



# Blue Books

Experts' views for expert investors

## Global Environment

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**Aaron Fischer, CFA**  
Head of Asian Property Research  
aaron.fischer@clsau.com  
(852) 26008256

Guest author

**Dr Christine Loh**  
CEO, Civic Exchange

**Andrew Lawson**  
Researcher, Civic Exchange

**Jonas Chau**  
Researcher, Civic Exchange



## Urban transformers

High-performance buildings clean up



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### Christine Loh

Dr Christine Loh, OBE, is the CEO of Civic Exchange, an independent non-profit, public-policy thinktank established in Hong Kong. A lawyer by training, Loh was a commodities trader and legislator before founding Civic Exchange in 2000. She has a long track record working on air-quality issues, both in Hong Kong and mainland China, and is an international advisory member to the G8+5 Climate Change Dialogue, as well as senior policy advisor to the C40 Cities Climate Leadership Group. Loh is a non-executive director of Hong Kong Exchanges and Clearing Limited. Her rare combination of skills and experience makes her a leading voice on many aspects of politics and public policy. She is a sought-after presenter locally and internationally, and has authored many academic as well as popular publications.



### Andrew Lawson

Andrew Lawson has qualifications in law and science and has worked for on-the-ground sustainability projects in Australia, as well as national R&D programmes with Land & Water Australia (an Australian government agency responsible for managing R&D on natural resources issues of national importance); and sustainable-building and climate-related research for Civic Exchange in Hong Kong.



### Jonas Chau

Jonas Chau is a UK-registered architect and cultural manager, and has work experience in the UK, China and Hong Kong. His academic work includes policy research on urban planning and cultural industry development with organisations such as the Business Environment Council, Hong Kong Design Centre and Civic Exchange.



## Foreword

With polar sea ice shrinking, seas rising, weather conditions increasingly volatile and polar-bear populations declining, climate change is unlikely to leave the political, business or social agenda anytime soon.

According to one study, buildings account for 21% of greenhouse-gas (GHG) emissions globally; and closer to 40% in developed economies (largely due to air conditioning and heating), exceeding the 14% contributions of both transport and forestry. The upside here is that the building sector offers the most promise in terms of readily available, cost-effective solutions.

The development of high-performance buildings represents a shift towards the elimination of waste and pollution; the creation of healthy work environments; the reduction of fossil-fuel use; and the increased use of sustainable resources.

With studies suggesting that 75% of the energy consumed by a building over its lifetime is during the operational phase, insulation, lighting systems, air conditioning and water heating are key areas for improvement.

Unfortunately, progress has been slow. In the absence of a strong government-policy response, developers, investors and other market participants do not consider the environment when weighing up the economic costs and benefits of constructing, buying, investing in or renting a building. Also, these are not equally distributed as the developer bears the initial outlay on green features such as lighting and air conditioning, while the tenant enjoys the benefits.

To some degree, the situation is worse in Asia where, in many economies, energy is subsidised or mispriced by the government.

Compounding this problem is the misperception that high-performance buildings are expensive and offer a low return on investment. In fact, studies suggest that incorporating sustainable features adds just 2-5% to the development cost, and these buildings typically realise high occupancy rates, rentals and capital values, with lower operating and refurbishment costs. One US study concluded that a 2% outlay would recover 10 times the initial investment over the building's lifecycle.

Those working faster towards change or targeting new opportunities in environmentally focused new-build and retrofits should achieve above-average returns. As such, the sector has a clear opportunity to reap financial rewards while also reducing climate change and saving the polar bears.



**Aaron Fischer, CFA**  
Head of Asian Property Research

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### Focus on the environment



### The property picture



**Push for stronger reduction target likely within a decade**

**Inadequate incentives to date**

**Business is ready to change and new policies will follow soon**

**Renaissance in property development and construction**

**Retrofits take centre stage?**

**Buildings are a major source of GHG emissions**

## Urban transformers

Buildings are set to play a central role in combating climate change as the most cost-effective and readily available means to reduce greenhouse-gas emissions. The future will bring new policies resetting incentives; tenants and buyers willing to pay more for high-performance buildings; and retrofits offering far more interesting business opportunities. Indeed, by employing green initiatives that also reduce costs, buildings will ultimately enhance the overall economy.

To date, the sector hasn't been "sexy" enough to motivate change. Although the technology is there, energy-efficient and healthy buildings are still rare for a number of reasons. First, governments have failed to provide policy leadership. Second, participants externalise environmental costs, such that they do not consider them at any stage of the building-development process. Finally, developers harbour general misperceptions that such "green" buildings entail higher costs and lower returns on investment.

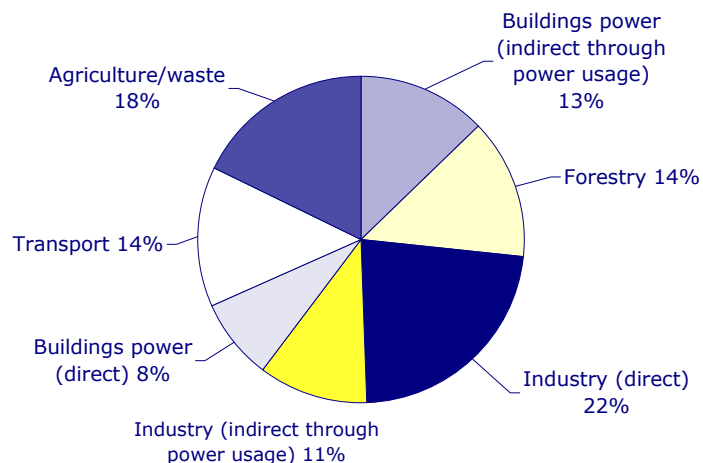
However, there are now cost-effective ways to build and operate high-performance buildings. Companies and cities are taking the lead amid a growing trend in Asia, as elsewhere, even ahead of regulation from national and provincial governments. Governments, in turn, are likely to provide added impetus to sustainable building.

The building sector of the future will feature more environment-related jobs across the board, as well as an emphasis on better integrated design upfront to optimise performance, with attention to lifecycle costing and avoiding over design so as to minimise wastage.

We also expect a shift in the marketing paradigm to one that showcases post-construction performance in high-performance buildings, encompassing the health and productivity of the people they house.

We are likely to see enhanced opportunities for adaptive reuse and retrofitting of buildings, as government policy tightens the requirements for new builds over the long term. Ultimately, planners and developers will extend such "high-performance" criteria to neighbourhoods and cities.

### Greenhouse-gas emissions as a percentage of the global total



Source: Vattenfall



**Climate change is the biggest contemporary environmental issue**

## Hot property

Climate change is shaping up to be the big issue of contemporary civilisation. The debate about whether it is a theory or a real phenomenon that will affect our lives is largely over and we are now asking: *How soon? What can we do to reverse it? What will we do to cope with it? How much will it cost?* While far from settled, the emerging consensus seems to be that the solution will require nothing less than an upheaval in the way we generate and use energy - the driving force that underpins the achievement of modern, developed economies. All upheavals involve great trauma, as well as great opportunities. As the implications of a changed climate cement themselves in the public consciousness and in government responses, the long-term opportunities for high-performing green buildings appear immense.

At a global level, there are a number of concurrent trends that are conceivably unstoppable and that will consolidate the opportunities for high-performance buildings.

**Development in Asia is not going to stop**

The developing world is still finding its feet. The big players, such as China, India and Brazil have set themselves on a development course that aims, over the long term, to lift vast swathes of human beings out of poverty. Average personal incomes are rising and the income earners will want to spend some of this newfound wealth on housing. In addition, this will in turn give many the confidence to demand a more comfortable workplace, hospitals, sports facilities and entertainment venues, driving more development.

**Urbanisation fuels construction**

Urbanisation is occurring at a rate and scale unprecedented in history. This will require a commensurate rate of construction and reconstruction of the big cities of the world, in a manner consistent with contemporary understanding of the environment.

**More households with fewer people**

If the trend in developed countries is replayed in developing economies, then we can expect values and choices to change as people become wealthier: they value independence and privacy, have fewer children, marry later, and want more choice about who they live with. This manifests itself in a greater number of households, though each with fewer people. In other words, the rate of construction of dwellings increases, even as the rate of population growth slows or even shrinks.

## What is a high-performance building (HPB)?

A high-performance building is one with a substantially better energy, economic and environmental performance than standard practice, resulting in a structure that:

- Is energy efficient;
- Saves money and natural resources;
- Is a healthy place to live and work; and
- Has a relatively low impact on the environment.

HPBs encompass concepts of green and sustainable building but moves beyond merely complying with a set of ostensibly green criteria at the design and construction stages. 'High performance' emphasises the performance of the building during its lifetime, in

terms of environmental performance as well as how the building performs for occupants and others affected by it. High performance is achieved through whole-building design, which considers all building components during the design phase, integrating all the sub-systems and parts of the building to ensure they work together. This requires that the design team (eg, architects, engineers, building occupants and owners, and specialists in indoor air quality, materials, and energy) be fully integrated from the beginning of the process.

Reference: Rocky Mountain Institute (2008) High-performance building: perspective & practice; and Office of Energy Efficiency and Renewable Energy, US Dept of Energy (10 Dec 2007) 'High-performance buildings' <[http://www.eere.energy.gov/buildings/highperformance/design\\_approach.html](http://www.eere.energy.gov/buildings/highperformance/design_approach.html)>, accessed 20 July 2008.

**Climate change will hurt**

The physical consequences of climate change will soon begin to bite: municipalities may find their water supply is reduced; businesses that rely on low-lying transport infrastructure may find it damaged by rising sea levels; public health systems will be strained by the health challenges of a hotter climate; and all will be looking for designs and construction methods that can alleviate these stresses.

**Environment, as an issue, won't go away**

Environmental awareness will continue its course of entrenchment in public discourse, and environmental thinking will seep into every arena of human endeavour. Indeed, massive urbanisation brings with it its own suite of environmental stresses that will mobilise citizens and governments. Consumers are more aware, educated and demanding. Governments and businesses are falling over themselves in the frenzy to assure constituents and customers that they take environmental concerns seriously. And, at some point, they will be called on to account for their performance by shareholders, investors, NGOs, journalists, electorates and law courts.

**Unrelenting pressure on governments to act**

In the case of governments specifically, the pressure to act on climate change and ensure the environment is better protected will become overwhelming. In the USA - perceived internationally as recalcitrant on climate-change issues - both Republican and Democratic Party Presidential candidates have issued strong statements committing to action on climate change. Governments will shape policy - some of it blunt, some of it sophisticated - to enforce, persuade, and motivate more sustainable approaches to creating the built environment.

**The science is not pretty**

Scientific understanding of climate change will continue to sharpen. And there are recent indications that the speed at which this phenomenon is occurring, the urgency with which humans must respond, and the scale of the appropriate response have all been seriously underestimated. If these scenarios are supported by stronger scientific consensus, then there will be added pressure on governments to act sooner and "harder". In other words, green regulations on the building industry will be unrelenting - if developers and contractors find it hard now, it certainly isn't going to get any easier. But there will be carrots as well as sticks, with public incentives and private investment favouring high-performance buildings and opening up new possibilities that hitherto have been unwanted, uneconomic or unthought-of.

## High-performance building in India

CII-Godrej Green Business Center Building  
 Location: Hyderabad, India  
 Completed: 2004  
 Features:

- ❑ The first building outside the USA to achieve a Platinum rating under the Leadership in Energy and Environmental Design Green Building Rating System (LEED), and the most energy-efficient building in the world at the time it was rated;
- ❑ Education and demonstration centre for green building;
- ❑ Boasting 88% greater lighting efficiency and 55% greater total energy efficiency than a conventional building;
- ❑ Almost 90% of the interior is day-lit;
- ❑ Wind towers integrated with ventilation and air conditioning systems to reduce energy consumption.

The fresh air that goes in the air-handling unit is pre-cooled 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;

- ❑ Photovoltaic panels on the roof produce solar energy and provide about 20% of the building's total energy needs, with the roof orientation and inclination designed to maximise the solar panels' efficiency; and
- ❑ Roof garden insulation cools the roof and acts as insulation, while providing an aesthetic benefit at the same time.

Reference: Summarised from Hong, W. *et al.* (2007) *Building Energy Efficiency: Why green buildings are key to Asia's future*, Laurenzi, M.P. (ed.), Hong Kong: Asia Business Council.

**Building sector  
has more opportunities  
than any other**

### **High-performance buildings - A crucial role**

It is hard to overstate the importance of buildings in discussing solutions for climate change: building-related measures have been identified in several studies as the most cost-effective and immediately applicable of any measure in any sector. None of the measures touted as essential in the low-carbon economy - not wind farms, reforestation, carbon capture and storage, biofuels, photovoltaics, etc - are as economically and technically feasible as installing insulation, more-efficient lighting and air conditioning, and better water-heating systems.

Therefore, buildings have the potential to lead the charge on climate change and if, as social research suggests, climate change is the number one environmental issue troubling the minds of consumers today,<sup>1</sup> then building-related investment stands to enhance its reputation and reap the benefits of consumer demands.

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<sup>1</sup> Curry, T. E., Ansolabehere, S. and Herzog, H. J. (2007) 'A Survey of Public Attitudes towards Climate Change and Climate Change Mitigation Technologies in the United States: Analyses of 2006 Results', MIT LFEE 2007-01 WP <[http://sequestration.mit.edu/pdf/LFEE\\_2007\\_01\\_WP.pdf](http://sequestration.mit.edu/pdf/LFEE_2007_01_WP.pdf)>

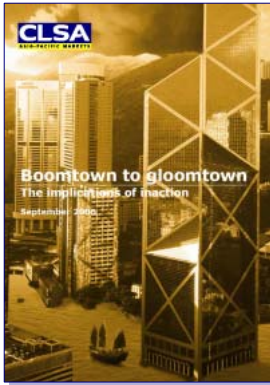
## Is climate change underestimated?

### A brief overview

**Scientific consensus:  
climate change is real**

The 2007 report of the International Panel on Climate Change (IPCC)<sup>2</sup> has consolidated a broad consensus in the worldwide scientific community: humans are changing global climate patterns by releasing gases (specifically greenhouse gases or GHGs) into the atmosphere, thus warming the earth. The most notable gas is carbon dioxide (CO<sub>2</sub>), but others are also important.

Globally, in simple terms, climate change is set to bring warmer temperatures, altered rainfall patterns and rising sea levels. (See Figure 1 presenting Hong Kong as an example.) In the worst-case scenarios, these changes could result in chaotic disruption to businesses and commercial systems, famines, species extinctions, submersion of low-lying regions, catastrophic natural disasters and the prospect of irreversible change to the patterns of nature on which humans and other organisms depend.



**Boomtownto Gloomtownto  
The consequences  
of Hong Kong's  
inaction on pollution**

Figure 1

#### Expected changes to climate in Hong Kong and the Pearl River Delta:

- ❑ A temperature rise of 4.8°C on average by the end of the century (above the 1990 average). This is on top of the already warmer temperatures experienced by the more densely populated parts of Hong Kong due to the Urban Heat Island effect.

*Consequences for buildings:* Need to keep occupants cooler, without adding more GHG emissions and air pollution.
- ❑ Annual rainfall increase of 1% per decade over the century; and a more variable pattern of rainfall (heavier rainfall events interspersed by longer dry periods).

*Consequences for buildings:* Need to ensure neighbourhood infrastructure and drainage systems can handle greater flows. Potential for longer dry periods, requiring better water-conservation measures.
- ❑ A rise of 30cm at the mouth of the Pearl River Delta by 2030. Guangzhou has been ranked as one of the top ten cities most at risk to a major coastal flooding event, in terms of the number of people affected. In terms of the value of assets at risk of damage from a major flooding event, Hong Kong and Guangzhou ranked in the top ten.

*Consequences for buildings:* Coupled with storm surges, a 30cm rise can magnify flooding to some metres, with obvious impacts for low-lying buildings and infrastructure.

Sources: Hong Kong Observatory 2008; Nicholls et al 2007<sup>3</sup>

### What do we have to do to?

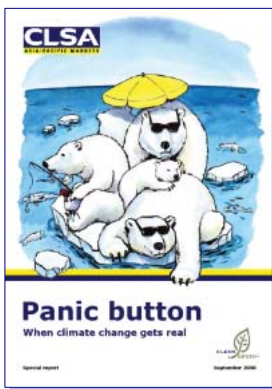
This is a subject of intense research and discussion, but the current debate hinges around identifying a threshold temperature above which there is a high risk of inducing dangerous climate changes and irreversible alteration of climate patterns. Then, this threshold has to be linked to a concentration of GHGs in the atmosphere.

<sup>2</sup> IPCC (2007) *Fourth Assessment Report*, <<http://www.ipcc.ch/ipccreports/ar4-syr.htm>>. The report is a compendium of several works. (For a brief introduction to the international climate change organisations, such as the IPCC, see Appendix 1. For a simple overview of climate change nomenclature, see Appendix 2).

<sup>3</sup> Hong Kong Observatory web page 'Hong Kong's Climate – What does the future hold?' [http://www.hko.gov.hk/climate\\_change/climate\\_change\\_e.htm](http://www.hko.gov.hk/climate_change/climate_change_e.htm), accessed 29 July 2008; and Nicholls, R. J. et al. (2007) *Environment working papers No. 1 - Ranking port cities with high exposure and vulnerability to climate extremes - Exposure estimates*, OECD, <[http://www.ois.oecd.org/olis/2007doc.nsf/LinkTo/NT0000588E/\\$FILE/JT03237444.PDF](http://www.ois.oecd.org/olis/2007doc.nsf/LinkTo/NT0000588E/$FILE/JT03237444.PDF)>

**The conventional view:  
Stay below 2°C and  
450-550 ppm . . .**

**. . . and spend  
1% of global GDP**



**Panic button  
When climate  
change gets real**

In simple terms, the fashionable threshold in the current debate is 2°C - in other words preventing the average temperature of the Earth rising by more than about 2°C above the average temperatures before the industrial era (we are currently at about 0.7°C above pre-industrial temperatures). This threshold was thought to correlate with a concentration of GHGs in the atmosphere of 450-550 parts per million (ppm), measured in carbon dioxide-equivalents (CO<sub>2</sub>e). We are currently around about 430 ppm CO<sub>2</sub>e.<sup>4</sup>

Using this as a basis, the UK Government review led by Sir Nicholas Stern in 2006 estimated that the economic cost of climate change could be equivalent to losing 5% of global GDP per year, now and forever. Stern also estimated that the cost of dealing with climate change would be about 1% of global GDP and his report concluded that the benefits of tackling climate change outweigh the costs.<sup>5</sup>

Even containing the global temperature rise to 2°C is likely to have some serious consequences. Stern mentions studies that estimate we should expect 15-40% species extinction at this threshold. And even meeting a 2°C/450-550 ppm target is enormously challenging and would involve reducing GHGs emissions by at least 25% below current levels by 2050 and by 80% in the longer term - all this in an environment where global emissions are currently rising, not falling.

To add to the seriousness of the situation, some eminent climatologists, such as Dr James Hansen of the NASA Goddard Institute for Space Studies, relying on more recent research than was used by the IPCC and the Stern Review, are saying that even before reaching 2°C there is a high risk of dangerous consequences and that climate change is proceeding at a faster rate than previously estimated. Of particular concern is the possibility that, once set in train, climate change will become impossible to reverse, making the planet a hostile place for human life and other organisms. Also of concern is the potential disintegration of the ice sheets of Greenland and West Antarctica, which could push current estimates of sea level rise of about 20-50cm out to several metres. The target for these climatologists is that atmospheric carbon dioxide should be 350ppm.<sup>6</sup>

**The stakes will get higher**

It is beyond the scope of this paper to comprehensively analyse all of the debates and discussions. What can be said is that the 2°C/450-550 ppm target has acquired such a degree of acceptance as to become conventional, and that this target is challenging enough for human society. Any new scientific insight that revises that target downwards only increases the stakes.

<sup>4</sup> There are many GHGs; some warm the atmosphere more than others. Scientists have developed a common unit for atmospheric concentrations of GHGs, which standardises the warming potential of any particular gas against the most notable GHG, CO<sub>2</sub>. Therefore the unit is called the 'CO<sub>2</sub>-equivalent' or 'CO<sub>2</sub>e'. Of the 430 ppm CO<sub>2</sub>e, most of this is CO<sub>2</sub> (roughly 385 ppm CO<sub>2</sub> at present).

<sup>5</sup> Stern, N. (2006) *The Economics of Climate Change: The Stern Review*, Cambridge, UK: Cambridge University Press.

<sup>6</sup> This is a target purely for CO<sub>2</sub>. Hansen and others have yet to publish a target that equates 350 ppm CO<sub>2</sub> to CO<sub>2</sub>-equivalents.

## Building for climate change

Buildings are major contributors to global warming (and other environmental problems), accounting for at least a fifth of all GHG emissions. The upside here is that the building sector is the most promising in terms of cost-effective, readily available solutions to combat climate change.

**The big-ticket item -  
Burning fossil  
fuels for energy**

### The downside: Buildings and greenhouse gas emissions

The primary source of building-related GHGs is the burning of fossil fuels for construction, operation and demolition. Of these, the major component is electricity used in the operational phase (for air conditioning in hot climates in particular and for heating in cold climates).

In the construction phase, energy is expended in the creation and delivery of building materials ("embodied energy"). Buildings may also emit certain GHGs of their own accord (eg, leakage of gases used as refrigerants) and some building-related emissions are linked not to fossil-fuel consumption, but to deforestation (eg, where virgin forest is cut down for building materials and replaced with a land use that captures less carbon than the forest).

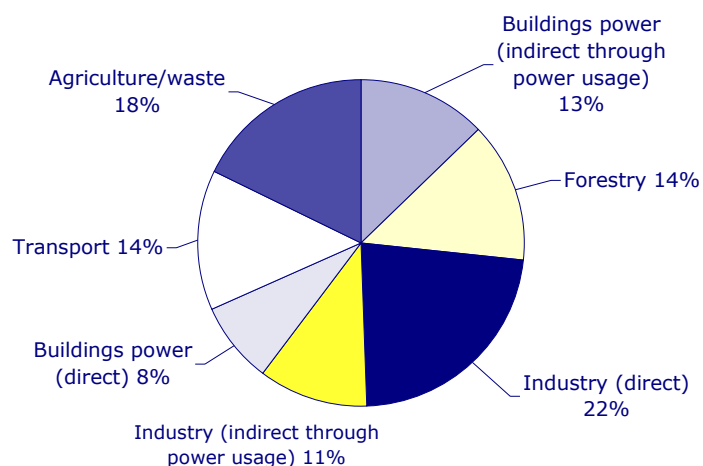
In summary then, there are a number of ways a building can contribute GHG emissions, but by far most emissions arise through energy consumption.

**Buildings produce about  
20% of GHGs globally;  
closer to 40% in  
developed economies**

There are regional differences in the contribution of buildings to GHG emissions. In developed countries that have made a substantial transition from heavy industry to service economies, buildings tend to account for a larger share. Globally, the Scandinavian energy company Vattenfall has estimated that buildings contribute about 8% of total global GHG emissions on their own account, plus another 13% via building-related energy consumption, mainly electricity, bringing the total to 21% (see Figure 2). For developed economies, the contribution is closer to 40%.

Figure 2

### GHG emissions as a percentage of the global total



Source: Vattenfall 2007a<sup>7</sup>

<sup>7</sup> Vattenfall (2007a) 'Global Mapping of Greenhouse Gas Abatement Opportunities: building sector deep dive' <[http://www.vattenfall.com/www/ccc/ccc/Gemeinsame\\_Inhalte/DOCUMENT/567263vattenfall/P0272861.pdf](http://www.vattenfall.com/www/ccc/ccc/Gemeinsame_Inhalte/DOCUMENT/567263vattenfall/P0272861.pdf)>, accessed 20 July 2008.

The US Green Building Council (USGBC) has collated figures that show that, in the USA, buildings:

- ❑ Consume 39% of all energy;
- ❑ Use 71% of all electricity;
- ❑ Account for 39% of all CO<sub>2</sub> emissions and 36% of all GHG emissions;
- ❑ Use 12% of all potable water; and
- ❑ Produce, in construction and demolition wastes, 65% of all municipal solid waste generated each year.<sup>8</sup>

On a global scale, the USGBC says buildings use 40% of raw materials.

In Hong Kong, buildings use close to 90% of electricity. We outline emissions for selected building activities in Figure 3. Air conditioning and lighting emerge as the major contributors to Hong Kong's overall GHG emissions.

Figure 3

**A quarter of HK's total GHG emissions come from air conditioning and lighting**

<b>Emissions from building activities in Hong Kong</b>	
<b>Activity</b>	<b>% of HK's total GHG emissions</b>
Air conditioning	17
Lighting	9
Cooking	5
Hot water	3
Refrigeration	3
Office equipment	2

Source: Gorer *et al.* 2008<sup>9</sup>

**Building sector shows the most promise in GHG abatement**

### The upside: Buildings can contribute to solutions

The lowest-hanging fruit of greenhouse gas abatement - not merely for the building sector but for *all* sectors - is improving energy efficiency in buildings through better insulation, lighting, air conditioning and water heating. Such is the importance of the built environment in tackling climate change that the IPCC's most recent report (2007) devoted a whole chapter to the relationship between climate change and buildings. That report summarised all the major research efforts on the subject:

- ❑ Of all sectors (energy supply, transport, buildings, industry, agriculture, forestry, and waste), buildings have the greatest potential to mitigate emissions economically.<sup>10</sup>
- ❑ Substantial reductions in GHG emissions can be achieved using mature technologies for energy efficiency that *already exist* and have been successfully applied. (Compare the situation for Carbon Capture & Storage (CCS) technologies for sequestering CO<sub>2</sub> from coal-burning power plants: the technology is relatively new, untested and another 20 years away from making an appreciable difference.)

<sup>8</sup> USGBC website Building Impacts, <<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1720>>; and Green Building Facts, <<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718>>, accessed 29 July 08.

<sup>9</sup> Gorer, P. et al. (2008), 'Green' House or Greenhouse? Climate Change and the Building Stock of Hong Kong & Macau, Hong Kong: Civic Exchange.

<sup>10</sup> IPCC, 2007 (above).

- ❑ A significant portion of these savings can be achieved in ways that reduce lifecycle costs, thus providing reductions in GHG emissions that have a net benefit rather than cost.

In support of the optimistic role of buildings, Vattenfall and McKinsey & Company have produced cost curves for various greenhouse gas-abatement options, showing most of the cost-effective opportunities are building-related; eg, insulation, lighting, air conditioning, and water heating. In fact, of all the sectors investigated in the cost curves, only the building sector can show a case for abatement substantially below zero cost<sup>11</sup>.

Figure 4

**Promising measures for GHG reductions in buildings**

Measure	Description and estimated energy savings
Efficient lighting	<ul style="list-style-type: none"> <li>❑ Four- to fivefold reduction in residential lighting energy use compared with incandescent/halogen lighting.</li> <li>❑ In commercial buildings, energy use can be cut by 50% compared with old systems by efficient lamps (eg, T8), ballasts, reflectors, occupancy sensors, and light colour finishes. Some 40–80% of remaining energy use can be saved in perimeter zones through daylighting.</li> <li>❑ Using low background lighting, with levels of greater illumination at workstations can cut lighting energy use in half.</li> </ul>
Reduce cooling loads	<ul style="list-style-type: none"> <li>❑ High-reflectivity building surfaces, external shading, optimal building form and orientation, glazing with low solar-heat gain, natural and night-time ventilation, internal thermal mass, external insulation.</li> <li>❑ High-efficiency lighting systems and efficient equipment.</li> <li>❑ Load reductions by a factor of 2 are possible.</li> </ul>
Passive design for ventilation and cooling	<ul style="list-style-type: none"> <li>❑ Estimated savings in cooling energy use in a variety of Californian climate zones: 92-95% for a house and 89-91% for a classroom.</li> </ul>
Efficient HVAC <sup>12</sup> systems	<ul style="list-style-type: none"> <li>❑ Displacement ventilation systems can reduce energy use for cooling and ventilation by 30-60%.</li> </ul>
Efficient equipment, properly sized, and fully commissioned	<ul style="list-style-type: none"> <li>❑ Realistic sizing can reduce annual energy use by 6-22%.</li> <li>❑ Computer-based systems for monitoring, data storage, communication and control are estimated to save 5-40% in energy.</li> <li>❑ Results of building commissioning in the USA show energy savings of up to 38% in cooling.</li> </ul>
System approach to energy efficiency and the role of the design process	<ul style="list-style-type: none"> <li>❑ Savings in the order of 35-50% for a new commercial building are achievable by: selecting a high-performance envelope and efficient equipment, properly sized; incorporating an energy-management system that optimises the equipment operation and human behaviour; and fully commissioning and maintaining the equipment.</li> </ul>
Retrofits of existing buildings	<ul style="list-style-type: none"> <li>❑ Energy savings of 50-75% in commercial buildings through integrated measures.</li> <li>❑ Standard measures such as thermal envelope upgrades can be combined with reconfiguration of the building to make use of solar energy for heating, cooling and ventilation.</li> <li>❑ Solar air collectors and domestic hot water heaters; advanced balcony glazing; external transparent insulation; and construction of a second skin over the original façade have achieved energy savings of 40-70%.</li> </ul>

Source: Üрге-Vorsatz et al. 2007

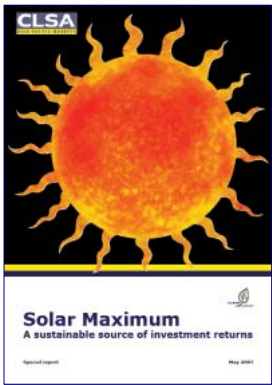
**Space conditioning, lighting, and heating water provide the best opportunities**

Figure 4 summarises some of the findings of another recent report that reviewed the most promising measures for GHG abatement in buildings.<sup>13</sup> As for priorities, the same report makes these comments:

<sup>11</sup> Vattenfall (2007b) 'Global Mapping of Greenhouse Gas Abatement Opportunities' <[http://www.vattenfall.com/www/ccc/ccc/Gemeinsame\\_Inhalte/DOCUMENT/567263vattenfall/P0273261.pdf](http://www.vattenfall.com/www/ccc/ccc/Gemeinsame_Inhalte/DOCUMENT/567263vattenfall/P0273261.pdf)>, accessed 20 July 2008; and Enkvist, P.-A., Naucler, T. and Rosander, J. (2007) 'A Cost Curve for Greenhouse Gas Reduction', *McKinsey Quarterly*, 1: 35–45.

<sup>12</sup> HVAC=heating, ventilation & air conditioning

<sup>13</sup> Üрге-Vorsatz, D. et al. (2007) 'Mitigating CO2 emissions from energy use in the world's buildings', *Building Research & Information*, 35 (4): 379–398, <<http://dx.doi.org/10.1080/09613210701325883>>



**Solar maximum**  
A sustainable source of investment returns

High-performance features complement each other

Integrated combinations mean lower energy use

- ❑ For all countries as a whole, efficient lighting is the most promising measure in buildings, in terms of both cost-effectiveness and the size of potential savings.
- ❑ In developed countries, appliance-related measures are typically identified as the most cost-effective, with cooling-related equipment upgrades ranking high in the warmer climates.
- ❑ Air-conditioning savings can be more expensive than other efficiency measures, but can still be cost-effective because they tend to displace more expensive peak power.
- ❑ In terms of the size of savings, efficiency measures related to space conditioning in the warmer climates come first in almost all studies.
- ❑ Other high-ranking measures in terms of potential savings are solar water heating, efficient appliances and building-energy management systems.

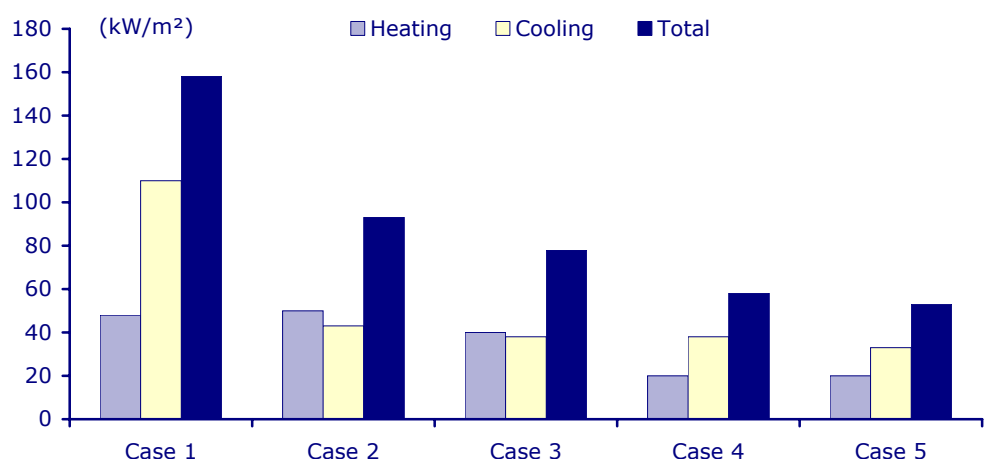
**Interactions and cumulative effects**

From a cost point of view, one of the most exciting aspects of energy-efficiency measures is that they can have cumulative effects. Figure 5 shows the results of a simulation of the energy consumption of a high-performance experimental building in Shanghai. The simulation compared a reference case with no specific energy techniques <Case 1> against various combinations of energy efficiency techniques, namely:

- ❑ Adding window shading devices <Case 2>;
- ❑ Adding window shading plus advanced glazing <Case 3>;
- ❑ Window shading, advanced glazing plus highly insulated envelopes <Case 4>;
- ❑ Window shading, advanced glazing, highly insulated envelopes plus natural ventilation <Case 5>.

Figure 5

**Effect of combinations of energy efficiency measures, Shanghai**



Source: UNEP 2007<sup>14</sup>

The simulation concluded that window shading had the biggest effect on savings in the combinations studied.

<sup>14</sup> UNEP (2007) *Buildings & climate change: status, challenges and opportunities* <[http://www.unep.fr/pc/sbc/documents/Buildings\\_and\\_climate\\_change.pdf](http://www.unep.fr/pc/sbc/documents/Buildings_and_climate_change.pdf)>

**Inefficient lighting heats up the room = more air conditioning**

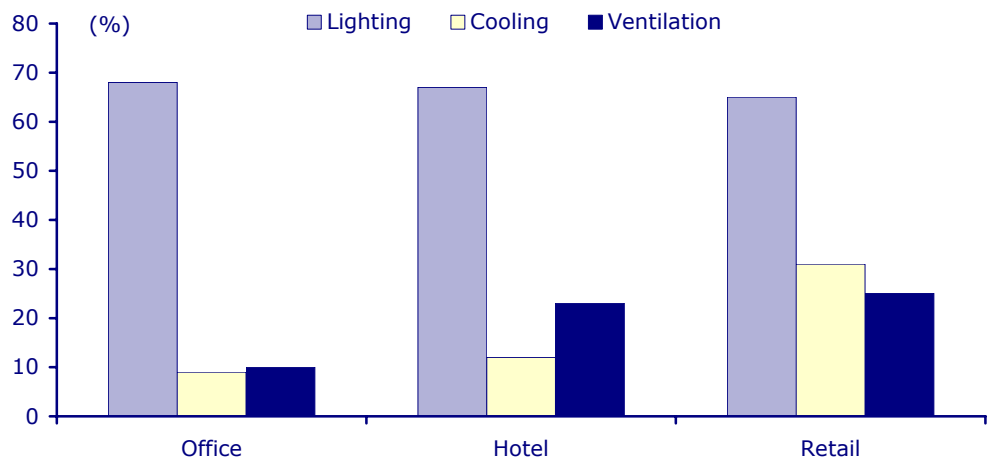
The overall energy balance of a building depends on interactions between the various components, such as lighting, heating and air conditioning. Lighting generally gives off heat as a by-product and the amount of heat can be significant enough to affect the ambient temperature of a room. This can be viewed as a waste of energy or an advantage depending on whether one wants the building to be cooler or warmer. In warm climates, such as in South East Asia, it is generally a wasted resource that results in the increased use of air conditioning.

A study in Bangkok simulated energy consumption of conventional lighting and various combinations of energy-efficient alternatives such as T8 lamps, electronic ballasts, occupancy sensors, dimmable ballasts, specular reflectors and compact fluorescent lamps. The most efficient combinations not only reduced energy use for lighting, but also resulted in savings in energy used for space cooling and ventilation. The most dramatic savings were for retail premises, with a reduction of up to 32% of total cooling and 25% of total ventilation energy use (Figure 6). The savings resulting from downsizing cooling equipment were said to reduce the payback period of various components of the project by 10-50%, with overall payback times ranging from three months to two and a half years.

**Efficient lighting = higher savings on lighting costs and on cooling costs**

Figure 6

**Energy savings of efficient lighting systems in Thailand vs conventional systems**



Source: UNEP 2007<sup>15</sup>

**Air pollution and climate change have common links**

**High-performance buildings not only about climate change**

Climate change is not the only reason to build high-performance structures and there are significant synergies between low-carbon buildings and tackling other types of environmental degradation in Asia, such as air pollution. The common ground between climate change and air pollution is the burning of fossil fuels for energy, as is shown in the Energy-Climate-Air Quality Treadmill in Figure 7.

**Running out of fuel and energy security**

In addition to environmental concerns, governments are worried about the availability and reliability of fuel sources for domestic energy supply (ie, energy security). The reserves of the two major fuel types - coal and oil - are finite and often sourced from troubled parts of the world. They are also

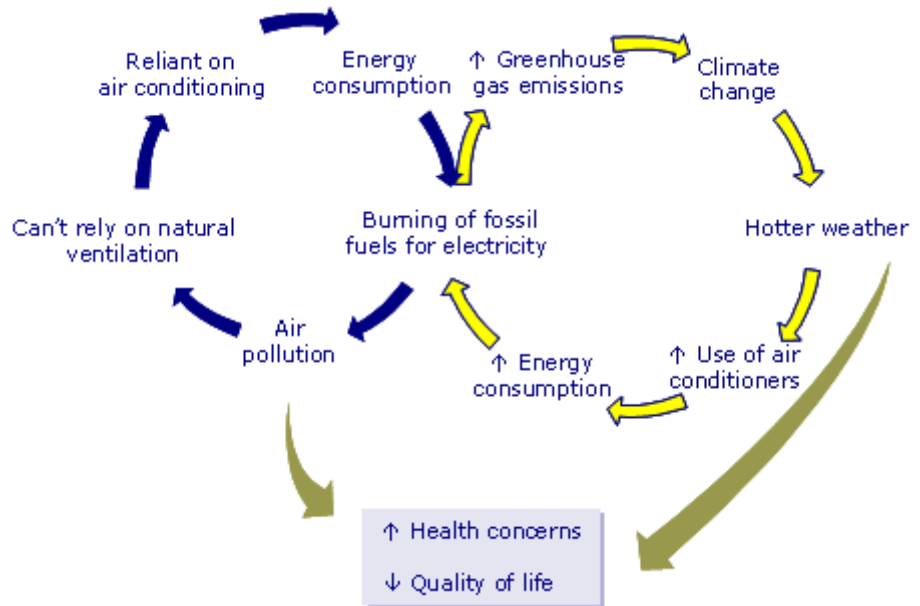
<sup>15</sup> UNEP, 2007 (above), p. 15, quoting Busch, J. et al. (1993) *Energy-The International Journal*, No.2, Pergamon Press.

becoming increasingly expensive as developing economies, such as China and India, pursue their amazing pace of development and increase their demand for fossil fuels. All of this builds a case for optimal efficiency in the consumption of fossil fuels in order to make the finite reserves last as long as possible, which will allow time to develop alternatives.

Figure 7

**The Energy-Climate-Air Quality treadmill**

**There are synergies when combating both air pollution and climate change**



Source: Gorer et al. 2008

## High performance building in Japan

Itoman City Hall  
 Location: Itoman, Okinawa, Japan  
 Completed: 2002  
 Features:

- ❑ Photovoltaic power generation system, with a capacity of 195.6kW (the largest among Japanese local government buildings), generating 12% of the building's energy requirements. The system has a dual function: to produce electricity and to act as sunshade louvers, reduce the air conditioning load by 25%;
- ❑ A highly efficient heat source with thermal storage HVAC system;
- ❑ Natural air ventilation system;
- ❑ Automated lighting system with high-efficiency lamps; and
- ❑ Educational function: The power generated by the system and the avoided GHG emissions are displayed in real time in a public gallery.

### Itoman City Hall



Image Source: commons.wikimedia.org

Reference: Summarised from Hong, W. et al. (2007) *Building Energy Efficiency: Why green buildings are key to Asia's future*, Laurenzi, M.P. (ed.), Hong Kong: Asia Business Council.

## Constructing a high performer

**Triple bottom line approach**

Sustainable development looks at a construction project in a holistic manner, by analysing the social, economic and environmental impacts, often referred to as the 'triple bottom line'.

**HPB looks at processes, features and performance**

'High performer' refers to the process of designing and constructing a building as well as the features of the completed structure and their performance.<sup>16</sup> It addresses the different stages of a building project: construction, operation and decommission. Relevant issues include creating a healthy indoor environments, eliminating waste and pollution from the materials used in the project, the methods of construction, the operating life of the building, and the ultimate disposal of the building and its components. Some overriding concerns such as a reduction in the use of fossil fuels and increase in the use of sustainable resources are relevant for all stages.

It should be highlighted that there are also other, more macro issues, such as the protection of ecosystems, supporting restoration of natural systems, promotion of liveable communities and the efficient use of resources (eg, energy, water, land and materials), that concern the earlier preliminary and planning stages of projects, that are beyond the scope of this paper, but which have equal, if not more, impact on the sustainability aspect of a project.

**Integration is the key**

### Need for integrated design

The role of delivering a high-performing sustainable building project does not lie with a single consultant or solely with the client. These building types are fundamentally new compared with the traditional buildings, and we should not expect to be able to deliver these using the same processes. The traditional arrangement of a series of tasks performed with little interaction and limited communication between players needs to be changed into a collaborative and self-conscious effort to integrate design strategies between all disciplines involved in the project, capturing the benefits of multiple systems that work effectively together rather than separately.<sup>17</sup> Such coordination can frequently lower the upfront as well as long-term cost.

**HPB requires a new way of looking at the project team**

Sustainable building often relies on challenging the status quo of the process from design to construction, much of which has been entrenched in the construction industry for decades. The need to expand the definition of the building team is also important: in order to bring new impetus and insight that might otherwise be overlooked, it is increasingly common to include community representatives, future users, facilities' managers, and so on into the consultancy process.

## HPBs - What are they good for?

Goals:

- ❑ Move towards eliminating waste and pollution in the production, construction, use and disposal of the building;
- ❑ Create healthy indoor environments; and
- ❑ Reduce the use of fossil fuels and increase the use of sustainable resources.

These can be achieved by:

- ❑ Promoting integrated design teams and design solutions;
- ❑ Establishing sustainable approaches from the point of conception of the project; and
- ❑ Encouraging continuous assessment to focus direction, promote learning and establish targets.

<sup>16</sup> Tam, A. (2006) *Sustainable Building in Hong Kong: The Past, Present and Future*, Hong Kong: Insitu Publishing Ltd.

<sup>17</sup> Mendler, S. F. (2000) *The HOK Guidebook to sustainable Design*, John Wiley & Sons Inc.

**Moving waste management from the construction phase to the design phase**

**Construction Waste**

Due to the sheer volume of materials involved in any construction project, waste elimination is one of the top priorities in the construction stage for green buildings. There is a desire to eliminate waste and pollution in the *production* of materials used in the project as well as during the actual construction process. Traditionally, achieving this objective has been reliant on the contractor to come up with creative solutions to limit wastage during operations onsite. However increasingly, especially on the matter of waste, solutions are emerging to tackle this problem during the *design* stages of the project.

**New design technologies reduce waste**

The increasing complexity of modern buildings, in form as well as in function, means that, more and more, modern technology relies on the design and delivery processes. For some projects, the process of translating a three-dimensional idea into a two-dimensional drawing for construction is becoming redundant. Given the complexities of design, as well as the sophistication of bespoke software available nowadays, consultants are increasingly relying on digital 3D modelling, and issuing the actual 3D digital model to contractors and manufacturers for production.

**Using 3D technology to eliminate waste and pollution**

One Island East  
 Location: Hong Kong  
 Completed: 2008

Swire Properties, the owner of One Island East - a 70-storey commercial office tower in Hong Kong - drove the use of Building Information Modelling (BIM) and Building Lifecycle Management on this project to reduce costs and construction time, increase efficiency and reduce waste. Swire Properties employed BIM consultant Gehry Technologies to lead the implementation of process innovation on this project.

This technology substantially reduced waste during the construction process. Use of 3D design software assisted in the calculation of precise quantities of construction material, allowing the team to "design out" around 15-25% of construction waste and affording a 10% saving on construction costs.

One Island East is one of the most important implementations of virtual 3D building lifecycle management ever undertaken. This owner-driven process combined the entire traditional design and construction system of information into one 3D building information model. This enabled and facilitated the high degree of information integration and exchange between members of the design and construction teams and the client.

The owner achieved a higher quality design while saving money and improving construction time by using collaborative, collocated work methods, and integrated 3D modelling tools to optimise construction sequencing.

**BIM modelling of One Island East, Hong Kong**



Source: Swire Properties and Gehry Technologies

The project was approached with sustainable principles in mind. During demolition of the existing building, by using concrete crushers and a waste-management plan, only 1% of waste was disposed of in landfill compared to an average industry standard of 20-25%.

The new building employs indirect office lighting designed with adjustable illumination levels, which reduces energy consumption by up to 60%; extra large low-emissivity ("low-e") glazing panels ensure maximum light penetration with minimum energy loss, heat gain and noise. One Island East has been given the highest rating (Platinum) of the Building Environmental Assessment Method (BEAM) (provisional).

This technology was initially adopted by architects and structural engineers for the critical components of a building, around which the other services components were “fitted”. However, as *3D building information modelling technology* is becoming more widespread and flexible, its use is being extended to all building elements to such an extent that we are approaching a stage where every component of a building project is being constructed and accounted for inside a complete 3D digital model prior to construction.

Advantages included reduced cost and construction time, increased efficiency and less waste. It resolves any “clashes” and errors between different components prior to material manufacturing and ordering. It also allows an increased spatial efficiency within the services components, which makes the design of the building more efficient, lowering operation costs and increasing revenue.

**Construction system**

The method of construction also has a significant impact on the environment. Whereas in commercial buildings where highly engineered curtain glazing has been in use for decades, residential buildings have for a long time relied on a comparatively primitive technique - *in situ* concrete structures formed with timber formwork, with all fittings such as windows and finishes installed onsite.

This type of construction is slowly being replaced by precast façade modules assembled at the factory, complete with fittings and finishes, and hung off the concrete superstructure onsite. This method is especially popular with high rises in Hong Kong.

This eliminates waste, enhances quality control and reduces risks associated with high-level working. By shifting construction from the building site to a factory floor, a much higher quality of finish is delivered due to the working conditions and ability to standardise the workflow. Studies suggest that wastage for finishes such as tiles are reduced by 50% when applied in factory compared to *in situ* application, which offsets the marginally higher cost. In time, as the method becomes more widely used, costs savings will become more substantial.

**Materials**

In addition to the energy expended in the construction process and the energy used for the operation of the project, one other issue that affects the environmental impact of a building is the embodied energy of the material used in the construction of the building.

The embodied energy of a material, put simply, is the amount of energy used to extract, process and transport the material in question. Estimations for Hong Kong residential buildings suggest that embodied energy amounts to 20-40% of total energy used over a 40 to 60-year lifetime.<sup>18</sup> Aluminium, for example, generally has the highest embodied energy due to the considerable energy required in the refinement process. However, the volume of aluminium in an average project is small compared to concrete. Timber, when sourced from certified sustainable sources, carries a low embodied energy, however it is also less durable than aluminium or concrete and is likely to be replaced numerous times as maintenance or renovation occurs during the full life of the building.

**Pre-fab: Moving construction off the site and into the factory**

**HPBs aim for low embodied energy**

<sup>18</sup> Chen, T. Y., Burnett, J. and Chau, C. K. (2001) ‘Analysis of embodied energy use in residential building of Hong Kong’, *Energy*, 26: 323–340.

All of these factors need to be taken into account and assessment using lifecycle assessment (LCA) and lifecycle costing (LCC) approaches can provide a holistic picture on the investment costs and returns affected by different solutions.

**Operation**

With the proliferation of building services and technologies, buildings are using up more and more energy. In fact, some studies suggest the operational phase consumes three-quarters or more of the energy that a building uses over its entire lifetime.<sup>19</sup> Therefore, it is imperative for high-performance buildings to conserve energy during the operational phase. This can be achieved through the design of the building and its systems. Again, this process is not limited to the skills of just the building-services engineers, but also relies on other partners in the team.

**Most of the energy a building uses over its lifetime is consumed in the operational phase**

There are many specifications that can be made to reduce energy consumption while ensuring the comfort and health of occupants. There are passive systems that prevent the need for energy consumption, such as the use of natural ventilation and natural lighting where appropriate, the inclusion of solar shading, appropriate building orientation and external envelope design to reduce heat gain or heat loss and solar water heaters. Likewise, there are active systems such as high-efficiency air-conditioning systems, lift-management systems, and energy-generating devices such as solar panels and wind turbines.

**HPBs are low-energy-users**

All this also reduces the emissions attributed to a building. Reducing energy use is the cheapest method of lowering emissions. Energy-reduction potential for buildings is typically 20-30% on a two- to three-year payback period, with 50% savings often available on a longer payback period.<sup>20</sup>

**Accreditation**

There are various assessment schemes that attempt to evaluate the environmental performances of buildings. However, there is not yet an international standard and each country tends to develop its own systems (see Figure 8). There are also numerous competing schemes in development such as the voluntary Comprehensive Environmental Performance Assessment Scheme (CEPAS) being developed by the Hong Kong Government.

**HPBs use certification schemes for verification and marketing**

Some of the schemes are operated as independent organisations, and some are administered by local governments, with accreditation resulting in eligibility for grants under government schemes (as is the case in Singapore).

**Assessment**

LCA and LCC are two methods that allow the assessment of the actual cost of a building throughout its life from construction to demolition. This allows meaningful comparison of building designs (in terms of their whole-life economic and environmental profiles) between different design solutions or different buildings.

**HPBs use techniques to assess costs and impacts over the entire lifecycle of the building**

<sup>19</sup> UNEP, 2007 (above); and Morton, S. (2002) 'Business Case for Green Design' <<http://www.facilitiesnet.com/bom/Nov02/Nov02environment.shtml>>, accessed 21 July 2008.

<sup>20</sup> Allender, R. (2008) *The Role of the Energy Audit in Establishing and Reducing your Carbon Footprint*, presentation to the 2<sup>nd</sup> Annual GreenBuild Asia Conference 2008, Hong Kong.

LCA has been adapted from the manufacturing industry and is a material-based analysis consisting of three components: *inventory*, *impact* and *improvement* analysis. *Inventory* analysis is concerned with the manufacturing processes from extraction of raw materials to production. *Impact* assessment looks at the effect of using these products on the environment and human health. *Improvement* analysis explores ways of reducing the negative impacts.

LCC is used as a high-level comparison tool that presents total costs, capital costs and recurring costs such as operating, repair and maintenance costs.

There are numerous well-established methodologies for completing LCA and LCC, such as the ISO 14040 for LCA that describes the principles and framework for conducting and reporting LCA studies, and includes certain minimal requirements. Like the accreditation tools, there is no singular international standard, but most of these methods are part of the above accreditation assessments.

## New skills in the green economy - Energy simulations

New National Library  
 Location: Singapore  
 Completed: 2005

As a key proponent for designing green buildings for the South East Asian climate, Ken Yeang is the world's leading architect in ecological design and passive low-energy design. His 'bioclimatic' towers have had an impact around the world, fusing high-tech and organic principles, of which the New National Library in Singapore is the most recent example.

The new 102-metre high National Library building was completed in July 2005. Significant attention was paid to simulating and analysing energy use both in terms of embodied energy and expected energy consumption in the operational phase. The total energy embodiment of the building (ie, "first costs") was calculated to be 17 GJ/m<sup>2</sup>, which is within generally accepted benchmarks for commercial buildings (ie, between 10-18 GJ/m<sup>2</sup>).

Simulations were also conducted on the energy consumption and building performance of the design. Results show an energy consumption rate of around 185 kWh/m<sup>2</sup>/annum, which is less than that of the typical commercial office tower (230 kWh/m<sup>2</sup>/annum) in Singapore. The building received the 2005 Singapore Green Mark Platinum Award.

New National Library, Singapore



Image: Creative Commons Attribution 2.5 License: Terene Ong 2006: <[http://commons.wikimedia.org/wiki/Image:National\\_Library,\\_Singapore.JPG](http://commons.wikimedia.org/wiki/Image:National_Library,_Singapore.JPG)>

Source: T.R.Hamzah Yeang Sdn. Bhd. International & Llewelyn Davis Yeang

Figure 8

**Some building accreditation schemes**

**Hong Kong**

Hong Kong Building Environmental Assessment Method (BEAM)

Effective since: 1996; standards were revised in 2004 and 2006

How it works: An existing or new building will be awarded a rating of platinum, gold, silver or bronze based on its environmental performance.

Web: [www.hk-beam.org.hk](http://www.hk-beam.org.hk)

**Japan**

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)

Effective since: 2001

How it works: Developers, builders, architects and others can download a program that allows them to assess any new building or renovation on their own; otherwise, trained architects who have passed a CASBEE assessor exam conduct the assessment.

Web: [www.ibec.or.jp/CASBEE](http://www.ibec.or.jp/CASBEE)

**South Korea**

Green Building Rating System

Effective since: 1999

How it works: The system has four grades based on an evaluation of six issues including the use of water and generation of airborne emissions.

Web: [www.gbc-korea.co.kr/](http://www.gbc-korea.co.kr/)

**Singapore**

BCA Green Mark Scheme

Effective since: 2005

How it works: Points are awarded to new and existing buildings in five areas including energy efficiency and innovation. Ratings range from platinum to gold plus to gold.

Accredited buildings are eligible for a range of government financial incentives. The size of the grant depends mostly on the Green Mark rating that projects achieve. Buildings that win the Platinum rating can get up to S\$1.9m.

Web: [www.bca.gov.sg/GreenMark](http://www.bca.gov.sg/GreenMark)

**Taiwan**

The Green Building Program and Green Remodelling

Effective since: 2001. In 2003, the programs became mandatory for all government structures.

How it works: Buildings are assessed and awarded a Green Building certification on nine points including biodiversity and waste reduction. The Green Building Program doesn't offer financial incentives to builders and developers, but it holds an annual national competition with cash prizes.

Web: [www.greenmark.epa.gov.tw](http://www.greenmark.epa.gov.tw)

**UK**

Building Research Establishment's Environmental Assessment Method (BREEAM)

Effective since: 1990. There is now a whole family of assessment methods and tools for different stages of the construction process. It is the world's longest standing and most widely used environmental assessment method for buildings.

How it works: BREEAM Buildings and BREEAM Tools act at different stages of the construction process; eg, for the manufacture of building materials (lifecycle analysis of materials with BREEAM Specification and BREEAM LCA) through design stage (BREEAM Envest and BREEAM Buildings), during construction (BREEAM Smartwaste) and post-construction (BREEAM Buildings). BREEAM Certification is undertaken by licensed assessors, ensuring that assessment services are offered competitively by assessors working within a rigorous quality assurance framework. BRE trains, examines and licenses organisations to carry out the assessment process and work with the design team

Web: [www.breeam.org](http://www.breeam.org)

**USA**

The Leadership in Energy and Environmental Design Green Building Rating System (LEED)

Effective Since: 1998

How it works: Different LEED versions have varied scoring systems based on a set of prerequisites and a variety of credits in six major categories. In LEED v2.2 for new construction and major renovations for commercial buildings, there are 69 possible points and buildings can qualify for four levels of certification.

Certification is obtained after submitting an application that documents compliance with the requirements of the rating system, as well as paying registration and certification fees. Certification is granted solely by the Green Building Council responsible for issuing the LEED system used on the project.

Web: <http://www.usgbc.org/LEED>

**Australia**

*Green Star*

Effective since: 2003

How it works: A voluntary environmental rating system for buildings in Australia. The system considers a broad range of practices for reducing the environmental impact of buildings and to showcase innovation in sustainable building practices, while also considering occupant health and productivity and cost savings. Green Star offers all tools freely for self-assessment as means of tracking environmental performance, for projects seeking certification third-party Certified Assessors validate documentation for all claimed credits. Some Australian state governments now will not rent commercial office space unless the building has a high Green Star rating.

Web: <http://www.gbca.org.au/green-star>

Source: Author

## So why haven't we done it already?

**The right incentives are missing**

Despite the enormous challenge of climate change - which will require a huge rearrangement of energy production and consumption if we are to achieve a 25-80% reduction in emissions this century - and despite the opportunity for the building sector to be an early player in mitigating GHG emissions, the right signals and incentives have not existed to take high-performance buildings mainstream.

**Government leadership is crucial where market fails**

### Lack of policy leadership

Unless corrected by strong policy measures, long-term environmental costs are usually regarded by developers, private investors, designers, buyers, tenants and even governments as outside of their consideration when weighing up the costs and benefits of investing in, constructing, buying or renting a building. Consequently, the market fails to take account of these externalities, to the detriment of society as a whole.

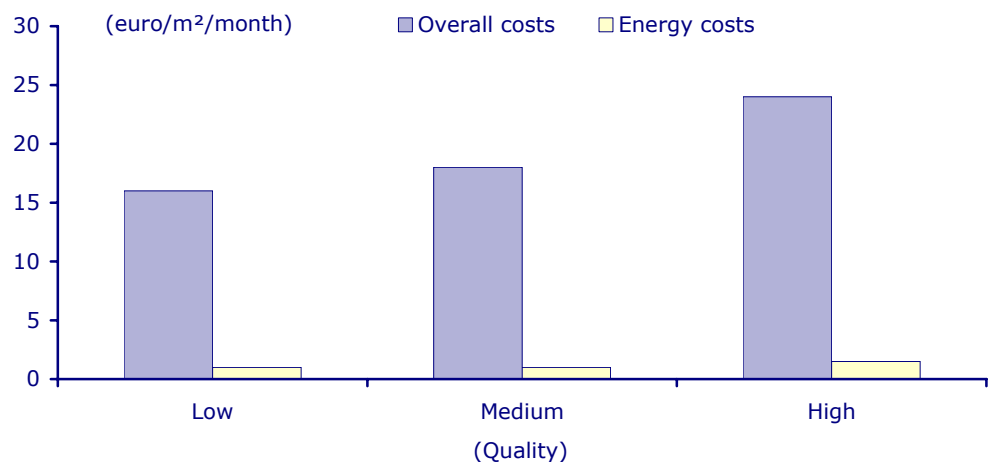
Theoretically, where markets fail to take into account important costs to society, governments have a responsibility to take a leadership role, acting in the interests of the public at large, to clarify the standards by which all players in a market must abide. Importantly, businesses are often willing (perhaps begrudgingly) to comply with more stringent environmental measures even at greater cost, provided that the government establishes a level playing field so that all businesses are required to meet a particular standard and no individual enterprise suffers a competitive disadvantage by implementing high standards.

Government stimulation can take a variety of forms but a mix of regulations (enforced by law) for urban planning and building standards, incentive schemes, research and education all need to be considered when determining the best approach for the building sector to improve energy efficiency, reduce environmental impacts and combat climate change.

**Energy costs are a small proportion of total costs at current prices**

Figure 9

### Energy as a proportion of total building costs in Europe, 2006



Source: WBCSD<sup>21</sup>

<sup>21</sup> WBCSD (2007) *Energy Efficiency in Buildings: business realities and opportunities* <[http://www.wbcds.org/DocRoot/kPUZwapTJKBNF9UJaG7D/EEB\\_Facts\\_Trends.pdf](http://www.wbcds.org/DocRoot/kPUZwapTJKBNF9UJaG7D/EEB_Facts_Trends.pdf)>, accessed 15 July 2008.

**Energy prices don't capture all the cost**

**Environmental costs are externalised**

Current energy prices do not yet reflect the cost of inefficient energy use in buildings to society as a whole, be they global costs, such as climate change, or local ones such as urban heat islands. In many Asian economies, energy is subsidised or mispriced under government energy policies, which effectively becomes an incentive to use energy inefficiently.

As the costs of environmental degradation are not captured in the cost of energy, the price of energy is kept low. Therefore, at current prices, energy costs are, of themselves, unlikely to be a significant driver of energy efficiency in buildings. The World Business Council for Sustainable Development (WBCSD) reports that in Germany, heating and electricity make up less than 5% of a building's total operating costs and this proportion becomes even less the higher the quality of the building (see Figure 9). In Hong Kong, monthly electricity and town-gas bills combined represent only about 3% of general household expenditure, so there is limited demand from owner-occupiers or tenants for energy-efficient buildings.<sup>22</sup>

**The Landlord-Tenant dilemma: No one takes responsibility**

**Costs and benefits fragmented across the industry**

The major barrier to progress on making buildings more sustainable is an economic one - while energy efficiency is in the public interest, it is not in the financial interest of any of the many different players in the building sector. The costs and benefits of green building are not distributed equally among all players in the housing and commercial building market and this mismatch is a disincentive to making the initial outlay in green building features, such as more efficient lighting and air-conditioning. In most cases, tenants gain the benefits of decreased electricity bills for the developer or landlord's outlay. Furthermore, tenants are reluctant to pay for an improvement, which may add to the long-term value of the property, but the capital gain of which the tenant will not share.

**Lack of info on performance prevents better management**

**Information flow**

Although market research suggests that consumers are more demanding about the environmental performance of products and services they purchase (including housing) and may be more willing to pay a premium for a higher-performing products<sup>23</sup>, it is difficult for prospective tenants and purchasers to access credible data on the environmental performance of a building they may wish to rent or buy.

**In some jurisdictions, environmental disclosure is mandatory**

Since 1999, the Australian Capital Territory (ACT) has required all vendors of existing homes to commission an energy-efficiency assessment, which must be made available to prospective purchasers. This measure has been said to have transformed the ACT housing market by giving energy efficiency a market value. This has accelerated the improvement of thermal efficiency in new and exiting houses.<sup>24</sup> This approach is being developed into a scheme for application across Australia.<sup>25</sup> The UK has implemented a mandatory carbon rating scheme from May 2008.

<sup>22</sup> Census & Statistics Department (2005) *2004/2005 Household Expenditure Survey*, Hong Kong SAR Government.

<sup>23</sup> Reported in <<http://www.eeca.govt.nz/eeca-library/residential/fact-sheet/hers-factsheet-07.pdf>>

<sup>24</sup> Ibid.

<sup>25</sup> The Nationwide House Energy Rating Scheme (NatHERS): <<http://www.nathers.gov.au/>>

**Higher performance requires better breakdown of costs**

A recent article in a Hong Kong real-estate facilities magazine investigated one of the top three gripes of corporate tenants in Hong Kong: 'Why do landlords and building managers refuse to decouple utilities costs from management fees?' In summary, the article argues that allowing tenants to track the cost of electricity, water and gas would give them an incentive to reduce their carbon footprint and energy use, as well helping tenants 'appreciate electricity and water as commodities and building management as a service'.<sup>26</sup>

**Perceptions of high cost and low return on investment**

The most common argument against improved building energy efficiency is based around the question of implementation cost and returns on investment - most developers do not expect a premium in sales or rentals for green features. Developers are typically not the end-users of a completed building, and therefore usually do not accrue any financial benefits from improvements that address long-term considerations (such as climate change and the health and well-being of occupants).

**Perceptions are changing: HPB can be cost-effective and add value**

Obviously, such a perception can have a demoralising effect on a green proposal, but the perception can sometimes amount to a misconception - green building can be cost effective, depending on the perspective of benefits. In the following section we discuss costs and benefits in greater detail. As well, a study by the World Business Council for Sustainable Development showed that building professionals are not always aware of the costs of green building, nor aware of the environmental degradation that buildings contribute to.

**Building professionals tend to underestimate the contribution to climate change, overestimate cost**

**Misconceptions among building professionals**

Research by the WBCSD in 2007 showed that building professionals tend to underestimate the contribution of buildings to climate change and overestimate the costs of green buildings<sup>27</sup>.

As part of its Energy Efficiency in Buildings project, WBCSD commissioned a survey of building professionals across the world to investigate gaps in knowledge about energy efficiency. The survey comprised interviews with architects, engineers, builders, contractors, agents, professional landlords and corporate tenants in France, Germany, Spain, USA, Brazil, China, India and Japan. The study did not cover private landlords or homeowners.

Buildings account for somewhere close to 40% of CO2 emissions in developed economies, when operational activities (eg, use of electricity) are taken into account. Professionals surveyed in the study tended to underestimate the contribution of buildings to total emissions by roughly half (see Figure 10).

The study took the likely cost premium of a certified green building to be about 5% compared with a conventional design. The building professionals surveyed tended to overestimate these costs, giving estimates of more than double the likely premium (see Figure 11).

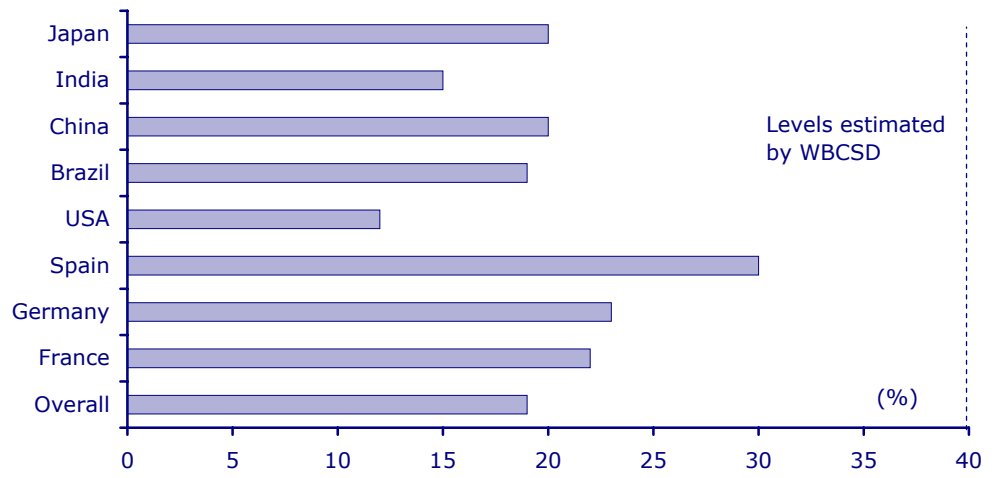
<sup>26</sup> RFP Magazine (2008) 'Landlord Fairy Tales: The Emperor's new management fees', Issue 42\_June 08 <[http://www.rfpmagazine.com/rfp\\_pages/realestate\\_30.htm](http://www.rfpmagazine.com/rfp_pages/realestate_30.htm)> ('Why do landlords and building managers refuse to de-couple utilities costs from management fees? And why isn't the government stepping in?')

<sup>27</sup> Reference: WBCSD, 2007

**Environmental impacts of buildings are generally underestimated**

Figure 10

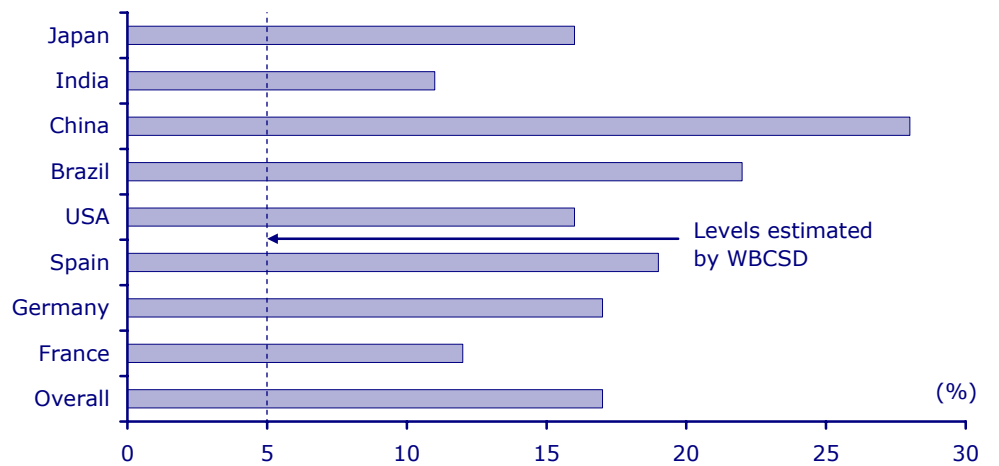
**Estimates by professionals of buildings' contribution to CO<sub>2</sub> emissions**



**Green building costs are generally over-estimated, even by professionals**

Figure 11

**Estimates by professionals of the cost premium for green buildings**



Source: WBCSD 2007

**HPB make good business sense**

## Building a business case

Drawing on North American research, international construction consultant Davis Langdon Seah International (DLSI) concludes that high-performing sustainable buildings make good business sense and are a way of future-proofing property assets. DLSI suggests that investors are increasingly distinguishing the benefits of high-performing buildings from conventional stock in terms of:

- ❑ Higher occupancy rates;
- ❑ Higher future capital values;
- ❑ Reduced risk of obsolescence;
- ❑ Less need for refurbishment in the future;
- ❑ Ability to command higher lease/rental rates;
- ❑ Attracting more interest from institutional investors;
- ❑ Lower operating costs;
- ❑ Lower tenant turnover;
- ❑ Attractiveness to market analysts; and
- ❑ Attractiveness to potential employees.<sup>28</sup>

**Can't afford not to have HPB**

If Asia follows trends in North America, developers may find that low-performance developments will have difficulty attracting capital. Some major investment sources (such as the pension funds, New York Common Retirement Fund, TIAA-CREF, and CalPERS) require green credentials for investments and, eventually, property valuations will be affected by sustainability ratings.<sup>29</sup>

The three biggest banking institutions in the USA - Morgan Stanley, JP Morgan Chase and CitiBank - have all signed on to a set of 'Carbon Principles' that aim to encourage clients to invest in energy efficiency and renewable energy, as well as importing these considerations into the due-diligence process.<sup>30</sup>

**Asia has enormous potential for HPB**

Figures from DLSI show that globally to 2010, China and India are set to have the highest growth in new construction (see Figures 12 and 13). However, only a small proportion of new projects in China and India have green credentials. Some 80% (two billion square metres) of new Chinese buildings have few or no energy-efficient features and consume up to three times more energy per unit of floor space than those in some developed countries.<sup>31</sup> Consequently, the potential for green building is immense.

<sup>28</sup> DLSI (2007) *Global Perspectives 2006-7* <<http://www.davislangdon.com/upload/DL/index.html>> pp. 6-7, accessed 19 July 2008.

<sup>29</sup> Lai, M. (2008) *The Real Estate Perspective*, presentation to the 2<sup>nd</sup> Annual GreenBuild Asia Conference 2008, Hong Kong.

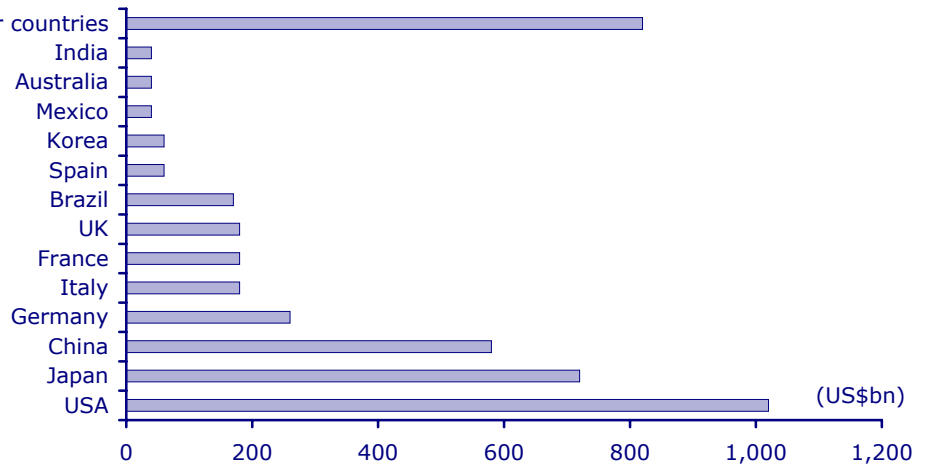
<sup>30</sup> Citigroup Inc. (4 Feb. 2008) 'Leading Wall Street Banks Establish The Carbon Principles' <<http://www.citi.com/citigroup/press/2008/080204a.htm>>, accessed 3 Aug. 2008.

<sup>31</sup> Chan, D. (2008) *The Green Building Premium: ensuring measurable benefits through project auditing*, presentation to 2<sup>nd</sup> Annual GreenBuild Asia Conference 2008, Hong Kong.

Currently the USA leads construction spending . . .

Figure 12

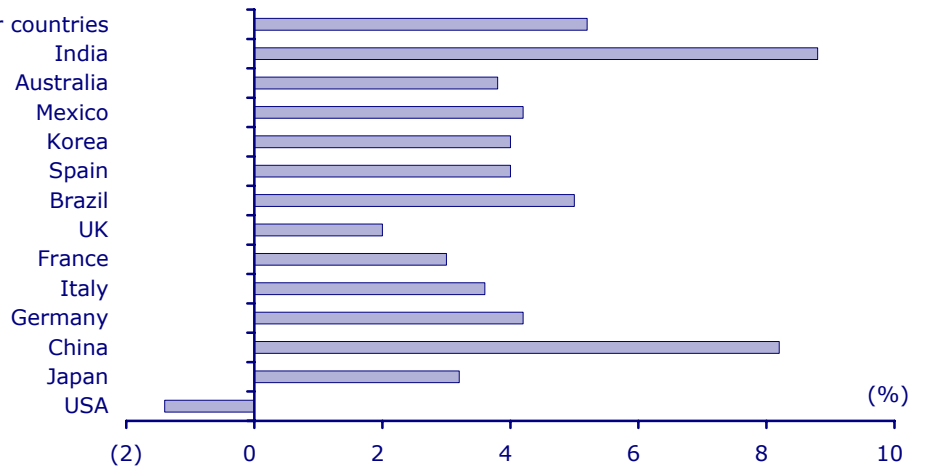
**Global construction spending 2006**



. . . but China and India show the greatest potential for growth

Figure 13

**Annual growth in construction spending 2006-10**



Source: DLSI 2007

HPB costs are decreasing

**Cost effective**

Generally, low or moderate levels of sustainable features can be incorporated into a building at little or no additional cost. Furthermore, this is becoming more and more achievable as:

- Sustainable systems and materials are becoming more affordable in the market place;<sup>32</sup>
- Designers are becoming more familiar with sustainable design elements; and
- Tenants and owners are demanding it.

<sup>32</sup> Robert Allender, an expert on energy efficiency in buildings in Hong Kong says that in the past the installation of meters to monitor usage of utilities may have been considered prohibitively expensive. However, nowadays metering is relatively cheap and simple: Asia's largest building by floor area, The Venetian in Macau, has a separate meter for each of its retail tenants. Reported in RFP Magazine, 2008 (above).

Costs tend to rise for more advanced features.<sup>33</sup> Research in the USA, Australia and the UK give an indication of the range of costs for different levels of building accreditation

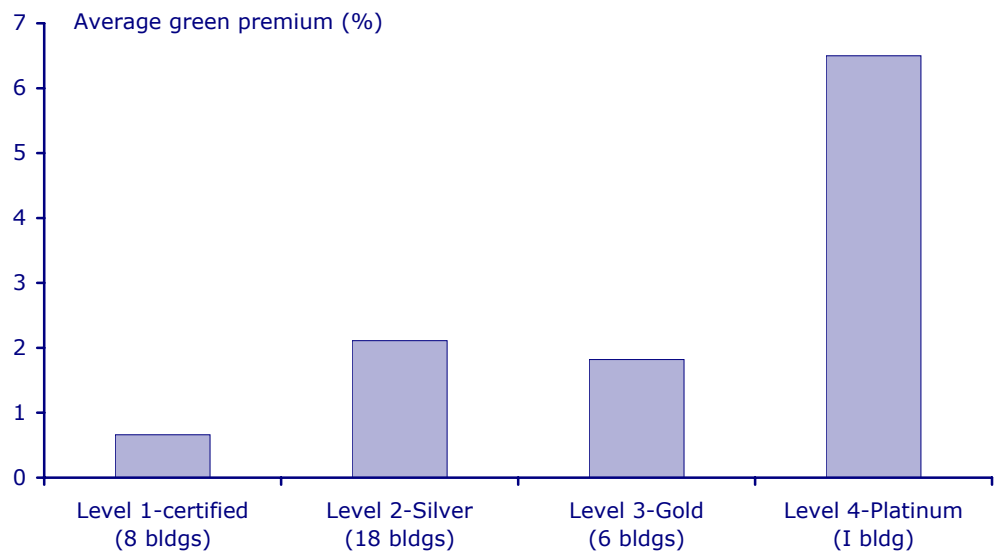
**In the USA, cost premium 2-7%**

**North America: Costs and LEED ratings**

A 2003 report for the California Sustainable Building Task Force estimated the cost premium for incorporating a moderate level of sustainability features (LEED Silver rating) was about 2%, with the highest level (Platinum) less than 7% (see Figure 14).<sup>34</sup>

Figure 14

**Average cost premium of different levels of LEED certification**



Source: Kats 2003

**Australia: Cost premium 3-5%**

**Australia: Costs and Green Star ratings**

Davis Langdon research in 2007 suggested that the initial impact on construction costs (above comparable conventional projects) is likely to be in the order of 3-5% for a 5-Star design, with an extra 5% or more for a 6-Star building.<sup>35</sup>

**UK: Costs and BREEAM ratings**

A study of BREEAM ratings in the UK suggests that three building types (houses, naturally ventilated offices and air-conditioned offices) at typical locations could all reach a 'Good' grade for relatively little or no cost, a 'Very Good' rating for a premium of less than 3%, moving to a premium of about 7% for the 'Excellent' rating.<sup>36</sup>

<sup>33</sup> Morris, P. (2007) 'What Does Green Really Cost?' *PREA Quarterly*, Summer 2007 <<http://www.davislangdon.com/upload/images/publications/USA/Morris%20Article.pdf>>

<sup>34</sup> Kats, G. (2003) 'The Costs and Financial Benefits of Green Buildings', a report to California's Sustainable Building Task Force, Capital E <<http://www.usgbc.org/Docs/News/News477.pdf>>

<sup>35</sup> Davis Langdon (2007), 'The Cost & Benefit of Achieving Green Buildings', <<http://www.davislangdon.us/ANZ/Research/Research-Finder/Info-Data-Publications/Info-Data-Green-Buildings>>

<sup>36</sup> BRE (2005) 'Costing sustainability: How much does it cost to achieve BREEAM and EcoHomes ratings?', Information Paper IP 4/05.

### Differences in methods of costing

Davis Langdon has compared the cost premium using three common methods of costing high performance. In studies where the sustainability costs were calculated by subtracting the final actual cost from the original budget and presuming any difference was due to sustainability features, *average* premiums of 1-2% have been reported for incorporating a 'moderate' level of sustainable design (eg, LEED Silver rating). However, the *averaging* masks the fact that a significant proportion of projects reported no increase in costs.<sup>37</sup>

Using a different method where high performance is costed as the cost of individual features, then premiums in the range of 2-6% are reported for a moderate level of sustainable design. However, this method presumes that sustainability features are 'add-ons' rather than integrated into the design.<sup>38</sup>

A third approach is to compare a population of buildings with similar programmes, some HPBs and some not. This is a more complex analysis but Davis Langdon used this approach in a 2006 comparison of 88 LEED-certified with 138 non-LEED academic buildings, laboratories, libraries, community centres and ambulatory care centres in the USA. The study found that there was no statistically significant difference between the average cost of LEED-certified buildings and the average cost of non-LEED buildings. Cost differences between buildings were due primarily to programme type: there were low-cost and high-cost LEED buildings; and there were low-cost and high-cost non-LEED buildings.<sup>39</sup>

### Over the long term, HPBs are winners

When costs are examined using longer-term analyses such as lifecycle costing, green buildings almost always come out ahead of conventional buildings. This is partly a function of the high proportion of total costs that occur over the operational phase of a building's life (as compared with the design, construction and demolition phases). Operational costs, such as air conditioning, lighting and maintenance, can consume over three quarters of the total lifetime costs (see Figure 15: 'First costs' include construction costs; and 'Other' includes land acquisition, conceptual planning, renewal or revitalisation, and disposal).

The 2003 study for California's Sustainable Building Task Force - which included a literature review, and analysis of 33 green buildings across the USA - concluded that an outlay of 2% in upfront costs to support a more environmentally focused design would, on average, result in lifecycle savings of 20% of total construction costs, or more than ten times the initial investment, over the life of the building.

A report on the Australian Green Star rating programme suggests that the benefits of HPBs - longer lifespan, reduced replacement and lower operating costs - are challenging to traditional valuation and accounting methods that use depreciation only. When valuation focuses on lifecycle costing (energy efficiency, employee productivity, etc), instead of simple payback (capital

**US study: LEED certification didn't add costs; programmatic considerations did**

**HPBs are cost effective on long-term analyses**

**The greener the building, the higher the NPV**

<sup>37</sup> Matthiessen, L. and Morris, P. (2007) *Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption*, Davis Langdon.

<sup>38</sup> Matthiessen & Morris, 2007 (above).

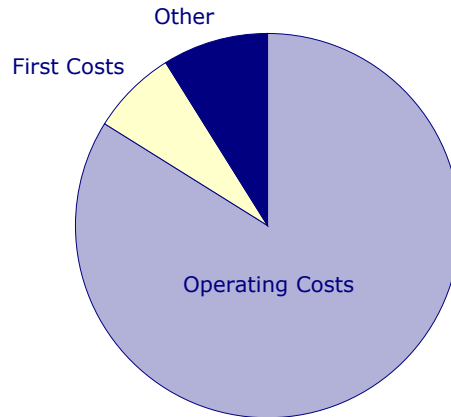
<sup>39</sup> Matthiessen & Morris, 2007 (above).

cost reduction), HPBs are consistently assessed as more valuable.<sup>40</sup> North American studies suggest that the net present values (NPVs) of sustainable buildings range from US\$540-4,300/m<sup>2</sup> depending on the time period for the analysis (20 to 60 years) and the level of 'greenness': generally, the greener the building, the higher the NPV.<sup>41</sup>

Figure 15

**The highest proportion of lifetime building costs occur in the operational phase**

**Operational costs are many times greater than construction costs**



Source: Morton 2002

**Good for commercial reputation**

**HPBs are a means of showcasing corporate social responsibility (CSR)**

With social research in almost all developed and many developing countries showing that environmental issues are high on the list of citizens' concerns, shareholders and other investors are increasingly anxious to ensure that companies they invest in are seen as environmentally responsible, in order to protect the public reputation of a company, and provide it with opportunities to differentiate itself by marketing corporate social responsibility or CSR.

**Decline in tenancy churn**

**Increased tenant satisfaction decreases change of tenants**

A Canadian study suggests that HPBs may result in an actual decline in churn rates because of increased occupant comfort and satisfaction. Furthermore, the modular design features commonly incorporated in such buildings, such as raised floors and moveable partitions, can lower the costs of accommodating churn: 'for example, raised floor systems utilise the spaces beneath the floor for cabling, electrical wiring, and ventilation, and it is generally easier and less costly to relocate specific elements (such as electrical outlets or data ports) in buildings with raised floor systems.'<sup>42</sup>

<sup>40</sup> Davis Langdon 2007 (above).

<sup>41</sup> Lucuik, M. et al. (2005) *A Business Case for Green Buildings in Canada*, a report prepared for Industry Canada by Morrison Hershfield  
<http://www.cagbc.org/uploads/A%20Business%20Case%20for%20Green%20Bldgs%20in%20Canada.pdf>

<sup>42</sup> Lucuik, 2005 (above).

## CSR policy, carbon accounting and real estate

Large multinationals are increasingly demanding products and services from suppliers that match their corporate social responsibility (CSR) policies. They are also potentially developing a pattern for standard business practice in the future, for example, in carbon accounting. Often these companies have business units or headquarters in countries with stronger environmental regulations (eg, Europe, North America, Japan), and they carry a corporate culture of CSR across their international operations. The effect is that these companies can create business opportunities for green buildings even where the domestic government's climate-change initiatives are relatively weak. For example:

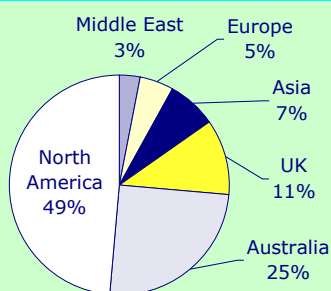
### KPMG

KPMG has introduced an initiative to reduce the carbon footprint across all its offices, including its 12 operations in China, by 25% below 2007 emissions by 2010 from a 2007 baseline, using renewable energy and by reducing emissions. As part of the initiative, KPMG is carrying out an internal carbon audit at all its China offices, in order to set annual goals to reduce carbon emissions further. (<http://www.kpmg.com.cn/>.)

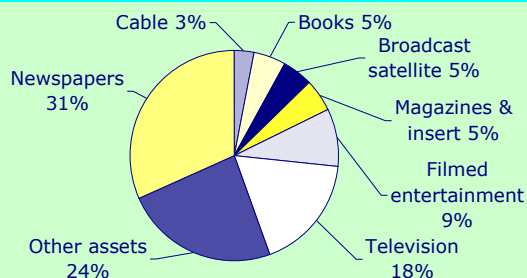
### News Corporation

News Corporation is a participant in the Carbon Disclosure Project and its inventory of greenhouse-gas emissions runs to over 50 pages, with detailed information on emissions from each enterprise, country, and energy source. The company has committed to becoming carbon neutral (through a combination of carbon reduction and offsets) by 2010 and, to that end, is investing in green buildings (one of its Fox studios will be LEED-certified). (News Corporation (2008), *FY2007 GHG Inventory: Summary & Methodology*.)

#### News Corp GHG emissions by geography



#### News Corp GHG emissions by segment



Source: News Corporation 2008

### Marks & Spencer

Marks & Spencer aims to make all its operations in the UK and Republic of Ireland carbon-neutral by 2012, stating that it will maximise the use of renewable energy and only use offsetting as a last resort. Some of the targets under its corporate policy on climate change include:

- ❑ *Energy efficiency*: Reducing the amount of energy used in stores by 25% per square foot of floor space, and achieving a 20% improvement in fuel efficiency and energy use in warehouses and offices.
- ❑ *BREEAM*: Targeting all new stores to achieve BREEAM 'Excellent' rating and all other stores to be assessed against the BREEAM rating system.
- ❑ *Electricity*: Sourcing or generating 100% renewable electricity for M&S stores, offices and distribution centres in the UK and Republic of Ireland.
- ❑ *Anaerobic digestion*: Working in partnership to build and operate anaerobic digestion facilities to generate renewable electricity.
- ❑ *On-site renewables*: Having 20% on-site energy generation from renewables in all new builds where practicable.
- ❑ *Influencing suppliers*: Mobilising key suppliers via its Supplier Exchange to significantly reduce their CO<sub>2</sub> emissions and supporting the development of "green" factories with suppliers.

This initiative is starting in the UK and Republic of Ireland but its experience there can be expected to influence its operations all over the world, including Hong Kong, India, Indonesia, Malaysia, the Philippines, Singapore, South Korea and Thailand. In May 2008, it partnered with one of its Sri Lankan suppliers to open a carbon-neutral bra factory. The factory expects to accommodate a workforce of 1,300 people and is designed to be carbon neutral. Some of its features include:

- ❑ The site is undergoing LEED certification;
- ❑ It will source 10% of energy from green supply from the national grid and onsite solar panels and is designed to use 40% less electricity than a conventional factory of similar scale;
- ❑ Low-embodied-energy bricks used in construction;
- ❑ Green roof;
- ❑ Rainwater harvesting and low-flow fixtures; and
- ❑ Waste separation for recycling, and anaerobic digestion to produce bio-gas for the kitchens. (<http://plana.marksandspencer.com/index.php?action=PublicAboutDisplay>.)

**Healthier,  
happier occupants**

### Increased productivity

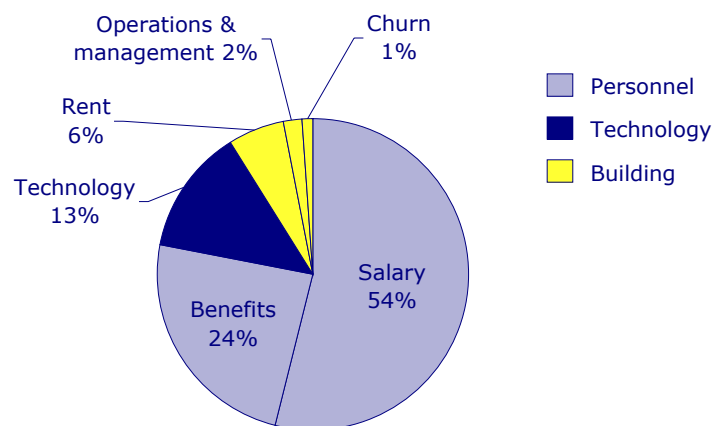
Many studies suggest that productivity is likely to be increased by:

- ❑ The effect of better ventilation on raising worker performance and reducing sickness;
- ❑ Good daylighting, combined with glare reduction; and
- ❑ The perception by personnel that their workplace is healthy, comfortable and contributing positively to the environment.

The importance of the issue for commercial businesses lies in the fact that staff costs for businesses outweigh all other costs by many times. In a US study, the costs of salaries and benefits were shown to make up 78% of total commercial costs for tenants, compared with expenses related to the building itself, which made up 9% (see Figure 16).<sup>43</sup> Consequently, features of HPBs that improve staff retention, health, or productivity can result in savings far greater than any others realised in building-lifecycle costs.

Figure 16

#### Estimated total business costs



Source: Morton 2002

**Even a small increase in productivity can pay for any extra cost of HPB**

After summarising numerous studies on productivity and HPBs, the Canadian study mentioned above concludes that:

‘There certainly is a strong indication that occupant productivity is greater, and that salary costs are reduced, in green buildings compared to conventional buildings. The magnitude of this difference is not clear, but it would be reasonable to assume a productivity gain of between 2-10%.<sup>44</sup>

The same authors suggest that for most office buildings, even a 2% gain in productivity would more than offset any extra costs associated with the design and construction of a high-performing structure.

### Reduced risk of litigation

In North America, poor indoor air quality is regarded as a serious health risk, and disputes over responsibility for ‘Sick Building Syndrome’ are appearing in the courts. Building tenants are increasingly blaming buildings for staff health

**HPB is a risk management strategy**

<sup>43</sup> Morton, 2002 (above).

<sup>44</sup> Lucuik, 2005 (above).

problems and seeking redress from building owners and managers through legal action. The emphasis on exceptional standards for indoor air quality in HPBs can be viewed from a risk-abatement angle.<sup>45</sup>

The document trail used in certification processes for HPBs (LEED, Green Star, HK BEAM, etc) could serve in the defence of any future litigation or changes in law to prove a high level of due diligence in constructing a healthy and efficient building. The Canadian study mentioned above refers to the decision of the Ford Motor Company to install an extensive green roof on one of its US factories; one of the reasons for incorporating this feature was said to be protection against potential future liabilities under water pollution laws.<sup>46</sup>

**Future proofing**

The in-built efficiency of HPBs could act as a safeguard against costs that at present are low but may be more problematic in the future. For example:

- ❑ High levels of energy efficiency will mitigate against price shocks of energy crises;
- ❑ Water-conservation measures will protect against increases in water fees, should climate change bring longer dry spells;
- ❑ The future response of governments to climate change is hard to predict. Highly efficient buildings will face a lower impact from measures, such as taxes on energy consumption or a carbon tax, than a less efficient building;
- ❑ An efficient building may at some point be advantageous in raising carbon credits in the event of the implementation of cap-and-trade emissions trading schemes; and
- ❑ High-performance construction reduces the risk of obsolescence in a political milieu where environmental constraints are set to become continuously tougher.

**Increased self reliance**

Passive design features (such as natural ventilation and daylighting) combined with rainwater-collection measures and some self-generated energy capacity mean HPBs are less reliant on external services, and therefore less vulnerable to power-supply failures (such as brownouts or blackouts), and failure or contamination of water supply. These issues might be priorities for buildings in areas considered to be at risk from terrorism or natural disasters.<sup>47</sup>

**Policy environment: Government responds**

Different governments are reacting in different ways to the challenge of climate change, but the general trend across the world has been adjustments to high-level policies; some hard regulation; implementation of voluntary initiatives that often, over time, become mandatory standards imposed by regulation; and a raft of sweeteners and incentives.

**Utility costs are low now, but climate change, carbon taxes, and reduced energy security may change that**

**HPBs reduce vulnerability to external crises**

**More sticks . . . but more carrots**

<sup>45</sup> Lucuik, 2005 (above).

<sup>46</sup> Lucuik, 2005 (above).

<sup>47</sup> Lucuik, 2005 (above).

In some cases, it is the business community that is pushing for tighter standards and regulations. In 2007, the Global Roundtable on Climate Change, which includes executives of some of the world's biggest corporations (including Alcoa, Citigroup, Dow Chemicals, Dupont, General Electric, Goldman Sachs, Toyota and Walmart), called on the world's governments to set scientifically informed GHG reduction targets and establish mechanisms to place a market price on carbon emissions to reward efficiency and emission avoidance, encourage innovation and maintain a level playing field.<sup>48</sup>

Climate change is clearly on the political agenda and is likely to become entrenched in building regulations. For example:

**In the UK,  
carbon disclosure  
for all new homes**

In the UK:

- ❑ From May 2008, all new homes must be assessed against a six-point rating system, which includes energy efficiency. A six-star rating is given to buildings that are carbon neutral;
- ❑ Progressive tightening of the minimum energy performance standards in building regulations means that by 2016, all new homes must be carbon neutral; and
- ❑ Stamp duty exemptions for zero-carbon homes.<sup>49</sup>

A similar pattern of regulations and incentives is occurring across the European Union as a result of EU directives on the energy performance of buildings.<sup>50</sup>

**In the USA, tax  
breaks for HPBs**

In the US, which has the highest per-capita GHG emissions in the world, the *Energy Policy Act* (2005) offers favourable tax incentives:

- ❑ To contractors that construct energy-efficient homes and to consumers who install energy-efficient windows, insulation, doors, roofs and heating and cooling equipment;
- ❑ To businesses that improve the energy efficiency of commercial buildings and those that install certain types of in-house energy generators (eg, solar power); and
- ❑ To manufacturers of energy-efficient appliances.

**In China, energy  
efficiency embedded in  
the Five-Year Plan**

In China, which has the highest total national emissions, the government has set out in the 11<sup>th</sup> Five-Year Plan various environmental targets for the period 2006-10, including a 20% reduction in energy consumption per GDP. Other targets that could affect the way construction projects are implemented include:

- ❑ Increasing recycling of industrial wastes;
- ❑ Increasing water use efficiency; and
- ❑ Reducing discharge of pollutants.

<sup>48</sup> Global Roundtable on Climate Change (20 Feb. 2007) 'The Path to Climate Sustainability: A Joint Statement by the Global Roundtable on Climate Change', <[http://www.earth.columbia.edu/grocc/grocc4\\_statement.html](http://www.earth.columbia.edu/grocc/grocc4_statement.html)>, accessed 29 July 2008.

<sup>49</sup> For more detail see UK Government website, 'Eco friendly ratings for all new homes', 27 Feb. 08, <<http://www.communities.gov.uk/news/corporate/705107>>, accessed 29 July 2008.

<sup>50</sup> EU Directives 2002/91/EC and 2006/32/EC. See Crédit Agricole Cheuvreux (2008) *Sector Report: 'The Lean Way: Efficient Buildings'*, pp. 15-16 for a summary of regulations in various EU member states.

**In Hong Kong,  
carbon-auditing  
scheme for buildings**

At an operational level, the Chinese Government has established a Green Building Council and green building rating system.

Recently, the Hong Kong Government developed a set of voluntary carbon-auditing guidelines for commercial and residential buildings, schools, universities, community centres and sports complexes. This refers to quantifying GHG emissions and sequestration and the guidelines are based on two internationally recognised protocols: the *Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard* of the World Resources Institute/WBCSD; and the International Organization for Standardization's standard ISO 14064-1. The Hong Kong Government intends to conduct a carbon audit of 10 of its buildings in 2008.<sup>51</sup>

**Governments are  
real-estate players**

Strong policies on building performance have a catalysing effect on a number of fronts. Firstly, government-procurement policy affects the real-estate sector because the government is an important investor in real estate as a tenant, owner, manager, and developer in its own right. Under a policy of the State Government of South Australia, all new government facilities and offices must be housed in buildings that have achieved at least a 4.5 out of 5 rating under the Australian Building Greenhouse Rating scheme (AGBR). This policy provided the impetus for the development of City Central Tower 1 in Adelaide.

## Sustainable building in Australia

City Central Tower 1 is a 21-storey building in Adelaide, South Australia, that has achieved a 5-star rating under Australia's Green Star system. High performance features include:

Passive chilled beam technology; sensor controlled lighting; minimal supplementary air conditioning; natural lighting linked to automated blinds; and modular office design.

According to architects Woods Bagot, the building has achieved:

- ❑ 30% energy savings;
- ❑ 50% reduction in GHG emissions;
- ❑ 50% savings in water consumption;
- ❑ Up to 4% increase in staff productivity.

The cost premium for high performance was around 1%, and the building has been fully tenanted at rentals that are 20% higher than the average in the market place.

City Central Tower is said to have driven further sustainable-building developments in South Australia.

**Interior of City Central Tower 1**



Image: Woods Bagot

<sup>51</sup> Environmental Protection Department, HK Government (24 July 2008) 'Guidelines to account for and report on Greenhouse Gas Emissions and Removals for Buildings in Hong Kong', <[http://www.epd.gov.hk/epd/english/climate\\_change/ca\\_guidelines.html](http://www.epd.gov.hk/epd/english/climate_change/ca_guidelines.html)>, accessed 8 Aug. 2008; **and** Hsu, A. (6 Aug. 2008)'Hong Kong Adopts GHG Protocol for Building Sector', World Resources Institute <<http://www.wri.org/stories/2008/08/hong-kong-adopts-ghg-protocol-building-sector>>, accessed 8 Aug. 2008.

**Government policy  
creates financing  
opportunities**

Additionally, government policy provides a platform for a range of private and public institutions to develop financing arrangements to incentivise and underwrite investments for high-performance buildings. For example, the *Pollution Prevention and Energy Efficiency Program (P2E2)* is an initiative of the US and Chinese governments that uses Hong Kong's legal and financial capacity to mobilise capital and technology from the private sector for use in energy-efficiency, air-pollution and other environmental projects in mainland China.

**Policy underpins  
international investment**

P2E2 uses loan guarantees from international financiers (such as the Asian Development Bank and the International Finance Corporation) to enable Hong Kong banks to make loans, leases and finance available to Hong Kong-based Energy Service Companies (ESCOs, also called EESCOs: *Environment and Energy Service Companies*). These companies upgrade factories, power plants and real-estate developments in mainland China under performance contracts. P2E2 has the support of the major business chambers in Hong Kong, with interest from eleven Hong Kong-based commercial banks and four investment funds. Around twenty Hong Kong-based ESCOs and twelve M&V (measuring and verifying) firms are participating in P2E2 projects in the aluminium, cement, iron and steel, power-generation and real-estate sectors, among others. The P2E2 model creates new buyers for environmental and energy technologies, as well as new business opportunities for financial, legal and engineering services firms.<sup>52</sup>

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<sup>52</sup> US Commercial Service (June 2007) 'Pollution Prevention & Energy Efficiency (P2E2)', <[http://www.buyusa.gov/hongkong/en/about\\_p2e2.html](http://www.buyusa.gov/hongkong/en/about_p2e2.html)>, accessed 29 July 2008.

## The future

The art, science and practice of green construction is moving quickly; what was once considered the cutting-edge of sustainability has now become standard or has even been surpassed. Indeed, a building that achieved Platinum LEED or HK BEAM accreditation five years ago would not now make the grade.

In the same vein, the sustainability scene in five years time will have progressed far beyond contemporary standards. Given current trends and the growing awareness of climate change as a global issue of importance, some of the likely developments that building designers and managers will have to keep abreast of include:

### Things to watch:

- ❑ **International agreements**
- ❑ **Energy prices and security**
- ❑ **Market drive for sustainability**
- ❑ **Carbon footprinting**
- ❑ **Unrelenting expectations**

- ❑ International protocols on greenhouse gas emissions that will effect the legality and economics of inefficient resource use;
- ❑ Continued anxiety about energy costs and energy security;
- ❑ Continued and increasing environmental awareness and market demand for environmentally sustainable products and services;
- ❑ Stricter due-diligence requirements and pressure to show rigorous reporting and verification, including carbon footprinting;
- ❑ High expectations of leadership placed on government departments, statutory agencies and leading commercial companies; and
- ❑ Evolution of new sustainability approaches in the building sector and new ways for businesses to differentiate themselves from standard green buildings practice. Already, the literature is speaking of 'intelligent buildings', 'net zero' buildings and 'regenerative' buildings (buildings that generate their own power and water supplies) with the aim of not merely stabilising emissions but reducing them.<sup>53</sup>

These and other developments signal changes for the building and real-estate sectors in at least five areas:

- ❑ More jobs in the environmental-building arena;
- ❑ An increased emphasis on better design at an early stage in development;
- ❑ Marketing focused on post-construction performance;
- ❑ A enhanced role for retrofitting; and
- ❑ A heightened awareness of the need for high-performing neighbourhoods and cities.

### More jobs

High-performance building can be expected to bring a range of new business opportunities, both small and large, including:

- ❑ Professional expertise - eg, architects; engineers, landscapers, and technicians;
- ❑ Energy Service Companies (ESCOs) and other consultants advising on cost-effective approaches to sustainability;

**HPBs mean a wide variety of new jobs and products**

<sup>53</sup> Rocky Mountain Institute (2008) 'Cooling the Warming' <<http://bet.rmi.org/our-work/cooling-the-warming.html>>, accessed 3 Aug. 2008.

- ❑ Auditing and management services;
- ❑ Sustainable building materials, building services and plants, fixtures and fittings, including timber, cement, appliances, and smart technologies; and
- ❑ Perhaps even carbon-trading services in the building context.

In a paper for the European Insulation Manufacturers Association (EURIMA), consultancy firm Ecofys concluded that European Union directives on energy saving in buildings would generate up to 100,000 jobs in Europe.<sup>54</sup>

### Integrated design early on

The late introduction of high-performance features into a building project is a major barrier to success because these technologies - just like any other modifications to the original layout - may incur a premium if they are deferred to a later stage in the design or construction processes. Figure 17 shows that HPB initiatives cost less and require less effort to implement if they are factored early into the design process. When sustainability questions are addressed later in construction, they require more money and effort to implement. In this regard they are no different from any other design feature.

Peter Morris from Davis Langdon points out that the building skin and plan of interior space affects energy efficiency, lighting and indoor air. Choice of materials and finishes affects air quality, lighting and energy loads. Designing components independently leads to redundancy or conflict between systems. Therefore, an integrated design approach reduces costs.<sup>55</sup>

**HPBs manage costs by incorporating features early on**

## What is an ESCO?

An ESCO, or Energy Service Company (often extended to EESCO: Environment & Energy Service Company), is a business that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs for facilities over a seven to twenty year time period. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project. Typically, they offer the following services:

- ❑ Develop, design, and arrange financing for energy efficiency projects;
- ❑ Install and maintain the energy-efficient equipment involved;
- ❑ Measure, monitor, and verify the project's energy savings; and
- ❑ Assume the risk that the project will save the amount of energy guaranteed.

ESCOs often operate on performance-based contracts, which means that the contract price is directly linked to the energy actually saved. The clients pay for the services from the savings in energy costs. Savings and therefore payment are determined by verification rather than estimation (which would apply if the services were paid for ahead of the actual savings). For this reason, ESCOs are at the forefront of metering technologies

The ESCO model originated in the USA and grew out of the 1973 oil crisis and the Iranian Revolution in 1979, both of which curtailed the USA's access to cheap oil. However, this also created a business opportunity for ESCOs to reduce clients' energy costs and the model potentially will suit an environment of rising energy costs and GHG restrictions.

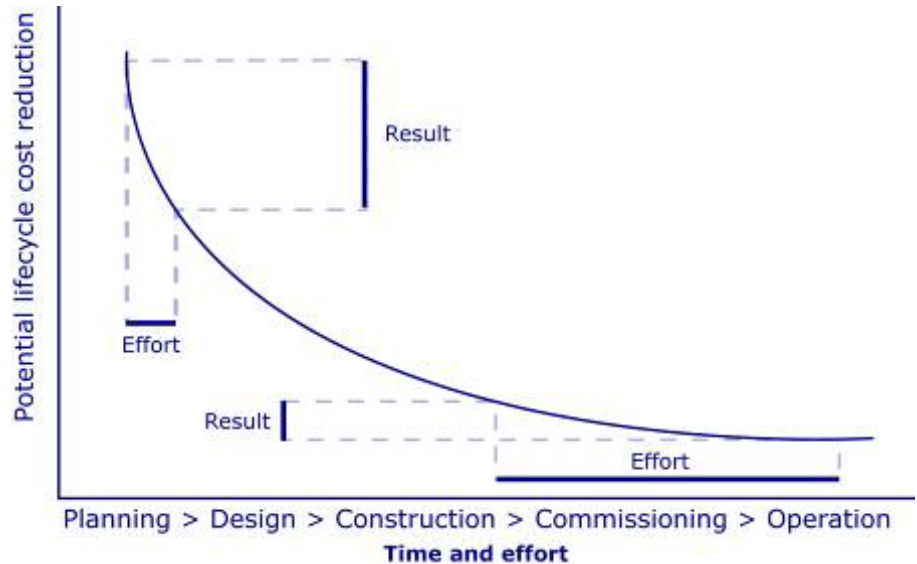
Reference: This summary is based on material from the (US) National Association of Energy Service Companies: <http://www.naesco.org/resources/esco.htm>

<sup>54</sup> Petersdorff, C. et al. (2005) 'Cost-Effective Climate Protection in the EU Building Stock', Ecofys GmbH for EURIMA.

<sup>55</sup> Morris, 2007 (above).

Figure 17

**Early incorporation means more cost reductions for less effort**



Source: Robert P. Charette Consultants, Inc., Montreal, Quebec, Canada

**HPBs avoid over design**

**Integrated design means "less is more"**

It might seem obvious that high performance would align the capacity of technology and appliances with needs, but a study of buildings in Hong Kong revealed that most buildings are over-equipped, resulting in wastage. Better matching of design with requirements was estimated to save 6-22% of electricity consumption of Hong Kong or HK\$12.2-44.7bn annually (at 2001 values).<sup>56</sup>

**New marketing will focus on health and productivity of HPB**

**Marketing of high-performance buildings**

The change in language from "green building" to "high-performance building" signifies a shift in emphasis from complying with a checklist of ostensibly green criteria in the design and construction phases to ensuring that the building actually lives up to expectations in the operational phase; in other words, that it performs well as a building. In this regard, the sector can expect to see a shift in marketing strategies from those based purely on green features and techniques to aspects more focused on operational efficacy, such as health and productivity.

**Will retrofitting take centre stage?**

**An enhanced role for retrofitting**

One of the principles of sustainable buildings is to anticipate changes in use by developing flexible designs to enhance building longevity. This encourages a reduction in waste and pollution generated during both the demolition and construction of a new building - regardless of how environmentally accredited it might be. As society looks to extract greater carbon savings from its built environment, attention will almost inevitably turn to the energy efficiency and resource consumption of a new-build, compared with retrofitting existing buildings.

<sup>56</sup> Lee, W. L. et al. (2001) 'Energy saving by realistic design data for commercial buildings in Hong Kong', *Applied Energy*, 70(1): 59-75.

**What if there was a moratorium on new build?**

Currently, sustainable-building initiatives are generally considered easier to implement in new buildings, where design features can be more cost-effectively incorporated through early attention at the design phase. However, imagine a scenario where a moratorium or restriction was placed on new-builds in order to cut emissions and save resources. As political pressure increases, policies are likely to emerge to make retrofitting a comparable option, either through increasing restrictions on new-build through regulation and taxes, or through incentives and financial schemes that reduce the cost and increase the viability of retrofitting.

**The right policy environment will make retrofitting viable**

Under the *Energy Efficiency Multi-Project Financing Project*, the Asian Development Bank (ADB) is working with global financial institutions such as Standard Chartered Bank and energy-management companies in a partial credit guarantee to support small- and medium-sized private sector energy-efficient projects in China. Among other things, the programme will support the retrofitting of existing buildings, aiming at energy savings of 20-40%.<sup>57</sup> Standard Chartered was one of a number of the world's largest financial institutions to commit to the Clinton Global Initiative, and will provide advice and finance of US\$8-10bn for new renewable- and clean-energy projects over the next five years.

The City of Berlin, in partnership with Berlin Energy Agency (BEA), has pioneered a model for retrofitting energy-efficiency measures in buildings. It project manages the retrofit of public and private buildings, preparing tenders for work that will guarantee reductions in emissions. CO<sub>2</sub> reductions of 26% on average are written into the public retrofit tenders so that winning ESCOs must deliver sustainable energy solutions. Some 1,400 buildings have so far been upgraded, delivering CO<sub>2</sub> reductions of more than 60,400 tonnes per year - these retrofits cost the building owners nothing - and the buildings make immediate savings.<sup>58</sup>

**Moving from industry to services - Everything old is new again**

Many major cities around the world have experienced a shift in their economic base from industry to services, leaving leftover industrial buildings. By nature these buildings are large structures with open spaces, and many have been successfully redeveloped into a multitude of uses. These redevelopments not only have the goal of reusing an old building, but usually are part of larger schemes aimed at rejuvenating the neighbourhoods in which these industrial buildings are situated. In fact, loft apartments borne from these projects are much sought after for their contrasting aesthetics to new buildings, including generosity of space and a very physical connection with the past, which is often lacking in new developments.

**In the UK, retrofitting has become highly profitable**

In the UK, many cities, especially in the industrial north of England around Manchester, Bradford and Liverpool, were faced with the problem of abandoned industrial areas and large unused building stock. In tackling this problem, a company set up in 1993 called Urban Splash has developed into one of the most successful development companies in the UK, famous for regenerating decaying industrial warehouses, mills, Victorian terraced houses and other buildings, into modern housing and mixed-use developments. The company is renowned for taking on difficult sites and projects that other

<sup>57</sup> RFP magazine (5 May 2008) 'New Financing Initiative for Private Sector Investment in Energy-Efficient Projects in PRC' <[http://www.rfpmagazine.com/rfp\\_pages/news\\_stories/news108.htm](http://www.rfpmagazine.com/rfp_pages/news_stories/news108.htm)>, accessed 29 July 2008.

<sup>58</sup> C40 Large Cities Climate Summit New York (2007) case study <[http://www.nycclimatesummit.com/casestudies/energy/energy\\_berlin.html](http://www.nycclimatesummit.com/casestudies/energy/energy_berlin.html)>

developers will not touch. Its success has shown that building reuse is not only possible, but also profitable, pushing its founder into the Sunday Times Rich List. Its work has kick-started many similar developments around the UK and has helped to highlight the possibilities of building reuse with good design.

Similarly, cities in Asia that are moving from industrial to service economies are faced with an increasing number of old industrial buildings. In Hong Kong, successful examples include the Jockey Club Creative Arts Centre, a collection of galleries, performances and studio spaces converted from a factory building, and the new headquarters for the Hong Kong Government's Electrical and Mechanical Services Department (EMSD).

## 'Cradle-to-cradle' thinking asks: Is demolition necessary?

EMSD Headquarters  
 Location: Hong Kong  
 Reconversion completed: 2004

The project to develop the new EMSD departmental headquarters was one of the first and largest conversion projects in Hong Kong. In 1994, the government decided to release the site of the former headquarters for redevelopment. After the relocation of the Hong Kong International airport from Kai Tak to Chek Lap Kok, an air-cargo terminal built by HACTL in the early 1990s remained. The structure was relatively new and in good condition, and the building's size and design matched departmental requirements.

It was decided early on that conversion was preferable to demolition, mainly for environmental reasons and also to save cost. The converted building has a gross floor area of 76,000 m<sup>2</sup> and eight floors, with two levels of office space at the top and six levels of vehicle workshops. With the completion of the new headquarters, about 2,100 EMSD staff working at nine disparate buildings were brought together under one roof, enhancing the operational efficiency of EMSD.

Total construction of the entire project cost HK\$880m (September 2000 prices). The building conversion and refurbishment unit cost was HK\$6,423 per square metre, substantially lower than similar sized new-build projects. The project also enabled the release of three sites with a total area of about 44,000 m<sup>2</sup> for redevelopment. The total value of the three sites is estimated at about HK\$4 billion. In addition, there were rental savings of HK\$3m per annum.

It was estimated that almost 100,000 cubic metres of construction waste, equivalent to a five-storey football field, would have been produced had the former cargo terminal building been demolished. By retaining most of the concrete and steel structure of the old building, savings of up to HK\$700m were realised, not to mention the energy that would have been used in constructing a new building.

### Green features:

Besides being a successful example of adaptive reuse, the building has incorporated a large catalogue of energy-efficient features and renewable-energy technologies, which are designed to make the building at least 10% more energy efficient. It supports Hong Kong's largest solar-energy installation (350kW) plus numerous natural lighting and energy-saving design elements. This supplies 3-4% of the building energy supply. For the air-conditioning system, slurry ice tanks are employed as peak power saving feature. Water-cooled ammonia chillers were employed to avoid ozone-depleting refrigerants, as well as for their higher efficiency. A greywater recycling system handles 26,000 litres of water a day, and the building envelope has been designed with ventilated double glazing, extensive use of sunshades, skylights and sun pipes to reduce heat gain and the need for artificial lighting.

### EMSD headquarters



Source: EMSD

**Next steps: HP neighbourhoods and cities**

**Moving from buildings to neighbourhoods and cities**

The challenge of climate change won't be solved merely with discrete high-performance buildings. How buildings relate to each other and their position in relation to services and facilities can affect the sustainability of the built environment as a whole. Too far from public transport, and the savings in energy and GHG emissions can be discounted by occupants' need to travel to work in private cars. Without consideration of the neighbouring environment, buildings can create street canyons and walls that trap heat and pollutants, resulting in increased air conditioning that once again can outweigh any gains in the building's intrinsic energy efficiency. Clearly then, high performance is a concept that must extend beyond individual buildings to whole neighbourhoods and even cities.

**Cities are big consumers of energy and big emitters of GHGs . . . .**

Cities have a special role to play given the increasing rate of urbanisation. In 2003, the UN estimated that mainland China had just over 500 million people in urban areas (or close to 40% of the population) and this is set to rise to over 877m by 2030 (about 60% of its expected population). The corresponding figures for India are 301m urban dwellers in 2003 (28%) and 586m by 2030 (41%).<sup>59</sup> Cities are the major consumers of the world's energy (75%) and the major emitters of GHGs (80%).<sup>60</sup>

**. . . but are also in the front seat for tackling climate change**

Cities are centres of population, seats of governments, focal points for business exchange, and hubs of intellectual, artistic, and political discourse. Consequently, cities and metropolitan regions have the ability to harness initiative and resources of large numbers of institutions and people in tackling climate change and other major environmental conundrums. Below we summarise how cities are facing up to these issues together, often ahead of national and provincial governments.<sup>61</sup>

**International alliances of cities tackling climate change**

□ *International Council for Local Environment Initiatives (ICLEI)* is an association of 815 local governments worldwide, including 101 members from Japan, South Korea, India, Indonesia, the Philippines and Thailand. ICLEI has a climate campaign called 'Cities for Climate Protection', which helps cities to adopt policies and implement quantifiable measures to reduce local GHG emissions, improve air quality, and enhance urban sustainability. More than 800 local governments participate in the campaign and 650 local governments worldwide have adopted carbon targets.

(See <<http://www.iclei.org/index.php?id=800>>.)

□ Established in 2005, the *C40 Cities–Climate Leadership Group* is a global initiative of some of the world's largest cities, dedicated to tackling climate change. Asian members include Beijing,

Shanghai, Hong Kong, Delhi, Mumbai, Dhaka, Jakarta, Bangkok, Hanoi, Seoul and Tokyo. In 2006, the group worked with the Clinton Foundation to secure US\$5bn from five of the world's leading banks for a programme that finances municipalities and private building owners in 16 cities across the world to retrofit existing buildings with energy-efficient technologies.

□ In 2008, China instigated the *Global Mayors Forum* with the aim of promoting exchanges and cooperation between cities in China and the world. The forum aims to use the global gathering of mayors in Hong Kong in 2009 to push sustainable development and build partnerships between cities.

(See the Global Mayors Forum website <<http://www.g-mforum.org/>>.)

<sup>59</sup> United Nations (2004) *Population Division: Urban and Rural Areas 2003*, produced for the UN Dept of Economic and Social Affairs <[http://www.un.org/esa/population/publications/wup2003/2003Urban\\_Rural.pdf](http://www.un.org/esa/population/publications/wup2003/2003Urban_Rural.pdf)>, accessed 29 July 2008.

<sup>60</sup> See <<http://www.c40cities.org/>>

<sup>61</sup> Summarized from Loh, C. and Stevenson, A. (in press) *Tackling Climate Change in the Post-2012 Regime: The Role of Cities and Urban Regions in Asia*, chapter in a book on Climate Change Policy in Asia, to be released November 2008.

**Asian cities are HPB centres of excellence**

## Asian cities' response to climate change

### Tokyo

Tokyo has developed a Climate Change Strategy that aims to reduce emissions by 25% between 2000 and 2020. It plans to use government buildings to lead the way on high-performance building, and climate change concerns are being integrated into urban planning and transport decisions. As well, Tokyo is investigating the implementation of a carbon tax ahead of the national government.

### Seoul

Like Tokyo, Seoul has developed a Climate Change Action Plan, targeting emissions reductions of 25% below 1990 levels by 2020. The Action Plan includes emissions strategies for transport, energy and waste management, and a target of 10% renewable energy use by 2020. By 2010, all buses are to be powered by compressed natural gas, and dumps and brownfield sites are being revitalised as city parks in order to cool the city, reduce emissions and create public spaces. About 64% of the city's waste is recycled for heat or power generation.<sup>62</sup>

### Singapore

As an island economy concerned about rising sea levels and reliant on imported water resources from Malaysia, Singapore has released one of the most comprehensive climate-change action plans, requiring new reclamation projects to be above even the worst-case scenario for sea level rise. The Public Utilities Board is also developing more effective drainage infrastructure, requiring low-lying areas to be raised with redevelopment, and studying the need to further protect coastlines.<sup>63</sup>

**Asian cities are vulnerable - It's time to act**

### Dongtan

Faced with the creation of new cities and conglomerations of mega-cities, China is experimenting in the design of high-performing sustainable cities with one of the world's most ambitious demonstration sites. The to-be-built metropolis of Dongtan is designed as a low-carbon city, and it is being constructed on Chongming Island near Shanghai. The plan for the city is to have 10,000 residents by 2010, 80,000 people by 2020 and 500,000 by 2050, with a goal to use 64% less energy than a typical city by using the best available technologies and ideas in buildings, energy, transport and urban planning.<sup>64</sup>

**Asian cities will demonstrate HPB to the world**

## Where from here?

- ❑ **Climate change here to stay:** Climate change is a hot topic with business and government and the stakes are set to get even more intense.
- ❑ **Faster, higher, stronger:** The conventional estimates on the seriousness of climate change will be difficult enough to deal with. New scientific understanding may increase the urgency.
- ❑ **Buildings hold all the cards:** Buildings are in a prime position to lead the way on climate change with cost-effective, immediately available, well-tested technologies.

<sup>62</sup> See Seoul Metropolitan Government (2007).

<sup>63</sup> National Climate Change Committee (2008) *Singapore's National Climate Change Strategy*.

<sup>64</sup> See <[http://www.c40cities.org/bestpractices/buildings/dongtan\\_city.jsp](http://www.c40cities.org/bestpractices/buildings/dongtan_city.jsp)>

Policy will be increasingly important

- ❑ **Well-considered policy is essential:** There are some barriers to the mainstreaming of high-performance buildings that should be eased by stronger government policy that will incentivise entrepreneurial responses from the private sector.
- ❑ **A bright new future:** The building sector of the future will be focused on the creation of new business and job opportunities, integrated design, and marketing of the advantages of high performance in the operational phase, especially well-being and productivity.
- ❑ **Looking back to old buildings and forward to big cities:** Climate change will force a rethink on a greater role for retrofitting and will move the concept of high performance from single buildings to whole cities.

The UN oversees international efforts to deal with climate change

Kyoto Protocol "expires" in 2012 . . .

. . . so all eyes are on the next two COPs

Reports from IPCC are considered most comprehensive summaries

## Appendix 1: Who's who in climate change

**United Nations:** Oversees the international treaty on climate change-UNFCCC.

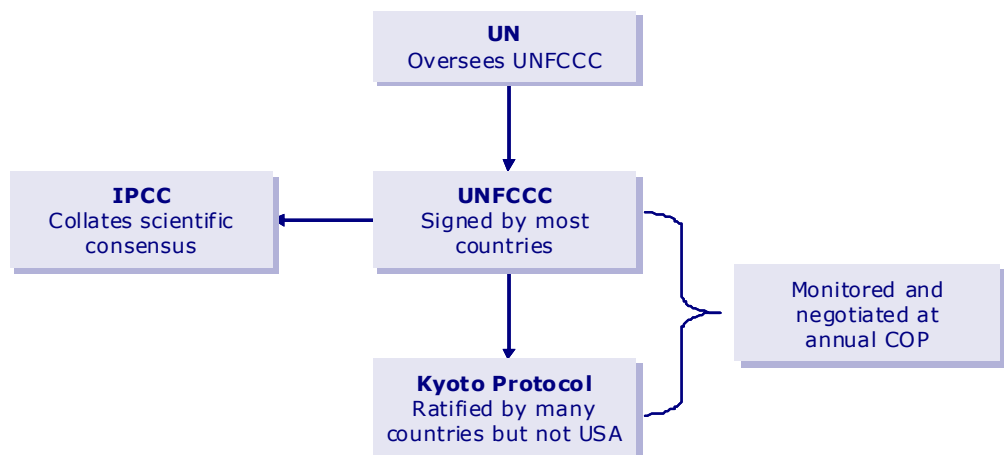
**UNFCCC:** UN Framework Convention on Climate Change was formulated in Rio in 1992 but does not contain binding targets. However, it does make provision for updates, most famously, the Kyoto Protocol. UNFCCC is also the name of the UN secretariat that supports the Convention.

**The Kyoto Protocol:** An update of the UNFCCC formulated in Kyoto in 1992. About 180 countries have ratified the Protocol, including China, India and Brazil and countries of the EU. The USA is the most notable exception. Under the Protocol, parties have different obligations (depending on whether they are developed or developing) to reduce GHG emissions during the Protocol's commitment period (2008-12).

**COP:** Conference of Parties. The annual meeting of the parties to the UNFCCC to assess progress and to negotiate international responses to climate change (2007: Bali; 2008: Poznan, Poland; 2009: Copenhagen). The focus of the COPs leading up to the end of the Kyoto Protocol's first commitment period in 2012 will be: what to do in the post-2012 period? The importance of these meetings for the building sector is that the post-2012 regimes may force (through legislation) or incentivise (eg, through carbon trading) low-carbon building initiatives, particularly in relation to energy efficiency and urban planning. An agreement at Copenhagen would encourage the development of a relatively uniform global position of greenhouse emissions, and, conversely, lack of agreement will encourage an array of national approaches as individual countries seek to "go it alone" with their own systems of regulation, reporting and even emissions trading schemes.

**IPCC:** The Intergovernmental Panel on Climate Change is a UN committee that supports the UNFCCC by drawing on research on climate change causes, impacts and potential solutions from around the world and publishing the results in regular reports. Its reports are generally regarded as the most comprehensive consensus of scientific understanding on climate change.

### The treaties and international players in climate change



Source: Author, CLSA Asia-Pacific Markets

## Appendix 2: Important terms

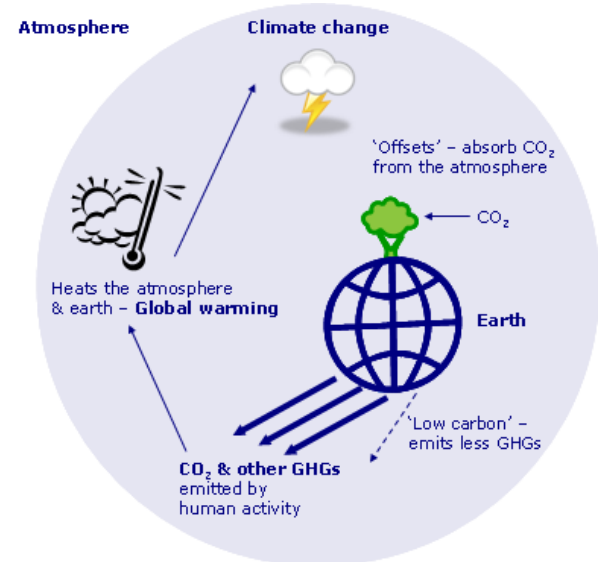
**Burning of fossil fuels for energy is major source of CO<sub>2</sub> emissions . . .**

**GHG** (greenhouse gas): A gas that when released to the atmosphere causes the planet to warm up. The most important is carbon dioxide (CO<sub>2</sub>) but there are others (eg, water vapour, methane, nitrous oxide, the CFCs and HFCs, and ozone). CO<sub>2</sub> is often used as a proxy for GHGs and the word 'carbon' is used interchangeably with GHG (a "low-carbon" economy is a low-GHG economy). Burning fossil fuels (eg, coal and oil) for energy is the main source of human-induced ('anthropogenic') GHG emissions, although other sources are important, such as deforestation. Reduction of GHG emissions is the main aim of the UNFCCC. Unlike other forms of air pollution that tend to have detrimental effects only at a local or regional scale, CO<sub>2</sub> has a global effect - emitted anywhere in the world, it is quickly assimilated into the global atmosphere.

**. . . which is warming up the atmosphere . . .**

**Global warming:** The warming of the earth through the release of GHGs to the atmosphere. It is partly a natural phenomenon and partly anthropogenic. The anthropogenic portion is of concern because of the likelihood that it will cause dangerous changes to climate patterns.

### The basic elements of climate change



Source: Author, CLSA Asia-Pacific Markets

**. . . which is set to result in dangerous climate change**

**Climate change:** The long-term effect expected of global warming. Climate change will vary from region to region. Most regions are expected to get warmer; some are expected to get wetter (especially tropical regions) and some drier (especially temperate regions). Global sea levels are expected to rise. The international concern about climate change is focused on the potential for climatic catastrophes - reduced food production, heatwaves, storms, floods, rising sea-levels, loss of biodiversity and all of the consequent human and environmental tragedies that might ensue.

**Building projects will need to be 'low carbon' in the future**

**Low-carbon projects:** Those that are constructed, operated and concluded, without releasing large amounts of GHGs to the atmosphere. Correspondingly, 'no carbon' or 'zero carbon' means no GHGs are released from the process. A confounding issue for investors is that a project could claim to be low or no carbon in its *net* effect, through the purchase of **carbon offsets** (eg, by planting trees - which are CO<sub>2</sub> absorbers or 'sinks' - equivalent to the GHGs emitted by the project). The due diligence exercise for a low/no carbon venture should distinguish the inherently low carbon elements of the project from offsets.

## China – Beijing

CLSA Beijing  
Unit 10-12, Level 25  
China World Trade Centre Tower 2  
1 Jian Guo Men Wai Ave  
Beijing 100004  
Tel : (86) 10 5965 2188  
Fax : (86) 10 6505 2209

## China – Shanghai

CLSA Shanghai  
3/F, Suites 305-310  
One Corporate Avenue  
No.222 Hubin Road  
Luwan District, Shanghai 200021  
Tel : (86) 21 2306 6000  
Fax : (86) 21 6340 6640

## China – Shenzhen

CLSA Shenzhen  
Room 3111, Shun Hing Square  
Di Wang Commercial Centre  
5002 Shennan Road East  
Shenzhen 518008  
Tel : (86) 755 8246 1755  
Fax : (86) 755 8246 1754

## Dubai

Calyon Gulf  
Dubai World Trade Centre  
Level 32  
PO Box 9256 Dubai  
United Arab Emirates  
Tel : (9714) 331 4211  
Fax : (9714) 331 3201

## Hong Kong

CLSA Hong Kong  
18/F, One Pacific Place  
88 Queensway  
Hong Kong  
Tel : (852) 2600 8888  
Fax : (852) 2868 0189

## India

CLSA India  
8/F, Dalamal House  
Nariman Point  
Mumbai 400 021  
Tel : (91) 22 6650 5050  
Fax : (91) 22 2284 0271

## Indonesia

CLSA Indonesia  
WISMA GKBI Suite 901  
Jl Jendral Sudirman No.28  
Jakarta 10210  
Tel : (62) 21 2554 8888  
Fax : (62) 21 574 6920

## Japan

Calyon Securities Japan  
15/F, Shiodome Sumitomo Building  
1-9-2, Higashi-Shimbashi  
Minato-ku, Tokyo 105-0021  
Tel : (81) 3 4580 5533 (General)  
(81) 3 4580 5171 (Trading)  
Fax : (81) 3 4580 5896

## Korea

CLSA Korea  
15/F, Sean Building  
116, 1-Ka, Shinmun-Ro  
Chongro-Ku  
Seoul, 110-061  
Tel : (82) 2 397 8400  
Fax : (82) 2 771 8583

## Malaysia

CLSA Malaysia  
Suite 20-01 Level 20  
Menara Dion  
27 Jalan Sultan Ismail  
50250 Kuala Lumpur  
Tel : (60) 3 2056 7888  
Fax : (60) 3 2056 7988

## Philippines

CLSA Philippines  
19/F, Tower Two  
The Enterprise Center  
6766 Ayala corner Paseo de Roxas  
Makati City  
Tel : (63) 2 860 4000  
Fax : (63) 2 860 4051

## Singapore

CLSA Singapore  
9 Raffles Place, No.19-20/21  
Republic Plaza II  
Singapore 048619  
Tel : (65) 6416 7888  
Fax : (65) 6533 8922

## Taiwan

CLSA Taiwan  
27/F,  
95, Tun Hwa South Road  
Section 2  
Taipei  
Tel : (886) 2 2326 8188  
Fax : (886) 2 2326 8166

## Thailand

CLSA Thailand  
16/F, M. Thai Tower  
All Seasons Place  
87 Wireless Road, Lumpini  
Pathumwan, Bangkok 10330  
Tel : (66) 2 257 4600  
Fax : (66) 2 253 0532

## USA

Calyon Securities (USA)  
Calyon Building  
1301 Avenue of The Americas  
New York, New York 10019  
Tel : (1) 212 408 5888  
Fax : (1) 212 261 2502

## United Kingdom

CLSA (UK)  
12/F Moor House,  
120 London Wall,  
London EC2Y 5ET  
Tel : (44) 207 614 7000  
Fax : (44) 207 614 7070



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