1. Applicability

This sector profile is designed to help fund managers quickly familiarise themselves with the most frequent and important environmental, social and governance (ESG) aspects of investments in the power generation, transmission and distribution sector. It aims to be a starting point for thinking about ESG risks and opportunities, and not a detailed technical guidance document.

- Using this sector profile
  A company can be affected by non-sector specific issues such as impacts on Indigenous Peoples and cultural heritage. Therefore, each company must be carefully considered based on its specific characteristics and circumstances including scale of operation, location, technology utilised, management capacity, commitment and track record, and supply chains. Additionally, environmental and social (E&S) impacts, risks and opportunities in a particular company or sector can change over time for a number of reasons (e.g. changes in the applicable laws, or expansion of a company's activities or assets). Fund managers should have systems in place to identify such changes and manage any associated risks and impacts and, where possible, capitalise on new opportunities.

  This sector profile draws on internationally recognised good practice standards and guidance, particularly the International Finance Corporation's (IFC's) 2012 Environmental and Social Performance Standards and the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. The sector profile identifies key standards that are generally applicable to the sector (refer to Standards, guidelines and other resources section below). It is not a substitute for such standards, which should take precedence as authoritative sources and basic technical references. Applicable laws and regulations must also be taken into account. Applicable national laws and regulations should always be regarded as the minimum acceptable performance standard.

  See also the Environmental and social checklist and Governance and business integrity checklist which provide questions that fund managers should consider when evaluating power generation, transmission and distribution investments from an ESG perspective.

2. Scope of this sector profile
   This sector profile covers the following activities:
   - Power generation infrastructure.
     - Thermal power – coal, gas, liquid fuel (heavy fuel oil, gas oil etc.) and biomass.
     - Renewable energy – wind, solar, hydro and geothermal power.
   - Service provision (transmission and distribution) of electricity from thermal and renewable sources.

   For related activities such as the extraction, refining and distribution of natural gas or the extraction of coal, refer instead to Sector profile: Oil and gas and Sector profile: Mining.

   Unless otherwise stated, this sector profile applies only to assets that are post-commercial operations date (COD) –the date on which the independent engineer certifies that a facility has completed all required performance tests and/or is built to the specifications outlined in the engineering procurement and construction (EPC) contract. Generic guidance on ESG risks, impacts and opportunities associated with Project design and construction of power generation, transmission and distribution facilities are discussed in the CDC Project Design and Construction Guide.

   CDC and its fund managers are excluded from investing in nuclear power. Consequently, this sector profile does not cover the nuclear power sector.

2. Key environmental and social aspects

This section outlines some of the specific risks and impacts that emerge from poor ESG practices. Weak management of these aspects may lead to reputational damage, have an impact on a company's capacity to raise funding (debt and equity) and, more broadly, negatively impact a company's financial performance. Conversely, sound ESG practices are likely to improve a company's reputation, access to investors and overall performance.

- Management commitment, capacity and track record
  Companies need management's commitment and sufficient capacity to ensure that the necessary resources are available for sound E&S management. Refer to CDC guidance: Assessing commitment, capacity and track record.

- Environmental and social management system (ESMS)
  Companies should develop and implement an ESMS commensurate with the level of risks and impacts associated with its activities. For further advice, refer to E&S topic: Environmental and social management systems (company-level).

- Labour and working conditions
  Note – Occupational health and safety is covered separately below.

  Companies shall operate in accordance with applicable labour laws and regulations and ILO Fundamental Conventions. Refer to E&S topic: Labour standards.

- Occupational health and safety (OHS)

Risks for the business:	- Companies may face prosecution or fines if workers or contractors are injured or killed. - Damage to or loss of, a company's assets, outages, increased insurance premiums and legal claims (both in the short and long term) can result from poor OHS practices. - Low workforce morale and erosion of trust can lead to higher staff turnover, additional training and recruiting costs, and reputational damage. - Use of security forces can present a risk for workers and local communities if security personnel are not carefully selected, trained and monitored. This can also affect the company's operations and reputation.
Opportunities for the business:	- Proactively involving workers and contractors in key decisions can help to identify and maintain good OHS practices, and improve their acceptance if new or significantly different to previous practices. - Productivity can be improved and insurance premiums for workers' and compensation payments can be reduced.

OHS is an important consideration for any business, regardless of sector, and all companies must have in place appropriate OHS and emergency preparedness and response management systems, commensurate with the level of risks.

If contractors are involved in operation and maintenance activities, companies should implement measures to ensure contractors work in accordance with applicable regulations and good international industry practice (GIIP). Such measures should be covered in companies' OHS and emergency preparedness and response management systems.

a) Thermal power generation

OHS risks associated with the operation of thermal power plants can include those in connection with:

- Physical hazards (e.g. electrocution risks due to the presence of electric equipment, work at height and work in confined spaces such as condensers and turbines).
- Exposure to heat (e.g. from working near combustion units, pipes and other hot equipment).
- Exposure to noise (noise sources include turbines, diesel engines, pumps, compressors, condensers, boilers and fans).
- Exposure to electromagnetic fields (EMFs). Power sector workers may have a higher exposure to EMFs than the general public due to working in proximity to power generating equipment and connecting high-voltage transmission lines.
- Chemical hazards (e.g. chlorine gas for treatment of cooling towers and chemicals used in emissions control systems such ammonia).
- Biological hazards (e.g. exposure to pathogens such as legionella in evaporative cooling systems).
- Fire and explosions due to the presence of significant quantities of fuels and high-pressure gases.
- Security. Power plants are often strategic assets for any country and are typically heavily protected in order to prevent sabotage or terrorist attacks.

For further sector-specific guidance, refer to the World Bank Group EHS Guidelines

for Thermal Power.

b) Renewable energy generation

OHS risks associated with the operation of renewable energy power plants (including hydropower, solar power, geothermal and wind power) can include those in connection with:

- Physical hazards (e.g. electrocution risks due to the presence of electric equipment, work at height and work in confined spaces such asin turbines).
- Exposure to noise (noise sources include turbines, engines, pumps, compressors, condensers and fans).
- Risks associated with dam failure (hydropower plants).
- Fire and explosion risks.
- Security. Power plants are often strategic assets for any country and are typically heavily protected in order to prevent sabotage or terrorist attacks.

For further sector-specific guidance, refer to the World Bank Group EHS Guidelines for Wind Energy and Geothermal Power Generation.

c) Electric power transmission and distribution

OHS risks associated with the operation of electric power transmission and distribution networks can include those in connection with:

- Physical hazards (e.g. electrocution from live power lines and work at height on poles and other structures).
- Exposure to EMFs as a consequence of working in proximity to power lines.
- Chemical hazards (e.g. use of pesticides for right-of-way maintenance and exposure to polychlorinated biphenyls (PCBs) during transformer maintenance).
- Road safety, as operation and maintenance activities typically require travelling

long distances.

- Security. Maintenance operators may also frequently work in remote or hard-to-access locations, or be required to disconnect illegal electric power connections, presenting additional OHS and security considerations.

For further sector-specific guidance, refer to theWorld Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

For further general guidance on GIIP relating to OHS, refer to E&S topic: Occupational health and safety, IFC Performance Standard 2: Labor and Working Conditions, World Bank Group General EHS Guidelines and CDC Good Practice: Preventing Fatalities and Serious Accidents.

- Resource efficiency and pollution prevention

Risks for the business:	- Fines and penalties can be imposed for non-compliance with national pollution prevention standards, especially with respect to air and water emissions (thermal power generation) and hazardous materials / waste management. - Excessive expenditure on energy and water supply. - Excessive expenditure on the management of emissions, solid waste and wastewater.
Opportunities for the business:	- Lower operating costs, reduced environmental footprint, and better preparedness for resource shortages or increased cost of resources can result from adopting energy efficiency, water efficiency and cleaner production measures. - Better preparedness for potentially costly regulatory changes such as the implementation of a carbon tax. - Participation in GHG emissions reduction markets, if the opportunity arises. - Demand-side management opportunities such as energy efficiency education can reduce pressure on capacity, providing wider economic benefits to consumers.

a) Thermal power generation

Energy efficiency and air emissions: This will normally be a key a focus for

companies in this sector. Companies should always consider energy efficiency measures, as they can have a significant positive impact on revenues by increasing the net energy conversion ratio (i.e. energy output per unit of energy/fuel input).

Air emissions regulations are generally becoming more stringent around the globe. Companies should be mindful of this trend when designing and operating thermal power plants. Companies should always explore business opportunities associated with the use of cleaner technology and energy efficiency measures (e.g. selling carbon emission reduction credits and/or accessing grants from international climate change funds).

Companies and their investors should apply GIIP and, additionally, give due consideration to implementing best available techniques (BAT) for the management of emissions wherever technically and financially feasible. The European Integrated Pollution Prevention and Control Bureau (IPPC) offers guidance on BAT for emissions control through its Directive and the associated industry specific BAT reference documents (BREFs).

Water management: Power plants may require cooling water for their operations. Opportunities to reduce water consumption should be explored (e.g. use of closed-loop water systems). This is particularly relevant when water consumption requirements are significant and/or water availability is restricted. Water use efficiency measures will potentially have a positive effect in terms of reducing the amount of wastewater generated by the plant, and hence, wastewater treatment costs and/or discharge fees.

Thermal power plants with once-through cooling (OTC) systems use a significant volume of water to cool and condense the steam for return to the boiler, and the heated water is normally discharged back into the water source (i.e. the river, lake, estuary, or ocean). Where this occurs, a detailed assessment of the impacts associated with OTC discharges should have been conducted during an Environmental and Social Impact Assessment (ESIA) prior to development, as this may generate major impacts for the receptor (e.g. river, ocean). Replacing an OTC system with a closed system may not be technically or financially feasible, and mitigation options are likely to be limited if the system presents negative environmental impact.

Waste management: Coal-fired and biomass-fired thermal power plants generate the greatest amount of solid wastes due to the relatively high percentage of ash originating from burning the fuel. Other wastes include cooling tower sludge, and

water or effluent treatment sludge.

Companies should investigate the reuse of solid ash waste or treatment sludge generated in the combustion process, or the recycling of it by other industries such as cement, construction or agribusiness. Where disposal to surface facilities is required, care should be taken to avoid leaching of waste or runoff of fine ash into surface water bodies.

Where even relatively small volumes of potentially hazardous wastes are generated (e.g. used oils, lubricants, solvents paints or cleaners, and the packaging and containers), companies must ensure that these are stored, handled, transported and disposed of according to GIIP, to prevent environmental contamination or danger to handling workers or communities nearby. Many emerging market countries have guidelines for the collection and disposal of used oil. There may also be specific licensing requirements for hazardous waste handling contractors, and disposal-permit requirements at registered landfills. Stringent regulations also apply for transboundary movement of hazardous waste by land or sea (see the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal).

Coal-fired power plants: These typically involve challenging issues with respect to climate change, including significant and harmful air emissions (e.g. greenhouse gas (GHG) emissions and particulate matter) per energy unit generated than non-coal-fired power plants. Some investors, such as CDC, will not invest in coal-fired thermal power generation unless stringent requirements are met (see CDC's Policy on Coal-Fired Power Generation).

For further sector-specific guidance refer, to the World Bank Group EHS Guidelines for Thermal Power.

b) Renewable energy generation

Wind farms, hydroelectric facilities, solar farms and geothermal power Projects generally present a smaller and more manageable range of resource efficiency and pollution prevention issues during operation (this may not be necessarily the case for other environmental and social aspects, which may be more relevant in renewable energy plants). Typical key matters include:

Energy efficiency: Companies should always consider energy efficiency measures as they can have a significant positive impact on revenues by increasing the net energy

conversion ratio. Companies in this sector may be able to benefit by selling carbon emission reduction credits and/or accessing grants from international climate change funds given the fact GHG emissions per unit of energy output are significantly lower than in thermal energy power plants.

Air emissions: Hydroelectric reservoirs can generate significant carbon dioxide and methane. This is because large amounts of carbon tied up in trees and other plants are released when the reservoir is initially flooded and the plants rot. After the first phase of decay, plant matter settling on the reservoir's bottom decomposes without oxygen, resulting in a build-up of dissolved methane. This is released into the atmosphere when water passes through a dam's turbines. A good predictor for the emissions rate is the reservoir surface area per unit of electricity output (i.e. reservoirs with a deep basin and less surface area may generate lower emissions than those with large, shallower dam that inundates a more productive agricultural area). Emissions decline over time as the biomass decays, so this source of air emissions may not be relevant for an established hydroelectric plant.

Geothermal power plants produce significantly lower emissions of carbon dioxide, hydrogen sulphides and methane than coal-fired power plants. While geothermal power plant emissions originate primarily from the existing geothermal resource gases and not from the power generation process itself, research has shown that the nature and properties of this resource, as well as the design of the power plant, influence the rate and extent to which gases are released. For example, binary system geothermal plants as closed-loop systems, achieve almost zero emissions levels. This is in comparison to open systems, such as flash steam or dry steam cycles, where GHGs are released.

Waste management: In hydropower Projects, large volumes of dredge materials may be generated during construction and operation. Companies should identify opportunities to minimise and reuse these materials, where possible, as well as identify appropriate disposal sites for materials that cannot be reused.

All companies should ensure that energy generation facilities focus on minimising the generation of waste. Where waste cannot be recovered or reused, policies and procedures should be implemented to ensure it is stored, handled, treated and disposed of in a manner that avoids environmental pollution or health threats to the workforce or community.

For further sector-specific guidance, refer to the World Bank Group EHS Guidelines for Wind Energy and Geothermal Power Generation.

c) Electric power transmission and distribution

Energy efficiency: Losses of electricity are an unavoidable consequence of transmitting electricity across a network and can have a significant financial and environmental impact (e.g. in 2011, electrical losses in India from transmission and distribution represented c.21%). Technical losses can be reduced (even by up to 5-10%) with the right equipment and maintenance. Losses from defective equipment and low metering/billing/collection efficiency can also be significant.

Hazardous materials and wastes: Where even relatively small volumes of potentially hazardous wastes are generated (e.g. insulating oils, gases and fuels, wood preservation chemicals for poles and associated wood construction material and the containers), companies must ensure that these are stored, handled, transported and disposed in accordance with GIIP to prevent environmental contamination or danger to handling workers or communities nearby. Many emerging market countries have guidelines for the collection and disposal of used oil. They also have specific licensing requirements for hazardous waste handling contractors, as well as for disposal at registered landfills.

For further sector-specific guidance, refer to World Bank Group EHS Guidelines for Electric Power Transmission and Distribution. This sector profile does not address the manufacturing of poles for electricity distribution networks. Refer instead to CDC Sector profile: Manufacturing.

For further general guidance on GIIP relating to resource efficiency and pollution prevention, refer to E&S topic: Resource efficiency, E&S topic: Pollution prevention, IFC Performance Standard 3: Resource Efficiency and Pollution Prevention and the World Bank Group General EHS Guidelines.

- Community health, safety and security

Risks for the business:	- Social licence to operate can be put at risk if community relations are not well managed (e.g. tensions caused by impacts on ecosystem services such as water, or insufficient engagement of local communications prior to Project construction). - Depending on the type of power generation, surrounding communities may be exposed to long-term health and safety risks arising from noise and vibration, EMFs, air and water emissions, and waste disposal. This could result in costs, liabilities and reputational damage for a company. - Reputational damage and costs associated with accidents involving local communities, including accidental electrocutions if live cables and poles fall on people. - Reputational damage and significant management costs can be incurred to address social opposition and criticism due to conflicting or non-transparent land access or acquisition practices, or Project development with little local benefit. - Reputational damage and loss of licence to operate if excessive, intimidating or aggressive use of force by security personnel is used against communities.
Opportunities for the business:	- Building relationships with local communities can contribute to reducing security risks and may yield other benefits in terms of increasing production through access to a better and/or bigger potential labour pool and protection of the power asset (e.g. through lower illegal power connections).

Community health, safety and security issues are a particularly important aspect in this sector. Apart from the impacts arising from pollution prevention and resource use discussed above, community health, safety and security risks and impacts associated with operation of both thermal and renewable energy generation, as well as transmission and distribution of power, primarily relate to:

Emergency preparedness and response: Companies must implement emergency preparedness and response systems to respond to accidents associated with the company's activities in a manner appropriate to prevent and mitigate any harm to people and/or the environment. Companies should develop these systems in collaboration with appropriate and relevant third parties (e.g. local authorities).

Security: Power plants are often strategic assets for any country and are typically considered critical national infrastructure (CNI). These facilities are typically heavily protected in order to prevent sabotage or terrorist attacks, particularly when there are

specific national or regional security risks. Companies should be guided by the principles of proportionality and good international practice in relation to hiring, rules of conduct, training, equipping, and monitoring of security workers, as well as by applicable law.

Safety: Power generation facilities of all kinds, as well as pylons and towers associated with power distribution, should be secured to prevent public access and illegal power connections. Fences, signage and security guards should ensure that the sites are secure in order to protect the public. The original design of pylons or high structures such as cooling towers or wind turbines should incorporate anti-climbing devices, as well as take into account the likelihood of natural hazards and the proximity of airports and flight paths. The efficacy of these access prevention measures should be monitored, and where necessary (e.g. following vandalism), maintained during operation. Similarly, operation of hydropower facilities should prevent or control public access to prevent falls from height at dam walls. Dam structural safety is an important aspect of design to prevent failure and breaching, and is addressed in the CDC Project Design and Construction Guide. However, ongoing maintenance and monitoring of dams (and, in fact, all power infrastructure) to ensure ongoing structural integrity and safety is vital.

Noise and vibrations: Power plants may generate significant noise and vibrations that could affect local communities. Noise in the form of buzzing or humming can often be heard around transformers or high-voltage power lines. Noise originating from wind turbines may also be significant. These potential impacts should be considered at the design and construction phase of the project. Noise or vibration prevention and control measures should be implemented at the design stage (e.g. selecting equipment with lower sound power levels and siting plants away from community areas). However, these situations involving significant noise and vibrations may require ongoing monitoring and maintenance during operation.

Electromagnetic fields (EMFs): Extra-low-frequency EMFs are found wherever electricity is used. They are a by-product of the use of electricity and occur around electric wires (including power lines) and substations. The strongest EMFs are found around major transmission lines that carry the highest voltages and currents. EMFs are also present around suburban distribution systems that, although at much lower voltages, still carry large currents. The World Health Organisation (WHO) has published interim guidelines for exposure to EMFs from power lines and other electric devices that operate at mains frequency.

Electrocution risks associated with electric transmission and distribution networks: In regions where illegal connections and copper theft are frequent, individuals involved in these activities are exposed to very significant electrocution risks. Additionally, local communities (particularly children) are at risk of electrocution as a consequence of falling cables due to bad weather and/or poor network condition (e.g. rotten poles).

In order to reduce risks, monitoring and maintenance systems should be implemented to ensure that the network is in good condition, new poles are well made and installed correctly, rotten poles are replaced or repaired, and downed cables are isolated and reinstated as soon as possible. Additionally, in order to prevent theft and contact with downed cables, companies should think about delivering awareness campaigns to local communities, with a particular focus on protecting children.

For sector-specific guidance, refer to the World Bank Group EHS Guidelines for Thermal Power, Wind Energy, Geothermal Power Generation, and Electric Power Transmission and Distribution.

For further general guidance on GIIP relating to community health, safety and security, refer to E&S topic: Community health, safety and security and IFC Performance Standard 4: Community Health, Safety and Security,UN Code of Conduct for Law Enforcement Officials, UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials.

- Land access, use and acquisition

The operation of power assets may be associated with ongoing land access requirements, and, in some cases, with additional land acquisition for expansion activities (e.g. additional generation capacity). Expropriation processes could be triggered. Usually companies and governments will generally seek to negotiate with Affected Communities before doing so. For further guidance, refer to CDC Project Design and Construction Guide and E&S topic: Land acquisition and involuntary resettlement.

Where land acquisition is lead by the government, companies should engage and collaborate with the government to the extent possible (refer to the Business integrity considerations section below), to avoid longer-term negative impacts arising from poorly designed and implemented compensation, relocation or expropriation terms.

Where possible, companies should actively participate in the preparation, implementation and monitoring of the process in order to avoid impoverishment of local communities. For further guidance see E&S topic: Land acquisition and involuntary resettlement and IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement.

8. Biodiversity conservation and ecosystem services

Risks for the business:	- Social licence to operate can be put at risk from negative impacts to ecosystem services used by local communities. - Reputational damage associated with hydropower or other power generation that directly or indirectly (i.e. via distribution corridors) adversely impacts biodiversity (e.g. impacts on primary tropical forests or loss of habitat through flooding of a dam basin). - Significant loss or alteration of natural habitats through flooding of river basins for hydropower, leading to increased carbon and methane emissions. - Lost production time and higher repair and maintenance costs through inadvertent wildlife access (e.g. fauna collisions with wind farms and electrocutions from transmission lines). - Financial risk where compensation payments are required to local communities for water abstraction or where elevated water discharge temperatures or quality negatively affect aquatic habitats and livelihoods such as fishing. - Delays and additional costs in investments that affect protected areas or species and/or Critical Habitats or endangered species due to the need to obtain additional permits and design and implement more complex management measures.
Opportunities for the business:	- Avoidance of potential financial risks or claims through proactive protection or conservation of biodiversity. - Lower maintenance costs or water abstraction charges by conserving water resources through closed-loop circulation, the use of dry scrubbers for thermal power generation, or through seasonal reduction of abstraction to address seasonal, low-flow rates.

As global demand for energy increases, threats to biodiversity in increasingly remote areas are mounting. As a result, there is now significantly greater interest from

regulators, buyers, investors and NGOs on the biodiversity impacts generated by the energy sector.

Habitat alteration and fragmentation are the most likely threats to biodiversity associated with power generation and distribution activities. Depending on the type and location of the power facility, varying degrees of habitat disturbance and population in-migration will result, both of which may extend beyond the immediate footprint of the facilities.If significant impacts on biodiversity and/or ecosystem services are likely, companies should specifically assess these potential impacts and implement (biodiversity) management systems and plans to manage biodiversity and ecosystem service risks in accordance with the mitigation hierarchy. Refer to CDC Project Design and Construction Guide for further information.

a) Thermal power generation

Risks and impacts to biodiversity associated with the operation of thermal power plants can include:

- Impacts on aquatic habitats as a result of water abstraction (high quantities of cooling water are required and discharge of warmer process water with polluting elements may affect aquatic biodiversity).
- Aquatic organisms may also be drawn into cooling water intake structures and killed or trapped (e.g. sea turtles).
- There may also be concerns about the potential impacts of cooling water intake structures located in or near habitat areas that support threatened, endangered or other protected species or where local fishing is important.
- Impacts to marine habitats as a result of seawater flue gas desulphurisation with discharge of high volumes of water at a higher temperature, acidity and hazardous substances.
- Emissions and accumulation of particulate matter can significantly impact surrounding vegetation and local fauna.

For further sector-specific guidance, refer to the World Bank Group EHS Guidelines for Thermal Power.

b) Renewable energy generation

Risks and impacts to biodiversity associated with the operation of renewable energy power plants (including hydropower, solar power, geothermal and wind power) can include:

- Physical hazards (e.g. avifauna collisions and electrocutions with onshore wind turbines).
- Impacts on aquatic habitats due to changes in water flow rates as a result of hydroelectric dams and flooding of riverbeds and surrounding basins which may also impact downstream habitats.
- Habitat alteration as a result of vegetation maintenance at renewable generation sites (e.g. use of mechanical means such as mowing or pruning, use of herbicides to prevent disturbance to panels or turbines, or where maintenance includes digging to expose buried cables).
- Temporary displacement or disturbance to marine fauna arising from maintenance to submarine cables or offshore wind turbines.
- Opening up previously inaccessible natural habitats to population in-migration (permanent or access to ecosystem services) along access roads to solar or wind farms resulting in clearing for agribusiness or access to firewood etc.

For further sector-specific guidance, see the World Bank Group EHS Guidelines for Wind Energy and Geothermal Power Generation.

c) Electric power transmission and distribution

Risks and impacts to biodiversity associated with the operation of electric power transmission and distribution networks can include:

- Habitat alteration as a result of right-of-way vegetation maintenance and access along transmission lines (e.g. use of mechanical means such as mowing or pruning or the use of herbicides to prevent disturbance to power lines, or where maintenance includes digging to expose buried cables).

- Habitat disturbance along transmission line right-of-way where maintenance activities may interrupt animal breeding (e.g. where avifauna nesting on power transmission infrastructure is removed). Aquatic habitat disturbance is also possible where maintenance to submarine cables is required.
- Increased potential for forest fires where vegetation control has resulted in the accumulation of slashed material or where undergrowth is left unchecked.
- Avian and bat collisions and electrocutions with transmission wires and towers.
- Potential localised soil pollution from reapplication of treatment to wooden transmission poles (e.g. creosote) or from replacement of old poles where initial pre-treatment has been ineffective.
- Opening up previously inaccessible natural habitats to population in-migration (permanent, or access to ecosystem services) along transmission rights-of-way, resulting in land clearing for agribusiness or access to firewood.

For further sector-specific guidance, refer to the World Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

For further general guidance on GIIP relating to biodiversity conservation and ecosystem services, refer to E&S topic: Biodiversity and ecosystems services and IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

9. Climate change

Risks for the business:	- Operational interruption (including interruption due to supply chain disruptions) due to extreme weather events (e.g. flooding). - Interruption to the provision of utilities (e.g. power, water) due to extreme weather events, and increased pressure on energy generation during prolonged periods of high temperatures. - Reduced efficiency of thermal power stations and transmission capacity and increased losses of transmission and distribution lines due to temperature increases.

Opportunities for the business:	- Additional revenue through carbon emission reduction markets. Access to funds/financing aimed at mitigating climate change risks (an increasing number of financial institutions and other investors have specific business lines, fund and/or strategies linked to climate change mitigation and adaptation). - Consumer and business shift from carbon intensive energy sources to renewables in face of legal/regulatory pressures. - Reduced reliance on fuel/oil prices.

As power generation, transmission and distribution assets have long operational lifetimes, they are sensitive not only to the existing climate at the time of their construction, but also to climate variations over the decades of their use. Climate change impacts include rising temperatures, changing rainfall patterns, rising sea levels, as well as potential increases in extreme weather events such as storms floods and droughts. More specifically, the power sector may be exposed to the following risks:

- Transportation and operational interruption due to extreme weather events (e.g. flooding).
- Interruption to provision of utilities (power, water, waste) due to extreme weather events, and increased pressure on energy generation during prolonged periods of high temperatures.
- Increased temperature reduces efficiency of thermal power stations and reduces the transmission capacity/increases the line losses of transmission and distribution lines. Increased periods of prolonged higher temperatures changes energy demand trends, with peak demand increasingly moving to summer periods.
- Increased peak electricity demand due to warmer and more frequent hot days leading to increased maximum transmission requirements, while at the same time transmission capacity of existing lines is reduced. More severe storms can cause power lines to touch and short circuit. Dust storms can damage high voltage switch gear and wind turbines.
- The energy sector is reliant on marine transport and port facilities, which could be disrupted through rising sea levels, increased occurrence and severity of extreme weather events, and changes in sea water temperature and acidity.

- Many energy and utility facilities are located in coastal sites, and so are particularly vulnerable to flooding from rising sea levels. Increased damage to facilities and infrastructure due to extreme weather events.
- Consumer and business shift from carbon intensive energy sources to renewables in face of legal/regulatory pressures.
- Wind and wave power systems may suffer in extreme, stormy conditions, with wind turbines having to shut down more frequently due to increased frequency of wind speeds in excess of the high-speed cut-off level.
- Temperatures increases may require additional cooling requirements to avoid impacts on employee welfare and production processes.

Considering the above (and other risks), countries are developing strategies and regulations aimed at mitigating climate change risks (e.g. restrictions in terms of greenhouse gas emissions). Companies should be aware of this trend as this may have economic benefits (e.g. paying lower carbon taxes).

Additionally, low carbon energy generation will form a significant part of the global approach to mitigating climate change. Climate finance and carbon market funding may enable an organisation to create market advantage from cleaner energy provision. For example the installation of renewable energy systems to reduce overall cost of power, through displacement of high-cost electricity from diesel-powered systems and/or sale of offsets (CERs).

3. Business integrity considerations

Fund managers should ascertain and continue to ensure that every company (regardless of sector) complies with the fund's business integrity requirements. For further information see Business integrity.

- Business integrity issues specific to the power sector
  The generation, transmission, and distribution of power is typically a medium-risk sector during operation, while the contracting phase is typically associated with high

risks. However, these risks can vary considerably depending on the country of operation. Corruption in the power sector is also closely intertwined with inefficiency, so corruption even in low-level operations can considerably undermine the success and stability of a company. In addition to standard Business integrity concerns, risks that are particularly relevant for the power sector include:

- Contract, license, and permit acquisition.
- Tariff negotiations.
- Customer interfacing.
- Subsidies.

Companies should have clear guidance and provide regular training for all employees on avoiding bribes and facilitation payments. There must also be strong oversight systems in place, including clear and secure whistleblowing procedures.

For further guidance refer to Transparency International.

4. Advice for Fund Managers

See also the Environmental and social checklist and Governance and business integrity checklist and Investment cycle.

- Sector risk overview
  The power sector intrinsically involves potentially complex and significant and diverse ESG risks and impacts that are likely to have material implications for long-term shareholder value. Therefore, addressing ESG matters should normally be a central element of due diligence, investment structuring and on-going ownership and monitoring. Fund managers should give serious consideration to using independent ESG experts to support them in transactions in this sector.

- Scoping considerations
  In addition to the aspects highlighted above linked to the company's assets, activities and workers, fund managers should take into account the following during the life of the investment, from screening to exit:

- **Associated facilities** which in this sector are very frequent and relevant (e.g. power transmission lines and gas/oil pipelines).
- **Contractors** whose operations present significant E&S issues which could have an impact on the business (e.g. EPC contractors, land clearing, maintenance of transmission lines or generation facilities themselves e.g. wind blades, solar panels).
- **Supply chains** presenting significant E&S risks and/or impacts. Even where a company cannot directly address risks because it lacks leverage or commercial influence, it is important that fund managers are aware of the risks. For further guidance refer to E&S topic: Supply chains.

- Situations requiring extra attention
  Extra attention, longer timescales and more intensive ESG due diligence may be required in more complex situations. This may involve engaging consultants (see CDC guidance: Working with consultants) to conduct a gap analysis against the applicable local and international E&S standards(e.g. IFC Performance Standards and World Bank Group EHS Guidelines).

  Examples of activities or situations in this sector requiring extra attention include:

  - New Projects/Expansions: Greenfield construction/major expansion Projects (refer to CDC Project Design and Construction Guide).
  - Associated Facilities: In some cases, associated facilities (e.g. power transmission lines for power plants which are not owned/operated by the company), could present significant E&S risks and impacts. Where relevant, the identification of such risks and impacts should also include assessment of the role and capacity of the third parties responsible for operating these facilities (e.g. suppliers, contractors, local or national governments) to the extent that they pose a risk to the primary Project or operation. While these risks and impacts are sometimes difficult to assess or mitigate, the company should try to engage the third party and address these risks and impacts as far as its influence and control allows.
  - Emissions of greenhouse gases: Air emissions regulations are becoming more

stringent around the world, in recognition of the serious threat climate changes poses to the world economy, people and habitats. Fund managers should be mindful of this trend when considering investments in thermal or hydro power plants. They should encourage companies to explore business opportunities associated with the use of cleaner technology/energy efficiency measures (e.g. selling carbon emission reduction credits and/or accessing grants from international climate change funds).

- Decommissioning: The primary aim at closure and decommissioning of power generation facilities is to ensure that the remaining infrastructure or cleared land poses no harm to the environment or surrounding communities in the future. This includes remediation of contaminated land (e.g. from oil spills), removal and/or securing of remaining infrastructure to prevent access by the public (e.g. to cooling towers, turbine halls, distribution lines, or wind turbines) and removal of electric circuits, wiring, and power distribution cabling. Reuse of infrastructure and generation components should be encouraged as far as possible. For further guidance refer to section 4 of the World Bank Group General EHS Guidelines.

- Transactions / geographies with high business integrity risks: The generation, transmission, and distribution of power is typically a medium-risk sector during operations and the contracting phase is typically associated with high risks.

- Any other activities/ Projects involving involuntary economic and/or physical displacement of communities or significant adverse impacts on biodiversity or ecosystem services, Indigenous Peoples, cultural heritage, or local communities.

5. Standards, guidelines and other resources

For authoritative guidance, fund managers should consult the applicable IFC Performance Standards and World Bank Group EHS Guidelines.

- Applicable IFC Performance Standards
  The IFC Performance Standards most commonly applicable to investments in this sector are:

- IFC 2012 Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts.
- IFC 2012 Performance Standard 2: Labor and Working Conditions.
- IFC 2012 Performance Standard 3: Resource Efficiency and Pollution Prevention.
- IFC 2012 Performance Standard 4: Community Health, Safety and Security.
- IFC 2012 Performance Standard 5: Land Acquisition and Involuntary Resettlement.
- IFC 2012 Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

In addition, other IFC Performance Standards may be applicable depending on the specific characteristics and locations of the company's operations. The screening stage of the fund manager's ESG due diligence should always include a routine check for the potential presence of significant impacts covered by the IFC Performance Standards.

- Applicable World Bank Group EHS Guidelines
  The most relevant World Bank Group EHS Guidelines in this sector are:
  - World Bank Group General EHS Guidelines.
  - World Bank Group EHS Guidelines for Wind Energy.
  - World Bank Group EHS Guidelines for Geothermal Power Generation.
  - World Bank Group EHS Guidelines for Thermal Power.
  - World Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

- Additional references, standards and guidelines

Additional resources that may be valuable are:

- CDC Guidance Note: Heavy Fuel Oil Fired Power Plants.
- World Bank Group Energy Sector Management Assistance Program (ESMAP) Large-Scale Residential Energy Efficiency Programs Based on Compact Fluorescent Lamps (CFLs) 'CFL Toolkit.
- The World Bank Renewable Energy Toolkit (REToolkit) Utility Scale Solar Power Plants – a guide for developers and investors. IFC 2012.
- International Hydropower Association.
- Hydropower Sustainability Assessment Protocol.
- The European Integrated Pollution Prevention and Control Bureau (IPPC) BAT reference documents (BREFs).
- IFC and EBRD (2009) Guideline on Workers' Accommodation Processes and Standards.
- WBCSD report on developing climate resilient power infrastructure.
- United Nations (UN) Code of Conduct for Law Enforcement Officials.
- United Nations (UN) Basic Principles on the Use of Force and Firearms by Law Enforcement Officials.
- World Health Organisation (WHO) interim guidelines for exposure to EMFs from power lines and other electric devices that operate at mains frequency.
- Transparency International.