EARTH SECURITY GROUP

CEO Briefing: Energy & Infrastructure

Navigating the changing global context

Content

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Note
All currency $ refers to US dollars unless otherwise stated.

Executive Summary

The operating context for resource-intensive industries is becoming more complex. Development pressures are undermining the business environment. Building trust in the role of energy and infrastructure companies in sustainable development requires investments in ecological resilience to secure water supplies, and in renewable energy to ensure that energy security is compatible with the low- carbon transition. Business leaders must align their companies to the societal priorities of the countries in which they operate. We call this 'business diplomacy for sustainable development'.

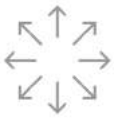
Key Messages

1
The business context is changing rapidly

Development pressures are converging along social, environmental, governance and energy issues. This is creating a more complex environment in countries that are vital to the profitability of global companies.

2
Societal challenges undermine investment

Companies are acutely challenged by societal issues, which can hamper their legitimacy to operate and their growth. Business leaders need to manage the risks by improving the social and ecological stability on which their investments depend.



3
Business diplomacy is a driver of change

Beyond their existing efforts to improve resource efficiency and corporate responsibility, companies should prioritise investments and relationships that build trust with their stakeholders in their capacity to be stewards of limited resources.

4
Regional approaches are needed

Each of the world's regions face a distinctive set of development pressures that affect the business environment. Companies have to understand these differences and develop clear regional priorities to navigate a mosaic of global realities.

The Earth Security Index 2016

The Earth Security Index is a visual data framework, mapping converging pressures along social, environmental, governance and energy dimensions for countries. It provides leaders in business, government and society with a way to assess a complex set of forces and scenarios that are shaping a country's development challenges.

The 2016 version of the diagram visualises the performance of countries across the 24 issues listed below. Higher scores represent higher levels of pressure. A visual benchmark highlights those dimensions whose scores exceed values of 50%.

Environmental

Climate Infrastructure Risk
The vulnerability of infrastructure to adverse climate impacts.

Land Deforestation
The loss of forest cover.

Land Degradatation
The costs of a reduction or loss of land ecosystem services.

Water Insecurity
The availability of water throughout the year and the relative performance of water provision.

Water Pollution
The degree of water pollution from households, industry and agriculture.

Water Virtual Imports
The amount of water that is imported by being embedded in commodities and products.

Weather Extremes
The level of exposure to extreme weather events, measured in human and economic losses.

Social

Food Import Dependence
The dependence on food imports.

Food Insecurity
The level of food insecurity, reflecting continuing or structural poverty and low income.

Gender Inequality
Gaps in reproductive health, empowerment and labour market participation due to gender inequality.

Land Tenure Insecurity
The lack of security that a person's land rights will be recognized and protected.

Poverty
The country's proportion of the population living in poverty.

Skills Gap
The country's level of knowledge-based skills and talent competitiveness.

Unemployment
The country's levels of total unemployment and youth unemployment.

Urban Population Pressure
The country's urban population growth rate.

Governance

Fiscal Sustainability
The sustainability of the public sector, including economic growth, government debt, and the probability of sovereign debt default.

Government Effectiveness
The quality and independence of the public service and the effectiveness of policy implementation.

Inflation
The increase in consumer prices and decline in the purchasing value of money.

Political Accountability
The level of transparency, accountability of and participation in government decisions, including the degree of press freedom.

Rule of Law
The quality of contract enforcement, property rights, the police, the courts, and the likelihood of crime and violence.

Energy

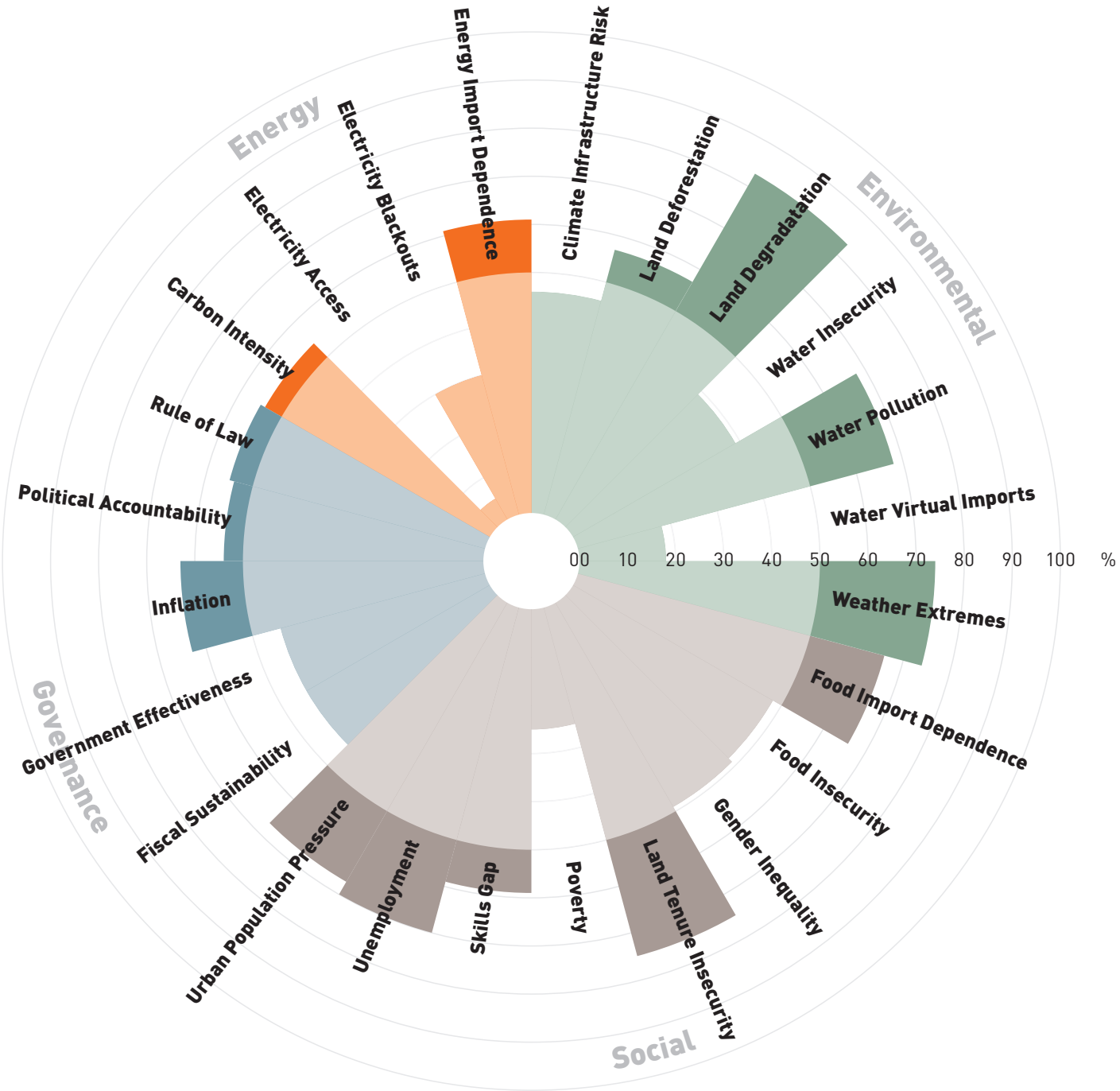
Carbon Intensity
Carbon emissions from electricity generation and industry.

Electricity Access
The proportion of the population without access to electricity.

Electricity Blackouts
The number of power outages.

Energy Import Dependence
The country's external dependence for primary energy.

The 2016 Earth Security Index Diagram



Introduction

Governments in developing countries are competing for private capital participation in large engineering and construction projects in power generation, water and transport.[1/2] This is also forging new global alliances driven by public-private participation. In 2015, under the auspices of China's 'One Belt, One Road' initiative, Chinese companies signed infrastructure deals worth more than USD 1.7 billion in Tanzania and plan to invest USD 46 billion in infrastructure in Pakistan — along vast land and maritime corridors.[3/4] These type of large infrastructure investments will shape the barriers and opportunities for the global sustainable development agenda and must focus on sustainable growth.

Climate change, water stress and land degradation are posing significant threats to infrastructure. India and Brazil are living examples of the crippling impact of more intense droughts on electricity generation.[5/6] But electricity demand in developing countries is set to grow significantly in the next decades alongside urban demographic pressures. The additional costs of adapting to climate change impacts for infrastructure assets are estimated to range from 5% to 20% of the initial investment cost.[7] This is prompting large infrastructure companies to rethink how to adapt to climate change.[8/9]

Companies are beginning to view investments into decentralised renewable energy infrastructure, and reinforcing 'green infrastructure' that maintains the hydrological functions of ecosystems, as pragmatic strategies to face the more volatile conditions that will clearly undermine infrastructure assets in the years to come.[10]

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Industry sector context

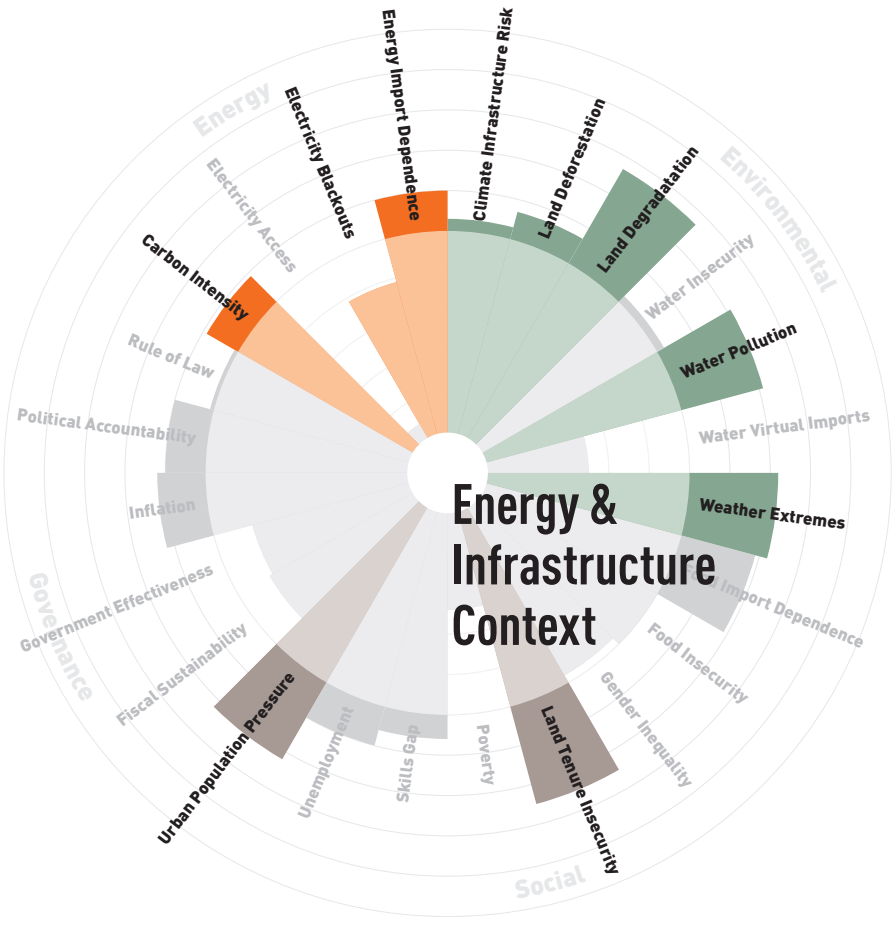
A snapshot of the development pressures that are shaping the operating context for infrastructure companies in key countries

We have identified a group of developing countries that are strategically important to the profitability of the 25 largest publicly-listed corporations in the infrastructure sector in engineering and construction projects in power generation, water and transport.[11] The companies reviewed, given their presence in developing countries, are listed below.

The group of countries includes major markets for infrastructure such as Brazil, China and India. Brazil is facing a profound political crisis that has affected the country's largest infrastructure companies on corruption charges and is likely in the short term to define the operating context for infrastructure companies. China's infrastructure spending is expected to grow by 10% per year to just under USD 3.5 trillion by 2025.[12]

In India, where 70-80% of the built infrastructure needed by 2050 has yet to be developed,[13] it is estimated that USD 724 billion will be needed by 2030 to invest in urban infrastructure.[14]

Development pressures shaping the operating environment for infrastructure companies across top developing countries



The visual represents the aggregate resource pressures in the developing countries that are key to the investments of the largest infrastructure companies. These are listed below.

Countries
Brazil
Chile
China
Colombia
India
Indonesia
Malaysia
Mexico
Peru
Qatar
Russia
Saudi Arabia
South Africa
Thailand
Turkey
United Arab Emirates
Vietnam

Companies
ABB (Switzerland)
Atlas Copco (Sweden)
Caterpillar (US)
China Railway Group (China)
China Railway Construction Corporation (China)
China Yangtze Power (China)
Corning (US)
Danaher (US)
Duke Energy (US)
Eaton (US)
EDF (France)
Enel (Italy)
Emerson Electric (US)
Engie (France)
E.ON (Germany)
General Electric (US)
3M (US)
Hitachi (Japan)
Hon Hai Precision Industry (Taiwan)
Hutchison Whampoa (China)
Iberdrola (Spain)
Schneider Electric SE (France)
Siemens (Germany)
TE Connectivity (US)
Vinci (France)

Exposure to development pressures

Two societal challenges where companies should develop a resource leadership position to create long-term conditions for their operations.

1
Electricity shortages due to climate change, water stress and demographic pressure

The growing demand for electricity in developing countries is straining energy infrastructure.[15] Power blackouts, and the more common 'brownouts' (dips in voltage), have serious consequences for a country's industry and population at large. At least USD 48 to 53 trillion in cumulative global investments are needed in energy infrastructure by 2035 to meet increasing energy demands. 50% of this needs to be directed to electricity transmission and distribution.[16] Failure to do so could leave electricity supplies of developing countries critically exposed.

In the last few years, extreme drought and floods have been increasingly responsible for country-wide power outages and load-shedding across Asia, Africa and Latin America. The Global Electricity Initiative found that over 70% of power utilities surveyed around the world have been severely affected by extreme weather events.[17] In 2012, for example, following a higher-than-average drought that crippled hydropower generation capacity by 19%, blackouts across 20 states in India affected over 670 million people.[18]

Today, India already faces a peak energy deficit of almost 7% of its total electricity demand.[19] The trend is expected to continue as multiple forces, including extreme weather that increased more than 4 times between 1980 and 2014, act to create a supply bottleneck.[20]

The average pressures on the most important developing countries for the global infrastructure sector show a convergence of carbon intensity, electricity blackouts and a general reliance on energy imports.[21] High exposure to extreme weather and the risk to infrastructure, coupled with urban demographic pressure, will increase the scrutiny from consumers and regulators on the quality of energy supplies. The pressure on companies in the infrastructure sector to deliver 'both' on goals of climate change and energy security will increase.

2
Water pollution and scarcity to worsen due to the conversion of land ecosystems

Energy and electricity production account for 15% of global water use. Water withdrawals for energy production are expected to increase by 20% by 2035. Hydropower facilities with large reservoirs can have some of the highest water consumption levels per unit of electricity generated.[22] The Global Electricity Initiative sees water security as one of the top challenges for the sector.[23] For example, in September 2015, the state of Maharashtra in India was considering a complete halt to hydropower generation at three Tata Power stations due to drought.[24] The challenge will only be aggravated by climate change. In Africa, failure to consider climate change in the planning stages of hydropower plants could lead to revenue losses of up to 60%, according to the World Bank.[25] Global investments in the construction of dams are expected to grow steadily by 3% to 4% annually.[26] However, many hydropower companies are already having to deal with more volatile water availability by cutting production.

This has exacerbated the intermittency of power supply and increased electricity tariffs leading to disputes with regulators.[27] Droughts have forced utilities in Brazil, Zimbabwe and Tanzania to revert to more carbon intensive power sources, affecting their overall carbon intensity and corporate footprint.[28/29] The awareness of these risks is creating more receptivity to climate change among corporate audiences.[30]

However, companies will be more vulnerable in regions where land is being degraded fastest. Unsustainable farming methods upstream can have a major impact on dams downstream,[31] such as less water flowing into a reservoir and more sedimentation damaging equipment.[32] Land degradation is particularly acute in the areas of highest projected growth for hydropower investments. Deforestation in the Amazon Basin, for example, has been directly linked to drought conditions that crippled Brazil's hydropower infrastructure from 2013 to 2015.[33] These pressures are converging in key countries for global infrastructure, with land tenure insecurity creating an additional barrier to the effective management of land.

Recommendations for business leadership

Strategic responses to resource pressures that build trust with stakeholders and align a company strategy with sustainable growth

1
Corporate commitments to 100% renewable energy, while partnering on energy infrastructure

Many large infrastructure companies, such as Siemens are committing to source 100% of their electricity from renewable sources. The average target date for these commitments is 2025–2030. This means that companies will not only need to commit their purchasing decisions but also play a proactive role in supporting the renewable energy infrastructure, such as transmission and distribution systems, to accomplish their target. Companies should sign up to global corporate networks, like The Climate Group's RE100, which are helping companies to plan such commitments.[34]

Partnerships that build a transmission infrastructure are key to scale up the supply of renewables.[35] For example, South Africa's state-owned utility, Eskom, partnered with independent power producers to overcome power shortages through the integration of renewable energy into the central grid.[36/37]

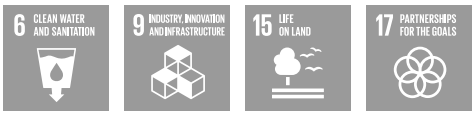
In 2015, Google announced an investment into Africa's largest wind farm — the Lake Turkana Project in Kenya. An attractive part of the investment project is a 266-mile transmission line that will be built as a backbone for the Kenyan grid and enable development of further renewable capacity.[38] Therefore, companies committing to source and generate 100% renewable energy will have to enter into such partnerships to help build the infrastructure needed to realise their goal.[39]

2
Investing in green infrastructure to maintain ecosystem services

The business case is clear: ecological restoration can lead to a 6% increase in water inflows to a dam's reservoir and a 5% rise in revenues from increased electricity generation.[40] Maintaining the ecological integrity of watersheds is vital to the future of hydroelectric investments.[41]

While water utilities have been pioneering such programmes for years, support for 'green infrastructure' by hydropower projects must become a part of the project finance considerations, especially by development investors. The acknowledgement of green infrastructure is starting to appear in 'voluntary' industry standards such as the Climate Bonds Standard for Water Infrastructure and the Standard for Sustainable and Resilient Infrastructure.[42/43]

Infrastructure companies must create programmes to pioneer 'green infrastructures' through ecological restoration. One example are Payments for Watershed Services (PWS), funds designed in collaboration with expert organisations such as Forest Trends,[44] which direct corporate funds to pay for watershed services, while resolving challenges like land tenure rights.[45] Dam operators must incorporate the practice of routinely evaluating the status of watersheds within their basins. They can collaborate with initiatives such as The Natural Capital Project, which has developed a system to measure the investment benefits of ecosystem protection that are a useful tool for companies to build an internal business case for action.[46] Global industry bodies, such as the International Hydropower Association (IHA) have a role to play in this agenda by incorporating more explicit guidance on the subject on an industry-wide scale.[47]



Guidance on the Global Goals for Sustainable Development
As companies take a proactive approach to managing this issue, they are advancing the Global Goals for Sustainable Development in the countries where they operate.

Case Study Elion Resources Group, China
Corporate commitment to 100% renewable energy

Country context

China is one of the world's most vulnerable countries to climate change – in particular droughts and floods.[48] Major flooding in 2011 led to the failure of 8,500 electricity lines.[49] Up to USD 11 billion annually are needed to upgrade infrastructure to deal with flood risks.[50] By 2024, up to two-thirds of the Chinese population will be living in cities — the fastest rate of urbanisation globally. Electricity consumption in China is forecast to grow 250% from 2010 to 2030.[51] This will put more pressure on electricity grids, as well as continue to raise the political pressure on air pollution — the latter already being a factor that supports decisions towards renewables in China.[52] Renewable off-grid and micro-grid technologies are seen as vectors of market growth, playing a larger role in energy provision than diesel engines and other polluting technologies that aggravate China's air pollution in growing cities.[53]

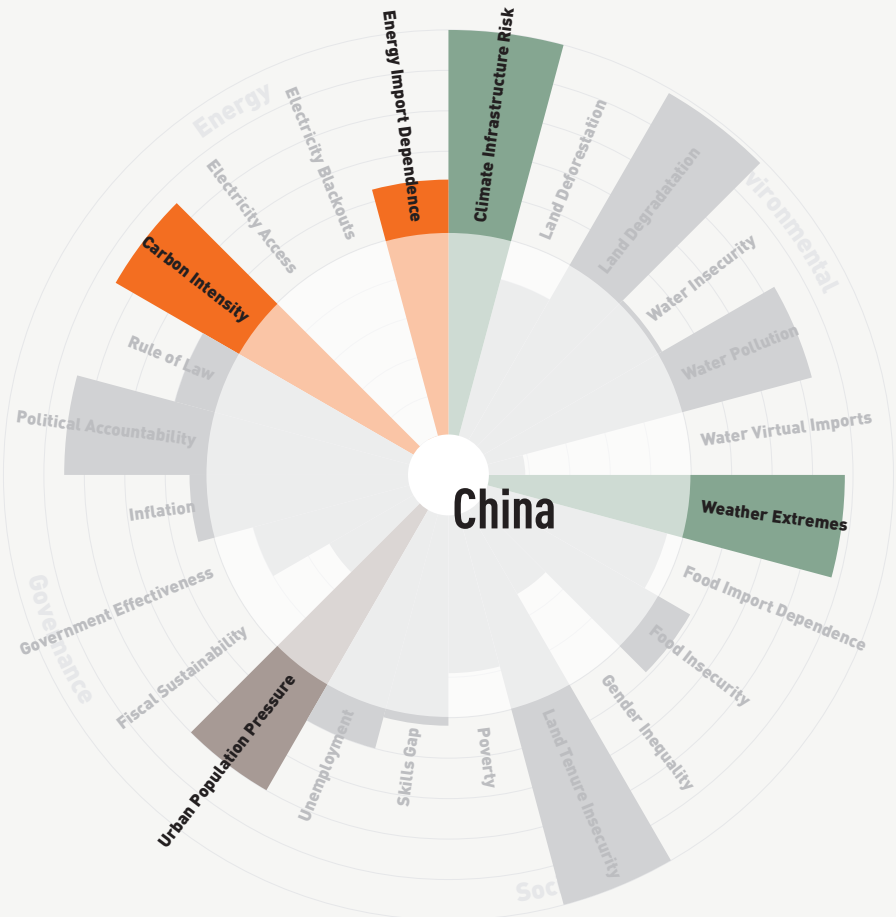
A resource leadership position

Elion Resources Group, one of China's top 100 private companies, with total assets of RMB100 billion (over USD 16 billion) is a leading desert and urban environmental restoration business. The company has committed to 100% renewable energy by no later than 2030. It did this by becoming the first Chinese company to join the RE100 global business initiative.[54]

Elion has been involved in eco-restoration for almost three decades, transforming decertified areas into green spaces through afforestation and projects that prevent erosion. The company is particularly focused on the Kubuqi Desert in Inner Mongolia and other ecologically fragile regions in line with China's 'One Belt One Road' (OBOR) initiative. China's OBOR strategy is critically relevant to business opportunities infrastructure sector.

It is underpinned by lending from the Asian Infrastructure Investment Bank (AIIB), and will direct investment in infrastructure along various regional corridors. The commitment to 100% renewable energy comes at a time when OBOR and AIIB, two key drivers of energy infrastructure investment in China, are in the process of considering their approach to sustainable development. Companies committing to 100% renewable energy must form partnerships with governments, development banks and investors to put in place the infrastructure needed to support their commitments. Elion has already invested USD 0.15 billion in a 110 megawatt (MW) solar PV power station in the Kubuqi desert, and plans to invest USD 6.4 billion in a large-scale, five gigawatt (GW) solar PV project.[55]

The company's chairman, Wang Wenbiao, has stated that 'The Elion Group is focusing on green energy in our corporate strategy to adapt to a new era where natural resources and environment have become a major constraining factor of human development.' China's Renewable Energy Industries Association (CREIA) further anticipates that besides large-scale projects, decentralised solar PV will grow faster as one of the most popular forms of energy in China, since rooftop solar projects currently offer industrial and commercial sectors a payback period of 7-9 years and an 8% rate of return.[56]



The combined forces of climate change and weather risks on infrastructure, urban demographic pressure and carbon intensity of electricity coupled with energy import dependence create a bottleneck on the growth of China's electricity supplies.

Case Study Energía del Pacífico, Colombia

Investing in green infrastructure and land restoration

Country context

Colombia is highly dependent on dams. 71% of its electricity is supplied by hydropower plants.[57] Since 2015, Colombia has experienced one of the worst droughts on record, leaving dam reservoirs at 65% of average levels, causing a 10-fold increase in electricity prices.[58] In December 2015, a court ordered the temporary closing of operations at El Quimbo dam, the largest hydropower plant in the country, in order to ration water, but reversed its decision to avoid electricity blackouts.[59] Fitch Ratings alerted that Colombian power utilities are exposed to volatile prices due to drought conditions.[60] Colombia's cloud forests (high-moisture rainforests) cover a third of of the watersheds supporting the country's dams. Deforestation has affected the ecological services that support their water provision.[61]

Forests help to extend the life of dams by generating moisture and rain, filtering water, regulating flows to rivers and – above all - reducing sedimentation that flows into the dam.[62] Weak land tenure security for local communities, which inhabit 50% of Colombia's forests, limit their ability to manage an invest in land conservation.[63/64/65]

A resource leadership position

Since 1999, the Colombian government's 'Plan Verde' has channelled funds from watershed users, such as agriculture, water utilities and hydropower operators, into forest recovery for the restoration of eco-hydrological services. This includes the restoration of cloud forest cover to regulate water flows and reduce sedimentation impacts in water supply reservoirs and hydropower dams.

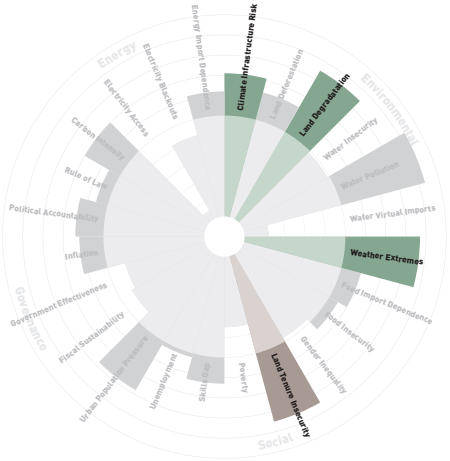
The scheme has required hydropower companies with an installed capacity of more than 10,000 kilowatts to transfer 3% of annual electricity sales to regional management corporations (decentralised bodies of the Colombian Ministry of Environment) who are in charge of projects.[66] Half of the amount received (USD 135 million from 1994–2000) must be channelled to the protection of watersheds where energy is generated. Energía del Pacífico, the power utility that operates the Calima dam in Colombia, has demonstrated that restoring cloud forest in 18% of its watershed could lead to a 5% increase in electricity output.[67] However, the programme's high administrative costs have been reported to be a bottleneck to the funding's impact. A more direct way of investing in the integrity of watersheds will be needed, such as corporate involvement with Payment of Watershed Services (PWS) funds through partnerships between industry, civil society and other stakeholders.[68]

The combined pressures of land degradation, land tenure insecurity, water pollution and exposure to extreme events, is likely to aggravate Colombia's water security, straining the conditions for its reliance on hydroelectric power.

Future regional challenges and opportunities

Our regional forecast is based on an average of the developing countries that are most important to the sector's investment outlook. The forecasts are intended to be used by global companies to ensure that their regional strategies, implemented by regional executives and country subsidiaries, are anticipating the region-wide trends and adopting a resource leadership position.

Region	What to expect
Asia Indonesia, Malaysia, Thailand, China, India, Vietnam	**Extreme weather risks to grow for projects.** Asia's infrastructure is highly vulnerable to extreme weather events such as typhoons and floods.[69] Lloyd's estimates USD 22.5 billion of GDP at risk from flooding in South East Asian cities alone.[70] Much of Asia-Pacific's power infrastructure is located in low-lying, flood-prone areas where extreme weather events are expected to grow.[71] Land degradation is a risk amplifier, as the resilience of landscapes to absorb shocks is diminished.
Latin America Brazil, Mexico, Chile, Colombia, Peru	**Water security fuels social opposition to projects.** Latin American countries are seeking to increase the private sector's participation in infrastructure in order to meet their development needs. The region is also strategic for global agribusiness. Large scale agriculture has been a primary driver of land use change. The conversion of land ecosystems erodes ecological services that help buffer against extreme weather changes. The acute challenges facing hydropower projects in Brazil and Colombia are cases in point.
Middle East United Arab Emirates, Qatar, Saudi Arabia, Bahrain, Kuwait, Oman	**Competition for water in cities to block projects.** Rapid urbanization in the Middle East is a major driver for infrastructure investments in transport, energy, housing and communications.[77] However, it is also accelerating pressure on water and competition with other sectors – namely energy and agriculture.[78] Energy demand for water will grow substantially in the next decade.[79] 9% of Saudi Arabia's total annual electricity consumption is attributed to ground-water pumping and desalination.[80]



Future regional challenges and opportunities

What to expect	Recommendations	
Asia	**Mitigating climate risk through insurance partnerships.**	
Weak land tenure rights are a barrier to the effective land management as well as land acquisition.[72/73] In Indonesia (which has high levels of tenure insecurity), a consortium bidding to build a new power plant in Central Java, which would provide electricity to 8 million people, stalled when landowners refused to sell their land, which accounted for 20% of the planned construction site. The dispute risks the consortium losing its concession.[74]	Companies have to anticipate the climate change risks they face, and form partnerships with insurance companies that are growing extreme weather products in the region (see Earth Security Group's projects in India and Indonesia advancing such partnerships). Companies should develop new strategies that help regenerate ecosystems, such as coastal mangroves and forests.	New business models need to be inclusive, supporting locals to resolve land tenure disputes in the process.
Latin America	**Invest in 'green infrastructure' with a social component.**	
Large infrastructure projects in the region are also affected by social opposition, which originates in weak land tenure rights.[75] Latin America, which has the greatest biological diversity on earth, registers infrastructure projects as a key driver of deforestation.[76]	Companies investing in infrastructure in Latin America must consider innovative business models, which can deliver greater ecosystem benefits with social inclusion. To anticipate the risks of more intense droughts, companies must develop a more holistic approach to the 'land nexus' by investing in ecosystem regeneration — e.g. getting involved in models for payment for ecosystem services.	This will help to avoid land degradation and loss of ecosystem services amplifying water insecurity for their projects, and strengthening land tenure rights where these increase a project's political risks.
Middle East	**Innovative joint ventures address the water-energy nexus**	
Other countries in the Gulf may be consuming 12% or more of total electricity consumption for desalination. With population set to double in the region over the next 40 years, per capita water availability is projected to fall by more than 50%.[81] The intensifying competition for water between different demands, like irrigation and energy production, will increase water insecurity and regulatory challenges for infrastructure companies.	New technology investments, business models and public-private partnerships that bring a holistic approach to water management will be favoured by governments, regulators and investors. These may include waste water plants that are energy self-sufficient; or desalination technology that runs on solar power. Cross-industry innovation strategies will be needed to turn systemic risks into opportunities.	Companies will need to develop a collaborative stakeholder approach in the region. Working towards a common goal of water security with regulators and the agriculture industry will be vital.

Partner

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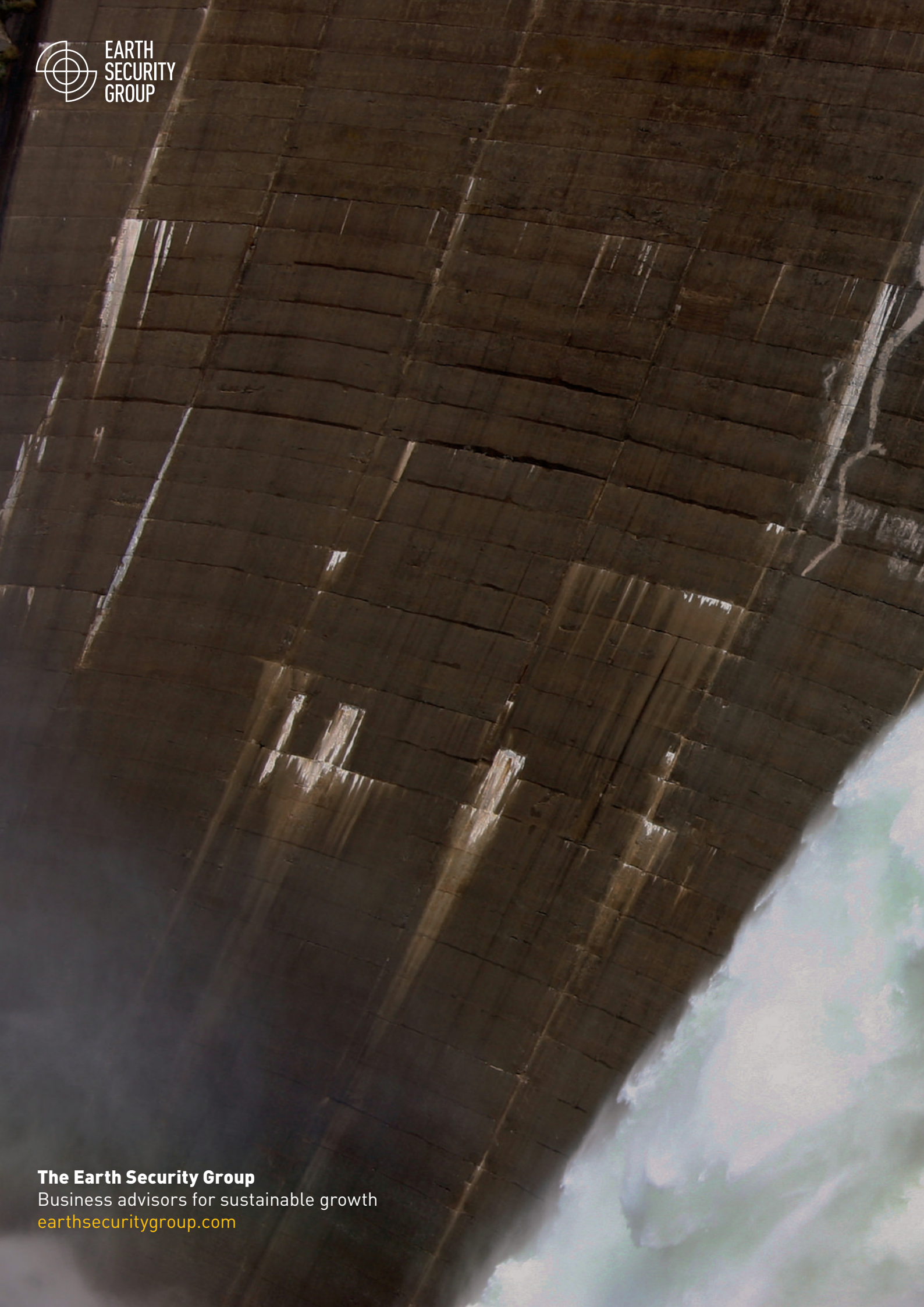

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