects as well.
- Despite clear differences in strategies between developed and developing nations, we expect to play a key role in addressing this challenge.

How Effective Might The U.S. Clean Power Plan Be?

We continue to expect that the Clean Power Plan will have substantial credit impacts in the next decade and a half.

But does this plan alone fulfill the U.S.'s objectives? Pushing back the final plan's implementation date to 2022 from 2020 and the imposition of a more gradual "Glide Path" to compliance could make the American goal of 26% to 28% reduction by 2025 somewhat more difficult. What's more, unlike some of the other nations' carbon–reduction plans, the Clean Power Plan is to be implemented at the state level. That means the federal government, by design, will have less control over the mechanisms used to comply with it. And given that climate change, in general, is more politicized and contentious in the U.S. than in other developed nations, legal battles could lengthen this process, despite significant efforts to date in carbon reduction at the state level.

Still, the U.S. may actually have more tools at its disposal to reduce carbon, despite its more checkered history. Copious amounts of cheap natural gas have already spurred significant carbon reduction (about 12% to 13% since 2005), and this abundance has no immediate end in sight. In addition, in most U.S. regions, energy efficiency could still be significantly improved, and curtailing demand remains a viable strategy for curbing price increases, which can be very effective in unregulated markets. Furthermore, at state and federal levels, significant incentives have contributed to the proliferation of renewable energy, which should continue and expand as renewable costs keep falling and as states look to comply with carbon-reduction goals while some, mostly in coal country, avoid the economic and political shock of closing large coal-fired plants.

We expect significant credit implications for a variety of energy-related issuers in the U.S.. Generators with large investments in coal-fired generation may see their fortunes worsen, as a possible carbon price wouldn't be fully offset by a related increase in power, especially if energy efficiency becomes a key component of carbon-reduction strategies. Margins for coal plants should shrink, and they'll likely become less frequently dispatched--while the U.S. currently receives about 39% of its energy from coal, that number will likely dwindle to about 27% within a decade.

Nuclear assets that have felt the pressure of low natural gas prices could also be revitalized, as they emit no carbon but could see some price uplift. Gas-fired generators also stand to benefit, though this effect could be weakened if renewable growth is above expectations and softens demand. Regulated utilities are less likely to be impacted, as they would likely recover costs associated remediation, and midstream energy entities could benefit because this plan is likely to precipitate an increased need for gas transportation.

As mentioned earlier, this plan delegates significant authority to the states in complying with reduction goals, but it by no means will affect all states evenly. We expect that states which have had more progressive environmental policies to date, including California, New York, New England states, and the Pacific Northwest to be less impacted, with easily identifiable strategies towards compliance (some of which have already been articulated). Contrarily, coal-heavy states, including Ohio, Indiana, Texas, and some Mountain states could have more difficulty meeting these goals, needing to pull multiple levers to achieve these required reductions. Not surprisingly, these states are most opposed to the rule, though, ironically, should they fail to file State Implementation Plans, they'd actually be subject to the Federal Implementation Plan, which is thought to be somewhat more stringent.

A Look At Carbon Emissions Plans Abroad

The U.S. Clean Power Plan is only one of many approaches to minimizing climate change among the world's large (and emissions-intensive) economies. At this point, a number of key countries have introduced their own Intended Nationally Determined Contributions (INDC) in pursuit of the two-degree goal, and they've shown varying degrees of commitment to carbon reduction. We expect that if the two-degree Celsius goal is to be reached, most large countries will have to commit to (and achieve) reduction goals they've announced in recent months. A failure to ratify these commitments within their own countries could jeopardize this two-degree target. And while our focus here is on the largest, most developed emitting nations, we note that most of the world's nations have set carbon-reduction goals knowing that climate change's effects are a shared problem that disproportionately affects nations that have more limited infrastructure investments, are located in low-lying areas, or have limited economic resources for adaptation.

Here's Standard & Poor's review of the carbon-reduction plans some major emitting nations have announced so far.

China

While we anticipate that China's ability to reduce carbon emissions during the next few years will be limited due to its expected economic growth and dependence on coal-fired generation, its recent announcements suggest that it has taken inspiration from the U.S. plan. Chinese President Xi Jinping presented the country's Green Dispatch system, which will give preference to lower carbon sources in electricity markets, effectively considering carbon a variable cost of generating power. Its proposed carbon-trading system, to be implemented in 2017, is considerably more comprehensive than the U.S. EPA's plan envisions, cutting across several industrial sectors. And while the time frame is somewhat more distant, the actual reduction goals are comparable. Like the U.S. plan, Green Dispatch seeks to put some of the burden on provinces for compliance, and similarly the impacts will be less pronounced in provinces that already have carbon-trading systems in place.

Still, at least two key challenges confront China at it seeks to meet the reduction target.

- First, while we expect the U.S. to lean heavily on energy efficiency in most states to meet reduction targets, this may be more difficult in China's higher-growth economy, where the relationship between GDP growth and electricity demand growth is stronger than in the U.S.
- Second, as in the U.S., reliability could become a concern. Although the U.S. has favored cheap natural gas as the chief compliance fuel for its plan, China seems to prefer renewables. Considerable investments in transmission infrastructure and supporting capacity are required to allay these concerns.

Importantly, China is supplementing its power sector environmental rules with methane and hydrofluorocarbon rules, which also have significant implications for climate change. This holistic approach may be preferable in parts of the world that are wary of upsetting economic growth with higher power prices.

Canada

Canada's announced goal for carbon reduction is similar in size to the U.S. goal, shooting for a 30% nationwide reduction of 2005 levels by 2030. Much like the U.S., Canada has been slow to adopt environmentally progressive policies. Indeed, while American carbon emissions have already dropped by about 13% since 2005, Canada's have fallen less than 2% during the same period, but with more significant economic growth.

Much like the Clean Power Plan, Canada's current plan relies very heavily on work already done at the province level. Ontario, specifically, has pointed to a 37% reduction through 2030. Still, questions abound:

- Aiding compliance, for now, are low gas prices that facilitate generators switching to gas from coal, but it's not clear that this will persist indefinitely. And low oil prices could slow previously anticipated oil sands production expansion post-2020, though this too could change.
- Compared with the U.S., Canada may have fewer building blocks to reduce carbon output. It already relies pretty significantly on zero-carbon hydropower (about 63%) and nuclear (15%), and it's somewhat more energy efficient than its southern neighbor, so demand management may be somewhat less impactful.
- Much like in the U.S., the politics of climate change remain divisive. With recent victories by progressive groups at the national and provincial levels, implementation may face less resistance during the next few years, but we note that this is a long-term goal that's subject to short-term policy shifts.

Three large provinces have been active in developing and participating in a carbon-emissions trading scheme along with California. Two of those provinces are blessed with abundant hydropower resources, which supply almost 100% of their needs and meaningful export revenues from the U.S. (British Columbia and Quebec). No credit impact is expected on these government-owned utilities that benefit from provincially guaranteed debt. The third province, Ontario, has already retired all of its coal assets. Load growth in that province is slow and being met with renewables and gas-fired generation supported by long-term government contracts. However, upcoming decisions on whether or not to refurbish six nuclear units in the province in the coming decade will determine how much of a longer-term credit impact any carbon pricing may have in the future. A no-go or delayed decision regarding nuclear asset renewal would signal more gas-fired generation to be built by private interests, likely under government contract, given the province's commitment to no coal.

An alternative would be to negotiate for hydropower from neighboring provinces but there is no track record of success on that front given the long distances involved. Furthermore, the price might not be attractive given those provinces benefit from exports to the U.S. and more often than not the currency exchange is in their favor as a seller.

The East Coast is soon to benefit from the Lower Churchill Falls development by Newfoundland and Labrador. Transmission lines are being built to bring hydropower to Newfoundland from Labrador to replace its key fossil-fueled plant and also 1 terawatt-hour of hydropower to Nova Scotia by 2020, which will help that province meets its environmental targets and reduce its reliance on fossil fuels. Additional surplus power from the project will be available to sell into the U.S. Northeast. The credit impact to date for the utilities involved has been relatively neutral given federal and provincial government and regulatory support for the generation and transmission buildout.

In Alberta, the combination of slower growth due to low oil and gas prices and the recent addition of the Shepherd plant are pressuring power prices, which we expect could remain quite depressed for the next two to three years. Generators in the province are feeling the pinch on their credit measures and some are looking for growth and cash flow relief outside the province as a result. In the longer term, federal legislation restricting generation from older coal-fired plants will limit the lucrative end-of-life merchant cash flows companies had hoped to collect post-2018 and beyond as their power purchase agreements roll off. Those cash flows were to be targeted at the capital expense associated with replacing these aging assets. A carbon tax could further pressure cash flows and balance sheets in the 2020s as these companies rebuild in the next decade.

In summary, Canada's recently elected government has pledged to work with the provincial premiers on emissions targets for the country, but it's too early to know how Canada's targets or implementation strategy will evolve other than to say there is an expectation of more to come. (e.g., one province has suggested bringing forward the target date to 2025 from 2030 to line up with the U.S.) More than one-half of electricity generation in Canada comes from hydro resources and only 18% by coal. The hydro generation is largely government owned and regulated, so we anticipate that any negative credit impact will be modest. Unfortunately, fossil-fueled generation is concentrated in certain provinces and, in Alberta in particular, generators do not benefit from regulatory support, so they are likely the most vulnerable to credit pressures. In all provinces however, consumers are likely to have to pay more, which can create regulatory uncertainty for all market participants.

India

Like several other large developing nations, India has asserted a 2030 goal rather than a 2025 goal in pursuit of the two-degree target. Notably, it's not seeking to reduce emissions on an absolute basis but in a way that's indexed to GDP growth, which we expect to be considerable. Still, for a country that has long relied on coal as its primary generating fuel, this is an ambitious target, as is an ancillary goal of 40% nonfossil-fuel sources over the same time frame. Given the relative absence of natural gas in India as an option (about 8& in 2013 versus 29% for oil and 55% for coal), this may be the most sensible compliance strategy.

Still, this presents a new challenge, and perhaps one that mirrors something now seen in the U.S. Amid a growing population and economy and with historically limited investment in electric transmission infrastructure, reliability continues to be a challenge in rural areas. India has faced a long-term generation deficit in its rapidly growing economy. To make renewables viable, significant investment in transmission infrastructure will be needed, and if solar and wind resources are weaker than India's government expects, we may see the country relying more heavily on complementary fossil fuel-fired generation than it originally plans.

Australia

Somewhat more controversial have been Australia's efforts. The federal government recently promised carbon cuts of about 26% to 28% by 2030. Although this is, on paper, an ambitious goal, the reality could be somewhat different. The Climate Action Network, an advocacy group for limiting human-caused climate change, estimates that rather than a sharp decrease as promised under the carbon-reduction goal, carbon emissions from Australia will likely rise by as much as 27% with a continuation of current policies. Recently, the nation scaled back its own, pre-carbon goal Renewable Energy Target by about 20%. While this change in domestic policy legally only affects the period before 2020, we expect that fewer incentives for renewable energy could have a ripple effect after that period as well, jeopardizing Australia's ability to meet its carbon-reduction goal. With coal currently generating 73% of energy, Australia has substantial work to do, and it's not clear that liquefied natural gas imports could be competitive from a dispatch cost basis with coal (see note 1). This isn't surprising, given Australia's prominence in world coal production. Still, given the modest economic growth rates Standard & Poor's projects in Australia during the next decade, demand reduction may be one part of a viable strategy, one that would allay fears of higher power prices.

European Union

Clearly, during the past decade, the EU has emerged as a global leader in progressive energy policies, with policy proposals on renewables, carbon reduction, biofuel usage, and coal curtailment. In 2008, it set a series of climate change objectives as part of its 2020 targets, including greenhouse gas emissions 20% lower than 1990; 20% of energy from renewables; and 20% increase in energy efficiency.

Although the environmental efforts have been embraced by all state members to progress toward the EU 2020 collective goals, solutions have been rather national than regional. This is because despite the willingness to build an energy union, energy policy and security of supply remain of national interests. This has led to significant tensions in the power markets across Europe, as solutions diverged (and competed against each other) depending on existing domestic energy mix and resource constraints. We have nevertheless observed a stronger commitment over the past couple of years across European governments to further strengthen the environmental package.

In 2014, the member states committed to reduce carbon emissions by 40% by 2030. The goal also includes EU-wide targets of 27% energy efficiency improvement and a 27% share of renewable energy consumption (which may imply 50% for power generation mix only). These targets represent a marked strengthening of existing 2020 goals. Carbon emissions have already been reduced by about 19% from 1990 levels within the eurozone.

Of course, much of the infrastructure needed to spur innovation to meet these goals already exists, but challenges still abound. The commitment to carbon reduction comes amid efforts to reduce nuclear generation in certain parts of the continent. Such stringent regulation also comes amid a low-growth environment in Europe, while carbon-reduction efforts may at first imply lower competitiveness and profitability for some heavy industries, as competitors outside Europe may not bear carbon levies. Also, heavy investments needed to upgrade the power networks to integrate the intermittency of renewables and the smart demand response are opposed to politically sensitive affordability issues for end-consumers. With natural gas resources not nearly as abundant or inexpensive in Europe as in North America, the EU must lean more heavily on renewables and demand reduction to curb carbon to the significant degree to which it aspires. Much like the U.S., the EU's participation in the U.N. conference is thought to be essential for compelling other large emitters to pursue stringent carbon-reduction goals.

Table 2

EU Electricity Generation By Fuel Type 2013

(Terawatt-hours)	
Solid fuels	871.8
Nuclear	876.8
Renewable	886.0
Gases	540.4
Petroleum	61.3
Other	20.7
Total	3,257.0

Source: EuroStat, May 2015

Germany

Among large and developed economies, Germany (fourth in the world, currently) stands out as a leader in addressing climate change, despite its considerable coal generation (about 45% of total generation in 2013). With its feed-in tariff system implemented since early 2000, Germany has notably been a precursor in large roll-out of residential solar photovoltaic panels. The subvention scheme has supported the R&D efforts over more than a decade and helped to massively lower the cost of the technology worldwide since then (installation cost is estimated to have reduced by 13% annually since 2006). In 2014, renewable energy represented 26%, and we expect renewables' penetration to deepen in coming years as Germany phases out nuclear power by 2022 (fourth-highest production in the world; 17 reactors were in operation in 2011). Germany seeks to reduce carbon emissions by 40% from 1990 levels by 2030 and by 80% by 2050, with targets of 30% of energy from renewables by 2030. Although it's not yet clear how Germany intends to replace baseload generation from coal and nuclear sources to achieve this goal, we expect to see considerable investments in battery storage, transmission (including interconnections), and other assets that would mitigate the reliability challenges of the country's vast (and growing) renewable energy sources. Such drastic transition bears risks, however, given technological uncertainties (storage), but also permitting issues to strengthen the network and, most importantly, social concerns, notably as the coal sector is a significant employer in the country. This has led the German government to adopt a more balanced approach to reducing coal capacities.

Importantly, Germany has also asserted itself as a leader not just in clean energy supply, but also in more energy efficiency and reducing demand. It now hopes to curb consumption by 50% by 2050. Although this is ambitious, it's not without precedent. Between 2005 and 2014, carbon emissions dropped by about 10%. A delinking of economic growth and carbon emissions will be critical to the carbon reduction plans' success, in Germany and elsewhere.

U.K.

We note that the U.K.'s participation in the wider 2030 climate goal will require carbon reduction in excess of 50% from 2005 levels by 2030.

On the generation mix front, three main pillars drive the country's action: development of renewables (and notably onshore and offshore wind farms), nuclear (with the Hinkley Point C plant as the most emblematic example), and the introduction of a carbon floor price.

The U.K. has favored a contractual scheme to support growth in renewables and nuclear, called Contract for

Difference, which provides greater certainty and stability of revenues to electricity generators by reducing their exposure to volatile wholesale prices.

To spur a faster energy transition, the U.K. introduced a carbon floor price in 2013. It was designed to set a minimum price, related to emissions from fossil fuels, which would rise annually and encourage manufacturers to switch to greener fuels. In April 2015, the carbon floor price went up to £18.08 per tonne of CO2 from £9.54. This comes in addition to the EU's emissions trading system. The U.K. also introduced a capacity market last year to support security of supply; as the less efficient power plants can hardly compete for the auction, this will lead to additional capacity closures, notably from coal, over the coming years. In this context, the closure of the country's largest coal plant in Longannet has been accelerated to 2016 versus 2020 initially.

Brazil

Numerically, Brazil has offered a sharper reduction goal than most other parties to the upcoming conference, promising a 37% reduction by 2025. That date is especially telling of Brazil's commitment because most emerging economies are delaying their goals somewhat to accommodate near- and medium-term economic growth. Brazil would then shoot to reduce emissions by a cumulative 43% by 2030. This is especially impressive given that Brazil already boasts the second-lowest carbon output per capita among large economies.

Crucial to Brazil's commitment is its wealth of renewable resources. It's aiming to attain 66% of its energy from hydropower and 23% from other renewable sources. Of course, its ability to do this in an economical fashion depends on the expected continued reduction in installed renewable prices. We expect energy efficiency to play a lesser role here, though Brazil's abundant agricultural resources position it to reduce carbon output not just through its power sector but also through its transportation in the form of advanced biofuels.

Russia

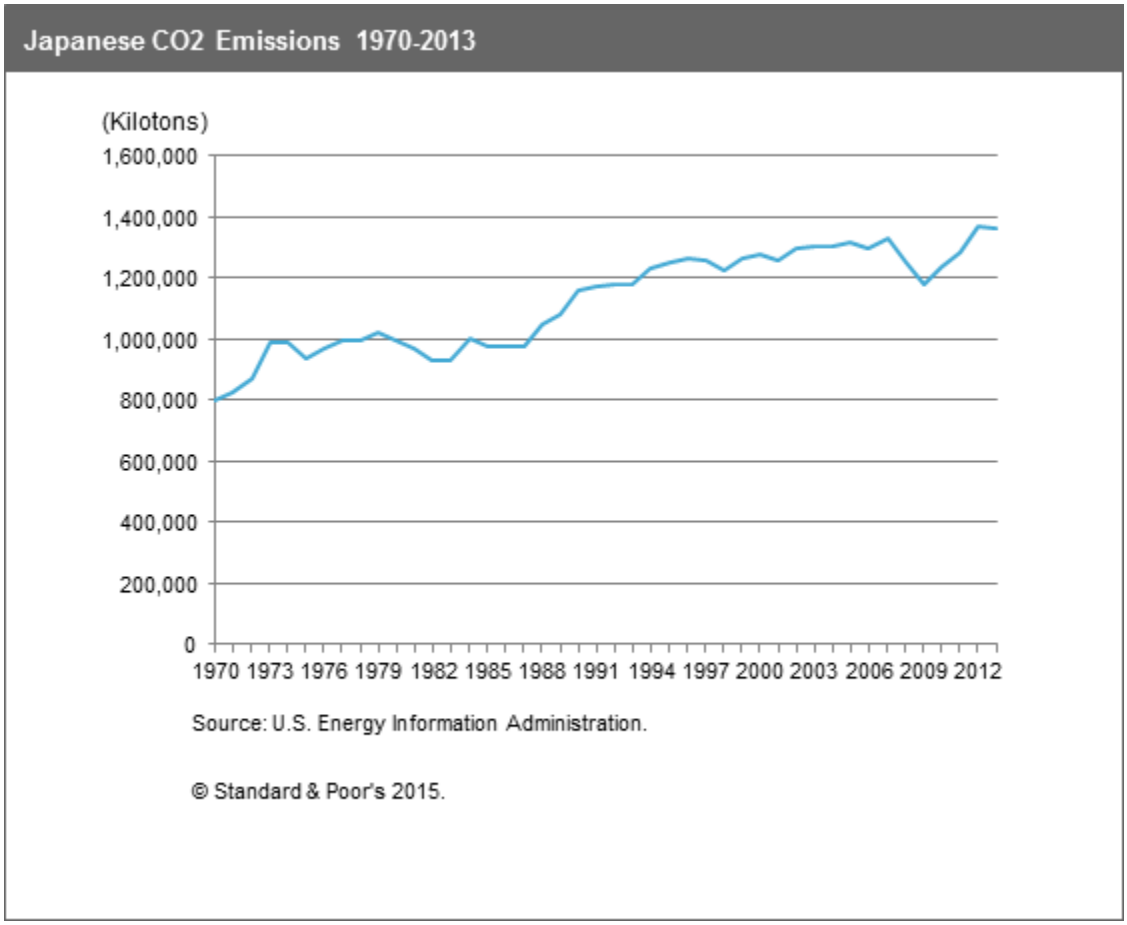
Around the same time that the U.S. issued its carbon-reduction goal, the Russian Federation followed suit, announcing that it would drop carbon emissions 30% from 1990 levels by 2030. But the Russian goal has, in some ways, prompted more questions than it answers. First, unlike other contributing nations, Russia has made its commitment contingent on other nations doing the same, and it has also stated that it can effectively sequester a large chunk of carbon via natural processes in its vast forests, suggesting that it may need to do little to actually achieve this reduction goal. Also, some observers note that the goals are effectively the same as those offered for the 2020 target, and, based on sharp reductions after the Soviet Union fell, Russia could actually increase carbon emissions by about 15% and still meet its goal. However, given Russia's staggering supplies of domestically produced natural gas, it could well reduce carbon output through more conventional means as well. We also note that weak commodity prices, currency depreciation, and economic sanctions are hurting the Russian economy, likely resulting in lower power demand.

Japan

The Japanese 2030 carbon-reduction goal of 18% from 1990 levels (or 26% from 2013 levels) remains comparatively low by developed nation standards. But even this goal remains in question as Japan seeks to rejigger its generating portfolio in light of the devastating nuclear accident during the 2011 earthquake. And with still-limited access to lower-carbon natural gas (in the form of liquefied natural gas imports), relying on demand reduction may be a viable strategy. This has, in fact, curbed emissions during the past two decades. Japan may be an outlier in that it is still

developing coal as a baseload fuel source, but it also seeks to get more than 24% of its power from renewables over the 2030 time frame.

Chart 1



Mexico

Mexico asserted itself as the first developing nation to establish an INDC. As the 13th-leading emitter of carbon in the world, it now seeks to reduce carbon emissions by 50% by 2050. However, it may be the first of the parties to the convention to demonstrate serious resolve in achieving that goal: It has begun exploring options for a cap-and-trade program modeled on Quebec's alliance with California.

A Different Reality For Power Generators

Not all nations have yet submitted plans to reduce carbon, but this is already becoming a large, collective effort. Indeed, Climate Action Tracker, an independent arbiter of climate change policies, cites none of the aforementioned nations as the leader, but rather Bhutan (and its 700,000 inhabitants), which has pledged to remain carbon-neutral over the next decade-and-a-half.

We believe that even if these carbon-reduction commitments fall short of achieving the desired two-degree goal, the

goals introduced by these participating nations will precipitate a major change in the way the world generates and uses power. In previous carbon-reduction efforts, some developing nations had resisted, but now it appears that the world's large carbon emitters are virtually all in agreement. And that means tomorrow's grid will look much different than today's.

Notes

https://www.originenergy.com.au/blog/about-energy/energy-in-australia.html

Related Criteria And Research

- The EPA's Final Clean Power Plan Affords U.S. Investor-Owned Utilities More Time To Build New Generation, Nov. 6, 2015
- The EPA's Clean Power Plan Is Not An Immediate Credit Threat To U.S. Public Power And Co-Op Utilities, But Uncertainties Remain, Oct. 20, 2015
- Credit FAQ: After Finalizing Its Clean Power Plan, The U.S. EPA Widens Its Focus, Sept. 24, 2015
- The U.S. EPA Finalizes Its Clean Power Plan, But Questions Still Remain, Aug. 6, 2015

RatingsDirect®

Carbon Constraints Cast A Shadow Over The Future Of The Coal Industry

Primary Credit Analyst:
Elad Jelasko, CPA, London (44) 20-7176-7013; elad.jelasko@standardandpoors.com

Secondary Contacts:
Karl Nietvelt, Paris (33) 1-4420-6751; karl.nietvelt@standardandpoors.com
Michael Wilkins, London (44) 20-7176-3528; mike.wilkins@standardandpoors.com

Table Of Contents

Carbon Constraints Cast A Shadow Over The Future Of The Coal Industry

*(**Editor's Note:** This article updates a previous version published July 21, 2014, and takes into account price movements, changes in governmental strategies, and technological developments affecting coal miners.)*

In December this year, Paris will host the latest summit under the U.N. Framework Convention on Climate Change (COP21). At the summit, delegates will aim to formulate a new global agreement to replace the Kyoto Protocol that was negotiated in 1997 and eventually enacted in 2005. The ultimate objective will be to set a viable roadmap to limit global warming to an average of no more than 2 Deg C (degrees celsius) relative to pre-industrial levels. Yet, to date, few countries have submitted their pledges to cut carbon dioxide (CO2) emissions, apart from the EU, Russia, the U.S., and others that collectively represent about one-third of global greenhouse gas (GHG) emissions.

The Paris summit will take place against the backdrop of flat CO2 emissions in 2014. This, coupled with the shale gas boom in the U.S., high investments in renewable energy sources, and the relatively sluggish global economic recovery effectively give countries another year's breathing space to refine their emissions-reduction plans. The global emissions trend of last year was not homogenous: Emissions continued to climb in China, while in Europe economic weakness dampened industrial production with a knock-on effect on emissions. Positive developments in 2014 included the fact that 50% of the additional energy capacity worldwide came from renewable sources, and the first commercial coal-fired power plant with a carbon capture and storage system was commissioned by SaskPower in Canada. Even so, Standard & Poor's Ratings Services expects CO2 emissions to increase in coming years, as a result of an increasing world population and economic growth in emerging countries. The question is at what pace emissions will rise.

Overview

- The global coal market remains in the doldrums, owing to excess supply and fundamental shifts in the U.S. energy mix toward gas, new coal mining projects, and a lower increase in demand compared with previous years.
- We nevertheless anticipate a slight recovery in prices over the medium term, although this will be highly sensitive to Chinese and Indian import balances.
- China will remain by far the most dominant player in the coal industry. However, demand is likely to flatten in the coming years as the Chinese government looks to switch to a more environmentally friendly energy policy.
- In the U.S., coal will retain its position as an important energy source in the medium term because cheap natural gas and other energy sources will only replace a portion of it.
- We expect the demand for electricity, and hence coal, to increase further as emerging Asian economies such as India and Indonesia boost their development.
- Given depressed prices and long-term uncertainty, coal miners have started writing-off assets from their balance sheets and may experience stranded assets as a result of carbon constraints.

The lower-than-expected demand for energy, coupled with increased coal production, has continued to put pressure

on coal prices. In the past 12 months, thermal coal prices have dropped by 20%, to $60 per ton, completing a collapse of 50% that began in early 2012 when prices reached $105 per ton; see sidebar headed "The Seaborne Coal Market And Coal Price" for further details. At the same time, coal-fired power plants around the world are coming under close public scrutiny as populations look to more environmentally friendly energy solutions.

Despite being the most polluting source of power generation, accounting for 41% of global carbon emissions, coal remains a cornerstone of the global economy, delivering 30% of energy and 40% of power generation worldwide. However, the pledges announced by the EU and the U.S., as well as the new Chinese energy policy, are likely to slow the pace of coal demand growth over the medium term. Longer term, a significant decline in coal production and consumption worldwide is becoming a much more realistic concept, in our view: as governments globally seek to reduce their CO2 emissions, it looks increasingly likely that "King Coal" will lose its crown. However, the pace and scale of change within the coal industry is far from clear, and investors could potentially remain in the dark for some time (as indicated by the widely diverging coal demand scenarios set out by the IEA--see chart 4).

New energy policies will require time to take effect. Meanwhile, the global coal market is in the doldrums due to a shift in China reducing coal imports in favor of higher domestic coal production, lower economic growth prospects around the globe with a now expected pronounced slowdown in China, and the ramp-up of new coal mining projects. While all commodities are currently experiencing a severe cyclical downturn, coal faces the additional challenge of emerging new environmental policies that could slow the demand for coal. That said, we believe that countries worldwide will find it hard to change their energy profiles materially over the next 5-10 years without compromising their economic competitiveness. This is mainly because of the competitive cost and availability of coal compared with other energy sources and the lack of alternative energy infrastructure. In this respect, we believe the pledges submitted by the U.S. to reduce GHG emissions by 32% by 2030 rely to a large extent on the shale gas phenomenon, and we're not sure we would have seen a similar target put forward otherwise. As a result, we still expect the demand for coal to grow in absolute terms over the next five years, notably in countries such as India and China, albeit at a lower-than-historical rate. On the other hand, demand could fall in some OECD (Organization for Economic Cooperation and Development) countries over the same period. Under any scenario, we believe coal will remain a key commodity worldwide as--at present--there is unlikely to be a viable alternative that could replace coal on a global scale and at reasonable cost.

The Seaborne Coal Market And Coal Price

Seaborne coal totaled 1 billion tons in 2014 (just 14% of world demand), one-quarter of which was taken by China, followed by India and Japan. Australia, Colombia, Indonesia, and South Africa and are the main seaborne coal exporting countries.

The seaborne market has increased markedly since 2007, when China became a net importer to meet its electricity needs. However, seaborne imports only equal 5%-6% of China's coal demand. In this respect, the seaborne market that balances Chinese demand is highly sensitive to changes in the country's demand.

In 2014 and through the first half of 2015, the seaborne market remained in oversupply due to softening demand from China as the country generated strong output from its hydroelectric power plants. This resulted in further pressure on prices. For example, the average thermal price of seaborne coal in 2014 was $70 per ton, 10% below the already depressed price in 2013. In the first half of 2015, prices continued to decline, reaching $55/ton. We estimate that this price is below the breakeven point for more than 50% of the seaborne coal exporters (mainly those in the U.S.). However, countries such as Australia, Columbia, Indonesia, and South Africa are still competitive, owing to falling oil prices and more favorable foreign exchange rates.

Notwithstanding the possibility of some limited supply cuts, we anticipate that the thermal coal market will remain stable in the coming 18 months at current price levels. Trends that could influence prices over the short term include:

- Planned increases in demand among Asian countries (excluding China). According to market consensus, the region's demand for coal will rise by 80 Mt to 120 Mt per year in the next 4-5 years, driven mainly by India. As a result, India will overtake China as the world's largest seaborne coal importer by 2017.
- Limited growth in capital expenditure. Based on the project pipelines of major coal companies, we see little seaborne supply coming to the market between 2015 and 2018. Most of the additional capacity will come from Indonesia (approximately 60 Mt-80 Mt) and Australia (about 20 Mt), and potential capacity of about 40 Mt from Columbia.
- Declining Chinese imports as the government ramps up domestic production in western China.
- Potential disruptions in Ukraine and Columbia, as we've observed earlier this year and in 2014.
- The renegotiation of take-or-pay contracts with rail and port operators in Australia, which could lead to a reduction in coal volumes since 15%-20% of the country's output is not profitable under existing prices.
- The prospect of additional coal export infrastructure, especially in the U.S. In 2014, U.S. coal miners exported about 90 Mt of thermal coal, compared with 45 Mt in 2006. However, at current prices, exports from the U.S. remain largely unprofitable, and are likely to shrink if existing prices persist.

In this multi-dimensional environment, changes in the demand for coal could have a relatively wide array of outcomes. Moreover, coal is a regional commodity, mainly due to the cost of transportation; and we believe that changes in the energy mix of most countries will take time to play out. We believe the main risk will be the speed of change: as we've observed in the U.S., the dramatic fall in gas prices over the past three years has put many coal producers under pressure, and now bankruptcy. While we do not envisage the U.S. shale gas phenomenon being easily implemented in other countries, including China, the global coal industry is facing a tough and likely prolonged period of adjustment as supplies need to be brought in line with new demand fundamentals.

The changes in the coal industry over the medium and long term could also result in stranded assets (coal reserves with no economic return). In our view, those potential impairments are less likely to affect ratings, compared with the

equity value of companies, under current prices. This is because we give limited weight to coal reserves that cannot be tapped over the next five to seven years.

The Significance Of Coal

Coal provides 30% of the world's primary energy, 40% of global electricity, and 68% of steel. The main advantages of coal are its availability, efficient heat-rate conversion for power generation, and construction costs per megawatt (MW). On the flip side, coal leaves a big carbon footprint compared with other energy sources.

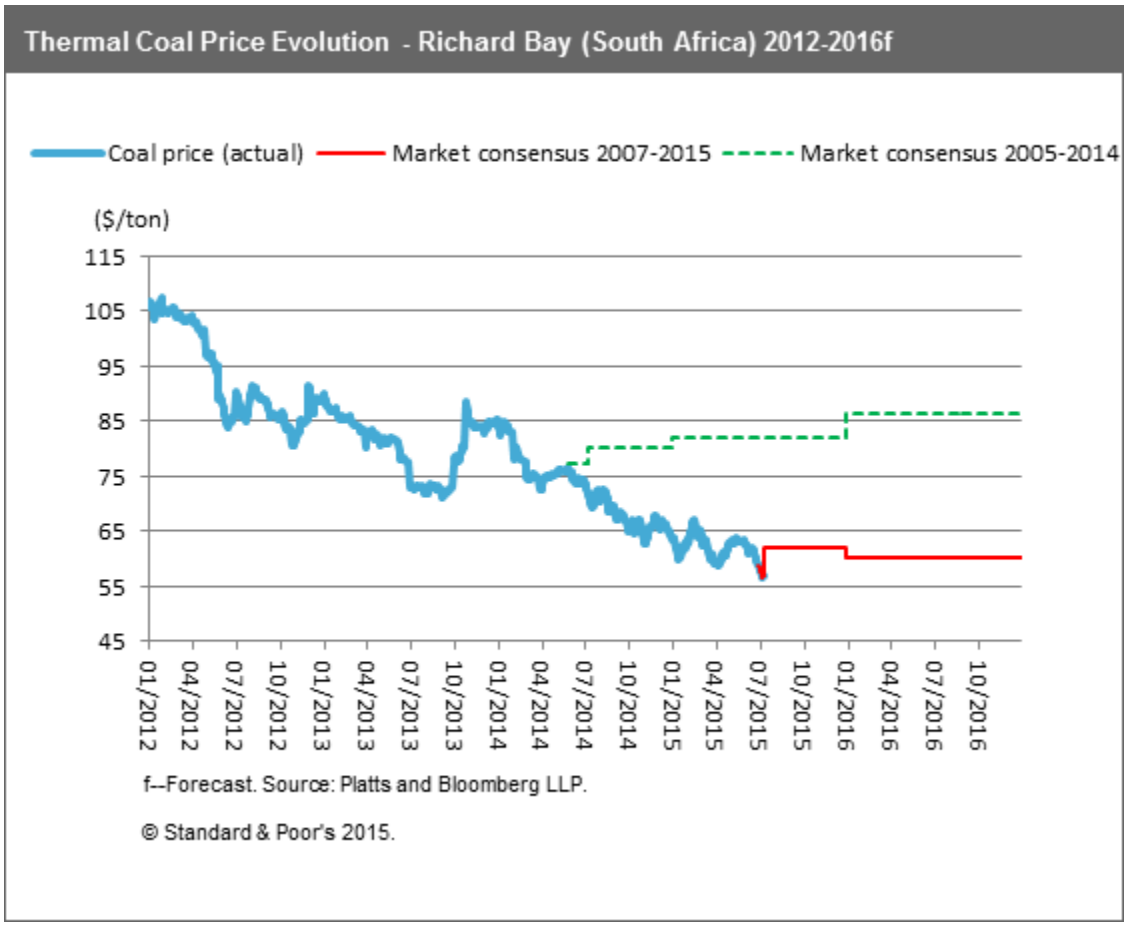
According to BP's Statistical Review of World Energy, global coal reserves are about 890 billion tons, which is enough to last more than 110 years at current production levels. However, if we analyze the quality of the reserves, we find that 50%-60% consists of low quality, sub-bituminous and lignite coal, mainly located in Russia, the U.S., China, Germany, and Indonesia. In a carbon-constrained environment, most of those assets will become stranded assets.

Other key facts:

- Coal consumption rose by 3.9% per year between 2000 and 2013, with an increase of about 3% in 2013, reaching 8 billion tons. According to the International Energy Agency (IEA), coal will become the world's top source of energy, before oil, in the coming years, reaching 9 billion tons by 2019.
- China produces and consumes about 45% of this, with more than half used for electricity generation.
- The top 10 coal producers in 2013 included China (3.6 billion tons), the U.S. (0.9 billion tons), India (0.6 billion tons), Australia and Indonesia (0.5 billion tons each), Russia (0.3 billion tons), South Africa (0.3 billion tons), Germany (0.2 billion tons), and Kazakhstan and Poland (0.1 billion tons each).
- Most thermal coal, used for power generation, is consumed domestically. The seaborne market (that is, exports to other countries) makes up just 14% of global demand.
- There are about 1,200 coal-fired power plants around the world, with more than 450 in India and 360 in China. Between 2010 and 2014, an additional power plant of 200 MW capacity on average was added to the market every day. The average life of these plants is 40 years.
- Thermal coal accounts for the lion's share of coal demand (87% or close to 7 billion tons), while consumption of coking coal, a key raw material in the steel industry, was about 1.1 billion tons in 2013.
- Governments of emerging economies see coal as an integral part of a reliable and secure energy supply.

Given the medium-term uncertainties in the coal industry, miners are unlikely to initiate big export-oriented projects. This is especially true of diversified miners, which can invest in more attractive segments. Given the very challenging market environment, we believe most small miners will try to weather the unfavorable market conditions without any financial flexibility to take on new ventures. As for all cyclical industries, assuming very limited capacity coming to the market, we cannot dismiss a rebound in prices at some point, especially with improving demand, operational disruptions, and supply cuts (particularly in the U.S.).

Chart 1



How Policies To Halt Climate Change Could Affect The Demand For Coal

Energy-related CO2 emissions have increased in emerging countries as they have experienced rapid growth. Climatologists are concerned about the impact of this increase on global warming and climate change. It is very difficult to predict the turning point and how much CO2 emissions can continue to rise before we see irreversible effects on sea levels or changes in rainfall, drought, flood, and other extreme weather conditions (see "Dealing With Disaster: How Companies Are Starting To Assess Their Climate Event Risks," published May 21, 2014, on RatingsDirect). International institutions, including the World Bank and NASA, have assessed that these scenarios could occur if the world's temperature rose by 2-3 Deg C. Drawing a line between the current policies in place and the impact on climate change, some scientists predict that the world's temperature could increase by more than 6 Deg C toward the end of the century.

Chart 2

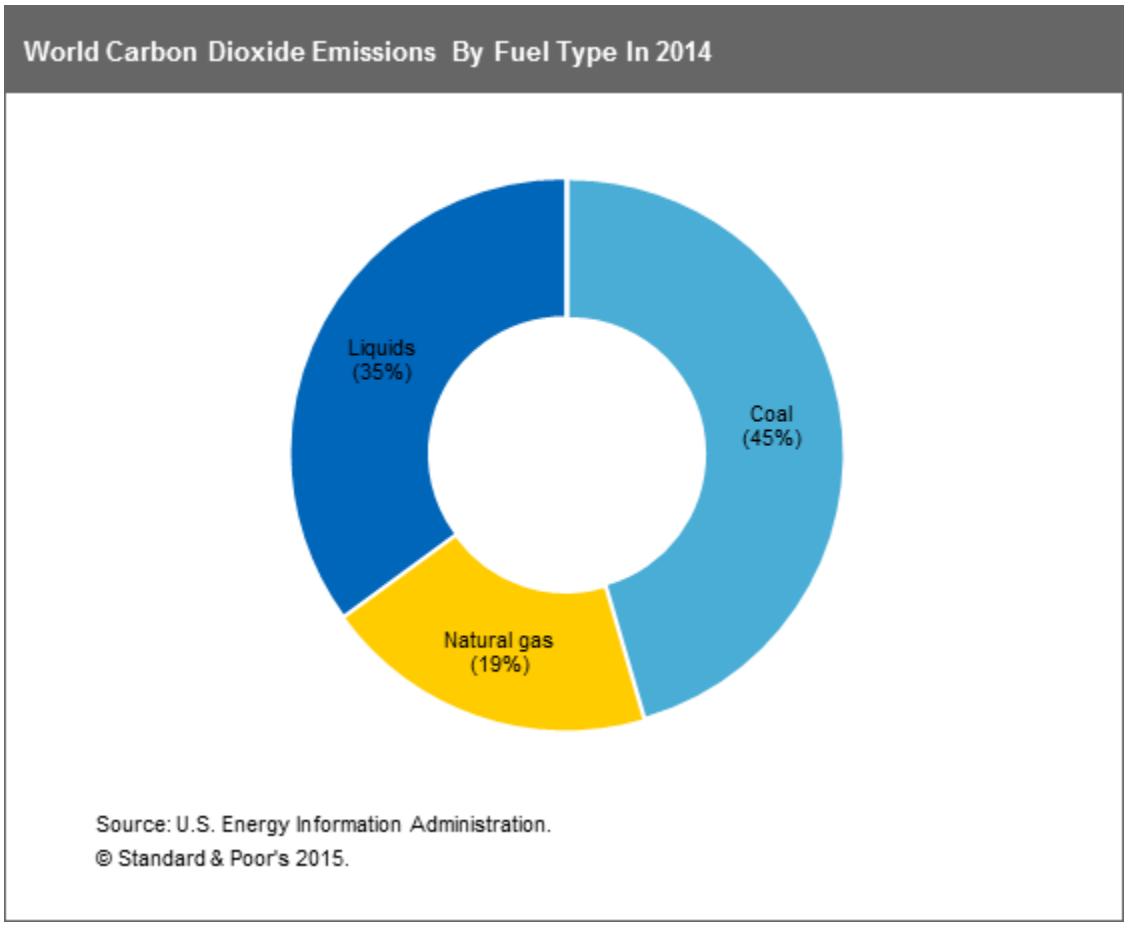
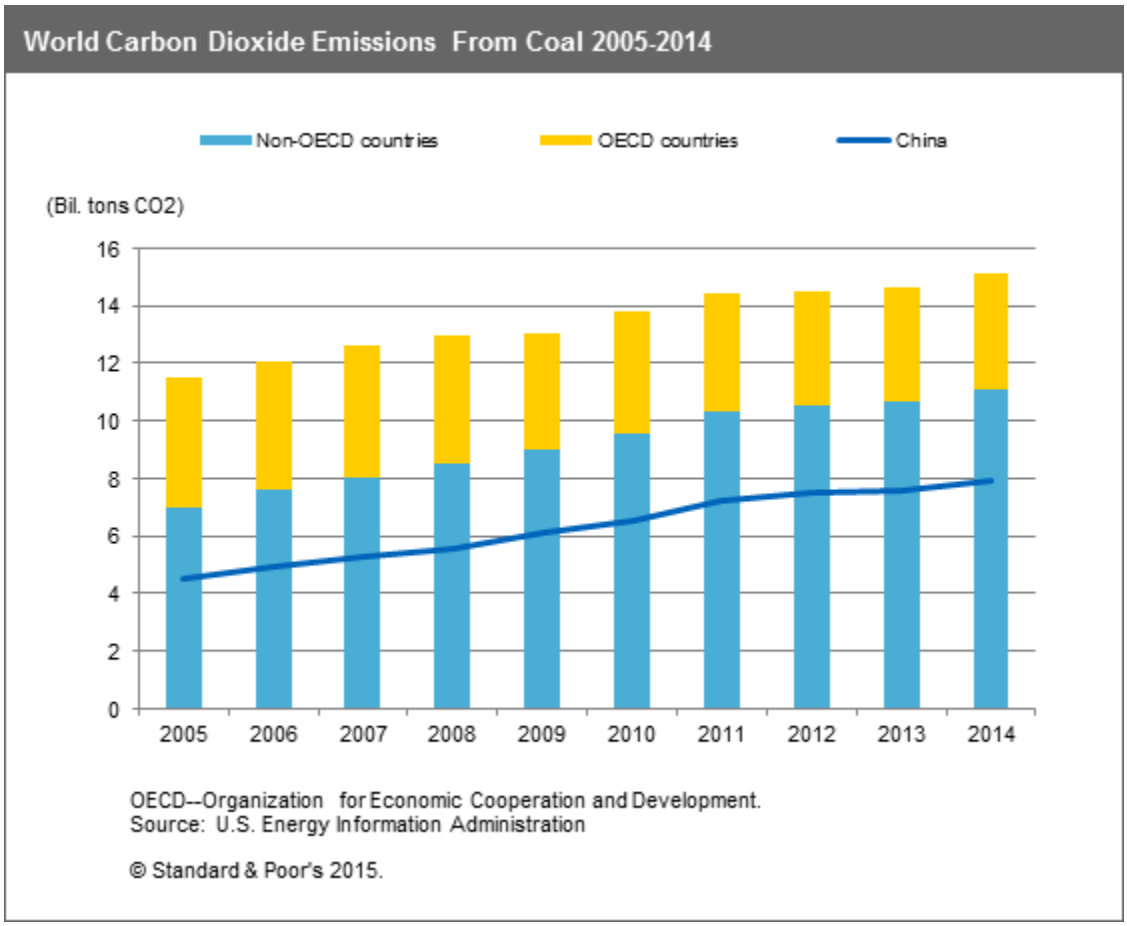

World Carbon Dioxide Emissions By Fuel Type In 2014
Liquids (35%)
Coal (45%)
Natural gas (19%)
Source: U.S. Energy Information Administration.
© Standard & Poor's 2015.

Chart 3



The IEA has assembled several scenarios and assessed their impact on the energy market.

- New policies scenario. In this situation, governments will introduce energy efficiency programs, support renewables, reduce fossil-fuel subsidies, and in some cases put a price on carbon emissions. Under this scenario, CO2 emissions will increase by 20% by 2035 and the world's temperature will rise by 3.6 Deg C.
- The 450 PPM scenario. Here, governments will implement selected energy efficiency policies, limit the use of inefficient coal power plants, increase the usage of renewables and nuclear power, and use carbon capture and storage (CCS) technology to prevent the CO2 emissions from power generation and industry reaching the atmosphere. In this scenario, the IEA estimates that there will be about a 50% chance of meeting the 2 Deg C target by 2035. What's more, the demand for coal should remain around current levels (8 billion tons) until 2020 and decline by 2.5%-3.5% per year by 2035, to 5 billion tons (including coking coal).

In our opinion, these scenarios appear challenging because new technologies will need to support a further increase in demand for electricity (an annual increase of 3.4% in the demand for coal in the last five years), as well as replace existing coal-fired power plants. (See "Assessing The Credit-Supportiveness Of Europe's Renewable Energy Frameworks," May 22, 2014.)

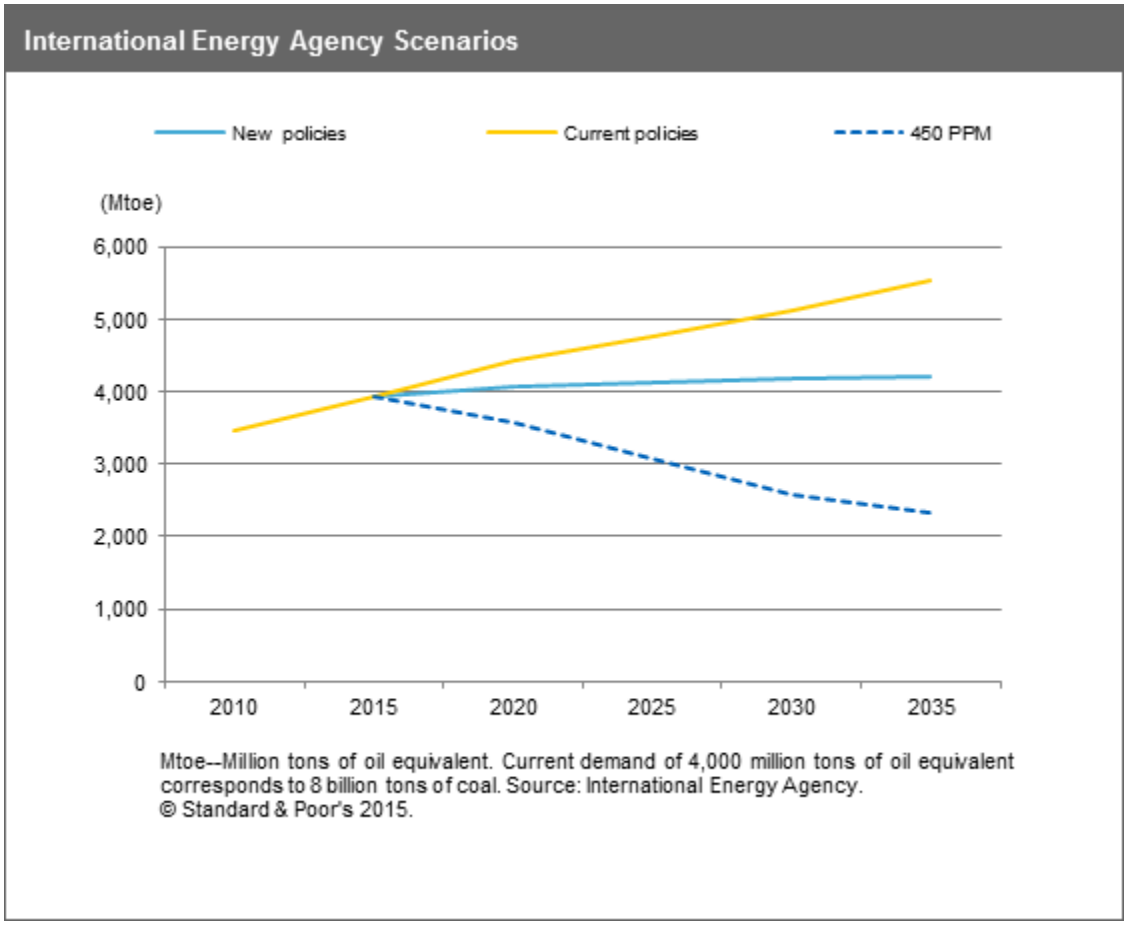
Moreover, given the lack of substitution for coking coal in the steel industry, the decrease in the consumption of thermal coal by 2035 would be higher than 3.5% under the 450 PPM scenario (assuming that the demand for coking

coal remains, at best, at the current level).

As can be seen from the divergence of the IEA's scenarios (see chart 4), the demand for coal in the future and its price will rely on numerous factors and their timing. Some of the most crucial elements include:

- A change in China's energy profile and that of other countries, with a potential move to shale gas.
- New governmental regulations, such as the recent announcement by the U.S. of a reduction in emissions by 30% by 2030 (compared with 2005).
- Technological breakthroughs, including reduced manufacturing costs, and the introduction of more efficient methods to generate electricity and capture carbon emissions.
- Carbon pricing through either taxation or cap and trade emission reduction schemes.
- Global economic growth and urbanization.

Chart 4



We believe new initiatives, such as those made recently by China, the EU, and the U.S. may flatten the growth in coal demand over the coming years. However, whether this will lead to a decline of coal use over time (as in the IEA's 450 ppm scenario) is more uncertain. In our view, any decline in coal would depend on the availability of viable alternatives, such as large-scale gas developments in China or renewables.

Clearly, falling demand for coal, both globally and regionally, would be negative for coal prices and coal miners' ability

to service their debt. While we believe that shale gas could be part of the solution, we also note that it has some side effects, which are not always taken into consideration. These include: high demand for freshwater, the production of large amounts of waste water, induced seismicity, GHG emissions, and groundwater contamination.

Increased Environmental Issues Will Support A Gradual Change In China's Energy Mix

After eight years of escalating demand at a rate of 7.5% per year, China's demand for coal increased by only 3.5% in 2014, according to the Coal Industry Association. Even so, China remains the world's largest coal consumer, accounting for about 45% of global coal consumption.

Besides raising the country's output of CO2 emissions, this rapid expansion has brought heavy air pollution in industrial provinces and issues regarding the availability of clean water. To counter these adverse effects, the Chinese government has introduced several policies to deal with the environmental issues, without risking growth. In November 2014, the government presented a new energy strategy for 2020, encompassing the following objectives:

- A cap on annual primary energy consumption until 2020, representing growth of about 3.5% per year.
- Holding coal consumption below 4.2 billion tons by 2020 (representing a potential increase of about 10% compared with the consumption in 2014).
- Increasing the share of non-fossil fuels in the energy mix to 15% by 2020 (and to 20% by 2030) from the current 10%, thereby reducing the proportion of coal in the country's energy mix to 62% from 66%.

The new strategy is an evolution rather than a revolution. We don't believe the program will trigger a fundamental change in China's energy profile over the short term, and more steps are needed between 2020 and 2030 to meet the IEA's 450 ppm scenario. In addition, targets may change. For example, in 2009 the government set a target to cut CO2 per unit of GDP by 40%-45% by 2020, compared with 2005 levels. Based on the increase in the consumption of coal in China since 2005, China is already approaching this CO2 target.

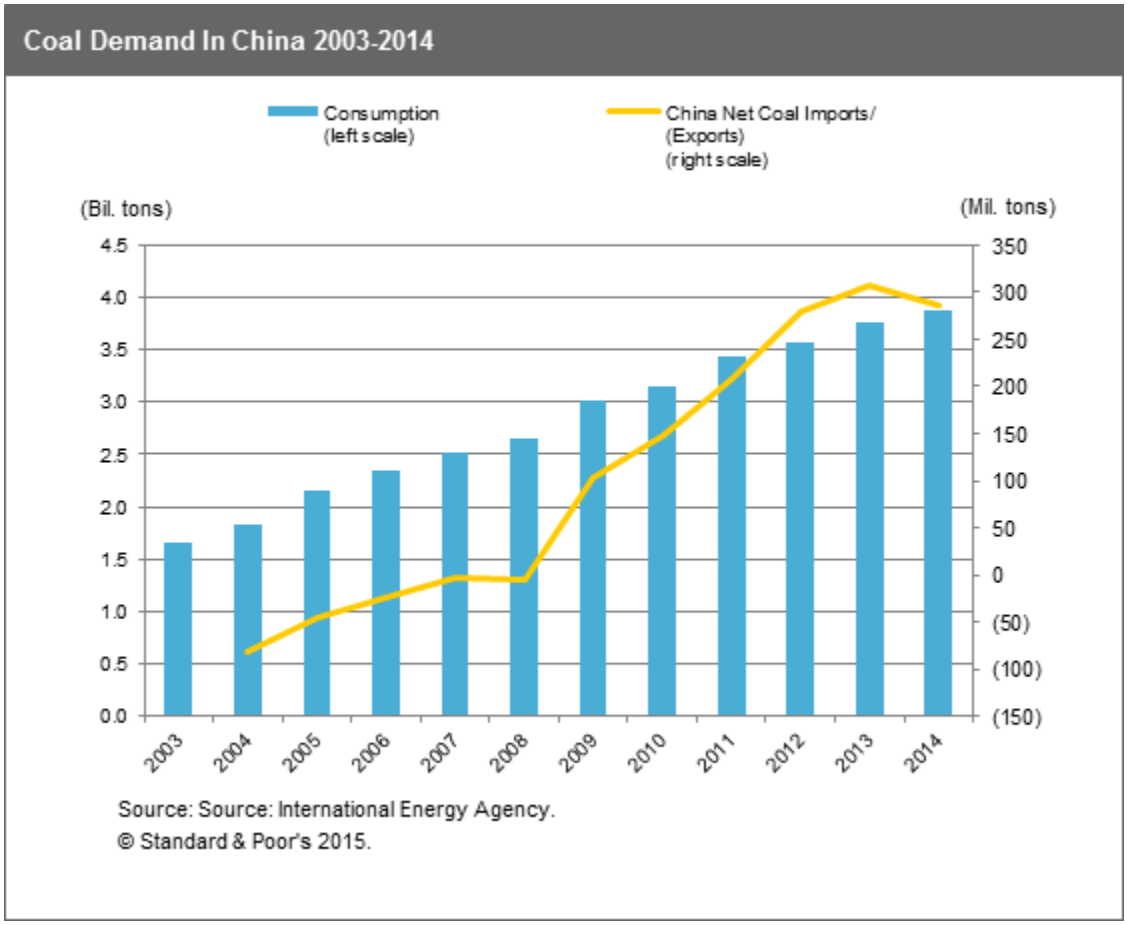
In 2014, China's coal demand totaled about 3.9 billion tons (see chart 5), compared with domestic production of about 3.6 billion tons. At the same time, total imported coal from overseas was about 280 Mt. The weak seaborne price has forced domestic producers to cut prices, leading to material losses across the coal industry in the first half of 2015. We note that a 6% import tax on coal imposed by China in late 2014 had a relatively small impact on the competitive position of domestic coal miners.

Under our assumption of GDP increasing by 6.8% in 2015 and 6.6% in 2016, we assume that coal demand growth will flatten in the coming years. This is due to the slow shift of the economy toward consumption from capital investments; lower GDP growth; and the Chinese government's increasing focus on tightening emission standards and moving to more renewable energy sources. Other tangible factors include the low level of fresh water and lack of long-term quality coal resources. On the other hand, coal is still the cheapest energy source and the application of new policies in China can take time.

According to BP, China has 113 billion tons of coal reserves (about half is low quality, sub-bituminous, and lignite coal), meaning that China's reserves are less than 30 years at current consumption levels. We believe that the life and

quality of the reserves, in addition to climate change issues, will push the Chinese government toward other energy sources.

Chart 5



In our view, capping demand in China is not good news for the industry. In previous years, China has offset the gap between domestic coal production and domestic demand with imports. We understand that China is currently ramping-up production in its coal mines and increasing output at coal-fired power plants in the west of the country to supply energy to the coastal cities. This shift is likely to result in lower demand for seaborne market coal.

We believe that gas in China is the main threat for the coal industry over the long term. Without it, we believe it unlikely that there will be a reduction in the use of coal over time or an ability to deal with its climate change challenges. Gas primarily originates from two main sources:

- Shale gas. This may become a game changer in future, but for now it remains an unknown factor. According to the EIA, China's technically recoverable shale gas resources are about 1,100 trillion cubic feet (70% more than U.S. shale gas resources). In 2013, the country produced only 0.5 billion cubic meters (bcm) of shale gas. The Chinese government aims to produce between 60 bcm and 100 bcm of shale gas by 2020 (equivalent to 150 Mt-250 Mt of coal, but only 4%-6% of Chinese coal consumption of 3.9 billion tons). In our view, these targets could be difficult given the current geological challenges, missing infrastructure, and local bureaucracy and, even if achieved, they are

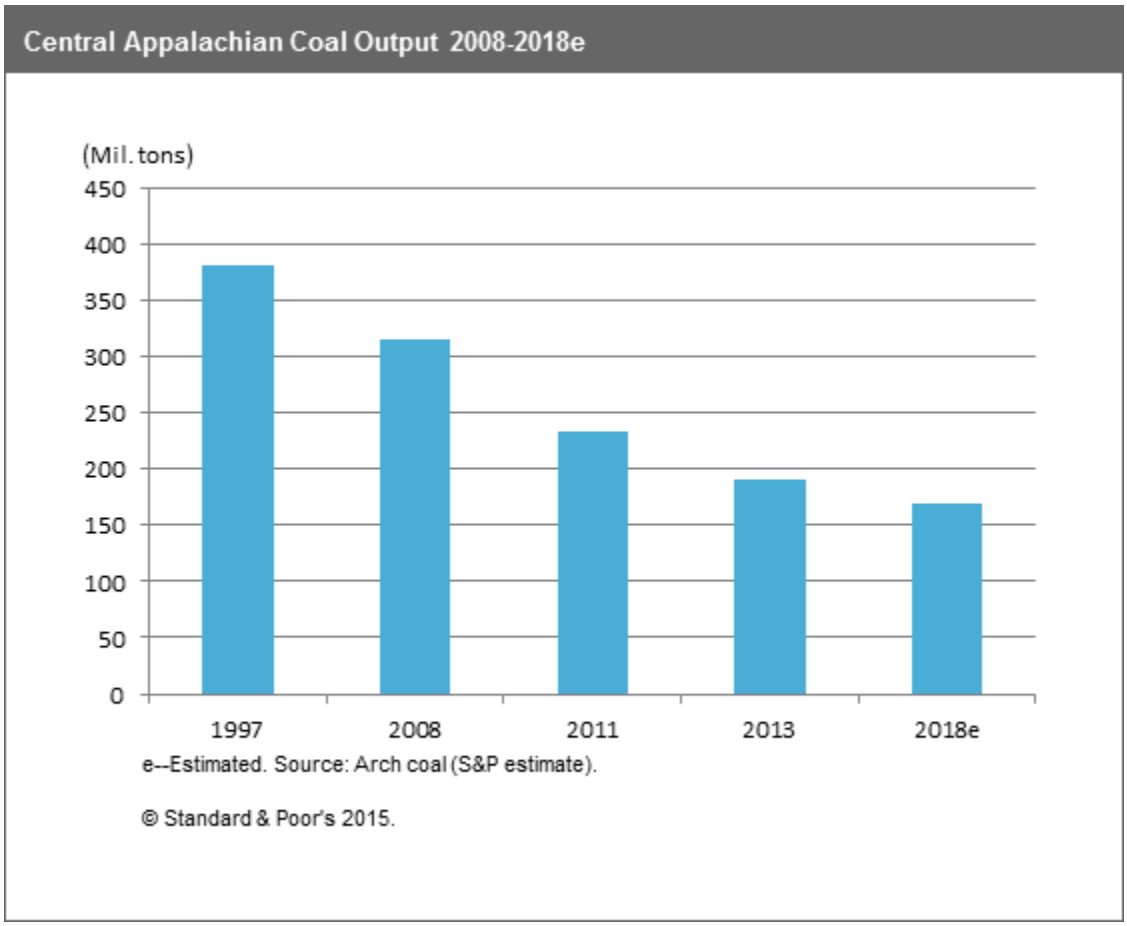
small compared with overall demand for energy in China.

- Natural gas. Last year, China signed a large natural gas deal with Russia to secure an annual natural gas supply of 38 bcm for 30 years (see "Standard & Poor's Perspective On Gazprom's Gas Contract With CNPC And Its Implications For Russia And China," June 6, 2014). The construction of the pipeline that will transport the gas will take between four and six years. This transaction is part of a larger objective to more than double the consumption of natural gas to about 400 bcm by 2020. In order to meet this objective, the country will need to build more liquefied natural gas (LNG) facilities and bring more piped gas to the country. We understand that as a result of the recent low energy prices, the commissioning of the Russian pipeline may be delayed.

Gas Rivals Coal In The U.S. Energy Mix

The structural change in the U.S. coal market is probably a more drastic scenario compared with the gradual change we anticipate the global coal industry will be going through from 2020. The discovery of large deposits of natural gas in early 2010 triggered a sharp decline in prices from $7/mmBtu (natural gas price) in 2009 to $1.9/mmBtu in 2012, before recovering to $2.8/mmBtu at mid-2015. As a lower cost and lower carbon energy source, natural gas has created incentives for utility companies in the U.S. to abandon the use of coal. Since 2010, the demand for coal in the U.S. has dropped by 125 Mt (or roughly 15% of annual production in the U.S.). In addition, in early August the U.S. Environmental Protection Agency (EPA) issued its final Clean Power Plan rules for reducing the carbon emissions of power plants (see "The U.S. EPA Finalizes Its Clean Power Plan, But Questions Still Remain," Aug. 6, 2015). Under its latest proposals, the EPA has moderately increased the emissions-reduction target to 32% by 2030 compared with 30% previously. On the other hand, it's given companies another two years to adjust with a compliance period that now starts in 2022 rather than 2020. We understand that the new regulations are likely to result in the retirement of more than 60 gigawatts of coal-fired capacity over the coming years, equal to 80 Mt-90 Mt. The main mines at risk are in Central Appalachia (CAPP; see chart 6).

Chart 6



In 2013, coal was responsible for about 18% of the U.S. energy mix. According to the EIA, coal will retain a similar market share in the future. In our view, discussions on the subject indicate that a complete replacement of coal with shale gas looks unrealistic over the short to medium term.

Over time, we assume that cheap natural gas will replace 100 Mt-200 Mt of coal. The exact quantity will depend on oil price levels and the success of U.S. natural gas exports. High oil prices would support the further use of coal, or could support the use of coal in coal-to-liquids (CTL) technology.

The coal-mining industry in the U.S. is no stranger to regulation. However, these latest proposals arrive as the industry is struggling, and the specter of bankruptcy is moving beyond the smaller miners to threaten the giants in the concentrated industry. The future of U.S. coal mining companies will rely on domestic natural gas prices, as well as their ability to export coal, and the momentum toward more gas-fired generation is only likely to accelerate following the EPA's latest pronouncements to curb emissions. In 2014, U.S. coal miners exported about 110 Mt of thermal coal, compared with 45 Mt in 2006 (see chart 7). While previously U.S. coal miners aimed to expand their export capabilities to more than 200 Mt over the coming years, the EIA anticipates that coal exports from the U.S. will decrease slightly to 80 Mt in 2016.

Chart 7

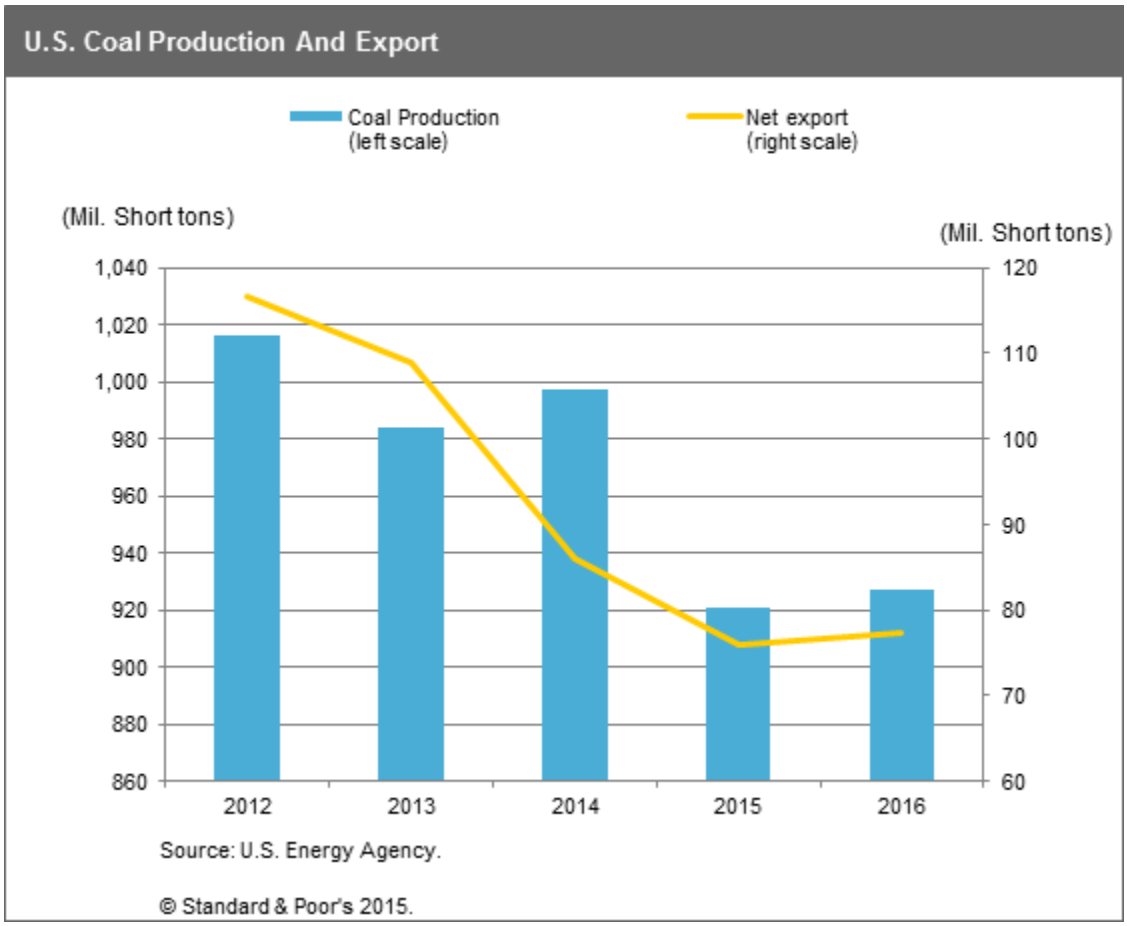


Table 1

Switching Point From Coal To Gas

Region	Natural gas price (mmBtu)
Powder River Basin	$2.50-$2.75
Illinios Basin	$3.25-$3.50
Central Appalachia	< $4.50

Source: Arch Coal.

Global Coal Market Growth Still Depends On Emerging Asian Economies

We don't expect CO2 policies to have a significant effect on coal mining in Australia, Indonesia, and Vietnam in the short term. Absolute demand continues to grow and net production (new growth versus shuttered production) remains positive. We see fairly sizable production growth in Indonesia (20 Mt-30 Mt in 2015 and 2016), even at current prices. This is because the top seven players there--who control 60%-70% of production--remain profitable and need to expand production to service their large debt burdens.

Even if coal consumption in China is capped, we believe that large energy deficits persist in key countries in Asia

(India, Indonesia, and Vietnam, for example), where pollution is either not top of the agenda or an environmental issue, and electricity growth through coal will continue to encourage production growth. New regulations in those countries could reduce output to the seaborne market, leading companies to sell their output domestically, which could force small domestic coal miners out of business. This will result in a shift of the regional cost curve to the left, leading to lower prices domestically.

In the near term, we expect India will continue to increase its imports of thermal coal, somewhat offsetting the reduced demand for seaborne thermal coal from China. With the current growth rates in India, the demand for coal could reach 1 billion tons by 2020 from 700 Mt at present. For example, in 2012 India imported 122 Mt of thermal coal. However, the country has huge domestic coal reserves, which it can tap. So any plans to improve mining efficiency and transport links could be a point of concern to seaborne players.

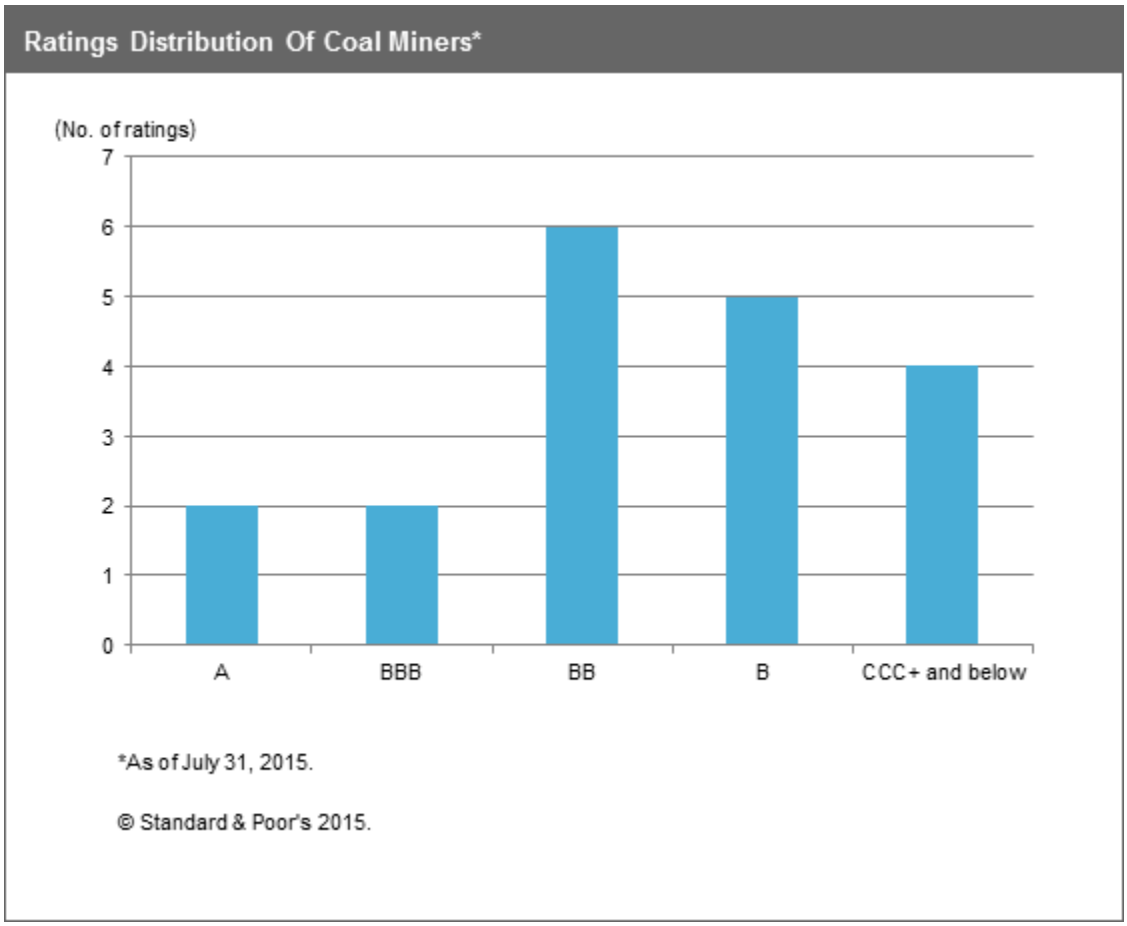
Who Will Survive The Structural Change In The Market?

Standard & Poor's rates 21 coal miners worldwide, with a combined output of about 1.1 billion tons (representing about 15% of total world annual output). We differentiate between two groups of coal companies: Pure miners and diversified miners. According to our calculations, coal activities for a well-diversified company typically represent 5%-20% of their EBITDA.

There are no pure miners rated investment grade (IG): IG companies encompass the international diversified miners Anglo American, BHP, Glencore, and Rio Tinto.

Our ratings on coal miners (see chart 8) already incorporate the current low prices. However, they don't capture the potential structural change and lower demand for coal that is likely over the medium term. This is because of multi-dimensional factors that affect the two generic groups of miners, and that could have different effects on prices:

Chart 8

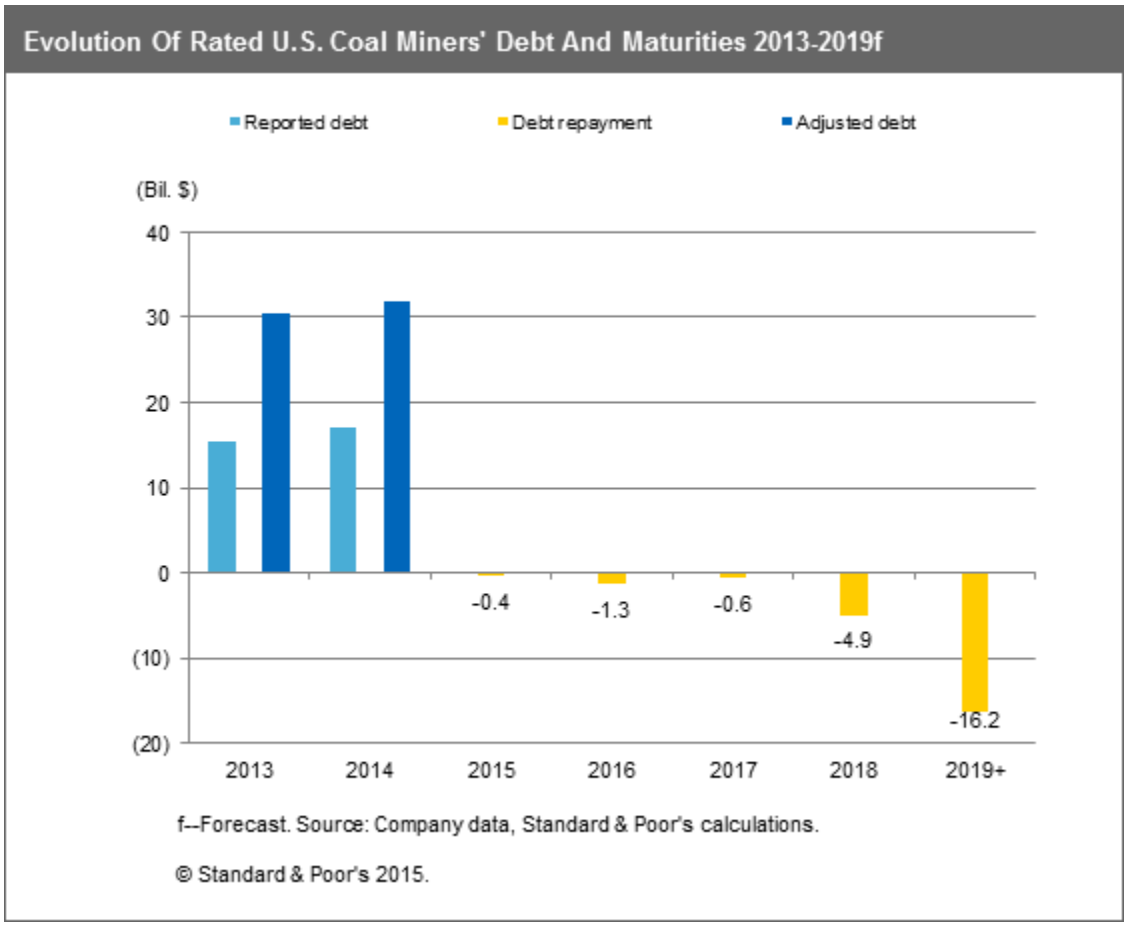


Pure miners: The coal market, unlike the oil market, is not homogenous, and is subject to different environmental, political, and technological changes. Over the short term, companies will need to cope with low prices. Uncompetitive firms may shut down capacity or file for bankruptcy. In the U.S., numerous coal miners have already filed for bankruptcy, including Patriot Coal Corp. and America West Resources. We contend that the surviving companies will need to further adjust their businesses to meet the gradual change in the market that may take between five and 15 years, including scaling down their operations and consolidating sites.

Net reported debt of rated companies is about $17 billion (see chart 9). However, taking into account asset retirement obligations and pension liabilities pushes this up to $32 billion. In our view, the additional nonfinancial obligations may become an imminent problem if prices remain at current levels, forcing companies to shut down capacity.

International diversified miners: In our view, the diversified miners are unlikely to face a material impact under the prevailing, less-supportive coal industry environment. For example, in 2012 Anglo American's thermal coal business generated EBITDA of $1.8 billion, representing about 20% of the company's underlying EBITDA. In 2014, the share of coal continued to shrink with the drop in thermal and coking coal prices, representing now only 15% of the EBITDA or $1.2 billion. According to several publications, which were not confirmed publically by the company, Anglo American is looking to sell some of its coal assets.

Chart 9



Can Coal Be Part Of The Solution?

Much of the world's existing stock of coal-fired power plants operates at an average efficiency of 33% (the average efficiency rate in the EU is 38%). This is far lower than power plants that rely on other fossil fuels, and significantly lower than the 45% efficiency possible with modern, ultra-supercritical coal-fired power plants. If existing coal-fired units were upgraded to an average 42% efficiency, says the IEA, annual CO2 emissions could be reduced by more than 2 billion tons (the latest available data puts total CO2 emissions at 31.7 billion tons in 2012). In addition, increased efficiency results in lower operating costs, improved air quality, and reduced water consumption. Based on several studies undertaken by utility companies, improved technology could push the efficiency of a coal-fired power plant to around 50% by mid-2020.

As part of its latest climate change and pollution strategy, China aims to achieve an average thermal efficiency from its coal-fired plants of 38.0% in 2015 and 38.4% by 2020, from a level of 37.2% in 2011. One way to achieve such an improvement would be to close the capacity of outdated power plants (mainly those of less than 200 MW) and build bigger, state-of-the-art power plants.

However, to make deeper cuts in CO2 emissions, CCS units would ultimately be required. Currently, there are several CCS pilot plants operating worldwide (in the U.K., Spain, and China), reducing CO2 emissions to the atmosphere by approximately 80%-90% compared with power plants without CCS technology. There is a downside, however: CCS units increase the fuel consumption of coal-fired plants by 25%-40%. Moreover, even if the CCS pilot plants are a success, storing the CO2 could be problematic because it requires a specific underground geological formation. This could prove challenging for existing power plants, which are usually not located near such geological formations.

Further Mine Closures And Bankruptcies Are Likely

As the discussion around global warming heats up, more questions arise about the future of coal. But the fact that there is at present no other viable alternative that could replace coal on a global scale and at reasonable cost means that coal will stay with us for quite some time. Until technology develops a breakthrough that allows affordable energy with a low carbon emission footprint, governments will have to focus their attention on energy efficiency alongside renewables projects.

In the short to medium term, coal miners will need to find ways to cope with lower prices. We therefore expect further mine closures and bankruptcies. Over the medium term, however, as for all cyclical extractive industries, the lack of investment in the industry at present could translate into much higher prices. Even if there were a cyclical recovery, in our opinion, the coal industry would continue to face an uphill struggle. We believe that demand for coal could decline further as new regulations on C02 emission reductions are highly likely to dominate the landscape.

Related Research

- The U.S. EPA Finalizes Its Clean Power Plan, But Questions Still Remain, Aug. 6, 2015
- Standard & Poor's Perspective On Gazprom's Gas Contract With CNPC And Its Implications For Russia And China, June 6, 2014
- S&P's First Take On The EPA's Proposed CO2 Rules For Power Generators, June 3, 2014
- Climate Change: Preparing For The Long-Term, May 22, 2014
- Assessing The Credit-Supportiveness Of Europe's Renewable Energy Frameworks, May 22, 2014
- Dealing With Disaster: How Companies Are Starting To Assess Their Climate Event Risks, May 21, 2014
- What A Carbon-Constrained Future Could Mean For Oil Companies' Creditworthiness, March 1, 2013

Additional Contact:
Industrial Ratings Europe; Corporate_Admin_London@standardandpoors.com

RatingsDirect®

Insurers May Anticipate A Smooth Road Ahead On Climate Change, But Their View Could Be Restricted

Primary Credit Analyst:
Miroslav Petkov, London (44) 20-7176-7043; miroslav.petkov@standardandpoors.com

Secondary Contacts:
Olivier J Karusisi, London (44) 20-7176-7248; olivier.karusisi@standardandpoors.com
Charles-Marie Delpuech, London (44) 20-7176-7967; charles-marie.delpuech@standardandpoors.com
Dennis P Sugrue, London (44) 20-7176-7056; dennis.sugrue@standardandpoors.com

Table Of Contents

Insurers May Anticipate A Smooth Road Ahead On Climate Change, But Their View Could Be Restricted

The insurance industry recognizes climate change as one of its top emerging risks and many insurers consider the potential consequences of the latest scientific findings for their operations. Insurers do not typically view climate change as a major threat to their day-to-day activities as they anticipate that their ability to reprice and renew non-life policies annually offers them protection against increases in weather-related claims attributed to climate change (see "Are Insurers Prepared For The Extreme Weather Climate Change May Bring?," published on RatingsDirect on May 19, 2014).

However, in Standard & Poor's Ratings Services' view, climate change may present a wider range of threats for insurers. Insurers' capital positions could be affected by lower investment income and higher capital requirements, as well as by the anticipated increase in weather-related claims. Taking into account those effects that we currently consider to be quantifiable, our analysis indicates that insurers' capital management will be sufficient to manage the additional strain of a reduction of about 0.5% in capital adequacy per year, possibly at the expense of dividends being 5%-10% lower.

The effect of a sudden climate change shock, however, could test the industry. Estimating how climate change will play out is inherently uncertain, so the picture may change dramatically over time. We cannot rule out the possibility that climate change could have a significant effect on insurers' capital positions in future. For example, if market values are adjusted to incorporate the expected lower returns under climate change, it could reduce insurers' capital adequacy by up to 10%.

Our analysis used a recent study by the Mercer Group, a consultancy, which indicates that climate change has implications for investment returns, and thus for earnings. In addition, we used an analysis by Risk Management Solutions Inc. (RMS), a catastrophe risk modeling company. RMS has reviewed likely changes to common perils, and considers that there is strong evidence that climate change will worsen the effect of tropical storms. This could increase capital requirements.

Much of the uncertainty regarding the magnitude of climate change comes from the lack of clarity regarding the level of future carbon dioxide emissions. At a UN conference on climate change in Paris in December 2015, the governments of more than 190 nations will discuss a possible new global agreement on climate change, aimed at reducing global carbon dioxide emissions. This will be an important step toward reaching an intergovernmental agreement on limiting future carbon dioxide emissions and so reducing the threat of dangerous climate change.

Climate Change's Potential Effect On Insurers' Capital Adequacy

Our analysis assumes that insurers do not anticipate the immediate impact when setting pricing levels and managing capital levels, but only react to it as its impact emerges. On this basis, we have estimated the potential consequences

of climate change on insurers' capital adequacy over 2016-2050.

Prospective capital adequacy is a key element in our rating analysis of insurers (see "Insurers: Rating Methodology," published on May 7, 2013). To determine an insurer's capital adequacy, we compare its available capital over the rating horizon to the required capital, which we determine by running our capital model at various rating levels (see "Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," published on June 7, 2010). Our assessment incorporates our view of the insurer's prospective earnings and its capital management (for example, its dividend policy).

In our view, climate change could affect insurers' prospective capital adequacy through reducing earnings and by increasing the level of required capital, if its impact is not anticipated. Earnings will be affected, not only by the potential for higher weather-related claims, but also through lower investment returns. We have also allowed for a possible increase in required capital as a result of increased volatility in weather-related claims.

Our analysis estimates how insurers' expected capital adequacy could be affected, on average, as a result of climate change. In practice, the future will not follow the "average" path and major weather events could have a significant effect on insurers' capital position. Although such events could happen with or without the impact of climate change, it could be argued that climate change may increase their likelihood. We do not consider that any such extreme event would be solely attributable to climate change. Reinsurers are particularly exposed to such major catastrophes and we have previously investigated the potential capital and rating impact on reinsurers as a consequence (see "Discipline Is Necessary As Reinsurers Adjust Their Exposure To Catastrophe Risk," published on Sept. 2, 2015).

Our Analysis Focuses On Quantifiable Risks

Our analysis focuses on what can reasonably be quantified despite the challenges involved in estimating the impact of climate change. We incorporate the views of experts in this area, in particular, the work done for the Mercer study on the impact on climate change on investment returns (see "Investing In A Time of Climate Change - 2015 Study," published on the Mercer Group's website) and RMS' estimates of how climate change may affect extreme weather events.

One of the aims of the Mercer study was to assess the impact climate change could have on the risk/return profile of an investment portfolio and when the impact may occur (see Appendix 1 for further details). From Mercer's report, we have used projections of the size of the annual change in the expected investment return for different asset classes that can be attributed to climate change across different scenarios, each reflecting a different future emission level. These projections assume that the impact of climate change on returns will be fairly gradual and most of the changes identified result in net reductions in investment return. We used the projections at asset class level for the following classes: equities, investment-grade bonds, and speculative-grade bonds.

RMS studied the impact of climate change on extreme weather in 2050, both at the expected level and at extreme level (that is, at a 250-year return period). See Appendix 2 for more details. We used RMS' results to estimate the likely hit on earnings and the impact on capital; the one-in-250-year figure drives our catastrophe charge. We applied linear interpolation between 2015 and 2050 to estimate the annual impact over the projection period.

In our analysis, we assume that insurers' current one-in-250 estimates accurately reflect the current effect of climate change on the probability of extreme weather events. However, any models estimating the magnitude of extreme weather events carry considerable modeling uncertainty. In the scenario we created for "Climate Change Could Sting Reinsurers That Underestimate Its Impact," published on Sept. 3, 2014, we extrapolated from recent catastrophe experience to explore whether reinsurers have underestimated their current catastrophe risk charges.

Our Base-Case Scenario Suggests That Insurers Can Manage The Effect Of Climate Change

Our analysis shows that if the impact of climate change is gradual, it will erode insurers' capital adequacy by about 0.5% per year. (For example, if an insurer capital adequacy shows expected surplus of 5% above the 'AA' required capital calculated by our capital model, after allowing for the impact of climate change, the surplus could reduce to 4.5%.) Over the projection period (2016-2050) the cumulative effect could be material, but set alongside the normal volatility of insurers' capital position--stemming from changes to the economic, competitive, regulatory environment--the outcome is not as significant.

Insurers' capital management tools should be effective in handling the additional strain of climate change. However, managing the repercussions of climate change may require insurers to balance maintaining capital adequacy against meeting the profit expectations of their shareholders. We anticipate that insurers could reduce their dividends moderately, slow growth rates, or increase their use of risk mitigation techniques such as reinsurance. Taking these actions may have consequences for insurers' risk/return profile, reducing their expected shareholders' total return and dividend income by about 5%-10%.

Different insurance subsectors will have different experiences

To explore the effect on different types of insurance company, we analyzed four sample companies--one offering insurance and reinsurance and operating in the London market (the reinsurer), a multiline insurer, a life insurer, and a non-life insurer. We created profiles by aggregating data from some of the biggest rated insurers within each category.

The investment impact appears to be more material than the weather-related impact across all four types of insurers. As a consequence, the estimated climate change impact on the life and multiline insurers, which are more exposed to investment risk, is slightly higher than that on the other two (an average annual capital impact of 0.5%, versus 0.3%-0.4%). Even for the non-life insurer and the reinsurer, the investment impact is bigger than the weather-related, representing 70% of the total impact and 60%, respectively.

Climate Change Projections Carry Significant Uncertainty

We recognize that the projections we used to estimate the impact of climate change over such a long period carry a high level of inherent uncertainty. In particular, it can arise from:

- The uncertainties regarding the degree of political consensus that may be achieved globally regarding the appropriate way to deal with carbon dioxide emissions, and the effectiveness of any agreed policies;
- The range of mitigation actions that society might adopt to deal with the new policies, regulations, and challenges

presented by climate change; and
- The precise impact of climate change on extreme weather.

Therefore, our analysis offers only an indication of the possible consequences, based on our current understanding and incorporating some of the latest research. We are aware that several other parties have tried to quantify the impact of climate change and that their projections may differ from those we have used. These differences illustrate the uncertainty in any estimates of the impact of climate change. As policy becomes clearer and advances in science and climate modeling improve our understanding of how climate change affects weather events, we may adjust our conclusions substantially. For example, if an agreement is reached in Paris, it could reduce policy uncertainty.

Abrupt Changes Could Hurt The Industry

Although we expect the industry to be able to absorb gradual adjustments, climate change may also lead to abrupt shifts, which could have a more severe effect on the industry's capital. For example, the financial markets may recognize that under climate change, returns will be lower than previously expected and may react by correcting market values to maintain the yield levels. If this were to occur now, it could cause a drop of up to 10% in the available capital for the insurance profiles we considered in our analysis. The life and multiline insurers would be most affected. We anticipate that insurers may find it difficult to quickly restore their capital positions after a capital drop of this magnitude.

Other shocks are more difficult to quantify. Climate change may trigger a cascade of shocks; an example is described in the food shock scenario published by Lloyd's (see "Food System Shock: The Insurance Impacts Of Acute Disruption To Global Food Supply," published on Lloyd's website). Lloyd's commissioned the development of a scenario describing an acute, but plausible, disruption to global food production due to sudden systemic shocks. Examples include catastrophic weather events or plant pandemics, many of which would be exacerbated by climate change.

Climate change may also lead to a sudden increase in the risk and volatility of weather losses if certain tipping points are reached, for example, the melting of the Greenland ice sheet. It is very difficult to estimate the likelihood and results of reaching such tipping points. However, following such an event, an insurer's required capital may rise. Additional risk to the insurer's capital position may arise if, due to political or consumer pressure, it cannot pass on the full increase in the risk to insured parties quickly.

Not All Effects Can Be Quantified

The U.K.'s Prudential Regulation Authority has released a report on how climate change may affect insurers (see "The Impact Of Climate Change On The UK Insurance Sector," published on the Bank of England website), which highlighted that insurers may see increased liability risks. Claimants who have suffered loss from climate-related risks could seek legal redress because, in their view, the accused did not take the necessary action to prevent climate change from affecting them, and so is liable for their loss. It is hard to predict whether claimants will win and the size of any awards that might result--it would depend on future court decisions. Because of this uncertainty, we have not attempted to quantify the impact of potential climate change-related liability claims.

Climate change may also affect people's health. For example, hotter and more humid conditions may help tropical diseases to spread to new areas. This could have a widespread impact on health, which could cause major losses for life and health insurers. Again, we have not allowed for this type of effect because it is too difficult to project losses in such a case.

Could there be positive effects?

Although we have focused chiefly on the negative potential of climate change, there could also be benefits for the insurance industry. For example, the climate change debate may improve risk awareness, which could lead to governments, corporates, and individuals taking better risk mitigation measures. This could, for example, reduce weather-related losses at insured properties. Increased risk awareness may also increase demand for insurance, even in less-developed insurance markets. As a result, insurers' geographical diversification would widen. Better diversification could lead to more stable insurance portfolios that required lower levels of capital.

Climate Change Is On Insurers' Radar

Climate change brings uncertainty to the insurance industry, and could have diverse consequences. The insurance industry is fully aware of the potential risks and actively monitors this area. We expect insurers to reflect these risks in their pricing, investment, and capital management. As long as the industry is not complacent, we anticipate that insurers should be able to manage the quantifiable effects on their capital, possibly at the expense of lower dividends.

The biggest danger stems from unexpected, abrupt changes. We recognize that making decisions regarding risk-mitigating actions is difficult when any assessment of the potential impact of climate change is inherently uncertain. We consider that the industry has processes in place to implement the necessary risk mitigation actions, provided that it is affected gradually and with sufficient warning. That said, we see a small risk that climate change may hit without giving any clear signals to guide decision makers.

Appendix 1: Mercer Group Study

Mercer and its partners undertook a study of the potential consequences of climate change for expected returns in different industry sectors and asset classes, and for total portfolio returns over the period 2015 and 2050. The study was based on four scenarios, each reflecting a different level of action taken to mitigate climate change. Different methods of reducing carbon dioxide emissions will vary in cost and effectiveness. They will, in turn, have varying effects on the expected increase in global temperatures, and thus the level of economic damage caused by climate change effects.

Mercer assessed the impact on the expected return according to the asset return's sensitivity to:

- T: Progress in developing Technology to support the low-carbon economy;
- R: Changes in Resource availability due to long-term shifts in temperature or precipitation;
- I: Physical Impact from changes in the frequency/severity of extreme weather, and;
- P: Policies and regulations meant to reduce the risk of further man-made climate change, under those four scenarios.

We assessed how Mercer's scenarios would affect insurers' investment portfolios. Given that most insurers have a well-diversified investment portfolio, we consider that variations across the four scenarios are not significant in the context of our analysis.

Appendix 2: Risk Management Solutions Inc. Study

We consider the following weather-driven natural catastrophes perils to be the most material for the insurance industry:

- U.S.: hurricane, severe convective storms, winter storms, and flood;
- Caribbean: hurricane;
- Europe: wind storms and flood; and
- Australia, China, and Japan: cyclone/typhoon.

RMS' study considered the impact of climate change on these perils (see table 1). It considers that there is conclusive evidence that changes in sea levels will worsen the impact of tropical storms (that is, hurricanes, cyclones, and typhoons), which may also be affected by changes in frequency and intensity. It based its projections for U.S. hurricane on a detailed modeling study conducted as part of the Risky Business project (see "Risky Business: The Economic Risks Of Climate Change To The United States," published on the Risky Business website). The research uses a standard risk-assessment approach to determine the range of potential consequences for each region of the U.S.--as well as for selected sectors of the economy--if we continue on our current path. It is focused on the clearest and most economically significant of these risks.

RMS then used the relativity between the U.S. and other tropical cyclone-exposed region to estimate the impact of climate change on Caribbean hurricane, Japan and China typhoon, and Australian cyclone. All projections are based on current exposure, including insurance penetration and defenses for flood and storm surge.

When RMS' model experts reviewed latest academic research on the other perils listed above, they found no conclusive evidence that climate change would be exacerbating loss estimates. In particular, they stated that the current evidence suggests that most increases in flood losses by midcentury will stem from increases in exposure inside the flood plain, rather than from physical changes in the nature of flooding in response to a changing climate.

Table 1

Risk Management Solutions' Estimated Increase In Insured Losses In 2050 Due To Climate Change

	Estimated impact of background change*		Total estimated impact§	
(%)	Change in AAL	Change in 1 in 250 year loss	Change in AAL	Change in 1 in 250 year loss
North America Hurricane	4	2	54	24
Japan and China Typhoon	10	5	45	20
Australia Cyclone	0	0	45	20

*Main background change is sea-level rise. §Including changes in event frequency and intensity changes. Source: Risk Management Solutions Inc. AAL--Annual average loss.

The authors would like to acknowledge the contributions of Alex Bernhardt, Mercer and Dr Paul Wilson at Risk

Management Solutions Inc. to this article.

Related Criteria And Research

Related Criteria

- Insurers: Rating Methodology, May 7, 2013
- Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model, June 7, 2010

Related Research

- Discipline Is Necessary As Reinsurers Adjust Their Exposure To Catastrophe Risk, Sept. 2, 2015
- Climate Change Could Sting Reinsurers That Underestimate Its Impact, Sept. 3, 2014
- Are Insurers Prepared For The Extreme Weather Climate Change May Bring?, May 19, 2014

External Research

- "Investing In A Time of Climate Change - 2015 Study," published on the Mercer Group's website
- "Risky Business: The Economic Risks Of Climate Change To The United States," published on the Risky Business website
- "Food System Shock: The Insurance Impacts Of Acute Disruption To Global Food Supply," published on Lloyd's website
- "The Impact Of Climate Change On The UK Insurance Sector," published on the Bank of England website

We have determined, based solely on the developments described herein, that no rating actions are currently warranted. Only a rating committee may determine a rating action and, as these developments were not viewed as material to the ratings, neither they nor this report were reviewed by a rating committee.

Additional Contact:
Insurance Ratings Europe; InsuranceInteractive_Europe@standardandpoors.com

STANDARD & POOR'S RATINGS SERVICES
McGRAW HILL FINANCIAL

RatingsDirect®

How Standard & Poor's Views The Credit Risk Of Energy Efficiency Projects

Primary Credit Analysts:
Michael Wilkins, London (44) 20-7176-3528; mike.wilkins@standardandpoors.com
Luisina Berberian, London (44) 20-7176-3276; luisina.berberian@standardandpoors.com
Pierre Georges, Paris (33) 1-4420-6735; pierre.georges@standardandpoors.com
Trevor J D'Olier-Lees, New York (1) 212-438-7985; trevor.dolier-lees@standardandpoors.com

Table Of Contents

How Standard & Poor's Views The Credit Risk Of Energy Efficiency Projects

A total of $90 billion was invested in energy efficiency in the buildings sector alone in 2014, and the International Energy Agency predicts this will grow substantially over the next decade, especially as policymakers target these kinds of projects as a cost-effective way to reach climate change goals. Investors are becoming increasingly interested in low-carbon investment opportunities--such as energy efficiency projects--which for their part are looking to attract financing. Interest in energy efficiency has also led to growth in bonds raised by corporates active in the sector, such as Schneider Electric, which on Oct. 13, 2015, issued its inaugural €200 million ($215 million) green bond to finance R&D programs dedicated to technologies enabling its customers to reduce carbon emissions. (Watch the related CreditMatters TV segment titled "Energy Efficiency Projects Seek Financing Solutions," dated Nov. 17, 2015.)

Renewable energy projects such as onshore wind and solar have reached a maturity level over the past 15 years where investors are now easily able to determine their ability to make timely and full repayments on debt. However, energy efficiency projects like those in the building sector are less established, and still raise questions for investors about how they will be repaid and the credit risk they face.

Overview

- Governments around the world are targeting energy efficiency as a cost-effective means to improve energy security and combat climate change.
- One way to finance the huge amount of investment needed is through energy efficiency projects, which would pay for the installation of such equipment and whose savings in energy costs repay the upfront capital.
- One issue that energy efficiency projects face is credit risk, which Standard & Poor's project finance ratings take into account.
- These credit risks most resemble those found in highly leveraged renewable energy, utility services, and social infrastructure projects--such as for schools and hospitals.

Barriers to investment in energy efficiency include the diverse kinds of projects, their long payback periods and small transaction size, as well as an absence of a visible cash flow stream for debt repayment. By way of illustrating diversity, it helps to know that projects in this area work in one of three main ways:

- Reduced energy consumption (through the use of more efficient appliances or LED lighting, for example);
- Energy conservation; in monitoring and thereby optimizing consumption (via "smart" technologies); and
- Use of a project's own energy resources (localized renewables).

For debt servicing, energy efficiency projects rely on measured cost savings for repayments, often backed by project counterparties. What's also adding to investor uncertainty has been the historical lack of a standardized system for measuring energy savings, though we are now seeing some progress in this area.

Here, Standard & Poor's explores how energy efficiency projects are structured today, and we discuss how our project finance ratings methodology views their credit risks.

The Politics And The Costs

Governments around the world are targeting energy efficiency as a cost-effective means to improve energy security and to combat climate change. The EU's Energy Efficiency Directive of 2012 aims to reduce energy consumption by 20% by 2020, and has required member states to transcribe policies to boost investment into energy efficiency into national law by June 2014. Such policies include:

- Requiring large companies to undertake regular energy audits, and giving small and midsize enterprises (SMEs) incentives to do the same;
- Mandating that utilities (energy distributors or retail energy sales companies) achieve 1.5% energy savings per year; and
- Upgrading public buildings.

How much will this cost? One study found that the EU will need investment totaling $2.9 trillion in low carbon infrastructure projects up to 2020, with buildings requiring the greatest share of about €67 billion a year starting in 2011. The total package would help Europe bring its emissions to 83% of 1990 levels by 2020, representing an abatement of 2.2 gigatons of carbon dioxide-equivalent. Energy efficient investments in buildings would represent about 18% of those emissions savings. (Source: "Carbon Capital," Accenture and Barclays, 2011.)

Similarly, under the U.S. Clean Power Plan, each state is required to produce a proposal for reducing carbon dioxide emissions, with levels varying sharply based on past efforts and capabilities. The plan highlights demand reduction in general, and energy efficiency more specifically, as a cost-effective option for compliance, especially in states with limited economic growth prospects or that are sensitive to sharp power price increases. The state of New York is reforming its power market to reward utilities for introducing energy efficiency measures, among other innovative mechanisms, to deliver a secure power supply.

Looking to China, the 12th five-year plan (2011-15) included a package of policies intended to provide incentives to industry to boost energy efficiency, and forced the closure of smaller, less efficient plants. Over the next five-year plan (2016-20), China's central bank aims to channel large-scale financial flows into green financial instruments, including energy efficiency initiatives.

At the same time, a growing number of facility managers are seeing that energy efficiency makes financial sense, if it can reduce a building's energy use and maintenance costs, especially in today's environment of volatile power prices.

The Basics

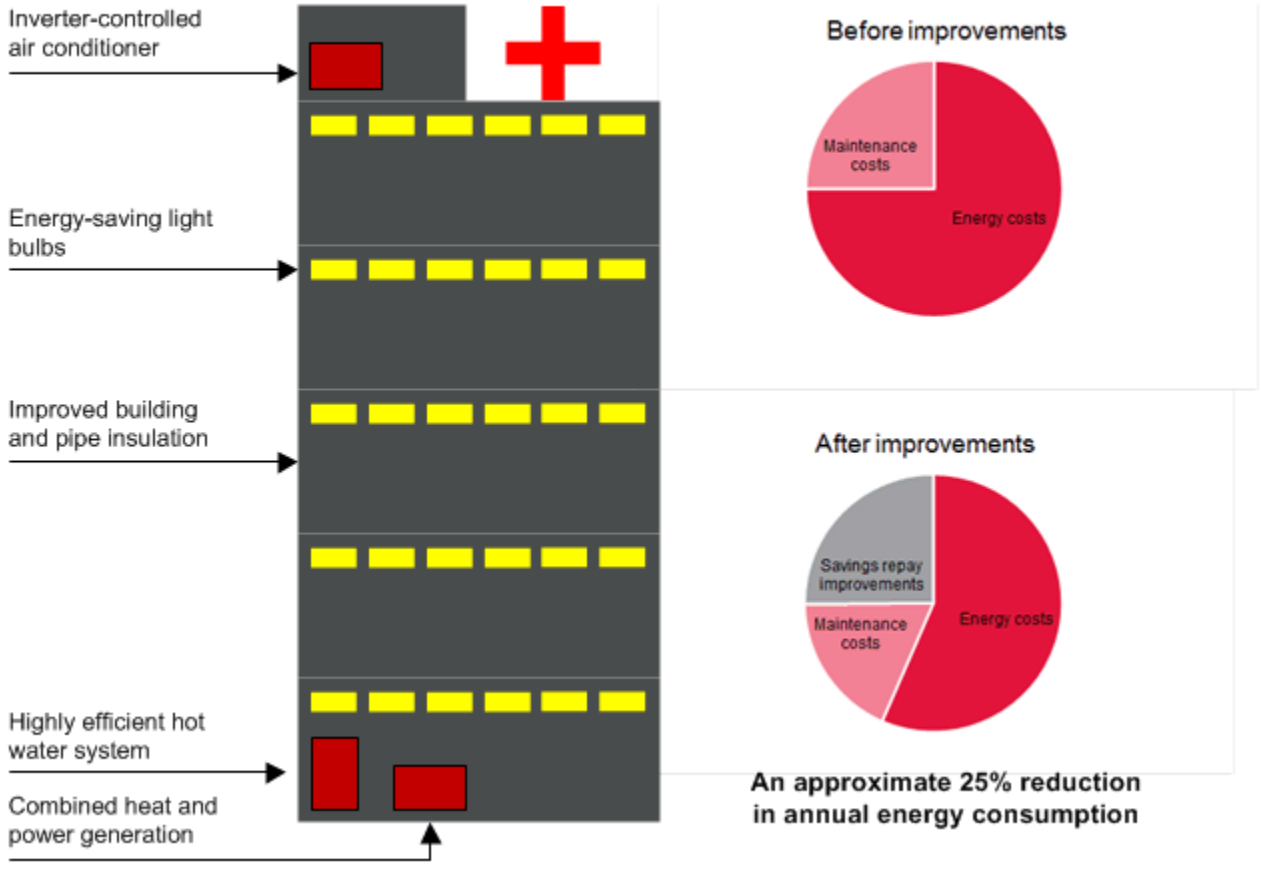
Many government entities and companies understand the concept of energy efficiency, in that investment in energy-saving buildings, plants, and other forms of infrastructure save on energy costs in the long term. Indeed, companies face more pressure and incentives to reduce energy consumption and cut costs, coming from several sources, for example, corporate responsibility initiatives, volatile oil prices, and slow business growth in some markets. The problem is that the upfront costs for energy efficiency measures can in some cases be significant in the short term, with cost savings only materializing over the longer term. The payback period for energy efficiency projects varies

greatly based on the client's energy consumption and the technologies involved. Energy-saving lighting with movement sensors can have a payback period of less than three years, whereas heating, ventilating, and air conditioning equipment and insulation can have a payback period of 10 years or more. For example, energy efficiency projects in U.K. public buildings showed overall payback periods of between four and seven years, according to the U.K. Department of Energy & Climate Change.

Energy efficiency projects, more common in the building, industry, transport, and appliance sectors, involves installing equipment that allows a company or an individual to use less energy without reducing productivity or comfort. Let's take the example of a hospital building that has introduced a number of efficiency measures including energy saving lighting as well as combined heat and power generation, which together enable a 25% reduction in energy consumption (see chart 1). These energy savings result in cash savings from utility bills, which the project can contractually ring-fence to repay the debt raised to finance the capital expenditure. Once the debt is repaid, the hospital benefits from reduced energy bills. In this example, the hospital wouldn't need to raise debt itself to upgrade its building and meet its environmental targets, while the investor would potentially earn a competitive rate of return on its investment. What's more, this scheme could imply no or limited government spending to achieve environmental goals.

Chart 1

Example Of Energy Efficiency Projects For A Hospital



Sources: Middle East Economic Engineering Forum, Energy Services Coalition.

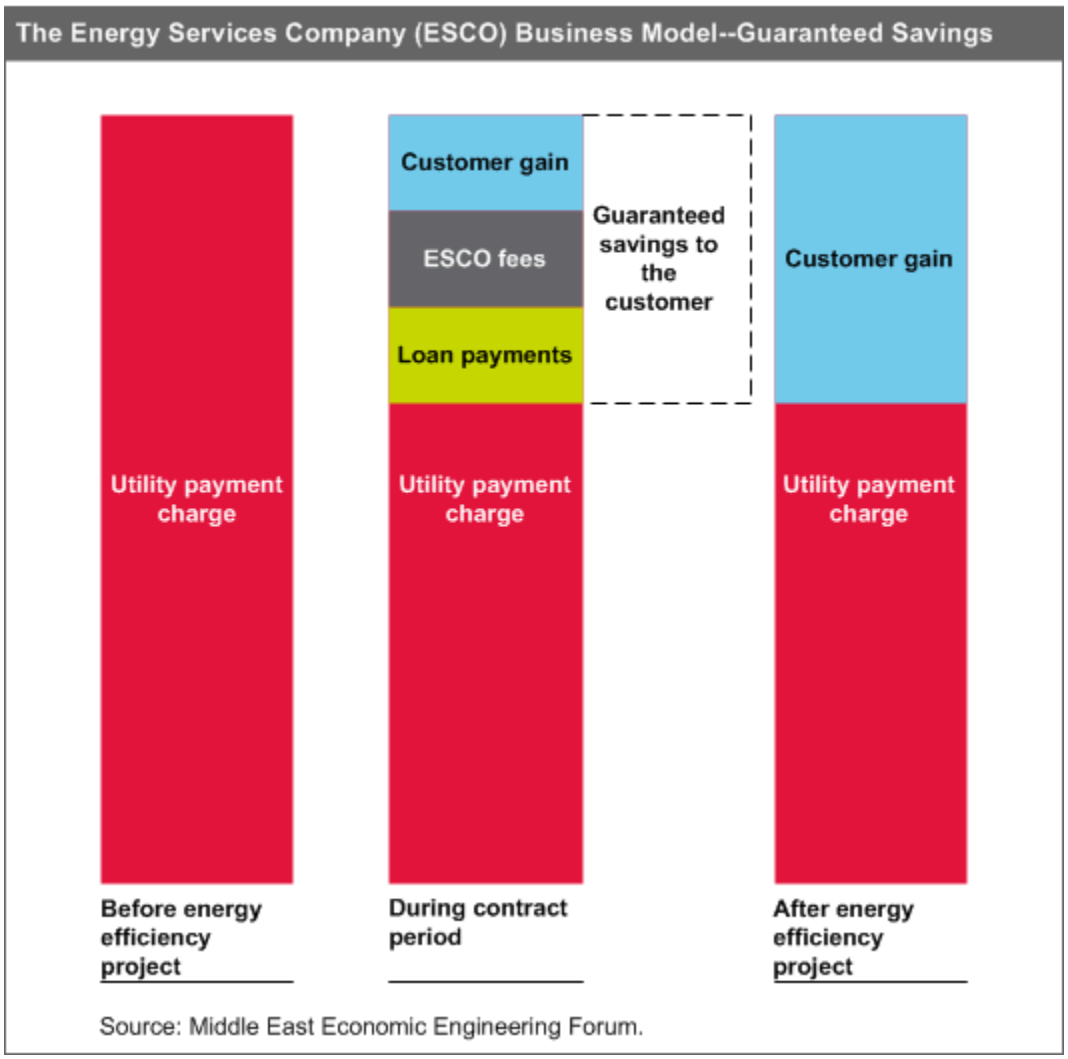
Financing Options

Funding for energy efficiency projects comes mainly from commercial banks, and public finance bodies--such as green investment banks and development aid programs. Or, they may be self-funded by companies and individuals. Power and gas utilities are increasingly looking to expand these energy services through bundled offers, first for heavy users and municipalities, and then for residential consumers. Emerging financing vehicles in the area of energy efficiency project finance include Energy Performance Contracts (EPCs) and mechanisms known as on-bill financing, where debt repayments are attached to utility or property tax bills.

An EPC involves a company or individual entering into a contract with an Energy Service Company (ESCO) and often a debt provider (see chart 2). The ESCO carries out an energy audit to identify and subsequently implement energy efficiency measures. ESCO fees and loan repayments are frequently linked to the resulting measured reduction in energy consumption. The ESCO/EPC model emerged in the U.S. in the 1970s within the municipal, universities, schools, and hospitals (MUSH) public sector, with many projects funded by municipal bonds offering a cheap,

long-term source of finance. Since the 1970s, the U.S. MUSH market has grown steadily, though moves into the commercial market have been sluggish. Companies in the U.S. and EU with ESCOs include Amaresco, Johnson Controls, Schneider Electric Buildings, and Siemens Building Technologies. The U.S. ESCO/EPC model has been promoted around the world with relatively limited success, with some take-up in China in recent years.

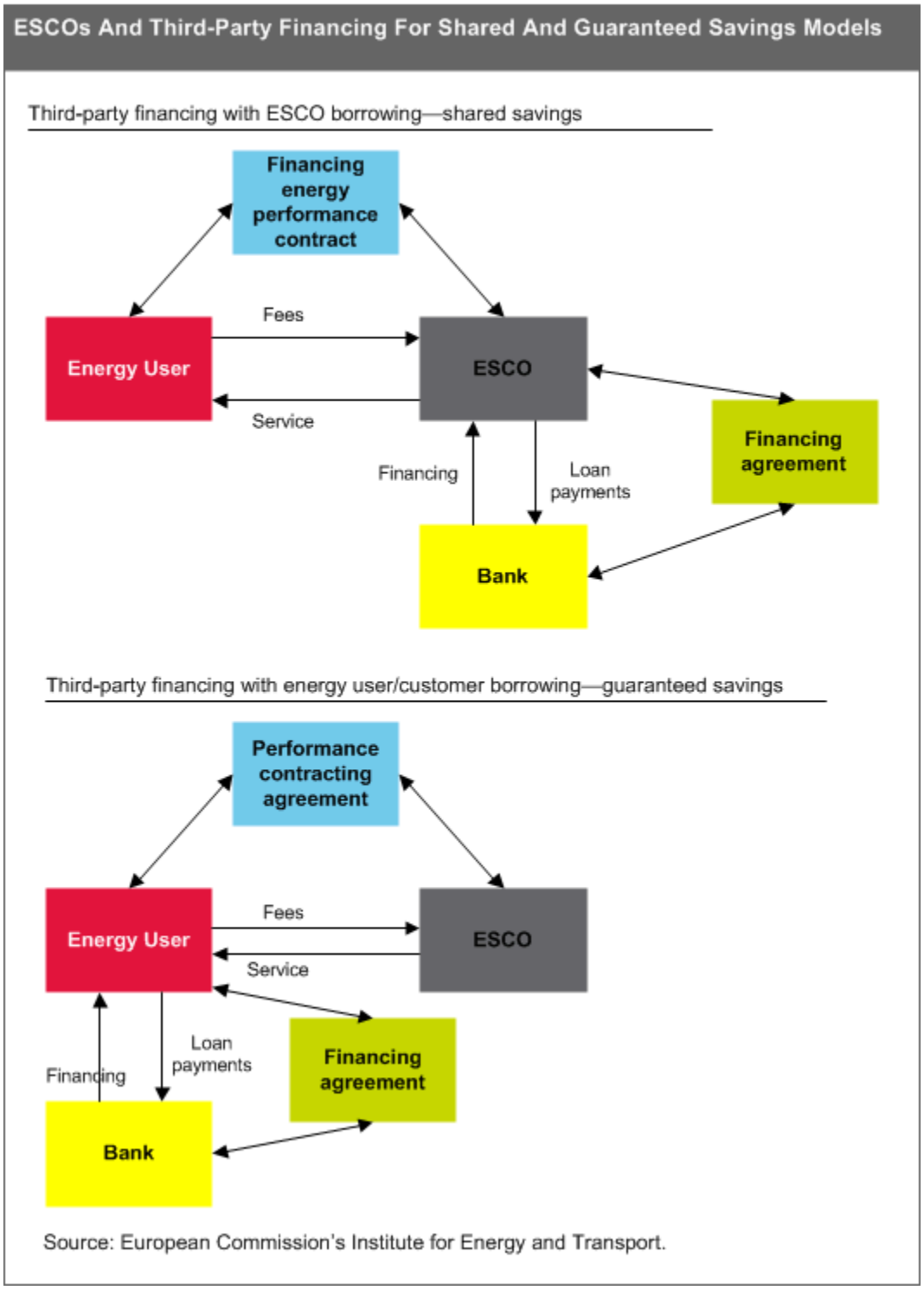
Chart 2



There are two main contract models used in an EPC, the shared savings model and the guaranteed savings model. Under a shared savings contract, the energy cost savings delivered by a project are split between the client and the ESCO for a pre-determined length of time at an agreed percentage. Under a guaranteed savings contract, the ESCO guarantees a certain level of energy savings and in this way shields the client from any performance risk. The value of energy saved is guaranteed to meet debt service obligations, down to a floor price. The shared savings model involves the ESCO carrying out the financing, whereas the guaranteed model involves the client sourcing funding from a third party and retaining the debt on its balance sheet (see chart 3).

Chart 3

ESCOs And Third-Party Financing For Shared And Guaranteed Savings Models



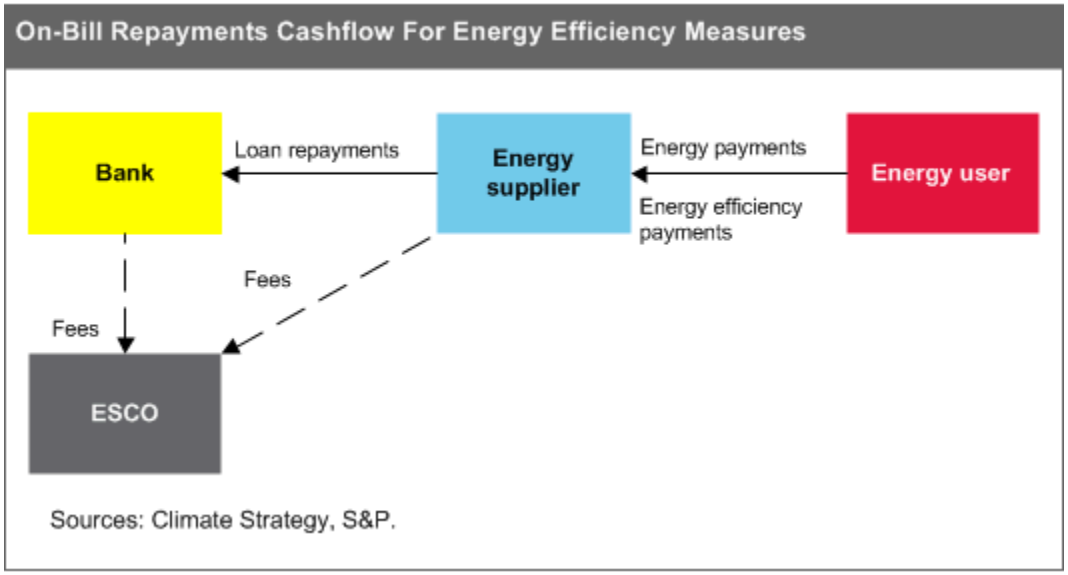
Source: European Commission's Institute for Energy and Transport.

In the world of project finance, we believe the shared savings model would most closely resemble a nonrecourse structure. That's because the ESCO would act as the "project company," raising the capital financing directly through a special-purpose vehicle (SPV) and repaying the project debt through service payments received from the energy user

(the party benefitting from the project), subject to performance standards. Lenders therefore would take ESCO performance risk, and the ESCO would take energy user counterparty risk. However, project lenders are also exposed to this counterparty risk if the project company is dependent on it. The guaranteed savings model is not nonrecourse project finance since the lender provides the loan directly to the energy user (rather than the ESCO) and directly takes on offtaker counterparty risk. The energy user will still take the ESCO's performance risk, even though it is "guaranteed," rather than the project lender.

On-bill financing, a mechanism used by government and utility-led schemes, makes capital available to a company or individual for energy efficiency installations where the property involved--rather than the company or individual--makes the loan repayments. Repayments then appear as additions to utility bills or property tax (see chart 4). An example in the U.S. is Property-Assessed Clean Energy (PACE), where a local government body issues a bond to investors to finance energy efficiency installations (as well as those for renewable energy and water conservation) for buildings. While on-bill financing is mainly for residential customers, legislation has been adopted in 29 states for owners of commercial and industrial properties. Similar schemes are starting up in the U.K., Canada, and Italy.

Chart 4



In the area of development aid for energy efficiency project finance, Brazil's Energy Efficiency Guarantee Mechanism (EEGM) supports investment into commercial buildings. The EEGM, a $25 million guarantee fund issued by the Inter-American Development Bank and the Global Environment Facility, covers up to 80% of the value of the energy efficiency investment against the risk that the project underperforms either financially or technically against the expected performance.

A model emerging in the U.S. with larger commercial and industrial clients, known as an Efficiency Services Agreement (ESA; also called an Energy Services Agreement), involves a third party contracting an ESCO to implement and guarantee the performance of the project. That third party enters into a separate agreement with the client to pay for the reduction in energy bill. This method helps to remove the project from the client's balance sheet.

One scheme shows that on-bill financing can be difficult to get right. In 2013, the U.K. government introduced The Green Deal program to finance energy efficiency improvements to homes or businesses. The Green Deal struggled to take off, partly because of its complexity and high interest rates compared to commercial loan and mortgage rates. The scheme closed in July 2015 due to low take-up, with just over 15,000 projects financed. Similarly in the U.S., there have been financing challenges for those on-billing projects where payments for energy savings were subordinated to other payments.

New models are emerging. This year has seen the first securitization of residential energy efficiency loans, as one way to circumvent one of the barriers to project finance in this area: small transaction size (see box).

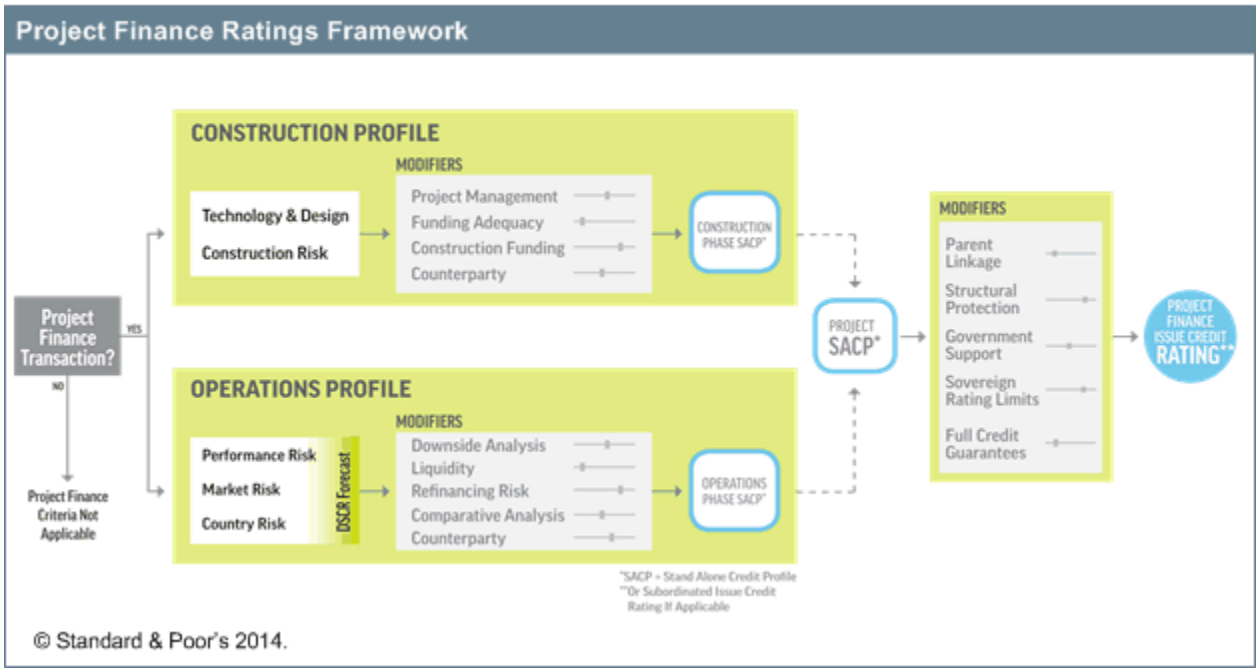
Landmark Energy Efficiency Loan Asset-Backed Security Transaction

In June 2015, Renew Financial and Citi announced a $12.6 million securitization transaction comprising a portfolio of homeowner energy efficiency loans from the Warehouse for Energy Efficiency Loans (WHEEL). The entire issuance was purchased by Calvert Investment Management. This asset-backed security (ABS) transaction, covering energy efficiency loans, creates a new asset class for investors and opens a new pathway for capital markets to access energy efficiency returns. WHEEL is a public-private partnership where energy efficiency loans are collected by Renew Financial, using a combination of public funds from state treasuries and private funding from Citi, until the size of the aggregated loans meets requirements for transaction markets. WHEEL includes Pennsylvania, Kentucky, and the Greater Cincinnati Energy Alliance, and more states are expected to join allowing for potentially larger transaction sizes in future. Citi and Renew expect to bring additional transactions to market in the coming years.

Assessing Credit Risk

One issue that energy efficiency projects face is the credit risk of those involved in their construction, operation, and finance. Financial institutions typically lend to borrowers with collateral that they can repossess in case of default. Standard & Poor's project finance ratings are designed to capture this type credit risk--as well as operational, construction, and market risks--under our criteria, updated last year (see "Project Finance Framework Methodology," published on Sept. 16, 2014; see chart 5).

Chart 5



Construction risks

The project might include construction risk related to the adaptation or construction of mechanical, electrical, lighting, and water systems. We would expect to classify such works as relatively simple building tasks, with limited exposure to technology, under our criteria. One key credit factor would be the track record of the technology, equipment, material, or technical solution as well as how the solution and its design address the site-specific challenges. In most cases, when assessing the technology track record of an energy efficiency project, we would expect to assign an assessment of "commercially proven." That's because we would expect most projects to use off-the-shelf technology.

In addition, sound project management and logistics skills are required to complete construction on schedule, on budget, and to performance requirements. As we have seen in other project finance sectors, we anticipate that projects in this sector might use fixed-price contracts, such as engineering and procurement and construction (EPC) contracts, to mitigate construction cost and delay risk, allowing the project to retain management of specific tasks, including the procurement and installation of specialized equipment, though the latter risk may be retained in the EPC contract.

Counterparty risk

The reliance on third parties under a contractual structure to make payments or perform under a wide range of agreements--such as revenues, construction, equipment supply, operations and maintenance--is a common feature in project finance debt issues. That's why it's important to assess counterparty risk. Standard & Poor's focus centers on where a material risk is transferred to the counterparty, for which we provide an estimate of the exposure to the project should the counterparty become insolvent, assessing whether the latter is replaceable or not. If they are replaceable, subject to the amount of available liquidity, a project can have a higher rating than the creditworthiness of the construction and equipment suppliers (see "Project Finance Construction and Operations Counterparty Methodology," published Dec. 20, 2011).

Under the shared savings type of energy efficiency project, even though the ESCO assumes both performance risk and the underlying customer credit risk, if the energy user were to stop paying, the revenue stream from the project would stop, putting the ESCO at risk. This risk is akin to an offtaker utility that purchases power from an independent power producer. Under this scenario, we would therefore consider the energy user or "customer" as the revenue counterparty, whose credit quality may constrain the project's rating.

Operations risk

The main operational factors we typically assess, to determine the "operations phase business assessment," or OPBA, are the performance (such as the "asset class operations stability") and the project's "resource risk" (see our "Project Finance Operations Methodology," published on Sept. 16, 2014, for definitions of these terms). The asset class operations stability assessment ranges from '1' (the most stable) to '10' (the least stable). Generally speaking, the more complex the project's operations and technology, the higher (i.e., weaker) the asset class operations stability assessment. Schools, offices, and small primary care facilities will typically receive an asset class operations stability assessment of 1. Small and midsize hospitals will typically receive an assessment of 2 due to their more intensive use and the more demanding standards, such as cleanliness, that these facilities are required to meet. (For more information, see table 2 and paragraphs 23-25 of the project finance operations methodology.)

We generally evaluate the independent engineer's assessment of the data used to estimate the resource potential of the project. Our view is that the development of standard procedures for measurement and verification of savings is an important task to forecast reliable cash flows to service debt payments. Good measurement practices and verifiability are some of the important elements in providing the confidence that energy efficiency investments will result in a savings stream sufficient to make debt payments.

Market risk

Market risk only applies when a project's cash flow available for debt service (CFADS) has the potential to decline by more than 5% from our base case to our downside case. In such cases, we then assess the project's market exposure (an assessment of its CFADS volatility due to market forces) and its competitive position. Our view of market risk reflects the extent to which a project is exposed to market changes, for example, if the pricing of the power generated is linked to commodity market pricing. Under the shared savings model, performance is related to the cost of energy saved, as the ESCO bills upon actual results. The cost of energy saved will be split for a predetermined length of time at an arranged percentage, depending on the cost of the project, the length of the contract, and the risks that the ESCO and energy user assume.

We understand some energy efficiency projects, to cope with the risk of energy price fluctuations, have contractually agreed to a single energy price. In this situation, the value of the service is fixed upfront and neither side gains from changes in energy prices. Therefore, if actual prices are lower than the agreed floor value, then the energy user earns a profit, which compensates for the project's lower return. Conversely, if the actual prices are higher than the stipulated ceiling, then the return on the project is higher, but the energy user pays no additional charge.

How we rate comparable projects

Assuming an energy efficiency project adopts highly leveraged project finance structures, we believe the most suitable peers that we rate would mainly be low-cost renewable generation assets. Such projects have commercially proven

technology, low design cost-variation risk, and relatively simple building tasks (if present), such as solar photovoltaic where we rate Solar Star Funding LLC (BBB/Stable).

Energy efficiency projects with a portfolio of independent assets with geographic diversification could benefit from a "positive" performance redundancy score in our OPBA. We have applied this assessment to renewable transactions such as Continental Wind LLC (BBB-/Stable), as it benefits from independent assets providing meaningful diversity and low correlation risk. In addition to renewable energy projects, another relevant peer would be the U.S. utility services project DTE Energy Center LLC (DTEEC; A-/Stable). We assess DTEEC's OPBA as '1' on a 12-point scale on which '1' is the strongest, reflecting its asset diversity (there are 62 systems at eight plants), low technology risk, and stable operating performance of the underlying utility assets. We would expect energy efficiency projects to display similar operating characteristics as well as potential linkages to the revenue counterparty which, as for DTEEC, could ultimately act as a constraint on the project rating.

Research Contributor: Madeleine Clifford of Imperial College London.

Related Criteria And Research

Related Criteria

- Project Finance Operations Methodology, Sept. 16, 2014
- Project Finance Framework Methodology, Sept. 16, 2014
- Project Finance Transaction Structure Methodology, Sept. 16, 2014
- Key Credit Factors For Power Project Financings, Sept. 16, 2014
- Key Credit Factors For Social Infrastructure, Accommodation, And Entertainment Project Financings, Sept. 16, 2014
- Project Finance Construction Methodology, Nov. 15, 2013
- Project Finance Construction And Operations Counterparty Methodology, Dec. 20, 2011

Related Research

- Credit FAQ: Standard & Poor's Approach To Rating Renewable Energy Project Finance Transactions, April 20, 2015
- Common Macroeconomic Assumptions Used In Project Financings, Sept. 16, 2014
- Credit FAQ: Assessing The Credit-Supportiveness Of Europe's Renewable Energy Frameworks, May 22, 2014
- Provision Of Information For Assessing Project Finance Transactions, Dec. 16, 2013
- Rapid Growth Is Expected In Rooftop Solar in The U.S., Nov. 15, 2013
- Solar Is Powering Up, On the Roof or Over The Grid, Nov. 15, 2013

STANDARD & POOR'S RATINGS SERVICES
McGRAW HILL FINANCIAL

RatingsDirect®

Climate Resilience Can Protect Ratings From Sea-Level Rise And Threats To U.S. Coastal Infrastructure

Primary Credit Analyst:
Geoffrey E Buswick, Boston (1) 617-530-8311; geoffrey.buswick@standardandpoors.com

Secondary Contacts:
David N Bodek, New York (1) 212-438-7969; david.bodek@standardandpoors.com
Joseph J Pezzimenti, New York (1) 212-438-2038; joseph.pezzimenti@standardandpoors.com

Table Of Contents

Climate Resilience Can Protect Ratings From Sea-Level Rise And Threats To U.S. Coastal Infrastructure

For years, policymakers have argued whether climate change is a naturally occurring phenomenon, a result of human activity, or some combination of the two. Regardless of cause, few disagree anymore with the scientific consensus that global warming is leading to higher sea levels--a reflection of melting glaciers in Arctic regions, as well as the greater volume of warmer water globally. Depending on the level and pace of the rising seas, coast-hugging highways, seawalls, harbors, nearby water, sewage, and power facilities, and other seaside infrastructure--in addition to millions of homes--could see billions of dollars in losses over the next few decades if nothing is done. Damage to these facilities also could seriously erode local tax bases, adding another level of risk to coastal areas.

Standard & Poor's Ratings Services considers the dangers from rising sea levels to be a long-term, macro-credit risk that is unlikely to be a significant ratings factor in the next five years. But in our view, the failure of states and localities to start planning for the logistical, structural, and financial risks of more water in the wrong places could leave them struggling to protect existing investments in seaside infrastructure.

Overview

- Coastal infrastructure and municipalities face increasing exposure to rising sea levels.
- Constructing barriers to avert flooding might avert billions of dollars of losses.
- The exact credit impact of the threat and preventative measures is unknown at this time.
- Entities taking steps now to protect credit quality long-term will not necessarily incur damage to current credit ratings.

Rising Seas Could Mean Heavy Losses

Between 1960 and 2013 relative sea-level change (the height of the ocean at particular locations, rather than globally) rose eight inches or more along parts of the Atlantic and Gulf coasts, according to the National Oceanic and Atmospheric Administration. Considering the global trend of ocean levels, which showed little change in the two millennia before the industrial era, rising an average 0.06 inch annually between 1880 and 2012--and double that rate since 1993, the rising seas need to be contemplated when designing coastal infrastructure.

Population growth and development that encroaches on shorelines and low-lying areas could greatly elevate losses if coastal protections aren't added (see table). For example, the World Bank estimates that average annual losses (AAL) from a moderate 20-centimeter (7.8-inch) rise in sea level between 2005 and 2050 in Florida's Tampa Bay-St. Petersburg area would boost AAL there to $3 billion from $763 million. Under the same conditions, AAL in Miami would rise to $7.3 billion from $2.1 billion, in Virginia Beach, Va., to $1.5 billion from $278 million, and in Houston to $6.1 billion from $119 million. Storms such as Hurricane Katrina and Superstorm Sandy underscore these exposures

and have eclipsed AAL projections.

Average Annual Losses In U.S. Coastal Cities

(Mil. $)*	In 2005	In 2050	In 2050	In 2050
	AAL with no rise in sea level	Projected AAL with no protection from 20-cm sea-level rise	Projected AAL with protection from 20-cm sea-level rise	Projected worst-case AAL for sea-level beyond 20-cm protection
Baltimore	238	1,178	271	12,741
Boston	741	5,557	793	38,400
Houston	119	6,088	190	9,053
Los Angeles-Long Beach-Santa Ana	188	9,427	203	9,960
Miami	2,099	7,340	2,549	228,589
New Orleans	1,583	161,141	1,864	182,592
New York-Newark	1,960	7,914	2,056	198,885
San Juan	68	1,680	89	4,239
Tampa-St. Petersburg	763	2,997	859	40,022
Virginia Beach	278	1,520	303	40,549

*Constant 2005 dollars. AAL--Avg. annual losses. Cm--Centimeter. Source: World Bank.

To mitigate such losses, in our view, local and state authorities need to determine what the necessary infrastructure is, investigate how to pay for it, and establish contingency plans for "worst-case" scenarios, all while adequate time to do so remains. The states, localities, and utility districts that we rate can typically tap reserve funds when regular revenue streams dry up--although by definition reserves are only a short-term fix. Some issuers could deplete their reserves within a year when responding to storm damage.

And some are also insured against damages through the use of catastrophe bonds, or other credit enhancements. And of course, coastal areas usually receive federal disaster aid, although getting these funds can be politically contentious, leaving the amount and timing of dispersal in doubt.

Localities Are Responding

After Superstorm Sandy and Hurricane Katrina, we have observed that localities have begun strengthening their flood-protection measures to avert a repeat of the catastrophic damage they suffered. One response has been to build new flood protection to greater strength, as measured by the event's severity. The floodgates, berms, or whatever protection is being built may be strengthened to protect against an event expected to happen once in every 200 years, instead of once in a century. Such strengthening can be done in interior flood areas as well as coastal ones.

After Sandy left millions of metropolitan New York City area residents without power when the storm surge knocked out substations and winds blew down transmission lines, some of the affected utilities, including the investor-owned utility Consolidated Edison Inc. and the public power entity Long Island Power Authority, embarked on a program of storm hardening. It partly entailed raising some key structures above expected storm surge levels. Recouping those costs can be difficult even after federal aid, so they may ask to raise rates, a politically unpopular measure. How much

utility customers pay for these improvements will differ in each service area, and Standard & Poor's considers the ratemaking process and its outcome a ratings factor for these issuers. But the larger point remains that protection against rising water levels has become a more important consideration for coastal utilities in light of storm surges and eventually rising sea levels.

Will Transportation Facilities Go Under?

Coastal transportation facilities, including toll roads, bridges, and rail lines, could become exposed to rising sea levels. Issuers for these facilities can obtain disaster aid for immediate catastrophes, but some have already begun planning for longer-term possibilities.

When Superstorm Sandy's waters receded, New York's Metropolitan Transportation Authority (MTA), which operates the subways, found severe damage in some of the system's tunnels. But its credit rating remained intact because MTA management put in place three liquidity facilities after the storm that provided the authority with $950 million of interim financing capacity. The MTA decided to supplement its property insurance coverage with a capital markets-based alternative: $200 million in fully collateralized coverage for losses from storm surges that occur until July 30, 2016. And its 2010-2014 capital budget included $5.8 billion toward hardening the system against future storms and catastrophes. Management's existing contingency plans, plus its quick response to the damage were enough to maintain credit stability. The other big transportation agency in the region is the Port Authority of New York and New Jersey, responsible for the area's harbors, airports, some of its bridges and tunnels, and the PATH commuter rail line that runs between New York and New Jersey. It also maintained credit stability and embarked on a 10-year capital plan (2014-2023) that includes $1 billion for repair, mitigation, and resiliency projects.

Issuers willing to invest in projects that look toward the possibility of higher sea levels are taking actions that may prevent long-term operational and financial difficulties. Any such long-term projects, of course, run the risk that issuers will encounter difficulty in raising taxes or user-fees sufficient to support them. Moreover, barring immediate emergencies, it could prove difficult to get local policymakers and the public to agree to begin large-scale and expensive planning for events that might not prove to be a chronic crisis until after their lifetimes.

The credit standing for transportation infrastructure has generally fared well following severe weather events because any disruptions to operations have been short in duration, typically lasting days or up to a couple of weeks, without major dislocations to key drivers of demand. However, in rare cases, credit quality can be adversely affected. For example, we lowered New Orleans International Airport's general airport revenue bond rating to 'BB' from 'A' in 2005 because of a dramatic drop in passenger traffic, high uncertainty regarding what the key drivers of air travel demand will be in a service area depopulated due to Hurricane Katrina, and the airport's inability to operate on a fully residual basis following the disaster. The airport, however, since then has regained much of its credit standing, presently rated 'A-.' With the global long-term forecast of rising sea levels, the frequency of severe events could threaten credit quality where preparations are short-sighted.

The Danger To Water Facilities

Sewerage and water facilities in areas where sea levels are likely to rise present special difficulties. In some U.S. coastal areas, such as Florida and California, where wells are a big source of fresh water, rising sea levels could eventually contaminate those underground water sources--the aquifers--with salt, making them unusable without expensive desalinization equipment. That problem can be especially serious in areas like Florida, where aquifers consist of a particularly porous limestone that allows water to enter more readily than other types of stone. As a result, seawater can get into these coastal aquifers fairly easily. Saltwater, moreover, is denser than fresh water, so it sinks to the bottom of the aquifer, pushing up the remaining fresh water until it essentially will be depleted. In some deeper wells, evidence of salinity is already apparent, forcing municipal water systems to get potable water from sources further from the coast.

Communities are developing responses to this issue now. For some it is better to use the saltwater rather than give in to it. That means desalinization plants, which are with present technology far more expensive than well water or that pumped in from mountain reservoirs. With drought pressing in California, for instance, desalinization plants are being more seriously considered than in the past. But they are costly: California authorities estimate that water from a $1 billion plant currently under construction north of San Diego will cost roughly twice what water from reservoirs would. Some inland areas, like El Paso, Texas, have already opted for desalinization, despite the cost, opening a major desalinization facility in 2007. But in coastal areas with rising sea levels, an abundance of swampland, or both, these plants are becoming increasingly common. According to the South Florida Water Management District, as of 2014, that region had 36 brackish and two seawater desalination plants operating, with three more under construction. The existing plants, says the district, can produce 269 million gallons of potable water per day.

In Florida, several communities have reacted to the prospect--or in some cases the reality--of rising sea levels by building berms to prevent salt water's encroachment into coastal areas and aquifers. Those berms do double duty in that they not only keep salt water out of the aquifers but also protect coastal highways and residential areas. As with any large infrastructure project, however, the questions are: How expensive will the undertaking be, and who will pay for it--state, county, and local taxpayers, or federal taxpayers?

If rising seas threaten to make many sources of drinking water unusable, they also could mean even worse trouble for localities when they endanger sewage treatment plants. Some scientists have already predicted that some Florida plants on the Atlantic Coast, in Dade County and elsewhere, may have less than 50 years of useful life as waters continue to rise. As with much expensive infrastructure, avoiding damage to sewer lines from saltwater corrosion or seeing those lines overloaded because of additional outside water--both potential public health issues--comes down to a combination of planning, political will, and funding.

Planning Is Key

Coastal areas have always been favored as transport and shipping centers, and as large population centers. Rising sea levels would not be attracting so much attention if most of the population lived far inland. But population growth and

business development near the oceans mean rising sea levels threaten much more now than they would have a century ago. Fighting that threat will not be easy all the time, nor cheap. But preparing for it has already started, and that's all to the good, in our view, because those who are structuring their operations and capital planning without climate change in mind are risking serious losses in the decades ahead.

Writer: Robert McNatt

Argentina
Australia
Brazil
Canada
China
France
Germany
Hong Kong
Italy
Israel
Japan
Korea
Mexico
Poland
Russia
Singapore
Spain
Sweden
South Africa
Taiwan
Turkey
United Arab Emirates
United Kingdom
United States

AFFILIATES

Chile
India
Indonesia
Malaysia
Philippines

www.standardandpoors.com