Access is everything™

Expertise
A comprehensive view of the global markets through our ratings and research.

Credibility
Over 100 years of experience delivering forward-looking, independent, stable and transparent opinions.

Engagement
Meaningful interactions across multiple channels between our analysts and market participants.
What is environmental risk?

Adverse effects of direct environmental hazards and the consequences of regulatory or policy initiatives that seek to reduce or prevent environmental hazards or perceived hazards.

Why do we care?

» One of many risks, but a growing one facing virtually all issuers
» Growing investor interest
» Weather related events can…
  – cause significant disruption for issuers
  – reduce revenues and increase capital and operational costs
  – in the extreme, cause increased defaults and losses
» Weather related events have become more frequent and more severe
Weather-related events are increasing

Source: Moody’s Investors Service, EM-DAT International Disaster Database
Incremental Climate Trends vs. Climate Shocks

Incremental climate trends exacerbate climate shocks

Climate trends lead to climate shock
- Warming of atmosphere
- CO2 emissions
- Warming trend/ extreme temperatures
- Drying trend
- Precipitation trend/ extreme precipitation
- Snow cover
- Sea level
- CO2 fertilization
- Ocean acidification

Clime shocks
- Drought
- Wildfire
- Floods
- Storms

Source: Moody's Investors Service
How do climate events impact credit?

Examples of how climate risk can be transmitted to credit risk

Sea-level rise → Increased coastal storm damage → Increased property damage, increased infrastructure costs, cost of adaptive strategies

Warmer temperatures → Increased frequency and severity of droughts, wildfires and heat waves → Compromised crop yields, increased energy demands, higher mortality rates, loss of labor productivity, cost of adaptive strategies

**NEGATIVE CREDIT IMPLICATIONS**

**BALANCE SHEET**
- Assets
  - Impaired assets
- Net assets
- Reserves
  - Inability to refinance
- Debt
  - Higher liabilities
- Other liabilities

**STATEMENT OF FINANCIAL PERFORMANCE**
- Revenue
  - Lower tax revenue e.g., property tax, state tax
- Expenses
  - Higher expenses e.g., public works, disaster recovery costs
- Additional debt to finance recovery
  - Increased debt

*Source: Moody’s Investors Service*
Incorporating ESG Analysis

Several methodologies already incorporate factors related to resilience to environmental risks; LG example

<table>
<thead>
<tr>
<th>Broad Rating Factors</th>
<th>Factor Weighting</th>
<th>Rating Sub-Factors</th>
<th>Sub-Factor Weighting</th>
<th>Impact of Climate Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy/Tax Base</td>
<td>30%</td>
<td>Tax Base Size</td>
<td>10%</td>
<td>Climate shocks may weaken economic output and tax base valuation and reduce the issuer's revenue base. Issuers with economies concentrated in sectors exposed to climate risks face higher credit vulnerability. Small economies that can be disproportionately impacted by climate events are at a heightened risk. Issuers with headroom between their current tax rate and the legal tax rate limit have additional flexibility to raise taxes/revenues as needed to provide additional resources. Issuers with large, diverse economies will suffer lower credit impacts from climate risks.</td>
</tr>
<tr>
<td>Full Value Per Capita</td>
<td></td>
<td></td>
<td>10%</td>
<td>Fiscal flexibility can be challenged by unanticipated emergency response costs, infrastructure repair costs, the loss of revenue or the cost of adaptive strategies. Issuers with healthy overall financial positions and strong liquidity are best positioned to service these risks with minimal credit impacts.</td>
</tr>
<tr>
<td>Wealth (median family income)</td>
<td></td>
<td></td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Finances</td>
<td>30%</td>
<td>Fund Balance (% of revenues)</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fund Balance Trend (5-year change)</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cash Balance (% of revenues)</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cash Balance Trend (5-year change)</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>
### Incorporating ESG Analysis

**LG example continued**

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>20%</td>
<td>Institutional Framework</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Climate events can test management's capacity to handle short and long-term</td>
</tr>
<tr>
<td></td>
<td></td>
<td>challenges to its economy, finances, and infrastructure. Issuers with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established and well-developed emergency management, financial, capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and debt plans will be best suited to overcome climate stressors.</td>
</tr>
<tr>
<td>Operating History</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Debt/Pensions</td>
<td>20%</td>
<td>Debt to Full Value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Issuers may be subject to increased debt burdens to finance the cost to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>repair or replace infrastructure assets. Issuers with already high debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>obligations will be stressed to accommodate new burdens into their existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>debt portfolios. Entities with low, manageable debt profiles will benefit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>from having capacity to incorporate obligations to finance capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>improvements.</td>
</tr>
<tr>
<td>Debt to Revenue</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Moody’s-adjusted Net Pension Liability (3-year average) to Full Value</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Moody’s-adjusted Net Pension Liability (3-year average) to Revenue</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Moody’s Investors Service*
Environmental risks vary by region
Great Plains

Great Plains and Midwest states will see their own unique challenges

Great Plains

» Rising temperatures could strain water and energy supply
» Reduced water supply could cause problems for highly productive energy sector
» Damage to coastal infrastructure and threats to agricultural productivity

Midwest

» More frequent extreme weather events such as cyclones and floods
» Increased temperatures and other climate changes could decrease agricultural productivity
Selected Sectors with Moderate to Elevated Environmental Risks
Selected Sectors with Moderate to Elevated Environmental Risks

<table>
<thead>
<tr>
<th>Moderate Risk</th>
<th>Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Issue:</strong></td>
<td>Diverse sector with some risks from pollution and carbon regulations, particularly when offshored to countries with less-developed environmental regulations</td>
</tr>
<tr>
<td><strong>Total Debt:</strong></td>
<td>$1157 billion</td>
</tr>
</tbody>
</table>

Manufacturing is a broad sector with generally moderate environmental risk, although certain sub-sectors and issuers may have greater exposures to pollution of air, soil and water – and the resulting costs of cleanup. However, well understood regulation and active compliance in most developed nations reduce the risk of unexpected cleanup costs. When manufacturing/assembly is offshored to countries that have less rigorous standards, regulatory costs are reduced but clean-up risks and exposure to carbon taxes that increase transportation costs are potentially higher. The impact of these risks to high-value manufacturing, including aerospace and defense, communications equipment, medical devices and consumer durables, is lower because cost increases from increased regulations can generally be passed along to consumers. Manufacturers can typically absorb disruptions from natural disasters, at least for short-term events, and the industry has shown flexibility in restoring just-in-time supply chains, as demonstrated after the heavy hurricane season of 2017. Other notable examples include the 1999 Taiwan earthquake and the post-Fukushima power shortage in Japan. Certain specific sub-sectors may face other environmental challenges – for instance lower demand at Brazilian manufacturers of hydro-electric equipment during drought conditions in recent years.
Selected Sectors with Moderate to Elevated Environmental Risks

**Moderate Risk**

<table>
<thead>
<tr>
<th>Protein and Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Issue:</strong></td>
</tr>
<tr>
<td>Inelastic demand for food ingredients mitigates risk of cost increases due to environmental risks and regulation</td>
</tr>
<tr>
<td><strong>Total Debt:</strong></td>
</tr>
<tr>
<td>$52 billion</td>
</tr>
</tbody>
</table>

Shifts in environmental regulations may raise costs of production for protein and agriculture companies. The resulting higher prices could lead to changes in eating habits away from animal-based proteins. In developed markets, increasing consumer focus on health and wellness, sustainability, and environmental concerns have helped accelerate an early but emerging trend toward plant-based proteins and meatless meals. Overall food demand, however, is inelastic and supported by population growth. Risk to protein and agriculture companies may be higher in developing countries due to unsustainable farming methods, including deforestation, that result in negative factors such as short-term over-production, air and water pollution, soil erosion, volatile weather conditions and increased regulation. A number of companies, including palm oil growers and aquaculture businesses, remain dependent on water availability to maintain constant production levels. We expect food production to receive priority in water usage.
### Selected Sectors with Moderate to Elevated Environmental Risks

<table>
<thead>
<tr>
<th>Elevated Risk - Emerging</th>
<th>Surface Transportation and Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Issue:</strong></td>
<td>Stricter emission standards, lower demand for freight exposed to environmental risks, notably coal</td>
</tr>
<tr>
<td><strong>Total Debt:</strong></td>
<td>$241 billion</td>
</tr>
</tbody>
</table>

The sector primarily consists of trucking and integrated railroads, which are heavy users of diesel fuel. Trucking is a highly competitive business with low barriers to entry and is thus sensitive to increases in costs, particularly fuel costs and the cost of upgrading fleets to trucks with new emission technologies. Growing concerns about the impact of nitrogen oxide and particulate matter in diesel engine emissions on air quality has also prompted a number of European local governments to ban diesel vehicles that do not meet certain emission standards, while legal action instituted by environmental groups has been successful in demanding bans on older diesel vehicles from city centers. In addition, road freight transport is responsible for an estimated 8% of global CO2 emissions, elevating the risk of more stringent regulatory standards, even though not imminent. Rail transport is more energy fuel-efficient and much less fragmented, but its infrastructure is more exposed to natural disasters, and rail accidents (such as derailments of rail tank cars with oil or other hazardous materials) have greater impact given the larger volumes being transported. Rail transport is also affected by lower demand for bulk freight that is exposed to environmental risks, especially coal, but also crude oil and frac sand. Similar to trucking, new emission standards have increased the cost of new locomotive purchases.
Selected Sectors with Moderate to Elevated Environmental Risks

Moderate Risk

Key Issue:
Future carbon and air emission regulations will increase airlines' costs, particularly on international routes.

Total Debt:
$67 billion

Airlines

We expect fuel expense to increase for airline operators from the more than 70 countries that have voluntarily elected to early adopt the International Civil Aviation Organization’s (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which caps carbon emissions at 2020 levels. Carbon offset costs will be incurred from 2021 and purchases will start from 2024, if not sooner. CORSIA becomes effective in 2026 for those not early adopting.

The industry remains intensely competitive, which we believe will limit the potential to fully recover increases in fuel costs, including from carbon offsets, via higher fares. Carbon emissions from aircraft will be covered by two regimes: (1) international flights will fall under the ICAO’s CORSIA scheme; and (2) domestic flights will be governed by yet-to-be-defined rules based on individual countries’ participation in the Paris Agreement. Retirement of aged aircraft and replacements with the latest technology models will help airlines reduce emissions to help lower the volume of carbon offsets to be purchased under the CORSIA regime, which seeks to limit emissions from aviation at 2020 levels starting in 2026.

Passenger airlines, and especially larger carriers, are well positioned to meet challenges over the next five years, as they continue to modernize their aircraft fleets. That said, strong growth in global demand for air travel will nonetheless make it difficult for the industry to meet CORSIA’s target without the purchase of a growing volume of offsets each year. The extent of competition across an airline’s international network will influence its ability to pass higher costs on to passengers. With countries’ implementation of the Paris Agreement not clear, the extent of exposure for purely domestic airlines is not estimable.
## Selected Sectors with Moderate to Elevated Environmental Risks

<table>
<thead>
<tr>
<th>Moderate Risk</th>
<th>US Public Power and Cooperative Utilities with Generation Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Issue:</strong></td>
<td>Regional variations in the generation supply mix prevail in this sector, with Midwestern entities typically most exposed to coal-fired generation plants, including some of the newest such plants in the US. The sector's strong ability to pass through costs into rates – including variable fuel and purchased power costs, costs of investments (including for environmental compliance), and any costs of plant abandonment – is among its most important credit strengths. Because most entities are not rate regulated, our main concerns focus on their willingness to exercise rate autonomy and consumers' ability to afford the costs of the essential service this sector provides. The current presidential administration is asserting significantly different views than the prior one, including increased support for coal-fired assets through a rollback of the Clean Power Plan and a pledge to withdraw from the Paris Accord. It is also proposing subsidies for uneconomic coal and nuclear plants to address system reliability and security concerns. Still, economic analysis and state policies are driving plant dispatch decisions and, in some instances, leading to earlier plant shutdowns. Entities in the Pacific Northwest, where very large hydroelectric generation assets are located, are usually the ones most exposed to drought and regulations to protect fish and other wildlife. Water related regulations can also pose risks to entities that rely on large amounts of thermal generation because of technology that relies on water for cooling. Overall, the environmental risks to this sector are offset by the even longer runway now provided by the rollback of the Clean Power Plan.</td>
</tr>
</tbody>
</table>

**Total Debt:**
$204 billion
Paying for infrastructure that mitigates climate shock and climate change impacts

States could benefit from federal infrastructure plan but remain debt-averse

- States have tremendous capital needs
- High matching contributions may be unaffordable with pay-go dollars
- Funding additional debt would be difficult given slow revenue growth and rising pension and Medicaid costs

Infrastructure spending has shifted to state and local governments
Transportation and water infrastructure spending in 2014 dollars

Source: Congressional Budget Office
Most local governments will be unable to meet high federal matching requirements

» The $200 billion federal investment over ten years is modest, equivalent to one year of local government capital spending.

» Competing spending priorities will make it difficult for local governments to maintain, let alone increase, capital spending.

» Most local governments’ revenue raising flexibility is insufficient to fund the 80% matching requirement for federal grants.

» Larger local governments, with the ability to manage complex capital projects and alternative procurement methods, may be better positioned to take advantage of the federal program.

» Local governments would still benefit from funding provided through states without a matching requirement.
Example Questions on Rating Calls

Analysts will increasingly devote time to understanding issuer’s resiliency plans around environmental risks

» How do you view your exposure and vulnerability to environmental risks?

» How are these risks incorporated into your budget and capital planning?

» Do you have a mitigation plan?
   – If yes, please elaborate on the details.

» If you experience an interruption in regular revenue flow from an environmental event, what liquidity in addition to reserves could be accessed to bridge the funding gap (market access, insurance coverage, etc.)?
Links to Reports and Research

Request for Comment (by Oct. 18, 2018): General Principles for Assessing Environmental, Social and Governance Risks


Evaluating the impact of climate change on US state and local issuers


Heat map: 11 sectors with $2.2 trillion debt have elevated environmental risk exposure
