

01

Collection of Studies
into Local and
Regional Public Policies
on Social Cohesion

Climate Change and Local Social Cohesion



urb-al III
Oficina de Coordinación y Orientación - OCO

Climate Change and Local Social Cohesion



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This document has been produced within the framework of a European Union grant. The content of this document is the exclusive responsibility of the author and should not in any way be considered a reflection of the position held by the European Union.

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© Publisher: Diputació de Barcelona
(URB-AL III Programme Coordination and Orientation Office)
Editorial Board: Agustí Fernández de Losada, Octavi de la Varga, Eduardo Feldman, Carla Cors, Víctor Godínez and Verónica Sanz
Editing: Directorate of Communication, Diputació de Barcelona
Design: Estudi Josep Bagà
Printing: DRG
LD: B. 9821-2012

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Preface

I am very pleased to present the series *Studies into Local and Regional Public Policies on Social Cohesion*. This series has been produced by the URB-AL III Programme Coordination and Orientation Office. Its aim is to explore the current situation regarding a set of central problems that form part of the present agenda for political bi-regional European Union-Latin American discussions relating to social cohesion.

This first edition deals with the problems of climate change and their relation to the issue of local social cohesion.

Climate change is a global phenomenon. However, CO₂ emissions originate for the most part in urban agglomerations. Thus, territorial governments have a clear role to play in the fight against climate change, whether in terms of mitigation or of adaptation to the consequences of this global change.

Climate change is not just an environmental problem but one which has important social, economic and political impacts. Dealing with climate change calls for complementary actions to be taken covering a varied and broad range of issues on the territorial public agenda (for example, mobility, renovating street furniture and housing stock, urban planning, local development, etc.). The fight against climate change also requires different levels of government to harmonise their policies, build co-responsibilities and foster greater coordination between public administrations and citizens. Either way,

the fight against climate change leads to the emergence of new challenges on the public agenda and at the same time it provides an opportunity for innovation in public policies, public management and public governance.

The environmental crisis caused by climate change and the importance of increasing awareness and adopting measures towards achieving sustainable development is perhaps one of the most eloquent examples of how unmistakably global problems can only be satisfactorily resolved by means of manifestly local approaches. Tackling these problems from a local level with a minimum guarantee of success calls for political leaders with a strategic vision of the territory and a desire to build a future. It also requires the explicit acknowledgment that this issue is not one that can be resolved by any one actor working alone, but is one that he or she can make a firm contribution towards resolving by agreeing to face it on a territorial level. On the one hand, local governments can lead the way by managing their own institutions in an environmentally friendly manner. They can also introduce clear eco-friendly criteria relating to the suppliers and businesses they work with. On the other hand, local governments can make a commitment to ensuring the complementarity of their agendas, building collaboration relationships with key actors, investing in the development of new technical skills and introducing the highest level of dynamism possible into the legal and administrative procedures required for tackling a phenomenon

whose own dynamism has been clearly documented.

The fight against climate change is, therefore, an intrinsic part of the strategic challenges that must be faced by territorial governments seeking to contribute to improving social cohesion.

Agustí Fernández de Losada
Director of International Relations at Diputació de Barcelona and General Coordinator of the URB-AL III Programme Coordination and Orientation Office.

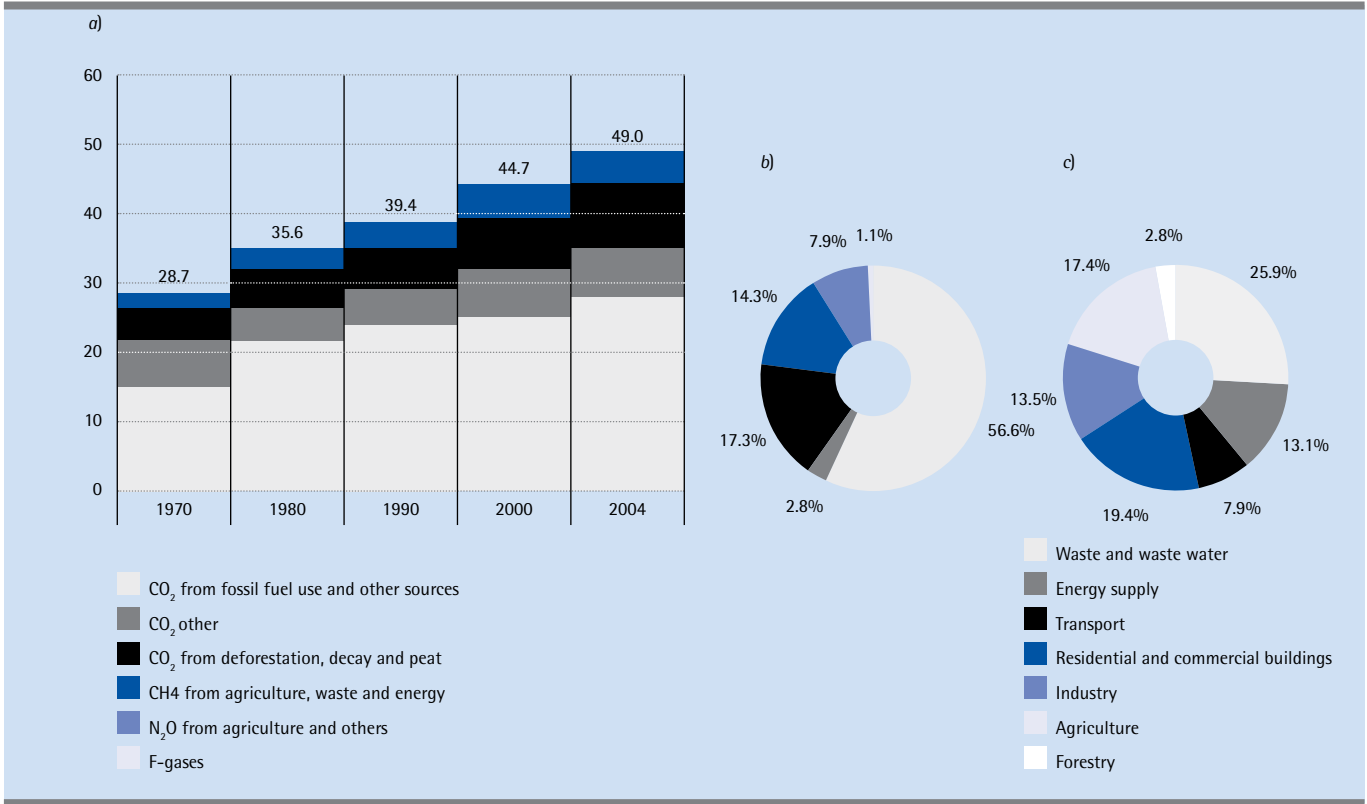
A. General introduction: Does global climate change pose new challenges for local social cohesion?

In its most recent report into the global climate change situation, the Intergovernmental Panel on Climate Change of the United Nations (Ipcc 2007) states that according to instrumental records of global surface temperature (since 1850) the period 1995-2006 ranked among the warmest years. The same report reiterates the causal relationship between greenhouse gas (GHG) emissions –particularly carbon dioxide and methane– and the production and excessive use of fossil fuels; in fact, it attributes almost 57% of global GHG emissions to the consumption of fossil

fuels. As shown in the following diagram, the report also provides an estimation of the different sectors' contribution to GHG emissions.

During the period 1906-2005 there was an acceleration of the upward trend in global average temperature compared to the estimation published in the IPCC's previous report (Ipcc 2001), corresponding to the period 1901-2000, with an increase from 0.6°C to 0.74°C between one period and the other. This supports the evidence that in recent years global warming has risen.

Figure 1
Global anthropogenic
GHG emissions
GtCO₂e/year



(a) Global annual emissions of anthropogenic GHGs from 1970 to 2004. (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO₂eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO₂e. (Forestry includes deforestation.) Source: Ipcc 2007.

At the same time as this increase in global average temperature, significant changes have taken place in global precipitation patterns which have aggravated extreme events occurring in different parts of the world, such as severe and long-lasting droughts or torrential rains and serious flooding. Both climate extremes have resulted in high economic, social and environmental costs which vary dramatically depending on whether the events occur in territories and societies with greater or lesser adaptive capacity to cope with these manifestations of climate change (IPCC 2007; STERN 2006).

The seriousness of this situation impacts on at least two basic aspects of public policy:

- The first concerns the problems that would be caused for social welfare and economic activity in general if the present trends were to continue or increase. This possibility calls for an urgent rethink and redesign of the conventional and persistently reactive ways in which most local governments still deal with these scenarios. The specific cases analysed in this report offer different policy alternatives generated by various social and institutional structures for addressing the challenges of climate change.
- The second aspect, although it may seem paradoxical, is linked to the fact that due to the GHG emissions that have already accumulated in the atmosphere

over recent decades, the present climate change trends (higher temperature, variable rainfall patterns, droughts, floods, heat waves, melting polar ice and snow caps, rising average sea levels, tropical storms and hurricanes, eroding coastlines and water basins, landslides and mudslides onto infrastructures, cities and people, loss of assets and human lives, etc.) will continue for at least three decades or more. This will still be the case even if effective mitigation (EMM) and appropriate adaptation measures (AAM) to counter GHG emissions are implemented immediately to avoid irretrievable damage and control the costs caused by the aforementioned extreme events. Obviously, however, the costs will be much higher if these measures are not implemented at all.

Effective mitigation and appropriate adaptation measures (EMM+AAM) against climate change must be set up urgently on a local, regional, national and global scale (or be maintained and strengthened where they are already in place). This necessity opens up an important public agenda of cooperation between different public stakeholders. Firstly, between different branches of government (executive or ministerial, legislative or parliamentary, and judicial or justice administration); secondly, between different levels of government (central or federal, state or provincial, and local or municipal); thirdly, between different actors in the same level of government, whether within the same country or between different countries; and finally, between national,

regional and local governments and multilateral agencies.

Public agendas that promote EMM+AAM in order to tackle local climate change scenarios should focus on the economic and urban activities that GHG emissions inventories identify as being the largest emission sources. Assessing these measures should involve measuring results according to whether progress is being made and goals are being achieved in relation to:

- Energy decoupling: the ratio of energy consumption per unit of product generated or value added ($C_{\text{energy}} / \text{GDP}$).
- Economic decarbonisation: the ratio of GHG emissions to energy consumption ($\text{tCO}_2\text{eq} / C_{\text{energy}}$).
- Abatement of net deforestation rate or an increase in the rate of recovery, maintenance and/or net expansion of forested surface area and urban green areas: the ratio of deforestation minus reforestation over stocks of forests, jungles, scrublands and/or mangroves ($\pm \text{forested surface area} / \text{total forested area}$); or the ratio of loss minus recovery of vegetation coverage over natural and cultivated green areas in urban environments ($\pm \text{vegetation surface area} / \text{total vegetation surface area}$).

It should be emphasised that if the aforementioned EMM+AAM are not

implemented and if conventional and inertial decision-making and actions persist within local policies, current climate forecasts and scenarios, with all the associated social, economic and environmental costs, could be even worse than previously envisaged and already observed. In fact, even if concentrations of GHG emissions remain at the same level recorded in 2000, we can still expect additional global warming of approximately 0.1°C per decade (IPCC 2007).

However, given that it is now widely accepted that these concentrations of GHGs cannot be maintained on a global scale, today's estimates place further global warming at 0.2°C, or even higher, per decade for the rest of the 21st century. To what degree will trends in global GHG emissions accelerate or stabilise over the coming years? This depends on the EMM+AAM that are implemented in the different productive sectors and on different territorial and time scales.

Taking the annual rate of global average temperature change recorded during the period 1980–1999 as a baseline, in this diagram the IPCC 2007 report presents some of the negative global impacts that could appear as a result of temperature increases of up to 5°C during the 21st century. These impacts involve such crucial public issues as: natural availability of water, droughts and/or floods; the degradation of ecosystems and the risk of wildlife becoming extinct;

Figure 2
Examples of impacts
associated with global
average temperature
change (impacts will vary
by extent of adaptation,
rate of temperature
change and socio-
economic pathway)



* Significant is defined here as more than 40%.
** Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2008.
Source: IPCC 2007.

production and productivity of food from farming and fishing; stronger storms and hurricanes and the subsequent net loss of coastal wetlands; increased correlation and causality between rising temperatures and new patterns of more widespread and more serious morbidity and mortality. In all these scenarios, as the temperature increases, the social, economic and environmental costs previously mentioned become higher and higher, and the more pronounced the changes are the greater the damage and the higher the costs will be, and in some cases these may be irretrievable. Broken-line arrows illustrate how these negative impacts worsen as the temperature rises, while the solid black lines link processes of degradation or significant productive damage. The information contained in the diagram does not take into account possible moderation of these trends through the implementation of EMM+AAM, but statistically speaking the confidence levels for the information are high (IPCC 2007).

Given this information, it is possible to better respond to the following questions:

- Should the local governments of cities and metropolitan areas be concerned about and take action to identify which climate threats are most likely to occur in their specific territories?
- Should these governments identify their main demographic, social, economic and urban vulnerabilities in order to try and limit or reduce them through new local public policies?

- Should they develop their institutional capacity for local public administration and financing in order to promote specific EMM+AAM in their territories and societies?

The answer to these three questions is yes, at least for the following reasons: i) climate change is a global process, the causes and consequences of which have specific manifestations in different parts of the territory; ii) the negative impacts of climate change have a greater effect (directly and indirectly) on places, cities and metropolitan areas with lower levels of social cohesion, higher rates of poverty, social inequality and marginalisation, as well as higher levels of mass unemployment and economic informality; iii) the worst-case scenarios, with greater damage and costs, are still avoidable or can be limited by the political will of local urban governments and the social commitment of their communities to implement diverse EMM+AAM in their respective territories.

Specialised reports on the problems of cities on a global scale state that, in 2005, more than 3.17 billion people were living in urban centres (UN-HABITAT, 2006). The same source estimated that the number of urban inhabitants would probably reach 5 billion by 2030, as this figure will continue to grow at an average rate of 1.8% a year – almost double the growth rate of the world’s population.

Urban centres occupy less than 1% of the planet's surface. Despite this, due to their highly concentrated populations, higher level of consumption of goods and services, greater economic activity and dynamic demand for human mobility and freight transportation, cities are responsible for the majority of GHG emissions (UN-HABITAT 2006). As an example, in the case of Mexico, the national urban system covers an aggregate area of approximately 900,000 hectares, representing close to 0.5% of the national territory. Nevertheless, more than 80% of the country's GDP is generated within this reduced area of urban land and more than 65% of the total national population resides there (PNDUOT-SEDESOL 2001).

Therefore, although we are dealing with a global process, the local and regional repercussions of climate change can to a certain extent be avoided or controlled if well-designed analyses and scenarios of the specific climate threats in each case are made available, and if EMM+AAM that address the specific social, demographic and economic vulnerabilities identified in each case are locally deployed.

To summarise, it could be said that with regard to global climate change scenarios, local risks (R) depend on the existence and combination of the following main factors:

- Climate change threats (CCT) already

recorded and/or estimated in the particular area. If these CCT have only been experienced but not analysed or systematised, this should be done.

- Social and economic vulnerabilities (SEV) present in each specific territory, city or metropolitan area, considering the differing degree or intensity of poverty as well as its territorial distribution, social inequality, marginalisation, unemployment and economic informality, or basically taking into account everything connected with higher or lower levels of local social cohesion.

- The conventional or inertial local public administration of these climate change threats to the territory and the management of social and economic vulnerabilities like those mentioned previously (BAU, or *business as usual*).

- The implementation of local public policies that are strategically expressed in a set of EMM and AAM (preferably in a coordinated, coherent and complementary way: EMM+AAM).

This formula can be expressed in the following way, where 't' may include different years or time periods to be analysed:

$$R_t = f(CCT, SEV, BAU, EMM, AAM)$$

It should be stressed that, despite differing in terms of intensity, frequency and specific territory of occurrence, climate change threats will appear anyway due to the GHG emissions already produced and accumulated in the atmosphere. Nonetheless, it will obviously be important to know which specific climate change threats are most likely to occur in each location.

Social and economic vulnerabilities include the presence and exposure of various productive and service provision activities that depend directly on local natural resources or the geo-climatic conditions of the immediate surroundings, such as agriculture, farming, forestry, fishing, mining, agricultural food industries, tourism, energy, water, etc. They also include vulnerabilities associated with the general characteristics of the population (number of inhabitants, demographic density, age structure, territorial distribution of human settlements, correlation of this demographic-spatial distribution with maps or atlases of climate risks and threats, etc.) and others which are more closely linked to social welfare, quality of life, level of formal employment, a community's commitment to itself in terms of sense of belonging and social solidarity – or to put it another way, SEV involve a set of variables related to the level of local social cohesion. It is absolutely crucial to take this last set of vulnerabilities into account as, depending on specific historically or institutionally built social capacities, some cities and

metropolitan areas have more resources and real possibilities than others of successfully dealing with pressures caused by extreme weather events.

According to the Council of Europe's (2005) conceptual definition, social cohesion is "the capacity of a society to ensure the well-being of all its members, minimising disparities and avoiding marginalisation". A cohesive society is a mutually supportive community of free individuals pursuing these common goals by democratic means. Social cohesion is a historical construction, a political creation, a mature social expression of the consolidation of contemporary civil society (SORJ AND TIRONI 2007). Nevertheless, social cohesion is not guaranteed forever.

In general, social cohesion in different cities can be compared by considering such diverse and complex aspects as the following (among others):

- Better or worse results of economic and social development experienced over several decades of urbanisation, industrialisation and economic modernisation.
- Construction and maturity of social active policies and institutions with universal coverage and significant budgetary resources (or the opposite).
- Whether these cities belong to countries and regions that have experienced

gradual processes of tariff, commercial, sectorial, legislative and/or monetary integration over recent decades and the related results (for example, European Union vis-à-vis Central American Common Market, Latin American Free Trade Association, Andean Pact, Mercosur, Free Trade Treaties, etc.).

- Design and implementation of urban, metropolitan and territorial development plans and programmes with an emphasis on the creation of public infrastructure, urban equipment and street furniture, as well as the ongoing provision of basic services (water, drainage, energy, communications, transport, information, etc.).

- Existence, differing intensity and varying extents of poverty, social inequality, marginalisation, unemployment, economic informality, social networks based on solidarity among families or associations, job insecurity, and/or violence.

Today, social cohesion in cities and metropolitan areas is facing, among other pressures, the challenge posed by climate change scenarios with their possible outcomes and extreme events. All of them are potentially at risk. Despite this, some urban societies and economies are better prepared than others to respond to the current demands of GHG emission mitigation, preventive and corrective adaptation to possible climatic disasters, and the local management of risks caused by water and temperature fluctuations in their territories.

The challenges facing local social cohesion due to global climate change scenarios will be more or less formidable depending on both the severity and real occurrence of these scenarios and the way in which specific territories and local societies have institutionally and historically dealt with and/or resolved the following public issues and problems:

- Structural problems or ongoing issues, linked to extreme poverty, social inequality, marginalisation, mass unemployment, economic informality and social exclusion. These situations are usually manifested by the presence of disadvantaged neighbourhoods, poverty-stricken outskirts, slums, ‘favelas’ or shantytowns, etc.

- Emerging social agenda, expressed during the last third of the 20th century in issues such as gender equality, social solidarity, public health and epidemiological transition, immigration-discrimination, civic involvement in politics, democracy, etc. Other crucial public issues that come under the heading ‘emerging social agenda’ but which do not directly relate to the challenges posed by climate change include freedom of sexual orientation, availability of reproductive information and sex education, domestic violence, human rights in general, etc.

- Additional contemporary challenges, in particular those that emphasise (among other public issues of the 21st century) the social, economic and environmental costs associated with climate change scenarios and risks.

This study highlights the analytical centrality and the political importance of what local governments and their respective urban and metropolitan societies, with their different levels of social cohesion, decide, do and don’t do with regard to the challenges of climate change.

What really matters here are the links that exist between the possible appropriateness and effectiveness of local public policies for managing specific economic and social vulnerabilities, correlated with the greater or lesser probability of climate change threats occurring in specific locations. Indeed, societies that are more cohesive and strategically organised to prevent, avoid or effectively deal with extreme events related to climate change will be at less risk and their costs will also be lower and more recoverable than societies in which these risks are directly linked to deeply ingrained and widespread existing social vulnerabilities and the absence or weakness of adequate local public policies.

In fact, considering the importance of social cohesion to clarify whether a city or metropolitan area is in a good or bad position to successfully cope with the challenges imposed by climate change scenarios, what we are trying to document in this study is whether the governments of cities and metropolitan areas are introducing methods of local public intervention which will genuinely lead to energy decoupling, economic

decarbonisation and a net increase of forested urban surface area and/or green areas in their respective territories.

The following table aims to illustrate the importance of local social cohesion when dealing with public issues and problems referred to here as either ‘structural’, ‘emerging’ or ‘additional’.

The social costs and damage caused by climate change will undoubtedly be even more serious the less progress is made in local actions that cover: energy saving and greater efficiency in the consumption of fossil fuels; promoting energy transition in favour of solar, wind, geothermal, methane-electric and/or hydroelectric alternatives; providing safe and efficient public transport systems in cities and metropolitan areas; recovering and preserving metropolitan public spaces; and launching early warning and rapid response systems for climate emergencies that avoid or significantly reduce the number of people affected by these events.

Furthermore, these and other local actions could be more easily implemented in cities and metropolitan areas that have basically resolved their structural social problems and whose institutions have correctly addressed the public issues on the emerging social agenda. In these cases, the additional contemporary challenges associated with local climate change scenarios could be faced with greater certainty and better results. Obviously,

| | a. In European cities | b. In Latin American cities |
|---|---|---|
| 1. Structural problems (or ongoing issues: extreme poverty; social inequality; mass unemployment; economic informality; marginalisation and social exclusion) | i) Problems basically resolved by universally applied social policies. ii) Existence of mature institutions that prevent and/or manage the residual presence of these problems; for example, unemployment is rather cyclical and 'structural unemployment' is managed through social policies and basic services with universal coverage. iii) Implementation of social policies that prioritise focusing attention on specific cases, sectors and/or places. | i) Persistent problems: disadvantaged neighbourhoods, poverty-stricken outskirts, slums, 'favelas' or shantytowns, etc. ii) Existence of aid-focused institutions that manage the widespread presence of these problems. iii) Implementation of social policies with national –not universal– coverage without prioritising the causes, exclusively specialised in direct grants to beneficiaries with formal employment links (ergo, the unemployed, marginalised and informal workers find themselves without public access to basic services). |
| 2. Emerging social agenda during the last third of the 20th century (gender equality; social solidarity; public health and epidemiological transition; immigration-discrimination; democracy; etc.) | i) Consolidated social agenda. ii) Widely available information, education and civic and social participation through institutionally democratic channels. iii) Existence of specialised public services to address specific cases or persistent problems. iv) Serious problems and specific social tension related to the issue of immigration-discrimination. | i) Social agenda in construction added to the conventional social agenda (or that dealing with structural problems). ii) Growing civic and social information and education about these public issues with regressive reactions in some social sectors that have conservative or even reactionary stances. iii) Precarious but increasing existence of specialised public services to address these issues. iv) 'Emigration-survival': exodus that highlights the existence of serious poverty and social inequality in the area. |
| 3. Additional contemporary challenges or those of the 21st century (emphasis on social, economic and environmental costs associated with climate change scenarios) | i) Existing national and local-multilateral agreements to promote local GHG emission mitigation measures (improvements to public transport and in the use of renewable energies in public buildings, infrastructure and homes). ii) Launch of some local appropriate adaptation measures to climate change (against heat waves, droughts, etc.). iii) A general disagreement with positions that emphasise the historical responsibility inherited by current developed economies with regard to GHG emissions already accumulated and the <i>per capita</i> estimation of these emissions. iv) In general, social cohesion that is widely consolidated. | i) Some existing national and local-multilateral agreements to promote local GHG emission mitigation measures (main problem unresolved: the primacy of private transport, poor public transport and an excessive use of fossil fuels). ii) Initial discussions about introducing some locally applied appropriate adaptation measures to climate change (serious problems due to heavy flooding, greater intensity of torrential rains, hurricanes or long-lasting droughts). iii) Important progress in estimating the economic and social costs of climate change, on a national scale (although not on an urban, metropolitan and regional scale). iv) 'Emigration-return': social erosion rather than social cohesion, in general. |

Source: prepared by the author.

Table 1
Local social cohesion vis-à-vis structural, emerging and additional problems by global climate change scenarios

the reverse also applies and this has been summarised in the previous table.

It should be remembered that although “the promotion of social cohesion is the responsibility of all sectors of society, it must be first guaranteed by local governments, not only because they are the closest institutional channel to the community but because they hold the territorial power, they have control over certain redistributive mechanisms that directly and instantly have an impact on citizens, and have the authority to carry out comprehensive and coherent local development policies” (GODÍNEZ 2008). This explains the central position of local public administration in implementing the urgently required EMM+AAM to tackle climate change scenarios in each specific area as part of public action plans to build, preserve and/or carefully, proactively and strategically consolidate local social cohesion.

From what has been presented in this General Introduction (or Part A), it is clear that global climate change is imposing new and enormous challenges on local social cohesion and, to a great extent, the efforts being made by different local governments to respond to these challenges will only result in successful and replicable experiences if they manage to build and/or consolidate cohesive societies.

In Part B, after presenting an overview of the economic and social causes and consequences of climate change in Latin America and the Caribbean, this study analyses the current situation regarding the formulation and implementation of public policies on climate change and the importance of local social cohesion. This is followed by a discussion of the problems of inertial and conventional decision-making in public administration (or *business as usual* – BAU) and the alternatives offered by the combination of effective mitigation measures and appropriate adaptation measures (EMM+AAM).

In Part C, the study presents a comparative analysis of current climate action plans in force in the local governments of Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City, respectively: i) Barcelona Energy Improvement Plan 2002-2010 and the Barcelona Energy, Climate Change and Air Quality Plan 2010-2020; ii) Plan for the Sustainable Use of Energy and the Prevention of Climate Change of the City of Madrid, in force since June 2008; iii) Paris Climate Protection Plan, in force since October 2007; iv) public actions against climate change in Bogotá; v) Buenos Aires Climate Change Action Plan 2030; and vi) Mexico City Climate Action Programme 2008-2012, in force since May 2008.

Based on the comparative analysis of these six local experiences, as well as on the lessons learned from the

implementation of the above-mentioned local plans and programmes, this part of the study concludes by proposing the construction of a 'local public intervention matrix for climate change'. This matrix, which could be widely applied to many cities and metropolitan areas, includes the following policy lines to guide local action which have been identified as the most effective and appropriate points:

- Mobility, transport and urban and road reorganisation (MTURR).

- The management of property holdings, public facilities and the construction of an eco-efficient urban infrastructure (PPFEUI).

- The conservation, renovation and/or expansion of public spaces and green areas of environmental value (PSEGA).

- Local energy transition as a key element of measures for GHG emission mitigation and adaptation to local climate change scenarios and outcomes (LETMIAD).

- The importance of local social cohesion, welfare and environmentally active citizens (LSCWEC).

- Financing urban resilience and metropolitan sustainability (FURMS).

These six lines of local public policy are considered to be the most effective, appropriate and efficient points based on the following reasons and evidence: on a global, national and local scale,

albeit with differing proportions and dynamics, there is incontrovertible evidence that the sectors of economic activity that contribute the majority of GHG emissions are those linked to the generation, transportation and supply of energy, the transportation of goods and mobility of people, the residential, commercial and institutional consumption of energy, the inadequate regulation and poor management of urban waste and discharge of wastewater, as well as the group of activities that lead to the conversion of woodland and/or green areas into urban land and places that favour territorial and functional conurbation – the same activities that result in the haphazard spread of metropolitan areas (IPCC 2007; STERN 2006; WB 2008; MDP 2007; RUIZ-NÁPOLES 2011). These sources and processes of GHG emission are confirmed in the climate action plans and programmes implemented in Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City, which are analysed in Part C of this study.

Thus, with regard to the challenges of climate change, local actions covering MTURR, PPFEUI, PSEGA and LETMIAD result in net savings of energy and a reduction of carbon equivalent emissions, at the same time as leading to better conditions for building or consolidating LSCWEC. This is what gives these policy lines their 'efficient' and 'appropriate' attributes. Their 'efficiency' comes from the progress and achievements that can be obtained on the ground through good local management of FURMS. The group

of specific and individual actions to be carried out within these six lines of local public policy is precisely what this study generically refers to as EMM+AAM.

There are some people who insist on including among the recommended lines of local public policy on climate change the creation of GHG emission inventories as a basic piece of information for taking more well-founded decisions in each case. But, with the evidence already documented for many cities, regions and countries relating to the anthropogenic processes and sources responsible for the greatest amount of GHG emissions, and considering serious budgetary constraints and a lack of fresh investment resources, it makes more sense to save the time and money needed to produce these emissions inventories and instead use them to urgently implement one or several of the lines of local public policy mentioned above. Within LSCWEC, however, it would definitely be wise to commission maps of civil, property/heritage and economic risk, as well as early warning systems for climate change threats.

In the Conclusions section, this study underlines the need to build and develop cohesive societies by means of the complementary, coherent and systematic implementation of the above-mentioned 'local public intervention matrix for climate change' as the most effective contemporary form of local public governance capable of making the creation and consolidation of resilient

cities and sustainable metropolitan areas a viable reality.

At the end of the study there is a list of Bibliographical References and websites consulted during the preparation of this report.

B. General diagnostic framework and main challenges for public policies to counter the economic and social consequences of climate change in Latin America and the Caribbean

Part B begins with an overview of the causes and economic and social consequences of climate change in Latin America and the Caribbean. This is followed by an account of the current situation regarding public policies on climate change being drafted and introduced in different cities and a look at the importance of local social cohesion for the optimum development of these efforts. This section concludes by comparing the problems associated with inertial and conventional decision-making in public administration (or *business as usual* – BAU) with the alternatives offered by effective mitigation and appropriate adaptation measures (EMM+AAM). Details of these measures can be found in Part C in the proposed ‘local public intervention matrix for climate change’, which is based on a study of three European cities (Barcelona, Madrid and Paris) and three Latin American cities (Bogotá, Buenos Aires and Mexico City).

1. Causes and economic and social consequences of climate change in Latin America and the Caribbean

Global climate change basically has two anthropogenic structural causes. The first is linked to the excessive consumption of fossil fuels (oil, gas, petrol, fuel oil, coal, etc.) by various economic sectors and human activities such as the transport of goods, mobility of people, energy generation, industrial production, contracting services and the day-to-day running of homes, governments and

cities. The second is related to changes in land use that affect different types of forest cover (woodland, jungle, scrubland and/or mangrove), either to extend agricultural and farming areas or to accommodate urban sprawl, property and tourist developments, and conventional infrastructure.

The excessive consumption of fossil fuels and changes in forested land use generate significant amounts of greenhouse gas (GHG) emissions which, when accumulated in the atmosphere, obstruct the refraction of sunlight, leading to a gradual increase in the global mean temperature. This global warming, in turn, modifies precipitation patterns, relative humidity, ventilation, the melting of polar ice and mountain snow caps, causes sea levels to rise, and changes the intensity, frequency and duration of tropical storms and hurricanes.

These climate consequences associated with the emission and accumulation of GHG produce huge social, economic and environmental costs which, when added together, result in present and future net welfare losses for the human populations of different locations and regions. Most reports and analyses on the socio-economic and environmental consequences of climate change scenarios have been carried out on global, national and sectorial scales (STERN 2006, GALINDO 2009, ECLAC 2009a, ECLAC 2009b, SEMARNAT 2009, ECLAC 2010b, RUIZ-NÁPOLES 2011) and, to a lesser extent, on local and/or

regional scales (Wb 2008, CUD 2009, ECLAC-IBD 2010). Similar analytical emphasis recurs in discussions about the design and implementation of the most appropriate public policies to deal with the present and future costs of climate change scenarios. An analytical background to this study can be found in VEGA-LÓPEZ 2010, which identifies some of the characteristics and challenges of public policies introduced by Latin American local governments to deal with risks imposed in their specific territories by global climate change scenarios.

Climate change is a global process, the causes and consequences of which are manifested in specific parts of the territory. Its negative impacts directly and indirectly affect municipalities and regions with higher levels of vulnerability, inhabited by individuals with their own properties and/or with collective heritage who work in various rural and urban productive areas. Thus, although it is a global process, climate change has different local and regional repercussions which, while potentially serious, could to some extent be avoided if well-designed analyses and scenarios are made available and if adequate local strategies for climate change adaptation and mitigation are adopted.

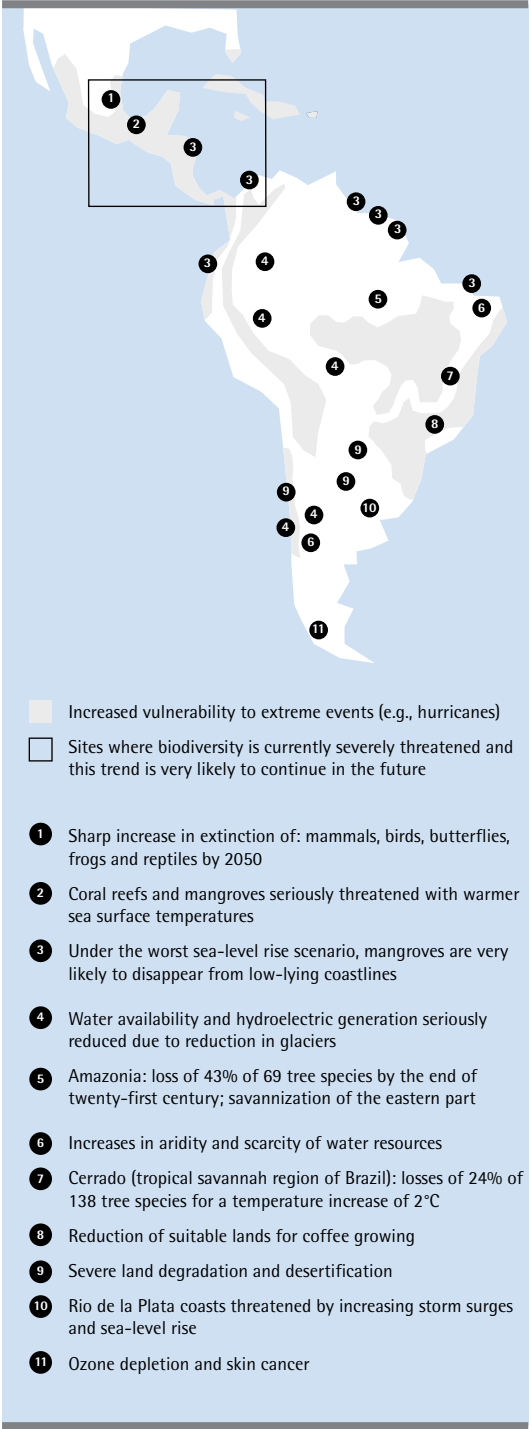
Different cities and regions in Latin America have already recorded extreme hydro-meteorological events associated with climate change scenarios, such as prolonged droughts, intense heat waves,

flash floods caused by torrential rains and hurricanes of greater intensity – all of which could aggravate negative impacts in the future if urgent measures are not taken on a local and regional level.

It must be stressed that the social and economic risks of these extreme events over time depend on both the climate threats that are present and expected in each location, city and/or region, and on the existing socio-demographic and economic-productive vulnerabilities in each of these same locations, cities and/or regions. However, the particular socio-demographic and economic-productive vulnerabilities to the above-mentioned climate threats in each location may vary in real intensity and could present different configurations and degrees of risk depending on how quickly and efficiently climate change mitigation and adaptation programmes and actions are designed and implemented in specific territories and regions.

This is where the role of local and regional governments becomes extremely important for facing the challenges of climate change in order to avoid the most serious outcomes and to promote alternatives for urban-metropolitan resilience and sustainable regional development.

Map 1
Latin America and
the Caribbean:
hot spots



Source: ECLAC-IBD 2010, *Climate change: a regional perspective*. Riviera Maya, Mexico, February 2010.

To summarise, if we refer back to the General Introduction section of this study, it could be said that local risks (R) depend on the predicted threats from climate change (CCT), the social and economic vulnerabilities (SEV) present in each location, city or region, and the various public policies that are implemented to deal with these two issues, especially by means of inertial and/or conventional strategies and actions (*business as usual* or BAU) or by following the lines of local public policy presented under the generic heading of EMM+AAM, which together make up the previously mentioned ‘local public intervention matrix for climate change’. The general formula for local risks can be expressed in the following way, where ‘t’ may include different years or time periods:

$$R_t = f(CCT, SEV, BAU, EMM, AAM)$$

This formula for local risks from climate change scenarios in Latin America can be expressed territorially as shown in the above vulnerability map (ECLAC-IBD 2010).

In addition to the ecological damage and consequent knock-on effects in the provision of countless environmental services in Latin America, the greatest risks and vulnerabilities associated with climate change, which may potentially result in significant present and future social costs, are concentrated in densely populated and economically important cities and metropolitan regions which present major lags in terms of social cohesion.

To expand a little on the previous map, which draws attention to these regions' increased vulnerability to extreme events (in particular violent tropical storms and more intense hurricanes), we could also mention some specific cases involving locations, cities and/or metropolitan regions that are very exposed to the hydro-meteorological extremes registered in Mexico, Central America and the Caribbean.

In the case of Mexico, the following table shows the geographical layout of municipal and metropolitan vulnerability to tropical storms and hurricanes of greater intensity. Looking at the figures contained in this table, we can see the following: 76% of these 107 events were concentrated in the first 10 municipalities, which were the most exposed and affected. Fifty-three of the 81 events were

Table 2
Tropical storms and hurricanes in Mexico 1970-2006

| Frequently affected municipalities | 1970-1979 | 1980-1989 | 1990-1999 | 2000-2006 | Total |
|---------------------------------------|-----------|-----------|-----------|-----------|-------|
| 1 La Paz, BCS | 3 | 5 | 3 | 1 | 12 |
| 2 Muleg , BCS | 6 | 2 | 3 | 1 | 12 |
| 3 Oth n P. Blanco, Q.R. | 3 | 1 | 3 | 2 | 9 |
| 4 Ahome, SIN | 3 | 3 | 3 | 0 | 9 |
| 5 L zaro C rdenas, MICH | 3 | 1 | 2 | 2 | 8 |
| 6 Soto la Marina | 4 | 1 | 3 | 0 | 8 |
| 7 Los Cabos, BCS | 0 | 1 | 4 | 2 | 7 |
| 8 Benito Ju rez, Q.R. | 3 | 2 | 0 | 1 | 6 |
| 9 Tuxpan, VER | 0 | 1 | 3 | 1 | 5 |
| 10 Mazatl n, SIN | 3 | 1 | 0 | 1 | 5 |
| Municipalities 1-10 subtotal | 28 | 18 | 24 | 11 | 81 |
| 11 Acapulco, GRO | 1 | 0 | 1 | 1 | 3 |
| 12 Tulum, Q.R. | 0 | 0 | 2 | 1 | 3 |
| 13 Comond , BCS | 0 | 0 | 1 | 2 | 3 |
| 14 Pinotepa, OAX | 0 | 0 | 2 | 1 | 3 |
| 15 Elota, SIN | 1 | 0 | 0 | 2 | 3 |
| 16 Tampico-Matadero, TAMP S | 1 | 0 | 1 | 1 | 3 |
| 17 Cozumel, Q.R. | 0 | 0 | 1 | 1 | 2 |
| 18 San Pedro Pochutla, OAX | 0 | 0 | 1 | 1 | 2 |
| 19 Tecpan de Galeana, GRO | 1 | 0 | 1 | 0 | 2 |
| 20 Salina Cruz, OAX | 1 | 0 | 1 | 0 | 2 |
| Municipalities 11-20 subtotal | 5 | 0 | 11 | 10 | 26 |
| Total TS&H in these 20 municipalities | 33 | 18 | 35 | 21 | 107 |

Municipalities in the north, central and south Pacific.
Municipalities in the Gulf of Mexico and the Caribbean.
Subtotals and total of the 20 municipalities most exposed to hurricanes (highest frequency).

Source: created by the author using information from National Water Commission of Mexico (CNA) statistics 2007, 2008 and www.conagua.gob.mx.

registered in municipalities in the north and central Pacific, and the remaining 28 occurred in municipalities in the Gulf of Mexico and Caribbean. In the next 10 municipalities most at risk of and affected by these phenomena, 18 of the 26 events were concentrated in municipalities in the north and south Pacific, and the remaining eight events occurred in

municipalities in the Gulf of Mexico and the Caribbean.

Eleven of these 20 municipalities, plus another three in the Pacific and two in the Gulf of Mexico, complete the geographical layout of municipal hot spots, showing that during the 38-year

Table 3
19 most intense hurricanes in Mexico 1970-2007

| 16 municipalities affected | 1970-1979 | 1980-1989 | 1990-1999 | 2000-2007 |
|-------------------------------|-----------|-----------|-----------|-----------|
| North & central-south Pacific | 3 | 2 | 1 | 2 |
| La Paz, BCS | Liza | Kiko | | Lane |
| La Paz, BCS. | | | | |
| Elota, SIN | | Tico | | |
| El Rosario, SIN | | | | |
| Ahome, SIN | Liza | | | |
| Mazatl n, SIN | Olivia | | | |
| San Blas, NAY | | | | Kenna |
| Acapulco, GRO | | | Pauline | |
| La Uni n, GRO | Madeline | | | |
| San Pedro Pochutla, OAX | | | Pauline | |
| Gulf of Mexico & Caribbean | 4 | 2 | 1 | 4 |
| R o Bravo, TAMP S | | Allen | | |
| Soto la Marina, TAMP S | Caroline | | | |
| Soto la Marina, TAMP S | Anita | | | |
| Soto la Marina, TAMP S | Ella | | | |
| Soto la Marina, TAMP S | | Gilbert | | |
| Telchac Puerto, YUC | | | | Isidore |
| Benito Ju rez, Q.R. | | Gilbert | | |
| Cozumel, Q.R. | | | | Wilma |
| Tulum, Q.R. | | | Roxanne | |
| Tulum, Q.R. | | | | Emily |
| Oth n P. Blanco, Q.R. | Carmen | | | |
| Oth n P. Blanco, Q.R. | | | | Dean |
| Total intense hurricanes | 7 | 4 | 2 | 6 |

Source: created by the author using information from CNA statistics 2007 and 2008.

period between 1970–2007 (2007 has been added to the previous historical series), the 19 most intense hurricanes to have hit the Mexican coast were concentrated in just 16 municipalities: nine in the north, central and south Pacific; and seven in the Gulf of Mexico and Caribbean.

Of the 20 municipalities most frequently affected and the 16 that have experienced the most intense hurricanes,¹ a total of 25 municipalities present the greatest level of historical (documented) vulnerability out of a total of 153 municipalities that border on the Mexican coast.

Table 4 shows the minimum, maximum and average duration of each of these 19 extreme events, measured by number of days (duration which, together with intensity is positively correlated with the greatest amount of damage and highest economic and social costs per hurricane suffered).

Based on the information contained in the three previous tables, it could be said that in terms of vulnerability and risk from future tropical storms and hurricanes that may strike the Mexican coast, attention should be focused on the intensity of these phenomena in the neo-economic and social regions containing the 25

Table 4

| 19 most intense hurricanes | Minimum duration | Maximum duration | Average duration |
|----------------------------|------------------|------------------|------------------|
| 2000–2007 (6) | 5 | 12 | 8.6 |
| 1990–1999 (2) | 5 | 13 | 9 |
| 1980–1989 (4) | 6 | 13 | 10 |
| 1970–1979 (7) | 2 | 12 | 6.8 |

Source: created by the author using information from CNA 2007 and 2008.

1 According to www.nhc.noaa.gov/HAW2/english/basics/saffir_simpson.shtml: ‘intense’ hurricanes are those with winds of over 177 kilometres per hour (H3, H4 and H5):

| Saffir–Simpson Hurricane Wind Scale | |
|-------------------------------------|--|
| Category | Wind speed range (kilometres per hour) |
| 1 | 119–153 |
| 2 | 154–177 |
| 3 | 178–209 |
| 4 | 210–250 |
| 5 | More than 250 |

municipalities which have the highest probability of reoccurrence of tropical storms and hurricanes and preparations should be made to respond to these emergencies for a duration of at least 12 days per event.

Thus, federal disaster prevention and response policies to manage gradually rising sea levels and the consequent strong winds, storms and hurricanes should, instead of attempting to achieve national coverage, be specifically composed of special regional adaptation programmes in the 25 municipalities identified above. These 25 programmes should, in turn, become priority policies for the governments of the nine federal bodies (the provinces and states involved), who should foster regional inter-institutional coordination on this matter; the priorities for local climate change adaptation policies must include risk maps, civil protection, early warning systems and territorial and sectorial reconfiguration of these regions. When defining the regional dimension of these programmes, the recorded trajectories in terms of direction and inland reach of the events already observed must be taken into account.

The regional aspect of local adaptation measures must also include detailed information about the human settlements and main economic activities carried out in these municipalities and regions. A

preliminary review of just the existing municipal information in the previous table (without taking into account the vital regional dimension) provides the following figures (table 5): more than 4,273,000 inhabitants reside in the 25 Mexican municipalities most vulnerable to and at risk from tropical storms and hurricanes. The primary housing stock is estimated to include more than 1,037,000 inhabited private dwellings (privately owned and rented: it is assumed that most of these homes are privately owned by a subgroup of municipal and/or regional residents).

Currently, the three smallest municipalities –Telchac Puerto (Yucatán), Pinotepa (Oaxaca) and Soto la Marina (Tamaulipas)– specialise in rearing livestock. The medium-sized municipalities specialise in agriculture and rearing livestock while in the majority of the most densely populated areas tourism services represent the bulk of the economy of their respective productive specialisations. Included among these municipalities are such internationally recognised tourist destinations as Acapulco, Cancun (Benito Juárez, Q.R.), Mazatlán, Los Cabos, La Paz, Tulum, Cozumel and Puerto Ángel (San Pedro Pochutla, Oaxaca).

The main focus and concern of any policies to prevent and reduce the damage caused by these events must be civil protection. Additionally, more

| | Population (inhabitants) | Inhabited private homes | Agriculture | Livestock (in thousands of dollars) | Tourism |
|---------------------------------|-----------------------------|-------------------------------|-------------|---|------------|
| North and central-south Pacific | 2,509,458 | 613,180 | 798,724 | 355,827 | 1,183,858 |
| 1 La Paz, BCS | 219,596 | 55,445 | 70,105 | 10,411 | 40,582 |
| 2. Mulegé, BCS | 52,743 | 13,555 | 90,327 | 18,390 | nd |
| 3. Los Cabos, BCS | 164,162 | 40,866 | 8,341 | 5,246 | 422,096 |
| 4 Comondú, BCS | 63.83 | 16,387 | 69,418 | 14,634 | nd |
| 5 Ahome, SIN | 388,344 | 93,944 | 290,733 | 41,011 | 0,595 |
| 6 Mazatlán, SIN | 403,888 | 103,534 | 12,252 | 38,678 | 454,319 |
| 7 Elota, SIN | 46,462 | 10,631 | 83,563 | 56,907 | nd |
| 8 El Rosario, SIN | 47,394 | 11,629 | 32,031 | 4,629 | nd |
| 9 San Blas, NAY | 37,478 | 10,085 | 39,118 | 55,619 | nd |
| 10 Lázaro Cárdenas, MICH | 162,997 | 39,098 | nd | 7,308 | nd |
| 11 Acapulco, GRO | 717,766 | 167,888 | 13,482 | 9,941 | 238,833 |
| 12 Tecpan de Galeana, GRO | 57,848 | 14,74 | 63,042 | 14,972 | nd |
| 13 La Unión, GRO | 25,230 | 5,922 | 24,835 | 14,972 | nd |
| 14 San Pedro Pochutla, OAX | 38,798 | 8,191 | 1,214 | 22,949 | 27,433 |
| 15 Pinotepa, OAX | 6,703 | 1,423 | 0,263 | 22,949 | nd |
| 16 Salina Cruz, =AX | 76,219 | 19,842 | nd | 17,211 | nd |
| Gulf of Mexico and Caribbean | 1,764,098 | 424,665 | 178,938 | 103,845 | 1,721,695 |
| 17 Río Bravo, TAMPS | 106,842 | 27,008 | 72,721 | 3,273 | nd |
| 18 Soto de la Marina, TAMPS | 22,826 | 5,874 | 8,856 | 25,146 | nd |
| 19 Tampico-Madero, TAMPS | 496,969 | 134,471 | nd | nd | 12,853 |
| 20 Tuxpan, VER | 134,394 | 34,957 | 1,180 | 16,999 | nd |
| 21 Telchac Puerto, YUC | 1,626 | 0,449 | nd | 45,906 | nd |
| 22 Benito Juárez, Q.R. | 572,973 | 123,687 | 9,567 | 1,759 | 1,1415,825 |
| 23 Tulum, Q.R. | 135,512 | 27,312 | 0,210 | 0,468 | 10,145 |
| 24 Cozumel Q.R. | 73,193 | 18,318 | 0,003 | 0,078 | 255,147 |
| 25 Othón P. Blanco, Q.R. | 219,763 | 52,589 | 86,401 | 10,216 | 27,725 |
| Totals | 4,273,556 | 1,037,845 | 977,662 | 459,672 | 2,905,553 |

■ High-risk municipalities that have registered a high frequency of tropical storms and hurricanes and the most intense hurricanes.

Sources: previous tables in this study; National Institute of Statistics and Geography (INEGI), Mexico and its Municipalities 2008 (with information from the 2nd Population Census 2005); SAGARPA-SIAP, Agriculture and livestock statistics 2007; and www.sectur.gob.mx/web/sectur/sect_Estadisticas_del-Sector.

Table 5
The 25 Mexican coastal municipalities most vulnerable to and at risk from hurricanes: potential social and economic costs

attention should be paid to protecting public infrastructure and the productive activities in each case. For example, if an extreme climate event temporarily paralysed one of the country’s main tourist destinations for a long period (more than a year), this would result in huge costs in terms of jobs, services, foreign exchange and additional migratory pressure on a regional, national and international scale.

In terms of loss of human life, just 10 intense hurricanes (Dean, Wilma, Stan, Emily, Kenna, Isidore, Pauline, Gilberto, Allen and Carmen) are estimated to have caused more than 1,200 deaths, either directly or indirectly. The economic cost of just hurricanes Wilma and Stan has been calculated at more than \$3b.

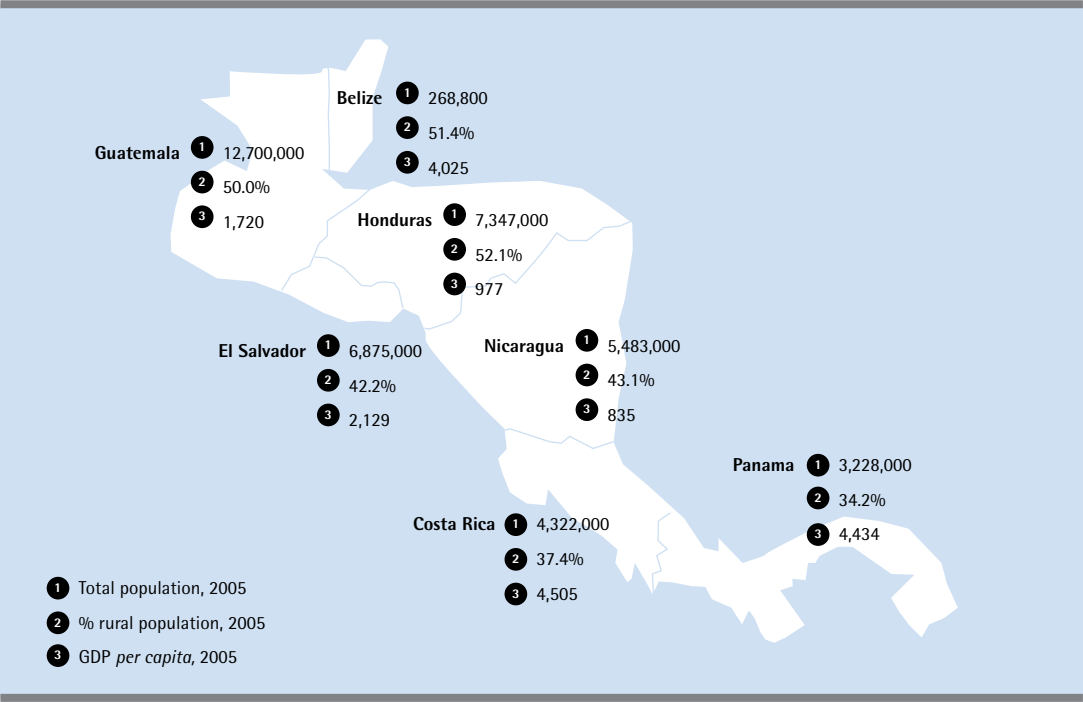
Therefore, when identifying the municipalities (and regions) most vulnerable to and at risk from the predicted consequences of gradually rising sea level, the demographic and economic strategic importance of these municipalities must be measured. In addition, new policies for preventing and reducing potential damage and costs must receive full institutional and budgetary backing, given the current population density and preferred economic use attributed to these territories.

Coral reefs, mangroves, other coastal wetlands and diverse ecosystems found on the marine-coastal interface have

become more essential than ever before as natural containment barriers against future tropical storms and hurricanes. Therefore, protecting these features should be not only an ecological priority but also a socio-economic priority within the set of public policies for dealing with local global warming scenarios and for promoting new forms of regional development by implementing adaptation and mitigation actions.

On the other hand, in the case of Central American countries, their respective populations most exposed to extreme hydro-meteorological events vary between 1,200,000 inhabitants and just over 26,000,000 inhabitants in each of the urban-metropolitan areas: Guatemala City (Guatemala), Tegucigalpa-Comayagüela (Honduras), San Salvador (El Salvador), Managua (Nicaragua), San José (Costa Rica), and Panama City (Panama). It is worth remembering that Belize City ceased to be the capital of the country of the same name after it was destroyed in October 1961 by hurricane Hattie. Since 1970, the capital of Belize has been Belmopan, which has only just over 13,000 inhabitants. Map 2 shows the national populations of the countries in Central America.

Records of tropical storms and hurricanes to strike Central American territories during the periods 1970–1989 and 1990–2008 show a very important increase in the number of severe storms and more intense hurricanes. The following graph



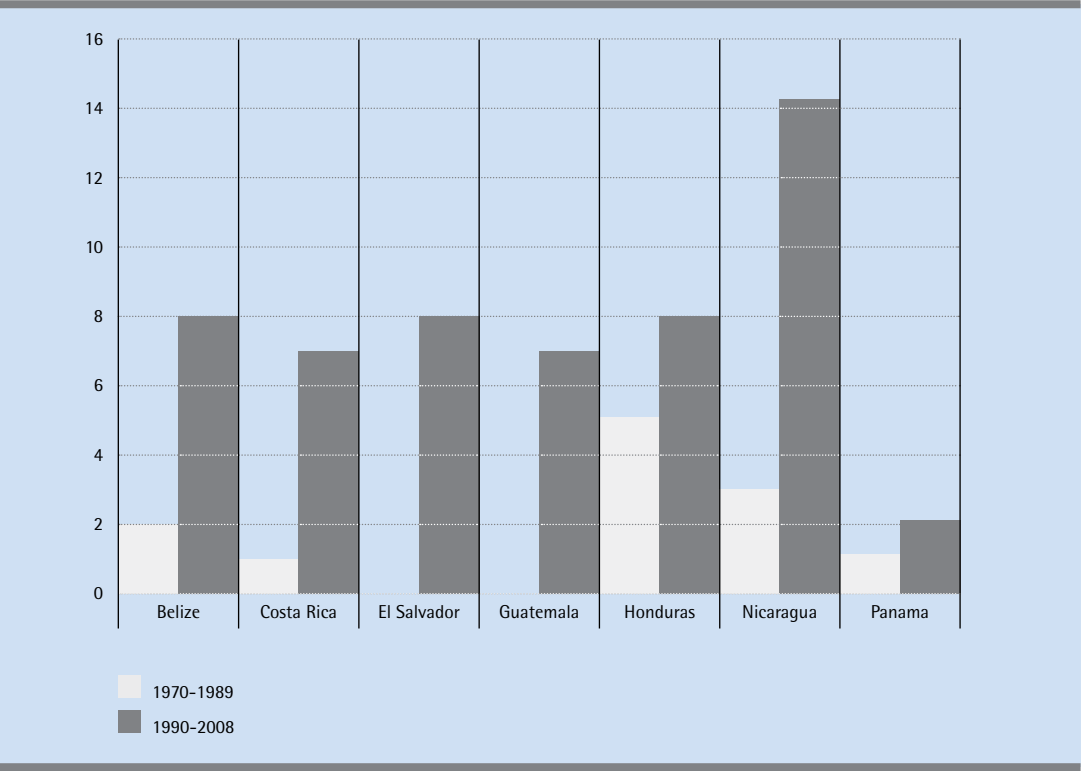
Map 2

Source: CENTRAL AMERICAN AGRICULTURAL COUNCIL (CAC)-ECLAC 2007.

shows the corresponding figures, in which El Salvador and Guatemala did not record these types of events in the first period, but they did in the second. In turn, Belize and Costa Rica recorded a very low number in the first period and a significant increase in the second. Honduras recorded the highest frequency of these events during the first period and holds second place in the number of storms and hurricanes that occurred during the second period. Panama is the only Central American country with a low incidence of tropical storms and hurricanes, although it recorded a slight increase in the second period. Nicaragua experienced the highest frequency in the second period with 14 events.

Assuming an increase of 5% in the intensity of tropical storms and hurricanes in this region of the planet and considering the recorded intensity and trajectories observed over the last four decades, the estimated economic cost of damage caused by these extreme hydro-meteorological events is calculated at approximately 7.6% of the Central American GDP for 2008 with a discount rate of 0.5%, or at 0.25% of the Central American GDP for the same year with a discount rate of 8% (ECLAC 2010b). In both estimates, the highest costs fall on Belize and Honduras (24% and 21%) while, to a lesser extent, economic costs would also apply to Costa Rica, Guatemala, Panama, Nicaragua and El Salvador. In any case,

Table 6
Central America:
registered tropical storms
and hurricanes in two
periods, 1970-1989 and
1990-2008



Source: chart taken from ECLAC 2010. The economics of climate change in Central America.

these climate threats and their respective social and economic vulnerabilities have a serious negative influence on economic growth and development expectations regardless of the local challenges and risks posed by global climate change scenarios for the whole of the 21st century. Obviously, if instead of a 5% increase in the intensity of tropical storms and hurricanes in Central America this figure was 10% or even higher, the potential damage and economic and social costs would rise substantially. These costs could be even higher if they also included indirect costs, which are estimated to be

equivalent to 70% of the direct costs, according to the same source quoted here (ECLAC 2010b).

These are just some examples that could be used as documentary evidence to support the arguments regarding the situations illustrated in the previous aggregated vulnerability map for the entire Latin American continent and, in particular, in relation to the potential risks and cost of severe tropical storms and intense hurricanes in Mexico, Central America and the Caribbean.

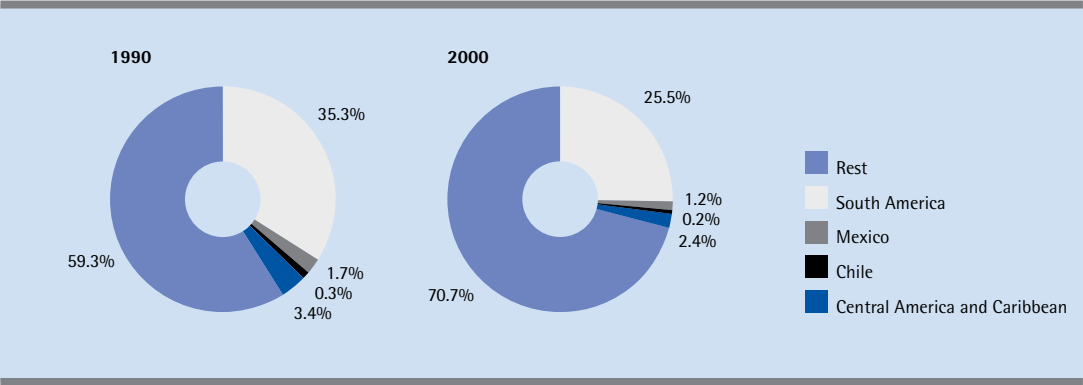


Figure 3
Latin America and the Caribbean: share of greenhouse gas emissions associated with changes in land use (percentages)

Source: prepared by the author on the basis of Economic Commission for Latin America and the Caribbean (ECLAC) and World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) version 6.0. [online] www.cait.wri.org. 2009.

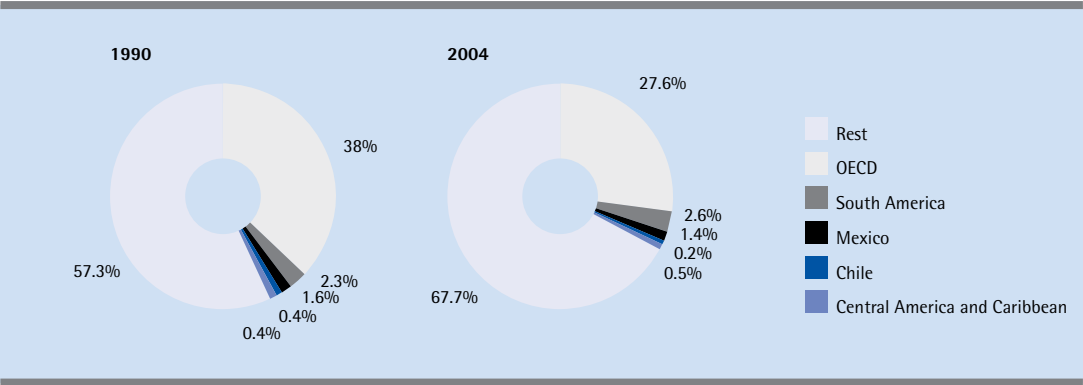


Figure 4
Latin America and the Caribbean: share of greenhouse gas emissions associated with energy consumption (percentages)

NOTE: OECD emissions exclude Chile and Mexico.
Source: Economic Commission for Latin America and the Caribbean (ECLAC) and World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) version 6.0. [online] www.cait.wri.org. 2009.

In general, the countries in Latin America and the Caribbean not only suffer, and will continue to suffer, the negative impacts of the climate threats and social and economic vulnerabilities mentioned in earlier examples, they will also have to think about how to reduce their volume and rate of GHG emissions, at the same time as tackling and reducing climate change risks

by implementing adequate local and regional public policies.

According to ECLAC-IDB (2010), and as shown in this chart, Latin America and the Caribbean's share of greenhouse gas emissions caused by changes in land use (net deforestation) fell by 10.4 percentage points between 1990 and 2000 relative

to global GHG emissions from this same source. The corresponding Latin American and Caribbean share of GHG emissions originating from the consumption of fossil fuels remained practically the same in terms of GHG global emissions during the period 1990-2004 (from 4.6% to 4.7%).

The pressure to convert forest cover into agricultural and grazing land or into property, tourism and mining developments or urban areas, as well pressure that leads to an excessive consumption of fossil fuels, stems from a group of perverse incentives that exist in current markets and policies, which include pricing, subsidies, regulations, contracts, government budgets, energy profiles, technological patterns and the general orientation of economic and public policies.

Many of the decisions affecting the continuation or removal of perverse institutional and/or market incentives are the responsibility of local and regional governments which, by establishing new environmental regulations within their urban and metropolitan areas, modifying the size, duration and destination of current subsidies, improving the use of their respective budgets and promoting cooperation between these governments, can progress towards local and regional development patterns that lead to energy decoupling (ratio of energy consumption to GDP), decarbonisation of their respective metropolitan economies (ratio of carbon emissions to

energy consumption) and halting net deforestation (ratio of deforestation minus reforestation divided by stocks of forests, jungles, mangroves and/or scrubland).

The social, economic and environmental costs of climate change must be considered, at the very least, based on the estimated costs of inaction (or the cost of 'doing nothing') associated with the inertial maintenance of conventional decision-making (or *business as usual* -BAU- behaviour), as well as the costs involved in taking important and long-lasting measures for mitigating carbon emissions and explicitly adapting to climate change.

Choosing not to change any of the practices that have been widely used for decades means taking the decision to manage (but not resolve) a reduced water supply, reduced agricultural productivity, greater intensity of extreme hydro-meteorological events, the emergence of old and new diseases that affect public health (malaria, dengue, cholera, leishmaniasis, AN1H1 influenza, Chagas disease, etc.), increased road congestion in cities and metropolitan regions, poor air quality and the social conflicts that will probably arise in these scenarios of increased scarcity of natural resources, environmental services and a general failure to meet people's daily needs. For example, in aggregate terms, for the Mexican economy the cost of inaction has been estimated at just over six percent of its annual GDP, while the cost

of mitigating 50% of current carbon emissions would be around 2% of the GDP (GALINDO 2009). Similar estimates, such as those mentioned in previous paragraphs, have been made for Central America and several South American countries (ECLAC 2009a, ECLAC 2009b and ECLAC 2010b). In all cases, the conclusion is that mitigating emissions and appropriately adapting to climate change is less expensive so cially, economically and environmentally speaking that deciding not to spend anything on public efforts in this direction and instead choosing to continue with ‘business as usual’.

According to the IPCC (2007), mitigation measures focus on directly reducing GHG emissions and/or maintaining and strengthening carbon dioxide capture and storage capacity in diverse carbon sinks.

The same source also indicates that adaptation measures include adjustments to natural and social systems in response to climate stimuli and/or their effects, whether projected or real, and that their importance lies in the fact that even when mitigation actions are successful, adaptation initiatives are still required due to climate threats caused by GHG emissions already accumulated over previous decades (http://www.ipcc.ch/home_languages_main_spanish.htm). The effectiveness of these mitigation and adaptation measures may vary. Mitigation can be measured in terms of net reduction of emissions and the amount of carbon equivalent

captured and stored *in situ*. In turn, the effectiveness of adaptation measures can be assessed in terms of damage prevented or controlled and costs avoided or maintained at low levels. These degrees of effectiveness can also be achieved with varying levels of efficiency, i.e., with the best economic and institutional alternatives available or incurring excessive expenses. Both criteria are important when designing and implementing packages of local and/or regional public policies to deal with climate change scenarios in each territory.

While mitigation measures and actions aim to reduce GHG emissions (and along with them, climate threats), adaptation measures and actions are designed to limit or regulate social and economic vulnerabilities. The effectiveness and efficiency of both mitigation and adaptation measures can be boosted by promoting local and regional active social policies that lead to greater social cohesion between specific or potentially affected rural and urban communities.

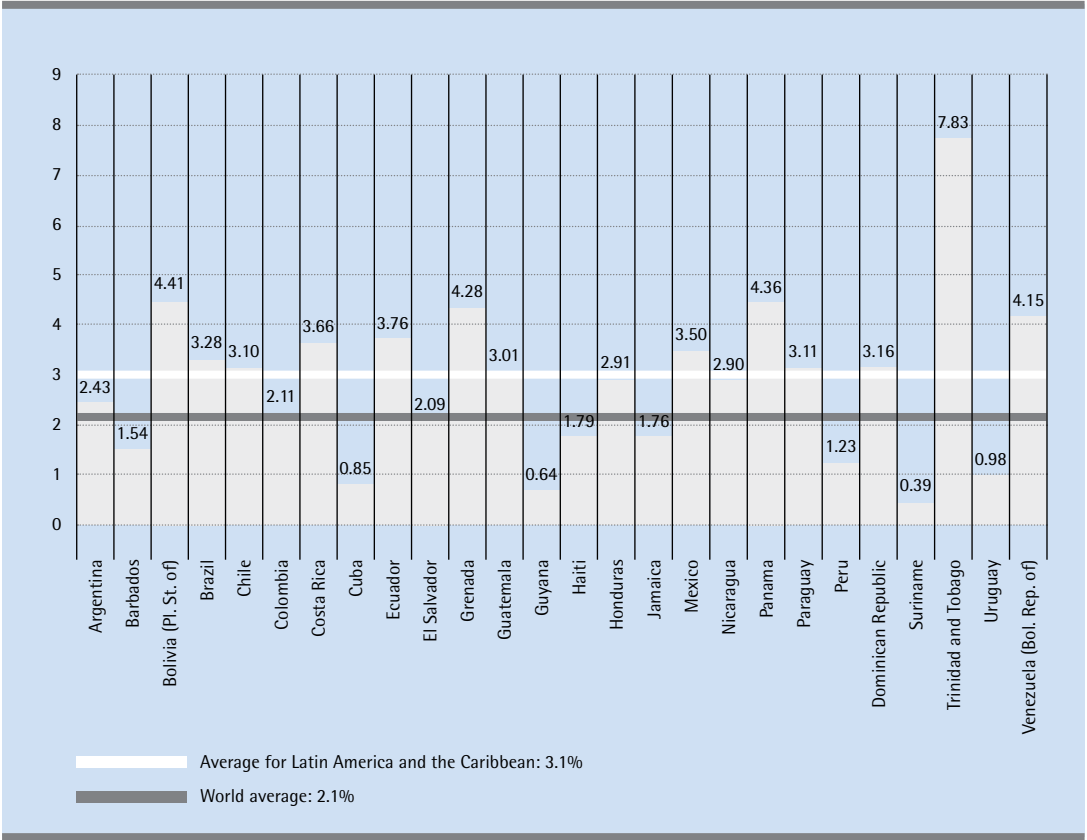
Despite fluctuating and uneven economic growth over recent decades, Latin American economies and societies’ share of global GHG emissions are associated with deep-rooted patterns of excessive consumption of fossil fuels.

During the last 40 years, global energy consumption has grown at an average

annual rate of around 2.1% while the corresponding rate in Latin America and the Caribbean is 3.1%. The economies of Brazil, Mexico, Venezuela, Bolivia, Ecuador, Panama and Costa Rica, among others, exceeded this Latin American annual growth rate of energy consumption, while others such as Colombia, Cuba, Peru and Uruguay show rates equal to or even lower than the

recorded global average. Argentina’s rate lies almost half-way between both averages (global and Latin American). This is illustrated in the following graph (taken from GALINDO AND SAMANIEGO 2010). Additionally, the available information for Latin America and the Caribbean shows different correlations between energy consumption and GDP, as well as between energy consumption *per*

Table 7
Latin America and the Caribbean: annual average growth rate of energy consumption, 1970-2007 (percentages)



Source: GALINDO AND SAMANIEGO 2010.
Note: The annual average growth rate for the world is calculated on the basis of data from World Development Indicators, published by the World Bank at www.worldbank.org.

capita and GDP *per capita* (see following charts). This allows us to argue that, going beyond some important progress in specific productive sectors and countries, the essential energy decoupling of Latin American economies must be made an undeniable strategic priority for economic and other public policies and must be systematically and persistently promoted.

Producing more and better quality added value for each unit of energy consumed is one of the main challenges of the 21st century. Economic policy is directly responsible for improving the regulation of pricing policies for alternative energies and it should also govern tax policy towards redefining energy consumption incentives by introducing new types of subsidies, taxes, rights and exploitations. Likewise, it is linked to a policy of medium and long-term loans and investments designed to consolidate the economic performance expectations

of alternative energies such as solar, wind, geothermal, methane-electrical and hydroelectric, and, at the same time, deterring and managing the reduction of inertial investments associated with fossil fuels, agricultural biofuels and nuclear energy.

Other public policies on energy, the environment, forestry and agricultural development, urban-metropolitan administration and regional development should also focus on energy decoupling by promoting increased and better local energy matrices instead of backing inertial or conventional BAU measures, or measures that may turn out to be environmental mirages such as promoting the use of agricultural biofuels, or even ones that could lead to greater potential risks in the medium and long-term such as those based on nuclear energy.

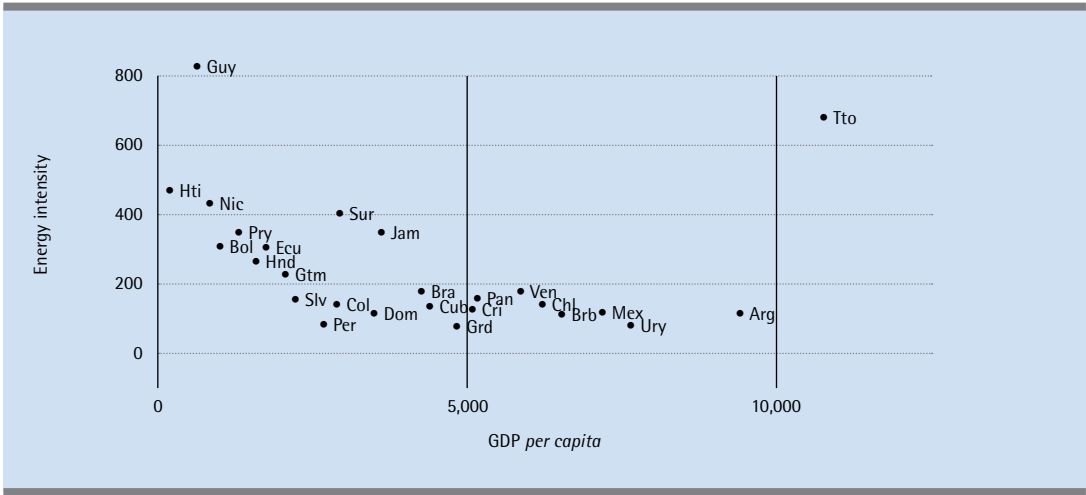


Figure 5
Latin America and the Caribbean: GDP *per capita* and energy intensity 2007 (barrels of oil equivalent/dollar at 2000 prices)

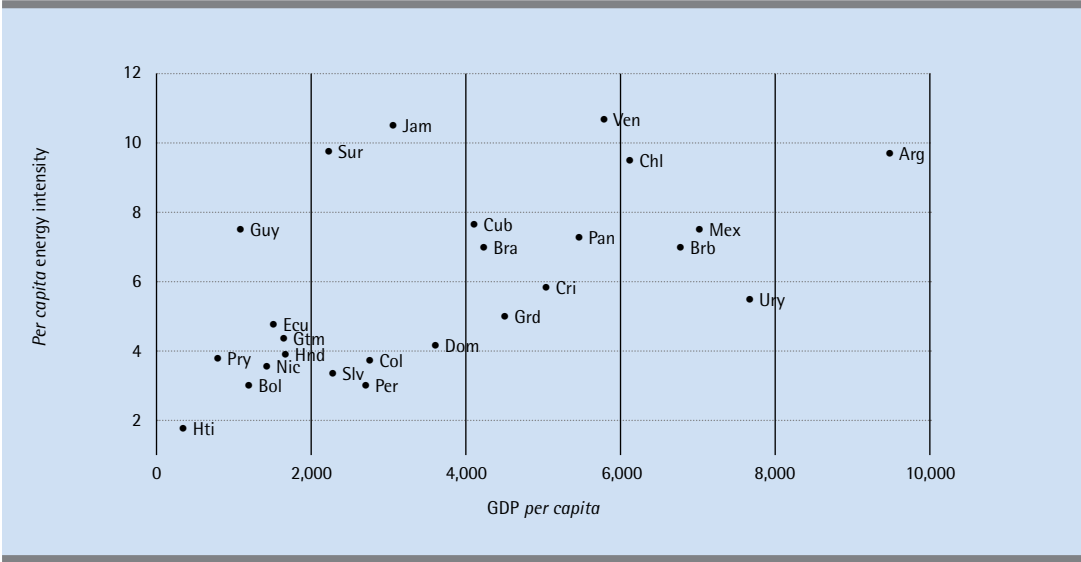
Source: ECLAC 2010a.

With significant variations, the energy intensity exhibited by the different countries in Latin America and the Caribbean shows a negative correlation between the volume of energy consumed (measured in terms of barrels of oil equivalent) and real GDP *per capita* corresponding to 2007 (measured in constant dollars for 2000). Measuring absolute energy intensity is one of the ways of estimating energy decoupling in any economy, as shown in the previous chart (ECLAC 2010a).

Nevertheless, according to the same source, "... this process of energy decoupling is not yet enough to halt the growth of energy consumption in Latin America and the Caribbean in absolute terms, as the current style of growth still requires high energy consumption. Accordingly, any agreement that caps

total energy consumption must be approached with extreme caution by the region" (ECLAC 2010a). This refers to the tension that exists between the need for economic growth and the current uncontrolled consumption of fossil fuels and the essential transition to sustainable development, which includes the equally urgent transition towards renewable energies and suitable environmental alternatives.

Failing to take into account the urgency and desirability of sustainable development in the 21st century by restructuring Latin American and Caribbean energy matrices could result in inertial or worse scenarios of GHG emissions and local risks from global climate change.



Source: ECLAC 2010a.

If the *per capita* element in these two variables of energy intensity is considered, a positive correlation can be seen between energy consumption per inhabitant and GDP per inhabitant for different countries in Latin America and the Caribbean. Based on figures from 2007, both the previous and following charts illustrate how the worst situations in terms of energy intensity (absolute and *per capita* energy decoupling) are found in Haiti, Guyana, Nicaragua, Suriname and Jamaica. Among the group of countries with low and very low incomes per inhabitant, the best relative energy intensity is found in the Dominican Republic.

Among the group of countries whose income per inhabitant is between \$4,000 and \$7,000 per year, the best relative energy intensities are those of Costa Rica and Brazil. Among the group of Latin American countries with incomes per inhabitant of over \$7,000 per year we find Mexico, Uruguay and Argentina, with the latter two recording the best energy intensities in all of Latin America and the Caribbean (see charts 5 and 6).

It is worth remembering that in terms of energy decoupling this counts as a vital element of sustainable development. These same countries present very different situations regarding another three crucial parts of this development: economic decarbonisation, net reforestation and social cohesion.

According to ECLAC 2010a: “Econometric estimates of energy demand run for South America using cointegration methods indicate that, although demand varies by country, its *per capita* income elasticity (η_y) is generally very high (even higher than 1), but its price elasticity (η_p) is very low, moving between values of 0 and -0.2... these estimates indicate that continuous economic growth in the region will be accompanied by rising energy demand. The low price elasticity of energy demand reflects multiple factors which would have to be analysed in detail on a case-by-case basis, and reveals the limitations of a pricing policy for controlling short-term demand” (see following table).

An equally contrasting situation exists regarding the economic decarbonisation of countries in Latin America and the Caribbean: there are important cases of carbon equivalent emissions decreasing as GDP *per capita* increases and cases where the opposite occurs or where the decarbonisation of the respective countries’ economic growth trajectories is barely perceptible. According to GALINDO AND SAMANIEGO 2010, “... for all Latin American and Caribbean countries, there is a positive association between *per capita* emissions, *per capita* energy consumption and *per capita* GDP.

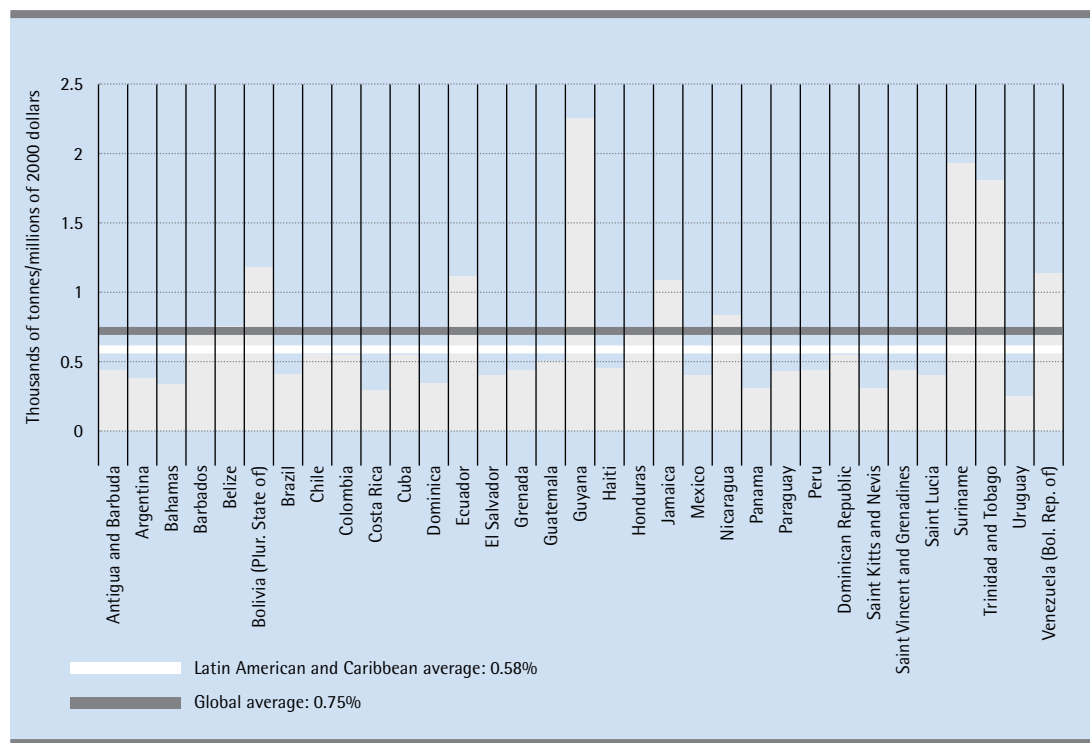
Trends in the CO₂ intensity of energy and the energy intensity of GDP for Latin America and the Caribbean overall are mixed, although reductions are more

Table 8
Latin America:
estimated energy
demand elasticities,
1985–2007

| | η_y | t-stat | η_p | t-stat |
|------------------------------------|----------|--------|----------|--------|
| Argentina | 1.20 | 7.67 | -0.02 | -4.14 |
| Bolivia (Plurinational State of) | 2.36 | 4.78 | -0.01 | -0.02 |
| Brazil | 1.94 | 8.29 | -0.01 | -9.16 |
| Chile | 0.99 | 27.44 | -0.07 | -4.16 |
| Colombia | 0.34 | 2.38 | -0.15 | -5.28 |
| Ecuador | 1.45 | 7.76 | -0.07 | -7.20 |
| Paraguay | 0.65 | 1.95 | -0.22 | -8.64 |
| Peru | 0.70 | 15.14 | -0.01 | -6.71 |
| Uruguay | 0.63 | 4.68 | -0.03 | -3.18 |
| Venezuela (Bolivarian Republic of) | 0.36 | 2.28 | -0.11 | -17.25 |
| Group | 1.06 | 26.04 | -0.07 | -20.79 |

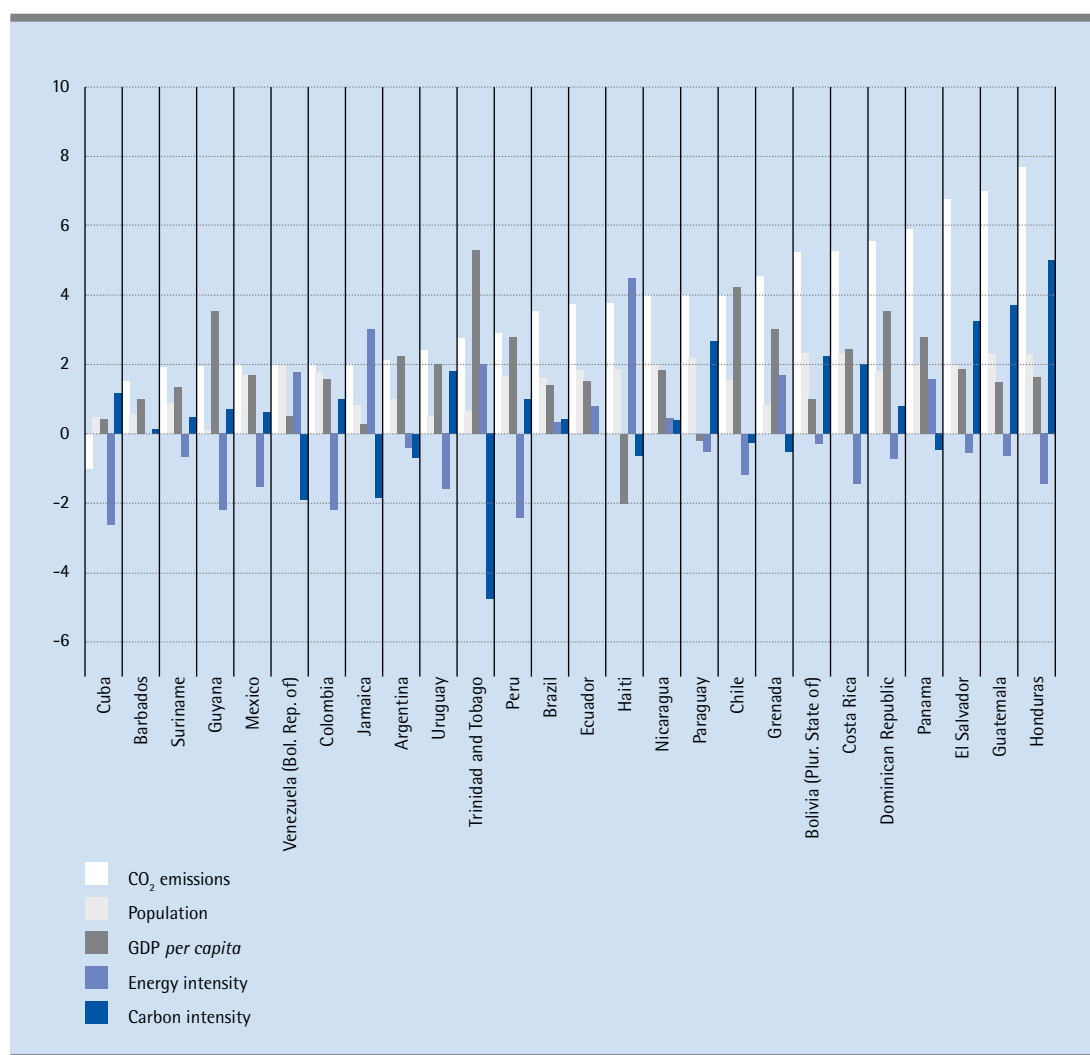
Source: ECLAC 2010a.

frequent in energy intensity than in carbon intensity. "This information can be illustrated and summarised as follows: in Latin American and Caribbean countries, energy decoupling is more evident and documentable than economic decarbonisation. Both are essential and strategic processes for mitigating GHG emissions, as well as for dealing more successfully with the locally-felt risks of global climate change.



Source: GALINDO AND SAMANIEGO 2010.

Table 9
Latin American and the Caribbean: CO₂ emissions per unit of GDP, 2005



Source: ECLAC 2009.

Table 10
Latin America and the Caribbean: average annual increase in CO₂ emissions and its components, 1990–2005 (percentages)

2. Current situation regarding local public policies on climate change: among inertial decision-making, effective mitigation and appropriate adaptation measures

Just over 20 years since the Intergovernmental Panel on Climate Change of the United Nations published its first assessment report, and after 16 sessions of the Conference of the Parties (COP), national and local governments have gained important experience in the design, implementation and evaluation of public policies on climate change (IPCC 2007, WMCCC-UCLG 2007, NICHOLLS 2008, WB 2008, CISCO-CONNECTED URBAN PLANNING 2009, EUROPEAN COMMISSION 2009, KAMAL-CHAQUI AND ROBERT 2009, METROPOLIS INTERNATIONAL INSTITUTE-CISCO-CONNECTED URBAN PLANNING 2010, VEGA-LÓPEZ 2010).

The main findings and lessons learned so far have been expressed in a very wide range of climate change mitigation and adaptation measures. Climate change mitigation measures focus on various technological, energy, regulatory and/or economic alternatives designed to reduce GHG emissions released from different sources and anthropogenic processes, or to capture and store carbon dioxide in different ecosystems which act as natural sinks. Mitigation centres on avoiding or reducing the presence or worsening of climate threats caused by the excessive consumption of fossil fuels and the fragmentation and net loss of forest ecosystems.

Climate change adaptation measures, in turn, are based on infrastructure, technological innovation, regulatory instruments, economic (dis)incentives and/or information strategies, communication and building a culture that can successfully cope with the negative impacts of climate change. Adaptation centres on eradicating or limiting the social, demographic and economic vulnerabilities to climate change facing each society in its own specific territorial situation and location.

Another important lesson learned, but one which is only very gradually being implemented, is the overwhelming evidence that it is less costly in environmental, social and economic terms to introduce mitigation and adaptation measures in each specific territory than to sit back and do nothing and maintain the status quo (see following diagram). More significant and dynamic progress towards implementing climate change mitigation and adaptation measures has been held back by the power of inertia. This inertia is not the result of foolishness, but rather a complex series of vested interests and economic, energy, technological and even geopolitical situations and decisions. In many countries and cities, inertial and/or conventional decision-making on energy and technological matters, as well as in financing and economic growth policies, have hindered the transition to a generalised and efficient use of renewable energies, and towards expansive processes of conservation and

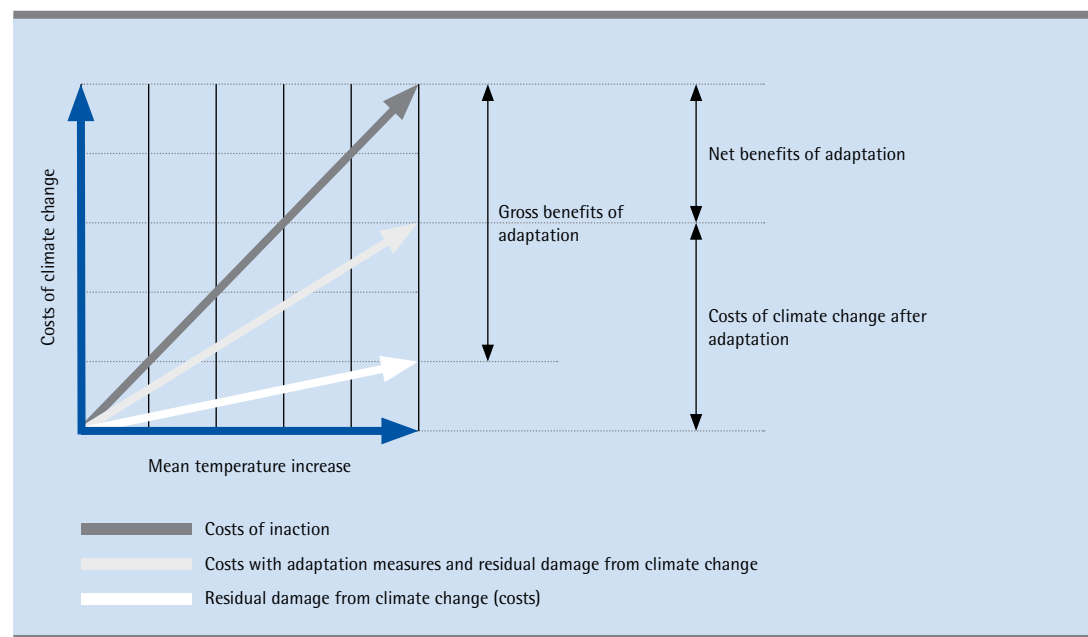


Figure 7
Correlation between
increase in temperature
and the costs and
benefits of adaptation
measures

Source: created by the author based on STERN 2006 and Wb 2008.

net recovery of ecosystems and natural carbon sinks.

The following are some of the many globally recommended public policies on climate change mitigation and adaptation:

- Save energy in absolute terms and per unit produced or consumed
- Make more efficient use of fossil fuels in diverse anthropogenic activities
- Improve fossil fuels
- Replace fossil fuels with renewable energies
- Improve industrial and automotive

combustion systems

- Improve public mobility systems, goods transportation and urban-metropolitan road networks
- Properly construct and manage intelligent buildings and eco-efficient infrastructure
- Promote the use of energy-saving and/or photosensitive light bulbs for domestic, industrial and public use
- Recover energy from sanitary landfills
- Create public-private funding
- Create and correctly manage protected natural areas, community ecological

reserves, private reserves, urban green areas, public spaces and net recovery of forest cover

- Carry out GHG emissions inventories and create systems for monitoring and evaluating climate change measures
- Create risk atlases and strategies for civil protection and preventing and controlling extreme events
- Promote information, communication, capacity building, dissemination, education and professionalization in ad hoc areas and activities
- Design and launch specialised national, provincial, local and regional climate change programmes and projects.

Coinciding with other sources, the policy measures the IPCC recommends and recognises as being the most effective for dealing with the negative impacts of possible climate change scenarios are shown in the following table (IPCC 2007).

While acknowledging the importance of global agreements and how these are reflected in the public policies in each state, it is now becoming increasingly clear how absolutely vital local and regional public policies are for successfully dealing with the local effects of climate change.

Table 12 summarises the experiences of 37 cities and metropolitan regions relative

to 15 lines of public policy specifically designed to avoid and/or reduce local damage caused by global climate change (Metropolis, Cisco and Connected Urban Development 2010).

Another important reference for reviewing the current situation regarding local public policies on climate change is undoubtedly the World Bank study *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities and International Strategy for Disaster Reduction* (WB 2008). This report focuses on three basic questions: i) How does climate change contribute to increasing urban vulnerabilities?; ii) What are the principal climate threats and most frequent natural disasters affecting cities and their inhabitants?; and iii) What has been learned and is already being done by local governments to improve their knowledge of climate change, build their diagnostic and response capacities, and promote direct investment in intelligent buildings, resilient communities and sustainable cities?

| Sector | Policies, measures and instruments shown to be environmentally effective |
|------------------|--|
| Energy supply | Reduction of fossil fuel subsidies Taxes or carbon charges on fossil fuels Feed-in tariffs for renewable energy technologies Renewable energy obligations Producer subsidies |
| Transport | Mandatory fuel economy; biofuel blending and CO ₂ standards for road transport Taxes on vehicle purchase and registration, use of fuels; road tolls and parking fees Influence mobility needs through land-use regulations and infrastructure planning Investment in attractive public transport facilities and non-motorised forms of transport |
| Buildings | Appliance standards and labelling Building codes and certification Demand-side management programmes Public sector leadership programmes, including procurement Incentives for energy service companies (ESCOs) |
| Industry | Provision of benchmark information Performance standards Subsidies; tax credits Tradable permits Voluntary agreements |
| Agriculture | Financial incentives and regulations for improved land management; maintaining soil carbon content; efficient use of fertilisers and irrigation |
| Forestry/forests | Financial incentives (national and international) to increase forest area, to reduce deforestation and to maintain and manage forests |
| Waste | Financial incentives for improved waste and wastewater management Renewable energy incentives or obligations Waste management regulations |

Source: IPCC 2007 d.17. Climate change 2007: Synthesis report. Summary for policymakers. Intergovernmental Panel on Climate Change. Internet: <http://www.ipcc.ch/ipccreports/ar4-syr.htm>.

Table 11
Selected examples of enviromentally effective policies, measures and instruments, according to IPCC

Table 12
Cities and fields of action

| Cities | Fields of action | | | | | | | | | | | | | | |
|----------------------|------------------|---------|--------|------------|---------|----------------|------------|----------|------|------------|----------------|----------------|-------|-------|--------|
| | Air | Cycling | Energy | City fleet | Funding | Green building | Green roof | Lighting | Plan | Renewables | Transportation | Urban greening | Waste | Water | Others |
| Atlanta | | | | | | ● | ● | | | | | ● | ● | | ● |
| Austin | | | ● | | ● | ● | | ● | ● | | | | | ● | |
| Bangkok | ● | | ● | | | | | ● | ● | ● | ● | | ● | | |
| Barcelona | | | ● | | | | | | ● | ● | ● | | | ● | |
| Beijing | | | | | | ● | | | | | ● | | ● | | |
| Berlin | | | | | | ● | | | ● | | ● | | | | |
| Bogotá | | | | | | | | | | | ● | | | | |
| Chicago | | ● | | | ● | ● | ● | ● | | ● | | ● | ● | | |
| Copenhagen | | ● | ● | | | | | | ● | ● | | ● | ● | | |
| Dallas | | | ● | | | ● | | ● | ● | | ● | | | ● | |
| Denver | | | | ● | ● | ● | | ● | ● | ● | | | ● | ● | |
| Guangzhou | | | | | | | | | | | ● | | ● | ● | ● |
| Houston | | | ● | | | ● | | ● | ● | ● | | | | | |
| Île-de-France Region | ● | | ● | | | | | | ● | | ● | | ● | ● | ● |
| London | | | ● | | | | | | ● | | ● | | ● | ● | |
| Los Angeles | | | | | ● | ● | | ● | ● | ● | ● | | | | |
| Madrid | | | | | | | | | ● | | ● | ● | ● | ● | ● |
| Melbourne | | | ● | | | ● | | ● | ● | | | | | ● | |
| Mexico City | | | ● | | ● | | | | ● | | ● | | ● | | |
| Minneapolis | | ● | | | ● | | | | ● | | ● | ● | | | |
| Montréal | ● | ● | | | | | | | ● | | ● | | ● | ● | |
| New York | | ● | ● | | | | | | ● | | ● | ● | ● | | |
| Paris | | ● | | | | | | ● | ● | ● | ● | | | | |
| Philadelphia | | | ● | | | ● | | ● | ● | ● | | | ● | | |
| Portland | | | ● | | ● | ● | | ● | ● | ● | | | | | ● |
| Sacramento | | | | ● | | ● | | | ● | ● | | | ● | ● | ● |
| San Diego | | | | | | | | ● | | ● | | | | ● | |
| San Francisco | | | ● | | | ● | | ● | ● | | ● | | | | |
| Seattle | | ● | | ● | | ● | | ● | ● | | | | ● | ● | |
| Seoul | | | | | ● | ● | ● | ● | ● | | ● | | | | |
| Shanghai | | | | | | | | | ● | | | ● | | | ● |
| Stockholm | | ● | | | | | | | ● | ● | ● | | | | ● |
| Sydney | ● | | ● | | | | | | | ● | ● | | ● | | |
| Tokyo | | | ● | | | | | | ● | | | | ● | ● | ● |
| Toronto | | | | ● | ● | ● | | | ● | ● | ● | | | | ● |
| Vancouver | | | ● | | | ● | | | ● | | ● | | ● | | ● |
| Washington | | | | | | ● | | | | | | | ● | | |

Source: METROPOLIS INTERNATIONAL INSTITUTE, CISCO ET CONNECTED URBAN DEVELOPMENT 2010.

The concept of resilience is frequently used to refer to natural processes of ecological restoration and the self-regeneration of attributes and functions of the ecosystem damaged, altered or lost for different reasons (among them anthropogenic causes). Nowadays, it is also commonly used when talking about social and institutional capacity for restoring living standards, levels of employment and assets after suffering serious damage inflicted by floods, droughts, hurricanes, etc.

The concept of resilience is central to understanding urban and regional vulnerabilities to the local effects of climate change. Resilience is a community or city's ability to adapt to risk by building in institutional buffers that enable it to anticipate and resist the impact of extreme events, and to rebuild itself after being damaged by these events. According to the above-mentioned study (WB 2008), the three main features of what is known as urban or regional resilience are:

- The amount of disturbance or damage a society can absorb and still remain within the range of aggregate self-control.
- The degree to which a society is able to self-organise or adjust its routines to cope with extraordinary events and restore normality.
- The degree to which a society can build and increase its capacity for continuous learning and adaptation.

Based on accumulated knowledge and proven experience gained from diverse public policies to tackle the risks associated with climate change, it is usually considered that urban resilience depends to a great extent on two key variables: firstly, the total amount of material and cultural assets that make up the specific possessions contained in homes, neighbourhoods, districts and cities; and secondly, the overall amount and quality of public services provided by local governments and the urban and/or metropolitan public infrastructure available. Every city should be aware of the degree and likelihood of the climate change risks they are facing, and should gather and systematise general and specialised information for improving civic and governmental adaptation and mitigation capacity. Every city should have specifically designed policies to provide measures and infrastructure for local adaptation and mitigation of emissions in coordination with regional and/or national authorities. The following table summarises the 16 local public policy measures against climate change risks which are presented and analysed in WB 2008.

Similar local public policy recommendations for tackling climate change risks are usually formulated after identifying a group of indicators or questions which, when answered, should provide an initial snapshot of specific risks from extreme climate threats. This allows the most worrying cases or climate change urban 'hot spots' to be identified

along with the corresponding measures for information, prevention, control and attention.

The following are some of these indicators and questions that may be used to assess whether a city or metropolitan area is on the way to becoming a resilient city, a sustainable region or an urban 'hot spot':

- Location and geo-climate conditions: coastal city, sea or river port, mountainous and/or lakeside region, river basin, temperature, rainfall, natural availability of water, wind patterns, sunlight, altitude, latitude, etc.
- Territory and demographic characteristics: urban, metropolitan or regional surface area; population; demographic density; resident and floating population; size and distribution of regular and irregular human settlements (formal or informal); demographic growth rate and dynamics of urban sprawl; territorial and/or functional conurbation processes; public spaces and green areas, etc.
- Local and/or metropolitan governments and institutions: elected or designated; duration of mandates; whether it is a city capital or not; with/without information, inventories, maps and civil protection programmes for extreme events; with/without specialised local climate change plans; with/without offices specialised in climate change; with/without urban development and land classification plans; with/without territorial reserves;

with/without classification of public infrastructure, urban zones and buildings; with/without risk atlases, etc.

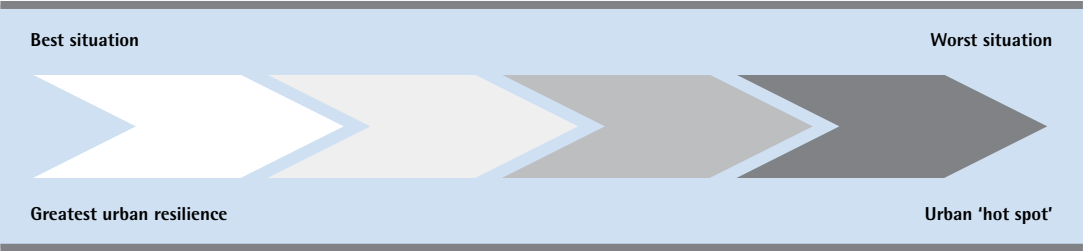
- Available budget and funding mechanisms: amounts and budget allocations; relationship between taxes and local rights to the total budget; relationship between national fiscal allocations and total budget; local, regional and national credit market; economic importance of the city or metropolitan zone; international credit options; funding mechanisms and/or donation via global institutions, etc.
- Economic specialisation and insertion: principal economic activities (agriculture, livestock, forestry, fishing, mining, industry, trade, tourism, transportation, communication, culture, knowledge, finance); energy sources and consumption; location and regional economic networks; specialised corridors and regions, etc.
- History of natural disasters and extreme events associated with climate change: earthquakes, seaquakes, volcanic eruptions, floods, tropical storms, hurricanes, droughts, heat waves, rising sea levels, landslides and mudslides, etc.
- History of response to and impact of these disasters and extreme events: responses organised by civil society, local governments, national governments or by nobody; adequate and well-organised responses or the opposite; adequate information and drills or the opposite; slight, serious or irretrievable impacts;

| Measures and actions | Content of these measures and actions | Cities |
|--|---|--|
| 1. Construct a strategic information base and an organisational structure to manage it | Gather correlatable information about threats, vulnerabilities, policies and risks from climate change in the local territory with the aim of designing and implementing an urban/regional risk management plan. | Seattle/King County, USA New York City, USA |
| 2. Coordinate institutional mechanisms | Prevent climate change mitigation and adaptation measures from being fragmented and not considered as a priority; promote representation mechanisms for experts, politicians, local administrators, entrepreneurs, media and others in the coordination of these institutional mechanisms. | Singapore New York City, USA Makati City, Philippines Dagupan City, Philippines Albay Province, Philippines |
| 3. Cross-cutting mitigation and adaptation measures | Guarantee shared responsibility within the different offices of local, regional and national governments which will encourage coordination and mutual support for implementing mitigation and adaptation measures. | Singapore Makati City, Philippines Tokyo, Japan |
| 4. Implement a local/regional climate change strategy | Develop a local/regional climate change strategy with short and long-term objectives, priorities, goals, programmes, projects, indicators and evaluation mechanisms. | Tokyo, Japan Milan, Italy Albuquerque, USA Seattle/King County, USA Thua Thien Hue Province, Vietnam |
| 5. Create recognition or public awards | Promote different forms of public recognition for contributions to the fight against climate change, in such diverse areas as: a) information, education and capacity building; b) civic participation and social commitment; c) motivation and empowerment of social and community leaders. | Rockville/Maryland, USA Singapore Makati City, Philippines Dagupan City, Philippines Albay Province, Philippines |
| 6. Carry out emissions inventories and set up monitoring systems | Carry out and update inventories of greenhouse gas emissions and construct emissions monitoring systems in order to measure progress and adapt mitigation and adaptation measures accordingly. | Singapore Milan, Italy Makati City, Philippines |
| 7. Create funding mechanisms for risk management | Foster funding mechanisms and joint insurance against risks caused by climate change. | London, United Kingdom Bogota, Colombia |
| 8. Develop climate change risk management systems | Prevent disasters ruining economic development achievements by introducing strategic plans and policies linked to a climate change risk management system. | Singapore New York City, USA Tokyo, Japan Makati City, Philippines Hanoi, Vietnam |
| 9. Mitigate emissions from energy generation and use | Improve processes of electricity generation, save energy and use it more efficiently, shift towards energy patterns led by renewable energies, energy decoupling and economic decarbonisation. | Albuquerque, USA Singapore Tokyo, Japan Makati City, Philippines Albay Province, Philippines. |

Table 13
Examples of climate
change mitigation
and adaptation measures
in different cities

| Measures and actions | Content of these measures and actions | Cities |
|--|--|--|
| 10. Mitigate emissions in the transport sector | Reduce GHG emissions per kilometre covered and per litre of fuel consumed; move towards renewable fuels and greater energy efficiency; reorganise public transport systems and public mobility on a local, metropolitan and regional scale, etc. | London, United Kingdom Milan, Italy Seattle/King County, USA. Singapore Jakarta, Indonesia Makati City, Philippines Dongtan, China Albuquerque, USA |
| 11. Mitigate emissions in town planning and the administration of buildings and infrastructure | Promote urban reorganisation and redensification in order to save energy, improve efficiency in different areas and back new architecture with environmental criteria, and sustainable urban planning: intelligent buildings; better use of natural lighting and ventilation; sustainable administration of the urban landscape; and eco-efficient urban infrastructure. | Albuquerque, USA. Singapore Rockville/Maryland, USA Seattle/King County, USA Makati City, Philippines Vancouver, Canada |
| 12. Mitigate emissions through urban reforestation and the maintenance of green areas | Increase the size of urban green areas and promote urban reforestation. Recognise the ecosystemic importance of these measures in terms of carbon capture and storage in natural sinks. | Albuquerque, USA Venice, Italy Singapore Makati City, Philippines Hanoi, Vietnam |
| 13. Mitigate emissions by developing adequate funding mechanisms | Redesign local, regional and national budgets to create new public funding that requires climate change mitigation and adaptation: taxes, rights, subsidies, exploitations, expenses, investments, etc. | Seattle/King County, USA Albuquerque, USA. |
| 14. Adapt to climate change in the infrastructure sector | Prioritise public and private investment in: a) infrastructure that supports and leads to sustainable economic and social development; and b) infrastructure that aids prevention and recovery from damage caused by climate change. | Venice, Italy Nam Dinh Province, Vietnam Navotas City, Philippines |
| 15. Adapt to climate change by sustainable water management | Promote measures that include: a) quality standards for drinking water and environmental flows; b) saving and efficient use of water; c) natural availability of water; and d) greater treatment and reuse of waste water. | New York City, USA Singapore Hanoi, Vietnam |
| 16. Adapt to climate change through better healthcare policies | Promote new prevention, vaccination and information campaigns against possible resurgence of diseases associated with high temperatures, floods, contagious conditions and carriers (mosquitoes, flies, cockroaches and rodents). | Singapore |

Source: created by the author using information from Wb 2008.



adequate equipment, services and logistics or the opposite (hospitals, refuges, transportation, communications, food, information), etc.

· Local risk management: have the climate threats to the city or region, its social and economic vulnerabilities and the current adaptation and mitigation measures and institutional responsibilities been clearly identified and disseminated?

Depending on the specific urban-regional situation identified after carefully considering all the information gathered from the previous eight broad analytical and local public action categories, it should be possible to determine whether a city is closer to urban resilience and sustainability or, on the contrary, whether it is on the way to becoming an urban ‘hot spot’.

In summary, the set of climate change mitigation and adaptation measures that are widely recommended as local policies could be grouped together in three large blocks:

· Reduce the excessive use of fossil fuels in energy generation and by motor vehicles, diverse industrial activities, domestic use and the general running of

cities and metropolitan regions. Likewise, all these activities and uses should move towards better energy profiles and use of territorial and water resources.

· Significantly reduce the rate of deforestation and halt the conversion of forest cover to other uses that degrade ecological attributes and the environmental services provided by these ecosystems. In addition, restore lost public spaces, extend urban green areas while the surrounding agricultural and livestock activity should move towards better energy profiles and use of territorial and water resources.

· Increase social welfare by promoting greater access to and better use of renewable energies, water resources and environmental services, at the same time as implementing actions to improve public healthcare, education, capacity building, information, gender equality and the conservation and correct use of natural capital (territory, energy, water and biodiversity).

Several local governments in Latin America have been promoting important mitigation and/or adaptation projects and

initiatives along these lines. The following table summarises the progress made so far by a number of Latin American local governments. These and other achievements could be strengthened in these cities and metropolitan regions, while the cities and metropolitan areas leading some of the projects in question could share their experiences and knowledge with other Latin American, Caribbean and European governments.

The following table shows the ten most demographically and economically important metropolitan regions in Latin America. These regions are spread across coastal, delta, lakeside, mountainous and highland zones, each one with its own geo-climate threats, demographic-economic vulnerabilities and public policies in place which, together, prefigure the present and future risks that each region will face due to global climate change.




The government of Bogotá has accumulated a lot of experience since it launched the TransMilenio transport system in 2000. Since then, it has been inspiring and advising other Latin American local governments to reproduce this successful project in their areas. It is now going a step further with its proposed Integrated Public Transport System (SITP) which includes connecting different modes of mobility and transport, improving the infrastructure of dedicated lanes, car parks, pre-pay and one-card schemes, as well as novel funding mechanisms to make the SITP flexible and efficient. This has been a very valuable experience for Mexico City where, for example, there are still institutional and market difficulties regarding the possible use of a one-card system for any form of transport.

Mexico City, in turn, has developed its knowledge and capacity in terms of carrying out GHG emissions inventories,

Table 14
Demographically and economically largest metropolitan regions in Latin America

| Global position | Position in LA | Metropolitan region | Country | Population in 2009 | Area km² | Demographic density | Projected demographic density 2009-2030% |
|-----------------|----------------|---------------------|-----------|--------------------|----------|---------------------|--|
| 8 | 1 | Mexico City | Mexico | 19,885,000 | 2,137 | 9,305 | 0.6 |
| 9 | 2 | São Paulo | Brazil | 19,505,000 | 2,590 | 7,531 | 0.7 |
| 17 | 3 | Buenos Aires | Argentina | 12,925,000 | 2,590 | 4,990 | 0.4 |
| 20 | 4 | Río de Janeiro | Brazil | 11,400,000 | 1,580 | 7,215 | 0.5 |
| 34 | 5 | Lima | Peru | 7,915,000 | 648 | 12,214 | 1.0 |
| 35 | 6 | Bogotá | Colombia | 7,750,000 | 414 | 20,600 | 1.2 |
| 47 | 7 | Santiago | Chile | 5,775,000 | 919 | 16,800 | 1.2 |
| 59 | 8 | Belo Horizonte | Brazil | 4,810,000 | 1,010 | 4,762 | 1.1 |
| 72 | 9 | Guadalajara | Mexico | 4,170,000 | 712 | 5,857 | 0.9 |
| 80 | 10 | Monterrey | Mexico | 3,725,000 | 712 | 5,232 | 1.0 |

Source: created by the author using data from Demographia 2009.

| Vehicles | Units | Space (m²) | Fuel (litres) |
|---|-------|------------|---------------|
|  | 2,000 | 24,000 | 200 |
|  | 167 | 8,800 | 80 |
|  | 71 | 3,550 | 40 |

Source: <<http://www.plandemovilidad.gob.ar/>>
<<http://movilidad.buenosaires.gob.ar/>>

Table 15
Options for transporting
10,000 people

and in the whole process of verifying, inspecting and monitoring emissions and updating the fleet of vehicles circulating in this metropolitan region. It has also made significant progress in the environmental management of its forest sinks on ecological conservation land and of its green areas and urban public spaces.

The government of Buenos Aires continues to promote its Sustainable Mobility Plan, the three key elements of which are: priority public transport; healthy mobility; and traffic organisation and road safety. In addition to expanding its underground train network and encouraging the use of bicycles, the city is also promoting the generalised use of the Metrobus transport corridor, as shown in table 15.

Meanwhile, for many years now, local and regional governments in the European Union have been building knowledge and developing public companies and institutions for improving urban mobility

and transport and organising the different modes of transport into genuinely integrated, efficient and effective systems, as well as operating flexible pre-pay schemes for passengers offering important discounts on annual and monthly passes and for special groups of users (young people, the elderly, disabled passengers, etc.).

For most local and/or regional governments, their institutional difficulties have not hindered certain significant progress being made *in situ* during the deployment of their respective actions to counter the possible effects of climate change. Although a detailed analysis of the cases of Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City is provided in Part C, the following is a preview of some of the progress made by Latin American cities and local governments:

· The governments of Lima, São Paulo and Bogotá have made progress towards drafting their climate action programmes

(or equivalents), while Buenos Aires, Mexico City and Rio de Janeiro already have plans in place.

· The government of Bogotá is leading the way in transport corridors and reconfiguring urban mobility with different modes and methods of transport - an example that has been replicated by the present governments of Buenos Aires and Mexico City.

· The governments of Bogotá and Buenos Aires have already carried out urban restructuring by creating new road links in their respective territories.

· In Bogotá, Buenos Aires, Mexico City and Lima clear progress can be seen in the growing use of bicycles in cycle lanes created in specific urban points or routes, in university zones and along some of the cities' main roads on Sundays. Obviously, further development of specialised infrastructure for bicycles and for parking conventional vehicles and switching to bicycles is still needed.

· The government of Mexico City plans to redesign its urban waste collection network, transfer stations, sorting and processing centres, and to eventually recover energy from methane produced in its sanitary landfill sites.

· The government of Buenos Aires plans to develop integrated neighbourhoods and has been promoting the construction of intelligent buildings that significantly improve the use of natural lighting and ventilation, leading to net benefits in

energy, environmental and economic terms. Furthermore, these buildings make better use of drinking water, treated water and conventional energy and, by having large underground car parks, they absorb the urban and road impact that these buildings would otherwise generate.

· Although the government of Mexico City has gained a lot of experience of carrying out GHG emissions inventories and all the cases referred to here have developed systems to monitor emissions, what they still seem to lack are risk atlases and early warning systems for the type of extreme events associated with climate change.

With regard to local policies to deal with the effects of climate change *in situ*, it is also crucial to closely monitor the additional initiatives being proposed by the global organisation United Cities and Local Governments (UCLG <http://www.cities-localgovernments.org/>). In fact, the basic components of public policy on the local impact of climate change scenarios include identifying a series of baselines for carrying out GHG emissions inventories and launching systems for monitoring these emissions and for pinpointing the vulnerabilities and risks from climate change in each specific territory.

Taking these baselines as a starting point, local and/or regional governments can draw up a schedule for meeting a series of 'minimum commitments' which will allow them to design integrated policies for sustainable development in their

respective cities and metropolitan areas. To this end, designing and implementing local EMM+AAM must be considered one of the keys to achieving significant results while at the same time partially reducing the costs of moving towards becoming ‘resilient cities’ and ‘sustainable metropolitan areas’ (Wb 2008; KAMAL-CHAOUÏ & ROBERT 2009; VEGA-LÓPEZ 2010). In the short and medium-term, current public policies in place to deal with the local effects of climate change widely recommend making a firm commitment to effective mitigation and appropriate adaptation measures and avoiding or reducing to the absolute minimum any inertial tendencies that basically equate to inaction. Putting into action the lessons learned over the past 20 years (since the first IPCC Assessment Report in 1990), there is no doubt that, although addressed to specific situations and at different rates depending on each case, the emphasis of local public policies on climate change should be:

- increased ‘energy decoupling’ of urban and metropolitan economies
- gradual ‘economic decarbonisation’ of their activities and operation
- significant reduction of net deforestation, in specific points and regionally
- greater social cohesion and cooperation from local citizens (or a significant reduction in local levels of marginalisation, pauperisation, disorganisation and social erosion)

In order to achieve these results in the medium term, the basic components underlying them are linked to new and improved policies on energy, water, territory, the environment, social issues, tax matters and urban/metropolitan planning. These policies should highlight the need for communication and cooperation between different branches of government (executive, legislative, judicial), as well as between the various levels of government (federal and central, state and provincial, and local).

Particular attention should be paid to public problems and issues relating to social cohesion. In this respect, the following section proposes some additional matters to be considered.

3. The importance of local social cohesion in climate change scenarios

Social cohesion is the full expression of mature economic development and the beneficial and productive inclusion in society of the associated benefits of higher levels of employment, income, education, health, housing and general welfare. At the same time, social cohesion also reflects a democratic society’s maturity in terms of its institutional mechanisms for public elections and political representation – aspects which although individualised, tend to provide an example of cooperation and solidarity in routine and extreme events.

Therefore, social cohesion is the result of development but it is also an irreplaceable element of maintaining this development as a priority. Social cohesion is not a ‘natural’ or ‘automatic’ consequence of experiencing economic growth (even sustained) or formally democratic processes, it is the result of combined social decisions which deliberately and institutionally address the task of social cohesion. The first step in this process is to set objectives for reducing social marginalisation, promoting social inclusion, fostering civic participation, and achieving and maintaining good rhythms and levels of employment, income and quality of life.

Albeit with considerable specificities and differences, the content of the two previous paragraphs can, broadly speaking, be compared to existing situations in many northern and western European countries, Canada, the United States, Australia, New Zealand and a few others: in other words, this is not a generalised situation. Nevertheless, as social cohesion is a reflection of contemporary societies’ maturity in terms of economic and political development, it is vital that it be considered an indispensable requirement for any economic development plan, and even more so if this plan is designed to be sustainable and socially inclusive.

In these times of climate change, however, social cohesion, or its weakness, fragility or inexistence, is a key element of analysis

when assessing the social and economic vulnerabilities facing any country, region, city or location in terms of climate threats of anthropogenic origin and in terms of their current public policies on climate change – whether these are conventional and inertial or appropriate and effective. This reiterates the content of the table in Part A of this study which illustrates the importance of local social cohesion in ‘structural’, ‘emerging’ and ‘additional’ public problems and issues, with ‘additional’ problems being understood as being those associated with the possible negative impact of climate change scenarios. Unfortunately, it will be very difficult to increase social cohesion in order to effectively tackle the potential negative impacts of climate change until these ‘structural’ and ‘emerging’ social problems have been resolved or are at least systematically and urgently dealt with.

The analytical centrality and political importance of what local governments and their respective urban and metropolitan societies, with their different levels of social cohesion, decide, do and don’t do with regard to the challenges of climate change must be the main concern when discussing, designing and implementing locally deployed mitigation and adaptation measures.

The possible suitability and effectiveness of local public policies for managing specific economic and social vulnerabilities, correlated with the

higher or lower likelihood of climate threats occurring in each territory, is of the utmost importance. The previous paragraph documents, as part of the review of the current situation of public policies on local climate change, how the cities that are most cohesive and strategically organised to prevent, avoid or efficiently respond to extreme events linked to climate change, are at less risk and their social, economic and environmental costs are also lower and recoverable. In contrast, in the case of cities and metropolitan areas in which these risks are directly linked to deeply ingrained and widespread existing social vulnerabilities due to the weakness or absence of social cohesion, it is highly likely that local public policies will also suffer from the same characteristics: disconnection, inefficiency, untimeliness, weakness, etc. Hence, in cases with greater social upheaval and, therefore, barely perceptible and sporadic social cohesion, promoting and institutionally building social cohesion cannot be delayed.

Considering the importance of social cohesion to clarify whether a city and/or metropolitan region is in a good or bad position to successfully cope with the challenges imposed by climate change scenarios, what needs to be documented is whether the respective local governments are introducing methods of local public intervention which will genuinely lead to energy decoupling, economic decarbonisation and a net increase of urban areas with forest cover and/or green zones in their respective territories,

at the same time as making a firm and lasting commitment to building and strengthening social cohesion in their communities and regions.

In this regard, it is useful to consider this rather long quotation: “In general, the design of local government social agendas and programmes takes into account governing the specific needs of the community, participation, the fight against poverty, exclusion and inequality, assistance to highly vulnerable groups and the promotion of citizenship. Actions and policies derived from such agendas coexist with social programmes designed and executed by central (or national) governments (...) It would be desirable that both types of programmes operate with high levels of coordination, but this is quite infrequent at least in Latin America (...) This all entails a clear contextual contrast with regard to localities in the European Union. The institutional and development framework of the latter is comparatively more conducive to the instrumentation of local public policies capable of influencing the basic vectors of social cohesion. While, in a socioeconomic context, the basic needs of individuals are somewhat met, the social cohesion strategies of European localities face other priorities and demands, and, as a result, their agendas and programmes also face complications and different challenges. In addition to guaranteeing basic social protection, the European central governments have mechanisms that counter social exclusion which produce higher coverage rates and social expenditure levels than the Latin

American averages” (GODÍNEZ 2008). According to GODÍNEZ 2008, among others, the ‘basic vectors of social cohesion’ are: the general spheres of national and regional economic growth; employment and job markets; economic policy (particularly fiscal policy which encourages or discourages economic activities, labour options and dynamism in cities and regions); and public policies, especially those with explicitly social content (education, health, housing, equality, etc.), where in addition to the amounts assigned to each of the previously-mentioned policy lines, national, sectorial or universal coverage is also very important.

Albeit with significant variations, the general sphere of long-term economic growth in Latin America and the Caribbean has not been conducive to creating structurally solid and sustainable conditions for promoting social cohesion. During the so-called ‘lost decade’ of the 1980s, all of these countries recorded negative GDP per inhabitant. During the 1990s, economic growth *per capita* recovered, but in most cases it was insufficient to repay the social costs of the previous decade. Towards the end of this same decade and during the first years of the 21st century, it seemed that determinants of economic growth were beginning to stabilise, but the global crisis that began in the autumn of 2008 soon made the external and structural fragility of many Latin American and Caribbean economies apparent (ECLAC 2010).

In 2009, only six Latin American economies registered aggregate economic growth rates above 1%, another five barely registered economic growth rates above zero and below 1%, while nine registered negative rates.

The frequent and pronounced cyclical fluctuations caused by Latin America and the Caribbean’s track record of non-sustained economic growth, together with their evident external and structural fragilities, have seriously hindered the solid and institutional construction of vital social cohesion in their cities, metropolitan areas and countries.

Latin America’s *per capita* GDP is barely a quarter of that generated by the seven most developed economies and just over a fifth of that of the United States of America. These baseline differences are most significant when comparing the respective quotients of lowest and highest quintiles and deciles of the distribution of *per capita* income in each case. In Latin America, those in the highest income quintile receive, on average, 17 times the amount of those in the lowest income quintile; this inequality doubles when we compare the income obtained by the wealthiest 10% of the population with that of the poorest 10%. In the most developed economies, inequality in income distribution is between seven and sixteen times the earnings differential, considering the quotient between quintiles of the seven most developed countries and the deciles of the United

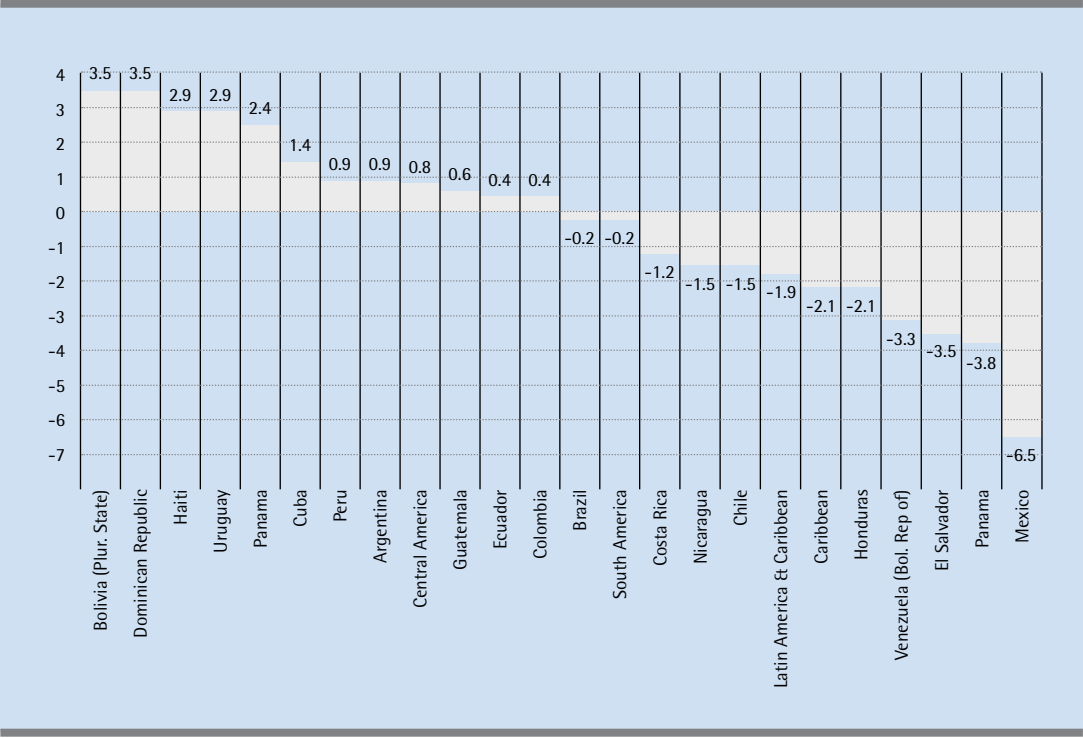


Figure 8
Latin America and the Caribbean: growth rate, 2009 (percentages)

Source: ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (ECLAC), on the basis of official figures. Chart taken from ECLAC 2010.

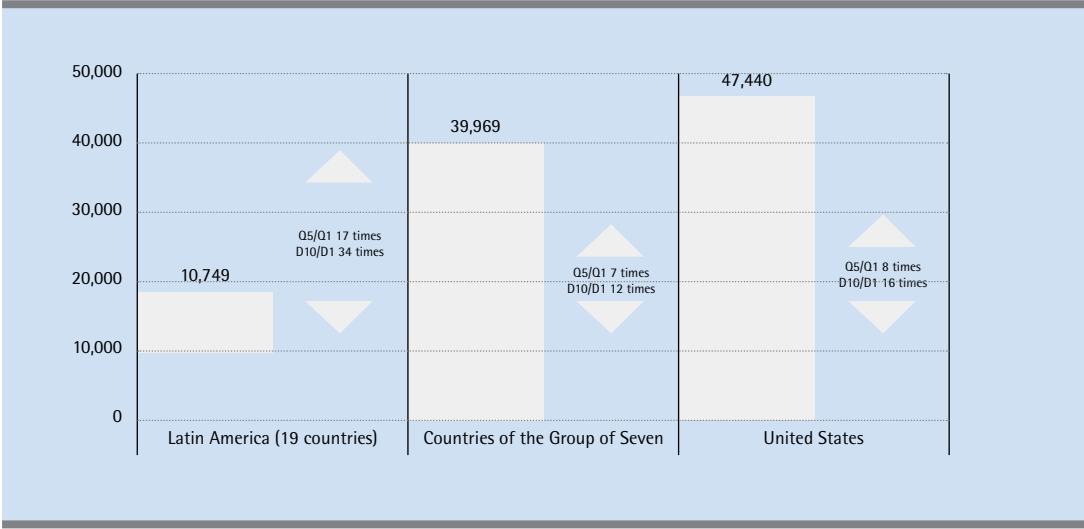
States of America (see figure 8).

This means that Latin America has a lower income per inhabitant and significantly greater variation in its distribution. Social cohesion is difficult to achieve against this backdrop of social inequality, and where active social policies with universal coverage are weak or non-existent, this social cohesion becomes virtually impossible. The routine vulnerability of Latin American populations is very high and when faced with extreme events such as those associated with climate change it increases even more. This is why it is

so important to consider the potentially negative impacts of climate change as a vulnerability and structural weakness that must be turned into an opportunity to strategically redesign national, regional and local public policies.

The inequality in *per capita* income is particularly alarming in countries such as Bolivia, Honduras, the Dominican Republic and Brazil, but this does not mean that it is not also serious in Nicaragua, Guatemala, Ecuador, Mexico and Peru. According to the following graph, the only significant case of lower levels of inequality is Uruguay, where the

Figure 9
Latin America and developed countries: *per capita* GDP and income distribution, 2008 (purchasing power parity dollars)



Q5/Q1 and D10/D1 are the ratio of the highest to lowest income quintiles and the highest to lowest income deciles of the population, respectively. Source: chart taken from ECLAC 2010.

poorest 40% of homes receive close to 22% of total national income, while the wealthiest 10% receive around 27% of national total.

With these economic growth and income distribution trajectories, the dynamics of Latin American labour markets have been erratic and have not resulted in cumulative productive experiences. The weakness of productive innovation, training and employment absorption have led to the spread of individual and family strategies of survival and precarious self-employment, while national and local governments have barely designed or implemented any public policies to abate and control the most serious costs. Poor and fluctuating economic dynamism results in the fragmentation of labour markets until finally they are

unable to absorb important contingents of the unemployed population during phases of recovery and shed excessive numbers of jobs in phases of decline. Due to a repetition of this process over and over again in Latin America and the Caribbean, underemployment and very diverse types of self-employment have become the most common forms of economic and labour informality.

According to ECLAC 2010 and GODÍNEZ 2008, it could be said that seven out of ten people employed in these countries are working in the informal sector. The least dramatic case is Chile, although even there, in 2005, more than 7% of the economically active population (EAP) were working in informally set up micro-enterprises, around 6.5% of the EAP held jobs in domestic service and almost

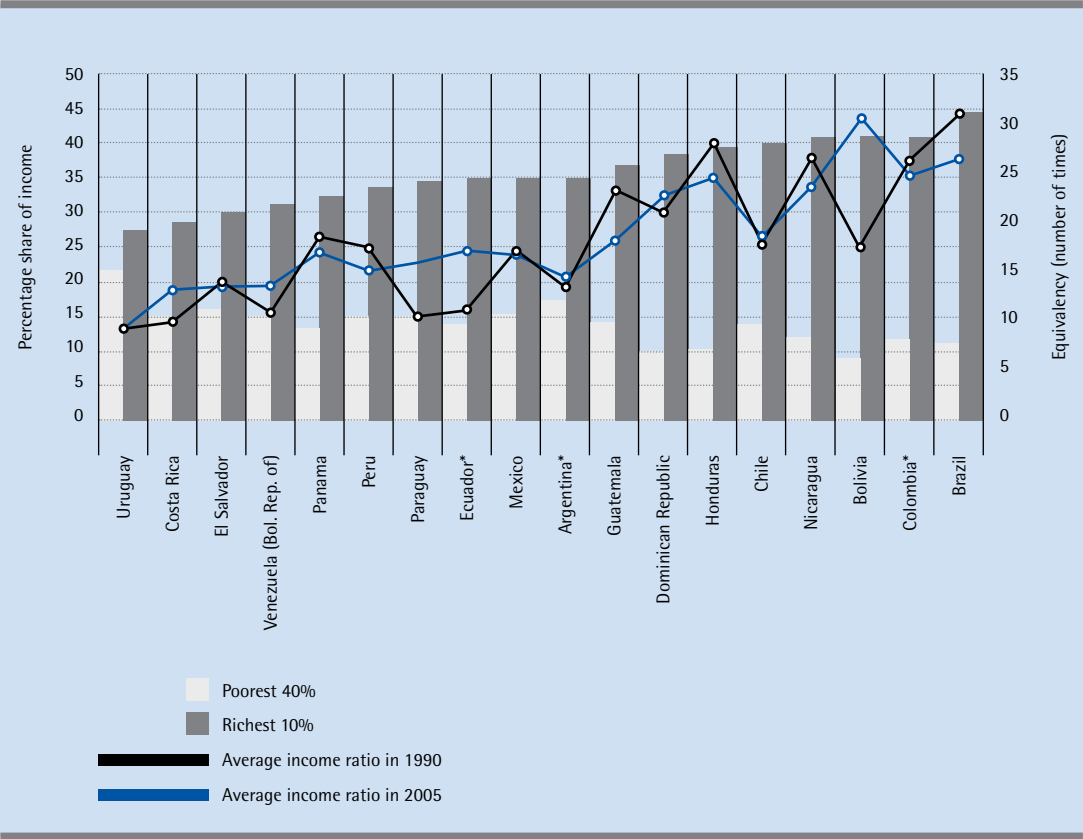


Figure10
Latin America: total
income shares and mean
income ratio for the
poorest 40% and richest
10% households
1990-2005

* Urban areas.
Source: ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (ECLAC), on the basis of special tabulations of national household surveys, and WORLD BANK, WORLD DEVELOPMENT INDICATORS (WDI).

15% of the EAP were self-employed. The most worrying case is Bolivia, where, in 2005, almost 17% of the economically active population (EAP) were working in informally set up micro-enterprises, around 4.6% of the EAP held jobs in domestic service and more than 44% of the EAP were self-employed. Larger economies such as those of Argentina, Brazil, Colombia, Mexico and Venezuela also present alarming figures in these areas and, in fact, admit to irretrievably

wasting ‘demographic bonuses’ in almost all cases (see table 16).

The difficult situation brought about by the global economic crisis of 2008-2009 –the processes of national recovery from which remain uncertain– has been further complicated in several countries in Latin America and the Caribbean due to the pro-cyclical economic policy these countries have implemented.

Table 16
Percentages of the
economically active
urban population
employed in the
informal sector, by
gender and type of
insertion, circa 2005

| Country | Establishments with up to 5 people (microcompanies) | | | Domestic service | | | Self-employment and unpaid family members | | | Total percentages | | |
|-------------|---|------|--------|------------------|------|--------|---|------|--------|-------------------|------|--------|
| | Total | Male | Female | Total | Male | Female | Total | Male | Female | Total | Male | Female |
| Argentina | 13.2 | 16.4 | 8.9 | 7.2 | 0.7 | 16.1 | 16.7 | 19.0 | 13.6 | 37.1 | 36.1 | 38.6 |
| Bolivia | 16.7 | 23.0 | 8.6 | 4.6 | 0.2 | 10.0 | 44.1 | 33.5 | 57.0 | 65.4 | 56.7 | 75.6 |
| Brazil | 9.4 | 10.7 | 7.7 | 8.5 | 0.8 | 18.7 | 22.6 | 23.8 | 20.9 | 40.5 | 35.3 | 47.6 |
| Chile | 7.1 | 7.6 | 6.4 | 6.5 | 0.2 | 16.3 | 14.9 | 17.8 | 10.5 | 28.5 | 25.6 | 33.2 |
| Colombia | | | | 5.1 | 0.3 | 11.1 | 37.5 | 38.1 | 36.8 | 42.6 | 38.4 | 47.9 |
| Costa Rica | 11.4 | 12.6 | 9.4 | 4.9 | 0.4 | 12.0 | 16.1 | 15.0 | 17.9 | 32.4 | 28.0 | 39.3 |
| Ecuador | 15.1 | 18.6 | 10.0 | 5.2 | 0.9 | 11.5 | 31.6 | 27.8 | 37.3 | 51.9 | 47.3 | 58.8 |
| El Salvador | 13.2 | 17.6 | 8.4 | 3.9 | 0.5 | 7.7 | 32.5 | 23.1 | 43.0 | 49.6 | 41.2 | 59.1 |
| Guatemala | 13.1 | 16.3 | 8.8 | 4.0 | 0.1 | 4.2 | 34.5 | 27.6 | 43.9 | 51.6 | 44.0 | 61.9 |
| Honduras | 13.4 | 18.0 | 7.5 | 4.1 | 0.5 | 8.7 | 36.8 | 33.1 | 41.6 | 54.3 | 51.6 | 57.8 |
| Mexico | 15.5 | 17.9 | 12.0 | 4.5 | 0.7 | 10.1 | 18.8 | 15.9 | 23.3 | 38.8 | 34.5 | 45.4 |
| Nicaragua | 15.8 | 21.5 | 8.0 | 4.4 | 0.1 | 10.3 | 35.3 | 28.6 | 44.5 | 55.5 | 50.2 | 62.8 |
| Panama | 8.7 | 9.9 | 6.9 | 6.8 | 1.2 | 14.9 | 21.5 | 23.4 | 18.8 | 37.0 | 34.5 | 40.6 |
| Paraguay | 15.2 | 21.6 | 7.2 | 11.1 | 1.5 | 23.0 | 29.4 | 26.3 | 33.3 | 55.7 | 49.4 | 63.5 |
| Peru | 12.4 | 15.9 | 8.1 | 5.6 | 0.8 | 11.5 | 42.0 | 35.8 | 49.7 | 60.0 | 52.5 | 69.3 |
| Uruguay | 13.7 | 13.3 | 14.1 | 7.2 | 1.1 | 14.8 | 20.3 | 23.0 | 16.8 | 41.2 | 37.4 | 45.7 |
| Venezuela | 10.2 | 12.8 | 6.1 | 1.9 | 0.1 | 5.0 | 35.3 | 34.5 | 36.6 | 47.4 | 47.4 | 47.7 |

Source: Godínez 2008.

The following chart illustrates the existing relationship between tax revenues and public expenditure in 2008 and 2009. The worst situations appear in Venezuela, Bolivia, Ecuador and the Dominican Republic, where important losses of tax revenues led to cuts in public expenditure. Other difficult cases are those of Mexico, Honduras, Guatemala and Haiti, where a drop in their tax revenues resulted in increases in public spending of between just zero and 1% relative to their respective GDPs. Despite important tax losses in the case of Chile, this country decided to increase its public expenditure by almost the same proportion (it lost approximately 4.5%

of its tax revenues and raised its public spending by 4.2%). The most comfortable situations in this group were experienced in Argentina, Uruguay, Paraguay and Colombia.

The combination of weak and fluctuating economic growth trajectories, the fragmentation and informalisation of labour markets and pro-cyclical economic policies is socially degrading and exclusionary, just the opposite of the required institutionalised and robust construction of social cohesion. Not working in formal employment means being excluded from national social

programmes the beneficiaries of which are precisely those people working under formal employment conditions.

This situation highlights the importance of social programmes with universal coverage instead of national coverage and which exclusively benefit formally employed populations. Clearly, however, this should not divert attention away from creating more formal employment and gradually eliminating labour informality.

The current legal and regulatory frameworks in Latin America and the employment and social policies built upon them show four paradigmatic sets: the best are found in Brazil and Venezuela, where employment and social policies offer a high level of protection and coverage; the worst cases are found in Guatemala, El Salvador, Honduras, Nicaragua, Bolivia and the Dominican Republic, where employment and social policies provide little protection and have limited coverage; Argentina, Chile, Uruguay and Costa Rica offer little employment protection but higher levels of social protection; and finally, with high levels of employment protection but

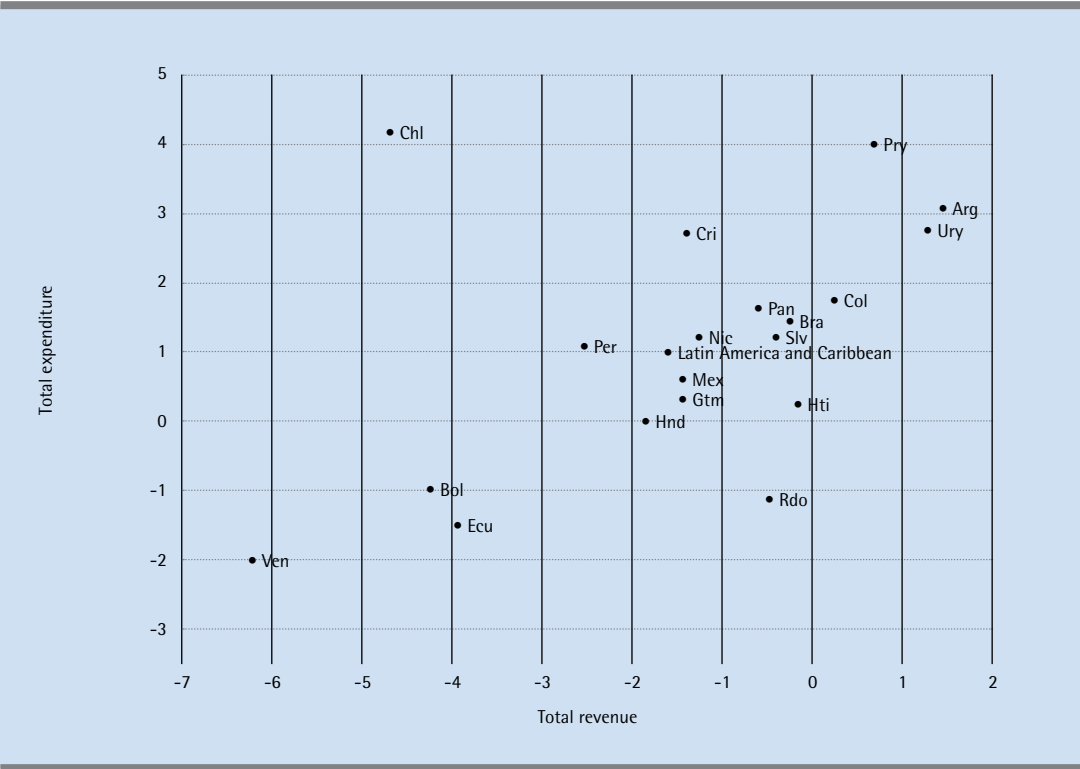


Figure 11
Latin America and the Caribbean: fiscal revenue and expenditure (percentages of GDP variation)

Source: ECLAC 2010.

low levels of social protection we find Mexico, Panama, Colombia, Ecuador, Peru and Paraguay (see table 17). For these reasons, it could be argued that far from heading towards consolidating social cohesion in most Latin American and Caribbean countries, what has really been occurring until now, and which unfortunately is expected to continue in the future, is both the spread of individual and family strategies of survival and precarious self-employment and national and local public policies to abate and control the most serious social costs.

‘Social snapshots’ taken prior to the global economic crisis of 2008-2009 also show rather bleak urban situations for metropolitan areas such as Greater Buenos Aires and Mexico

City. Aspects taken into consideration include overcrowding in homes, years of schooling completed by the head of the household, percentage of teenage mothers out of the total number of mothers and rates of unemployment of the head of the household.

All of which contrasts with the emphasis of this study on the urgent need to build and develop cohesive societies by means of the complementary, coherent and systematic implementation of the ‘local public intervention matrix for climate change’ proposed in this study. Despite the complexity of these ‘structural’, ‘emerging’ and ‘additional’ social problems, and the difficulty of achieving and consolidating social cohesion in Latin American cities and metropolitan regions, it must be reiterated that the

Table 17
Latin America: combinations of labour and social protection

| Social protection | | | |
|-----------------------|------|--|--|
| | | High | Low |
| Employment protection | High | Stringent labour legislation: second highest Spending on social protection: second highest Perception of security: second highest Brazil and Bolivarian Republic of Venezuela | Stringent labour legislation: highest Spending on social protection: second lowest Perception of security: lowest Colombia, Ecuador, Mexico, Panama, Paraguay and Peru |
| | Low | Stringent labour legislation: lowest Spending on social protection: highest Perception of security: highest Argentina, Chile, Costa Rica and Uruguay | Stringent labour legislation: second highest Spending on social protection: lowest Perception of security: second lowest El Salvador, Plurinational State of Bolivia, Guatemala, Honduras, Nicaragua and Dominican Republic |

Source: ECLAC 2010.

most effective contemporary form of local public governance, which could facilitate the constitution and consolidation of resilient cities and sustainable metropolitan regions, is precisely via the implementation of the six basic policy lines detailed in the above-mentioned matrix (referred to in Part A and revisited in Part C).

C. Local public policies against climate change: proposals and actions of some local governments of Europe and Latin America

After analysing the local causes and consequences of global climate change and the new challenges that this situation is posing for the countries, cities and metropolitan areas of Latin America and the Caribbean, the principal local measures for mitigating and adapting to climate change and the costs of not taking action were highlighted. Also analysed was the importance of social cohesion as a strategy for local development and adaptation, considered a key factor in dealing as best as possible with climate threats and in reducing social and economic vulnerabilities in such risk scenarios. Here, in Part C, on the basis of the analyses of the local actions and/or programmes against climate change that the governments of Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City have been implementing for the last few years, this study's proposal on the need to urgently and simultaneously put into action the six policy lines that form the 'local public intervention matrix for climate change' is strengthened.

1 Climate action plans and programmes in Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City

As has been previously mentioned in another part of this study, the lessons learned over the course of the last 20 years include, as a priority, putting special emphasis on the following local public policies against climate change:

- Increased 'energy decoupling' of urban and metropolitan economies.
- Gradual 'economic decarbonisation' of their activities and operation.
- Significant reduction of net deforestation, in specific points and regionally.
- Greater social cohesion and cooperation from local citizens (or a significant reduction in local levels of marginalisation, pauperisation, disorganisation and social erosion).

Each of the following six cases, three European and three Latin American, offers a good view of the experiences accumulated by local governments that have taken seriously the fight against the possible impacts of climate change.

1.1 Barcelona Energy Improvement Plan (PMEB) 2002-2010 and the Barcelona Energy, Climate Change and Air Quality Plan (PECCQAB) 2010-2020¹

City and metropolitan area: energy consumption and GHG emissions

Barcelona, with a territory of 101 km² and a population of over 1,620,000 inhabitants, stands 9 metres above sea level on Spain's northeastern Mediterranean coast. If Barcelona's metropolitan region is considered, its population is in excess of 3,218,000 inhabitants and it has an area of conurbation and influence of about 636 km². It forms Spain's second largest urban and economic concentration after Madrid, and its demographic, economic and energy consumption-related importance is indicated by the following figures: it represents 3.7% of Spain's total population, 7% of the national gross domestic product, and about 2% of the country's energy consumption. In 2005, Barcelona's gross domestic product was 140 billion dollars, positioning it in 31st place in the ranking of the world's leading cities by GDP

Barcelona's percentage contribution, also

in relation to the autonomous region of Catalonia and the European Community, is given in table 18.

The economic structure of Barcelona shows advanced efficient dynamics of tertiarisation by registering a high GDP and low energy consumption. The energy efficiency of Barcelona's urban system is confirmed by comparing its carbon dioxide equivalent emissions with those of other important cities, as is shown in the following graph (PMEB 2002). It should be pointed out that this graph deals in all cases only with the emissions generated directly by the energy consumption made within their respective urban territories, without taking into account the indirect emissions of CO₂e. That is to say, consideration is not given here to the indirect emissions produced in other territories which are derived from the energy demand of each of the respective cities and metropolitan regions, in this case Barcelona.

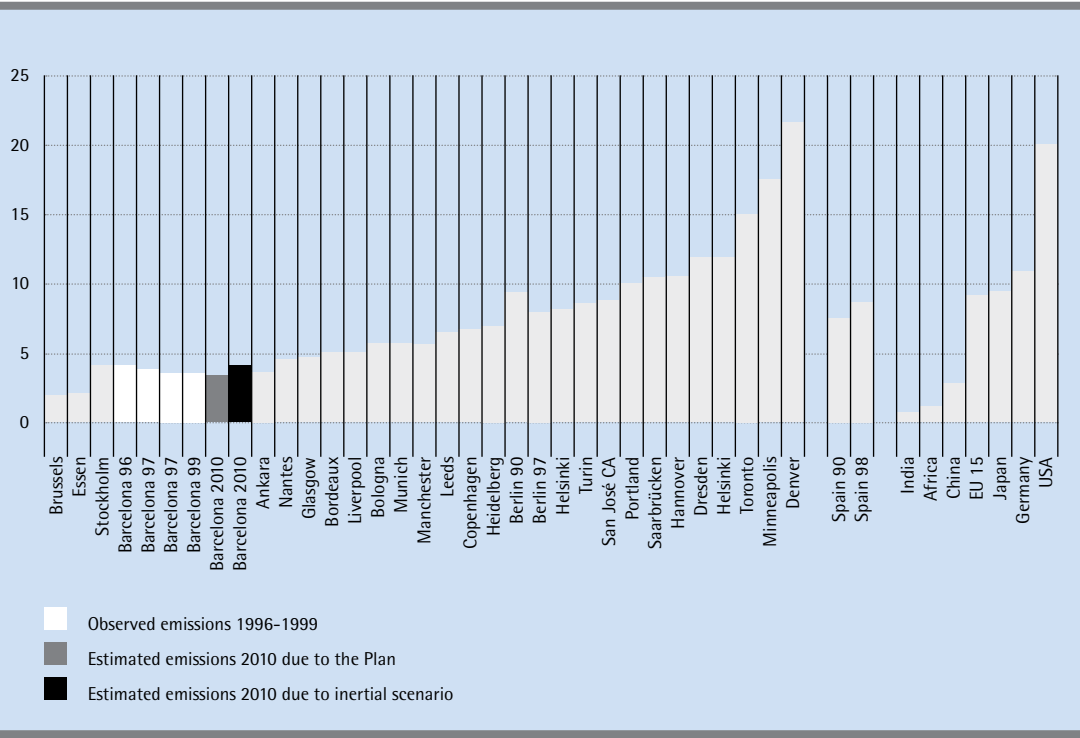
Barcelona's annual energy consumption is approximately 50.78 PJ and its main sources are: electricity, 41%; oil, 31%; natural gas, 25%, and liquefied petroleum gas, 3%. It should be pointed out, however, that the electric energy consumed in its

Table18
Barcelona: percentage participation of its energy consumption, population and gross domestic product vs. those of Catalonia, Spain and European Community

| | Catalonia | Spain | EC |
|----------------------------|-----------|-------|--------|
| Primary energy consumption | 9.7% | 1.86% | 0.154% |
| Population | 25% | 3.75% | 0.4% |
| GDP | 33% | 7% | 0.5% |

Source: PMEb 2002-2010.

Figure 12
Barcelona: per capita CO₂ emissions. Comparison of emissions



Source: PMEb 2002.

1 Pla d'Energia, Canvi Climàtic i Qualitat Atmosfèrica de Barcelona, 2010-2020.

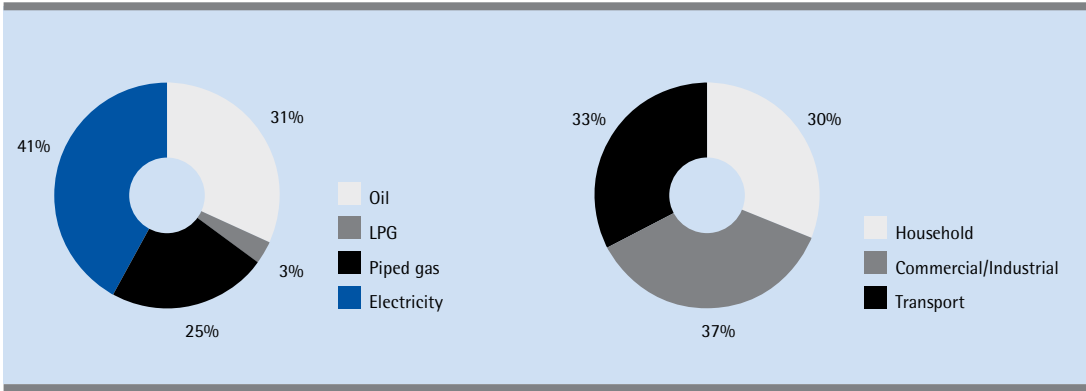
territory is primarily generated by nuclear energy (49%), followed by natural gas (23%), liquid fuels (18%), hydraulic power (4%), liquefied petroleum gas (4%), coal (1%) and renewable energies other than hydroelectricity (1%).

According to the analysis presented in this Plan (PMEB 2002), the predominant uses of these sources of final energy are concentrated in an aggregate way under the following headings: household, 30%; transport, 33%, and commercial/industrial, 37%. Both the final energy sources and the aggregate consumptions are shown in the following diagrams.

PMEB 2002, however, points out that the sectorial studies for the calculation of the present energy consumptions and for the modelling and estimation of the future energy consumption scenarios in Barcelona took the figures registered in 1999, which covered only 74% of the buildings and built-up architectural elements of the city, and the dynamics of the transport services

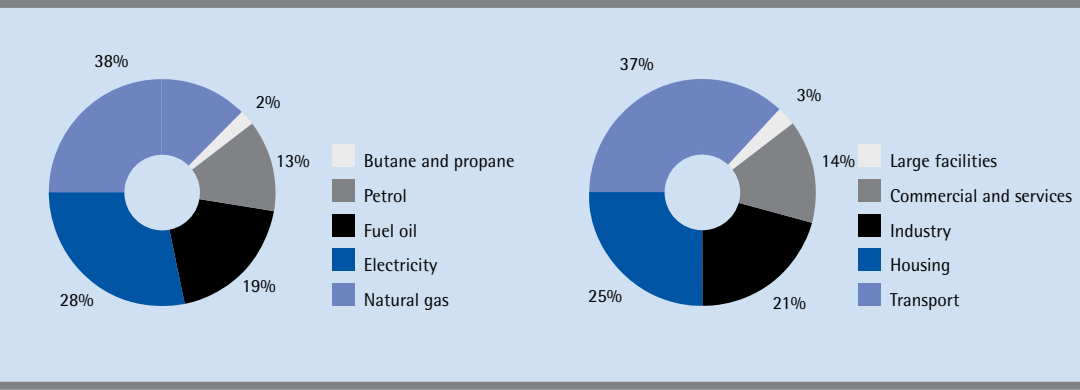
and of the management of urban waste. That is to say, the studies were based on the knowledge of 74% of the total built-up area of Barcelona (housing, hotels, restaurants, rest of the tertiary sector, municipal services and public networks, facilities and services) plus transport and urban waste in the aforementioned year

With figures for the year 2006 and with a 100% coverage of the activities carried out in Barcelona, the Barcelona Energy, Climate Change and Air Quality Plan (PECCQAB) 2010-2020 (replacement and continuation of PMEB 2002) now shows important changes with respect to the CO₂e emissions dynamics, both in relation to the composition of such emissions by sources of consumed energy and in relation to the main sectors of anthropogenic activity that account for them. This updated information is presented in the following diagram, in which natural gas and electricity represent 66% of the GHG emissions in terms of energy sources, while transport entails 37%, the household sector 25%,



Source: PMEB 2002.

Figure 14
Greenhouse gas
emissions (2006)



Source: BARCELONA ENERGY, CLIMATE CHANGE AND AIR QUALITY PLAN 2010-2020.

the aggregate commercial/industrial sector 35% and the major public facilities 3%.

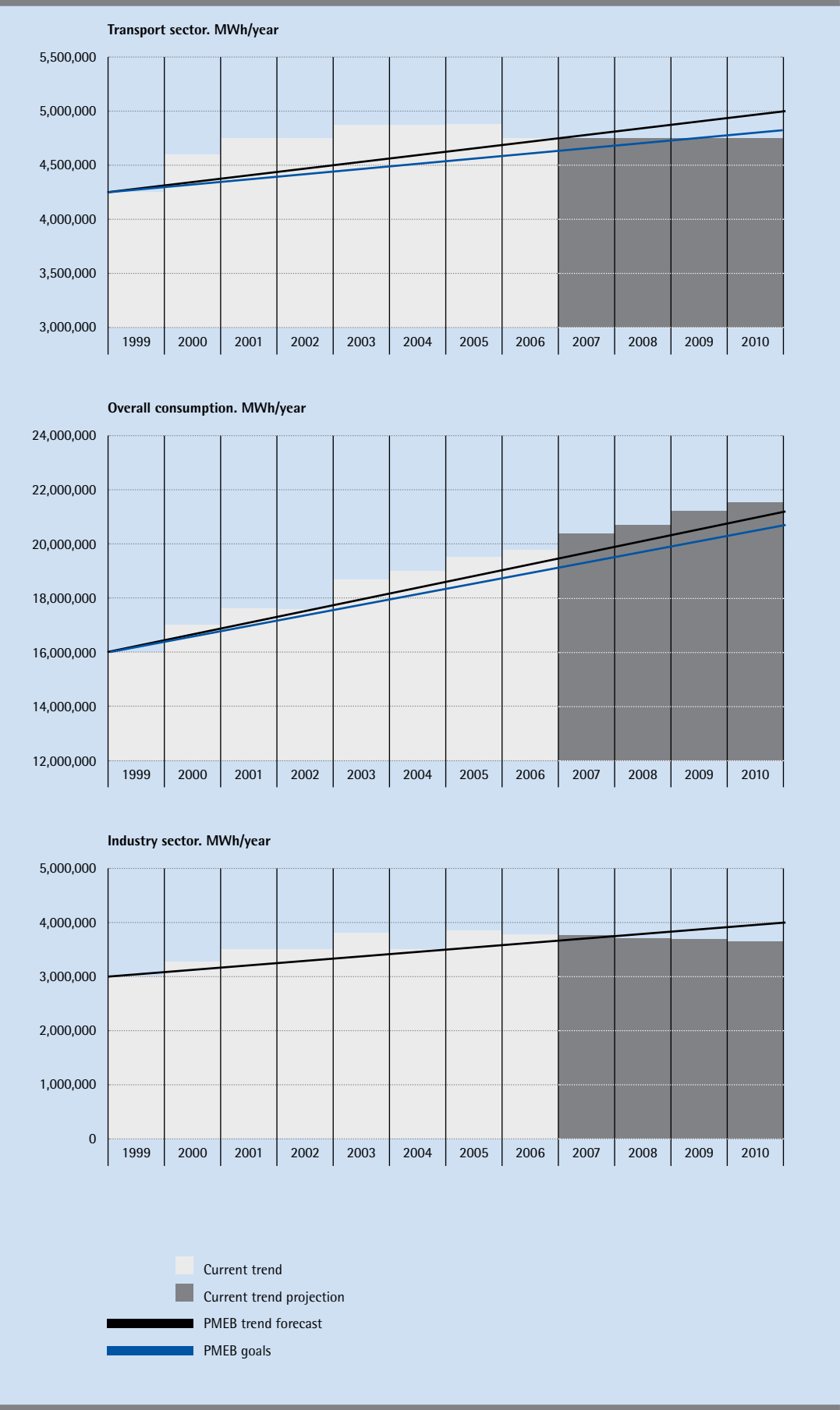
These changes are due to the annual average growth rates registered in the period 1999-2006 for key variables such as the gross domestic product, the population, the consumption of final energy, the *per capita* GDP and the energy intensity.

Energy demand and CO₂ emissions scenarios

With the updating of these figures and observed trends, the scenarios originally foreseen in PMEB 2002 were also brought up to date. Now, on the basis of the information recently published by the Barcelona Energy Agency through PECCQAB 2010-2020, the following may be identified in this case (and corroborated in the graphs):

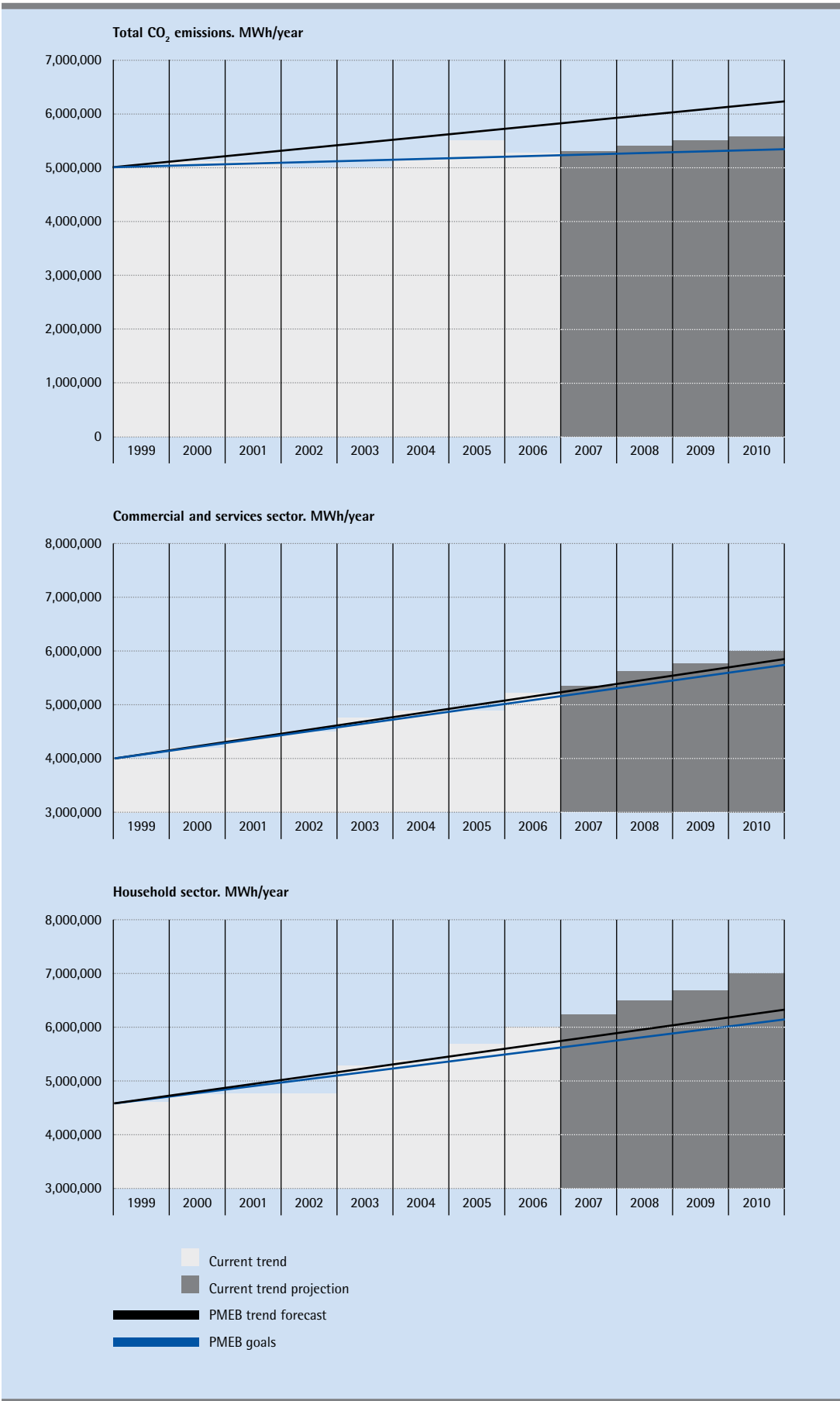
- With the updated figures, the overall consumption of estimated final energy for the year 2010 exceeds both the trend forecast (inertial or BAU) and the target trajectory of PMEB 2002.
- The greatest breach of the target trajectory, the same as that of the trend forecast (inertial or BAU) of final energy consumption foreseen in PMEB 2002, is registered in the household sector and, to a lesser extent, in the commerce and services sector.
- Although PMEB 2002 did not estimate the target trajectory for the consumption of final energy in relation to the industry sector, it did calculate its trend forecast (inertial or BAU), which shows better performance according to the updated estimation in PECCQAB 2010-2020, indicating a lower expected consumption of final energy for that sector.
- Even better is the energy performance of the transport sector since the estimate given in PMEB 2002 as the trend forecast

Figure 15
Comparison between
trends and goals



Source: BARCELONA ENERGY AGENCY.

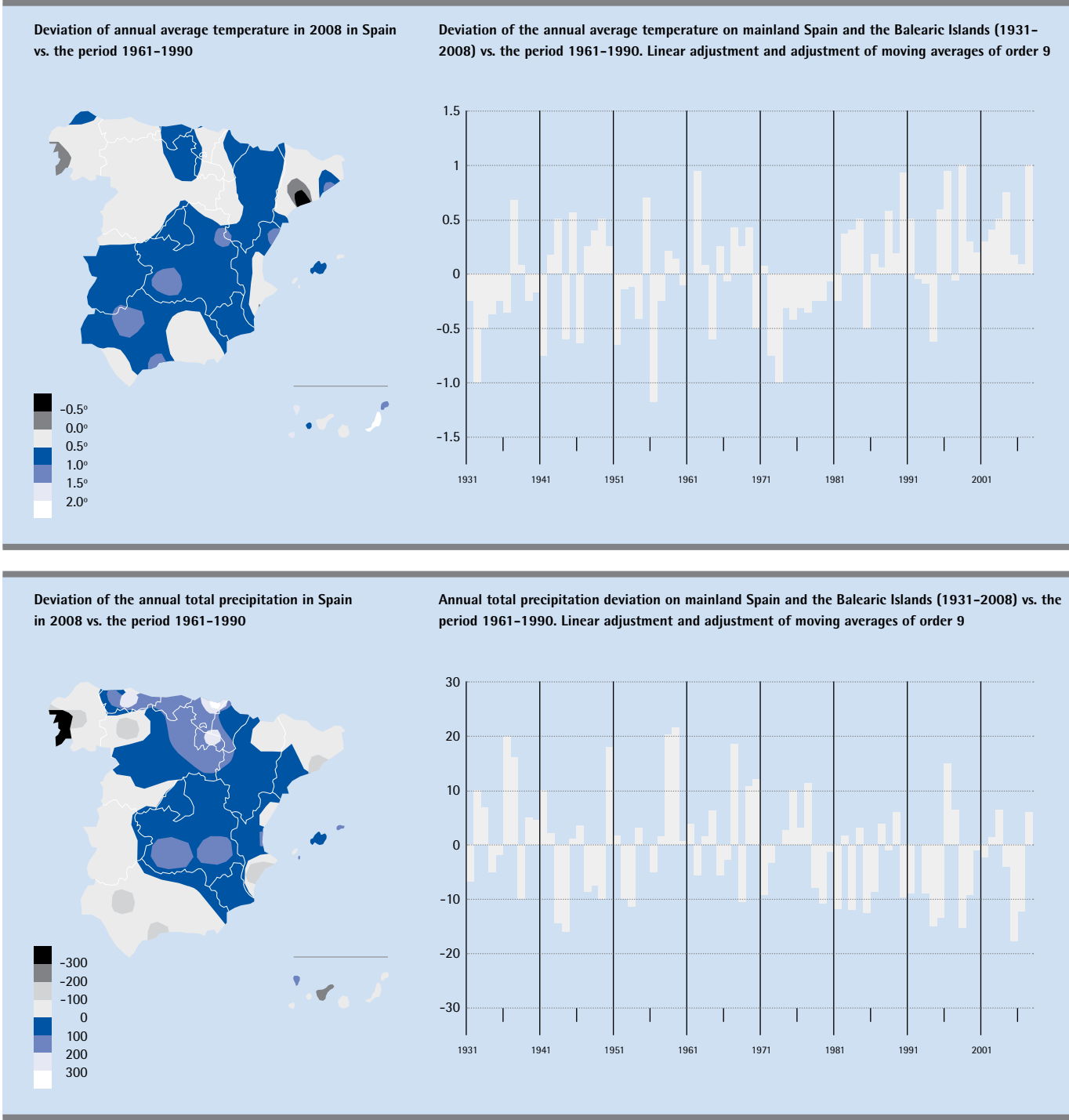
Figure 16
Comparison between
trends and goals



Source: BARCELONA ENERGY AGENCY.

Map 3
Surface air temperature
change

Map 4
Change in precipitation



Source: prepared by the author.

(inertial or BAU) and as the target trajectory of the final energy consumption in this sector shows lower figures in the updated estimation for 2010.

Risks from climate change threats, vulnerabilities and local policies

The BAU trends and those relating to the target trajectories of both PMEB 2002 and PECCQAB 2010-2020 lead to very distinct situations, which are expressed in turn in different specific climate threats that should be avoided or faced by means of strategic risk management.

According to the information contained in the most recent publication of the Spanish Sustainability Observatory (OSE 2009), both the rise in the average temperature of the Mediterranean region where Barcelona and its metropolitan area are located and the significant decrease in rainfall pose climate threats which the city is or will be facing, namely:

- Intense lasting droughts
- Intense heat waves

These climate threats translate into possible significant economic and social costs relating to:

- The lesser availability of water for different uses.
- The lower relative humidity of the air, the soil and the subsoil.
- A probable higher morbidity and/or mortality associated with the dryness of the environment and the high temperatures, above all in the spring and summer.
- Lower yields of various crops and of livestock production in the surrounding regions.
- A possible greater frequency and intensity of forest fires.
- A greater energy demand for ventilation and cooling of urban buildings and homes, and for the preservation and transport of perishable goods.
- High costs for the maintenance of the port infrastructure or for the repair of its damage as a result of the probable rise in the average sea level².

2 In relation to the degrees of vulnerability or exposure shown by several port cities with respect to climate change threats, see: NICHOLLS 2008. The complete reference is: NICHOLLS, R. J., ET AL. (2008), 'Ranking port cities with high

exposure and vulnerability to climate extremes: exposure estimates', OECD Environment Working Papers, no. 1, OECD Publishing. DOI: 10.1787/011766488208, 2008.

With the aim to learn of and avoid the most severe scenarios involving highly significant and/or irreversible costs, the Barcelona Energy Agency undertook the task of updating the trends observed and estimated in PMEB 2002 (as was previously mentioned) and has developed the new Barcelona Energy, Climate Change and Air Quality Plan 2010-2020. This Plan insists on the need to continue to promote the actions that save energy or that use it more efficiently in the various sectors identified as priorities: transport, housing, commercial and service buildings, local public infrastructure, and industry. This new Plan also emphasises the gradual replacement of Barcelona’s energy matrix and the net increase of its carbon capture and storage through the improvement and enlargement of its natural sinks. The Plan proposes that its actions should be continued through the establishment of working groups on the following issues, among others:

- Air quality, simulation of emissions and additional action proposals.
- Technological evolution and promotion of more efficient solutions.
- Management and prevention of risks associated with climate change.
- Management of the energy demand.
- Urban planning and development of major urban projects.
- Improvement of the energy efficiency of the residential and services sectors.

- Continued innovation in the transport sector.
- Improvement of the energy performance of the industry sector.
- Innovation in the integrated management of urban waste.
- Better energy management of the public infrastructure and facilities under the responsibility of the City Council.
- Renewal of the fleet of municipal vehicles and improvement of the municipal services.

As from now and up to the year 2020, the general aim of this Plan is to continue PMEB 2002-2010 and to fully and strategically reconcile the local energy policy with the policy for the on-site improvement of air quality and prevention of climate change scenarios. It is held that this will make Barcelona a more efficient and even more competitive city (PECCQAB 2010-2020).

1.2. Plan for the Sustainable Use of Energy and the Prevention of Climate Change of the City of Madrid 2008-2012

City and metropolitan area: energy consumption and GHG emissions

Madrid has a territory of 606 km², which represents only 0.12% of Spain’s total area, but it has a demographic weight of

Barcelona Energy, Climate Change and Air Quality Plan 2010-2020

1. Introduction

In 2002, the Barcelona City Council approved the Barcelona Energy Improvement Plan (PMEB), which has formed the general framework for the city’s energy policy in the period 2002-2010.

Two years before reaching the end of the PMEB’s period of validity, the City Council, through the Barcelona Energy Agency, began to work on a new and broader energy plan that would encompass the current situation not only in energy matters but also with respect to climate protection and air pollution. The new plan will allow the city of Barcelona to position itself appropriately and to meet the challenges of the future in this field.

2002

2010

?

PMEB

PECQ

At present the Barcelona Energy Agency is working on the conceptualisation phase of the new Barcelona Energy, Climate Change and Air Quality Plan (PECCQAB) 2010-2020, as the phase previous to the drafting of the Plan, with the collaboration of the Environment Area’s Strategy Department, Barcelona Regional and Estudi Ramon Folch.

3. Goals

Strategic goals

- To position the city of Barcelona in the current energy situation on the level of Catalonia, Spain and the EU, redefining its energy strategy with new goals and measures.
- To establish a municipal strategy with respect to climate change and to air quality that is fully related to the energy strategy.
- To give visibility to the commitment of the City Council as a whole from its highest levels of responsibility, and to create a climate of cooperation between all the actors involved in the conception and development of the new Plan.
- To position Barcelona on the horizon of 2020 as a highly competitive city. Energy efficiency, renewable generation and air quality will allow this.

Specific goals

- To involve the citizens in the Plan by means of ambitious municipal projects in the field of awareness, communication and citizen-oriented measures.
- To incorporate the current and envisaged planning at the local and autonomous regional levels, as well as the new directives and laws of higher rank.
- To define possible and desirable future scenarios and to establish some quantifiable objectives for them.
- To determine and define the actions and projects to be carried out in order to achieve the chosen target scenario, on the basis of the establishment of diverse strategic lines.

nearly 7% with respect to the country's total population. It is situated in the central region of Spain at an altitude of 655 metres above sea level. In 2009, the population of Madrid was in excess of 3,273,000 inhabitants, which gives it a demographic density of about 5,400 inhabitants per square kilometre. Its metropolitan area has a population of more than 6 million inhabitants. For this reason, Madrid is the third most highly populated city of the European Union, after Berlin and London, and it is likewise the third most highly populated metropolitan region after Paris and London. In 2005, its gross domestic product was 201 billion dollars, which made it the 23rd city in the ranking of the world's leading cities by GDP.

In 2003, Madrid's economy represented about 10% of Spain's gross domestic product, which translates into about 5.5% of the total energy consumption at national level and a little over 5% of the national greenhouse gas emissions. As in other big cities and metropolitan areas, its demographic and economic dimensions contrast with the scarcity of

its own energy resources. Practically all of Madrid's energy consumption is produced in and brought in from other cities and regions: 97.4% of its energy consumption is from outside, producing internally only the remaining 2.6%, basically through the utilisation of the methane from wastewater and sanitary landfills (ADM 2008). Madrid's annual energy consumption is approximately 4,188 kilotonnes of energy and its main sources are shown in table 19.

The predominant uses of these energy sources are concentrated under the following headings: 48% in residential, commercial and services uses; 40.3% in the transport sector; 7.5% in industrial activities, and 4.2% in the treatment of urban waste. Considering the total amount of energy consumption, the combustion technologies and the mentioned main uses, Madrid shows the following composition of carbon equivalent emissions (figure 17).

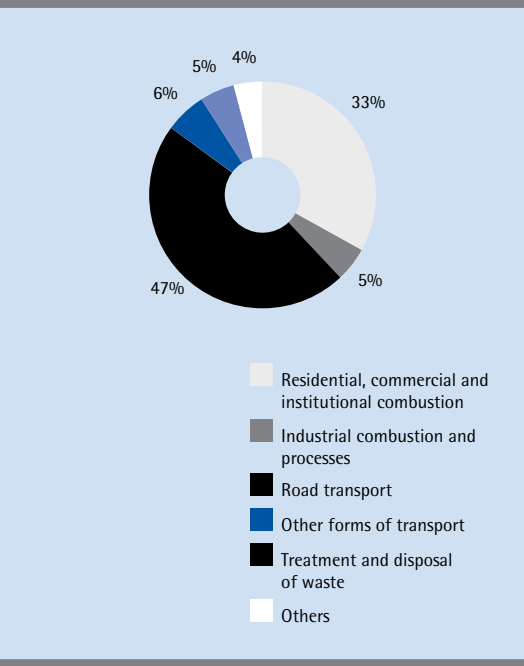
As may be seen, the aggregate transport sector represents 53% of these emissions;

| Sources | Ktoe/year | % | Origin |
|--------------|-----------|-------|----------|
| Oil | 1,987 | 47.5 | External |
| Electricity | 1,041 | 24.8 | External |
| Natural gas | 996 | 23.8 | External |
| Urban waste | 81 | 1.9 | Internal |
| Coal | 52.1 | 1.3 | External |
| Biogas | 27 | 0.6 | Internal |
| Solar energy | 0.4 | 0.1 | Internal |
| Total | 4,188 | 100.0 | |

Source: prepared by the author with information from ADM 2008.

Table 19

Figure 17
Madrid 2004: percentage composition of direct CO₂e emissions

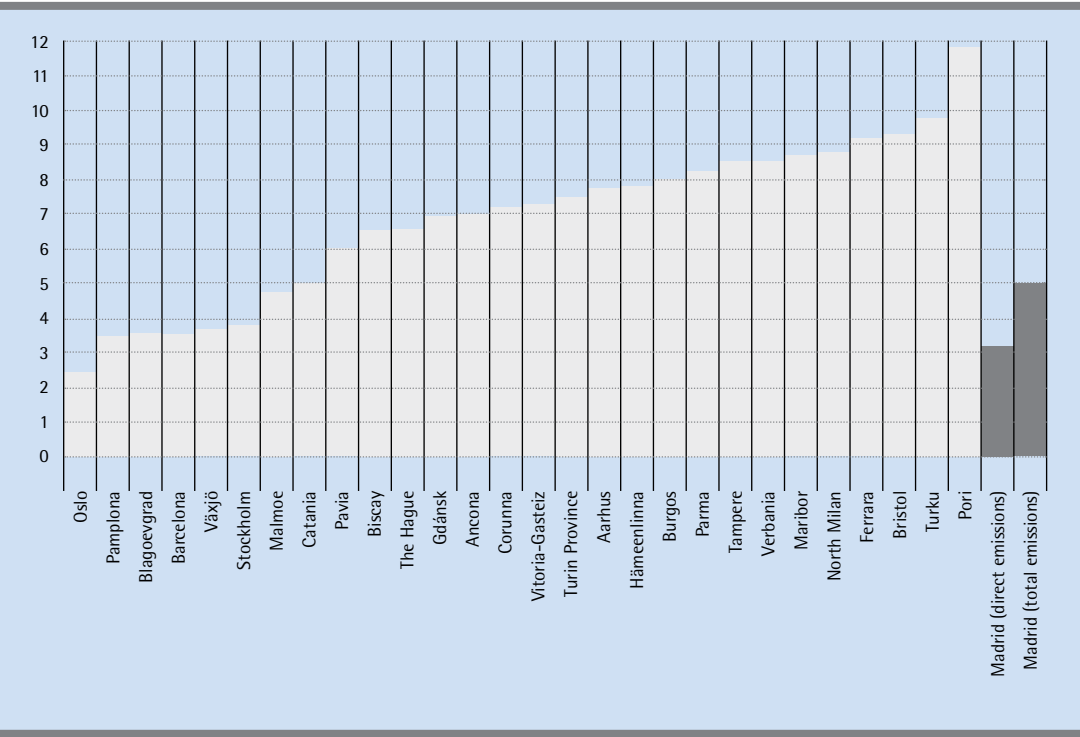


the residential, commercial and institutional sector entails 33%; industrial activities contribute 5%; the treatment and disposal of urban waste represent another 5%, and other activities account for the remaining 4% of emissions.

According to the same source (ADM 2008, also mentioned here as the 'Madrid Plan 2008'), however, the GHG emissions generated by the total economic and anthropogenic activities carried out in Madrid's territory of 606 km² represent in *per capita* terms approximately 3.14 tonnes of CO₂. When considering the indirect emissions which are generated outside its limits but which stem from

Source: MADRID PLAN 2008.

Table 20
Total *per capita* tCO₂ emissions



Source: MADRID PLAN 2008.

Madrid’s energy demand, its *per capita* emissions come to 5 tonnes of CO₂. This is illustrated by the following graph, which compares Madrid’s emissions to those of other cities, including Barcelona.

Energy demand and CO₂ emissions scenarios

Between 1990 and 2004, Madrid’s direct and indirect GHG emissions underwent a 15.3% increase. In this period, the direct emissions increased by a little over 5%, while the indirect emissions grew 39%. The Madrid Plan 2008 states that these differences between the dynamics of the direct and indirect GHG emissions are due to both the gradual electrification of the industrial sector and the residential, commercial and institutional sector, and to the general improvement of the Madrilenians’ quality of life, expressed, among other ways, by the rise in the general level of consumption.

In the aforementioned Plan, it is estimated that the trend in the city of Madrid’s energy consumption will be rising at an annual average rate of 3%, which

will be expressed in the year 2012 in a consumption of 5,299 kilotonnes of energy. Considering these trends, however, and assuming an economic growth in Madrid of an annual 2% and BAU inertial decisions, the result is that the GHG emissions will grow at an annual average rate of 1.1% from 2004 to 2050. On the other hand, taking into account the same aforementioned trends and the same economic growth of an annual 2% in Madrid, but within the energy-related and regulatory framework of the implementation of the 55 measures included in the Madrid Plan 2008, the estimated reductions in GHG emissions are -1%, -8% and -42% for the years 2012, 2020 and 2050, respectively, in relation to the year 1990, and of -14%, -20% and -50% for the same aforementioned years with respect to 2004.

Risks from climate change threats, vulnerabilities and local policies

The BAU trends and those relating to the implementation of measures for mitigating and adapting to the climate change scenarios lead to extremely

| | Actual (ktCO ₂) | Trend (ktCO ₂) | Plan goals (ktCO ₂) | Reduction vs. 1990 | Reduction vs 2004 |
|------|-----------------------------|----------------------------|---------------------------------|--------------------|-------------------|
| 1990 | 13,181 | | | | |
| 2004 | 15,192 | 15,192 | | | |
| 2012 | | 16,341 | 13,045 | -1% | -14% |
| 2020 | | 17,490 | 12,153 | -8% | -20% |
| 2050 | | 21,799 | 7,596 | -42% | -50% |

Table 21
Madrid Plan 2008: GHG emissions scenarios

Table 22

| Targets for reduction of GHG emissions | Year of compliance |
|--|--------------------|
| 20% trend reduction | 2012 |
| 1% reduction compared with 1990 emissions | 2012 |
| 14% reduction compared with 2004 emissions | 2012 |
| 20% reduction compared with 2004 emissions | 2020 |
| 50% reduction compared with 2004 emissions | 2050 |

Source: PLAN FOR THE SUSTAINABLE USE OF ENERGY AND THE PREVENTION OF CLIMATE CHANGE OF THE CITY OF MADRID 2008-2012.

distinct situations, which are expressed in turn in different specific climate threats that should be avoided or faced by means of the strategic management of risks.

According to the information contained in the most recent publication of the Spanish Sustainability Observatory (OSE 2009, also cited in the case of Barcelona), both the increase of the average temperature of the area where the city of Madrid and its autonomous region are situated and the relative decrease of rainfall pose climate threats that the city and its metropolitan area are potentially facing, namely:

- Intense lasting droughts
- Intense heat waves

These climate threats translate into possible significant economic and social costs relating to:

- The lesser availability of water for different uses.
- The lower relative humidity of the air, the soil and the subsoil.
- A probable higher morbidity and/or

mortality associated with the dryness of the environment and the high temperatures, above all in the spring and summer.

- Lower yields of various crops and of livestock production in the surrounding regions.
- A possible greater frequency and intensity of forest fires.
- A greater energy demand for ventilation and cooling of urban buildings and homes, and for the preservation and transport of perishable goods.
- Others.

In order to avoid the most severe scenarios involving highly significant and/or irreversible costs, Madrid is promoting actions that emphasise energy savings, the more efficient use of energy, the gradual replacement of its energy matrix and the net increase of its capture and storage of carbon by means of the improvement and enlargement of its natural sinks. These actions were formalised in the Plan for the Sustainable Use of Energy and the Prevention of Climate Change of the City of Madrid 2008-2012 which, in accordance

with the Strategy for Air Quality and Climate Change of the Region of Madrid (2006-2012) (Blue Plan), with the Spanish Strategy for Climate Change and Clean Energy, and with the mitigation strategy of the European Union, has the goals for the reduction of GHG emissions shown in table 22.

Giving continuity to earlier efforts, it is sought to achieve these goals through the saving and more efficient use of the energy consumed in the various economic and urban activities of the municipality of Madrid, through the greater incorporation of renewable energies into Madrid's energy matrix (especially through energy production from sanitary landfills and from wastewater discharges) and through

the net increase in the capture and storage of carbon in natural sinks, expanding forests and urban green areas and promoting green roofs.

A large part of the climate change mitigation measures are actions addressed to improving the knowledge of the possible impacts of climate change on the social, economic and natural systems of the municipality of Madrid, and to explicitly integrating the strategic management of risks and the adaptation to climate change into the planning of the municipal actions.

The goals or 'target emissions' of the Plan for the year 2020 are shown in figure 18.

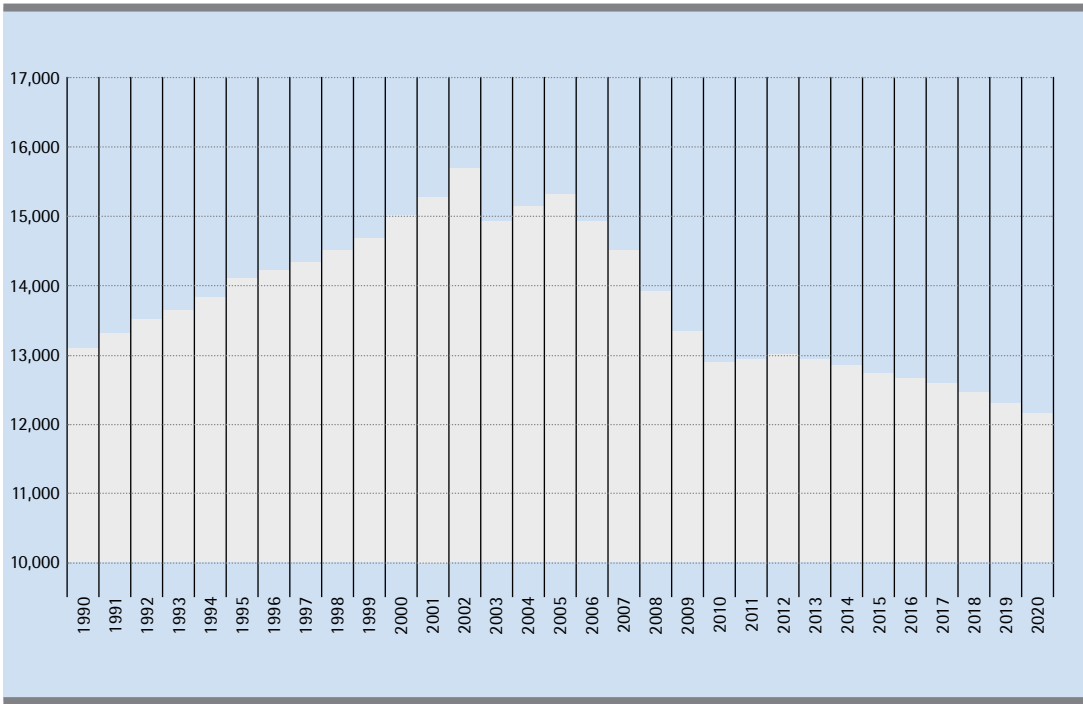


Figure 18
Plan target emissions
(kt CO₂e)

SOURCE: PLAN FOR THE SUSTAINABLE USE OF ENERGY AND THE PREVENTION OF CLIMATE CHANGE OF THE CITY OF MADRID 2008-2012.

According to the Madrid Plan 2008, the GHG emissions reduction goals can be achieved by means of the implementation of 55 policy measures, 49 of which are considered emission mitigation measures and 6 of which are measures for adaptation to local climate change scenarios. These 55 measures are being implemented in 6 key sectors:

- Residential
- Commercial and institutional
- Transport
- Urban waste
- Industry
- Natural sinks

At the same time, there are other programmes under way which, far from conflicting with the Madrid Plan 2008, complement it, and it is held that this Plan specifically designed to encourage sustainable use of energy and to prevent the most severe climate change scenarios on site represents a powerful tool that forms part of a more ambitious local management process aimed to promote the reduction of GHG emissions and to adapt appropriately to local climate change scenarios. Other policies and/or plans that are currently making a contribution with aims similar to those of the Madrid Plan 2008 include:

- Local Strategy for Urban Waste

- Urban Mobility Plan
- Local Agency for Energy Programme
- Local Strategy for Air Quality

The following are the underlying instruments of the Madrid Plan 2008:

- Regulatory instruments: rules, ordinances, voluntary agreements with diverse actors, and other legal-administrative instruments.
- Tax instruments: tax or expenditure incentives and disincentives, subsidies, public aids, taxes, co-funding of specific projects and budgets.
- Market instruments: promotion of renewable energies and opening of markets; new products, technologies and services; new trades and professions associated with alternative energies and with the maintenance of the new devices, etc.
- Information and communication instruments: emphasis on spreading information on the commitments and goals of local government ('practising what one preaches'), and on explaining which ones are the responsibility of the city and which ones fall under the authority of the metropolitan area and of the national State.

The estimated budget for the Plan's period of validity (2008-2012) is €101,229,000.00 (one hundred and one million two

hundred and twenty-nine thousand euros).

As may be seen in the following table, one single measure of the Madrid Plan 2008 concentrates 63.2% of the annual potential of total reduction of GHG emissions envisaged in the Plan. This measure (number 44) likewise concentrates 82.2% of the Plan's total budget, and it includes the set of actions, investments, construction works and formalities relating to the Madrid Local Strategy for Urban Waste. The production of energy from the methane generated in the sanitary landfills and in the wastewater dumps is as important as all that.

On adding 5 more measures, numbers 27, 28, 29, 35 and 36 (all of which are related to the so-called residential, commercial and institutional sector), it may be seen that with 8.8% of the Plan's budget, it is sought to reduce 2% of the GHG emissions in Madrid through

| Quantity of measures | Measure number | Sector | Reduction of tCO ₂ /year % | Amount in Euros | % | % accumulated amount in Euros |
|----------------------|-----------------------|---|---------------------------------------|-----------------|-------|-------------------------------|
| 1 | 44 | Municipal waste | 63.2% | 83200,000 | 82.2 | 82.2 |
| 5 | 27, 28, 29, 35 and 36 | Residential, commercial and institutional | 2.0% | 8940,000 | 8.8 | 91.0 |
| 3 | 4, 5 and 10 | Information, communication and social participation | 0.0% | 3480,000 | 3.4 | 94.4 |
| 1 | 16 | Transport | 0.0% | 800,000 | 0.8 | 95.2 |
| 1 | 45 | Industrial | 3.3% | 700,000 | 0.7 | 95.9 |
| 44 | Other measures | Various | 31.5% | 4101,000 | 4.1 | 100.0 |
| 55 | 1 to 55 measures | All | 695.455 | 101229,000 | 100.0 | 100.0 |

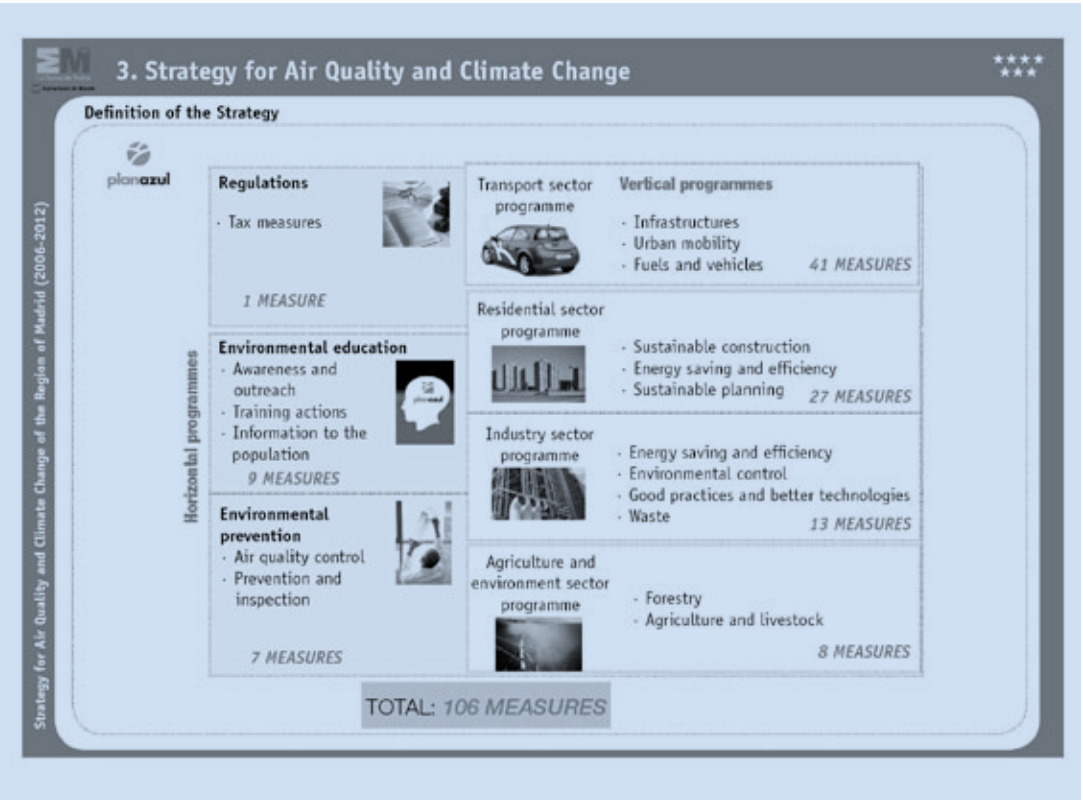
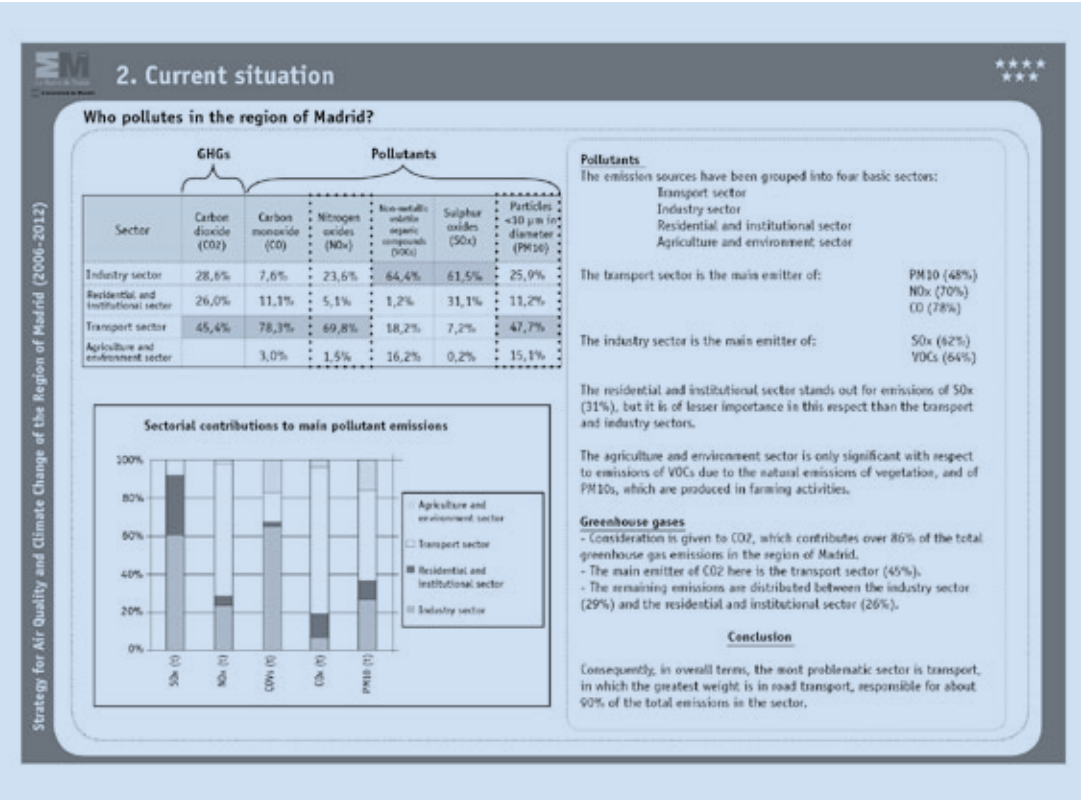
Source: created using information from Adm 2008.

the promotion of energy efficiency in private and public buildings and in the operation and management of the public infrastructure and facilities, as well as through the renewal of the ventilation, cooling and temperature conditioning equipment in diverse buildings. The programme for the certification of energy efficiency systems in industrial processes, in small and medium enterprises, is measure number 45. In itself, this measure represents 3.3% of the annual potential reduction of the GHG emissions envisaged in the Plan, and at the same time it accounts for 0.7% of the Plan's total budget.

Taken as a whole, these 7 measures of the Madrid Plan account for 68.5% of the GHG emission reductions that it envisages, representing 91.7% of its overall budget for the period 2008-2012.

With 1.4% of the aforementioned total budget, 9 measures linked to the transport sector (numbers 16 to 24) contribute a by

Measures for mitigation and adaptation to climate change in Madrid 2008-2012



Source: <www.madrid.org/cs/Satellite?blobcol>

no means negligible 16.1% of the total reduction of GHG emissions envisaged in the Plan. Standing out among these measures are the ones promoting both alternative fuels and vehicles, the massive use of public transport, the renewal of the fleet of vehicles, the energy efficiency in the fleet of vehicles of the Madrid City Council and the integrated operation of the Madrid Urban Mobility Plan.

In terms of financial/environmental efficiency, on the basis of the ratio of mitigated emissions to the allocated budget (<tCO₂/€), measure 45 and the 9 measures relating to the transport sector stand out.

Nevertheless, with respect to the potential volume of mitigated emissions and the assigned budget, the foremost measure of the Madrid Plan 2008 is unquestionably the one relating to the integrated implementation of the Madrid Local

Strategy for Urban Waste.

As previously mentioned, with respect to both its diagnosis and its local/regional public policy measures, the Plan for the Sustainable Use of Energy and the Prevention of Climate Change of the City of Madrid 2008-2012 is fully consistent with the Strategy for Air Quality and Climate Change of the Region of Madrid (2006-2012) (Blue Plan). Two samples of this Strategy are presented here: one synthesis of the diagnosis and another relating to the local measures for mitigation and adaptation.

1.3. Paris Climate Protection Plan 2007

City and metropolitan area: economic importance and GHG emissions

Paris has a territory of 105 km², which represents barely 0.015% of France's total

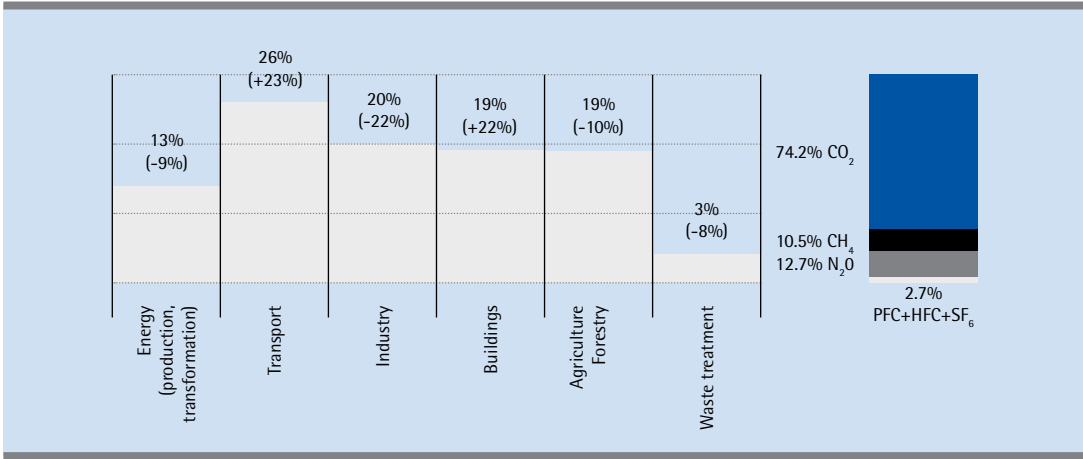


Figure 19
Greenhouse gas emissions in France* (in parentheses: evolution since 1990)

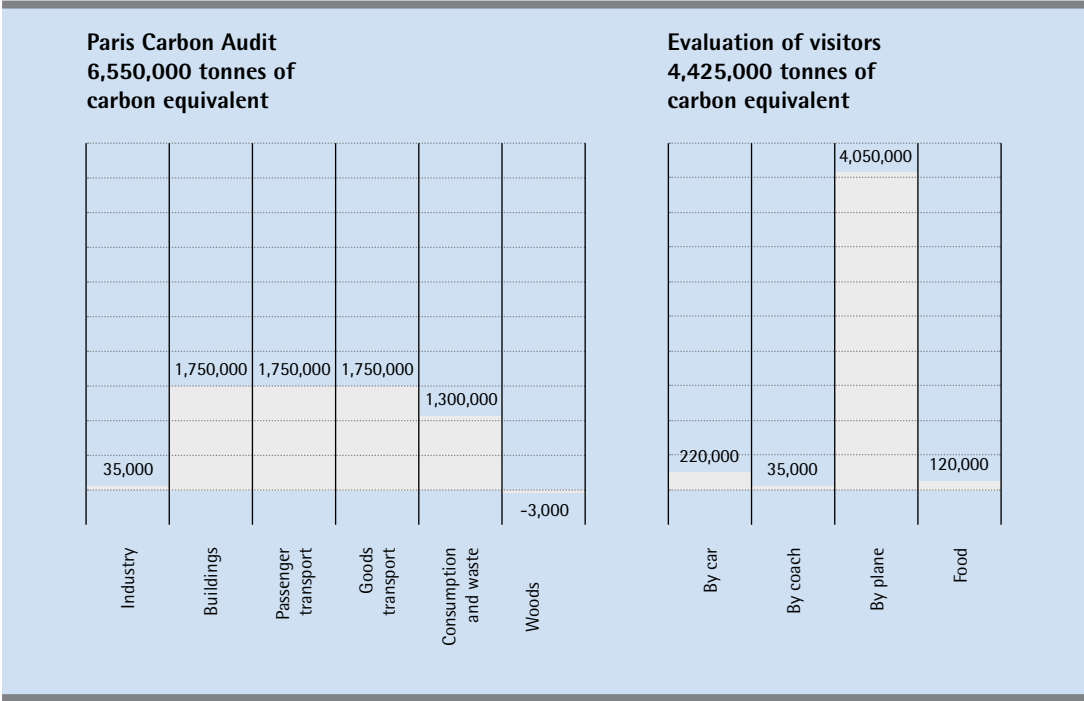
* including Overseas Departments and Collectivities in 2004, by sectors (not including use of land, its changes and forests - UTFIC)
Source: FRENCH INTERPROFESSIONAL TECHNICAL CENTRE FOR STUDIES ON AIR POLLUTION (CITEPA) / INVENTAIRE-SECTEN / PNLC format, February 2006.

area. Its demographic weight is about 3.4% of the country's total population and it stands 33 metres above sea level on the banks of the river Seine. In 2007, Paris had a population of over 2,215,000 inhabitants, giving it a demographic density of about 21,095 inhabitants per square kilometre. If its wider metropolitan area, Île-de-France, is considered, its population is almost 12 million inhabitants. Paris is the European Union's largest urban-metropolitan concentration as well as its main economic and financial centre and the world's most visited tourist destination. Paris's economy accounts for a little over 10% of the gross domestic product (GDP) of France and about 48% of the country's GHG emissions (MDP 2008). In 2005, the gross domestic product

of Paris was 460 billion dollars, which positioned it as the 5th leading city in the world ranking by GDP.

Paris has approximately 1,322,000 homes and about 351,000 companies engaged in diverse non-industrial activities, that is to say, companies devoted to commerce, finance, culture, tourism, transport, personal services and other services in the tertiary sector (MDP 2008). Locally, it produces a total of 24.1 million tonnes of direct carbon dioxide equivalent emissions per year. However, if we add to this territorial total the 16.2 million tonnes of indirect carbon dioxide equivalent emissions derived from the round trips made in diverse transport means and from

Figure 20



Source: PARIS CARBON AUDIT 2008.

the food consumption of the domestic and foreign visitors connected with its tourism dynamics and importance, we find that Paris produces a sum total of direct and indirect emissions of 40.3 million tonnes of carbon dioxide equivalent per year (MDP 2007).

To draw up the Paris inventory of GHG emissions, the French Agency for Environment and Energy (ADEME) decided to use the ‘carbon equivalent’ (Ce) as its measure instead of ‘carbon dioxide equivalent’ (CO₂e). Nevertheless, in order to indistinctly express Paris’s GHG emissions with both measures, the inventory offers the equivalence between the two: one unit of CO₂ weighs 44 g and one unit of carbon weighs 12 g. Consequently, in order to establish the equivalence between the two measures, the tonnes expressed in carbon should be multiplied by a factor of 44/12, allowing them to be represented in terms of CO₂ (MDP 2008).

As may be seen in the left-hand part of the graph 20, the aggregate transport sector accounts for 53% of the direct (or locally generated) emissions, the buildings of the residential, commercial and institutional sector represent 26.5%, consumption activities and urban waste contribute 20%, while the few industrial activities located

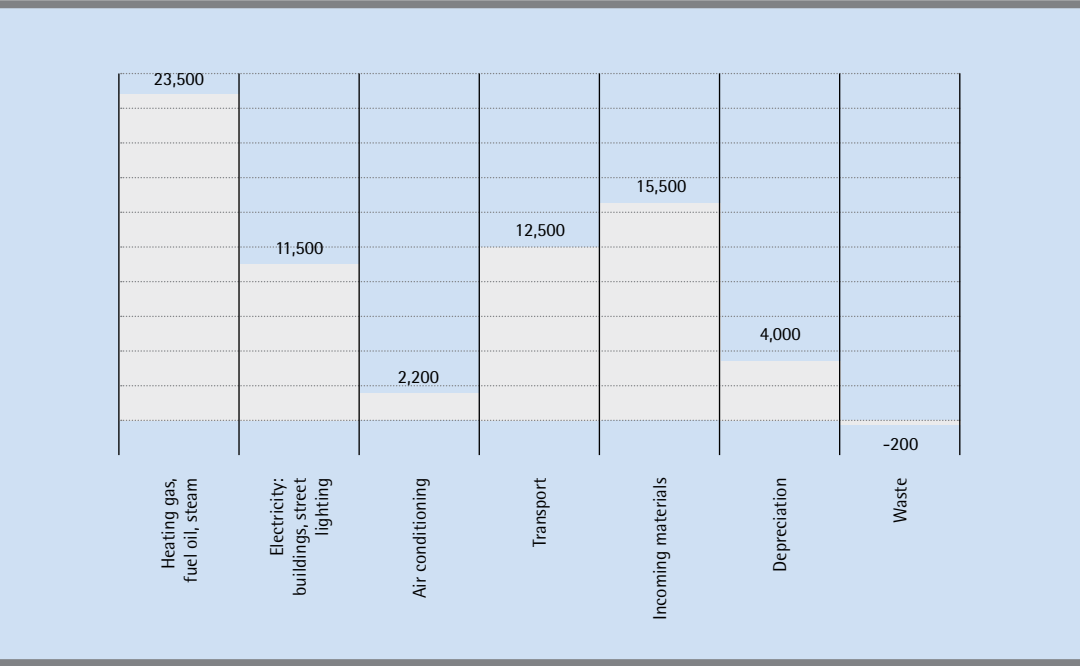
in Paris represent the remaining 0.5% of the GHG emissions³. The right-hand part of the graph shows that the proportional weight of the transport sector versus the sum total of yearly emissions (direct and indirect) is even larger (70.7%), since the indirect emissions produced by domestic and international tourism are added to it.

The net accounting of Paris’s carbon emissions estimates that its urban forests and other green areas capture and store yearly some 11,000 tonnes of CO₂e, while its parks and gardens are deemed to be carbon neutral since it is assumed that the GHGs which they emit as a result of their use, care and maintenance are offset by their simultaneous absorption of GHGs. For this reason, the 3,000 tonnes of carbon emissions associated with Paris’s green spaces that are deducted in the above graph are equal to the aforementioned total of almost 11,000 tonnes of CO₂e when multiplied by the factor of 44/12. This capacity of carbon equivalent absorption and storage is achieved thanks to the existence of about 3,000 hectares of forests, parks, gardens and other green areas in Paris’s territory, which function as natural carbon sinks (MDP 2008).

The Paris Climate Protection Plan 2007 holds that, beyond the unquestionable importance of the national and European

3 “[...] passenger transport: 1.75 million tCe, or 6.4 million tCO₂e; goods transport: 1.75 million tCe, or 6.4 million tCO₂e; buildings: 1.75 million tCe, or 6.4 million tCO₂e; consumption and waste: 1.3 million tCe, or 4.8 million tCO₂e; other items: 0.035 million tCe, or 0.13 million tCO₂e; visitor-generated emissions: 4.4 million tCe, or 16.2 million tCO₂e [...]” (MDP 2007).

Figure 21
Carbon Audit of the city
of Paris administration;
69,000 tonnes of carbon
equivalent 253,200
tonnes of CO₂ equivalent



SOURCE: PARIS CLIMATE PROTECTION PLAN, 2007, MDP, 2007.

policies and the multilateral negotiations between countries, the essential nature of the decisions that are made and the actions that are carried out locally to counteract climate change stands out. The Plan insists on the importance of citizen participation and of the public responsibility of local governments in connection with the organisation and use of the territory in the immediate future and the long term, and this translates into the construction and/or everyday management of buildings, transport services, urban infrastructure, public spaces and green areas.

For this reason, according to the Plan,

the strategic regulation of the everyday decisions on such matters as heating, ventilation, cooling, lighting, the mobility of persons, goods transport, food services, shopping and consumption, and the generation and treatment of urban waste and wastewater discharges are crucial to the achievement of the best environmental performance and the sustainability of Paris.

With this concern in mind, Paris’s inventory of GHG emissions specifically identifies the ones that are caused directly by the administration of the city’s heritage and which are, consequently, the responsibility of what the local

government does or doesn’t do. The City Council of Paris administers over 2,500 public spaces and facilities (built and non-built) through the daily work of about 46,000 local employees. These spaces and facilities include, among others, 600 primary schools, 109 lower secondary schools, 46 upper secondary schools, 8 universities, 280 nurseries, 300 sports facilities, 65 libraries and 15 museums.

All told, this inventory of emissions estimates a total of 253,000 tonnes of carbon dioxide equivalent per year, generated directly by the public activities associated with the municipal services. This is illustrated in figure 21 (MDP 2007 and MDP 2008).

Risks from climate change threats, vulnerabilities and local policies

According to the information contained in the Paris inventory of GHG emissions (MDP 2008), in the course of the 20th century the increase in the average temperature in France was 0.9°C, a trend that continues at present. In the summer of 2003, over 70,000 people died in Europe as a result of the intense heat waves. About 28% of these deaths occurred in French territory, including 1,150 people who died in Paris for this reason. In another extreme climate calamity that took place at the end of 1999, over 6,500 trees fell in Paris owing to gusts of wind in excess of 170 km/h, while in Île-de-France at large a forested area equivalent to twice the territory

of Paris was devastated. In this disaster alone, a total area of over 320 hectares of forest was lost.

Accordingly, the scenarios and possible outcomes correlated with the rise of temperatures and the greater fluctuation of the rain cycle and calendar in Paris and the Île-de-France region pose climate threats to which the society, the economy and the heritage of this city and its metropolitan area are potentially most exposed, namely:

- Intense lasting droughts
 - Extreme heat waves
 - Torrential rains
 - Exceptionally strong winds
- These climate threats translate into possible important economic and social costs connected with:
- The lesser availability of water for different uses in some summers in particular.
 - The lower relative humidity of the air, the soil and the subsoil.
 - A probable higher morbidity and/or mortality associated with the dryness of the environment and the high temperatures, above all in the spring and summer.

Table 23

| Strategic actions | Targets, by comparison with the 2004 levels | Target year |
|--|--|-------------|
| 'Paris as a model city' (or 'green local government') | a 30% reduction in the emissions of the municipal services | 2020 |
| | a 30% reduction in the energy consumption of the Paris City Council's fleet of vehicle and of the city's street lighting | 2020 |
| | a 30% share of renewable energies in the City Council's energy mix | 2020 |
| 'Paris as a socially cohesive city and as the organiser of its region' (or 'green city') | a 25% reduction of direct (territorial) emissions | 2020 |
| | a 25% reduction in the urban region's energy consumption | 2020 |
| | a 25% share of renewable energies in the city's energy mix | 2020 |
| 'Paris, Île-de-France and the State' (or 'green intergovernmental cooperation') | a 75% reduction of the overall GHG emissions in Paris's territory | 2050 |

Source: PARIS CLIMATE PROTECTION PLAN 2007, MDP 2007.

· Lower yields of various crops and of livestock production in the surrounding regions.

· A possible greater frequency and intensity of forest fires.

· A greater energy demand for ventilation and cooling of urban buildings and homes, and for the preservation and transport of perishable goods.

· A possible loss of forest sinks due to gusts of extremely strong winds.

· The need to suitably drain more water in the event of torrential rains.

For the purposes of avoiding the most severe scenarios involving highly significant and/or irreversible costs, Paris

has been promoting actions that emphasise the saving of energy and its more efficient use, the gradual replacement of the city’s energy matrix and the net increase of its capture and storage of carbon through the improvement and expansion of its urban green areas and forests. These actions are contained in the Paris Climate Protection Plan 2007, and more recently in the French Climate Plan 2010, both of which are consistent with the European Union’s mitigation strategy.

The Paris Plan envisages the following three strategic actions to achieve its goals:

· ‘Paris as a model city’, based on mitigation and adaptation actions that are under the direct responsibility of the City Council.

· ‘Paris as a socially cohesive city and as the organiser of its region’, based on the reorganisation of the uses of the urban territory and the promotion of good practices among the other actors in the city.

· ‘Paris, Île-de-France and the State’, based on the indispensable cooperation between the City Council of Paris and the national State to assure the Plan’s success.

It is sought to achieve these objectives through ambitious actions involving energy saving and efficiency, technological innovation, the development of sustainable architecture, and urban planning and development – in short, through the deployment of a set of mitigation and adaptation measures in the sectors of economic and anthropogenic activity which have been identified as the main emitters of GHGs or in which the capture and storage of carbon equivalent may be increased in Paris:

· Mobility of persons

· Goods transport

· Residential, commercial and institutional buildings

· Public spaces and green areas

· Consumption patterns and management of urban waste and wastewater discharges

· Sustainable tourism

The measures involving the mobility of persons and goods transport are linked to the Travel Plan for City of Paris Staff (PDAP) and the Paris Travel and Transport Plan, the many actions of which include, among others, the renewal and improvement of the City Council’s automotive vehicles; the requirement that the municipal vehicle fleets should bear a label recalling the relationship between energy consumption and carbon emissions; a greater use of bicycles (the Vélib programme makes available 11,000 bicycles in 750 stations set at a distance of less than 300 metres from one to the next) and a greater use of the train by government employees when moving within the territory of Paris or beyond the city; the promotion of programmes for sharing automotive vehicles; the strengthening of the public transport networks; a better connection and coordination of the various modes of public transport; an expansion of the Mobilien network (similar to Bogotá’s TransMilenio or Mexico City’s Metrobus), and the diversification of the transport offering on the river Seine, which should not be conceived only for the mobility and enjoyment of tourists but also for the everyday movement of Paris’s inhabitants and for goods transport

Since the year 2001, the general circulation of automotive vehicles in the city has dropped 13%, while the use of the public transport services has risen 5%, particularly including the use of the metro, which has increased 7%, and that of bicycles and bike paths, which has gone up 48%. The newly

constructed tramway, which went into operation in the south of Paris in December 2006, also highlights the Plan’s will to favour and strengthen the public transport alternatives in the city and its metropolitan area (MDP 2007).

The measures conceived to improve the energy performance of the residential, commercial and institutional buildings of Paris include the renewal of the thermal installations in all the municipal buildings; the renovation of the infrastructure connected with heating, ventilation and air conditioning, and the replacement of conventional spotlights and light bulbs with LED bulbs, an action which, despite the greater density of the street lighting network in Paris, has reduced the general energy demand in the city from 160 GWh in 1995 to 145 GWh in 2006. These modifications in the use of energy in residential, commercial and institutional buildings and in the urban infrastructure and facilities are promoted in both the already existing buildings and in those to be constructed. In fact, a Paris label now exists that identifies low energy consumption buildings (the BBC label: Bâtiment à basse consommation).

The conservation of the urban forests and green areas and the revegetation of the city through the promotion of green roofs is one of the ways in which the Plan seeks to capture and store more tonnes of carbon equivalent per year while regulating the city’s climate better.

Likewise, the measures relating to the better environmental regulation of consumption patterns and to the integrated management of urban waste and wastewater discharges notably include the following: ‘green procurement’ by the various offices of the Paris City Council; responsible municipal procurement policy and dissemination of eco-labels; paperless administrative procedures in the city, which translates into a reduction in the use of paper, fewer personal movements to perform diverse administrative formalities, and more procedures that can be carried out on the Internet; the implementation of the Paris Waste Prevention Plan, which promotes less waste production and the reuse and recycling of waste; the gradual elimination of the use of plastic bags in supermarkets; the conversion of organic waste; the gathering of used textiles and used tyres; the gradual elimination of bottled water and the promotion of tap water consumption in all public buildings.

Paris, the world capital of tourism, welcomes yearly almost 30 million visitors, about 60% of whom are from abroad. In terms of employment, foreign currency, and direct and indirect taxes and income generated, the importance of tourism is unquestionable. Nevertheless, as was previously mentioned, it makes a significant contribution to the sum total of GHG emissions in Paris. For this reason, the Plan encourages certain mitigation and adaptation measures in this sector with the aim to reduce its net emissions and to improve its transport,

accommodation, food-related, cultural, entertainment-related and financing services. The goal is to decouple energy consumption from the dynamics of domestic and international tourism in Paris while gradually decarbonising this sector.

The Paris Climate Protection Plan 2007 clearly emphasises two additional aspects:

- Its local energy capacity and specific nature.
- Its manifest concern over the consolidation of local social cohesion.

With respect to its energy capacity and specific nature, it is interesting to note that the Paris City Council is associated with Électricité de France (EDF), Gaz de France (GDF) and Compagnie Parisienne de Chauffage Urbain (CPCU) through co-participation and shared-responsibility arrangements involving both economic aspects and energy and the environment. Accordingly, in addition to enjoying a good deal of room for manoeuvre in terms of energy security, the Paris City Council, thanks to the POPE Act (French planning act setting the direction of France's energy policy), has the support and commitment of these public utilities companies to achieve the goals of the Paris Climate Protection Plan 2007.

This legal-institutional design is interesting for the purposes of discussing local energy policy options in relation to the climate change scenarios and the

financial, tax-related and environmental challenges posed by the urgent energy transition. Just as there is a network for the supply of steam and water heating, in Paris there is a network that distributes cooling energy. This cooling network has been under the responsibility of the company Climespace since 1991. There are 6 urban centres that produce, transport and supply chilled water. At the same time, the Paris City Council is promoting projects linked to a greater use of renewable energies such as geothermal, solar and wind energy.

In connection with the Plan's manifest concern over the consolidation of Parisian society's cohesion, it suffices to consider the following: within the framework of its goals, the Paris Climate Protection Plan 2007 seeks to fight against 'energy insecurity' and to favour the availability of sufficient energy in the homes of families on modest incomes; that is to say, it raises the need to assure that each Parisian will have the means to enjoy heating, hot water and electricity. In order to make these goals feasible, it mentions both the complementarity existing between the Energy Solidarity Fund (FSE) and the Social Housing Fund (FSL), and the Major Urban Renewal Project (GPRU), which has been financing, by means of a yearly performance project (Bleu Budgétaire), the improvement of the urban infrastructure and facilities in disadvantaged districts since 2002. Indeed, this experience has led to the formalisation of Urban Contracts on Social Cohesion (CUCS).

1.4 Bogotá Climate Change Mitigation and Adaptation Plan

City and metropolitan area: urban reorganisation of passenger mobility and GHG emissions

Bogotá has a territory of 1,837 km², which represents barely 0.16% of Colombia's total area, and a demographic weight equal to 14.8% of the country's total population. It is located in the eastern range (Cordillera Oriental) of the Andes at an altitude of 2,600 metres above sea level. In 2009, Bogotá had a population of over 6,776,000 inhabitants, giving it a demographic density of about 3,689 inhabitants per square kilometre. If its metropolitan region is considered, it has a population of a little over 7,881,000 inhabitants.

Following Mexico City, São Paulo, Buenos Aires, Rio de Janeiro and Lima, Bogotá is the sixth largest urban-metropolitan concentration in Latin America and the Caribbean, holding 35th place among the largest metropolitan conurbations worldwide. In 2005, its gross domestic product was 98 billion dollars, setting it in 47th place in the ranking of the world's leading cities by GDP.

According to official information, Bogotá is currently in a process of technical and institutional coordination to establish the basic features and guidelines of its Climate Change Mitigation and

Adaptation Plan. This process began in 2009 and its completion is envisaged for 2012, with a programmed rate of progress of 25% per year.

In the 1st National Communication to the UN Framework Convention on Climate Change, published by Colombia in 2001, the part dealing with 'sectorial policies and strategies' mentioned the need to promote widespread use of public transport in Bogotá and Medellín through the expansion of the TransMilenio service and the building of the metro, respectively.

In the context of the Latin American cities, Bogotá is a forerunner in the establishment of long rapid public transport corridors for urban passengers. Its TransMilenio rapid bus system, which went into operation in the year 2000, now moves over 1,600,000 passengers each day in its 850 biarticulated buses, 84 kilometres of route and 9 main lines. These TransMilenio buses replaced 2,109 conventional public transport buses, eliminating a yearly total of about 287,087 tonnes of CO₂ emissions in this way. While the TransMilenio experience is still very important, ten years ago it was a major institutional innovation in the reorganisation of urban transport and mobility in the Latin American cities for several reasons:

- The replacement of conventional buses by bi-articulated buses of larger capacity that travel along a physically separated lane that is dedicated to their use alone.

- Stops with automated ticketing systems and quick access to the buses on raised platforms.
- Connectivity with other routes and passengers by means of transport feeder services with small vehicles, short journey times and arrivals at the main stations (today there are 9 main routes, 78 feeder routes, 850 bi-articulated buses running at an average speed of 27 km/h along the 84 kilometres of routes, and 114 stops).
- The control and monitoring of the progress and route of each of the buses in order to assure fulfilment of the established journey times between stops and runs.
- The Bogotá City Council set up the company TransMilenio S.A., which owns the infrastructure, the buses, the collection system and the urban mobility service, and which administers and finances its daily activities and corporate development.

In addition to the TransMilenio system, Bogotá has also contributed to improving the mobility of passengers through the implementation of the CicloRuta Master Plan. This Plan started out in the year 2000 with 180 kilometres of bike paths or lanes specially designed for bicycle traffic, and it now has over 340 kilometres of bike paths connecting cyclists with the main public parks and gardens, urban subcentres and the TransMilenio lines and stations. The CicloRuta Master Plan envisages a total of 500 kilometres of

available bike paths before 2012. Between the years 2000 and 2007, the percentage of inhabitants who moved about in Bogotá on bicycles along these paths rose from 2% to 4%, making about 320,000 trips a day. As a result of the system's success and the greater safety of cyclists throughout the bike path network, about 60% of the homes in Bogotá now possess bicycles. It is estimated that this bicycle-based urban mobility system prevented the emission of some 6,449 tonnes of CO₂e in 2007.

Considering that in the other 5 cases studied here the transport sector is the one that contributes the most to the aggregate emission of GHGs, it must be acknowledged that even though Bogotá does not yet have a formal climate change plan, it is making pragmatically appropriate decisions and, with the TransMilenio system and the bike paths, it is fostering a greater social integration and responsibility in its citizens with respect to their city, their environment and their future.

Like all cities and metropolitan areas with the territorial, demographic and economic dimensions of Bogotá, other challenges associated with climate change scenarios are being partially dealt with here. These challenges include a new policy for urban solid waste and for the collection, treatment and reuse of wastewater, and the implementation of incentives favouring the saving and efficient use of energy in public and private buildings,

homes and public infrastructure and facilities.

The progressive average increase of temperatures and the fluctuations of the rainfall pattern in the Bogotá region could translate into the gradual disappearance of the Andean snows and, consequently, a lesser natural availability of water and a lower capacity of producing hydroelectric power. The efforts which are being made to draw up the Bogotá Climate Change Mitigation and Adaptation Plan should surely emphasise an updated identification of the set of climate change threats to which the city is exposed, in order to estimate its social and economic vulnerabilities as well as its local public policy options for preventing or limiting the scope of possible extreme events, while promoting new projects of urban reorganisation and of energy saving and efficiency at a metropolitan level.

1.5. Buenos Aires Climate Change Action Plan (PACCBA) 2030

City and metropolitan area: energy consumption and GHG emissions

Buenos Aires has a territory of 202 km², representing only 0.007% of the total area of Argentina, and its demographic weight is equivalent to 7.6% of the overall national population. The city stands on the plain of the Pampas, 25 metres above sea level on the western

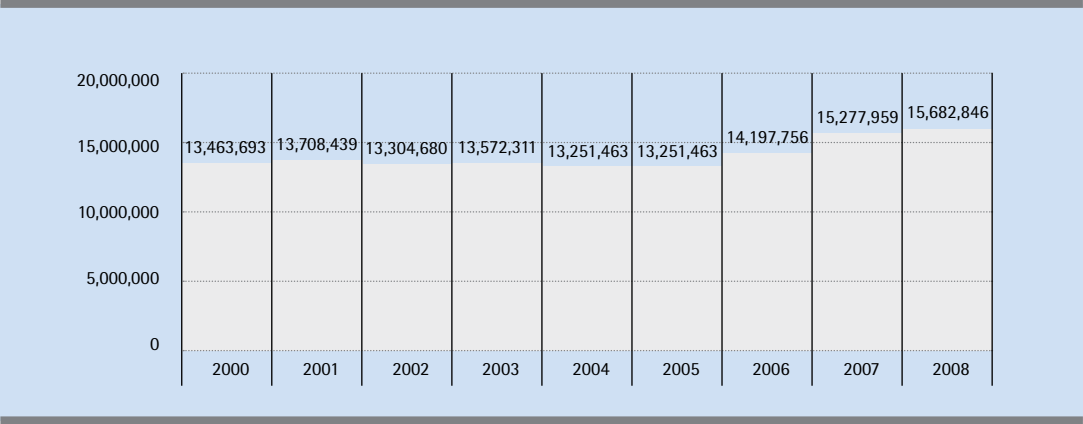
bank of the River Plate. In 2009, Buenos Aires had a population of over 3,050,000 inhabitants and its demographic density is consequently about 14,826 inhabitants per square kilometre. Its metropolitan region, Greater Buenos Aires, has a population of almost 13 million inhabitants.

After Mexico City and São Paulo, Buenos Aires is the third biggest urban-metropolitan concentration in Latin America and the Caribbean, standing in 17th place among the world's largest metropolitan areas. In 2005, its gross domestic product was 245 billion dollars, which gives it a 13th position in the ranking of the world's leading cities by GDP.

In 2008, Buenos Aires generated total direct emissions of about 15,682,846 tonnes of CO₂e. Of this amount, 95% were 'community' emissions while the remaining 5% came from the 'local government sector' (PACCBA 2030).

According to this source, to represent the community GHG emissions, three sectors were chosen that, in aggregate, accounted for practically all the GHG emissions of the city's 'community'. These sectors were:

- Energy consumption
- Transport
- Waste



Emissions of the city not including those directly attributable to the local government = 95%
Emissions exclusively attributable to the local government = 5%
Source: table prepared with information from the BUENOS AIRES ACTION PLAN 2030.

The ‘energy consumption’ sector includes the emissions stemming from electricity and gas consumption. It is subdivided into the residential, commercial and industrial categories.

The ‘transport’ sector includes the various public and private transport means and services. The private transport sector, for its part, is subdivided into the following categories: automobiles, vans and utility vehicles, light trucks, and heavy trucks (comprising diesel engines alone). The quantification of the emissions coming from the public transport sector is based on a subdivision into the following four categories: buses, powered by diesel engines; taxis with diesel or CNG engines; underground and pre-metro, which

operate on electricity, and trains, which run on diesel fuel or electricity.

The ‘waste’ sector includes the following urban solid wastes (USW) that are produced in the city: food waste, trimmings and garden waste, wood, textiles, and paper and cardboard.

The GHG emissions from the ‘governmental sector’, on their part, include the following categories:

- Buildings and other facilities
- Street lighting and traffic signs
- Vehicle fleet

Table 24
Total emissions of tCO₂e

Table 25
Buenos Aires 2008:
percentage composition
of CO₂e emissions

| Community | | Public administration | |
|--------------------|-----|-----------------------|-------|
| Energy consumption | 61% | Buildings | 74% |
| Residential | 35% | | |
| Commercial | 20% | | |
| Industrial | 6% | | |
| Transport | 29% | Lighting | 16.3% |
| Waste | 10% | Waste | 8.6% |
| | | Vehicle fleet | 1.10% |

15,682,846 tonnes = total emissions
14,893,181 tonnes = community emissions
789,665 tonnes = local government emissions
Source: table prepared with information from the BUENOS AIRES CLIMATE ACTION PLAN 2030.

· Water supply

The category of buildings and other facilities includes the consumption of electric power and gas in all the public buildings and facilities belonging to the local government (schools, hospitals, administrative facilities, etc.).

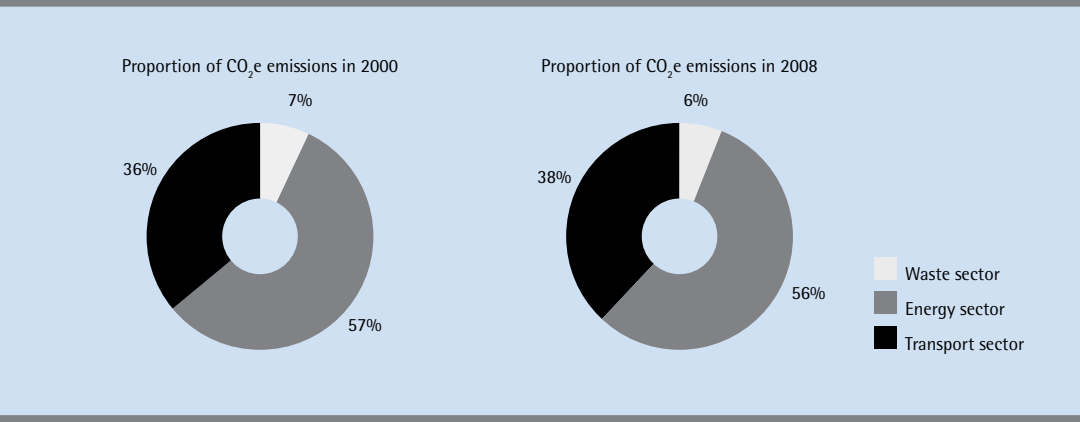
The street lighting and traffic signs category comprises the overall consumption of electric power in public spaces, urban facilities and street furniture administered by the City of Buenos Aires

(parks, squares, fountains, monuments, traffic lights, etc.).

The vehicle fleet category includes the fuel consumption of the vehicles allocated to the local government. In this case, the consumption of petrol is distinguished from that of diesel fuel.

Lastly, the water supply category measures the GHG emissions stemming from the consumption of electric power for the supply of drinking water and for

Figure 22
Comparison of the
evolution of CO₂e
emissions between the
years 2000 and 2008 //
Community sector



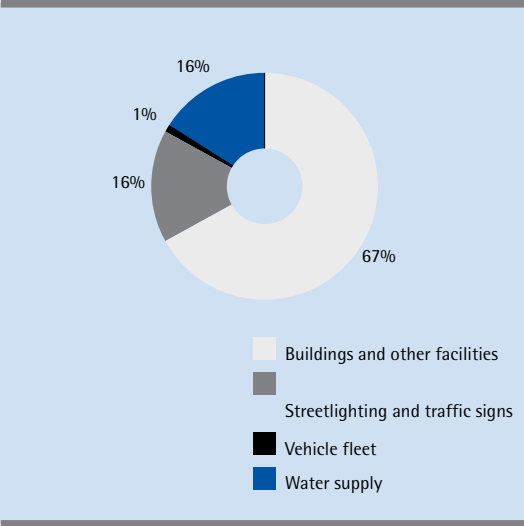
Source: PACCBA 2030.

the pumping, drainage and treatment of wastewater discharges. As in the cases previously studied, the sectors that produce the most carbon dioxide equivalent emissions in Buenos Aires are those of the production, distribution, supply and consumption of energy, private and public transport (light and heavy), the tertiary sector and the industry sector.

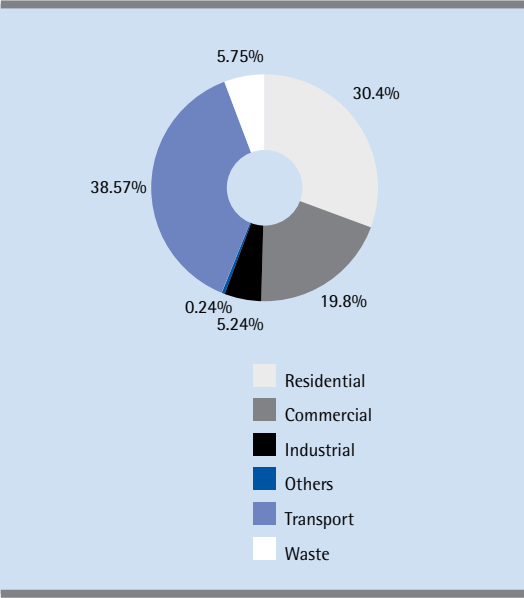
Figures 22, 23 and 24 show this with respect to both the ‘community’ GHG emissions and those of the ‘governmental area’, highlighting the contributions of the main sectorial emissions: transport, 38.6%; residential, 30.4%; commercial, 19.8%; waste, 5.7%; industrial, 5.2%, and other sectors, 0.3%.

Energy demand and CO₂ emissions scenarios

In accordance with the economic and demographic dynamics currently registered in the city of Buenos Aires, the Plan builds its inertial (or BAU) scenarios for three key variables that have a direct influence on energy consumption: GDP, population and *per capita* GDP. Given the existing parametric relations between these variables and energy consumption with its constant technological profiles, the result is the set of CO₂e emissions by economic and institutional sectors. PACCBA 2030 presents these specific estimates, considering the aforementioned components, subdivisions and categories for the ‘community’ and the ‘local



Source: PACCBA 2030.



Source: PACCBA 2030.

Figure 23
CO₂e emissions of the public sector in 2008

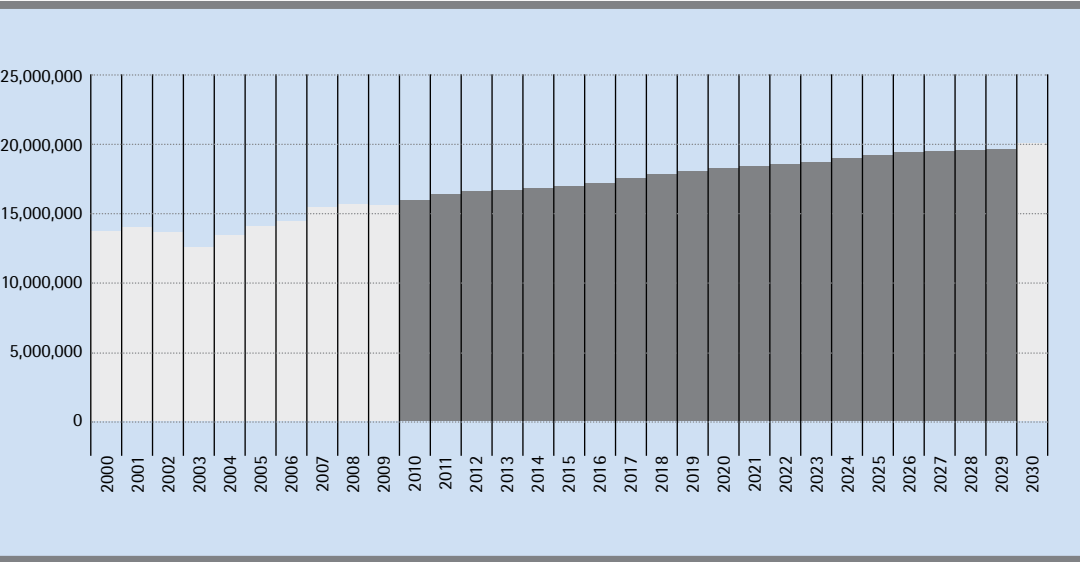
Figure 24
Distribution of GHG emissions (tonnes of CO₂ per year) by users of Buenos Aires

Table 26
Buenos Aires 2030: socioeconomic, energy and GHG-emission inertial scenarios

| Socioeconomic and energy variables | Year 2030 scenarios based on the data observed in 2008 (average annual growth rate 2008-2030 in %) |
|--|--|
| GDP | 2.8 |
| Population | 0.23 |
| GDP/Population | 2.6 |
| 'Community' CO ₂ e emissions | 1.09 |
| 'Local government' CO ₂ e emissions | 1.37 |
| Total CO ₂ e emissions | 1.1 |

Source: prepared by the author with information from PACCBA 2030.

Figure 25
BAU scenario tonnes of CO₂ year



Source: PACCBA 2030.

government’. Here we provide only a summary of the variables, their annual average growth rates in the period 2008-2030, and the GHG emissions expected in such BAU scenarios.

The average annual economic growth rate of the city of Buenos Aires and the

respective growth rate of its population allow the growth rate of the *per capita* GDP to be estimated. These figures, in turn, account for different specific energy consumptions, which translate into the annual average growth rate for both the total CO₂e emissions in the period 2008-2030 in Buenos Aires and for those of each of its components: the ‘community’

and the ‘local government’. This is shown in the above table.
The aggregate amount of tonnes emitted in each of the years of the same period is shown in figure 25.

Risks from climate change threats, vulnerabilities and local policies

According to the information contained in PACCBA 2030, a temperature increase of +0.5°C over the average temperature registered in the period 1961-1990 is expected in Buenos Aires and its metropolitan area during the period 2020-2029. Intense heat waves are also expected as a result of the urban heat island effect. Considering the same periods, no significant changes are envisaged in the local rainfall pattern. All this is shown on the respective maps.

In the coastal region of Buenos Aires, there is expected to be an average rise in the sea level of about 0.6 metres in the 21st century, with a variance of between 0.3 and 1.0 metre. An increase in speed and frequency is also foreseen for the winds blowing inland and, despite the previously mentioned lack of major changes in rainfall patterns, storms or *sudestadas* (‘Southeast blow’, a climatic

phenomenon common to the River Plate region) are expected that could cause significant flooding in the port area of Buenos Aires.

Given these climate change threats, the following economic and social costs may be anticipated and they should be avoided or reduced through local public policies:

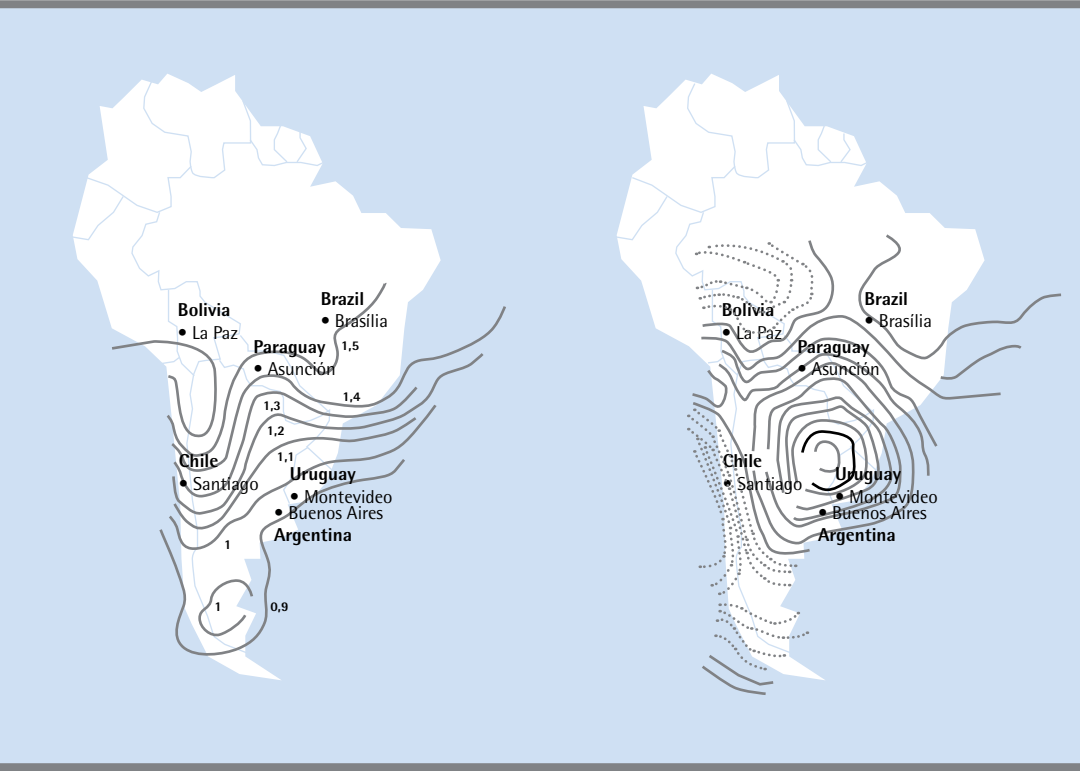
- Lesser availability of water for different uses.
- Probable higher morbidity and/or mortality associated with the high temperatures and the possible heat waves.
- Lower yields of various crops and of livestock production in the surrounding regions.
- Possible greater frequency and intensity of pasture fires.
- Greater energy demand for ventilation and cooling of urban buildings and homes, and for the preservation and transport of perishable goods.
- Damage caused by the probable rise of the average sea level⁴.

In order to avoid the most severe scenarios

4 Concerning the degrees of vulnerability or exposure shown by several port cities with respect to the climate change threats, just as was recommended in the case of Barcelona, the following document should be consulted: NICHOLLS 2008. The complete reference is:

NICHOLLS, R. J., et al. (2008), ‘Ranking port cities with high exposure and vulnerability to climate extremes: exposure estimates’, OECD Environment Working Papers, no. 1, OECD Publishing. DOI: 10.1787/011766488208.

Map 5
Annual temperature
change scenarios (°C)



Annual temperature change scenario (°C), on the left, and rainfall change scenario, on the right, for the years 2020/2040, with respect to 1961-1990 for scenario A1B.
Source: 2ND NATIONAL COMMUNICATION OF THE REPUBLIC OF ARGENTINA TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE.

involving highly significant and/or irreversible costs, Buenos Aires has been promoting actions that emphasise energy savings, the more efficient use of energy, the gradual replacement of the city’s energy matrix and a net increase in its capture and storage of carbon through the improvement and enlargement of its natural sinks. These actions are contained in the Buenos Aires Climate Change Plan 2030.

By means of this Plan, the city of Buenos

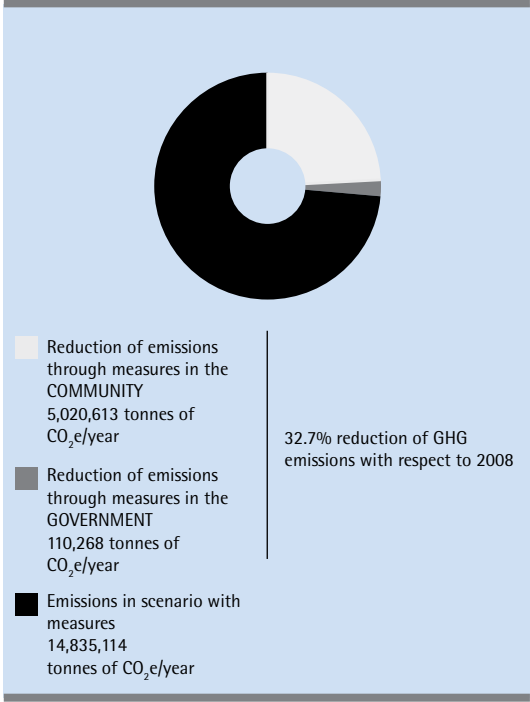
Aires seeks to integrate, coordinate and promote public policies aimed to reduce GHG emissions and the risks associated with the effects of climate change in order to assure the population’s welfare. Following an in-depth analysis of the various actions addressed to mitigating climate change and the appraisal of their potential for reducing GHG emissions, the city has set the overall goal of reducing its GHG emissions by 32.7% with respect to those of 2008, that is to say, by 5,130,881 tonnes of CO₂e in the year 2030. In a BAU scenario for 2030, the

estimated emissions would be in the order of 19,965,995 tonnes of CO₂e. Through the implementation of the measures contained in the Plan, the emissions would be reduced to 14,835,114 tonnes of CO₂e, which is 26% less than the amount estimated for the BAU scenario 2030 (PACCBA, 2030).

The achievement of this overall goal would not only reduce the expected emissions but would also set those of 2030 beneath the levels observed in 2007. In this way, the growth of emissions would be avoided and they would even be reduced with respect to the base value for the year 2008. Moreover, the city plans to carry out an integrated programme of adaptation to climate change in order to deal directly with the local impacts on the most vulnerable sectors of society (PACCBA 2030).

With the aim of reducing GHG emissions as envisaged by 32.7%, while promoting the measures for adaptation to climate change in Buenos Aires, the Plan intends to make coordinated use of the following local management instruments:

- Direct government investments.
- Financial incentives, such as subsidies and tax allowances.
- Financing at low interest rates.
- Implementation of projects set within the framework of the Clean Development



Total emissions in 2030 in the BAU scenario: 19,965,995 tonnes of CO₂e/year
Source: PACCBA 2030.

Mechanism (CDM).

- Education, capacity building, information and dissemination.
- Baseline studies to support specific actions.
- Technical cooperation.
- Coordination with the national strategy and the regional strategies.

All this effort to achieve an efficient mitigation and a suitable adaptation would translate into the energy

Figure 26
GHG emissions scenario
2030

decoupling and the economic decarbonisation of Buenos Aires towards the year 2030. The above diagram shows the reduction of 5,130,881 tonnes of CO₂e in that year and the respective contributions of the Plan's two basic components: the 'community' and the 'local government'.

1.6. Mexico City Climate Action Programme (PACCM) 2008-2012, launched in May 2008

City and metropolitan area: energy consumption and GHG emissions

Mexico City has a territory of 1,485 km², representing just 0.1% of the country's total area, and a demographic weight equivalent to 8% of the overall national population. The city stands in the Basin of Mexico (the central area of the country) at an altitude of over 2,240 metres above sea level. About 58% of the city's territory is listed as conservation land, formed by peri-urban pockets, rural properties, cultivated fields, irregular human settlements and large pine and holm oak forests. The remaining 42% is, properly speaking, urban land (VEGA-LÓPEZ 2006). In 2009, the city had a resident population of around 9 million inhabitants, giving it a demographic density of about 6,000 inhabitants per square kilometre. The city's metropolitan region, called the Mexico City Metropolitan Area, has a population of almost 22 million inhabitants.

Indeed, Mexico City is the largest urban-metropolitan concentration in Latin America and the Caribbean, standing in 8th place among the world's biggest metropolitan conurbations. In 2005, its gross domestic product was 315 billion dollars, which also set it in 8th place in the ranking of the world's leading cities by GDP.

In 2006, Mexico City generated total direct emissions of about 36.2 million tonnes of CO₂e. This represents approximately 61% of the emissions in the Mexico City Metropolitan Area and over 9% of the country's total CO₂e emissions (see figure 27, SMA-GDF 2008). According to the direct GHG emissions inventories drawn up for Mexico City, transport is the largest emitter, with a share of 43%, followed by the industry sector (22%), the residential and commercial sector (19%), solid waste (11%), and facilities and activities of the public sector (5%).

As in several of the previously studied cases, this accounting of GHG emissions for Mexico City does not include indirect emissions. For example, among others, it does not consider the emissions generated each year by the consumption of the energy equivalent of about 3.5 million barrels of oil, which are required to produce the electric power pumping some 30% of the water consumed by the city. This water comes from the Lerma river basin and the Cutzamala system across a distance of over 127 kilometres, with

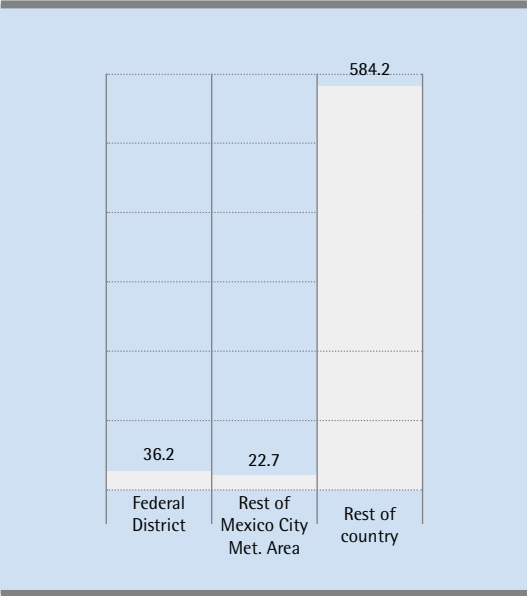
altitude differences of more than 1,100 metres.

On the basis of the information from the aforementioned inventory of emissions and of the estimates updating the data on the primary sources of such direct CO₂e emissions, it may be affirmed that Mexico City's GHG emissions are correlated on a level of 90% with the consumption of primary energy (mainly oil and natural gas) that is demanded by the transport, industry, commerce, services and housing sectors (SMA-GDF 2008).

Risks from climate change threats, vulnerabilities and local policies

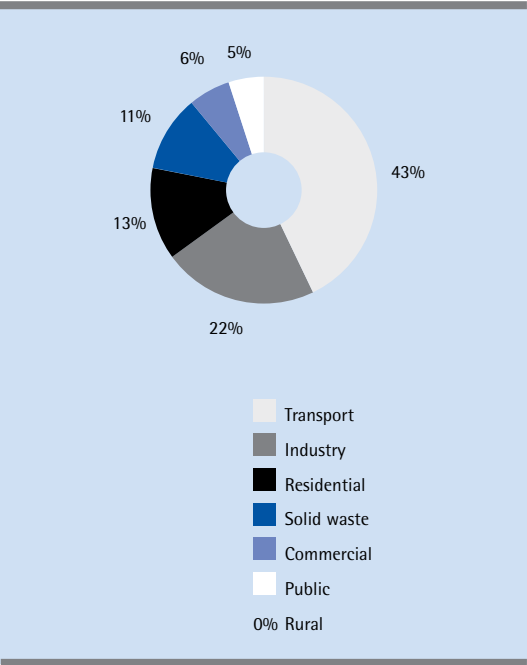
In accordance with the information contained in the Mexico City Climate Action Programme 2008-2012, it is expected that, in correlation with the increase of local and regional temperature, the hydrologic cycle will continue to show significant fluctuations with a marked upward trend in both the number of rainfall events and their intensity.

According to information from the National Water Commission (CONAGUA 2010), in Mexico City (that is to say, the Federal District) it rains on the average some 700 millimetres a year, which is equivalent to the national mean. Nevertheless, in a period of a little over 30 years (1970-2001), the greatest proportion of the extreme hydrometeorological events that took place in the city involved



Source: NATIONAL EMISSIONS INVENTORY, 1990-2002, AND LOCAL STRATEGY FOR CLIMATE ACTION (ELAC), 2006.

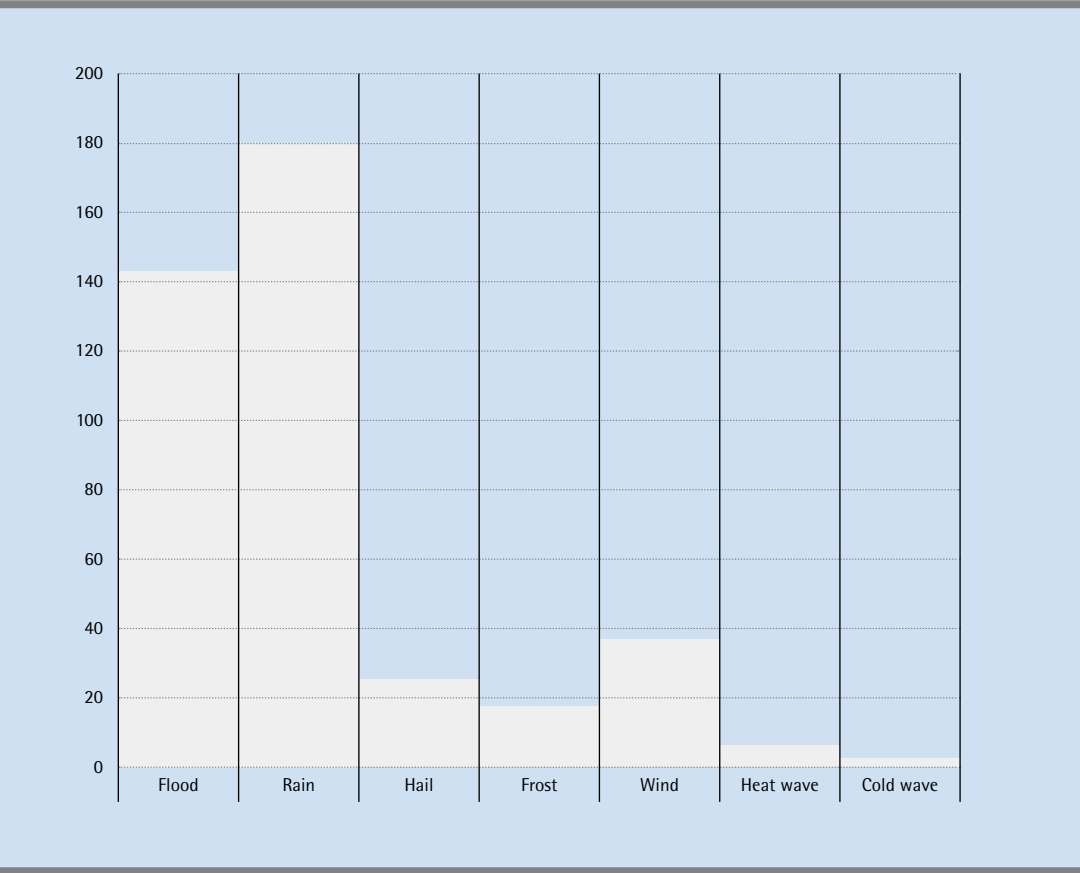
Figure 27
GHG emissions in Mexico, 2006
Millions of tonnes of CO₂e



Source: ENVIRONMENT SECRETARIAT (SMA), FEDERAL DISTRICT LOCAL STRATEGY FOR CLIMATE ACTION (ELAC), 2006.

Figure 28
CO₂e emissions in the Federal District, 2000

Figure 29
Hydrometeorological events causing disasters in the Federal District in the period 1970-2001



Source: SOCIAL STUDIES NETWORK FOR DISASTER PREVENTION IN LATIN AMERICA, DesInventar V.6, 2003 (<http://www.desinventar.org/desinventar.html>)

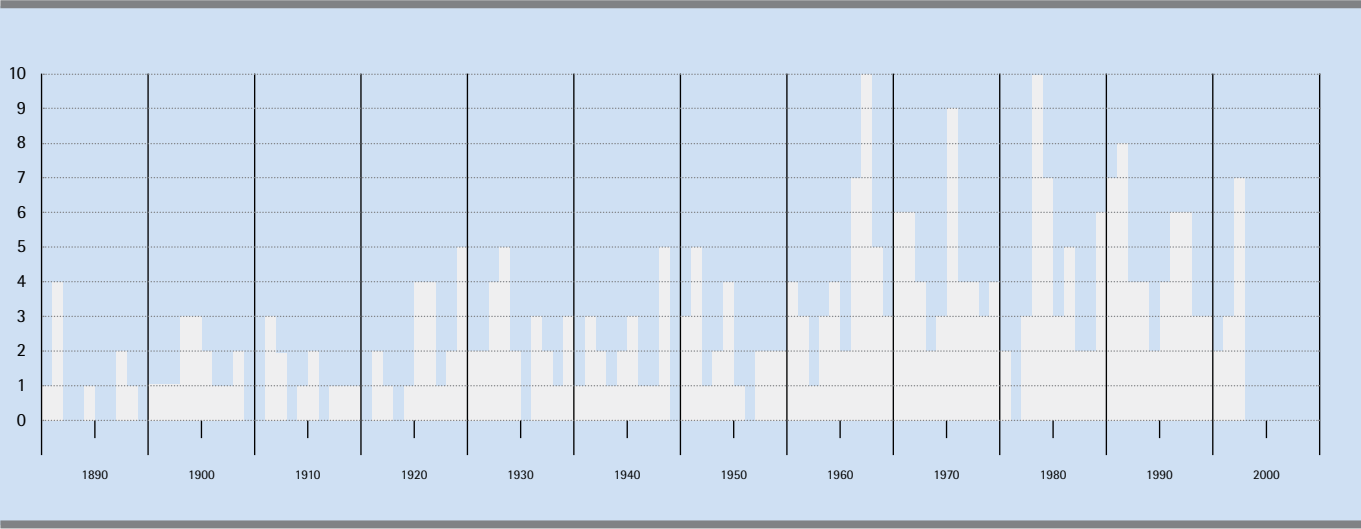
torrential rains and floods, and to a lesser extent strong winds and hailstorms, as may be seen in the figure 29.

It should be recalled that the territory where Mexico City is located was once an area of immense lakes (Zumpango, Xaltocan, Texcoco, Chalco and Xochimilco), which were formed by the surface runoff of water to the lower parts of the Basin of Mexico (an originally endorheic basin, for which the artificial outlet to the sea did not begin to be built

until the 17th century).

Faced with scenarios of significant anthropogenic alteration of the hydrologic cycle due to climate change, this natural geo-climatic location translates into severe threats of torrential rains posing the risk of costly floods and occasionally of major temperature rises that favour large-scale forest fires, especially when El Niño occurs.

Recent decades have been characterised by the fast urban expansion of the Mexico



Source: NATIONAL WATER COMMISSION, NATIONAL WEATHER SERVICE 2004.

City Metropolitan Area. In this respect, the foremost problems in relation to vulnerability include the appearance of irregular settlements on unstable slopes and on floodplains, as well as buildings that have little resistance to extreme hydrometeorological events. Climate change increases the size of the risk and the social and economic vulnerability of Mexico City.

In short, the Mexico City Climate Action Programme 2008-2012, which was launched in May 2008, has the following objectives, goals and lines of local action.

General objective

To integrate, coordinate and promote public actions in the Federal District with the aim to reduce the environmental, social and economic risks from climate change, and to foster the welfare of the population through the reduction of

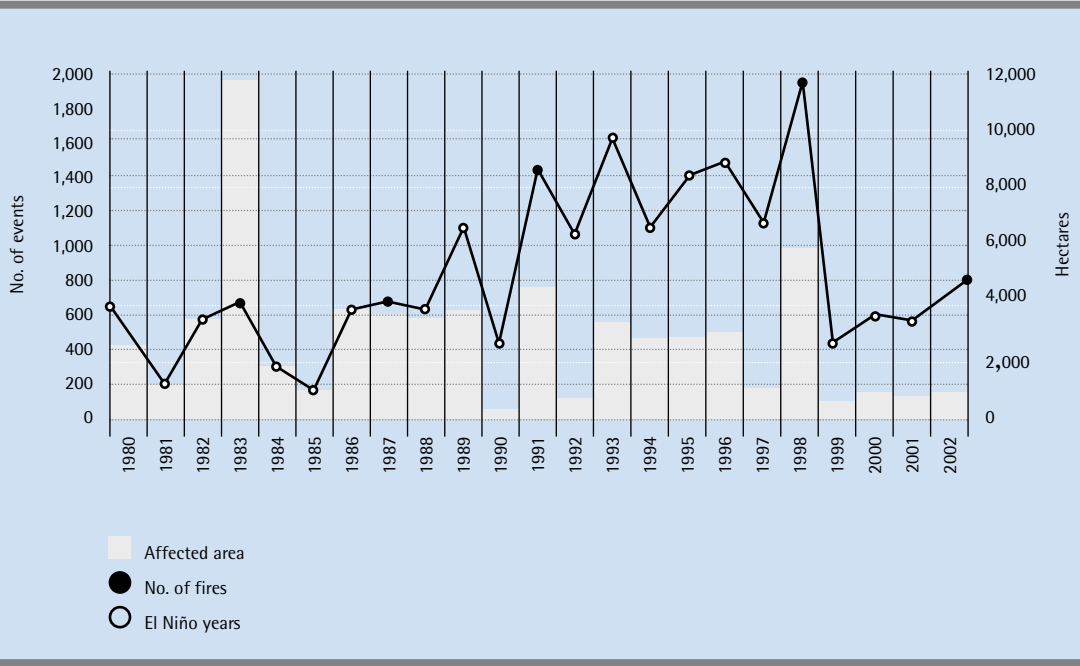
emissions and the capture of greenhouse gases.

Specific objectives

- To influence the patterns of behaviour, habits and attitudes of the people living in the Federal District so that they will help to mitigate climate change and implement adaptation measures.
- To attract investments and funding for projects conceived to mitigate the emission of greenhouse gases, allowing the barriers to the implementation of the pertinent measures to be overcome.
- To promote technological innovation relating to the fight against climate change.
- To position the government of the Federal District and Mexico City itself as leaders in the national and international efforts to mitigate the emissions of greenhouse gases, in the context of the

Figure 30
Number of extreme rainfall events (>30 mm/day) at the Tacubaya station of the Federal District, 1890-2003

Figure 31
Number of forest fires and affected area in hectares in the Federal District, 1980-2002



Source: UNDER-SECRETARY'S OFFICE FOR FOREST RESOURCES, DIRECTORATE-GENERAL FOR FORESTRY.

commitments undertaken by Mexico under the United Nations Framework Convention on Climate Change.

- To set standards for the public policies on climate change mitigation and adaptation in Mexico and to produce a multiplying effect in the country and the world at large.

Goals

The Programme has two overall goals: one for the mitigation of GHGs and the other for adaptation to climate change.

Goal no. 1: to reduce emissions by 7 million tonnes of carbon dioxide

equivalent in the period 2008-2012.

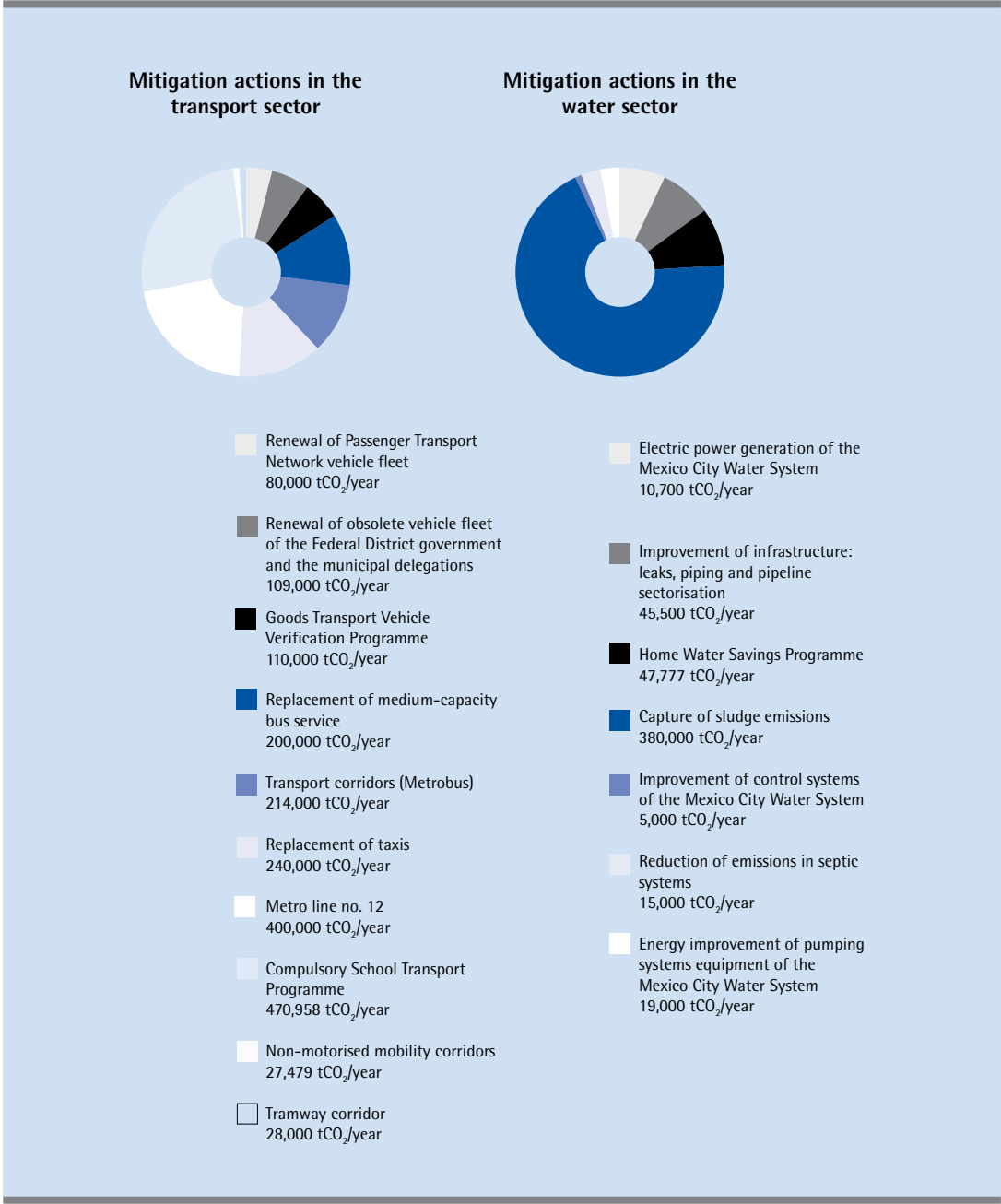
Goal no. 2: to carry out an integrated programme of adaptation to climate change for the Federal District and to have it fully operational by 2012.

Lines of action

- Mitigation in the transport sector
- Mitigation in the water sector
- Mitigation in the waste sector
- Mitigation in the energy sector

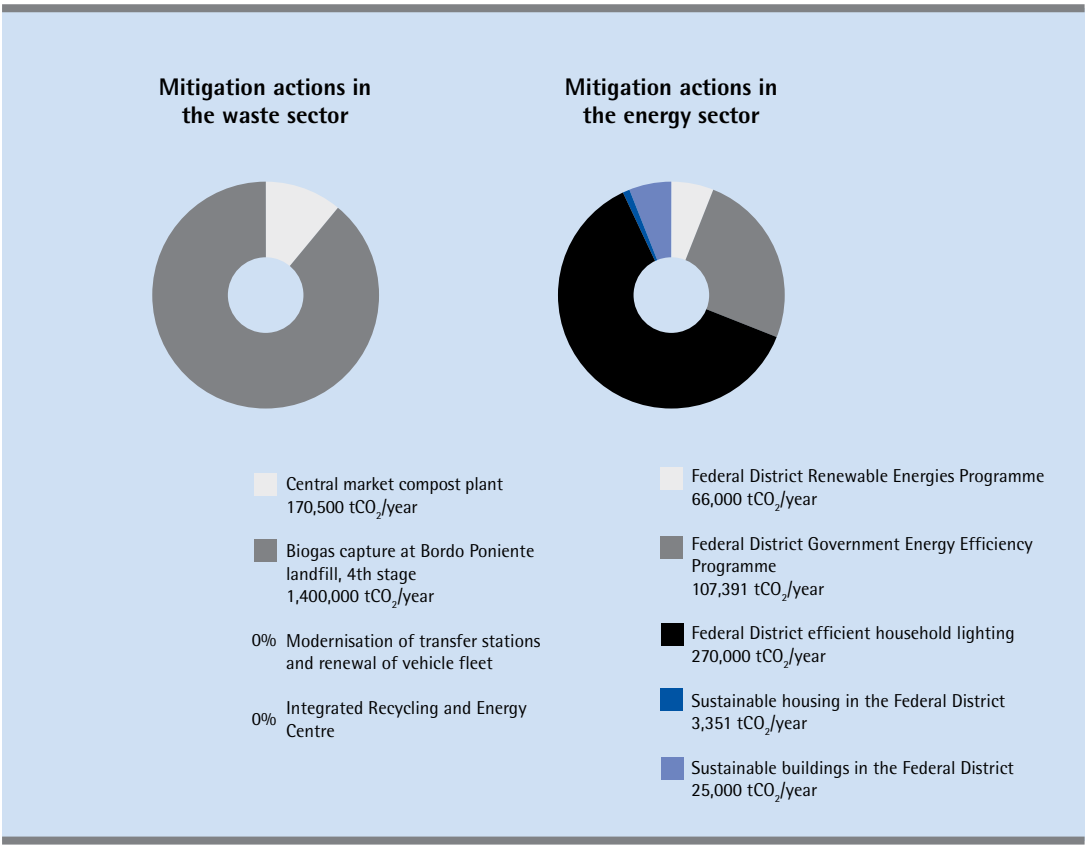
The Programme envisages 26 actions focused on GHG mitigation, with the

Figure 32



Source: PACCM 2008.

Figure 33



Source: PACCM 2008.

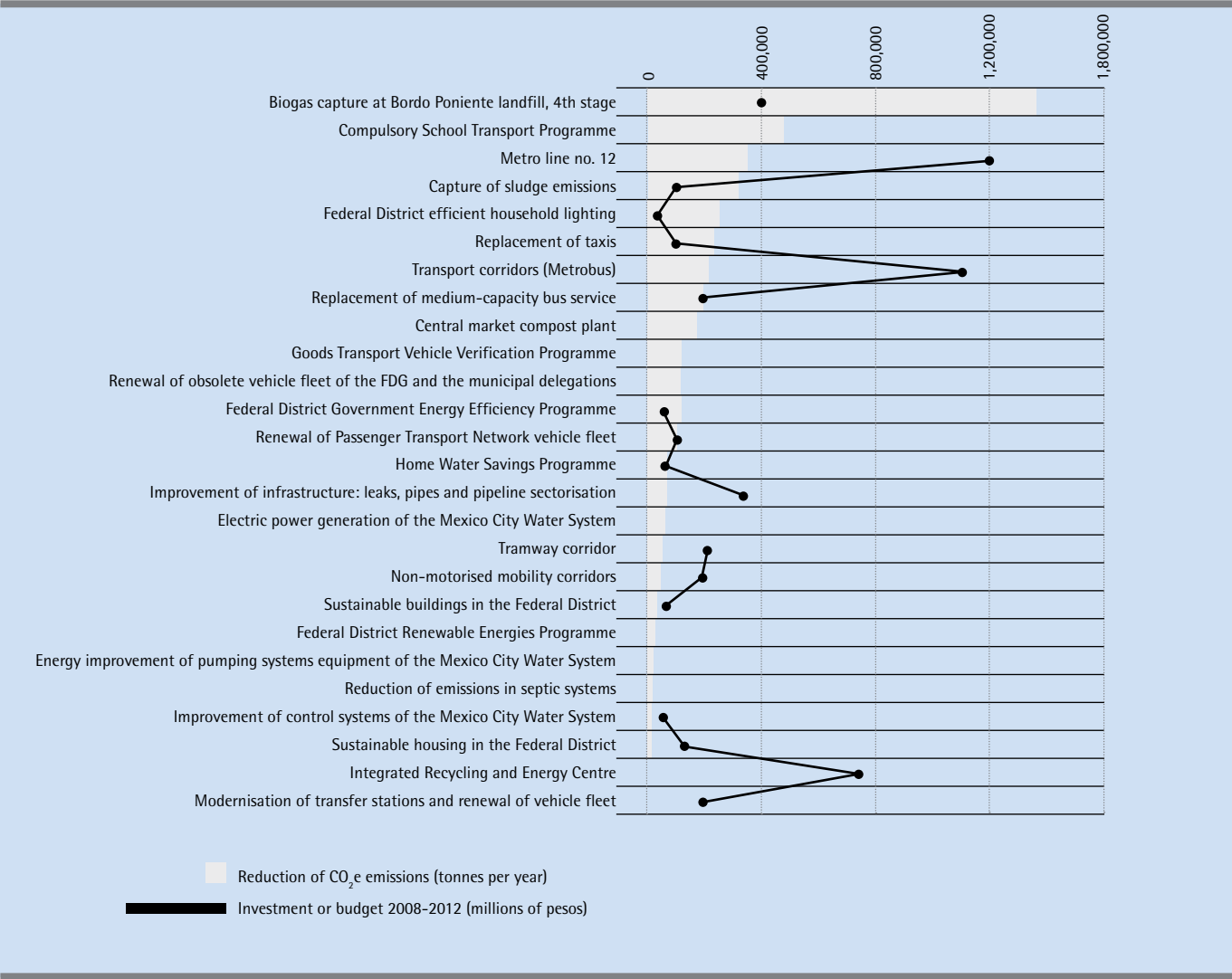
goal of achieving an estimated reduction of 4.4 million tonnes of carbon dioxide equivalent per year, representing 12% of the annual GHG emissions of Mexico City. To implement all these actions, a budget of 56,152 million pesos is required for the period 2008-2012.

Of the 4.4 million tonnes of carbon dioxide equivalent that could be reduced per year, 12% would be achieved in the water sector through the 7 planned actions, 10% in the energy sector (5

actions), 35% in the waste sector (4 actions), and 42% in the transport sector (10 actions). Figure 10.1 (so numbered in the Programme itself) shows the envisaged mitigation actions, their contribution to the reduction of GHG emissions, and the investment required to carry out each measure.

The actions in the water sector that have the greatest impact on the mitigation of GHG emissions include the capture of sludge emissions, accounting for 69%

Figure 34
GHG reduction actions



Source: PACCM 2008.

of the reduction in this sector, and the Home Water Savings Programme, which accounts for 9%.

2. 'Local public intervention matrix for climate change': lessons learned and replicable actions

In this study, a comparative analysis has been made of six local experiences involving climate action plans which are now under way, promoted by the local governments of Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City, respectively:

I) Barcelona Energy Improvement Plan 2002-2010 and Barcelona Energy, Climate Change and Air Quality Plan 2010-2020.

II) Plan for the Sustainable Use of Energy and the Prevention of Climate Change of the City of Madrid, in force since June 2008.

III) Paris Climate Protection Plan, in operation since October 2007.

IV) Public actions against climate change in Bogotá.

V) Buenos Aires Climate Change Action Plan 2030.

VI) Mexico City Climate Action Programme 2008-2012, launched in May 2008.

Thanks to these plans, many lessons have been learned and it may now be considered appropriate to build and implement a 'local public intervention matrix for climate change', which

could be applied to many cities and metropolitan regions. This matrix would include the following six policy lines:

- Mobility, transport and urban and road reorganisation (MTURR).
- The management of property holdings and public facilities, and the building of an eco-efficient urban infrastructure (PPFEUI).
- The conservation, recovery and/or expansion of public spaces and green areas of environmental value (PSEGA).
- Local energy transition as a key element of measures for GHG emission mitigation and adaptation to local climate change scenarios and outcomes (LETMIAD).
- The importance of local social cohesion, welfare and environmentally active citizens (LSCWEC).
- Financing urban resilience and metropolitan sustainability (FURMS).

These six lines of local public policy are considered to be the most effective, appropriate and efficient points based on the following reasons and evidence: on a global, national and local scale, albeit with differing proportions and dynamics, it is unquestionably proven that the sectors of economic activity that contribute the majority of GHG emissions are those linked to the production, distribution and supply of energy, to the transport of goods and the mobility of

people, to the residential, commercial and institutional consumption of energy, to the inadequate regulation and poor management of urban waste and wastewater discharges, and to the set of activities that favour the conversion of woodland and/or green areas into urban sprawl zones and places encouraging territorial or functional conurbation processes which result in the haphazard spread of metropolitan areas. This is also confirmed by the climate action plans and programmes implemented in Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City, which have been studied here.

For this reason, to face the challenges of climate change, the local actions taken on **MTURR**, **PPFEUI**, **PSEGA** and **LETMIAD** translate into net savings of both energy and carbon equivalent emissions, while providing better conditions for building or consolidating **LSCWEC**. This, in itself, lends these actions their qualities of ‘effectiveness’ and ‘suitability’. Their ‘efficiency’, however, must be provided by the progress and achievements that can be obtained locally through good local management of **FURMS**. The set of specific and individual actions to be carried out within these six lines of local public policy is precisely what has been generally called throughout this study **EMM+AAM** (see the diagram at the end of paragraph 2 in **Part B**).

Some people insist on including among the recommended lines of local public

policy on climate change the creation of GHG emission inventories as an indispensable piece of information for making more well-founded decisions in each case. They certainly do represent a basic piece of information on which to build other information, social communication, progress-monitoring and policy-correction systems. However, with the evidence that has already been documented for many cities, regions and countries with respect to the anthropogenic processes and sources that give rise to the largest GHG emissions, and considering serious budgetary constraints and a lack of fresh investment resources, in many cases it would be more suitable to save the time and funds needed to produce such emissions inventories and instead use them to urgently implement one, several or all the local public policy lines that have been defined here.

With respect to **LSCWEC**, as was previously explained in paragraph 3 of **Part B**, in addition to promoting processes of sustainable regional development and of reduction of social marginalisation through the creation of formally established jobs and through a greater and better coordination between the national public policies and those locally designed and implemented, it would be advisable to prepare maps of civil, economic and property/heritage risks as well as early warning systems against climate change threats, considering the local vulnerabilities and the estimated risks.

With respect to mobility, transport and urban and road reorganisation (**MTURR**), the six cases studied here have really made notable advances. In the three European cities and in Bogotá, these advances have pivoted around the greater efficiency of the engines in circulation, the improvement of the public collective transport services and the replacement of vehicle fuels, and around a significant improvement of the urban and road organisation, which has also promoted the widespread use of bicycles as a means of personal mobility. Buenos Aires and Mexico City are gradually advancing in this direction. Along this line of policy, the best example of the three European cases could be Paris, and the best of the Latin American ones would possibly be Bogotá.

The management of property holdings and public facilities and the building of an eco-efficient urban infrastructure (**PPFEUI**) is perhaps the line along which the best results have been obtained in the cities of Barcelona, Madrid and Paris. Specifically, Barcelona stands out for its impressive urban planning and the management of its architectural-urbanistic landscape. The case of Madrid is enlightening with respect to the integrated management of its urban waste, while Paris is of great interest for the successful measures it has implemented in connection with energy performance in residential, commercial and institutional buildings and the local ‘green procurement’ programme in the City Council’s various offices.

Among the European cases that have been studied, Paris and Barcelona stand out with respect to the conservation, recovery and/or expansion of public spaces and green areas of environmental value (**PSEGA**). Along this line of local policy, Mexico City has achieved some progress, although always under the pressure of the irregular human settlements on its conservation land and permanently exposed to real estate speculation in practically the whole city and its metropolitan area.

The local energy transition as a key element of the measures aimed to mitigate GHG emissions and to adapt locally to the scenarios and outcomes of climate change (**LETMIAD**) has registered notable advances in the three European cities. In this respect, standing out once again are the mitigation and adaptation measures of Paris based on the coordination of the energy policy between the Paris City Council, Électricité de France (**EDF**), Gaz de France (**GDF**) and Compagnie Parisienne de Chauffage Urbain (**CPCU**). In the three Latin American cities, no local advances have been achieved along this line of policy because of the local governments’ complete energy subordination to the national energy policy.

This study has dealt extensively with the importance of local social cohesion, welfare and the existence of an environmentally active citizenship (**LSCWEC**) with a view to facing up as

well as possible to the local challenges of global climate change. For the reasons previously mentioned, Barcelona, Madrid and Paris are in significantly better condition than Bogotá, Buenos Aires and Mexico City. Having solved their ‘structural’ and ‘emerging’ social problems, today they can face, with well-founded optimism, the ‘additional’ problems derived from climate change risks. The three Latin American cities find themselves in the opposite situation.

The financing of urban resilience and metropolitan sustainability (FURMS) poses a challenge to all six cities, but since these cities hold 5th, 8th, 13th, 23rd, 31st

and 47th place in the world ranking in terms of GDP (Paris, Mexico City, Buenos Aires, Madrid, Barcelona and Bogotá, respectively), much depends on their local governments’ financial intelligence and political effectiveness in taking advantage of the various international funding mechanisms.

The following table provides a summarised appraisal, based on the findings of this study, of the advances achieved by each of these cities along the six lines of local public policy against climate change.

| Cities and metropolitan areas | Priority lines of local/regional public policy = "local public intervention matrix for climate change" | | | | | |
|---|--|--------|-------|---------|--------|-------|
| | MTURR | PPFEUI | PSEGA | LETMIAD | LSCWEC | FURMS |
| Barcelona | ● | ● | ● | ● | ● | ● |
| Madrid | ● | ● | ● | ● | ● | ● |
| Paris | ● | ● | ● | ● | ● | ● |
| Bogotá | ● | ● | ● | ● | ● | ● |
| Buenos Aires | ● | ● | ● | ● | ● | ● |
| Mexico City | ● | ● | ● | ● | ● | ● |
| <div><div>●</div> Effectiveness of the implemented policy or its good verifiable results.</div> <div><div>●</div> Surmountable weakness of the implemented policy or of the potential results in progress.</div> <div><div>●</div> Absence of policy or poor results following its implementation</div> | | | | | | |

Table 27

Source: prepared by the author.

D. Conclusions: Towards the construction and development of cohesive societies, resilient cities and sustainable metropolitan areas

In order to construct and develop cohesive societies, resilient cities and sustainable metropolitan regions the following seven key issues must be carefully analysed and discussed:

- The underlying causes of global climate change scenarios.
- The social, economic and environmental consequences of these scenarios.
- The challenges for public policy to fight these causes, deal with the consequences and take advantage of the opportunity to refocus urban and regional development.
- The essential coordination and complementarity of national public policies with the corresponding local policies.
- The centrality of energy decoupling in urban-metropolitan economies, the economic decarbonisation of their productive and service activities, net reforestation and greater recovery of environmentally valuable green areas and public spaces.
- The vital importance of social cohesion in promoting any local public policies designed to effectively tackle the locally-felt risks of climate change.
- The construction of a local public intervention matrix for climate change.

It is precisely these issues that have been

analysed in this study in parts A, B and C. Based on the findings of this study, the following conclusions can be drawn.

The public agenda to promote effective mitigation measures and appropriate adaptation measures (EMM+AAM) to deal with local climate change scenarios must focus on fighting the principal causes leading to an excessive consumption of fossil fuels and the dynamic conversion of forested land to other anthropogenic uses. Recommendations should identify regulatory, technological, economic and cultural solutions in order to boost the efficiency of efforts to reduce the rate of GHG emissions and to increase the capacity of natural carbon sinks.

It should be emphasised that if the above-mentioned EMM+AAM are not implemented and conventional or inertial decisions and behaviour continue to flourish in local policy, climate forecasts and scenarios, with all their social, economic and environmental costs, could be even worse than already estimated or observed. Given this information, it is possible to better respond to the following questions:

- Should the local governments of cities and metropolitan areas be concerned about and take action to identify which climate threats are most likely to occur in their specific territories?
- Should these governments identify their main demographic, social, economic and

urban vulnerabilities in order to try and limit or reduce them through new local public policies?

· Should they develop their institutional capacity for local public administration and financing in order to promote specific EMM+AAM in their territories and societies?

Obviously, the answer to these three questions is yes, at least for the following reasons:

- Climate change is a global process, the causes and consequences of which have specific manifestations in different parts of the territory.
- Its negative impacts have a greater effect (directly and indirectly) on places, cities and metropolitan areas with lower levels of social cohesion, higher rates of poverty, social inequality and marginalisation, as well as higher levels of mass unemployment and economic informality.
- The worst-case scenarios, with greater damage and costs, are still avoidable or can be limited by the political will of local urban governments and the social commitment of their communities to implement diverse EMM+AAM in their respective territories.

To summarise, it could be said that with regard to global climate change scenarios, local risks (R) depend on the existence

and combination of the following main factors:

- Climate change threats (CCT) already recorded and/or estimated in the particular area. If these CCT have only been experienced but not analysed or systematised, this should be done.
- Social and economic vulnerabilities (SEV) present in each specific territory, city or metropolitan area, considering the differing degree or intensity and territorial distribution of poverty, social inequality, marginalisation, mass unemployment, economic informality and/or social solidarity, or basically taking into account everything connected with higher or lower levels of local social cohesion.
- The conventional or inertial local public administration of these climate change threats to the territory and the social and economic vulnerabilities mentioned previously (or *business as usual* – BAU).
- The implementation of local public policies that are strategically expressed in a set of EMM and AAM (preferably in a coordinated, coherent and complementary way: EMM+AAM).

Thus, the social, economic and environmental costs of climate change must be considered, at the very least, on the basis of the estimated cost of inaction (or the cost of ‘doing nothing’) associated with the inertial maintenance of conventional decision-making (or *business as usual* –BAU– behaviour),

as well as the cost involved in adopting important and long-lasting measures for mitigating carbon emissions and explicitly adapting to climate change.

Choosing not to change any of the practices that have been widely used for decades means taking the decision to manage (but not resolve) a reduced water supply, reduced agricultural productivity, greater intensity of extreme hydro-meteorological events, the emergence of old and new diseases that affect public health (malaria, dengue, cholera, leishmaniasis, AN1H1 influenza, Chagas disease, etc.), increased road congestion in cities and metropolitan regions, poor air quality and the social conflicts that will probably arise in these scenarios of increased scarcity of natural resources, environmental services and a general failure to meet people’s daily needs.

What this study highlights is the analytical centrality and political importance of what local governments and their respective urban and metropolitan societies, with their different levels of social cohesion, decide, do and don’t do with regard to the challenges of climate change.

The main findings and lessons learned so far have been expressed in a very wide range of climate change mitigation and adaptation measures that have been implemented in different European, Latin American and Caribbean cities, although

those discussed in greatest detail involve Barcelona, Madrid, Paris, Bogotá, Buenos Aires and Mexico City.

This study documents how climate change mitigation measures focus on diverse technological, energy, regulatory and/or economic alternatives designed to reduce GHG emissions produced by different sources and anthropogenic processes, or on capturing and storing carbon dioxide in different ecosystems which act as natural sinks. Mitigation centres on avoiding or reducing the presence or worsening of climate threats caused by the excessive consumption of fossil fuels and the fragmentation and net loss of forest ecosystems.

Likewise, the study also documents how climate change adaptation measures are based on infrastructure, technological innovation, regulatory instruments, economic (dis)incentives and/or information strategies, communication and building a culture that can successfully cope with the negative impacts of climate change. Adaptation centres on eradicating or limiting the social, demographic and economic vulnerabilities to climate change facing each society in its own specific territorial situation and location.

In summary, the set of climate change mitigation and adaptation measures that are widely recommended as local policies could be grouped together in three large blocks:

· Reduce the excessive use of fossil fuels in energy generation and by motor vehicles, diverse industrial activities, domestic use and the general running of cities and metropolitan regions. Likewise, all these activities and uses should move towards better energy profiles and use of territorial and water resources.

· Significantly reduce the rate of deforestation and halt the conversion of forest cover to other uses that degrade ecological attributes and the environmental services provided by these ecosystems. In addition, restore lost public spaces, extend urban green areas while the surrounding agricultural and livestock activity should move towards better energy profiles and use of territorial and water resources.

· Increase social welfare by promoting greater access to and better use of renewable energies, water resources and environmental services, at the same time as implementing actions to improve public healthcare, education, capacity building, information, gender equality and the conservation and correct use of natural capital (territory, energy, water and biodiversity).

In the short and medium term, current public policies in place to deal with the local effects of climate change widely recommend making a firm commitment to effective mitigation and appropriate adaptation measures and avoiding or reducing to the absolute minimum any inertial tendencies that basically equate to

inaction. Putting into action the lessons learned over the past 20 years, there is no doubt that, although addressed to specific situations and at different rates depending on each case, the emphasis of local public policies on climate change should be:

· Increased ‘energy decoupling’ of urban and metropolitan economies.

· Gradual ‘economic decarbonisation’ of their activities and operation.

· Significant reduction of net deforestation, in specific points and regionally.

· Greater social cohesion and cooperation from local citizens (or a significant reduction in local levels of marginalisation, pauperisation, disorganisation and social erosion).

Despite all these findings, evidence and recommendations, in Latin America and the Caribbean a combination of weak and fluctuating economic growth trajectories, the fragmentation and informalisation of labour markets and pro-cyclical economic policies has led to socially degrading and exclusionary situations – precisely the opposite of the institutionalised and robust construction of social cohesion that is needed.

For these reasons, it could be argued that

far from heading towards consolidating social cohesion in most Latin American

and Caribbean countries, what is really occurring now, and which unfortunately is expected to continue in the future, is both the spread of individual and family survival strategies and precarious self-employment and national and local public policies to abate and control the most serious social costs of climate change.

Finally, as an overall conclusion it could be said that considering all the lessons learned on this matter, the importance of building and implementing the following ‘local public intervention matrix for climate change’ is undeniable:

· Mobility, transport and urban and road reorganisation (**MTURR**).

· The management of property holdings and public facilities, and building of an eco-efficient urban infrastructure (**PPFEUI**).

· The conservation, recovery and/or expansion of public spaces and green areas of environmental value (**PSEGA**).

· Local energy transition as a key element of measures for GHG emission mitigation and adaptation to local climate change scenarios and outcomes (**LETMIAD**).

· The importance of local social cohesion, welfare and environmentally active citizens (**LSCWEC**).

· Financing urban resilience and metropolitan sustainability (**FURMS**).

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Collection of Studies
into Local and
Regional Public Policies
on Social Cohesion

URB-AL III is a regional decentralised cooperation programme run by the European Commission, the aim of which is to contribute towards increasing the level of social cohesion in sub-national and regional groups in Latin America.

Led by Diputació de Barcelona, the URB-AL III Programme Coordination and Orientation Office's mission is to facilitate the implementation of the programme by providing technical assistance and support in the different projects in order to help achieve the programme's objectives.