KONRAD ADENAUER STIFTUNG

2

NDCs

WHAT IS THERE FOR LATIN AMERICAN BIG CITIES?

NDCs: What is there for Latin American big cities?

Phase 2 | Final Report

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KONRAD ADENAUER STIFTUNG

IIS International Institute for Sustainability

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INTRODUCTION

THE PROJECT. The International Institute for Sustainability (Rio de Janeiro) completed, in November 2017, the KAS-funded activity "INDCs: What is there for Latin American big cities?". The key objective was "to help both national governments as well as selected city governments in Latin America to strengthen the dialogue in order to align the national NDC with existing city government plans and initiatives on climate change, which may have synergies with each other".

The exercise was carried out in four countries and their respective main cities. The successful outcome of the first phase and the continued interest in an effective implementation of the Paris Agreement worldwide encouraged expanding it to other countries in Latin America – which was the objective of the Project's Second Phase.

A quick preliminary analysis indicated that only a very limited number of countries had both an NDC with clear targets as well as a capital city with its own climate plan. At the same time, it was observed that the adaptation agenda has been gaining weight in the post-Paris Agreement negotiations, so it was decided to do an exercise similar to mitigation – comparing national and city level plans – in the case of adaptation. The challenge was to find countries in Latin America where both national and city governments had developed climate adaptation plans.

The second phase of this project consists of an analysis comparing national and city climate plans, with four countries focusing on the mitigation agenda and

The challenge is how can national and city governments best coordinate their efforts to reduce emissions, fulfilling countries' commitments to the Paris Agreement, minimizing costs, identifying opportunities and ensuring the 'right' institutional coordination framework

4 other countries on the adaptation agenda. They are: Mitigation – Colombia/Bogotá, Uruguay/Montevideo, Ecuador/Quito, and Honduras/Tegucigalpa. Adaptation – Chile/Santiago, Panama/Panama City, Costa Rica/San José and Guatemala/Guatemala City.

Two key features distinguish the first from the second phase. Apart from the inclusion of the adaptation agenda and the participation of eight rather than four countries and cities, (i) it has been agreed that the second phase analyses would be less in-depth and would not involve field discussions, although one closing workshop was also programmed and took place in October 2018 in Santiago de Chile, with the participation of most countries and cities; (ii) the substantive analyses consisted of desk-reviews only, and were prepared over a period of two months only. The Second Phase Report was also expected to be much shorter than the first one.

CONTEXT AND MOTIVATION (WITH FINDINGS FROM PHASE I)

Many reasons exist to look for synergies between national and local government initiatives on climate change: (i) NDCs were typically determined by National Governments 'only', with little or no consultation and engagement of subnational entities; (ii) half of the world's population lives in cities (80 percent in Latin America); cities house most built assets, generate more than 80 percent of the world's GDP, are responsible for around 70-80 percent of the energy consumed, and generate three quarters of energy related GHG (Greenhouse Gas) emissions; (iii) cities are particularly vulnerable to the impacts of climate change, while at the same time it is more cost-effective to focus both mitigation and adaptation action on cities; (iv) cities house most scientists and research bodies, they are major sources of innovation and dissemination of ideas and practices, therefore they often are front-runners in climate action.

The challenge is how can national and city governments best coordinate their efforts to reduce emissions, fulfilling countries' commitments to the Paris Agreement, minimizing costs, identifying opportunities and ensuring the 'right' institutional coordination framework. There is no archetypical way of planning for climate change, and multiple interests and motivations are inevitable. A multi-scale approach is needed, mainly ensuring sufficient capacity and resources to enable local authorities to plan and respond to their specific climate change agendas. However, tackling global issues requires more than planning and action from the most forward-looking cities. Stronger and coherent national strategies are required, even if they are not always sufficient to trigger climate change action on the ground (Corfee-Morlot *et al.*, 2010).

Different frameworks of climate policy coordination between national and local governments have been proposed. They essentially depend on the extent to which the national government imposes requirements for local climate change policy. Even in more centralized systems, central governments can amply support local governments, with or without financial support. In more bottom-up approaches, local authorities are encouraged or allowed to go beyond national requirements to independently address climate change. Inevitably both directions of influence – top-down and bottom-up – co-exist to shape action and policy across levels of decision making (Corfee-Morlot *et al.*, op. cit.).

In the specific Latin American context, "most national governments have given priority to mitigation over adaptation, and to impact or top-down assessments with strong participation of physical scientists over bottom-up or vulnerability assessments. … Some urban centers are actively participating in the climate arena and the region's population and organizations have a long experience of responding to climate related hazards" (Hardoy and Lankao, 2011).

While it is indisputable that national and city governments should coordinate, align and support each other's initiatives on climate change, such coordination is extremely limited and often non-existent. "Despite over two decades of policy interventions at the city level to address issues of climate governance, there remains a stubborn gap between rhetoric and action. Explanations for this gap vary from case to case but focus on issues of institutional capacity and factors of political economy" (Bulkeley, 2010).

Many, or most, government responsibilities regarding climate change are well beyond the mandates of cities and local governments. This includes energy policies and pricing, the design of the energy matrix and the sources of energy supplying cities, fiscal and market mechanisms, and others. Even many decisions that are taken at the local level are largely influenced by the national government owing to its funding – notably urban infrastructures such as transport systems – or owing to regulations, such as energy efficiency, standards for appliances and vehicles. Cities do have more autonomy with regard to land-use planning, education, and voluntary programs.

Photo: Annie Spratt

Mitigation country and city case studies

This section presents and analyzes basic socioeconomic and climate data and indicators of the four countries and respective four cities analyzed for their mitigation plans. It is entirely based on the findings of the desk review. The section is divided into four subsections, one for each country and city case study.

Before jumping into the details of each case, a few summary socioeconomic and climate statistics are presented comparing the four countries and their four cities. Table 1 shows six of these main statistics for the four countries and for the world, and Table 2 does the same for the four cities. Table 3 details sectoral emissions and reduction targets for the four cities, as contained in their official climate plans, detailed later on.

In socioeconomic terms, Uruguay and Montevideo stand out as the "rich cousins" relative to the other three countries and cities. Better socioeconomic conditions such as these are not associated to higher emissions. Ecuador is the country with the highest per capita CO_2 emissions from fossil fuels due to its not so clean energy matrix. The four cities show very similar emissions per capita. The four countries and the four cities have low emissions per capita relative to the world. Among the cities, all four have very similar emissions per capita. Table 4 disaggregates national and city emissions by sector.

As observed in other countries and contexts, the direct contribution of cities to national emissions is rather small relative to their populations. This reflects the fact that their importance in terms of emissions is indirect, via consumption of goods and services, which are produced outside city limits and/ or that the countries' emissions are mostly related o AFOLU (Agriculture, Forestry and Other Land Use) emissions which occurs mainly in rural areas.

TABLE 1 – GENERAL SOCIOECONOMIC AND CARBON EMISSIONS STATISTICS, 4 COUNTRIES

	POPULATION (MILLIONS) **2017**	CO_2 EMISSIONS FROM FOSSIL FUELS PER CAPITA (T) **2014**	GDP PER CAPITA (US$) **2017**	SHARE OF GLOBAL EMISSIONS **2010**	SHARE OF GLOBAL POPULATION **2017**	HDI (WORLD RANK)* **2014**
Colombia	49.1	1.76	6,301	0,42%	0,65%	0.727 (95°)
Ecuador	16.6	2.76	6,199	0,10%	0,22%	0,739 (89o)
Honduras	9.3	1.07	2,480	0.03%	0,12%	0.625 (130°)
Uruguay	3.5	1.97	16,245	0,06%	0,05%	0,795(54°)
World	7,530	4.97	10,714	100%	100%	--

* - HDI data from UNDP's Human Development Report 2016 (http://hdr.undp.org/en/countries)
SOURCE: World Bank Climate Change Database – https://data.worldbank.org/country

TABLE 2 – GENERAL SOCIOECONOMIC AND CARBON EMISSIONS STATISTICS, 4 CITIES

	POPULATION (MILLIONS) **2018**	SHARE OF NATIONAL POPULATION	GDP PER CAPITA (US$)	ANNUAL EMISSIONS PER CAPITA
Bogotá MR	10.9	22.2%	10,670 (2014)	2.5t (2008)
Quito MR	1.4	8.4%	NA	2.5t
Tegucigalpa MR	1.2	13.3%	2,300 (2015)	2.5t (2011)
Montevideo	1.3	37.1%	21,000(2010)	2.7t

SOURCES: World Bank, UNDP and various statistics from country analyses below.

TABLE 3 – FOUR CITIES' EMISSIONS INVENTORIES AND REDUCTION TARGETS

	INVENTORY	TOTAL EMISSIONS- $MtCO_2eq$ (%)	REFERENCE YEAR	REDUCTION TARGET
Bogotá MR	• Energy (35%) • Transport (27%) • AFOLU (23%) • Waste (14%)	9.5 7.2 6.1 3.8	2008	56%/62% BAU (2038/2050)
Quito MR	• AFOLU (25%) • Waste (33%) • Transport (10%) • Energy (5%)	1.5 1.1 2.8 0.7	2011	≈5% (BAU 2025)
Tegucigalpa MR	• AFOLU (40%) • Transport (22%) • Energy (20%)	1.2 0.6 0.5	2011	≈ 26% (BAU 2050)
Montevideo	• Energy (52%) • Transport (35%) • Waste (12%)	2.0 1.3 0.5	2012	NA

SOURCES: Various country tables below.

TABLE 4 – NATIONAL EMISSIONS (MTCO2EQ) AND CITY EMISSIONS (% OF NATIONAL EMISSIONS)

	COLOMBIA **2008**	BOGOTÁ **2008 (1)**	ECUADOR **2012**	QUITO **2007 (2)**	HONDURAS **2000**	TEGUCIGALPA **2011 (3)**	URUGUAY **2012**	MONTEVIDEO **2012 (4)**
Energy	43.3	22%	20.6	3.4%	1.7	35%	4.9	40.5%
Transport	25	28.9%	16.9	16.6%	2.4	27%	3.1	42.4%
Industry	7.7	3.9%	4.6	0%	0.7	--	0.6	--
AFOLU	125	4.9%	35	4.4%	8.6	3.4	27.1	--
Waste	12.5	30.8%	3.4	32.9	1.7	30.6	1	47.9%
TOTAL	213.5	12.6%	80.6	7.7%	15.1	19.3	36.8	10.3%

(1) Bogotá MR % of Colombia (2008), (2) Quito MR % of Ecuador, (3) Tegucigalpa MR % of Honduras, (4) Montevideo MR % of Uruguay

TABLE 5 – COUNTRY AND CITY REDUCTION TARGETS

	COLOMBIA	BOGOTÁ	ECUADOR	QUITO MR	HONDURAS	TEGUCIGALPA MR	URUGUAY	MONTEVIDEO
Target year	2030	2038/ 2050	2025	2025	2030	2050	2030	2030
Base year	2010	2008	2011	2019	1995-2012	2011	1990	2012
Not cond. Target	20% BAU	56%/62% BAU	20,4% to 25% BAU (energy sector)	5% BAU	15% BAU (conditioned)	Estimated reduction 26% BAU	According to each sector and GHG	Estimated reduction 11,6Mt

SOURCES: Country and City documents referenced below.

Lastly, in terms of overall comparisons of the four cities and four countries, **Table 5** presents their reduction targets. In general terms, countries aim at a 15% to 25% reduction of their emissions relative to a base year. Ecuador's target is only related to energy emissions, and Uruguay's target varies according to each GHG. Uruguay also aims to become a CO_2 sink, with methane (CH4) being the main GHG of Uruguay as a result of beef production.

Table 5 shows that city's reductions target vary considerably. Montevideo does not have a specific target, nor does the Municipio de Tegucigalpa; however, the latter has estimated a GHG emission reduction according to mitigation action that is coupled with an adaptation strategy – which is quite understandable since the city is located in one of the most vulnerable countries in the world. The next four subsections detail the efforts of countries and cities in more details.

COLOMBIA AND BOGOTÁ

In terms of population and GHG emissions, Colombia is the largest of the four countries analyzed. Although representing only about 0.42% of world emissions and 0.65% of the global population, Colombia is up to date with its mitigation agenda. In its NDC Colombia has not only presented its target but also the processes of planning and implementation to reach it. Since 2010, Colombia has been developing policy instruments to address climate change, such as the CONPES 3700 document, that describes the institutional strategy to articulate politics and actions regarding to climate change in Colombia, the Colombian Low Carbon Development Strategy (CLCDS), The National Strategy for Reducing Emissions from Deforestation and Forest Degradation (ENREDD+), and the National Policy on Climate Change (PNCC), which is the main institutional tool of public policy on climate change in the country. Colombia has in addition developed a substantial Third National Communication published in 2017, updating estimates of GHG emissions from 1990 to 2012 and mitigation strategies.

The Colombian NDC seeks to allow greater participation to the territories and sectors at the local level to prioritize and design their own climate change strategies, taking into account their regional circumstances by means of differential approaches, adjusting them to their particular circumstances. In this way, it aims to reconcile "bottom-up" and top "top-down" strategies with the objective of greater coordination and participation of the different actors at different levels of government and sectors. The Colombian NDC has prioritized mitigation measures through eight Sectoral Mitigation Action Plans (Agriculture and Rural Development, Commerce, Industry and Tourism, Transport, Housing, City and Territory, and Mines and Energy), while strengthening the capacities of the territories. To promote a better identification of the main mitigation measures at local level, the Colombian Low Carbon Development Strategy provides for a regionalization process that implements a local level perspective of the territory through the creation of a system called "Regional Nodes of Climate Change". This perspective of the territory in regions aims to promote, support and accompany the implementation of specifics policies, plans, projects and actions of climate change in each region of the country.

Table 6 shows basic emissions and socioeconomic statistics of Colombia and of the Metropolitan Region Bogotá.

TABLE 6 – COLOMBIA NATIONAL AND CITY EMISSIONS, VARIOUS COMPARABLE STATISTICS

COLOMBIA	BOGOTÁ MR
• 0.65% of the world population	• 22.2% of country's population
• 0.38% of world GDP	• 37.6% of national GDP
• 0,42% of world emissions	• 14.9% of national emissions
• Total emissions in 2008 ≈ 213.5 $MtCO_2$- eq • Per capita ≈ 4.75t CO_2- eq (2012)	• Total emissions: in 2008 ≈ 34.7 $MtCO_2$- eq • Per capita 2.5t CO_2- eq (2008)
• AFOLU = 58.8% of national emissions	• Energy and transport = 64% of city emissions

SOURCES: http://www.dane.gov.co/reloj/

The Metropolitan Region of Bogotá is composed of 18 municipalities, comprises 22.2% of country's population and emits 14.9% of the national emission. Emissions per capita are almost half of the country, even with its high share of national GDP, which indicates that the region is able to develop economically with lower GHG emissions.

Under the "Regional Nodes of Climate Change" perspective, the Bogotá Capital and the Cundinamarca district (altogether 18 counties) are considered together and published a 2008 GHG inventory (Table 7) that calculates the emissions of Bogotá and Cundinamarca together, and developed the Regional Integral Plan of Climate Change – Region of Bogotá – Cundinamarca (PRICC). The PRICC was developed between 2010 and 2014 aiming to strengthen the capacity of regional governments to constitute resilient territories that are able to face the challenges of climate change. In political and administrative terms, the PRICC achieved the consolidation of an inter-institutional association platform between national, regional and local entities such as the IDEAM, the Mayor of Bogotá, the Government of Cundinamarca, the Regional Autonomous Corporation of Cundinamarca – CAR, and the Regional Autonomous Corporation of Guavio - CORPOGUAVIO, among others, demonstrating that institutional articulation is possible and that climate change requires a political-administrative vision beyond the local scale.

TABLE 7 – COLOMBIA NATIONAL AND CITY SECTOR EMISSIONS AND RESPECTIVE SHARES ($MTCO_2$-EQ)

SECTOR	COLOMBIA 2008 (1)	%	BOGOTÁ DISTRICT 2008 (2)	(2)/(1)	BOGOTÁ MR - CUNDINAMARCA 2008 (3)	(3)/(1)
Energy	43.3	20.3%	5.5	12.7%	12.9	29.8%
Transport	24.9	11.7%	5	20.3%	9.36	37.6%
Industry	7.7	3.6%	0	0	0.8	10.4%
AFOLU	125	58.8%	2.5	2%	7.3	5.8%
Waste	12.5	5.9%	3.2	25.7%	4.3	34.4%
TOTAL	213.5	100%	16.3	7.6%	34.7	14.9%

SOURCES: 3rd National Communication, Inventario de Emisiones de Gases Efecto Invernadero para la Región Bogotá – Cundinamarca and Plan Distrital de Adaptación y Mitigación al Cambio Climático para Bogotá 2015-2038 con visión al 2050.

As can be seen from Table 7, AFOLU is the sector that emits most GHG in Colombia. As on most cities worldwide, Energy (≈35%) and Transport (≈27%) are the sectors with the highest emissions in Bogotá MR, although AFOLU still has a significant share of ≈21% owing to emissions from agriculture and pastures. The high proportion of AFOLU is due to Colombia's high rates of deforestation, the clean matrix of power generation in the country (hydropower accounted for 68% of power generation in 2010), and a much lower energy consumption relative to international averages. Alongside with most cities in the world, Bogotá MR emits ≈ one third of transport and waste of national emissions.

In terms of emissions projections and reduction targets, Colombia has an unconditional target of reducing by 20% its projected emissions in 2030 relative to the BAU, with a base year of 2010. It also has a conditional reduction of 30%, depending on the availability of external funding. The projections are based on individual sector projections. Figure 1 shows the projected country emissions in the 2010-2030 period without the NDC commitments (the BAU). The Regional Integral Plan of Climate Change – Region of Bogotá – Cundinamarca (PRICC) does not define a specific reduction target, but the Bogotá District has developed an emission reduction target as shown in Table 8.

FIGURE 1 – COLOMBIA BAU EMISSIONS PER RESPONSIBLE MINISTRY, 2010-2030 ($MTCO_2$-EQ)

	CATEGORÍAS INCLUIDAS EN EL INVENTARIO SERIE 1990 A 2012	GASES ESTIMADOS	METODOLOGÍA	FUENTE INFORMACIÓN FACTOR DE EMISIÓN	FUENTE INFORMACIÓN DATO DE ACTIVIDAD
INDUSTRIA DE LOS METALES	Producción de hierro y acero	CO_2, CH_4	Nivel 1	IPCC – 2006. Volumen 3. Capítulo 4. Cuadro 4.1	1990 a 2006: SIMCO – UPME 2007 a 2012: ANDI
	Producción de ferroaleaciones	CO_2	Nivel 2	CERROMATOSO S.A.	1990 a 1997: SIMCO – UPME 1998 a 2012: CERROMATOSO S.A.
USO DE PRODUCTOS NO ENERGÉTICOS DE COMBUSTIBLES Y DE SOLVENTE	Uso de lubricantes	CO_2	Nivel 1	IPCC – 2006. Volumen 3. Capítulo 5. Cuadro 5.2	EAM – DANE
	Uso de cera de parafina	CO_2	Nivel 1	IPCC – 2006. Volumen 3. Capítulo 5. Numeral 5.3.2.2	EAM – DANE
USO DE PRODUCTOS SUSTITUTOS DE LAS SUSTANCIAS QUE AGOTAN LA CAPA DE OZONO	Refrigeración y aire acondicionado	HFC-32, HFC-134a, HFC-152a, HFC 143a	Nivel 1	IPCC – 2006. Volumen 3. Capítulo 7. Anexo 1	UTO – MADS
	Protección contra incendios	HFC-125, HFC-227ea	Nivel 1	IPCC – 2006. Volumen 3. Capítulo 7. Anexo 1	UTO – MADS

CATEGORÍAS NO INCLUIDAS EN EL INVENTARIO SERIE 1990 A 2012

Se incluyeron todas las categorías cuyos procesos existen en el país. El plan de mejora de este módulo se centra en la reducción de incertidumbre a través de la mejora en datos de actividad y nivel metodológico; esto en el mediano y largo plazo.

SOURCES: Colombia 3rd National Communication

TABLE 8 – MITIGATION TARGETS OF COLOMBIA AND THE BOGOTÁ DISTRICT

	COLOMBIA		BOGOTÁ DISTRICT
Target year	2030 Unconditional	2030 Conditional	2038/2050
Base year	2010	2010	2008
Target (Mt)	-66,5	– 99,9	26.3/36.7
Target (%)	– 20% BAU	– 30% BAU	56%/62%
Per capita target (t/yr)	4.6	4.05	2.01/1.97

SOURCES: Colombia iNDC and Plan Distrital de Adaptación y Mitigación al Cambio Climático para Bogotá 2015-2038 con visión al 2050

Bogota / Colombia – Photo: Altagamba

The 20% non-conditional reduction target in relation to the BAU was reassessed later and the Colombian government found it possible to achieve a reduction of 22.8% in relation to the BAU, reducing up to 75.7 Mt until 2030 with prioritized measures. These prioritized measures will be reflected later in the Sectoral Integral Plans of Climate Change that the ministries must draft according to article 170 of the Law of the National Development Plan, and the National Policy of Climate Change.

Due to the significant portion of AFOLU in the Colombian emissions, the country has ratified its commitment to reduce deforestation and preserve important ecosystems such as the Amazon, and the lion share of emissions reductions in the NDCs are from AFOLU. As mentioned before, the clean matrix of power generation in Colombia also helps the country to focus on actions related to the AFOLU, rather than the energy sector.

Bogotá MR does not have a specific mitigation target, as the regional strategy is based on the national strategy through the Regional Nodes of Climate Change. The PRICC is an important institutional tool to align national, regional and local level climate change strategies. The plan was prepared with the active support from various national entities (PNNC, IAvH, DNP and MADS). Although PRICC does not propose a specific mitigation target, it does present estimates of emissions reductions for each sector that altogether amount to 432Gg of CO_2eq. The main reductions are to be obtained from AFOLU, energy and waste (with respective targets of 129, 116 and 64 thousand t of CO_2-eq). The PRICC could not find much space to reduce

emissions of the transport sector, although it is the highest emitting source.

Besides the PRICC, the Bogotá District has also developed its own "Plan Distrital de Adaptación y Mitigación al Cambio Climático" that establishes a specific emissions reduction target (Table 9), projects BAU emissions (Table 10 and Figure 2) and describes the mitigation actions for Bogotá. This plan is aligned with both iNDC and PRICC, maintaining the importance of institutional articulation. The Bogotá District seeks to reduce 33% of BAU CO_2eq emissions in 2020, 49% in 2025, 56% in 2038 and 62% in 2050.

TABLE 9 – MITIGATION TARGET OF THE BOGOTÁ DISTRICT

	METAS DE MITIGACIÓN			
	CORTO PLAZO 2020	MEDIANO PLAZO 2025	LARGO PLAZO 2038	VISIÓN INSPIRADORA 2050
Meta de reducción de las emisiones de CO_2eq*	33%	49%	56%	62%
Emisiones reducidas o evitadas**	9.353.060,10 toneladas CO_2eq	16.526.029,10 toneladas CO_2eq	26.315.111,30 toneladas CO_2eq	36.566.840,70 toneladas CO_2eq
Emisiones tendenciales Business As Usual	28.608.340,07 toneladas CO_2eq	33.688.468,44 toneladas CO_2eq	46.896.802,20 toneladas CO_2eq	59.089.110,29 toneladas CO_2eq
Emisiones generadas descontando la mitigación	19.255.280,04 toneladas CO_2eq	17.162.439,33 toneladas CO_2eq	20.581.690,91 toneladas CO_2eq	22.522.269,59 toneladas CO_2eq
Intensidad per cápita esperada con medidas de mitigación	2,30	1,93	2,01	1,97

SOURCES: Plan Distrital de Adaptación y Mitigación al Cambio Climático para Bogotá 2015-2038 con visión al 2050

*Respecto a las emisiones proyectadas para el escenario Business As Usual

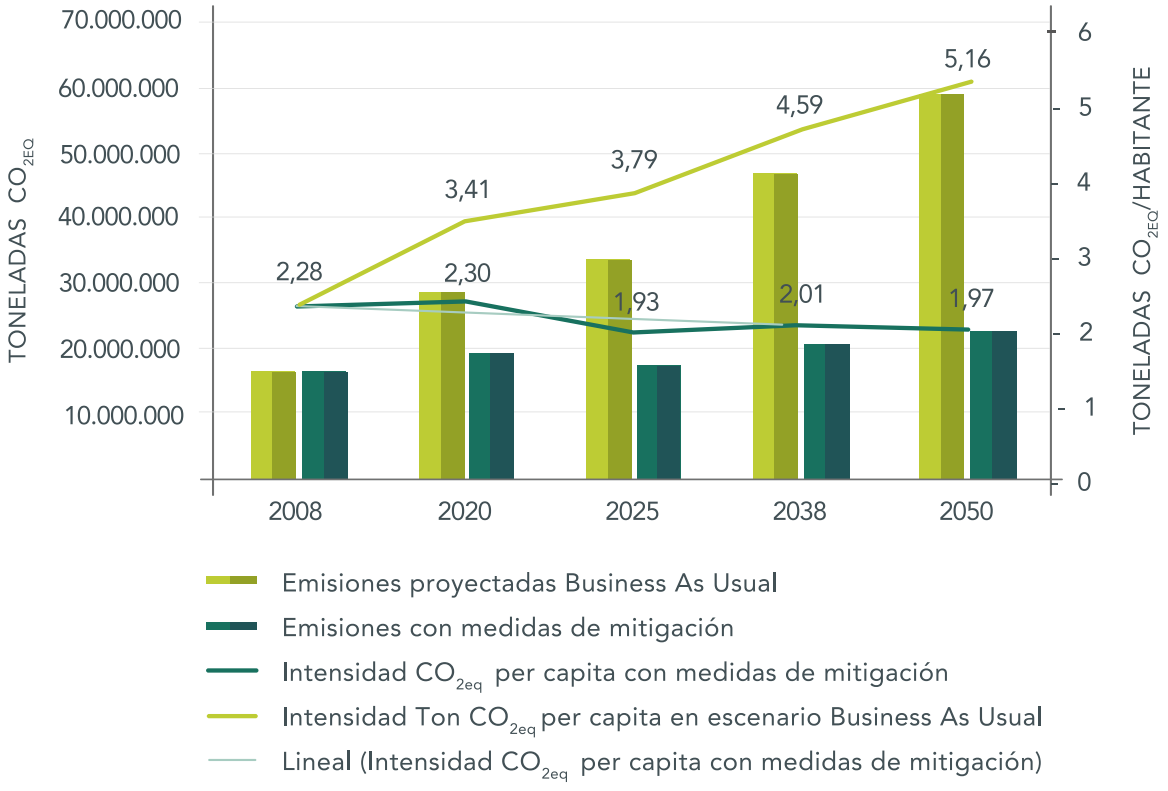
** Corresponde al total de emisiones de CO2eq reducidas en el año proyectado (no son valores acumulados).

To reach its ambitious targets, the "Plan Distrital de Adaptación y Mitigación al Cambio Climático" established 5 programs:

1. Sustainable mobility - responsible of 55% of the target until 2038 and 44 % until 2050.
2. Bogotá Zero Waste - responsible for 7% of the target until 2038 and 7 % until 2050.
3. Energy efficiency - responsible for 8% of the target until 2038 and 14 % until 2050.
4. Sustainable construction - responsible for 5% of the target until 2038 and 6% until 2050.
5. Carbon capture for the consolidation of the Main Ecological Structure - responsible for 25% of the target until 2038 and 29% until 2050.

Lastly, it must be noted that, according to the information available, there was a considerable amount of coordination between the national government, Bogotá MR and the Bogotá administration in terms of drafting their respective mitigation plans. This is an encouraging example for other countries and cities.

FIGURE 2 – PROJECTIONS OF BOGOTÁ EMISSIONS BAU AND WITH MITIGATION ACTIONS (TCO_2-EQ)



SOURCES: Plan Distrital de Adaptación y Mitigación al Cambio Climático para Bogotá 2015-2038 con visión al 2050

URUGUAY AND MONTEVIDEO

Uruguay is the smallest country in terms of population in this study, although is not the the least GHG emitting country. Its emissions per capita are high, almost 11t CO_2eq. Uruguay's NDC has focuses mainly on power generation and beef production, the first being the main concern globally, and the second because it is by far the activity with the highest GHG emissions in Uruguay, owing to its important cattle ranching and beef industry. Uruguay intends to become a net CO_2 sink because of its native forests, reforestation and renewable energy sources. With regard to Montevideo, the city emits around 10% of national emissions, in line with other cities in the world, and its per capita emissions are well below world average. Montevideo's emissions represent a large share of the country's urban emissions, mainly because of the share of its population relative to other cities and the country, with more than 40% of the national emissions from energy, transport and waste – shown inTables 10 and 11.

TABLE 10 – URUGUAY AND MONTEVIDEO EMISSIONS, VARIOUS COMPARABLE STATISTICS

URUGUAI	MONTEVIDEO
• Uruguay total emissions in 2012 ≈ 36.8 $MtCO_2$-eq, ≈ 10.8t CO2eq per capita, 74% from AFOLU	• Montevideo: 36.5% of the country's population.
• 0.05% of the world population, 0.075% of world emissions	• Total emissions in 2012 ≈ 3.8 $MtCO_2$- eq ≈ 10.3% of national emissions, 48% of national waste emissions.
• Main sector emissions: AFOLU – subsector enteric fermentation and agricultural soils ≈ 70% of total emissions	• 2.7t CO_2eq per capita
• Transports and Energy industry ≈ 16,9%	• Energy and transport represent 87% of city emissions

SOURCES: Cuarta Comunicación Nacional a la Conferencia de las partes en la y Convención Marco de las Naciones Unidas sobre el Cambio Climático - Uruguay 2016 Inventario de Emisiones de Gases de Efecto Invernadero de Montevideo año 2014

TABLE 11 – URUGUAY AND MONTEVIDEO SECTOR EMISSIONS AND RESPECTIVE SHARES ($MTCO_2$-EQ)

SECTOR	URUGUAY 2012 (1)	MONTEVIDEO 2012 (2)	(2) / (1)
Energy	4.9	2	40.5%
Transport	3.1	1.3	42.4%
Industry	0.6	0	0%
AFOLU	27.1	0	0%
Waste	0.9	0.5	47.9%
TOTAL	36.8	3.8	10.3%

SOURCES: Cuarta Comunicación Nacional a la Conferencia de las partes en la y Convención Marco de las Naciones Unidas sobre el Cambio Climático - Uruguay 2016 Inventario de Emisiones de Gases de Efecto Invernadero de Montevideo año 2014

With regard to mitigation targets, Uruguay's NDC focuses on power generation, beef production and net CO_2 sink. For power generation the target is presented as emission intensity per kWh produced, for beef production as emission intensity per kilogram of beef, and for CO_2 removal the target is an absolute value by 2030. For all other sectors and activities, targets are aggregate indicators measured as efficiency in relation to GDP. The NDC 2030 mitigation targets are divided according to the types of GHG – as shown in Table 12.

TABLE 12 – URUGUAY NDC MITIGATION TARGETS

GAS	SECTOR/ACTIVITY		2030 TARGETS - PERCENTAGE EMISSION REDUCTION TARGETS FROM BASE YEAR 1990	
			WITH DOMESTIC RESOURCES	WITH ADDITIONAL MEANS OF IMPLEMENTATION
CO_2	**Net CO_2 removal by 2030 with domestic resources** by means of the targets listed to the right	**LULUCF**	Remove 13200 Gg annually	Remove 19200 Gg annually
		Energy (Accounts for 94% of CO_2 emissions in 2010)	Reduce emission intensity per unit of GDP by 25%	Reduce emission intensity per unit of GDP by 40%
			Keep power generation emissions below 40 gCO_2/kWh	Keep power generation emissions below 20 gCO_2/kWh
		Industrial Processes (Accounts for 6% of CO_2 emissions in 2010)	Keep the intensity of emissions per unit of GDP at the reference value	Reduce emission intensity per unit of GDP by 40%
CH_4	**Beef Production** (Accounts for 78% of CH_4 emissions by 2010)		Reduce emission intensity per kilogram of beef by 33%	Reduce emission intensity per kilogram of beef by 46%
	Waste (Accounts for 7% of CH_4 emissions by 2010)		Reduce emission intensity per unit of GDP by 44%	Reduce emission intensity per unit of GDP by 68%
	Other sectors and activities (Accounts for 15% of CH_4 emissions by 2010)		Reduce emission intensity per unit of GDP by 45%	Reduce emission intensity per unit of GDP by 60%
N_2O	**Beef Production** (Accounts for 61% of N_2O emissions by 2010)		Reduce emission intensity per kilogram of beef by 31%	Reduce emission intensity per kilogram of beef by 41%

SOURCE: Uruguay's iNDC

Uruguay's NDC mitigation target and measures takes into account the early mitigation efforts already undertaken thanks to strong public policies on climate change, both at national and departmental level, to the design of a National Climate Change Response Plan and sector-specific policies. Uruguay's 2010 "National Plan of Response to Climate Change (PNRCC)" also acknowledged the need for national climate plans to take into account regional and local differences in the territory. Mitigation measures contained in both the PNRCC and NDC included the following main sectors and lines of action:

- Diversification of the energy matrix and the promotion of energy efficiency.
- Reduction of transport energy consumption by (i) diversifying fuels and improving efficiency in the use of energy, (ii) improving efficiency in public transport systems, passengers and freight, (iii) promoting biofuels to replace fossil fuels in transport.
- With regard to cattle, actions include (i) reducing methane emissions in dairy farms and in beef-cattle enclosures, coupled with proper management of manure, (ii) improving animal diet, and (iii) carbon sequestration in soils promoting pasture productivity.
- In agriculture actions include (i) reduced or zero tillage and proper crop sequencing and/ or rotation of pastures, (ii) reducing methane emissions from flooded rice cultivation, (iii) using biomass of agricultural and agro-industrial waste to substitute fossil fuels, and (iv) increasing efficiency in the use of fossil energy and nitrogen fertilizers.
- In the forestry sector, the dynamics of afforestation for commercial purposes and the protection of the native forests in Uruguay allowed the country to be a net CO_2 sink between 1998 and 2004. Current trends for forested areas suggest that Uruguay may become a net CO_2 sink around 2030. Specific actions in the sector include protective forests for agricultural activity (shade and shelter), soil and watershed protection, use of wood residues in forests and waste from forest industry as alternative energy sources, among others.
- For solid waste, measures include the incorporation and operation of new urban sanitary landfills with methane capture and generation of biogas, and replacement of industrial anaerobic treatment plants with intensive anaerobic processes.

Montevideo / Uruguay

- In terms of departments, actions were defined within the framework of a Sustainable Urban Mobility Plan and are being implemented in Montevideo. Some of these actions are the construction of exclusive corridors for collective transport, the promotion bicycle lanes and public bicycles, a mobility management center and units of electric taxis, buses and utilities in the capital.

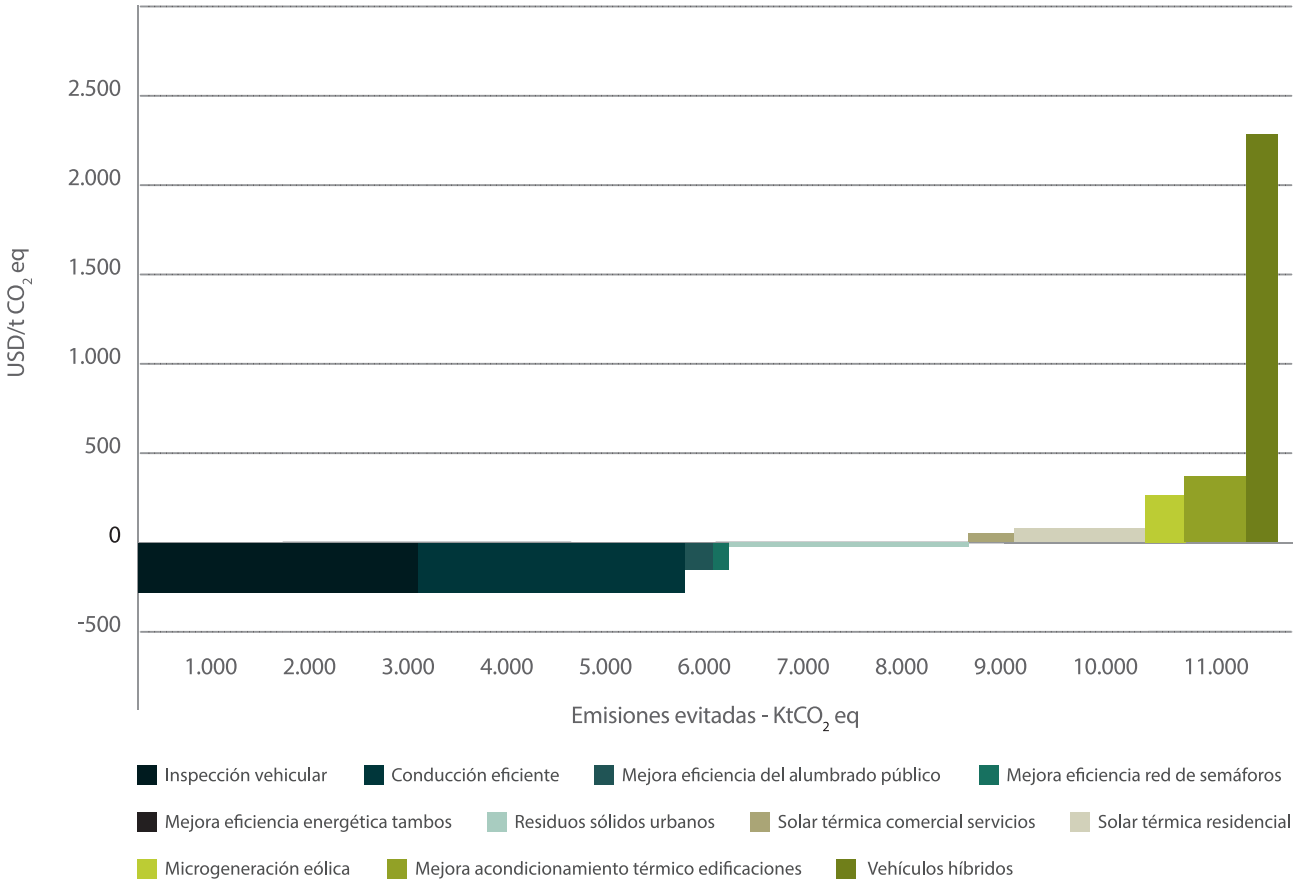
As expected, unlike national emissions, Montevideo has no significant AFOLU emissions, with emissions concentrated in energy, transport and waste as their main sources. In order to mitigate its emissions, Montevideo, with the Canelones and Sao José Districts, have developed the "Plan Climático de la Región Metropolitana de Uruguay (PCRM)", although the GHG inventory was only taken for the Montevideo district. Even though it was an independent and decentralized initiative, the PCRM was developed by incorporating approaches, methodologies and special considerations of the PNRCC. The PCRM itself reflects, even if not created in response to a PNRCC directive, strengthening decentralization, local and regional development and local capacity development. In this way, the PCRM reinforces and proposes actions aligned with the PNRCC. This interaction allowed, without neglecting local and regional specificities, maintaining the necessary coherence with the National Policy. Furthermore, the local PCRM mainstreams climate measures into existing sectoral plans or sector plans being developed. Lastly, there is a solid technical basis underlying the PCRM, which contains a marginal abatement cost curve coupled with cumulative emissions avoided by 2030 for the Metropolitan Region – as shown in Table 13 and Figure 3.

TABLE 13 – CUMULATIVE EMISSIONS AVOIDED BY 2030 FOR THE METROPOLITAN REGION

MEDIDAS	EMISIONES EVITADAS DE CO_2	
	KTONS CO_2	EN %
Mejora de acondicionamiento térmico en edificaciones	649	5,6%
Energía solar térmica residencial	1.339	11,5%
Energía solar térmica comercial/servicios	474	4,0%
Mejora en eficiencia de alumbrado público	324	2,8%
Mejora en eficiencia de red semáforos	133	1,1%
Mejora en eficiencia energética de tambos	5	0,1%
Microgeneración eólica	387	3,3%
Conduccion eficiente	2.703	23,2%
Vehículos híbridos	312	2,7%
Inspección vehicular	2.866	24,6%
Residuos sólidos urbanos	2.467	21,1%
TOTAL	**11.659**	**100,0%**

SOURCE: Plan Climático de la Región Metropolitana de Uruguay

FIGURE 3 – CO_2 ABATEMENT COST CURVE – METROPOLITAN REGION



SOURCE: Plan Climático de la Región Metropolitana de Uruguay

Although Uruguay and Montevideo have different emission patterns and thus different mitigation actions, both levels of government are aware of the importance of the coherence and interaction between local, regional and national level plans and also between sectors. The principle of decentralization and subsidiarity enshrined in the PNRCC recognizes the importance and complementarity of each level of decision-making and seeks to ensure the congruence of policies between the different levels of planning. Local and regional governments thus become key actors in the implementation of national policies, in spite of their own regulatory and planning functions. This understanding and coordination reinforces and gives credibility to both plans and to the broader national climate policy.

ECUADOR AND QUITO

Quito / Ecuador – Photo: Cesar Viteri

Among the four countries in this study, Ecuador is the one with the highest per capita emissions, mostly because its energy matrix is not as clean as the other three countries'. Quito MR has a small share of the national population and an even smaller share of emissions, but its emissions from waste, energy and transport are high – as shown in Table 14.

Ecuador's NDC focuses on the two most emitting sectors: energy and AFOLU. Energy, because of its considerable dependence on thermal power, and AFOLU, mainly because of deforestation. Quito MR also struggles with high rates of AFOLU emissions, but transport is the major source – as shown in Table 15.

In terms of emissions reduction targets, they are 15,2 $MtCO_2$-eq (20.4 – 25%) below the BAU scenario until 2025 in the energy sector, with the potential to push these targets to between 37.5 and 45.8, depending on the availability of funding (conditional NDC targets). The mitigation target of Quito RM is 5% below the BAU scenario also until 2025 – as seen in Table 16 and Figure 4.

TABLE 14 – ECUADOR AND QUITO MR'S EMISSIONS, VARIOUS COMPARABLE STATISTICS

ECUADOR	QUITO MR
• 0,22 % of the world population	• 8.4% of country's population
• 0,13% of world GDP • 0.16% of world emissions	• 32.9% of national Waste emission • 16% of total National Transport emissions • 7.7% of National emissions
• Total emissions in 2012 80.6 $MtCO_2$-eq • Per capita ≈ 5.2 CO_2-eq	• Total emissions in 2011≈ 6,18 $MtCO_2$-eq • Per capita ≈ x4.4 CO_2-eq

SOURCES: Third National Communication of Ecuador and Acción Climática Participativa En Las Administraciones Zonales del DMQ.

TABLE 15 – ECUADOR AND QUITO MR SECTOR EMISSIONS AND RESPECTIVE SHARES ($MTCO_2$-EQ)

SECTOR	ECUADOR 2012 (1)	QUITO MR 2011 (2)	(2) / (1)
Energy	20.6	0.7	3.4%
Transport	16.9	2.8	16.6%
Industry	4.6	0	0
AFOLU	35.1	1.5	4.4%
Waste	3.4	1.1	32.9%
TOTAL	80.6	6.2	7.7%

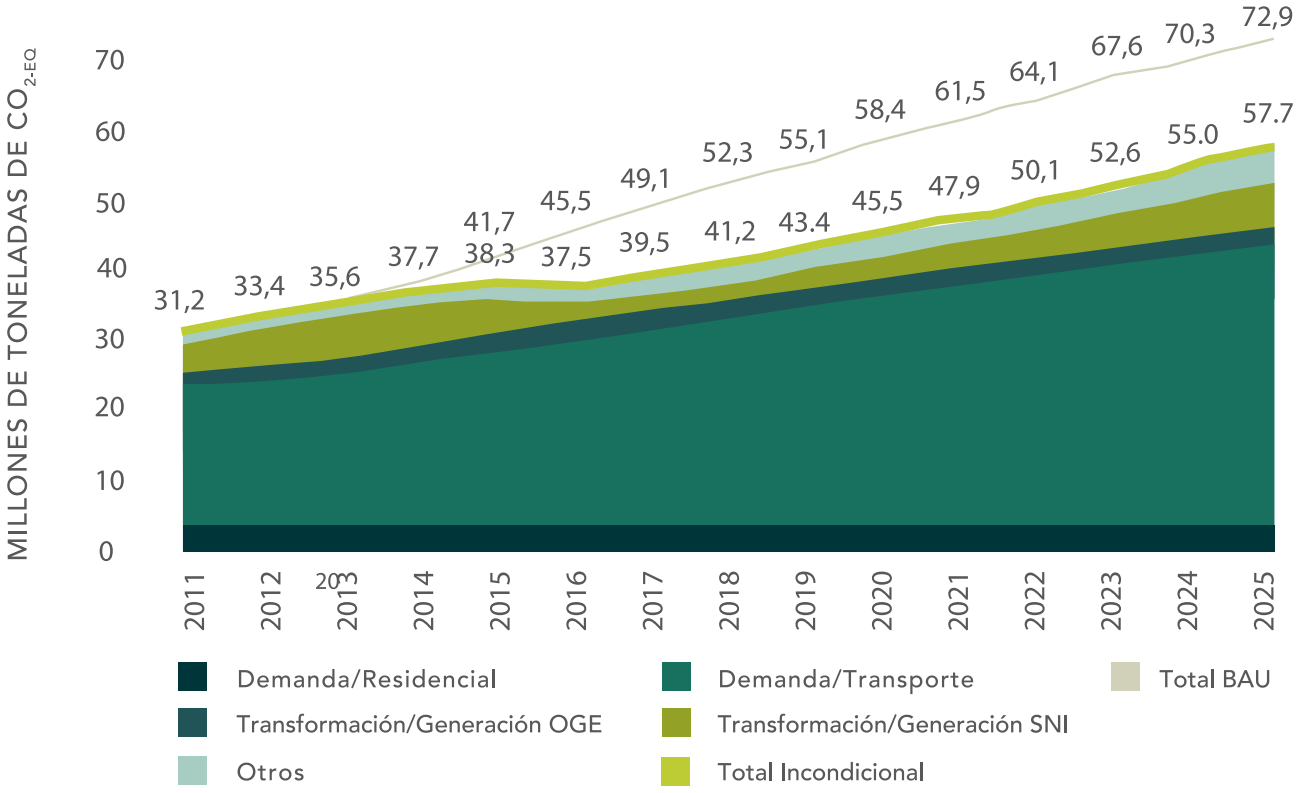
SOURCES: Third National Communication of Ecuador and Acción Climática Participativa En Las Administraciones Zonales del DMQ.

TABLE 16 – MITIGATION TARGET OF ECUADOR AND QUITO MR

	ECUADOR (ENERGY SECTOR ONLY)		QUITO MR
	NOT CONDITIONAL	CONDITIONAL	
Target year	2025	2025	2025
Base year	2011	2025	BAU projections from 2019
Target (Mt)	-15,2 $MtCO_2$-eq	---	
Target (%)	20.4% - 25% BAU	37.5 - 45.8% BAU	5% BAU

SOURCE: ECUADOR'S INDC AND ACCIÓN CLIMÁTICA PARTICIPATIVA EN LAS ADMINISTRACIONES ZONALES DEL DMQ.

FIGURE 4 – ENERGY EMISSIONS: BAU X SCENARIO WITH MITIGATION ACTION UNTIL 2025



SOURCE: Third National Comunication of Ecuador

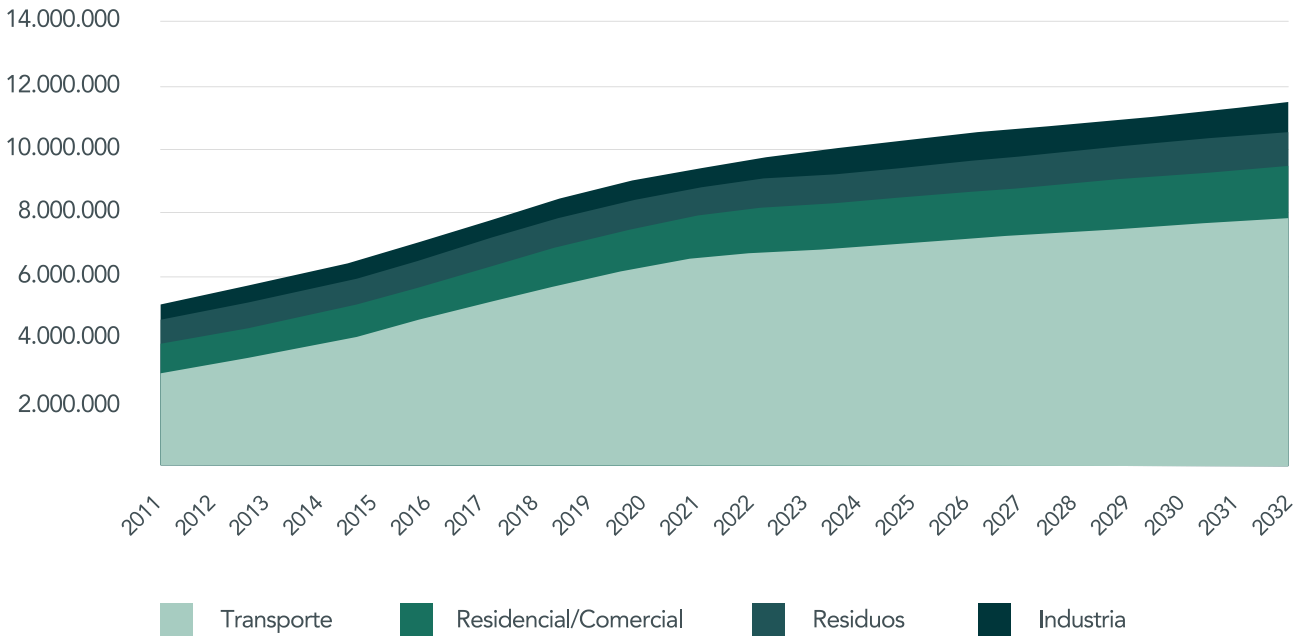
The three main proposed actions to achieve the NDC mitigation target are:

- Introduction of hydropower plants – reduction of 12.4 $MtCO_2eq$ in 2025;
- Incorporation of 1.500.000 induction stoves in the unconditional scenario and 4.300.000 in the conditioned scenario – reduction of 2.9 $MtCO_2eq$ in 2025;
- Optimization of power generation and energy efficiency in the oil interconnected system (OGE & EE) – reduction of 1.8 $MtCO_2eq$ in 2025.

The main AFOLU mitigation action is to be done through the National Forestry Restoration Program. Ecuador plans to restore 500.000 additional hectares until 2017 and increase this total by 100.000 hectares per year until 2025, counteracting deforestation in the country, contributing to the recuperation of the forest cover and combating climate change.

With regard to the Quito MR, its BAU projections suggest that in 20 years emissions will double if mitigation measures are not implemented. Most of the emissions and their growth come from the transport sector – as shown in Figure 5.

FIGURE 5 – QUITO MR'S EMISSION PROJECTIONS IN SCENARIO BAU (TCO_2EQ)



SOURCE: Acción Climática Participativa En Las Administraciones Zonales del DMQ.

According to the Climate Plan, the main proposed mitigation actions are the following:

- Sustainable mobility: by 2022 reduction of 16% of the Carbon Footprint in relation to the BAU through the implantation of the first metro line in Quito, extension of the Trolleybus system, implantation of the cable system, use of non-motorized transports and priority to pedestrians, cyclists and public transports.
- Sustainable construction: improving public-private partnerships, implementation of incentive to sustainable constructions, promoting sustainable technologies and promoting energy efficient buildings.
- Public Service: 39% of the Carbon Footprint reduced in the solid waste sector with the installation of a 5 MW power plant using methane produced in the sanitary landfill, with a potential reduction of 100,000 Ton CO_2-eq / year. Another 150,000 tons of CO_2eq will be reduced with power generation from the wastewater treatment of the DMQ, and another 200 ton of CO_2 eq per year with the replacement of 1000 luminaries.
- Forests: (i) Generation and dissemination of information about forests, carbon stocks, baselines and how the sector can help reduce GHG and conserve the natural patrimony; (ii) Coordination with the Directorate of the Natural Heritage and its strategies that contribute to having a REDD + Strategy or other mechanisms for the DMQ such as land titling, land use control, among others; and (iii) Approaching and involving the private sector, to be part of the compensation system.

Ecuador and Quito MR are working in their mitigation processes in an independent way. The National government has focused on its two major emission sources in the country, allowing the Quito MR and other Ecuadorian cities to work on their own.

HONDURAS AND TEGUCIGALPA

Tegucigalpa / Honduras

Honduras is a little behind with its climate change agenda relative to the other countries, certainly reflecting its lower level of development (GDP between 2.5 and 6 times lower than the other 3 countries). Its latest GHG inventory is from 2000, making the analyses of current mitigation options in Honduras rather difficult. The country's NDC stresses the need to prioritize adaptation over mitigation, emphasizing its low rate of emissions, high vulnerability to climate change impacts coupled with its low income level. Although more concerned with adaptation than mitigation, Honduras has published its NDC with mitigation targets and according to the UNDP Honduras will present its Third National Communication in the COP 24 in December of 2018. The municipality of Central District (Tegucigalpa and Comayagüela), on the other hand, is further ahead with the climate agenda

due to the support from the Inter-American Development Bank, that helped the local Government to prepare its Emerging Sustainable Cities Action Plan 2015.

It is difficult to compare the national and local emissions, due to the outdated inventory from the country (year 2000). The local inventory is also not so up-to-date either – having been made in 2011. In 2000, AFOLU was the highest GHG emitter in the country, with emissions mainly from cattle enteric fermentation and from deforestation, followed by transport sector – Tables 17 and 18.

TABLE 17 – HONDURAS NATIONAL AND CITY EMISSIONS, VARIOUS COMPARABLE STATISTICS

ECUADOR	QUITO MR
• % 0.12 of the world population	• 13.3% of country's population
• 0.03 % of world GDP	• 12,4 % of the country's GDP
• % 0.04 of world emissions	
• Total emissions ≈ 15.13 $MtCO_2$-eq in 2000, 18.9 MtCO2-eq in 2012 • Per capita ≈ 2.33 tCO_2-eq (2000), 2.38 tCO_2-eq (2012)	• Total emissions ≈ 2.9 $MtCO_2$-eq in 2011 • Per capita ≈ 2.54 t CO_2-eq (2011)

SOURCE: Second National Communication of Honduras and Plan de Acción Tegucigalpa y Comayaguela – Capital Sostenible Segura y Abierta al Pblico

TABLE 18 – HONDURAS AND TEGUCIGALPA SECTOR EMISSIONS AND RESPECTIVE SHARES ($MTCO_2$-EQ)

SECTOR	HONDURAS		TEGUCIGALPA MR	
	2000	%	2011	%
Energy	1.66	10.9	0.58	19.8
Transport	2.4	15.9	0.65	22.4
IPPU	0.69	4.6	--	--
AFOLU	8.62	56.8	1.16	39.6
Waste	1.74	11.5	0.53	18.2
TOTAL	15.13	100	2.92	100

SOURCE: Second National Communication of Honduras and Plan de Acción Tegucigalpa y Comayaguela – Capital Sostenible Segura y Abierta al Público

Table 18 indicates that even in the Capital City, Tegucigalpa, AFOLU is the main GHG emitter, a feature only observed in the poorer countries in the world. Forest fires represent 28% of total emissions from AFOLU, with transport being the second largest emitter (22% of emissions), followed closely by energy and waste (19.8% and 18.2%, respectively). Such percentages are not common among the countries included in this study, again reflecting the lower level of development of Honduras, with a higher prevalence of rural activities even in urbanized areas.

Even though Honduras is more concerned with adaptation than with mitigation, the country has an NDC target of reducing its emissions by 15% compared to the BAU scenario for 2030. This commitment is conditioned to the availability of favorable and predictable international support coupled with accessible climate financing mechanisms. Honduras has committed to planting and reforesting 1 million hectares before 2030. Also, through the NAMA of efficient stoves a 39% reduction is expected in the consumption of firewood by families, which reduces emissions and at the same time the pressure for deforestation – as seen in Table 19.

The Municipio Distrito Central does not have a target commitment but has a strong and structured emissions reduction plan. The implementation of the action plan could result in a reduction of at least 1.78 million tCO_2eq by 2050, which is 26% below the BAU scenario. The emission projections are shown below in Table 20 and Figure 6.

TABLE 19 – HONDURAS EMISSIONS PROJECTIONS AND MITIGATION TARGETS

	2000	**2012**	**2030**	SHARE OF GLOBAL EMISSIONS **2010**	SHARE OF GLOBAL POPULATION **2017**	HDI (WORLD RANK)* **2014**
Total Emissions	15.1	18.9	28.9	24.6	15%	4.3

SOURCE: Honduras NDC

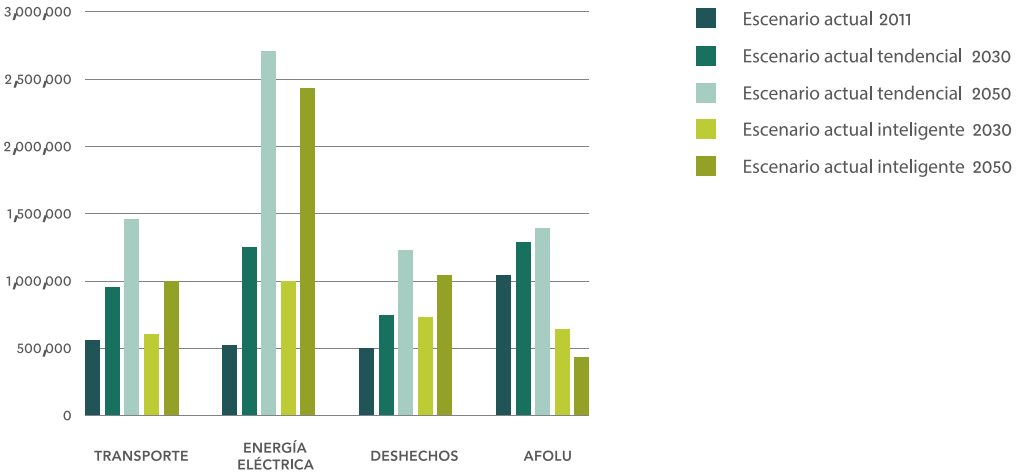
TABLE 20 – TEGUCIGALPA MR EMISSIONS PROJECTIONS AND MITIGATION TARGETS ($MTCO_2$-EQ)

SECTOR	2011	2030 BAU	2030 WITH MITIGATION	% OF TOTAL REDUCTIONS IN 2030	REDUCTION/ BAU 2030 EMISSIONS
Energy	0.58	≈ 1.25	≈ 1.0	20%	0.25
Transport	0.65	≈ 0.95	≈0.7	26%	0.25
AFOLU	1.16	≈ 1.33	≈0.7	47%	0.63
Solid Waste	0.53	≈0.8	≈0.7	12.5%	0.1
TOTAL	2.92	4.33	3.1	28%	1.23

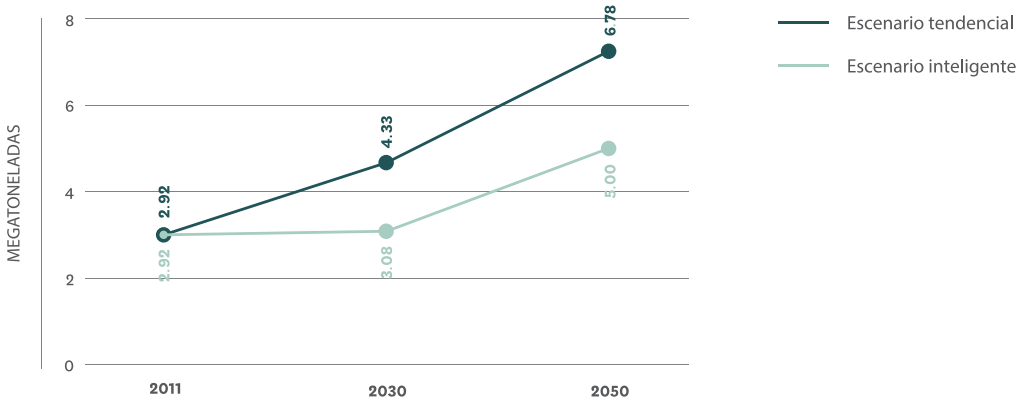
SOURCE: Plan de Acción de Tegucicalpa y Comayaguela – Capital Sostenible Segura y Abierta al Público

FIGURE 6 – TEGUCIGALPA EMISSIONS PROJECTIONS UNDER DIFFERENT SCENARIOS

COMPARACIÓN DE EMISIONES DE CO_2 EQUIVALENTES (TCO_2 E) PARA ESCENARIOS POR SECTORES



COMPARACIÓN DE EMISIONES EN TCO_2 E PARA LOS DIFERENTES ESCENARIOS PARTIENDO DEL AÑO BASE 2011



SOURCE: Plan de Acción de Tegucicalpa y Comayaguela – Capital Sostenible Segura y Abierta al Público

NOTA: Para las proyecciones se ha asumido el crecimiento lineal de las emisiones con base en factores de influencia como el crecimiento poblacional, el crecimiento del PIB y la expansión de huella urbana.

To achieve this target, the Action Plan developed mitigation actions for transport, energy, waste and AFOLU, although the individual emissions reductions obtained with each action are not presented – as seen in Table 21 below. In aggregate, the measures proposed in the mitigation scenario could lead to a reduction of emissions of 1.78 million tCO_2e per year by 2050. AFOLU and urban transport present the greatest potential to collaborate with t his reduction, the first due to frequent forest fires that are preventable, and the second due to the strong growth of the vehicle fleet and the opportunity to apply the regulations on emissions more strictly.

In conclusion, Honduras is still preparing for a mitigation strategy update which might be published through the Third National Communication that will be presented at the COP 24. Municipio Distrito Central, on the other hand, is more advanced in the mitigation agenda due to the IDB support. Coordination of the national and city level can be greatly improved and this is another upcoming challenge for both national and city governments.

TABLE 21 – TEGUCIGALPA MR MITIGATION MEASURES PER SECTOR

SECTOR	MITIGATION MEASURES
Transport	Implantation of bus with exclusive lanes
	Implantation of bicycle lanes
	Encouraging the use of low-powered vehicles and increased energy efficiency
	Regulating the operating permits for public transport
	Moving loading and unloading activities of waste collection to periods of low traffic
Energy	Energy saving measures of the Secretary of Natural Resources and Environment
Waste	Investing in and improving the sewage treatment process
	Utilization of the gases generated in the municipal landfill
AFOLU	Fire prevention and control programs
	Education program for forest protection
	Forest restauration program
	Reduce wood consumption
	Use of forest waste to generate energy

SOURCE: PLAN DE ACCIÓN TEGUCIGALPA Y COMAYAGUELA – CAPITAL SOSTENIBLE SEGURA Y ABIERTA AL PÚBLICO

In conclusion, Honduras is still preparing for a mitigation strategy update which might be published through the Third National Communication that will be presented at the COP 24. Tegucigalpa MR, on the other hand, is more advanced in the mitigation agenda due to the IDB support. Coordination of the national and city levels can greatly be improved and this is another upcoming challenge for both national and city governments.


PASO
PEATONAL
EN DOS
TIEMPOS

Santiago / Chile – Photo: Mauro Mora

Adaptation Countries and Cities Case Studies

The four countries and capital cities selected for an analysis of their adaptation plans were Chile and Santiago de Chile, Panama and Panama City, Costa Rica and San José, and Guatemala and Guatemala City. They are significantly vulnerable to the impacts from climate change, and these cities have developed more adaptation initiatives as far as the accessible information indicates.

This does not mean that all these countries have adaptation plans at the national and municipal levels, but most mention adaptation as a higher priority issue than mitigation. The level of awareness and interest does not guarantee a good level of coordination between national governments and their respective municipal governments – and this introduces an opportunity to help them to coordinate actions in their adaptation agenda.

CONTEXT

Beyond political and economic nuclei, the four selected capitals have a large part of the national population living in them. Table 22 summarizes the national and capital city populations together with their respective Metropolitan Regions, according to the most recent official data.

it is worth noting that the four countries and cities in this study perceive themselves as highly vulnerable to climate change threats and impacts – such as more intense heat waves, increased number of days with extreme temperatures, hurricane winds, water scarcity, etc.

These four capital cities have been particularly affected by the impacts of extreme events under current climate variability, including heat waves, long periods of drought, extreme winds and storms that cause water shortages, floods, landslides, impacts on critical infrastructure, and health and safety impacts on the population. Brazil's National Institute of Space Research (INPE) has made projections (Chou et al., 2016) of the changes in average temperature and precipitation between the present (1961-1990) and the future, considering three time-slices of 30 years (2011-2040, 2041-2070, 2071-2100) for two different climate scenarios (RCP 4.5 and RCP 8.5), using two regional climate models – Eta-MIROC5 and Eta-HadGEM2-ES – see Table 23. Considering that the numbers presented are average temperatures and rainfall, even under the less pessimistic scenarios and models the impacts are likely to be very significant.

TABLE 22 – NATIONAL, METROPOLITAN REGION AND CITY POPULATIONS, 4 COUNTRIES

COUNTRY (000)	METROPOLITAN REGION	CITY
Chile: 17.373	RM Santiago: 7.482	Santiago: 404
Panama: 4.158	RM Panama City: 2.187	Panama City: 1.162
Costa Rica: 4.301	RM San José: 1.404	San José: 288
Guatemala: 17.302	RM Guatemala City: 3.489	Guatemala City: 994

SOURCES: Chile (INE, 2017); Panama (INEC, 2013a) and (INEC, 2013b); Costa Rica (INEC, 2011); Guatemala (INE, 2008-2020)

Before presenting the individual countries' and cities' efforts towards climate adaptation, it is worth noting that the four countries and cities in this study perceive themselves as highly vulnerable to climate change threats and impacts – such as more intense heat waves, increased number of days with extreme temperatures, hurricane winds, water scarcity, etc. Such threats vary by country and city but they all feel pressured by the urgency of managing risks and adapting to climate changes, in addition to increasing their capacities for coordination, planning, and implementation of adaptation measures. The following is a summary of the desk review made about climate change and its impacts on these in these countries, as described in the official, accessible documents.

TABLE 23 - APPROXIMATE DATA OF AVERAGE TEMPERATURE DIFFERENCE (°C) BETWEEN THE PERIODS OF THE FUTURE (2011-2040, 2041-2070, 2071-2100) AND THE PRESENT (1961-1990), ACCORDING TO THE RCP 4.5 AND RCP 8.5 SCENARIOS AND THE ETA-MIROC5 AND ETA-HADGEM2-ES MODELS, IN MEGACITIES OF CENTRAL AND SOUTH AMERICA

FUTURE PERIODS	CITIES	DECEMBER, JANUARY, FEBRUARY				MARCH, APRIL, MAY				JUNE, JULY, AUGUST				SEPTEMBER, OCTOBER, NOVEMBER			
		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES	
		RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
2011-2040	Guatemala City	1.5, 2	1.5, 2	2, 2.5	2.5, 3	1.5, 2	1.5, 2	2, 2.5	3.5, 4	1, 1.5	1, 1.5	2, 2.5	2.5, 3	1, 1.5	1, 1.5	2, 2.5	2.5, 3
	San Jose	1.5, 2	1.5, 2	2, 2.5	2.5, 3	1.5, 2	1.5, 2	2, 2.5	2.5, 3	1, 1.5	1, 1.5	2, 2.5	2, 2.5	1, 1.5	1, 1.5	2, 2.5	2, 2.5
	Panama City	1.5, 2	1.5, 2	2, 2.5	2.5, 3	1.5, 2	1.5, 2	2, 2.5	2.5, 3	1, 1.5	1, 1.5	2, 2.5	2, 2.5	1, 1.5	1, 1.5	2, 2.5	2, 2.5
	Santiago	0.5, 1	0.5, 1	1.5, 2	2, 2.5	0.5, 1	0.5, 1	1.5, 2	2.5, 3	0.5, 1	0.5, 1	1, 1.5	2, 2.5	-0.5, 0.5	-0.5, 0.5	0.5, 1	1.5, 2
2041-2070	Guatemala City	2, 2.5	2.5, 3	2.5, 3	4, 4.5	1.5, 2	2.5, 3	2.5, 3	4.5 - 5	1.5, 2	2, 2.5	2.5, 3	4, 4.5	2, 2.5	2.5, 3	3, 3.5	4, 4.5
	San Jose	2, 2.5	2.5, 3	2.5, 3	3.5, 4	1.5, 2	2.5, 3	2, 2.5	3.5, 4	1.5, 2	2, 2.5	2, 2.5	3, 3.5	2, 2.5	2, 2.5	2.5, 3	3, 3.5
	Panama City	2, 2.5	2.5, 3	2.5, 3	3.5, 4	1.5, 2	2.5, 3	2, 2.5	3.5, 4	1.5, 2	2, 2.5	2, 2.5	3, 3.5	2, 2.5	2, 2.5	2.5, 3	3, 3.5
	Santiago	1, 1.5	1.5, 2	2.5, 3	4, 4.5	1.5, 2	2, 2.5	2, 2.5	3.5, 4	1, 1.5	1.5, 2	2, 2.5	2.5, 3	1, 1.5	1.5, 2	2, 2.5	2.5, 3
2071-2100	Guatemala City	2.5, 3	3.5, 4	3, 3.5	5, 6	2, 2.5	4.5 a 5	3.5, 4	6, 7	2, 2.5	3.5, 4	3.5, 4	6, 7	2, 2.5	3.5, 4	3.5, 4	6, 7
	San Jose	2.5, 3	3.5, 4	3, 3.5	5, 6	2, 2.5	4, 4.5	3.5, 4	5, 6	2, 2.5	3.5, 4	3.5, 4	6, 7	2, 2.5	3.5, 4	3, 3.5	5, 6
	Panama City	2.5, 3	3.5, 4	3, 3.5	5, 6	2, 2.5	4, 4.5	3.5, 4	5, 6	2, 2.5	3.5, 4	3.5, 4	6, 7	2, 2.5	3.5, 4	3, 3.5	5, 6
	Santiago	2, 2.5	3.5, 4	3, 3.5	5, 6	2.5, 3	4, 4.5	2.5, 3	5, 6	1.5, 2	2.5, 3	2, 2.5	5, 6	1.5, 2	3.5, 4	3, 3.5	5, 6

SOURCE: After Chou et al., 2016.

TABLE 24 - APPROXIMATE DATA OF AVERAGE PRECIPITATION DIFFERENCE (MM / DAY) BETWEEN FUTURE PERIODS (2011-2040, 2041-2070, 2071-2100) AND THE PRESENT (1961-1990), ACCORDING TO THE RCP 4.5 AND RCP 8.5 SCENARIOS AND THE ETA-MIROC5 AND ETA-HADGEM2-ES MODELS, IN MEGACITIES OF CENTRAL AND SOUTH AMERICA

FUTURE PERIODS	CITIES	DECEMBER, JANUARY, FEBRUARY				MARCH, APRIL, MAY				JUNE, JULY, AUGUST				SEPTEMBER, OCTOBER, NOVEMBER			
		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES		ETA-MIROC5		ETA-HADGEM2-ES	
		RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
2011-2040	Guatemala City	0.5, -0.5	-0,5, -1	0.5, -0.5	0.5, -0.5	-1, -2	-1, -2	0.5, -0.5	1, 2	-1, -2	-1, -2	-1, -2	-1, -2	-2, -3	-2, -3	-0.5, -1	-0.5, -1
	San Jose	-0,5, -1	-0,5, -1	-0,5, -1	1, 2	-0.5, -1	-0.5, -1	-0.5, -1	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-2, -3
	Panama City	-0,5, -1	-0,5, -1	-0,5, -1	1, 2	-0.5, -1	-0.5, -1	-0.5, -1	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-2, -3
	Santiago	0.5, -0.5	0.5, -0.5	0.5, -0.5	-0.5, -1	0.5, -0.5	-1, -2	0.5, -0.5	0.5, -0.5	3, 4	-1, -2	0.5, -0.5	0.5, -0.5	0.5, -0.5	0.5, -0.5	1, 2	-1, -2
2041-2070	Guatemala City	0.5, -0.5	-0,5, -1	0.5, -0.5	0.5, -0.5	-1, -2	-1, -2	0.5, -0.5	1, 2	-2, -3	-2, -3	-1, -2	-1, -2	-2, -3	-2, -3	-1, -2	-1, -2
	San Jose	-0,5, -1	-0,5, -1	-0,5, -1	1, 2	-0.5, -1	-0.5, -1	-0.5, -1	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-2, -3
	Panama City	-0,5, -1	-0,5, -1	-0,5, -1	1, 2	-0.5, -1	-0.5, -1	-0.5, -1	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-2, -3
	Santiago	0.5, -0.5	-0.5, -1	0.5, -0.5	0.5, -0.5	0.5, -0.5	-1, -2	0.5, -0.5	0.5, -0.5	0.5, -0.5	0.5, -0.5	-0.5, -1	-1, -2	0.5, -0.5	-2, -3	-1, -2	-2, -3
2071-2100	Guatemala City	-0,5, -1	-0,5, -1	0.5, -0.5	0.5, -0.5	-1, -2	-1, -2	0.5, -0.5	1, 2	-2, -3	4, 6	-1, -2	-2, -3	-2, -3	4, 6	-1, -2	-2, -3
	San Jose	-0,5, -1	-1, -2	-1, -2	1, 2	0.5, 1	-0.5, -1	-0.5, -1	-2, -3	-1, -2	-2, -3	-2, -3	-2, -3	-1, -2	-1, -2	-2, -3	-3, -4
	Panama City	-0,5, -1	-1, -2	-1, -2	1, 2	0.5, 1	-0.5, -1	-0.5, -1	-2, -3	-1, -2	-2, -3	-2, -3	-2, -3	-1, -2	-1, -2	-2, -3	-3, -4
	Santiago	-0.5, -1	-1, -2	-0.5, -1	-0.5, -1	0.5, -0.5	-2, -3	0.5, -0.5	-1, -2	-1, -2	-2, -3	-1, -2	3, 4	-1, -2	-2, -3	-2, -3	-3, -4

SOURCE: After Chou et al., 2016.

CHILE

The country is highly vulnerable to natural disasters. Temperature and rainfall already severely impact water resources, a condition experienced particularly by Santiago, located in a basin with seasonal rains and small masses of circulating air, accompanied by meteorological phenomena such as thermal inversion and the coastal trough. Future climate scenarios indicate temperature increases between 2°C and 4°C throughout the country at the end of the century; decrease in rainfall between 5-20% in the

Central Zone and an increase in rainfall between 10-15% in the Southern Zone; defrosting of the glaciers and decrease of the snow storing areas in the Andes; and a sea level rise between 20 cm and 30 cm. In addition, the frequency and intensity of extreme hydrometeorological events, such as droughts, extreme rainfall, and floods, are expected to increase. With urban areas facing atmospheric pollution problems and mountainous ecosystems such as the mountain ranges of the Coast and the Andes, the changes will have both direct and indirect impacts on Chilean cities, its people's way of life, natural resources and ecosystems, particularly water resources. All the more because there are other non-environmental vulnerabilities that compound the intensity of impacts – like the high levels of inequality of the Chilean economy and limitations in technological capacity on climate change. Incentives and finance are limited with regard to absorption of technology transfer and for research and development. Adaptation remains a challenge and a priority for the country.

PANAMA

The country is exposed to a wide range of natural and anthropogenic threats that produce significant impacts: it is estimated that the annual cost of recurrent events range between US$125 and 150 million (0.36% to 0.42% of GDP), which can have significant effects on Panama's long-term growth. The main extreme weather events include droughts, excessive rainfall, hurricane winds, floods, and

Panama City / Panama – Photo: Octávio Fossatti

The climate in the different regions of Costa Rica is expected to be marked by dry extremes, such as the 2008 drought, and extreme rain events, such as the one that occurred during the El Niño episode of 2014-2015. CNE estimates that between 2005 and 2017 there were losses of US $ 2.210 million in the areas of infrastructure, services, and other economic activities

landslides. Climate change can intensify the risks in the country and increase the economic vulnerability of important sectors such as agriculture, particularly land-use change and forestry, and navigation in the Panama Canal. The loss of agricultural productivity can reach 4% to 7% of GDP. The operating regime of the Canal can be affected by climate change due to changes in the availability of water for lockage. The climatic scenarios show an aggravation in the next decades of what Panama is already suffering at the present time. The projections to the year 2050 reflect an average increase in temperatures between 0.5°C and 2°C, with an increase in the variability of rainfall patterns (CATHALAC, 2016). The main expected impacts of climate change in Panama are related to the occurrence of extreme precipitation events and the subsequent floods and landslides on unstable slopes; the events of water shortages resulting from phenomena such as El Niño; the impacts on health with an increase in the incidence of water-related diseases; sea-level rise and general impacts on the economy.

COSTA RICA

The country is located in an area especially vulnerable to climate events, under two climatic regimes – the Pacific and the Caribbean – both with dry and rainy seasons. The most frequent extreme weather events are tropical depressions, tropical storms, hurricanes, tropical waves, low-pressure systems, troughs, and cold fronts. Any of these intense phenomena can cause floods (MINAE-IMN, 2014). In recent decades, important changes have been observed in precipitation patterns and increases in temperatures. The climate in the different regions of Costa Rica is expected to be marked by dry extremes, such as the 2008 drought (IMN, 2008), and extreme rain events, such as the one that occurred during the El Niño episode of 2014-2015. The National Commission for the Prevention of Risks and Emergency Care (CNE) estimates that between 2005 and 2017 there were losses of US$ 2.210 million in the areas of infrastructure, services, and other economic activities (CNE, 2017). Road

San José / Costa Rica

infrastructure is the most affected sector, followed by electricity generation and distribution, agriculture and housing. Sixty-nine percent of these losses correspond to infrastructure impacts. The scenarios foresee the intensification of these phenomena and national studies evaluate that by 2030 the losses would amount to more than the US$ 7,000 million (constants of 2006), and by 2050 to almost US$ 30,000 million. These losses will be naturally higher among vulnerable groups.

GUATEMALA

The country is located in a highly vulnerable region, between three intercontinental plates and with particular hydrological and geomorphological characteristics. Guatemala is between the Atlantic Ocean and the Pacific in an area of intertropical convergence, in the zone of influence of the El Niño and La Niña phenomena, and is on the route of the hurricanes and tropical storms of the Caribbean. Guatemala is also exposed to extreme events. From 1998 to 2014, eight extreme hydrometeorological events linked to climate change have been recorded: hurricanes and tropical storms Mitch (1998), Stan (2005) and Agatha (2010); and some important tropical depressions and droughts. Accumulated losses and damages are estimated to amount to more than US$ 3.5 billion, distributed mainly between infrastructure, agriculture, and health. Hurricane Mitch alone caused damages to the road infrastructure with losses of around US$ 116 million. The

magnitude and frequency of natural phenomena such as storms, droughts, and frosts are expected to increase, impacting especially the most vulnerable populations in the country. The socio-environmental vulnerability of the country is largely caused by the prevailing high levels of poverty (approximately 51% of the population is in poverty and 15% in extreme poverty). However, 33.7% of Guatemala's territory has native forest cover that contributes significantly to the livelihoods of local populations. In addition, around a third of the national territory has been declared as a protected area.

INSTITUTIONAL FRAMEWORS AND GOVERNANCE

There are great differences in the institutional frameworks of the four countries and between the four capital cities, as well as between the cities and their respective countries. This allows for a comparison of their institutional frameworks and an analysis of the opportunities and obstacles to adaptation policies. A key factor that underpins decisions at the government level is the information (and its quality) regarding climate change. Schaller et al. (2016) suggest that inconsistent information leads (i) both the population and policymakers not to develop awareness about the possible magnitude of climate change, as they perceive the possible impacts as something very far off in the future; (ii) climate change to be considered as an issue that pertains more to science than to policy or planning; (iii) local actors and local governments not to be aware of the projected climate scenarios, making it nearly impossible to make better long-term decisions. There is also a marked difference among sectors concerning their interest in obtaining information, depending on political will, vulnerability to climate impacts, synergy between sectors and the capacity to use information.

Decisions have been made for the advancement of adaptation even when the information is not high quality. Most of the time the information comes

A key factor that underpins decisions at the government level is the information (and its quality) regarding climate change

under a top-down approach: the commitments assumed internationally by the countries tend to have a determining role in the adoption of national adaptation policies and planning. In many cases also, the information is generated under a bottom-up approach, coming from traditional knowledge about the environment, from perceptions of local risk, and from concerted evaluation processes. In the best of cases, the integration of these two approaches also bridge different levels of government as well as science-based and more political solutions.

Table 25 indicates commitments, policies, and plans for climate change undertaken by the four countries, followed by a descriptive summary on the institutional structures that govern national climate policies, their NDCs, national adaptation plans, and actions.

TABLE 25 – COMMITMENTS, POLICIES, AND PLANS FOR CLIMATE CHANGE, 4 COUNTRIES, PER YEAR OF RATIFICATION AND PUBLICATION OF THE LEGAL NORM

LEGAL FRAMEWORKS	CHILE	PANAMÁ	COSTA RICA	GUATEMALA
UNFCCC Ratification	1994	1995	1994	1995
Paris Agreement	2017	2016	2016	2017
NDC	2015	2016	2015	2015
First National Communication	1999	2001	2000	2001
Second National Communication	2011	2011	2009	2015
Declared as a Protected Area	declared	declared	declared	declared
CC Framework Law	(for 2019)	1998, 2015	2016	2013
National Policy on CC	-	2007	-	2009
National Climate CC	2006	2015	2009	-
National Action Plan for CC	2008, 2017	2007	2015	2016
National Policy on Adaptation to CC	-	2007	2018	-
National Plan of Adaptation to CC	2014	-	-	-
Adaptation Plan for Cities	2018	-	-	-

SOURCES: UNFCCC https://unfccc.int/documents and https://treaties.un.org (both accessed in October 2018); Official government websites (accessed October 2018).

Guatemala City / Guatemala

Santiago / Chile

CHILE

The policy on climate change was initiated through the ratification of the UNFCCC (United Nations Framework Convention on Climate Change) in 1994, and the Kyoto Protocol in 2002. In 2006, Chile formalized a National Climate Change Strategy and its implementation through the National Action Plan for Climate Change (PANCC I) 2008-2012. Chile ratified the Paris Agreement in January 2017, and presented its NDC in September 2017. The NDC is based on five pillars: mitigation; adaptation; capacity development; technology development and transfer; and financing. The National Action Plan for Climate Change 2017-2022 (PANCC II) is the instrument that articulates the national climate change policy for the coming years in the country, considering four strategic axes: adaptation, mitigation, means of implementation, and regional and community climate change management.

Chile has identified adaptation as the fundamental axis of its climate change strategy. For its implementation, the involvement of all stakeholders it considered crucial, particularly sub-national governments. In this context, each region has created a Regional Committee on Climate Change (CORECC), consisting of representatives of the Regional Ministerial Secretariats (SEREMIs), the Regional Government, the Regional Council, and municipalities in the region. This committee coordinates the regional actions of the national plan with the sectoral plans. The participation of the municipalities in the Committee is voluntary and is framed according to the interests and singularities of each commune. The adaptation actions will be structured based on two different cycles: until 2021, Chile proposes to implement concrete actions to increase resilience in the country, within the framework of the PNACC 2014 and the Sectoral Plans, to identify sources of financing and to strengthen the institutional framework for adaptation. Starting in 2021, Chile will begin a second cycle of sectoral adaptation plans, updating the PNACC 2014.

PANAMA

The country ratified the UNFCCC in 1995 and the Kyoto Protocol in 1997. Panama presented its First National Communication in 2001 and the Second in March 2012. It plans to present the Third Communication and the First Biennial Update Report in December 2018. In April 2016, the Republic of Panama presented its NDC. The country's commitments are reflected in the Strategic Plan for the Government of Panama (PEG 2015-2019) and Law 8 of March 25, 2015, which amends the General Environmental Law of 1998 and creates the Ministry of the Environment. In 2007, Panama established its National Climate Change Policy, with its respective Action Plan. In 2009, the National Committee on Climate Change (CONACCP) was created, the most important national collegiate body on the topic of climate change, responsible for institutional coordination and compliance with the provisions of the international agreements. In 2015, CONACCP published the National Climate Change Strategy (ENCCP), which guides the formulation of sectoral adaptation and mitigation plans. The ENCCP is structured under three components: adaptation, low-carbon development, and capacity development and technology transfer. This last component seeks to address the scarcity of information and technologies related to national adaptation and mitigation processes. The thematic axes of the ENCCP are food security, water security, energy security, marine-coastal security, logistics security, and resilient districts.

Panama City / Panama - Photo: Miguel Bruna

COSTA RICA

The country presented its NDC in September 2015, which defined its commitment to climate actions until 2030. In 2009 the country published its National Climate Change Strategy (ENCC), and its action plan in 2015, with guidelines for national climate change policies and establishing strategic work axes, among which adaptation to climate change. In this axis, the key sectors are water, energy, agriculture, fisheries and coastal areas, health, infrastructure, and biodiversity. In April 2018 the National Adaptation to Climate Change Policy 2018-2030 (PNACC) was published, with the objective of strengthening capacities and resilience conditions, reducing vulnerability, damages and losses, and seizing opportunities to couple development and adaptation. The implementation and follow-up of the PNACC will be carried out looking for sectoral and inter-institutional coordination, using existing structures that facilitate the coordination of the various State institutions and that encourage the participation of social actors. Among these are the Sectoral Council of Environment, Energy, Seas, and Territorial Organization, the Inter-ministerial Technical Committee on Climate Change, the Citizen Advisory Council on Climate Change, the Scientific Council on Climate Change and the Municipal Emergency Committees.

GUATEMALA

The country presented its NDC in September 2015, in the context of a recently stabilized political crisis. The country has had a National Climate Change Policy since 2009, and the Framework Law to regulate both mitigation and adaptation processes since 2013. This Framework Law created the National Council on Climate Change, which integrates key sectors and actors of the country (government, municipalities, mayors and indigenous populations, the private sector, peasants, NGOs, and universities). The National Council promotes compliance with the country's commitments to the UNFCCC. The contributions contained in the NDC will also be incorporated into the K'atun National Development Plan: Our Guatemala 2032, and the National Action Plan on Climate Change (PANCC), launched in October 2016. The PANCC is an instrument containing guidelines that define the actions of the State to reduce the country's vulnerability, increase resilience and improve its adaptation capacities. These various national instruments prioritize actions in key sectors. It is expected that with the National Adaptation Action Plan, still under development, each government agency will draft its strategic plans according to its legal mandate and budget. In terms of disaster risk reduction, the country is developing a process of unification of climate information and early warning systems; however, major technological, financial and cultural barriers challenge the institutions' response capacity.

CITY PLANS AND COORDINATION WITH NATIONAL PLANS

The four cities studied present clear differences in terms of their advances in the planning of adaptation actions. There are also internal variations between the country and the city plans, particularly in terms of their strategic axes. Local strategies and national strategies are not always compatible or have not been developed collaboratively, which jeopardizes their effectiveness. While national plans must reflect global and international commitments (such as the NDCs), they must also take into account local needs and demands, implementation capacity, financing possibilities, etc. However, the vast majority of cities do not have climate plans (either mitigation or adaptation), so that national governments have to pursue national policies and plans with only limited inputs from cities.

The need for coordination is not specific to the climate agenda. It is entirely feasible and also in their best interests that countries and cities work together in planning adaptation. This requires openness and an interest in coordination. This section analyzes the experience of the four countries and respective cities in terms of the information flow in both directions: national plans feeding and being fed by local policies and plans, and vice-versa. Table 26 summarizes the existing initiatives which were here analyzed, by country and city.

TABLE 26 – EFFORTS TOWARDS CLIMATE ADAPTATION, BY COUNTRY AND CITY

COUNTRIES/CITIES	NATIONAL PLANS	LOCAL PLANS
Chile, Santiago	National Adaptation Plan for the Cities of Chile (2018-2022)	Adaptation to Climate Change Plan for the Metropolitan Region of Santiago de Chile – Plan CAS (2012)
Panama, Panama City	National Climate Change Strategy of Panama	Plan of Action "Panama Sustainable City" (2015)
Costa Rica, San José	National Policy of Adaptation to Climate Change of Costa Rica	Municipal Development Plan of San José (2017-2020)
Guatemala, Guatemala City	National Action Plan for Climate Change of Guatemala (PANCC 2016)	---

SOURCES: Official government websites (accessed October 2018).

SANTIAGO DE CHILE

In 2010 the capital began drafting the Adaptation to Climate Change Plan for the Metropolitan Region of Santiago de Chile (CAS Plan). It was the first nation-wide project to identify measures to adapt to climate change at the city level. It was developed during the years 2010 to 2012 in a participatory framework between the Regional Government, the municipalities of the Metropolitan Region, the Regional Secretariats of the Ministry of the Environment, the Ministry of Public Works, the Ministry of Housing and Urban Development and the Ministry of Health as well as different local actors, representatives of the civil society and scientists who contributed to the process in the framework of round tables. The planning process was largely supported by international research collaboration. In response to the diagnosis made, the adaptation measures proposed in the CAS Plan aim mainly at the problem of water scarcity, rising temperatures and extreme heat waves, and the high probabilities of floods that can affect certain territories of the region. Table 27 below summarizes the main lines of Santiago's CAS Plan.

TABLE 27 – SUMMARY STRUCTURE AND LINES OF ACTION OF SANTIAGO'S CAS PLAN (2012)

STRATEGIC AXES	LINE OF ACTION
Land Use: Reduction of extreme heat and flood threats	Measure 1: Monitoring system for climate change
	Measure 2: Green factor in new constructions (public and commercial)
	Measure 3: Use of existing irrigation channels along the Andean foothills to minimize the risk of flooding
Vulnerability: Reducing exposure to threats	Measure 4: Program for the Implementation of Ecological/Green Ceilings
	Measure 5: Management and creation of urban green areas with citizen participation
	Measure 6: Passive cooling techniques for low-income households
Water	Measure 7: Reducing the demand for drinking water through the introduction of water-efficient sanitation facilities in existing housing and hotels
	Measure 8: Public awareness on the treatment and reuse of gray water and implementation of the system in new residential areas
	Measure 9: Reduction of water demand from agriculture through the introduction of new efficient irrigation technologies
	Measure 10: The implementation of a water management structure for the basin

SOURCE: Metropolitan Regional Government of Santiago (GORE), 2012.

Despite having been a comprehensive plan, with underlying technical analysis and broad participation in its preparation, the CAS was never implemented. On the other hand, it served as an important basis for the National government to prepare , the "2018-2022 Adaptation Plan for Cities" in 2018. Coordinated by the Ministry of the Environment and the result of a process of inter-ministerial discussion and public consultations with the participation of Regional Governments and Municipalities, it took as a basis the guidelines contained in the National Policy of Territorial Ordering, the National Policy of Urban Development, and the National Policy for Disaster Risk Management. The general objective of the Plan is to propose adaptation guidelines for cities to face climate change, strengthening their response capacity. The Plan has a territorial approach and specific objectives to generate investments, develop capacities and governance in cities, and to promote cooperation and coordination. It is structured along five strategic axes: urban and territorial planning; infrastructure and sustainable construction; disaster risk-reduction and management associated with climate change; local management and inter-institutional collaboration; dissemination. Lines of action emerge from each strategic axis as summarized in Table 28.

TABLE 28 – SUMMARY OF NATIONAL ADAPTATION PLAN FOR THE CITIES OF CHILE (2018-2022)

STRATEGIC AXES	LINE OF ACTION
Territorial and urban planning	• Territorial planning tools and urban norms • Urban mobility
Sustainable infrastructure and construction	• Infrastructure Investment • Public space • Public buildings • Housing
Reducing and managing climate disaster risk	• Reducing disaster risk and managing impacts
Local management and interinstitutional collaboration	• Capacity building and collaboration • Management

SOURCE: Ministry of the Environment of Chile, 2018.

The different approaches of these two plans are clear. Santiago's local adaptation plan of (CAS) involved various local actors and was based on a prior evaluation study, having a strong focus on its perceived immediate needs. On the other hand, the top-down approach of the national plan, despite having the participation of local and regional actors, loses the details and specificities of localities. Yet, in its broad lines it establishes a framework that includes the local level – a political environment favorable to the implementation and financing of local plans and actions.

PANAMA CITY

The Municipality of Panama has two departments in charge of matters related to climate adaptation: the Department of Risk Management and Resilience (DGRR) and the Department of Adaptation and Mitigation to Climate Change (DAMCC). In 2016, within the framework of the Emerging and Sustainable Cities Initiative of the IDB (ICES-BID), the DGRR evaluated the main physical threats and vulnerabilities facing the City of Panama and developed hydrological models and atlases of risks and vulnerability to climate change. This study made recommendations for the improvement of the Metropolitan Area of Panama in order to achieve an "intelligent growth" scenario, distributed along four axes: urban planning; mobility and urban infrastructure; protection and enhancement of natural resources; housing policy governance, legal and fiscal measures. In August 2018, the Municipality of Panama launched the Resilient Panama Strategy proposing initiatives for the City to face its vulnerabilities and to develop its capacity for adaptation. The strategy is based on five key pillars: access to opportunities; local neighborhood infrastructure; revamping wetlands; knowledge and information sharing; and shared management.

TABLE 29 – SUMMARY OF THE ADAPTATION GOALS OF THE PANAMA SUSTAINABLE CITY ACTION PLAN

STRATEGIC AXES	LINE OF ACTION
Flood Vulnerability: • Structural measures in the main channels • Non-structural measures against floods	• Cleaning, clearing, dredging and increasing hydraulic capacity in certain sections of riverbeds of main rivers to avoid overflow. • Maintain flood areas that serve as buffer and lamination of floods. • Evaluation for the treatment of middle and upper river basins. • Development of an early warning system. • Information to the population potentially affected by flood events. • Promotion of insurance against natural risks. • Delimitation and demarcation of the public hydraulic domain in the areas potentially affected by rivers and streams.
Vulnerability to extreme winds: • Regulatory and management measures • Structural measures	• Update and improve the current cadaster and carry out a d etailed study of gale risks, with individual building surveys recording construction techniques and structural status, number of floors, demographic data, etc. • Considerations related to wind risks in the General Plan for Urban Planning. • Review of the map of maximum winds in Panama, with detailed maps in the areas of highest densities. • Review of various technical coefficients used in regulations. • Review of recommended roofs and construction methods, according to winds. • Relocation or reconstruction of category C and D houses with resistant materials. • Enable a line of credit to facilitate investments, especially in low-income areas.

SOURCE: Municipality of Panama (MUPA) and Initiative of Emerging and Sustainable Cities (ICES-BID), 2015.

The other department – DAMCC – launched the Panama City Sustainable Action Plan - Towards a Modern and Integral Urban Planning in 2015. The Plan is presented as an opportunity to reverse the trend of unplanned urban growth observed in Panama City in recent decades and to manage growth in a sustainable manner. The Action Plan is structured along three strategic lines: comprehensive planning; quality public services; and modern and efficient management. These strategic lines are in turn divided into five axes: land use and land use planning; housing and urban inequality; transportation and mobility; mitigation; vulnerability to natural disasters and adaptation to climate change, in which structural and regulatory measures against floods and extreme winds are planned. In the water axis of the Plan, water losses are expected to be reduced with investments in expansion and remodeling of the pipeline network, coupled with investments in new water treatment infrastructures and monitoring and control technologies – as shown in Table 29.

As seen previously, one of the objectives of the National Climate Change Strategy of Panama (ENCCP) is to develop adaptation and sectoral programs, among which the Resilient Districts Program, which covers all Districts of Panama where Panama City is located. Among the objectives of this Program is the evaluation of vulnerabilities and definition of municipal strategies and plans of action addressing climate change – as seen in Table 30 below.

TABLE 30 – SUMMARY OF THE NATIONAL CLIMATE CHANGE STRATEGY OF PANAMA

STRATEGIC AXES	LINE OF ACTION
Resilient districts	• Identify, value and use existing methodologies for vulnerability analysis. • Calculate vulnerability indexes to different climatic threats. • Estimate the carbon and water footprint. • Define municipal climate change strategies and their respective action plans.

SOURCE: Ministry of the Environment of Panama, 2015.

Comparing the local plan of the City of Panama and the National Strategy, it appears important that the national strategy strengthens its communication, dissemination and strategic coordination with different actors and institutions, by identifying institutional and sectoral synergies, particularly with the sub-national levels, and also by identifying and mobilizing financial resources for the implementation of the existing strategies. It is also important to strengthen the planning capacity by accessing reliable and updated data and information. With limited information and limited institutional capacity, it is important to strengthen national and sub-national capacities for the formulation of proposals, which presupposes promoting higher level research, partnerships, including international ones, and coordination of initiatives.

SAN JOSÉ

The municipality does not have a specific adaptation plan but it does have a Municipal Development Plan (2017-2020) – a medium-term planning instrument for urban, economic, social, cultural and environmental development. The Plan reports that floods and landslides are the main events that repeatedly affect the city. They occur mainly in human settlements located on the banks of rivers and are worsened by problems of obstruction of the storm sewer system. The vulnerable systems with the greatest exposure to floods are the urban infrastructure of the road network, water, sanitation, and housing. 2.3% of the area of the San José Canton has a very high susceptibility to landslides, 4.6% has a high susceptibility, and the remaining have a moderate to low susceptibility. The Plan also informs that the disaster risk reduction and climate change goals and commitments of the 2030 Development Goals, the Sendai Framework for Action 2015-2030, the Disaster Risk Management Policy of Costa Rica, the COP 21 and the Paris Agreement 2015, among others, are not being met. It indicates that the budgetary and human resources allocated to risk management are not enough to address the effects of emergencies, to implement inter-sectoral, institutional, and municipal management processes, to address existing risks and to reduce future risks, or to carry out training and provide information tools. The Plan recommends the compliance with the commitments of the international disaster risk management which somehow overlap with adaptation measures, some of which are summarized in Table 31.

In the National Adaptation Policy of Costa Rica (PNACC 2018-2030), one of the axes is improving the resilience of human and natural systems through territorial planning. According to the Policy, adaptation to climate change should be the starting point for territorial ordering. It thus aims to integrate adaptation into planning and territorial management based

TABLE 31 – SUMMARY OF DISASTER RISK GOALS OF THE MUNICIPAL DEVELOPMENT PLAN OF SAN JOSÉ (2017-2020)

GOAL	OUTCOMES
Disaster risk reduction through the planning of preventive actions, emergency response and the recovery of municipal services and infrastructure, to reduce the impacts on people, services, infrastructure and the environment – Canton of San José	• Disaster risk reduction, preparedness, response and recovery. • Regulation and urban control of 100% of risk areas through the a pplication of urban development regulations. • Studies of flood risks in micro basins, bridges, seismic vulnerability, others. • Preparation of a proposal for disaster risk indicators. • Implementation of the inventory of damages for emergencies and disasters. • Proposal for the installation of monitoring cameras in critical flood sites. • Proposal for an inter-municipal agreement for a hydro-meteorological hazard. • Cleaning 4 rivers and maintenance plans for the prevention of urban floods. • Construction of bridges. • Extension of the riverbed by placing pipes under the public highway. • Technical studies that include rainfall and hydrological data collection and analyses, primarily for the prevention and mitigation of droughts. • Development of disaster risk atlases by type of threat as tools for urban planning.

SOURCE: Municipality of San José, 2017.

on existing and new and more agile mechanisms, with an emphasis on regional and local participatory processes. The main lines of adaptation action of the Plan are summarized in Table 32.

The implementation indicator of the PNACC 2018-2030 is the incorporation of the adaptation variable in the evaluation of local development planning carried out by the General Comptroller of the Republic, as well as municipal planning instruments that incorporate criteria and adaptation actions. The PNACC also promotes improved communication, dissemination, and coordination with sub-national actors, strengthening their capacities for planning and implementing adaptation measures.

TABLE 32 – SUMMARY OF THE NATIONAL POLICY OF ADAPTATION TO CLIMATE CHANGE OF COSTA RICA

STRATEGIC AXES	LINE OF ACTION
Promotion of the conditions for the resilience of human and natural systems through territorial, marine and coastal planning.	• Development of criteria and guidelines for adaptation to climate change in sector, regional, territorial, marine and coastal planning instruments. • Incorporation of adaptation criteria in municipal management, taking advantage of existing planning instruments. • Fostering the conditions for community-level resilience, and developing local capacities in the implementation of communal planning instruments, and mainstreaming local investment for adaptation in local risk management plans.

SOURCE: Government of Costa Rica, 2018.

San José / Costa Rica

GUATEMALA CITY

In Guatemala City, there is no specific program or plan focusing on adaptation to climate change. The Municipality of Guatemala has a Vulnerability and Emergency Management Plan (AVE), aiming to guarantee coordination and an effective response. The AVE Plan complies with emergency care protocols, considering prevention, immediate response/ mitigation or reduction of impacts, and reconstruction or management of the damage that an event may have caused. In parallel, the Constitution of the Republic of Guatemala empowers municipalities to develop their own territorial planning. The Municipal Code has allowed the City of Guatemala to structure the Territorial Ordering Plan (POT), approved in 2008, with its corresponding public institutions. In the Municipality of Guatemala, the Urban Planning Directorate (DPU) and the Metropolitan Housing and Urban Development Company are currently doing studies to understand territorial dynamics and zoning and to anticipate new metropolitan challenges. These studies seek to inform urban planning regarding the need to ensure territorial sustainability and robustness and the benefits that could be obtained by integrating a vision of adaptability or resilience to climate change in the territory.

Beyond the Municipality, the infrastructure chapter of the National Action Plan for Climate Change of Guatemala (PANCC 2016) aims to ensure that municipalities and relevant public institutions apply design and construction standards that take into account variability and climate change according to the characteristics and vulnerability of their location. Among the infrastructures to be taken into account in defining adaptation actions are ports and airports; housing complexes; the health system; water supply and sanitation; drainage; and socio-urban infrastructures – as seen in Table 33 .

Guatemala City / Guatemala - Photo: Perry Grone

TABLE 33 – SUMMARY OF THE GOALS FOR INFRASTRUCTURE AND MUNICIPALITIES OF THE NATIONAL ACTION PLAN FOR CLIMATE CHANGE OF GUATEMALA (PANCC 2016)

GOAL	LINE OF ACTION
Increase the number of municipalities that have building regulations	• Update and apply construction and maintenance standards and regulations for strategic infrastructure • Develop or update Municipal Construction regulations.
Increase by 5% the network of strategic infrastructures, mainly roads, which includes construction standards that consider risk factors, climate change and land use in the life cycle of the project.	• Develop verification mechanisms for the inclusion of strategic infrastructure construction standards in the project. • Design and implement methodologies for capturing, measuring and analyzing vulnerabilities of the strategic infrastructures. • Develop methodologies and apply damage and loss evaluations to the occurrence of adverse events that affect strategic infrastructures. • Development of a risk transfer mechanism for strategic infrastructures (insurance, reinsurance, bonds and payment for damages)
Reduce the infrastructure of the road network affected by extreme events by 5%.	• Develop and implement contingency plans by type of extreme event focused on the social, vital and strategic infrastructure. • Strengthen and expand early warning systems in high-risk areas to extreme hydrometeorological events. • Mapping high-risk areas to disasters

SOURCE: National Council on Climate Change of Guatemala, 2016.

The PANCC 2016 indicates that among the main problems of the infrastructure sector is the lack of land management plans in the municipalities, especially in those most vulnerable to natural disasters. Another weakness is the lack of communication and coordination between central government agencies with other governmental institutions related to the problem of climate change. The government has indicated the need to create a national policy framework for disaster reduction that requires plans and projects at all administrative levels. Under current Municipal Codes, municipalities are responsible for issuing construction licenses, but at present few municipalities have regulations for construction that take into account the new challenges presented by climate change.

An evaluation of GWP Central America (2017) highlights the complexity of administrative procedures in Guatemala for the national approval of adaptation projects coupled with the lack of interest of decision makers in prioritizing climate change and water resources. This calls for strengthening technical capacities, developing studies and strategic plans, both at a local and regional level, and building political support at the highest levels of decision-making.

Photo: Mtthew T Rader

Conclusions, Lessons and Recommendations

Many findings and lessons learned in Phase 2 are similar to those already found in Phase 1. We begin by summarizing the main findings presented in the Phase 1 Final Report, specifically those that were reinforced in Phase 2. We then complement this with new additional findings, which apply mostly to adaptation (only Phase 1 included analyses of mitigation plans). Also, Phase 2 included a significant number of poorer and less developed countries, and that broadens and enriches findings and lessons.

SUMMARY FINDINGS OF PHASE 1, REINFORCED IN PHASE 2

The need for national and local governments to coordinate. "The engagement of all levels of government – local, sub-national and national – is crucial to tackle effectively climate change" [28]. "Vertical and horizontal integration allows two-way benefits: locally-led or bottom-up where local initiatives influence national action and nationally-led or top-down where enabling frameworks empower local players. The most promising frameworks combine the two into hybrid models of policy dialogue …" (Corfee-Morlot et al., 2010). In almost all case studies, unfortunately, consultation and negotiation processes among the different policy levels did not take place broadly. Encouraging good exceptions, even though not without problems and limitations, were the cases of Uruguay and Montevideo, Chile and Santiago, and Colombia and Bogotá (all in Phase 2). Some cities also suggested that while

the NDCs and adaptation plans were typically prepared without proper consultation and engagement by local governments, coordination begins to appear at the level of implementation: national governments are now approaching local governments to plan the implementation of NDC targets and policies, including adaptation.

- **PROACTIVE CITIES AND OPPORTUNITIES** The cities analyzed took a proactive role in developing local level climate action plans, committing to climate goals even before national governments. Such commitments in principle ignored funding from national governments and competition within the country and across cities.

- **SUPPORT FROM NATIONAL GOVERNMENTS** The difficulties to coordinate are not unique to the climate change problem. The national government needs to conceive a system to engage lower levels of government, but worldwide, the experience has been that federal governments "have only provided limited and largely inconsistent support, and it is currently unclear as to whether they will support future municipal action" (Bulkeley, 2010).

- **HOW TO COORDINATE** National governments can support municipalities by helping to create a sound institutional foundation and knowledge base to support decision-making and action at local levels, making tools available to help them to design and implement policies. A contrary approach, however, suggests that cities can provide and deliver strategies without wider support and guidance, but they need to have the capacity, resources and political will to do so. Where such wider support is limited, only larger or capital cities have achieved this, creating a considerable gap between smaller and larger cities, which should be addressed by providing support for cities of any size (Heidrich et L., 2016). In any case, the best way to induce coordination is tuning policies and incentives, strengthening government capacity, synergies with the private sector, and adequate financing and institutional development.

  Mexico (Phase 1) provides a good example of such initiatives: the National Institute of Ecology (INE) is planning on designing a platform for States and Municipalities to prepare their emissions inventories. Another platform will focus on designing sustainable cities more broadly. This is aimed specifically at small and medium size cities. In the case of Chile (in Phase 2), the same approach has been implemented for adaptation planning. The national government has developed the "2018-2022 Adaptation Plan for Cities", coordinated by the Ministry of the Environment with the general objective of proposing adaptation guidelines for cities to face climate change, strengthening their response capacity.

- **INCENTIVES TO COORDINATE** Cities have a crucial role in both mitigation and adaptation, but surely more so in the adaptation agenda. In adaptation, support from the national government will be dictated by a city's level of vulnerability. With mitigation, this support will depend on the significance of emissions by individual cities and regions - thus the criterion for providing support will be mostly a function of their size and level of economic activity. In either case, however, the fundamental drive to promote coordination between different levels of government seems to be political: whether the two governments belong to the same political parties, the level of political and economic decentralization of the country, and the degree of autonomy of cities and municipalities.

Cities have a fundamental role in influencing demand. This means changing consumer habits and developing a culture towards sustainability, which affects both mitigation and adaptation needs and capacities

- **CITIES AUTONOMY AND NETWORKS** Cities have a fundamental role in influencing demand. This means changing consumer habits and developing a culture towards sustainability, which affects both mitigation and adaptation needs and capacities. This requires cities to have a good degree of independence from national governments. An important mechanism that facilitates such autonomy is their participation in international networks, which gives municipalities access to flows of opportunities, allows them to be a part of the flow, and may strengthen their ability to attract investments from the private sector and from public funding to bring about sustainable development. But cities also have a stake beyond participating in networks: their real potential "lies then not in complying with the existing frameworks and modes of operating within the international architectures of international climate policy, but in illuminating how other pathways are possible" (Bulkeley, 2015).

- **WORK AT THE LEVEL OF METROPOLITAN REGIONS** It makes eminent good sense, and ultimately becomes much cheaper and cost-effective, to work at the level of Metropolitan Regions, as opposed to individual city or municipality level. This applies to both mitigation and adaptation planning. Of all 12 city case studies in Phases 1 and 2, only Lima, Bogotá, Montevideo and Tegucigalpa have taken this approach (at different levels). The necessary coordination is not unique to the climate agenda – it applies equally to transport, sanitation, solid waste, and other services where economies of scale call for integrated action.

- **THE BROADER SUSTAINABILITY OBJECTIVE** City climate actions take place in the context of a broader sustainability. Climate plans must be aligned with the broader dimension of other environmental, social and economic objectives. Most actions that aim at reducing GHG emissions are also beneficial to other environmental (for example, air pollution), social (health), and economic (energy efficiency) goals. These are the co-benefits, and they generate not only higher social and economic returns, but also make them much easier to be accepted politically. Co-benefits are much stronger even in the case of adaptation, where essentially all actions bring along local welfare improvements and conversely, many local development actions increase resilience to climate events. The adaptation plans of the four city studied in Phase 2 proved to be sustainable development plans with varying degrees of attention to adaptation to climate change.

ADDITIONAL FINDINGS AND LESSONS

- **MAINSTREAMING** Mainstreaming climate change in sector policies and programs is rather difficult. Uruguay appears to be the most successful example of mainstreaming, but that does not mean that a mainstreamed model is more appropriate in every context. Both Guatemala and Honduras, for example, suggested that given the current difficulties in coordinating policies across sectors and across levels of government, it may be more appropriate to have one specific ministry or institution in charge of climate issues, and that institution should (attempt to) push the problem into other sectors' agendas.

- **ADAPTATION BEFORE, BUT NOT IN SPITE OF, MITIGATION** The NDCs and many of the mitigation and adaptation plans reviewed already indicated that for all countries and cities, adaptation is a greater priority than mitigation. This became perfectly clear in the final workshop. The sense of priority is stronger in the poorer countries in Central America – like Honduras, Guatemala, Costa Rica – that are particularly vulnerable to climate change. For these countries in particular, climate change is already an urgent problem, perceived as a priority development challenge.

- **MITIGATION STUDIES ARE AHEAD OF VULNERABILITY ASSESSMENTS** Like in most countries in the world, including richer countries, cities and countries tend to have emissions inventories and mitigation policies more often than they have vulnerability assessments and adaptation policies. Reasons for the mismatch between priorities and planning, also suggested in the workshop, include the fact that (i) funding was initially almost exclusively available for mitigation, (ii) emissions inventories are technically easier to prepare than vulnerability assessments, and (iii) mitigation is a global issue that attracts more attention than local adaptation, in addition to the fact that mitigation is more easily quantifiable – thus easier to monitor and evaluate.

- **EARLY POLITICAL WILL AND LEADERSHIP** A lesson emphasized particularly at the closing workshop: it is crucial to have political engagement at the highest possible level. This engagement needs to take place early on in the process of drafting climate plans, in order to increase the chances that the plan will be mainstreamed in broader government development policies, in sector policies, and also so that they are eventually funded.

- **DATA, TECHNICAL AND ECONOMIC ANALYSES** As also found in Phase 1, countries and cities prepare their mitigation and adaptation plans based on the best available data and planning tools, but the data and information are often very limited and/or low quality. This is more evident in the case of vulnerability analyses and adaptation planning, because the data are essentially local and, unlike mitigation, proxies from other contexts are of more limited value. As a consequence, almost the entirety of plans lack a detailed economic analysis of the costs and benefits of alternative actions. Yet, like all types of plans, as more data and information become available, the plans need to be revisited and updated.

- **ABSENCE OF QUANTITATIVE MODELING TO ASSESS VULNERABILITIES** In order to assess vulnerabilities to future climate conditions. it is necessary to know what these future conditions will be, plus assessing how they interact with geophysical, environmental, infrastructure and other local conditions. The amount of data required is significant and typically unavailable, so that mathematical projections of these interactions, which determine the level of vulnerability,

are essentially non-existent in all countries and cities analyzed. For emission inventories and estimation of "feasible" emissions reductions, this data and modeling are much more common.

- **EXTREME VULNERABILITY OF CENTRAL AMERICAN COUNTRIES** The review of case studies indicated the very high level of vulnerability of Central American countries to extreme weather events – Honduras, Guatemala, Costa Rica and Panama. As a consequence perhaps, data are available about the incidence of events, some of their costs, and the problem is clearly in the development agenda of these countries: the costs are simply too high. There is particularly good integration with the laws, institutions and frameworks from the disaster risk reduction sectors.

- **GENERAL LACK OF INFORMATION ABOUT CLIMATE CHANGE** Climate change is still perceived as a complex scientific theme that does not need to be addressed by poor developing countries – and thus it is a long-term problem, to be addressed only at the highest levels of the public administration. This perception, which is often shared by government employees, clearly takes the attention to climate change away from the administration's immediate concerns.

In closing, it is worth pointing out that many limitations hinder the good planning and implementation of adaptation. The common limitations are scarce financial and human resources, limited integration or coordination of government policies and plans (vertical and horizontal), uncertainties about the projected impacts, different perceptions of risks and adaptation alternatives among sectors and among social groups, and an absence of strong leaders and advocates of adaptation.

Adaptation is gaining importance in all the cities and countries studied, and it is increasingly becoming a priority. It must be kept in mind, however, that adaptation may come before, but not in spite of mitigation – which is the common obligation of all countries and individuals in the world. Both mitigation and adaptation come in the wake of the sustainable development agenda. The idea that climate change is a long-term challenge, a scientific problem to be addressed by the richer countries needs to be reversed with simple, didactical and accessible information.

Climate planning remains a complex challenge, full of uncertainties, which can only be addressed with the use of the most accurate available technical information. Climate planning also must be part of the agenda of the main economic sectors as well as local governments – mainstreaming – because the impacts from climate change will be felt locally and at the sector level. Both mitigation and adaptation actions will consist of sector actions that need to be incentivized by sector policies and plans, integrated with the perspectives of each region.

Cities have been proactive with the climate agenda, and increasingly in the adaptation agenda. This must be encouraged and strengthened, but national governments must support the less prepared and less capable cities. This requires a good effort towards coordination, which needs to start with strong political will and commitment – by all. But as with all development problems and challenges, governments need to have the adequate technical, financial and managerial skills to advance the climate agenda. This is a key role for the international development community to help with.

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