

Climate policies in China, India and Brazil: current issues and future challenges

Elie Bellevrat (IDDRI)

SOCIAL AND ECONOMIC DEVELOPMENT AS A MATTER OF PRIORITY

Emerging countries will have to tackle different social and economic development challenges in the future, which translate nationally into the concepts of “harmonious society” in China and “inclusive growth” in India, and into the Brazilian slogan “a wealthy country is a country without poverty”. Per capita (current US\$), Brazil is more than two times richer than China, which in turn is three times richer than India. This graduation explains the variety of priorities of those countries: reducing inequalities and achieving the development processes in China and Brazil, alleviating poverty and enhancing energy access in India. Furthermore, these countries are increasingly linked internationally, along with the globalisation process. Energy security is a key issue for China and India, while Brazil aims at playing a key role on future international energy markets.

EARLY DEVELOPMENT OF LOW-CARBON STRATEGIES

Emerging economies are progressively laying the foundations for low-carbon development strategies that will depend on their national contexts and priorities. Investments in building and transport infrastructures are increasingly important in all those countries, creating the conditions today for tomorrow’s low-carbon economic development. China recently made important resolutions in the framework of its 12th Five-Year Plan, decoupling economic growth from GHG emissions. India has developed eight “National Missions” on climate change and is now exploring future low-carbon strategies. And Brazil is affirming its position internationally, pushing for innovative “green growth” concepts, within the framework of the Rio+20 Conference.

IMPLEMENTATION OF INNOVATIVE POLICY INSTRUMENTS

All countries have already implemented several energy and climate policies and plan to develop them further, through innovative policy institutions and instruments. They are switching progressively from command-and-control to economic instruments. In particular, market-based mechanisms are increasingly used in all countries: mandatory pilot Emission Trading Systems (ETS) in China, voluntary ETS experiments in Brazil, and the Perform, Achieve and Trade (PAT) scheme in India to improve energy efficiency in the industry sector. Design issues are often related to the huge uncertainties in future economic development of these countries, as well as to the robustness of domestic statistical instruments (availability and quality of data). But they are learning fast and are already taking advantage from other international experiences in this task.

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For more information about this document, please contact the author:

Elie Bellevrat – elie.bellevrat@iddri.org

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1. FROM INTERNATIONAL PLEDGES TO NATIONAL POLICIES

International climate negotiations provide a forum for discussions between countries to agree on greenhouse gas (GHG) emissions reduction targets, with the aim of getting closer to the levels advocated by climate scientists. More specifically, the goal is to come to an agreement on effort sharing between countries and major regions.

In the lead-up to the Durban climate conference (December 2011), it is clear that the United Nations process is slowing down, with the difficulty of reaching an agreement on the issue of a legally binding framework to succeed or replace the Kyoto Protocol; the principle of common but differentiated responsibility is the stumbling block between developed and developing countries. Furthermore, discussions focus on pledges, in other words commitments expressed as a unique indicator of the evolution of national GHG emissions.

1.1. Pledges that are difficult to decipher

Although 41 developing countries have taken mitigation actions, only 16 have translated these into quantitative emissions reduction terms. Moreover, the very expression of pledges (in absolute terms, in carbon intensity or in relation to business as usual, BAU) differs considerably from one country to another, as shown in Table 1, especially between Annex 1 and non-Annex 1 countries.

Furthermore, the levels of commitment recorded in the Cancun agreement (December 2010) are difficult to decipher. The metrics chosen, the inclusion or exclusion of emissions from land use, land-use change and forestry (LULUCF), and the possible inclusion of flexibility mechanisms are just some of the obstacles to assessing the level of

rigour for pledges made. This has consequences in terms of credibility, not only at the level of the international community (mutual understanding between countries), but also for the countries themselves, which must develop their own conviction that ambitious targets are achievable (a matter of self confidence).

The heterogeneous breakdown of pledges and the lack of information in some cases (for example concerning the references for calculating business as usual, or BAU), also make it difficult to compare and aggregate GHG reductions pledges at the international level. Most analyses show, however, that according to the most optimistic hypotheses, the sum of pledges made by countries will not be enough to meet the long-term target of limiting global warming to +2 °C relative to pre-industrial times (UNEP, 2010).

Not only do the pledges give no specific definition of the effort to which they are supposed to correspond, but they also fail to account for their translation into policies and measures at the national level. This hampers effective cooperation between countries, especially concerning the implementation of coherent public policy instruments for energy and climate; cooperation that is vital to meeting ambitious targets at the global level.

1.2. The need to analyse national climate policies

All of these difficulties thus argue for an in-depth study of the policies and measures already implemented or simply planned by the countries, beyond the pledges made at the international level. This approach supports the objective of the Learning Platform, which was set up in 2011 between Europe and emerging countries to provide a veritable discussion forum for decision-makers, researchers

and experts in energy-climate public policy, and is aimed at ensuring a better mutual understanding of domestic debates. This project must facilitate international cooperation in order to overcome tension felt in negotiations.

The policies and measures implemented or discussed in the different countries may prove to be insufficient to meet international pledges or, on the contrary, appear more ambitious than these pledges.

The first case concerns countries that are behind schedule in terms of developing a genuine low-carbon development strategy, or which use international negotiations to drive national debates or for strategic purposes.

In the second case, uncertainty concerning long-term pathways is of course one explanatory factor, but a country may also be tempted to set a target it knows it can easily meet in order to minimise risks taken on the international scene. Furthermore, the developing countries readily hide behind the principle of common but differentiated responsibility

in negotiations, even though they are making some real efforts at the national level.

1.3. The case of the major emerging economies

In this article we detail the state of policies and debates in three emerging countries associated to IDDRI's Learning Platform: China, India and Brazil. They are among the top GHG emitters even though emission sources differ a lot: in China and India, emissions widely come from fuel combustion whereas land-use and agriculture emissions are the bulk of the Brazilian emissions. Recent trends are also contrasted: emissions are booming in China and India, especially in the former country, due to growing energy demand, while they are decreasing in Brazil thanks to recent efforts in deforestation reduction. According to the Current Policies Scenario from the latest World Energy Outlook (IEA, 2011), CO₂-energy emissions in China would account for 29.5% of the global total in 2030 (compared to 23.8% in 2009), and for 8.8% of global emissions in India in 2030 (compared to 5.4% in 2009). As for Brazil, CO₂-energy emissions represented only 1.2% of the global total in 2009 and are expected to represent a slightly higher share by 2030, with 1.5% (increasing dramatically in absolute terms).

The pledges made by China and India at the international level are expressed in carbon intensity. This is explained by the considerable uncertainty about future growth and the determination to avoid jeopardising this growth, which guarantees social peace. For these high economic growth

countries, the spotlight is therefore on the decoupling of GHG emissions from economic growth, and more specifically on the energy efficiency of factors of production, which implies the structural transformation of economies. In Brazil, commitments have been pledged in reference to a Business as Usual scenario (BAU), thus providing a clearer vision about the future emissions path but still allowing some flexibility for its definition. Of course, it would be preferable that all countries pledge emission reductions in absolute terms, but the approach will remain very linked to the national contexts and priorities, in particular the level of economic development. So far, most developed countries from Annex 1 have defined their pledges in absolute terms as shown in Table 1.

Focusing on pledges from emerging countries prevents from understanding clearly the intentions, strategies and instruments that are being set up within countries. What, therefore, are the specific policies and measures discussed, already adopted and/or implemented by China, India and Brazil, standing behind the pledges they made at the international level?

2. CHINA'S CLIMATE POLICY

In China, the main institution responsible for energy and climate policy-making is the National Development and Reform Commission (NDRC). It acts as a super-ministry in charge of drawing up medium- and long-term economic and social development plans, under the supervision of the State Council. In particular, the institution formulates and coordinates energy and climate policies, especially through the National Energy Administration (NEA) and its Department of Climate Change.

Chinese policy goals are usually defined by the central government and assigned to the provinces, which are then responsible for implementing and monitoring policies across the whole country. Economic and social development objectives are set out in five-year plans, which lay the foundations for new economic development strategies and launch reforms that follow centralised government planning.

2.1. The 11th five-year plan

Under the 11th five-year plan, the main objective of energy policy was a 20% reduction in energy intensity over the 2006-2010 period, which also applied to the provincial level. This objective was a real trend reversal after energy intensity rose over the previous period (an average yearly increase of

Table 1. A selection of pledges recorded in the Cancun agreement (Source: UNFCCC)

Country	Type of emissions reduction targets	Quantitative targets for 2020	Reference year/Nature of target	Share of global emissions in 2005
Annex 1 countries				
United States	In absolute terms	- 17 %	2005	14.3 %
EU27	In absolute terms	- 20 % to - 30 %	1990	10.6 %
Japan	In absolute terms	- 25 %	1990	2.8 %
Russia	In absolute terms	- 15 % to - 25 %	1990	4.2 %
Canada	In absolute terms	-17 %	2005	1.7 %
Australia	In absolute terms	- 5 % to - 25 %	2000	1.2 %
Non-Annex 1 countries				
China	In intensity	- 40 % to - 45 %	2005-2020 variation	15.1 %
India	In intensity	-20 % to - 25 %	2005-2020 variation	3.9 %
Indonesia	In relation to BAU	- 26 %	BAU in 2020	4.3 %
Brazil	In relation to BAU	- 36 % to - 39 %	BAU in 2020	6.0 %
Mexico	In relation to BAU	- 30 %	BAU in 2020	1.4 %
South Korea	In relation to BAU	- 30 %	BAU in 2020	1.2 %
South Africa	In relation to BAU	- 34 %	BAU in 2020	0.9 %

Note : BAU: Business as usual scenario

3.8% between 2002 and 2005). This upward trend broke with more than 20 years of almost continuous reduction, illustrating the growing difficulty of improving energy efficiency in a heavily industrialised economy.

The first *ex-post* assessments of the evolution of energy intensity over the 2006-2010 period showed that the target had been met, or nearly met, with an improvement of more than 19.1% in energy intensity according to the authorities. In reality, the objectives of the 11th five-year plan ought to have been easier to meet as they should have been accompanied by the progressive growth of the tertiary sector. Against all expectations, the opposite occurred, with the continued industrialisation of the country despite contrary political will.

Most of the policies and measures implemented during the 11th five-year plan were top-down in nature and therefore had limited efficiency, implying high administrative and financial costs. In addition, the social costs of command and control measures proved very high (such as the measure to close small, inefficient plants).

China implemented several policies during the 11th five-year plan, including the Renewable Energy Law in 2006 and the Energy Conservation Law in 2007 (CPI Beijing, 2011). In addition, the central government encouraged capacity building at provincial level and provided assistance to Energy Service Companies (ESCOs). This plan involved considerable central government investment in the form of financial transfers, subsidies, different

incentives, preferential interest rates and loans, etc. A wide array of accompanying policies was implemented, ranging from regulated market access for energy-intensive industries to incentive policies such as tax reductions or financial support, as well as a number of other economic instruments such as preferential rates in the electricity sector.

The main measures concern the largest sources of emissions, especially the 1 000 largest energy-consuming enterprises through the Top-1000 Programme, as well as small sources of industrial emissions with the planned closure programme known as “structural optimisation” (Price *et al.*, 2011). On the other hand, the Chinese authorities experienced difficulty regulating medium-sized sources of emissions with command and control instruments.

The 11th plan also provided for the installation of more than 200 GW of renewable energy capacities, including 190 GW of hydropower, 5.5 GW of biomass, 10 GW of wind power and 300 MW of photovoltaic power. The targets were met in 2009 and were therefore largely exceeded over the period of the 11th plan.

In addition to the provincial programmes, the total emissions reductions from these measures were to represent almost 4.3 Gt of CO₂ according to the 11th plan, equivalent to one year of European Union emissions. Initial studies show that most of these projects made the expected savings, and sometimes even exceeded them, with the exception of the programme for the renovation of

existing buildings and the targets for the expansion of the tertiary sector.

Analysis of policy efficiency remains a complex task due to a level of public information that is still low and to a lack of robust data. The Chinese administration is nevertheless attempting to remedy these problems by setting up more efficient monitoring, reporting and verification (MRV) systems.

2.2. The objectives of the 12th five-year plan

The 12th and latest plan to date covers the 2011–2015 period. It was adopted by the 11th National People's Congress in March 2011. The objectives of the 12th plan have been considerably revised downwards in order to take into account the fact that the least costly emissions reductions have already been made. For example, the potential for closing small power plants is now lower: only 20 to 30 GW of power capacities remain to be closed in the short term, consistent with standard efficiency criteria (according to the Energy Research Institute).

The five-year energy intensity reduction target is now only 16% by 2015, but for the first time it is accompanied by a carbon intensity reduction target of 17%, which also applies to the provinces but is differentiated across them. This reflects the determination to progressively move towards a lower-carbon economy, even though future growth must continue to rely essentially on coal, the only fuel that is sufficiently low-cost and abundant to meet the enormous demands of the Chinese economy. Despite being revised downwards, the outlook for economic growth is still very high (7% on average by 2015). In particular, the challenges linked to urbanisation have become a key issue, with one billion people living in cities and the prospect of having 221 cities with more than one million inhabitants by 2025.

According to the Chinese Academy of Sciences, 33.3% of the objectives of the 12th five-year plan are aimed at a better use of natural resources or environmental protection, compared to 27.2% in the 11th plan (Fulton, 2011). The 12th plan provides for higher energy efficiency targets for buildings (especially commercial ones), electricity generation using renewable energy, an increase in forest cover (of 12.5 million hectares), the continued development of high-speed railway lines (an additional 4,700 km by 2015) and the deployment of electric vehicles (500,000 vehicles by 2015).

The share of coal in electricity generation should fall from 72% to 63% by 2015, substituted by renewables. The share of non-fossil fuels should increase from 9.6% of supply at the end of the 11th plan to 11.4% of primary energy by 2015. Very

ambitious targets for the installation of new renewable energy capacities concern hydropower (90 GW), wind power (40 GW) and solar power (4 GW). Furthermore, the grid will be developed to cope with problems of connecting the new capacities and thereby ensure a better integration of renewables into the energy system. By 2020, the share of renewables in total consumption in China could reach 20%.

The moratorium imposed on the construction of new nuclear power plants should imply a delay in the Chinese nuclear programme (more than 30 GW of additional capacities in the 12th plan), while the authorities find safer solutions and reassure the public. In the short term, this should mean more opportunities for renewables and natural gas in electricity generation. Nevertheless, it is unlikely that the development of this low-emitting energy will truly be called into question.

The massive use of command and control public policy instruments revealed its limitations in the 11th plan, and the 12th plan therefore aims to increase the use of market instruments. These must have a direct impact on energy consumption levels and on GHG emissions via the price effect, especially by triggering energy efficiency actions among end consumers. The instruments envisaged mainly consist in environmental taxes, including the carbon tax, but also and above all in emissions trading systems (ETS). The government has announced the creation of pilot carbon markets in seven provinces and cities around the country by 2013, and appears to be seriously considering the implementation of a national ETS by 2015. According to a recent NDRC proposal, electricity prices could become progressive, according to user consumption levels, if not completely deregulated in the short term.

Beyond a simple list of environmental targets, the 12th plan particularly focuses on the development of promising strategic industries, including clean vehicles, energy management and environmental protection, new energies, new materials and new generation information technologies. To achieve this, research and development investment should progress further to reach 2.2 to 2.5% of GDP by 2015, compared to 1.7% today (Climate Group, 2011).

2.3. Necessary economic changes

Among the global leaders in energy and climate policy, China is unquestionably one of the most advanced developing countries in terms of the sophistication of the instruments developed. China learns quickly, especially from the experience of the developed countries, and from Europe

in particular. But further progress is needed regarding the transparency and quality of data. The main reason for this enthusiasm is that its tremendous economic development must not be challenged by energy supply problems and environmental constraints. Conversely, the environment and the quality of life of the population must no longer be compromised by economic growth at any cost. In this respect, Chinese policy for 2020 can be compared to the European Commission's Resource-Efficient Europe initiative.

In addition, a new law on climate change is planned in two or three years' time. It could lay the legal groundwork for the future institutions responsible for energy and climate policy and better regulate the role of existing institutions.

In the longer term, China will need to undertake a dramatic transformation of its economy, beginning with massive de-industrialisation along with the considerable expansion of the tertiary sector. For several years, China has been very dynamic and shown considerable capacity in terms of infrastructure development, largely supported by public investment. This capacity must be progressively put towards the transition to a low-carbon economy. Despite the considerable problems of security and of transparency from the authorities, in just a few years, China has for example developed the most extensive high-speed rail network in the world (more than 8,000 km in 2010). Even if this country has not yet set itself long-term objectives (for 2050), there is no doubt that it will be among the first powers to put in place specific strategies for an ambitious and pragmatic energy transition. China fully intends to seize the opportunity to become the indisputable leader in the next industrial revolution, which will undoubtedly be linked to the green economy.

3. INDIA'S CLIMATE POLICY

The general guidelines for Indian policy are set out by the Planning Commission in five-year plans. Initially a highly centralised planning body, this commission now delivers strategic visions of long-term development and decides on national priorities, according to an integrated approach. It is made up of sectoral divisions, such as the Power and Energy Division and the Environment and Forests Division, which also includes a climate change cell.

Energy policy is defined and implemented by different ministries, including the Ministry of Power, the Ministry of Environment and Forests (in charge of climate issues) and the Ministry of New and Renewable Energy. The Bureau of Energy

Efficiency (BEE), under the Ministry of Power, conducts energy efficiency programmes. This body was created in 2001 after the Energy Conservation Act was voted by the Indian Parliament.

3.1. Priority to development

Indian priorities are clearly geared towards economic development and poverty reduction (see the Millennium Development Goals). The pace of economic growth nevertheless generates increasing energy requirements, and environmental issues are now a priority. Thus, Indian policy particularly focuses on targets for energy security, economic competitiveness, the reduction of local pollution and land management and control.

Electrification is constantly expanding (almost 84% in 2009 according to the Ministry of Power, this number being subject to controversy), but remains far behind the levels reached by the developed countries. India contrasts sharply with China on this point (a country that has already achieved almost 100% rural electrification). The priorities for these two countries therefore differ and the eradication of energy poverty is a priority for the Indian State. GHG emissions per capita are still very low (less than 2 tCO₂eq/person) and could double by 2030, without exceeding the global average. The Indian Prime Minister's announcement in Heiligendamm in 2007 that per capita emissions should never exceed average developed country levels (currently almost 14 tCO₂e/person) thus seems lacking in ambition given that India is behind schedule.

Tackling climate change is also a key issue, since it is closely linked to the vulnerability of many regions to natural disasters, especially to extreme weather events. Over three quarters of India's coastal areas are likely to be hit by cyclones and 68% of the country is subject to drought. In the short term, India would therefore benefit greatly from adopting proactive climate change policies from the viewpoint of adaptation.

The availability of land resources is also a crucial issue in view of the demographic changes taking place. This is probably one of the greatest obstacles to the social acceptability of new industrial projects (including nuclear ones). New development strategies and future energy and climate policies will clearly have to take into account these resource constraints.

3.2. Existing energy and climate policies

As in China, Indian policy is largely set out in five-year plans. The 11th plan covers the 2007-2012

period and focuses particularly on pursuing the liberalisation and openness to foreign investment policies initiated in 1991. It also aims to limit dependence on oil product imports through energy demand management and the development of domestic production capacities.

The power capacity scheduled in the 11th Indian plan is 79 GW. It provides for the installation of 60 GW of new power capacities, half of which is to be coal-fired, followed by hydropower (16 GW) and nuclear (3 GW). However, the targets set out in Indian plans are often far from being met and installed capacity by the end of the 11th plan is expected to be 20% below the capacity initially planned (at 63 GW). The numerous delays are due in particular to energy supply problems or to the time needed to obtain environmental permits. For the 12th plan, which will cover the 2012-2017 period, the target is of the same order of magnitude, with 65 GW of new capacities to be installed. India is aiming to install 49 GW of renewable capacities between 2013 and 2022 (the period covering the 12th and 13th five-year plans), including more than 22 GW of wind power, more than 4 GW of biomass, more than 3 GW of small hydropower and 19 GW of solar power (The Climate Group, 2011). India's energy and climate policy has been largely drawn up via two reference texts:

- The Integrated Energy Policy, published in 2006, which makes recommendations concerning the organisation of energy markets and the future development of the sector;
- The National Action Plan on Climate Change, released in 2008, which identifies eight "National Missions" for a strategy for 2017, addressing both climate adaptation and mitigation issues.

The National Mission on Enhanced Energy Efficiency anticipates a 20 GW saving in electricity demand relative to BAU by 2020, which is double the target set in the 11th plan. The emissions reduction target is almost 100 MtCO₂ per year by 2015 and the energy saving target is 23 Mtep per year. This mission, supervised by the BEE, clearly consolidates the previous programmes, especially the one concerning the creation of energy labels (2006), which was aimed at inefficient equipment in the residential and tertiary sectors. In particular, it provides for four different yet complementary mechanisms, implying the progressive application of economic instruments in order to maximise cost-effective energy saving potential; packages of measures aimed at speeding up the replacement of inefficient equipment in certain sectors and making this equipment more affordable for consumers; programmes to finance energy efficiency; and new fiscal instruments, etc.

India has high hopes for solar power through its National Solar Mission, with an ambitious target of 20 GW of solar power in 2022, especially for water treatment. Emphasis is placed on research efforts, which have been constant since the 1990s. Clean energy development targets, which are part of the national energy plan, are generally met or even exceeded. However, the problem of subsidies for energy consumption persists and goes against energy efficiency targets, cancelling out the expected benefits of energy conservation policies. Forests also play a crucial role in India. They cover a third of the country and secure the livelihoods of almost 300 million people. This is why the National Mission for a Green India has invested \$10bn over 10 years to improve 10 million hectares of forest and to plant 5 million hectares of new forest. These results are important, especially to foster the emergence of new natural products and for the development of ecotourism.

3.3. The low-carbon development strategy

An expert group was recently set up by the Planning Commission in order to translate the carbon intensity target announced into a long-term low-carbon development strategy (Planning Commission of India, 2011). In reality, the expert group goes beyond the Indian pledge as recorded in international negotiations and is studying two scenarios.

- A first scenario, known as "determined efforts", leading to a 23 to 25% reduction in emissions intensity by 2020 relative to 2005 levels, or a level of ambition similar to the Indian pledge in Copenhagen, then in Cancun. According to the report, this corresponds to the vigorous pursuit of existing policies and measures.
- A second scenario, known as "aggressive efforts", leading to a 33 to 35% reduction in emissions intensity by 2020 relative to 2005 levels, or a level of ambition 10 percentage points above the pledge recorded in international agreements. According to the report's expert authors, this is the upper limit of what can be achieved.

To do so, several assumptions regarding economic growth and energy demand (especially for electricity) were studied by the experts, but all of them place the scenarios in a context of sustained economic growth: from 8 to 9% on average per year by 2020. There has been a certain amount of criticism about the quality of the study (methodology adopted, data used, analyses, etc.), and especially about the level of ambition reflected by the scenarios. Indeed, in certain sectors, the level

of ambition appears to be as high, or lower, than those taken into account in current legislation and the programmes already implemented by the government. For example, targets for the development of renewables are lower than those proposed by the National Action Plan on Climate Change in 2008, even in the “aggressive efforts” scenario (CSE, 2011).

The formulation of a low-carbon development strategy remains a long-term process, and Indian experts should take on board criticism already made in the production of future reports. The exercise must be credible, especially to the international community, if it is not to prove counter-productive. It must eventually propose specific avenues for meeting the targets announced by India, or even exceeding them. This, in any case, is the goal of the expert group.

3.4. Some major uncertainties still exist

The Indian position evolved considerably between the Rio and Cancun summits, with the country working towards the acceptance of binding commitments “in an appropriate legal form”, as well as international procedures to verify effective GHG emissions reductions. However, domestic policy, especially the cabinet reshuffle in summer 2011, seems to have “refocused” India’s official position at the international level, with a return to a more rigid stance in the lead-up to the Durban conference.

Nonetheless, there is no doubt that India is taking action at the domestic level and is determined to limit the environmental impact of its development. But given that it is lagging behind economically, the country is calling for international financial and technical support.

Analysis of Indian policies and measures on energy and climate issues reveals an imbalance between the different sectors of the economy, with over half of these policies and measures concerning the power system and almost none for other sectors (rail transport, for example). Moreover, long-term scenarios remain relatively fragile and open to criticism regarding their assumptions (economic growth, energy demand analysis, etc.), with consequences in terms of the credibility of BAU projections and therefore of the assessment of energy intensity and emissions reduction potential. Future studies by the expert group in charge of studying long-term low-carbon development strategies should be the opportunity to remedy some of the current shortcomings.

4. BRAZIL’S CLIMATE POLICY

Two ministries are in charge of defining and implementing the domestic energy and climate policy in Brazil: the Ministry of Environment and the Ministry of Energy. The Interministerial Commission on Global Climate Change, chaired by the Ministry of Science and Technology, has been established in 1999 in order to coordinate the government action in the area of climate change.

The Brazilian federal Energy Research Centre (EPE) supervised by the Ministry of Energy is the main planning body for the energy system. The governmental planning tools are the ten-year energy plan (PDE) and the indicative long-term energy plan at 25 or 30 years (PNE), under the responsibility of EPE. IBAMA is the federal environment agency in charge of combating deforestation in Brazil, in particular in the Amazon Forest and the *Cerrado* regions.

4.1. Early Brazilian climate policy framework focused on deforestation

The bulk of Brazilian GHG emissions are coming from land-use change and the agricultural sector, with 80% of total country emissions in 2005 according to the country’s second national communication elaborated by the Ministry of Science and Technology in 2010. The contribution of LULUCF emissions makes Brazil one of the major emitters worldwide (the fourth largest with 2.2 GtCO₂eq in 2005), with a very specific context compared to the situation in other countries. Past emission trends resonate with the focus put on deforestation activities and the agricultural sector of early climate policy developments in Brazil.

The pledge taken at Copenhagen during COP15 has been soon introduced in the Brazilian domestic law (National Policy on Climate Change) in December 2009, with the objective of reducing the country’s GHG emissions by 36% to 39% compared to projected emissions to 2020. The federal decree detailing the National Policy on Climate Change, passed in early 2010, introduces the Nationally Appropriate Mitigation Actions (NAMAS) defined through five sectoral plans to be set up by end 2011 (Viola and Franchini, 2011). Five of them have been soon released and are underway, albeit at different levels of advancement:

- Action Plan for the Prevention and Control of Deforestation in the Amazon
- Action Plan for the Prevention and Control of Deforestation in the *Cerrado* Region
- Action Plan for the Consolidation of a Low-Carbon Economy in Agriculture

- Action Plan for Emission Reductions in the Steel Sector (replacement of coal from deforestation with planted forests)
- Action Plan for the Energy Sector (as established by the PDE to 2020)

Deforestation reduction objectives represent around 75% of overall emission reductions by 2020 (almost 900 MtCO₂eq) and are defined in the first two sectoral plans, which target 80% deforestation reduction in the Amazon and 40% in the savannahs (*Cerrado* region). These objectives were already more or less met/obtained in 2011, thus demonstrating the willingness of Brazil to fight against deforestation, with potential great results. But as those objectives have been achieved with the current legislative package, one could ask why even more ambitious results could not be obtained by 2020?

Good results on forests were certainly achieved thanks to global economic conditions and to the increased and improved surveillance of deforestation activities, using almost real-time deforestation detection satellite monitoring system. However, a new Forest Code has been in debate in Brazil for a while, with the objective to make the old code flexible. It is considered that there is room for improvement of the current regime, replacing many small landowners inside the law (after having illegally cleared forest during the last decades) and allowing better enforcement and compliance of the rules thanks to a comprehensive and effective registry system. But this new code is very controversial, accused by environmentalists of weakening the current framework and giving incentives for starting deforestation again.

4.2. Brazilian climate governance issues

The governance of energy and climate policies is not easy to articulate and operate effectively across the three levels: federal, state and municipal. Meanwhile, Brazilian states are moving forward, preparing mitigation/adaptation plans as well as REDD and environmental service plans. Almost every state has established a GHG inventory serving for the identification of mitigation actions, designing new policy instruments and monitoring future emissions reductions (IPEA, 2011).

In 2009, the state of São Paulo has been the first state to define a voluntary target of reducing by 20% its CO₂ emissions by 2020 from its 2005 levels. The state of Rio de Janeiro is less advanced than São Paulo on this aspect, whereas the municipalities of São Paulo and Rio de Janeiro have adopted emission reduction targets. In terms of

policy instruments, states are at an early development phase of mitigation actions and incentives in a low-carbon development perspective. In particular, there is a certain eagerness to develop emissions trading schemes (ETS), especially in view of the Rio+20 Conference in the case of Rio de Janeiro.

Brazil is still at the early stage of its climate policy definition and of course, there is room for future improvement and better governance effectiveness.

4.3. Energy-related challenges for post-2020

Energy-related emissions are very low (1,7 tCO₂ per capita in 2009), mostly because the Brazilian energy system is already low-carbon intensive thanks to its almost zero-emission power generation. Carbon-free electricity accounts for over 90% of total power production, with hydropower representing 75% of installed capacity, and the electricity emission factor is around 10 times lower than the world average. One challenge for the next decades will be to maintain this supply-side pattern. According to EPE, hydroelectricity could expand so as to follow the soaring of power demand at 2020, and maintain its share as technical potentials appear to be substantial (estimated at 260 GW). The contribution of wind, biomass and solar should also be increasing.

LULUCF emission reductions are one shot mitigation actions in the short-term that should now be associated with anticipated and sustained actions on energy-related CO₂ emissions. This is supposed to be the challenge in the Brazilian post-2020 era as illustrated in recent long-term energy scenarios for Brazil (de Gouvello et al, 2010 and La Rovere et al, 2012). Energy demand is expected to increase dramatically over the next decades, under the effect of economic and social development (ie. more people, consuming more goods and services), and if mitigation actions are not anticipated on the largest energy-consuming sectors that are transport and industry, energy-related carbon emissions could start soaring. So far, Brazilian policy responses are essentially supply-oriented, but will those energy-harvesting technologies (like hydro and biomass) remain socially acceptable under growing environmental concerns?

Additional sectoral address the fast-growing emissions from energy-consuming sectors. They detail mitigation actions and policy instruments to be implemented, establish MRV standards and ask for sectoral impact assessment studies, on the following areas:

- Public urban transportation and interstate freight and passengers transport
- Manufacturing industry and durable consumer goods industry
- Chemical industry
- Pulp and paper industry
- Mining sector
- Civil construction and building industry
- Health services sector

Transport represents the largest share of final fossil fuel demand (almost 50% in 2009 according to Enerdata), followed by the industry but with a much lower share (around 40%). With huge urbanization rates, the growth of energy demand will be concentrated in cities and the challenge of the urban-transport nexus will be increasingly central. The issue of energy efficiency should be further deployed in the industrial sector, which already suffers from competitiveness concerns. Biomass is expected to support the development of the transport sector in official scenarios, and more especially private mobility. Biofuels would mitigate this huge expansion and the role of sugar cane-based ethanol is supposed to increase.

4.4. The Brazilian position and macro-economic issues

Brazil is a fast growing economy, which became the sixth richest country in the World in 2011, overtaking the United Kingdom. Its economic growth has been fluctuating for the last 20 years, with long and short-wave variations, but an average growth of over 3% has been reached (and almost 4,5% on average over the last 5 years according to the World Bank). Inflation is the scourge of the Brazilian economy, and this threat is usually managed through careful regulation of priority need tariffs. Indirect regulation of oil products by Petrobras is particularly sensitive, entailing risks of harmful price distortions between ethanol and gasoline prices.

Brazil has already achieved great social development, mostly based on its immense natural resources and thanks to wide agricultural spaces and suitable climatic conditions (primary materials represent 43% of Brazilian exportation). High standards of living have been reached in the main cities and over 40 million poor people have got out of destitution over the last decade, thanks to ambitious and effective social programmes. But inequalities remain high and the country is still facing huge socio-economic challenges for the decades to

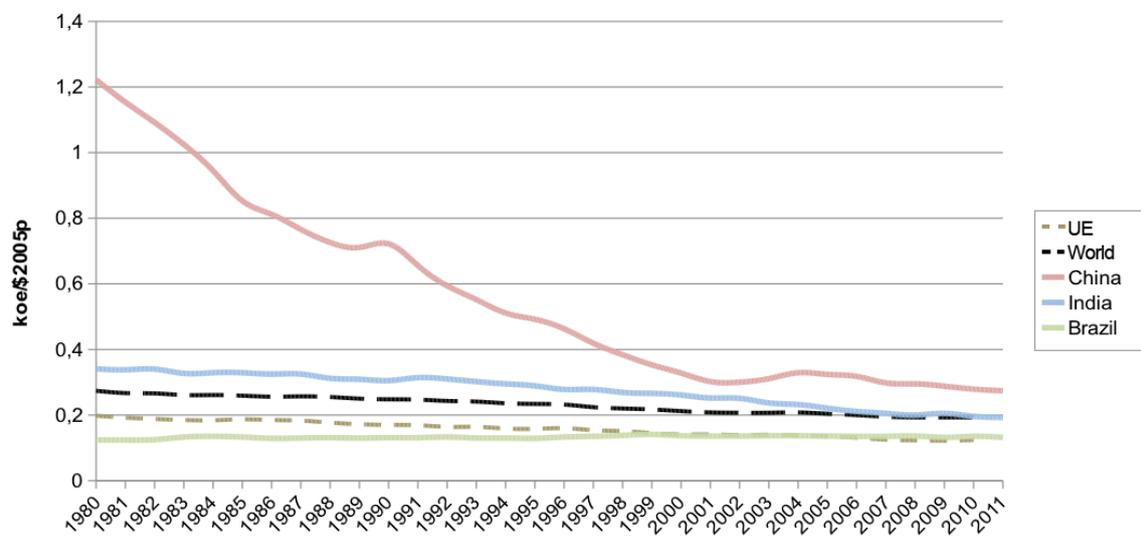
come. The Gini coefficient is still far above most developed countries (almost 20 basis points higher), even though it has been decreasing steadily for 20 years. Extreme poverty is concentrated outside cities, even though favelas have developed at a very high pace in the recent years in urban centres (São Paulo, Rio de Janeiro...).

Brazil has recently reached a position that allows it to push for a worldwide “green economy” agenda. This country organised the Rio+20 Conference in June, in a context of widespread economic crisis with environmental concerns pushed into the background. It is advocating for the right to development against already developed regions, in the name of all developing and emerging countries, and dreams of paving the way for new models of development.

As a next step, Brazil is caught between the prospects of developing its recently discovered hydrocarbon resources (in particular pre-salt oil reserves in the Santos, Campos and Espírito Santo Basins, south-east off-shore, believed to hold over 50 billion barrels of oil equivalent) and setting off on a low-carbon or “green”-led economic path, with biotechnologies like ethanol-based transport. More broadly, it is caught between its social and economic development priorities and the preservation of its unique environmental endowments (forests, water, etc.). To this regard, the issue of royalties sharing between producing and non-producing states is attracting much political and financial attention. Maybe more crucial is the question of the utilization of these huge financial resources: will they be used to support welfare programmes and/or to finance the transition toward a green economy in Brazil, anticipating the unavoidable rarefaction of hydrocarbon resources?

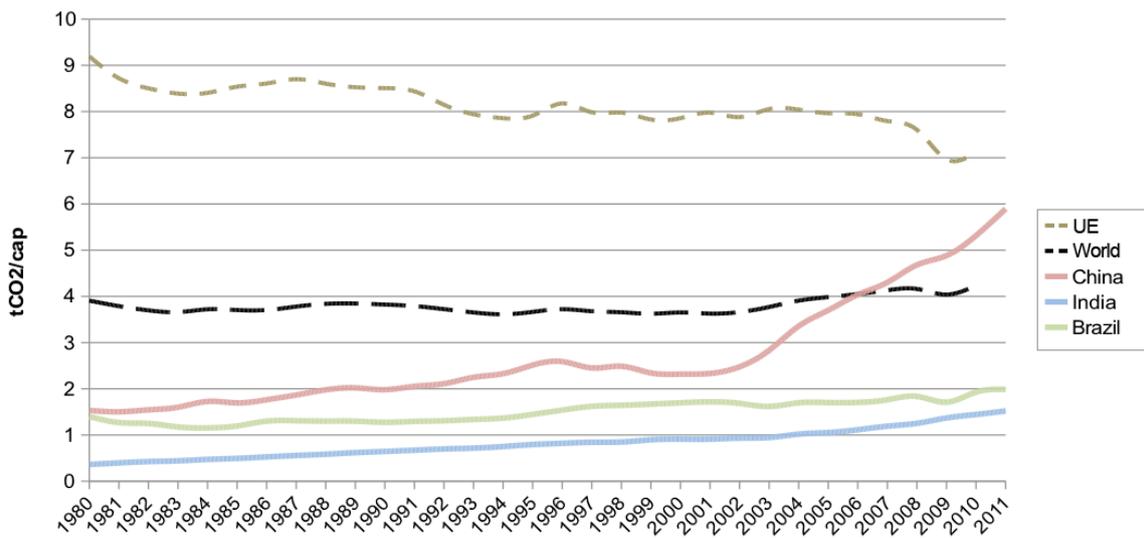
There are still huge future macro-economic challenges to achieve the development of Brazil and its insertion in the global economy. Its economy needs to be rebalanced, as industrial production is lagging well behind the consumers’ boom. Brazil is increasingly dependent on imports for manufacturing goods (mainly from China), and suffers from a maladapted productive sector. The threat of a progressive commoditisation of its economy is real, as this process is amplified by the country’s willingness to massively develop oil and gas reserves, as well as becoming the biggest ethanol exporter. This is certainly why the future macro-economic and energy challenges in Brazil are deeply interconnected, and will certainly have to be further tackled together. ■

Figure 1. Energy intensity in China, India & Brazil – Comparison with European and world averages (1980-2010)



Source: Enerdata, 2011

Figure 2. CO₂ emissions (combustion) per capita in China, India & Brazil – Comparison with European and world averages (1980-2010)



Source: Enerdata, 2011

4. CONCLUSION

Most predictive global modelling exercises and so-called “450 ppm” scenarios such as the European Roadmap 2050 (EC, 2011) suggest that developing countries should bring their GHG emissions in line with their 1990 levels by 2050. At present, it is uncertain whether China, India and Brazil will be capable to do so and whether the proactive approach launched by these countries will suffice.

China and India nevertheless have ambitious environmental objectives and are gradually adopting the means to meet these. Their development strategies have a number of similarities, especially regarding local pollution, which is a pressing issue in the short term. These countries must tackle the challenges of energy security and social development, even if they are starting from very different levels. This translates into the concepts of the “harmonious society” in China and “inclusive growth” in India. Less stressed by direct pollution concerns and primarily focusing on LULUCF emissions, the social priority in Brazil is summarized in Dilma Rousseff’s government slogan: “a wealthy country is a country without poverty”. The question here is rather to invent a new development model that would serve as an example worldwide for the “green growth” concept. In addition, all these countries are facing huge challenges regarding the development of infrastructure (transport and housing) that will lay the foundations for a low-carbon economy in the longer term.

However the challenges to be met remain fundamentally different, especially because these countries are objectively at incomparable levels of economic development (see Table 2).

Table 2. Macro-economic parameters in China, India and Brazil in 2010

	China	India	Brazil
Population (millions)	1,338	1,171	195
Share of urban Population	45%	30%	87%
GDP growth	10,4%	8,8%	7,5%
Total GDP (current million US\$)	5,927	1,727	2,088
Share of Industry	47%	26%	27%
Share of Services	43%	55%	67%
Share of Agriculture	10%	19%	6%
GDP per capita (MER, current US\$)	4,428	1,475	10,710
GDP per capita (PPP, current international \$)	7,599	3,582	11,210

Source: World Bank, 2012

Brazil is more than two times richer than China, which in turn is three times richer than India. Climate targets imply very different pathways for these countries in terms of public policy implementation:

- China must undertake a dramatic structural transformation of its economy, especially by fostering the expansion of its tertiary sector and reducing the share of heavy industry in its national production. The same applies to the overall rebalancing of the investment share in favour of consumption in the country’s growth;
- India will have first to develop its economy, eradicate poverty and meets its growing energy requirements at least environmental cost. The structure of the Indian economy is not problematic in the short term, with a growing share of the tertiary sector, and could even be conducive to some leapfrogging in the overall economic development pattern. However, the agricultural sector still requires significant reorganisation;
- Brazil still has a poverty alleviation priority, while rebalancing its economy by empowering its industrial sector in order to play a significant role at the international level. Its main issue will be to maintain the energy-related demand-supply pattern for the coming decades, in particular its almost CO₂-free power system, while preserving natural spaces and indigenous populations.

By way of conclusion, Table 3 shows the fundamental differences in positioning, environment (economic and social), capacities and governance between these major emerging countries and Europe. The priorities for these regions are different as they are linked to sets of constraints that are themselves diverse, and largely dependent on the pathway chosen, whether political, social or technological. Ambitions in terms of the transition to low-carbon economies are significant in all of these regions, even if visibility for the pathway to be adopted is not the same. This is particularly linked to the very high uncertainty about their future level and content of economic growth.

Whereas the European Union has set itself the objective of achieving the transition to a 75% emissions reduction or more by 2050, China, India and Brazil must first guarantee economic and social development in the medium term (by 2020) and invent new models for low-carbon economic growth in the longer term, with no certainty at present about the emissions levels achievable by 2050.

Table 3. Relative contexts in Europe, China, India and Brazil with a view to the transition towards low-carbon societies

	Europe	China	India	Brazil
CONTEXT				
Institutions/governance	Liberalisation (=> planning ?)	Centralised planning => liberalisation	Planning => liberalisation	Planning with limited liberalisation
Political decision-making	EU + Member States Complex coordination	Central power + provinces Hierarchical	Federal level + States Complex and fragmented	Federal level + States Complex governance
Economic context	Stable – crisis management	High growth secondary priority	High growth top priority	Growth second priority
Social context	Stable – crisis management	Growth top priority	High growth absolute priority	Growth top priority
VISION				
Energy/climate strategy (role international scene)	Remain among world leaders	Become world leader	Become an established force - independence	Become a first-in-class actor on energy markets
Energy/climate strategy (national priorities)	Follow the planned pathway	Become world leader (innovation, technologies, etc.)	Find the best possible pathway	Limit deforestation as a priority
Energy prospects	Renewables + nuclear are sufficient	High growth Coal essential	High growth Coal essential	Growth maintain renewables share
GHG prospects	Reduction Achieve the transition	High growth Prepare the transition	High growth Prepare the transition	Anticipate energy-related emissions growth
Uncertainties (level and content of growth)	Low	Very high	Very high	High
Timescales	Policy for 2020 Target coherence by 2050	5-year plans, 2020 targets, 2050 approach	5-year plans, 2020 targets	National plans at 2020, 2030 approach
TERMS				
Efficiency	Becoming a priority again (final consumption)	Absolute priority (use of fossil fuels)	Absolute priority (use of fossil fuels)	Becoming a priority
Infrastructures	High inertias – not organised	On schedule – organised and proactive	Behind schedule – catch up objective	Already developed – require adaptations
Adaptation vs. mitigation	Mitigation	Both	Adaptation > mitigation in short term	Both
Finance	Contributor	Short-term beneficiary (future contributor?)	Beneficiary	Short-term beneficiary (future contributor?)

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Elie Bellevrat (IDDRI)

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