SISC Società Italiana per le Scienze del Clima

SECOND
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Climate change: scenarios, impacts and policy

Venice
September 29-30, 2014

#sisclima2014

Proceedings

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Mitigating GHG emissions in subnational contexts: the case of the city of Rio de Janeiro

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Abstract

This paper summarizes the main findings of a study carried out by the CentroClima/COPPE/UFRJ for the Environmental Secretariat of the City of Rio de Janeiro. The results of the city's GHG emissions inventories for 2005 and 2012 as well as its performance in terms of avoided GHG emissions are compared to the voluntary targets established by the municipality. The update of the city's Mitigation Action Plan was designed to meet the mitigation goals for 2016 and 2020.

Keywords: cities, GHG emissions, inventories, mitigation, urban policy

1. MITIGATION OF THE GHG EMISSIONS OF THE CITY OF RIO DE JANEIRO

The greenhouse gas (GHG) emissions of a city, region or country arise from burning fossil fuels (oil products, natural gas and coal), waste treatment, industrial processes and changes in plant cover, among others. Practically all economic sectors of modern society (industry, services, transports, farming, and construction) produce carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions, the main GHG gases, to a greater or lesser extent. Estimates of GHG emissions have an inbuilt uncertainty because of the difficulty in obtaining data on all these activities and emission factors. This is even more so when dealing with cities, where delimiting the boundaries of the activities is more complex. Nevertheless, the City Government of Rio de Janeiro was one of the first cities to carry out a GHG emissions inventory on a municipal scale. In 2000, the City Government presented the inventory of the emissions of the three main GHG gases in the City of Rio de Janeiro for the years 1990, 1996 and 1998; and in 2010, it did it for the year 2005, in addition to developing Scenarios and a Plan of Action to mitigate its GHG emissions, always with the technical support of CentroClima/COPPE/UFRJ. This paper summarizes now the results of the third GHG emissions inventory of the city of Rio de Janeiro, which amounted to 22.6 million tonnes of CO_2 equivalent (Mt CO_2e) in 2012, in addition to revising the estimates for 2005 (11.6 Mt CO_2e).

The reduction of GHG emissions in Rio de Janeiro is one of the strategic projects of the City Government. Emissions reduction targets were defined and consolidated in the Municipal Climate Change and Sustainable Development Law, enacted in January 2011. Targets were set using the total emissions verified in 2005 as reference. Reduction targets were defined as follows: avoid 8% of the 2005 emissions in 2012 (0.93 Mt CO_2e), 16% in 2016 (1.86 Mt CO_2e) and 20% (2.32 Mt CO_2e) in 2020.

Targets were established while many City Government projects for emissions reductions were being defined and detailed. Large-scale works and interventions such as the inauguration of the Waste Treatment Center in Seropédica and the operation of large high-capacity express bus lanes (BRTs) are leading to a significant reduction of GHG emissions.

On the other hand, GHG emissions avoided by the actions of the City Government were not enough to ensure an overall reduction of the level of GHG emissions in the city, which almost doubled from 2005 to 2012. Population growth and economic development of a city induce a rise in GHG emissions. While the city's population has been increasing slowly over the past few years (growth of 3.6% from 2005 to 2012), the economic dynamics began to accelerate in November 2009, when Rio de Janeiro was chosen as the host city for the 2016 Olympic and Paralympic Games (45% growth in the municipal GDP from 2005 to 2012). Deployment of a large-scale steel mill using coke (manufactured from coal) within the boundaries of the city at the end of 2010 also contributed to increase GHG emissions. The Companhia Siderúrgica do Atlântico (TKCSA) had gross on-site emissions of 8.8 Mt CO_2e (scope 1), even though attenuated by the company's major efforts, resulting in net GHG emissions estimated by the company to be around 6.3 Mt CO_2e in 2012. Changes in the country's energy policy, arising from decisions made beyond the responsibility of the city, such as the increased use of thermopower for electricity generation, increase use of gasoline due to price subsidies and growth in the number of private vehicles, in addition to the crisis in ethanol production, also contributed to the increase of GHG emissions in the City of Rio de Janeiro from 2005 to 2012.

As a result, the Rio de Janeiro City Government decided to steer public policies towards a low-carbon urban development. Investments and interventions must have a climate component in their priorities, demonstrating to economic agents and civil society that it is indeed a priority. Moreover, the main guideline of the City's Strategic Plan is tp promote sustainable development. The option of the City Government, with the support from the City Council, was to adopt realistic and transparent GHG emission reduction targets, in accordance with the public policies of City Government. This decision allowed Rio de Janeiro to preside with New York the meeting of the cities participating in the C40 Climate Leadership Group, an entity bringing together 58 megacities of the world, during Rio+20. The C40 mayors made the commitment to reduce global greenhouse gas emissions by 1.3 billion tonnes by 2030, according to the policies being implemented in their

respective cities. The commitment contrasted with the difficulty of achieving consensus in the multilateral area and with the absence of climate change debate during the United Nations Conference on Sustainable Development, Rio +20, promoted by national governments. Notwithstanding the leadership and autonomy of the cities, the perspectives and goals of national, regional and local governments, including the city of Rio de Janeiro, also suffer the direct consequences of these negotiations.

Within this context, the Government of the City of Rio de Janeiro has updated the Municipal Plan of Action for Emissions Reduction in order to meet the voluntary mitigation targets established for 2016 and 2020.

Consolidated Results of City of Rio de Janeiro Emissions in 2012

Table 1 shows the total amounts obtained in the Greenhouse Gas Emissions Inventory of the City of Rio de Janeiro. The amounts are tabled per emission source and per gas, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions, and the total amount is in carbon dioxide equivalent. Scope 1 emissions include the direct GHG emissions within the city geographical boundaries. Scope 2 emissions correspond to the electricity imported from the grid (National Interconnected System). Scope 3 emissions correspond to the balance of emissions from the ethanol production chain; the fugitive emissions of the coal consumed by the city, but which is mined outside its borders; and the wastes generated by the city, but taken for disposal in landfills outside its borders.

Analysis of Indicators

With respect to the carbon content of the GDP of the City of Rio de Janeiro, there is an increase in this indicator, as in the emission per capita, as shown by Table 2. However, as the population of the city did not grow significantly, the emission per capita almost doubled. However, the economic growth of the city from 2005 to 2012 occurred in activities that are more intense in their use of energy and their GHG emissions. The intensity of emissions per GDP unit increased by 34% in the period.

Updated Mitigation Plan

A Plan of Action including the measures that the City Government must undertake to achieve the greenhouse gas emissions reduction targets has been updated.

According to the updated 2005 inventory results, the total city emissions in 2005 amounted to 11,613 tonnes CO2e. Thus, emission reduction targets provided for in law correspond to 929,000 tonnes CO2e (8% of 2005 emissions) in 2012. For 2016, the 16% would mean 1,858,000 tonnes CO2e.

Due to the delay in the construction of the new Waste Treatment Centre and of the methane capture facilities in the main landfill, the estimates of the current study show that the actions carried out by the City Government until 2012 were not enough to achieve the 8% target. However, for 2016, the projected actions, if actually implemented, will be close to achieving the 16% target, as shown by Table 3.

It should be stressed that the city is thriving and it is necessary to consider that the huge steel mill recently built in the city (Complexo Siderúrgico do Atlântico), which is not yet operating at its full capacity, should achieve it by 2016. Given that for production of 3.5 million tonnes of crude steel, gross emissions for the complex amounted to 8.8 million tonnes CO2e, and net emissions 6.3, in 2012; with a full load of 5 Mt of crude steel, these emissions will be greater and will probably overshoot the reductions foreseen by the city's mitigation actions.

2. ACKNOWLEDGMENTS

The authors thankfully acknowledge the institutional support from the Environmental Secretariat of the City of Rio de Janeiro and the financial support from TKCSA.

3. REFERENCES

1. La Rovere, E.L.; Carloni, F.B.B.A. et al; Greenhouse Gas Emissions Inventory of the City of Rio de Janeiro in 2012 and Updating of the Municipal Plan of Action for Emissions Reduction, Technical Summary, Environmental Secretariat of the City of Rio de Janeiro & CentroClima/COPPE/UFRJ, December 2013.

4. TABLES

Tab. 1 Total GHG emissions in the City of Rio de Janeiro, in 2012, by scope (Gg CO_2e)

	Scope 1	Scope 2	Scope 3	Total
ENERGY	16,346.49	1,413.43	-133.37	17,942.41
Energy sector consumption	2,702.10	469.83		3,171.93
Losses	1,614.57	469.83		2,084.40
Coke production	1,087.53			1,087.53
Residential	1,574.94	314.71		1,889.65
Commercial/services	1,283.32	343.56		1,626.88
Public sector	436.44	126.36		562.80
Farming	0.54	0.14		0.68
Transports	6,733.68	20.09	-315.86	6,753.77
Road	5,301.37		-315.86	4,985.51
Rail	72.96	20.09		93.05
Air	1,664.87			1,664.87
Water	10.34			10.34
Industry	2,361.05	138.74		2,499.79
Fugitive emissions	1,254.42		182.49	1,436.91
IPPU	2,355.33	0.00	0.00	2,355.33
Industrial processes	2,286.59			2,286.59
Product Use	68.74			68.74
AFOLU	8.57	0.00	0.00	8.57
Land Use Change	-11.66			-11.66
Livestock	10.11			10.11
Agriculture	10.12			10.12
WASTES	634.42	0.00	1,696.41	2,330.83
Solid Wastes	10.17		1,696.41	1,706.58
Urban Solid Wastes	9.72		1,637.98	1,647.70
Healthcare Wastes			6.33	6.33
Incineration	0.44			0.44
Industrial Wastes			52.10	52.10
Sewage and Effluents	624.26			624.26
Res + Com Sewage	526.97			526.97
Industrial Effluents	97.28			97.28
TOTAL	19,344.81	1,413.43	1,563.04	22,637.14

Source: La Rovere, E.L.; Carloni, F.B.B.A. et al, 2013 [1]

Tab. 2 GHG emissions, GDP and population of the City of Rio de Janeiro, 2005 and 2012

	2005	2012	2012/2005 Increase (%)
Total emissions (million tonnes CO_2e)	11.61	22.64	95%
GDP (billion Reals at 2012 prices)*	167.00	242.50	45%
Population (million inhabitants)	6.10	6.32	4%
Total emissions/GDP (t CO_2e/million 2012 Reals)	69.54	93.35	34%
Total emissions per capita (t CO_2e/inhabitant)	1.90	3.58	88%

Source: La Rovere, E.L.; Carloni, F.B.B.A. et al, 2013 [1]

**Amount estimated from the 2010 amount.*

Tab. 3 Estimated emissions reductions for 2012 and for the Strategic Plan period (2013-2016) in the City of Rio de Janeiro (thousand tonnes CO_2e)

Reduced emissions	2012	2016
Energy – stationary sources	0.7	0.7
Energy – fugitive emissions Replacement of gas distribution network (CEG)	5.7	17
Energy – transports	79.6	525
BRTs (1 in 2012, 4 in 2016)	7.7	211.1
Copacabana BRS	17.6	17.6
Subway expansion	51.1	289.9
Expansion of bicycle lanes network (300km)	3.2	6.4
Agriculture, Forests and Land Use – AFOLU	36.3	49.7
Urban Solid Wastes	243.8	1,240
Capture and burning of biogas in Gramacho Landfill	235.1	329
Capture and burning of biogas in Seropédica Landfill	8.7	911
Liquid effluents	11.9	–
Total Emissions Reductions	*378.00*	*1,832.40*
Targets of the City Climate Change Policy	*929*	*1,858*

Source: La Rovere, E.L.; Carloni, F.B.B.A. et al, 2013 [1]