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Who Drives Climate-relevant Policies in Brazil?

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Abbreviations

ANEEL	Agência Nacional de Energia Elétrica (Brazilian Electricity Regulatory Agency)
ANP	Agência Nacional do Petróleo, Gás Natural e Biocombustíveis (Brazilian National Agency of Petroleum, Natural Gas and Biofuels)
b/d	barrels per day
BNDES	Brazilian National Social and Development Bank
CGMC	General Coordination on Global Climate Change
CIM	Inter-ministerial Committee on Climate Change
CIMGC	Comissão Interministerial de Mudança Global do Clima (Inter-ministerial Commission on Global Climate Change)
CNPE	Conselho Nacional de Política Energética (National Council for Energy Policy)
CO_2	carbon dioxide
CSP	concentrated solar power
EPE	Empresa de Pesquisa Energética (Energy Research Company)
FBDS	Fundação Brasileira para o Desenvolvimento Sustentável (Brazilian Foundation for Sustainable Development)
FBMC	Fórum Brasileiro de Mudanças Climáticas (Brazilian Forum on Climate Change)
FFV	flex-fuel vehicle
GDP	gross domestic product
GHG	greenhouse gas
GW	gigawatt
HDI	Human Development Index
ICMS	Imposto sobre a Circulação de Mercadorias e Prestação de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação (Value Added Tax)
IEA	International Energy Agency
INPE	Instituto Nacional de Pesquisas Espaciais (National Institute for Space Research)
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land use change and forestry
MAPA	Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Livestock and Food Supply)
mb/d	million barrels per day
mboe/d	million barrels of oil equivalent per day
MCTI	Ministério da Ciência, Tecnologia e Inovação (Ministry of Science, Technology and Innovation)
MMA	Ministério do Meio Ambiente (Ministry of Environment)
MME	Ministério de Minas e Energia (Ministry of Mines and Energy)
MRE	Ministério das Relações Exteriores (Ministry of Foreign Affairs)
MW	megawatt
NGO	non-governmental organisation
NPCC	National Plan on Climate Change
PEACH	Political Economy Analysis of Climate Change Policies
PNPB	Programa Nacional de Produção e Uso do Biodiesel (National Programme for the Production and Use of Biodiesel)
PROALCOOL	Programa Nacional do Álcool (National Fuel Alcohol Programme)
PRODEEM	Programa de Desenvolvimento Energético dos Estados e Municípios (Programme for Energy Development in States and Municipalities)
PROINFA	Programa de Incentivo às Fontes Alternativas de Energia Elétrica (Programme to Incentivise Alternative Electricity Sources)

PV	photovoltaic
R&D	research and development
Rede CLIMA	Brazilian Network on Global Climate Change Research
SIN	Sistema Interligado Nacional (National Interconnected Power System)
SSHP	small-scale hydropower plant
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Global concerns for reducing carbon emissions to mitigate global climate change are rising (IPCC 2014a). Shifting from fossil fuels to renewable energy is seen as an essential component of climate change mitigation (IPCC 2014b). The debate on the policies and measures needed to bring about this shift is also growing (IPCC 2011). Brazil is in a strong position in this global debate. Unlike other rapidly developing countries such as China and India, a relatively high level of energy demand in Brazil is already met by renewable energy sources. In 2013, over 40 per cent of all primary energy produced in the country came from renewable energy sources (EPE 2014a). This value is high when compared to the world average of around 13 per cent (IEA 2013). Most of the renewable energy sources used in the country come from sugarcane products (16.1 per cent of total primary energy), hydropower (12.5 per cent) and other biomass (8.3 per cent), while wind, solar and other renewables still play a minor role in the country's energy mix (with less than 5 per cent of the total primary energy produced) (EPE 2014a).

However, the energy demand in Brazil is expected to rise further in the next few decades to meet the needs of a rapidly expanding and developing economy. At the same time, Brazil faces a near exhaustion of its environmentally feasible hydropower potential (most of the country's untapped potential lies in the Amazon region, and therefore faces severe local environmental constraints) (ANEEL 2011; Lucena 2010; Lucena *et al*. 2010). Also, with the recent oil discoveries in the pre-salt layer and the prospects for an increased deployment of low-cost, coal-fired electricity generation, there is pressure to increase the use of fossil fuels (EPE 2013b). As a result, it is unclear whether socioeconomic development in Brazil is easily compatible with the goals of a less carbon-intensive, and more environmentally sustainable, economy.

Brazil, therefore, is at a crossroads with regard to its energy future and sustainable development. In spite of having one of the world's cleanest energy systems, a combination of demand- and supply-side factors suggests an increase in the carbon intensity of Brazil's energy future (IEA 2013). These factors include a growing demand for fossil fuels in general, emphasis on expanding oil and gas production, an increasing reliance on coal and natural gas for power production, serious problems in the bioenergy sector, and a consequent rapid growth in energy-related greenhouse gas (GHG) emissions (Nogueira *et al*. 2014; Lucena *et al*. 2015; Luomi 2014).

Policies that promote renewable energy can play an important role in meeting the rising demand for, and alleviating the supply-side constraints of, energy supply. As mentioned above, Brazil has a long history of investing in renewable energy which precedes, by decades, the current climate change debate (Szklo *et al.* 2005). This suggests that investments in renewable energy were not driven purely by climate (or environmental) concerns but were driven by motivations of economic and social development. For instance, Viola and Franchini (2014) note that 'The government [of Brazil], the private sector, and most parts of society give absolute priority to economic growth and development; the social pillar of sustainable development comes in second, and environmental concerns come in last'. Thus, the historically high proportion of renewables in the Brazilian energy mix was attained without reliance on narratives of climate change, which suggests that Brazil can learn from its own renewable energy policy history.

Of course, crucial determinants of the carbon intensity of an energy mix include the range of available technologies as well as the stage of economic development. But recent examples of successful and unsuccessful experiences around the globe suggest that the spread of

these technologies is determined, to a large extent, by political choices. Over the past decade, wind and solar have emerged as potentially viable technologies. They are becoming increasingly more competitive with other forms of renewable and non-renewable sources of energy. They have expanded in some countries, while in other countries there has been limited progress. In Brazil, wind and solar are still a relatively small proportion of the country's energy supply. This is an opportunity for the country to meet its rising energy demand and, at the same time, maintain, or even decrease, the already low-carbon intensity of its energy mix. However, the expansion of wind and solar would depend crucially on the political choices made by the key actors who drive, or obstruct, climate-relevant policies and, specifically, energy policies in Brazil.

In this report, the central question of our research is who drives/obstructs climate-relevant policies in Brazil, paying special attention to renewable energy policies, climate policies and politics. We aim to identify the actors (in government, the private sector and civil society) who drive, or obstruct, efforts to reduce the carbon intensity of Brazil's energy mix. The hypothesis here is that the actors who drive climate policies in Brazil are not specifically concerned with global climate change itself, but with economic, social or even political issues, such as energy security, job creation, competitiveness, promoting national industries, and gaining political power domestically or internationally. In that sense, climate change mitigation can be regarded as a co-benefit of other policies (energy policies included) that may have very different objectives (Szklo *et al.* 2005).

To answer the above-mentioned question, this research assesses renewable energy policies in Brazil, identifying key actors from government, business and civil society and their explicit, or implicit, motivations.[1] The study is based on three sources: first, a review of the existing literature; second, on 14 interviews with key stakeholders from relevant institutions, including government, business, non-governmental organisations (NGOs) and civil society; and third, on the authors' own knowledge of, and participation over time in, debates on climate and energy policies in Brazil. The lead author of this report was present at high-level meetings on climate policies in Brasília and witness to many behind-the-scenes discussions on climate and energy policies in the country.

This Evidence Report is organised as follows. In Section 2, we discuss the climate policies and the involved stakeholders as well as the key elements of climate politics in Brazil. In Section 3, we look back at Brazil's long history of promoting biofuels and analyse the actors and motivations behind the associated policies. We believe this provides further insights into the potential for expanding the solutions provided by wind and solar energy under consideration in the country today. In Section 4, we analyse the potential of the wind and solar energy sectors in the current Brazilian context. We use the methodology proposed by the Political Economy Analysis of Climate Change Policies (PEACH) project. Finally, in Section 5 we present the main findings and provide concluding remarks.

[1] Although land use, land use change and forestry (LULUCF) is a major source of emissions in Brazil and a crucial component of climate policy, the focus of this report is on energy.

2 Climate policy, stakeholders and drivers in Brazil

According to Viola and Franchini (2014), the governance of climate change is typically based on the interactions between reformists and conservative forces. While reformists include agents interested in a transition to a low-carbon economy for various reasons, the conservatives resist changes in the traditionally carbon-intensive development paradigm. In Brazil, conservative and reformist forces can be easily found at different levels of government, business and civil society.

Having this framework in mind, this section lists the key stakeholders and provides a brief description of Brazilian climate policy. Climate policy in Brazil is influenced, to a large extent, by debates on land use, land use change and forestry (LULUCF) because of domestic and international attention on deforestation/degradation in the Amazon region. Our discussion suggests that the dominance of concerns related to LULUCF also has implications for the carbon intensity of the Brazilian economy in general, and for some energy policies devised for the country over time in particular. However, this report focuses largely on the links between energy and climate policy.

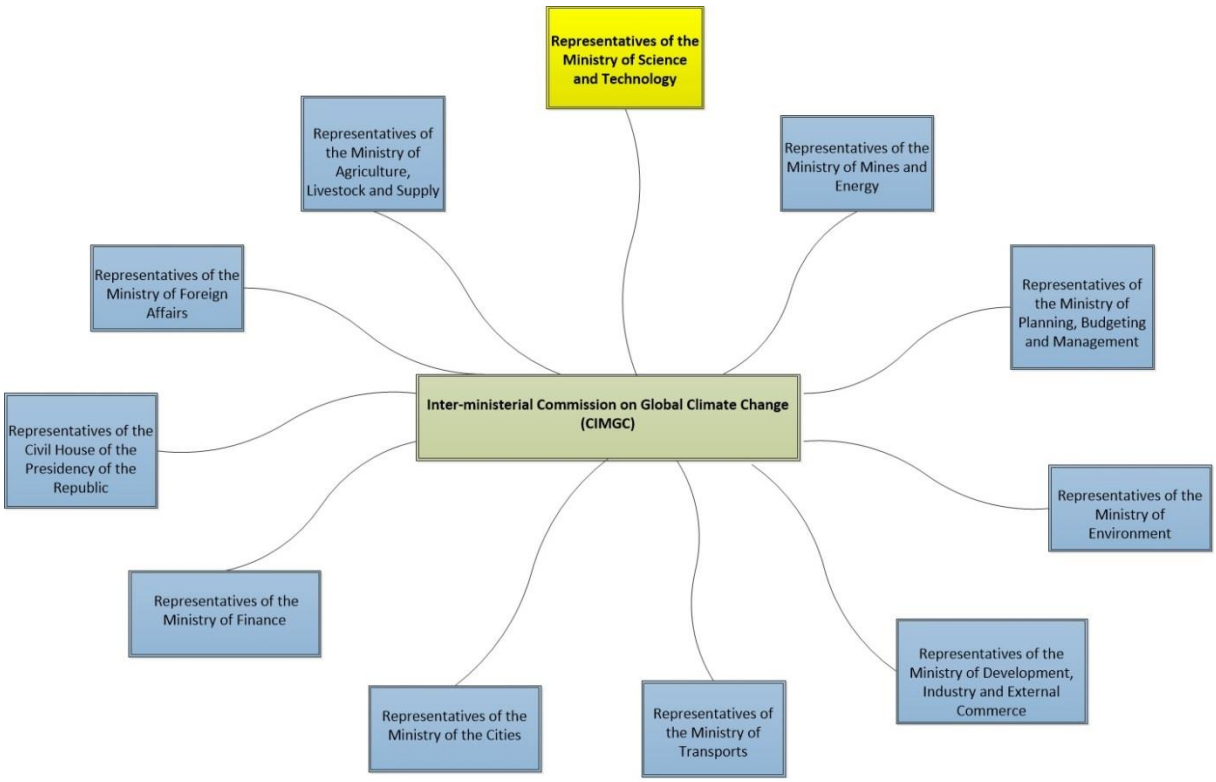
2.1 Government institutions for climate policy[2]

A number of government institutions are involved in the development of policies, programmes and projects related to climate change issues in Brazil. National coordination for implementing agreements under the United Nations Framework Convention on Climate Change (UNFCCC) is a responsibility of the Ministry of Science, Technology and Innovation (Ministério da Ciência, Tecnologia e Inovação – MCTI), according to Presidential Decree No. 1,160 of 21 June 1994.

The Inter-ministerial Commission on Global Climate Change (Comissão Interministerial de Mudança Global do Clima – CIMGC) was established by the federal government in 1999, with the purpose of articulating government actions resulting from the UNFCCC and its subsidiary instruments in which Brazil takes part (BRASIL 1999). The CIMGC was instituted by decree on 7 July 1999, as amended by another decree of 10 January 2006 (BRASIL 2006). The President of the CIMGC is the head of the MCTI, while the Vice-President is the head of the Ministry of Environment (Ministério do Meio Ambiente – MMA). Figure 2.1 shows the constitution of the CIMGC.

[2] This section emphasises the government institutions associated with climate policy formulation and with energy policy in Brazil. Climate change stakeholders related to LULUCF issues are not covered here.

Figure 2.1 Members of the Brazilian Inter-ministerial Commission on Global Climate Change (CIMGC)



Source: Authors' own, based on information from BRASIL (1999).

The Brazilian Forum on Climate Change (Fórum Brasileiro de Mudanças Climáticas – FBMC) was created by Decree No. 3,515 of 20 June 2000 as an institutional interface between the government and civil society. The main purpose of the FBMC is to raise awareness of, and catalyse discussions on, climate change through stakeholder dialogues. The Forum was created by President Fernando Henrique Cardoso, and its first Executive Secretary was Fabio Feldman, an environmentalist and former congressman politically linked to President Cardoso. He greatly facilitated periodic meetings between civil society representatives and the government, at which President Cardoso was present, to discuss climate change policies in Brazil.[3]

In November 2007, Presidential Decree No. 6.263/2007 was issued creating the Inter-ministerial Committee on Climate Change (Comitê Inter-ministerial sobre Mudança do Clima – CIM) to direct the elaboration, implementation, monitoring, evaluation and proposals for the periodic review of the National Plan on Climate Change (NPCC) (see Section 2.3). It is coordinated by the Executive Office of the President and composed of 17 federal bodies, having the FBMC as an invitee. Its Executive Group, a subsidiary body, has the mission to elaborate, implement, monitor and evaluate the NPCC. It is coordinated by the MMA and is composed of eight ministries and the FBMC (see Figure 2.2).

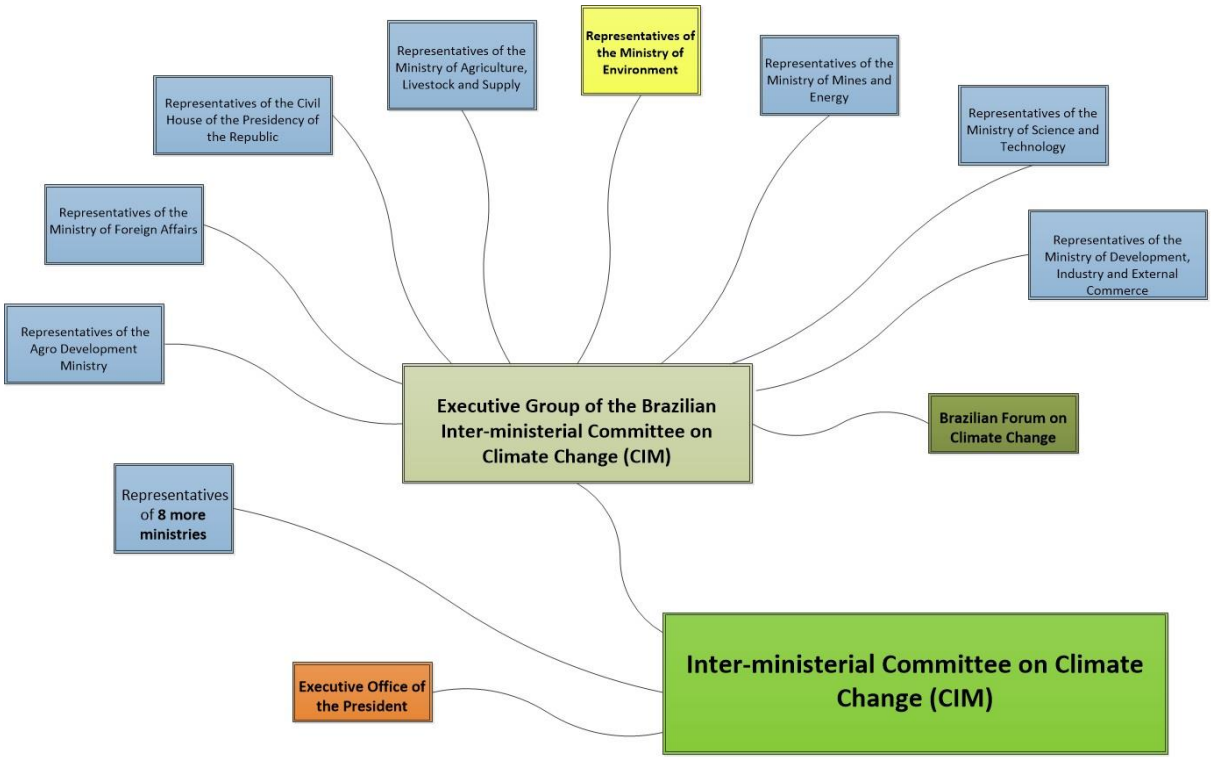
The MCTI and its allied agencies develop key actions on climate change, especially through the General Coordination on Global Climate Change (CGMC), which is the technical focal point of the UNFCCC in Brazil. Its mandate includes the coordination and publication of

[3] The lead author of this report was present at many of these meetings, which took place in the Ministry of Foreign Affairs and in the Palacio do Planalto, Office of the President, in Brasília.

studies and scientific research on global climate change, especially with regard to the Intergovernmental Panel on Climate Change (IPCC). The CGMC also manages the National Climate Change Programme and the Brazilian Network on Global Climate Change Research (Rede CLIMA). Finally, the CGMC is responsible for preparing national communications (now biennial update reports) to the UNFCCC and serves as the Executive Secretariat of the CIMGC.

Rede CLIMA, a network of Brazilian academic and research institutions, is coordinated by the MCTI and the network's secretariat is based in the National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais – INPE). It is financed by the MCTI and was established in 2007 to generate and disseminate knowledge about the causes and effects of global climate change. Rede CLIMA produces information for the formulation and follow-up of public policies on climate change and supports Brazilian negotiations under the UNFCCC. The network includes 13 thematic sub-networks: agriculture, biodiversity and ecosystems, cities, natural disasters, regional development, economy, renewable energy, modelling, oceans, water resources, health, environmental services and coastal zones.

Figure 2.2 Members of the Inter-ministerial Committee on Climate Change (CIM) and its executive group



Source: Authors' own, based on information from BRASIL (1999) and BRASIL (2007b).

The Ministry of Foreign Affairs (Ministério das Relações Exteriores – MRE) is responsible for Brazil's international negotiations and therefore has a key role in the country's position and negotiating processes at UNFCCC Conferences of the Parties. Although it does not directly formulate climate policies, the MRE plays a strong role in influencing the Brazilian position internationally.

The MMA is responsible for promotion of knowledge on environment (including climate change), protection and restoration of the environment, sustainable use of natural resources,

the valuation of environmental services and the inclusion of sustainable development in the formulation and implementation of public policies. The climate change department of the MMA participates, in conjunction with the MRE, in international negotiations and events related to global climate change. It also carries out studies for the protection of the global climate system and the ozone layer, and develops policies and strategies for mitigation and adaptation.

The Secretary for Strategic Studies of the Presidency of Brazil (Secretaria de Assuntos Estratégicos da Presidência da República – SAE), along with other organisations and entities of the federal public administration, elaborates long-term strategic actions and projects (including those related to climate change). The Executive Office of the President is responsible for the Action Plans for Preservation and Control of Deforestation of the Amazon and the *Cerrado* with the participation of inter-ministerial groups. The Brazilian Agricultural Research Company (Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA) is a public institution linked to the Ministry of Agriculture, Livestock and Food Supply (Ministério da Agricultura, Pecuária e Abastecimento – MAPA) in charge of research, development and innovation for the sustainability of agriculture and animal husbandry.

A few, but not all, of the government institutions involved in the development of policies, programmes and projects related to climate change issues in Brazil also have connections with the development of energy policies in the country, as discussed next.

2.2 Government institutions for energy policy

The Brazilian energy sector has a complex and robust structure, as shown in Figure 2.3. At the top of the organogram, directly related to the energy policymaking process in Brazil, is the Casa Civil (or the State Office, once led by the current President of Brazil, Dilma Rousseff, when Luiz Inácio Lula da Silva was president). Along with the Casa Civil, the other key agencies are the Congress, the National Council for Energy Policy (Conselho Nacional de Política Energética – CNPE) and the Ministry of Mines and Energy (Ministério de Minas e Energia – MME).

On issues specifically related to energy, the CNPE advises the President of Brazil, as well as formulating policies and guidelines for the energy sector.

The MME formulates energy policies and represents Brazilian interests in the energy sector domestically and internationally. Its core functional areas are related to: (a) geology, mineral and energy resources; (b) use of hydraulic energy; (c) mining and metallurgy; and (d) oil, fuels and electricity, including nuclear energy. The MME is also responsible for the provision of electricity to rural areas and the development of agro-energy (MME 2013). The MME is an interesting example of reformist and conservative forces trying to influence the same ministry: a pro-climate influence arising from renewable energy interests, including hydro, ethanol and even wind, and an anti-climate influence from the fossil fuel lobby represented by the oil sector (Viola and Franchini 2014).

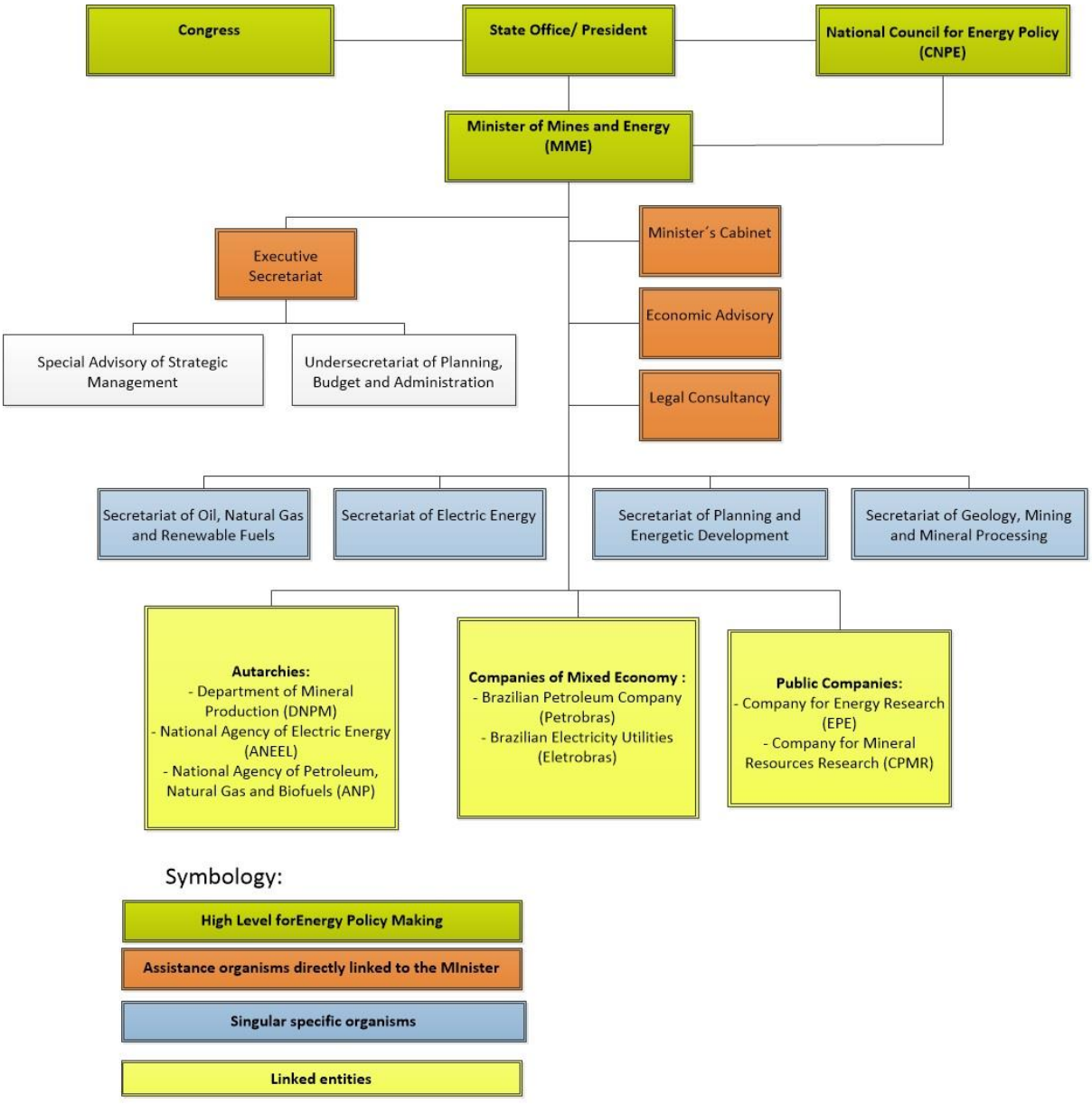
In order to achieve its mission, the MME is supported through research and advice from its Energy Research Company (Empresa de Pesquisa Energética – EPE). The EPE conducts research and undertakes studies aimed at subsidising the energy planning sector in the areas of electricity, oil, natural gas, coal, renewable sources and energy efficiency, among others.

In the case of renewable energy policies, the most important institutions involved in the energy sector, besides the MME, are Eletrobras (a state-owned power company) and its energy research centre, the Centre for Electric Energy Research (Centro de Pesquisas de

Energia Elétrica – CEPEL). For fossil energy, the state-controlled oil company, Petrobras, is a key player in the Brazilian energy sector.

Among the institutions that play a relevant role in incentivising the adoption of renewable energies in Brazil – not necessarily in the energy sector – are the MCTI and even the MMA. The MCTI carries out actions at many levels and has been stimulating the development of science, technology and innovation in the field of renewable energy, which encompasses both wind and solar (BRASIL 2014). However, the MMA is increasingly playing an important role, for instance heading the management committee of the National Fund on Climate Change (Fundo Clima), which has the objective of financing projects, studies and enterprises aiming at mitigation and adaptation to climate change. In this vein, the MMA has increasingly been funding renewable energy-related research projects and studies.

Figure 2.3 Brazilian energy sector structure



Source: Authors' own, based on information from MME (2013).

Other institutions that can be considered relevant stakeholders in climate and energy policies in Brazil include: financing institutions that foster wind and solar energy, e.g. the Brazilian National Social and Development Bank (Banco Nacional de Desenvolvimento Econômico e Social – BNDES); associations that represent actors involved in the wind and solar industries, e.g. the Brazilian Association of Wind Energy (Associação Brasileira de Energia Eólica – ABEOLICA), the Brazilian Association of Solar Energy (Associação Brasileira de Energia Solar – ABENS) and the Association of Photovoltaic Solar Energy (Associação Brasileira de Energia Solar Fotovoltaica – ABSOLAR); civil society organisations that work with energy and environment issues, e.g. the Brazilian Foundation for Sustainable Development (Fundação Brasileira para o Desenvolvimento Sustentável – FBDS) and the World Wide Fund for Nature – Brazil (WWF-Brasil).

In terms of economic sectors, Viola and Franchini (2014) argue that the most relevant ones are predominantly conservative when it comes to climate change. The authors identified four key sectors:

- The manufacturing sector, which is traditionally inefficient in terms of energy use (with some exceptions, basically the export-oriented, energy-intensive industries);
- The agribusiness sector, which sees environmental policies, in general, and climate policies, in particular, as a threat to its expansion;
- The transport sector, which is mostly road-based and highly inefficient, in terms of both technology and logistics; and
- The energy sector, which, despite its large share of renewable energy, sees the recently discovered pre-salt oil fields[4] as a major barrier to climate change mitigation in the country.

2.3 Official climate change policies in Brazil

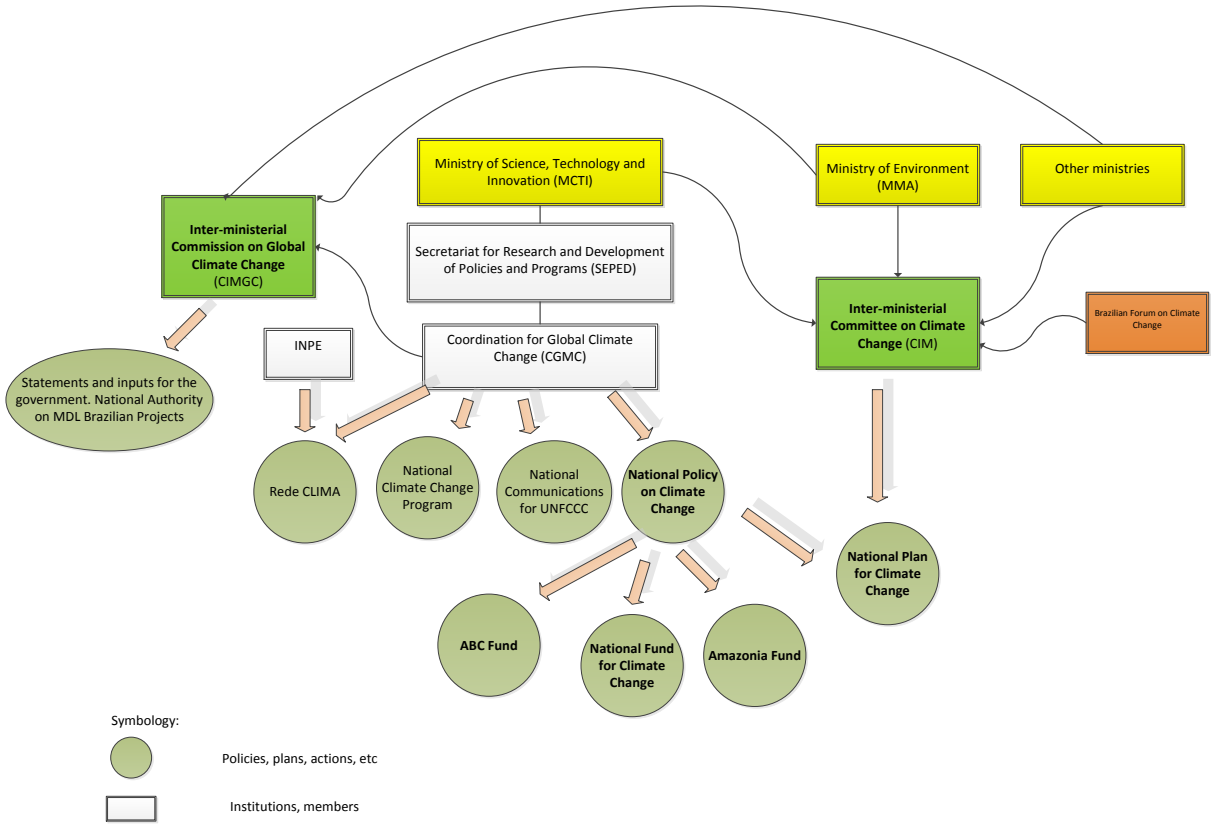
The National Policy on Climate Change was proposed by the Executive to the Congress in 2008. The National Plan on Climate Change (NPCC) was approved in December of that year and became a national law in 2009. It has four general themes: (i) mitigation; (ii) vulnerability, impact and adaptation; (iii) research and development; and (iv) enhancement of skills and dissemination. Its main objectives are to: (i) stimulate increased efficiency in a constant search for better practices in the economic sectors; (ii) keep the high share of renewable energy in the power mix, preserving the important position Brazil has held in the international scenario; (iii) encourage the sustainable increase in the share of biofuels in the national transport mix and also work towards the structuring of an international market for sustainable biofuels; (iv) seek for a sustained reduction in deforestation rates in all Brazilian biomass, in order to reach zero illegal deforestation; (v) eliminate the net loss of forest coverage in Brazil by 2015; (vi) strengthen inter-sector actions concerned with the reduction of the vulnerabilities of populations; and (vii) identify environmental impacts resulting from climate change and stimulate scientific research that can outline a strategy to minimise the socioeconomic costs of the country's adaptation.

At the 15th session of the Conference of the Parties to the UNFCCC (COP 15) in Copenhagen in 2009, the Government of Brazil announced voluntary mitigation targets of 36.1 per cent to 38.9 per cent by 2020, as compared to a projected business-as-usual scenario of GHG emissions by that year. This reduction was established in the National Policy on Climate Change (Federal Law 12,187 of 29 December 2009). The policy provides for the elaboration of sectoral plans for mitigating and adapting to climate change, with a view to consolidating a low-carbon economy and meeting the national voluntary commitments announced under this policy.

[4] The pre-salt oil fields are so called because of the 2,000m layer of salt above the oil. Estimated reserves in these fields range from 30–100 billion barrels of oil (OCD 2009).

Figure 2.4 shows the main relationships between entities linked to climate change and policies, plans and other actions.

Figure 2.4 Relationships between the main institutions linked to climate change in Brazil and official policy



Source: Authors' own, based on information from BRASIL (2007b), CIM/MMA (2008) and BRASIL (1999).

The NPCC has been criticised both domestically and internationally. It is heavily dependent on the Brazilian pledge presented at COP 15, which relies on a baseline that is difficult to defend, and upon which all emission reductions were estimated, as some studies have shown (de Gouvello 2010). In fact, within the NPCC, the sector plan for energy makes use of the Ten-Year National Energy Expansion Plan produced by the EPE (2013b) as the country's mitigation strategy. However, this document is the official government mid-term energy plan, and does not consider, per se, mitigation alternatives. On the contrary, it is regarded by agents within the energy sector as a reference case (the 'real baseline' for the country) and not a mitigation scenario. Therefore, the voluntary targets set by the NPCC will be easily reached because of the inflated baseline used at the time of COP 15. Brazil's real baseline is what is presented in the EPE's ten-year expansion plan.

In the context of climate policy, the preparation of plans for adaptation, mitigation and monitoring of climate change are the responsibility of the MMA and MCTI. However, due to the absence of these actors in the design of energy policies, there is a disconnect between energy and climate policies in Brazil. The incentives for promoting renewable energy, for instance, are driven by the sector ministry, the MME. However, climate policies are also shaped and influenced by the MMA and MCTI, which do not necessarily see the climate co-benefits of energy policies. Take, for example, the case of the new model for the electricity

sector which was proposed by the MME in 2003 and introduced in 2004, at the beginning of President Lula da Silva's first term (MME 2003). This model facilitated the construction of new large hydroelectric power plants, mostly in the Amazon region, which had been on hold since the mid-1980s partly due to the fiscal constraints of the state-owned power companies and partly to opposition from environmental and social movements. The paradox is that the re-birth of hydropower in Brazil can be attributed to conservative forces within the MME, focused on traditional economic growth and with economic interests associated with the building of large power plants (but with clear benefits in terms of GHG emission reductions).

The expansion of hydropower has, however, been opposed by segments expected to be supporters of climate change mitigation policies, such as the MMA and pro-environment NGOs. Interestingly, public opinion, civil society and the environmental movement in general have been strong enough to allow only the construction of new run-of-river hydropower plants, greatly reducing the capacity of the power system to operate all year long. This has increased reliance on fossil fuel-based power plants to complement the hydro-based power system, with significant implications for the country's GHG emissions (Rebennack *et al*. 2012). This has been especially true during the past two years (2013 and 2014), when adverse hydrological conditions have triggered the use of backup natural gas-fired power plants at their full capacities.

2.4 Climate politics in Brazil

The first decade of this century was an intense, and interesting, time for both climate policy and climate politics in Brazil. Environmental movements became more active, contributing to, and benefiting from, progress made in terms of deforestation reduction over time. Certain segments of the private sector, for the first time in the history of the country, started engaging with the issue of climate change and began to ask for changes in the way government deals with climate change issues (Viola and Franchini 2014; FBDS 2009).

In order to understand what kind of forces were at play in Brazil at that time, it is useful to split the analysis into periods and movements, as suggested by Viola and Franchini (2014). According to these authors, during President Lula da Silva's Partido dos Trabalhadores (Workers' Party) administration, the environmental movement was able to increase its influence in the political arena, forcing the government to abandon alliances with certain conservative forces largely associated with illegal deforestation in the country. This led to the implementation of extremely effective deforestation control policies, including the real-time satellite monitoring of deforestation by the INPE (INPE 2014).

Marina Silva, founder of the Partido Verde (Green Party) and symbol of the environment movement for decades, played a key role in achieving the outcome of reduced deforestation during her tenure as the minister in charge of the MMA from 2003 to 2008 (Viola and Franchini 2014). She led the formation of an anti-deforestation coalition involving 11 ministries in addition to the MMA and convinced President Lula to end the historical support to the illegal deforestation sector (MMA 2014). The enhanced influence of the MMA had an impact not only on forest-related policies but also on Brazil's international climate policy. As mentioned above, in 2009 Brazil committed to a voluntary emission reduction at COP 15 in Copenhagen.

After some disagreements inside and outside the government, Marina Silva was replaced by Carlos Minc in 2008. Minc managed to further increase the influence of the MMA in Brazilian politics. He was able to convince President Lula of the political gains of making voluntary GHG emission reduction commitments in Copenhagen (Minc pers. comm. 2011).

The climate change agenda was used for political advantage at different moments from 2005 to 2009. There was a surge in public awareness before Copenhagen, accompanied by large-

scale media coverage and a series of events. President Lula, being a skilful politician, tried to make the most out of it. As well as using climate change politics to counter the political threat of Marina Silva in the 2010 elections, he also used climate change as a political instrument at the international level. For instance, as Viola and Franchini (2014) argue, Lula launched what the authors call 'ethanol diplomacy' in an attempt to create a global market for Brazilian ethanol in 2006. Brazil is in a relatively good position in terms of renewable energy and this was seen as political capital for the country internationally. The image of Brazil as a low-carbon country is regarded as crucial for the country's ambitions to be seen as a leader internationally. The position of regional and, more ambitiously, international leadership was strongly promoted by President Lula. This is best illustrated by his campaign to earn a permanent seat at the United Nations Security Council. During the Lula administration (2003–10), this motivation was often behind efforts to promote renewable energy in the country and COP 15 was, perhaps, the high point of this/his 'green diplomacy'.

As climate change policy cuts across different sectors, it is also a source of dispute over power between the ministries responsible for these sectors. On occasions, it is not clear who is in charge of climate policy in Brazil. The ministry in charge is usually the one that is headed by the most politically influential individual, reflecting the personality-driven nature of Brazilian politics. This came out strongly when President Lula followed the MMA's position on pledging voluntary emission reductions in Copenhagen despite the opposition of the MRE, which was against voluntary targets. Interestingly, the MRE currently advocates for the adoption of voluntary targets, as was clear from the Brazilian position presented at COP 20 in Lima in December 2014.

After Copenhagen, the Brazilian reformist agenda around climate policy lost momentum. In fact, as Viola and Franchini (2014) argue, since 2010 there have been multiple setbacks affecting the advancement of climate policies in Brazil. A series of events and actors were responsible for this. In general, President Rousseff, whose first term started in January 2011 (her second in January 2015), demonstrated support to conservative forces by giving full priority to economic growth. More importantly, the MRE was designated as the Brazilian representative leading climate negotiations. This elevation of the MRE comes at the expense of the MMA and MCTI and strengthens the conservative position. The MMA and MCTI, traditionally responsible for incentivising renewable energy research and investment, have been weakened in this process.

Despite the positive ramifications of the announcement of the NPCC domestically and internationally, there is a clear lack of progress in its implementation. The main achievements in terms of mitigation in Brazil have come from reducing deforestation, but this result cannot be fully attributed to the NPCC. The reduction in deforestation rates and the implementation of simple, but effective, command and control measures were already in place at the time of the NPCC's formulation. However, the reform of the Forest Code, approved in 2011, significantly weakened the code and may hamper future deforestation control in the country. This reform was a clear victory for the agribusiness lobby which historically has been strongly represented in the House of Representatives.

One major obstruction to climate change mitigation has to do with the country's automobile industry. After the 2009 financial crisis, the sector received government support with no conditionality on the energy efficiency of the models produced. The industry's labour unions have had long connections with the Workers' Party. President Lula started his professional career as a blue-collar worker in the metallurgical industry, associated with Brazil's automobile industry, and later as a union leader in the same industry. Aimed at stimulating economic activity, such support is still in place and has led to a large increase in the country's private transport fleet, with long-term consequences for GHG emissions.

Furthermore, gasoline prices have been kept below international levels through subsidies. Given recent inflationary pressures, the Rousseff administration has used energy prices – both gasoline and electricity – as a means to reduce short-term inflationary forces. The consequences of these actions over the long term are still uncertain. However, it is clear that the ethanol industry is suffering a major market loss in the fuel used by flex-fuel vehicles,[5] due to the artificially low price of its competitor (gasoline). According to experts in the ethanol sector, a large proportion of the sugarcane fields needs to be replanted soon, as old sugarcane plants need to be replaced every five or six years, which means that the sector will need to invest to maintain – let alone expand – current levels of ethanol production. Given the subsidised gasoline prices, investment in the sector is very uncertain and may hamper future ethanol production in the country.

Finally, the large oil discoveries in the so-called pre-salt fields have led to a massive increase in Brazil's oil reserves, which could act as a force against the decarbonisation of the Brazilian economy. According to some projections (Saraiva *et al*. 2014), there is a possibility of sustaining the country's oil production at levels higher than 4 million barrels per day (mb/d) for almost 30 years. This figure is almost twice current petroleum production in Brazil. According to BP (BP 2014), only four countries are currently capable of producing more than 4 mb/d (Saudi Arabia, Russia, the United States and China).

In October 2014, during her re-election campaign (which she later won), President Rousseff took the time to go to the United Nations Climate Summit in New York where she made a speech reinforcing the country's commitment to a legally binding agreement, while at the same time emphasising the common but differentiated responsibilities principle. However, at that same summit, President Rousseff did not join the agreement made by 27 countries[6] to eliminate deforestation by 2030. The forthcoming COP 21 in Paris in 2015 will be crucial to future climate change policies and politics in Brazil. President Rousseff seems inclined to agree to a legally binding agreement, in accordance with common but differentiated responsibilities (at least, as was mentioned previously, this was the official position of Brazil during the recent COP 20 in December 2014). At the same time, as also mentioned above, she has been supporting conservative forces.

In the October 2014 elections, Marina Silva of the Green Party was once again one of President Rousseff's competitors. This time, however, the climate and environmental agenda played no major role in campaign discussions. As Viola and Franchini (2014) argue, the Rousseff administration managed to set a conservative agenda without incurring any political costs. Media coverage and public debate about environmental issues, and climate change in particular, have weakened. Even Marina Silva's campaign focused on other issues. The results of the first round held on 5 October 2014 placed Dilma Rousseff in the first position (41.5 per cent), followed by Aécio Neves of the Social Democracy Party (Partido da Social Democracia Brasileira) in second position (33.5 per cent). Marina Silva, in third place with 21.3 per cent of votes, was left out of the second round of the presidential elections, leaving Aécio Neves as President Rousseff's opponent. Neves had not publicly shown a strong position on climate change, despite former congressman Fabio Feldman, the first Executive Secretary of the FBMC, leading Neves' proposals in the environmental arena. Dilma Rousseff finally won a close victory, with 51.63 per cent of the vote versus Neves' 48.36 per cent.

Issues such as corruption, inflation control, public spending, economic growth and employment dominated the 2014 presidential campaign, and these issues are likely to be a

[5] Close to 100 per cent of all cars sold in the Brazilian domestic market are flex-fuel vehicles, meaning that they can run on any combination of gasoline and ethanol. Drivers decide at the service station which fuel they will choose to fill their tanks with based on the difference in price between gasoline and ethanol.

[6] Belgium, Chile, Colombia, Costa Rica, Côte d´Ivoire, Democratic Republic of Congo, Ethiopia, France, Germany, Guyana, Indonesia, Japan, Kenya, Liberia, Lithuania, Mexico, Mongolia, Nepal, Netherlands, Norway, Peru, Philippines, Republic of Korea, Togo, United Kingdom, United States of America and Vietnam.

high priority for the newly elected government. However, this may change in 2015. The spotlight will again be back on climate change with COP 21 scheduled for December 2015. The recent agreement on limiting future GHG emissions announced by China and the United States in November 2014 will also have implications for the climate change agenda in Brazil.

As preceding paragraphs highlight, climate policy is influenced by a diversity of actors (within and outside government) who have a range of objectives and priorities. Some of these actors would drive climate mitigation forward; others would obstruct it. However, our discussion also suggests that certain actors who are largely concerned with economic growth could also potentially benefit the climate change mitigation agenda (as in the case of large hydropower plants). We have also outlined how the relative importance of climate change as an issue in Brazilian politics has fluctuated over the past 15 years. Climate change reached its peak in Brazilian politics during the run up to COP 15. Since then, it has become less significant in domestic politics. However, with rising international attention on climate change, personality-driven Brazilian politics might see individuals latching on to climate change for political gain or even to build political careers. Brazil longs to be seen as a rising power that is progressive and which cares for the planet.

3 Lessons from the experience with biofuels in Brazil: policies and drivers

The previous section has shown why a political economy approach is needed to understand climate change policies in Brazil. The remainder of this report seeks to deepen this understanding by analysing renewable energy policies and trying to answer the question of who drives or blocks such policies in Brazil. Given that Brazil has a long history in renewable energy policies, we do this in two stages. Section 3 draws lessons from history, in particular from the policies for biofuels. Section 4 analyses more recent policies, in particular those for the wind and solar sectors.

As mentioned above, GHG emissions from energy use in Brazil on a per capita or per unit of gross domestic product (GDP) basis are among the lowest in the world. The reasons behind this are the large shares of hydroelectricity used to generate power and biofuels production for use in the transport sector (EPE 2013a). According to the International Energy Agency (IEA 2013), world consumption of biofuels is projected to rise from 1.3 million barrels of oil equivalent per day (mboe/d) in 2011 to 2.1 mboe/d in 2020, and 4.1 mboe/d in 2035. By 2035, biofuels would meet 8 per cent of total road transport fuel demand, up from 3 per cent today; ethanol would remain the dominant biofuel, making up about three-quarters of global biofuels use throughout the period; and consumption of biodiesel in road transport would more than triple. Brazil would remain one of the largest world producers and consumers of biofuels, with 38 per cent and 19 per cent of the total respectively in 2035.

This section starts with a brief historical description of renewable energy policies in Brazil, with a focus on biofuels, and discusses the various stakeholders and motivations behind those policies. Other policies and programmes to foster energy efficiency, such as the National Electrical Energy Conservation Programme (PROCEL), the National Programme for the Rational Use of Petroleum and Natural Gas (CONPET) and the National Policy for Conservation and Rational Use of Energy (PNEf), have also been relevant in the Brazilian energy policy and climate change frameworks.[7] Although these end-use policies and programmes may also be relevant for climate change mitigation, we focus on policies and programmes related to energy supply.

Renewable energy policies in Brazil date back to the 1970s as an attempt to cope with the oil price shocks at that time. The relevance of biofuels in the Brazilian energy matrix derives from the implementation of two government programmes: (i) the National Fuel Alcohol Programme (Programa Nacional do Álcool – PROALCOOL) and (ii) the National Programme for the Production and Use of Biodiesel (Programa Nacional de Produção e Uso do Biodiesel – PNPB). Although these programmes have had significant results in terms of emission reductions, the motivations behind them were not based on climate mitigation concerns, as will be discussed throughout this section.

PROALCOOL was initiated in 1975. The main aim of the programme was to save foreign exchange by using ethanol as a supplement to the nation's gasoline supply (Hira and Oliveira 2009). PROALCOOL has been active for almost 40 years now, enabling Brazil to be one of the world leaders, along with the United States, in terms of technology and

[7] For a review of these policies, please refer to Szklo *et al.* (2005) and Calili *et al.* (2014).

consumption of ethanol. There have been several studies of the PROALCOOL experience in Brazil, mostly discussing the technical issues behind it.[8]

The PNPB, which was launched in December 2004, is a more recent initiative for which literature and experience are much rarer. One of the major objectives behind increasing biodiesel production through the PNPB was to promote socioeconomic development and foster regional development via small family agricultural units (Goldemberg *et al*. 2004; Takahashi and Ortega 2010). These programmes are discussed below.

3.1 Brazilian National Fuel Alcohol Programme (PROALCOOL)

The production of sugarcane and ethanol are not new activities in Brazil. Legislation enacted in 1931 made the addition of ethanol to gasoline mandatory. Since then, ethanol-gasoline blends of up to 40 per cent ethanol have been used in automobile Otto engines (Geller 1985). The quadrupling of world oil prices in 1973, at a time when nearly 50 per cent of Brazil's export earnings were spent on imported oil, had serious repercussions for the country's balance of payments situation. At the same time, the sugar industry had made large investments in modernisation in response to high sugar prices in the international market in the early 1970s. These investments were at risk as sugar prices almost collapsed in the middle of that decade. The introduction of PROALCOOL was partly driven by the need to assist the sugar industry in times of low world sugar prices (Geller 1985). A combination of these factors, along with other government objectives, led to the creation of PROALCOOL to raise the production of ethanol from sugarcane and increase the use of ethanol as a replacement for gasoline (CNPq 1980; Rosillo-Calle and Cortez 1997; Coelho *et al*. 2006).

The officially stated objectives of PROALCOOL, other than saving foreign currency by reducing the country's oil imports, were:

a) To reduce regional income disparities by allowing the expansion of sugarcane production in poor regions (such as the north-east, the poorest region of the country but with a long tradition of sugarcane plantations going back to the late sixteenth and seventeenth centuries);
b) To reduce individual income disparities by generating jobs for poorly-educated rural peasants;
c) To promote economic activity in the country in general;
d) To expand the capital goods industry with the production of new ethanol distilleries, pleasing the politically-strong industrial sector of the state of São Paulo.

However, as mentioned above, the main aspects that really concerned the federal government at that time were: a crisis in the sugar exports market due to low international sugar prices, the low activity level of the country's capital goods and industrial sectors in general, and the need to find a new liquid motor fuel to replace gasoline (Geller 1985). This latter aspect was probably the most important for the country's new, affluent middle class who, to some extent, had supported the military coup only a few years earlier. They did not want their cars stranded in their garages without fuel, as happened to people in some Western countries because of the two 1970s oil shocks.

The successful inclusion of ethanol in the Brazilian fuel structure was the result of an enormous state intervention which included: shaping the agricultural and industrial policies toward the goals of the programme; investing public resources in research and development

[8] For further reference see Geller (1985); Rosillo-Calle and Cortez (1997); Moreira and Goldemberg (1999); Puppim de Oliveira (2002); Goldemberg *et al.*(2004); Szklo *et al.* (2005); Pousa *et al.* (2007); Goldemberg *et al.* (2008); Nardon and Aten (2008); Hira and Oliveira (2009); Takahashi and Ortega (2010); Hall *et al.* (2009) and Garcez and Vianna (2009).

(R&D); regulating and giving incentives to the private sector to pursue innovation and invest in ethanol-related activities; and giving incentives to car owners to shift to ethanol-fuelled cars (Puppim de Oliveira 2002).

The implementation of PROALCOOL can be divided into four phases. In the first phase (1975–79), the objective of the programme was to install annexed distilleries to existing sugar mills and to produce anhydrous ethanol to be blended with gasoline. This first phase was marked by a difficult relationship between the government and multinational automobile corporations in the country. Also, due to the opposition of several key government officials who did not believe that such an ambitious, and costly, programme would ever succeed, the programme had a difficult inception period. However, it was largely due to the State's resolve that ethanol-fuelled passenger cars succeeded (BNDES 2008). It is also important to note that Brazil was ruled by a military-led dictatorship during the initial years of PROALCOOL. The regime facilitated many of the top-down interventions during implementation of the programme.

Some authors called the second phase of PROALCOOL the 'honeymoon phase' (1979–85) (Hira and Oliveira 2009; Hira 2009). In this phase, ethanol succeeded as a gasoline substitute, consolidating the programme. According to Hira and Oliveira (2009), the specific policies implemented by the Brazilian Government in this phase were:

- Establishing higher minimum ethanol fuel blends with gasoline (progressively increased to 25 per cent);
- Guaranteeing lower prices for ethanol as compared to gasoline;
- Guaranteeing minimal prices to bioethanol producers;
- Creating credit lines for sugar mills to expand;
- Requiring the availability of ethanol at gas stations;
- Maintaining strategic reserves to stabilise supply; and
- Establishing several policies to push ethanol-based car production.

In response to the intervention and the favourable conditions (high petroleum prices in the international market, among others), pure ethanol-fuelled cars accounted for more than 90 per cent of all new cars sold in Brazil in the mid-1980s. The remaining fleet ran on a blend of 25 per cent ethanol and 75 per cent gasoline. Fuel distribution systems were adapted and ethanol became available in most service stations (Takahashi and Ortega 2010).

In 1986, however, petroleum prices fell from US$30–40 to US$12–20 a barrel, pushing down the market price for ethanol. At the same time, in an attempt to curb inflation, a newly elected government launched an economic programme that reduced incentives for ethanol production. Lower oil prices and consequent lower ethanol retail prices, coupled with the reduction in ethanol incentives, made ethanol production unattractive. However, the demand for ethanol remained high due to the predominance of an ethanol-fuelled fleet, leading to an ethanol supply crisis (Takahashi and Ortega 2010). The honeymoon period of the PROALCOOL programme was over.

The programme received further setbacks for reasons unrelated to energy policy. In 1989, the new-elected young president, Fernando Collor de Mello, started to criticise the lack of modernisation in the country's well-established car industry,[9] which at the time consisted of four international manufacturers (General Motors, Fiat, Ford and Volkswagen). These manufacturers were protected from international competition in a market closed to imports. They also had significant incumbency advantages due to their ability to produce cars powered by ethanol, something the international competition was not able to do at that time.

[9] For instance, he once mentioned that Brazil was producing 'wagons', not modern cars.

The four automobile manufacturers had significantly benefited from PROALCOOL and a continuation of the programme would have significant implications for their market share.

President Collor won the contest against the car manufacturers, however, and started a process of market liberalisation that opened the economy to other international suppliers. He discontinued the incentives for the ethanol programme. Several European and Japanese car manufacturers established production facilities in Brazil and started producing gasoline-fuelled cars (Mendonça 2010). By 1997–98, only 1,000 pure ethanol vehicles were sold in the country (Nardon and Aten 2008). After two decades of expansion, the ethanol sector suffered a long period of decline.

The rebirth of ethanol as a pure motor fuel started in 2003–04, with a new phase that was not designed specifically as a government programme. However, it benefited from government interventions in the form of tax policies favouring vehicles capable of using ethanol. This new phase, to some extent still present today, was marked by the revitalisation of the use of ethanol as a fuel due to the massive introduction of flex-fuel vehicles (FFVs). In August 2002, the government gave the emerging market a major spur when it reclassified FFVs as eligible for the same tax breaks as the old ethanol-based vehicles. Government-supported R&D has been key to the growth of FFVs in Brazil (Nardon and Aten 2008).

In the recent past, more than 90 per cent of new vehicles sold in Brazil have been equipped with flex-fuel engines.[10] These cars are popular because they enable consumers to choose the fuel with the lowest price at the service station. For this reason, along with the compulsory addition of anhydrous ethanol to gasoline, ethanol production has more than doubled since 2003. The flex-fuel technology has been supported by the strong agricultural lobby, representing the sugarcane industry, and by the car industry, which was able to easily incorporate the technology. With such wide-ranging support, in 2006 President Lula was able to launch his efforts at 'ethanol diplomacy'. The objective of these efforts was to create a global market for Brazilian biofuels. However, this created tensions with some of the country's allies, such as China, India and Indonesia, at the UNFCCC negotiations. The most important achievement of such 'diplomacy' happened in 2007, culminating in an agreement with the United States to develop an ethanol market. However, in the same year, Brazil announced the discovery of vast deep-water offshore pre-salt oil reserves, with significant consequences for Brazilian climate politics over the years to come. Some experts suggest that these reserves are probably the single most important obstacle to Brazilian policymakers opting for a transition to a low-carbon economy (Viola and Franchini 2014).

3.2 Brazilian National Biodiesel Programme (PNPB)

Over the years, Brazil has promoted the introduction of biodiesel in the country's energy mix through various socioeconomic, energy and environmental policies and measures (MAPA 2006; Rathmann *et al*. 2012). Although the use of vegetable oils for fuel purposes has been discussed since the 1920s, serious efforts at obtaining biodiesel from oilseeds began as recently as 2002 under the aegis of the Brazilian Biodiesel Network (PROBIODIESEL) (BRASIL 2007a). In December 2004, the PNPB was established and defined targets for blending biodiesel with mineral diesel (BRASIL 2005). Its main objective was to guarantee the economically and technically viable production and use of biodiesel. Its major goals were social inclusion and regional development via the promotion of small family agricultural units and to encourage technology research (Nunes 2011; Pousa *et al*. 2007; Hall *et al*. 2009).

According to the Brazilian Federal Government (BRASIL 2005, 2007a; MAPA 2006), other motivations behind the PNPB have been:

[10] Introduced in March 2003, flex-fuel type vehicles represented approximately 2.7 per cent of vehicles produced in Brazil in that year. In 2012, approximately 98 per cent of vehicles produced in the country were of the flex-fuel type (ANFAVEA 2013).

- Potential improvement in the country's trade balance, since Brazil is a net importer of diesel;
- Availability of many oilseed plants suitable for biodiesel production without affecting food security;
- Perfect substitutability between biodiesel and regular diesel; and
- Greater energy efficiency associated with biodiesel as compared to diesel so as to reduce CO_2 emissions by 78 per cent as compared to the emissions associated with the consumption of the same volume of regular diesel.

The PNPB also created the Social Fuel Stamp. Biodiesel industries must purchase part of their feedstock from small farmers, sign commercial agreements with them and provide them with technical assistance in order to receive the Social Fuel Stamp (Rathmann *et al.* 2010). The Social Fuel Stamp requires the biodiesel industry to participate in auctions to supply the domestic market. In addition, the stamp allows producers to have access to better finance conditions with the BNDES and other domestic financial institutions.

The PNPB's most important action was to introduce biodiesel in the Brazilian energy matrix by means of law (Law 11097) (BRASIL 2005). This law also assigned responsibility for changing the mandatory biodiesel mixture to the CNPE. The current mandatory biodiesel mixture is at 7 per cent in volume. Biodiesel production reached 2.7 billion litres in 2012 from 64 authorised plants (ANP 2013a), which is basically replacing the same amount of mineral diesel, part of which would have been imported.

Expansion of biodiesel supply in Brazil is promoted by auctions. By February 2013, the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis – ANP) had held 35 auctions (ANP 2013b). According to the ANP (2014), the main raw material used for biodiesel production in Brazil in 2013 was soybean oil, with about 70 per cent (in volume), followed by bovine fat (26 per cent) and cottonseed oil (3 per cent) (data for December 2013). Despite the low yield of vegetable oil obtained from soybeans, the highly organised production chain, mechanised production and state-of-the-art facilities has enabled growth in all regions of the country. The spread of soybean production has been highly responsive to the increasing demand for biodiesel (Garcez and Vianna 2009).

The launch of the PNPB had very little to do with climate concerns. The expectation from the State Office, the Ministry of Agriculture and former president Lula da Silva was that it would contribute to economic development and alleviate poverty in the poorest areas of the north-east of the country. This also influenced the choice of manona (*Ricinus Communis L.*) as the feedstock for biodiesel production. Since the crop requires manual harvesting, it would have had a positive impact on job creation but, as mentioned previously, biodiesel has mostly been produced from soybean oil and bovine fat, leaving behind all positive social benefits originally expected from the programme.

3.3 Who drives/obstructs biofuels policies in Brazil?

The historical discussion above provides evidence that the explicit major forces driving renewable energy policies have motivations other than climate change. In this section we summarise the objectives and motivations of the involved stakeholders. The discussion is based on our experience, supported by the 14 interviews conducted during the project.

An analysis of the motivations for biofuels policies in Brazil indicates that there was a convergence of interests from many different stakeholders from various segments of society. For instance, although the ethanol programme was promoted by the government, the motivations and agents behind it were many. Initially, the federal government's motivation was to reduce the outflow of foreign currency by reducing reliance on oil imports and

enhanced energy security. After 2005, however, the government used the country's large share of biofuels to build its reputation internationally. Through its biofuels diplomacy, Brazil wanted to be seen as a leader in renewable energy supply. With the recent discovery of pre-salt oil reserves, Brazil is no longer at the forefront of climate-relevant discourse around energy supply. This is reflected domestically in the strong price controls on gasoline during Dilma Rousseff's administration, ostensibly to fight inflationary pressures.

As mentioned above, the automobile industry used the ethanol motor technologies as a hidden market barrier to imported vehicles, especially after President Collor's 'opening' of the Brazilian economy in the early 1990s. The reduction in protectionism around the domestic industry led to the import of gasoline cars. The manufacturing of ethanol-based vehicles was stopped, only to return with the flex-fuel automobile technology in the early 2000s. The support provided by the government, by granting the flex-fuel automobile similar tax breaks to the ethanol-based vehicles of the 1980s and 1990s, was key in converging the interests of all groups supporting the ethanol industry in Brazil (e.g. sugarcane producers and the manufacturing goods industry).

The sugarcane industry (the so-called '*usineiros*') had a direct interest in increasing ethanol production and in creating a large market for ethanol. Other industries, especially the manufacturing goods industry which produced equipment for both the sugarcane and automobile industries, also drove ethanol production. In fact, as mentioned above (see Section 3.1), the expansion of sugarcane production in poor regions of the country (although most expansion took place in the most developed state, São Paulo) and the expansion of the capital goods industry, with the production of new ethanol distilleries, were both part of the officially stated objectives of PROALCOOL (CNPq 1980; Geller 1985). What is not clear, because the literature it not explicit about this, is how the '*usineiros*' and São Paulo's politically strong industrial sector have influenced the process. These two groups have probably acted collectively, given their strong affiliations with congressmen in the central government. In fact, the Senate and House of Representatives have many politicians who come from the agriculture sector, or who have strong connections with São Paulo's industrial sector, which is the most important in Brazil.

Actors who supported the PNPB – but opposed the emphasis given to mamona – were those involved with the oilseed production agro-industrial sectors, especially given the price depreciation they faced at the time. On the other side, the sugarcane industry was – and still is – an obstructive force to the biodiesel industry. The motivation for this opposition is an understanding that biodiesel would compete for resources that would otherwise be directed to the sugarcane industry. As will be discussed later, the sugarcane industry has often opposed other renewable energy sources with the intention of maintaining ethanol as the most important renewable energy option for the country.

Other obstructive forces to the biodiesel industry come from those who claim logistical problems associated with fuel distribution and higher fuel prices arising from the addition of biodiesel to regular diesel.

Sectors within the federal government in favour of the ethanol industry – mostly the MME – also oppose some policies to foster the penetration of biodiesel in the Brazilian fuel mix. Although the compulsory addition of biodiesel to mineral diesel has recently been increased from 5 per cent to 7 per cent in volume terms, the Minister of Mines and Energy, Edison Lobão, has announced that solving the current ethanol crisis – mostly caused by gasoline price controls – was a priority of his administration. Therefore, no further incentives for biodiesel are to be expected from the current government.

At the state level, however, governments have acted through their representation in Congress in favour of increasing the addition of biodiesel to diesel. The major argument for

this, however, is the high tax revenues from increased biodiesel production. For instance, the governor of the state of Rio Grande do Sul recently mentioned that a 1 per cent increase in the biodiesel addition would generate an annual revenue of R$70m (some US$30m) for the state.

In sum, the expansion and contraction of the biofuels programmes in Brazil, in particular of PROALCOOL, which have direct climate co-benefits have had little to do with actors working with climate change as their agenda. In fact, much more important have been other motivations (economic, social or simply political) that, from time to time, have been top of the government agenda. Also, some exogenous shocks to the system, like the international oil shocks and the recently-discovered pre-salt oil reserves, have led to realignment of objectives and interests. This, in turn, has been critical for the evolutionary dynamics of alliances that can drive or block the transition to a low-carbon economy based on renewable energy sources.

In this sense, it is interesting to note that, in the Brazilian context, even sectors within the low-carbon industry actively lobby against each other. Opposition arises not only from the conservatives but also due to conflicts within the reformists about the way forward. This shows how important the role of the government is in shaping the way forward and in supporting the formation of alliances through policy interventions in Brazil.

4 Brazilian policies for renewable electricity generation

Between the mid-1960s and mid-1970s, a period referred to as the Brazilian economic miracle, the country experienced GDP growth rates above 10 per cent. A large share of the current installed hydroelectric generation capacity was built during this period. The military government faced little resistance to the construction of large hydropower plants and to the flooding of large reservoir areas. At that time, environmental concerns were not taken seriously. Despite the large environmental impact caused by this expansion of hydropower during the 1970s, the foundations of the Brazilian National Interconnected Power System (Sistema Interligado Nacional – SIN) were laid. The SIN is a hydrothermal[11] system heavily based on hydropower generation[12] and with very low GHG emissions which, paradoxically, is beginning to change because of environmental and social concerns associated with the flooding of large areas.

Since the 1990s, the Brazilian government has attempted to encourage power generation from renewable sources other than large hydroelectric power plants. However, this effort has not been great enough to create a favourable environment for large-scale projects. This is largely due to the evolution of the regulatory framework which, instead of promoting investments, generated uncertainties (Dutra 2007).

According to Dutra (2007), the creation of independent and self-producers of electricity in 1996 was the first attempt to promote private investments in power generation.[13] This favoured hydroelectric and thermal generation, although some investments in wind power were also made, mostly on an experimental basis. Another initiative was the utilisation of resources from the Fuel Consumption Account (Conta de Consumo de Combustíveis – CCC) for renewable energy projects located in isolated regions. This cross-subsidy was extended to renewable energy sources, provided they replaced partly or totally oil-based thermal power generation in isolated power systems, largely located in the Amazon region. This measure addressed a historical barrier to the use of small-scale renewable energy sources in stand-alone systems created by the cross-subsidy awarded to thermal power generation (mostly diesel). Although this initiative, implemented in 1998, was supposed to incentivise renewable electricity generation sources, only some small-scale hydropower plants (SSHPs) and biomass projects benefited from it. The reasons for this include the low wind potential in isolated (off-grid) regions and the high upfront costs to implement renewable generation in areas with difficult access.

The sections below provide a brief description of the main renewable energy policies for wind and solar technologies in Brazil. This section concludes with a discussion on the actors that drive or obstruct these policies in Brazil.

[11] The term 'hydrothermal' is often used to describe the Brazilian interconnected power system given the important role that thermal power generation, mostly fueled by natural gas, has in terms of guaranteeing supply during hydrologically-adverse periods.
[12] Roughly 80 per cent of the electricity generated in Brazil has come from hydropower generation in the past decade (EPE 2013b).
[13] An independent power producer is an entity which is not a public utility but which owns facilities to generate electric power for sale to utilities and end users. A self-producer of electricity is a privately held facility, corporation, cooperative or non-energy industrial plant capable of feeding excess energy into the system.

4.1 Brazilian policies for wind energy

Although Brazil has implemented policies to foster renewable energy generation, there has been no policy with a sole focus on wind power. The only policies that have influenced wind power generation in the country have been the Brazilian Programme to Incentivise Alternative Electricity Sources (Programa de Incentivo às Fontes Alternativas de Energia Elétrica – PROINFA) and alternative energy auctions. However, with time, wind energy has become more competitive and major incentives for this technology have ceased. This section describes the PROINFA, which historically was the initial point for wind energy in Brazil. Despite not being exclusively focused on wind, the alternative energy auctions are also described because of their role in installing around 1.5GW of wind energy. Recently, wind energy has been left out of the separate auctions for alternative energy and has started to compete with conventional technologies at the free auctions.

The main objective in setting up PROINFA was to increase the share of electricity generated from wind, biomass and small hydroelectric plants in the SIN. The strategic objectives of the programme were diversification of energy sources by making use of local and regional potentials within the country, energy security, job creation, capacity building, and GHG emission reduction (MME 2010).

The programme was launched in 2002 and was split into two phases (Dutra and Szklo 2008). The goal of the first phase was to install 3,300MW distributed between wind generation, biomass and SSHPs through means of long-term contracts. Initially, these forms of energy generation were to begin operation in 2006 with a 15-year contract. However, operations did not start until 2008 and the contracts were later extended to 20 years. The promotion system adopted was based on feed-in tariffs and the establishment of quotas for installed power generation capacity.

The PROINFA also established a nationalisation index to promote industrial development, especially of durable goods, and job creation. In the first phase, at least 60 per cent of the equipment deployed had to have been produced in Brazil. In the second phase, this requirement was raised to 90 per cent. According to Hashimura (2012), however, this local content feature of the PROINFA has led to higher costs and delays.

The second phase had an initial aim of achieving a 10 per cent share of alternative electricity generation sources in the country by 2026. However, after the reforms of the Brazilian electricity sector that began in 2003, the percentage target was replaced by the new renewable alternative energy action system (see below). It is interesting to note that the market faced uncertainties not only due to the programme, but also because of uncertainties related to the new Brazilian regulatory framework, which, at that time, was still being implemented and tested.

After the regulatory reform of the power sector,[14] the auction system was implemented with the objective of selecting energy suppliers through biddings, based on the energy tariff. The share of renewable sources in the biddings would be defined by the MME and based on a maximum share of renewables that would not lead to a price increase in Brazil's final electricity tariff greater than 0.5 per cent each year, nor greater than 5 per cent in total on the accumulated tariff, when compared to the tariff based on conventional sources.

Within this context, special auctions for alternative energy sources have been promoted in order to increase the participation of small-scale hydro, biomass and wind power plants, and have achieved relative success (CCEE 2014). These exclusive auctions were set up based on the understanding that the alternative sources could not compete commercially with conventional energy sources, given their higher costs.

[14] For details of Brazil's power sector reform, see Araújo (2009).

Only two alternative energy auctions have been conducted so far. The first was in 2007, in which 639MW of energy was contracted (none of the contracts went to energy from wind). The second auction was in 2010, contracting 1,686MW (1,519MW of which came from wind). A third alternative energy auction will take place in April 2015, with wind projects totalling around 13GW already registered to participate. When the first two auctions for alternative energy were conducted, wind energy increased its competitiveness and is now able to compete in auctions with the traditional sources of electricity generation. For instance, in the two latest full auctions for new generation sources which took place in 2013, most of the contracted electricity came from wind energy bidders (CCEE 2014).[15]

Wind energy has quickly become a competitive option in the country. Although, the international development of wind technology has been a crucial contributor in enhancing the competitiveness of wind energy, the prospects for wind energy have been supported by the quality of wind resources in certain regions. For instance, in some regions capacity factors reach levels as high as 50 per cent, making wind energy competitive compared to traditional sources. It remains to be seen whether wind energy will remain competitive with expansion to sites with lower capacity factors, and whether further policy interventions will be needed to foster enhanced wind power penetration levels.

The lack of policies focused on wind energy provides some evidence about the drivers of wind energy in Brazil. The main objective of the New Model for the Brazilian Power Sector is to lower electricity tariffs. The advance of wind without major incentives is, at least considering the competitive conditions of the energy auctions, in compliance with this objective. Thus, other motivations related to, for instance, energy security, job creation and even climate change mitigation seem to be of lower relevance, otherwise wind (and solar) energy would have received much higher incentives over time than has been the case.

4.2 Brazilian policies for solar energy

Policies to foster solar energy in Brazil started with the 1994 Programme for Energy Development in States and Municipalities (*Programa de Desenvolvimento Energético dos Estados e Municípios* – PRODEEM) and the 2003 Light for All (*Luz para Todos*) programme. These programmes were directed at providing electricity to isolated communities and had a focus on photovoltaic (PV) panels. In 2011, new incentives for solar PVs were introduced by the Brazilian Electricity Regulatory Agency (Agência Nacional de Energia Elétrica – ANEEL) through means of a public call for R&D projects. Eighteen projects were selected, totalling 24MW which was due to be installed by 2015 (CRESESB 2014).

The largest programme, Light for All, was launched in 2003 by the Brazilian Government to eliminate electrical exclusion in the country. The initial target was to promote rural electrification, reaching 10 million people by 2008 (MME 2010). The programme is based on the constitutional obligation of utilities to universalise electrification in rural areas, on substantial federal and state resources for the service providers, and on low tariffs for low-income and rural consumers. Many regions under the programme have a low Human Development Index (HDI) rating, which makes the Light for All programme a means of social development and opportunities.

The programme was created when two federal-led electrification programmes were being implemented, including PRODEEM, which was the first attempt to install distributed power systems in households, including PV arrays. Goldemberg *et al*. (2004) mention that it provided mainly non-grid solar PV electrification to community installations, health facilities and schools and its effectiveness was hindered by its top-down management with little

[15] At the 17th auction in November 2013, all energy contracted (867MW) came from wind. At the 18th auction, in December 2013, 67 per cent of 3,507MW came from wind (CCEE 2014).

stakeholder involvement, lack of cost recovery schemes and lack of coordination with grid electrification plans.

The timetable for the Light for All programme went up to 2010, but it faced some difficulties in keeping on schedule (Niez 2010). The main reasons were lack of experience, equipment and service supply shortages, and high demand. Despite expectations that the programme will meet previously anticipated and additional demand, it should be noted that the electrification challenge becomes more difficult as it moves on to remoter areas, which increases the cost of connection and/or equipment transportation and installation (Brasil Energia 2011).

There are currently three tax regimes that indirectly benefit solar power generation in Brazil: the Special Incentive Regime for the Development of Infrastructure (*Regime Especial de Incentivos para o Desenvolvimento da Infra-Estrutura* – REIDI) created by law 11.488/2007; the Programme for Supporting Technology Development in the Semiconductors Industry (*Programa de Apoio ao Desenvolvimento Tecnológico da Indústria de Semicondutores* – PADIS) created by law 11.484/2007; and the Information Technology Law (*Lei da Informática*, law 11.077/2004). The REIDI programme provides tax breaks to all infrastructure investments, thus affecting all energy sources, including solar. The PADIS programme and the Information Technology Law provide tax breaks to firms that perform R&D activities in semiconductors, hardware and electronic equipment. These two programmes therefore create incentives throughout the solar panel production chain. However, no specific policy is targeted at the solar panel industry in particular.

Further incentives were provided in 2012 by ANEEL through resolutions 481/12 and 482/12. The first provides discounts in the transmission and distribution tariffs for solar PV generation and the second sets the institutional framework for connecting small-scale distributed generation to the grid. According to this second resolution, using net metering, eventual energy surpluses that micro-generators send to the grid would be compensated as electricity consumption credits (ANEEL 2012). However, as no financial compensation is involved, there is little incentive for installing power generation capacities higher than the agent's own electricity demand.

Despite the measures mentioned above, solar generation in Brazil is still only just beginning to happen. In 2011, Tauá, the first PV centralised power plant in the country was inaugurated, with an installed capacity of 1MW. This project was financed by the R&D programme of a private company (MPX), which partially depended on Inter-American Development Bank (IDB) financing. As of the end of 2014, only about 15MW of PV has been installed in the country (ANEEL 2014). Recently, dedicated solar auctions have contracted some PV centralised power plants, giving the signal that the development of solar energy is just starting in Brazil. The Pernambuco State held the first solar auction in the country in December 2013, where 123MW of centralised solar PV were contracted (SRHE 2013). And at the end of October 2014, 890MW of centralised solar PV were contracted in the sixth national energy reserve auction, which should be operating by 2017 (EPE 2014b). Most of this capacity will be installed in the north-east of the country, which today looks like a solar energy expansion pole. The high solar resources (both global and direct irradiations) of this region are the main drivers that explain the development of solar power plants, not only PV but also concentrated solar power (CSP) plants. In fact, in the 31 October 2014 auction, 240MW of eight CSP projects were registered, although none of them was successful in the bid (EPE 2014b). However, the very participation, for the first time, of CSP projects in electricity auctions shows a growing interest on the part of private investors to develop CSP power plants in Brazil.

Although cost is still the major barrier for solar energy, there are other barriers related to the small production scale and lack of specialised services for the installation and maintenance of solar technologies in the country.

With regard to the diffusion of photovoltaic micro-generation, there are problems associated with the consumer habit of receiving electricity from distribution utilities and also numerous barriers imposed by financial institutions to provide financing for the installation of distributed systems. Conversely, actors who have little power to influence public policy for the sector, such as representative associations and NGOs, argue that to overcome these barriers it would be important to improve access to credit and reduce taxes levied on different stages of the production chain – as well as removing the distortions caused by the Value Added Tax (Imposto sobre a Circulação de Mercadorias e Prestação de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação – ICMS) on self-generated electricity.

From this brief discussion of the policies related to solar energy in Brazil, it can be noted that solar technology itself has seldom been the direct target of those policies. Rather, its development has been incentivised by policies with other motivations. Initially, electrification of remote areas was the major driver and solar energy was regarded as a means to that end. Tax exemptions have only indirectly benefited solar energy. Finally, although the ANEEL resolution on small-scale distributed generation applies to all decentralised generation options, it is perhaps the policy that will benefit solar generation most. However, the lack of financial compensations associated with it may limit its impact in promoting solar energy.

4.3 Who drives/obstructs wind and solar policies in Brazil?

In order to facilitate a discussion on who drives/obstructs wind and solar policies in Brazil, both energy sources were lumped together here, as a real differentiation between the two would be, somehow, artificial. Also, the agents that drive/obstruct both energy sources are often the same.

Once again, the analysis made here is based on the authors' knowledge and experience as well as on the basis of the 14 interviews with key stakeholders. In fact, despite the vast literature on the technological and economic aspects of wind and solar energy, there is not much on the politics behind solar and wind policies in Brazil. However, the authors of this report have studied these industries for the past 20 years (especially their economic and technical dimension). During this period, we have met stakeholders from government, business and NGOs working on issues related to wind/solar energy. From these encounters and from reports in the press, we have gained a good knowledge of who was driving the policy processes forward or holding them back. In the absence of academic research on this issue, we draw on this knowledge, which comes from observing the policy processes over long periods of time. We validated our impressions and conclusions with experts or stakeholders in these industries by means of in-depth interviews[16] and discussions with key researchers in the field. We would like to particularly thank Professor Eduardo Viola from the University of Brasília (UNB) whose insights and discussions have contributed immensely to this work.

Several interest groups are associated with the wind energy industry in Brazil. Promoting wind energy is a win-win situation because it is aligned with the interests of most stakeholders. As mentioned above, wind is now a competitive renewable energy source and this has resulted in its promotion by local policies. Wind energy has also helped in promoting development in low-income regions (where biodiesel failed) and helps Brazil maintain its low-carbon image.

Wind energy has also received support from strong political and industrial and services groups based in the north-east of the country. The leadership of these groups is associated with former President and Senator José Sarney, who, through his political strength, has heavily influenced MME lines of action over the years. This has included his power to

[16] We acknowledge the respondents' understandable caution in expressing views on controversial policy issues and therefore promised not to reveal their identity.

propose various MME ministers to different presidents. As of December 2014, for example, the MME minister is Edison Lobão, Sarney's personal appointee to President Rousseff.

Recent international developments in wind energy have also been a key element in the increasingly high penetration of wind energy in Brazil. The reductions in the cost of wind have been crucial in this regard. The global leader in the industry, China, considers Brazil an emerging and promising market. With the 2008/09 financial crisis, Brazil became an attractive market for wind energy, as the demand in Europe and the United States (US) fell (Nogueira 2011).

As the solar energy industry is in a nascent stage of development, most of the interests associated with it have come from the scientific and technological communities. These groups see good prospects for solar energy in the future and work under the assumption that Brazil needs to follow closely the research and development of the international vanguard in solar energy. Solar is of special interest for foreign investors in the country as well. The three major foreign investors are the US, China and Germany, all of which see Brazil as a potential market for solar energy goods and services. Although the first sign of interest was shown by a private company with the inauguration of Tauá's (1MW) centralised PV plan in 2011 in the north-east region, it was only at the end of 2013 that the first solar auction was organised by the Pernambuco State Government. Nevertheless, the development of PV centralised power plants has started at the national level, with the sixth reserve energy auction that contracted 890MW from centralised PV power plants on 31 October 2014.

From the consumer point of view, distributed solar and wind electricity would compete favourably with utilities' tariffs rather than with generation costs of less expensive power generation technologies (Miranda *et al.* 2015). But this group does not have the political power of the others opposing distributed electricity in the country. Also, decentralised solar and wind energy face some resistance from grid-connected generation. Decentralised generation and smart grids will require adaptation of utilities, whose business would need to adapt. In that sense, conservative forces that oppose these changes can also be found within power utilities in the country which see a real threat to their businesses. Also, state governments see decentralised generation as a loss of tax income, leading, in some cases, to the (non-expected) taxation of excess energy produced by the consumer and sent to the grid, which, in turn, decreases the competitiveness of decentralised options.

The agents who decide the country's energy policies at the federal level, who have a key role in fostering the integration of solar energy in the energy mix, have defended the deepening of the power-sector model based on large generation projects. As such, these agents have listened to interest groups that have the power to influence energy policies in the country, particularly large state-owned power companies. It should be noted that, in the power sector's auction model, solar had not been competitive until October 2014 when, for the first time, 890MW of centralised solar PV were contracted in the sixth reserve energy auction. Furthermore, large solar power plants to be integrated into the SIN would face the same restrictions as other sources, particularly the bottleneck for transmission and distribution, which have hampered the successful integration of wind generation and compromised the objective of promoting lower tariffs. In fact, auctions in 2015 will not only consider the economics of the offers, but also the transport capacity according to the different locations. This constraint is especially important for wind and solar projects, which should now be prioritised with this additional geographical criterion.

Ironically, the sectors associated with hydroelectricity and sugarcane generally oppose other renewable sources such as wind and solar. These sectors include large construction firms specialised in building dams and conservative segments of the energy bureaucracy, as well as the '*usineiros*' (sugar plantation/mill owners). Although they do not directly oppose wind or solar energy, these sectors use these sources as a comparison benchmark for the expansion

of renewable energy in Brazil. They emphasise the higher costs and dispatchability problems of wind and solar energy to argue for the construction of new hydropower plants. As hydroelectricity faces large opposition from environmentalists and social movements, undermining other renewable power generation options such as wind and solar is a strategy used by the hydroelectricity and sugarcane sectors. Biofuels, once in the spotlight of renewable energy in Brazil, see their leading role threatened by these newcomers.

4.4 Assessment of the perceptions of the drivers of renewable energy policies in Brazil

This section evaluates the motivations and levels of influence of the agents involved in renewable energy policies in Brazil and attempts to identify possible coalitions among those agents. The approach used was the methodology proposed by the PEACH project (Schmitz 2012). The PEACH methodology was applied based on the literature and personal experience of the authors. Also, questionnaires were sent to key informants from institutions relevant to renewable energy policies in the country, with a focus on wind and solar energy, from different sectors of society to identify the motivations and possible coalitions. We received 16 responses from government institutions, business groups and civil society. Initially, an inventory of stakeholders was made, which helped us to define the actors involved with renewable energy in Brazil. This inventory is based on the identification of stakeholders made in Sections 2.1 and 2.3 of this report, and includes different government institutions, business groups and/or business associations and civil society (universities and NGOs, among others).

A list of possible motivations or drivers for renewable energy policies in Brazil were distilled from the analysis of the historical discussion on renewable energy policies in the country: climate change (reduction of carbon emissions); energy security; competitiveness; and job and income generation. We then assessed the motivations of the identified stakeholders based on our own experience, the historical evolution of Brazilian energy policy, and responses to the questionnaires. Also, a level of influence was qualitatively attributed to these stakeholders in the process of renewable energy policymaking based on the historical capacity of that institution/sector of society to influence renewable energy policy decisions in Brazil.

Stakeholders were mapped according to their priorities. Business groups and associations are clearly more concerned with economic drivers, such as competitiveness and, to a lower extent, job creation and security of energy supply, leaving climate change mitigation as a second order effect.

4.5 Results from the analysis

The analysis of this report shows a divided position among government institutions. The motivations of these stakeholders are concentrated around energy security and climate change. However, it is interesting to note that the sectors of the government that perceive energy security as the main driver for renewable energy policies are those directly associated with energy policy formulation (e.g. the MME). At the same time, those motivated by climate change issues (e.g. the MCTI and MMA) are the ones in charge of the climate change agenda within the federal government but they do not have any direct influence on energy policies in Brazil.

Climate change is clearly a priority for stakeholders from civil society. Interestingly, NGOs and academics, for example, see climate change as the main force behind renewable energy policies, despite the different perceptions held by actors in other segments of society (e.g. business and government). In fact, they are more connected to international discussions and usually see long-term issues with a relatively higher priority than short-term pressing matters.

Civil society, however, has little influence on the formulation and implementation of renewable energy policies, especially those related to solar and wind. The same is true for some national government institutions that are concerned with climate change but have no direct influence over the country's energy policies. In fact, the most influential actors from federal government, i.e. those directly responsible for renewable energy policies, usually see energy security as the major driver. This provides evidence, therefore, that climate and energy policies in Brazil may not be well synchronised and that the different agents involved may have different driving priorities.

As for the business institutions involved with renewable energy, two groups are identified. The first includes financial institutions that finance socioeconomic development, in particular Caixa Econômica Federal (Caixa) and the BNDES. Institutions, like Caixa, which operate at the national level, have priorities related to job creation and income generation, while institutions like the BNDES, which work at a more international level, dealing with export sectors, are more concerned with competitiveness issues. These two, Caixa and the BNDES, make up the most influential business group. Their influence is high because they are responsible for a large share of the financial support used for renewable energy in Brazil.

Caixa is the most important institution in the country for the financing of low-income public housing. Increasing numbers of these housing projects now include solar water heating. As a result, Caixa has had a positive role in the promotion of renewables in the country. The motivations behind this, however, are not directly linked to climate change mitigation or energy security, as financing low-income housing projects is mainly motivated by benefits in terms of socioeconomic and income-distribution improvements.

The role played by the BNDES in promoting renewable energy technologies is not so straightforward and public literature documenting these actions is not available. One of the main objectives of the BNDES is to finance infrastructure investments, among which energy supply plays an important role. In this sense, there is no clear priority for the BNDES as it finances all types of energy investments. On occasions, different departments from the BNDES may act in different directions – one supporting large infrastructure, energy projects, sometimes fossil-fuel oriented (fuel oil and coal-based power plants), while others, for environmental reasons, support energy efficiency and wind energy projects. The final result of these internal tensions is not easy to determine and it is difficult to portray a precise picture of the institution's motivations. However, its role as a lever for infrastructure development, whether for renewable or fossil fuels, stands out as a motivation of the BNDES in a general sense.

The second group consists of the business associations of Brazil's wind and solar energy sectors. Their priority is the enhanced competitiveness of their sector but their level of influence in policymaking is very limited.

Possible coalitions were identified based on similar interests and policy initiatives. This analysis helps to visualise possible alliances of actors from different sectors, at different levels and with different priority concerns.

A coalition between actors from civil society who seek renewable energy initiatives as a way of mitigating climate change would have little influence, making it attractive for these groups to seek alliances with government institutions with aligned priorities. Such government institutions, in turn, do not themselves have a large degree of influence over renewable energy policymaking in the country (i.e. they are concerned with climate change issues but have little power to influence the implementation of renewable energy policies). A coalition between civil society actors and government institutions could increase both groups' level of influence on renewable energy policymaking.

Government institutions not only have different priorities, their level of influence also varies with regard to energy policymaking. Institutions that prioritise climate change have historically tackled LULUCF issues, based on the premise that the Brazilian energy mix is relatively low-carbon intensive and also because they are obstructed by influential energy-related government institutions. Thus, no coalitions are identified within government actors with different levels of influence. In fact, there is a clear disconnect between climate and energy policies in the country.

High-influence, energy security-driven government agencies see wind and solar energy as a means to diversify the mix of power generation sources in Brazil, which is currently largely concentrated on hydropower. They also see it as a means, eventually, to reduce the generation costs of the system (in the case of wind, especially). Reducing GHG emissions (among other drivers) would come as a co-benefit, but would hardly be the major motivation for policies to incentivise renewable energy in the power grid.

Although energy security and climate change can be aligned, there can be trade-offs between them if there is no coordination at the policy level. Fossil fuels, for instance, can provide security of supply, especially in a country where oil and gas reserves are large, and growing. Also, these trade-offs become higher as the penetration of variable renewable sources – like wind and solar – increases and the operation of the power system becomes more complex. Up to a 20 per cent limit, 'the integration of wind energy generally poses no insurmountable technical barriers and is economically manageable' (Wiser *et al*. 2011: 560). Higher penetrations are feasible, but would require changes to the power system operation, to which there may be resistance and some may see it as a threat to energy security. Therefore, climate and energy policies need to be coordinated so as to not compromise energy security. The methodology applied here, along with the analysis performed throughout this document, indicates that such coordination still faces some barriers in Brazil.

We conclude that the coalition of stakeholders to induce climate change mitigation policies is composed of low-influence actors, rendering them unable to effectively affect energy policymaking in the country. This conclusion is corroborated with the political history of Brazilian climate change politics discussed in Section 2.3, in which reformist forces had a short period of influence, based on specific events, and were quickly overcome by the conservative forces that oppose low-carbon development strategies for the country.

5 Concluding remarks

The goal of reducing GHG emissions necessarily implies a greater use of renewable energy sources, as well as a greater reliance on energy efficiency. These options, however, still face technical and economic constraints with regards to large-scale deployment. On the policy side, there is still a need for creating and/or improving the institutional framework to promote renewable energy sources, as well as energy efficiency, in Brazil.

An analysis of wind and solar policies and their motivations shows that climate change mitigation has not been a major driver for these policies in Brazil. Rather, it is clear that these policies provided co-benefits in terms of GHG mitigation. Szklo *et al.* (2005) and Calili *et al.* (2014) provide estimates of the CO_2 emission reductions that some of these policies indirectly promoted. It is true that government institutions were created and formally tasked with mitigating climate change. As set out in Section 2.3, the CIM was created in 2007 and one year later the NPCC was approved. However, as discussed, the government failed to properly implement the NPCC, which was highly criticised for proposing actions that would have happened anyway.

In this sense, an interaction between those forces promoting climate change mitigation and those opposing it – or reformists versus conservatives, using Viola and Franchini's (2014) nomenclature – can be identified. To date, this has led to a more conservative position, despite some conjectural periods of reformist leadership. In this context, renewable energy policies in Brazil have been driven, mostly, by motivations other than climate change.

Brazil still has significant potential for progress in the area of renewable energy. In terms of available resources and capacity, the country is extremely well positioned, but current government plans and actions are not directed at fully exploiting this potential. Climate and renewable energy policies, whilst comprehensive and relatively well integrated in the relevant sectoral plans and policies, still lack ambition. Many of the existing programmes and interventions to support sustainable energy are fragmented and have a limited impact. There is no explicit connection between renewable energy incentive policies and climate change mitigation in Brazil, except for a few moments in the recent past when political gains from doing so facilitated that link.

This report has attempted to provide an overview of who drives and who obstructs climate policy in Brazil, with a main focus on solar and wind energy. We conclude that Brazil still has a reputation as a low-carbon country given the high share of traditional renewables in its energy mix. Climate change policy has been mostly focused on LULUCF issues, which are also motivated by reasons other than climate change. Energy policy in the country sees climate change as a secondary priority, behind energy security and other economic aspects. It is clear from the current trend, however, that energy will soon become the main source of GHG emissions in the country. With increasing pressure to adopt legally-binding targets after 2020, it is not clear how long the opposing forces will maintain their hegemony and how long they will prevent climate change mitigation from becoming a national priority. This is an issue that the recently re-elected president of Brazil will have to deal with, especially since COP 21 (Paris 2015) will take place during the first year of her second term in office.

Our analysis also identified the agents that obstruct renewable energy policies in the country. These agents are fragmented and can be found even in the reformist camp. For instance, the sectors associated with hydroelectricity and biofuels generally oppose other renewable sources such as wind and solar. Solar and wind energy are also regarded as competitors for renewable energy incentives by the sugarcane industry. Biofuels, once in the spotlight of

renewable energy in Brazil, see their leading role threatened by these newcomers. The reasons for this include not only the competition for limited public resources and actions for fostering renewable energy, but also the loss of political capital and bargaining power in terms of being the best low-carbon solution for Brazil. To complete the picture, it is worth mentioning that the ethanol sector has been unable to compete with wind in the most recent electricity auctions.

In this sense, for instance, the possibility of the introduction of electric vehicles is regarded as a threat by the country's sugarcane industry. This sector argues that biofuels are the major decarbonisation option for the transport sector in Brazil. On the other hand, wind and solar energy could benefit from a large fleet of electric vehicles associated with smart grid technologies (Borba *et al.* 2012). However, it is likely that the future vehicle platform adopted in Brazil will follow whichever platform becomes internationally dominant, be it biofuel, electric or hydrogen based.

In sum, Brazil has taken a climate-friendly position in international fora and has a high share of renewables in its energy mix. Neither, however, is driven primarily by climate change mitigation ambitions. The international stance is primarily about Brazil seeking to reposition itself in the new global order. The advances made in renewables were, or are, driven by energy security, industrial policy and job creation motives. As of today, climate change mitigation in Brazil is, at best, seen by most as a co-benefit.

Annex 1 Actors involved, motivations and outcomes of the main renewable energy policies in Brazil

Start year	Programme	Actors involved	Main targets and/or motivations	Outcomes
1975	PROALCOOL first phase	National Alcohol Commission (CNAL), Banco do Brasil, BNDES, Petrobras	Increase the net supply of foreign exchange through reducing the demand for imported fuel Reduce income disparities among regions and individuals Increase growth of the domestic capital goods sector Produce anhydrous ethanol to be blended with gasoline Create a market for sugarcane products	Temporary solution to the fall in sugar prices Increase in the number of flexible distilleries Addition of 22 per cent of ethanol to gasoline Incentives to sugarcane producers and distilleries in the north-east
1979	PROALCOOL second phase	CNAL, Banco do Brasil, BNDES, Petrobras, National Association of Automobile Manufacturers (ANFAVEA)	Introduction of ethanol-fuelled vehicles Construction of ethanol-only distilleries Expansion of sugarcane crops	Use of ethanol as a fuel Increase in ethanol-fuelled vehicles Improvement in the country's balance of trade Expansion of the agricultural frontier (north-east)
1985	PROALCOOL third phase	CNAL, Banco do Brasil, BNDES, Petrobras, ANFAVEA	Increase in the legal addition of ethanol to gasoline Increase the productive capacity of ethanol Development of a flex-fuel vehicle	Crisis in the ethanol market due to the 1980s oil price fall Expansion of sugarcane production, but for sugar production More recently (2003) creation of flex-fuel vehicles reaching high sales
2002	PROINFA first phase	MME, Eletrobras, ANEEL, BNDES	Install 3,300MW equally distributed between wind generation, biomass and small-scale hydropower plants (SSHPs) through means of long-term contracts	964MW wind; 1,152MW SSHPs; 533MW biomass

(Cont'd.)

Annex 1 (Cont'd.)

2003	Luz para Todos	MME, Eletrobras, ANEEL	Provide access to electricity to all rural households in the country	2.6 million households connected up to 2010
2003	PROINFA second phase	MME, Eletrobras, ANEEL	Achieve a 10 per cent share of alternative electricity generation sources in the country by 2026	The second phase was replaced by the alternative energy auction system implemented along with the New Model for the Power Sector
2005	PNPB	Interministery Executive Commission (CEIB), CNPE, Petrobras, ANP	Generate jobs and income in the agriculture sector Potential improvement in the country's trade balance Availability of many oilseed plants suitable for biodiesel production without affecting food security Perfect substitutability between biodiesel and regular diesel Greater energy efficiency associated with biodiesel as compared to diesel so as to reduce CO_2 emissions	Compulsory blend of 6 per cent biodiesel to diesel Concentration of soy-based biodiesel in the south and mid-west regions Improve the balance of trade by decreasing diesel imports GHG emission reduction Alternative markets for producers of oilseeds
2007	Alternative energy auctions	EPE, ANEEL, MME, Câmara de Comercialização de Energia Elétrica (CCEE)	Increase the participation of small-scale hydro, biomass and wind-power plants without affecting Brazil's final electricity tariff by more than 0.5 per cent in each year	Two auctions that hired 639MW and 1,686MW, respectively

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