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Environmental Risks

Moody's To Analyse Carbon Transition Risk Based On Emissions Reduction Scenario Consistent with Paris Agreement

» **For considering the credit implications of greenhouse gas emission reduction regulation we assume as a starting point for analysis a scenario consistent with the national commitments put forward as part of the Paris Agreement**. The Paris Agreement, signed on 22 April 2016 by 174 countries,[1] aims to keep global warming well below 2°C above pre-industrial levels. Its near universal adoption substantially increases the likelihood of coordinated and effective policies to materially reduce carbon and other greenhouse gas emissions over time, which has in turn the potential to become a significant ratings driver in a broad set of industries. Thus, our baseline scenario is a forecast of the global emissions pathway if all countries were to implement their national contributions put forward for the Paris Agreement. While not sufficient to meet a less than 2°C warming objective, this baseline represents a plausible central scenario given current policy commitments of national governments and technology trends.

» **Considerable uncertainty about policy implementation and the pace of technological innovation could affect the timing and magnitude of carbon transition risks**. We will also consider scenarios consistent with the 2°C warming objective, the "business-as-usual" scenario, and other alternative scenarios that may be plausible at a national or regional level. Carbon reduction policies may be implemented at a pace and scope that is much slower than our base case due to political obstacles and challenges of evolution to a low-carbon economy. Alternatively, the ratchet mechanism under the Paris Agreement — or a major advancement in clean energy technology — would increase the potential for a more rapid emissions reduction pathway. We would expect to review and, if necessary, adjust, our central scenario if one of these other scenarios becomes more plausible.

» **We have identified four primary categories of risk associated with carbon transition that we will use to assess credit implications for corporate and infrastructure sectors**. These are: 1) policy and regulatory uncertainty regarding the pace and detail of emissions policies; 2) direct financial effects such as declining profitability and cash flows, due to higher research and development costs, capital expenditure and operating costs; 3) demand substitution and changes in consumer preferences; and 4) technology developments and disruptions that cause a more rapid adoption of low-carbon technologies. Sectors and individual entities are likely to differ

in terms of their ability to mitigate such risks based on their relative exposure and their financial, operational and technological flexibility.

» **In this report we focus on corporate and infrastructure-related issuers.** We also consider the credit implications of carbon transition risk for sovereigns, sub-sovereign issuers, financial institutions and structured finance vehicles. However, for the majority of these industries, carbon transition risk is not typically an immediate credit driver. We plan to address the risks of climate change and carbon transition faced by sovereign and sub-sovereign issuers in a separate publication.

» **We see 13 industries in our corporate and infrastructure portfolio as most exposed to carbon transition risk**.[2] For three sectors — coal, coal infrastructure and unregulated power utilities — material credit impacts and rating adjustments are being felt now. For the others, we expect that they will be affected over the next three to five years, and beyond. For each, our analysis will consider the specific ways in which the four categories of risk will most likely develop under our central emissions scenario. We will focus on specific risk factors and metrics that assess an individual company's exposure to those risks and assess the credit implications by considering the impact for each entity in that industry.

» **Our analysis will assess the implications for each entity in a sector under the relevant industry methodology**. Such methodologies are one of the key tools we use in assigning and monitoring credit ratings. The impact of carbon transition risk is captured in the relevant rating methodologies through our assessment of its impact on the key factors outlined in that methodology that assess an issuer's fundamental credit strengths. Key factors include business profile, debt leverage and interest coverage, and profitability and efficiency. Our view of trends that may impact the business profile of an entity or drive costs higher and/or drive revenues and cash flow lower are reflected in the forward-looking scoring of these broad factors. This approach applies for carbon transition risks as well as the many other risks that are important for ratings, including future changes in technology, labour costs, labour relations, capital costs, demographic trends, product preferences, industry structures, regulation, litigation, and geopolitical trends.

» **For illustrative purposes, we provide the application of such an approach to the automotive manufacturing and unregulated power industries.** Under our central scenario, both industries face much greater risk of material change. The unregulated power sector is already experiencing such change, especially in the European Union. We see growing risks for automotive manufacturers because they will increasingly need to improve emissions-reducing technologies and adapt to the emergence of alternative fuel vehicles, which will increase operating and financial risk for the sector.

» While not the subject of this report, **Moody's also considers the credit implications of direct climate change hazards**, including environmental risks induced by a possibly slower pace in the reduction of greenhouse gas transmissions. However, based on the current limited visibility into the nature, probability and severity of the follow-on risks to global warming trends, and the extremely long projected time frame, direct climate change hazards are not at present a material driver for most ratings.

Our central scenario for considering the credit and ratings implications of emission reduction pathways is consistent with the commitments outlined in the Paris Agreement

We have adopted a carbon emissions pathway consistent with the national commitments put forward as part of the Paris Agreement, as our central scenario for considering the credit and ratings implications of carbon transition risk. We define carbon transition risk as the credit impact of increased costs and business model adjustments associated with the trend towards materially reducing global greenhouse gas (GHG) emissions, including for carbon.

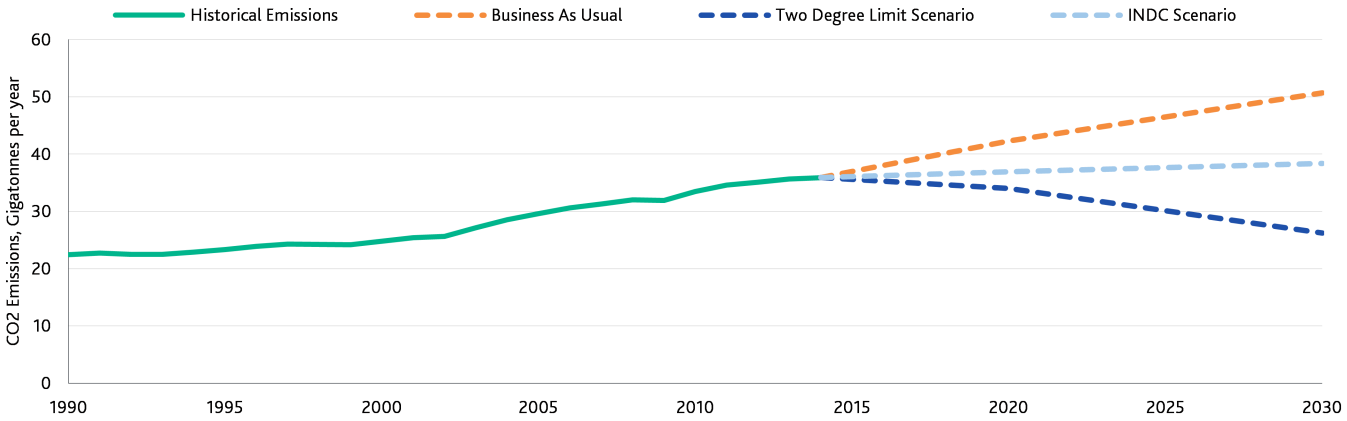
Our central scenario is based upon a forecast of the global emissions pathway if all countries were to implement their intended nationally determined contributions (INDCs) maintained as part of the Paris Agreement.

As illustrated in Exhibit 1, this scenario would see annual carbon emissions climb steadily through to 2030, which is broadly consistent with global warming of 2.5°C-3.0°C above pre-industrial levels. This baseline scenario for emissions pathways is also referred to as the INDC scenario by the International Energy Agency (IEA). For information on alternative scenarios, please see Appendix A.

Exhibit 1

Our Baseline Case Is Consistent with the INDC Scenario

Various Pathways for Energy-Related Global CO_2 Emissions, Gigatonnes per year



Note: The "business as usual" and "two degree limit" scenarios are sourced from the Carbon Dioxide Information Analysis Centre. The INDC Scenario, which incorporates more than 150 INDCs submitted as of October 2015 and covers around 90% of global emissions, is based on data from the International Energy Agency.
Sources: Moody's Investors Service, Carbon Dioxide Information Analysis Centre, International Energy Agency

The Paris Agreement is an international climate pact which aims to keep global warming well below 2°C above pre-industrial levels and commits countries to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.[3]

The near-universal adoption of the Paris Agreement marks a significant landmark in global climate negotiations that substantially increases the likelihood of coordinated and effective policies to reduce carbon emissions and promote low-carbon technologies. This development will pose heightened carbon transition risks for rated entities in a number of industrial sectors globally.

While not legally binding, the agreement was signed by 174 countries on 22 April 2016. The agreement will enter into force when at least 55 signatories — accounting for 55% of global greenhouse gas emissions — have deposited their instruments of ratification, acceptance or approval. So far, 17 parties have done so.[4] The agreement will remain open for signature until 21 April 2017.

The agreement comprises of the individual country targets, or INDCs — aimed at reducing emissions over time — with many countries unveiling formal pledges for the first time. Exhibit 2 shows the INDCs submitted by the top 10 carbon emitters globally.

Exhibit 2

Paris Agreement Will Lead to Faster Adoption of Carbon Reduction Policies Over Time

INDC Greenhouse Gas Emissions Goals for Top-Ten CO_2 emitters

UNFCCC Party	Intended Nationally Determined Constribution (INDC)
China	Achieve the peaking of GHG emissions by 2030 or earlier and lower emissions per unit of GDP by 60-65% from 2005 level. Increase share of non-fossil fuels in primary energy consumption to ~20%.
United States	Reduce GHG emissions by 26-28% below 2005 by 2025, make best efforts to reduce emissions by 28%.
European Union	Binding target of an at least 40% domestic reduction in GHG emissions by 2030 compared to 1990.
India	Reduce the emissions intensity of GDP by 33-35% by 2030 from 2005 level. Achieve about 40% cumulative electric power installed capacity from non-fossil fuel energy resources by 2030; create additional carbon sink of 2.5-3bn tonnes of CO2 equivalent through additional forest and tree cover by 2030.
Russia	Limit GMG emissions to 70-75% of 1990 levels by 2030 subject to the maximum possible account of absorbing capacity of forests.
Japan	Reduction of 26% by 2030 compared to 2013 (25.4% reduction compared to 2005).
South Korea	Emission reduction by 37% from the business-as-usual level by 2030.
Canada	Reduce GHG emissions by 30% below 2005 levels by 2030.
Brazil	Reduce GHG emissions by 37% below 2005 levels in 2025.
Mexico	Reduce by 25% of GHG and Short Lived Climate Pollutants emissions (below BAU) by 2030.

Sources: UNFCCC, Moody's Investors Service

While the INDC scenario is insufficient to meet the less than 2°C warming objective outlined in the Paris Agreement, it is reasonable to use this pathway as our central scenario, given its near-universal adoption and because it represents the current policy commitments of national governments.

By allowing national policy to dictate regulation within a collective agreement, there is a greater likelihood that countries will adhere to their Paris Agreement targets. As the first significant global climate deal since the Kyoto Protocol was signed in 1997, the Paris Agreement comes after several years of failed attempts to impose binding quotas on emissions reductions or a global consensus on carbon pricing.

Furthermore, the technology and market shifts that are already underway suggest that the successful implementation of country commitments is a plausible scenario. For instance, the INDC scenario for developed economies implies a 1.5%-2.0% reduction rate in emission before 2030, which is consistent with the EU emission reduction rate between 2010 and 2015.

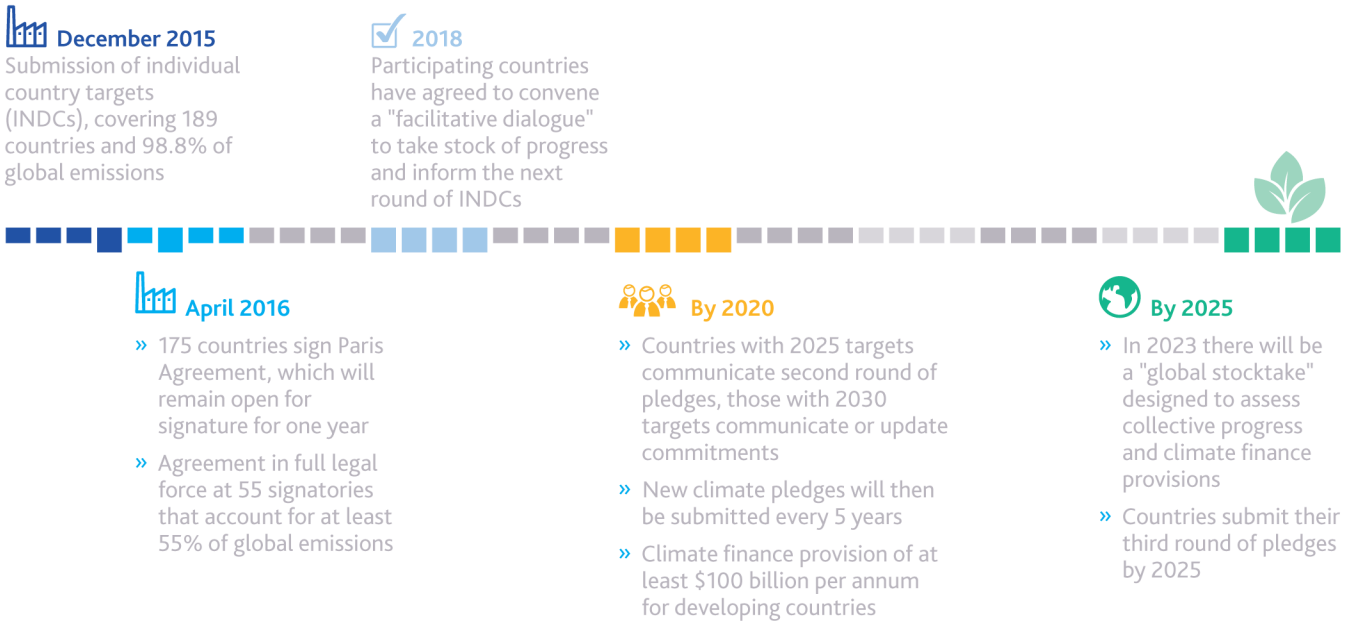
Finally, the collective review processes outlined in the Paris Agreement will improve the prospects of country carbon reduction goals becoming more ambitious and far-reaching over time, which will encourage a faster take-up of polices aimed at controlling emissions and promoting low carbon technologies. As illustrated in Exhibit 3, the Paris Agreement's "ratchet mechanism" sets dates for the first "facilitative dialogue" in 2018 to help inform the next round of INDCs, a commitment to renew or update pledges by 2020 with five year reviews thereafter, and the first formal "global stocktake" of collective progress by 2025.

Coupled with measures to ensure a measurement and monitoring framework and climate finance provisioning for developing countries, this "ratchet mechanism" is designed to increase global oversight and compliance. Moreover, even if national policy continues to drive overall outcomes, the systematic review processes will pressure countries to ramp up carbon reduction regulation over time.

Exhibit 3

The Paris Agreement's "Ratchet Mechanism" Will Increase Global Oversight and Ambition of Carbon Reduction Policies

Timeline of Key Events Outlined in Paris Agreement



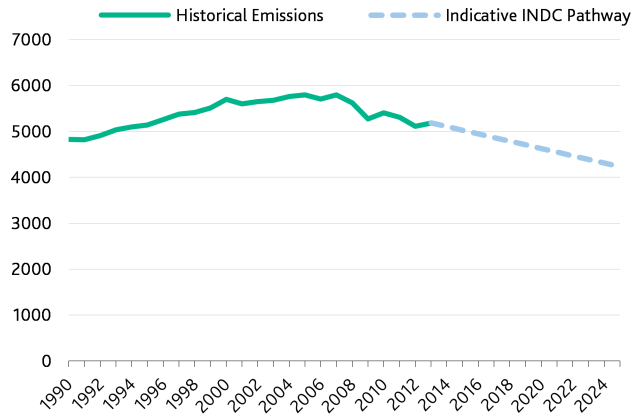
Sources: Moody's Investors Service, UNFCCC, Carbon Brief

The global scenario, however, conceals significant variations in emissions pathways at a national or regional level. In part, this situation reflects the different stage of economic development between the developed and emerging economies. For instance, INDCs submitted by the US (Aaa stable) and European Union (EU, Aaa stable) would imply a significant reduction in carbon emissions for their respective economies (Exhibits 4 and 5). China (Aa3 negative) will see a material reduction in the emissions intensity of its economy based on its pledge to reduce the carbon intensity of GDP by 60%-65% below 2005 levels by 2030, but is unlikely to see emissions peak before then (Exhibit 6). India (Baa3 positive), meanwhile, will continue to experience a material increase in carbon emissions based on its pledge to reduce emissions intensity by 33%-35% below 2005 levels by 2030 (Exhibit 7).[5]

Exhibit 4

The US Faces a Significant Reduction in Emissions

US CO_2 Emission Pathways, Million Tonnes per Year

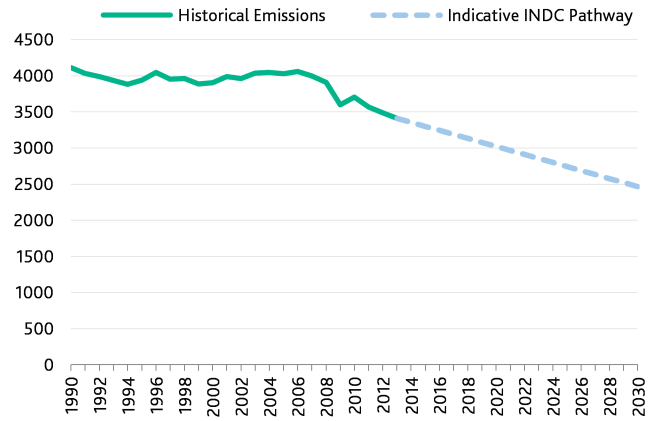


Note: Total CO_2 emissions from fossil-fuels and cement production. US target is for total greenhouse gas emissions but we assume the same reductions apply for CO_2. Focusses on the mid-point of the US's CO_2 emissions commitment only and excludes impact of other targets maintained as part of the INDC. Assumes linear extrapolation, actual future emission pathway likely to differ.
Sources: Moody's Investors Service, CDIAC, UNFCCC

Exhibit 5

EU Pathway Implies Dramatic Emissions Reduction

EU-28 CO_2 Emission Pathways, Million Tonnes Per Year

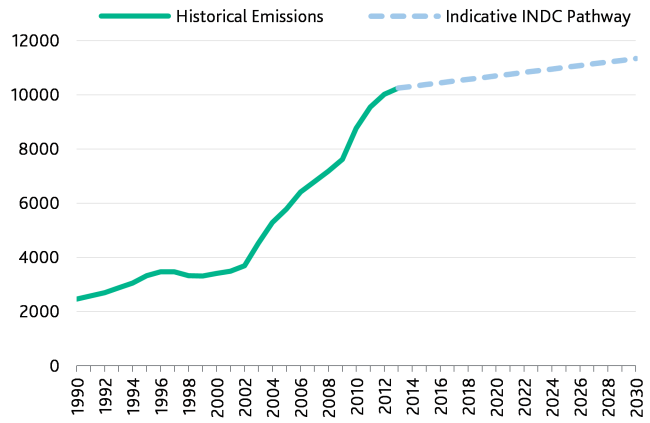


Note: Total CO_2 emissions from fossil-fuels and cement production. US target is for total greenhouse gas emissions but we assume the same reductions apply for CO_2. Focusses on CO_2 emissions commitment only and excludes impact of other targets maintained as part of the INDC. Assumes linear extrapolation, actual future emission pathway likely to differ.
Sources: Moody's Investors Service, CDIAC, UNFCCC

Exhibit 6

China's Emissions To Peak in 2030

China's CO_2 Emission Pathways, Million Tonnes per Year

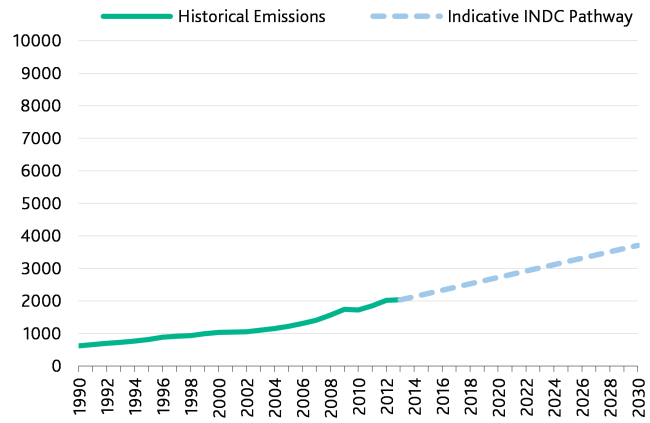


Note: Total CO_2 emissions from fossil-fuels and cement production. Indicative emissions pathway is a Moody's estimate based on OECD long-term economic projection data and mid-point of China's INDC carbon intensity pledge. Focusses on CO_2 emissions commitment only and excludes impact of renewable energy and other targets maintained as part of the INDC. Assumes linear extrapolation, actual future emission pathway likely to differ.
Source: Moody's Investors Service, CDIAC, OECD, UNFCCC

Exhibit 7

Indian Emissions Will Continue to Grow

India's CO_2 Emission Pathways, Million Tonnes per Year



Note: Total CO_2 emissions from fossil-fuels and cement production. Indicative emissions pathway is a Moody's estimate based on OECD long-term economic projection data and mid-point of China's INDC carbon intensity pledge. Focusses on CO_2 emissions commitment only and excludes impact of renewable energy and other targets maintained as part of the INDC. Assumes linear extrapolation, actual future emission pathway likely to differ.
Source: Moody's Investors Service, CDIAC, OECD, UNFCCC

Considerable uncertainty about policy implementation and the pace of technological innovation could affect the timing and magnitude of carbon transition risks

Our central scenario for global emissions provides a consistent benchmark for analysts and investors to consider carbon transition risk for rated entities. However, there remains a considerable lack of visibility on the future carbon emissions pathway, due to uncertainties regarding policy implementation and the pace of innovation in low-carbon technologies. As such, while the INDC Scenario will anchor our analysis, we will also consider scenarios consistent with the 2°C warming objective outlined in the Paris Agreement, the "business-as-usual" scenario, and other alternative scenarios that may be relevant at a national or regional level.

On the one hand, it is possible that national policies will be implemented at a slower pace and shallower scope than suggested by the INDCs. Despite the breakthrough nature of the Paris Agreement, there remain important questions about the strength of political commitment to carbon emission reduction policies in some countries. A lack of bipartisan political support for carbon regulation could result in considerable delay in the implementation of Paris Agreement commitments, such as ongoing legal challenges to the Clean Power Plan in the US, or indeed policy reversal, as in we have observed in the past, for example in Australia (Aaa stable). Equally, effective international coordination could prove challenging. Equally, the challenges of evolution to a lower-carbon economy could translate into delays in INDC implementation. Slower or more limited implementation of INDCs would reduce the immediate credit implications for carbon intensive industries.

The differences in the national INDC commitments, as well as variations in the way that these commitments are implemented at a regional level, could also result in uncertainties at a region or sector-specific level. While we expect industries operating on a global basis, such as automotive manufacturers, to face a common set of risk factors associated with carbon transition, other industries, such as power utilities, that are more affected by local market structures and forces will face varying credit risk from region to region.

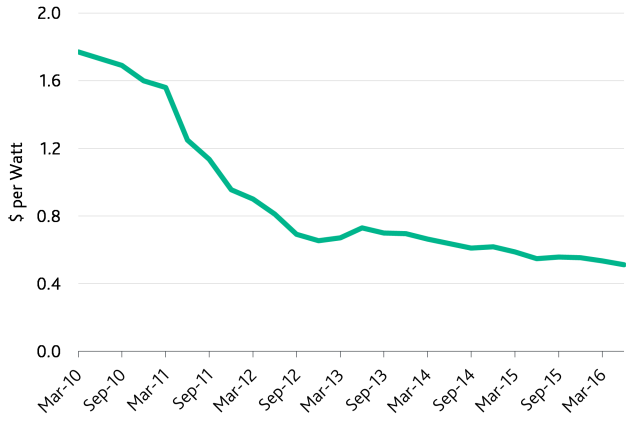
On the other hand, we could also see a more aggressive carbon reduction pathway globally. The estimated greenhouse gas emissions implied by the INDC submissions would be larger than that consistent with the 2°C target for global warming. This suggests that more stringent commitments to carbon reduction will be required on a country-by-country basis for this target to be achieved. Indeed, the "ratchet mechanism" under the agreement, and the commitment to seek to minimise global temperatures well below 2°C above pre-industrial levels, increase the potential for a more rapid emissions reduction pathway than our central emission scenario, particularly if there are increasing signs of climate change.

Importantly, the likely future carbon reduction pathway will also depend on the speed with which low-carbon technology — including carbon capture and storage — can be developed and deployed. The pace of innovation in low-carbon sectors, such as solar power, electric vehicles and energy storage technology, has in recent years been much more rapid than initially expected. Technology learning curves (the speed with which costs have declined over time) have been tremendous in the solar and wind energy sectors (Exhibits 8 and 9). Technological innovation is highly path-dependent. For example, they are subject to the risk of a slowdown, in the absence of institutional and behavioural change supporting the innovation process, and sudden breakthrough on the other hand.

Exhibit 8

Costs of Solar Energy Component Parts Have Declined...

Average Silicon Solar Module Spot Price, $ per Watt

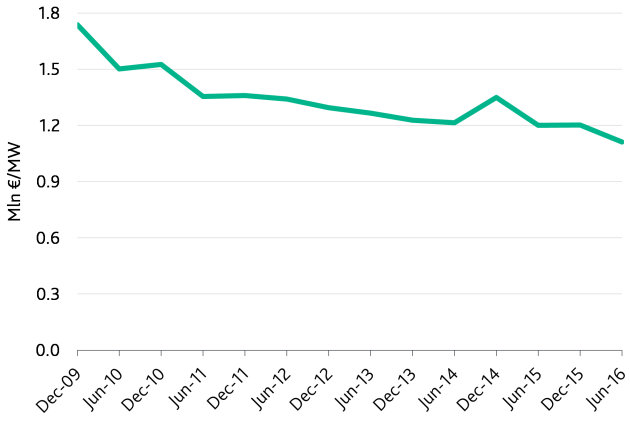


Sources: Bloomberg New Energy Finance, Moody's Investors Service

Exhibit 9

...as Have Costs of Wind Power

Wind Turbine Price Index, Mln €/MW



Sources: Bloomberg New Energy Finance, Moody's Investors Service

We would expect to periodically review and update our central scenario if we see trends that indicate that one of the above scenarios — or even a separate scenario — is becoming more plausible. We would also update the central scenario as the nationally determined contributions are themselves updated.

We have identified four primary categories of risk associated with carbon transition that we use to assess the credit implications

The transition to a lower carbon emissions future consistent with country commitments outlined in the Paris Agreement will have direct and material credit implications for carbon-intensive industries. In the absence of substantial counterbalancing initiatives, it will result in increasing pressure on the affected companies' credit profiles.

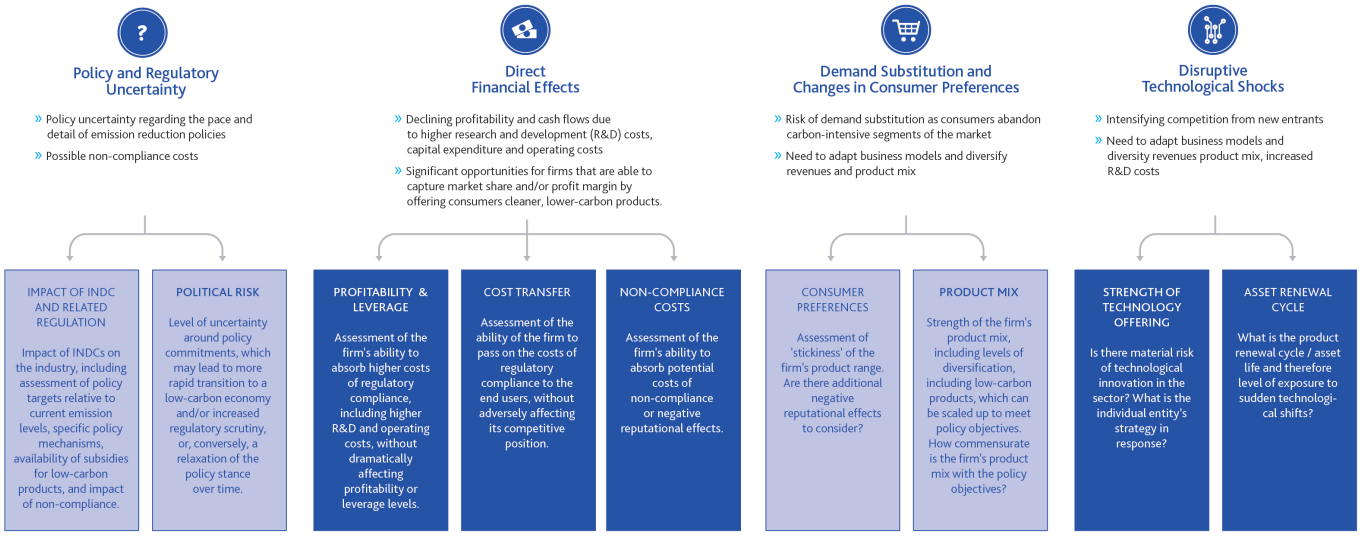
In addition, while we expect the financial effects of carbon transition to become evident gradually in some cases, the risks of a sudden and rapid transition cannot be ruled out for industries undergoing significant technological development.

We have identified four primary categories of risk that we use to assess the credit implications of carbon transition (Exhibit 10):

1. Policy uncertainty regarding the pace and detail of emissions policies;
2. Direct financial impacts, including declining profitability and cash flows due to increased research and development (R&D) expenses, capital expenditure and/or higher operating costs related to carbon emissions;
3. Demand substitution, as rising costs render products increasingly uncompetitive and consumer preferences shift away from high carbon emitting products; and
4. Technology developments and disruptions that cause a more rapid adoption of low-carbon technologies.

Exhibit 10

Four Primary Transmission Channels for Carbon Transition Risk to Credit and Ratings



Source: Moody's Investors Service

The four categories demonstrate considerable interplay: most clearly, new and/or cheaper low-carbon technologies could trigger a more material shift in consumer choices that would otherwise be less plausible. As such, exposed industries could face feedback loops with material credit implications.

At the same time, for some issuers, transition to a low-carbon economy may present a considerable opportunity, especially for companies at the forefront of technological innovation, and which may be able to capture significant market share and/or profit margin by offering consumers cleaner, lower-carbon products. This may also be the case for established companies that are able to adapt in a quick and nimble fashion. We will evaluate the degree to which such companies benefit from carbon transition using the four transmission channels outlined above, with particular emphasis on their degree of adaptability.

Similarly, we overlay our assessment of the four categories of risk with considerations of management strategy. How management sets out its strategy for addressing the implications of the INDC scenario and other possible — more severe or less severe – carbon pathway transitions is a key analytical consideration and will inform our overall assessment of a given company's exposure to carbon transition risk.

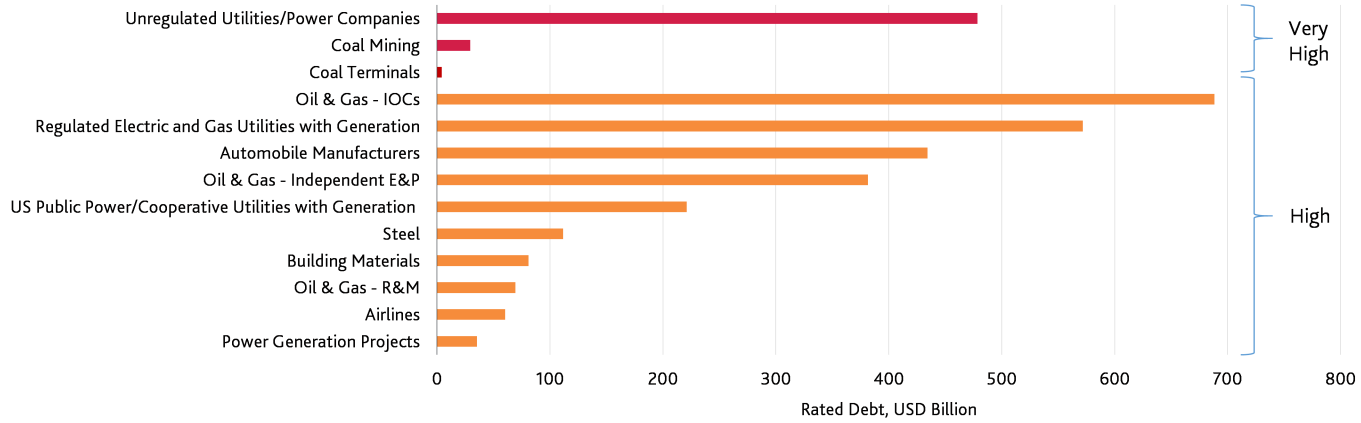
We assess the transmission channels for such trends to individual sectors with our most immediate focus on the 13 industries we see as most exposed to carbon transition risk

We will consider the specific ways each of the four categories of risk outlined above will affect rated sectors under the INDC scenario by focusing on the specific ways in which such risks could impact materially the relevant sector's credit quality. In turn, we will identify specific metrics that best capture such risks and assess the credit implications by considering the impact for each entity in that industry. This analysis will include assessing the implications for each entity under the relevant industry methodology, which is one of the key tools we use in assigning and monitoring credit ratings (see Box 1).

In particular, we have identified 13 industries in our corporate and infrastructure-related portfolio with high or very high levels of exposure to carbon-related risks, ranging from coal mining and other fossil fuel-related industries to building material and steel in the industrial space. Together they account for roughly $3.2 trillion of rated debt (Exhibit 11).

Exhibit 11

13 Sectors with Very High or High Exposure to Carbon Regulations



Note: Qualitative scoring assessment of the credit exposure of a given sector to carbon regulations. The scoring was part of a heat map developed by relevant Moody's analytical teams and Moody's credit strategy and standards groups. The review took place on a globally coordinated basis from September to November 2015.
Source: Moody's Investors Service

For three of the identified industries — coal mining, coal terminals and unregulated utilities — we believe that the exposure from carbon regulation is material to credit quality now. For unregulated utilities, policies to reduce carbon emissions have already resulted in increased supply of renewable sources of energy, depressing prices and margins. This situation has led to rating changes, particularly for European unregulated utilities. For the two coal-related industries, although ratings changes have not been directly linked to carbon regulation, environmental concerns have reduced the demand for coal. We incorporate these considerations into forward estimates of coal producers' revenues and margins.

For six other industries affected by carbon transitions risks, we believe the credit impact could become material over the next three to five years. These sectors are power generation projects, building materials, steel, automobile manufacturers, independent exploration and production oil & gas companies, and oil & gas refining and marketing companies. Companies in these sectors have greater flexibility in responding to regulations, in developing or adjusting to technology, in the timing for required capital expenditures to remediate or prevent environmental hazards, and in passing on expected cost increases to customers or taxpayers. For example, many automotive manufacturers are already active in technological innovation, such as the development and production of alternative fuel vehicles.

For four other industries with high exposure to carbon transition risks, we believe the credit impact could be material over the medium to long term (five or more years). These sectors are airlines, integrated oil & gas companies, regulated electric and gas utilities with generation, and US public power/cooperative utilities. We believe it is less certain that the risks will develop in a way that is material to ratings for most entities in these three sectors.

Box 1: How Are Carbon Risks Captured in Moody's Ratings Methodologies?

Our methodologies for fundamental debt issuers provide general guidance that helps companies, investors, and other interested market participants understand how quantitative and qualitative factors are likely to affect rating outcomes. They provide summarized guidance for the factors that are generally most important in assigning ratings to issuers in particular sectors.

Methodology scorecards largely focus on factors that assess an issuer's fundamental credit strengths and their overall ability to withstand the various types of risks and challenges that issuers may encounter. Most rating methodology scorecards contain a small number of factors that are explicitly scored. It would theoretically be possible to disaggregate these factors into a much larger number of more granular factors that drive resilience to default and recovery risks. However, instead of scoring a large number of factors individually, our usual approach is to incorporate multiple considerations into a small number of broad factors. For example, scorecards in Moody's corporate rating methodologies generally include broad factors that are scored for (i) business profile, (ii) leverage and coverage, and (iii) profitability and efficiency.

Our view of trends that may drive costs higher and/or drive revenues and cash flow lower are reflected in the forward-looking scoring of these broad factors. This approach applies for environmental risks as well as the many other risks that are important for ratings, including future changes in technology, labor costs, labor relations, capital costs, demographic trends, product preferences, industry structures, regulation, litigation, and geopolitical trends.

The impact of these risks is captured in the scorecards in our corporate rating methodologies through our scoring for business profile, leverage and coverage, and profitability and efficiency. Business profile and profitability generally relate to the long-run cash generation capacity of an issuer. And to the extent climate change or carbon emission regulation causes a material degradation to these factors in a time frame that does not permit companies to react, reinvent themselves or pay off existing debt (e.g., through asset "stranding"), then climate change could be a key ratings driver or a contributing driver. For example, our current weak financial and business profile projections for most companies in the mining industry incorporate escalating environmental and litigation costs and falling demand that are due to growing global concerns about adverse environmental impacts. However, our forward-looking scoring for these same scorecard factors also includes other negative trends for mining companies, such as weakening demand resulting from slower expansion of the industrial and infrastructure sectors in China, and rising pension liabilities.

In most cases, methodologies have not focused on scoring individual risks for three main reasons. First, trying to gauge the probability, impact and timing of an individual risk is usually not a fruitful exercise, because these elements change over time with changing circumstances. They can be influenced by macroeconomic trends, commodity cycles, availability of credit, etc. Second, issuers do not face risks individually, but rather in aggregate. For instance, for an industry that contends with environmental risks, commodity cycles, product substitution risks and increasing pension liabilities, the significance to ratings does not lie in analyzing exactly how much pressure environmental risks represent, but rather to assess in aggregate how the totality of risks will affect an issuer's default and recovery. Third, even if a full catalogue of known risks could be individually calibrated, as-yet unidentified risks would be left out of the process.

In certain sectors, environmental risks may be somewhat more specifically addressed in methodologies. Our utilities methodologies are one example. For these issuers, environmental costs are generally recoverable in rates, but management of these costs may affect affordability for consumers and relationships with regulators who set the tariff level. In some cases, environmental risks are specifically mentioned as one of the considerations in scoring qualitative factors, such as the business profile factor in the Global Automobile Manufacturing Industry methodology. For fundamental issuers, methodologies include rating factors that are considered outside the scorecard grid, an approach that is sometimes used where a positive assessment does not necessarily confer credit strength, but a negative assessment creates a higher degree of issuer specific risk. For instance, in the Global Mining Industry methodology, environmental risks are specifically cited in the description of these additional factors.

For further information, please see Cross Sector – Global: Moody's Approach to Assessing the Credit Impacts of Environmental Risks, November 2015.

For illustrative purposes, we provide the application of such an approach to the automotive and unregulated power industries.

Under our base case scenario, the automotive manufacturing sector faces a much greater risk of material change than in the past

Using the four primary transmission channels for carbon transition risk, we expect the following trends to materialise for automotive manufacturers and their ratings under our central scenario for carbon emissions (Exhibit 12).

Exhibit 12

Material Industry Change from Increasing Emissions-Reducing Regulatory Targets and Growth in Alternate Fuel Vehicles

Policy and Regulatory Uncertainty

- Increasing emissions-reducing regulatory targets will be targeted at the auto sector.
- Increasing regulatory risk and the challenges of operating across jurisdictions and numerous platforms will add significantly to management complexity and business risk.

Direct Financial Effects

- Profit margins and cash flows face increasing pressure as OEMs develop and implement further emissions-reducing technologies.
- Pick-up in demand for AFVs will cause a need for greater production capacity. This will likely cause both higher capex and R&D expenditures well in advance of sales.

Demand Substitution and Changes in Consumer Preferences

- Growth in the development of alternative fuel vehicles (AFVs);
- Brand and reputational risks of failure to comply with relevant emissions regulations.

Risks of Disruptive Technological Shocks

- The likely take up of AFVs and the difficulty of predicting the speed of such transition represent significant business risks for traditional OEM.

Source: Moody's Investors Service

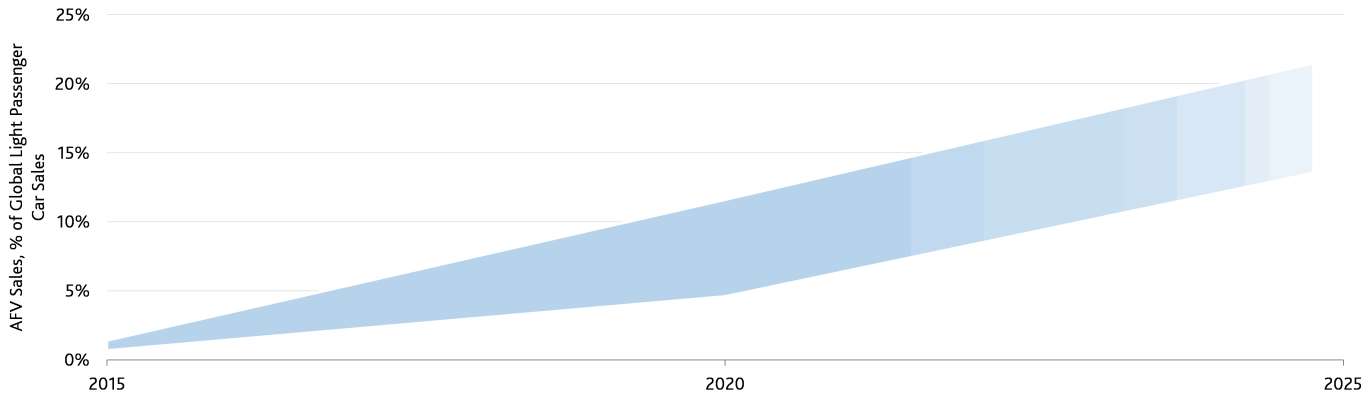
Two clear trends stand out. First, there is a need for original equipment manufacturers (OEMs) to rapidly increase the use of emissions-reducing technologies to meet regulatory targets. High profile breaches — such as Volkswagen Aktiengesellschaft's (VW, A3 negative) and Mitsubishi Motors Corporation's (unrated) recent admissions that they breached emissions standards — will prompt far greater regulatory and consumer attention on the sector. This situation will further pressure OEMs to lower their emission levels, especially because of the significant financial and reputational penalties associated with any non-compliance.

Second, we expect significant growth in the development of alternative fuel vehicles (AFVs), given technological innovation, the mentioned regulatory pressures and likely consumer demand. The multiple variables involved — including energy prices and the speed of technological innovation and policy implementation — make it difficult to predict accurately the take-up of electric vehicles and other AFVs. Nevertheless, some market sources estimate that AFVs could account for between 5% and 10% of new car sales by the end of the decade, and between 15% and 20% by 2025 (Exhibit 13).

Exhibit 13

Alternative Fuel Vehicles Will Make Up A Greater Share of the OEMs' Product Suites

Alternate Fuel Vehicle Sales, % of Global Passenger Car Sales



Note: Upper and lower bands use a range of external forecasts.

Sources: Moody's estimates based on market sources, KPMG, IEA, Goldman Sachs International Research, Arthur D. Little

The likely take-up of AFVs and the difficulty of predicting the speed of such transition represent significant business risks for OEMs, which need to make decisions around the pace of investment and the likely returns. If they proceed too quickly, they may not obtain appropriate returns for many years. Alternatively, they may invest too slowly and find their market share and competitive position under pressure. Some manufacturers are likely to adopt strategies that are more successful than others, enabling them to maintain or improve market share. Most clearly, the rise of AFVs is a significant business opportunity for new entrants focussing on these products.

HOW DO WE ASSESS THESE RISKS IN OUR RATINGS?

The analysis and table below set out how we link the above trends to the way we assess ratings for the automotive manufacturing sector in the relevant industry rating methodology.[6]

Broad Rating Factor	Factor Weighting	Rating Sub-Factor	Impact of INDC Scenario
Market Position and Trend	35%	Trend in Global unit Share over 3 years	The OEMs' product range will need to evolve to meet emissions regulation and growing AFV demand to protect competitive position, market share and product range profitability. OEMs that lack robust emission reduction technologies and AFV product development will likely be scored lower on this metric over time as risks to competitive profile and profitability increase. Conversely, firms that are able to adapt nimbly or AFV manufacturers, that are able to capture market share, may be scored higher. Finally, brand damage is an increasing risk, as the VW example highlights.
		Product Breadth and Strength	
Leverage and Liquidity	20%	Debt/EBITDA	Higher R&D and capex required to develop AFV model lineup and improve emissions technology. Long lead times between development and sales will pressure profitability and cash flows. Uncertainty that increased expenses can be recovered will lead to risk of lower margins over time. Rising risk that leverage will increase to invest in emissions-reducing technologies and AFV product development. As this happens, OEM scores on these metrics could decline absent counter-balancing initiatives to reduce costs overall (e.g. alliances) or increased equity capital.
		Debt/Capital	
		Cash and Marketable Securities/Debt	
Profitability and Returns	15%	EBITA Margin	
		EBITA/Average Assets	
		Net Profit After Tax and Before Unusual Items/Sales	
Cash Flow and Debt Service	30%	Free Cash Flow/Debt	
		Retained Cash Flow/Debt	
		EBITA/Interest	

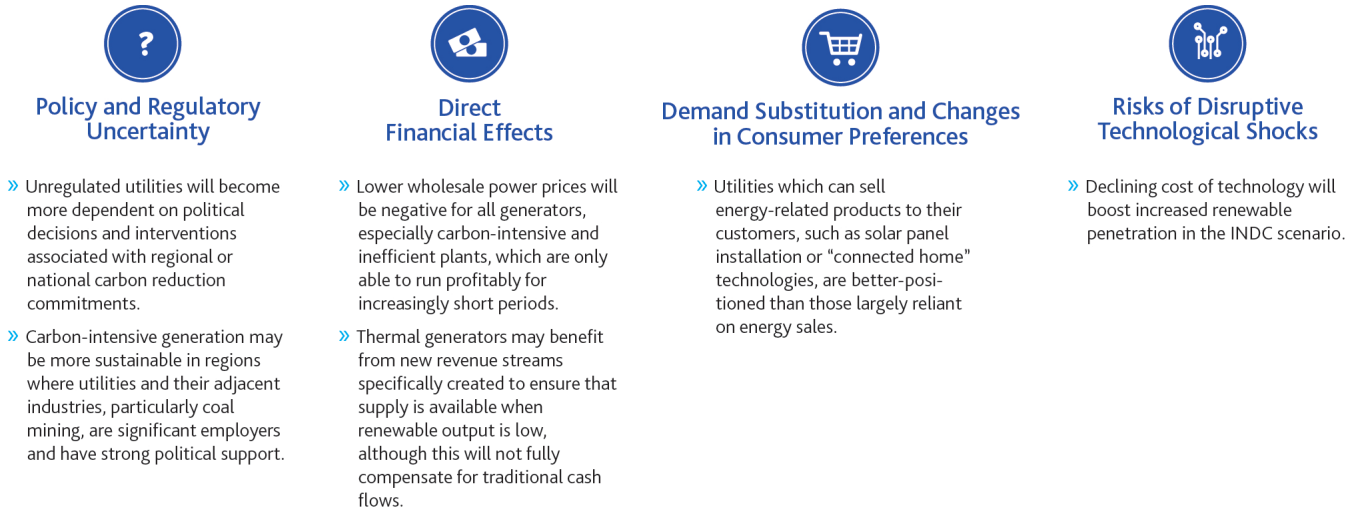
Business models of unregulated utilities and unregulated power companies will need to evolve in a lower-carbon future

As the largest direct source of carbon emissions in most developed countries, unregulated utilities will need to generate a large share of the emissions reductions required to achieve the INDC base scenario. The role of a utility will need to change in a lower-carbon future, as baseload thermal generation becomes increasingly unviable as a business model.

Applying the four primary transmission channels for carbon transition risk, we expect the following trends to materialise for unregulated utilities and unregulated power companies and their ratings under our central scenario for carbon emissions (Exhibit 14).

Exhibit 14

Unregulated Utilities and Power Companies Are Vulnerable to Carbon Transition Risks



Source: Moody's Investors Service

Specifically, we have identified the following key issues:

Efficiency of existing generation and scope to diversify generation revenues. We expect mandated renewable targets and the declining cost of technology to lead to increased renewable penetration in the INDC scenario. The low marginal cost of most renewables will tend to displace existing thermal plant with high variable costs, notably coal in markets which introduce a high carbon price, and place downward pressure on wholesale prices. In addition, we see it as likely that carbon prices for emissions will become more common and costly.

While lower wholesale power prices will be negative for all generators, the highest-cost plants, which are often the most carbon-intensive, will be affected sooner and more significantly than others, as they are able to run profitably for increasingly short periods. They would also be affected disproportionately by a carbon price.

In Europe, load factors for conventional thermal generation fell to 30% from almost 50% between 2000 and 2014, despite recent capacity closures, as the share of production from renewables doubled. In the US, wholesale prices have declined, due to the dramatic fall in natural gas prices since 2008. This situation has already displaced substantial amounts of coal-fired generation, which declined from 48% of the total in 2007 to 33% in 2015 and continues to fall. This has reduced carbon emissions from the power sector and the trend will likely accelerate in the US under the INDC scenario.

Although thermal generation is likely to be displaced by renewables in baseload production, utilities may still benefit from having generating capacity which is flexible enough to capture peak prices. Thermal generators may also be able to benefit from new revenue streams specifically created to ensure that supply is available when renewable output is low, such as payments for capacity. While a helpful mitigant, there is a significant risk that such alternative earnings streams may not fully replace cash flows generated by current generation operations.

Ability to develop regulated and service-based revenue streams. Utilities which earn significant revenues from regulated networks will generally show more stable earnings than those which are largely reliant on merchant generation.

In the US, the only merchant power generators that have investment grade ratings are those where the majority of consolidated cash flows come from regulated network operations. In Europe, networks on average contribute around a third of EBITDA, and larger regulated shares have been associated with significantly greater cash flow stability.

In addition, utilities which can sell energy-related products to their customers, such as solar panel installation or "connected home" technologies, may be better positioned than those largely reliant on energy sales.

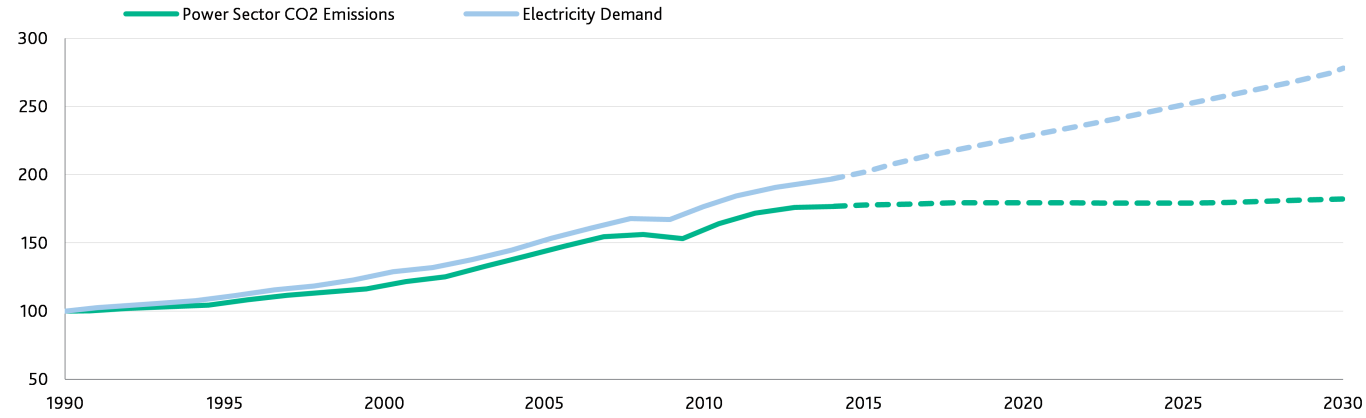
Pace of change and supportiveness to the sector of national carbon policies. As unregulated utilities become more dependent on political decisions associated with the INDCs, a key credit driver for utilities will be the supportiveness and flexibility allowed by these interventions.

Carbon-intensive generation may also be more sustainable, at least in the medium term, in regions where they and their adjacent industries, particularly coal mining, are significant employers and have strong political support.

The INDC scenario breaks the traditional link between electricity demand and carbon emissions (Exhibit 15).

Exhibit 15

The IEA Expects Power Sector Emissions to Stabilise Even as Demand Continues to Grow



Note: Re-indexed using 1990 as base year.
Sources: World Energy Outlook Special Briefing for COP21, International Energy Agency October 2015

The specific mechanisms will vary from country to country, but in most regions we expect unregulated utilities and power companies to be affected by some combination of increased renewable penetration, more self-generation and local generation of electricity, and lower total energy demand, due to improved efficiency. This situation will create challenges for incumbent utilities, as existing coal-fired plants — and in some markets also gas-fired plants — are forced to close or are called on to run less often, and as the low marginal cost of new renewable generation places downward pressure on wholesale electricity prices.

These factors have already contributed to sharply lower profitability for many types of generation in Europe and the United States, and these trends are likely to continue and to affect other markets over time.

HOW DO WE ASSESS THESE RISKS IN OUR RATINGS?

The analysis and table below set out how we link the above trends to the way we assess ratings for the unregulated power companies and utilities in the relevant industry rating methodology.[7]

Broad Rating Factor	Unregulated Utility Weighting	Unregulated Power Company Weighting	Rating Sub-Factor	Impact of INDC Scenario
Scale	10%	10%	Scale	Total assets are likely to decline for many utilities due to write-offs of obsolete generation, although this may be partly offset by growth in similarly asset-intensive regulated networks.
Business Profile	40%	35%	Market Diversification	
			Hedging and integration impact on cash flow predictability	Renewable subsidies and contractual earnings from capacity will increase the visibility of cash flows, a positive for this factor.
			Market framework and positioning	If implementation of the INDC scenario increases the risk of adverse political interference, it would be negative for this factor. The sustainability of renewable subsidy schemes will also be reflected in this factor.
			Capital requirements and operational performance	Early closure of existing plant may lead to significant investment in new generating capacity or alternative businesses, a negative for this factor, or lead to low capacity factors and a weaker operating profile.
			Business mix impact on cash flow predictability	Reduced earnings from conventional, market-exposed generation, while negative for leverage and coverage metrics, could be positive for this factor if they increase the share of regulated and contracted earnings
Financial Policy	10%	15%	Financial policy	
Leverage and Coverage	40%	40%	(CFO Pre-W/C + Interest) / Interest Expense	Risk that metrics will deteriorate for utilities with higher carbon intensive generation as returns for such assets decline and there is increased debt funded capital expenditure to increase renewables generation as part of business mix.
			(CFO Pre-W/C) / Debt	
			RCF / Debt	

Appendix A – Carbon Emissions Pathway Scenarios

We use three primary scenarios in our analysis of the likely direction of future carbon emissions:

1. **Our Baseline Scenario (INDC Scenario)**. This scenario is a forecast of the global carbon emissions pathway if all countries were to implement their Paris Agreement commitments, taking into account individual country pledges. We base the aggregate INDC scenario on the IEA's modelled forecast. On an individual country basis, for those countries that have provided carbon emission reduction targets, we incorporate these consistent with the timeline provided in the INDC. For a number of countries, where the INDC targets are based on emissions intensity — rather than being emission-oriented, such as with China and India — we estimate the future carbon emissions trajectory consistent with the INDC based on long-term economic growth (source: OECD) and, where applicable, energy demand projections.

The INDC scenario is broadly viewed as being consistent with a 2.5°C-3.0°C temperature warming relative to the pre-industrial era and relative to the 2°C warming objective espoused by the Paris Agreement. The IEA estimates that under the INDC scenario, global energy-related carbon emissions will rise by 8% from 2014 levels by 2030.

2. **The 2°C Scenario**. This scenario is a modelled forecast of the maximum remaining allowable carbon emissions consistent with a 2°C warming relative to the pre-industrial era. The International Panel on Climate Change's (IPCC) 450 scenario is defined as the scenario with a greater than >66% likelihood of the temperature change relative to the 1850-1900 period staying below 2°C. There are multiple carbon emission trajectories consistent with this objective. We use the average of the IPCC's Representative Carbon Pathways under the 450 scenario as our estimate of the 2°C scenario.

Broadly, the 2°C scenario is characterised by emission reductions of 40%-70% by 2050 and in most projections, zero net emissions post 2100.

3. **The Business-As-Usual Scenario**. This scenario is a modelled projection of current global carbon emissions trends, assuming no change in the trajectory, as the result of the Paris Agreement. The scenario is broadly consistent with the IPCC's Representative Carbon Pathways that imply warming relative to the pre-industrial era between 4°C and 6°C.

We have adopted the INDC scenario as our baseline carbon emission pathway for analysing the credit impact of carbon regulation. We will apply this aggregate scenario for industries operating on a global basis. For industries operating within national borders, we will apply the national INDC pledge.

Appendix B – Definitions of Heat Map Scores – Overall Scores and Subcategory Scores

In November 2015, we developed a heat map that qualitatively scores the relative exposure of 86 sectors globally to environmental risks, in terms of both the materiality and timing of any likely credit effects, including exposure to carbon regulation. For further information on our approach, see Environmental Risks: Heat Map Shows Wide Variations in Credit Impact Across Sectors, November 2015.

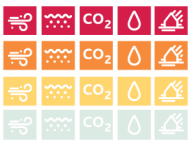
While the same shading is used for both the overall sector score and the subcategory scores, the overall score definitions are oriented toward the materiality and timing of the expected credit impact, whereas subcategory scores relate to a general level of exposure.

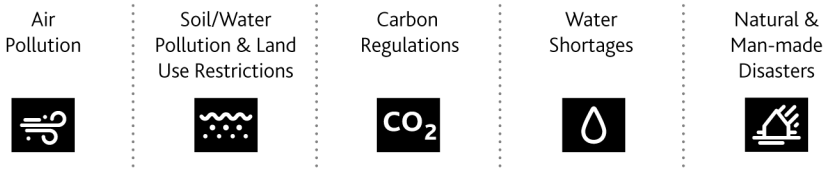
Overall Sector Environmental Risk Scoring

Immediate, Elevated Risk	Sectors scored "immediate/elevated" overall are already experiencing material credit implications as a result of environmental risk. Therefore, rating changes have either already been occurring for a substantial number of issuers or we believe such rating changes are likely within the next three years.
Emerging, Elevated Risk	Sectors scored "emerging/elevated" overall have clear exposure to environmental risks that, in aggregate, could be material to credit quality over the medium term (three to five years), but are less likely in the next three years.
Emerging, Moderate Risk	Sectors in this category have a clear exposure to environmental risks that could be material to credit quality in the medium to long term (five or more years) for a substantial number of issuers. However, in contrast to emerging/elevated sectors, it is less certain that the identified risks will develop in a way that is material to ratings for most issuers.
Low Risk	Sectors in this category have either no sector-wide exposure to meaningful environmental risks or, if they do, the consequences are not likely to be material to credit quality or ratings over the next seven years.

ICON KEY

Icon color indicates weight of each environmental exposure for the sector





Moody's Related Research

- Environmental Risks and Developments – Global: Paris Agreement Advances Adoption of Carbon Regulations; Credit Impact to Rise, April 2016 (1024553)
- Moody's Approach to Assessing the Credit Impacts of Environmental Risks, November 2015 (1010009)
- Environmental Risks: Heat Map Shows Wide Variations in Credit Impact Across Sectors, September 2015 (1009845)
- Environmental, Social and Governance (ESG) Risks - Global: Moody's Approach to Assessing ESG Risks in Ratings and Research, September 2015 (1007087)
- Environmental Risks and Developments: Impact of Carbon Reduction Policies is Rising Globally, March 2015 (1003462)
- Increasing risks in global auto sector, November 2015 (1009745)

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

Endnotes

1 As at 20 May 2016 the Paris Agreement has been signed by 177 countries.

2 In total we have identified 14 industries exposed to elevated carbon transition risk. One industry, Aircraft Asset-Backed Securities, is outside of the scope of this report. See Environmental Risks: Heat Map Shows Wide Variations in Credit Impact Across Sectors, November 2015.

3 See Environmental Risks and Developments – Global: Paris Agreement Advances Adoption of Carbon Regulations; Credit Impact to Rise, April 2016.

4 See http://unfccc.int/paris_agreement/items/9485.php.

5 CDIAC data are from Boden, Marland and Andres, 2016, 'Regional and National Fossil-Fuel CO_2 emissions'

6 See Rating Methodology: Global Automotive Manufacturing Industry, June 2011.

7 See Rating Methodology: Unregulated Utilities and Unregulated Power Companies, October 2014.

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