CLIMATE
EVERYONE'S
BUSINESS

Climate Change:
Implications for Cities

Key Findings from the Intergovernmental Panel on Climate Change Fifth Assessment Report

UNIVERSITY OF CAMBRIDGE
Cambridge Judge Business School
Cambridge Institute for Sustainability Leadership

ICLEI
Local Governments for Sustainability

The **Physical Science** of Climate Change

Rising temperatures:

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) concludes that climate change is unequivocal, and that human activities, particularly emissions of carbon dioxide, are very likely to be the dominant cause. Changes are observed in all geographical regions: the atmosphere and oceans are warming, the extent and volume of snow and ice are diminishing, sea levels are rising and weather patterns are changing.

Projections:

Computer models of the climate used by the IPCC indicate that changes will continue under a range of possible greenhouse gas emission scenarios over the 21st century. If emissions continue to rise at the current rate, impacts by the end of this century are projected to include a global average temperature 2.6–4.8 degrees Celsius (°C) higher than present, and sea levels 0.45–0.82 metres higher than present.

To prevent the most severe impacts of climate change, parties to the UN Framework Convention on Climate Change (UNFCCC) agreed a target of keeping the rise in average global temperature since pre-industrial times below 2°C, and to consider lowering the target to 1.5°C in the near future.

The first instalment of AR5 in 2013 (Working Group I on the physical science basis of climate change) concluded that by 2011, we had already emitted about two-thirds of the maximum cumulative amount of carbon dioxide that we can emit if we are to have a better than two-thirds chance of meeting the 2°C target.

Impact of past emissions:

Even if emissions are stopped immediately, temperatures will remain elevated for centuries due to the effect of greenhouse gases from past human emissions already present in the atmosphere. Limiting temperature rise will require substantial and sustained reductions of greenhouse gas emissions.

About this document

The Fifth Assessment Report from the Intergovernmental Panel on Climate Change is the most comprehensive and relevant analysis of our changing climate. It provides the scientific fact base that will be used around the world to formulate climate policies in the coming years.

This document is one of a series synthesizing the most pertinent findings of AR5 for specific economic and business sectors. It was born of the belief that the cities sector could make more use of AR5, which is long and highly technical, if it were distilled into an accurate, accessible, timely, relevant and readable summary.

Although the information presented here is a 'translation' of the key content relevant to this sector from AR5, this summary report adheres to the rigorous scientific basis of the original source material.

Grateful thanks are extended to all reviewers from both the science and business communities for their time, effort and invaluable feedback on this document.

The basis for information presented in this overview report can be found in the fully-referenced and peer-reviewed IPCC technical and scientific background reports at: **www.ipcc.ch**

PUBLISHED:
May 2014

FOR MORE INFORMATION:
E-mail: AR5@europeanclimate.org
www.cisl.cam.ac.uk/ipcc
www.iclei.org
www.europeanclimate.org

AUTHOR:
Rian van Staden

REVIEWERS:
Debra Roberts
Jørgen Abildgaard
Cambridge Project Team:
Nicolette Bartlett
Stacy Gilfillan
David Reiner
Eliot Whittington

PROJECT DIRECTOR:
Tim Nuthall

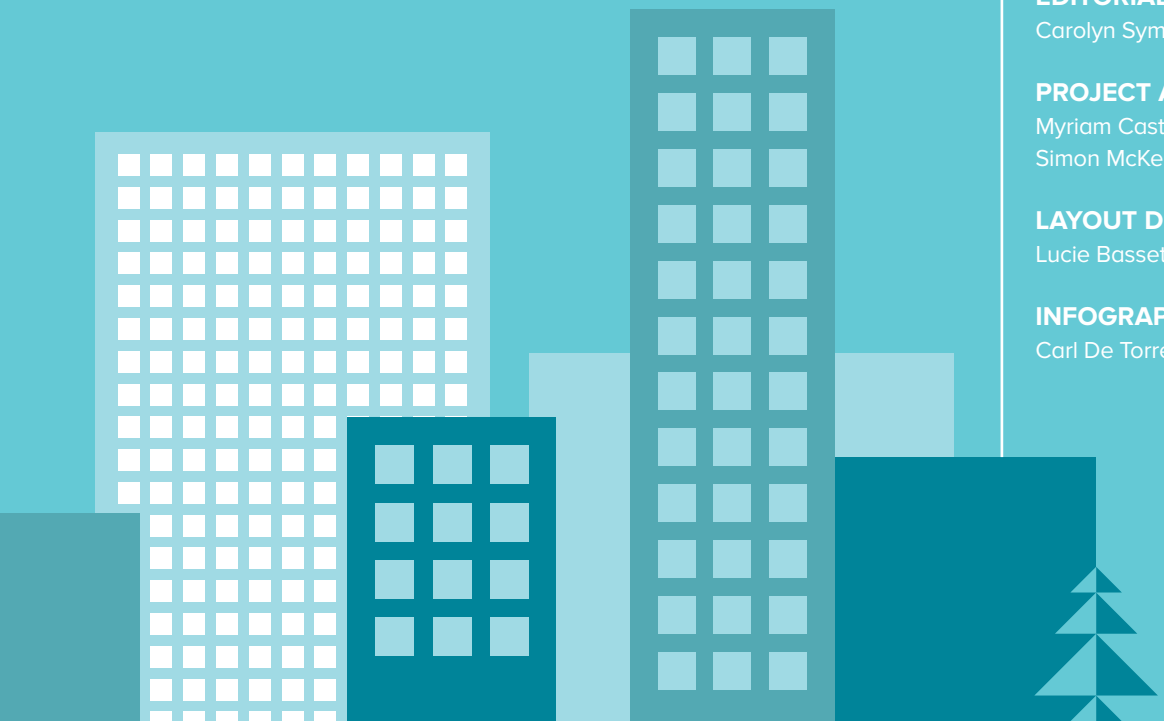
PROJECT MANAGER/EDITOR:
Joanna Benn

EDITORIAL CONSULTANTS:
Carolyn Symon, Richard Black

PROJECT ASSISTANTS:
Myriam Castanié,
Simon McKeagney

LAYOUT DESIGN:
Lucie Basset, Burnthebook

INFOGRAPHIC:
Carl De Torres Graphic Design



Key Findings

1. **Many emerging climate change risks are concentrated in urban areas.** Urban areas hold more than half the world's population and most of its built assets and economic activities. They also house a large proportion of the population and economic activities most at risk from climate change.

2. **Climate change impacts on cities are increasing.** Key issues include rising temperatures, heat stress, water security and pollution, sea-level rise and storm surges, extreme weather events, heavy rainfall and strong winds, inland flooding, food security, and ocean acidification.

3. **The world's urban population is forecast almost to double by 2050, increasing the number of people and assets exposed to climate change risks.** Rapid urbanisation in low- and middle-income countries has already increased the number of highly vulnerable urban communities living in informal settlements, many of which are at high risk from extreme weather events.

4. **Steps that build resilience and enable sustainable development in urban areas can accelerate successful climate change adaptation globally.** Adaptation options exist in areas such as water, food, energy and transport.

5. **The greatest potential for mitigating greenhouse gas emissions may lie in rapidly developing cities in industrialising countries.** City-based sectors with potential for mitigation include buildings, energy, transport, and industry. However, many rapidly developing cities lack the financial, technological, institutional and governance capacity required for effective mitigation.

Executive Summary

By 2050, the global urban population is expected to have increased by 2.5–3 billion relative to 2009, corresponding to 64–69% of the world population. Urban areas are a key driver of greenhouse gas (GHG) emissions across multiple sectors and currently account for over 70% of global energy use.

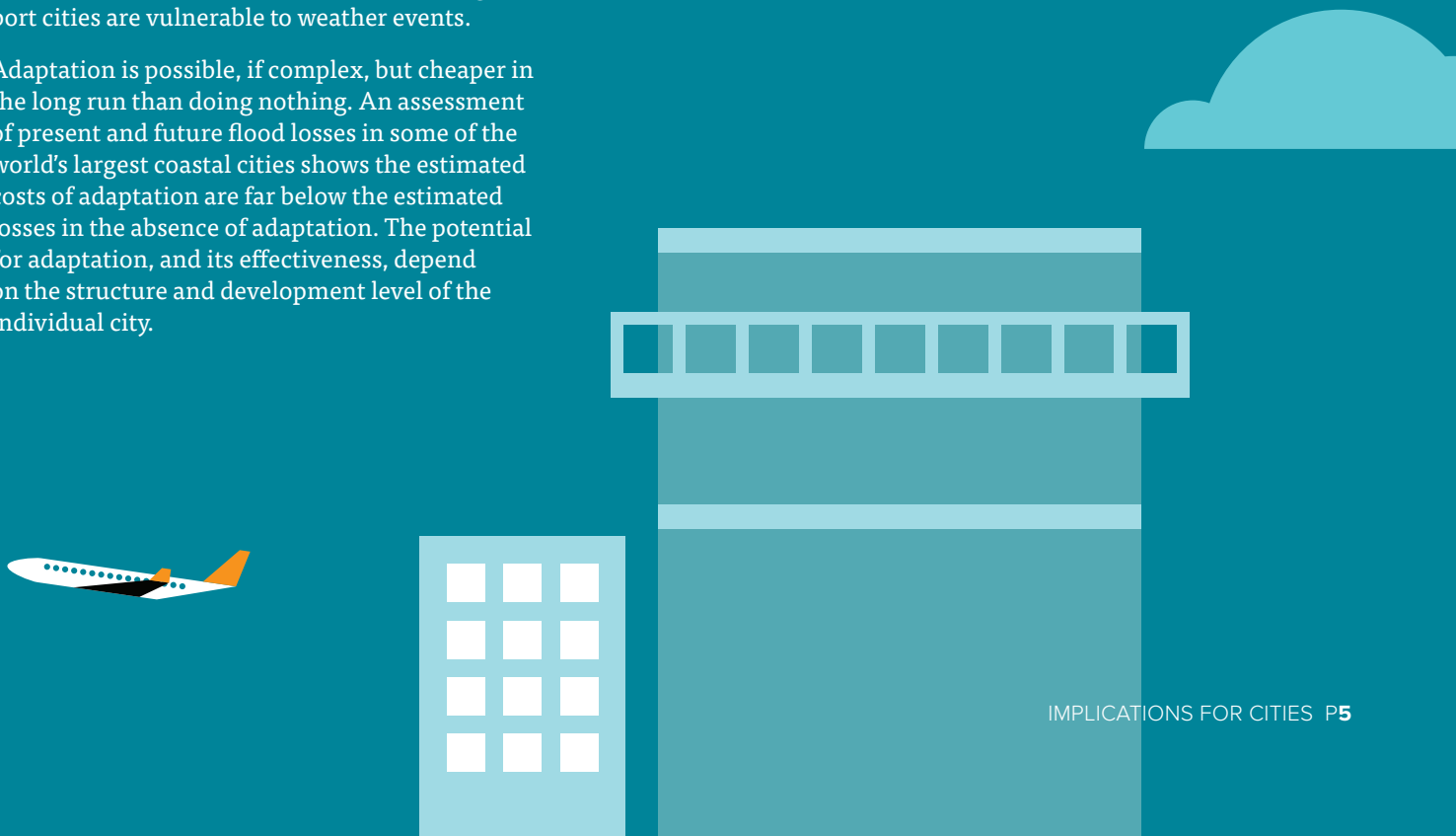
Rising sea levels, inland floods, frequent and stronger tropical cyclones, periods of increased heat and the potential spread of disease, as well as increased drought, associated water scarcity and air pollution, will have widespread negative impacts on people's health, livelihoods and assets. Climate change may worsen access to basic urban services and the quality of life in cities. Most affected are likely to be the urban poor in developing countries where the population is growing rapidly. Three-fifths of the world's urban population is in centres with fewer than 1 million inhabitants and it is here that much of the growth in urban population is occurring. Climate change will also affect local and national economies and ecosystems. As an example, over US Dollar (USD) 3 trillion in port infrastructure assets in 136 of the world's largest port cities are vulnerable to weather events.

Adaptation is possible, if complex, but cheaper in the long run than doing nothing. An assessment of present and future flood losses in some of the world's largest coastal cities shows the estimated costs of adaptation are far below the estimated losses in the absence of adaptation. The potential for adaptation, and its effectiveness, depend on the structure and development level of the individual city.

Risk levels for most key climate change hazards in urban areas will increase over the near-term, but a high level of adaptation can reduce these risk levels significantly. Adaptation will become progressively more difficult for every degree of temperature rise.

Options for mitigating emissions in urban areas vary, and are likely to be most effective when policy instruments are used together. For rapidly developing cities, options include shaping urbanisation and infrastructure towards more sustainable and low-carbon pathways. In mature or established cities, options are constrained by existing urban forms and infrastructure but there is potential by refurbishment and retro-fitting.

Current findings suggest the need to increase the pace of mitigation in both developed and developing world cities, focussing on emissions generated in sectors such as energy supply, transportation, buildings and industry. At the same time, a wide range of available urban planning and development strategies can also reduce emissions.



Impacts of Climate Change

Rising temperature

By the mid-21st century, most of the world's population living in the largest urban areas will be exposed to a minimum 2°C rise over pre-industrial levels, excluding urban heat island (UHI) effects. By the late 21st century, some of the urban areas expected to be among the largest in 2025 will be exposed to a rise of up to 2.5°C over pre-industrial levels (excluding UHI effects), especially in the high latitudes. This implies that mean temperature rise in some cities could be over 4°C. Peak seasonal temperatures could be even higher and the increased frequency of hot days and warm spells will exacerbate UHI effects, causing heat-related health problems and, possibly, increased air pollution, as well as an increase in energy demand for warm season cooling, clean water, and infrastructure damage. Each degree (Celsius) of warming is projected to decrease renewable water resources by at least 20% for an additional 7% of the global population.

Water security

Risks to freshwater resources, such as drought, can have many effects in urban areas, including increases in water shortages, electricity shortages (by affecting hydropower and plant cooling), water-related diseases (through use of contaminated water), and food prices and food insecurity from reduced supplies. These may all contribute to negative economic impacts and increased rural-to-urban migration. An estimated 150 million people currently live in cities with perennial water shortage (i.e. less than 100 litres per person per day for basic human needs). This number is projected to increase, possibly up to 1 billion by 2050.

Rising sea levels and storm surge

Sea-level rise represents one of the primary shifts in urban climate change risk, given the increasing concentration of urban populations in coastal locations. In 2000, the Low Elevation Coastal Zone (LECZ) comprised just 2% of the world's land area but contained 10% of the global population (600 million people), including 13% of the world's urban population (360 million). Two-thirds of cities with populations above 5 million are located in the LECZ.

If GHG emissions continue to rise at the current rate, sea level could rise by almost one metre by the end of the century. To compound matters, sea-level rise is not uniform. For example, in the Sea of Japan it is currently rising twice as fast as the global average. Rising sea levels, associated coastal and riverbank erosion, or flooding in conjunction with storm surge could have widespread effects on populations, property and coastal vegetation and ecosystems, and present threats to commerce, business, and livelihoods. Cities with extensive port facilities and large-scale petro-chemical and energy-related industries are especially vulnerable to risks from increased flooding. With a 0.5 m rise in sea level, the population at risk could more than triple while asset exposure is expected to increase more than ten-fold. The value of assets exposed in 2005 to flood risk from sea-level rise and storm surge in the world's major port cities is estimated at USD 3 trillion – about 5% of global Gross Domestic Product (GDP). By the 2070s, this is projected to increase to about 9% of global GDP. In fast-expanding and vulnerable cities such as Ningbo (China), Dhaka (Bangladesh) and Kolkata (India), asset exposure may increase more than 60-fold.

Many of the emerging global climate risks are concentrated in urban areas.

Inland flooding

By the end of the 21st century, changes in extreme rainfall in the range 10–60% may lead to changes in flood and combined sewer overflow frequencies and volumes of up to 400% depending on system characteristics. Inland flooding is often made worse by uncontrolled city development that builds over natural drainage channels and flood plains, increasing the speed and volume of runoff, or by a failure to maintain drainage channels. The volume of sewage released to the environment by combined sewage overflow spills and flooding is projected to increase by 40% in some cities.

Food security

Cities depend on their surrounding areas as well as the rest of the world for food supply. In many regions, there is likely to be a loss of food production and productive arable lands. Without adaptation, climate change is projected to reduce yields of major crops such as wheat, rice, and maize at local temperature increases of 2°C or more above present-day levels. After 2050, the risk of more severe yield impacts will increase, and will depend on the level of warming. The variability of harvests is also forecast to increase. All aspects of food security are potentially affected by climate change, including food access, utilisation, and price stability. Urbanisation changes land-use cover, generally reduces the amount of ecologically intact land, and causes fragmentation of the remaining land. Climate change also affects the physical and chemical properties of the ocean. Fish and shellfish are affected directly by changes in seawater temperature, pH and oxygen levels. Societies relying on fish for subsistence are likely to be particularly disadvantaged. A 2°C global temperature rise by 2050 is projected to cause global losses in landed catch value of USD 17–41 billion annually (relative to 2005 levels). Cities with a heavy reliance on local fishing for local food provision would be significantly affected.

Impacts and risks

- **Rising temperatures could exacerbate urban heat island effects** and thus increase heat-related health problems and air pollution in cities.
- **Warming is projected to decrease renewable water resources,** potentially compromising drinking water supplies in many urban areas and increasing water-related diseases, food prices and food insecurity.
- **Ocean acidification** is a risk for marine resources.
- **Sea-level rise, extreme weather events and inland flooding** will result in threats to life and livelihood, destruction of infrastructure, service provision failure and governance issues.
- **The value of economic assets in coastal cities exposed to damage from floods** is projected to rise from 5% of global GDP in 2005 to 9% by 2070.
- **Hazards such as floods and cyclones** are a risk for half to two-thirds of Asia's cities with 1 million or more inhabitants.

Cities on the front line of a changing climate

Urban centres account for more than half of the world's population, most of its economic activity and the majority of energy-related emissions. The role of cities in reducing emissions and protecting their inhabitants is therefore central to effective climate policies.

IMPACTS

Climate change is expected to affect numerous aspects of urban life.

Adaptation is possible if complex, but cheaper in the long run than doing nothing. How cities adapt to the effects of climate change will vary enormously.

Sea-Level Rise

Two-thirds of cities with populations above 5 million are located in the Low Elevation Coastal Zone. Rising sea levels and storm surge flooding could have widespread effects on populations, property, and ecosystems, presenting threats to commerce, business and livelihoods.

ADAPTATIONS

Responses include: **(A)** improving early warning systems, **(B)** strengthening coastal infrastructure, a significant degree of rezoning (including relocation of critical services), **(C)** and evacuation and crisis response management.

Food Insecurity

All aspects of food security are potentially affected by climate change, including access to food, food utilisation and price stability. Climate change is likely to cause food production in some regions (including the ocean due to warming and acidification) to decline.

ADAPTATIONS

Local responses include support for urban and peri-urban agriculture, **(D)** green roofs, local markets and enhanced social (food) safety nets. **(E)** Develop alternative food sources, including inland aquaculture, to replace ocean-based resources under threat.

Mitigation efforts can have positive impacts for generations to come

Energy Supply

Reductions in greenhouse gas (GHG) emissions can be achieved by the use of low-carbon technologies including renewables, nuclear, and carbon capture and storage. Switching from coal to gas can be a bridging solution.

Transport

Emissions can be reduced by avoiding journeys, shifting to low-carbon transport systems, enhancing vehicle and engine efficiency, and reducing the carbon intensity of fuels by substituting oil-based products with natural gas, bio-methane or biofuels, or with electricity or hydrogen produced from low GHG sources.

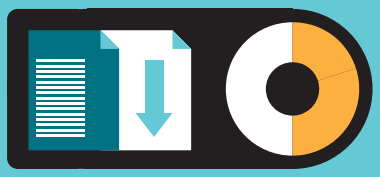
Buildings

Retrofitting existing buildings can reduce heating energy requirements by 50–75% in single-family housing and 50–90% in multi-family housing at costs of about US Dollar 100 to 400 per square metre. In contrast, substantial new construction in fast-growing regions presents a great mitigation opportunity as emissions can be virtually eliminated for new builds.

Cities account for 37–49% of global GHG emissions

Urban infrastructure accounts for over 70% of global energy use

Over 64% of the world population to live in cities by 2050, significantly increasing energy use for infrastructure



New infrastructure and land-use policies could reduce GHG emissions by 20–50% by 2050

Extreme Weather Events

Changes in extreme rainfall could cause the amount of sewage released to the environment from combined sewage overflow spills and flooding to increase by 40% in some cities. Inland flooding is often made worse by uncontrolled city development.

Increased Temperatures

The mean temperature rise in some cities could be over 4°C by 2100, with peak seasonal temperatures even higher. More hot days will exacerbate urban heat island effects, resulting in more heat-related health problems and, possibly, air pollution.

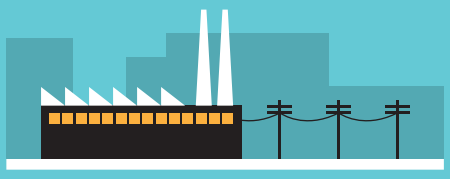
Freshwater Availability

Risks to freshwater resources, such as drought, can cause shortages of drinking water, electricity outages, water-related diseases (through use of contaminated water), higher food prices and increased food insecurity from reduced agricultural supplies.

ADAPTATIONS
Responses include strengthening infrastructure, **(F)** localised migration, wastewater, stormwater and runoff infrastructure and management, and better emergency measures including **(G)** stockpiling fuel, water and food.

ADAPTATIONS
Development of urban planning heat management strategies, **(H)** including green zones, wind corridors, green roofs and water features. **(I)** Building codes will need to be improved, and the infrastructure used by vulnerable parts of the population will need to be made more resilient.

ADAPTATIONS
Options include **(J)** encouraging water recycling and grey water use, improving runoff management and developing new/alternative water sources, **(K)** storage facilities and autonomously powered water management and treatment infrastructure.



Energy Demand

Increasing the efficiency of buildings, appliances and distribution networks will reduce energy demand. Changes in the awareness and behaviour of residents can also reduce demand. Projections suggest demand may be reduced by up to 20% in the short term and 50% by 2050.

Low Carbon Cities

Options for rapidly developing cities focus on shaping their urban and infrastructure development trajectories. For mature cities, options lie in urban regeneration (compact, mixed-use development that shortens journeys, promotes transit/walking/cycling, and adaptive reuse of buildings) and rehabilitation and/or conversion to energy-efficient building designs.

Policy Instruments

Approaches include co-locating high residential with high employment densities, achieving high land-use mixes, investing in public transit. The best plans for advancing sustainable urbanisation and low carbon development, especially in fast-growing parts of the world requires political will and institutional capacity.

Resilience

Steps that build resilience and enable sustainable development can accelerate successful climate change adaptation.

Urban governments are at the heart of successful urban adaptation because so much of this depends on local assessments and integrating adaptation into local investments, policies and regulatory frameworks. Well-governed cities with universal provision of infrastructure and services provide a strong base for building climate resilience if processes of planning, design and allocation of human, capital, and material resources are responsive to emerging climate risks.

Urban adaptation provides opportunities for a shift towards resilience and sustainable development via multi-level urban risk management, alignment of policies and incentives, strengthened local government and community adaptation capacity, synergies with the private sector, and appropriate financing and institutional development. Although the many rapidly growing cities provide good opportunities for such developments, there is limited evidence of this being realised in practice.

Planning

There is no single approach to urban adaptation planning because of the complex, diverse and context-dependent nature of climate change adaptation and of cities themselves. Although top-down and bottom-up approaches are widely recognised, in practice adaptation entails a combination of both. Local governments can play a central role addressing the challenges of adaptation planning and implementation in close partnership with the public, low-income groups, and civic and private sectors. Closer integration of disaster risk management and climate change adaptation, with the incorporation of both into local, sub-national, national and international development policies can provide benefits at all scales.

Funding

Large cities with strong economies and administrative capacity can best attract external funding and raise internal funding for adaptation. Less prosperous and smaller urban centres and cities with fragmented governance structures or administrations lacking in capability have weaker prospects. Types of financing that can be used to facilitate adaptation include local revenue raising policies (taxes, fees, charges), the use of local bond markets, public-private-partnership (PPP) contracts and concessions, national or local financial markets, national (or state/provincial) revenue transfers or incentive mechanisms, market-based investments and grants and concessional financing (such as an Adaptation Fund).

Housing

Good quality, affordable, well-located housing provides a strong base for city-wide climate change adaptation that minimises current exposure and loss. Possibilities for adapting the existing building stock rest with owners and public, private and civil society organisations.

Rising temperatures

In response to increased temperatures, cities may develop urban planning heat management strategies, including green zones, wind corridors, green roofs and water features. This implies improved building codes and the proofing of infrastructure used by the weakest population groups against high temperatures – especially schools, retirement facilities, and hospitals.

The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) is the most detailed assessment of climate change ever.

Basic services

Reducing basic service deficits and building resilient infrastructure systems (water supply, sanitation, storm and waste water drains, electricity, transport and telecommunications, health care, education, emergency response) can significantly reduce hazard exposure and vulnerability to climate change, especially for those most at risk or vulnerable.

Water security

Increased freshwater demand due to increased temperatures will require cities to look at water management infrastructure and planning. Cities can react to challenges in freshwater availability and pollution by creating strengthened, distributed, autonomously powered water management and treatment infrastructure; by encouraging water recycling, the use of grey water and improved runoff management; and by developing new/alternative water sources and expanding storage facilities. Energy generation may also be affected, requiring cities to expand water-independent generation capacity.

Rising sea levels and storm surge

Risk through sea-level rise and storm surge may lead to cities strengthening coastal infrastructure, especially ports and electricity generation capacity. This will require the construction of storm surge protection (barriers, floodgates, dikes) and a significant degree of rezoning and upland expansion, as well as the relocation of critical services. Improved early warning, evacuation, and crisis response management will reduce the health and livelihood risk to residents, as will the development of alternative intra-coastal transport routes and modes and non-coastal, distributed energy generation capacity.

Extreme weather and inland flooding

Extreme weather events will require that cities develop distributed, resilient energy, healthcare and command-and-control services. This will include strengthening public transport infrastructure, and potentially stockpiling fuel, water and food. Improved building standards can be used to strengthen built infrastructure, with a special focus on poorer communities. Wastewater, stormwater and runoff infrastructure could be improved.

Food security

Adaptation measures concerning urban food security can reduce climate vulnerability especially for low-income urban dwellers. Adaptive local responses can include support for urban and peri-urban agriculture, widespread green roofs, local markets, and enhanced social safety nets. Improving the efficiency of urban markets, promoting farmers' markets, investing in infrastructure and production technologies may all moderate food price increases. Food security may be enhanced by support for street food vendors, access to cheaper food and measures like cash transfers (e.g. Brazil's Bolsa Familia Programme) or, for older groups, pensions. Initially rural in focus, cash transfer programmes have expanded in urban areas, in some places reaching much of the low-income population. Changes in the availability of key resources from ocean-based sources may require cities to develop alternative food sources and strengthen logistics for the acquisition and distribution of alternative foodstuffs. This might also include the introduction of inland aquaculture.

Mitigation Potential

Sectoral strategies

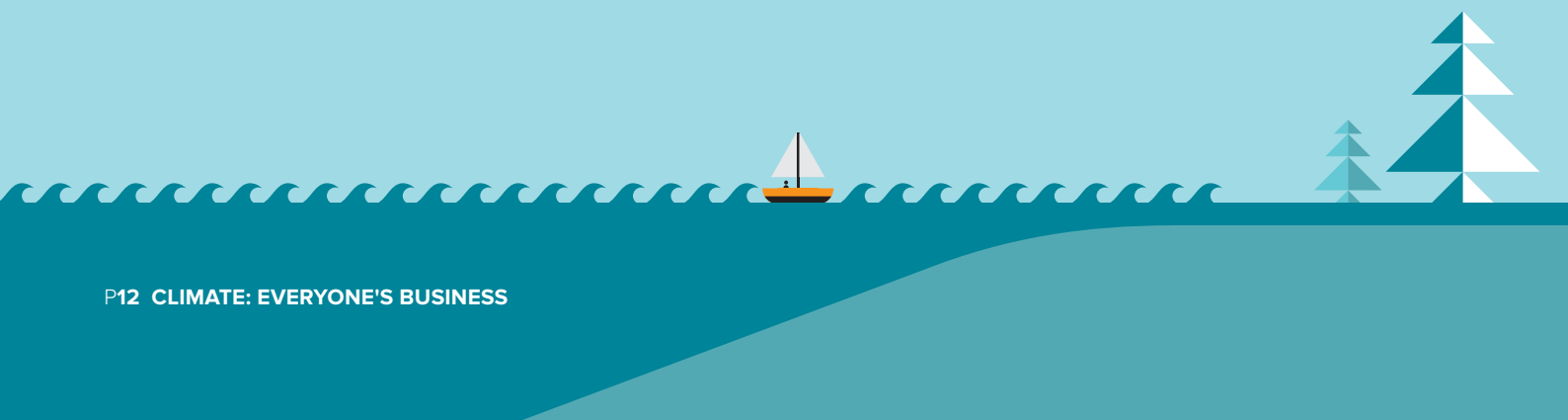
The long lifetime of the built environment limits the speed at which emissions in some sectors (such as buildings and transport) can be reduced. Large amounts of primary resources are used in their initial construction, which contributes to lifecycle emissions. Energy use in human settlements mainly concerns urban areas. Cities account for about 71% of energy-related CO_2 emissions, but only 37–49% of global GHG emissions (other sources of GHG emissions are predominantly associated with rural areas).

Energy demand Increasing the efficiency of buildings, appliances and distribution networks will reduce energy demand. Changes in the awareness and behaviour of residents can also reduce demand. Projections suggest demand may be reduced by up to 20% in the short term and 50% by 2050.

Buildings Retrofitting existing buildings can lead to potential reductions in heating energy requirements of 50–75% in single-family housing and 50–90% in multi-family housing at costs of about USD 100 to 400 per square metre. In contrast, substantial new construction in dynamically growing regions presents a great opportunity from a mitigation perspective as emissions can be virtually eliminated for new builds. Both approaches are generally cost-effective but barriers remain to their widespread implementation.

Energy supply Significant reductions in cities' GHG emission from energy production can be obtained by (for example) switching from coal burning to Natural Gas Combined-Cycle (NGCC) power plants (provided that fugitive methane emissions are controlled) or Combined Heat and Power (CHP) plants. Low-carbon options include carbon dioxide capture and storage (CCS), nuclear and renewable energy technologies. These may have co-benefits for cities, for example in reducing urban air pollution. Initiatives that encourage companies to exchange ideas and techniques for reducing material and energy use, such as eco-industrial parks and regional eco-industrial networks, can reduce emissions.

Transport Emissions from transportation can be reduced by avoiding journeys where possible, a modal shift to low-carbon transport systems, lowering energy intensity by enhancing vehicle and engine performance, and reducing carbon intensity of fuels by substituting oil-based products by natural gas, bio-methane or biofuels, or with electricity or hydrogen produced from low GHG sources.



Urbanisation is a global trend and is associated with increases in income, and higher urban incomes are correlated with higher consumption of energy and GHG emissions.

Urban form and infrastructure

Urban form and infrastructure significantly affect GHG emissions. They are strongly linked to the use of materials and energy in a city, waste generated, and system efficiencies of a city.

Mitigation options vary by city type and development. The options available for rapidly developing cities include shaping their urbanisation and infrastructure development trajectories. For mature, built-up cities, mitigation options lie in urban regeneration (compact, mixed-use development that shortens journeys, promotes transit/walking/cycling, and adaptive reuse of buildings) and rehabilitation/conversion to energy-efficient building designs.

An area of special focus is infrastructure, especially in terms of density, land-use mix, connectivity and accessibility. Connectivity and accessibility are tightly related. While individual measures of urban form have relatively small effects on vehicle miles travelled, they become more effective when combined. There is consistent evidence that co-locating higher residential densities with higher employment densities, coupled with significant public transit improvements, higher land use mixes, and other supportive demand management measures can lead to greater emissions savings. Highly accessible communities are typically characterised by low daily commuting distances and travel times, enabled by multiple modes of transportation. There is robust evidence that following these guidelines in urban development reduces city emissions.

Urban mitigation options are likely to be most effective when policy instruments are bundled. These can include instruments that help decrease emissions such as land use regulations, density regulations, urban containment, building codes, parking and design regulations, land management and acquisition regulations and increasing green space and urban carbon sinks. Market-based instruments include property taxes, development taxes, fuel prices and transportation costs.

Income and scale exert important influences on the mitigation potential for technologies. While lock-in may limit the rate of mitigation in mature cities, the opportunity exists in rapidly growing cities to leapfrog to new technologies. For mature cities, technology is important for R&D and knowledge concentration, and access to capital that facilitates the development and early deployment of low-carbon technologies.

AR5 highlights two key knowledge gaps important in relation to mitigation that can be addressed by cities and their local governments. These are the lack of emissions data at a local level and the lack of consistency and comparability on local emissions accounting methods, demanding the development, standardisation and active use of GHG inventories in cities.

Conclusion

The next two decades present a window of opportunity for mitigation in urban areas, as a large portion of the world's urban areas will be developed during this period.

The urban population is projected to increase from 3.4 billion in 2005 to 6.3 billion in 2050. Urban population growth will be concentrated in Asia and Africa. The rural population is projected to begin declining around 2020.

The full likely impact of climate change on cities has yet to be determined, and is dependent on location, level of development, size, resources and the ability and political will to adapt. Case studies and regional reviews assessing urban vulnerabilities to climate change have revealed diverse physical and societal challenges and large differences in levels of adaptive capacity. Well-governed cities with universal provision of infrastructure and services have a strong base upon which to build climate resilience. However, even high levels of successful adaptation in well-governed cities cannot address all risks in the longer term without both effective global mitigation and horizontal learning between cities for adaptation and mitigation.

Linkages between urbanisation and GHG emissions trends are complex and involve many factors including the level of development, rate of economic growth, availability of energy resources and technologies, and urban form and infrastructure. Transition from coal-based energy supply to low-carbon electricity could help mitigate the fast-increasing CO_2 emissions associated with rapid urbanisation. Other options for cities include good-quality, affordable, well-located housing, providing a strong base for city-wide climate change resilience. International financial institutions provide limited support for transformation in urban areas. Local fiscal policy itself can restrict mitigation efforts to support pursuing more compact city strategies. Overcoming the lack of political will, restricted technical capacities, and ineffective institutions for regulating or planning land use will be central to attaining low-carbon development at a city scale.

Both developed and developing cities are under pressure to build up the skills and resources to contribute directly to reducing local emissions in close co-operation with regional and national bodies. Action in urban centres is essential to successful global climate change adaptation and mitigation, as these areas hold more than half the world's population and most of its built assets and economic activities.

Glossary

ADAPTATION

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects.

BIOFUEL

A fuel generally in liquid form, produced from organic matter or combustible oils produced by living or recently living plants.

CLIMATE CHANGE

Any significant change in climate that persists for an extended period, typically decades or longer.

CLIMATE IMPACT

The effects of climate change on natural and human systems.

CO-BENEFITS

The positive effects that a policy or measure aimed at one objective might have on other objectives.

FOOD SECURITY

Secure access to sufficient amounts of safe and nutritious food for normal growth, development, and an active and healthy life.

FUGITIVE EMISSIONS

Emissions of gases or vapours from pressurised equipment due to leaks and other unintended or irregular releases of gases, mostly from industrial activities.

GREENHOUSE GAS

A gas in the atmosphere, of natural and human origin, that absorbs and emits thermal infrared radiation. Water vapour, carbon dioxide, nitrous oxide, methane and ozone are the main greenhouse gases in the Earth's atmosphere. Their net impact is to trap heat within the climate system.

MITIGATION

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

OCEAN ACIDIFICATION

A reduction in the pH of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide from the atmosphere.

PERI-URBAN AGRICULTURE

Farm units close to town which operate intensive semi- or fully commercial farms to grow vegetables and other horticulture, raise chickens and other livestock, and produce milk and eggs.

PROJECTION

A potential future evolution of a quantity or set of quantities, often computed by a model. Projections involve assumptions that may or may not be realized, and are therefore subject to substantial uncertainty; they are not predictions.

RESILIENCE

The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure.

SUSTAINABLE DEVELOPMENT

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

URBAN AGRICULTURE

Small areas (e.g. vacant plots, gardens, verges, balconies, containers) within the city for growing crops and raising small livestock or milk cows for own-consumption or sale in neighbourhood markets.

URBAN HEAT ISLAND

The relative warmth of a city compared with surrounding rural areas.

WATER SECURITY

Secure access to an acceptable quantity and quality of water for health, livelihoods and production.

"The IPCC's Working Group II report is a clear signal to local governments of the urgent need to ramp up the adaptive capacity of the world's urban areas. This summary document is a critical tool in helping local governments determine the extent of the challenge and the scope of the opportunities that such foresighted adaptation action requires."

DEBRA ROBERTS, DEPUTY HEAD: ENVIRONMENTAL PLANNING AND CLIMATE PROTECTION, DURBAN, SOUTH AFRICA.

Disclaimer:

This publication has been developed and released by the European Climate Foundation (ECF), ICLEI - Local Governments for Sustainability (ICLEI) and the University of Cambridge's Judge Business School (CJBS) and Institute for Sustainability Leadership (CISL).

This project was initiated and financed by ECF and endorsed by CJBS and CISL.

The family of summaries, of which this report is part, is not meant to represent the entirety of the IPCC's Fifth Assessment Report (AR5) and they are not official IPCC documents. The summaries have been peer-reviewed by experts both from the business and science communities. The English version constitutes the official version.

About us:

The University of Cambridge Institute for Sustainability Leadership (CISL) brings together business, government and academia to find solutions to critical sustainability challenges.

Cambridge Judge Business School (CJBS) is in the business of transformation. Many of our academics are leaders in their field, creating new insight and applying the latest thinking to real-world issues.

ICLEI - Local Governments for Sustainability (ICLEI) – is the world's leading association of more than 1000 metropolises, cities, urban regions and towns representing over 660 million people in 86 countries.

For more information:

E-mail: AR5@europeanclimate.org
www.cisl.cam.ac.uk/ipcc
www.iclei.org
www.europeanclimate.org