HSBC Climate Change

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Shally Venugopal

Dana Krechowicz

with contributions from

Deepa Shinde

HSBC

Charanjit Singh

Roshan Padamadan

SURVEYING RISK, BUILDING OPPORTUNITY

Financial Impacts of Energy Insecurity, Water Scarcity, and Climate Change on Asia's Commercial Real Estate Sector

India, Indonesia, Malaysia, Philippines, Thailand, Vietnam

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ABOUT THE PROJECT

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The research project's objective is to guide investors and analysts through assessing the financial impacts of select environmental trends on listed companies in India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam. Other research reports produced within this series are listed below. More information on the project and copies of the reports are available for download at **http://www.wri.org/project/envest.**

- ***Emerging Risk:*** Impacts of Key Environmental Trends in Emerging Asia.
- ***Undisclosed Risk:*** Corporate Environmental and Social Reporting in Emerging Asia.
- ***Weeding Risk:*** Financial Impacts of Climate Change and Water Scarcity on Asia's Food and Beverage Sector.
- ***Over Heating:*** Financial Risks from Water Constraints on Power Generation in Asia.

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ABOUT THE AUTHORS

Shally Venugopal is an Associate in the Envest project at WRI. **svenugopal@wri.org**
Dana Krechowicz is an Associate in the Envest project at WRI. **dkrechowicz@wri.org**

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Key Findings

Energy insecurity, water scarcity, and climate change pose growing risks for the real estate sector in South and Southeast Asia, yet the connections between these trends and financial impacts are not well understood by analysts, investors, companies, and governments in the region. This report presents a framework to assess risks associated with these trends, and also discusses financial opportunities in the region's growing green building market. The analysis considers current and planned commercial office buildings in India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam, with a particular focus on the Indian market given the large size of its real estate market and data availability. The report's lessons and the risk framework may also be applied and adapted to other countries and building types. Although other resource scarcity, demographic and/or environmental trends may be relevant to the region's buildings (for example, air pollution, waste, or ecosystem degradation), the report's scope extends only to specific aspects of energy insecurity, water scarcity, and climate change as defined in this report.

KEY POINTS

- Emerging energy insecurity, water scarcity, and climate change trends in South and Southeast Asia will affect the risk and return associated with investments in (1) commercial building projects and (2) companies involved in commercial real estate development and investing.
- The focus countries' limited energy and water infrastructure; rapidly growing demand for energy and water resources; and physical exposure and vulnerability to climate change impacts, all increase the likelihood and magnitude of financial impacts.
- Green building investments can minimize energy and water-related risks while achieving net positive returns in as few as three years.

CONTEXT

India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam face increasing energy insecurity-, water scarcity-, and climate change-related risks over the coming decade.

- **Energy insecurity risks**—including higher electricity/diesel prices and shortages—will likely affect major cities in all the focus countries as energy demand is expected to outpace production capacity and energy infrastructure. India faces the greatest price and shortage risks, considering the already existing—and worsening—energy supply-demand gap. But even energy-abundant countries like Malaysia could see price increases in the long run as significant public and private investment, and imports, will be required to keep up with growing demand.
- **Water scarcity risks**—including poor availability and quality—are greatest in India. Several river basins in the country are expected to face acute stress or shortage by 2025, and groundwater sources are rapidly declining. But even in water-abundant countries like Philippines and Malaysia, seasonal shortages are expected to worsen (and already have) around major metropolitan areas due to high demand, water pollution, and climate change impacts.

- **Climate change risks**—created by more frequent and intense floods, droughts, storms, and precipitation—are difficult to predict with certainty, but are expected to have significant physical and economic impacts on all the focus countries over the next decade. Coastal and low-lying cities like Mumbai, Kolkata, Chennai, Jakarta, Manila, Bangkok, and Ho Chi Minh City face severe flood and storm risks.

These three trends are interrelated, thus further exacerbating the magnitude and likelihood of their impacts on the building sector. For example, water scarcity can worsen energy insecurity because water is necessary for cooling in thermal and nuclear power plants, and as an input in hydropower plants (see WRI's 2010 report *Over Heating*). Similarly, climate change can constrain water supply (through changes in precipitation, for example) and increase the demand for energy and water during heat waves.

FINANCIAL IMPACTS AND RISK ASSESSMENT

The financial impacts of energy insecurity, water scarcity, and climate change trends on existing and planned commercial buildings will vary by country and city but can include:

- **Higher utility costs**—driven by increasing prices and unreliable power/water—which can lead to higher/uncertain operating cash flows, less competitive rental rates, and lower occupancy rates. Building utility use intensity is also expected to increase as consumers demand modern building features like air conditioning and landscaping, thus further increasing utility costs.
- **Higher nonutility operating costs**—including accelerated building depreciation, higher operations maintenance, reserve and replacement (OMRR) costs and higher insurance premiums—which can lead to less competitive rental rates and lower occupancy. OMRR cost increases are driven by:
  - Physical building deterioration due to more frequent/intense weather events; and
  - Obsolescence arising from energy- and water-inefficient building systems.
- **Higher construction costs**—including input costs, capital costs, and lost rental income—driven by:
  - Project/permitting delays caused by local energy insecurity, water scarcity, and the increased frequency of extreme weather events due to climate change; and
  - Pass-through of fuel costs from transportation of material inputs, particularly imports.

Project-level impacts will flow through to investors and developers:

- **Real Estate Investment Trusts (REITs).** Higher nonutility operating costs from a REIT's portfolio—like insurance premiums and maintenance expenses—will flow directly to the REIT's operating cash flow. Higher utility costs may be passed on to tenants although this may have adverse impacts on rental/occupancy rates, depending on prevailing market conditions.
- **Real Estate Developers.** Regardless of market conditions, real estate developers will have to contend with higher capital costs created by project/permitting delays. Developers who hold and lease completed projects (more common under unfavorable market conditions) will also face the risk of operating cost increases and lost rental income in the case of project delays.

To help analysts, investors, and developers evaluate these risks at a project and company level, this report provides regional data and a general risk assessment framework for buildings.

Commercial building projects that are both exposed (based on their location) and vulnerable (based on their design) to energy insecurity, water scarcity, and climate change trends, face the greatest risks. Table 1 presents the report's risk assessment framework.

1. **Building Location:** Location determines a building's *exposure* to and likelihood of encountering risks such as extreme local weather events, power or water disruptions, and related regulations.

TABLE 1. Framework to Assess a Building's Exposure and Vulnerability to Energy Insecurity, Water Scarcity, and Climate Change Trends

Financial Impact	Cost Type	Key Trend Drivers	Building Exposure Factors (Location)	Building Vulnerability Factors (Design)
Utility Operating Costs	Water utility costs	• Water scarcity • Climate change	• Limited local water infrastructure relative to expected demand • Drought-prone region • Fluctuations in seasonal water availability, resulting in water quantity and quality supply problems • Proximity to sources of water pollutants (for example, industry or agriculture) • High price of alternatives to local municipal water supply (for example, if substitute sources are located far away)	• High per occupant water use due to water intensive design and building features • Lack of adequate gray water storage systems in buildings
	Energy utility costs	• Energy insecurity • Water scarcity	• Weak or no energy infrastructure • Insufficient power supply to satisfy area demand for power • Area power outages and/or energy shortages • Subsidized diesel fuel prices and/or country dependence on foreign fuel sources	• High per occupant energy use due to energy intensive building systems and/or features • Expensive sources of power/back up generation • Older/outdated building systems that may not comply with new building codes
Nonutility Operating Costs	OMRR costs and depreciation	• Climate change	• Coastal area (exposure to flooding, cyclones) • Low lying locations (exposure to flooding) • High recent/predicted frequency of climatic events (historical occurrence may not sufficiently forecast future impacts)	• Architectural design or use of building materials that are vulnerable to water and/or storm damage • Limited or no insurance coverage against flood, fire, and other extreme weather events
	Insurance premiums			
Construction Costs	Project and permit delays	• Energy insecurity • Water scarcity • Climate change	• Area water and energy availability • Coastal and/or low-lying locations	• Inadequate budget or construction contract, i.e., one that does not account for delays in permitting processes and construction
	Material input prices	• Energy insecurity	• High fuel and energy costs	• Use of imported materials (long distances may result in high transportation costs)

Source: WRI.

2. **Building Design:** Architectural design, materials, and building systems dictate a building's financial *vulnerability* to these risks.

EXPOSURE AND VULNERABILITY IN SOUTH AND SOUTHEAST ASIA

Several current and planned projects of the region's largest developers are located in cities exposed to water scarcity, energy insecurity, and climate change impacts.

- This report contains detailed geographic information systems (GIS) maps of areas of water scarcity, energy insecurity, flooding, drought, and storm risks, relative to a sample of current and planned projects constructed by the region's largest developers.
- Table 2 summarizes the risk exposure for some of the largest cities in the region. As a whole, this region faces some of the greatest risks globally, given its low-lying coastal

TABLE 2. Current Risk Exposure (likelihood and magnitude) to Energy Insecurity, Water Scarcity, and Climate Change Trends by City

	Energy Insecurity	Water Scarcity		Climate Change *(Floods/Droughts, Storms, Sea Level Rise)*	
City	Energy Import Dependency	Availability Risk	Quality Risk	Physical Exposure	City Vulnerability
Mumbai	High	Medium	High	High	High
Kolkata	High	High	High	High	High
Delhi	High	High	High	High	High
Hyderabad	High	High	High	Medium	High
Chennai	High	High	High	High	High
Jakarta	Low	Medium	Medium	High	High
Kuala Lumpur	Medium	Medium	Low	Medium	Medium
Metro Manila	High	Medium	Medium	High	High
Bangkok	High	Medium	Low	Medium	Medium
Ho Chi Minh City	Medium	Low	Medium	High	High

Source: WRI and data and analysis from Asian Development Bank, World Wildlife Fund (WWF), Intergovernmental Panel on Climate Change, and United Nations Global Risk Data Platform.

Notes: Risk levels are based on intra-regional (not global) comparisons; some risk levels are aggregated at the national level rather than the city level due to data constraints. Detailed methodology and and additional notes are available in Appendix 3.

geographies, poor energy and water infrastructure, and limited financial ability to cope with emerging energy, water, and climate change risks.

TABLE 3. Questions and Potential Solutions to Consider When Evaluating Building Vulnerability to Energy Insecurity, Water Scarcity and Climate Change

Project Vulnerability Assessment Questions	Examples of Building Design Solutions	Relevant Trend: Energy Insecurity	Water Scarcity	Climate Change
Does/will the project use water and energy auditors and/or efficient technologies?	Passive and active energy/water technologies and building systems including lighting, insulation, and smart building design; for example, using a light-colored roof, motion-activated lighting, and water-efficient landscapes, and fixtures	X	X	
Does/will the building's architectural design and materials account for risks from floods and storms? Do the operating budget and reserves account for higher damage and repair costs, and potential increases in insurance premiums, in weather-exposed areas?	Examples of design features for mitigating flood and storm risk include: • Flood vents and barriers • Water-resistant flooring (e.g., tiles versus carpeting) • Landscaping and exterior features that incorporate storm water management (e.g., rain gardens) • Impact resistant windows and outward opening doors to withstand strong winds • Elevation of mechanical and electrical equipment • Natural ventilation and solar hot water to cope with power disruptions			X
Does the construction or renovation budget account for potential project delays and higher materials costs?	Purchase products which originate close to the building site to reduce fuel costs from transportation	X	X	X

Source: WRI, adapted from Whole Building Design Guide; Global Green; local Green Building Council recommendations; and Wilson, Alex and Andrea Ward, "Design for Adaptation: Living in a Climate-Changing World," *Environmental Building News*, September 1, 2009.

Table 3 presents critical questions to consider when evaluating a project's vulnerability and potential building design solutions to minimize vulnerability.

GREEN BUILDING MARKET OPPORTUNITIES

Green building investments can reduce vulnerability to operational risks and provide net financial returns relative to conventional buildings.

- Energy and water-saving technologies (like targeted task lighting, solar water heating, and rainwater harvesting) can reduce utility costs for building owners and/or tenants (thus reducing operating costs and/or improving rentability).
- Green building markets in South and Southeast Asia are nascent, but growth is likely, especially as (1) water scarcity, energy insecurity, and climate change impacts worsen and (2) awareness of financial and social benefits grows in the private and public sectors.

New and retrofitted green buildings in this region have demonstrated net positive returns on energy and water efficiency investments. According to a 2008 Asia Business Council report[1]:

- Jakarta's Plaza IIB commercial building retrofit undertook energy efficiency investments which enabled the building operator to achieve a 22 percent savings in electricity consumption.[2] The operator believes these investments helped raise the building's occupancy rate from 84 percent before 2002 to 96 percent in 2006.[3] According to Cushman & Wakefield, average CBD office space occupancy in Jakarta was around 78 percent in 2002 and 85 percent in 2006.[4]

- Energy efficiency retrofits in Ayala Land's Makati Stock Exchange building in Manila, Philippines, allowed the operator to achieve 30 percent energy cost savings or approximately US$127,000 (or 941,000 kWh) per year;[5]
- The first Leadership in Energy and Environmental Design (LEED, a green building rating system) Platinum building in India—the 2003 CII-Godrej Green Business Center (CII-Godrej GBC)—achieved a 55 percent reduction (120,000 kWh/year) in energy use, and a 35 percent reduction in potable water consumption, with an expected seven-year payback period on green investments;[6]
- More recently built LEED Platinum/Gold buildings in India, such as the Patni Knowledge Center, have achieved payback periods on green investments of just three to four years.

Net positive returns on water and energy efficiency investments are currently achievable in approximately three to five years.

Detailed assumptions and HSBC's analysis of a typical 300,000 square foot commercial building in Mumbai are provided in Section V.

Energy efficiency investments also protect operating costs from rising electricity prices.

For a typical Indian commercial building, HSBC estimates that a 10 percent increase in power costs increases total operating costs by 1 percent in a normal building. In a green building, the pass-through effect is only 0.50 to 0.85 percent of expenses due to the energy savings.

Estimated future savings may be even greater, driven by:

- Worsening energy insecurity, water scarcity, and climate change impacts;
- Growing consumer demand for utility savings and improved branding, among other factors; and
- Future government regulation, enforcement, and incentives addressing building emissions and energy/water use.

NEXT STEPS

Analysts, investors, and developers should use the information in this report to assess a project or company's exposure, vulnerability, and capacity to mitigate, energy, water, and climate risks. Possible techniques to incorporate energy, water and climate change risks into financial analysis include:

- *Scenario analysis* around water, energy, and climate risks based on future projections (if available) or key risk factors present at the local level.
- *Sensitivity analysis* of cash flow impacts of increases in electricity, water, and insurance costs to reveal project vulnerabilities.
- *Management quality assessment* of real estate developers and REITs based on their ability to cope with emerging risks. As a proxy, analysts and investors should favor companies that disclose these risks and are expanding green practices—signs that a company is

aware of, and managing, the risks highlighted in this report and the benefits of green investments.

Real estate developers and REITs should develop green building capacity and practices. Building in-house capacity will increase preparedness for emerging energy, water, and climate risks, and enable organizations to profit from green building investments.

Governments should establish and enforce stricter energy, water, and climate-resilient building codes, particularly in cities with high exposure to these trends. Governments should also mandate green retrofits and new construction in their own buildings to achieve financial savings and to set an example.

Local green building councils should expand green building guidelines and emphasize building features that improve resilience against extreme weather events.

To ensure the growth of green building practices at scale, it is critical that governments, the private sector, and green building councils work together to improve green building awareness, invest in R&D for region-specific green building technologies, and correct misaligned incentives in the market.

I. Energy Insecurity, Water Scarcity, and Climate Change Trends in South and Southeast Asia

Energy insecurity, water scarcity, and climate change are growing trends in South and Southeast Asia. The social and economic impacts of these trends (ranging widely from manufacturing disruptions to public health crises) are expected to be particularly severe as the region's countries generally have limited capacity to respond to and protect themselves from these trends. In addition to large-scale impacts on the region's economies, these trends will also have localized impacts on investments in exposed areas.

This section provides an overview of energy insecurity, water scarcity, and climate change trends in South and Southeast Asia as context for Sections II and III, which discuss likely financial impacts of these trends on the region's commercial buildings. The risks associated with these three trends also underscore the importance of green building investments, as discussed in Section IV and V of this report.

KEY POINTS

- Higher electricity and diesel fuel prices are likely across the region in the next decade as domestic demand grows faster than production capacity and energy infrastructure.
- Availability of water will also become more unreliable, especially in India where several major river basins are expected to face stress or shortages by 2025 and groundwater sources are drying up due to climate change and overexploitation, among other factors.
- All major cities in the region are exposed to climate change impacts, including flooding, droughts, storms, and changes in precipitation; the most vulnerable are coastal or low-lying cities such as Mumbai, Kolkata, Chennai, Bangkok, Jakarta, Manila, and Ho Chi Minh City.

Table 4 summarizes the definitions (as used in this report), drivers, and regional impacts of the three trends. Readers should note that although this section generally discusses each trend in isolation, the three trends are interrelated. For example, water scarcity can exacerbate energy insecurity because water is necessary for cooling in thermal and nuclear power plants, and for production in hydro power plants. Growing power demand can also affect water availability if water resources are diverted to power plants. Similarly, climate change impacts can constrain water resources and increase the demand for energy and cooling. These interrelations will likely exacerbate the magnitude and likelihood of financial impacts on the region's commercial buildings.

TABLE 4. Summary of Drivers and Impacts of Energy Insecurity, Water Scarcity, and Climate Change Trends in South and Southeast Asia

Trend	Definition	Aspects Examined	Drivers	Regional Impact
Energy Insecurity	Limited access to high-quality, low-cost, and reliable sources of energy	• Higher electricity and diesel fuel prices • Electricity shortages	• Limited supply and weak electricity infrastructure • Global and regional demand for electricity and other forms of energy	• Higher electricity (and diesel fuel) prices across the region, especially as energy imports increase and governments are forced to rollback subsidies • Worsening power shortages, especially in major Indian cities
Water Scarcity	Limited access to high quality, low-cost, and reliable sources of freshwater	• Unreliable access and disruptions to freshwater supply • Higher municipal and private water prices • Poor freshwater quality • Conflicts between water users	• Limited clean freshwater and renewable supplies • Weak water infrastructure • Climate change impacts on water availability • Local and regional demand for freshwater	• Higher and more volatile water prices in major urban areas including Kuala Lumpur, Bangkok, Jakarta, Manila, and most major Indian cities; governments may be forced to rollback municipal subsidies • Localized and seasonal shortages may increase dependence on water trucking, thus exposing water costs to rising fuel prices
Climate Change	Higher temperatures; changes in the distribution, frequency, and intensity of extreme weather events; and sea level rise	• Rising temperatures • Changes in precipitation • Extreme weather events including floods, droughts, storms, and heat waves • Sea level rise	• Global greenhouse gas emissions • The region's cities are vulnerable to extreme weather events and have limited capacity to protect themselves against climate change impacts	• Low-lying (Jakarta, Manila, Bangkok) and coastal (Mumbai, Ho Chi Minh City, Hanoi) cities will experience increased flood and storm damage • Drought-prone cities such as Delhi could face water shortages • Rising insurance premiums and uninsurable risks

Source: WRI.

A. ENERGY INSECURITY

ASPECTS OF ENERGY INSECURITY EXAMINED IN THIS REPORT

- Higher electricity and fuel prices
- Electricity shortages

This section generalizes energy insecurity trends affecting the focus countries. For a more nuanced discussion of energy insecurity issues by country, refer to the Asia Pacific Energy Research Centre's *APEC Energy Overview 2007* and the Asian Development Bank's 2009 *Asia Pacific Energy Outlook.*

These publications are available at

- http://www.ieej.or.jp/aperc/2007pdf/Overview2007.pdf
- http://www.adb.org/Documents/Books/Energy-Outlook/Energy-Outlook.pdf

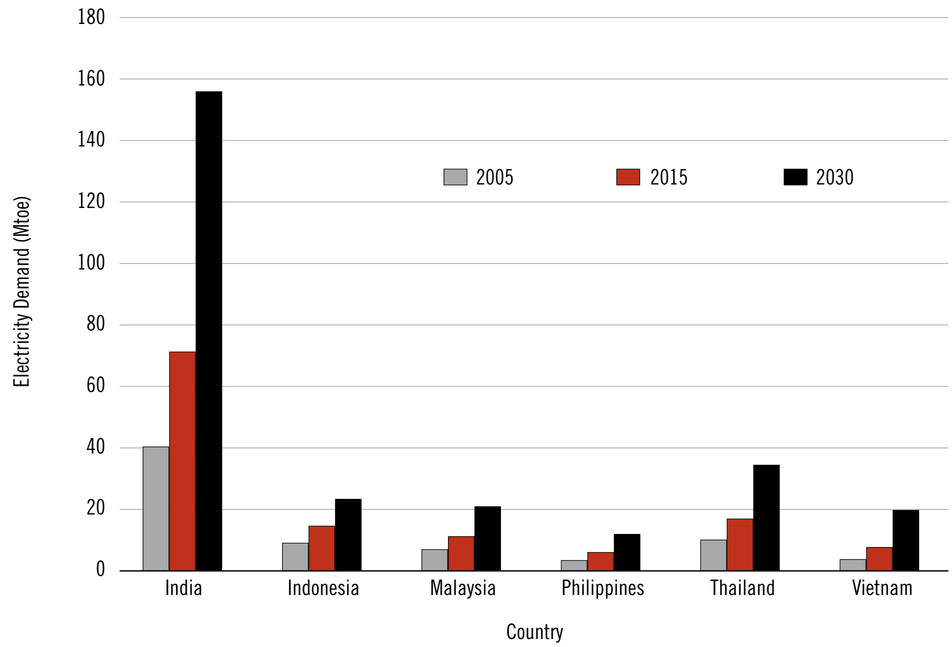
Electricity demand in the focus countries has increased rapidly over the past two decades and is expected to increase further in coming years as shown in Figure 1.

Although the current global financial crisis has somewhat tempered this growth in recent years, experts still predict that this region will experience the world's largest growth in electric power consumption over the next decade.[7] Residential/commercial demand is expected to be a critical driver in electricity demand in all focus countries through 2030.[8] Of the focus countries, Malaysia exhibits the highest per capita electricity consumption rates, followed by Thailand.[9]

India faces the most acute electricity price and shortage risks.

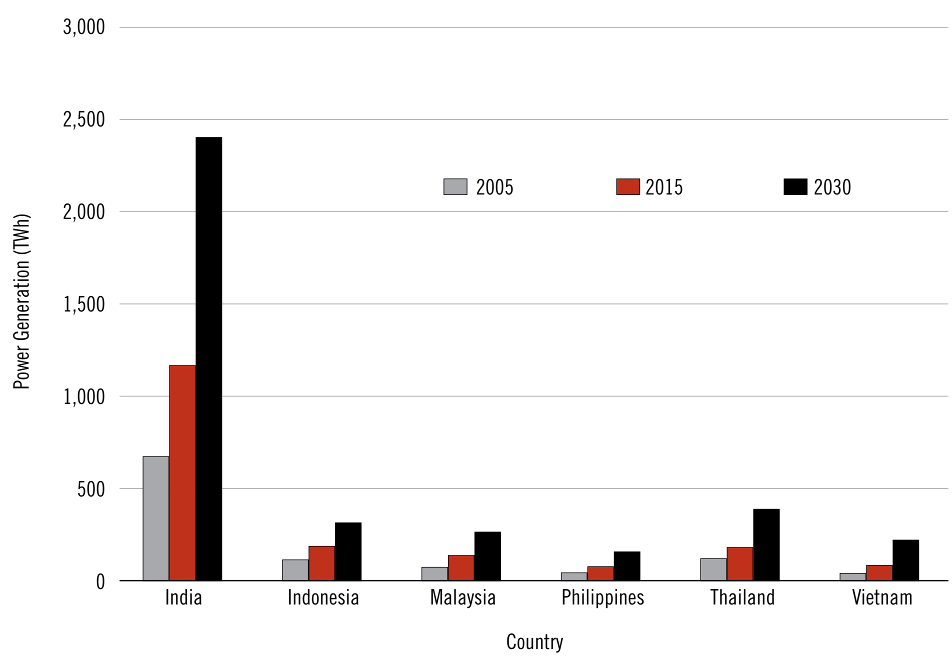
All the focus countries are expected to increase power generation capacity by 2015 and 2030 (Figure 2), but in some countries production capacity may not grow as quickly as demand. India, in particular, is already experiencing a serious shortfall in electricity production, triggered by growing demand, combined with inadequate investment in production capacity (partly caused by electricity price controls that have limited investment incentives) and an inefficient energy infrastructure.[10] The Indian Central Electricity Authority has set a goal to reach "power for all" by 2012, requiring an additional 56 GW from 2008 levels.[11] But even if this rapid capacity addition were achieved, supply would still fail to meet ballooning demand, with a supply-demand mismatch projected to continue until at least 2017.[12]

FIGURE 1. Electricity Demand in 2005 and Projected Demand in 2015 and 2030 (Mtoe*)



Source: Asian Development Bank, *Energy Outlook for Asia and the Pacific,* 2009.
Note: *Mtoe - Megatons of oil equivalent

FIGURE 2. Power Generation Capacity in 2005 and Projected New Generation Capacity in 2015 and 2030 (TWh*)



Source: Asian Development Bank, *Energy Outlook for Asia and the Pacific,* 2009.
Note: * TWh - Terrawatt hours.

Malaysia is the best positioned of the six countries, with relatively abundant domestic energy sources, adequate transmission and distribution infrastructure, and ample power generation capacity.

But in the long run, additional investments in production capacity and energy infrastructure may still be required. The Asian Development Bank predicts that Malaysia will become a net energy importer by 2030.[13] Indonesia, like Malaysia, has abundant energy resources, but poor energy infrastructure and inadequate generation capacity have created frequent power shortfalls in recent years.[14] Vietnam also has abundant domestic energy resources, and power generation capacity is growing; but it is unclear whether the capacity growth will be adequate to meet rapidly growing domestic demand in coming years. The Asian Development Bank expects Vietnam to become a net energy importer by 2015.[15]

Thailand and Philippines have limited domestic energy resources; but meeting demand should be manageable in the short run as both governments have ramped up domestic power generation capacity.[16] Thailand has also made significant power infrastructure investments in neighboring countries like Laos and Myanmar to secure future supply.[17] But given the limited domestic resources, in the long run, both Thailand and Philippines are likely to become more reliant on imports.

These supply-demand dynamics are likely to create rising electricity and diesel fuel prices across the focus countries in the long run.

Even in the short run, governments may be forced to roll back existing subsidies as the cost of domestic production and/or importing power increases. Already, in early 2008, India, Indonesia, and Malaysia, all decreased electricity and fuel subsidies primarily due to rising energy prices.[18] In late 2009, the Indonesian government was considering raising electricity prices by 10 to 20 percent in response to frequent blackouts in the Greater Jakarta area.[19]

Electricity shortages—due to limited generation capacity, weak energy infrastructure, and/or water shortages—will increase dependence on expensive alternatives like diesel fuel.

All the countries, but particularly India, are likely to face local/seasonal water shortages that limit power generation because water is a critical input in the generation of most sources of electricity. (See WRI's 2010 report *Over Heating: Financial Risks from Water Constraints on Power Generation in Asia.*) Climate change impacts, including a higher frequency/intensity of heat waves and drought events, can also increase the risk of power shortages. During these shortages, electricity consumers will likely have to depend on expensive alternatives like diesel fuel-powered generators. The cost of diesel fuel power is typically substantially higher than municipal electricity prices in this region.

B. WATER SCARCITY

ASPECTS OF WATER SCARCITY EXAMINED IN THIS REPORT

- Unreliable access and disruptions to freshwater supply
- Higher municipal and private water prices
- Poor freshwater quality
- Conflicts between water users

Overuse of freshwater resources has depleted aquifers, lowered water tables, shrunk inland lakes, diminished stream flows, and polluted waters across South and Southeast Asia.[20] India, in particular, faces severe water availability and quality constraints in many areas. Most Southeast Asian countries, notably Malaysia, have abundant freshwater, but localized scarcity is likely to increase around urban areas. Localized water scarcity has already created water allocation and rights tensions in the region's megacities including Bangkok, Jakarta, and Manila.[21]

Limited freshwater supplies plague India; demand is already outstripping renewable supply.

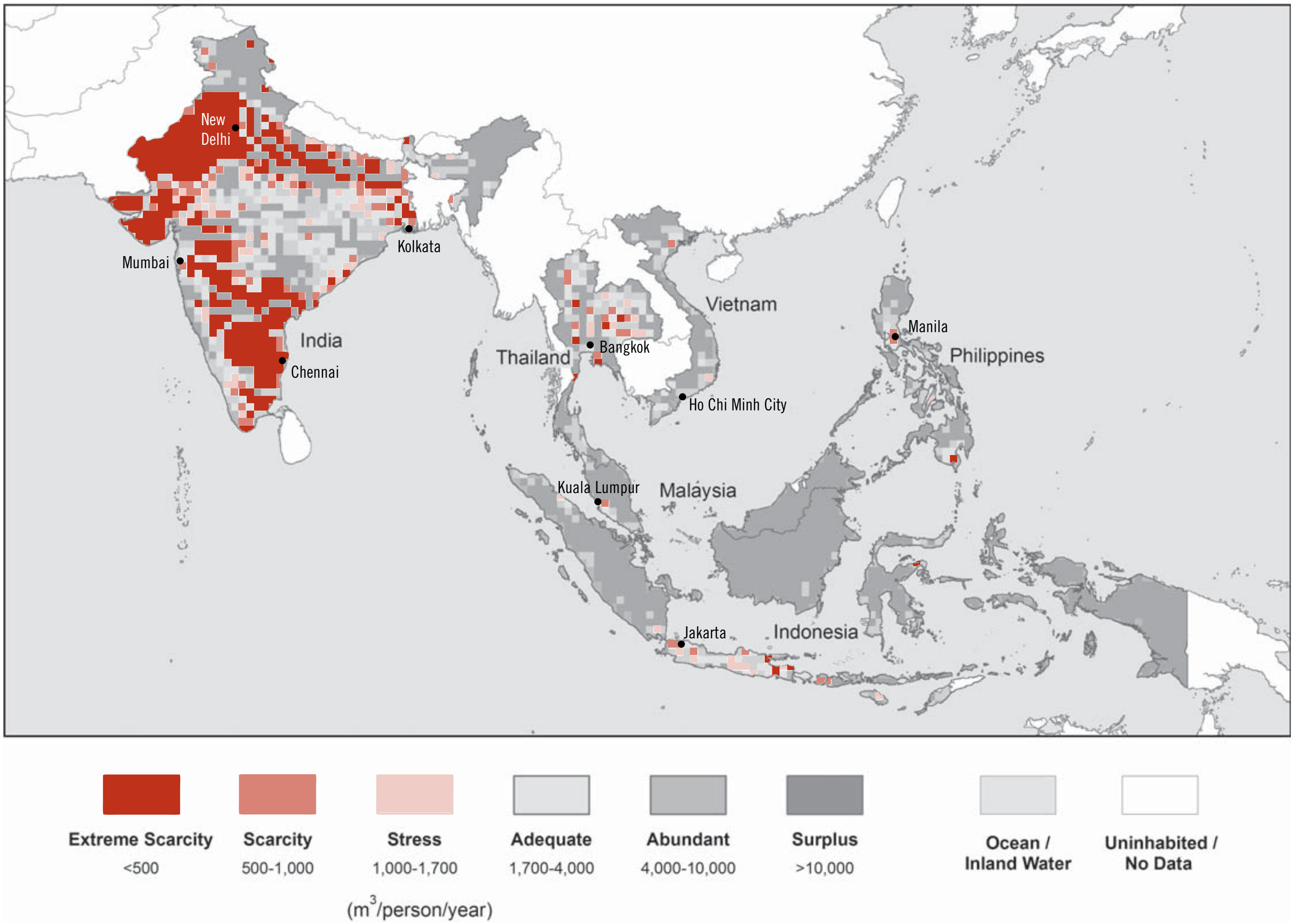
In India, over 70 percent of freshwater resources are inaccessible, not renewable, unreliable, or restricted due to environmental regulations.[22] Furthermore, by 2030 water demand is expected to outgrow supply by 50 percent, and the World Bank estimates that India will exhaust all available freshwater supplies by 2050.[23] Water access is severely limited. The country's 20 major water utilities only supplied water for an average of 4.3 hours per day in 2007.[24]

Even in relatively water-abundant countries, seasonal supply shortages, coupled with high urban demand, will likely create scarcity in the region's major cities.

Although still low, domestic water consumption in this region has increased rapidly in the last two decades. In Vietnam the volume of freshwater consumed has tripled, and in Malaysia and India it has doubled.[25] As shown in Figure 3, all major cities in this region are already facing freshwater scarcity or stress on a per capita basis. This stress is expected to worsen due to a variety of factors including reduced precipitation in dry seasons (induced by global warming), growing urbanization, increasing population, and increasing per capita demand for water. Lack of central sewage systems in many major cities (especially in India and Vietnam) also creates water quality issues and increases water treatment costs. Country-specific water concerns are detailed below.

- **Indonesia:** Although Indonesia has adequate national water resources and high average annual rainfall, water scarcity is a problem in urban regions due to concentrated demand, poor infrastructure, inefficient use, and lack of land and erosion management, among other factors.[26]
- **Malaysia:** Although Malaysia is rich in water resources, the northwest, where much of the country's industry and population is located, is vulnerable to water scarcity.[27] Seasonal water deficits due to geography and water pollution have created conflicts between users.[28] Selangor, Kuala Lumpur, and Putrajaya are projected to face water stress as early as 2011.[29]
- **Philippines:** Although the country has adequate water resources, pollution has become a major concern. The discharge of domestic and industrial wastewater, and agricultural runoff have caused extensive pollution to waterways.[30] Inadequate water infrastructure is also an issue in some areas.
- **Thailand:** Thailand has abundant water resources, but they are unevenly distributed. The most important river basin, the Chao Phraya, already faces shortages and these shortages are expected to worsen.[31] In the northeast, where a third of the population lives, water availability and storage are limited; experts forecast that water will have to be transported in from other regions in the future, thus greatly increasing costs.[32] Surface, ground, and coastal waters are also polluted in most regions due to agricultural and industrial runoff.

FIGURE 3. Annual Renewable Freshwater Supply Per Capita, 2000



Sources: ISciences LLC: University of New Hampshire/Global Runoff Data Center; Center for International Earth Science Information Networks/Centro International de Agricultura Tropical.

- **Vietnam:** In spite of abundant rainfall, water supply falls short of demand in many urban and rural areas due to inadequate water infrastructure.[33] Owing to rapid industrialization and urbanization, water quality is poor in heavily populated areas. Seasonal availability may also be affected by changing monsoon patterns due to climate change in future years.

Climate change trends are expected to constrain water resources in this region. Table 5 provides examples of already observed climate change impacts on water resources in Southeast Asia.

TABLE 5. Observed Impacts of Climate Change on Water Resources in Southeast Asia

Climate Change	Observed Impact on Water Resources in Southeast Asia
Increasing temperature	• Increased evapotranspiration in rivers, dams, and other water reservoirs, leading to decreased water availability
Variability in precipitation (including El Niño southern oscillation)	• Decreased river flows and water level in many dams and water reservoirs, particularly during El Niño years, leading to decreased water availability • Increased stream flow, particularly during La Niña years, leading to increased water availability in some parts of the region • Increased runoff, soil erosion, and flooding, which affected the quality of surface water and groundwater
Sea level rise	• Advancing saltwater intrusion into aquifer and groundwater resources, leading to decreased freshwater availability

Sources: Asian Development Bank (Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review,* April 2009) from Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008).

C. CLIMATE CHANGE

ASPECTS OF CLIMATE CHANGE EXAMINED IN THIS REPORT

- Rising temperatures
- Changes in precipitation
- Extreme weather events including floods, droughts, storms, and heat waves
- Sea level rise

For additional information on predicted climate change impacts in this region, refer to the Asian Development Bank 2009 report *The Economics of Climate Change in Southeast Asia: A Regional Review.* http://www.adb.org/Documents/Books/Economics-Climate-Change-SEA/Economics-Climate-Change.pdf

Due to their coastal geography and low elevation, most major cities in South and Southeast Asia are highly exposed to several climate change impacts. These impacts include increased frequency and magnitude of droughts, floods, and typhoons, as well as temperature increases and sea level rise.[34] Already, several of these impacts have been observed in the countries of focus as shown in Table 6. The current ability of cities in this region to adapt to these impacts is limited, given their weak urban infrastructure and inadequate damage prevention measures.

Climatic changes that could have physical impacts on building structures and systems include:

- **Rising Temperatures.** According to the Intergovernmental Panel on Climate Change (IPCC)'s 2007 projections, the mean surface air temperature in Southeast Asia is expected to increase by between 0.75 and 0.87°C by 2039.[35] These temperature increases may appear small, but will likely have significant impacts on the climate in this region. Impacts include volatility in temperature, changes in precipitation patterns, more extreme weather events, and rising sea levels, among others.
- **Precipitation.** Generally, projections for Southeast Asia show an overall decrease in average rainfall in the next few decades followed by an increase by the end of the century, with strong variation expected between March and May. But local impacts are likely to vary greatly between and within countries. In India, although overall precipitation will increase, it will be concentrated in the monsoon season with drier months for the rest of the year.[36] Some studies predict an increase in precipitation across Indonesia, except in southern Indonesia where rainfall is expected to decline. Jakarta is projected to become substantially drier during June to August.[37] In Thailand, some experts project shifts in precipitation from north to south.[38] Across the region, in broad terms, the wet season is expected to become wetter, the dry season drier, and changes are expected in the timing and duration of monsoon seasons.

TABLE 6. Observed Climate Change Impacts in Focus Countries (2009)

Country	Observed changes*
India	• General warming and heat waves, particularly during post-monsoon and winter • Increase in seasonal extreme rains in northwest, but lower number of rainy days along eastern coast with severe droughts in North East India • Heavy rains and flooding around Bay of Bengal
Indonesia	• In Southern Indonesia, wet season precipitation has increased while dry season precipitation has decreased • Rapid increase in the number of floods/storms in the last four decades
Malaysia	• Number of rainy days has declined
Philippines	• Increase in annual rainfall and in the number of rainy days • Rapid increase in the number of cylones/typhoons/floods in the last four decades
Thailand	• Decreasing annual rainfall for the last five decades • Storms have become more intense in the last four decades
Vietnam	• Decrease in monthly rainfall in July-August and increase in September–November • Rapid increase in the number of typhoons, floods, and droughts in the last four decades

Source: WRI, adapted from Asian Development Bank,[a] World Wildlife Fund,[b] IPCC (2007 4th Assessment Report) and related reference studies.

Notes: *Observed studies were conducted over varying periods.

a. Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review,* April 2009.

b. Case et. al., "Climate Change in Indonesia: Implications for Humans and Nature," World Wildlife Fund, November 2007.

- **Extreme Weather Events.** Regional heat waves, droughts, floods, and tropical cyclones have become more intense and frequent in this region in recent years.[39] For example, in Philippines, the number of floods and storms rose from 20 during 1960–1969 to 120 in 2000–2008.[40] In Vietnam, compared with 1960–1990 levels, the maximum monthly flow of the Mekong River is projected to increase by 35 percent in the basin and 16 percent in the delta by 2010-2038.[41] The minimum flow is expected to decrease by 17 percent in the basin and 26 percent in the delta; thus causing floods in wet seasons and droughts during dry seasons.[42] The IPCC predicts that the rise in sea surface temperature is expected to increase tropical cyclone intensity by 10 to 20 percent in Southeast Asia. [43] These events can cause severe damage to buildings and disrupt water and power supply, among other impacts.
- **Sea Level Rise.** Global warming is expected to increase sea levels over the next several decades. Because Southeast Asia's 563 million people are concentrated along coastlines, this region is particularly vulnerable to rising sea levels.[44] Since the 1950s, sea levels have risen by approximately 1 to 3 millimeters per year.[45] Cities most at risk include Mumbai, Ho Chi Minh City, and Kolkata.[46] Vietnam and Thailand are among the top 10 countries worldwide with populations living in low-elevation coastal zones, implying vulnerability to sea level rise and coastal storm surges.[47]

II. Financial Impacts on the Region's Buildings

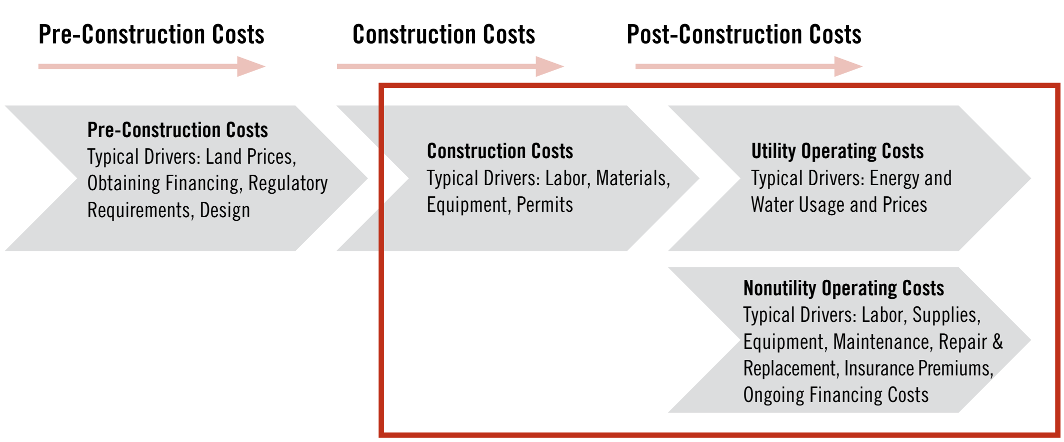
This section examines the financial impacts of energy insecurity, water scarcity, and climate change on commercial buildings in South and Southeast Asia.

KEY POINTS

- Up to 80 percent of a building's lifecycle costs are water- and energy-related, exposing the building sector to rising utility prices and disruptions.
- Climate change-related weather events, such as floods and storms, can accelerate building depreciation; increase operations, maintenance, repair, and replacement (OMRR) costs; and increase insurance premiums, especially for buildings in coastal cities.
- Project delays, resulting from extreme weather events or permitting delays related to water scarcity, can increase construction and financing costs.

As shown in Figure 4, this section focuses on operating and construction risks. Table 7 summarizes conclusions from this section.

FIGURE 4. Typical Cost Drivers in a Building's Lifecycle



Source: WRI, adapted from National Institute of Building Sciences.

Notes: Box denotes areas of impacts from water, energy, and climate change examined in this report.

TABLE 7. Key Trends and Risk Mapping for the Building Sector

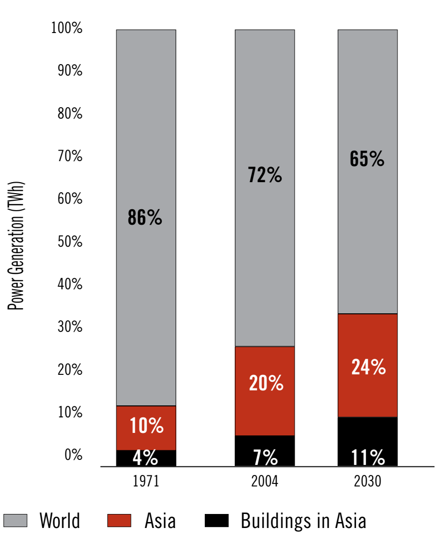
Cost Area	Type of Financial Impact	Notes on Financial Impact
Operating Utility Costs	• Higher electricity/water prices and back-up costs	• Energy costs are the largest cost contributor in a building's lifetime; this cost contribution will likely increase over time as consumers demand energy-intensive features and governments roll back price subsidies • Water risks are less significant now because of low use in commercial buildings and current municipal water subsidies. Risks will likely rise over time as subsidies rollback and buildings become more water intensive (for cooling and landscaping) • Additional capital expenditures may also be required to comply with new building code requirements for water and energy efficiency
Nonutility Operating Costs	• Higher maintenance costs, unexpected repair/replacement costs or need for larger reserves • Accelerated depreciation • Higher insurance premiums	• Typically minor over a building's lifetime, but may be large in a given year due to damage from weather events not covered by insurance • Rising insurance premiums will become a more significant contributor to operational costs over time, especially as the need for extensive "Acts of God" insurance becomes more important due to increased frequency of extreme weather events
Construction Costs	• Project and permitting delays/regulatory compliance costs • Higher materials and import prices	• Small over a building's lifetime, but impacts initial developer the most since delays increase financing costs • Construction costs can increase for buildings that source imported materials and/or materials that need to travel long distances

Source: WRI.

A. UTILITY OPERATING COSTS (Energy and Water)

■ Utility costs for buildings in this region are driven by (1) increasing electricity and water prices, combined with rising demand per occupant, and (2) the high cost of alternatives during times of shortage.

FIGURE 5. Asia's Share *(current and projected)* of Global Energy Consumption, 2008



Source: Asia Business Council, "Building Energy Efficiency: Why Green Buildings are the Key to Asia's Future," October 2008.

Note: Includes China and other countries beyond the scope of report.

(1) Increasing Utility Prices and Demand

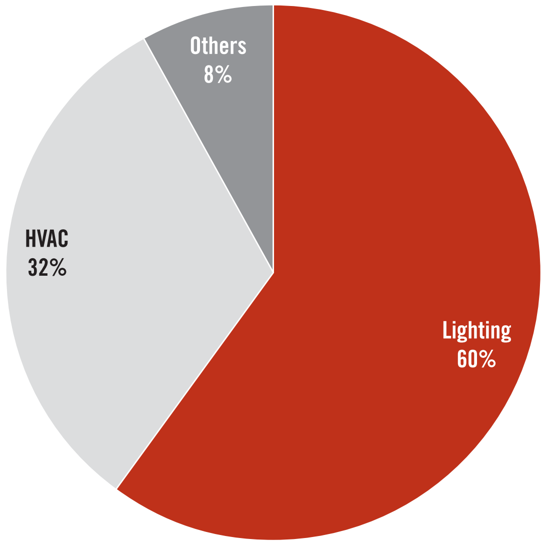
The building sector's high energy and water use, which can constitute up to 80 percent of a building's lifecycle costs, expose the sector to utility price and shortage risks.

Building energy use accounts for approximately 40 percent of energy use and 17 percent of freshwater withdrawal globally.[48] Asian buildings alone account for 7 percent of the world's energy use, and this percentage is growing rapidly.[49] In Asia, buildings are consistently one of the largest sectoral users of energy as shown in Figure 5.

Most energy and water consumption occurs during a building's operational phase for cooling, lighting, and direct use.[50]

Energy use in buildings varies depending on the type of building, the climate zone where it is located, and the level of development.[51] Urban buildings, especially in this region, use more energy because urban surfaces tend to store heat, whereas in rural areas vegetation creates shade and keeps temperatures cool. In commercial office buildings, air conditioning and lighting are typically the biggest energy use categories across the region. Energy use breakdown in India is shown in Figure 6 for typical commercial buildings. As with energy, water usage most occurs during a building's operational phase and is typically used for direct tenant consumption, cooling in building systems, and operations and maintenance.

FIGURE 6. Typical Energy Use Breakdown in Commercial Buildings (India, 2007)



Source: Bureau of Energy Efficiency (India), 2007.

Regional electricity and water prices are likely to rise in the coming decade.

As described in Section I, various factors—including the region's limited supply of water and energy, increasing use intensity, potential rollbacks in energy and water subsidies, climate change, and weak infrastructure—are all likely to contribute to rising energy and water costs for buildings.

Utility costs are a significant part of a building's operating costs and sensitive to electricity/water rate changes.

HSBC estimates that for a typical commercial building (300,000 square feet) in Mumbai, India, assuming all other factors are equal, a 1 percent increase in electricity costs could increase annual operating costs by approximately Rs. 2.8 million, or around US$60,000. See Box 1 for additional information on estimated utility contributions to annual operating expenses. Detailed assumptions are available in Section V.

Even if energy and water prices stay constant, rising demand for energy and water-intensive building features will increase total utility use, and thus increase costs.

Total building energy and water needs have grown over the last decade alongside rapid urbanization and population and economic growth. As evidence of this trend, the electricity consumption of Indian commercial buildings jumped 45 percent between 2002 and 2006.[52] This trend is expected to continue as both commercial and residential occupants demand energy and water-intensive building features like air conditioning, lighting systems, and landscaping.[53] As shown in Figure 5, the share of Asian building energy consumption as a percentage of global energy consumption is expected to rise by 53 percent between 2004 and 2030—faster than total relative energy consumption growth. In the longer term, climate change could also contribute to rising temperatures and more frequent heat waves, which could lead to spikes in energy and water demand in buildings.

Box 1: Estimated Utility Contributions to Total Annual Operating Expenses

For a typical Mumbai, 300,000 square foot, office building today:

- Water costs as percentage of total expenses = around 2%
- Water costs as percentage of rent = around 3%
- Electricity as percentage of total expenses= around 11%
- Electricity as percentage of rent = around 12%

Source: HSBC; detailed assumptions provided in Section V.

(2) High Cost of Backup Power

Backup power generation during times of shortage can be costly and exposes companies to higher diesel fuel prices.

Most commercial building complexes in this region use diesel fuel generators to provide backup power during times of shortage. This exposes buildings to changing diesel fuel prices, as driven by global prices, national supplies, and the level of government subsidies. In 2008, the cost of diesel fuel was several times higher than municipal grid power costs in our focus region.

Major cities in India already face severe power disruptions as shown in Table 8. According to an independent study commissioned by Wartsila India, a provider of lifecycle power solutions for the Indian energy market, Indians spend around US$6.2 billion every year on backup power generation due to outages and disruptions. The premium paid by commercial consumers for generators over grid power can be significant. Across major cities in India that experienced shortages, commercial consumers with a 1,500-unit (kWh) monthly consumption in cities with outages pay a premium ranging from 14 to almost 200 percent over grid power for using a generator.[54]

TABLE 8. Severity of Power Shortages Across Major Indian Cities Through the Week, 2009 (outage hours)

	Peak Season Average Daily Outage Hours							Non-Peak Season Average Daily Outage Hours						
City	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Bangalore	1.5	1.5	1.5	1.5	1.5	1.5	1.5							
Bhopal	2.5	2.5	2.5	2.5	2.5	2.5	2.5							
Chennai	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Coimbatore	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Delhi	2	2	2	2	2	2	2							
Faridabad	5	5	5	5	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Gurgaon	5	5	5	5	5	5	5	4	4	4	4	4	4	4
Hyderabad	1	1	1	1	1	1	1							
Indore	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Kanpur	7	7	7	7	7	7	7	6	6	6	6	6	6	6
Lucknow	3.5	3.5	3.5	3.5	3.5	3.5	3.5	1	1	1	1	1	1	1
Ludhiana	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Madurai	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Mumbai														
Mysore	2.5	2.5	2.5	2.5	2.5	2.5	2.5							
Navi Mumbai	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Noida	5	5	5	5	5	5	5	2	2	2	2	2	2	2
Pune	3	3	3	7	3	3	3	Infrequent up to 1 hr			5	Infrequent up to 1 hr		
Rajkot	Infrequent up to 3 hr. No fixed pattern.							Infrequent up to 1 hr. No fixed pattern.						
Vadodara	Infrequent up to 3 hr. No fixed pattern.							Infrequent up to 1 hr. No fixed pattern.						
Vishakapatnam	2	2	2	2	2	2	2							

Severity of Daily Outage: No Outage; >0, <3 hours; >=3, < 6 hours; >= 6 hours

Source: Universal Consulting, "The Real Cost of Power", Wartsila India, 2009.

Water shortage and disruption costs can also be significant.

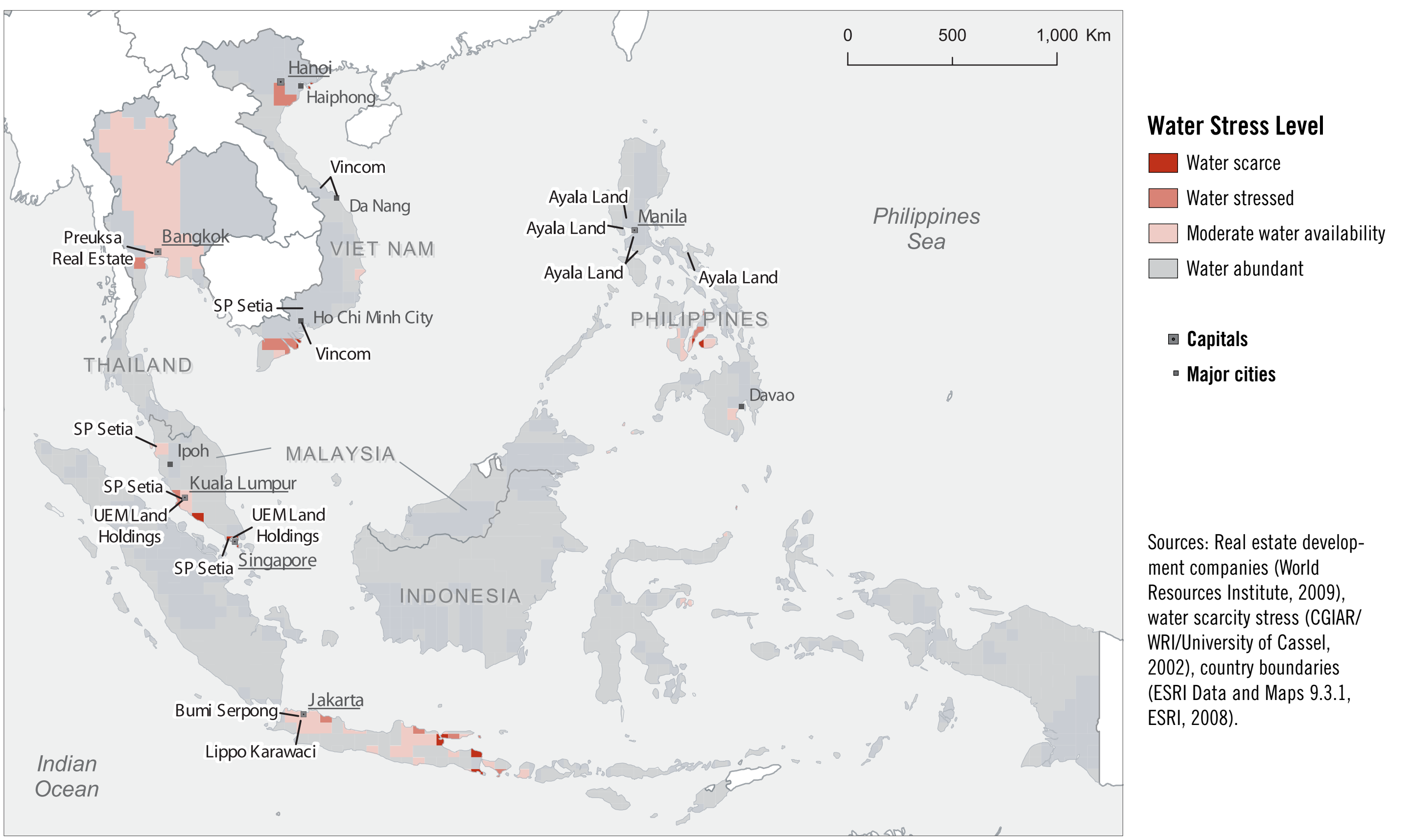
Water shortages and disruptions expose buildings to utility cost risks as private alternatives can be expensive. The price of private water supply is dependent on energy prices and transportation costs. In several cities, especially those in India, municipal supplies in many areas are severely underpriced, while private supplies are often overpriced. This price variation between public and private supplies, combined with the frequency and intensity of water disruptions, plays an important role in determining utility costs.

Well drilling, a common way to access backup water, may face more regulatory restrictions in the future.

Water scarcity and inadequate infrastructure in this region have forced many building owners to drill their own wells. These wells contribute to the lowering of groundwater levels, salt intrusion, and land subsidence in cities such as Jakarta[55] and Bangkok.[56] Restriction of well water use and increased enforcement in cities where such restrictions already exist are likely as these conditions worsen. For example, in Jakarta, the city government proposed a new groundwater tariff in March 2009 to prevent groundwater exploitation.[57]

Several current and planned developments of the largest public real estate developers in the region are in water-scarce areas (Figure 7 and Figure 8).

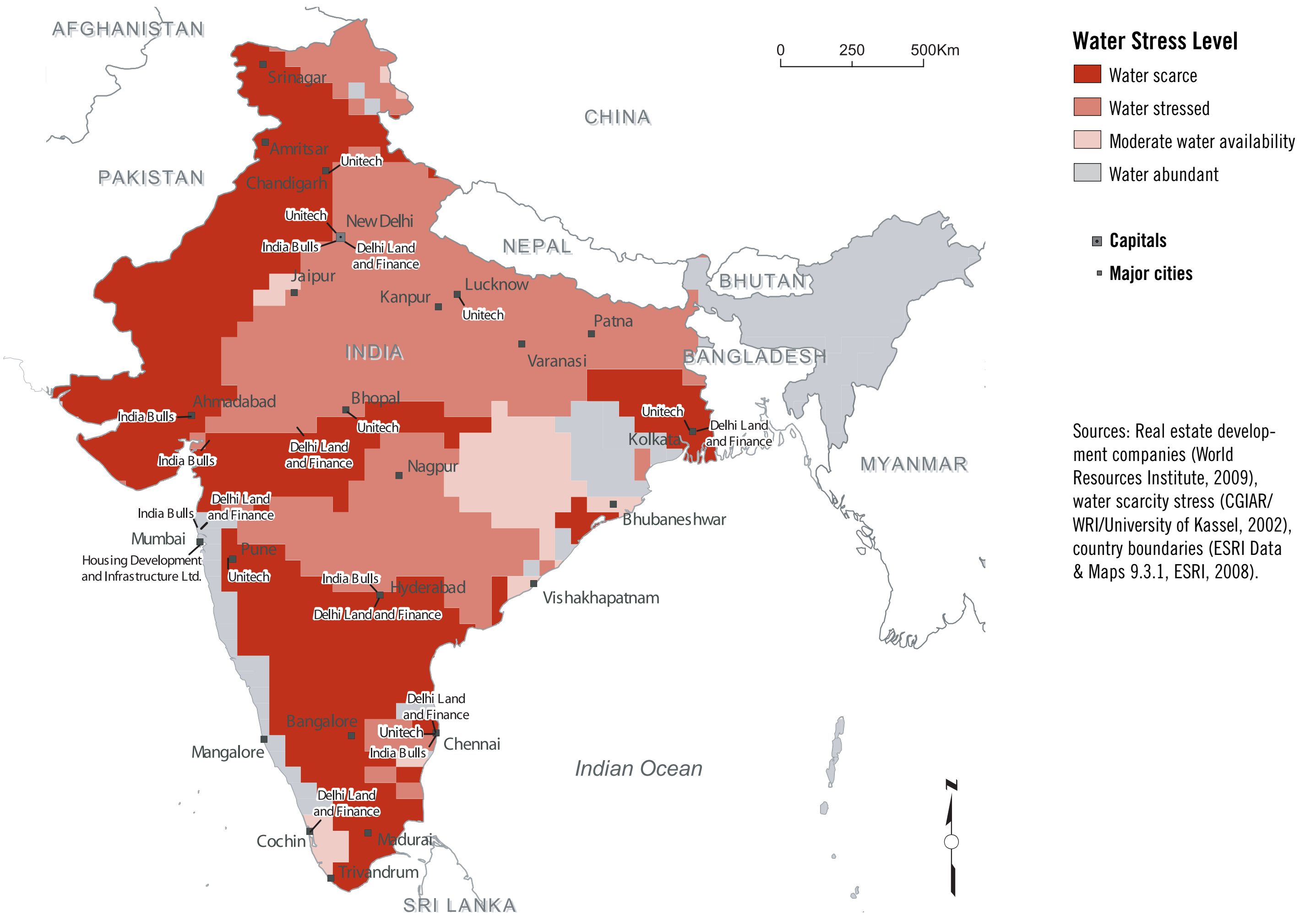
FIGURE 7. Sample of Current and Planned Real Estate Projects in Southeast Asia (2009) Overlaid on Water Scarce Areas (2002)



Sources: Real estate development companies (World Resources Institute, 2009), water scarcity stress (CGIAR/WRI/University of Cassel, 2002), country boundaries (ESRI Data and Maps 9.3.1, ESRI, 2008).

Notes: Current and planned real estate development projects of the top 11 companies by market capitalization in the region based on best available information from company websites and annual reports. This is not a robust mapping of all real estate development projects constructed by these, or other companies; it is meant to serve as a sampling of where real estate development is occurring and demonstrate that several current and planned real estate projects are present in water scarce areas. Please see Appendix 2 for the company data used for this map.

FIGURE 8. Sample of Current and Planned Real Estate Projects in India (2009) Overlaid on Water Scarce Areas (2002)



Sources: Real estate development companies (World Resources Institute, 2009), water scarcity stress (CGIAR/WRI/University of Kassel, 2002), country boundaries (ESRI Data & Maps 9.3.1, ESRI, 2008).

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Commercial buildings are typically less protected from severe water shortages than residential projects in this region.

Generally water rights go first to domestic use, followed by agricultural use and industrial use. A summary of water priorities is shown in Table 9. These may not be as much of a concern for projects in central urban areas, but competing urban uses and priorities may still pose challenges.

TABLE 9. Regional Water Use in Asia: Priorities in Times of Shortage

Country	Priorities in Times of Shortage
India	• Drinking water for humans and livestock • Irrigation • Hydropower • Preservation of ecological balance
Indonesia	• Domestic use • Agriculture in existing small-scale irrigation systems
Philippines	• In emergency situations- domestic and municipal purposes; otherwise, rights established first in time
Thailand	• Water supply in cities and communities, including domestic and industry • Agriculture using limited water • Salinity control • Second rice crop • Water transport and sailing boats
Vietnam	• Water for daily life • Water for cattle and poultry rearing and aquatic and marine product culture • Important industrial establishments and research institutions • Food security and crops of high economic value • Other water exploitation and use purposes

Source: Asian Development Bank*

Note: Based on national government policies and regulations.

* Bird et. al., *Water Rights and Allocation: Issues and Challenges for Asia*, Asian Development Bank, 2009. http://www.adb.org/Documents/books/Water-Rights/Water-Rights.pdf

There is an acute lack of awareness of lifetime utility costs and the high price of backup power among real estate developers, building owners, and tenants in India.[58]

Furthermore, because project designers and developers are not necessarily operating the building after construction, there are limited incentives for mainstreaming the reduction of building water and energy intensity. Information transparency regarding future expected utility costs is low, not just in this region but even in real estate markets in OECD countries. (Refer to WRI's 2007 publication Empowering People for a discussion of information transparency and access to information issues in the electricity sector in India, Indonesia, Philippines, and Thailand.) Emerging government building codes in the region could help better align incentives, but it would likely be several years before governments could effectively mandate and enforce these codes.

B. NONUTILITY OPERATING COSTS (OMRR-Operations, Maintenance, Repair, Replacement, Depreciation, and Insurance)

- Climate change exposes buildings to (1) increased OMRR costs and accelerated depreciation as well as (2) rising insurance premiums.

(1) Increased OMRR Costs and Accelerated Depreciation

Climate change impacts will increase maintenance, repair and replacement costs and accelerate depreciation.

The effects of climate change—including temperature variations, and changes in humidity, solar radiation, wind, and precipitation patterns —can cause paint staining, movements in building structures, cracks in concrete, and corrosion to building materials.[59] More extreme weather events like typhoons and heavy precipitation can cause permanent damage and increase replacement costs and/or decrease building lifetimes.

Table 10 summarizes the key physical impacts and consequences for buildings in the region.

TABLE 10. Physical Impacts of Climate Change on Buildings

Impact	Consequence for Building Owner	Timeframe of Impact on a New Building
Storm damage	Increase in frequency and severity of storms will lead to more storm damage. Buildings will require more repair and maintenance work.	0-5 years and beyond
Geotechnical problems	Ground movements may increase in some areas due to increased drying of soil; repair and underpinning work will be needed for affected constructions.	0-5 years and beyond
Flood damage	Vulnerable buildings will face increased risk of flooding. Affected buildings will require extensive repair.	0-5 years and beyond
Corrosion of metals	Corrosion of metal components from water damage may increase, and thus buildings will require more repair and maintenance.	5-10 years and beyond
Degradation of plastics and rubbers	Plastics will degrade faster due to increased UV-B levels. Maintenance and replacement cycles will need to be more frequent.	5-10 years and beyond
Degradation of surface coatings	Surface coatings will degrade faster due to increased UV-B levels. More frequent maintenance will be required.	5-10 years and beyond
Rain penetration and water damage	Rain penetration problems will increase. Affected buildings will require repair and, where possible, corrective action.	5-10 years and beyond
Higher summer temperatures	Lead to a significant increase in the demand for air conditioning in buildings (and hence in higher summer energy demand). Higher ground temperatures would also lead to ground contaminants becoming more active.	Major effects 10-20 + years
Durability of concrete	Concrete may carbonate more quickly due to higher CO_2 levels in the atmosphere; this and other mechanisms may lead to cracking problems with concrete elements. Vulnerable components will require monitoring, and repair where necessary.	Major effects 10-20 + years
Increased rates of coastal erosion	Sea level rise and storm surges will have catastrophic consequences for buildings in vulnerable locations.	Storm surges 0-5 years and beyond; sea level rise major effects 10-20 + years

Source: WRI, adapted from Sustainable Concrete. Original sources include Garvin SL, Phillipson MC, Sanders CH, Hayles CS and Dow GT, Impact of climate change on building, BRE, 1998, UKCIP, Climate change and the built environment research fora, 2001.

Increased rains, flooding, storms, and landslides have already had an impact on building structures across the region.

Water damage from increased precipitation can damage building structures, promote mold, undermine drainage systems, and cause power interruptions in buildings. Jakarta, where almost 40 percent of land is below sea level, has acute vulnerability to the increasing rains and flooding created by climate change.[60] Flood events in 2007 caused more than US$900 million in total damages, while 2002 floods caused an estimated US$1.1 billion in property damage.[61] Manila faces similar flood risks, triggered by extreme weather events. Officials estimate that damage from typhoon Ketsana in 2009, which flooded 80 percent of Manila at its peak, cost the city approximately US$30 million.[62] According to the *Philippine Star,* the Filipino Insurance Commission chief estimates the amount of damages to real estate properties to be PHP 12 billion (approximately US$250 million) from two 2009 tropical storms, Ketsana and Pepeng.

(2) Rising Insurance Premiums

In addition to higher routine maintenance, repair, and replacement costs, the region's buildings will likely face hikes in weather-related insurance costs.

For example, in Jakarta, after the 2007 floods, insurance firms faced over US$200 million in flood claims, of which 75 percent were expected to come from commercial buildings.[63] Building insurance premiums subsequently increased by 25 percent in 2008 according to the finance ministry's head of insurance bureau.[64] In some cases, insurers may be unwilling to provide coverage, exposing building owners and operators to spikes in OMRR costs.

In the longer run, warming temperatures and increased humidity could affect structural building components and reduce building lifetimes.

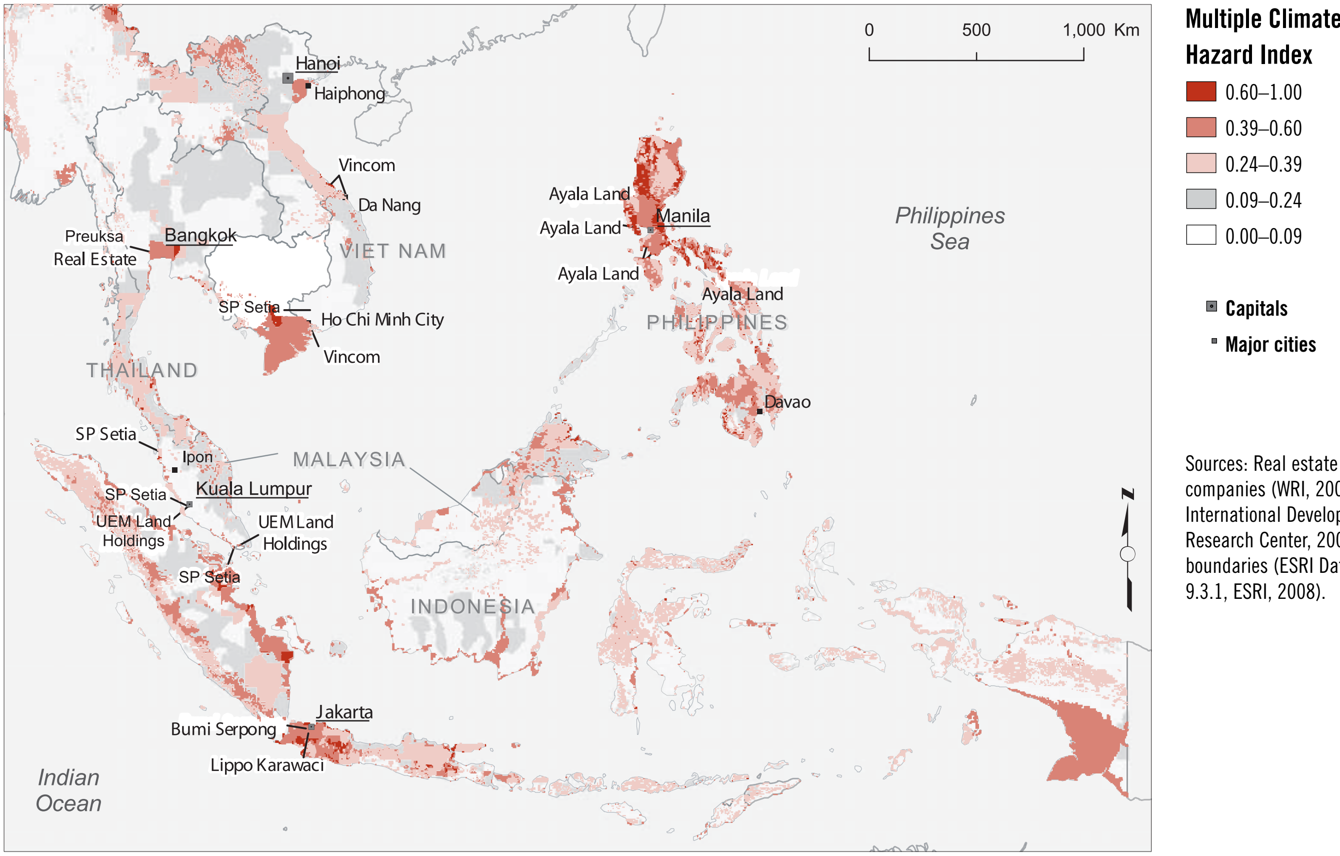
Generally, many materials degrade faster in humid climates. Many building materials also need time to dry out after construction, and higher humidity extends this process.[65] Volatility in temperatures can cause materials to expand and contract, creating cracks and structural faults. Beyond physical risks, human health risks may include poor indoor environmental air quality and uncomfortable indoor temperatures.

Coastal city buildings are highly vulnerable to climate change impacts, including salt damage.

In addition to water damage and power losses from storms and flooding, coastal cities also face exposure to salt damage. This is exacerbated by increased winds and precipitation that lodge salts into building structures and increase corrosion/damage to building foundations. Sea level rise, especially when combined with higher water tables, can also exacerbate flooding in the longer term.

Several current and planned developments of the largest real estate developers in each country are located in areas with multiple climate hazards (see Figure 9 and Figures 10A and 10B).

FIGURE 9. Sample of Current and Planned Real Estate Projects in Southeast Asia Overlaid on Areas Exposed to Climate Hazards



Sources: Real estate development companies (WRI, 2009), International Development Research Center, 2009, Country boundaries (ESRI Data & Maps 9.3.1, ESRI, 2008).

Notes: Current and planned real estate development projects of the top 11 companies by market capitalization in the region based on best available information from company Web sites and annual reports. This is not a robust mapping of all real estate development projects constructed by these or other companies; it is meant to serve as a sampling of where real estate development is occurring and to demonstrate the presence of current and planned real estate projects in areas exposed to the trends discussed in this report. Please see Appendix 2 for the company data used for this map.

C. CONSTRUCTION COSTS

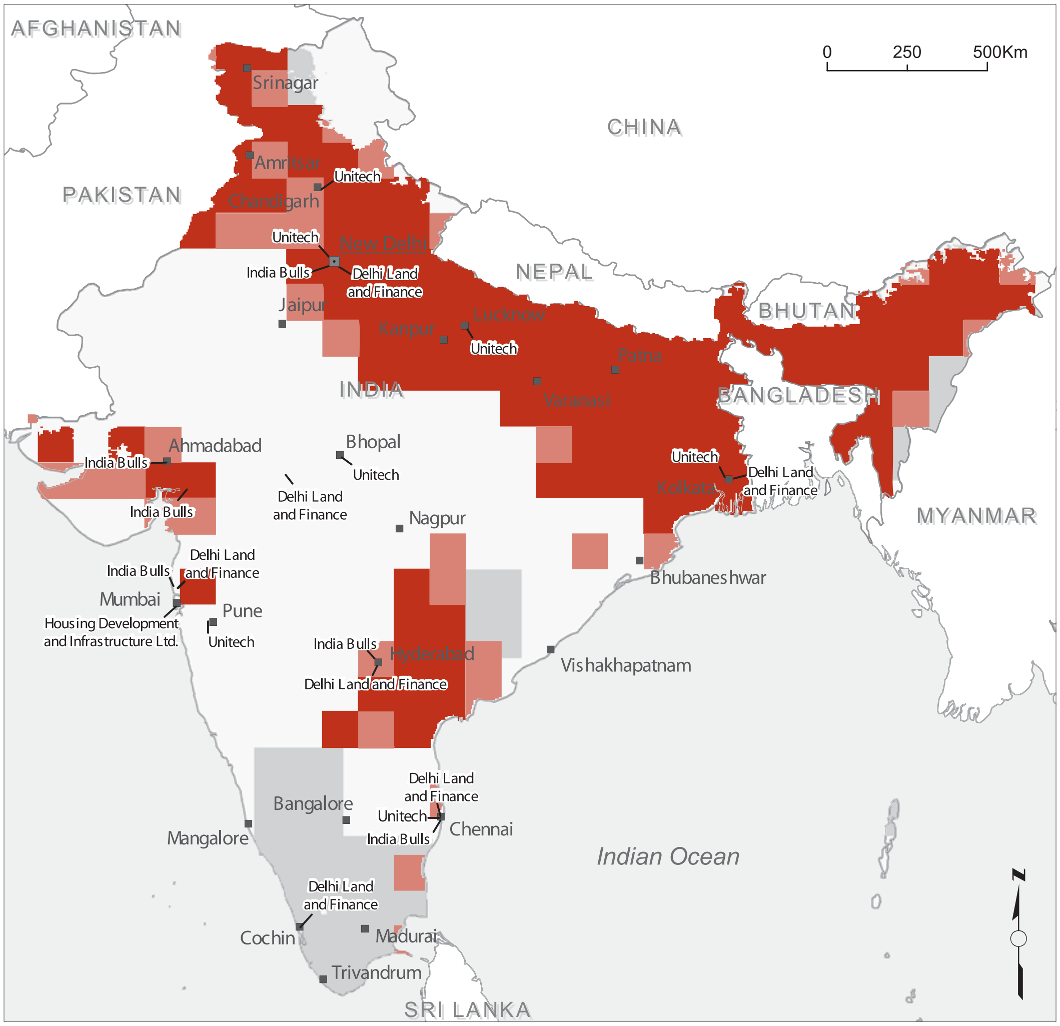
- Energy insecurity, water scarcity, and climate change expose buildings to higher construction costs in the form of (1) project and permitting delays and (2) higher material costs.

(1) Project and Permitting Delays

Increased frequency of floods and storms from climate change can increase project delays, either through construction stoppage or late arrival of building materials due to transportation disruptions.

These risks are most likely in low-lying cities like Manila, Jakarta, Mumbai, Bangkok, and Ho Chi Minh City, which are already prone to flooding. For example, in 2009 floods delayed several large infrastructure construction projects in Vietnam, causing most major projects to "set up steering committees for storm and flood control to cope with the unusual weather."[66] Even elevated cities could be affected by the increased frequency of heavy precipitation. Financial impacts will vary depending on the stage of construction and magnitude of physical impact on the project and local area. Project delays could result in greater borrowing costs and lost rental revenue, in addition to other construction costs.

FIGURE 10A. Sample of Current and Planned Real Estate Projects in India Overlaid on Flood Hazard Distribution



Flood Hazard
(Deciles)

- 8th–10th
- 5th–7th
- 1st–4th

- **Capitals**
- **Major cities**

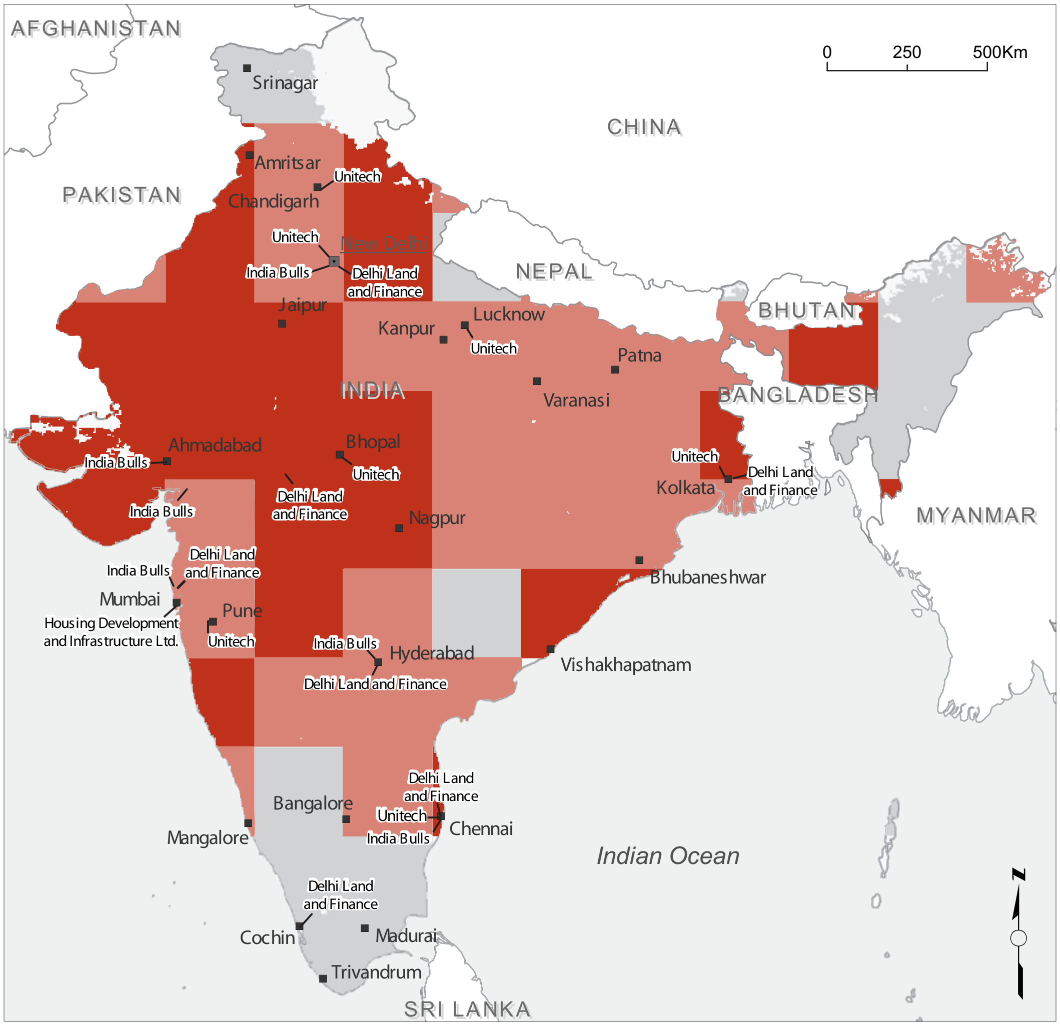
Sources: Real estate development companies (WRI, 2009), Flood and Drought Hazard (Center for Hazards and Risk Research), Center for International Earth Science Information Network, Columbia University, The World Bank, United Nations Environment Programme Global Resource Information Database Geneva, 2005), Country boundaries (ESRI Data & Maps 9.3.1, ESRI, 2008).

Notes: Current and planned real estate development projects of the top 11 companies by market capitalization in the region based on best available information from company Web sites and annual reports. This is not a robust mapping of all real estate development projects constructed by these or other companies; it is meant to serve as a sampling of where real estate development is occurring and to demonstrate the presence of current and planned real estate projects in areas exposed to the trends discussed in this report. Please see Appendix 2 for the company data used for this map. Cyclone and landslide data are available upon request.

The region's building owners and developers should be prepared for stricter enforcement of permitting terms and tougher regulatory requirements relating to energy and water use.

For example, in Manila governments are now cracking down on commercial buildings that have illegally blocked natural waterways in the city as floods become more frequent and intense.[67] In India, the Energy Building Conservation Code is currently voluntary, but state or local governments may adopt it as mandatory in coming years.[68] In November 2009, the state of Haryana decided to make it mandatory for all buildings built after April 2010 to comply with the green rating norms of India's Green Rating for Habitat Assessment (GRIHA).[69]

FIGURE 10B. Sample of Current and Planned Real Estate Projects in India Overlaid on Drought Hazard Distribution



Drought Hazard
(Deciles)

- 8th–10th
- 5th–7th
- 1st–4th

- **Capitals**
- **Major cities**

Sources: Real estate development companies (WRI, 2009), Flood and Drought Hazard (Center for Hazards and Risk Research), Center for International Earth Science Information Network, Columbia University, The World Bank, United Nations Environment Programme Global Resource Information Database Geneva, 2005), Country boundaries (ESRI Data & Maps 9.3.1, ESRI, 2008).

Notes: Current and planned real estate development projects of the top 11 companies by market capitalization in the region based on best available information from company Web sites and annual reports. This is not a robust mapping of all real estate development projects constructed by these or other companies; it is meant to serve as a sampling of where real estate development is occurring and to demonstrate the presence of current and planned real estate projects in areas exposed to the trends discussed in this report. Please see Appendix 2 for the company data used for this map. Cyclone and landslide data are available upon request.

Developers in India are well aware of the costs associated with permitting delays. According to the vice chairman of DLF, one of India's largest real estate developers, it already takes 12 to 18 months to secure all the requisite approvals to start a project.[70] More specific environmental approvals can cause additional project and permitting delays of several months.[71] In addition to cost overruns, project delays can also result in arbitration, litigation, or even total abandonment of a project.[72]

(2) Higher Material Costs

Developers could face longer-term price increases for energy-intensive and imported materials.

The prices of material commodities are difficult to predict and depend on several drivers. An increase in global or regional energy prices is one driver that could easily factor into increasing the price of materials with energy-intensive production processes. Higher fuel prices may also result in higher transportation costs for imported materials. As evidence of the importance of transportation costs to material prices, in 2008 Australian producers obtained a substantial price premium for iron ores sold to the Asian market due to the shorter transportation distance to the buyers (relative to other exporters).[73]

Water scarcity can also create risks for domestic material inputs traditionally considered relatively cheap, such as sand, as demonstrated by the example in Box 2.

Box 2. Bangalore Developers Caught in Quicksand?

In Bangalore, the price of sand rose rapidly in 2008 due to increasing demand from real estate developers and subsequent government limits on sand extraction from riverbeds to prevent groundwater depletion and ecological damage. Farmers then started extracting sand from agricultural land to supply to real estate developers. In 2008, 25 percent of sand supplies around Bangalore were from agricultural sources, and the remaining 75 percent came from riverbed sources.

Sand extraction from agricultural sources is also harmful: Associated problems include loss of surface soils, nutrients, and crop yields (10 to 20 percent), the siltation of tanks, excessive groundwater exploitation, and soil erosion.

Both riverbed and agricultural sources are unsustainable over time, given the food and water insecurity plaguing the region. Nearly 132,000 liters of water is required to wash four tractor loads of soil in order to produce one truckload of sand. A conservative estimate suggests that nearly 21,900 lakh (2.19 billion) gallons of water is used for sand extraction per year around Bangalore. This water is pumped from deep bore wells, the levels of which have fallen rapidly due to sand extraction. Open wells in the region have dried up.

The Karnataka state government is attempting to stop sand extraction from both agricultural and riverbed sources. This may result in a rapid increase in the price of sand. Even if sand extraction is not limited, dwindling water supplies and longer-term energy price increases could also increase sand extraction costs. Given the high demand relative to supply, developers would be forced to absorb these higher costs or truck in sand from other states—a potentially cumbersome endeavor depending on state regulations and logistics.

Source: *The Hindu,* Current Science, July 2008, and WRI.

III. Risk Assessment Framework

To assess the financial impacts of energy insecurity, water scarcity, and climate change, investors and analysts should understand a building's exposure to these trends and the vulnerability of the building's design to associated financial impacts. The magnitude of financial impact on a developer, owner, tenant, or future owner will also depend on prevailing market conditions and the ability to pass along costs. In a buyers/renters market for commercial buildings, passing along costs could be more difficult, especially if potential buyers/tenants are aware of these risks. This section outlines a project-level risk assessment framework for investors and analysts and then outlines how this may be translated into risk assessments for REITs and real estate developers.

KEY POINTS

- Analysts, investors and developers should conduct an exposure and vulnerability analysis on existing and future real estate projects using the factors presented in this section.
- By aggregating project-level risks and evaluating management and strategy, analysts of REITs or real estate developers can also incorporate energy, water, and climate risk into company-level evaluation.

A. PROJECT-LEVEL RISK ASSESSMENT FRAMEWORK

The buildings at greatest financial risk are both exposed and vulnerable to water scarcity, energy insecurity, and climate change impacts.

1. **Building Risk Exposure (Location):** Location determines a building's physical *exposure* to risks arising from energy insecurity, water scarcity, and climate change impacts. To address location-based exposure to such risks, investors and tenants should ensure that project budgets account for increases in energy and water prices, project delays, and maintenance cost increases among other factors.
2. **Building Vulnerability (Design):** A building's architectural design, materials, and systems dictate its financial *vulnerability* to energy insecurity, water scarcity, and climate change impacts. To address such vulnerabilities, investors and tenants should seek buildings with adequate design features to weather exposure to risks.

(1) Building Location Exposure

Investors and analysts can use the factors in Table 11 to assess the geographic exposure of a building project. Table 12 provides relative risk exposures for major cities in the region although, even within cities, risk exposure may vary greatly.

TABLE 11. Assessment of Building Location Exposure

Financial Impact	Cost Type	Building Exposure Factors (Location)
Utility Operating Costs	Water utility costs	• Limited local water infrastructure relative to expected demand • Drought-prone region • Fluctuations in seasonal water availability, resulting in water quantity and quality supply problems • Proximity to sources of water pollutants (for example, industry or agriculture) • High price of alternatives to local municipal water supply (for example, if substitute sources are located far away)
	Energy utility costs	• Weak or no energy infrastructure • Insufficient power supply to satisfy area demand for power • Area power outages and/or energy shortages • Subsidized diesel fuel prices and/or country dependence on foreign fuel sources
Nonutility Operating Costs	OMRR Costs and depreciation Insurance premiums	• Coastal area (exposure to flooding, cyclones) • Low lying locations (exposure to flooding) • High recent/predicted frequency of climatic events (historical occurrence may not sufficiently forecast future impacts)
Construction Costs	Project and permitting delays	• Area water and energy availability • Coastal and/or low-lying locations
	Material input prices	• High fuel and energy costs

Source: WRI.

TABLE 12. Current Risk Exposure (likelihood and magnitude) to Energy Insecurity, Water Scarcity, and Climate Change Trends by City

	Energy Insecurity*	Water Scarcity**		Climate Change*** (Floods/Droughts, Storms, Sea Level Rise)	
City	Energy Import Dependency	Availability Risk	Quality Risk	Physical Exposure	City Vulnerability
Mumbai	High	Medium	High	High	High
Kolkata	High	High	High	High	High
Delhi	High	High	High	High	High
Hyderabad	High	High	High	Medium	High
Chennai	High	High	High	High	High
Jakarta	Low	Medium	Medium	High	High
Kuala Lumpur	Medium	Medium	Low	Medium	Medium
Metro Manila	High	Medium	Medium	High	High
Bangkok	High	Medium	Low	Medium	Medium
Ho Chi Minh City	Medium	Low	Medium	High	High

Source: WRI and data and analysis from Asian Development Bank, World Wildlife Fund (WWF), and Intergovernmental Panel on Climate Change, and United Nations Global Risk Data Platform.

Notes: Risk levels are based on intra-regional (not global) comparisons; some risk levels are aggregated at the national level rather than the city level due to data constraints. Detailed methodology is provided in Appendix 3.

*Energy import dependency was based on 2006 national-level statistics in the Asian Development Bank's October 2009 report "Energy Statistics in Asia and the Pacific (1990-2006)." Energy import dependency levels do not provide a complete picture of current or future energy price risks; energy price risks will depend on several factors not reflected in our methodology and in this report.

**Water quality based on national-level analysis from Asian Development Bank's Index of Drinking Water Adequacy; city-level water availability based on per capita internal renewable freshwater resources data from CIGAR, WRI, and University of Kessel.

***Physical exposure considers the likelihood of a city facing climate change impacts purely based on its location. City vulnerability to climate change impacts considers three factors: (1) physical exposure, (2) socioeconomic sensitivity (including population and assets threatened), and (3) inverse adaptive capacity.

(2) Building Design Vulnerability

The metrics presented in Table 13 assess financial vulnerability to our focus trends based on a developer's design decisions. Generally, during the design phase, all real estate projects should use:

- Energy and water auditing and lifecycle analysis;
- Design that is resilient to extreme weather, including flooding and storms; and
- Accurate budgets and contracts that account for higher utility costs, project delays, reserve and replacement costs, and insurance premiums based on risk exposure and project vulnerability.

TABLE 13. Assessment of Building Design Vulnerability

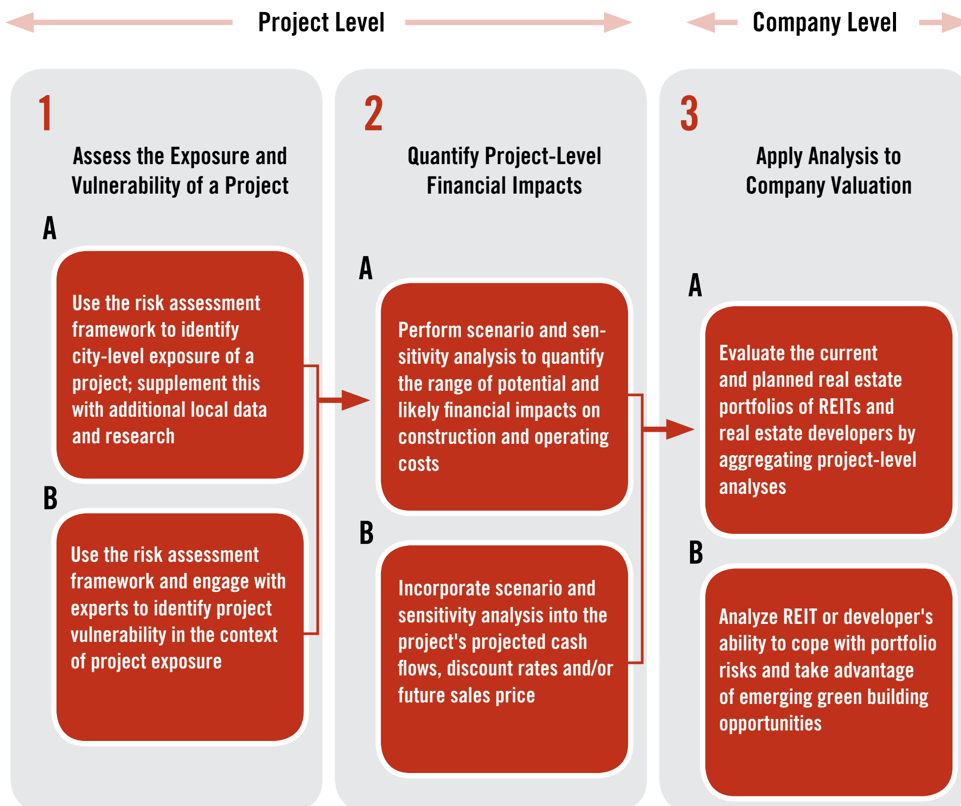
Financial Impact	Cost Type	Building Vulnerability Factors (Design)
Utility Operating Costs	Water utility costs	• High per occupant water use due to water intensive design building features • Lack of adequate gray water storage systems in buildings
	Energy utility costs	• High per occupant energy use due to energy intensive building systems and/or features • Expensive sources of power/back-up generation • Older/outdated building systems that may not comply with new building codes
Nonutility Operating Costs	OMRR costs and depreciation	• Architectural design or use of building materials that are vulnerable to water and/or storm damage • Limited or no insurance coverage against flood, fire, and other extreme weather events
	Insurance premiums	
Construction Costs	Project and permitting delays	• Inadequate budget or construction contract, i.e., one that does not account for longer permitting processes and construction timeline
	Material input prices	• Use of imported materials (long distances may result in high transportation costs)

Source: WRI.

B. PROCESS TO CONDUCT PROJECT AND COMPANY-LEVEL ASSESSMENTS

To incorporate energy, water, and climate change risks into investment decisions either at the project or company level, analysts and investors should follow the process outlined in Figure 11 and described below.

FIGURE 11. Process for Project and Company Risk/Opportunity Analysis



Source: WRI.

1. **Assess the Exposure and Vulnerability of a Project.** As outlined in Figure 11, the analyst/investor's first step is to use the risk framework, analysis, and questions contained in this report to evaluate a project's exposure and vulnerability to energy, water, and climate risks. To apply the framework and evaluate *exposure,* the analyst/investor may need to conduct additional research on local impacts and predictions of energy, water, and climate risks. To evaluate *vulnerability*, the analyst/investor will need to engage with project owner/seller and local green building councils to understand how well a project is protected against emerging risks.
2. **Quantify Project-Level Financial Impacts.** Once the analyst/investor has a general sense of the key sources of exposure and vulnerability, he or she will need to engage with regional environmental and energy experts, as well as building operators, to create likely risk scenarios and perform sensitivity analyses for specific projects. This will inform the range of likely financial impacts. Historical data may be used as a baseline, but it is important to create scenarios and sensitivities that consider worsening energy, water,

and climate risks in each focus country. For these risks, the past may not be a good predictor of the future.

3. **Apply Analysis to Company Valuation.** Project-level risks can flow through to REITs, real estate developers, and other companies involved in real estate markets. Thus, analysts/investors in real estate companies should aggregate project-level risks (or ask companies to do so) across the real estate portfolio of any company being evaluated. Company-level impacts will depend on the type of company and horizon of investment in each project within the portfolio, among other factors. Impacts on REITs and real estate developers could include:

   - **Real Estate Investment Trusts (REITs).** Higher nonutility operating costs from a REIT's portfolio—like insurance premiums and maintenance expenses—will flow directly to the REIT's operating cash flow for current investments. The impact will depend on the likely holding period and whether these costs may be passed on to tenants. Passing along costs could also have adverse impacts on rental/occupancy rates depending on prevailing market conditions.
   - **Real Estate Developers.** Regardless of market conditions, real estate developers will have to contend with higher capital costs created by project/permitting delays. Developers who hold and lease completed projects (more common under unfavorable market conditions) will also face the risk of operating cost increases and lost rental income in the case of project delays. Land holdings in highly exposed areas may also lose value over time.

IV. Green Building Opportunities

Green buildings are gaining momentum around the world, given their financial benefits and smaller environmental and resource use footprint. The six countries covered in this report are no exception, although their green building markets are at very different stages of growth. This section demonstrates the financial benefits of green building investments and provides an overview of green building markets in each of the focus countries. Section V, written by contributors from HSBC, includes a more detailed analysis of the Indian green building market. Because local green building guidelines in this region go beyond energy/water savings and climate adaptation technologies, both sections consider some green building features that are outside the scope of the report (for example, using sustainably produced materials or improving indoor air quality).

KEY POINTS

- Incorporating green features into a building, whether in retrofits or new construction, can:
    - Reduce a project's financial vulnerability to energy, water, and climate change risks
    - Achieve net positive returns through utility cost savings, higher occupancy rates, and quicker sales

A. LOW-COST GREEN BUILDING INVESTMENTS

Although guidelines vary by country, generally green buildings incorporate several architectural design features and specialized building systems, materials, and technologies to reduce the water, energy, and waste footprint of a building while also creating a healthier living space for occupants (including air quality and natural lighting).

Table 14 highlights examples of low-cost green building methods that address the three trends discussed in this report: energy insecurity, water scarcity, and climate change.

B. REGIONAL GREEN BUILDING DRIVERS

Green building investments in India have demonstrated a net positive return in as few as three years.

Green buildings provide a range of cost and revenue benefits over their lifetime. These include utility cost savings, rental premiums, and longer building lifetimes. In South and Southeast Asia, a significant sales or rental premium is currently hard to achieve, especially given the current economic downturn. However, operational savings are achievable immediately through reduced water and energy use.

Although green buildings typically require additional design and construction costs, payback periods in recent buildings have been reasonable. In India, for example, several green buildings constructed since 2005 have achieved positive returns on green investments in three to five years as shown in Table 15. Outside India, there are limited regional data on the pay-

TABLE 14. Examples of Low-Cost Green Building Methods to Minimize the Impact of Energy Insecurity, Water Scarcity, and Climate Change Trends

		Risk Mitigated		
Method	**Benefit**	**Water Scarcity**	**Energy Insecurity**	**Climate Change Impacts**
Smart site selection	Avoiding environmentally sensitive (to floods, droughts, water scarcity, storms) areas reduces risk exposure	X		X
Select a light colored roof	Reduces heat buildup through the roof, reducing air conditioning costs	X	X	
Install fluorescent lights and occupancy sensors	Reduces energy consumption and lowers utility costs		X	
Design water-efficient landscapes (i.e. xeriscape) and efficient drip irrigation systems	Using native or drought tolerant plants as well as efficient irrigation systems eliminates overwatering and lowers water costs	X		X
Install water efficient toilets and fixtures	Low-flow toilets and waterless urinals can significantly lower water use and costs	X		
Use permeable paving materials / reduce hard-paving on site	Allowing storm water to percolate into the soil reduces water pollution, replenishes ground water supplies and reduces flood risk	X		X
Use high efficiency windows and insulation in walls, ceilings and floors	Reduces energy consumption and lowers utility bills; protects against strong winds and flooding	X	X	X
Use mold and water-resistant materials; avoid carpeting and opt for tiles	Water-resistant materials protect against flood and storm risks			X
Preserve and retrofit an existing commercial building if possible	Obsolescence of inefficient buildings can be avoided without high capital expenditures	X	X	X
Purchase products which originate close to the building site	Reduces fuel costs from transportation		X	
Provide natural, fan-assisted ventilation by optimizing window placement and building placement	Taking advantage of and circulating prevailing wind and thermal convection reduces the need for air conditioning and reduces energy costs	X	X	

Source: WRI, adapted from Whole Building Design Guide; Global Green; local Green Building Council recommendations; and Wilson, Alex, and Ward, Andrea, "Design for Adaptation: Living in a Climate-Changing World," *Environmental Building News*, September 1, 2009.

back period of green building features because green certification bodies and standards have only recently been introduced. However, energy-efficient retrofitting has been employed with financial success in all the focus countries. Detailed case studies are provided in Box 3 and Appendix 2.

Payback periods are expected to decrease as energy and water costs rise, technical capacity increases, and markets for associated technologies broaden. In just the past few years, green building marginal costs have dropped dramatically in India as shown in Table 15.

TABLE 15. Payback Period in Recently Constructed Green Buildings in India, 2008

Building	Year Awarded	Built-In Area (Sq ft)	Rating Achieved	% Increase in Cost	Payback (Years)
CII-Godrej GBC, Hyderabad	2003	20,000	Platinum	18%	7
ITC Green Centre, Gurgaon	2004	1,70,000	Platinum	15%	6
Wipro, Gurgaon	2005	1,75,000	Platinum	8%	5
Grundfos Pumps, Chennai	2005	40,000	Gold	6%	3
Technopolis, Kolkata	2006	72,000	Gold	6%	3
Spectral Services Consultants Office, Noida	2007	15,000	Platinum	8%	4
HITAM, Hyderabad	2007	78,000	Silver	2%	3
Patni Knowledge Centre	2008	N/A	Platinum	6%	3

Source: Indian Green Building Council.

Box 3. A Green Building Retrofit in Jakarta, Indonesia

In 2005, the Plaza BII Building—a 10-year-old private, commercial office building—received the ASEAN Energy-Efficiency award for energy efficiency retrofits. The building, located in Jakarta's central business district, consists of a 39-story tower, a 3-story basement, and a gross floor area of 80,000 square meters.

The following energy-saving measures were undertaken from 2003 to 2005:

- Rescheduling and reducing building-essential electrical loads for equipment rooms (savings of 1,743,000 kWh/year, or 24 percent)
- Eliminating operating of select lighting (savings of 54,000 kWh/year)
- Upgrading building automation system (savings of 1,227,000 kWh/year, or 35 percent)
- Modifying power outlet and integrating with operating schedule of floor lightings (savings of 68,000 kWh/year, or 4 percent)
- Installation of door switches to all equipment rooms (savings of 5,000 kWh/year, or 33 percent)

These measures enabled the building operator to achieve a 22 percent savings in total electricity consumption and may have contributed to a rise in the occupancy rate from 84 percent before 2002 to 96 percent in 2006. According to Cushman & Wakefield, average CBD office space occupancy in Jakarta was around 78 percent in 2002 and 85 percent in 2006.[1] As shown by the table below, the Plaza BII was able to continuously improve its energy efficiency and reduce its consumption of electricity since the energy savings programs were implemented.

Jakarta Plaza BII Building Energy Savings from 2002 to 2006

	1999-2002 (Before Energy-Saving Program)	2003 (Start of Energy-Saving Implementation)	2004 Continued Saving Program	2005 Continued Saving Program	2006 Continued Saving Program
Occupancy Rate	84% (2002)	94%	93%	96%	96%
Consumption of Electricity	196 kWh/sqm/yr.	156 kWh /sqm/yr.	154 kWh /sqm/yr.	156/sqm/yr.	154/sqm/yr.
Energy-Efficiency Index (Air Conditioned Area)	225 kWh/sqm/yr.	181 kWh/sqm/yr.	177 kWh/sqm/yr.	178 kWh/sqm/yr.	176 kWh/sqm/yr.

Source: Duta Pertiwi and ASEAN Energy*

*Pertiwi, Duta, "Energy Efficiency and Conservation: Best Practices of Plaza BII Building, Jakarta, Indonesia."

Notes

1. Cushman & Wakefield, Market Beat, "CBD Jakarta Office Report, 4Q 2007 and 3Q 2008."

There is a small but growing market for green buildings in the six countries.

There are fewer than 100 certified green buildings in this region currently, but several hundred were awaiting evaluation in 2009 as shown in Table 16. The Indian market is the largest and is growing rapidly. The square footage of green buildings in India grew 1,500 times between 2003 and 2007 from 20,000 to 30 million square feet.[74] Table 17 shows Indian Green Building Council estimates of the Indian green building market potential. While there are limited data on Malaysian and Thai green buildings, both countries' governments have shown support for green building projects. In Vietnam, no green buildings have been certified yet; but local standards are emerging, and the government may soon introduce green building incentives.[75]

TABLE 16. Number of Green Buildings and Certification Bodies by Country, 2009

Country	Number of Certified Green Buildings	Estimated* Number of Buildings Awaiting Evaluation	Certification Body (See "Sources" at the end of this report for links to organization Web sites)
India	50	410	Local: Indian Green Building Council (IGBC) LEED
	1	28	Local: Energy and Resources Institute (TERI)'s Green Rating for Integrated Habitat Assessment (GRIHA)
Indonesia	3	Unknown	Local: Greenship in development, based on Australia's LEED. Regional: Greenmark of Singapore
Malaysia	3	30 (estimate)	Local: Green Building Index Regional: Greenmark of Singapore previously used; GBI Accreditation Panel (GBIAP) is now the recognized body.
Philippines	0	7 (estimate)	Local: BERDE, Philippines GBC in development International: LEED US Green Building Councile
Thailand	6	200 (estimate)	Local: Thailand Energy and Environmental Assessment Method (TEEAM); not full green building standard International: LEED US Green Building Council
Vietnam	0	0	Local: LOTUS standard is in development

Source: Local green building councils and interviews with local green building experts in 2009.

*Estimates not verified.

TABLE 17. Indian Green Building Council Estimates of Indian Green Building Market Potential, 2008

Year	Number of Newly Certified Green Buildings	Estimated Market [Potential] (US$ Million)
2006	20	80
2007	50	200
2008	150	500
2012	1000	4000

Source: Indian Green Building Council. (CCI-Sohrabji Godrej Green Business Centre, "Green Buildings in India Emerging Business Opportunities," Indian Green Building Council, February 2008.)

*Estimates not verified

Three factors—(1) lifecycle utility cost savings, (2) consumer demand from large/multinational companies, and (3) emerging government incentives— are likely to push green practices forward in the region.

McGraw Hill Construction predicts that the Asia-Pacific region will exhibit the highest growth relative to other regions in the next five years.[76] Green buildings allow projects to achieve direct financial cost savings over the lifecycle of a building but also appeal to new consumer segments like multinational companies. Emerging government incentives are likely to provide an impetus for sustainable practices in the future, whether through carrot or stick approaches.

(1) Lifecycle Utility Cost Savings

Green building utility savings are significant.

Energy and water cost savings can be achieved through sustainable design, technologies, and building systems in both new and retrofitted buildings. Examples of energy savings achievable through technology and design implementation in this region are shown in Table 18.

TABLE 18. Energy Efficient Technologies and Savings for Buildings (India)

Energy Use in Buildings	Savings Potential*			Examples of Technology and Design
		Commercial	Residential	
Lighting	Energy-efficient lighting	5%	15%	• Targeted task lighting can reduce electrical energy demand by 2050 percent. Light levels can also be safely reduced in noncritical areas, such as hallways, lobbies, and waiting rooms
Cooling	Proper orientation, fenestration, shading, insulation	10%	15%	• Internal shading, such as curtains and solar films on windows, which block heat without blocking light
Energy Source	Solar water heating system		10%	• In most parts of this region, rooftop solar panels can help meet peak demands for power and hot water generation

Source: Adapted from TERI Compilation, Analysis 2008 and India Green Building Council.
*Percentages applicable to Indian market, relative to a conventional building.

Up-front costs for technology and design implementation can be offset through savings.

The head of the Non-Residential Green Building Index development committee has estimated the construction cost premium relative to energy efficiency benefits for Malaysian buildings under the newly launched Green Building Index (GBI). As shown in Table 19, more stringent certification results in additional up-front costs starting at 1 percent, but the energy savings are also greater.

TABLE 19. Estimated Costs and Energy Benefits of Malaysian Green Building Index Certification, 2009

Green Building Index Rating	Average Malaysian Building	Meets MS1525	GBI Certified	GBI Silver	GBI Gold	GBI Platinum
Building Energy Efficiency (BEI) kWh/m²/year	250	200–220	150–180	120–150	100–120	<100
Energy Savings %	Base	10–20	30–40	40–50	50–60	> 60
Incremental Construction Cost %	Base	1–3	5–8	8–12	12–15	> 15

Source: Chen, Ir and Thiam Leong, "Green Design Forum: Preview of Green Building Index Malaysia," January 2009.
* MS1525 is the Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings.
Note: Estimates are not verfied

(2) Corporate Demand

Corporate demand is a significant driver for green buildings.

Companies with green buildings in the region include ABN Amro, Wipro Technologies, British Gas, and Godrej. More than 120 of the 170 LEED-registered projects in India in 2009 are corporate offices. According to a 2008 McGraw Hill Construction survey, the top green building motivators for corporations in Asia include branding, internal corporate commitment, and global competitiveness. Multinational companies are likely to be an important consumer demand force going forward as they move to make their global office buildings green.

(3) Government Regulation and Incentives

Government-driven regulatory instruments and financial incentives are emerging, to promote energy efficiency in particular.

For example, India is planning to make the Energy Conservation Building Code mandatory in the near future, while Malaysia is contemplating stricter energy standards for buildings. As shown in Table 20, India, Malaysia, and Thailand have a number of control and market-based instruments in place to promote green buildings. Comparatively, Philippines and Vietnam have limited incentives. Demand for green government buildings is also likely to increase. In India, several government buildings have incorporated green design. In the Philippines, new mandates from the Government Energy Program require increased water and energy efficiency for its buildings.

Future international policy responses to mitigate climate change could trigger additional incentives for green building developers.

Promoting building energy and water efficiency is gaining traction globally given its potential to reduce CO_2 emissions and conserve precious water resources. More international funding sources may become available for building retrofitting or new green construction. Currently, the Clean Development Mechanism (CDM) of the Kyoto Protocol offers some incentives, but may not be adequate to help green building projects grow at scale in this region.

TABLE 20. National Regulatory Instruments and Financial Incentives Related to Green Buildings

Country	Instrument Types	
	Control and Regulatory Instruments	Economic and Market-Based Instruments
India	• Energy Conservation Building Code (ECBC) will shortly become mandatory for commercial buildings with a connected load of 500kW or greater, and applicable to all buildings with a large air-conditioned floor area of 1000sqm or greater, and is recommended for all other buildings. • The National Building Code (2005) is voluntary.	• The Government of India is planning an expenditure of INR490m through the Ministry of New and Renewable Energy (MNRE) during 2008-12 for the promotion of energy efficient solar or green buildings in India. • Energy Service Companies (ESCO) market is developing with government support. See WRI 2009 report "Powering Up".
Indonesia	• Currently the national and municipal governments in Jakarta are updating the building code. • The Ministry of the Environment is currently drafting a regulation (Indonesian: Peraturan Menteri Lingkungan Hidup) that would require new buildings to meet and be certified against green criteria.	
Malaysia	• A Code of Practice on Energy Efficiency and Renewable Energy for non-residential buildings (MS 1525)- issued by SIRIM Berhad, a government owned national organization for industrial standards, will provide minimum criteria for new and retrofitted buildings to be designed, constructed, operated and maintained in a manner that reduces energy use. • Contemplating stricter energy use standards to be released in the next year.	• The Malaysian government provides incentives for buildings to use photovoltaic (PV) technology. The government will pay fully for PV projects that cost less than six million Malaysian ringgit. The government will subsidize 50 percent of the cost of projects greater than six million). • In October 2009, the Malaysian government introduced substantial incentives to promote the use of the newly launched Green Building Index certification.
Philippines	• The Senate has been recently discussing the creation of government incentives for green buildings. • The Government Energy Management Program (GEMP) requires all government buildings to reduce by 10 percent or more the consumption cost of fuel, water, office supplies, electricity and other utilities by installing energy-efficient lights and fixtures. • Companies consuming more than two million fuel oil equivalent liters annually are also required to submit annual energy conservation reports detailing conservation efforts and results.	• The Department of Trade provides incentives for the use of new green building technologies.
Thailand	• Office of Natural Resources and Environmental Policy and Planning (ONEP) issued a requirement that all new buildings, including offices, hotels and condominiums, plant one tree with a minimum height of five meters for every two tons of air conditioning emissions. In addition, 50 percent of total open-space footage must be a designated green area. • Thailand will also be introducing an updated building code. The first mandatory Thai energy code was endorsed in 1995 for large, energy intensive buildings. Thus far, it has not been diligently enforced and has been mainly applied to existing buildings. • Thailand's energy conservation law has several components: – Demand side management (DSM) program for labeling and replacing chillers, refrigerators, and lighting in buildings. – Mandatory audits. – Subsidies, awareness raising, and training as well as demonstration projects.	• Revenues raised through a petrol tax (since 1992) are used to support energy efficiency projects.
Vietnam	• National Targeted Program on Energy Efficiency and Conservation for the Period 2006–2015. The Program calls for a concerted effort in improving energy efficiency, reducing energy losses, and instituting measures for improving energy conservation in all sectors of the economy, using economic incentives and regulations. • Ministry of Industry and Trade has instituted measures to decrease building energy consumption. The Ministry of Construction has developed a building energy code that became effective in 2007.	

Source: UNEP SBCI, 2007.[a] Asian Development bank and WRI, based on interviews with local green building councils, 2009.

Notes

a. United Nations Environment Programme Sustainable Buildings and Construction Initiative and Central European University, "Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from Buildings," 2007.

The CDM allows industrialized countries to meet part of their emission reduction commitments under the Kyoto Protocol through Certified Emissions Reduction (CER) credits, which are bought from offsetting projects in developing nations like India. According to the United Nations, since 2006 the mechanism has already registered more than 1,000 projects and is anticipated to produce CER credits amounting to more than 2.7 billion metric tons of CO_2 equivalent in the first commitment period of the Kyoto Protocol, 2008–2012. As of November 2009, six energy-efficient building projects had been registered, validated, or were in the process of validation in India.[77] But there remain significant barriers to receiving CER credits for building projects due to the high fixed transaction and monitoring costs. Additionally, it is not clear how the CDM program will evolve over time.

C. BARRIERS TO GREEN BUILDING GROWTH

Green building practices are emerging in the region, but barriers to growth exist.

A few of the largest regional real estate companies are starting to use green practices. But the market is still small; several tenant-, developer-, and government-related challenges must be addressed before green building practices can grow at scale. These challenges are summarized in Table 21.

TABLE 21. Tenant-, Developer-, and Government-Related Barriers to Green Building Growth

Tenant-Related	Developer-Related	Government-Related
• Lack of understanding or awareness of green buildings • Focus on up-front rather than lifetime costs • Inconsistent market demand for green buildings (i.e., not all tenants place a premium on green buildings) • Negative connotation of recycled materials	• Focus on up-front rather than lifetime costs • Lack of accredited professionals • Lack of both region-specific and general technology • Lack of understanding or awareness of (1) potential risks arising from environmental/resource scarcity issues, and (2) cost savings from green building	• Lack of harmonization between certification standards and local laws • Limited enforcement of building code standards • Insufficient incentives to correct market misalignment and promote green building practices

Source: WRI, based on interviews with green building councils and regional experts.

Misaligned incentives hamper the growth of green practices.

Developers usually incur the up-front costs of green building features, while future tenants and owners benefit from ongoing savings. In the absence of a clear rental rate premium, there is not always a clear incentive for developers to build with green practices. Other market forces, including tenant demand and investor focus on longer-term costs, could help realign incentives in the future.

Regional voluntary standards and government incentives have embraced energy efficiency but have paid less attention to risks related to water scarcity and climate change impacts.

The government initiatives highlighted in Table 20 have focused on integrating energy efficiency into building design, with only limited attention to water efficiency, storm water management, waste reduction, or adaptation to climatic changes. Green building standards do go beyond energy to include water and air pollution concerns, but many mimic U.S. or Australian standards, which are not always compatible with local concerns. For example, given this region's susceptibility to extreme weather events, it is surprising that out of the focus countries, only Vietnam's emerging LOTUS building rating system specifically incorporates climate change adaptation as a priority.

Despite challenges, green building markets in the region are poised for long-term growth.

Green practices are gaining mainstream momentum, especially in India. In those countries with strong government support and strongly established green building standards, like Malaysia and India, short-term growth is likely. The markets in Indonesia, Philippines, and Vietnam will probably grow more slowly given the lack of established standards and awareness. However, as water, energy, and climate change concerns increase, it is likely that green building markets in all countries will grow significantly over the next decade. Table 22 summarizes some of the critical drivers and challenges in each of the countries. Box 4 provides an example of an emerging green building project in the Philippines.

TABLE 22. Green Building Practices: Status of Drivers, Challenges, and Expected Growth of Green Building Practices in Asia

Country	Mainstream Use and Awareness of Green Practices*	Government Support for Green Building Practices	Additional Comments	Estimated Growth in Use of Green Practices Over the Next 3 Years, Based on Drivers and Challenges*
India	Low	Medium	Largest and fastest growing green building market; strong support from local green building councils and government bodies	High
Indonesia	Very low	Low	Early stages and limited use of sustainable practices; green building council only recently established	Low
Malaysia	Medium	Medium	Early stages but strong support from professional industry groups	High
Philippines	Low	Low	Early stages; limited use of sustainable practices	Low
Thailand	Low	Medium	Early stages; independent green building council has yet to be established, but government support for green practices exists	Medium
Vietnam	Very low	Low	Early stages and limited use of sustainable practices; green building council only recently established	Low

Source: WRI.
*Based on WRI's assessment of mainstream use of green practices, current government regulations, and interviews with local green building councils.

Box 4. Next-Generation Green Building in Philippines

Although Filipino green building market development is still in its early stages, larger developers are starting to embrace green building practices. For example, Ayala Land is currently constructing a 1,700-hectare mixed-use eco-community in Laguna, Philippines. NUVALI will be the first sustainably developed large-scale development in the Philippines and is an example of privately funded green building initiatives in the region. The master plan includes the following environmentally-friendly features:

- Gray water recycling through dual pipeline systems allowing treated effluent water from the sewage treatment plant to be used for watering plants and flushing toilets
- Planning for cleaner transportation by building bike lanes and encouraging clean buses and public transportation
- Using green building materials, such as native bamboo-based plywood and efficient heat-insulating glass windows
- Integration of low-flow water fixtures, natural lighting, cross ventilation, native plants, and energy-efficient lighting fixtures in all buildings
- Permeable paving, allowing rainwater to drain into underwater aquifers
- Building a lake as part of a bird sanctuary. The lake doubles as a retention pond during heavy rains
- Innovative community recycling and solid waste management program

Source: Ayala Land Annual Report 2008 and company Web site.

V. HSBC's Analysis of India's Green Building Market

Legal Disclaimer: The case study below is written by an HSBC equity research analyst and is based on his/her knowledge of the climatic and environmental factors that have an impact on the business of companies in this sector. It does not constitute investment research and is not part of the analyst's ongoing research coverage. Readers of this report, whether existing clients of HSBC or not, should in no circumstances rely on this material when making investment decisions or use it as the basis of an investment strategy.

This section, written by contributors from HSBC's Climate Change Centre of Excellence, examines the financial case for, and market potential of, green buildings in India. As Indian green building guidelines go beyond energy/water savings and climate adaptation technologies, this section considers some green building features that are outside the scope of this report.

KEY POINTS

- The incremental cost of constructing a commercial green building (relative to a conventional building) in India is estimated to have a payback period of three to five years.
- Construction premiums for green buildings in India have decreased substantially over the past decade, due to an experience curve effect (improved technical capacity).
- The Indian green building market is poised for growth, but large-scale adoption of green building practices will still require an aggressive awareness campaign in the absence of supportive policy and stronger incentive mechanisms.

A. CONTEXT

India's construction sector is expected to be a key contributor to GDP in coming years.

HSBC estimates that India's GDP will have grown at 7.9 percent [Compound Annual Growth Rate (CAGR)] from 2008 to 2010. Considering the increasing contribution of the real estate sector to GDP (from 5.9 percent in 2002 to 7.3 percent in 2008), the construction sector is expected to be a key contributor to the country's growth.

There exists vast potential for building energy-efficiency improvements in India.

Buildings consume approximately 47 percent of India's electricity. Various estimates, including one from the Bureau of Energy Efficiency (BEE), forecast significant energy savings potential in buildings (approximately 50 percent in commercial buildings) that can be realized with small incremental investments. As such, energy savings projects, such as green buildings, are low-hanging fruit for India.

In 2008, green buildings accounted for only around 8 percent of total Grade-A commercial construction in India. There remains an enormous energy savings potential. Some experts project total built-up green building area will increase three-fold to approximately 100 million square feet by 2014. Over the coming years, we expect an increase in the proportion of green buildings in commercial retail, hospitality, and residential projects, further boosting the growth of the green building industry in India. The incremental green building capacity addition of approximately 70 million square feet will result in savings of approximately 150 MW of generating capacity and around one million tons of CO_2 equivalent in annual emissions savings.

Energy-efficient buildings create a win-win case for both developers and users. Not only can the incremental cost incurred on green buildings be recovered by charging higher lease rentals (inclusive of operating expenses), but also higher demand for these buildings results in faster occupancy, thereby benefiting developers. However in the absence of operating leases where the rent and utility bills are paid by the tenant, there are misaligned incentives. Any additional cost incurred by the developer to make a building greener results in cost savings for the tenant's utility bills, but this does not guarantee a rent premium or cost savings for the owner or developer in all instances.

Presently green buildings are certified through two rating systems in India, LEED and GRIHA:

- **The Leadership in Energy and Environmental Design (LEED)** rating system was developed by the United States Green Building Council (USGBC), and was adapted for the Indian market by the Indian Green Building Council (IGBC) in 2001. Under this system, buildings are given ratings of Platinum, Gold, or Silver, based on their green building attributes (environmental performance and energy efficiency during the design, construction, and operation stages). IGBC has separate rating systems for residential and commercial buildings. The majority of points—40 points out of the available 75 points—in the LEED Rating System focus on energy savings.
- **Green Rating for Integrated Habitat Assessment (GRIHA)** was developed by The Energy and Resources Institute (TERI) to rate commercial, institutional, and residential buildings (non-air conditioned or partially air conditioned buildings) in India. The criteria for the rating are both qualitative as well as quantitative.

B. SCENARIO ANALYSIS

Cost Economics of Green Buildings

Per the IGBC, green buildings typically achieve 30 to 50 percent less energy consumption and 20 to 30 percent less water consumption vis-à-vis conventional buildings. In India, since 2003, the average construction cost premium (relative to a conventional building) for a green building has ranged from 2 to 18 percent but has rapidly decreased since 2003 as shown in Table 15 of Section IV. Typically, the higher the rating, the greater the construction cost premium. Older buildings generally have longer payback periods due to technological challenges; costs are typically lowest if efficiency measures are implemented in the design stage. The ITC Green Centre at Gurgaon had a cost premium of 15 percent over similar conventional buildings (2004). However, the Wipro office at Gurgaon, a Platinum-rated building of the same size as the ITC Green Centre, was built at a premium of just 8 percent. We believe that this improvement reflects a movement up the experience curve of designing and building green buildings.

Payback Period

We broadly analyzed the incremental cost of constructing a green building vis-à-vis savings in operating costs—primarily expenses incurred on electricity and water. We have considered three scenarios (A,B,C) for this analysis with varying construction premiums and incremental rental revenues. Table 23 summarizes the key assumptions on parameters, including building cost, annual rental, annual electricity, and water consumption.

TABLE 23. Building Parameter Assumptions for Scenario Analysis

Parameter	Assumption Value
Cost of construction	1,700 (INR/sqft.)
Rental rate/lease rate	65 (INR/sqft./ month)
Working days in a year	300 (days)
Number of building occupants	3,000 (persons)
Life of building	20 (years)
Discount rate	12%
Building construction time	2 (years)
Annual average electricity consumption	160 (kWh/m^2)
Average water consumption	45 (litres/day/person)
Cost per unit of electricity	5.5 (INR/unit)
Increase in cost of electricity per annum	3%
Cost per m^3 of water consumed	150 (INR/m^3)
Increase in cost of water per annum	3%
Area of the commercial building	300,000 (sqft.)
Annual rent (300,000 sq ft. x 65 x 12)	INR 234,000,000
Water cost per annum (200 days x 45 per person x 3000 persons x INR0.15 per litre)	INR 6,075,000
Electricity cost per annum (160/9.3 kWh./sq ft. x 300,000 x INR 5.5 per kWh.)	INR 28,387,000
Water as % of total expenses	2.26%
Water as % of rent	2.60%
Electricity as % of total expenses	10.57%
Electricity as % of rent	12.13%

Source: HSBC.

Table 24 provides construction cost and incremental rental revenue assumptions for the three scenarios considered.

TABLE 24. Incremental Green Building Construction Cost, Rental Revenue, and Water and Electricity Usage Assumptions for Scenario Analysis

	Scenario A	Scenario B	Scenario C
Construction cost premium	18.0%	9.0%	2.0%
Incremental rental revenue*	1.5%	0.7%	0.0%
Water usage reduced to	60.0%	75.0%	85.0%
Electricity usage reduced to	50.0%	65.0%	85.0%

Source: HSBC.
Note: *Due to higher occupancy rate.

The results of our analysis are captured in Table 25. As shown, the base-case scenario, which includes a moderate construction premium, results in a discounted payback period of around three years after commissioning.

Impact of Water Prices

Water scarcity is a growing concern in several Indian cities. Because municipal water is highly subsidized across India, water costs constitute a small fraction of total costs (approximately 2 percent) for the tenant; even if water costs increased substantially, water costs would still be a relatively small contribution to total utility costs.

Impact of Energy Prices

Energy costs constitute about 10 percent of total operating costs. A sharp rise in electric power costs is material to the tenancy costs. For example, a 10 percent increase in power costs increases total operating costs by 1 percent in a normal building. In a green building, the pass-through effect is only 0.50 to 0.85 percent of expenses (see Table 24 for scenario assumptions) due to the energy savings. This would translate into a relative savings for the developer (if the developer holds the operating leases), or to the tenant (if the tenant is paying all the utility bills). Green buildings dampen the effect of future electric power price rises, and this would make it attractive to owners/tenants who wish to control the volatility of their total operating costs in the future. Therefore, a key determinant of demand is the perceived volatility and trend of future energy prices.

TABLE 25. Scenario Analysis For Hypothetical Indian Commercial Green Building

	Scenario A	Scenario B	Scenario C
Payback period (years)	5.0	3.5	2.0
Discounted payback period (years)	8.0	5.0	2.5

Source: HSBC.

Key Considerations

Building and certifying a green building requires technical capacity, team coordination, and proper documentation from planning to measurement and verification after commissioning of the building. The following key considerations have an impact on construction premiums and payback periods in India:

- **Permits and Certification:** Building projects with a builtup area of less than 20,000 square meters are excluded from obtaining environmental clearance in India. Buildings larger than this threshold require environmental clearance from the Ministry of Environment and Forests. Although there seems to be no special preference given to green buildings in terms of approval and permit processing, generally clearance is relatively quicker, given the level of planning and documentation prepared for green building.

- **Labor/Manpower:** Architects, planners, and engineers with green building technical expertise are primarily based in tier I cities; not much expertise is available in lower-tier cities. According to IGBC reports, there were only 62 LEED Accredited Professionals in India as of 2009. The number of professionals trained on the LEED rating system increased from 10 in 2001 to around 5,000 in 2008. The IGBC membership grew from 0 to 280 during the same period. Industry experts believe that the gap in knowledge regarding green buildings among various players will even out in five years. It is very likely that during this period, experts can charge a slightly higher cost of labor in terms of consultancy costs.

- **Raw Materials:** Green building standards in India require the use of certain sustainable building materials, equipment, and systems. These materials, equipment, and systems are sometimes not widely available. As a result, the first green buildings in India used a large proportion of imported material, which resulted in higher construction costs vis-à-vis conventional buildings. The cost involved in the CII-Godrej Green Business Centre and ITC Green Centre exceeded similar conventional buildings by around 18 percent and 15 percent, respectively.

  This has changed more recently, but according to IGBC estimates, in 2008, there was still a growing need for green building materials and equipment in India. Locally available products that are commonly used in green buildings include fly-ash cement and blocks; recycled steel, aluminium, and tiles; bamboo-based products; green roofs; and recycled wood.

  Typical building materials that are not available in India and are imported include waterless urinals, certified carpets, certified wood, certified cooling towers, HFC-based high-efficiency chillers, and building controls. Imports can add significant costs (and add to transportation-related emissions); for example, transportation and import duties are currently at approximately 15 percent on certain building materials. Carpets, which are conducive to moderate, but not hot and humid climatic zones, are generally imported from Malaysia, China, and Singapore. So while these carpets are labeled green, importing them due to local unavailability adds to emissions. LEED India allows credits only for FSC-certified wood, and currently there is no certification of wood in India. Given the low demand for high-performance chillers, their manufacture in India is not commercially viable. As a result, these are imported, thereby adding to the cost of green buildings.

- **Water:** The various municipal corporations in India have their own tariff structure, ranging from INR20.55 per cubic meter in Mumbai to INR1.13 per cubic meter in Kolkata. Generally, revenues from the tariffs do not cover the operational and maintenance costs on account of problems related to tariffs and metering of supply, followed by large receivables and the inability of municipal corporations to collect these payments or disconnect water supplies to defaulters. So, while cost of water is not a major factor for buildings, water scarcity is a concern that needs to be taken into account both from builder and the consumer's perspective. Due to high use over the past few decades, water table levels have fallen and continue to deteriorate. In the states of Gujarat, Haryana, Rajasthan, and Tamil Nadu, the water table has been falling by around two to three meters per year on average since 2000.

- **Land:** The Indian rating systems assign points to buildings if basic amenities, such as grocery stores, schools, banks, restaurants, and hospitals, are located within a kilometer of the site location. However, we believe this is not a key parameter for developers with regard to choice of land for a green building.

Also, although rating systems provide for points based on the percentage of landscaped area within the site, this also does not seem to be a major consideration for developers. The ITC Green Centre at Gurgaon, a Platinum-rated building, is constructed on a two-acre land area with around 75 percent building coverage. However, another Platinum-rated building, CII-Godrej Green Business Centre, is built on 5½ acres but has only 17 percent building coverage. Rather, because buildings that are larger than 20,000 square feet or discharge sewage greater than 15,000 liters per day would require in-house water treatment plants, construction of sewage treatment plants would increase the land requirements of a project, irrespective of whether the building is green or conventional.

Central and state governments in India do not currently seem to have any priority mechanism for the allocation of land for green buildings in any prime location or any special zones.

- **Rent Premium/Occupancy Rates:** There are mixed views on whether a rental rate premium or higher occupancy rate is achievable for a green building (relative to a conventional building) because the small sample size has not allowed for robust studies to date. We reflect this uncertainty in the assumptions used in the scenarios used in Table 24. We have used conservative assumptions that green buildings with low savings (scenario C) will not be able to get a premium, while buildings that show substantial savings (around 50 percent of energy costs, Scenario A) will be able to get a rent premium of 1.5 percent.
- **Energy:** Currently, the government provides huge subsidies for electricity in India. According to the 2001 IEA report, on an average, up to 38 percent of electricity costs are subsidized, with the agricultural sector enjoying a 93 percent subsidy and households 58 percent. If the government plans to reduce subsidies on electricity, the burden of generation cost would be passed on to consumers. Energy-efficient buildings could contribute to additional savings relative to traditional buildings in this situation.

C. FUTURE GROWTH

From a mere 20,000 square feet in 2003, the area under green buildings has grown to about 30 million square feet in 2009. According to the IGBC, there are currently 71 LEED-certified and 501 LEED-registered green buildings in India, implying a total area of 328 million square feet (including proposed green commercial, residential, and industrial structures). Further, TERI mentions that about 28 new green buildings are under construction and are being evaluated by GRIHA. One has already been rated.

Some estimates point to total built-up green building area increasing three-fold to approximately 100 million square feet by 2014. This would require 35 percent of the pan India estimated demand of office space of 196 square feet from 2009 to 2013 to be green building construction. With the use of Scenario C style of building, this is possible, in our opinion.

In the absence of any mandatory regulation and/or incentive mechanisms, the increasing demand for green buildings is primarily attributable to tenants' corporate branding. The government of India, which seeks to make the Energy Conservation Building Code (ECBC) 2007 mandatory, has proposed incentive schemes for architects and state governments to promote green buildings. However, we consider these insufficient and believe that an aggressive awareness campaign on energy-efficient buildings is required, especially in lower-tier cities across the country.

Consumer Trends

More than 120 of the 170 LEED-registered projects in India in 2009 are corporate offices. Brand value is an important corporate motivator in India. Currently there are only three pre-certified residential green projects in India. Despite growing consumer demand, we believe much more action is required for the green building concept to penetrate the Indian consumer psyche.

National Energy Regulations

At present, there is a lack of regulatory support for the green building industry. The Energy Conservation Building Code (ECBC), formulated by the Bureau of Energy Efficiency, will be mandatory for all new commercial buildings that have a connected load of 500kW or greater and applicable to all buildings with a large air conditioned floor area of 1,000 square meters or greater. The ECBC is recommended for all other buildings. It covers minimum requirements for building envelope performance as well as for mechanical systems and equipment. However, at present it is still voluntary. The National Building Code (2005) is also voluntary as of now. Although the government has plans to make the ECBC mandatory, the timing is uncertain.

Other Government Support

The government of India, through the Ministry of New and Renewable Energy (MNRE), has planned to spend INR490 million to promote energy-efficient solar or green buildings in India during 2008–12. By 2012, it is targeting 3.5 million square meters of area under green buildings. The state governments of Himachal Pradesh, Punjab, Haryana, and Nagaland have already made it mandatory to construct all new buildings in the government and public sectors with solar features.

To encourage Indian architects and consultants to design buildings on green architectural concepts and get them rated under GRIHA, the government provides the following incentives through MNRE:

- For projects up to 5,000 square meters and a minimum three-star rating by GRIHA, MNRE gives INR 250,000 to architects. An incentive of INR 500,000 is given for projects having a buildup area of greater than 5,000 square meters and a four-star or higher rating.
- The government has also planned for a one-time financial incentive of INR 5 million for municipal corporations that announce a property tax rebate for buildings rated under GRIHA and make it compulsory that new public sector buildings be rated by GRIHA.
- One of the criteria under GRIHA is to meet 1 percent of the total connected load for interior lighting and space conditioning through solar photovoltaic cells. Under the MNRE scheme, photovoltaic systems will be supported through a capital subsidy in urban areas.
- The municipal corporations of Thane, Nagpur, Amravati, and Durgapur are already providing property tax rebates of 6 to 10 percent to individual buildings that have installed solar water heating systems. For solar buildings, various state governments (Rajasthan, Karnataka, West Bengal, Haryana, and Uttranchal) provide a fixed rebate of about 15-50 paise (100 paise=1 INR) per unit in electricity tariffs (or depending on the area of solar panels installed).

- The State Bank of India, the largest commercial bank in India, is offering lower up-front margins, lower interest rates and zero processing fees on loans for homes rated by IGBC. The bank charges an up-front margin of only 15 percent, instead of the normal 20 percent, and an interest rate lower than the card rate by 0.25 percent.

VI. Recommendations

Commercial real estate markets in the focus countries do not currently consider the full extent of emerging energy, water, and climate change risks. Most developers do not mention these risks in their annual reports even though these risks could contribute significantly to utility costs, maintenance costs, and insurance premiums for buildings they own. To conclude this report, we provide recommendations to help ensure that green practices scale up and that the financial risks associated with energy insecurity, water scarcity, and climate change are minimized in this region.

- **Investors and analysts should engage with building sellers and real estate developers** to assess a project's exposure, vulnerability, and capacity to mitigate energy insecurity, water scarcity and climate change risks. When analyzing or investing in real estate companies, as a proxy, analysts and investors should favor companies that have developed and are expanding green practices—a sign that a company is aware of, and managing, the risks highlighted in this report and is well-positioned to reap the growing benefits of green properties.
- **Real estate developers** should expand their green building capacity and start reporting energy, water, and climate risks. One of the main barriers to scaling up green practices is the lack of local technical capacity in the region. Achieving green building certification can be costly if developers need to employ foreign contractors. Building in-house capacity will help real estate developers prepare for emerging risks and achieve the financial benefits of green buildings while minimizing costs.
- **Governments** should establish and enforce stricter building codes that contemplate energy insecurity, water scarcity, and climate change impacts, particularly in cities with high exposure. Development of strong green building codes and standards will ensure that market incentives are environmentally aligned regardless of prevailing market conditions. This will help to expand the green building market, giving developers compliance and demand certainty, as well as a more level playing field. Governments should also mandate green investments in their own buildings to set an example and help demonstrate the financial benefits of green buildings.
- **Green building councils** should expand building guidelines to include materials/design features that are resistant to floods and storms. Additionally, site selection guidelines should consider how extreme weather events and sea level rise may affect the construction site and future occupants. Incorporating climate adaptation elements into buildings may be expensive, but it is necessary for human health and building longevity.
- **Governments, real estate developers, green building councils, universities, engineers and architects** should work together to improve green building awareness, technical capacity, public data on resource and environmental risks, and investment in R&D for region-specific green building technologies. The building sector provides a unique opportunity for companies and governments to reduce risk and gain financial benefits while reducing resource use and carbon dioxide emissions.

Appendix 1. Regional Green Building Case Studies

The sampling of case studies that follows was extracted from the Asia Business Council's document on "Why Green Buildings are Key to Asia's Future." The document can be found at http://www.asiabusinesscouncil.org/docs/BEE/BEEBookPartII.pdf.

HYDERABAD, INDIA

CII-Godrej Green Business Center Building[78]

The CII-Godrej Green Business Center (CII-Godrej GBC) Building is the office of CII-Godrej GBC, a joint initiative of the government of Andhra Pradesh, the Confederation of Indian Industry (CII), and Godrej, with the technical support of USAID. It is a unique model of a successful public-private partnership that is dedicated to promote efficiency and equitable growth leading to sustainable development.

The building is the first green building in India. It is the first LEED platinum-rated building outside the United States, and was the most energy-efficient building in the world at the time it was rated. It was built to promote the green building concept and demonstrate that India can build to global environmental standards. The building incorporated such features as water efficiency, energy efficiency, and construction waste recycling. According to CII-Godrej GBC, the building is capable of reducing its total energy consumption by 55 percent and its lighting energy consumption by 88 percent.

The building is centered around a circular courtyard, with a series of smaller interior courtyards. Energy-efficiency features of this building include:

- North light for indoor day lighting: Almost 90 percent of the interior is lit by day, with north lighting and windows facing onto the courtyards. (The site uses north light to minimize heat gain in its tropical location.)
- Wind towers integrated with HVAC: The wind tower is a traditional passive cooling technique of the subcontinent. Here, the wind tower has been combined with the HVAC system to reduce energy consumption. The fresh air that goes in the air handling unit is precooled in the wind tower, reducing the intake air temperature by three to five degrees Celsius. The wind tower itself is made of hollow masonry and acts as a thermal mass. It is cooled periodically by trickling water from the top of the tower.
- Solar energy photovoltaic panels: Photovoltaic panels installed on part of the roof provide about 20 percent of total energy consumption, with the roof orientation and inclination designed to maximize the solar panels' efficiency.
- Roof garden insulation: A roof garden prevents formation of heat islands on the roof and acts as insulation while providing an aesthetic benefit at the same time.

The features incorporated in the building drew high praise from the president of India as noteworthy steps toward energy efficiency, renewable energy, and water management. The platinum rating for this building has garnered attention, particularly in the construction industry, and generated considerable public awareness about green buildings in India.

PUTRAJAYA, MALAYSIA

LEO Building[79]

The LEO building is the first government building in Malaysia to be built with an integrated energy-efficient design. The building was finished and occupied in 2004. It is a six-story office building with a total gross floor area of 38,600 square meters.

Located in the recently built government complex of Putrajaya, the LEO building was designed as a showcase building to demonstrate energy-efficient and cost-effective features in Malaysia. The building exceeded its targeted energy savings of more than 50 percent compared to buildings without energy-efficient design. An energy analysis based on consumption monitoring results revealed that actual energy savings reached 58 percent. The LEO building was awarded the ASEAN Energy Award in 2006.

- The building uses a wide variety of design elements and innovative technology. The approach to the building's use is integrated. For example, a comprehensive procurement system requires the purchase of energy-efficient appliances.
- Building Orientation and Envelope:
  - The windows are primarily orientated to the north and the south, with less direct sunshine. In addition to their optimum orientation, the windows are protected by appropriate shading mechanisms to allow for maximum light to penetrate while minimizing the heat transfer. Toward the east, shading is deeper to protect against the low morning sun. The western façade has virtually no windows. The window glazing allows 65 percent of the available daylight in while keeping 49 percent of the heat out.
  - The thick, light-colored walls of the LEO building reduce solar heating of the walls and insulate 2.5 times better than a traditional brick wall.
  - The roof of the building is insulated with 100 mm of insulation, compared with the typical 25 mm of insulation. A second canopy roof also protects the roof surface, preventing direct solar radiation. Along the perimeter of the roof, green landscaping provides shade and improves the aesthetics of the roof areas.
- Natural Air Ventilation:
  - In the LEO building, the four-story atrium provides daylight deep into the heart of the building. At the top of the atrium is a solar wall, or "thermal flue," that naturally cools the air by a few degrees.
- Interior Space Layout Design:
  - Permanent working areas are concentrated along the perimeter where there is maximum daylight. Secondary functions, such as storerooms and smaller meeting rooms, are relegated to the interior, where there is only artificial lighting.
- Air Conditioning:
  - Air conditioning in the LEO building has been made efficient in three ways. First, the air conditioning is not controlled from one central point. Instead, it can be switched off in individual rooms. Second, the air conditioning is set to keep occupied areas in the building at 25 degrees Celsius. Computer modeling shows that if the room temperature is 20 degrees Celsius, rather than 24 degrees Celsius, total electricity consumption of the building increases by one-third due to the higher cooling load. Third,

Putrajaya as a whole receives chilled water from a district cooling plant, which operates on natural gas and which pumps cold water through underground pipes to all the buildings in the area, reducing the need for individual electric air conditioning chillers in the different ministerial and commercial buildings.

- Innovative Lighting System:
  - The building uses high-efficiency light fixtures that automatically switch off when there is sufficient daylight. Additionally, a motion detector automatically switches off the lights and air conditioning in a room once no physical motion is detected.
- Mechanical Ventilation:
  - In the LEO building, air intake rises with higher CO_2 levels, which in turn are affected by occupancy. The more people there are in the building, the higher the CO_2 as a result of breathing, and therefore the greater the intake of fresh air. A high-quality filtration system improves indoor air quality.

MANILA, PHILLIPINES

Makati Stock Exchange Building[80]

The Makati Stock Exchange Building is an eight-story office building with a total leasable area of around 30,000 square meters. Owned by the Ayala Corporation, the building was built in 1971 and formerly served as the headquarters of both Ayala Corporation and Ayala Land, as well as the Makati Stock Exchange.

Because the building was 25 years old when the retrofit began, upgrading its energy efficiency was a challenge. In addition, the 24-hour-a-day, seven-days-a-week operations of the building's largest tenant, Accenture, meant that any retrofitting work would have to be done in a low-impact manner. From 1996 to 2005, the building went through continuous energy-efficient improvements, including equipment upgrades, introducing new technologies, and implementing energy-saving projects. Savings generated by these improvements total around US$127,000 (or 941,000 kWh) per year. The building retrofit included the following measures.

- Air Conditioning:
  - Replacement of the chiller units with more efficient ones.
  - Installation of a condenser cleaning system. The system keeps chiller condenser tubes clean and thus increases efficiency.
  - Replacement of cooling coils of all the air handling units. This restored the cooling efficiency of the air handling units to their designed efficiency.
  - Installation of high-efficiency air handling unit motors. To improve the efficiency of the air handling units, all motors were replaced with high-efficiency units.
  - Installation of variable frequency drives in all condenser and chilled water pumps to improve efficiency.
- Elevators:
  - All elevator units of the building were replaced with more efficient units.

- Lighting:
  - Installation of energy-saving equipment for the lighting system. Voltage controllers for fluorescent lighting units were installed to help cut the electrical consumption of the common area lighting by reducing the input voltage once the lamps are turned on.
  - De-lamping of parking level lighting. All parking levels with 2x40-watt fluorescent lamp fixtures were replaced with 1x40-watt fluorescent lamps and mirrored reflectors. Individual switches were also provided so lights can easily be turned off at night.
  - Re-lamping of basement parking. The existing rapid-start ballasts were replaced with electronic ballasts.
  - De-lamping of hallway lighting. The existing 4x40-watt lighting was reduced to 2x40-watt lighting.
  - Re-lamping of fire exit stairs. The existing 50 watt incandescent bulbs used to light the fire exit stairs were converted to fixtures using 11 watt compact fluorescent lamps.
  - Calibration of kWh meter. All electric meters in both the tenant spaces and common area were calibrated.

Recently the building management system was also upgraded to effectively control and monitor the centralized air conditioning system and ventilation equipment of the building. The building administration and staff have established an energy conservation management team to manage the schedule of all operating equipment within the building. In 2006, the building received the ASEAN Energy-Efficiency Award (Retrofit Category) (2nd Runner-Up).

Appendix 2. Company Data Utilized for GIS Maps

Current and planned projects of the region's 11 largest (by market capitalization) real estate developers

COMPANY	COUNTRY	PROJECT	CITY	LATITUDE	LONGITUDE	TYPE
Delhi Land and Finance	India	DLF Cyber Terrace	Cyber City, Gurgaon	28.453902	77.054329	Commercial
Delhi Land and Finance	India	DLF Building 9	Cyber City, Gurgaon	28.499622	77.093811	Commercial
Delhi Land and Finance	India	DLF Technology Park	Cyber City, Gurgaon	28.451185	76.989441	Commercial
Delhi Land and Finance	India	DLF New Indore	Indore, Madyapradesh	22.728374	75.870552	Residential
Delhi Land and Finance	India	DLF Rajarhat	Kolkata	22.601492	88.466549	Residential
Delhi Land and Finance	India	DLF Riverside Kochi	Kochi, Kerala	9.9396	76.260567	Residential
Unitech	India	The Chambers at Vile Parle	Vile Parle, Mumbai	19.092091	72.858496	Commercial
Unitech	India	Garden Galleria	Lucknow	26.774426	80.940742	Commercial
Unitech	India	Uni Homes - Noida	Noida, Delhi	28.575402	77.334909	Residential
Unitech	India	Uni Homes - Greater Noida	Greater Noida, Delhi	28.477443	77.532234	Residential
Unitech	India	Uni Homes - Mohali	Mohali, Punjab	30.682359	76.765938	Residential
Unitech	India	Uni Homes - Bhopal	Bhopal, Madhya Pradesh	23.206956	77.428207	Residential
Unitech	India	Uni Homes - Kolkata	Kolkata	22.561074	88.291111	Residential
Unitech	India	Uni Homes - Chennai	Chennai	13.058326	80.256178	Residential
Unitech	India	Unitech Grande (AQUA & TERRA)	New Delhi	28.601591	77.299762	Residential
Ayala Land	Philippines	Ayala Land TechnoHUB	Quezon City	14.70378	121.053629	Commercial
Ayala Land	Philippines	Bonifacio Super City	Bonifacio	14.553761	121.044531	Commercial
Ayala Land	Philippines	Makati City CBD	Makati City	14.55226	121.02582	Commercial
Ayala Land	Philippines	One Serendra East	Makati City	14.55334	121.055088	Residential
Ayala Land	Philippines	MarQuee Shopping Mall	Angeles City, Pampanga	15.145044	120.574951	Commercial
Ayala Land	Philippines	NUVALI Technopod 1	Laguna	14.28235	121.095428	Commercial
Ayala Land	Philippines	Solaris One (Dela Rosa Building)	Makati City	14.556445	121.019066	Commercial
Ayala Land	Philippines	Glorietta 5	Makati City	14.551186	121.027601	Commercial
Ayala Land	Philippines	San Lazaro Vertex	Manila	14.618717	120.980501	Commercial
Ayala Land	Philippines	BGC E-Services	Taguig City	14.522439	121.062641	Commercial
Ayala Land	Philippines	Ayala Westgrove Heights	Silang, Cavite	14.221789	121.008911	Residential
Ayala Land	Philippines	Anvaya Cove	Morong, Bataan	14.671283	120.417366	Residential
Ayala Land	Philippines	Avida Towers Sucat	Parañaque City	14.470918	121.021872	Residential
Ayala Land	Philippines	St. Alexandra Estates	Antipolo	14.67859	121.240997	Residential
Ayala Land	Philippines	San Antonio Heights	Batangas	13.717373	121.102295	Residential
Ayala Land	Philippines	San Francisco Village	Naga	13.649657	123.269348	Residential
Housing Dev. & Infra. Ltd.	India	Majestic Tower	Mumbai	19.166978	72.933061	Commercial
Housing Dev. & Infra. Ltd.	India	HDIL Industrial Park	Virar, Mumbai	19.454736	72.813435	Commercial
Housing Dev. & Infra. Ltd.	India	Galaxy Apartments	Kurla East, Mumbai	19.064389	72.85841	Residential

Current and planned projects of the region's 11 largest (by market capitalization) real estate developers *(cont.)*

COMPANY	COUNTRY	PROJECT	CITY	LATITUDE	LONGITUDE	TYPE
Housing Dev. & Infra. Ltd.	India	Premier Residences	Kurla West, Mumbai	19.077287	72.885103	Residential
Housing Dev. & Infra. Ltd.	India	Metropolis - Andheri (W)	Andheri, Mumbai	19.112813	72.870426	Residential
Housing Dev. & Infra. Ltd.	India	HDIL Heights - Ghatkopar (E)	Ghatkopar, Mumbai	19.097322	72.913857	Residential
Housing Dev. & Infra. Ltd.	India	HDIL Astra - New Bombay	New Bombay	19.108839	73.065262	Commercial
Housing Dev. & Infra. Ltd.	India	Mulund	Mulund, Mumbai	19.165032	72.961836	Commercial
India Bulls	India	Centrum Park	Gurgaon, Delhi	28.502111	77.098446	Residential
India Bulls	India	Central Park - Ahmdavad	Amdevad, Gujarat	23.043484	72.553968	Residential
India Bulls	India	High Street Vadodara	Vadodara, Gujarat	22.291241	73.16843	Residential
India Bulls	India	India Bulls Greens	Kandachavadi, Chennai	12.965751	80.245042	Residential
India Bulls	India	India Bulls Greens	Jalladianpettai, Chennai	12.997616	80.254612	Residential
India Bulls	India	Central Park - Hyderabad	Himayathnagar, Hyderabad	17.405725	78.485255	Residential
India Bulls	India	Mumbai - India Bulls Green	Vashi, Navi Mumbai	19.083371	73.005867	Residential
India Bulls	India	Central Mumbai - India Bulls Sky	Central Mumbai	19.003942	72.81558	Residential
UEM Land Holdings	Malaysia	Johor State New Administrative Centre	Johor	1.466	103.773594	Government
UEM Land Holdings	Malaysia	Horizon Hills, East Ledang, Nusa Idaman, Ledang Heights	Nusajaya, Johor	1.501554	103.644022	Residential
UEM Land Holdings	Malaysia	Southern Industrian and Commercial Cluster		1.481959	103.760204	Commercial
UEM Land Holdings	Malaysia	Blocks 20-24, CyberJaya	Cyberjaya, Putrajaya	2.940984	101.672974	Residential
Lippo Karawaci	Indonesia	City of Tomorrow	Surabaya, Kemang Village	-6.261295	106.809769	Mixed use
Lippo Karawaci	Indonesia	St. Moritz	West Jakarata	-6.214623	106.800499	Residential
SP Setia	Vietnam	JV with Vietnamese Company	Binh Duong Province	11.275387	106.707458	Mixed Use
SP Setia	Malaysia	Penang Island Development	Penang Island	5.371296	100.26947	Residential
SP Setia	Malaysia	Setia City Mall	Setia Alam, Shah Alam	3.149322	101.445436	Commercial
SP Setia	Malaysia	JV w with Kuala Lumpur City Hall.	Kuala Lumpur	3.116948	101.676149	Mixed Use
Preuksa Real Estate	Thailand	Preuksa Ville	Bangkok	13.724752	100.476537	Residential
Vincom	Vietnam		Ho Chi Minh City	10.759386	106.662591	Commercial
Vincom	Vietnam		Da Nang	16.05167	108.214967	Commercial
Vincom	Vietnam		Hue	16.463085	107.585099	Commercial
Bumi Serpong	Indonesia	BSD City	Southwest of Jakarta	-6.313934	106.679649	Residential
Bumi Serpong	Indonesia	Sunburst Office Park	Southwest of Jakarta	-6.313934	106.679649	Commercial
Bumi Serpong	Indonesia	General Development	Cisauk District	-6.320673	106.641626	Commercial
Bumi Serpong	Indonesia		Pagedangan	-6.302331	106.639481	Commercial
Bumi Serpong	Indonesia		Tangerang	-6.16095	106.65272	Commercial

Appendix 3. Methodology for City Risk Exposure Assessment

The methodology used to assess relative risk exposure in Table 2 (Key Findings) and Table 12 (Section III) is outlined below.

ENERGY INSECURITY

We examined *energy import dependency* as one indicator of energy insecurity. Import dependency does not provide a complete picture of all factors that determine energy insecurity as defined in this report; it is provided as a reference point rather than a proxy for energy insecurity risk exposure. True energy price and disruption risks will depend on several factors not reflected in our methodology and in this report.

- *Energy import dependency* was based on the national-level values provided in the Asian Development Bank's (ADB) October 2009 report, "Energy Statistics in Asia and the Pacific (1990-2006)." As shown in Table 26, we categorized energy import dependency percentage values from -50 to -100 as low risk; - 50-0 as medium risk; and 0 to 50 as high risk. Because data were not available on a city level, we used national-level statistics.

TABLE 26. WRI Categorization of ADB Import Dependency Ratios (2006)

Country	ADB Import Dependency Percentage (2006)	WRI Categorization
India	23%	High
Indonesia	-56%	Low
Malaysia	-48%	Medium
Philippines	44%	High
Thailand	50%	High
Vietnam	-45%	Medium

Source: WRI and Asian Development Bank, 2009.

WATER SCARCITY

Water scarcity exposure levels were based on the Asian Development Bank's (ADB) 2007 Index of Drinking Water Adequacy. For use in this report, we used only those rankings and indicators that related to availability and quality. Please refer to the full publication for additional details on methodology at http://www.adb.org/Documents/Books/AWDO/2007/appendix-IDWA.pdf

Water quality was based on the national values provided in the Index of Drinking Water Adequacy (IDWA). As shown in Table 27, we categorized water quality values from 91–100 as low risk; 81-90 as medium risk; 80 and below as high risk. Because data were not available on city-level water quality, we used country-level quality as a proxy.

Water availability was based on city and metro level per capita internal renewable freshwater resources from 2002 data from CIGAR/WRI/University of Kessel. Cities that were facing

TABLE 27. WRI Categorization of Water Quality Risk by Country (2007)

Country	ADB Quality Value (2007)	WRI Categorization
India	57	High
Indonesia	84	Medium
Malaysia	99	Low
Philippines	84	Medium
Thailand	93	Low
Vietnam	87	Medium

Source: WRI and Asian Development Bank Drinking Water Adequacy Index.

water stress or shortage were categorized as high risk; those facing moderate water availability were categorized as medium risk; those with water abundance were categorized as low risk.

CLIMATE CHANGE

Climate change exposure levels in Southeast Asia were based on physical exposure and vulnerability (including physical exposure, socioeconomic sensitivity, and inverse adaptive capacity) to tropical storms, sea level rise, flooding, and drought using WWF's analysis and methodology contained in the report "Mega-Stress for Mega Cities: A Climate Vulnerability Ranking of Major Coastal Cities in Asia." The WWF report and our exposure rankings relied on analysis by Ariel Yusuf and Herminia Francisco in the January 2009 publication "Climate Change Vulnerability Mapping for South East Asia." Cities with a score of 3-5 on WWF's scoring system were categorized as medium risk. Cities with a score of 6-8 were categorized as high risk. We did not categorize any cities as being low risk.

Because the scoring of physical exposure and vulnerability was only available for Southeast Asia, we made a qualitative determination of the physical exposure and vulnerability of Indian cities by applying WWF's methodology and using the scoring from WWF's report as a basis. Relative exposure was qualitatively determined using India flood/drought/storm data from WRI's GIS labs, as well as elevation and physical geography of major Indian cities (to determine exposure to sea level rise). To determine the relative vulnerability of Indian cities, we considered socioeconomic sensitivity (including population and assets under risk) and inverse adaptive capacity.

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Conference

- United Nations Environment Programme Sustainable Buildings and Climate Initiative (UNEP SBCI), Buildings and Climate Change, April 15-16, 2009, Washington D.C., USA.

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- India Green Rating for Integrated Habitat Assessment (GRIHA): http://www.grihaindia.org/
- Indonesia Green Building Council: http://www.gbcindonesia.org/agenda.php?id=16
- Malaysia Green Building Index: http://www.greenbuildingindex.org/
- Philippines Green Building Council: http://philgbc.org/
- Vietnam: http://www.vsccan.org/vgbc/

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