

ESG Industry Report Card: Technology

May 21, 2019

(Editor's Note: Our ESG Industry Report Cards include an analysis of ESG factors for a selection of companies. We intend to expand our ESG Industry Report cards to include more companies throughout the year.)

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Key Takeaways

- For software and services, privacy and data security concerns are key since many technology companies collect, manage, and monetize sensitive information for corporations and individuals that are at risk of misuse.
- Data centers face environmental concerns due to their large energy consumption, but mitigated by their efforts to improve energy efficiency.
- The hardware and semiconductor subsectors are more exposed to social risk like criticism over labor management, such as poor working conditions and lax occupational safety standards, particularly in Asia.
- Environmentally, these subsectors' supply chains require mining precious metals and rare earth elements to produce electronic components. Production also requires large volumes of ultra-pure water, and the wastewater generated contains high amounts of heavy metals and toxic chemicals.
- Extreme weather is also a factor notably in Asia Pacific, which is a key region where manufacturing operations have been outsourced.

The ESG Risk Atlas

To calibrate the relative ranking of sectors, we use our environmental, social, and governance (ESG) Risk Atlas (see "The ESG Risk Atlas: Sector And Regional Rationales And Scores," published May 13, 2019). The Risk Atlas provides a relative ranking of industries in terms of exposure to environmental and social risks (and opportunities). The sector risk atlas charts (shown below) combine each sector's exposure to environmental and social risks, scoring it on a scale of 1 to 6. A score closer to 1 represents a relatively low exposure, while 6 indicates a high sectorwide exposure to environmental and social risk factors (for details see the Appendix). This report card expands further on the Risk Atlas sector analysis by focusing on the credit-specific impacts, which in turn forms the basis for analyzing the exposures and opportunities of individual companies in the sector.

Software And Services

Environmental exposure (Risk Atlas: 1)

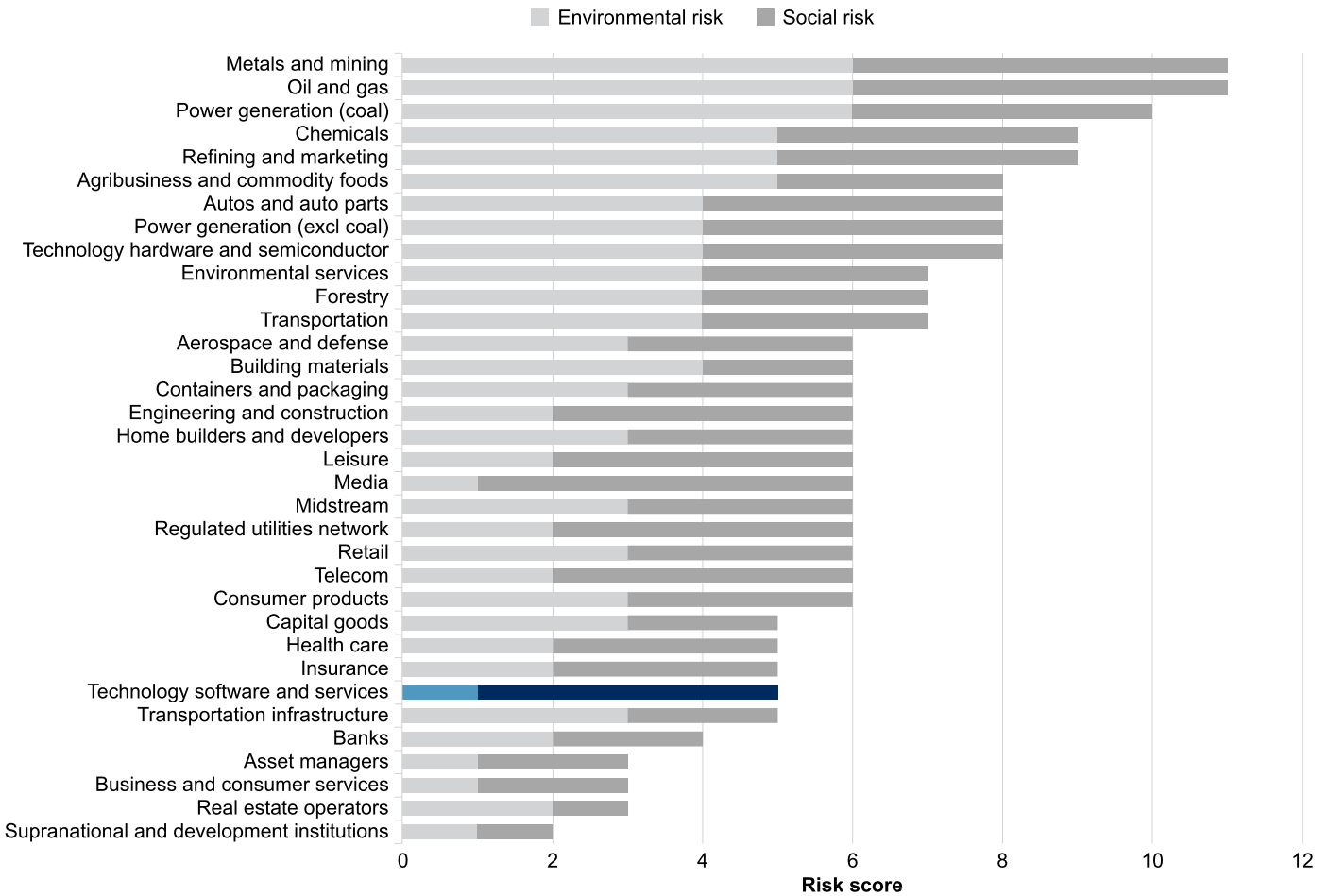
Companies in the software and services industry have limited use of physical infrastructure or facilities and most do not have manufacturing operations. Overall, they produce comparatively low greenhouse gas (GHG) emissions, pollution, or environmental waste, and have low land and water use. However, companies that operate data centers or provide hosting services to customers carry more significant risk exposure to GHG emissions. As companies increasingly rely on cloud computing to offload the data and services and consumers use, social media and gaming in particular, they have an exponentially growing need for computing and data storage. The companies providing these services run data centers, which consume large amounts of energy. Mitigating factors include greater environmental risk awareness, which has led data center companies to improve their energy efficiency, use environmentally friendly Leadership in Energy and Environmental Design (LEED)-certified buildings, and increase the share of renewables in their energy mix.

Social exposure (Risk Atlas: 4)

In our view, the most relevant social risks in the software and services sector are privacy and data security concerns because many technology companies collect, manage, and monetize sensitive information for corporations and individuals that are at risk of misuse. Data security breaches can cause significant reputational and monetary damages to companies, weakening their credit risk profile because their competitive position could be harmed and, in turn, hurt revenue and profitability. Moreover, these privacy and data security concerns could invite increased regulatory scrutiny, which could lead to a more restrictive business environment and additional operational costs to comply.

Other social risk factors that are important to the sector include gender inequality, lack of workforce diversity, and rapid change in consumer preferences and tastes (i.e. smartphone and gaming products). These demand shifts and high standards are important credit risk factors because they require technology companies to invest aggressively in research and development without any guarantee of adequate returns.

ESG Sector Risk Atlas



Source: S&P Global Ratings.
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Hardware And Semiconductors

Environmental exposure (Risk Atlas: 4)

Environmental risk is comparatively more relevant for hardware and semiconductor companies because they carry significant risk exposure to water and waste management. Manufacturing semiconductors requires large volumes of ultra-pure water. Since water is becoming an even scarcer resource around the globe, robust management of water usage is key to avoiding higher supply costs and the potential loss of access to water-scarce areas, which could cause production disruptions and affect revenues.

Regarding waste management, the wastewater generated in the production process contains high amounts of heavy metals and toxic chemicals, often requiring high clean-up costs. Higher operating costs and capital expenditures to deal with hazardous waste, as well as poor management of waste disposal can also put companies at a higher risk of regulatory fines.

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Hardware and semiconductor companies are exposed to environmental risks related to sourcing minerals such as tin, tantalum, tungsten, gold, and cobalt, which are key materials used in electronic equipment. Given the risks and more regulatory and industry focus, technology hardware and semiconductor companies have increasingly emphasized their mitigation efforts by creating and implementing best practices across their vast global supply chain networks. While it's difficult to assess the associated costs that pressure companies' operating margins and operating cash flow generation, we believe these actions should help protect companies' brand value and avoid unnecessary future cost increases stemming from supply chain disruptions, brand damage, regulatory fines, or litigation.

Another important issue for the industry is product lifecycle management and e-waste. The high turnover rate for electronic equipment fueled by innovation and fashion trends has created an ever growing challenge of how to deal with the end-of-life product disposal. Robust product lifecycle management programs can help companies mitigate increased regulatory costs, as well as realize cost savings by recovering precious and rare earth metals by recycling electronic equipment.

Over the past few decades, many hardware and semiconductor firms have outsourced their manufacturing operations to specialists in lower-costs regions. Because these manufacturing operations are mainly located in the Asia-Pacific region, they are exposed to chronic or acute weather-related events such as floods and earthquakes. For example, the severe flooding across Thailand in November 2011 that significantly disrupted the manufacturing of hard disk drives, a crucial component for personal computers, caused global industry supply shortages and elevated component costs for almost two years. During those two years, not only was the financial performance of hard disk drive vendors hurt, it also resulted in lower unit sales of PC and storage systems, weakening those vendors' credit profiles.

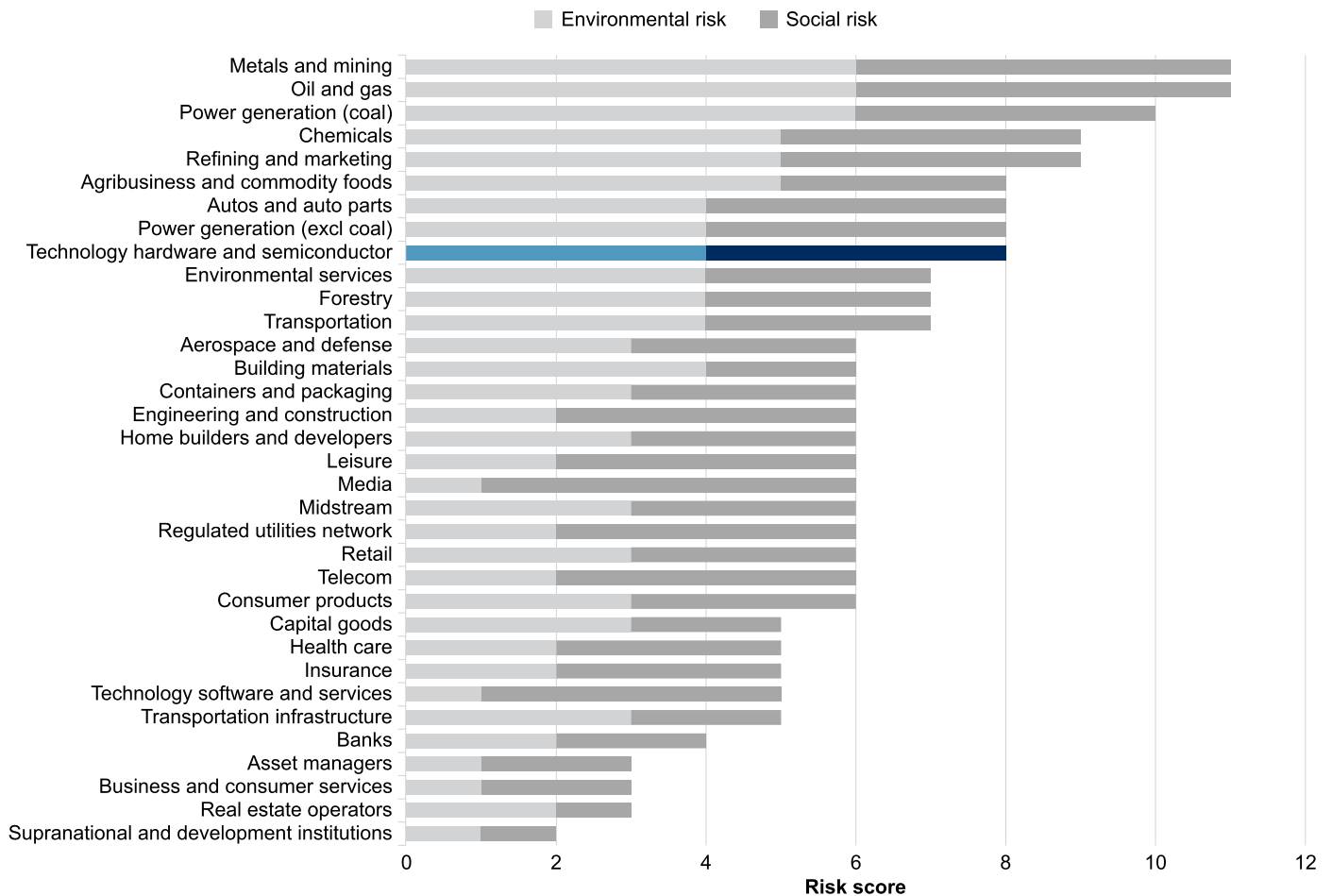
Social exposure (Risk Atlas: 4)

Electronic manufacturers have been facing growing scrutiny and criticism over its labor management. Issues related to long working hours, poor working conditions, and lax occupational safety standards are major areas of concern, particularly in Asia. Improving working conditions and labor relations can help address lower productivity and avoid production disruptions and work stoppages, which could affect sales volumes and revenues. It can also prevent reputational damage and fines linked to labor-related scandals.

The other source of social risk exposure lies in the supply chain. Precious metals and rare earth elements are mined, often in geopolitically unstable areas, and used to make electronic components. Cobalt for instance, a crucial component for lithium-ion batteries, is mostly mined in the Democratic Republic of Congo, where child and forced labor are common practices. Robust management of labor risks and adherence to international covenants on human rights throughout the entire supply chain can help mitigate production disruptions and avoid costly scandals, which can lead companies to lose their social license to operate.

Finally, because of its concentrated supply chains (notably in Asia) the industry has an above-average exposure to geopolitical concerns or global trade disputes. We factor these risks into our industry risk and company-specific business risk profile assessments.

ESG Sector Risk Atlas



Source: S&P Global Ratings.
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Governance

Overall, governance is company-specific because it usually reflects corporate culture, strategy, and ownership structure. At the sector level, certain companies have a dual-class ownership structure that favors founders with super voting power and antitrust disputes.

Founder-led companies with super voting power can reduce the board's effectiveness; however, it isn't necessarily a weakness because in many instances founder-led companies have been able to pursue longer-term growth objectives by prioritizing corporate culture and product innovations rather than short-term shareholder remuneration. Companies must ensure that they take steps to manage their key-person risk when the founder's presence, absence, or behavior hinders the company's performance. Some technology companies also have excessive executive compensation practices to ensure that incentives are well aligned with corporate strategy and do not encourage unnecessary risk-taking.

Litigation, specifically antitrust disputes, are common in intellectual property (IP)-centric segments of the technology sector, such as software applications, hardware devices, and

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semiconductor designs. Legal infractions can disrupt and threaten an organization's long-term survival, so they're an important factor in our credit rating assessment.

ESG Risks In Software and Services

Table 1

Company/Rating/Comments	Country	Analyst
<p>Alibaba Group Holding Ltd. (A+/Stable)</p> <p>We believe social risks are key for Alibaba, with environmental risks playing a lesser role in our rating assessment. The most significant social factors for Alibaba are the assurance of safety and fraud prevention for transactions on its platforms and the protection of user data and privacy. Consumers' trust in marketplace platforms such as Alibaba's Tmall and Taobao are critical to its success. Preventing fraudulent transactions, ensuring payment security, and security of user and merchant data are key concerns for its e-commerce platforms. To counter these risks, Alibaba uses algorithms to detect and remove high-risk merchants from its platform and uses sophisticated encryption technology to protect transactions conducted through Alipay (online payment platform operated by Ant Financial). To ensure the security of its user and merchant data, Alibaba employs various measures including employing strict protocols to share user information across affiliates. We believe Alibaba has good governance, with balanced oversight between the partners of the firm, major shareholders including Softbank, and independent directors. The board is well represented by six executive directors and five independent directors.</p>	China	Cliff Kurz
<p>Alphabet (AA+/Stable/A-1+)</p> <p>Alphabet has recently faced privacy, antitrust, and workforce issues. We believe that the general public may be reconsidering how much data it shares with digital advertising platforms in light of recent privacy controversies affecting major technology companies, and politicians across the globe may be considering regulatory actions that could affect Alphabet's business. During the past few years, the European Commission has fined the company over antitrust matters relating to display advertising, mobile operating systems, and shopping search results. Increased scrutiny of Alphabet's business practices could lead to more fines or adverse changes to its business model. In late 2018, many Google employees and contractors staged a walkout to protest the company's harassment and discrimination policies. Management supported the walkout and responded to some of the organizers' demands, which in our view signals the company's willingness to address the issues the workers raised. On the environmental side, data centers use significant amounts of electricity, which could cause significant GHG emissions. Alphabet has maintained carbon neutrality since 2007, matching 100% of its global operations 2017 electricity consumption with renewable energy purchases. Governance-wise, CEO and co-founder Larry Page, president and co-founder Sergey Brin, and former CEO Eric Schmidt together control 56.5% of the voting power through their super-voting class B shares. Despite their good track record leading the business, we think this structure, combined with their propensity to make big bets, increases the risk of a credit negative, high-impact, low probability event.</p>	U.S.	Chris Frank
<p>Atos (BBB+/Negative)</p> <p>Social risk factors, which we incorporate into our industry risk and business risk assessments, are the most material to our credit analysis of Atos. Atos' exposure to social risks centers on cyberattacks, security breaches, and customer data leakage. If data is mismanaged, Atos could be exposed to significant litigation, monetary damages, claims from customers, or fines. However, we are not aware of any recent material breaches and we believe Atos closely monitors these risks and complies with laws and regulations to protect personal data and individual privacy. To minimize the impact of security incidents, Atos has implemented a computer security incident response team to manage all security events and security incidents worldwide. We assess Atos' exposure to environmental risk factors, mainly energy, travel, and GHGs, to be low. To mitigate these risks, Atos has taken steps to lower carbon emissions from its datacenters. Governance risk factors are not currently key rating drivers. Atos ensures that its suppliers and partners adhere to its own ethics and compliance policy, which prevents human rights violations, environmental damage, and health and safety risks in its supply chain.</p>	France	Thierry Guermann
<p>CapGemini SE (BBB+/Stable)</p> <p>While ESG factors are relevant to our ratings analysis of Capgemini, they aren't currently material rating drivers. Risks mostly encompass social issues that we believe have a high potential to affect earnings, such as reputational damage stemming from client dissatisfaction, information security and data protection, values and ethics issues, diversity-related issues, and talent engagement and retention. To our knowledge Capgemini complies with all laws and regulations to protect customers' and personal data. It also runs programs like its workforce health and safety management program and diversity initiatives, to foster gender diversity and promote ethics (it aims for women to be 30% of executive leadership and 40% of its total workforce). Additionally, Capgemini, like its competitors, requires its suppliers to adhere to high standards on the environment, labor, health and safety, ethics, and management systems. We believe holding its supply chain members to these standards is an important risk-mitigating factor.</p>	France	Thibaud Laguache
<p>International Business Machines Corp. (A/Negative/A-1)</p>	U.S.	David Tsui

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IBM faces long-term risks from environmental factors such as GHG emissions from manufacturing and disposing of old equipment and potential business disruptions from extreme weather conditions, but they're not material rating drivers. While IBM has transitioned its business model to more services-oriented from product sales-based over the years, its service offerings still involve operating data centers globally and the technology infrastructure they house. Despite IBM's massive scale and global reach, we find it has done a good job mitigating these risks through energy conservation, mineral sourcing, renewal energy use, and waste reduction efforts. IBM requires its suppliers to adhere to the same high environmental standards and advocates for transparency in the supply chain by requiring audits and public disclosures. IBM focuses exclusively on enterprise customers, which are less exposed to constantly evolving consumer behavior and preference changes. Potential privacy and data security breaches, however, could pose significant reputational and monetary damages to IBM because enterprise customers place great emphasis on technology partners' data protection capabilities in order to consider them trusted business partners. We assessed IBM's management and governance as strong, based on our positive view of the company's ability to track, adjust, and control execution of strategy and risk management processes, management's expertise and depth, and positive employee relations and corporate culture.

Microsoft Corp. (AAA/Stable/A-1)

David Tsui

Microsoft faces long-term environmental risks from GHG emissions, pollution, and waste, but they're not material rating drivers. Over the past 20 years Microsoft has added hardware product offerings, such as the Xbox gaming console, Surface-branded tablets, data center equipment, and also the management of data center facilities to complement its software product offerings. Microsoft not only enforces a strong energy conservation, mineral sourcing, renewal energy use, and waste reduction culture, but it also holds its suppliers to the same high standards in these environmental practices. Recently, Microsoft announced in April 2019 that it will nearly double its internal carbon fee to \$15 per metric ton on all carbon emissions. This internal "tax" was established in 2012 to hold its business divisions financially responsible for reducing their carbon emissions, with the funds from the higher fee used to maintain Microsoft's carbon neutrality and improve sustainability. We find certain products within Microsoft's product portfolio to be more exposed to rapid changes in consumer demand than other technology companies because its gaming products and PC tablets tend to be consumer and not enterprise-oriented, which means they typically have shorter lifecycles. The company's hardware, software, and advertising products face customer privacy and data security risks, which could cause significant reputational and monetary damages to Microsoft if compromised. That said, we believe Microsoft greatly emphasizes its product offerings' security features and we believe its security enforcement efforts and financial resources are key factors in mitigating any negative impacts from potential vulnerabilities. We assessed Microsoft's management and governance as strong, reflecting our positive view of its strategic planning and risk management processes and its consistency in achieving its operational goals despite challenging economic and market conditions.

Oracle Corp. (AA-/Negative/A-1+)

U.S.

Andrew Chang

Social risk factors such as security and data breaches are ongoing risks for the software industry but we believe Oracle's exposure to these factors is comparable to industry peers. However, as regulatory focus increases and laws and regulations concerning the handling of personal information and data expand and become more complex, a breach could damage Oracle's brand and reputation and expose it to legal claims and regulatory actions. To mitigate these risks, Oracle rigorously assesses and validates its software before release and provides training and certification programs to employees and customers. We assess Oracle's governance risk as significant because its founder, chairman, and chief technology officer, Larry Ellison, has a 33% ownership. However, we believe Mr. Ellison's 40-year-plus track record of running a leading software company, as well as a credible succession plan (with Mark Hurd and Safra Catz currently serving as co-CEOs), make Oracle's governance risk manageable. Our management and governance assessment of the company is strong as a result. Oracle's environmental risks are low, as is the case for the software industry overall.

SAP SE (A/Stable)

Germany

**Thierry
Guermann**

Social risks are the most material to our credit analysis of SAP, but also relatively comparable with peers. SAP mainly faces social risks like cyberattacks, security breaches, and customer data leakage. Many companies use SAP applications for mission-critical transactional data and, as a result, data protection against IT breaches is critical. To mitigate these risks, SAP conducts regular training of all employees on IT security, and before a release is made its software is assessed and validated by internal IT security experts. Furthermore, SAP has developed a global data protection and privacy policy and management system to ensure it complies with applicable laws. We believe SAP maintains high ethical standards and encourages its suppliers and partners to adhere to its ethics and compliance policy and respect for human rights. We assess SAP's risk exposure to environmental and governance factors as low. Environmental risks relate to carbon emissions, energy consumption, and travel. SAP has taken measures to reduce carbon emissions in its operations and it has relatively low emissions compared with its customers running SAP software on their hardware and premises (about 38 times the size of SAP's own net carbon footprint). As a result, SAP's environmental strategy also focuses on helping its customers run greener operations via SAP's green cloud services and data centers (using 100% renewable electricity). Governance risk factors are also low, in our view, because SAP's supervisory board composition is sufficiently independent and diversified in terms of gender and nationality.

ESG Risks In Hardware And Semiconductors

Table 2

Company/Rating/Comments	Country	Analyst
<p>Apple Inc. (AA+/Stable/A-1+)</p> <p>Like most hardware providers, Apple faces various environmental risks from manufacturing its products, but we believe these risks are lower than peers due to the company's strong commitment to maintaining policies to manage them. Apple outsources virtually all hardware manufacturing but has significant influence over its supply chain's exposure to GHG emissions, waste, pollution, and disposal of electronic products. The vice president of environment, policy, and social initiatives reports to the CEO, indicating that decisions about environmental and social issues are reviewed at the company's highest levels. Labor issues also pose risks. Over the past decade, Foxconn, a key manufacturer of Apple's products, has faced serious issues ranging from unsafe working conditions to hiring underage workers and violating employment laws. We believe Apple takes these allegations seriously and enforces a supplier code of conduct that reviews its partners for commitment to human rights and sound business practices. We believe this is critical to preserving not only Apple's profitability but its brand value. Other potential social risks include protecting customer data, which over the longer term will grow in importance as transactions and data storage continue to migrate to digital devices. We assess Apple's management and governance as strong based on its consistent good operating track record, effective strategic planning, and generally positive employee relations and corporate culture.</p>	U.S.	Andrew Chang
<p>Broadcom (BBB-/Stable/A-3)</p> <p>We assess the Broadcom's exposure to environmental risks as relevant to our credit analysis, and its exposure to social and governance risks as less so. Broadcom has a fab-light operating model whereby it outsources most of its manufacturing to third-party foundry, i.e. TSMC, and test and assembly facilities. Through these outsourced manufacturing partners, Broadcom faces various environmental risks like GHG emissions, climate change, and hazardous materials and waste, which could have a material impact on Broadcom's business if problems arise. We believe Broadcom enforces its own social and environmental code of conduct on its suppliers as well. We view the company's management and governance as satisfactory, reflecting management's experience, expertise, and ability to adjust business strategies when needed. Broadcom's board comprises eight members, of which six are independent directors.</p>	U.S.	Jenny Chang
<p>Cisco Systems (AA-/Stable/A-1+)</p> <p>We view social and environmental risks to be significant for Cisco, but also comparable to other hardware providers and don't expect them to affect our rating in the near term. The manufacturing of Cisco's hardware carries environmental risk like GHG emissions, waste, and pollution from manufacturing and packaging. However, risk exposures are mostly indirect since it outsources virtually all manufacturing. We believe Cisco has a good track record of enforcing its supplier ethics policy, which influences how suppliers conduct business in the areas of labor safety and the environment. Cisco faces social risks including potential reputational damage or liability claims arising from cyberattacks or data security breaches of its customers' networks, but we believe the company has a good track record of managing these risks. We view the company's management and governance as strong, reflecting our overall positive view of the company's strategic planning and risk management processes and its consistency in achieving its operational goals. Current CEO and Chairman of the Board Chuck Robbins has been with the company for over 20 years, the past four as CEO. While we view the lack of an independent board chairperson unfavorably, we think Cisco's lead independent director role helps mitigate some of the potential conflicts.</p>	U.S.	Andrew Chang
<p>CommScope Holding Co. Inc. (BB-/Watch Neg)</p> <p>We view social and environmental risks to be material for CommScope, but we believe the company is adequately managing them and we don't expect them to affect our rating in the near term. Commscope faces social risks like workplace safety and child labor stemming from its manufacturing operations and supply chain. CommScope's program to mitigate safety risks has resulted in lower injury rates over the past 10 years to below critical benchmarks. The company also has a program to manage child labor risks by conducting reviews, assessments, and audits of its own operations and those of its suppliers deemed to be high risk. We think the company's management of these risks adequately mitigates the potential for legal liabilities, costly regulatory actions, and reputational damage. The company seeks to address waste management and GHG emissions through its product lifecycle management and manufacturing design processes. The company has reduced harmful chemicals used in its products and waste produced by manufacturing. It has minimized packaging and seeks out recyclable materials in any remaining packaging, and maximizes reuse, refurbishment, or recycling for its products at the end-of-life stage. The company also manages its manufacturing processes to reduce energy consumption and GHG emissions. It has already reduced them by 10% and targets GHG emissions 25% below 2016 levels by the end of 2020. We think this puts the company in a good position to handle potential future emissions regulations or taxation.</p>	U.S.	Chris Frank
<p>Dell Technologies Inc. (BB+/Negative)</p> <p>Dell faces long-term environmental risks from GHG emissions, waste and pollution from product manufacturing, and environmental degradation from sourcing minerals used in its electronic equipment. That said, we currently do not find these environmental factors to be material rating drivers. The earthquake and tsunami in Japan and severe flooding in Thailand in 2012</p>	U.S.	David Tsui

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hurt Dell, damaging infrastructure and factories that disrupted the supply chain for various components used in its products. Since then, Dell has continued to diversify its global supply chain and manufacturing footprint to minimize negative impacts from natural disasters. We find certain products within Dell's product portfolio to be more exposed to rapid changes in consumer demand than most hardware companies because its PC and gaming products have shorter product lifecycles given their consumer and gaming, rather than enterprise, focus. These products tend to require higher research and development costs, in addition to higher costs for recycling or disposal. Furthermore, privacy and data security breaches could pose significant reputational and monetary damages to Dell as its enterprise customers increasingly emphasize the security technology infrastructure. We assessed Dell's management and governance to be fair because it's exposed to key man risk from its founder and CEO Michael Dell, who has controlling ownership of the company and voting power. Currently, there are six members of the board of directors: the CEO, two from Silver Lake Partners, and three independent board members. The recently approved class V tracking stock for class C common stock exchange in December 2018 allows for an independent director to be elected by June 30, 2019.

<p>Ericsson (Telefonaktiebolaget L.M.) (BB+/Stable/A-3)</p> <p>Governance and social factors are material to our credit analysis of Ericsson. Ericsson is currently subject to an investigation by the U.S. Securities and Exchange Commission and the Department of Justice into potential noncompliance with the U.S. Foreign Corrupt Practices Act. The probe has been ongoing for several years and prompted the company to dismiss 50 employees in fall 2018. We consider this a potential issue for the rating because it may result in penalties or fines that could weaken credit metrics, if material. The discussion about the admission of Ericsson's competitor Huawei to tender processes for 5G in many countries highlights possible social risks related to telecom equipment vendors' abilities to guarantee that their products adhere to the highest data protection and privacy standards. Even though we think Ericsson could incrementally benefit from Huawei's possible reputational fall-out, we believe this also underscores potential risks if Ericsson's own equipment was found vulnerable to interception or if it didn't allow operators to manage traffic in compliance with country-specific security and data protection laws. Environmental risks are not a decisive factor in the credit rating at this point, but could gain weight over time because the continued densification of networks and the roll-out of 5G may increase power consumption. This will require Ericsson, like its peers, to continue investing in the development of state-of-the-art power management technology.</p>	<p>Sweden</p>	<p>Lukas Paul</p>
<p>Hewlett Packard Enterprise Co. (BBB/Stable/A-2)</p> <p>HPE, similar to many technology solutions providers, faces long-term environmental risks such as GHG emissions, waste and pollution from product manufacturing, and environmental degradation from sourcing minerals that are key materials used in electronic equipment, even if these are not currently material rating drivers. We believe HPE places significant emphasis on mitigating its long-term environmental risk exposures. For example, in 2017, HPE lowered its own operational GHG emissions by 29% from 2015 by reducing its real estate footprint and increasing the proportion of renewable electricity purchased to 27% in 2017 from 12% in 2015. We believe HPE is better positioned than most hardware companies to mitigate social risks such as privacy and data security and rapid changes in customer preferences and tastes because it focuses exclusively on enterprise customers, which are less exposed to constantly evolving consumer behavior and preference changes. Still, any privacy and data security breaches could pose significant reputational and monetary damages to HPE as its enterprise customers increasingly emphasize on the security of technology infrastructure. We assessed HPE's management and governance as satisfactory, reflecting our positive view of the company's strategic planning process, its standards for operational performance, and management's expertise and experience.</p>	<p>U.S.</p>	<p>David Tsui</p>
<p>Hon Hai Precision Industry Co. Ltd. (A-/Stable)</p> <p>Hon Hai faces significant social risks mainly because of its enormous operating scale and labor force, which exceeds one million employees mostly located in China. The company's extensive labor force presents challenges managing employees and their safety, and possible negative public perception. The company also faces high exposure to environmental risks typical of the technology hardware sector with significant energy, water, and chemical consumption during its manufacturing process. Hon Hai's failure to manage these risks could result in the loss of its key customers and be detrimental to its performance. Still, environmental and social factors are not currently key rating drivers because Hon Hai has materially strengthened its workforce management system after experiencing a few labor events associated with low wages and poor working conditions, and the resultant damage to its market reputation during 2010-2012. In addition, the company has also increased reliance on automation to improve working conditions and minimize the potential impact of labor shortage and rising wages. We assess Hon Hai's management and governance as satisfactory, reflecting its good track record and ability to adjust and control the execution of its strategies, its higher-than-industry-average performance standards, and its management team's strong expertise. Hon Hai's chairman and founder has strongly influences the company's strategic directions. The company's board of directors has eight members, of which three are independent directors.</p>	<p>Taiwan</p>	<p>Raymond Hsu</p>
<p>HP Inc. (BBB/Stable/A-2)</p> <p>HP faces environmental risks like GHG emissions stemming from resources consumed in the product manufacturing process and disposal of old equipment. While environmental risks are relevant to our analysis, they're not significant drivers of credit quality because we believe HP is committed to maintaining policies to manage them. We believe HP has high exposure to personal computing products, where it faces significant risks related to consumer behavior and preferences for innovative products and services. We believe HP's global scale and substantial revenue base allow it to be well positioned to invest and develop new products amid a highly competitive marketplace. We factor these risks into our analysis of HP's overall competitive position. Various governance-related issues have presented challenges to the business, some of which were material. Over the past</p>	<p>U.S.</p>	<p>Tuan Duong</p>

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decade, HP was involved in several material governance-related controversies including board level and senior management changes and the \$9 billion write-down of its acquisition of U.K.-based software firm Autonomy. While these events affected the company's operations and reputation when they occurred, we do not expect them to weigh on credit metrics in the future. We believe management has taken steps to ensure proper checks and balances, including reorganization of reporting lines, ongoing business conduct training for employees and the board of directors, and increased board independence, which we believe will reduce the likelihood of these types of events. We view HP's management and governance as satisfactory, reflecting its strategic planning, standards for operational excellence and management's expertise and experience. These stem from management's focus on outgrowing markets served and driving product innovation to support future growth.

Infineon Technologies AG (BBB/Stable)

Germany

Thierry
Guermann

Environmental and social factors are material to our credit analysis of Infineon. We think these risks are relatively higher than fab-less peers because of Infineon's large share of in-house manufacturing (about 75%), which exposes it to environmental risks including water management, waste management, energy use, and GHG emissions. These risks could result in regulatory penalties or social consequences, such as customers turning to other suppliers. However, these risks are relatively modest in our view because we believe Infineon has a strong track record of ESG risk management. For instance, in 2017 Infineon's front-end sites consumed approximately 29% less water to manufacture a square centimeter wafer than the World Semiconductor Council's global average. The company has also taken steps to reduce energy consumption and GHG emissions. Furthermore, as part of its corporate social responsibility, Infineon is committed to comply with legal requirements, as well as voluntary commitments like the 10 principles outlined by the United Nations Global Compact, and we aren't aware of any laws or regulations that may affect Infineon's credit quality. Infineon also requires its suppliers to comply with all valid laws including those dealings with human rights and fair business practices. Though it is not legally required to do so, Infineon voluntarily complies with the U.S. Securities and Exchange Commission's requirements regarding access to minerals. With over 40,000 employees, Infineon is also exposed to social risks including workforce health and safety and compliance with human rights and labor standards, though we view these as typical for the sector and not having a material impact on the rating. We assess Infineon's risk exposure to governance factors to be low and management's demonstrated governance commitment further supports our confidence in Infineon's environmental risk mitigation.

Intel Corp. (A+/Positive/A-1+)

U.S.

Andrew Chang

Social and environmental risks are relevant for Intel but we believe these risks are comparable to those of other semiconductor providers and don't expect them to affect our rating in the near term. Intel manufactures most of its products in-house, which exposes it to various environmental risks including water contamination, energy use, and GHG emissions. But, we believe Intel has properly addressed these potential risks through strong recycling and conservation efforts. We also believe Intel upholds similar standards for its suppliers by conducting supplier audits throughout the year. Like most of the sector, Intel is exposed to social risks including the health and safety of its workforce and compliance with human rights and labor standards. We assess Intel's risk exposure to governance factors to be modest. Intel recently promoted its chief financial officer (CFO), Bob Swan, to CEO. While he lacks technical background, we believe he has a good track record of meeting operational and financial targets. Our management and governance assessment of the company is strong, reflecting our overall positive view of the company's strategic planning and risk management processes.

LG Electronics (BBB/Stable)

South Korea

JunHong Park

We view LG's exposure to environmental and social risk factors as relevant to our credit analysis, but not currently material rating drivers. LGE's operations in the consumer electronics industry expose it to social risks such as changing consumer preferences owing to technological advancements, as high product turnover rates fueled by innovation or consumer tastes increase research and development costs as well as costs to deal with product disposals. Additionally, worker safety remains a key social risk for the company and it continues to take measures to improve its safety record, with its Lost-Time Injuries Frequency Rate (LTIFR) decreasing to 0.76 in 2017 from 0.90 a year earlier. LG's manufacturing processes also expose it to environmental risks such as waste and pollution. However, the company is committed to constantly improving its manufacturing and packaging process, building more energy efficient products, and reducing electronic waste. The company is also working toward mitigating its impact on the environment by introducing green businesses such as making components for electric vehicles. We view the company's management and governance to be satisfactory, mainly reflecting our positive view of its strategic planning process and operational effectiveness. The company currently has four outside directors out of seven board members.

Micron Technology Inc. (BB+/Positive)

U.S.

Jenny Chang

We assess the company's exposure to environmental risks as relevant to our credit analysis, while its exposure to social and governance risks is less so. Micron has manufacturing operations globally and is subject to various environmental risks like GHG emissions, climate change, and hazardous materials and waste. We believe Micron is more vulnerable to these risks compared with fabless semiconductor companies because of its extensive in-house manufacturing capabilities. However, we believe the company has an established framework to ensure high standards for labor, health, and safety at these facilities. We view the company's management and governance as satisfactory, reflecting management's experience, expertise and ability to adjust its business strategies when needed. Micron has an independent board of directors with no known conflicts of interest.

NEC Corp. (BBB-/Stable/A-3)

Japan

Hiroyuki
Nishikawa

ESG Industry Report Card: Technology

NEC, a Japanese major information and communications technology company, has strategically shifted its focus to systems integration and network infrastructure for enterprises from consumer electronics. It's now less affected by rapidly shifting consumer preferences, a key social risk. However, to capture clients' demand for digitalization, we believe NEC, similar to peers, faces challenges securing and managing talented employees with advanced skillsets. Additionally, the company's business is potentially exposed to risks such as personal or classified information leaks and cyberattacks. However, we believe the company will manage these risks appropriately through strengthening its in-house training and human resources. Governance risks are neutral to our credit analysis of NEC due to adequate board effectiveness and public disclosure. The company faces compliance risks related to anti-monopoly laws because it conducts many transactions with the public sector. In the past we saw some violations and NEC was suspended from bidding on public sector contracts, but the effect on earnings was limited. We think the compliance system is now stronger.

Nokia Corp. (BB+/Stable/A-3)

Finland

Lukas Paul

Social factors are material to our credit analysis of Nokia. The discussion about the admission of Nokia's competitor Huawei to tender processes for 5G in several countries highlights possible social risks related to telecom equipment vendors' abilities to guarantee that their products adhere to the highest data protection and privacy standards. Even though we think Nokia could incrementally benefit from Huawei's possible reputational fall-out, we believe this underscores potential risks if Nokia's own equipment was found vulnerable to interception or if it didn't allow telecom operators to manage traffic in compliance with country-specific security and data protection laws. Nokia is currently scrutinizing certain transactions in the former Alcatel-Lucent business it acquired in 2016 and that violated anticorruption laws in the past. However, the company currently expects that any possible financial impact of the ongoing investigation would be limited and immaterial. Environmental risks are not a decisive factor in the credit rating at this point, but could gain focus over time because the continued densification of networks and the roll-out of 5G may increase power consumption. This will require Nokia, like its peers, to continue investing in the development of state-of-the-art power management technology.

Panasonic Corp. (A-/Negative/A-2)

Japan

**Hiroyuki
Nishikawa**

We believe Panasonic, a major Japanese consumer electronics company, is exposed to social risks due to changes in consumer preferences, product safety, and labor-intensive manufacturing processes, which can affect its profitability and competitiveness. To align with the consumer preferences, Panasonic incurred huge losses in the past and we downgraded it. For instance in 2013, Panasonic stopped producing plasma-display panels and TVs as consumers began to prefer LCD TVs. Nonetheless, we believe Panasonic's shift to home appliances with strong brand recognitions and business-to-business and capital goods businesses will likely stabilize its earnings. Panasonic is also exposed to environmental risks because the company's supply chain and sales network are spread around the world and natural disasters have somewhat affected its earnings. Nonetheless, the impact has been absorbed by its decentralized supply chains and diversified business portfolios, and we believe that it will likely maintain backup plans for business continuity for unexpected disasters. Panasonic's social and environmental risk exposures are comparable to Japanese technology peers, in our view.

Qualcomm Inc. (A+/Negative/A-2)

U.S.

Andrew Chang

Qualcomm's exposure to governance risks, specifically legal risk, weigh on our view of its business risk assessment and is material to our credit analysis. Qualcomm recently resolved its two-year long dispute with Apple Inc., agreeing to dismiss all litigation between the two parties. The settlement also includes overdue payments from Apple and new license and chipset supply agreements. While this is clearly a positive development, other legal risks remain, such as the ongoing Federal Trade Commission lawsuit that alleges that Qualcomm engaged in anticompetitive behavior, and ongoing license dispute with Huawei, one of its most important customers. We believe that over the longer term, customers will continue to challenge Qualcomm's licensing terms. The company has also been investigated and fined by regulators in most regions it conducts business in, including the U.S., EU, China, Korea, and Taiwan, with fines reaching up to \$1.2 billion (it incurred \$554 million in litigation expenses in fiscal 2018). We expect further challenges to Qualcomm's business practices in the future, creating some level of uncertainty around its cash flow. In all, we believe Qualcomm's management has sufficient experience adjusting to changing business environments, including legal and regulatory challenges. Qualcomm recently lost its CFO to a competing firm, but its CEO has been in his role since 2014. The board of directors has changed significantly in recent years and now comprises 11 independent directors out of 12 members. Qualcomm's environmental and social risks are considered modest, in our view, as it outsources most manufacturing to foundries.

Samsung Electronics Co. Ltd. (AA-/Stable/A-1+)

South Korea

JunHong Park

We view Samsung's exposure to social and environmental risk factors as relevant to our credit analysis, but not currently material drivers given their limited financial impacts. Product quality remains a key social risk to Samsung. Battery incidents with its Galaxy Note 7 smartphone in 2016 and its subsequent recall and discontinuation resulted in litigation, substantial brand damage, and lost earnings in the smartphone division. Although, Samsung was able to withstand this event due to its significant net cash holdings and solid overall operating cash flows, a repeat of such severe quality issues could be detrimental to its rating. The company has taken measures to avoid these issues and has since strengthened safety checks and quality control measures for its products. Samsung's manufacturing processes also expose it to waste and pollution concerns. However, the company is committed to constantly improving its manufacturing and packaging process, building more energy efficient products, and reducing electronic waste. Our management and governance assessment of the company is strong, reflecting our positive view of the company's strategic planning and execution, and management's considerable expertise and experience in the technology

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industry.

<p>Semiconductor Manufacturing International Corp. (BBB-/Stable)</p> <p>We believe environmental and social risk factors are currently not key rating drivers for SMIC. Nevertheless, the company faces environmental risks from GHG emissions, water supply, and disposing of toxic materials. We believe SMIC has good awareness of these risks and tries to contain them, for example, by installing pollution control equipment for waste treatment and water recycling. It also follows applicable environmental standards. SMIC is exposed to social risks such as rapidly changing consumer preferences and safety concerns. We believe the company is well positioned to cope with varying consumer preferences due to its diversified product and service portfolio. The company may also face experience business challenges if it fails to attract and retain highly qualified engineering talent. SMIC has good awareness and measures in place to manage production safety, which is also vital to its performance. Legal risks associated with IP are considered a significant governance factor for SMIC. It was embroiled in two IP litigations with TSMC in 2002 and 2006. The two cases cost SMIC as much as US\$175 million and US\$200 million, in addition to shares and warrants granted to TSMC, which we view as immaterial to the company's financial profile. We believe SMIC's awareness and management of IP protection have substantially improved since then, with a dedicated team of engineers managing integrated circuit design libraries and IP.</p>	<p>BBB-/Stable</p>	<p>Hins Li</p>
<p>Sony Corp. (BBB+/Positive/A-2)</p> <p>Sony has some exposures to social and environmental risks through its various business lines, but none are currently material rating drivers. As a major consumer electronics company in Japan, Sony manages consumer and product-related risks effectively through technological innovation and significant marketing capabilities, demonstrated by its game business, while restructuring noncompetitive businesses, such as downsizing its smartphone business. Sony has controlled environmental risks, but as one of the top global consumer electronics makers, its supply chain spreads all over the world, and climate change can have some impact on earnings. For instance, in 2011 Sony was forced to postpone its digital single-lens camera due to significant flooding in Thailand. We believe Sony will continue to diversify its global supply chain and manufacturing footprint, manage back-up plans for continuing operations during disasters, and hedge risks using insurance to minimize these risks. Governance factors are neutral for Sony's rating. We believe Sony's measures for protecting itself from cyberattacks have improved due to lessons learned from its own experience (Sony incurred ¥4.9 billion primarily for investigation and remediation activities, though not direct losses from the cyberattack on the U.S. movie business in 2014).</p>	<p>Japan</p>	<p>Hiroyuki Nishikawa</p>
<p>Taiwan Semiconductor Manufacturing Co. Ltd. (AA-/Stable)</p> <p>Environmental and social risks do not drive the ratings on TSMC and we believe that the company is in a better position than peers to minimize these risks. TSMC faces environmental risks such as GHG emissions and water supply, with high energy and water consumption in the manufacturing process, as well as unstable power and water supplies and business interruptions related to natural disasters such as earthquakes since most of its production facilities are in Taiwan. TSMC may also experience business adversities if it fails to attract and sustain sufficient human capital in Taiwan, where the population is aging and highly qualified engineering talent is becoming scarce. However, TSMC's strong capabilities and commitment to minimizing the environmental impact of its operations are evidenced by its industry-leading metrics on energy consumption, water recycling, and other emissions that show persistent improvement. The company's strong business reputation and its importance to Taiwan's economy also alleviate the potential risk of insufficient power and water supplies on TSMC's operations because the government will likely prioritize the company. Furthermore, the company's fabrication facilities are spread across three major locations and built with high safety standards against major natural hazards, minimizing their potential impact. We view TSMC's management and governance to be strong as it has clear short- and long-term goals for business and technology development, and a good record of executing these strategies.</p>	<p>Taiwan</p>	<p>Raymond Hsu</p>
<p>Western Digital Corp. (BB+/Stable)</p> <p>We assess Western Digital's exposure to environmental risks as relevant to our credit analysis, while its exposure to social and governance factors is less so. Western Digital's manufacturing operations are subject to various environmental risks concerning GHG emissions, climate change, and hazardous materials and waste. We believe the company is more vulnerable to these risks than fabless hardware and semiconductor companies because of its in-house manufacturing capabilities. The company conducts periodic audits to assess its compliance with applicable environmental laws and regulations and requires that manufacturing facilities meet minimum energy, water, and waste conservation targets in addition to location-specific targets. We view the company's management and governance as satisfactory, reflecting management's experience, expertise, and ability to adjust its business strategies when needed.</p>	<p>U.S.</p>	<p>Jenny Chang</p>
<p>Xerox Corp. (BB+/Watch Neg)</p> <p>Xerox faces environmental risks in its manufacturing operations, which are exposed to GHG emissions, energy management, hazardous materials and waste, air and water pollutants, and materials recycling. We don't view these factors as major drivers of our rating on Xerox because of its global sustainability policies. In terms of social risks, Xerox's core printer and copier products are facing secular headwinds related fewer printed pages as most workplaces shift to digitizing their content and documentation. In addition, we believe consumer focus on waste management and reduction will limit printed pages. Both of these factors will hurt Xerox's revenues, in addition to intensifying competition and mature market conditions. We incorporated these factors into our analysis of Xerox's competitive position. We assess Xerox' management and governance as fair, based on our positive view of management's standards for operational excellence related to its strong focus on improving operations by</p>	<p>U.S.</p>	<p>Tuan Duong</p>

executing its revenue stabilization plan over the next few years.

Appendix: Components In The Sector ES Risk Atlas

Here is a list of examples of factors we consider in evaluating sector-specific environmental exposure. For example, we examine to what extent each sector is relatively exposed to:

Greenhouse gas emissions (GHG): actual or potential regulations such as carbon taxes, emissions trading schemes, and other direct or indirect costs. The GHG emissions under the Kyoto climate change agreement are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).

Sensitivity to extreme weather events: incremental costs or the potential physical impact on assets associated with recurring (for example, hurricanes) or infrequent (droughts) severe weather events.

Sensitivity to water scarcity: potential costs related to the need for extracting or sourcing large quantities of water, or requiring on-site water treatment, in comparison to other water users of the same water basins or utilities.

Waste, pollution, and toxicity: potential fines or rising costs associated with prevention and treatment of waste and pollution, including hazardous waste and air pollution.

Land use and biodiversity: asset retirement obligations, developing natural land or potential operating constraints, or increased costs associated with protecting plant and animal life.

The following is a list of examples of factors we consider in evaluating sector-specific social exposure. For example, we analyze to what extent each sector is relatively exposed to:

Human capital management: a sector's capacity to develop a long-lasting productive workforce while reducing potential operational disruptions from workforce mismanagement; diversity and inclusion attributes; exposure to strikes and the sector's general exposure to dealing with emerging skills scarcity or surplus labor.

Changing consumer or user preferences: We recognize that changes in consumer behavior are often the result of complex dynamics, such as changes in technology or fashion or other disruptive business trends. Therefore, we treat a change in consumer preferences as a social factor related to sustainability, health, safety, the environment, privacy, financial mis-selling, or community and human rights, particularly when an entity has triggered the change.

Demographic changes: potential costs or opportunities related to population growth and composition, such as an aging population, urbanization, changing living standards, or a growing middle class.

Safety management: potential direct or indirect costs resulting from problems related to the safety of a sector's production processes and final customer products.

Social cohesion: potential or actual costs in direct operations or in the supply chain resulting from geopolitical or community-related events such as conflicts, community unrest, and terror attacks.

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