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São Paulo—The "Other" Brazil: Different Pathways on Climate Change for State and Federal Governments

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Abstract

The state of São Paulo, the most populous state in Brazil with 40 million people, is leading the way in Brazilian environmental policies. This article discusses the implications this has particularly for climate change policies. Located in the southeast part of the country, far from the Amazon rainforest, São Paulo state has adopted policies and actions that are leading to effective improvements in the quality of air and to the partial recovery of the original Atlantic rainforest, and that promote sustainable practices for ethanol production from sugarcane. Compared to the state of São Paulo, Brazil as a whole faces a considerably different situation, with the federal and the state governments having chosen different pathways for addressing the challenges posed by climate change.

Keywords

sustainable development, policies, climate change, air pollution, renewables, sugarcane ethanol

> Environment—current issues: deforestation in Amazon Basin destroys the habitat and endangers a multitude of plant and animal species indigenous to the area; there is a lucrative illegal wildlife trade; air and water pollution in Rio de Janeiro, São Paulo, and several other large cities; land degradation and water pollution caused by improper mining activities; wetland degradation; severe oil spills.
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> CIA Factbook, Brazil page (CIA, 2008)

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Introduction: Brazil and São Paulo

Located in the southeast region of Brazil, the state of São Paulo has an overall standard of living and economy comparable to that of a developed country. This article compares the situations of Brazil and the state of São Paulo. Brazil is witnessing challenging development options that continue to put considerable pressure on still unexplored natural resources, whereas the state of São Paulo has already been through this stage and has recognized the need to step up the effort to conserve natural resources and address pollution. Their different environmental policies and development pathways clearly reflect such differences.

Brazil is a developing country with a vast territory located mostly in the tropical zone. It is endowed with tremendous richness in natural resources such as water and arable land, and it embraces most of the Amazon rainforest, the largest rainforest in the world. The predatory destruction of this forest is the object of constant media coverage and fosters a perception that environmental considerations are absent in all regions of Brazil. By 2003, 15% of the forest had already disappeared and models estimate that these losses will grow to 40% by 2050, far above the 30% natural regeneration rate (Soares-Filho et al., 2006). In 2005, total greenhouse gas (GHG) emissions, including from land use change, were equivalent to 11.8 tCO_2eq/capita year (Government of Brazil, 2009c; Instituto Brasileiro de Geografia e Estatística [IBGE], 2009). In this year, GHG emissions from energy amounted to only 1.94 tCO2eq/capita (Government of Brazil, 2009c; IBGE, 2009), thanks to a clean energy mix that in 2008 included 46% from renewable energy sources and amounts to an average energy consumption per capita of 1.33 tonnes of oil equivalent (toe; Government of Brazil, 2009a). Renewable sources account for 80% of electricity generation. Brazil, one of the richest countries in the world in terms of hydroresources, generated 374 TWh of electricity from renewable sources, out of a total 463.1 TWh and 11.8% of total global hydroelectricity production in 2008. Besides the strong hydraulic base (78.5% domestic plus 8.5% of imports) in electricity, electricity generation from biomass waste combustion is also significant (mainly sugarcane bagasse). Nevertheless, thermal generation increased by 63.2% in 2007, specially from natural gas (116.6%) and nuclear (13.1%), according to the Brazilian energy balance (Government of Brazil, 2009a).

Recent plans indicate a vigorous expansion of oil and gas power generation, boosted by the recent discoveries in the southeastern offshore presalt layer. The 10-year plan for energy expansion 2008-2017 (Government of Brazil, 2009d) foresees 15.3 GW of thermal generation, 90% of which is expected to come from fossil fuel sources. This will lead to a 172% growth of CO_2 emissions during the same period. With few measures for energy efficiency in place, the increased demand is expected to result from increases in population, gross domestic product (GDP), and per capita consumption. Environmental challenges to the licensing of hydropower plants, especially for large ones in the Amazon Region, further encourage a shift to more power generation from fossil sources. Existing plans still allocate only a small role to modern renewable energy technologies, such as to small hydropower plants, biomass, and wind power (see Figure 1).

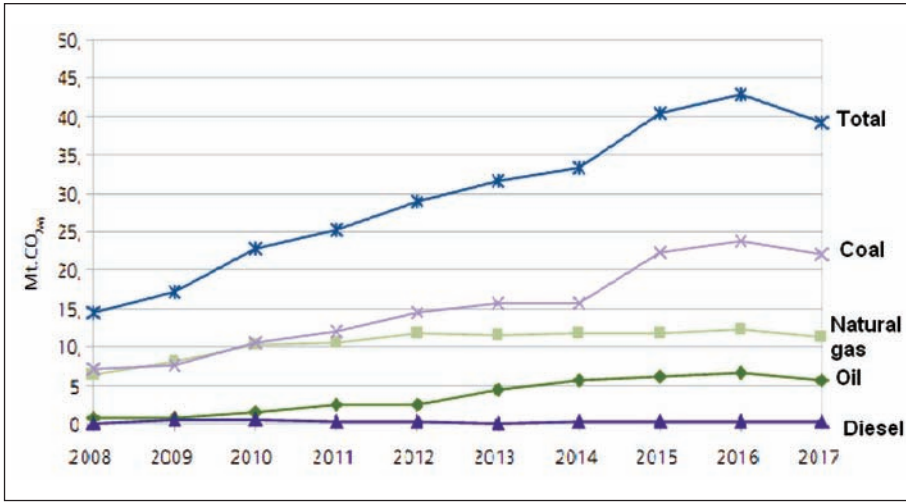

Figure 1. Thermoelectric expansion in Brazil).
Source: Government of Brazil, 2009d

Federal stimulus funding for "modern" renewable energy sources (wind, biomass, and small hydro) is still incipient, despite the federal governments efforts through the Program for Investments in Alternative Sources of Electric Energy (Proinfa Law n.10.43/2002). Proinfa's first phase supports the establishment of generation capacity of 3,300 MW from renewable sources. Its second phase originally foresaw that 10% of total electricity consumed in Brazil would have to be generated from renewable sources within 20 years, but this provision was ultimately abandoned. Law n.10.762/2003 reviewed Proinfa and does not mention Phase 2.

São Paulo is Brazil's most populated and developed state, with 40 million inhabitants and 31% of national GDP. Its energy matrix is composed of more than 50% by renewable. São Paulo State produces one fourth of the world's bioethanol and a large share of hydropower. It therefore exhibits relatively low per capita carbon emissions (around 2.5 tCO_2 equivalent in 2007) coupled with a good standard of living. Compared with Brazil as a whole (Table 1), and specially with the Amazon region, São Paulo follows a different environmental pathway.

São Paulo's experience is linked to different policies and actions, as illustrated by the following examples: (a) policies for forestry protection and recovery; (b) state lawsuit on sulfur in diesel; (c) the "air basins" decrees, which created a cap and trade system for local air pollutants; (d) sustainable bioethanol production, including a voluntary certification scheme, agricultural zoning, and political measures; (e) proposals for changing the world energy matrix through a global target of 10% for renewables by 2010, taken to the World Summit for Sustainable Development (WSSD); and (f) the state climate change policy, mandating a target for GHG emissions and encouraging similar initiatives at national and international levels.

Table 1. Indicators for Brazil, the State of São Paulo, and Its Capital City

	Brazil	São Paulo State	São Paulo capital city
Inhabitants, million (2006)	186	41	10.8
Area (thousand km^2)	8,547	248	1.52
Population density (inhabitants/km^2)	22	165	7,105
GDP, nominal, US$ billion (2006)	1,067	363	131
GDP PPP, US$ (2006)	10,073	15,610	21,920

Source: IMF (2009), UNSD (2009), and SEADE (2009).
Note: GDP = gross domestic product; PPP = purchasing parity power per capita income. Exchange rate (2006) for reference, Brazilian Real to US$: R$2.1753 = US$1.

The following sections will detail the ongoing sustainability initiatives of São Paulo State as well as examine their effects on the rest of the country.

Forest Recovery in São Paulo

The process of deforestation in São Paulo accelerated in the mid-19th century, driven by land clearing for agriculture and pasture land. This process remained intensive over time, especially in the interior. The Atlantic rain forest, a biodiversity sanctuary concentrated along the coast, was the last frontier to explore (Figure 2).

According to SMA (2005), vegetation coverage in São Paulo declined from 7,257,300 ha in 1963 to 4,393,880 ha in 1973, then to 3,330,740 ha in 1992. With the reversal of the historic trend of deforestation, coverage grew by 126,561 ha annually on average and reached 3,457,301 ha in 2002 (13.7% of the total state area; SMA, 2005). Reforestation accounted for 3.1% of total state area. Other biomes include grasslands and mangroves. Several factors contributed to the stop in deforestation: the emergence of civil society environmental awareness, improved monitoring, stricter enforcement, and more sensible land use planning and zoning. In the coastal Atlantic forest area, a US$30 million project supported by the Kreditanstalt für Wiederaubau (KfW) bank was implemented by the state environment secretariat, covering an area of 22,000 sq. km involving 52 cities, with an integrated command and control system being adopted against real estate speculation, predatory hunting practices, and exploitation of natural resources.

Another initiative is the promotion of sustainable wood products, together with the enhanced control of the use of illegally extracted timber, mainly from the Amazon region. One of the main targets of this initiative is civil construction. Another is the timber supply chain: trading companies, transport services, and wood product stores. The goal is a phase-out of products from unauthorized logging by 2010, through wide and stricter state border control. Actions include inspections, online transport control, and identification of species and types of wood. A state decree[1] created a database of suppliers and procedures for governmental purchasing (SMA, 2008a).

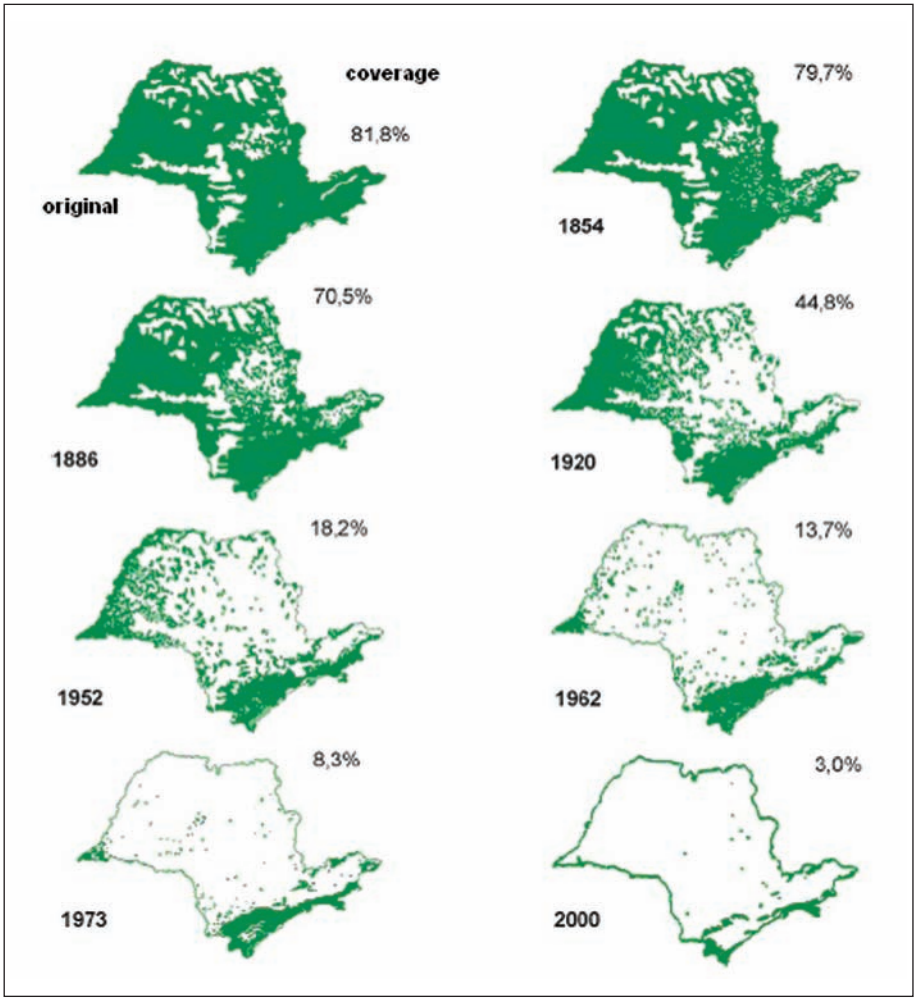

Figure 2. Historical deforestation in São Paulo
Source: SMA (2005).

In the Court: The High Sulfur Diesel Lawsuit

In 2003, 6.5 million light vehicles were registered in the São Paulo metropolitan region (SPMR) as well as approximately 11,000 diesel fuelled buses and thousands of cargo trucks (Companhia de Tecnologia de Saneamento Ambiental de Brasil [CETESB], 2008). The 18 million people who live in the city of São Paulo and its surroundings are affected not only by episodes of high levels of local pollutants, such as ground-level ozone (O_3), nitrogen oxides (NO_x), and particulate matter (PM), but also by carbon

monoxide (CO), volatile organic compounds (VOCs), and other atmospheric pollutants. The high level of sulfur in Brazilian diesel is a matter of major concern because of its health impacts. Currently, two types of diesel oil are commercialized in the country: the "metropolitan diesel" (25% of volumes sold) and "interior diesel" (75% of the total volume). The first type of diesel sold in the main metropolitan regions in Brazil contains 500 ppm S (parts per million of sulfur). The "interior diesel" distributed to all other cities contains 2,000 ppm S. For comparison, since 2009, diesel oil in Europe can contain only 10 ppm S and in the United States 15 ppm S (European Union, 2007; U.S. Environmental Protection Agency, 2009). The national Vehicles' Pollution Control Programme (PROCONVE—Programa de Controle da Poluição por Veículos Automotores—established in 1986) sets legal limits for new model vehicle emissions that are getting progressively more stringent. Clean fuels are sine qua non conditions for the introduction of new vehicle technologies—such as injection systems and tailpipe exhaust catalysts—which in turn are absolutely necessary for urban air pollution control. A study conducted by the medical school at University of São Paulo demonstrated that due to PROCONVE, 14,495 deaths were avoided between 1996 and 2005 in the metropolitan area of São Paulo alone. If expanded to other metropolitan regions, such as Recife, Rio de Janeiro, Belo Horizonte, Curitiba, and Porto Alegre, an estimated 34,447 deaths could be avoided annually.

In 2002, a new law (Resolution CONAMA 315/2002 from the Brazilian Environmental Council)[2] established more stringent tailpipe emission standards that were to come into effect from January 1, 2009. This new phase (locally named "P-6" but similar to EURO IV standards for heavy-duty vehicles) required a low-sulfur diesel oil, named "S-50," which contains no more than 50 ppm S. This fuel should have been made available to the Brazilian market and distributed countrywide for the new fleet. This law also determined that the diesel S-50 should be made available to vehicle manufacturers for tests at least 36 months prior to the launch of the P-6 phase, that is, since January 1, 2006. This has not happened in practice. Petrobras, the national oil company, did not supply the low-sulfur diesel mandated by law. The Brazilian diesel oil market is a captive one and cannot obtain a better quality fuel except from Petrobras, which is responsible for the production of almost all diesel consumed domestically as well as for drilling, refining, and transporting. Petrobras argued that a prior regulation by Agência Nacional do Petróleo (ANP), the Brazilian National Oil Agency, was necessary for them to have to comply. A lawsuit was subsequently filed by the state of São Paulo against the ANP and Petrobras to ensure the supply of an adequate fuel complying to the 50 ppm S content regulation in the whole state territory. The lawsuit was first taken up in the court of São Paulo State but was eventually amended and filed by the federal public prosecutor on behalf of the federal government. This lawsuit also sued vehicle manufacturers for not developing the new models that can fulfill the P-6/Euro IV requirements. Federal public prosecutors are authorized by the Brazilian constitution to bring action against private individuals, commercial enterprises, and the federal, state, and municipal governments in the defense of minorities, the environment, consumers, and the civil society in general. After 1 year of litigation, an agreement

was reached to supply S-50 diesel oil to captive fleets. The outcome was considered insufficient by many but created the conditions for a new phase (P-7) of PROCONVE, compatible with EURO V and requiring 10 ppm S diesel oil, starting in 2012. This new legislation (Resolution CONAMA 403/2008) is already enacted, requiring ultralow sulfur diesel fuel for tests and product development.

Due to the publicity that the "diesel case" had in the media, the public is now aware of the problem—especially of the health impacts and social costs of air pollution caused by high-sulfur fuels. This has increased public support for strict enforcement of national environmental legislation. Prospects for moving forward include establishing (a) a test laboratory for heavy-duty vehicles as a result of the judicial agreement; (b) interim deadlines for actions, such as for regulations for fuel additives to reduce pollution; and (c) significant investments in refineries for diesel desulfurization.

Local Pollutant Caps: The "Air Basins" Decrees

Industries and other stationary sources also contribute to worsening air quality. The SPMR is home to about 42% of all state industries, approximately 50,000 companies. Among them are 2,000 firms considered significant polluters. Moreover, evaporative emissions from gas stations, large fuel storing facilities, and refineries aggravate the situation (Lucon, Sogabe, & Coelho, 2005).

There has been an increased urgency to control fine particulates and secondary pollutants, notably ozone, after recent studies in many countries have now conclusively shown their long-term health impact. This new recognition required a change in the legislation for licensing stationary sources enacted in 1976. New pollution sources can no longer be licensed in a region considered environmentally saturated, that is, where ambient pollution levels already violate air quality standards (any new licensing in these areas would be considered illegal). Changes to the law, however, should allow new industries to be licensed without leading to a worsening of the air quality in pollutant-saturated areas. The first change came in 2003 through new state decrees,[3] which established a 5-year renewable licensing process for stationary sources and corrected the "right to pollute" of older enterprises. Another decree[4] was passed in the following year establishing an air emissions offset policy for noncompliant pollution hot spots. Emission compensation among enterprises is based on total pollution balances. In a given site or vehicle fleet, emissions are inventoried by pollutant, prior to and after a process change is established. Abatements are converted into credits, which can be used to license new processes in nonattainment areas. Credits can be created by several means, like (a) shutting down an existing industry, (b) moving it to a nonsaturated area, (c) installing end-of-pipe emission control equipments (e.g., scrubbers, baghouse filters, electrostatic precipitators, VOC controls etc.), (d) promoting cleaner production measures for pollution abatement (such as technological improvement, fuel switch, or even better housekeeping practices), or (e) offseting emissions from mobile sources within the no-attainment area to obtain credits.

The abated emissions must be validated by the environmental agency and endorsed in the permitting license. Generated emission credits can then be traded freely by the process owner. In practice, however, few credits were generated mostly because of implementation problems related to a new system Not all processes are required to compensate their additional emissions: There are threshold emission limits by pollutant, which means that only the larger polluters fall under the law. Meetings held between industrial unions and the environmental agency led to several changes to the decree. A transitory adaptation regime made sure that credits can be exchanged throughout the state—instead of only within an attainment zone. The most emission-intensive production sectors initially showed significant resistance to chances but eventually came to better understand that effectiveness of the local pollutants' cap-and-trade system.

An interesting fact related to air pollution abatement is that Brazilian nongovernmental organizations (NGOs) and the press have shown little interest in the issue, in part due to lack of knowledge and also because local pollution has been less of a focus of national NGOs compared to "mainstream" environmental concerns like climate change or biodiversity conservation. A lack of factual understanding can be inferred from the fact that it is not rare to find the press referring to CO, locally toxic air pollutant, as CO_2, a GHG.

Sustainable Sugarcane Ethanol: The Environmental Protocol and Sugarcane Zoning

Most of the ethanol produced in the world comes from sugarcane, produced mainly in Brazil, and from corn in the United States. The Brazilian Alcohol Program (Proalcool) was established in 1975 for the purpose of reducing oil imports. Production of ethanol from sugarcane has risen from 0.6 million cubic meters in 1975 to 24 million cubic meters in 2009 (União da Indústria de Cana-de-açúcar [UNICA], 2009). A renewable fuel, it avoids net carbon emissions to the atmosphere when replacing gasoline in vehicle engines.

Sugarcane is an important energy source for São Paulo State accounting for 30% of primary energy consumption and 71% of primary energy produced. In 2008, the state alone produced 13.3 billion liters of bioethanol, 20% of world production and 59% of national output (REN21, 2009; UNICA, 2009). Since 1975, biofuel has been added to all gasoline in blends varying from 20% to 25% in volume. This has allowed the phasing out of lead and resulted in a significant reduction in particulate and sulfur emissions. The expanding fleet of flexible-fuel vehicles (FFVs) allowed the replacement of more than 40% of all gasoline needs. At the pump, ethanol costs less than 70% of gasoline, which makes the renewable fuel attractive to the end user. This experience is highly relevant to almost 100 countries—most of them developing—that already produce sugarcane. Moreover, sugarcane bagasse (a by-product in the sugar and ethanol production) can be used for electricity cogeneration, which reached an installed capacity of 1700 MWe in 2006 in São Paulo State (Goldemberg, Coelho, & Guardabassi, 2008). Sugarcane

Table 2. Sugarcane and Land Use in São Paulo in 2008

Area utilized by		Million hectares	
Sugarcane	4.83		
Other cultures	3.66		
Cultivated areas		8.49	
Natural forests and "cerrado" grasslands		3.45	
Reforestation		1.14	
Pasture land		8.43	
Total São Paulo State			22.03

Source: SMA (2008b).

crop expansion has been occurring largely over underutilized pasture land and therefore presents a good potential for intensification without deforestation (Table 2).

Before the sugarcane ethanol program can be expanded, the Brazilian government needs to address a number of urgent issues related to social and environmental impacts of the production and distribution cycle, especially those related to technical trade barriers and air pollution. Environmental objectives for sugarcane ethanol production include accelerated phase-out of sugarcane crop burning practices; water conservation and protections of water bodies; protection of remaining forests, recovery of riparian areas, and biodiversity corridors; minimization of emissions to air, water, and soil; prevention of soil erosion; adequate management of agrochemical use; and enforcing fair labor practices and encouraging environmental education and public awareness. Besides relying on government regulation and strong law enforcement, the development of voluntarily agreements between the government and producers were explored as well. Such agreements follow basic guidelines used in social and environmental certification schemes. Legislation enacted in 2000 (Law 10,547) regulated agricultural burning practices and restricted burning to 25% of mechanized and 13.35% of non-mechanized areas (Decree 45,689). A decisive new step was taken by the state governor, the secretaries of environment and agriculture, and the president of the sugarcane producers union in May 2007 with the launch of the agroenvironmental protocol (SMA, 2008b). The text stipulates a set of measures to be followed, anticipating the legal deadlines for the elimination of sugarcane harvest burning and immediately halting burning practices in any sugarcane harvests located in expansion areas. It furthermore targets the protection and recovery of riparian forests and water springs in sugarcane farms, controls erosion and content water runoffs, implements water conservation plans, stipulates the proper management of agrochemicals, and encourages reduction in air pollution and solid wastes from industrial processes. The guidelines are clear and require formal commitments to be detailed in plans, maps, and a simplified table with baselines, action targets, and defined indicators (SMA, 2008b). Producers signing the agreement have to report their compliance progress, under penalties of being excluded from the scheme. Adhesion is voluntary, but environmental enforcement is

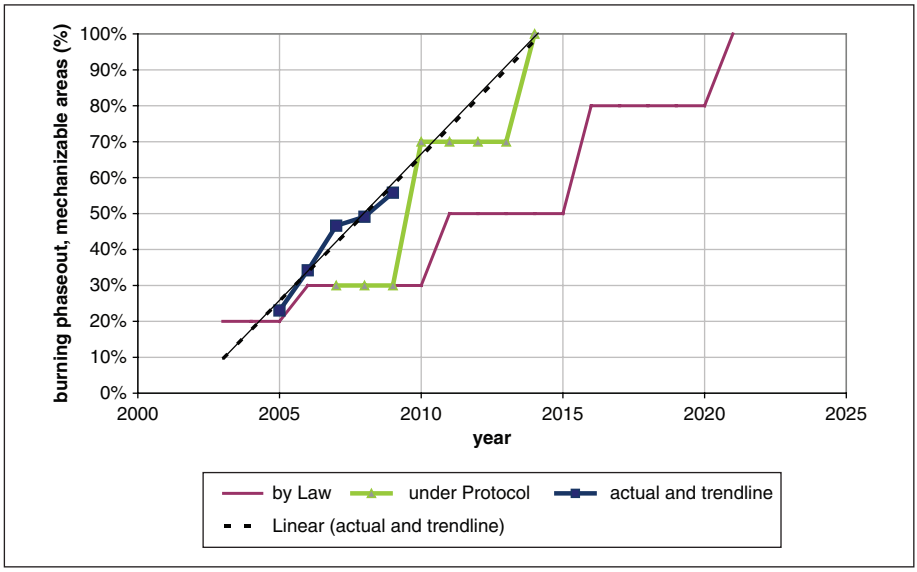

Figure 3. Results of the protocol: Sugarcane harvest burning
Source: SMA (2008b).

focused on enterprises not participating in the protocol. Other advantages of taking part in the agreement include (a) it provides a first step to other certification schemes, through improved registering; (b) it helps better control operations; and (c) it responds to preferences by ethanol importers.

Protection of biodiversity is a special chapter in the protocol: Out of the 1.8 million hectares of degraded lands potentially suitable for recovery for forest restoration in São Paulo (impacts due to agriculture, all cultures), the sugarcane protocol has committed 0.4 million hectares for restoration. As of June 2008, 145 out of the 177 ethanol plants in the state had adhered to the protocol. These represent 89% of total cane crushing (377 million tons). The few nonadherent plants are being targeted by environmental inspections and satellite surveillance. Cane farmers were also included: 21 associations, representing around 13,000 suppliers, have formally adhered and are subjected to basically the same guidelines that ethanol plants are asked to comply with—except those applicable only to the industrial process. Practical results were already observed. Comparing the year 2008 with 2007, 0.55 million hectares was harvested but less 0.11 million hectares was burned, avoiding emissions of 33 tons of particulate matter. Preliminary results lead to the hope that by 2012 all mechanizable areas will have phased-out harvest burning, in anticipation of the legal deadline of 2021. For nonmechanizable areas with the legal deadline of 2031, this goal would possibly be reached by 2017 (Figure 3).

The protocol was also the beginning for sugarcane zoning in the state territory. Information provided by producers under the voluntary protocol were linked to eight

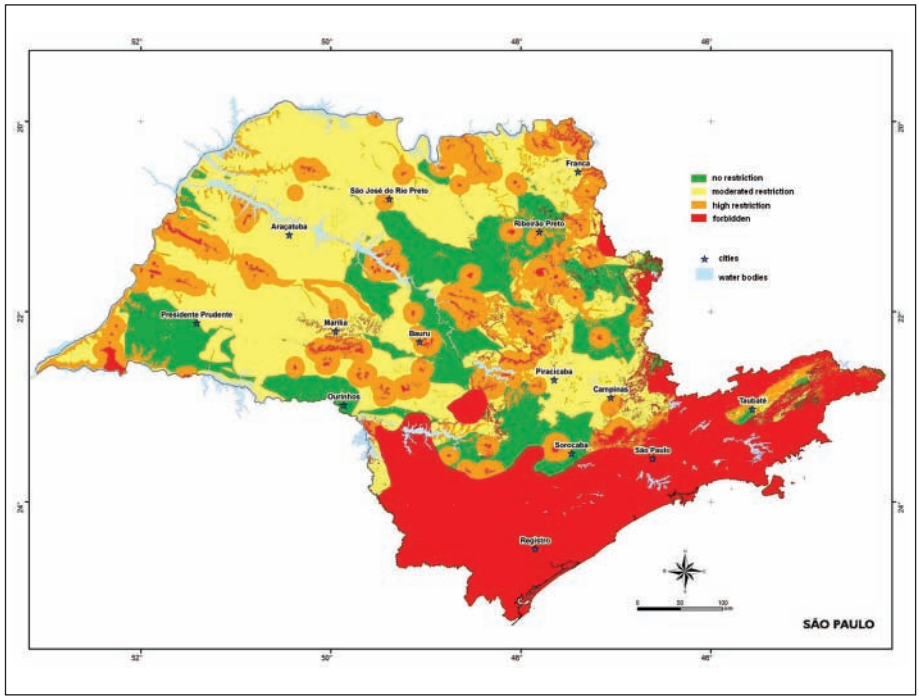

Figure 4. Sugarcane agroenvironmental zoning in São Paulo
Source: SMA (2008b).

indicators: climate potentials, surface water availability, restrictions to mechanized harvesting, underground water vulnerability, biodiversity protection areas, biodiversity connectivity, biodiversity protection importance, and integral protection units (sanctuaries that must be fully preserved, with no economic activity allowed). The result was mapped and is being utilized for environmental licensing (Figure 4).

This initiative had an impact on the federal level in Brazil: A national ecological zoning program was issued for sugarcane production (Empresa Brasileira de Pesquisa Agropecuária, 2009), providing guidance for environmental licensing at both federal and state levels.

The Brazilian Energy Initiative: A Global Target for Renewables

Renewables play an important role in sustainable development, but the deployment of such technologies requires additional efforts in terms of policies, R&D, capacity building, and financing. The world's energy system is worth at least 1.5 trillion dollars annually, and it is dominated by fossil fuels. Dramatic changes are necessary to reach

sustainability. Renewable energy sources are key to achieving this goal. But in 2001, renewable—excluding traditional biomass—represented only 4.4% of global primary energy consumption, unevenly distributed between developed and developing countries. Environmental problems at local, regional, and global levels as well as external dependency and security of supply will persist in an energy future based on fossil fuels. Solutions to energy security must combine top-down and bottom-up policies to extend the life of fossil fuel reserves and to expand the share of renewable energy sources in the world energy system (Goldemberg, 2006).

In March 2002, at the eve of the WSSD (also called "Rio+10"), São Paulo launched a proposal for a global target on renewable energy to increase the share of renewable from 4% in 2002 to 10% by 2010 (SMA, 2002). Such a target should be pursued by all countries and would include the possibility to exchange renewable energy credits. The proposal was first tabled by the Brazilian government at a regional Latin American meeting and subsequently introduced at the Johannesburg WSSD. Latin American environment ministers ratified the initiative in May 2002. Although no agreement was reached at the WSSD, in August 2002, the final plan of implementation, in Paragraph 19, recognized the importance of targets and timetables for renewable energy.[5] At WSSD, the Johannesburg Renewable Energy Coalition (JREC) was formed, aiming to continue to advance the use of renewable energy (Johansson & Turkenburg, 2004).

GHG Emissions Reductions Targets in Emerging Economies: The State Climate Change Policy

World climate change and its negative effects are of common concern to present and future generations of humanity. Human activities are substantially increasing atmospheric concentrations of GHGs, which intensify the natural greenhouse effect and result on average in additional warming of the Earth's surface and atmosphere. The international scientific consensus is that climate change will negatively affect natural ecosystems and humanity. The greater share of global emissions of GHGs, both historical and current, originates in the developed countries, while per capita emissions of developing countries are generally relatively low. However, the share of global emissions originating in developing countries is on the rise, as emerging economies seek to satisfy their social and development needs. The uncertainties surrounding climate change projections are no justification for inaction, while the global nature of climate change demands the greatest possible cooperation of all nations, all levels of government, and society as a whole. Driven by a recognition of the urgency of the problem, the São Paulo climate change policy (State Government of São Paulo, 2009) recognizes the role and the importance of GHG sinks and reservoirs as well as the fact that the global nature of climate change requires the greatest cooperation possible and full participation in an effective and appropriate response, according to the principle

of shared but differentiated responsibilities and according to the social and economic capabilities and conditions of each segment of society.

Until recently, Brazil held a position in line with the Group of 77 plus China (G77+China) consensus which opposed the acceptance of any mandatory GHG control measures for developing countries based on the understanding that such control measures would hamper economic progress and development. At the same time, Brazil and other developing countries emphasized the historic responsibility of industrialized countries as major emitters of such gases.

São Paulo is part of Brazil, which is part of the G77+China. The multilateral process requires consensus, which is very difficult to achieve. Developing countries represented by the G77+China are composed by different nations with different objectives: emerging economies, oil-producing countries, least developed countries (LDCs), small island states (SIDs), and the Africa group are some of its subgroups. Producing a unified position of its 137 members and changing the course of the negotiations is a difficult tasks. The G77+China refuses any reclassification or distinctions among developing countries based on economic criteria; although it acknowledges national mitigation actions by developing countries, it demands that industrialized countries commit to a minimum 40% emission reduction target below 1990 by 2020 and provide stepped-up financial and technological support for mitigation and adaptation actions by developing countries (Organisation Internationale de la Francophonie, 2009).

Since 1995, São Paulo has a Climate Change Program,[6] which established a permanent forum on climate change and biodiversity.[7] Historically, the state has followed a political understanding that the principle of common but differentiated responsibilities means strong and urgent action. A relevant reason is its stage of development, based on past environmental degradation: (a) deforestation occurred many decades ago, and at present, thanks to enforcement and forest recovery initiatives, there has been an increase in the forested area on state territory; (b) highly populated urban areas demand improved environmental control; (c) transportation needs are growing rapidly and therefore a matter of concern; (d) industries have reached a good level of efficiency and technology; (e) agriculture is highly sensitive to climate change. With such facts in mind, the São Paulo state climate change policy was enacted into Law (No. 13.798) in November 2009, a few weeks prior to the 15th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen (COP15; State Government of São Paulo, 2009), after a public consultation process that lasted from February to August 2008.

Targets and timetables can be considered the core of any consistent climate change policy. Without targets, policies become merely programmatic, detached from environmental goals. According to the climate policy, the state of São Paulo shall define the real, measurable, and verifiable actions for reducing its emissions of GHGs, and to do so it may adopt, among others (a) emission reduction targets, both individual or jointly, with other regions of Brazil and the world; (b) sectoral efficiency targets, based on GHG emissions; (c) additional mechanisms for exchanging rights obtained (an important tool for a non–Annex I region that cannot "buy" carbon credits under the

present clean development mechanism [CDM] rules). The policy does not allow for the possibility to obtain marketable CDM credits. The core of São Paulo climate change policy is therefore the mandatory, economy-wide GHG emissions reduction target of 20% by 2020, considering 2005 as a baseline. Establishing a mandatory GHG reduction target in a region located in a non–Annex I country is a matter of intense political controversy. On one hand, there is the recognition that urgent and necessary measures must be taken to avoid global temperature increase. On the other hand, there is a deadlock in the multilateral international negotiations under the UNFCCC and the Kyoto Protocol. The political debate echoes similar discussions in developed countries and invokes different assessments of the possible economic outcomes from implementing mandatory climate measures, perceiving them to either hamper economic competition or contributing toward building a green economy.

So far, most—if not all—of the subnational governments (above municipal level) in the southern hemisphere strictly follow national policy frameworks on climate change. A very common view reflected at subnational levels (municipalities, states, provinces, and other regions) is that national commitments are the upper limit on how far climate policies can go. In Annex I regions, these are the assumed GHG reduction targets. In non–Annex I ones, it is avoiding the establishment of targets or any other measure that could affect the additionality criteria of the clean-development mechanism. The GHG target initiative from São Paulo has no precedent in the developing world and stands as the most far-reaching climate policy initiative on the subnational level in a developing economy. It resembles the environmental leadership provided by the state of California, which has set ambitious GHG reduction targets despite the fact that such targets are lacking on the U.S. federal level. California's GDP is equivalent to the Brazilian GDP and represents 13% of the United States' GDP.

The approach chosen for the São Paulo climate change policy heavily emphasizes educational efforts, to generate a better understanding of the problem and of the means of implementation by the key sectors where action is required. Several definitions are expressed in internationally recognized wordings. Such approach helped considerably the processes of public hearings and legislative approval. Also, an extended and comprehensive law is more stable—and therefore more resistant to political shifts—than regulatory plans made by administrative authorities that are easier to challenge and reverse.

The São Paulo policy is driven by the ultimate objective of the UNFCCC, Article 2:

> To achieve, in accordance with the relevant provisions of the Convention, stabilization of green house gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner (UNFCCC, 1992).

Other specific objectives derive from it: social and economic development compatible with the protection of the climate system; fostering the CDM, and other projects for

reducing emissions, sinks, and sequestration of GHGs; establishing transition mechanisms that create behavioral changes; increasing the share of renewable sources in the energy matrixes within and outside the state; promoting effective actions for adaptation to the impacts of climate changes; promoting environmental education, public information, awareness, and wide disclosure of the aspects involving global climate change; stimulating R&D, and encouraging broad participation; defining and effectively applying environmental performance indicators and goals; increasing the value of the state's environmental assets, while reducing liabilities; expanding carbon stocks; promoting market competitiveness; and coordinating with national, state, and municipal levels.

The policy is based on several well-recognized principles. It first considers that environmental protection is an integral part of sustainable development and acts by combating unsustainable production and consumption patterns, equitably allowing the best quality of life and meeting the needs of present and future generations. The precautionary principle adopted by the international community in the Rio Declaration in 1992 stipulates that the lack of full scientific certainty should not be used as a reason for postponing cost-effective measures for preventing environmental degradation when there is a threat of serious or irreversible damage. The idea of prevention is the basis for adopting measures and public policies that are capable of mitigating known impacts on the climatic system. The user-pays and the polluter-pays principles recognize that those who cause environmental impacts must bear the costs of resulting damages and mitigation efforts and that the government must promote the internalization of environmental costs as well as the use of economic instruments taking into proper account to the public interest. The climate policy furthermore provides for broad participation of civil society in the consultative and deliberative processes, with full access to information as well as legal and administrative mechanisms related to damage compensation and reparation.

The GHG emissions reduction target is supported by the principle of common but differentiated responsibilities, by which the more developed, in a spirit of proactive partnership for conservation, protection, and restoration of health and integrity of the Earth's ecosystem, must take the initiative to combat climate change and its negative effects, taking into account the specific needs and special circumstances of the less developed, particularly those more vulnerable to the negative effects of climate change.

Three final objectives included in the state climate change policy act are cooperation (both national and international), in the spirit of goodwill and partnership; the broad public involvement and transparency through access to information from public authorities about emission levels of contaminants as well as about environmental quality and potential health risks; and finally stepping up environmental education to enable active participation in protecting the environment, to build capacity in society at all educational levels and to provide incentives for technology research and development for the rational use and protection of environmental resources.

The São Paulo climate policy includes objectives both on mitigation and adaptation and calls for the use of respective policy instruments: (a) credit and microcredit for

mitigation and adaptation activities, (b) tax incentives, (c) taxation and other means of charging for activities that emit GHGs, and (d) economic incentives for avoided deforestation and for reforestation. The policy determines the next steps for the short term, which includes (a) issuing of the state communication on climate change, which has GHG Emissions Inventory at its core; (b) establishment of a public registry of emissions for enterprises; (c) setting up a strategic environmental assessment with an ecological-economic zoning and a sustainable transport plan; and (d) definition of global and/or sectoral GHG emission reduction targets—which is the most important part of the policy act.

Similarly to what countries have committed themselves to under the Framework Convention on Climate Change, the state will issue a communication, to be revised every 5 years, that includes a GHG inventory in accordance with the methodology approved by the Intergovernmental Panel on Climate Change (IPCC), a vulnerability map for adaptation plans, assessing the impacts caused by climate change as well as a description of the foreseen policies and measures. Emissions inventories and vulnerability maps will be part of the strategic environmental assessment, a dynamic process gathering policies, plans, and programs. Part of this process includes determining ecological-economic zones, reviewed every 10 years, organizing economic activities, transportation, land occupation and the rational use of natural resources, and determining local models for sustainable development. Guided by environmental quality indicators, plans for helping municipalities, both in terms of actions for mitigating emissions and for adaptation to extreme climate events are foreseen. The private sector will be invited to voluntarily report their emissions to a public register. This is expected to lead to measurable criteria and transparent monitoring of the results of GHG absorption and mitigation measures. Besides being the first step to increased transparency, efficiency, and productivity, the public register will also allow determining emissions baselines for companies, protecting these rights for the future in case of changing legislation.

The São Paulo Climate Change Policy Act has other detailed provisions addressing topics affecting or being affected by climate change. Land use management in urban and rural areas will seek to prevent irregular occupation of vulnerable areas (coastal regions, hillsides, and valley floor zones), to attenuate effects of disasters, to promote sustainable transport, to arrange agricultural and extractive activities, to organize multiple water usage, to protect micro climate, and to increase carbon absorption by vegetation.

Sustainable standards of production, trade, and consumption are designed to encourage using materials with lower environmental impacts. Areas include sustainable procurement, postconsumption responsibility (life-cycle approach), energy conservation and renewables, efficient mineral extraction, civil construction, agriculture and extractive activities, macro drainage and multiple usage of water, and reduction of deforestation.

Environmental licensing of projects and their databases will include climate goals, compatible with the state communication, the strategic environmental assessment, the

public register of emissions and integrated with atmospheric pollution control and air-quality management.

Sustainable transport policies prioritize nonmotorized and public transport, rationalizes and redistributes the demand for space on the roads, encourages multimodal cargo systems and replacement of old vehicles already in use, provides transparent consumer information, foresees additional vehicle environmental standards and vehicular inspection, and removes unsustainable subsidies and market imperfections. It is coordinated with land use, discouraging individual motorized transport and the demand for urban infrastructure from private vehicles. Actions are coordinated in metropolitan regions and harmonized with local authority initiatives.

Already existing and planned integrated water resource management systems, such as water basin plans, must take into consideration climate change and must define areas of greater vulnerability and need for mitigation and adaptation actions. Solid waste management plans must also factor in climate change.

Education, training, and information initiatives aim to develop sensitivity, awareness, and mobilization among the general public and affected private sector entities. Scientific research and new technology development will be encouraged on all climate change–related issues.

Economic instruments include credit and micro credit, tax incentives, charging for activities that emit GHGs, economic incentives for maintaining existing forests and where deforestation is avoided, voluntary compensation for tree-planting, and certification of sustainable products with regard to deforestation avoided within and outside the state boundaries. CDM projects as well as other similar carbon markets will be fostered (see, for example, Friberg, 2009 for a discussion of Brazilian CDM governance).

It is important to highlight the fact that the São Paulo Climate Change Policy is not intended to affect the additionality criteria of CDM projects. This is supported by the CDM Executive Board (EB) Decision 16, which states that

National and/or sectoral policies or regulations that give positive comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g., public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs). (. . .) may not be taken into account in developing a baseline scenario (i.e., the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place). (UNFCCC, 2001a, p. 1)

This is also considered in the EB Decision 22, where "national and/or sectoral policies and circumstances are to be taken into account on the establishment of a baseline scenario, without creating perverse incentives that may impact host Parties' contributions to the ultimate objective of the Convention" (UNFCCC, 2001b).

The implementation of the São Paulo Climate Change Policy Act will require an enormous effort of all local state and nonstate actors involved: Environmental, energy, transport, land use, agriculture, education, and science are some to mention. To make it work, further steps will be required in the coming years. New legislation will be needed as expanded voluntary sectoral agreements with the private sector and

institutional strengthening. Such steps can only happen after widespread consultation with civil society on regular basis and based on cooperation with municipalities, federal authorities (respecting each jurisdiction and managing efforts in a strategic and integrated manner), and international partners to secure additional funding. They also require the systematic incorporation of the climate dimension in the decision-making process.

The São Paulo Climate Change Policy has had a strong impact on Brazilian climate policy. Two weeks prior to the 15th Conference of the Parties to the UNFCCC, Brazil shifted away from its historic position in negotiations and adopted a target for reducing its GHG emissions. Brazil has adoped a law that aims to reduce GHG emissions between 36.1% and 38.9% by 2020 from the base year 2005 (Government of Brazil, 2009e). The commitment and detailed steps to reach it are foreseen to be regulated by a decree to be adopted in 2010, which departs from the official GHG emissions inventory.

Prior to COP15, preliminary figures of GHG emission trendlines and related mitigation efforts and their impact were issued by several Brazilian ministries (Environment, Agriculture, Mines and Energy, Development Industry and Trade, Finance, Science and Technology, External Relations, and Casa Civil—the Department of State; Government of Brazil, 2009b). Figure 5 presents a synthesis of this document. Total emissions are expected to be reduced over the baseline of the year 2005 by 1052 $MtCO_2$ (–38.9%) compared to the 2020 business-as-usual (BAU) trendline. Compared to the emissions baseline of the year 2005, this would represent a reduction of 191 $MtCO_2$ (or –10.3% over emissions already occurred). In the energy sector, there are expected reductions of 207 $MtCO_2$ by 2020 compared to the BAU scenario (–22.9%). However, compared to a 2005 baseline, this represents an actual doubling of total emissions and an increase of 347 $MtCO_2$. Thus, under all official scenarios, there will be a substantial increase in GHG emissions in the energy sector—due to the expected great expansion of use of conventional fossil fuel sources. Main mitigaton actions focus on (a) control of land-use and of deforestation in the Amazon and Cerrado regions (669 $MtCO_2$); (b) recovery of degraded agricultural and cattle raising lands (83-104 $MtCO_2$), integrated cattle raising—crops production systems (18-22 $MtCO_2$), direct plantation (16-20 $MtCO_2$), and biological nitrogen fixation (16-20 $MtCO_2$); and (c) energy, efficiency (only 12-15 $MtCO_2$), enhanced biofuels use (48-60 $MtCO_2$), hydropower expansion (79-99 $MtCO_2$), biomass-solar-wind power (26-33 $MtCO_2$), and coal switch to planted charcoal (8-10 $MtCO_2$). The National Climate Change Policy reflects this assessment (Government of Brazil, 2009e).

Conclusions

São Paulo state provides an excellent example that there are sustainable developmental pathways for developing countries to explore. It is clear that to ensure social and economic prosperity, economic development pathways must also protect the global climate system. Society may learn from the past mistakes made by industrialized

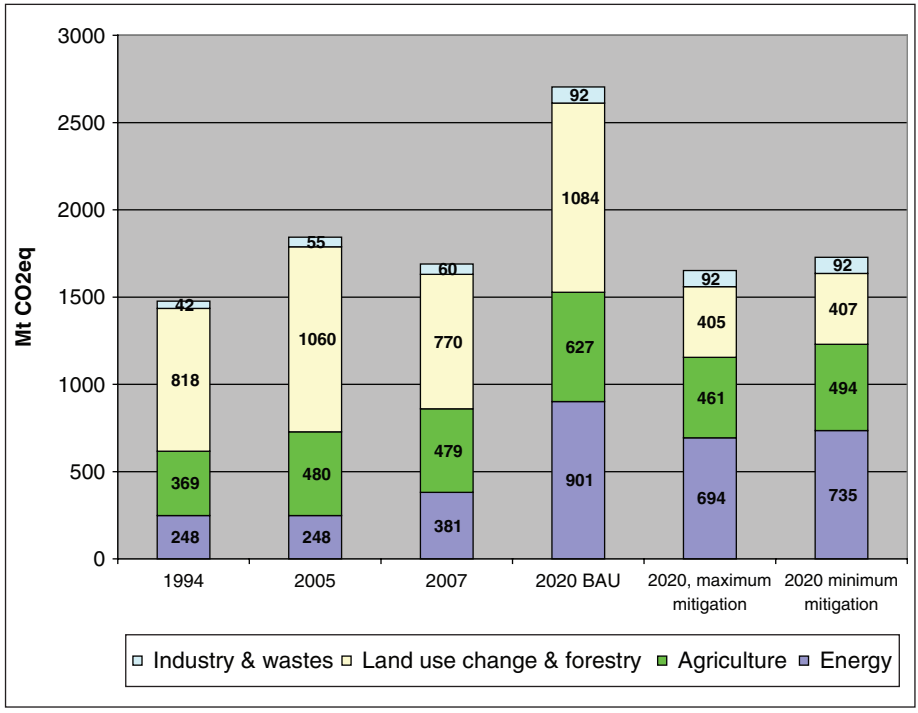

Figure 5. GHG emissions (MtCO2) in Brazil in Years 1994, 2005, 2007—Outlooks for 2020 under business-as-usual (BAU) trendline and with two mitigation scenarios (Government of Brazil, 2009b).

countries and can "leapfrog" into the future (Figure 6) by avoiding much of the undesirable impacts on the environment that comes from relying on unsustainable extraction and pollution pathways for transitioning from primitive agrarian to industrial societies and then to the modern societies of the information and service age.

What the experience has shown in São Paulo is that environmental concerns can become a powerful instrument for modernization and that in the long run, policies for controlling pollution have a positive effect on a country's income.

One of the major global challenges countries are facing on the international level is to achieve an adequate multilateral agreement that provides the framework to preserve the integrity of the global climate system and to stabilize the Earth's global average temperature at safe levels and that also assists countries to adapt to the impacts of climate change in the present and in the future. This requires ambitious actions to reduce the emissions of GHGs as well as to provide means for sustainable development through financing, technology transfer, capacity building, and information exchange. Such initiatives are needed at all levels of society. In many cases, regional governments at the subnational level (states, provinces, and others) are more capable and

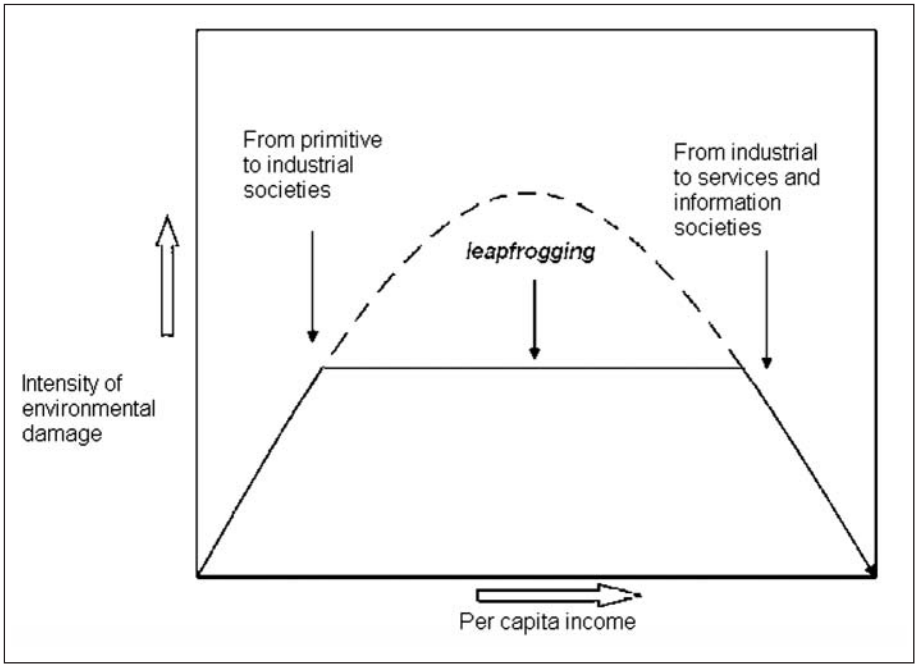

Figure 6. The "leapfrogging" effect: Avoiding unsustainable pathways along the Kuznets Curve
Source: Goldemberg and Lucon (2010).

flexible than national governments to act in a timely manner by adopting laws, policies, programs, and fiscal mechanisms that cover sectors such as energy, environment, transport, and land use and are able to change the emissions trajectory of the economy. Measures implemented at the subnational level can also influence action at the municipal and at the national levels. São Paulo State is an encouraging example of a subnational actor who is playing a leadership role with an impact far beyond its state territory. No wonder did the last Conference of the Parties to the Climate Change Convention (COP15) recognize the important role of regional and local governments in a future response to the climate threat.

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1. State Decree 53047 (June 2, 2008) and SMA Resolution 81 (November 27, 2008).
2. *Conselho Nacional do Meio Ambiente* (CONAMA).
3. State Decrees 47397/2003 and 47400/2003.
4. State Decree 48523/2004.
5. WSSD Plan, Par. 19 e calls on the international community to "Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed. With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty, and regularly evaluate available data to review progress to this end."
6. Proclima, SMA Resolution 22, June 8.
7. Decree 49.369, February 11.

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