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The Green Economy and the Prosperity of Cities

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List of Abbreviations and Acronyms

BREEAM	Building Research Establishment Environmental Assessment Method
BSD	Bumi Serpong Damai
CC	climate change
CDM	Clean Development Mechanism
CFCs	chloro-flurocarbons
CO_2	carbon dioxide
COP	Conference of the Parties [to the UNFCCC]
CNG	compressed natural gas
ESEE	environmentally focused social economy enterprises
ETS	Emissions Trading Scheme (EU)
EU	European Union
GDP	gross domestic product
GEC	global environmental change
GHG	greenhouse gas
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
LEED	Leadership in Energy and Environmental Design
LPG	liquid petroleum gas
MDGs	Millennium Development Goals
NGOs	non-governmental organizations
OECD	Organization on Economic Co-operation and Development
PIR	passive infrared
PV	photovoltaic
PPP	public-private partnership
RDP	Reconstruction and Development Programme
TRIPS	trade-related intellectual property rights
UK	United Kingdom
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme
UPA	urban and peri-urban agriculture
USA	United States of America

Summary of Key Findings and Messages

Attention to the green economy has mushroomed in recent years owing to the combination of the worldwide recession, the challenge of climate/global environmental change and growing appreciation that, as demonstrated by the landmark 2006 Stern Review Report, taking proactive measures to address climate change would be considerably cheaper than not doing so. Hence green economic investment has become a tool for technological innovation, energy efficiency, employment generation and environmental improvement that simultaneously mitigates (and perhaps provides some forms of adaptation to) climate change. However, as with sustainability, there are many different interpretations of, and approaches to, the green economy, some of which are incremental but others of which require changes to current practices, technologies and lifestyles.

As hubs of economic activity and innovation, as well as now being the dominant human habitat, urban areas have become a key green economic focus. There is no single recipe for greening urban economies but effective and flexible governance of private and public sector institutions appears to be a prerequisite. Market systems tend to deliver socially more effective and equitable outcomes when combined with official incentives and restraints to guide environmental quality, the location, nature and appropriate standards of urban (re-)development and pro-poor provisions. Public-private partnerships may also prove beneficial.

Many green economic measures, including sustainable urban transportation to deployment of renewable energy systems, maximisation of recycling and minimisation of waste, the retrofitting of existing buildings and construction of new and environmentally appropriate green buildings, rehabilitation of natural habitats and the enhancement of ecosystem services have been demonstrated to promote prosperity and climate resilience in very different urban contexts around the world. The links are complex and far broader than merely employment and income generation, relating also to enhanced quality of life as air and environmental pollution and traffic congestion are reduced, green space and recreational areas are expanded and more liveable neighbourhoods and cities designed or remodelled so as to reduce the need for intra-urban travel by encouraging mixed-use zones and more compact designs. Positive externalities from economic greening can have demonstration effects, synergistic impacts and knock-ons in other dimensions or in adjacent areas, thus increasing the overall impact and benefits of interventions.

Nevertheless, such green economic and sustainability transitions are not always straightforward. Conflicts of vision, interest and strategy can prove deep-seated, leading to delays or sub-optimal outcomes. Sometimes, too, positive green interventions have unintended consequences that adversely affect accessibility or equity, such as when enhanced aesthetics or climatic resilience leads to increased land prices and property values in particular areas, thereby displacing poorer residents. Other forms of trade-off have also been documented in the literature. Urban green economic opportunities will not be uniformly distributed; they are likely to be more limited in small and intermediate urban areas and in the poorest countries where infrastructure is smaller in scale and where innovation and production for export are more difficult. Even here, however, locally appropriate technologies and building design, perhaps drawing on relevant aspects of indigenous traditions where they exist, may have valuable potential.

There are also likely to be some employment losses in traditional energy and urban construction sectors that cannot be switched directly into green activities; these must be offset against employment gains from the green economy. It is also important to distinguish between short-term employment opportunities created by one-off green infrastructural construction projects, for example, and long-term employment in the green construction sector (both new build and retrofitting of existing stock), the manufacture, installation and maintenance of renewable energy systems and low-energy equipment, recycling processes and the operation and maintenance of green facilities and associated ecosystem services.

Key conclusions and implications for promoting green economies in cities and hence urban prosperity include:

1. ensuring that green economic strategies are locally appropriate to conditions and socio-cultural values in particular urban areas and their national and regional contexts. Universal ‘silver bullets’ do not exist.
2. successful green economic initiatives draw on collaborations and coalitions between the public, private and non-governmental sectors.
3. education and training are essential to provide the capabilities to exploit new green economic and technological opportunities.
4. international learning networks among cities and particular types of institution are proving invaluable assets, whether organised globally, on a South-South or South-North basis. UN and other agencies can and often do play important facilitatory roles.
5. the greening of urban economies is most effective when the strategies are multi-faceted so that climate/environmental change mitigation and adaptation measures form integral elements rather than being afterthoughts or requiring trade-offs.
6. further work is required to develop comparative and more holistic, integrative analyses and policies to promote urban green economies and greater prosperity.
7. public sector planning and implementing institutions with appropriate capacity and able to undertake effective and responsive governance are essential to the increasingly complex and challenging conditions facing cities and their inhabitants in the context of globalization and climate/environmental change.
8. funding and intellectual property constraints to rapid green economic transitions in poorer countries will need concerted multilateral action in the face of the global economic recession, uncertainties and the need for longer-term planning to ensure greater urban resilience.

1. Introduction

The term 'green economy' first came into circulation during the 1980s as part of the growing conceptual and practical commitment to sustainable development. The 1987 Brundtland Commission (World Commission on Environment and Development) Report, *Our Common Future*,[1] did much to galvanise such thinking on the global stage and among political leaders. The 'green economy' emerged as shorthand for a different kind of economic system that minimises its impact on the environment and promotes sustainable resource utilisation. More formally, it refers to increased efficiency of resource and energy utilisation, so that economic growth and broader development occur with progressively less than proportionate increases in resource and energy use since the conventional trajectory has become untenable. Although very difficult to achieve and certain to involve considerable cost and major lifestyle change, the ultimate goal is zero net energy use and carbon emissions. In other words, economic growth and more broadly based development are 'decoupled' or delinked from the traditional linear increases in resource and energy consumption. Examples include the utilisation of more efficient production and construction technologies and processes; recycling; and attaching economic values to depletion and degradation of resources such as water and clean air so that they are no longer regarded as 'free' resources, as well as to waste products and the costs of dealing with them. Such market-based thinking, centred on internalising the externalities within a neoclassical economic approach contributed substantially to the evolution of 'environmental economics' as a distinct sub-discipline and underlies climate change mitigation initiatives such as emissions trading schemes.

Probably the first explicit book-length account of green economic thinking from this perspective was *Blueprint for a Green Economy*.[2] Together with its four sequels, it found a ready audience in official circles both in the UK and internationally, since it offered a relatively palatable way to address some of the most evident problems of environmental degradation, pollution and biodiversity loss. Most importantly, it was market based and provided the prospect of developing new domestic and international markets where more profound alternatives might challenge the very existence of such markets.

Moreover, at a stroke, environmental 'bads' would be transformed into tradable environmental 'goods'. Indeed, this spawned initiatives ranging from various categories of waste processing contracts to emissions trading schemes at different geographical scales from individual US cities to the European Union's Emissions Trading Scheme (ETS). The record of such schemes is contested, with advocates claiming that they have contributed directly to reducing emissions and critics arguing that they are ineffective palliatives which provide little more than a cover for the continuation of polluting activities. For CO_2 emissions trading efforts, much hinges on the price of carbon; recent reductions in this price have jeopardised the viability of such markets. The Kyoto Protocol's Clean Development Mechanism (CDM) is also underpinned by supposedly emission-reducing investments in poor countries designed to offset emissions in OECD countries in excess of permitted levels. However, the mechanism remains controversial, not least because of verification and compliance difficulties that may provide profitable loopholes.[3] Although the qualifying emissions may originate in urban areas of OECD countries, very few of the CDM investments are urban in focus but pertinent examples are examined below (see Box 4.2).

Following the formal adoption by the G-20 group of leading industrial countries of the green economic approach in 2009, considerable new effort is going into research and development in an effort to promote green transitions. The UN's High-Level Panel on Global Sustainability has given further impetus to such efforts within the UN System; indeed, this Background Paper and the planned State of the World's Cities 2012/3 form part of that momentum.

[1] World Commission on Environment and Development (1987) *Our Common Future*. New York: Oxford University Press.
[2] Pearce, D.W., Markandya, A. and Barbier, E.J. (1989) *Blueprint for a Green Economy*. London: Earthscan.
[3] Bond, P. (2007) Privatization of the Air Turns Lethal: ''Pay to Pollute'' Principle Kills South African Activist Sajida Khan, *Capitalism, Nature, Socialism* 18(4): 6-37.

1.1 The diversity of green economic initiatives

Over time, the nature and diversity of 'green economy' programmes and individual initiatives has increased dramatically. While some constitute carefully designed and implemented initiatives that provide both economic and environmental benefits, others involve barely any change to existing polluting or unsustainable practices. Indeed, the corporate sustainability literature and media advertising are replete with examples of such 'greenwash', i.e., superficial efforts to paint current activities with environmental credentials in order to appear progressive and caring when the reality is the opposite. This phenomenon has generated considerable public scepticism regarding the green economy in many advanced market economies.

More broadly, it is helpful to distinguish between 'weak' and 'strong' green economic initiatives. The former do not require substantial changes to current production processes and other behaviours but which are helpful (such as recycling domestic and commercial waste rather than sending it to landfill, or fitting passive infrared (PIR) sensors to lighting that does not need to burn continuously). By contrast, strong initiatives that involve more substantive changes make a commensurately larger contribution, such as developing cleaner, more resource-efficient production technologies as part of mitigation strategies, or adaptation measures such as redesigning urban areas to foster multifunctional land-use zones and reduce the need to commute and make other single-purpose journeys. It is important to note that 'weak' or 'strong' initiatives could be led by either public or private sectors. Indeed, some of the most promising initiatives have originated from the private sector. For example, Ericsson has been an information and communication technologies industry leader in carrying out Life Cycle Assessments of its products.

Green economies can provide new job opportunities in many cities. Sometimes termed green jobs, these avenues for employment include, for example, construction of green buildings, retrofitting of older buildings to make them more energy efficient, development and implementation of alternative energy systems, and design, production and sales of new types of green products such as hybrid and electric cars, thermal insulation, recyclable and biodegradable packaging, solar-powered lights and street signs, non-toxic solvents and greater use of water-based paints and, at the urban district or city scale, integrated energy systems, combined heat and power systems, and infrastructure planning. As explained below, efforts to promote green jobs are playing a prominent role in economic development plans and strategies in many cities.

Since towns and cities constitute the densest concentrations of both people and industrial and commercial activities, this is where efforts to promote environmental sustainability in economic activities and human lifestyles have multiple co-benefits that go beyond a single sector and should increasingly be prioritised. Urban areas, now home to more than half of the world's population, are traditionally centres of technological, social, and institutional innovation. Harnessing this innovation potential in order to foster green economies is vital to the future prosperity of cities.[4] Indeed, it is no exaggeration to say that green economic innovation and adoption, in combination with broader adaptation strategies, hold the key to enhancing the sustainability and resilience of existing forms of urbanism. New urban areas will need to be designed for sustainable living *ab initio*. At the same time, the green economy can be a framework for redesigning and renovating existing urban areas. This Background Paper provides an overview of the subject, illustrated with examples from cities around the world.

In this Paper, prosperity and development are defined broadly, i.e. they are multifaceted, quantitative and qualitative concepts of wellbeing and quality of life and are not restricted to immediate, quantifiable economic variables like income, employment and the production of goods and services.

[4] Ernstson, H., van der Leeuw, S., Redman, C., Meffert, D., Davis, G., Alfsen, C. and Elmqvist, T (2010) Urban transitions: on urban resilience and human-dominated ecosystems**.** *Ambio,* 39(8): 531-545*,* DOI 10.1007/s13280-010-0081-9.

1.2 The green economy and climate/global environmental change

There is a danger that the multiplicity of priorities demanding the attention of policy makers, officials and the public will deflect or dilute efforts to address them, especially if these are perceived, rightly or wrongly, to be contradictory. In the present context, it is therefore important to state clearly at the outset that there should be no contradiction between efforts to green the economy and to address climate/global environmental change. Ultimately, they should both form complementary and mutually reinforcing elements of the long-term sustainability challenge.

Climate Change (CC) vs Global Environmental Change (GEC): Climate change refers to rising atmospheric greenhouse gas concentrations, themselves triggering increasing mean atmospheric temperatures, changing wind and precipitation patterns and hence climates over the longer term. By contrast, global environmental change is defined as climate change plus other environmental changes that on aggregate affect large areas, e.g., sea level rise, land use and land cover change, loss of biodiversity, and urbanisation. As such it reflects more directly the human impacts and the complex biospheric feedback mechanisms in which anthropogenic changes are enmeshed. This is consistent with the approach of the Intergovernmental Panel on Climate Change (IPCC), which regards climate change as having natural or anthropogenic causes. By contrast, the UN Framework Convention on Climate Change (UNFCCC) defines climate change as directly or indirectly anthropogenic.

Mitigation vs Adaptation: Policies and actions to tackle CC/GEC are generally divided into two categories. Mitigation relates to the reduction of greenhouse gas emissions and/or of vulnerability to the impact of such emissions. Urban examples include switching to low energy light bulbs, using cleaner energy sources and fitting catalytic converters to car exhausts. Adaptation relates to often more challenging changes to lifestyles, livelihoods and urban structure in order to live with the realities of a changing environment and its various implications. Urban examples include planning and developing more compact, multifunctional urban zones to replace unifunctional ones that require extensive private transport use, adopting building construction and design standards and using materials more appropriate to anticipated or prevailing climatic conditions, and the development of efficient and accessible public transport systems to facilitate a shift away from reliance on private motor vehicles.

Unfortunately, mitigation and adaptation are often incorrectly thought of as totally distinct and sometimes even conflicting arenas of policy and action. This may be partly due to the differences in disciplines that address mitigation versus adaptation. Historically, mitigation has primarily focused on engineering or technology approaches to production in order to reduce greenhouse gas emissions, and adaptation has focused on changing human behaviour and consumption. Increasingly, researchers conceive of the two as complementary and synergistic. There is also recognition that mitigation strategies can precede later adaptation actions. Indeed, many mitigation actions facilitate or at least don't hinder adaptation actions. For instance, switching to less polluting motor vehicle fuels may stimulate vehicle design changes that in turn affect use and may integrate with processes to re-engineer roadways and encourage public transport. Instances of conflict do sometimes arise, as when the shift to biofuel use in vehicles and some machinery leads to large-scale clearance of virgin tropical forest or the displacement of food crops in order to undertake the monoculture cultivation of biofuels. In this case, the apparent benefits accrue in urban areas but at a heavy rural cost in terms of loss of biomass and biodiversity and an increase in emissions from clearance and use of mechanical equipment. The carbon sink value of indigenous forest far exceeds that of plantation crops.

One of the key insights from the 2006 report of the Stern Review[5] on the economics of climate change is that – even in purely economic terms – it is far cheaper to tackle CC/GEC than not to. Appropriate positive intervention would cost no more than 1% of global GDP and perhaps yield an increase, whereas doing nothing – the 'business as usual' approach – could cost 5-20% of global GDP. This reflects predicted long-term increases in costs when innovations are delayed, increasing costs of disaster rescue and remediation as well as the

[5] Stern, N. (2007) *The Economics of Climate Change; the Stern Review*. Cambridge: Cambridge University Press.

loss of assets and productive capacity through the various environmental impacts, and the loss of the economic opportunities provided by mitigation and adaptation initiatives and the associated innovations. Hence, in the previous examples, the innovation, development and marketing of low energy light bulbs, or of cleaner burning motor fuels, represent large and highly profitable economic opportunities that would simply not have arisen in the absence of such imperatives and initiatives. Similarly, increasing the extent and geographical distribution of green urban spaces and recreation areas – the literal greening of urban areas – on aesthetic and public health grounds simultaneously adds to their urban carbon sequestration capacity and helps reduce heat island effects.

The same applies to other categories of economic greening – which underlines the point made above about CC/GEC mitigation and adaptation being one category of sustainability promotion. Importantly, this perspective opens new terrain, demonstrating the business and economic opportunities represented by mitigation and adaptation, and giving the lie to traditional claims that economic development and employment creation conflict with environmental conservation and sustainability. Indeed, many cities are recognizing the need to bundle mitigation and adaptation efforts into their broader economic development plans and policies.[6] This is not to suggest that transitions to low-carbon economies in cities, especially in transitional economies and low-income countries, will be costless. Investments in new construction and heating/cooling systems; integrated, multimodal public transport and hybrid or electric vehicles for public sector vehicle fleets and the like are lumpy and often initially expensive, especially if protected by patents and other forms of restrictive intellectual property rights. This is why the establishment and maintenance of a transition fund to assist low-income countries in 'going green' is an important element of the protracted negotiations over a successor to the Kyoto Protocol, which expires in 2012. However, the urgency of the energy transition is now very widely accepted, even among governments of low-income countries. There are also many new employment opportunities – even for semi- and unskilled workers – in green economic initiatives, from infrastructure upgrades to the rehabilitation and expansion of wetlands and other environmental projects to help green cities and enhance the effectiveness and sustainability of ecosystem services. Crucially, therefore, unemployment and poverty can no longer be seen as short-term priorities that trump environmental concerns and sustainability.

A substantial issue with regard to the urban green economy is an accounting one: how to draw the system boundaries around a city? That is, how does one account for the energy and materials use within a city? Does it include only the energy or materials used within the city boundaries, or should a green economy also consider the energy and resources used to produce the items used within a city? Defining different system boundaries would result in widely varying results. For example, some studies show that by accounting for the energy used to manufacture building and infrastructure materials, some 'green' buildings and 'green' infrastructure are not as energy efficient as previously thought.[7]

The remainder of this Background Paper comprises five sections. Section 2 examines how and why cities are key engines of the economy and drivers of green economic transition. This focuses on population concentrations, the role of cities in technological and economic innovation, and the intensity of emissions and other contributors to environmental change that require mitigation and underline the need for adaptation. Section 3 addresses links between the green economy and economic prosperity, expanding on some of the points made above about the opportunities provided by transitions to low-carbon economies. Section 4 pursues this line of reasoning at the city scale by explaining the particular urban opportunities and potentialities of the green economy with particular reference to quality of life and prosperity. Pertinent examples are illustrated in separate text boxes. Section 5 then explores the factors that determine the extent to which greening the economy can contribute to urban prosperity.

[6] Seto, K., Sánchez-Rodríguez, R., Fragkias, M. (2010) 'The new geography of contemporary urbanization and the environment'. *Annual Review of Environment and Resources,* 35: 167-194. doi: 10.1146/annurev-environ-100809-125336; Simmie, J. and Martin, R. (2010) 'The economic resilience of regions: towards an evolutionary approach'. *Cambridge Journal of Regions, Economy and Society,* 3:27-43.

[7] Huang, S.-L. and Hsu, W.-L., (2003) Materials flow analysis and energy evaluation of Taipei's urban construction, *Landscape and Urban Planning* 63(2): 61-74; Güneralp, B. and Seto, K. C., (2012) Can gains in efficiency offset the resource demands and CO_2 emissions from constructing and operating the built environment? *Applied Geography* 32(1): 40-50.

Finally, Section 6 comprises the conclusions that draw together the main threads of the argument.

2. Why Cities are Key Drivers of the Green Economy

Cities today have a key role in driving the green economy as primary spaces for consumption of energy and resources but also as the spaces for the generation of innovative thinking for sustainable economies. Urban areas contain the majority of the world's population and account for some 60 – 80% of total global energy consumption,[8] but per capita urban energy consumption is often lower than national averages[9] due to a combination of factors such as economies of scale and levels of economic development. In many parts of the world, urban expansion is transforming agricultural land and natural ecosystems, resulting in altered local climates and habitat losses. Cities have become engines of economic growth, albeit often at great cost in terms of unsustainable resource consumption and waste generation overall and per capita. But as spaces for sustainable governance of production, consumption and distribution of goods and services, cities can reduce fossil fuel based energy consumption and promote renewable energy consumption.

As the green economy increasingly operates within an understanding of planetary boundaries, integrating the economic and social effects of global warming and incorporating the value of ecosystem services, the role of cities in addressing challenges but also offering solutions will become more prominent. The sustainability challenges and opportunities that arise from urbanization, affecting the functioning of green economies, will depend in large part on how and where urban areas grow, on urban lifestyles and consumption patterns, and on the ability of institutions and governance structures to address these issues.

2.1 How urban areas present challenges for the functioning of a green economy

The geography of urbanization, namely the spatial extent and locations where urbanization is occurring, is changing rapidly and in multiple dimensions.[10] The same is true of the economics of urbanization, linked to technological change, processes and patterns of globalization and rapid changes in comparative advantage. These changes in the characteristics of contemporary urbanization are fundamentally transforming the relationship between cities and the global environment and consequently the potential for the functioning of a green economy. Today it is clear that urbanization is occurring faster and at larger volumes in locations that are at less technologically sophisticated stages of economic development and face rapid demographic changes. City systems will continue disproportionately to affect ecologically-fragile areas and contribute to the loss of agricultural land compared to other systems. Rapid urban growth is expected in coastal and arid ecosystems, which are particularly sensitive to the effects of climate change.[11]

While the progressive international urban agenda has recently moved rapidly towards issues related to global environmental change, it is important to bear in mind that urbanization hotspots have not been addressed successfully and often still lack infrastructure such as durable housing, access to improved water, key resources and sanitation while being overcrowded, with high levels of unemployment and social exclusion.[12] Institutional settings in such hotspots are weak, lacking the rule of law, accountability and faced with rampant corruption. All the above factors, operating in concert with climate change impacts create 'stress bundles' that increase the probability of dangerous global environmental change. These multifaceted problems and the way they impact the prospects over a green economy in urban environments differentially are addressed in detail in Sections 3 and 4.

[8] IIASA (2011), 'Chapter 18: Urbanization,' *Global Energy Assessment,* Cambridge: Cambridge University Press.
[9] Dodman, D. (2009) 'Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories,' *Environment and Urbanization* 21(1): 185-201.
[10] Seto, K., Sánchez-Rodríguez, R., Fragkias, M. (2010), *ibid.*
[11] McGranahan G., Balk, D. and Anderson, B. (2007) The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones, *Environment & Urbanization,* 19(1)**:** 17-37.
[12] McGranahan, G., Jacobi, P., Songsore, J., Surjadi, C. & Kjellen, M. (2001) *The Citizens at Risk: from urban sanitation to sustainable cities,* London: Earthscan.

Much has been written about the demographic characteristics of contemporary urbanization at regional and global scales.[13] The massive demographic changes that the world is currently experiencing through differing rates of natural increase and net migration are crucial in terms of linking up the geopolitical realities and also prospects for rapid transitions to low carbon cities and economies in the respective contexts. In the span of the last two centuries, the number of cities with populations of one million or greater grew from one to 442 in 2010.[14] As of 2011 there are 45 such cities in India and 88 in China. By 2025, there will be more than 600 cities of one million or more worldwide.[15] Between 2009 and 2050, the world's urban population is expected to increase from 3.4 billion to almost 6.3 billion.[16] The green economies of the future will be to a large extent the economies of a planet consisting primarily of urban dwellers. Although impressive, global urban population trends are not as rapid as the trends of physical urban development (see below).

New research shows that larger populations in urban areas present sustainability advantages and thus facilitate the functioning of green economies.[17] In addition to the economies of scale in terms of providing infrastructure, education, health care and sanitation services at lower unit cost, there is evidence of increasing returns to innovation and wealth creation as urban areas become larger.[18] Assuming that a portion of that innovation will be directed towards responding to global environmental change, larger urban agglomerations have higher chances of providing solutions for sustainability through new technological tools and novel institutional arrangements. Using a scaling relationship between population and CO_2 emissions for US metropolitan areas, researchers have discovered that a 1% increase in population (or economic output) is associated with only a 0.92% (or 0.79%, respectively) increase in CO_2 emissions.[19] Given rapid urbanization, it not surprising that a recent calculation using a production-based analysis estimates that urban areas contribute approximately 30 – 40% of total anthropogenic greenhouse emissions - while, in contrast, a consumption-based analysis puts urban contributions at 60% of total, with a few wealthy cities contributing a majority of the emissions.[20]

Although the demographic characteristics of contemporary urbanization are well covered, less has been written about the interactions between the social and the physical dimensions of urbanization and the bidirectional feedback between urbanization and global change.

The physical process of urbanization—the conversion of land to urban uses—is also less well understood, especially at global scales, but also a critical component in the set of interacting factors driving the urban challenges to a green economy. Urbanization today is not a homogeneous process.[21] Recent studies report a significant increase in land requirements for urban uses in the next 40 years – potentially an added 1 to 2 million square kilometres.[22] This increase is expected to occur primarily in sprawled patterns,[23] with significant effects on emissions of GHG, air pollution and waste management. Assuming that densities will remain the same in more-developed countries, urban land cover is predicted to grow by 29% between 2000 and 2050. However, if densities drop by 1% per annum, urban land cover is expected to grow by 113%. The situation in poorer countries is particularly dire. For example, urban land cover in sub-Saharan Africa is expected to expand at the fastest rate – a 12-fold

[13] Cohen, B. (2004) Urban growth in developing countries: A review of current trends and a caution regarding existing forecasts, *World Development* 32(1): 23-51.
Montgomery, M.R. (2008) The urban transformation of the developing world, *Science* 319: 761-4
[14] United Nations. (2010) *World Urbanization Prospects: The 2009 Revision*, New York: United Nations.
[15] United Nations (2010), *ibid.*
[16] United Nations (2010), *ibid.*
[17] Bettencourt, L.M.A., Lobo, J., Helbing, D., Kuehnert, C. and West, G.B. (2007) Growth, innovation, scaling and the pace of life in cities. *Proceedings of the National Academies of Science* 104: 7301-6.
[18] Bettencourt, L.M.A., Lobo, J. and Strumsky, D. (2007) Invention in the City: Increasing Returns in Patenting as a Scaling Function of Metropolitan Size. *Research Policy* 36: 107-20.
[19] Lobo, J., Strumsky, D., Bettencourt, L.M.A.. (2009) *Metropolitan Areas and CO2 Emissions: Large is Beautiful*, Toronto: Rotman School of Management, University of Toronto.
[20] Dodman, D. (2009) Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. *Environment and Urbanization* 21: 185-201.
[21] Seto et al., (2010), *ibid*.
[22] Seto, K., Fragkias, M., Guneralp, B. and Reilly, M. (in press), A meta-analysis of global urban land-use change, PLoS one
[23] Angel, S., Parent, J., Civco, D.L. and Blei, A.M. (2010) *Atlas of Urban Expansion*, Cambridge, MA: Lincoln Institute of Land Policy, Online at http://www.lincolninst.edu/subcenters/atlas-urban-expansion/.

increase for the same period. In general, assuming that densities in developing countries decline by only 1% per annum on average, urban land cover is expected to grow by 326% between 2000 and 2050.[24] Notwithstanding the urban densification projects that are increasingly taking place in 'western' countries, the trend of expansive low density urban development could be reversed through policy interventions, urban design and rising prices of non-renewable resources or other unforeseen events and processes.

The rate and scale of physical urban expansion present challenges and opportunities for the green economy. On the one hand, the magnitude of new urban development will require substantial investments in transportation infrastructure, construction of the built environment, and materials and energy use, thereby allowing for incorporation of green products and services. At the same time, the rapid rate of development also means that it may be difficult for new and emerging technologies and engineering approaches to be applied on a large scale. We are witnessing this firsthand in China, for instance, where the sheer scale of urban development overwhelms small and local scale attempts at applying green economy approaches.[25]

At the local scale, urban form affects energy consumption across a range of urban land uses. Factors defining the ways through which the spatial configuration of the built environment affects energy use[26] include residential density,[27] private automobile use and travel demand,[28] public transportation options,[29] home energy use,[30] and the composition of industries and sectors.[31] Recent US National Research Council report findings suggest that overall compact urban development coupled with high residential and employment densities can reduce both total and per capita energy consumption, vehicle miles travelled, and carbon dioxide emissions.[32] The report validates in part findings for cities in Europe, the US[33] and China[34] among others but important points of departure given specific contexts need to be further explored in the future. In addition to the link between urban form and energy use, the spatial form of cities also affects wildlife habitat and agricultural land. Worldwide, urban expansion is one of the primary drivers of habitat loss and species extinction.[35] In the United States, expansion of residential housing development is a major threat to protected areas.[36] The expansion of the built environment and impervious surfaces has rapidly destroyed, fragmented, or invaded natural ecosystems in many low- and middle-income countries, including Chile,[37] Mexico[38] and the Congo.[39] Cities are thus affecting the functioning of green

[24] Angel, S., Parent, J., Civco, D.L., Blei, A.M., and D. Potere, (2010) A Planet of Cities: Urban Land Cover Estimates and Projections for All Countries, 2000-2050, Lincoln Institute of Land Policy Working Paper.
[25] Liu, J. & Raven, P. H. (2010) China's Environmental Challenges and Implications for the World. *Critical Reviews in Environmental Science and Technology,* 40**:** 823-851.
[26] Hankey, S., and Marshall, J. D. (2010). Impacts of urban form on future US passenger-vehicle greenhouse gas emissions. *Energy Policy*, 38(9): 4880-4887.
[27] Norman, J., MacLean, H., and Kennedy, C. A. (2006). Comparing high and low residential density: A life-cycle analysis of energy use and greenhouse gas emissions, *Journal of Urban Planning and Development*, 132(1): 10-21.
[28] Anderson, W. P., Kanaroglou, P. S., and Miller, E. J. (1996) Urban form, energy and the environment: A review of issues, evidence and policy, *Urban Studies* 33(1): 7-35.
Vance and Hedel 2008 Vance, C. and Hedel, R. (2008) On the Link Between Urban Form and Automobile Use: Evidence from German Survey Data, *Land Economics* 84(1): 51-65.
[29] Kenworthy, J. and Laube, F. (1999) A global review of energy use in urban transport systems and its implications for urban transport and land-use policy, *Transportation Quarterly* 53(4): 23-48.
[30] Bin, S. and Dowlatabadi, H. (2005) Consumer lifestyle approach to US energy use and the related CO_2 emissions, *Energy Policy* 33(2): 197-208.
[31] Bullard, C. W. and Herendeen. R.A. (1975). The energy cost of goods and services,*Energy Policy* 3(4): 268-278.
[32] National Research Council. 2009. Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO_2 Emissions. Washington, DC: The National Academy of Sciences pp.
[33] Mindali, O., Raveh, A. & Salomon, I. (2004) Urban density and energy consumption: a new look at old statistics. *Transportation Research Part A: Policy and Practice,* 38**:** 143-162.
[34] Chen, H., Jia, B. & Lau, S. S. Y. (2008) Sustainable urban form for Chinese compact cities: Challenges of a rapid urbanized economy. *Habitat International,* 32**:** 28-40.
[35] Hahs, A. K., McDonnell, M.J., McCarthy, M.A., Vesk, P.A., Corlett, R.T., Norton, B.A., Clemants, S.E., Duncan, R.P., Thompson, K., Schwartz, M.W., and Williams, N.S.G.. (2009) A global synthesis of plant extinction rates in urban areas. *Ecology Letters* 12(11): 1165-1173.
[36] Radeloff, V. C., Stewart, S.I., Hawbaker, T.J., Gimmi, U., Pidgeon, A.M., Flather, C.H., Hammer, R.B. and Helmers, D.P. (2010) Housing growth in and near United States protected areas limits their conservation value, *Proceedings of the National Academy of Sciences of the United States of America* 107(2): 940-945.
[37] Pauchard, A., Aguayo, M., Peña, E., and Urrutia, R. (2006) 'Multiple effects of urbanization on the biodiversity of developing countries: the case of a fast-growing metropolitan area (Concepción, Chile),' *Biological Conservation* 127(3): 272-281.

economies through the degradation of ecosystem services, services that will have to be priced in the context of green economies.

Energy efficiency improvements can be obtained both through new construction with efficient materials and good insulation, and through the retrofitting of insulation and efficient lighting/heating – as achieved in Germany and other European countries. The United Nations Economic Commission for Europe (UNECE) has played a leading role in recent years in raising awareness and creating a platform for such work in the transitional economies of central and eastern Europe.[40] Notwithstanding the benefits of such initiatives in reducing overall energy consumption, new evidence suggests that the gains in energy efficiency at the building scale could be offset by increases in the magnitude of urban expansion.[41] Similar challenges exist in relation to the sustainable provision and conservation of water, where reuse of grey water for toilet flushing, garden watering or irrigation and recycling, as well as demand abatement measures (e.g., low-flow shower heads, reducing the size of toilet cisterns, not filling baths completely), reducing leakage from pipe systems and introduction of waterless toilets[42] in new urban construction (especially in arid and semi-arid areas) could make a substantial difference. Leaks from aged underground water pipes are problematic in many contexts where cast-iron pipes were installed during the Victorian era or early decades of the last century and have long outlived their design life, a problem exacerbated by vibrations from the increased volume and weight of traffic on the roads above them. In extreme cases, up to a quarter of purified water may therefore be wasted between treatment plants and consumers. Many cities in temperate zones across North America, Europe and Russia, where seasonal freezing and thawing of the ground is an additional contributory factor, are currently undertaking extensive renewal programmes at great expense, much of it having to be recouped from consumers via higher water tariffs. However, Australasian cities and the older parts of cities across the ex-colonial world have similar challenges, albeit often with rust replacing frost as a key erosive force; the cost implications are particularly serious where low-income consumers represent a substantial proportion of the population.

2.2 How cities can drive solutions, pathways and policies towards a green economy

Higher population densities bring about the opportunity for interactions and exchange of ideas, a critical aspect of the process of innovation. Cities thus become spaces of institutional and technological innovation – processes that drive economic growth. As global environmental bads (negative impacts, the opposite of environmental goods and services) begin to be priced (due to increased flows of more precise information), innovation processes in cities will be increasingly connected to green economic goals. But cities can also operate as green technology laboratories from the standpoint of government as eco-innovation becomes a strategic target of a green economy and is promoted by local governments.

We must recognize that several issues of international political economy complicate matters of innovation and the greening of economies. Industrial restructuring and changing international divisions of labour have often meant relocating older, less efficient and more polluting plants to low-income cities, thus creating pollution hotspots in the global South, especially when accompanied by rapid population and motor vehicle growth. This occurred on a vast scale during the deindustrialization of Europe and North America during the late 1970s and 1980s,[43] when heavy industrial plant was often dismantled in industrial cities of the USA, UK and elsewhere and shipped to rapidly growing cities like Bangkok, Jakarta, Kuala Lumpur and Shanghai in newly industrializing countries, where labour and other input costs were

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[38] Lopez, E., Bocco, G., Mendoza, M. and Duhau, E. (2001) 'Predicting land-cover and land-use change in the urban fringe in Morelia city, Mexico,' *Landscape and Urban Planning* 55(4): 271-285.
[39] Wilkie, D., Shaw, E., Rotberg, F., Morelli, G., and Auzel, P. (2000) 'Roads, development, and conservation in the Congo Basin,' *Conservation Biology* 14(6): 1614-1622.
[40] See the various resources at http://www.unece.org/hlm/prgm/hmm/welcome.htm#energyefficiency
[41] Güneralp, B. and Seto, K. C., (2012) Can gains in efficiency offset the resource demands and CO_2 emissions from constructing and operating the built environment? *Applied Geography* 32(1): 40-50.
[42] Cooke, J. (2009) Waterless toilet systems. http://www.uttlesford.gov.uk/documents/website%5CClimate%20Change%5CSHN%20Downloads%2FWaterless%20Toilet%20Systems.pdf, accessed 2 August 2011.
[43] Dicken, P. (2011) *Global Shift; Mapping the changing contours of the world economy*, Sixth Edition. London: Sage/ New York: Guilford.

lower. This process can create the illusion of green cities in the global North when one looks at the consumption side and not the production side of a local economy or the overall product or commodity chain. Several international policies create a complex landscape for the diffusion of innovations that arise from urbanization. Intellectual property rights protection measures assist in the process of technological change but also block technology transfer that would be important in promoting a transition to greener, more sustainable low-carbon economies in poorer countries. The elimination of CFC gases from aerosol spray cans and refrigerators in terms of the Montreal Protocol is a good example of how an initial stumbling block was overcome through international treaty and technological transfer to China and other key producers.[44] Hence, international agreements reached at COP16 in December 2010 and hopefully to be progressed at COP17 in December 2011 must take account of intellectual property rights agreements such as TRIPS and other restrictions on the adoption of new, low-carbon technologies, and provide a realistically sized fund to assist adoption/transition.

A green market economy will require a solid set of institutions and governance structures to enable restructuring of economic activity. Outside of national guidance, such institutions can be provided through good urban governance.[45] Through globalization, democratization and new economic development plans, the emergence of decentralized governance has increased the emphasis on the role and abilities of cities to govern themselves. At least in theory, this allows for better-informed social choice (such as the establishment and greening of public utilities and infrastructure, the greening of public transportation, urban development densification, realistic growth expectations and slum alleviation) and more effective and sustainable use of local resources (such as protecting ecosystem services and fragile lands). However, there are major differences between and within regions and individual countries. Hence, for example, within Brazil there are 'model cities' of sustainable urban planning and integrated public transport (e.g., Curitiba) and participatory urban budgeting (e.g., Porto Alegre) but also former industrial pollution hotspots like Cubatão, the environmental rehabilitation of which provides some instructive lessons.[46]

Effective urban governance is crucial to the establishment and functioning of a green economy given the complex interactions between urbanization and the local, regional and global environment. Cities can operate as spaces for pursuing, implementing and monitoring green growth strategies, policies and standards through regulatory interventions. It is important, also, that cities examine the respective context and regional differences that can lead to differential success of such interventions. Achieving good urban governance can further promote mitigation and adaptation actions but also create a push for economic development, addressing climate change at a fundamental level. Governance will also have to be adaptive: cities can become new policy laboratories and response generators.

Good urban governance is critical for a green economy in order to ensure the necessary accountability and transparency mechanisms to incentivize the green transition and gain wide acceptance among key stakeholders and the population at large. Various theoretical concepts can be used for pinpointing good governance at the level of the city: a local government's ability to provide adequate public services to its citizens (capacity), raising and managing sufficient revenue (financial), coping with the variation, fragmentation and inequity within cities (diversity), dealing with rising urban violence and crime (security); dealing with increasing complexity in managing the jurisdictional mosaic as cities grow in population and extent (authority), sharing responsibility and co-ordinating for the empowerment and linking of actors in different levels of government, (responsibility sharing and co-ordination), offering wide

[44] Andersen,S.O., Sarma, K.M. and Taddonio, K.N. (2007) *Technology transfer for the ozone layer: lessons for climate change*. London: Earthscan.
[45] Bulkeley, H. (2010) Cities and the Governing of Climate Change, *Annual Review of Environment and Resources*, 35: 229-253 DOI: 10.1146/annurev-environ-072809-101747.
[46] Gret. M. and Sintomer. Y. (2005) *The Porto Alegre Experiment; Learning lessons for better democracy*. London and New York: Zed Books.
Moore, S.A. (2007) *Alternative Routes to the Sustainable City: Austin, Curitiba and Frankfurt*. Lanham, MD: Lexington Books.
Rabinovitch, J. (1992) Curitiba: towards sustainable urban development, *Environment and Urbanization*, 4(2): 62-73. doi: 10.1177/095624789200400206
De Mello Lemos, M. C. (1998) The politics of pollution control in Brazil: State actors and social movements cleaning up Cubatão, *World Development*, 26(1): 75-87.

participation in strategizing for understanding and consensus building and motivating actions and efforts for progress assessment (participatory governance) and networks for communications and capacity-building among practitioners and stakeholders (network building).[47]

Effective urban governance can either lead or respond to public opinion by providing incentives to promote greening of urban economies through use of subsidies and tax incentives, particular consumption mandates and public sector procurement arrangements. High-density living presents sustainability challenges in terms of the scale and intensity of resource use and pressure on green spaces but does simultaneously provide opportunities for a move towards the consumption and production of green products through increased consumer awareness, leading to both informal and formal norm and behavioural change.

Some dramatic examples exist in Chinese cities, where the government has recently adopted radical plans for enhanced sustainability and green economic development (see Section 3 below). Progressive city authorities in Nanjing, for instance, have transformed one of the oldest continuously inhabited cities in the world into a well integrated, cleaner, greener and far more liveable place for its seven million inhabitants in just a few years, Their ability to do this reflects resource availability generated by central grants and increased living standards but also symbolizes forward-looking governance which recognises that quality of life and urban efficiency hold the key to future inward investment and sustained prosperity in the contemporary world.

Good urban governance can also come about by paying attention to the problems of fit/match, scale and interplay of (political) institutions as they interact with the Earth system as well as the dimensions of architecture, agency, adaptiveness, accountability, access and allocation at the urban scale of global governance.[48] Furthermore, cities can promote participatory urban governance using adaptive and resilience-building management approaches favouring flexible, open to learning, management that can build resilience and avoiding rigidities that could result in the breakdown of socio-economic systems.

It is also important to consider other pathways through which cities can move towards a green economy. One such pathway is the involvement of the private sector in the provisioning of public goods into public-private partnerships (PPPs). Private sector involvement in public infrastructure is not new, with a substantial experience accumulated of past successes and failures.[49] As suggested above, local or national governments may not be capable of fully addressing needs for the greening of public infrastructure investments in a massively and rapidly urbanizing world. This may be due to needs for substantial levels of innovation and efficiency that the public sector may lack. Thus, private sector-led initiatives may become attractive as a mode of green infrastructure provision. Such a move gives rise to obvious economic challenges of aligning incentives and goals as well as the consideration of issues of economic viability of projects for the private sector due to long project time horizons (including design, construction, operation, and maintenance of assets).[50]

3. Links between the Green Economy and Urban Prosperity

If we define urban prosperity broadly beyond economic measures to include quality of life, equity, and social inclusion, studies show a definite link between the green economy and urban prosperity. Across many cities, sustainable urban transport planning is expected to reduce poverty through increasing the mobility of the urban poor and providing more access

[47] Redman, C. L., & Jones, N. S. (2005). The environmental, social, and health dimensions of urban expansion. *Population and Environment, 26*(6), 505-520.
[48] Biermann, F., M. M. Betsill, J. Gupta, N. Kanie, L. Lebel, D. Liverman, H. Schroeder, and B. Siebenhüner, with contributions from K. Conca, L. da Costa Ferreira, B. Desai, S. Tay, and R. Zondervan. 2009. *Earth System Governance: People, Places and the Planet. Science and Implementation Plan of the Earth System Governance Project*. Earth System Governance Report 1, IHDP Report 20. Bonn, IHDP: The Earth System Governance Project.
[49] Harris, C. (2003) Private Participation in Infrastructure in Developing Countries: Trends, Impacts and Policy Lessons. *World Bank Working Paper No. 5.* Washington, DC: World Bank.
[50] Koppenjan, J. F. M. & Enserink, B. (2009) Public–Private Partnerships in Urban Infrastructures: Reconciling Private Sector Participation and Sustainability. *Public Administration Review,* 69**:** 284–296.

to services, jobs, and social networks. Numerous studies make a connection between sustainable transportation policy and poverty alleviation.[51] For example, studies of the links between social equity and transport policies in Karachi and Beijing have found that investments in transport infrastructure that favour private cars over public transport options can create and in some cases exacerbate social inequities.[52] Since mobility is vital for accessibility for employment and social services such as education and health, unaffordable transportation and inadequate access to public transportation can create physical and financial barriers for social inclusion.[53] Similar conclusions have been made for Delhi, where studies find that sustainable transport policies may reduce air pollution, greenhouse gas emissions and poverty. As in Karachi and Beijing, the expectation is that increasing accessibility for the urban poor will increase economic opportunities and thereby reduce poverty. Model simulations of the links between urban transport and emissions in Delhi find that increasing passenger transport capacity would reduce greenhouse gas emissions and urban pollutants such as sulphur dioxide, while simultaneously reducing poverty through increasing the mobility of the urban poor and providing more access to services and economic opportunities.[54]

One effect of the green economy is cleaner energy use in urban areas, which in turn is expected to reduce air pollution and reduce income inequality.[55] Quantitative studies of urban air pollution and income equality in China's cities find that reducing air pollution can also improve welfare distribution because the most negative consequences of pollution have been found to be experienced by the poorest inhabitants, including substantial health costs.[56] Across cities in low income countries, it is often the urban poor who use the dirtiest forms of energy such as coal and woodfuel. In Amman, Jordan, the poorest communities also suffer a triple environmental threat. They are often located in places that pose outdoor environmental health risks and at the same time these households use dirtier and less efficient fuels and, partly as a result, are exposed to high levels of pollutants in their homes.[57] In 2000, 579 million people in India did not have access to electricity, representing 35% of the world total.[58] One effect of limited electricity access is that there will be opportunities to use a green economy framework to both increase energy access and construct energy infrastructure.

Recent research suggests that local climate change adaptation and mitigation efforts, including green infrastructure such as green roofs, urban forestry, and water conservation can enhance urban resilience, urban prosperity, and urban sustainability.[59] Resilience refers to the capacity of social systems to absorb environmental shocks and the degree to which the system can learn and adapt.[60] Specifically, investments in green infrastructure create benefits in land values, public health, quality of life, hazard mitigation, and regulatory compliance.[61] For example, green roofs can reduce the urban heat island effect while simultaneously reducing noise pollution and making the ambient temperature inside more comfortable. Another concept of urban resilience is related to how cities integrate concepts of security and

[51] Gupta, S., N. Ranganathan, and Iabse, *Role of urban transport in poverty reduction*. IABSE Conference New Delhi, India 2005 - Role of Structural Engineers Towards Reduction of Poverty. 2005, Zurich: Iabse-Aipc-Ivbh. 409-414. Thynell, M., Mohan, D. and Tiwari, G. (2010) Sustainable transport and the modernisation of urban transport in Delhi and Stockholm. *Cities*, 27(6): 421-429.

[52] Ahmed, Q.I., Lu, H.P. and Ye, S. (2008) Urban transportation and equity: A case study of Beijing and Karachi. *Transportation Research Part A-Policy and Practice*, 42(1): 125-139.

[53] Kenyon, S., Lyons, G. and Rafferty, J. (2002) Transport and social exclusion: investigating the possibility of promoting inclusion through virtual mobility, *Journal of Transportation Geography,* 10: 207-219.

[54] Han, J., Bhandari, K. and Hayashi, Y. (2010) Assessment of Policies toward an Environmentally Friendly Urban Transport System: Case Study of Delhi, India. *Journal of Urban Planning and Development*, 136(1): 86-93.

[55] Brajer, V., Mead, R.W. and Xiao, F. (2010) Adjusting Chinese income inequality for environmental equity*, Environment and Development Economics*, 15: 341-362.

[56] Ho, M.S. and Nielsen, C.P. (eds) *Clearing the Air: The Health and Economic Damages of Air Pollution in China*. 2007, Cambridge, MA: MIT Press.

[57] Jaber, J.O. and Probert, S.D. (2001) Energy demand, poverty and the urban environment in Jordan. *Applied Energy*, 68(2): 119-134.

[58] Bhattacharyya, S.C., (2006) Energy access problem of the poor in India: Is rural electrification a remedy? *Energy Policy*, 34(18): 3387-3397.

[59] Center for Clean Air Policy (2011) *The value of green infrastructure for urban climate adaptation*. Washington, DC: Center for Clean Air Policy.

[60] Adger, W.N. et al. (2005) Social-ecological resilience to coastal disasters*, Science* 309(5737): 1036-1039.

[61] Center for Clean Air Policy (2011) *The value of green infrastructure for urban climate adaptation*. Washington, DC: Center for Clean Air Policy.

risk management into urban planning, governance, and the built environment.[62] In this case, investments in green infrastructure may create mutual synergies between creating both a 'green' and a 'secure' city.[63] For example, energy efficient buildings help make a city more resilient to disruptions in energy supply and other civic services. In other words, strategies to create a more environmentally and socially resilient city may also result in a city more resilient to terrorism and other security concerns.

Overall, very recent initiatives to construct model green cities in several Asian countries demonstrate that local authorities and private consultants and developers are beginning to buy-in at forward-looking level to green economic ideas and the fundamental importance of developing low-carbon, energy efficient and sustainable forms of urbanism (Box 3.1).

Box 3.1 Construction of new green cities

Just as many new forms of hyper-modern urbanism, epecially in water-scarce areas, such as the United Arab Emirates, appear to pay little heed to sustainability imperatives, several entirely new model green or eco-cities are planned or under construction. Designed holistically as integrated, high-tech and energy efficient systems, they utilise green technologies and aspire to low-carbon or even carbon neutral living. Two prominent examples are Dongtan, on Chongmin Island off Shanghai, and Gangneung in South Korea. Dongtan was designed by Arup consultants under contract to Shanghai Industrial Investment Corporation but construction has been delayed and has not yet begun. The plan is to reduce the population's per capita ecological footprint to 2.2 ha, one-third of that in Shanghai itself, through energy efficiency and behavioural change. Gangneung was begun in 2009 with an initial target population of 19,000 and future growth guided by a long-term master plan that embeds green principles. Watershed restoration and ecosystem conservation are central features, and all facilities have to comply with green design principles, including the industrial area, convention centre and integrated, multimodal transport system. It is expected to generate three times more wealth in the area than its total construction costs, and will serve as a testbed for new Korean green technologies.[64]

3.1 Connections between the green economy and Millennium Development Goals

The Millennium Development Goals (MDGs) aim to reduce poverty, with clearly established targets across eight general components. The MDGs range from ending the spread of HIV/AIDS to providing primary education worldwide. Although the MDGs are fundamentally development goals to improve livelihoods, there are clear linkages between environmental sustainability and poverty reduction.[65] A green economy can be both pro environment and 'pro poor'.[66] For example, investments in green energy can be an alternative to dirty energy, which in turn can improve health, livelihoods and living conditions. A central component in the MDGs is the provision of infrastructure such as roads, schools, and hospitals. There are potential synergies between a green economy and achieving the MDGs if strategies to build green infrastructure address poverty alleviation and increased access to infrastructure explicitly and in gender-sensitive ways.[67]

As explained in more detail above, in China, low urban air quality disproportionately hurts the poor because of where they live. As such, reducing air pollution through cleaner energy

[62] Coaffee, J. (2008) Risk, resilience, and environmentally sustainable cities. *Energy Policy*, 36(12): 4633-4638.
[63] *ibid.*
[64] Dongtan: the world's first large-scale eco-city? http://sustainablecities.dk/en/city-projects/cases/dongtan-the-world-s-first-large-scale-eco-city, accessed 3 August 2011; UN-HABITAT (2011) *What does the Green Economy Mean for Sustainable Urban Development?* Report of an Expert Group Meeting, 17-18 February, Tribe Hotel, Nairobi: 18-19.
[65] Sachs, J.D. et al. (2009) Biodiversity Conservation and the Millennium Development Goals. *Science*, 325 (5947): 1502-1503.
[66] Urban, F. (2010) The MDGs and Beyond: Can Low Carbon Development be Pro-Poor? *IDS Bulletin*, 41(1): 92-99.
[67] Fay, M., et al. (2005) Achieving child-health-related Millennium Development Goals: The role of infrastructure. *World Development*, 33(8): 1267-1284.

investments would reduce inequality and improve health.[68] In Cape Town, South Africa, retrofitting of home insulation and installation of solar heating on homes of the poor in a low-income township have had marked health benefits during cold winters, also thereby enhancing income-earning potential and reducing expenditure on medicines (see Box 4.2). This illustrates the potential importance of co-benefits that affect the ability of people and communities to meet their basic needs and thus the MDGs.

Having introduced the existence and nature of links between the green economy and urban prosperity in this Section, we now turn to explore in greater detail the mechanisms and channels through which the adoption of green economic principles and instruments can contribute to urban prosperity. Section 4 thus contains more detailed explanations and examples, with several case studies in the form of boxes. This structure develops our arguments with minimal overlap or repetition.

4. How and via what Mechanisms can the Green Economy Contribute to Urban Prosperity?

The recent prominence of the green economy in international environmental and development policy discourse has created significant expectations about its potential contribution to the prosperity and sustainable development of urban areas. The United Nations Environmental Programme (UNEP) and other international organizations (UNDP, UN-HABITAT, the World Bank, the International Labor Organization and OECD among others) recognize that urban areas can play a fundamental role in transforming the green economy as the basis of a more sustainable development path. Urbanization is a key process transforming societies and their interactions with the environment. The role of urban areas as key elements of current and future global and local changes is deeply related to the extraordinary rate and scale of urbanization during the last few decades and its projected growth during the rest of the current century. Urbanization constitutes a prime mover of cultural change, with an enormous impact on ideas, values, beliefs and social organization, economic growth, and social well-being.[69] These characteristics make urban areas potential drivers for the green economy at global, regional, and national scales. The expansion of a green economy in urban areas would also multiply and accelerate the transformations introduced by the green economy globally. They can become important factors building responses and resilience to climate change and other global environmental problems, and to the dynamic socio-economic and geopolitical processes of globalization.

This section discusses the potential contributions of the green economy to urban prosperity, including the major benefits identified by the available literature, case studies and research results, such as the creation of sustainable jobs, improving the quality of life, and creating a more equitable and inclusive society. Ensuring prosperity also requires that cities become more resilient to shocks and stresses that are both natural and social in origin. Empirical evidence from around the world illustrates the contributions of these elements. They also show two important aspects of their potential contributions to prosperity: although each one of these elements create benefits, it is really their combined synergies that enable the creation of prosperity; the notion and vision of prosperity requires frequent and periodic discussion according to the conditions of each society over different time horizons. It should not be taken for granted that prosperity is a blueprint for all urban areas in developed and developing countries, nor should it be considered a static goal over time.

4.1. Green jobs and urban prosperity

Job creation is a critical challenge for cities throughout the world. In rapidly growing and developing cities throughout Asia, Africa, and South America, there is a continuous influx of

[68] Brajer, V., Mead, R.W. and Xiao, F. (2010) Adjusting Chinese income inequality for environmental equity. *Environment and Development Economics*, 15: 341-362.

[69] Martine G., McGranahan, G., Montgomery, M. and Fernandez-Castilla, R. (2007) Introduction. In Martine G., McGranahan, G., Montgomery, M., and Fernandez-Castilla, R. (eds) *The New Global Frontier. Urbanization, Poverty and Environment in the 21st Century*. London: Earthscan, 1-16.

new residents in search of full-time employment (as implied by the urban population growth data presented in Section 2). Within slower growing (or shrinking) cities in Northern Europe, the US, Canada, Australasia, Japan and elsewhere, there is need to maintain the existing employment base in the face of industrial restructuring, albeit taking advantage of green economic opportunities to replace obsolescent high-carbon processes and activities.

Green economies have tremendous potential to promote economic prosperity in cities, and creation of green jobs is a key pillar for these efforts. Green jobs can be found in nearly every sector of the economy, including agriculture, natural resources, manufacturing, transportation, construction, services, government, and research and development. Commonly used criteria that define a job as 'green' include contribution to either conservation or restoration of environmental quality both locally and globally. These include jobs that "protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution."[70] Within cities and urbanizing regions, green job creation often emphasizes investment in renewable energy and clean technology. Yet green jobs can also be created in activities ranging from restoration of local wetlands to design and construction of new green buildings, retrofitting of older and less efficient buildings, installation or expansion of more efficient transportation options such as high-speed rail, development and manufacturing of greener products, expansion and maintenance of green metropolitan open space and encouragement of urban and peri-urban agriculture. Specific examples are provided below.

Green economies can be promoted through many channels including private sector investments, government-led efforts, public-private partnerships and social economy enterprises. Social economy enterprises, often termed 'alternative economies may entail for example, community gardening, self-build housing projects with minimal environmental impacts and community-based energy efficiency projects.[71] Green jobs also span a wide array of skills, educational backgrounds, and occupational profiles. This is especially true with regard to so-called indirect jobs — those in supplier industries. Even for new industries like wind and solar power, supply chains consist largely of traditional industries.

However, the creation of green jobs in urban areas will not occur automatically but will require the support of national governments and international organizations and broad collaboration among the public, private and social sectors. This support is particularly important in the case of poorer countries, where many urban areas face significant challenges to create jobs and lack financial resources to invest or to provide incentives and other forms of investor risk reduction beyond the maintenance of basic salaries and services. The transition to a green economy and the creation of green jobs in those areas will require substantial support. On the other hand, semi- and unskilled labour is in ready supply for undertaking basic greening tasks in the urban environment and for construction work on green projects.

4.1.1 Renewable energy

Numerous international organizations and domestic companies consider that renewable energy presents major economic opportunities. Investment in clean energy continues to growth and is estimated to have reached US$ 243 billion in 2010.[72] This represents close to 19% of all investment in power-generation facilities and equipment. OECD countries account for the bulk of global renewables investments (almost 82% in 2006, of which the European Union and the United States together had 74.1%), compared with 7.5% for China, 4.3% for India, 3.1% for Latin America, and 3.5 for all other developing countries. To date, a small

[70] Renner, M., Sweeney, S. and Kubit, J. (2008) *Green jobs: towards decent work in a sustainable, low-carbon world*. Nairobi: United Nations Environment Programme, p. 3.

[71] Davies, A.R. and Mullin, S. (2010) Greening the economy: interrogating sustainability innovations beyond the mainstream. *Journal of Economic Geography*, doi:10.1093/jeg/lbq050, p.8.
Pickerell J. and Maxey L. (2009) Geographies of Sustainability: Low Impact Developments and Radical Spaces of Innovation. *Geography Compass* 3(4): 1515-1539.

[72] UNEP (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative.

number of countries account for the bulk of renewable energy installations. In wind power, the top five countries represent 72% of global capacity (Germany, the USA, Spain, China, and Denmark); in grid- connected solar PV installations, the top two (Japan and Germany) account for 87%; in solar hot water, the top five control 91% (and China, the leader, alone accounts for 65%); in solar thermal electric installations, the United States alone has almost all the existing capacity; in fuel ethanol, the top two (United States and Brazil) produce 90% of global output; and in biodiesel, the top five represent 78% of production (ILO 2008). These data may change rapidly as the rate of investment is increasing in many countries; China stands out as investing heavily in renewables at present.

The renewable energy sector, which includes hydropower, solar energy, wind energy, bio-fuel related energy, and geothermal energy, employed an estimated 2.3 million people in 2006, with the majority of these jobs located in Brazil, China, Japan, Germany, and the United States.[73] By 2030, an estimated 20 million jobs are projected in the areas of solar energy, wind energy, biofuels and agriculture. While there is no clear estimation of the proportions of those jobs in urban areas, it is expected that this will vary according to the type of renewable energy sector. For example, large wind farms and solar (photovoltaic (PV)) panel arrays tend to be located in remote rural areas, not least for aesthetic reasons, but the turbines and solar panels that are integral to these sectors are likely to be manufactured in cities or urbanized regions. Many urban jobs have already been created through the installation of PV panels on the roofs of domestic and commercial buildings (see below), a trend that is accelerating rapidly worldwide. The Global Wind Energy Council puts worldwide wind employment at more than 400,000 jobs in 2008 (including jobs in supplier industries). These projections are based on 15.1 jobs per new MW (manufacturing) and 0.4 jobs per cumulative MW (operations and maintenance), declining gradually (with rising labour productivity) to 11 and 0.29 jobs, respectively, by 2030. Solar power generation also has considerable employment creation capacity (Box 4.1).

Box 4.1 Employment potential of the solar photovoltaic energy sector

The Solar Generation V report also projects that as many as 10 million jobs will be created in the solar PV sector worldwide by 2030. A total of 50-53 jobs might be created per MW of installed capacity, though over time rising labour productivities will reduce these numbers. PV manufacturing is thought to add 10 jobs per MW, installation 33 jobs, wholesaling of systems 3-4 jobs, indirect supply 3-4 jobs, and research 1-2 jobs.[74] In concentrating solar power and solar thermal energy, nearly half the industry's employment is generally found in retail, installation, and maintenance, typically in small and medium sized enterprises. Given the industry's dynamic expansion, in a few decades it may employ a significant amount of workers.

Wind and solar technologies can also be downscaled for individual home installations, making them appropriate for urban areas, especially where, as in the UK, generous generation and feed-in tariffs guaranteed for 25 years encourage installation so that surplus output can be sold to the electricity grid. Fifty percent of total generation is assumed to be sold in this way. Hence, individual producers gain a triple benefit from a generation tariff for each kW produced, the feed-in tariff for half their output, and the savings from reduced purchases of electricity from the grid. In general terms, jobs in installing, operating, and maintaining renewable energy systems tend to be more local in nature and can thus benefit urban and peri-urban areas.

The estimates mentioned above are based on the assumption of strong policy support for renewable energy production, and includes assumptions about technological innovation, adequate investment, growth of markets, supportive national regulations, and continued economic growth and development. Approximately two-thirds of the total new job gains, or roughly 12 million jobs, are likely to arise in biofuels and agriculture, and approximately 1/3, or

[73] Renner, M., Sweeney, S. and Kubit, J. (2008) *Green jobs: towards decent work in a sustainable, low-carbon world*. Nairobi: United Nations Environment Programme.
[74] ILO (2008), op. cit.

approximately 6 million jobs, are likely to occur in wind and solar energy.[75]

It is important to note that these estimates are based on the experience of jobs created in OECD countries and there might be differences in poorer countries. Unfortunately, only isolated figures are available from some examples in this large group of countries, making generalization difficult. Some of the success stories in the creation of jobs in renewal energy are precisely in the installation and service of solar PV sector or in concentrating solar power. In Bangladesh, for instance, Grameen Shakti microloans have helped to install more than 100,000 solar home systems in rural communities in a few years, with a goal of 1 million by 2015. Grameen is training local youths and women as certified solar technicians and as repair and maintenance specialists, hoping to create some 100,000 jobs.[76] There are also numerous urban examples of PV energy installation and its benefits (Box 4.2).

Box 4.2 Urban PV systems and their benefits

Kenya, for example, has one of the largest and most dynamic solar markets in the developing world. In Nairobi, the Kibera Community Youth Programme initiated a simple solar PV assembly project, providing young people with employment and engendering considerable interest in emulating the success story in neighbouring countries.[77] Rizhao, China has turned itself into a solar-powered city; in its central districts, 99% of households already use solar water heaters.[78] In the Kuyasa low-income housing improvement scheme in Cape Town, South Africa's first Clean Development Mechanism (CDM) project has retrofitted solar water heating along with roof insulation in 2,300 poorly built post-apartheid Reconstruction and Development Programme (RDP) houses to provide on-the-job training and employment and earn 2.82 tonnes of carbon credit per house annually.[79] Besides reducing expenditure on heating fuel (and hence reducing emissions), the improved insulation also had the important benefit of a substantial decline in bronchial and related illness among residents, especially during winter, thus reducing household expenditure on medical bills and medicines and enabling meager incomes to be used for other priorities.

In considering the net employment effects of renewable energy, it also important to distinguish between the creation of jobs as the result of installation (installers, retailers, service) of new energy facilities,[80] which are short term, versus permanent jobs created with the ongoing operation of the facilities.[81] In some cases, green activities may ultimately lead to more jobs within some sectors than conventional options over the long run, even if there are job losses in the short term. For example, a recent study estimates that renewable energy creates 1.8 and 4 times more jobs per MW installed in Aragon, Spain, than conventional production.[82] The study also finds that more than half of the workers employed in the renewable sector require high levels of professional training.[83]

[75] UNEP. (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative.
[76] ILO (2008), op. cit.
[77] UNEP (2011), *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World.* See also: http://ecoswitch.com/articles/kibera-community-youth-programme-how-photovoltaics-are-helping-africa/
[78] ICLEI, UNEP and UN-HABITAT (2009).
[79] Meyer, E.L. and Odeku, K.O. (2009) Climate change, energy, and sustainable development in South Africa: developing the African continent at the crossroads, *Sustainable Development Law & Policy* 9(2): 49-53, 74-5. The value of carbon credits was provided by Carl Wesselink in a presentation at the ICLEI Local Climate Solutions for Africa 2011 conference, Cape Town, 1 March 2011.
[80] Ghani-Eneland, M., Renner, M., & Chawla, A. (2009). *Low Carbon Jobs for Europe: Current Opportunities and Future Prospects*. Gland, Switzerland: World Wide Fund for Nature (WWF)
[81] Dalton, G.J. and Lewis, T. (2010) Metrics for measuring job creation by renewable energy technologies, using Ireland as a case study. *Renewable and Sustainable Energy Reviews*, 15(4): 2123-2133.
[82] Llera Sastresa, E., Uson, A., Bribian, I. and Scarpellini, S. (2010). Local Impact of renewables on employment: Assessment methodology and case study. *Renewable and Sustainable Energy Reviews* 14(2): 679-690.
[83] *Ibid.*

4.1.2 Urban transport

Public transport jobs account for 1–2% of total employment in many countries.[84] However, few employment statistics appear to exist for green jobs in the urban transport sector, particularly in developing countries. Studies in Europe and the United States show that about 30 jobs are created for each US $ 1.3 million invested in public transport infrastructure, and 57 jobs for the same level of investment on the transport operations side.[85] Public transport investments in Europe have an average job multiplier effect of 2 to 2.5 (but reaching as high as 4.1 in some cases). A survey of about 170 cities found that inefficient and polluting diesel buses account for about 90% of all urban buses in EU countries.[86] Less-polluting alternatives have been implemented in a number of cities in Europe, the US, Canada and other developed countries (using CNG, LPG, biodiesel, and hybrids). Some developing countries have implemented also less polluting public transportation in some urban areas, particularly in Brazil, but also in India, Colombia, Mexico, and other emerging economies.

New jobs can be created not only by replacing or retrofitting old, polluting buses, but also in retrofitting other vehicles used in urban transport to reduce air pollution. Pilot projects in the Philippines suggest that retrofits of two-stroke engines in two and three-wheeled vehicles that represent an important part of public transport in many developing countries, cut fuel consumption by 35–50 percent and emissions of air pollutants by as much as 90 percent. Jobs can be created through installing and servicing the kits.[87] The bicycle industry also offers employment, but only in a few countries. The manufacture of bicycles is dominated by five producers: China, India, the European Union, Taiwan and Japan account for 87% of global production. China alone produces more than half the world's bicycles. Production of electric bicycles is booming, reaching about 12 million units in 2005. Almost all of them were manufactured in China.[88]

4.1.3 Waste and recycling

Waste and recycling activity is similarly labour-intensive. A recent estimate reveals that up to 15 million people are engaged in waste collection for their livelihood in low-income countries[89] (Box 4.3).

> Box 4.3 Urban employment in waste collection and recycling
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> In Dhaka, Bangladesh, a project for generating compost from organic waste helped create 400 new jobs in collection activities and 800 new jobs in the process of composting. Workers collect 700 tons/day of organic waste to obtain 50,000 tons/year of compost. In Ouagadougou, Burkina Faso, a project for collecting and recycling plastic waste has helped improve the environmental situation and has created jobs and incomes for local people. The project was designed by an Italian master's student, received initial support from the World Bank, and created a recycling centre run by the association of local women. The project has enabled many locals to secure some income either by collecting the plastic waste or by working in the recycling centre. It has also created a cleaner environment in the suburbs and generated revue of US$ 35,000 in 2006.[90]

Many European cities have achieved impressive levels of waste reduction. For example, Copenhagen sends only 3% of its waste to landfills, despite still generating high volumes of waste per capita relative to most other European cities.[91] Over the last two decades, the city has invested resources to develop incineration plants that can convert municipal waste to energy. The city estimates that 32% of all waste is recycled and 62% is incinerated. Thirty-

[84] UNEP, ILO, IOE and ITUC (2008).
[85] UNEP (2009)
[86] UNEP (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative.
[87] UNEP (2011), *Green Jobs: Towards decent Work in a Sustainable, Low-Carbon World*.
[88] UNEP, ILO, IOE and ITUC (2008).
[89] UNEP (2011), *Green Jobs: Towards decent Work in a Sustainable, Low-Carbon World*.
[90] http://www.ilo.org/global/about-the-ilo/press-and-media-centre/insight/WCMS_084547/lang--en/index.htm
[91] http://sustainablecities.dk/en/city-projects/cases/copenhagen-waste-to-energy-plants

nine percent of all waste is converted to energy, which in 2004 provided sufficient energy for 70,000 households. In 2005, the district heating system prevented 950,040 tons of CO_2 emissions.[92] Waste reduction and recycling levels in other European cities are close to 50%. In 1991, Curitiba in Brazil established an innovative green exchange programme (Cambio Verde) that encourages people to exchange recyclable waste for fresh fruits and vegetables acquired by the city from local surpluses. This longstanding and successful project is still active.[93] Composting is a further critical component for greening waste. It is also labour-intensive, thus enhancing employment opportunities. Positive examples range from Dhaka's decentralized composting to San Francisco's municipal food composting programmes and the well-known, highly organized waste collection and recycling system operated by the Zebaleen community in Cairo.

4.1.4 Buildings

The construction industry has the largest potential to create green jobs in urban areas.[94] The building and construction sector employs more than 111 million people worldwide, or approximately 5–10% of total employment at the country level with 75% in developing countries and 90% in micro firms (less than 10 employees).[95] Attention has concentrated on changes in how buildings are designed, built, and operated, along with how building components are manufactured and energy is used, are likely to affect job numbers and types of employment. Less attention has been given to the creation of jobs in the construction of green or sustainable infrastructure.

Buildings have emerged as a critical focus for climate mitigation and urban sustainability. The operation of buildings worldwide is responsible for close to 40% of all primary energy use, greenhouse emissions, and waste generation. This does not include energy used to construct buildings or their embodied energies. The IPCC Fourth Assessment Report[96] identifies buildings as having the single largest potential of any sector for the reduction of greenhouse gases: the capacity to reduce projected emissions 29% by 2020. While there are variations both between and within countries, overall, 60% of the operational energy is used for heating and cooling purposes. This is followed by 18% for water heating, 6% for refrigeration and cooking, 3% for lighting, and 13% for other purposes.[97] Space heating also represents the single largest use of energy in commercial buildings in both Canada and the EU, accounting for up to two-thirds of total energy use. Lighting is the largest single use of electricity in commercial buildings in the US. Water heating is not significant in commercial buildings in OECD countries.[98]

In contrast, no clear pattern emerges for household energy consumption in poorer countries. This is largely due to the disparity in climatic and weather factors which necessitate the partitioning of a country into smaller units in order to obtain a clearer picture. But it is also due to the polarization of socio-economic conditions among their inhabitants and their levels of urbanization. Coal and biomass are still significant sources of energy for heating in buildings in large parts of urban areas, invariably with adverse effects on the occupants' health. Water heating and lightening are two other important uses of energy in urban areas of poorer countries. Hence the largest mitigation potential in CO_2 emissions is in electricity consumption, whereas in OECD countries these savings are from heat-oriented measures.[99]

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[92] OECD (2009) *Territorial Review Copenhagen.* Paris: OECD.
[93] UNEP. (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative.
[94] Energy-efficient buildings, also known as green or high-performance buildings, drastically reduce emissions, material, and water use and have the potential to reduce energy by up to 80% or more. Green buildings reduce their energy load by integrating efficient systems (heating, cooling, lighting, water); use alternative energy sources (passive solar, alternative energy sources); retain energy (efficient insulation and windows, thermal mass); and use recycled, reused, or low-energy building materials.
[95] ILO (2008), op. cit.
UNEP (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative.
[96] IPCC (2007).
[97] ILO (2008), op. cit.
[98] Ürge-Vorsatz, D., Koeppel, S., Mirasgedis, S. (2007) An appraisal of policy instruments for reducing buildings' CO_2 emissions. *Building Research and Information* 35 (4): 458-477.
[99] ILO (2009)

The characteristics of contemporary urbanization, including its concentration primarily in low- and middle-income countries and high rates and magnitudes of urban expansion suggest other important differences among the contributions of a green economy in buildings. The construction of new buildings will be limited in many OECD countries. The situation in the UK illustrates this situation. New buildings make up less than 1% of the total stock at a given time and it is estimated that at least 75% of the homes that will exist in 2050 have already been built. Carbon emissions from existing homes are therefore considered to be of greater significance than those from all the new homes that will be built by then.[100] It has been estimated that refurbishment of existing homes to high environmental standards is relatively low-cost, representing between a tenth and a quarter of the cost of new build. Homes need periodic reinvestment and modernization plus major refurbishment every 20-30 years, requiring about 1% of capital value at current market levels each year to be spent.[101] Studies in other European countries suggest that new buildings will only comprise 15% of total housing stock by 2020, inevitably focusing attention on refurbishment of the existing stock as the main route of addressing targets of CO_2 abatement.

The creation of green jobs in the construction sector will be mostly associated with retrofitting buildings in those countries. However, the construction of new buildings is higher in the US and other developed countries with higher rates of urbanization. In the United States, there are currently over 40,000 Leadership in Energy and Environmental Design (LEED)-accredited professionals involved in design, construction, operation, or maintenance of energy-efficient buildings. In addition, there are 1,500 LEED-accredited professionals in India, 900 Green Star professionals in Australia, and 1,197 Building Research Establishment Environmental Assessment Method (BREEAM)-licensed assessors in the United Kingdom.[102] These numbers have been increasing and are projected to rise further as green building takes over a larger share of the construction market.

The Apollo Alliance — a coalition of private and public sectors including community leaders and environmental interests that aims to enable a clean energy revolution similar to the US Apollo space programme — recently developed a New Energy for America Report which projects that 827,260 jobs could be created in the United States through investment in high-performance buildings, both retrofitting and new green construction. The plan requires an $89.9 billion dollar investment to improve financing for green buildings, provide tax incentives, invest in research and development, and promote new building codes and standards. Most of the jobs created through green building practices are likely to occur from energy savings and reinvestment, particularly during the initial construction or investment period. They are expected to stimulate the local economy because they are performed at the work site.[103] The Canadian government estimates implementing a retrofitting program on a national scale would result in 5,600 to 7,840 person-years of employment at the local level. This is 20 jobs for every $1 million invested, or 1 job for every $50,000. A potential investment of $280–392 million dollars invested in energy-efficiency improvements could reduce greenhouse gases by 800 kilotonnes per year. After the initial payback of 5 to 7 years, this would save the government $56 million dollars per year.[104]

The construction sector in poorer countries generates a larger number of unskilled jobs. In India, 16% of the working population relies on construction for a livelihood; in sub-Saharan Africa evidence suggests a substantial reliance on the construction sector even in the absence of economic growth.[105] The construction sector could make an even greater contribution to the economy and social development when the employment potential of a green economy is associated with adaptation and mitigation measures for climate change. A recent study[106] indicates that the greatest economic potential for mitigating CO_2 emissions in buildings lies in poorer countries. The report estimates that such countries have the largest

[100] ILO (2008)
[101] UNEP (2011).
[102] This British system is claimed to be the world's most widely used environmental assessment method for the rating of buildings (www.breeam.org).
[103] ILO (2008).
[104] *ibid.*
[105] ILO (2009).
[106] Urge-Vorsatz and Novikova (2008), op. cit.

cost-effective potential abatement with up to 52% of the total reduction, transition economies with up to 37%, and OECD countries up to 25%.[107] It is also worth noting that in poorer countries the largest CO_2 mitigation potential results from savings in use of electrical appliances.

The characteristics and geographies of contemporary urbanization mentioned above highlights the importance of constructing energy-efficient buildings and the potential creation of green jobs in urban areas of developing countries. The first part of this background paper mentioned that close to 90% of future urban growth will take place in developing countries. In countries like India and China, where expansion of the middle class and urbanization is occurring rapidly, the emissions and energy use of buildings are projected to increase dramatically. More than 50% of all new building construction is now taking place in Asia, mainly in China. In the next two decades, 300 million Chinese are projected to move into urban centres, and China alone will add 2 billion square metres (21.5 billion square feet) of new construction each year, doubling its building stock by 2020. The building sector in China is expected to grow by 7% annually; in India and Southeast Asia it will grow by 5%. The rapid pace of construction taking place in Asia highlights the need to alter current building and construction methods. Those changes are important to reduce the immense amounts of energy, material, and water use in their construction and operation, a significant contribution to global climate change.

Green buildings in poorer countries need to follow different strategies from in OECD countries. Technological solutions (intelligent buildings) have been the core element in the design of energy-efficient buildings but this strategy is too expensive for many urban areas in low-income and middle-income societies. A more suitable strategy for these countries is the use of passive technology that offers flexibility, accessible know-how, and traditional knowledge through vernacular architectures adapted to local climatic conditions. Urban areas might want to consider combining passive technology with some features of modern technology taking advantage of their declining cost in recent years (solar PV, solar thermal energy, water harvesting).

It is difficult to estimate the creation of green jobs in the construction sector in low-income countries.[108] The few case studies mentioned in recent publications suggest that a significant number of jobs could be created in the construction of green buildings and infrastructure. Two fundamental questions are: how much better would those jobs be compared to those in the conventional construction sector, and what are their contributions to the prosperity of urban areas in developing countries? Such jobs are dangerous, low paid, and largely unskilled, but have the potential to be modified through training workers within the construction sector of the green economy. This process would require planned intervention and co-ordination between the public sectors and other actors.

*4.1.5 Environmenta*l serv*ices*

Approximately 15-20% of the world's food is produced in urban areas, with urban crops and animal products often representing a substantial part of the urban annual food requirement.[109] Green urban agriculture has the potential to create green jobs and provide other environmental services through re-use municipal wastewater and solid waste, preserve biodiversity and wetlands, and make productive use of green belts.

In many contexts, urban and peri-urban agriculture (UPA) is increasingly being recognised as providing a triple benefit: helping to 'green' human settlements, employing un- and semi-skilled workers and helping to feed urban populations, especially the poor. In European and North American cities, longstanding traditions of essentially leisure-time cultivation in back yards or dedicated allotments (legally recognised in the UK, for instance) have taken on a new significance as concerns with food miles, organic or wholesome foods and green

[107] *Ibid*.
[108] ILO (2008).
[109] Amar-Klemesu and Maxwell (2001) Urban cultivation in Accra: An examination of the nature, practice, problems, potentials, and urban planning implications. *Habitat International* 26 (4): 591-607.

economies have increased. In shrinking cities such as Detroit, urban farms have been established some of the areas with particularly low development pressures on land.[110]

Various urban design initiatives have taken advantage of this interest and enhanced the availability of cultivable space, e.g., on urban rooftops, with the added benefit of helping to reduce heat island effects.

In poor countries, UPA as a survival strategy of the poor has frequently been met with resistance by urban officials on the grounds that it violates outmoded planning regulations and is not a legitimate urban activity. However, such attitudes are gradually changing and some progress is being made, so that persecution of people cultivating road margins, traffic roundabouts and vacant plots is being halted. In some cases land is being made available for this purpose, as in post-apartheid South Africa, where anti-poverty local economic development is more inclusive in some towns and cities However, such policies can be reversed, as with Operation Murambatsvina and its successors in Zimbabwe's major cities from 2005, when all informal and unregulated housing and economic activities were destroyed in the name of political control and orderly urban planning.[111] UPA is also no necessary sinecure: various land-use conflicts, toxic waste and pathogenic contamination and other challenges exist, while many rural migrants desire less arduous waged employment.[112] Kampala in Uganda has recently been the focus of considerable appropriate policy research and innovation.[113]

The findings of national censuses, household surveys and other research suggest that "up to two-thirds of urban and peri-urban households in poorer countries are involved in agriculture".[114] As discussed in a recent UNEP report,[115] the extensive role of food production in cities is a common feature of many urban areas. Estimates suggest that 35% of households of Nakuru, Kenya were engaged in urban agriculture in 1998 and nearly half of households in Kampala, Uganda in 2003.[116] In Accra, Ghana 90% of the city's vegetable supply was produced within the city's boundaries in the mid-1990s.[117] In Cuba, urban agriculture in la Havana and other major cities has helped the country address severe food shortages, improve nutritional status and create income for local inhabitants.[118] Successful urban agriculture projects are usually on a small scale, making use of communal gardens, roof spaces and unused urban spaces.

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[110] Kaufman, J. and M. Bailkey. (2000) *Farming Inside Cities: Entrepreneurial Urban Agriculture in the United States*. Lincoln Institute of Land Policy, Cambridge.

[111] Kamete, A. (2006) The return of the jettisoned: ZANU-PF's crack at 're-urbanising' in Harare, *Journal of Southern African Studies* 23(2): 255-271; Potts, D. (2006) 'Restoring order'? Operation Murambatsvina and the urban crisis in Zimbabwe, *Journal of Southern African Studies* 32(2): 273-291.

[112] Gregory, P. and Mattingly, M. (2009) Goodbye to natural resource-based livelihoods? Crossing the rural/urban divide, *Local Environment* 14(9): 879-890; Laband, D. (ed) (2007) *Proceedings: Emerging issues along urban-rural interfaces II: linking land-use science society*. Atlanta, GA: Auburn University; Laband, D. (ed) (2010) *Proceedings: Emerging issues along urban-rural interfaces III: linking science and society.* Atlanta, GA: Auburn University. McGregor, D.F.M., Simon, D. and Thompson, D.A., eds., (2006) *The peri-urban interface in developing areas: approaches to sustainable natural and human resource use*. London: Earthscan; Mattingly, M. (2009) Making land work for the losers; *Policy responses to the urbanisation of rural livelihoods, International Development Planning Review* 31(1): 37-53; Simon, D. (2008) Urban environments: issues on the peri-urban fringe. *Annual Review of Environment and Resources*, 33, 167–185.

[113] Cole, D., Lee-Smith, D. and Nasinyama, G. (eds) (2008) *Healthy city harvests: generating evidence to guide policy on urban agriculture*. Lima and Kampala: International Potato Center (CIP) and Makerere University Press.

[114] FAO (2001) Urban and peri-urban agriculture: A briefing guide. SPFS/DOC/27.8, Revision 2, Handbook Series Volume III. FAO, The Special Programme for Food Security, Rome. http://www.fao.org/fileadmin/templates/FCIT/PDF/briefing_guide.pdf, accessed 4 August 2011.

[115] UNEP (2011), op cit.

[116] Foeken, D. (2006) *To Subsidize my Income – Urban farming in an East African town*. Leiden and Boston: Brill; David, S., Lee-Smith, D., Kyaligonza, J., Mangeni, W., Kimeze, S., Aliguma, L., Lubowa, A. and Nasinyama, G. (2010) Changing trends in urban agriculture in Kampala. In: Prain, G., Karanja, N. and Lee-Smith, D. (eds) *African urban harvest: Agriculture in the cities of Cameroon, Kenya and Uganda*. Springer and Ottawa IDRC, New York; , cited in UNEP (2011).

[117] Annorbah-Sarpei, A.J. (1998) *Urban Market Gardens: Accra, Ghana*. The Mega-Cities Project, Publication MCP-018C, cited in UNEP (2011)

[118] Cruz and Medina (2003) *Agriculture in the City: A key to sustainability in Havana,* Cuba. Ottawa: Ian Randle and IDRC.

4.1.6 Net job creation

In considering the net effect of green job creation on urban employment, it is important to recognize that the creation of green jobs in some sector may be counterbalanced by job losses in other sectors, including energy production based on fossil fuels, and production of fossil-fuel intensive goods. Green job gains may occur in some industries, but 'brown' job losses will occur in others. Importantly, some of these effects will be geographically distanced, – e.g. CDM jobs created in the global South may be counterbalanced by possible offsetting losses in North.

A recent study suggests that net job creation by green economies will not be significant, even though green economies are likely to account for a growing share of employment. In other words, over the long term employment in green economic sectors will replace employment in other sectors. [119] Local level efforts to create green jobs in some sectors may also inadvertently undermine or displace workers involved in longer-standing sustainability initiatives. In a study of efforts of environmentally focused social economy enterprises (ESEEs) to promote green economies within Ireland, the authors found that mainstream efforts, which emphasize technological innovation and private sector entrepreneurship, sometimes marginalized social economy enterprises that were also engaged in environmental activities that promoted green jobs.[120]

One important lesson from this discussion is that the creation of green jobs cannot be considered an isolated goal but must be assessed in conjunction with other benefits to improve the quality of life, respond to climate change and reduce the risk of natural hazards, and create a more equitable and inclusive society. All these are important elements for creating better opportunities for sustainable development and prosperity.

4.2. Environmental quality

While most efforts to promote green economies emphasize mitigation of greenhouse emissions, the creation of green jobs also enhances local environmental quality, which in turn improves quality of life for urban residents, makes a city more attractive and desirable for other green sectors, and ultimately contributes to both economic and social well-being. As discussed in Section 3, green development can also improve quality of life for local residents by reducing air and water pollution. Less polluted cities can, in turn, be expected to have lower health care expenditures for asthma and other environment-related illnesses. This is the inverse of the widely known trend towards increased respiratory complaints as air pollution increases. At the domestic scale, too, innovations such as cleaner cooking fuel or smokeless stoves instead of traditional open fires have been shown to reduce chest infections and bronchial complaints among low-income populations in cities of the global South.[121]

Environmental amenities within OECD cities are a consistent and reliable predictor of overall attractiveness for new firms and new residents. A recent study of the relationship between urban leisure amenities and urban growth across US cities found that cities that were more attractive for leisure tourists, due to the variety of environmental and other amenities, experienced more rapid growth in population and employment than other cities. The study also found that these 'beautiful' cities attracted a disproportionate number of highly-educated individuals and experienced more rapid increases in housing prices and that local government investment in public recreational spaces enhances a city's attractiveness.[122] In addition to the cross-city analysis (which compares average rates of growth across cities), the study also found that specific neighbourhoods within cities that were closer to environmental amenities tended to grow more quickly than other neighbourhoods.

[119] UNEP (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme, Green Economy Initiative, 464.
[120] Davies, A.R. and Mullin, S. (2010) Greening the economy: interrogating sustainability innovations beyond the mainstream. *Journal of Economic Geography*. (Advance Access Publication) doi:10.1093/jeg/lbq050.
[121] Harpham, T. (2001) Healthy city projects in developing countries: the first evaluation, *Health Promotion International* 16: 111-125.
[122] Carlino, J. (2009). Beautiful City. Business Review, Philadelphia Federal Reserve, Q3: 10-13.

The importance of environmental conditions has not gone unnoticed by new property developers in many parts of the developing world. New housing developments and gated communities for middle and upper class residents are frequently marketed on the basis of environmental attractiveness as well as security[123] (Box 4.4).

Box 4.4 Gated communities and secure housing developments in poor countries

Within Jakarta, for example, deconcentration of population out from the urban core in recent years has partly entailed a relocation of wealthy residents to new developments on the urban-rural fringe and a positioning of associated environmental amenities to serve these areas[124] (Leichenko and Solecki 2008). Such is the case with the emergence of new of private cities of Lippo Karawaci, Lippo Cikarang, and Bumi Serpong Damai (BSD) in the region. These cities, located approximately 35 kilometres outside central Jakarta, are wholly owned by private investment banks including The Lippo Group and L-Bank. The cities, which range in population from 30,000 to 60,000, contain a full array of urban facilities including commercial, industrial, educational, health, social, and recreational activities. A website advertising BSD sold the city as a way to live in the midst of nature while avoiding the crowding, pollution, and expense of central Jakarta (italics inserted by authors):

> The development of Bumi Serpong Damai (BSD) and its neighbouring cities Lippo Karawaci and Bintaro has marked the dawn of a new era in Indonesian urban planning . . . Living and working in these self-contained cities is different …*This is due to the fact, that on the one hand you can enjoy all the amenities of a metropolis, and on the other hand, you can live in the midst of nature without dealing with problems like chaotic traffic conditions, polluted air and a high cost of living.*[125]

New urban housing developments with lower environmental impact (e.g., zero-emissions housing; car free communities) have also begun to spring up in cities including London and elsewhere. While these developments typically reflect urban environmental best practices, such as low-emissions construction, zone planning, green belting, and traffic calming, one important caveat is that such developments must also be linked to larger, city-wide strategies to promote green infrastructure. However, green housing developments are likely to have only a limited overall impact on energy consumption, air pollution and greenhouse gas emissions if they are predicated on individual motor vehicle usage for travel to jobs in other parts of the cities.[126]

Another potential limitation of green housing development aimed at middle and upper classes is that such communities can reinforce socio-spatial inequalities within cities. Wealthy residents are able to live in amenity-rich areas that are separate from areas where lower income and poor residents live and are often inaccessible to these residents.[127] In the case of Jakarta, the residents of these private cities have access to urban and environmental amenities that are not available to most of Jakarta's residents. These include piped water and sewerage, recreational amenities such as parks and golf courses, and excellent road infrastructure. By virtue of the distance from central Jakarta, residents of these cities are also able to minimize their exposure to hazards and toxic industrial pollution that is dumped on public land and into the river delta system.[128]

[123] Leichenko, R. and Solecki, W. (2008). Consumption, inequity, and environmental justice: the making of new metropolitan landscapes in developing countries. *Society and Natural Resources* 21(7): 611-624.
[124] *ibid*.
[125] German Centre for Industry and Trade (2004) Webpage that advertised Bumi Serpong Damai city.
[126] Leichenko, R. and Solecki, W. (2008) Consumption, inequity, and environmental justice: the making of new metropolitan landscapes in developing countries. *Society and Natural Resources* 21(7): 611-624.
[127] *Ibid.*
[128] Hogan, T. and Houston, C. (2002). Corporate cities – Urban gateways or gated communities against the city? The case of Lippo, Jakarta. In *Critical reflections on cities in Southeast Asia,* eds. Bunnell, T., Drummond, L. and Ho K.C., pp. 243-264. Tokyo: Brill Academic Publishers

For poorer residents of developing world cities, urban environmental quality is seen through a different set of parameters. The rapid rate of urbanization in many cities has resulted in massive informal settlements and slums. The informal city is often bigger than the formal city. In Indonesia, an estimated 70-80% of housing construction is informal. In Brazil, more than half of all low-cost homes are built by the informal sector.[129] For residents of informal settlements, metrics of urban environmental quality are intertwined with measures that are intended to alleviate poverty, including adequate access to clean water and sanitation, access to clean energy, food, a clean environment and a safe city. Innovative approaches incorporating elements of a green economy in urban planning and management can make urbanization inclusive and contribute to improve their quality of life.

Examples of how greening cities can help alleviate poverty and equity concerns include improving sanitation and fresh water supply that can reduce persistent poverty and the adverse impacts of water-borne disease. Retrofitting buildings in lower-income neighborhoods can improve energy efficiency and resilience, reducing the vulnerability of poorer communities when energy prices rise. Upgrading infrastructure in slum areas offers both health benefits and fewer adverse impacts on the environment.[130] Ecosystem services (urban agriculture, water harvesting, urban greenery) provide opportunities to improve environmental conditions and social well being. For example, new design strategies have pioneered the use of green roofs and facades on buildings, to add to the quantity of natural surfaces in cities and to reduce cooling energy demand. Efforts to improve water access to counter severe water shortages in Delhi also have a positive impact in poor communities. The Municipal Corporation made rainwater harvesting a requirement for all buildings with a roof area above 100 square metres and a plot area greater than 1,000 square metres. It is estimated that 76,500 million litres of water per year will be made available for groundwater recharge.[131]

In order to achieve the potential benefits of a green economy to improve the quality of life in urban areas requires a concerted effort from diverse actors and a strong leadership within the local government. Examples like Curitiba or Bogotá in Latin America demonstrate the critical role of local leadership improving the quality of life of urban areas even under difficult socio-political conditions and limited economic and financial resources.

4.3. **Creating a more equitable and inclusive society**

Provision of alternative energy and green infrastructure can be among of a series of strategies that improve environmental conditions, enhance access to basic services, reduce vulnerability to natural hazards, and contribute to better living conditions of the poor. Cleaner and more efficient energy can also free resources for investment in other basic needs. New approaches can contribute to providing electricity to the 1.5 billion people in poorer countries currently living without it, and to lifting 100 million people from slum conditions and providing them with safe water and sanitation – a distinct Millennium Development Goal – for example, the installation of solar PV systems on schools, clinics and community centres in Zambia, the introduction of solar lighting and electricity into urban and rural homes by local solar entrepreneurs in Malawi, the electrification of 60 health centres using solar energy in Mozambique, and the construction of windmills and solar-powered water systems as well as 10,000 improved cooking stoves for more than 250,000 people in Somalia.[132] Green buildings, green roofs, urban agriculture, water harvesting and the expansion of green cover also contribute to improving the incomes and livelihoods of urban low-income residents. India, for example, is experimenting with three approaches, namely vernacular building (which focuses on local solutions and traditional knowledge), green building and energy-efficient building (focused on energy-use in commercial buildings).[133] Innovation in indigenous and green building approaches include rainwater harvesting with segregation of surface and roof-top run-off, the use of pervious paving to maximize groundwater recharge, as well as the

[129] UNEP (2011).
[130] WHO (2009)
[131] ICLEI, UNEP and UN-HABITAT (2009)
[132] The WHO (2009) estimates that every year about 1.3 million people (mostly women and children) die prematurely owing to indoor air pollution from biomass. Estimates by the WHO (2009) further attribute 76% of all lung cancer deaths to the indoor use of solid fuels.
[133] Retrofitting of existing commercial buildings in India is estimated to create potential energy savings of 25%.

introduction of waterless urinals (*ibid*). Retrofitting of existing commercial buildings is estimated to create potential energy savings of 25%.[134] Green jobs in the construction of green buildings and infrastructure, retrofitting urban transport, urban agriculture or renewal energy has benefited the weakest groups in society in several poor countries.

The examples mentioned above illustrate the contributions of a green economy to a more equitable and inclusive society and open opportunities for sustainable development. The introduction to this section mentioned that the greatest opportunities to take advantage of the potential benefits of a green economy are through integrated designs combining synergies among their different elements. This requires a multidimensional approach broadening conventional urban planning and design. It also needs political will, leadership, and new approaches to governance addressing the broad arrange of social processes building the urban space. However, it is worth noting that implementation of green projects is not always universally accepted and politically straightforward. Conflicting interests and agendas can make such processes fraught, as happened with habitat restoration on the Cheonggyecheon stream in urban Seoul, South Korea.[135]

4.4. Urban resilience: Green economies, disaster risk reduction and climate change adaptation

'Resilience' has entered the lexicon of climate/environmental change mitigation and adaptation over recent years, spawning considerable research effort and publications, Resilience describes the extent to which an ecosystem or human settlement can withstand or recover from a disturbance, shock or stress. In broader terms, however, resilience or recoverability is just one of the core features of sustainability, along with productivity, stability and equitability. Since climate/environmental change represents a profound environmental challenge to the sustainability of human systems of all kinds, it is important to consider these other features alongside resilience. After all, unsustainable cities and systems may be resilient up to a critical ceiling or tipping point. The objective of greening urban economies is ultimately to enhance overall sustainability and thereby social, economic and environmental justice, rather than unsustainable resilience.

Resilient cities are able to withstand or recover relatively quickly from a wide range of shocks and stresses, both environmental and economic.[136] Resilience is, of course, multifaceted. Many activities that promote green economies can also contribute to the enhanced resilience in cities by reducing disaster risks, promoting activities that enhance adaptation to climate change, and by ultimately strengthening the ability of cities to respond to wide range of shocks and stresses, both environmental and economic. In particular, ecosystem services have become an important tool helping communities reduce their vulnerability to both natural hazards and climate change. Mangrove replanting in Vietnam, for example, saves US$7.3 million annually on dyke maintenance while it costs only US$1.1 million.[137] An increase in the amount of green cover in urban areas not only increases a city's ability to reabsorb CO_2 but also ameliorates the urban heat island effect, facilitates the recharge of groundwater and helps reduce runoff and the risk of flooding, while often also providing new recreational areas in urban parks. Safeguarding natural ecosystems in cities' hinterlands is also important in reducing their exposure to risk. This is of particular relevance to fresh water supply and food security. As they have expanded, many cities have exhausted local fresh water sources and rely on importing water from their wider region. This requirement to 'import' water is already associated with enormous costs for cities such as Mexico City and São Paulo.

Protection and enhancement of ecosystem services, together with effective planning and adequate information and knowledge to address risk to natural hazards contribute to efforts to build resilient communities. As noted above, within many poor-country cities, a large

[134] UNEP, ILO, IOE, ITUC (2008)
[135] Cho, M-R (2010) The politics of urban nature restoration; the case of Cheonggyecheon restoration in Seoul, Korea, *International Development Planning Review* 32(2): 145-165. doi:10.3828/idpr.2010.05.
[136] Leichenko, R. (2011). Climate Change and Urban Resilience. *Current Opinion in Environmental Sustainability*, April (in press) doi:10.1016/j.cosust.2010.12.014
[137] Adger, N. (1999) Social vulnerability to climate change and extremes in coastal Vietnam. *World Development* 27: 249-269.. International Federation of the Red Cross and Red Crescent Societies 2002 quoted in UNEP 2011).

proportion of the urban population works in the informal sector with: a) inadequate access to social security, including health insurance; b) homes in informal settlements in disaster-prone areas–both of which make them more vulnerable to crises. With climate change posing its own threat,[138] the urban poor are likely to be more affected as most live in non-durable structures and in more vulnerable locations such as riverbanks and drainage systems. More generally, the poor have little if no means to reduce potential risks and prepare for the consequences of or be insured against natural hazards.

Although vulnerability to natural hazards is a common problem in urban areas worldwide, rapid and unplanned development often aggravates the risk in poor countries. For example, tropical cities such as Jakarta have dramatically increased their risk exposure to flooding as a consequence of local deforestation. The city's most recent floods in 2007 affected 60% of the city region, killed 80 people and forced more than 400,000 residents to leave their homes.[139] Similarly, the 2005 floods in Mumbai, which killed more than 1,000 people and paralyzed the city for almost five days,[140] were linked to a lack of environmental protection of the city's Mithi River.[141] As explained above, city greening through reforestation, wetland restoration and the creation of urban parkland can mitigate such effects, thereby promoting resilience and broader sustainability.

4.5 Green economies and unintended outcomes

While it is sometimes assumed that different dimensions of urban prosperity are positively and synergistically related to each other, it is important to note that the promotion of one dimension can sometimes undermine another. Promotion of economic prosperity at the expense of environmental quality is the typical example, but there can also be a negative association between promotion of economic prosperity, environmental quality, and resilience, on the one hand, and enhancement of social equity and inclusiveness, on the other. In the context of green economies, this type of situation is also illustrated via the phenomenon of environmental gentrification' whereby efforts to restore a city's green spaces or environmental amenities sometimes come at the expense of individuals who are no longer able to live in newly 'greened' areas.[142] Within New York City, for example, a recent study of the socio-economic impacts of soil restoration and redevelopment of polluted industrial sites (i.e., brownfields) found that such measures contributed to higher rents and reduced availability of rent-stabilized apartments, particularly in areas with other environmental amenities such as a waterfront location. [143] The study noted that population groups found to be most vulnerable to displacement due to brownfield site redevelopment include elderly residents, renters, and residents receiving public assistance.[144]

Efforts to increase urban resilience can also contribute to increased spatial inequalities in some cases, whereby enhancement of resilience in one location or for one group reduces resilience in other locations or for other groups.[145] In the case of earthquake recovery in

[138] IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)] Cambridge, UK and New York: Cambridge University Press,.
[139] Steinberg, F. (2007), Jakarta: environmental problems and sustainability, *Habitat International* 31 (3-4): 358-372
[140] Revi, A. (2008) Climate change risk: an adaptation and mitigation agenda for Indian cities, *Environment and Urbanization*, 20: 207,- 229.
[141] Stecko, S and Barber, N., (2007) Exposing Vulnerabilities: Monsoon Floods in Mumbai, India, Case study prepared for Revisiting Urban Planning: Global Report on Human Settlements 2007, www.unhabitat.org/grhs/2007
Chatterjee, M. (2010) Slum dwellers response to flooding events in the megacities of India. *Mitigation and Adaptation Strategies for Global Change* 15**:** 337-353.
[142] Pearsall, H. (2010). From brown to green? Assessing social vulnerability to environmental gentrification in New York City. *Environment and Planning C: Government and Policy* 28(5): 872-886..
[143] *ibid.*
[144] *ibid.*
[145] Adger, W., Hughes, T., Folke, C., Carpenter, S., & Rockstrom, J. (2005). Social-ecological resilience to coastal disasters. *Science* 309 (5737): 1036; Pike, A., Dawley, S., & Tomaney, J. (2010). Resilience, adaptation and adaptability. *Cambridge Journal of Regions, Economy and Society* , 3, 59-70; Sapountzaki, K. (2007). Social resilience to environmental risks: A mechanism of vulnerability transfer? *Management of Environmental Quality: An International Journal* 18 (3): 274-297.

Athens, for example, a recent study[146] identifies a number of instances where actions that enhanced resilience of individuals and firms, including staying in place and relying on informal support networks, reduced the resilience of the communities to future earthquakes because buildings and structures were not properly repaired. In order to be effective, efforts to promote green economies must take into account the potential for unintended effects on the other dimensions. The next section discusses factors that influence the success of efforts to use green economies to promote urban prosperity.

5. Factors Determining the Extent of Green Economic Contribution to Urban Prosperity

This section of the Report examines the factors that determine the extent to which green economic activities contribute to urban prosperity. In this context, green economies are defined as opportunities to create wealth from utilizing and promoting system-wide:

1) use of ecosystem services (e.g., urban vegetative and forestry, energy capture, and species services);
2) energy and other resources (e.g., water, energy) use efficiency, and,
3) recycling (e.g., resource recovery).

Urban prosperity is defined broadly beyond economic measures such as the level to which wealth is generated for the residents of city, and also the quality of life, equity, and social inclusion. Urban prosperity and the level of capital and human resources available within a city are predicated on the overall level of development of the city and, in turn, the country in which it is located. Developed cities typically have more financial, technological, and intellectual resources available and governance institutions available for developing green economy opportunities. A second set of critical contextual variables is the relative importance of green economic programmes as part of a city's overall development strategy. Urban development strategies are multi-faceted including economic growth, poverty reduction, and political stability, among others. Green economic development must be connected to these larger city goals if it is to be perceived as an urgent and viable component of a city's economic development planning, and compete with immediate pressing needs, particularly for the poor, such as housing, unemployment, crime, infrastructure failures, etc.

The amount of wealth created from green economy activities (i.e., ecosystem services, resource use efficiency, and recycling) within a city reflects the relative contribution of a set of environmental, economic, and socio-political factors.[147] The importance of each factor will vary between and within cities. Underlying these factors are mechanisms and drivers that contribute to how, when, and where green economic contributions emerge in specific cities.

The mechanisms include the:

1) extent of interaction between the various factors (e.g., socio-economic factors might influence the definition and management of environmental factors);
2) transformation of existing systems (e.g., rebuilding of water supply infrastructure);
3) emergence of new systems (e.g. leapfrogging with new technologies) or enhancement of previously unutilized and/or under-utilized resource opportunities (e.g., recycling, solar energy etc.).

In this section, the factors determining the extent of green economic contribution are described first. Next the contribution and relative importance of the mechanisms is reviewed.

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[146] *ibid*.

[147] Alberti, M. 2008. *Advances in Urban Ecology, Integrating Humans and Ecological Processes in Urban Ecosystems*. New York: Springer.
Niemela, J., Breuste, J.H., Guntenspergen, G., Nancy E. McIntyre, N.E., Elmqvist, T. and James, P. (eds) (2011) *Urban Ecology: Patterns, Processes, and Applications.* New York: Oxford University Press.
Suzuki, H., Dastur, A., Moffatt, S., Yabuki, N., and Maruyama, H. (2010) *Eco2 Cities: Ecological Cities as Economic Cities.* Washington, DC: The World Bank.

5.1 Factors determining the green economic contribution

The extent of green economic contribution to urban prosperity emerges from a diversity of factors. While some of the factors are sufficient for promoting green economies, others are necessary. Particularly important are those factors that enable the opportunities to be realized and distributed within urban societies, e.g., socio-political factors as opposed to environmental factors.

A critical foundational issue in this regard is whether or not cities have the institutions and governance structures that enable green economic activities to reach their full potential. Over the last few decades, urban governance has become more horizontal than explicitly vertical, which has allowed for more participation from a range of stakeholders, particularly local neighbourhood and community representatives.[148] Although the increased participation in governance by the private sector and civil society has both reflected and contributed to the decentralization of decision-making, it has also reduced government responsibility — at all levels, national, state, and local — for and accountability of urban development (Jouve 2005; Kell 2006). In many cities around the world, we have seen an increase in decentralized and fragmented models of developing and financing urban infrastructure and public services. Cities in both high- and low-income countries now commonly outsource the provision of certain public services to the private sector in some, if not all, areas. It is also common to have special utilities and services within cities that operate separately from the municipal government while simultaneously charging citizens for these services. Some examples include water and sewer services, education, health services, bridges and tollways, security, and waste management. These new arrangements limit the effectiveness of local governments to shape urban development policies such as the development of a green urban economy.

5.1.1 Urban ecology, urbanization, and engineering

Environmental qualities and accessibility of ecosystem services are critical to the relative amount of green economic contribution to prosperity, and provide enhanced opportunities for ecosystem service utilization.[149]

Urban ecology

The presence and profile of a green economy within a particular locale is at least partially defined by the local ecological potential. All cities are built on sites which present natural opportunities and challenges for development and green economic benefits. While urban design and development processes during much of the 20th century did not focus on catalyzing the natural systems within cities and indeed often ignored or sought to override them with modern engineering 'solutions', contemporary principles increasingly focus on utilizing natural lighting, cooling, heating, and energy generating capacities in cities. In other cases, neglected or remnant ecological function more and more are being analyzed as opportunities for green economic development. In New York City for example, water flow and tidal cycles in local waters are being reviewed as sites for potential renewable electric power generation, while several noteworthy multi-purpose ecosystem-service initiatives are under way (Box 5.1).

> Box 5.1 Environmental and ecosystem service initiatives in New York City
>
> Local waters which have been increasingly viable as marine habitat as a result of federal water pollution control legislation have been analyzed as bivalve (e.g. oysters) spawning grounds. Within New York City's sustainability plan (PlaNYC 2030), bivalve habitat promotion is seen as an opportunity to further enhance local water quality protection. In general the urban coastal zone, particularly including estuarine, bay,

[148] Seto, K. C., Sanchez-Rodriguez, R., and Fragkias, M. (2010) The new geography of contemporary urbanization and the environment, *Annual Review of Environment and Resources* 35: 167-194.
[149] Wilson, S.J. (2008) *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services.* Vancouver: David Suzuki Foundation.

and beach environments, is often associated with the highest per unit area ecosystem service values. The nearly-complete linear Hudson River Park along the southwestern margin of Manhattan involves considerable recreated biodiversity in natural areas, green space, pathways, sports facilities and water access forming an intensively-used recreational area that includes fishing in the rehabilitated marine habitat. Interest also has increased in undertaking a major ecological restoration of Jamaica Bay, an extensive yet severely degraded wetland ecosystem (~3600 ha) adjacent to Kennedy International Airport. The driving force for the restoration effort is the increased provision of ecosystem services, particularly water quality protection, storm water management, promotion of native fisheries, and open space recreation.

Other natural systems increasingly utilized in urban green economies include solar radiation and wind for electric power generation. Again in New York City, a comprehensive web-based solar map of the more than one million roof surfaces in the New York was recently released (http://nycsolarmap.com/). The objective was to provide information for property owners to take advantage of previously untapped electricity generating capacity.

Urbanization

The processes and conditions of urbanization are also important in developing green economies in cities. Several elements of urbanization are important beyond the typical scaling metrics (i.e., green economic opportunities increase with population size because there are more sites for resource use efficiency and recovery). The rate of population growth is one factor that will influence the wealth generating capacity from green economies. A high rate of growth promotes dynamism in urban systems that bring forward challenges for green economic activities because of rapidly changing ecological and resource demand baselines. For example, rapid population growth dramatically changes the character and condition of local water withdrawal and use, as well as resulting wastewater production and flow. These types of changes will make the sustained management of green economic benefits associated with water use more difficult to accrue because of either the loss of green economic potential (e.g., increased presence of impervious surfaces mostly through building construction and roadway development), or decline in the ability to assess and access the value of ecosystem services. This condition is widely evident in cities throughout the world but particularly in those facing rapid expansion of the built environment such as seen in East and South East Asia and many parts of Africa, from Cairo to Dakar, Lagos, Nairobi and Cape Town. In these contexts, basic assessments of environmental amenities and ecosystem services become difficult because the ecological baseline (e.g. water quality, vegetative cover, open space) of the city is changing so rapidly.

The overall rate and character of urban spatial development also can affect how green economic benefits contribute to urban wealth.[150] Rapid population growth coupled with increased level of urban wealth and increased inequity has been associated with rapid urban spatial expansion into lower density suburban and extended metropolitan regions and corridors.[151] This phenomenon has been observed in cities in many developing country regions especially in Central and South America (e.g., Mexico City, Caracas) and Asia (e.g., Jakarta, Manila) but also South Africa's Gauteng province around Johannesburg, the Durban-Pietermaritzburg corridor, and the Ibadan-Lagos-Lomé-Accra corridor on the Gulf of Guinea. Developments of this type can negatively affect the efficient utilization of ecosystem services and green economic development.[152] Dispersed settlement makes a variety of green

[150] Bugliarello, G. (2006) Urban Sustainability: Dilemmas, Challenges, and Paradigms. *Technology in Society* 28: 19-26. Chen, H., Jia, B. and Lau, S.S.Y. (2008) Sustainable Urban Form for Chinese Compact Cities: Challenges of a Rapid Urbanized Economy, *Habitat International* 32(1): 28-40.
Webster, D., Bertaud, A., Jianming, C., and Zhenshan, Y. (2010) *Toward Efficient Urban Form in China*. Working Paper No. 2010/97 World Institute for Development Economics Research (WIDER) UNU-WIDER.
[151] Solecki, W.D. and Leichenko, R. (2006) Urbanization and the Metropolitan Environment: Lessons from New York and Shanghai. *Environment* 48: 8-23.
[152] Glaeser, E.L., and Kahn, M.E. (2010) The Greenness of Cities: Carbon Dioxide Emissions and the Urban Development. *Journal of Urban Economics* 67(3): 404-418; UN-HABITAT (2010) *The State of African Cities 2010*. Nairobi: UN-HABITAT.

economy programmes more expensive and less cost effective.[153] The evolution of urban form sheds light on the underlying socio-economic factors that shape urban areas.[154]

The spatial dimensions of urban development also impact the overall accessibility of specific types of green economy benefits and associated prosperity, as well as the effects of urbanization on local ecosystem services. For example, several elements of green economic enterprise are associated with positive externalities and amenities including open space, water access points, and other urban amenities.[155] Structural social inequities resulting from pervasive poverty and market forces typically result in these elements being more prevalent in higher income areas of cities and extended metropolitan zones than in lower income areas of cities. Given this, it is important to recognize that the wealth generated from the green economy likely will be distributed unevenly across the urban landscape. For example, in many cities, greater volumes of urban vegetation (e.g., street tree canopy or parkland) are typically synonymous with higher real estate values.[156] Similarly, the rapid physical expansion of cities results in geographically uneven impacts on ecosystem services. For example, in South China, recent expansive urban development places differential impacts on air quality and the demand on local water and energy resources.[157]

Engineering

The structure and function of urban systems (e.g., water supply, energy production and distribution, transport infrastructure) also can play a role in the presence and strength of the local green economy, particularly with respect to how well the existing urban systems are designed and organized to promote resource flow efficiency. A critical question is how easily can an urban system be changed or altered to take advantage of green economy opportunities? Issues include whether the systems are flexible and can be easily adapted or they are relatively fixed and rigid. Large scale infrastructure elements of cities, such as water supply, energy supply, and transportation represent massive public investment typically developed over decades that are difficult to change or retrofit within a short time frame.

Whether the current systems are managed near to efficiency, overwhelmed or outmoded add to the level of relative green economy contribution. For example, a mature and well developed energy distribution system could be assessed with respect to green technology capacity. In many urban contexts, particularly in developing countries, systems often operate under extreme limitations. Extensive informal segments of the resource allocation and distribution systems typically are present because of disconnects between the level of demand and available capital resources for expanding the systems.

Opportunities for increased green economic growth are present within the process of maintenance and upgrades, and incorporation of larger-scale design innovations. The regular process of capital cycle upgrades provides moments when cutting edge green technology can be integrated into large scale urban infrastructure. Concurrently, there is also increased interest in revisioning and rebuilding of urban systems to take advantage of additional state-of-the-art green building and infrastructure design elements, including networks of sensors to modulate resource flow, just in time resource delivery systems, and even movable surfaces which change and adjust to micro-climate and solar conditions.

5.1.2 Social innovations and engagement, and governance

While the physical and material factors influencing green economic contribution to urban prosperity are crucial, socio-political factors in many ways are even more important. While

[153] Carruthers, J.I. and Ulfarsson, G.F. (2003) Urban Sprawl and the Cost of Public Services. *Environment and Planning B: Planning and Design* 30(4): 503-522.
[154] Seto, K. C., and Fragkias, M. (2005) Quantifying spatiotemporal patterns of urban land-use change in four cities of China with time series landscape metrics, *Landscape Ecology* 20(7): 871-888.
[155] Cohen, B. (2006) Urbanization in Developing Countries: Current trends, Future Projections, and Key Challenges for Sustainability. *Technology in Society* 28: 63-80.
[156] Leichenko, R. and Solecki. W. (2008) Suburban Consumption Landscapes and Environmental Justice in Cities of the Developing World. *Society and Natural Resources* 21(7): 611-624.
[157] Güneralp, B., and Seto, K. C. (2008) Environmental impacts of urban growth from an integrated dynamic perspective: A case study of Shenzhen, South China, *Global Environmental Change* 18(4): 720-735.

many urban areas have characteristics which enable green economic development, it is the social constraints and opportunities which modulate their realization.

Social innovations and engagement

Opportunities for innovation including the positive conditions for green economic techniques, strategy, and protocol development and experimentation are crucial for increased prosperity. Institutional mechanisms to enhance innovation are multi-faceted and include non-traditional forms of economic development enhancement strategies such 1) partnerships between the public, private, and civic society/NGO communities; 2) educational leadership and experimentation; and 3) technology incubators.

These three enhancement strategies facilitate more direct connections between intellectual capital and resources so as to test new ideas, define successes, and promote rapid implementation of vetted green economic approaches. This strategy has been widely used in North American cities such as Chicago, New York, Seattle and Toronto. In these cities, consortia of local interest groups and decision-makers are validating new concepts designed to promote sustainability and green economic activity. The City of New York government, for example, has developed a multi-billion dollar storm water management-focused, green infrastructure initiative with the objective of connecting the local engineering community and local environmental organizations for joint development projects involving new types of pervious surfaces, water detention/retention structures, and blue roofs. Higher education institutions increasingly play a critical role as mediators and catalysts for green economy expansion.

At a human scale, policy entrepreneurs – individuals at all levels of government who are committed to the issue of promoting green economic initiatives – also are important for enhancing opportunities for green economic contribution to urban prosperity. Globally, mayors of cities of all sizes have encouraged and sponsored the development of green economic enterprise in their cities. Numerous mayors' councils and organizations such as the C40 network of the world's major cities and the Mayors Summit as part of the COP climate change process have formed to promote urban sustainability and green innovation.[158]

Governance

A key governance component in the variation among the non-traditional economic development initiatives is the relative size and composition of the public, private, and civic society sectors. In developing country city contexts such as sub-Saharan Africa, civic society and NGOs play a significant role in green economic development because of the often limited extent of the formal public and private sector.[159] Governance structure and government institutions also are important. The presence of codes and standards for building, transport and other urban infrastructure provide mechanisms through which green technology innovation can be implemented and evaluated. The codes and standards also provide metrics for estimating or measuring ecosystem services benefits.

Equally important is the level of enforcement of the codes and standards. Critical modulating elements are the level of corruption and the degree or extent to which the city in question is unregulated and/or ungoverned. This is particularly important in cities with large scale informal settlement areas in which formal governance and government structures and institutions are weak or largely absent.

In advanced, high-income countries, elements of a green economy are closely associated with the restructuring of urban governance. However, there are interesting differences between North America and Europe. In North America (the US and Canada), urban governance is confronted by fragmented financial and policy making systems, reducing the

[158] Rosenzweig, C., Soleck,i W., Hammer, S.A. and Mehrotra, S. (2010) Cities lead the way in climate-change action. *Nature* 467: 909-911.
[159] McCarney et al (2011) Cities and climate change: The challenges for governance. In Rosenzweig, C., Solecki, W.D., Hammer, S.A. and Mehrotra, S. (eds) *Climate Change and Cities: First Assessment of the Urban Climate Change Research Network*. Cambridge University Press: New York, 249-269.

role of local planning and authorities in shaping urban growth.[160] This fragmented structure of urban governance has been an obstacle in creating consensus among such a diverse array of actors needed to integrate plans for urban sustainability. The driver to integrate a coherent and broad approach in the design and construction of green economy in urban areas has been delegated to the market with limited success. The financial crisis of a large number of local governments aggravates the obstacles created by fragmented governance structures. Although many cities in these two countries have incorporated several elements of a green economy (waste management, renewable energy, green buildings, etc.), those actions are not integrated into a coherent plan to make a difference in the way they grow. Some cities have been able to capitalize public attention to global environmental issues, particularly climate change, in favour of sustainable growth programmes in their communities with large components of a green economy (New York, Chicago, Portland, Seattle and Toronto among others). But in general, the role of the public sector and regional coalition building with other sectors appears to be key-missing factors to expand a green economy at the local level in a larger number of urban areas.

In contrast, the new processes of decentralization and regionalization in the European Union have led a wave of territorial reorganizations and major transformations of European states. Urban areas have been considered key elements addressing those transformations and the challenges of globalization.[161] The promotion of sustainable urban development and the partnership principle seeking successful urban governance by the EU appear to create a favorable framework for the promotion of a green economy in urban areas. The reforms of urban institutions aiming at optimizing the delivery of public services and at creating projects that would bring together a larger number of local actors from diverse areas of civil society, together with a broader public support for environmental responsibility, create favourable conditions for the promotion of a green economy.

In low-income countries, urban governance is strongly bound up with problems of political process and limited human, technical, and financial resources to direct the urbanization process. The lack of inclusive governance has aggravated the urbanization process characterized by social and physical marginalization of large number of urban inhabitants, poverty, environmental degradation and sharp contrasts between the formal and the informal urban space. Financial crises in these countries further aggravate the lack of inclusive governance and multiply the obstacles to develop a green economy in urban areas. Overall, the promotion of a green economy in such urban areas is made problematic because of these factors.

Several scholars are devoting growing attention to linkages between resilience and urban governance in such contexts.[162] Governance studies have considered issues including how principles such as adaptive management can be used to promote sustainability in highly developed, urban coastal zones, and which characteristics of urban governance can enhance climate resilience while at same time reducing the vulnerability of those citizens who are most at risk from climate-related shocks and stress.[163] These studies raise questions regarding the implications of different types of institutional arrangements affecting the resilience of local environments,[164] and the mechanisms by which improved governance mechanisms, such as new types of social contracts and community-based adaptation efforts, can foster resilience to climate change.[165] Some of the many characteristics of urban governance that are identified

[160] Pagano, M. and Perry, D. (2008) Financing Infrastructure in the 21st Century City. *Public Works Management and Policy* 13: 22-38.
[161] Kell, A. (2006) New urban processes on the level of neighborhoods. *European Planning Studies* 14: 335-364.
[162] Leichenko R (2011) Climate Change and Urban Resilience, *Current Opinion in Environmental Sustainability* (Article in press). doi: 10.1016/j.cosust.2010.12.014.
[163] Duxbury J, Dickinson S. (2007). Principles for sustainable governance of the coastal zone: in the context of coastal disasters, *Ecological Economics*, 63, 319-330.
Tanner T., Mitchell T., Polack E., Guenther B. (2009) Urban governance for adaptation: assessing climate change resilience in ten Asian cities. *IDS Working Papers,* 315, http://www.ntd.co.uk/idsbookshop/details.asp?id=1069.
Wardekker J, Jong A, Knoop J, Sluijs J. (2010). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting & Social Change* 77: 987-998.
[164] Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change* 20(4): 550-557.
[165] O'Brien K, Hayward B, Berkes F. (2009). Rethinking social contracts: building resilience in a changing climate. *Ecology and Society*, 14(12).

as promoting resilience include: polycentricity, transparency and accountability, flexibility, and inclusiveness.[166] But rather than prescribing a single, 'best practice' arrangement, the governance literature advocates a diversity of approaches, suggesting that effective institutional arrangements take many different forms according to local contexts.[167] By the same token, effective governance is also necessary to ensure that efforts to promote green economies are successful and sustainable.

5.1.3 Financing green economic development

Another ever-present factor in green economic development opportunities and maintenance is how to finance the activities and investments over the long term. These finance issues centre on three key concerns: 1) capital resource availability, 2) mechanisms for capital exchange, and 3) means of protecting capital investment.

A key question is how can people and organizations with good ideas get the financial resources to develop their innovations? Capital resources at the local level, particularly within the public sphere, are often constrained and in most settings have become even more so since the global financial crisis of 2008. In development settings, resources remain scarce even with a variety of macro and micro loan and funding opportunities that could be deployed to promote green economic expansion.

Given the ever-present constraints on capital resources and relatively limited capital markets in developing country cities, there has been significant growth in the roles of the central/regional/local state as entrepreneur, investor, financial guarantor and, regulator which include partnerships between private and public sectors, e.g., public-private partnerships as well as NGOs. In addition, decision-makers and stakeholders in these cities are actively focused on mechanisms to connect local informal markets to green economic development. In developed country cities, the presence of clear market structure and opportunities is critical for bringing in private capital in green economy ventures. Many cities have been fostering these markets and their structure and organization through the creation of codes, standards and incentives that promote the installation of green technology (e.g., new paving surfaces, solar panels, building skin materials, etc.).

5.1.4 Risk management and insurance

Another mechanism to promote green economic expansion is focused on risk management and insurance. Loss protection strategies create conditions whereby people and organizations can be insulated from large negative financial impacts from extreme events (e.g., disaster, fires, etc). Insurance plays a powerful role in modulating investments in high risk capital ventures and high-risk locations both of which have implications on what level of funds an institutional or individual investor might be willing to put into a green economic venture. For example in New York City, a limiting factor in the installation of electric generating, wind-driven turbines on buildings or green or blue roofs is the added insurance and potential liability associated with the structures (e.g., concern for them to be blown off the building, people accidentally falling from roofs, or material damage to the building structure because of added weight). In a more positive context, increasing insurance rates for coastal properties because of heightened flooding and storm surge risk from climate-changed induced sea level rise can enhance opportunities to convert these locations from residential or commercial land uses to uses that more directly promote green amenity/ecosystem services, e.g., parkland, open space and wildlife habitat, while simultaneously reducing their vulnerability to coastal hazards.

Swalheim. S and Dodman D. (2008). Building resilience: how the urban poor can drive climate adaptation. Institute for Environment and Development IIED, *Sustainable Development Opinion* 2008 (November)., www.iied.org/pubs/pdfs/17043IIED.pdf.

[166] Tanner, T., Mitchell T., Polack E., Guenther B. (2009) Urban governance for adaptation: assessing climate change resilience in ten Asian cities. *IDS Working Papers,* 315, http://www.ntd.co.uk/idsbookshop/details.asp?id=1069.

[167] Ostrom,E. (2010) Polycentric systems for coping with collective action and global environmental change, *Global Environmental Change* 20(4): 550-557.

5.1.5 Human behaviour and psychology

A final, ever more important factor of the green economy contribution to a city's wealth is how much the general public – the city's residents, workforce, and employers – utilize and take advantage of the emerging technology and lifestyle choices. As more green economy programmes emerge in cities, how, when, and where people can and do engage with them has been become a major issue of debate and discussion. Behavioural psychology work on this topic has expanded significantly in the past few years. An overall key finding is that outreach programmes must clearly illustrate and demonstrate conditions where consumers can connect and directly engage with green economic advancements. Consumers must see them as an opportunity for their own material and financial advantage, and not as an imposition on their regular routine and/or as a mechanism of control. In the US, electricity consumers have voiced opposition to smart metering, which provides detailed information on consumers' energy use patterns, which is seen as an invasion of privacy.

5.2 Differential green economy contributions: Mechanisms and drivers

The emergence of a green economy and its contribution to urban prosperity can be further understood by investigating how the factors discussed above develop within cities. Three primary mechanisms through which this takes place include a set of potential drivers. The mechanisms include

1) conceptualization of the urban environment;
2) transformation of existing systems; and
3) emergence of new systems.

5.2.1 Conceptualizing the urban environment

Interaction between the above three sets of factors influences the relative role that any one factor has on their overall contribution to the green economy. Many illustrations of this can be derived from the discussion above. For example, changes in metropolitan transport policy could impact upon the rate and character of urban land use expansion which in turn will affect the physical conditions from which ecosystem services are derived. A range of other interactions – some more subtle yet still profound – need to be noted as well. These interactions reflect conceptual shifts which influence the specification of resources and the definition of management regimes. For instance, the emergence of green economic ideas has come with the redefinition of the urban environment as a source of potential benefits.

Much of the history of urban environmental management has focused on the presence of negative externalities and their control, e.g., protecting individual stakeholders from the negative environmental implications of a neighbouring stakeholder. In the context of amenity values, these were typically associated with specific and targeted activities (e.g., passive or active recreation) or sites (e.g., park, open space). More recently, implicit in green economic enterprise is the emergence of a new conceptualization of the urban environment where a wider set of 'positive' externalities can accrue from a specific location that would not only benefit the site where it was located, but also neighbouring areas as well. The development of 'green infrastructure' includes prospects for enhanced storm water management and flood control.

5.2.2 Transformation of existing systems

The transformation of existing systems also can become important drivers influencing the relative amount of prosperity contribution. Urban resource systems are constantly being upgraded and re-evaluated. Within this process, there can be increased access to ecosystem services. For example, with the application of new and emerging technologies, opportunities for dramatically re-imaging and re-visioning traditional urban water and waste water systems

for increased green economic development.[168] The use of multiple flow and volume sensors to provide real data on systems operation can be used to identify locations and times where energy recovery could take place.

5.2.3 Emergence of new systems

The combination of new technologies and emerging urban restoration and ecological sciences is dramatically changing the relative value of specific factors and the interaction between the factors. New technologies and their application are enabling great opportunities for experimentation in cities. This shift is enhancing the rapid development of previously un-utilized and/or under-utilized resource opportunities (e.g., recycling, solar energy, biota, etc.). More specifically, this trend is facilitating the emergence and identification of new resources such as urban biotic resources for green economic development. For example, the push to restore urban wetlands as a way to not only provide opportunities for urban biodiversity protection and recreation but also for water quality management (via oysters and other bivalves) and flood control.

Furthermore, even the existing built environment is increasingly being conceived and managed as a green economic resource. Buildings are seen as opportunities for white, green, and blue (to store water) roofs that can provide a variety of ecosystem services. Projections into the near future provide illustration that this trend will continue. For example, cutting-edge architectural planning speaks to the possibility that soon the 'skin' of buildings might change in quality and adjust in position during the course of a day in order to maximize the amount of solar energy capture.

6. Conclusions

This Background Paper has addressed salient dimensions of a green economy in the context of urbanization and efforts to promote urban prosperity. The discussion recognizes that green economies are still at a nascent phase of development in many urban areas. Yet there is a growing consensus among international organizations and part of the scientific community reviewed for this paper that a green economy is expected to become the norm in future.

However, it remains difficult to achieve synergies that simultaneously deliver economic prosperity, reduce resource intensity and promote social inclusion. The transition to a green economy faces several obstacles. One of the major challenges is the current globally dominant economic system in which economic added-value is derived from processes and regimes that fail to account properly for environmental and social externalities or the value of ecological services. The advances in payment for ecosystem services, the promotion of renewable energy, green buildings and infrastructure, the creation of green jobs, appear as fragmented successes with little impact on the structural conditions of society. It is worth stressing that unless broad-based cultural movements capable of shifting the aspirational horizons of ordinary people, it will prove difficult to promote and institutionalize the numerous reforms needed to expect a broad implementation of integrated approaches of a green economy in a large number of urban areas.

There is no single path or model fostering a green economy in urban areas. As an important component of sustainable development, an urban green economy faces challenges and opportunities according to conditions and resources in each urban area and their domestic socio-cultural and political context. But the discussion above allows us to identify elements that can open or expand opportunities to promote urban green economies.

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[168] Sanctuary, M., Tropp, H., and Haller, L. (2005) *Making Water a Part of Economic Development: The Economic Benefits of Improved Water Management and Services*. Stockholm: Stockholm International Water Institute.

1. The importance of creating strategies for a green economy according to the characteristics and conditions in OECD and lower-income countries. Differences between urban areas in these two groups of countries are created by the gap in their socioeconomic conditions and the type of urban space they create. The extent and importance of informal growth (urban growth outside the formal planning framework) in low- and most middle-income countries is a major element that cannot be ignored in the design of green urban economic strategies. Such strategies and policies should be locally appropriate and not imitate blindly what is being done in the OECD countries. Greater flexibility and approaches based on incremental steps could yield better results. For example, policies for green buildings and green infrastructure could be based on affordable technologies and vernacular architecture taking advantage of traditional knowledge to adapt buildings and the urban form to climatic conditions.
2. The need to build collaboration and coalitions between the public, private, and social sectors to develop policy frameworks that will enable urban areas in different parts of the world to make the transition to green economic models.[169] Such local coalition building is widely seen as increasingly important, both in terms of reaping the benefits of the best aspects of private and public sectors – as through particular public-private partnership (PPP) mechanisms that have been implemented in many contexts, and in terms of collaborative approaches to resource constraints and political alienation in the current recessionary context.
3. Building capabilities in all urban contexts is a fundamental step in promoting a green economy. Investing in education and training at the level of the urban area is essential for assisting communities to build integrated approaches to a green economy.[170] Training of workers in green technologies and job skills would be required to ensure that they can access green employment opportunities.[171] For a large number of urban areas in poorer countries, however, access to finance, green technologies and skills may be out of reach. This is where support in up-front finance, technology, and capacity building is needed from the national government and the international community. UN-HABITAT and other UN agencies can play a key role in these efforts.
4. Strengthen North-North, North-South, and South-South collaboration and partnerships focusing on urban sustainability. Some existing urban networks, such as the C40 and Mayors' Summit previously referred to, already play useful roles but tend to operate in isolation. Combining efforts could pay dividends. SUDNET and other UN-HABITAT initiatives can be expanded in conjunction with the participation of other UN agencies and other international organizations. Building synergies between UNEP, UN-HABITAT and UNDP can be instrumental in strengthening these collaborations. UN-HABITAT could consider collaborating with non-UN networks like the C40 to cement learning partnerships across the North-South divide and tapping different pools of resources.
5. Integrating the design of strategies and policies for a green economy within the framework of global environmental change, particularly climate change, is essential to avoid conflicts and contradictions between the goals for a green economy and urban responses to climate change. This integration is also essential in long-term planning of urban sustainability. Bridging the gap between science and policy/practice can be instrumental in these efforts. Current UN-HABITAT pilot efforts in this direction could be expanded to serve a large number of urban areas in low-income and middle-income countries.
6. The study and promotion of a green economy has to date been based overwhelmingly on fragmented perspectives from individual empirical case studies. Efforts should be made to create multidimensional and analytical green economic perspectives in urban areas. These perspectives are important to support the creation of synergies among the different elements.

[169] Siemens (2010) Sustainable Cities. Trends, Investment Challenges & Financing Solutions. A Reserach Report from Siemens Financial Services. Siemens Financial Services. Accessed 24 January 2011.
[170] D'Orville, H. (2009) "The role of education and knowledge society." UNESCO (http://portal.unesco.org/es/ev.php-URL_ID=46332&URL_DO=DO_TOPIC&URL_SECTION=201.html), accessed 28 February 2011.
[171] OECD/ Martinez-Fernandez, C., Hinojosa, C., Miranda, G. (2010) "Green jobs and skills: the local labor market implications of addressing climate change." Working document, CFE/LEED, OECD (www.oecd.org/dataoecd/54/43/44683169.pdf?conte ntId=44683170).

7. Urban institutions are an essential component for developing a green economy. Particularly important are public planning institutions. Unfortunately, they have often limited resources and structural and operational constraints to create, promote, and develop initiatives towards a green economy in low- and middle-income countries. Efforts towards a green economy should consider attention to improve, expand, and strengthen their urban institutions and the quality and flexibility of their governance.
8. UNEP (2011) suggests that policy makers need to examine the conditions that will enable urban areas in different parts of the world to make the transition to a green economic model in relation to the maturity of their own political infrastructure. This implies a strong connection between the development of a green economy and efforts to improve urban governance. The information analyzed in this Background Paper suggests differences in the way this connection has been created thus far in wealthy and poorer countries.
9. Inadequate access to funding resources has been a major obstacle to urban development initiatives in low- and middle-income countries. This will continue to retard transitions to green urban economies in many such countries. But the experiences mentioned above stress the importance of creativity to overcome financial constraints. International, national, and local collaboration can boost creativity and help local communities overcome financial limitations.

Finally, it is important to stress that while a green economy is useful in building long-term sustainable and climate-resilient urban areas, it should not be considered a substitute for overall development and prosperity. Rather promotion of green economies must complement broader, locally appropriate sustainable development efforts.