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CITY HALLS AND THEIR OWN ROLE ON FIGHTING CLIMATE CHANGE:
THE CASE OF RIO DE JANEIRO

MASTER OF PUBLIC ADMINISTRATION

New York

2016

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City halls and their own role on fighting climate change: the case of Rio de Janeiro

Dissertation presented to the School of
International and Public Affairs, Columbia
University, as a partial requisite to obtain the
title of Master of Public Administration.

Advisor: Prof. Arvid Lukauskas

New York

2016

ROMERO, Rafaela Dias

City halls and their own role on fighting climate change: the case of Rio de Janeiro/ Rafaela Dias Romero - New York, 2016.

51 p.: il.

Advisor: Prof. Arvid Lukauskas

Dissertation (Master Degree)

Columbia University, School of International and Public Affairs, Master of Public Administration, 2016.

1. Climate change 2. Sustainability management 3. Rio de Janeiro

I. Lukauskas, Arvid (advisor). II. Columbia University, School of International and Public Affairs. III. Title.

Name: ROMERO, Rafaela Dias

Title: City halls and their own role on fighting climate change: the case of Rio de Janeiro

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I dedicate this thesis

to my mom Ana Maria,
who holds my hand all the way since always;

to my husband Leonardo,
who supports me through this path and put everything in order;

and to the memory of my dad,
who had inspired me to look for this experience and to take it as a personal challenge.

Abstract

This dissertation aims to analyze the role of local level in terms of sustainability management, taking city halls not only as regulators of city wide emissions, but also as corporations that indeed generate their own emissions through their operations, buildings and fleet. Based on literature review, and making use of comparative analysis of New York, San Francisco and Rio de Janeiro climate action plans, the main objective is to highlight strategies for Rio de Janeiro's city hall in order to improve its corporate's sustainability management. The document begins presenting climate change issue as a public good, its challenges, and examines the relationship between sustainability management and cities competitiveness. Then it discusses sustainability management at the local level, while presenting a comparative analysis of case studies. In addition, data management is presented as a challenging issue when building a public corporate sustainability information system. Finally, it proposes strategies to improve Rio's sustainability management and observes both gaps and benefits.

Keywords: Climate change, Sustainability management, City level, Brazil, Rio de Janeiro

Resumo

Essa dissertação tem o objetivo de analisar o papel do governo a nível local no que se trata do gerenciamento da sustentabilidade, considerando as prefeituras não só reguladoras das emissões de gases na cidade, mas também como corporações que também geram suas próprias emissões através de suas operações, edificações e frota. Com base em revisão bibliográfica e fazendo uso de análises comparativas dos planos de ação para o clima elaborados em Nova York, São Francisco e Rio de Janeiro, o principal objetivo é destacar estratégias para aprimorar o gerenciamento sustentável na Prefeitura do Rio de Janeiro. O documento inicia apresentando o problema da mudança climática como um bem público, seus desafios e examina a relação entre gerenciamento da sustentabilidade e competitividade entre as cidades. Em seguida, discute o gerenciamento da sustentabilidade a nível local (municipal), enquanto apresenta uma análise comparativa entre os estudos de caso. Além disso, a gestão dos dados é abordada como uma questão desafiadora, já que é necessário criar um sistema público de informações de sustentabilidade corporativa. E, finalmente, propõe estratégias para aprimorar o gerenciamento da sustentabilidade da cidade do Rio de Janeiro e observa lacunas e benefícios.

Keywords: Mudanças climáticas, Sustentabilidade, Nível local, Brasil, Rio de Janeiro, Governo municipal

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INTRODUCTION

“Climate change is now a scientifically established fact.”¹ In 1990, the total amount of emissions was 36 gigatons of carbon dioxide equivalent. In 2005, they had risen to 46 gigatons. By 2050, in order to have a 50% probability of staying below two centigrade increase in temperature, the world needs to get down to 18 gigatons, which is half of what it was emitted in 1990 and less than half even than was already emitted in 2005.²

There is no doubt that climate change requires extremely serious and sustained global attention. The basic structure of the problem is well known: “humans emit greenhouse gases (GHGs), particularly carbon dioxide (CO₂), but also methane, nitrous oxide, and hydrofluorocarbons (HFCs), through consumption and production. These flows of emissions accumulate into stocks of GHGs in the atmosphere. The rate of accumulation depends upon Earth’s ‘carbon cycle’, whereby CO₂ is reabsorbed into the oceans and land. Over time, the accumulated GHGs trap heat and the result is global warming. As the planet warms, the climate changes, which affects human and animal life through rising sea-levels and events such as storms, floods, and droughts.”³ It is not just a distant future problem. Many of its impacts will be felt by people currently alive.

In the other hand, formulating appropriate policies is highly challenging due not only to scientific complexity, but also to an ambivalent general public and a major international prisoner’s dilemma.⁴ For instance, one country could incur the cost of doing research on renewables and pay a higher cost now. At the same time, other country could incur less costs doing nothing, while also receiving benefits from what the first country has done. There is a free rider problem. Countries may wait for others to incur the cost while they continue the old way.

¹ UNDP (2007).

² Stern e Nicholas (2006).

³ Hepburn e Stern (2008).

⁴ Ibid.

According to Carbone (2007), the concept of global public goods (GPGs) has become a key theme in the debate on international development. The author also mentions that an adequate provision of GPGs can not only “help manage the negative consequences of globalization” but also “considering that these goods provide benefits to both developed and developing countries, resources should be additional to foreign aid”.⁵

The economics of climate change is still relatively young and GHG emissions are classified as a global public bad, “possibly the most significant yet in human history.” There is no way to prevent someone from receiving the same effects from the public good while it is not possible to subtract what some person consumes from what somebody else consumes (it is a non-rivalrous and non-excludable good). Moreover, nobody consumes less or more climate once you reach a certain degree of average temperature.⁶

On the other hand, that does not mean that everybody is affected the same way by that. Although carbon concentration is a global public good, this concentration will affect various parts of the world differently. It must lead to major changes in the human geography and it will affect all countries, but the most vulnerable, such as the poorest countries and populations, will suffer earliest and most, even though they have contributed least to the causes of climate change.⁷

Moreover, many middle income countries are also becoming significant emitters, even though they do not have the carbon debt to the world that the rich countries have accumulated over the decades and even though they are still low emitters in per capita terms.⁸

The point is that adaptation to fight against climate change is an essential issue. Thus, it means taking steps towards building resilience and minimizing costs while also

⁵ Carbone (2007)

⁶ Dervis (2015)

⁷ Stern e Nicholas (2006)

⁸ UNDP (2007)

finding ethical and political acceptable paths in order to circumvent natural disagreements.⁹

In a positive approach, this will also create significant business opportunities, as new markets are created in low-carbon energy technologies and other low-carbon goods and services. “The world does not need to choose between averting climate change and promoting growth and development.”¹⁰ However, again, this could be easier for advanced countries since they are abler to develop the necessary technology.

Moreover, because new climate change policies will likely be indeed developed and implemented in the next few years, they will also mean challenging efforts for democratic governance.¹¹ Political systems will must agree to pay the early costs in order to obtain the long term gains and “leadership will require looking beyond electoral cycles.”¹²

Thus, this works starts from the premise that sustainability management is urgent and it aims to analyze the role of local level in terms of sustainability management. It takes city halls not only as regulators of city wide emissions, but also as corporations that indeed generate their own emissions through their operations, buildings, fleet, etc. By not having a corporate control of their environmental sustainability limits, municipal agencies can not implement improving actions addressed to energy efficiency and consumption reducing.

Moreover, this dissertation is based on a research made in 2014 by a group of six public servers from Rio de Janeiro’s city hall (Carlos Góes, Catia Poyares, Edijane Ballesteros, Gabriel Carreira, Nelson Lima and Rafaela Romero) and its main objective is to highlight strategies for Rio de Janeiro’s city hall in order to improve its corporate’s sustainability management. The group found that the city misses an opportunity to save financial resources, minimize environmental impacts and GHG emissions from its operations, and to lead the community by examples in sustainability actions.

⁹ Stern & Nicholas (2006)

¹⁰ Ibid

¹¹ Brainard & Sorkin (2009)

¹² UNDP (2007)

Chapter one starts by analyzing the city level government's roles on sustainability management. Then, it presents an economical approach by highlighting the relationship between sustainability and competitiveness. In sequence, it makes a comparative analysis of New York, San Francisco and Rio de Janeiro climate action plans.

Chapter two presents the challenges on collecting and managing data. Moreover, it also addresses sustainability data and greenhouse gas emissions inventories.

Chapter three highlights strategies that can be used in Rio de Janeiro towards a sustainability corporate information system.

Finally, this dissertation presents its conclusions.

CHAPTER ONE – SUSTAINABILITY MANAGEMENT

1. Sustainability management at local level

Cities are not only engines of economic growth but also that they are crucial to both economic growth and climate action. Urban areas are home to half the world's population and generate around 80% of global economic output and around 70% of global energy use and energy-related GHG emissions. Moreover, over the next decades, nearly all of the world's net population growth is expected to occur in urban areas and that by 2050, the urban population will increase by at least 2.5 billion, reaching two-thirds of the global population.¹³

Indeed “cities around the world are growing almost twice as fast as the global population.”¹⁴ Brazil's population, for instance, was estimated at 202.8 million in 2014, up 6.3% since 2010 Census.¹⁵ As shown in Figure 1, the urban population has grown since mid-1960s while rural population has dropped.

This will require more infrastructure, energy and transportation, all of which are important drivers of greenhouse gas emissions.

Therefore, municipalities have a comprehensive role on climate change. They must prevent resilience in their communities, by reducing vulnerabilities; track and control citywide emissions by making GHG Inventories, designing Climatic Action Plans and implementing public strategies and policies. Finally, they should track and control their own corporate emissions, also through Inventories and Action Plans, playing a major Leading by Example role.¹⁶

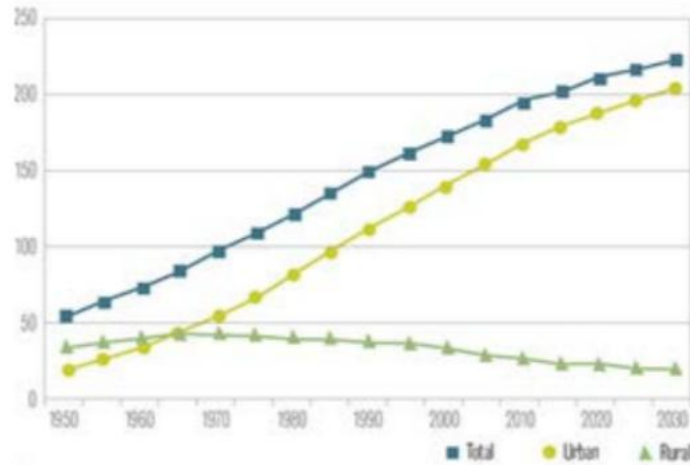
Figure 1. Brazilian population and projection (in thousands)

¹³ New Climate Economy (2014)

¹⁴ Ibid

¹⁵ IBGE (2015)

¹⁶ United States Environment Protection Agency (2016)



Source: Kahn and Brandão (2015)

Menon and Welsh (2011) corroborates by saying that sustainable peace operations require the involvement of organizations and institutions that are themselves sustainable.¹⁷ Acuto (2013) also reinforces the role of the local level on dealing with sustainability. She mentions that the international society's lack of leadership is often blamed for many of the limitations in addressing global challenges. However, she argues that effective international responses might be better addressed by ordinary influence of city leaders rather than by heads of state and diplomats. The focus might have been on the wrong kind of leaders. Mayors have a catalytic influence in global governance and have a key role for effective response to important challenges like climate change and sustainability.¹⁸

Thus, cities are part of the climate change problem, but they are also a key part of the solution.¹⁹ While targets at international levels are not binding and they are not linked to specific policies, initiatives at the municipal level have established more

¹⁷ Menon and Welsh (2011)

¹⁸ Acuto (2013)

¹⁹ Kamal-Chaoui, Lamia and Alexis Robert (2009)

concrete provisions, producing some impressive results.²⁰ Local level can measure, follow-up and be close to local authorities to make things done.²¹

City leaders can support the national government in pushing for a better international climate agreement.²² Although Brazilian cities, for instance, have limited policy instruments available to reduce GHG emissions (many approaches, such as subsidies, taxation, regulations, are responsibility of the federal government), their political influence is huge.

Therefore, it is urgent that cities should be prepared for sustainability management. It is a practice of economic production and consumption that minimizes environmental impact and maximizes resource conservation and reuse.

2. Sustainability and cities competitiveness relationship

Competitiveness is defined as a “city’s ability to attract capital, businesses, talent and people.”²³ Although not mentioned in the Global Competitiveness Report²⁴ and not representing a direct condition for countries competitiveness, the city’s social and cultural character plays an important role in shaping its attractiveness for talent and visitors in a local scale.²⁵

Moreover, the growing incidence of natural disasters influences investors in order to increasingly build locational risks into their operational strategies. It means that this affect business attraction. Thus, the environmental quality of cities is also an important trend of benchmarking between cities.²⁶

Thus, the Cities Competitiveness Report presented by The Economist (2013) includes both social and cultural character, and environment and natural hazards as

²⁰ UNDP (2007)

²¹ Romero (2015)

²² Kahn and Brandão (2015)

²³ The Economist (2013)

²⁴ Schwab, Klaus. (2016)

²⁵ The Economist. (2013)

²⁶ *Ibid*

categories with 5% weight each. Indicators for environment and natural hazard and their weights are shown on Table 1.²⁷

Another cities competitiveness report, but from World Economic Forum, also considers sustainability as a relevant aspect that influences cities competitiveness. It mentions six global “megatrends” especially relevant to cities: (1) urbanization, demographics and the emerging middle class; (2) rising inequality; (3) sustainability; (4) technological change; (5) industrial clusters and global value chains; and (6) governance.²⁸

This report defines city competitiveness as the set of factors – policies, institutions, strategies and processes – that determines the level of a city’s sustainable productivity. Sustainability is about economic, environmental and social issues. Productivity is about the efficient use of resources due to drive economic growth. Thus, productivity has to be sustainable: maintained beyond the short term, and in a way that reconciles economic, environmental and social goals.

Table 1. Environment and natural hazard category and its indicators

SUB-INDICATOR WEIGHTS		2025	2012
Risk of natural disasters			
Disaster management/business continuity plan	1	33.3%	n.a.
Physical exposure to natural hazards	1	33.3%	n.a.
Susceptibility to climate change	1	33.3%	n.a.
Environmental governance			
Water quality monitoring	1	33.3%	33.3%
Waste strategy	1	33.3%	33.3%
Air quality code	1	33.3%	33.3%
Quality of air in the city/pollution	0	n.a.	0.0%

Source: Cities Competitiveness Report

According to this report, as population and incomes grow, pressures grow on resources and the environment. “Global demand for energy could increase by up to 50% by 2030. Despite efforts to develop renewable energy, this will lead to a large rise in fossil-fuel consumption, which increases carbon emissions. At the same time, growing demand for food collides with the lack of new land for agriculture. And, energy and food production are water-intensive, thus putting growing pressure on water

²⁷ *Op. Cit.*

²⁸ World Economic Forum. (2014)

resources.”²⁹

Cities and their concentrations of people and economic activity are especially intensive users of energy, food and water, being responsible for over half of global greenhouse gas emissions. Their challenge, particularly in the developing world, is to “fuse technology and markets to become much more efficient in using available resources.”³⁰

Curitiba, a city located at the south of Brazil, is leader in innovation and green growth, where a clear strategy focused on developing local capacities and an efficient and effective public transportation policy have helped the city to become one of the richest cities in the country and the greenest city in Latin America.³¹

Curitiba has overcome the urban sprawl disorganization through strengthening the links between integrated urban transportation, appropriate land use and environmental preservation. Its most recognized creation and innovation is known as Bus Rapid Transit (BRT) system, which helped the city to earn the title of the world’s most innovative city in 1996 (UN-Habitat), as well as the Sustainable Transport Award (Institute for Transportation and Development Policy [ITDP]) and the Globe Sustainable City Award, both in 2010.

The city currently has one of the lowest air-pollution concentrations in Brazil while its economic development has been strong. From 1970 to 1980, the city’s annual GDP growth rate (11.78%) was well above the country’s 8.56%. From 2006 to 2010, this trend continued, although at a slower pace but still above Brazil’s 4.61%.³²

Corroborating to this, CDP report mentions that “the vulnerability of major infrastructure for transportation and energy is an important factor for business development” and that “instantaneous events such as flooding will decrease the ability of

²⁹ *Op. Cit.*

³⁰ *Ibid*

³¹ World Economic Forum. (2014)

³² *Ibid*

businesses to operate due to closed roads and damages to buildings”, having immediate consequences for tourism and supply chains and causing lasting impacts.³³

The nature of the city’s mobility is a crucial determinant of its sustainability. Transportation is one of the major responsible for GHG emissions and it is also directly related to resilience and the urban vulnerability to climate disasters.

Public transportation policies are relevant since public transportation generally emit less gas per person per kilometer. According to the Institute of Applied Economic Research (IPEA), buses emit 4.6 times more gases than subway per passenger per kilometer, motorcycles produces 20.3 times more GHG emissions and automobiles generates 36.1 times more, as shown in Table 2.³⁴ Individual transportation in Brazilian major cities responds for 35% of motorized trips. However, they correspond to 60% of emissions.

Table 2. Public transportation GHG emissions

MODAL	GHG emissions per passengers kilometers
Subway	x
Bus	4,6 x
Motorcycles	20,3 x
Automobile	36,1 x

Own source, based on Carvalho (2011)

Indeed, climate change has added a new responsibility to the dimension between cities and business.³⁵ CDP (2014) corroborates that 76% of cities reported that climate change could impact business, from shipping and food production to tourism and service industries.

Moreover, city government adaptation actions contribute to business resilience.³⁶ Cities that identifies climate change risks are able to deliver initiatives in order to reduce the impacts of climate change citywide. They could offer information, regulations and

³³ CDP (2014)

³⁴ Carvalho, C. (2011)

³⁵ *Ibid*

³⁶ *Ibid*

incentives in order to assist business to be also more resilient. This provides an attractive environment to business and residents alike.

Thus, CDP (2014) assumes that “physical capital, such as infrastructure and public transport, as well as human capital, including education and healthcare, are two major drivers for growth – but resilience to climate change is now a growing factor for cities’ economic competitiveness.”³⁷

São Paulo, for instance, is the largest city by population in the southern hemisphere and it is investing in infrastructure due to improve climate resilience. It is not only managing land-use but also creating new urban greenspaces, building flood-defenses and mainly investing to improve its transport infrastructure. It undertakes that such investment has the potential to increase conditions for business to operate not only increasing staffs and customers’ mobility, but also providing more efficient movement of supplies and products.

The city is also collaborating with large companies to improve its water infrastructure. “The health impacts of poor sanitation are exacerbated by climate change” and collaboration between cities and businesses is essential to reduce the impacts to the most vulnerable populations.³⁸

Driven by the increasing risks of rising global temperatures, cities are now emerging as a leading force for climate change adaptation³⁹ Cities adaptations actions due to fight against climate change is an essential issue. It means taking steps towards resilience and minimizing costs while also finding ethical and political acceptable paths to circumvent natural disagreements between involved parts.⁴⁰ This should also be seeing as an opportunity to optimize cities’ operations, the use of resources and to achieve more efficiency through government and private sector.

Moreover, cities could take this as a competitive advantage, while leading changes and impacting positively in several value chains.⁴¹ This would also create

³⁷ The Economist. (2013)

³⁸ CDP (2014)

³⁹ CDP (2014)

⁴⁰ Stern & Nicholas (2006)

⁴¹ Kamal-Chaoui, Lamia and Alexis Robert (2009)

significant business opportunities, as new markets are created in low-carbon energy technologies and other low-carbon goods and services. “The world does not need to choose between averting climate change and promoting growth and development.”⁴²

Corroborating to this, several institutions elaborate reports by considering the relationship between cities competitiveness and sustainability management. The 2025 Global City Competitiveness Index, which measures the competitiveness of 120 cities, defines competitiveness as “a city’s ability to attract capital, business, talent and people.”⁴³ And CDP (2014) is very explicit when relating resilience to natural disasters with business attraction.

In the other hand, Kahn and Brandão (2015) points out that competition between cities may also make cities reluctant to adopt ambitious measures that might make them less economically competitive.⁴⁴ Moreover, this negative approach may be expanded in a short term view inner a political mandate.

As urban development is a key national priority, which efforts to address poverty and equity will rely in cities with the largest concentrations of poverty, climate policies at national or urban level will have to support development priorities.⁴⁵

Brazil’s top development priorities, for instance, are the eradication of hunger and poverty, and the provision of health care and security. In addition, the government is trying to reduce barriers to economic growth, including through a reduction of the interest rate and the tax burden across the supply chain. There are also programs like “Bolsa Família” and “Brazil’s Growth Acceleration Program” (PAC - which aims to expand urban infrastructure to encourage rapid but sustainable growth, including projects on sewage, water and transportation).⁴⁶

It also requires cooperation across the public and private sectors. Kahn and Brandão (2015) corroborates that economic development in Brazil depends today on a mix of public- and private-sector investment, and the government has tried to incentivize

⁴² Ibid

⁴³ The Economist. (2013)

⁴⁴ Kahn and Brandão (2015)

⁴⁵ Ibid

⁴⁶ Kahn and Brandão (2015)

private-sector investment. However, the authors highlight that many of those policies, such as incentives for purchasing motor vehicles, have driven up GHG emissions with no benefits to the economy.⁴⁷

Despite these challenges, authors identify opportunities for urban greenhouse gases (GHG) abatement in Brazilian cities, with potential in shifting modes of transportation, improving vehicles' fuel efficiency, increasing the energy efficiency of residential and commercial buildings, and improving waste management.

“Cities have a responsibility to contribute to reduce emissions. Cities no longer have to choose between economic growth and emission reduction – they can do both”.⁴⁸

3. Sustainability management in American cities

City halls around the world are gradually adopting three approaches when fighting against climate change while taking emissions inventories as a starting point to sustainability management, as shown on Table 3.⁴⁹

Table 3. Three local level approaches for emissions inventories

<i>Community-Scale GHG Inventory</i>	It covers city-wide emissions and allows the City to promote mitigation strategies for the entire community.
<i>Local Government Operations (LGO) Inventory</i>	It covers emissions from responsibility of the Municipality, enabling to control its emissions through general energy efficiency strategies and sustainable consumption. It is interesting to mention that local government emissions are typically a subset of the community-scale ones, reaching 3-7% of citywide total emissions.
<i>Corporate GHG Inventory</i>	It addresses emissions of an organization. It allows any Department or Agency to control its emissions and apply direct reduction strategies. In Brazil, Programa Brasileiro GHG

⁴⁷ *Op. Cit.*

⁴⁸ *Ibid*

⁴⁹ Romero (2015)

	Protocol provides the necessary guidelines to private and Public Sector organizations; and a specific protocol was designed for public agencies in the United States: GHG Protocol for the US Public Sector.
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Source: Romero (2015)

Municipalities that implement corporate programs in order to reduce emissions in their facilities, operations and fleet not only build capacity and save resources at local level, but also achieve community's awareness to the benefits of green technologies (leading by example) and consequently improve the city's competitiveness.⁵⁰

Experiences in San Francisco and New York City include those strategies.

San Francisco experience: DepCAPs

The commitment of San Francisco City and County to environmental goals dates back to the 1990s, and it is linked to California State commitments that establish renewable energy consumption and GHG reduction targets. The first Climate Action Plan of San Francisco was launched in 2004 considering transportation, energy efficiency, renewable energy and solid waste concerns.⁵¹ San Francisco has joined with over 500 cities around the world to participate in the Cities for Climate Protection (CCP) campaign, sponsored by the International Council for Local Environmental Initiatives (ICLEI).

In 2005, San Francisco has committed to support Kyoto Protocol emission reduction targets, that were reached in 2008. From this year, City coordinates through SF Environment Department a corporate climate change program by annually tracking and publishing GHG emissions from 60 Departments through the Departmental Climate Action Plans – DepCAPs.⁵²

⁵⁰ United States Environment Protection Agency (2016) and Schwab (2016)

⁵¹ San Francisco Department of the Environment (2004)

⁵² Ibid

DepCAPs were regulated by Law in 2008, and each Department started to account their emissions and to track the following items: equipment and fleet fuel consumption, energy and water use in buildings, waste generation, employee's transportation and purchasing procedures. The process, which allows Departments to identify possible improvements of their operations and reduce their carbon footprint, is assisted by Climatic Liaisons represented by employees in each Department. Local Government Operations (LGO) emissions accounted for 4.03% of citywide emissions in 2010.⁵³

Moreover, there were published 46 DepCAPs Action Plans in 2013.⁵⁴ The Table 4 shows a common structure of these plans. Related impacts in the Community are reported and the Environmental Goals of the Department are also declared.

Table 4. Common structure of DepCAPs Action Plans

Department profile	mission, activities, responsibilities, budget, facilities, fleet
Department's carbon footprint	City and the Department targets, annual emissions, energy use, energy efficiency measures, renewable energy use, green building, water reducing and fleet fuel measures, employees' transportation raising
Other sustainable practices	regulatory compliance: Zero Waste, Green Procurement, Carbon Sequestration and Urban Planting

In addition, the Green Procurement Program is highlighted by US Environment Protection Agency (EPA) as a reference in Leading by Example, for assisting San Francisco Municipal Departments to implement City procurement policies.⁵⁵

New York City experience: PlaNYC and OneNYC

New York City elaborates GHG inventories since 2007, reporting both citywide emissions and LGO emissions. Since 2008, they are annually updated in order to register

⁵³ ICF International (2012)

⁵⁴ San Francisco Department of the Environment (2013)

⁵⁵ United States Environment Protection Agency (2014)

the progress towards targets and to fit legal requirements. Moreover, local government operations (LGO) emissions accounted for 7.10% of citywide emissions in 2009.⁵⁶

PlaNYC 2030 is a plan to responsibly meet the city's growing population and infrastructure needs while focusing on sustainability and resilience as a main theme in citywide planning. It was released in 2007 and it has become a model for other large global cities. More than 25 City Agencies and external partners in Academy, Private Sector, and Society contributed to set goals, initiatives and milestones.⁵⁷

Mayor's Office of Long Term Planning and Sustainability (OLTPS) and Mayor's Office of Recovery and Resiliency (ORR) oversee PlaNYC progress, updating it every 4 years and providing annual progress reports. OLTPS coordinates its development transversely with other municipal agencies. From 132 initiatives presented by PlanNYC update, in 2011, about 10 initiatives addressed Local Government Operations, in Energy, Air Quality, Solid Waste and Climate Change areas.

Since the first PlaNYC in 2007, the City has made considerable progress on reaching its goals, by reducing GHG emissions 19 percent, investing billions of dollars to protect the water supply, planting millions of trees, installing 300 miles of bike lanes, developing programs to phase out polluting heating oils and working to make buildings and neighborhoods more resilient.⁵⁸

As a continuation of the previous plan, but from another political mandate, OneNYC 2050 was launched in 2014 as a new approach for the city sustainability management. It expands on prior sustainability plans to address the social, economic and environmental challenges the City expects to face. OneNYC establishes goals and targets for a strong, sustainable, resilient and equitable city putting a new emphasis on economic justice.⁵⁹

⁵⁶ Dickinson and Desai (2010)

⁵⁷ NYC Mayor's Office of sustainability (2016)

⁵⁸ The City of New York (2016)

⁵⁹ Ibid

As it is shown on Table 5, there are four principles informed OneNYC goals and initiatives. Thus, this plan introduces a new focus on equity and reducing poverty for the initial plan.⁶⁰

Table 5. OneNYC four principles and its initiatives

Growth	Population growth, real estate development, job creation, and the strength of industry sectors
Equity	Fairness and equal access to assets, services, resources, and opportunities so that all New Yorkers can reach their full potential
Sustainability	Improving the lives of our residents and future generations by cutting greenhouse gas emissions, reducing waste, protecting air and water quality and conditions, cleaning brownfields, and enhancing public open spaces
Resiliency	The capacity of the city to withstand disruptive events, whether physical, economic, or social

Source: The City of New York (2016)

The plan also mentions that “the strength of the city is essential for the strength of the region, and strong communities around the city make it more competitive nationally and globally”.⁶¹ Environmental groups also claim that there is an attraction of the interest of the population to merge the sustainability issue with other issues closer to their reality and difficulty, such as housing, inequality, education, unemployment, poverty, etc. It also helps everyone to understand that sustainability will not happen only where the rich live, but everywhere, leading the focus of sustainability to public policies.

It puts nearly all City agencies together in cross-cutting working groups to examine underlying trends and data in order to develop new initiatives. However, it will need a clear roadmap that allows progress to be measured. OneNYC is abundant in terms of goals but not in terms of how those goals will be met. For example, the goal set to lift 800,000 people out of poverty is not under the exclusive city's control.

Moreover, critics also point out that the policy will face a trade-off that has not been faced before between social and environmental issues. For instance, when an initiative of housing development is proposed on a piece of land that is needed for a green

⁶⁰ *Op. Cit.*

⁶¹ The City of New York (2016)

infrastructure project, or when a proposed housing development stresses local infrastructure or environmental quality.

Therefore, central to success is the transformation of the aspirational, visionary goals of OneNYC into specific, operational management indicators. Vision is good, but tangible measurable performance is better. Management best practices dictates that in order to manage something you must measure it. On the other hand, sustainability and social metrics are still in an early stage of development.

Citizens, nonprofit organizations and the private sector can provide useful input in order to develop operational indicators, improve existing strategic ones, and prioritize objectives and develop plans of action. The City Hall website already calls citizens to speak up and declare their opinions about the plan (<http://our.cityofnewyork.us/page/s/onenyc>). The indicators and roadmap that result from this collaborative process should then be part of the management practices of the City Hall, promoting a policy oriented for learning.

4. Sustainability management in Brazilians cities

According to the National Inventory, Brazil's GHG emissions were 1.25 Gt CO₂e.⁶² At this time, the country has decreased 41.1% of its emissions relative to 2005, and the largest contribution to this decrease was from the agriculture, forestry and land use sectors.⁶³

Under the Copenhagen Accord, Brazil was the first major developing country to set emission reduction targets. The government promised to reduce emissions by 36.1 to 38.9% below business-as-usual scenario which was predicted to be 2.7 Gt CO₂e per year by 2020.⁶⁴

The country has a comprehensive federal regulatory background related to climate change that defines governance structures, plans and tools. There are also several key

⁶² See <http://www.mct.gov.br/clima>

⁶³ Kahn and Brandão (2015)

⁶⁴ Brazil's Government (2010)

institutions active on urban climate mitigation. Institutions play an important role due to identify, plan and coordinate climate actions at different scales.

The Brazilian National Plan on Climate Change includes not only participation in global initiatives but also national efforts, and has four main pillars: mitigation opportunities; impacts, vulnerability and adaptation; research and development; and education, training and communication. Its targets, such as reducing Amazon deforestation by up 80% by 2020, replacing 1 million old refrigerators each year over 10 years, and increasing recycling of solid waste by 20% by 2015, are deployed and controlled by two main institutions: The Interministerial Committee on Climate Change (CIM) and Executive Group on Climate Change (GEx).⁶⁵

There is also the Climate Observatory, which is a civil society organization that gathers specialists and social actors focused to drive climate action and to hold the government accountable on its commitments. Many NGOs are members, including WWF Brazil and Greenpeace Brazil. The Climate Observatory has established targets concerning land use, farming, electricity, transportation and fuel. It estimates that emissions in Brazil will be limited of 1 Gt Co2e by 2030.⁶⁶

Indeed, cities have significant potential to contribute to climate mitigation in Brazil. The main sources of emissions in major Brazilian cities are energy (including transportation) and waste management, such as shown in Table 6.

By following the guideline of the National Plan for Climate Change Mitigation, there are councils to discuss climate action in most major cities in Brazil that act in a local scale and, usually, also prepare and present the cities' GHG emissions inventories.

Belo Horizonte, for instance, has a Municipal Plan for Reduction of Greenhouse Gas Emissions acts with four pillars, each led by a work group: mobility, sewerage, energy, sustainable procurement and adaptation.⁶⁷


⁶⁵ *Op. Cit.*

⁶⁶ *Ibid*

⁶⁷ Kahn and Brandão (2015)

Table 6. Annual GHG emissions of major Brazilian cities and GHG emissions per sector in Rio de Janeiro (2012)

City	Emissions (in Mt CO ₂ e)	Inventory's year
São Paulo	15	2009
Curitiba	3	2008
Belo Horizonte	2	2007
Rio de Janeiro	22	2012



Sector	% of emissions
Energy	73%
Waste	21%
Industries	4%
Agriculture and land use	2%

Sources: Kahn and Brandão (2015), Prefeitura de São Paulo (2014), Prefeitura de Curitiba (2012), Prefeitura de Belo Horizonte (2009), Prefeitura do Rio de Janeiro (2013) and Rio de Janeiro's Climate Change Plan.

Besides that, São Paulo is one of the cities that founded the C40 Cities Climate Leadership Group in 2005. The C40 is a network of the world's megacities committed to address climate change. They are now 85 affiliated cities representing 25% of global gross domestic product (GDP). This network supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change.⁶⁸

In addition, there is also the CB27, a forum for the 27 Brazilian state's capitals, which aims to disseminate good sustainable practices inner country.⁶⁹ It has created a database with tools for measuring implemented projects performance and documents its implementation.

Rio de Janeiro, for instance, has a similar entity of Belo Horizonte, called Forum for Climate Change and Sustainable Development, which discusses proposals and

⁶⁸ See <http://www.c40.org/>

⁶⁹ See <http://www.forumcb27.com.br/>

evaluates environmental policies.⁷⁰ And its mayor Eduardo Paes has been chair of C40 since 2013.

Rio de Janeiro's climate change policy

In 2011, Rio de Janeiro has established the Municipal Policy on Climate Change and Sustainable Development, setting citywide emissions reduction targets: 8% in 2012, 16% in 2016 and 20% in 2020, related to emissions in 2005.⁷¹ Works, programs, activities and projects from municipality should consider the reduction targets and estimate their emissions impacts; and procurement and contracts should consider environmental products purchasing and social sustainability.

It means that Rio de Janeiro already have sustainability guidelines for citywide, such as improvements in bicycle paths lengths, CO2 emissions reduction plans for buses and implementation of BRS (Bus Rapid Service) and BRTs (Bus Rapid Transit).⁷²

However, it does not have such guidelines for its self-operations and own building stocks as a corporate. Emissions accounting and tracking, and the other sustainable measures resulting from Local Government Operations, although under Law, are still waiting for specific rules for their implementation.

Rio Climate Action Plan consider two inventories as baseline: the first Community Emission Inventory published in 2000 and related to 1998, and other published in 2011, related to 2005.⁷³ It has also established alternative scenarios based on not only city level project, but also regional and national government initiatives.

Citywide emissions were updated in the 2012 Inventory and Action Plan. It was also estimated that emissions will approach the established reduction target by 2016,

⁷⁰ Ibid

⁷¹ Rio de Janeiro Municipal Agency of Environment (2011)

⁷² Romero (2015)

⁷³ Rio de Janeiro Municipal Agency of Environment & COPPE/UFRJ (2011)

considering, among other factors, initiatives in City of Rio de Janeiro Strategic Plans⁷⁴, regarding to urbanization projects, urban mobility, reforestation and urban afforestation.⁷⁵

It is also relevant that the city has two voluntary initiatives of corporate GHG emissions tracking: The Municipal Urban Cleaning Company (COMLURB), which tracks the annual emissions of fleet and landfills under its control; and the Planetarium Foundation, which annually discloses its Inventories in Programa Brasileiro GHG Protocol since 2013, as part of its low-carbon policy.

In addition, there are also initiatives in management, governance and business areas that would provide many opportunities for carbon reduction measures:

- the efficient procurement initiative (*Governo de Alto Desempenho* program) which would have a potential impact in reducing waste generation;
- regulations to implement municipal projects and policies facing climate change and disclosure of sustainability actions by publishing Global Reporting Initiatives (GRI) - Sustainability Reporting (*Rio Capital Sustentável* program) which would respectively allow a clear allocation of responsibilities, targets and milestones setting;
- initiatives that engages Energy Research Centers based in Rio (*Rio Capital da Energia* program) which could be also used to help with performance analysis and search for energy efficiency solutions for City operations.

It is also relevant to mention that Rio de Janeiro faces multiple hazards related to climate change, including heavy rains, rising sea levels, storm surges, heavy winds, as well as increased waves and diseases such as dengue and zika that prosper in hot and wet conditions.⁷⁶ Indeed, because of its geological and geographical characteristics, and many constructions in risky areas, the city has historical flash floodings and landslides cases.

However, in 2010, the state of Rio de Janeiro, including capital and mountain cities in the nearby, had more fatalities caused by climate disaster than all country in 2010. The necessity of an urban resilience plan for Rio de Janeiro municipality became clear in april 2010, when heavy rains hit the city and caused several damages for the region.

⁷⁴ Rio de Janeiro City Hall (2012)

⁷⁵ Fundação Planetário (2013)

⁷⁶ Kahn and Brandão (2015)

Roads were blocked and Rebouças tunnel, which is one of the main connection between south, downtown and north zones in the city, was interrupted by a huge landslide. This caused critical issues for the urban mobility system and affected different regions of the city indirectly.

Thus, at the end of this year, Rio de Janeiro city hall implemented the municipal Operations Center which integrates the data and monitors functions of approximately 30 municipal and state agencies, including police, the central fire department, the health department and other relevant agencies that can monitor weather, traffic, trash collection, electricity, water, gas, disease outbreaks or emergency situations. It also integrates communication with the media due to facilitate information with public in case of contingencies. The main objective is to increase efficiency of service and improve responses to outages and service failures. Therefore, it helps the city to become more sustainable, integrated and resilient.

According to United Nations (2012), these disasters are not “accidental”. Although it is not possible to act in the climate incident itself, risks of urban disasters are a combination of other elements which government can act on, such as vulnerability, exposure to the incident and resilience, or capacity to face the problem.⁷⁷ This corroborates to the relevant role of municipal level on dealing with climate changes. During disasters, local governments are the first ones that need to respond.

⁷⁷ United Nations (2012)

CHAPTER TWO – COMPARATIVE ANALYSIS

Since cities will be affected by the impacts of climate change, with growing economic costs, cities have good reasons to engage in climate action. “There is no longer a choice to be made between economic growth and emission reduction. Knowing their mitigation options and the benefits of those measures, cities will find it strategic to take action.”⁷⁸

Cities costs to deal with extreme weather events in US, for instance, between 2011 and 2013, were more than a thousand fatalities and up to \$188 billion dollars in economic damages.⁷⁹

In a comparative analysis, San Francisco and New York City are quite different from Rio in political, economic and social contexts. However, to observe these experiences may be helpful in evaluating potentials not yet exploited in Rio de Janeiro Climate Change Policy.

As shown in Table 7, New York and San Francisco clearly track and disclosed their own operation emissions while preparing Community GHG Inventories, differently from Rio de Janeiro experience.

In addition, since they track it, both North Americans cities know the municipal government activities' participation on citywide emissions (San Francisco: 4.03%; New York: 7.10%). In the other hand, most of South American cities are not able to predict its own participation yet. Thus, they are not able yet to set clear targets for their own operations and cannot contribute to LGO Climate Action Plan.

⁷⁸ Ibid

⁷⁹ Weiss and Weidman (2013)

Table 7. LGO Climate Policies: San Francisco x New York City x Rio de Janeiro

	SAN FRANCISCO	NEW YORK CITY	RIO DE JANEIRO
Population	808.976	8.363.710	6,453,682
City Agencies	60 Departments	128 Agencies	54 Agencies
Municipal Building Stock	446 buildings (29 types)	4.000 (300 million square feet)	2190
Number of employees	28.861	More than 300.000	118.503
Managers of Climate Policy (LGO)	SF Environment	Mayor Office: OLTPS e ORR	No
LGO emission Inventories	Yes	Yes	No
LGO emissions/ city-wide emissions	4,03%	7,10%	No

Own source, based on United State Environment Protection Agency (2014), San Francisco Department of Environment (2013), NYC Mayor's Office of Sustainability (2016), San Francisco Water Power Sewer (2013), IBGE (2014) and New York City (s.d.)

The establishment of detailed regulations addressed to city hall's operations (San Francisco and New York experiences) and centralization of climate governance process in Mayor's Office (New York experience only) seem to be the best strategy to ensure that the investments towards Public Administration will be implemented within objective criteria of environmental economic and social sustainability in Rio de Janeiro.

To conclude this chapter, the worldwide fight against climate change was systematized with IPCC⁸⁰ support that prepared GHG emissions tracking methodologies, and the celebration of Kyoto Protocol, that set global reduction targets for the main emissions (1997). The starting period for meeting reduction targets established ran out in 2012, without achieving the initial goals, and today nations look for a new deal.

Climate Change issues involve severe impacts on national economies, and impasses between development and growth lead to delays and uncertainties in meeting the targets.

However, local government initiatives have been providing the most effective and economical solutions to achieve sustainability goals through its influence and authority on various topics related to climate, such as: urban forestry, waste management, public transport and others.

Indeed, municipalities have a comprehensive role on climate change. They must prevent resilience in their communities, by reducing vulnerabilities; track and control citywide emissions by making GHG Inventories, designing Climatic Action Plans and implementing public strategies and policies.

Finally, they should track and control their own corporate emissions, also through Inventories and Action Plans, playing a major Leading by Example role.

Rio de Janeiro could implement sustainability management strategies inspired by New York and San Francisco experiences. The size of Rio de Janeiro in terms of population, number of employees and public buildings stock is closer to New York than those in San Francisco. However, both American cities have set clear targets and action plans to reduce not only the city wide emissions, but also the city hall operations emissions. This idea is aligned to the Rio Municipal Strategic Plan 2017-2020 and Visão Rio 500 Plan.

By tracking its own emissions, Rio de Janeiro could lead by example, influencing in several value chains, while reducing city hall's consumption of resources like water, fuel, gas, energy, reducing costs. Moreover, this can drive Rio de Janeiro to be at the forefront of sustainability cities that also track its own emissions, since it is still an inedited policy in Brazil.

⁸⁰ Intergovernmental Panel on Climate Change

Therefore, it is urgent that cities should be prepared for sustainability management. Since it is a practice of economic production and consumption that minimizes environmental impact and maximizes resource conservation and reuse, “all competent managers will be sustainability managers.”⁸¹

⁸¹ Cohen (2011)

CHAPTER THREE – DATA COLLECTION AND MANAGEMENT

1. Data management challenge

Corroborating to that, Drucker quoted: “you can’t manage something if you can’t measure it”.⁸² Thus, this paper assumes that corporate carbon management in municipal administration should measure and control the activities that cause emissions. This should also be seeing as an opportunity to optimize its operations, the use of resources and achieve more efficiency. Moreover, cities could take this as a competitive advantage, while leading changes and impacting positively in several value chains.⁸³

In this effort, municipal government must organize its agencies consumption data or even collect it when it is necessary. This will enable the city to make diagnosis and to build actions plans for reducing emissions from its own operations, buildings and fleet.

A government that uses and organizes its data to support all decisions, policies and performance metrics is considered a data-driven government. In order to develop more assertive strategic plans, governments must rely on information captured in the public service which is not always available or it is available in such way that governments can not use them properly for decision making.⁸⁴ There is neither time nor financial resources for government decisions based on trail, failures and political wiliness. By using data, decisions are targeted, strategic and informed, making the service to be more efficient, and sustainable.

This approach brings also more transparency and accountability. Communications between public sector and population could be also improved, setting clear, simple and transparent standards.

In order to effectively rely on data to make decisions, governments have to collect, store and process information. One challenge for deployment of data-driven projects is to aware managers in relation to data sharing. Usually, data owners prevent other areas to use it. Governments must disseminate data sharing so that the actions can be planned and executed more precisely. To accomplish that, information systems must have the ability

⁸² Drucker (2016)

⁸³ Kamal-Chaoui, Lamia and Alexis Robert (2009)

⁸⁴ Romero et al (2016)

to communicate with other systems, through data bridges, and cooperation agreements between public bodies must be developed to overcome issues.⁸⁵

Indeed, there is a lack of data integration. “Public data still live in personal computers, spread across several databases and spreadsheets, allocated in different government agencies, presenting all sort of information with neither access restriction nor protection. A single person who has knowledge about it often handles this data. To deploy a data-driven project, I.T. teams must be prepared to understand, identify, check, catalog and systematize each dataset, in order to make it reliable and inconsistencies free. To ensure that data is reliable, it must be captured digitally at the origin”.⁸⁶

To the extent that the computer storage and data processing capacity of computers increase and prices decrease, people and systems collect and store more and more data. However, this kind of data are not always presented in a structured format. Unstructured data is a challenge. A study from International Data Corporation - IDC shows that in 2014 the amount of unstructured data stored was seven times higher than the amount of structured data.⁸⁷

Thus, governments have to be able to understand and process this huge amount of data in order to generate value to society.

2. Carbon management and GHG inventories

GHG reduction results from the control of activities that cause its emissions. The main steps for emissions control are:

- recognizing the relevant activities and selecting the emissions to control;
- collecting consumption and waste generation data related to these activities;
- calculating GHG emissions;
- planning and running actions that lead to emissions reduction.

⁸⁵ Ibid

⁸⁶ Ibid

⁸⁷ Primmer, R (2016)

Emissions management relies on the construction of GHG inventories, which are the basis for development of Climate Action Plans. A Climate Action Plan typically considers risks, regional and local vulnerabilities, the definition of baseline and mitigation scenarios, goals and targets settings, and selection of mitigation options.⁸⁸

The development of Inventories and Action Plans includes the following stages:

(a) defining physical, organizational and operational boundaries: which facilities, administrative units and activities will be evaluated;

(b) defining scope: to decide emission sources and/or categories of activities to be included, and which GHG will be addressed;

(c) choosing approach to quantification: Corporate Inventories generally adopt the bottom-up approach to data collection, aggregating information of local end users;

(d) engaging stakeholders: internal stakeholders, from employees to senior managers; and external stakeholders, such as suppliers, private sector and the Academy. The joint collaboration ensures the transversality of strategies;

(e) preparing inventories, by implementing tools for information collection and management needed to carbon emission calculations. Internal and external verification of inventories are desirable;

(f) establishing goals, plans and emission reduction targets: to develop future scenarios, a baseline and alternative scenarios must be constructed. Baseline illustrates the amount of GHG that tend to be emitted within a certain period of time, based on Inventories already made. Alternative scenarios incorporate emission reductions resulting from efficiency measures. Once defined the measures, reduction targets and deadlines are set;

(g) Establishing implementation, evaluation and measurement procedures, by identifying resources and agents, and setting tracking reports schedules;

(h) Disclosing results: the disclosure of Inventories and Action Plans shows the commitment to the results.

The first Community Emissions Inventory in Rio de Janeiro was published in 2000, related to 1998. The Inventory used as a reference to Law n. 5,248 was disclosed in 2011,

⁸⁸ EPA (2014)

related to 2005.⁸⁹ The resulting Action Plan considered these Inventories for the baseline, and alternative scenarios were established considering not only City projects, but also State and Federal Government initiatives.⁹⁰ Citywide emissions were updated in the 2012 Inventory and Action Plan. It was also estimated that emissions will approach the established reduction target by 2016, considering, among other factors, initiatives in City of Rio de Janeiro Strategic Plans, regarding to urbanization projects, urban mobility, reforestation and urban afforestation.

At least two voluntary initiatives of corporate GHG emissions tracking are registered in Rio de Janeiro City:

- COMLURB (Municipal Urban Cleaning Company) tracks the annual emissions of fleet and landfills under its control;
- Fundação Planetário (Planetarium Foundation) annually discloses its Inventories in Programa Brasileiro GHG Protocol since 2013, as part of its low-carbon policy.⁹¹ Rio de Janeiro Strategic Plan 2013-2016 highlights the need for environmental sustainability actions in City operations as a Climate Action Plan: eight initiatives involve expansion of the municipal building stock, totaling at least 324 new constructions and 200 refurbishing of municipal buildings.⁹² These new buildings will demand, when in use, an increase in energy, fuel, water and gas consumption, and more waste generation. The use of energy efficiency strategies in these low-scale projects would bring down maintenance costs, environmental impacts and low emissions.

There are also Strategic Plan Initiatives in management, governance and business areas that would provide many opportunities for carbon reduction measures, such as:

- the efficient procurement initiative (*Governo de Alto Desempenho*) would have a potential impact in reducing waste generation;
- regulations of the 5248 Law to implement municipal projects and policies facing climate change, and disclosure of sustainability actions by publishing GRI Sustainability

⁸⁹ Prefeitura do Rio de Janeiro (2011)

⁹⁰ Ibid

⁹¹ Fundação Planetário da Cidade do Rio de Janeiro (2015)

⁹² Prefeitura do Rio de Janeiro (2013)

Reporting (*Rio Capital Sustentável*) would respectively allow a clear allocation of responsibilities, targets and milestones setting;

- the initiative that engages Energy Research Centers based in Rio (*Rio Capital da Energia*) could be also used to help with performance analysis and searching for energy efficiency solutions for City operations.

Moreover, GHG Protocol is one of the most widespread methodologies to elaborate GHG inventories. The establishment of an inventory under its guidelines includes the following stages:⁹³

(a) Identification of emission sources is by classifying them in Scopes (Scope 1, direct emissions controlled by the organization; Scope 2, indirect emissions from purchased electricity; Scope 3 indirect emissions not controlled by the organization), setting of sources categories: stationary combustion, mobile combustion; chemical and physical processes; and fugitive emissions;

(b) Selection of emission calculation tools: the application of emission factors registered in protocols based on IPCC guidelines is the most common way;

(c) data collection of the activities and selection of emission factors. In most organizations, emissions are calculated as follows: Scope 1, based on the quantity of purchased fuel and gases by applying the published emission factors; Scope 2, based on the measured electricity consumption by applying published or supplier released emission factors; Scope 3, based on activity data, by applying published emission factors;

(d) Application of calculation tools: intersectoral tools (applicable in various industries) are generally used, or specific sector tools (applicable in specific industrial sectors), when necessary;

(e) Data consolidation at corporate level: aggregation and synthesis of data from several facilities in different locations and hierarchies.

⁹³ Pinho (2009)

CHAPTER THREE – HIGHLIGHTING STRATEGIES

1. Proposing initial steps towards a public corporate sustainability information system for Rio de Janeiro City Hall

It can consider the following requirements for a preliminary corporate climate action plan for the city of Rio de Janeiro:

- (a) a governance structure with political, administrative and financial support;
- (b) a data and communication structure to enable information collection and processing, management reports and inventories, in order to build scenarios and allow decision making;
- (c) technical support in climate change, in order to generate inventories and build GHG emission scenarios;
- (d) technical support in energy efficiency, fuels, water and waste management, in order to model GHG mitigation strategies.

Moreover, it is necessary to organize a system with the necessary information, bringing them together in a single database. This tool will enable decision-makers to set different possibilities of data aggregation in order to elaborate different strategies addressed to emissions reducing. Data structure would be organized to meet the accounting of emissions under GHG Protocol Methodology. Sources for the most common building and service operations to all administrative units should be monitored, such as fuel, water consumption, effluent and waste disposal, as shown in Table 8.

The success of the project will require an appropriate framework for governance, as noticed in the experiences of New York City and San Francisco. It would be up to the mayor to decide on the adequate management structure, whose leader should decide on the agencies to be monitored, the actions to be taken, the call of agencies managers to join the project, schedule implementation, definition and dissemination of targets and results. A working group should also be assigned to consolidate information and generate the Corporate Sustainability Information Reports.

Table 8. Consumptions and disposals input data by Scopes and Emission Sources under GHG Protocol organization

SCOPES	EMISSION SOURCES	CONSUMPTIONS AND DISPOSALS INPUT DATA ⁹⁴
Scope 1	Stationary Sources	<ul style="list-style-type: none"> electricity generators: fuel consumption data and motor specifications; gas heaters, stoves, boilers: Natural gas consumption data provided by CEG, and purchased LPG
	Mobile Sources	<ul style="list-style-type: none"> vehicle fleet (cars, motorcycles, trucks, buses, etc.): data and fuel consumption, specifications, traveled distance and vehicle specifications (model / year of manufacture)
Scope 2	Fugitive Emissions	<ul style="list-style-type: none"> Air conditioning systems: data consumption of CFC, specifications, and system specifications Fire extinguishers: consumption data and gas specifications
	Purchased Electricity	<ul style="list-style-type: none"> Electricity consumption data provided by LIGHT
Scope 3	Effluent generation	<ul style="list-style-type: none"> Water consumption data provided by CEDAE Recommended Return coefficient (C)⁹⁵ Building occupancy data (number of occupants)
	Solid Waste Generation	<ul style="list-style-type: none"> Recommended Waste gravimetry Data Building occupancy data (number of occupants)

After developing the reports of various agencies, the manager should enable the development of Sectorial Climate Action Plans. These plans should harmonize with City Strategic Plans and the assumed emissions reduction targets. The Corporate Emissions Inventories and Sector Action Plans should be consistent with the Inventories and Climate Action Plan of the Municipality.

The necessary database for the Information Reports and Emission Inventories should be fed by members of the various Municipal Agencies. It is suggested to be made a preliminary survey data of energy, water, gas and fuel consumption from all of the agencies. This first survey will allow the Mayor to assess the most representative agencies in order to concentrate efforts on raising other complementary data to enable

⁹⁴ CEG, LIGHT and CEDAE are companies that provide respectively natural gas, electricity and water. CEDAE is responsible for sewage treatment almost citywide.

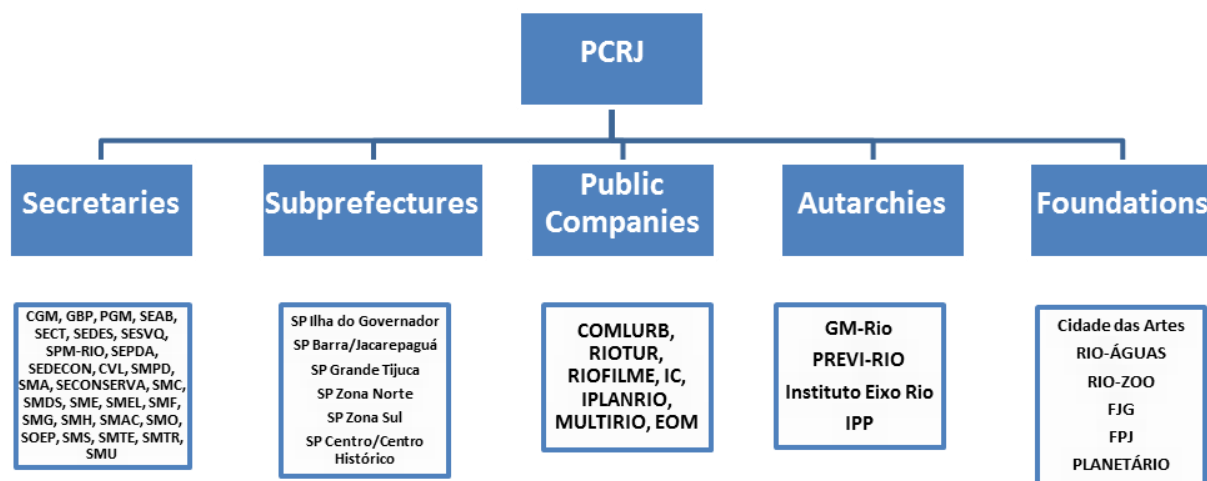
⁹⁵ Return coefficient (C) is the average ratio between the volumes of sewage produced and water effectively consumed.

better accuracy in the preparation of future GHG Emission Inventories and Climate Action Plans. Database should be updated monthly, and the closing of the reports should be annual, allowing the disclosing of the reports in the following year.

As recommended by US Public Sector Protocol, an appropriate framework for development of corporate GHG Inventories should be set, considering: the different autonomy levels within the existing hierarchy; levels where significant operational policy decisions can be implemented; and levels where data can be collected more conveniently.⁹⁶

The City of Rio de Janeiro is current divided into more than 50 agencies, as shown in Figure 2.⁹⁷

Figure 2. Rio de Janeiro City Agencies summarized Organogram



These Agencies are functionally organized in Administrative Units, and distributed in several facilities, identified by their addresses in an Integrated Institutional Coding. Agencies should conduct survey and data completion related to the quantities of consumed supplies and their costs, effluents, waste and occupancy data of each facility. In this way, it will be possible to get reports from each facility and aggregate them by similar uses and/or by agency and tracking its hierarchy.

⁹⁶ See http://www.ghgprotocol.org/files/ghgp/us-public-sector-protocol_final_oct13.pdf

⁹⁷ Prefeitura do Rio de Janeiro (2014)

The Information System should relate the data according to the following physical/administrative organogram structure.

(a) Agencies: each City Agency (Secretary, Subprefecture, Public Company, Autharchy or Foundation) institutionally identified, compiles the information of all controlled facilities. All its Administrative Units must be organized by address, characterizing the Facilities;

(b) Administrative units: it is assumed that they are responsible for the operational control of the facilities, thus, for bottom-up data collection in accordance with each Agency characteristics;

(c) Facility: group of buildings, single building, or internal occupying area of a building under the control of a specific administrative unit and holding a defined use. A Facility may correspond to an Administrative Unit (eg, school, kindergarten, hospital), to one or more buildings. On the other hand, a single building can meet various administrative units. As the control of building consumption and efficiency measures should be addressed to Facilities controlled by Administrative Units of each Agency, a Physical / Administrative Organogram should be structured. Each facility should have the information structured as in Tables 9 and 10.

Table 9. Technical specifications, consumption and waste data

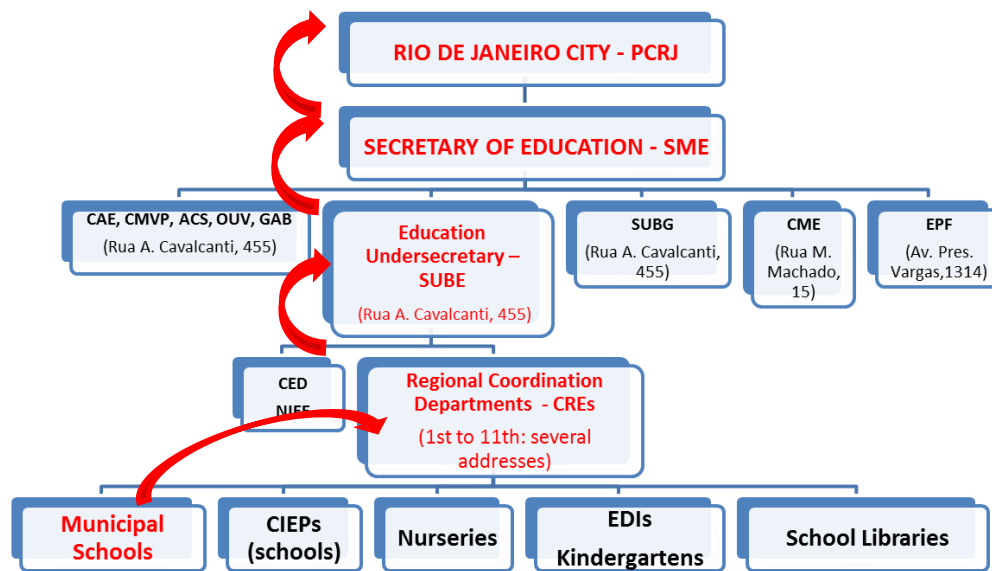
TECHNICAL SPECIFICATIONS	FIELD	DESCRIPTION
General Information	identification	name, address, phone, e-mail, homepage, contact
	type	group of buildings, single building, or internal occupying area
	Use	Administrative, educational, health, etc.
Area and occupation data	Hierarchical subordination	Administrative unit which is subordinated to, and responsible for ordering costs
	Area (m2)	land area, total area built, projection area
	Occupation (person)	Number of servers / outsourced (fixed) and users (floating population)
Technical information	Illumination system	Description and installed power
	Air-conditioning system	Description and installed power
	Motors and pumps	Description and installed power, used fuels
	Vehicle Fleet	Description, used fuels

Table 10. Consumption and waste data (Total and/or unit quantities monthly consumed, unit costs, disposal for effluents and waste)

CONSUMPTION & WASTE DATA	FIELD	INDICATORS
Scope 1	Fuels (by destination and type)	L , L/m ² , L/ person, R\$, R\$/m ² , R\$/person, TCO ₂ , TCO ₂ /m ² , TCO ₂ / person
	Gas (by destination and type)	m³ , m ³ /m ² , m ³ / person, R\$, R\$/m ² , R\$/ person, TCO ₂ , TCO ₂ /m ² , TCO ₂ / person
Scope 2	Electric Power	kWh , kWh /m ² , kWh / person, R\$, R\$/m ² , R\$/ person
Scope 3	Effluents	m³_{water} , m ³ _{water} /m ² , m ³ _{water} / person, R\$, R\$/m ² , R\$/pessoa, m ³ _{effluent} , m ³ _{effluent} /m ² , m ³ _{effluent} / person, TCO ₂ , TCO ₂ /m ² , TCO ₂ / person
	Solid Waste	m³_{waste} , m ³ _{waste} /m ² , m ³ _{waste} / person, R\$, R\$/m ² , R\$/ person, TCO ₂ , TCO ₂ /m ² , TCO ₂ /person

It may generate reports that allows to aggregate data's consumption, waste and costs at several levels. Taking as an example the Secretary of Education structure and one of its specific facility typology, such as a Municipal School. It would be possible to observe each school consumption; make comparisons between various units; aggregate indicators of different schools under a Regional Coordinating Department; compare several Regional Coordinating Department consumptions; aggregate data from all Departments, etc. This is shown in Figure 3.

Figure 3. Municipal Schools Data Aggregation in Secretary of Education - SME



Finally, at the level of Rio de Janeiro City Hall, data from several agencies can be addressed in different ways: viewing the consumption of each agency; comparing consumption of several agencies; aggregating total inputs and disposal quantities of each agency, including involved expenses; aggregating global quantities of specific sectors for indicator comparisons; tracking data and indicators of all city agencies.

2. Negotiating to integrate data from different municipal agencies

Humans communicate and negotiate all the time and all over the world. They follow a standard of reciprocity consisting on preparation, information exchange, negotiation and commitment. Negotiation is interactive communication process that may occur when you want something else or when someone wants something from you.⁹⁸

And although people negotiate in business, government, family, etc, these decisions are not always satisfactory.⁹⁹ The negotiation framework which will guide this topic is based on three steps as bellow.

⁹⁸ Shell (2006)

⁹⁹ Fisher & Ury (2011)

Setting the stage by planning “communication” and “relationship”

In this case, it is urgent to engage all municipal agencies’ commissioners in order to build a sustainable information system for city hall operations. The parties proposed for this negotiation are the project manager and his/her team, the IT team responsible for this project and municipal agencies’ commissioners.

Moreover, other stakeholders are:

- the mayor, which has the interest to make the city more competitive and to develop the city brand;
- society, that will benefit of gases emissions reductions and decreasing municipal services costs;
- NGOs and other sectors, that could use open data to generate other innovative solutions;
- Public servers involved on this project, which must cooperate and be engaged.

Since without communication there is no negotiation¹⁰⁰, it must separate people from problems and also positions from interests.¹⁰¹ Parties and stakeholders are open to bring ideas and questions. They must be listened actively and different points of view must be put on the table and registered. Dialogue can reduce misunderstandings and data should generate value.

Negotiations take place in the context of an ongoing relationship where it is important to conduct each negotiation in a way to help, not harm future relations and future negotiations.¹⁰²

Furthermore, it is important to avoid escalation of emotions during meetings, because it makes difficult to build common values, to be rational and to keep away from hard positions.¹⁰³ In addition, not only emotions and words must be controlled, but also the body language is very important. Everyone can model the behavior they want from their counterparts, since one behavior influences the others’ behavior.

¹⁰⁰ *Op. Cit.*

¹⁰¹ *Ibid*

¹⁰² *Ibid*

¹⁰³ Ringer, J (2016)

Working through the issues by analyzing “interests”, “options” and “standards”

Indeed, there is a complex network of several stakeholders on this table, from different fields of work such as traffic, housing, education, health and etc. that could have conflicting interests and different perceptions from the same issue. Thus, it is important to build democratic processes and values of collaboration and cooperation.¹⁰⁴

The project manager interest is to have free access to agencies' data in an integrated manner. Agencies' commissioners interests could vary: to hide data, to avoid creating more tasks for their agencies, to have other priorities, to avoid competing between agencies, etc. On another hand, IT team most of the time is concerned about budget and deadlines.

Previous preparation is fundamental to achieve the interests of each part. Often interests are revealed through dialogue, but it is not always easy to find out what the other part wants, so one need to grab all communication opportunities to probe it.

It is necessary to insist on using objective criteria and invent options for mutual gains. Moreover, it must separate interests from positions, focusing on the essential needs, and then present some value-oriented options. At the end, meetings will generate documents highlighting all decisions and setting clear what are the expected actions, results and who are responsible for what.

Moreover, agencies can provide benchmarks for each decision, or the project manager can bring successful experiences from other cities or abroad. New York City and San Francisco had similar experiences in the past and they are now reference on this issue. Both cities have stablished targets and goals through climate action plans that are international recognized.

One option is that the manager could reach agreements with some agencies first and then use these these partnerships to encourage other agencies to engage after. He/her can also propose a pilot project, a small version of the project, to try it with some agencies and with some data in order to convince the others in the future. In addition, other alternative could be to use only forth-coming data.

¹⁰⁴ Deutsch, M. (2006)

Making a decision through “commitment” or “alternatives” (and BATNA – Best Alternative to a Negotiated Agreement)

In case of agreements, the manager should sign a contract that exposes every important agreement reached between parties. Then, start the process by calling different teams to act.

In case of no conclusions, the manager could try to convince the mayor to persuade with his/her authority to make agencies' commissioners to cooperate and give some priority to this project. Moreover, media could be used to make pressure on all stakeholders.

One possible BATNA is to assemble a specific team to get just data that are already available, then transform it into usable data in the system and then build first parameters.

Finally, it is difficult, but not impossible, to negotiate with a large group with different interests. Self-esteem, determination, empathy, adaptability, self-control and sociability could be powerful tools to succeed.

Moreover, it is necessary to prepare ourselves in advance and make action plans, focusing on interests and not in positions, separating people from the problem, insisting on using objective criteria and inventing options for mutual gains. “If you want to influence them, you also need to understand empathetically the power of their point of view and to feel the emotional force with which they believe in it.”¹⁰⁵

3. Expected Benefits from the public corporate sustainability information system

Resulting information from the initial data collection would allow an immediate assessment of discrepant indicators through statistical analysis, allowing the prospection of reasons for these deviations. Most severe problems can be detected and corrected, related to: building conservation and maintenance, engine overhauls, correction of excesses in material consumption.

¹⁰⁵ Fisher & Ury (2011)

At the same time, campaigns involving behavioral changes, applied without significant costs, could be promoted, such as shutdown of lamps and equipment out of use, and selective waste collection.

Comparing consumption and costs in a same source of information would assist the public manager to compare the performance of agencies under his responsibility with other units and institutions, and take more accurate decisions to optimize the use of resources. Many data are not available today in the same source of information, resulting in a hard joint analysis, which may lead to delays and errors in decision making.

The disclosure of Emission Inventories and implementation of Corporate Climate Action Plans would highlight the commitment of the municipality to sustainability, and would provide greater transparency in public management, by reporting their results of mitigation measures to society.

The disclosure of sustainability management actions, through demonstration projects and the involvement of attended population (eg. students of public schools), has great educational potential. Population would reproduce some of these actions, especially if they were accompanied by specific public policies. The implementation of a Carbon Corporate Public Policy would be an innovative initiative in Latin America. Disclosing indicators, methodologies and all technical procedures involved would be a strong contribution to sustainable development in public management.

Several cities are developing studies to track their own emissions, but only a few of them completed the wide approach from macro to low scale as proposed in the mentioned references that inspired this project.

4. Next steps: GHG inventories and climate action plans

The collected database and its continued upgrade would allow the production of Emissions Inventories and Climate Action Plans of City Agencies. Decisions on prioritization of agencies and sources of emissions to be addressed, considering the environmental impacts to be reduced and resource efficiency to be achieved would lie with the mayor and the project manager. An expansion of the project would lead to the disclosure of Inventories and City Hall Action Plans as a whole.

CONCLUSION

Climate change is a fact and it has added a new responsibility to the dimension between cities and business. Urban areas are home to half the world's population and generate around 80% of global economic output and around 70% of global energy use and energy-related GHG emissions.

Cities are now emerging as a leading force for climate change adaptation. They are part of the climate change problem, but they are also a key part of the solution. They are able to enhance the national climate strategy. However, they need support to maximize the effectiveness of their actions. The strongest tool Brazilian cities have for climate actions is their political influence.¹⁰⁶

Moreover, although competition between cities may also make them reluctant to adopt ambitious measures that might make them less economically competitive, cities could also take this as a competitive advantage, while leading changes and impacting positively in several value chains. It is possible to do both economic growth and emission reduction.

A sustainability corporate information system, taking city halls not only as regulators of city wide emissions, but also as corporations that indeed generate their own emissions would be the starting point in order to define the basis for sustainable management decisions at Rio de Janeiro's city hall. However, this is a challenging process.

The core action in order to bring about the change is to establish the governance for this plan, delivering accountability for a specific group in order to get it done and follow its development. This governance should not just be accountable for technical solutions, but also responsible for engaging stakeholders. This represents low cost policy with high impact. Moreover, it could observe the New York structure as an example, due to similarities existent.

After setting the governance accountable to make the plan work, the next step would be to start agencies' data collection in order to build a diagnosis of city hall's resources consumption and wastes.

¹⁰⁶ Kahn and Brandão (2015)

However, defining and restricting data to use could be also challenge. Since each agency has its own way to read data, building a unique data base for all involved will require not only GHG Protocol methodology analysis in order to set scopes and most relevant sources of emissions, but also negotiations, organization and adaptation from municipal agencies.

In fact, it is not easy to collect, to aggregate and to manage agencies consumptions data. However, it could be quick, cheap and it would enable relevant results in the long-term. This diagnosis would enable the city to develop a Corporative GHG Emissions Inventory and to set the city hall's corporative climate action plan. Moreover, this idea is already aligned to the Rio Municipal Strategic Plan 2017-2020 and *Visão Rio 500* Plan.

There are several benefits expected from this. The main one is to learn from the present scenario while reducing city hall's consumptions of resources like water, fuel, gas, energy, etc. Moreover, the city hall will also actively be contributing to reduce GHG emissions and wastes and fighting against climate change by optimizing its consumptions.

In addition, there is also benefits by increasing Commissioners accountability and growing transparency to taxpayers. The possibility of highlight this policy in the media is also a benefit, which can drive Rio de Janeiro to be at the forefront of sustainability cities that also track its own emissions, since it is still an inedited policy in Brazil. Moreover, Rio de Janeiro could share its experience to other cities in Brazil and Latin America in order to spread sustainability policies.

The Planetarium Foundation initiatives on implementing low carbon strategies and also energetic efficiency, already stablished in Rio, are demonstratives of high potential benefits that could be expanded through all agencies in the city.

Concluding, Rio de Janeiro has sustainability guidelines in the urban scale but not for its own operations, as a sustainable institution. It does not exist yet in Rio a clear identification of the Municipal Government as an organization that uses sustainability indicators, emissions reduction targets and that is oriented through action plans.

Rio's city hall misses a great opportunity not only to save financial resources, minimize environmental impacts and GHG emissions from its own operations and gain efficiency, but also to lead by example and push several local businesses through a

sustainable path. By tracking and reducing its emissions, Rio would also improve its competitiveness and can be to the forefront of cities in Brazil that implement Corporate Sustainability Management.

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