CRISIS, POLICY CHANGE AND BIOENERGY TRANSITIONS IN BRAZIL – INVESTIGATING LANDSCAPE PRESSURES.

Author: Luiz Gustavo Silva de Oliveira[1] [2]

1- Innovation studies group, Copernicus Institute of Sustainable Development, Utrecht University (l.g.silvadeoliveira@uu.nl)

2- ICIS (International Centre for Integrated assessment and Sustainable development), Maastricht University.

Abstract:

Energy transitions are diverse in motivations, speeds and determinants, which makes the role of politics and policies crucial for aligning the multiple goals, interests and conditions for such achievement. Furthermore, a turbulent political environment, for example political or institutional crises and changes in geopolitical power balance, complicates the political processes and may affect institutional change required for energy transitions. This is the current case of Brazilian energy transitions, which have to face the bad mood of macro politics. Currently, the national government, which took power in middle of an extreme political crisis and after the contested impeachment of the previous president, has proposed institutional reforms for important energy sectors. For bioenergy field, after one year of discussion a new policy was approved. This research aims to examines how the crisis in the political environment may affect bioenergy transitions in Brazil. For doing so, applying sociotechnical transitions framework, it focuses on how landscape pressures influence regimes and niches. However, understanding that the literature of sociotechnical transitions is limited in explaining landscape pressures, the research also uses the concepts of Multiple Streams framework to improve this analysis. Empirically, the findings indicate the political crisis led to an environment where market-based instruments were favoured, which may create hurdles for sociotechnical configurations that present low level of structuration. Conceptually, the findings demonstrate that the concept of policy window, couplings, criteria for survival and policy entrepreneur support a more precise explanation of landscape pressures.

Keywords: Brazil, sociotechnical transitions, multiple streams framework, energy transition, bioenergy.

1 INTRODUCTION

Energy transitions are diverse in motivations, speeds and determinants [1–3]. For instance, the geopolitics [4], national institutional structures [5] as well as the local availability of resources and knowledge [6] may play out an important roles. The current situation of Brazilian politics and energy policy reforms – some proposed and some implemented – is an excellent illustration of the interplay of motivations and determinants of energy transitions. On one hand, Brazil has been recognized as an important player in global energy discussions because of its success in promoting high diffusion of renewable energies [7]. On the other hand, the current political and economic crises have abruptly changed the national politics scene, with the impeachment process. The new government has not only strongly changed the directions and assumptions of sectoral policies[1] but also has proposed important reforms for energy sector; power sector, natural gas, oil and bioenergy reforms were proposed.

Understanding that the role of public policy and of state have been key factors to the success of these energy transitions and observing the current turbulence on Brazilian macro politics, this paper aims to explain how this bad mood of politics may affect energy transitions in Brazil. More specifically, I focus on the policy change of bioenergy field that has acquired high level of legitimacy among stakeholders and has established new instruments affecting future pathways of bioenergy transition. To achieve this goal, I borrow concepts from the theoretical frameworks of sociotechnical transitions (STT) [8] and of Multiple Streams Framework (MSF) [9,10].

STT analyses explain energy transitions by focusing on interaction of regimes and niches, sociotechnical systems with different level of structuration, under certain landscape influences which entails distinct possible pathways for energy transitions [11]. However, landscape pressures and consequent impacts on regimes and niches are an underestimate issue in STT literature [12]. This issue is critical for my analysis because the political crisis in Brazil clearly represents a landscape influence. In this way, MSF is very suitable. First, it presents the conceptual tools to explain agenda and policy changes. Second, MSF concepts also help to explain landscape influences. Beyond its main hypotheses of interaction and ripeness of problem, policy and political streams as conditions for agenda and policy change, MSF introduces the concepts of policy windows, stream couplings, policy and political entrepreneurs [13].

This paper continues discussing the main STT and MSF concepts (Section 2). Then, I presented the methods applied (Section 3) before introducing the discussion about the bioenergy case in Brazil (Section 4). The latter focuses on presenting the bioenergy transitions pathways for bioethanol, biodiesel and biogas, highlighting the role of landscape influences. Section 5 brings the discussion of the Brazilian political crisis and its influences for policy change, whereas Section 6 examines how bioenergy policy changed. Lastly, Section 7 consolidates the discussions and conclusions of the research.

[1] Even though macroeconomic policies have not change that much.

2 UNDERSTANDING THE IMPACT OF MACRO POLITICS ON ENERGY TRANSITIONS

2.1 SOCIOTECHNICAL EXPLANATION FOR TRANSITIONS

Energy transitions can be investigated by different conceptual frameworks depending on the focus of the analysis [3,14]. Sociotechnical concepts are relevant for energy transitions because they explain the emergence and diffusion of new technologies by focusing on replacing, changing or transforming of sociotechnical configurations (STC), composed of "(1) actors and social groups, (2) rules and institutions, and (3) technologies and wider socio-technical system" [12:897]. STT are explained by shifts in sociotechnical regimes/systems as consequence of interactions between three levels of structuration: niche, regime and landscape [15]. The main hypothesis is that for a change in sociotechnical system/regime to occur is necessary the interaction of novel, less structured socio-technical configurations with more established and structured ones under specific background conditions [16]. Novel sociotechnical configurations emerge in particular protected spaces (niches) so that they are nurtured by learning processes, network formation and expectations building [17]. Configurations that achieve high structuration provide coordination and guidance for actors and stability for sociotechnical systems [18]. Still these interactions of niches and regimes are influenced by factors external to these configurations – landscape conditions – i.e. conditions that influence but are not directly affected by the new or established socio-technical configurations in a nested hierarchy fashion [19].

The vast majority of studies focus on niche or regime levels and few studies have explored the specific characteristics of these landscape pressures, which is an issue constantly recognized [11,12,20]. Scholars [21] have classified landscape factors in three groups: rapid external shocks, long-term changes or slow or no changes. Geels and Schot (2007) [11] went a bit further and used the typology of environmental changes of [22], which accounts for frequency, amplitude, speed and scope. Hence, they could improve the proposition of different transition trajectories [11,16]. These trajectories or pathways, which were refined in [12] by specifying the activities and conditions for actors, technologies and institutions (see Table 1), have different roles for landscape pressures.

For substitution pathway, landscape pressures are considered either of high amplitude, scope or speed and lead to "major regime tensions" [11:410]. For transformation pathway, landscape pressures are regarded as moderate and perception and translation by regime actors are necessary to these pressures have influences. This type of influence is similar to reconfiguration pathway. Lastly, landscape pressures are crucial for de-alignment and re-alignment pathways. They are considered to be high in amplitude, scope and speed and to have fundamental impact on regime structures, they can even "pull the regime apart" [11:408]. Nevertheless, apart from these stylised descriptions, the exact influences landscape pressures have on regimes and niches still represents an important research avenue.

Table 1 – Transition pathways

Transition pathway	Landscape changes and pressures	Actors	Technologies	Rules and Institutions
Substitution	Landscape changes pressure regime creating major tensions in existent regimes	-New firms struggle against incumbent firms, leading to overthrow -Different kinds of 'new entrants' (e.g. citizens, communities, social movement actors, incumbents from different sectors) replace incumbents	Radical innovation(s) substituting existing technology	-Limited institutional change, implying that niche-innovation needs to compete in existing selection environment ('fit-and-conform') ('Incremental adjustment', 'Layering') -Creation of new rules and institutions to suit the niche-innovation ('stretch-and-transform') ('Disruption', 'Displacement')
Transformation	Moderate landscape pressures that make regime actors to frame problems and search for solutions	-Incumbents reorient incrementally by adjusting search routines and procedures -Incumbents reorient substantially, to radically new technology or, even more deeply, to new beliefs, mission, and business model	-Incremental improvement in existing technologies (leading to major performance enhancement over long time period).'' -Incorporation of symbiotic niche-innovations and add-ons (competence-adding, creative accumulation) -Reorientation towards new technologies: (a) partial reorientation (diversification) with incumbents developing both old and new technologies (b) full reorientation, leading to technical substitution	-Limited institutional change ('Layering') -Substantial change in institutions ('Conversion', 'Displacement')
Reconfiguration	Moderate landscape pressures that make regime actors to frame problems and search for solutions	New alliances between incumbents and new entrants	From initial add-ons to new combinations between new and existing technologies; knock-on effects and innovation cascades that change system architecture.	From limited institutional change ('Layering') to more substantial change, including operational principles ('Drift', 'Conversion')
De-alignment and re-alignment	Important and strong landscape changes that cause the erosion of regimes and create opportunity for several niche innovations	Incumbents collapse because of landscape pressure, creating opportunities for new entrants	Decline of old technologies creates space for several innovations which compete with one another	Institutions are disrupted by shocks and replaced, possibly after prolonged uncertainty ('Disruption')

Source: adapted from [11,12,16]

2.2 MULTIPLE STREAMS EXPLANATION OF AGENDA AND POLICY CHANGES

The policy studies literature has consistently investigated how policy changes and what is the role of actors and coalitions [23]. Recently, Kern and Rogge (2017) [24] discussed how the transition field could learn from different theories of policy change. This paper focuses on the MSF [9,10] because it provides the conceptual tools to the main goal of examining landscape influences. It also presents several similarities to the STT explanation; MSF is a process-oriented framework that assumes ambiguity, time constrains, problematic preferences and fluid participation [10]. The main hypotheses of MSF are that changes on agendas are consequence of couplings between different streams under certain conditions [9,25]. The most accepted framework defines three streams – problems, policy and politics/political – which are "relatively independent […] as having a life and dynamics of its own" [26:517]. However, recent developments [13,25,27] have highlighted the different relevance of the streams for the agenda change and for the decision-making (policy change) phases.

The problem stream refers to the conditions that are perceived as problematic situations; a current condition different from an ideal one [13]. Several situations are perceived as problematic by many different actors but only some of them get the attention of policymakers. This is explained by changes in indicators, focusing events or feedback effects [10] and by the presence of problem broker, which "is a role in which actors frame conditions as public problems and work to make policy makers accept these frames" [28:452]. Moreover, problem stream do not require strict conditions for couplings in agenda change phase because policy entrepreneurs are always intending and able to couple a solution for different problem frames [10]. Once a problem gets into the policy agenda the relevance of the problem streams decreases [25]. Therefore, problem stream is more relevant for agenda change than decision-making phase.

The policy stream introduces the solution side, i.e. it presents the policy propositions. It basically tries to explain how actors advocate for policy ideas [26,29]. These ideas are understood as part of a "primaveral soup", which comprise a large number of possible solutions that by a process of softening up are selected to policy alternatives [10]. Institutional structures, external influences affect these processes in which policy alternatives emerge [25,27]. Béland (2016) argues that ideas are important components as well. These conditions define criteria by which actors select policy alternatives, the criteria for survival. It may be technical, financial aspects, value acceptability or public acquiescence [10]. Another important concept for policy stream is the policy entrepreneur, who is responsible to give support and carry out the development of specific propositions [9]. Policy entrepreneurs that have more access to policymakers and more resources are expected to achieve higher success in promoting a specific policy alternative [25]. Therefore, policy stream is ripe for coupling and agenda changes when there is at least one viable policy alternative that fulfil the criteria for survival [13]. Similarly to the problem stream, policy stream is less relevant for decision making phase because agenda has already changed, i.e. there has been already a coupling between problem and solution [25].

The political/politics stream represents the high level politics, with the composition of government and parliament by political parties and interest groups campaigns [10]. Additionally, as it is highly difficult that a single political party or interest group have the absolute majority to take decision, coalitions are seen to have a very relevant role in this stream [31,32]. Another important concept for political stream is the national mood, which brings the broader general public opinion the equation [9]. However, national mood does not refer to the opinion of general public by itself but to the perception of policymakers on this general opinion [9,10]. Therefore, although the political stream may be considered to be ripe when there is a majority or a coalition around a specific proposal, it is the interaction (or alignment) of the national mood, interest groups and government and legislature composition that explains stream ripeness [10,25]. The political stream is the most relevant stream for decision-making phase, in which the main task is to build a majority to approve a bill [25].

The last two concepts that support the explanation of agenda and policy change are the streams' couplings and the policy windows. First agenda policy windows (agenda windows) can be opened in problem or political streams [26]. In political stream an agenda window is opened by changes in national mood or in composition of government and legislatures [13]. In problem stream, it occurs when there is a dramatic changes in key indicators or when there is a focusing event [9]. Couplings are distinct depending on the type of policy window [33]. If there is a window opening in problem stream, the coupling is called 'consequential coupling'. It represents the search for a solution for a given problem. In contrasts, a policy window in political stream leads to a 'doctrinal coupling', which is characterised by "finding a problem to a given solution" [25:27]. Other characteristic that differs is the duration of the policy windows, which tends to be shorter for windows in problem stream. It is worth to mention that couplings happen if streams are ripe, there is a policy entrepreneur and a policy window [13].

For decision-making phase, there is a reduced number of actors and institutional structures are more influential [27]. A decision policy window (or decision window) opens when agenda is changed and there is a proposal. The institutional structures define who are the eligible actors, which, in general, are elected government members and legislators. In addition, the institutional structures also define the number of veto actors, which explain to an easier or more difficult decision coupling process [25]. Here, the main role is the political entrepreneur, who is responsible to negotiate the majority for the approval of the proposal [13]. The political entrepreneur is expected to adopted either package, concession or manipulation strategies to achieve his/her goal [25]. Package strategy refers to include other proposition in the proposal to gain more support. Concession, instead, is the ability to give up some parts of the proposal. Lastly, manipulation may occur in several fashions but, in general, means to provide meanings to the issue so that it becomes more appealing.

3 ANALYTICAL FRAMEWORK AND METHODOLOGY

Having presented the concepts, this paper explores the research problem in three analytical steps. The first step aims to describe the main aspects of the bioenergy STT in Brazil as a case study. It focuses on identifying the main transition pathways (as in Table 1) and discussing the landscape pressures for bioethanol, biodiesel and biogas technologies. The second analytical step aims to introduce the context of Brazilian political crisis to examine how the crisis has established the conditions for agenda and policy changes. For this, it is necessary to interpret these conditions through the MSF lens. The third analytical step explores the dynamics of bioenergy agenda and policy change and briefly discuss the possible impacts on bioenergy transitions in Brazil. It does so by presenting the strategies of policy and political entrepreneurs and discussing selection of problems and solutions. Furthermore, it aims to investigate whether or not the conditions identified in the second analytical step were present in the process of agenda and policy change.

In order to develop the analysis stated before, I used different methods for the different analytical steps. For the first and second steps, I performed a literature review on the development of bioenergy field so that I could characterise the bioenergy STT and build up the narrative of the Brazilian crisis. It comprised mainly scientific literature but also covered news, books, technical reports, and press releases of the main actors. In contrast, for the third step, there is very little literature on the new bioenergy policy. Therefore, I applied an event history analysis, including the mapping of events, identification of sequence of events and construction of a narrative. The main data was mainly policy documents (laws, decrees, policy briefs and papers, legislative documents and public consultation documents), news (extracted from LexisNexis® database) and technical reports of key players.

4 BIOENERGY TRANSITIONS IN BRAZIL

Bioenergy in Brazil presents several technological trajectories, comprising mainly bioethanol, biodiesel, charcoal and biogas. Given the focus on the paper on the RenovaBio policy, I focus on the analysis of bioethanol, biodiesel and biogas technologies. The biokerosene, which is also addressed in the new policy, is not considered due to its very restrict character and earlier stage of development. Moreover, this section does not aim neither to detail all the discussion about these bioenergy technologies nor to presented a fully description of their transitions.

4.1 BIOETHANOL

The sugarcane agroindustry is by far the most relevant bioenergy transition in Brazil. This industry has historical roots in Brazil, being sugar an important commodity since colonial times, and first experiences with alcohol from sugarcane date from the beginning of twentieth century [34]. It is also from this period the first important landscape pressure that yielded the initial structuration of the bioethanol field. The 1929 crisis reduced the price of sugar in international markets which resulted in the first blend

(5%) of bioethanol in the gasoline [34,35]. It also indirectly resulted in the creation of IAA (Institute for sugar and alcohol) in 1933 to regulate production and trade of sugar and ethanol [34]. This creation was also consequence of a second important landscape event, the first Getúlio Vargas government (from 1930 to 1945) and the modernisation of the Brazilian economic structure. This period observed institutional changes and creation of several infrastructure companies [36]. Then, the World War II led to an increase of the bioethanol blend in gasoline to 20% (1941), consequence of shortage of imported gasoline [34,35,37]. Although the 1929 crisis were extremely relevant internationally and influenced the new government's agendas, these initial landscape pressures did not fully destabilised sugarcane regime. However, it did provide the incentive to include bioethanol technologies as add-ons to the current regime sociotechnical configurations, for complying with the quota system. However, the subsequent pressures intensified these regime reconfiguration, motivated by the increase to the blend quota, which led to considerable bioethanol production expansion. Thus, bioethanol upraised from its secondary position to be a relevant product in the industry [34].

This relevance would really increase after the oil shocks in 1970s. By this time, Brazil had become highly dependent on oil imports for its industry and transportation sectors and the automotive industry comprised important part of the industrial development [38]. Therefore, the oil shocks in 1973 and 1979 incredibly pressured Brazilian trade balance, leading the government to act against the oil dependence. Additionally, the international sugar markets faced huge drop in prices, pressuring sugarcane regime. In this scenario, the ProÁlcool I and II programmes (1975 and 1979) came up [34,38]. Initially, the main goal "was to use the existent productive structure to install annexed distilleries to existent sugar mills and to produce anhydrous ethanol to be blended with gasoline" [39:166]. This initial faced did not show any great structural change but an intensification of prior movements. This scenario changed in 1979 with the second oil shock and the agreement between the government and the automotive industry, which resisted during the first phase. The development of a dedicated ethanol engine stimulated and the incentive to hydrated ethanol were crucial for the great expansion of ethanol production during this phase [38,40]. Moreover, the main instrument used in these programmes was subsidised financing, applied to different streams of value chain. However, several other instruments were also applied, such as R&D incentives, public purchases, tax incentives for ethanol vehicles, use of Petrobras for infrastructure development [34,38]. This fact not only demonstrated that the state was the most relevant actor in this period but also evidences that there was huge money transfer for the players in sugarcane industry [34,39]. These landscape pressures clearly created major tensions in regime actors. For instance, it started to split the interest of sugarcane industrial players of São Paulo, to threaten the sustainability of automotive industry [41] and to create tension between governmental agencies [38]. Thus, the processes of reconfiguration intensified for sugarcane regime and started in transportation sector, with the introduction of ethanol cars. The outcome was a huge increase of production from around 0,6 to more than 7 million m^3 per year from 1975 to 1985 [38].

After this boom, landscape changes played out again. The drop of oil prices in 1986, the national macroeconomic crises, the re-democratisation in Brazil (1985-1988) and liberalisation process in the beginning of 1990s changed the type of pressures on regimes. The first two removed the need for replacing oil and the financial capacity of the state, i.e. the main motivation and the main instrument [39,42]. The last two completely change the institutional environment in which actors operated. The new constitution changed the centralised character of the state that was kept in dictatorship and the liberalisation intensified the interaction of private players [41]. For instance, the IAA was extinct in 1990 and other institutional players took over. Additionally, from 1986 onwards, the expansion of ethanol vehicles sales associated to the reduction of oil prices and the choice to export more sugar resulted in a shortage of ethanol supply which fuelled the distrust on the sector and questioned the effectiveness of public policies [40,41]. These landscape changes created an environment of high uncertainties among incumbents, which led to a de-alignment situation during this period.

This situation was kept until 2003, when a niche innovation was introduced, the flex-fuel vehicle (FFV) [38,43]. This innovation quickly transformed the passenger vehicle market, going from around 50,000 licensed FFV in 2003 to more than 3 million in 2012 [34]. It is important to mention that a set of background conditions enabled this quick substitution pathway. First, apart from 2008, this was a period of constant economic growth and boost of commodity prices. Second, a set of policies, mainly special financing lines and tax exemptions for FFV, were crucial to support this expansion. Therefore, moving from the de-alignment situation in the beginning of the 1990s, favourable landscape pressures and the enactment of a substitution pathway on transportation regime allowed the re-alignment of the sugarcane regime.

Nonetheless, the current situation of sugarcane regime was once more affected by landscape pressures. First, the 2008 financial crisis strongly hit the sector due to high level of financial debts consequence of the investment on production expansion [44]. Part of this expansion was directed to the ‘greenfield’ units, which are dedicated to bioethanol production, have higher efficiency and consequently may export power. Another factor was the increase of the concentration of the sector by merge and acquisitions, including by international players [34,44]. Second, the high sugar prices in international markets resulted in higher sugar production in mixed units – which produce ethanol and sugar – for exportation [34,44]. Third, the control of gasoline prices via Petrobras or tax exemption by federal government reduced the competitiveness of the bioethanol [34,44,45]. Along with those, other problems reduced the productivity of bioethanol, viz. agronomic issues (partly consequence of financial problems), the diffusion of mechanised harvest, and climate conditions [34,44]. The main consequence of these problems and unfavourable background conditions was the bankruptcy of several bioethanol plants [34,44]. Although this situation has alleviated in recent years, the sector still experiences harsh financial situation [46]. In sum, these mix of landscape and regime factors have again supported a period of tensions and de-alignment in sugarcane regime. For example other problems started to be raised, e.g. sustainability issues [47,48], power and role of elites [49] and future perspective [50].

4.2 BIODIESEL

Similarly to bioethanol, biodiesel experiments in Brazil has a long history, mainly as consequence of local vegetable oils production and shortage of diesel imports due external factors as during the two World wars [51]. As discussed before, the oil shocks caused the need to replace oil fuels, diesel included, and several measures were taken. Biodiesel was also contemplated in 1980 with two programmes one focuses on production and another on R&D, but the programmes were discontinued when the oil prices dropped in 1986 [38,51]. Although this period had the engagement of incumbents, such as governmental bodies and multinational companies, it was not sufficient to structure the field. Thus, the external shocks were definitive for the beginning and the end of this phase. One cannot classify these experiments as transition trajectories because not there was no significant change in regimes

The second phase, which led to the development of biodiesel field in Brazil, started with series of studies under the supervision of the Ministry of Science and Technology, resulting in the Probiodiesel programme in October 2002 [38,51]. The new government, in 2003, took over the programme and between September and December of 2004 the bases of the new PNPB (National Biodiesel Programme) were established. The role of the presidency was crucial for programme implementation. The type of legal instrument was strategically selected – provisory measure from the presidency – to facilitate approval in congress [38]. In other words, the president took over the role of political entrepreneur to enact this policy. First, similar to bioethanol, it was defined blend quotas of biodiesel into diesel. The quotas would be revised several times to get progressive increase. Second, financial support was created along with the national development bank (BNDES). Third, the social label was also created. The initial goal of the social label aimed to promote social inclusion and reginal development in the biodiesel supply chain, by promoting purchases of raw material from family farmers in the North or Northeast regions. It also aimed to avoid the concentration of the biodiesel industry in developed regions as occurred with bioethanol and its concentration in São Paulo. The label also gives advantages for funding and for participating the national purchase auctions. The auctions are another important instrument. Initially the auctions aimed to guarantee the market and define the prices.

These several instruments resulted in the expansion of biodiesel production and use and structuration of biodiesel field. The external factor for biodiesel transition movement was the important role of the presidency as political entrepreneur. The implementation of the policy pressured the diesel and agricultural (vegetable and animal oil) regimes, which made actors to incorporate biodiesel technologies – a reconfiguration pathway. However, incumbents used the regime structures to conform these new technologies in the current regime practices [42,52]. Therefore, it is not a surprise that the biodiesel production is based basically on soybean oil and beef tallow, around 80% and 20% respectively.

It also helps to understand the reasons that the policy could not achieve higher effectiveness in avoiding regional concentration and social inclusion[2].

4.3 BIOGAS

Biogas technological field is the less structured among the three analysed. Similarly to bioethanol and biodiesel, biogas experiments lie upon agricultural regimes, more specifically the livestock regime. However, given the higher flexibility of feedstock for producing and using biogas, biogas technologies also interacts with other sectors, such as sanitation, waste management and natural gas. It has also experiments before the 1970s, but studies regard the inauguration of the *Granja do Torto* biodigester (1979) as the initial event of the development of the field. However, similarly to biodiesel and distinctly from bioethanol, prior experiments did not entail important structures. A national programme was established in 1980, the national biodigester programme, which came out also as consequence of the oil shocks and the pressing problems of rural and urban sanitation and was influenced by the expansion of biodigester use in China and India [53]. Although there was some success of biogas experiments, they were very restricted, did not resulted in further institutionalisation and could not scale up or replicate solutions. Subsequently, the changes in landscape conditions from the middle of 1980s onwards – as for bioethanol and biodiesel – closed the window of opportunity of biogas technologies, which were in ostracism until the end of the 1990s. Thus, these activities of biogas technologies did not represent a transition pathway. They are more niche experiments that did not undergo sufficient learning, network formation and legitimation.

The biogas technologies became salient once more because another important landscape change. The background condition of increasing pressure of sanitation problems was always there but the Kyoto Protocol (1998) and the possibility to develop projects under the Clean Development Mechanism (CDM) provided the necessary conditions to align problems and solutions [53]. The landfill projects with biogas recovery and swine manure treatment projects that applied biodigester became two of the most popular types of projects under the CDM scheme [54]. However, changes in CDM rules in 2007 for swine manure projects and the 2008 financial crisis – two other landscape changes – affected the feasibility of swine manure CDM projects and reduced the price of carbon [53]. Of course, other problems such as the lack of capabilities for designing and operating biogas projects played out important role. Although these problems had a negative impact, actors continued to promote specific experiments. This fact led to the enactment of state-level policies in 2012, important R&D call by ANEEL[3] also in 2012 and a national programme in 2013 (PROBiogás). These measures had a positive impact on the biogas agenda and it was observed more structuration. Two industry associations, one research centre and one formal research network were created during this period. However, once more macro changes posed

[2] Technological factors were also important, such as the assumption of the expansion of use of castor oil for biodiesel production in Northeast region [51].
[3] Power sector regulatory agency

important challenges. The current economic and political crises affected the investment capacity of states and private actors, which along important problems of an emerging technological field must be addressed. Therefore, biogas experiments still have a long way to achieve the same level of institutionalisation of bioethanol and biodiesel.

5 BRAZILIAN CRISIS AND THE BIOENERGY POLICY CHANGE

The political crisis in Brazil may be discussed through a historical perspective in which would necessary go back further in history. However, the approach presented here focuses on a specific sequence of events that starts with a series of protests in June of 2013. By the time I write this paper, there is still no consensus about the causes and solutions of current crises that despoils Brazilian society and I think this debate will endure for long time. Superficially speaking, there are two main streams of interpretation: one focuses on the fight against corruption and sustains that institutions are working properly; another states that institutional framework has been captured by coalitions that want to impose their interests being one of them the impeachment of president Dilma Rousseff, which is therefore considered a new type of coup-d'état. I follow the latter to present the sequence of events and description of the crisis (Section 5.1) to then interpret them using MSF concepts (Section 5.2). As last remarks, the narrative presented below by no means aims to introduce a complete picture of the crisis and the sequence of events is hugely based on [55].

5.1 BRAZIL IN CRISIS

In June of 2013, the initial protests concentrated on municipal and state-level issues, basically protesting for higher quality in basic services and infrastructures. However, the broadening of these protests brought different complaints, agendas and people for the game. This multiform protests allowed the capture – or the framing [56] – of these agendas. By the end of the year, corruption and the federal government emerged as main targets, and groups that would become important players in supporting protests against the government were consolidated.

This atmosphere continued throughout the electoral campaigns in 2014. After aggressive campaigns from both sides, the current government, which party (PT) was in power since 2003, was re-elected. Two important remarks have to be made. First, this election resulted in the fourth straight loss for the PSDB party. Second, the PT's programme aimed to continue the 'neo-developmentist' agenda [57,58] . The elections also brought an extremely conservative congress, indicating the hurdles to proceed with this programme. This fact became pivotal because of the structure of Brazilian political system which is composed by several political parties and implies huge effort to build coalitions to govern. The heated mood of the electoral campaigns was not reduced after election. For instance, just four days after the results the opposition party (PSDB) asked for an official votes recounting, claiming the very close outcome [55]. However, it can also be interpreted as way to delegitimate the results and winners. This

strategy of attacking the legitimacy of the government continued and already in the earlier months of the government, in 2015, the possibility of impeachment was raised.

This adverse atmosphere for the government was also nurtured by two other important sequence of events. First, the development of the '*Lava Jato*' operation, led by the Federal Police, the Federal Prosecution Service and the Federal Justice in Curitiba, Paraná state. The operation that started in 2014 before the elections and aimed to dig into the corruption schemes in the projects of *Petrobrás* (the national oil company) revealed to be an important element in producing the background conditions for political actions. Among the benefits and success of this operation, the most celebrated was the fact of arresting high-level politicians and businessmen. However, it supplied the media with critical information in critical moments and in general via controversial (if not illegal) information leakage[4]. The macroeconomic policies and worsening of economic crisis were the second factors that fuelled the political crisis. The international scene influenced the Brazilian macroeconomic environment during this period mainly due to the drop of oil prices and European debt crisis. Oil sector comprised an important share of public investment and faced a huge retraction by the end of 2014 and beginning of 2016. Another factor was the decision for a minister of economy and finance that supported austerity measures, just after the election, in 2014. This controversial choice aimed at increasing the support of the government by important players in financial markets [55]. However, it was not well received by several supporters of the government and created internal noise within the PT, in the negotiation with congress and was used by the opposition [55]. Meanwhile, the austerity measures proved to be inefficient to alleviate the economic crisis.

In the political dimension, in 2015 crucial events were the election of an important adversary for the government of the lower house in congress and first the dissatisfaction and later rebellion (not to say conspiracy) of the vice president. The coalition that elected the president Rousseff in 2014 was led by the two biggest political parties in Brazil, the PT – the party of the president – and PMDB – the party of the vice president and of the elected president of the lower house. The PMDB is a heterogenous conservative party and it has been the party that guarantees the governability since the re-democratisation [59]. The president of the lower house, who was charged by the federal prosecution office and accused of several cases of corruption, started the bargain to save his mandate. In the bargain game the acceptance of the impeachment of the president Dilma Rousseff was his leverage. The possibility of impeachment was raised earlier in 2015 by the opposition party and reverberated in the media and among the movements that led protest against the government [55]. The acceptance of the impeachment process in the lower house occurred in the same day that PT's congressmen voted against the case of the president of the lower house, in the ethical committee in December of 2015. Meanwhile, the relationship between the vice president and the government was deteriorating, even with the indication of the vice president for political coordination, given government's lack of ability for (or style of)

[4] The most emblematic illustration was the coordinated disclose of the phone tapping recordings between the President Dilma Rousseff and the ex-president Lula da Silva just before his nomination as minister [55].

political coordination in the congress [55]. For instance, important illustrative events are his statement in a trade association and a letter complaining about his relevance in the government. Moreover, meetings with opposition members called the government's attention for his practices. The interpretation was that he was forming a coalition around his name for a government after the impeachment. The publication of PMDB's new party programme entitled *'ponte para o futuro'* (bridge to the future), in October of 2015, was a decisive event for this interpretation. The most significant aspect of the programme was its directions of economic policies. It was aligned to the programme of PSDB, which lost the election in 2014, and went back to the neoliberal agenda of the Washington consensus.

The convergence of these different fronts of the crisis led to the consolidation of important coalitions supported by different interest groups. First, a political majority was built in congress giving support for the promoted agendas in the PMDB's programme. With several betrayals to the coalition formed in the election of 2014, the impeachment process passed through both congress houses easily[5]. The alleged crime for impeachment process was a series of accounting manoeuvres, used by all the presidents before, denied by the criminal investigation later[6] and legalised by the congress few months after the impeachment[7]. This is one of the main reasons to classify this process as a coup-d'état. Second, this political coalition was supported by several interest groups which also converged around the idea of evicting the government. Following Souza's (2015) analysis, this interests groups have a hierarchy, which is led by the financial elites, and operationalised by controlling the media discourse in combination with the capture of judicial and police institutions. These points are aligned to what scholars have been discussing on the central role of judicial system in weakened democracies [60,61] and to the discussion on authoritarian neoliberalism [62]. After the impeachment, in April and May of 2016, the new government with a majority in the congress and support of strong these interest groups, led by the vice president, started to propose and implement reforms in several areas, including the energy sectors.

5.2 Brazilian crisis and its impacts for Policy Change

- ***Opening and timeframe of agenda windows and type of coupling***

Opening of policy windows is the most obvious consequence of this crisis. The new government with personnel and a new set of proposed agendas created the opportunity for the selection of problems and solutions. Several agenda windows were opened across several policy subsystems. In addition, the hypothesis that policy windows have a certain timeframe also holds for Brazilian case, mainly because of three factors. First, the most obvious is the elections in 2018. Second, after the removal of the last government the dispute for allocation of benefits is intensified, which may reduce the convergence of several interest group and support for political coalitions in congress. Lastly, changes in national mood, mainly due to reaction and reorganisation of defeated group of the group, may also lead to divergence in

[5] It was required at least two thirds for its acceptance, a constitutional requirement.
[6] https://brasil.elpais.com/brasil/2016/06/28/politica/1467141285_004935.html
[7] http://www.jb.com.br/pais/noticias/2016/09/02/apos-impeachment-senado-transforma-pedaladas-fiscais-em-lei/

interest groups and political support for the new government. Furthermore, agenda windows opened in political stream, as the case of Brazilian crisis, leads to doctrinal couplings in which solutions chase problems. It also suggests policy stream has higher relevance than problem stream.

- ***RIPENESS OF POLICY AND PROBLEM STREAMS FOR AGENDA CHANGE***

For problems and policy proposals, it becomes clear that they have to adhere to the new agendas promoted by the new government and supportive coalitions. In this environment, the critical criteria for survival of a proposal is value acceptability. Although technical and financial aspects continue to be essential for policy formulation, if the solution is not aligned with the basic ideational aspects of the new agendas, it seems very unlikely to continue forward. This fact combined with the doctrinal coupling hypothesis defines the conditions for policy entrepreneurs. Put simply, the strategy of policy entrepreneurs has to be able to frame solutions as expansion of private actors and markets and misallocation of resources. For problems, as briefly discussed in Section 4, as bioenergy stakeholders have been emphasizing different types of problems, it expected the selection of problems which have a better fit with the pre-defined solutions.

- ***POLITICAL STREAM AND DECISION MAKING***

In decision making phase, as the political coalition has a major control, it is not expected that proposed bill faces many hurdles for approval. The coalitions formed to sustain the new government have converged around the proposed programme, which facilitates the decision-making process after the establishment of new agendas. This is aligned to the MSF hypothesis that if the agenda was established in line with veto players and supported by the leading coalition, policy change is likely to occur [13,25]. However, if the proposed policy touches upon a sensitive topic area for the opposition and they are able to organise a strong narrative around the proposal, it is likely to occur delays and to require more effort of political entrepreneurs. For instance, this was what occurred for the proposal of pension reform.

6 RENOVABIO POLICY PROCESS

The RenovaBio took around a year from the initial discussions and proposals to its approval in congress. By the end of 2016, the Ministry of Mines and Energy (MME) opened the discussions with bioenergy stakeholders to develop a new policy or plan for the field. Meanwhile, as a result of the Ministry of Foreign Affairs negotiations after the COP 21, the launching of the Biofuture platform in COP 22 led the two ministries to discuss common actions. The formalisation of the new RenovaBio proposition occurred during a workshop in December of 2016 in MME. At the same day, bioenergy players met the President. After this initial workshop, there were a series of meetings with stakeholders until the public consultation of the proposal in February of 2017. Subsequently the proposal was consolidated in August, the law project presented in congress (lower house) in November and approved in upper house in December.

The initial discussions promoted by the MME aimed to increase the participation and to bring to the ministry the contribution of different stakeholders. At that time, end of 2016 to February of 2017, and through a series of meetings and workshops, the MME has opened the agenda window collecting the initial contributions for a new sectoral action plan. The available documents of these workshops show a great variety of problems and solutions across different bioenergy technologies. After this initial phase, the first consolidation of the proposal was published in a public consultation in February of 2017. It brought to the general public four strategic axis – the role of biofuels in energy matrix, economic and financial balance, commercialisation and new biofuels – with key questions to be answered and guidelines to steer the contributions. This illustrates one of the first steps of the "softening up" process. The outcome of this public consultation were 32 contributions from companies, individuals, other ministries, but mainly from industrial associations and unions. With all these contributions, it started the process of defining the main problems and solutions.

This process was led by the MME, however other institutional players such as the ANP and the EPE were relevant as well. During this period, which lasted until August, the interactions with stakeholders decreased but the ministry kept an agenda of dialogues. The outcome of this process of selection of ideas and problems led to the publication of the detailed proposal of the RenovaBio in the end of August of 2017. The proposal specified, in a 138 pages document[8], the problems, solutions, justifications and impacts of the implementation and non-implementation of the policy. The chosen solution was a "cap and trade" system, in which will be defined GHG emissions reduction targets for the fuel distribution sector and biofuel producers will sell certificates of mitigation (CBIO) according to certified life cycle analysis. In the proposal document, the experiences of Renewable Fuel Standard (RFS), in United States, and Low Carbon Fuel Standard (LCFS), in California, are mentioned as examples and discussed in its strengths and weaknesses. The document also brings other alternative solutions, basically tax, subsides and quotas, which are discussed focusing on the negative aspects. It not only reinforced the argument for market-based instruments but also might give some leverage for the political entrepreneur during the decision-making negotiations.

During this process, the institutional position of MME[9] was crucial for its leadership in this process. Since the beginning MME played out as policy entrepreneur. The initial discussions were conducted presenting the main values, goals and guidelines of the future policy. These goals, values and guidelines represented the strategy of the MME, which can have comprised three main points. First, given the simultaneous development of the Biofuture platform by the Ministry of Foreign Affairs, MME tagged the biofuel issues to the climate change issues. This aimed to achieve higher legitimacy and to produce a positive agenda for the government[10]. Second, the ministry focused on promoting extensive participation of stakeholders, mainly via industrial associations. This practice met important criticism made to previous

8 http://www.mme.gov.br/web/guest/secretarias/petroleo-gas-natural-e-combustiveis-renovaveis/programas/renovabio/documentos/apresentacoes/renovabio-detalhamento-da-proposta-25/08/2017
9 According to the Brazilian institutional framework, the ministry is in charge of design and execute energy policies.
10 Fact mentioned by the biofuels director of MME in an interview (Estado de São Paulo, 17/12/2016)

government, who was criticised by not providing enough room for dialogue. As the minister said in a UNICA forum[11], MME wanted to "release the dialogue". Third, since the very beginning, MME representatives reinforced the idea of reducing state intervention and improve market efficiency. For instance, in the same forum the ministry said: "the country needs the contributions of the private sector, because the government cannot and should not want to restrain or to measure any type of gain of private sector". This was aligned not only with the agenda of the new government as discussion in previous section but also to criticisms of bioenergy stakeholders about the intervention in gasoline prices and about the operationalisation of biodiesel social label.

Another important actor was the UNICA, the Brazilian sugarcane industry association. Since the very beginning UNICA proposed and backed the chosen solution. During the first discussions of RenovaBio, 13/12/2016, UNICA has proposed a solution based on the RFS. In this sense, although the policy entrepreneur role was taken by the MME, due institutional power, the initial idea came from UNICA. This is relevant because UNICA is an important incumbent in sugarcane regime, representing 50% of Brazilian bioethanol production. The association has also played to facilitate the decision making before the disclosure of the proposal in August. For instance, in June, the association had a meeting with several parliamentarians to discuss the RenovaBio, building support in congress before the formalisation of policy proposal.

After the RenovaBio proposal, different strategies were discussed including the discussion of most suitable political entrepreneur. Initially, the idea was to use the same strategy of the PNPB (Section 4.2), with the president publishing a provisory measure. However, as the government had already sent several of these measures, the negotiation with the congress would be difficult[12]. Therefore, the strategy was to send the bill to the congress via a congressman linked to the biofuel discussions (leader of the biodiesel parliamentary front). The bill was presented in congress (lower house) at 14/11/2017, approved and sent to upper house at 30/11, approved and sent to the presidency at 12/12 and sanctioned by the president at 27/12. Although the process was easy, it was necessary to make some concessions. The concessions were some veto in the lower house and by the president[13], which basically removed the definition of targets of future blend quotas and market share for biofuels. In words, it reduced market intervention.

7 DISCUSSIONS AND CONCLUSIONS

The new bioenergy policy achieved high legitimacy being supported by a great number of players. It is also a very interesting proposition for a "cap and trade" system in Brazil, which is extremely aligned with other initiatives, mainly the climate change policies. The policy was carefully designed via intense collaboration of governmental and private sector actors, addressing an important demand of bioenergy

[11] Forum about the future of energy sector and renewable energy (28/11/2016).
[12] For instance, the government published provisory measure about the controversial labour reform. As there is an order to congress address these measures, it could be a risky strategy.
[13] In the upper house, the process was led by a senator linked to the agribusiness groups and the evaluation in the internal commission of economic affairs was coordinated by the father of the ministry of MME.

players. Moreover, it aims to remove some market inefficiencies that resulted from the intervention on fuels markets. However, the future impacts might not be so positive as have been sold by most of the stakeholders.

The choice for a market instrument tend to underestimate problems other than market failures. An important example for Brazilian case is the problem of logistic infrastructure. Additionally, the current policy instruments enacted aims to reallocate of financial resources from the fossil fuel distribution players to biofuels players. Such mechanism seems more suitable for addressing financial problems as the bioethanol sector is facing in the recent years. However, not addressing other problems may also hinder positive impacts and may lead player to question the effectiveness of the policy, as it happened before for bioenergy policies. At last, the policy was sponsored as a way to promoted efficiency in the bioenergy sector by promoting competition among the different biofuels. This is not necessarily true because biofuels may have different markets and, mainly, have different level of institutionalisation and structuration of their value chain.

Thus, by presenting how the macro situation of the Brazilian political crisis set the conditions for the promotion, selection and implementation of RenovaBio policy, favouring market instruments, this research indicates a way to evaluate landscape pressures on regimes and niches. More specifically, beyond of the generic discussion of windows of opportunity in STT, the MSF framework allowed to qualify the type of policy window and the probable behaviour of actors. Still, the concepts of criteria for survival of policy ideas, different types of couplings and policy entrepreneur helped to examine how regime actors played out to promote and select policy proposals. Although other type of windows of opportunity may occur in STT leading to other type of behaviours, given the relevance of policies and states in sustainability transitions, this way of exploring landscape to explore landscape factors seems to be a pertinent research avenue for STT.

8 ACKNOWLEDGMENT

The researcher is supported by the CNPq (Brazilian Research Council) under the Science without Borders programme.

9 REFERENCES

[1] Fouquet R. Historical energy transitions: Speed, prices and system transformation. Energy Res Soc Sci 2016;22:7–12. doi:10.1016/j.erss.2016.08.014.

[2] Grubler A. Energy transitions research: Insights and cautionary tales. Energy Policy 2012;50:8–16. doi:10.1016/j.enpol.2012.02.070.

[3] Sovacool BK. How long will it take? Conceptualizing the temporal dynamics of energy transitions. Energy Res Soc Sci 2016;13:202–15. doi:10.1016/j.erss.2015.12.020.

[4] Power M, Newell P, Baker L, Bulkeley H, Kirshner J, Smith A. The political economy of energy transitions in Mozambique and South Africa: The role of the Rising Powers. Energy Res Soc Sci 2016;17:10–9. doi:10.1016/j.erss.2016.03.007.

[5] Cherp A, Vinichenko V, Jewell J, Suzuki M, Antal M. Comparing electricity transitions: A historical analysis of nuclear, wind and solar power in Germany and Japan. Energy Policy 2016;101:612–28. doi:10.1016/j.enpol.2016.10.044.

[6] Coenen L, Raven R, Verbong G. Local niche experimentation in energy transitions: A theoretical and empirical exploration of proximity advantages and disadvantages. Technol Soc 2010;32:295–302. doi:10.1016/j.techsoc.2010.10.006.

[7] IEA. World Energy Outlook 2013. Paris: OECD/IEA; 2013.

[8] Geels FW, Sovacool BK, Schwanen T, Sorrell S. The Socio-Technical Dynamics of Low-Carbon Transitions. Joule 2017;1:463–79. doi:10.1016/j.joule.2017.09.018.

[9] Kingdon JW. Agendas, alternatives, and public policies. Essex: Pearson; 2014.

[10] Herweg N, Zahariadis N, Zohlnhöfer R. The Multiple Streams Framework: Foundations, Refinements and Empirical Applications. In: Weible CM, Sabatier PA, editors. Theor. Policy Process. Fourth Edi, New York: Westview Press; 2017, p. 17–54.

[11] Geels FW, Schot J. Typology of sociotechnical transition pathways. Res Policy 2007;36:399–417. doi:10.1016/j.respol.2007.01.003.

[12] Geels FW, Kern F, Fuchs G, Hinderer N, Kungl G, Mylan J, et al. The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). Res Policy 2016;45:896–913. doi:10.1016/j.respol.2016.01.015.

[13] Herweg N, Huß C, Zohlnhöfer R. Straightening the three streams: Theorising extensions of the multiple streams framework. Eur J Polit Res 2015;54:435–49. doi:10.1111/1475-6765.12089.

[14] Sovacool BK, Hess DJ. Ordering theories: Typologies and conceptual frameworks for sociotechnical change. Soc Stud Sci 2017:1–48. doi:10.1177/0306312717709363.

[15] Raven RPJM, Geels FW. Socio-cognitive evolution in niche development: Comparative analysis of biogas development in Denmark and the Netherlands (1973–2004). Technovation 2010;30:87–99. doi:10.1016/j.technovation.2009.08.006.

[16] Geels FW, Schot J. The Dynamics of Transitions - A Socio-Technical Perspective. Transitions to Sustain. Dev. New Dir. Study Long Term Transform. Chang., Routledge; 2010.

[17] Smith A, Raven R. What is protective space? Reconsidering niches in transitions to sustainability. Res Policy 2012;41:1025–36. doi:10.1016/j.respol.2011.12.012.

[18] Fuenfschilling L, Truffer B. The structuration of socio-technical regimes—Conceptual foundations from institutional theory. Res Policy 2014;43:772–91. doi:10.1016/j.respol.2013.10.010.

[19] Geels FW. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. Technol Forecast Soc Change 2005;72:681–96. doi:10.1016/j.techfore.2004.08.014.

[20] Geels FW. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study 2002;31:1257–74. doi:10.1016/S0048-7333(02)00062-8.

[21] van Driel H, Schot J. Radical Innovation as a Multilevel Process: Introducing Floating Grain Elevators in the Port of Rotterdam. Technol Cult 2005;46:51–76.

[22] Suarez FF, Oliva R. Environmental change and organizational transformation. Ind Corp Chang 2005;14:1017–41. doi:10.1093/icc/dth078.

[23] Weible CM, Sabatier PA. Theories of the Policy Process. Fourth Edi. New York: Westview Press; 2017.

[24] Kern F, Rogge KS. Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey. Environ Innov Soc Transitions 2017. doi:10.1016/j.eist.2017.11.001.

[25] Herweg N. European Union Policy-Making - The Regulatory Shift in Natural Gas Market Policy. Palgrave Macmillan; 2017. doi:10.1007/978-3-319-49400-5.

[26] Zahariadis N. Ambiguity and choice in European public policy. J Eur Public Policy 2008;15:514–30. doi:10.1080/13501760801996717.

[27] Zohlnhöfer R, Herweg N, Huß C. Bringing Formal Political Institutions into the Multiple Streams Framework: An

Analytical Proposal for Comparative Policy Analysis Bringing Formal Political Institutions into the Multiple Streams Framework: An Analytical Proposal for Comparative Policy Analysis. J Comp Policy Anal Res Pract 2016;18:243–56. doi:10.1080/13876988.2015.1095428.

[28] Knaggård Å. The Multiple Streams Framework and the problem broker. Eur J Polit Res 2015;54:450–65. doi:10.1111/1475-6765.12097.

[29] Blum S. The Multiple-Streams Framework and Knowledge Utilization: Argumentative Couplings of Problem, Policy, and Politics Issues. Eur Policy Anal 2017. doi:10.1002/EPA2.1029.

[30] Béland D. Kingdon Reconsidered: Ideas, Interests and Institutions in Comparative Policy Analysis. J Comp Policy Anal Res Pract 2016;18:228–42.

[31] Zohlnhöfer R. Putting Together the Pieces of the Puzzle: Explaining German Labor Market Reforms with a Modified Multiple-Streams Approach. Policy Stud J 2016;44:83–107. doi:10.1111/psj.12135.

[32] Béland D, Howlett M, Mukherjee I. Instrument constituencies and public policymaking: an introduction. Policy Soc 2017.

[33] Zahariadis N. Ambiguity and Choice in Public Policy: Political Decision Making in Modern Democracies. Georgetown University Press; 2003.

[34] Moraes ML de, Bacchi MRP. Etanol: do início às fases atuais de produção. Rev Política Agrícola 2015;23:5–22.

[35] Andersen AD. A functions approach to innovation system building in the South: the pre-Proálcool evolution of the sugarcane and biofuel sector in Brazil. Innov Dev 2015;5:1–21. doi:10.1080/2157930X.2014.996855.

[36] Pandolfi DC. Repensando o Estado Novo. Rio de Janeiro: Fundação Getúlio Vargas; 1999.

[37] Szmrecsányi T, Moreira EP. O Desenvolvimento da Agroindústria Canavieira do Brasil desde a Segunda Guerra Mundial*. Estud Avançados 1991;11:57–99.

[38] Giersdorf J. Politics and Economics of Ethanol and Biodiesel Production and Consumption in Brazil. Freien Universität Berlin, 2012.

[39] Rosillo-Calle F, Cortez LAB. TOWARDS PROALCOOL II - A REVIEW OF THE BRAZILIAN BIOETHANOL PROGRAMME. Biomass and Bioenergy 1998;14:115–24.

[40] Furtado AT, Scandiffio MIG, Cortez LAB. The Brazilian sugarcane innovation system. Energy Policy 2011;39:156–66. doi:10.1016/j.enpol.2010.09.023.

[41] De Mello FO, Paulillo LF. METAMORFOSES DA REDE DE PODER SUCROALCOOLEIRA PAULISTA E DESAFIOS DA AUTOGESTÃO SETORIAL. Agric 2005;52:41–62.

[42] Kohlhepp G. Análise da situação da produção de etanol e biodiesel no Brasil. Estud Avançados 2010;24:223–53. doi:10.1590/S0103-40142010000100017.

[43] Hira A, Guilherme De Oliveira L. No substitute for oil? How Brazil developed its ethanol industry. Energy Policy 2009;37:2450–6. doi:10.1016/j.enpol.2009.02.037.

[44] Milanez AY, Nyko D, Luiz J, Garcia F, Luiz B, Ferreira S, et al. O déficit de produção de etanol no Brasil entre 2012 e 2015: determinantes, consequências e sugestões de política. BNDES Setorial 2012;35:277–302.

[45] Cavalcanti M, Szklo A, Machado G. Do ethanol prices in Brazil follow Brent price and international gasoline price parity? Renew Energy 2012;43:423–33. doi:10.1016/j.renene.2011.11.034.

[46] MME/EPE. Plano Decenal de Expansão de Energia 2026. Brasília: 2017.

[47] Goldemberg J, Coelho ST, Guardabassi P. The sustainability of ethanol production from sugarcane. Energy Policy 2008;36:2086–97. doi:10.1016/j.enpol.2008.02.028.

[48] De Oliveira Bordonal R, Luís J, Carvalho N, Lal R, Barretto De Figueiredo E, Gonçalves De Oliveira B, et al. Sustainability of sugarcane production in Brazil. A review. Agron Sustain Dev 2018;38. doi:10.1007/s13593-018-0490-x.

[49] Lehtonen M. Social sustainability of the Brazilian bioethanol: Power relations in a centre-periphery perspective. Biomass and Bioenergy 2011;35:2425–34. doi:10.1016/j.biombioe.2009.05.027.

[50] Salles-Filho SLM, Castro PFD De, Bin A, Edquist C, Ferro AFP, Corder S. Perspectives for the Brazilian bioethanol

sector: The innovation driver. Energy Policy 2017;108:70–7. doi:10.1016/j.enpol.2017.05.037.

[51] Rico JAP, Sauer IL. A review of Brazilian biodiesel experiences. Renew Sustain Energy Rev 2015;45:513–29. doi:10.1016/j.rser.2015.01.028.

[52] Stattman SL, Hospes O, Mol APJ. Governing biofuels in Brazil: A comparison of ethanol and biodiesel policies. Energy Policy 2013;61:22–30. doi:10.1016/j.enpol.2013.06.005.

[53] De Oliveira LGS, Negro SO. Endogenous and Exogenous Influences on the Evolution of Brazilian Biogas Innovation System n.d.

[54] Dechezleprêtre A, Glachant M, Mé Niè Re Y. Technology transfer by CDM projects: A comparison of Brazil, China, India and Mexico. Energy Policy 2009;37:703–11. doi:10.1016/j.enpol.2008.10.007.

[55] Almeida R de. À sombra do poder : bastidores da crise que derrubou Dilma Rousseff. LeYa; 2016.

[56] Souza J. A radiografia do golpe : entenda como e por que você foi enganado. LeYa; 2016.

[57] BRESSER-PEREIRA LC. The two forms of capitalism: developmentalism and economic liberalism. Brazilian J Polit Econ 2017;37:680–703. doi:10.1590/0101-31572017v37n04a02.

[58] Morais L, Saad-Filho A. Neo-Developmentalism and the Challenges of Economic Policy-Making under Dilma Rousseff. Crit Sociol 2012;38:789–98. doi:10.1177/0896920512441635.

[59] Nobre M. Imobilismo em movimento : da abertura democrática ao governo Dilma. Companhia das Letras; 2013.

[60] Serrano PEAP. Autoritarismo e golpes na América Latina: breve ensaio sobre jurisdição e exceção. Alameda; 2016.

[61] Valim R. Estado De Exceção: A FORMA JURÍDICA DO NEOLIBERALISMO. CONTRACORRENTE; 2017.

[62] Bruff I. The Rise of Authoritarian Neoliberalism. Rethink Marx 2014;26:113–29. doi:10.1080/08935696.2013.843250.