Energy Policy, Social Exclusion & Sustainable Development: The Biofuels and Oil & Gas Cases in Brazil

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Abstract

Recent Brazilian policies have encouraged impoverished communities to participate in the country's growing energy industry. This paper explores the country's attempts to encourage such participation within the oil & gas and biofuels sectors. Our research is based on interviews with industry executives, policymakers, non-governmental organizations and farmers conducted between 2005-2009 in Brazil, an emerging energy leader, yet a country grappling with social exclusion. We present three cases, exploring the evolution of sustainable energy and social inclusion policies. In the oil & gas sector, government policies towards technological accumulation have allowed Brazil to emerge as a global leader in deep and ultra deep oil & gas development, but they have not provided opportunities for impoverished communities. For fuel ethanol, economic efficiencies have encouraged capital intensive, concentrated production, where only temporary, low paying jobs are available for impoverished farmers. The biodiesel sector is being shaped by social inclusion policies, yet take-up within impoverished communities remains weak due to a lack of trust and basic education. We propose that some sectors have a propensity to be exclusive due to technological complexity, whereas other sectors, although less complex, tend to economize at the expense of social programs. We conclude with managerial and policy implications.

Keywords: Brazilian biofuels, Oil & gas sector, Social exclusion, Sustainable development

1. Introduction

In 2006, President Luiz Inácio 'Lula' da Silva announced that Brazil was "*the owner of their own nose*" a colloquialism to describe the nation's achievement of energy self-sufficiency (*Folha Online,* 2006). The path to self-sufficiency involved the evolution of three main sectors spanning over 30 years: large-scale hydroelectricity, deep and ultra-deep offshore oil & gas and biofuels (Silvestre and Dalcol, 2007). The focus of this paper is on the latter two for automotive fuels. We discuss how these sectors evolved, and specifically how economic, environmental and social parameters shaped their development. Nelson and Winter (1982) suggest that technological development solves some problems but also creates negative externalities that must also be addressed. We discuss how these dynamics shaped the policies and direction of automotive fuels, leading to energy self-sufficiency but also creating a series of environmental and social externalities that are now being addressed.

One particularly difficult externality in Brazil concerns 'social exclusion', the denial of equal access to opportunities of certain groups of society (Behrman et al., 2003; Buvinic et al., 2004; Commins, 1993). According to (Hall et al, 2008), the modernization of the Brazilian economy led to greater economic efficiencies, but also led to wider social exclusion problems such as increased crime and corruption. Eradicating social exclusion has since become a major mandate of the Lula government, and there have been recent policies encouraging participation of impoverished communities within the energy industry. For example, up until recently, Brazilian biofuels have been dominated by sophisticated and large-scale actors, with only very low paying 'poverty employment' (Mazza, 2004) under harsh working environments for socially excluded populations (Hira and Oliveira. 2009, Hall et al, 2009).

Brazil's oil & gas sector, particularly deep and ultra deep offshore production pioneered by the national oil company *Petroleo Brasileiro SA* (Petrobras), has become one of the world's leading centres and has freed Brazil from foreign oil dependency (Silverstre and Dalcol, 2009). However, the oil & gas sector is widely known by its social exclusivity (Neto, 2006), due to specialized competencies required to find, exploit and distribute oil & gas safely and efficiently. Conversely, the sector has also been scrutinized as being a 'curse of oil', where profits from resource exploitation have led to unbalanced distribution of wealth or have been misallocated through corruption, generating major problems such as environmental degradation, social exclusion and civil war (Economist, 2005; Gettleman, 2006; Humphries et al, 2007). In Brazil and abroad, Petrobras is seen as a sustainability leader and model for corporate social responsibility (Magrini and Lins, 2007), but the company has been facing growing government pressure to spread the benefits of Brazilian resource revenues towards impoverished communities (Gabrielli de Azevedo, 2009).

In contrast to oil & gas, biofuels have been recognized as more sustainable due to the potential to be renewable with lower CO2 and other emissions (Zarrilli, 2006; Goldemberg et al (2008); D'Agosto and Ribeiro, 2009; Laser *et al.*, 2009). Biofuels have also been identified as a potential source of employment for subsistence farmers in Brazil, one of the world's leading agricultural producers (Reid, 2007). Paradoxically, biofuels have also been criticized for creating the so-called 'food for fuel crisis', where demand for biofuels may increase prices for commodities such as corn and soybeans, with harsh impacts on impoverished communities (Hoyos and Blas, 2008; FAO, 2008) or exacerbating social exclusion by concentrating agricultural production at the expense of small-scale farmers (Hall et al, 2009). Recent Brazilian policies have encouraged refiners and distributors to source from small-scale farmers that have

previously been excluded from participating in Brazil's growing agricultural sector. For example, a new market is being created through government intervention under the National Program of Production and Use of Biodiesel (PNPB). Its main goal is "*to include family farmers in the oil chain and to encourage the use of previously rarely employed feedstock*" (Abramovay and Magalhães, 2007). However, there remain major problems with these wider participatory schemes, especially with very poor illiterate farmers that lack basic business knowledge and have become distrustful with industry and government.

This paper discusses Brazilian energy policies that have provided economic stability, followed by environmental and social disruptions that are now being addressed. We focus on recent policies designed to encourage participation of impoverished communities within the energy industry. The research is framed within the sustainable development discourse that has recently argued for a more holistic approach to sustainability that considers the interactions among economic, environmental and social parameters. Sustainable development has also been recognized as a cornerstone of Brazilian energy policy and a key strategic thrust of Petrobras. In the next section, we briefly review the sustainable development literature. We then outline our methodology, followed by our three case analyses, the development of Brazilian oil & gas, fuel ethanol and biodiesel sectors. We conclude with a discussion of our findings and implications for business and policy.

2. Balancing Sustainable Development Pressures

The Brundland Commission's (WCED, 1987) seminal definition of sustainable development emphasizes the interdependence among social, economic and environmental parameters from an intergenerational perspective. From a firm's perspective, Elkington (1997) suggests using the so-called 'triple bottom line" that considers financial, environmental and social parameters when making business decisions. Seuring and Muller (2008) observe that the sustainability discourse has evolved from the relationship between economic and environmental parameters to emphasize social impacts such as social exclusion. Matos and Hall (2007) suggest that the transition from mostly environmental concerns towards a sustainable development perspective creates greater managerial challenges due to *complexity*, a situation with many interacting parameters. Because of complexity, decision-makers are limited in what they can know, what Simon (1969) called bounded rationality, and thus should pursue satisfactory solutions to their problems – '*satisficing*' – rather than look for optimal solutions.

In addition to complexity, Matos and Hall (2007) further argue that the trend towards sustainability presents greater dimensions of *ambiguity,* where neither the parameters nor probabilities can be identified or estimated (Knight, 1921). Matos and Hall (2007) suggest that the social dimension of sustainable development is emerging as a key challenge, as it may involve a wide range of stakeholders with disparate goals, demands and values that may interpret the same situation differently, what Hall and Vredenburg (2003; 2005) call 'stakeholder ambiguity'. Table 1 is a sample of such sustainable development values, most of which are social.

Table 1 about here

We suggest that the relationship among government policies (regulations and incentives) and stakeholder pressures play an important role in improving sustainable energy production. However, the complex and sometimes ambiguous nature of these relationships calls for an evolutionary perspective, as the development of a specific policy often leads to unintended

consequences that may (or may not) later be under scrutiny from various stakeholders. Such dynamics can be expected with economic change, which resolves some problems but also creates other problems that must then be addressed (Nelson and Winter, 1982). The contemporary issue faced by the Brazilian energy industry is resolving social exclusion, a key policy mandate of the Lula government. As we will show below, this is a particularly difficult challenge, as some sectors have a propensity to be exclusive due to high technological complexity and risks associated with hazardous materials, whereas others have a tendency to economize at the expense of social programs

3. Methodology

We used a case study methodology to understand the dynamics present in a particular setting (Eisenhardt, 1989; Gephart, 2004; Yin, 1994), specifically how Brazilian policies have shaped the country's energy industry and are now addressing social inclusion. We selected three cases, the oil & gas, ethanol and biodiesel energy sectors. Brazil is a world leader in deep and ultra-deep offshore oil and automotive biofuels production and distribution, fueling the world's largest fleet of domestically produced 'flex fuel' automobiles able to operate on ethanol, natural gas and/or gasoline (Almeida, 2007; Zarrilli; 2006; Kamimura and Sauer, 2008; Silvestre and Dalcol, 2009). However, Brazil also has major problems with poverty and social exclusion, and is now attempting to reduce these social ailments while improving the sustainability of their energy matrix.

Yin (1994) recommends using multiple sources of evidence (triangulation), establishing a chain of evidence, and providing drafts for review key informants to ensure construct validity. We interviewed a variety of stakeholders in numerous Brazilian cities between 2005 and 2009[1] to provide insights from various perspectives (see Table 2). Interviewees were identified from desk research and then through the snowball technique (Berg, 1988), where participants suggest additional people for the study. Interview questions were developed through literature reviews and used to open the discussion but not to limit the interviewee's scope for raising relevant issues. Interviews were supplemented with academic papers, technical documents, government reports and the popular press to establish a chain of evidence and reinforce triangulation (Yin, 1994).

Nine individual interviews with impoverished biofuels farmers were conducted. Subjects were identified through the Brazilian Agricultural Research Corporation (EMBRAPA), a government-owned organization for agricultural research with close ties to the farming community. We also conducted four farmer focus groups (organized through local biofuel co-ops rather than EMBRAPA to strengthen validity) to explore issues identified in the individual interviews. Data saturation (Eisenhardt, 1989), the repetition of common issues, emerged during this phase. To reduce social desirability bias (Fisher, 1993), we informed interview subjects that we would keep their names and participation confidential, and would check our data against observed behavior and the perspectives of other supply chain members (Singer *et al.*, 1992). Following the interviews, the research team discussed, reviewed and summarized the data and EMBRAPA and Petrobras officials with extensive knowledge of the topic reviewed case drafts.

Table 2 about here

We also recognized that, given the controversial nature of the research, that there was a risk of social desirability bias, whereby research participants might express viewpoints that they

think the interviewer wants to hear or is politically appropriate rather than what the participants truly believe (Fisher, 1993). To reduce this risk, we informed interview subjects that we would keep their names and participation confidential, as suggested by Singer et al (1992); that we would not use information that could place the interviewee in any form of jeopardy, and that we would check our data against observed behavior and the perspectives of other supply chain members.

4. Brazilian Oil & Gas Industry

The Brazilian upstream oil & gas sector emerged gradually with the discoveries of oilfields made by Petrobras and their subsequent development. The first oilfield, Garoupa, was discovered in 1974 in the Campos Basin region off the coast of Rio de Janeiro State. Petrobras set up operational units in the area to provide infrastructure as well as technical and engineering support. As a result of this evolutionary process, the Campos Basin region is currently responsible for more than 80% of the country's oil, and 45% of the natural gas production (Silvestre and Dalcol, 2008). Due to the technical challenges of deep and ultra deep wells, most industry players regarded these oilfields as economically unviable. However, over time Brazil's commitment to development, along with technological breakthroughs and increased oil prices made these oilfields viable (Surrey, 1987).

Direct suppliers soon followed Petrobras to the region, the first being suppliers of goods and services with high technological complexity and long-term contracts with the Brazilian oilfield operator. Other firms later migrated from various Brazilian regions and from abroad, attracted by Petrobras and other large international suppliers, while additional firms emerged through entrepreneurial initiatives and from knowledge spillovers, usually operating in niche markets. The role of Petrobras in the formation and development of the oil & gas sector in Brazil has thus been crucial, and this role continues even after the end of the sector's monopoly in 1997. Although the presence of MNCs increased over the last few years (mostly through joint ventures), Petrobras remains the most important player and the most desired partner for any oilfield operator in the Brazilian oil & gas upstream segment. In addition to government protection, Petrobras also possesses accumulated knowledge acquired over the last 30 years, providing the firm with substantial competitive advantage within this specialized area.

According to Petrobras CEO Gabrielli de Azevedo (2009), Petrobras' past operations had been mired by poor environmental performance. The company has since made extensive efforts to maintain high environmental standards, and is now seen as a model for corporate social responsibility. The company continues to face growing domestic pressures to adopt more socially oriented policies and to spread the benefits of the revenues from Brazilian resources towards impoverished communities. However, the success of the firm, in terms of profitability and reputation, was based on the accumulation of sophisticated, world-leading technologies and a major emphasis on environmental protection; wider inclusion, particularly with impoverished communities, could erode these hard won attributes.

According to Silvestre and Dalcol (2009), there are four levels of firms based on technological capabilities. The first three includes major oilfield operators, suppliers and niche players with high technological capabilities. Such firms require skills beyond what is available within impoverished communities. The fourth group includes micro and small firms offering goods and services of moderate to low technological complexity. Since micro and small firms have the potential to provide a wide range of employment opportunities (Baldwin and Picot, 1995) and is seen as a mechanism for long-term poverty and social inclusion (Tendler and

Amorin, 1996), these firms may possess the characteristics of generating most of the jobs in the sector, with a wider range of educational levels.

A number of programs have been implemented to strengthen the Brazilian upstream oil & gas sector, such as the Science & Technology Ministry's Funding Agency for Studies and Projects (FINEP), National Institute of Metrology, Standardization and Industrial Quality (INMETRO) and the National Council for the Scientific and Technological Development (CNPq). The Brazilian Service of Support for Micro and Small Enterprises (SEBRAE) an industry sponsored agency for capability development also offers support the micro & small firm in terms of capability building in total quality management, productivity and competitive advantages and financing to innovative projects, summarized in the Table 3. Other initiatives have been carried out by National Association of Advanced Technologies Entrepreneurship (ANPROTEC), together with other initiatives from the financing institutions and state-owned banks such as the Brazilian Development Bank (BNDES), Bank of Brazil (BB), and Regional Development Banks, among others. According to Milani and Canongia (1999), Brazil is creating a support structure to develop its micro and small firms and consolidating several sectors across the country.

Table 3 about here

Petrobras has also been pressuring suppliers (especially smaller ones) to obtain quality and environmental certifications to compete in Petrobras' bids. The high-standards demanded by the oil majors and their direct suppliers (usually large multinational companies) is a major limitation for micro and small firm participation, which is further exacerbated by the scarcity of financial resources to implement the changes and obtain certification (FIEMG/IEL and SEBRAE, 2006). SEBRAE has established programs to increase quality, provide management and technology training and to encourage the cooperation networks among these economic agents (Campos and Figueiredo, 2007). However, surveys show that around 50 percent of Brazilian firms fail within three years (SEBRAE, 2004). This is high when compared to developed countries (Andreassi and Siqueira, 2006). Furthermore, the majority of these programs are for relatively educated professionals and potential entrepreneurs. Even with the strong and dynamic industrial activity in the Campos Basin region, Campos and Macae (both cities centrally located in the oil & gas production area) are facing increasing problems related to unemployment, unplanned migration flows and '*favelization'* of their suburbs, i.e. the process that transforms rural areas in *favelas* (Neto, 2006) or shantytowns (Ferraz, 1999). While a technological and economic success and major contributor towards Brazil's energy self-sufficiency, the oil & gas sector has done poorly when measured against social impacts.

5. The Emergence of Brazilian Fuel Ethanol

The development of ethanol as an automotive fuel is an example of Brazil's agricultural paradox of high productivity and social exclusion. As discussed above, ethanol is a renewable energy source and provides environmental benefits like lower CO2 emissions. The barriers to entry, in terms of educational levels and capital requirements are also lower, thus making them a potentially more inclusive energy source. However, there are also considerable pressures within the sector to concentrate production to exploit economies of scale, which may negate their favorable sustainability and inclusively characteristics.

Fuel ethanol production in Brazil emerged with the Federal Government's ProAlcool Program, which was a response to the oil crises in the1970s, and to save sugarcane producers from bankruptcy after major modernization investments were followed by a significant drop in sugar prices (Rosillo-Calle and Cortez, 1998). According to Oliveira (2002), the ProAlcool program involved a wide range of stakeholders such as numerous government ministries, the military, the ethanol industry, researchers, the media and established sugarcane producers controlled by wealthy families to create a market and stimulate the use of ethanol as an automobile fuel. The Brazilian Agricultural Research Corporation (EMBRAPA), a government owned organization, played a major role in the technological development of ethanol and other sectors of Brazilian agriculture.

During this time, Petrobras was opposed to the program. According to a senior Petrobras manager, oil & gas companies at the time did not believe that ethanol was a viable energy source, and would only result in unfair competition due to heavy subsidies that supported the ProAlcool program. However, technological innovation, supply chain improvements, industry concentration and capital-intensive, mechanized production techniques, along with increases in petroleum prices made it a viable fuel, and it is no longer subsidized. Sugarcane, a crop well suited for Brazil's climate, is currently one of the most efficient crops for ethanol production. For example, while Brazil produces an average of 7,000 liters of ethanol per hectare of sugarcane, the US produces 3,800 liters per hectare from corn and the European Union 5,400 liters per hectare from sugar beet (IAE, 2007). Today, Brazil is currently the world's largest producer and exporter of fuel ethanol, with a widely available distribution infrastructure and an automotive sector producing the world's largest fleet of 'flex fuel' cars powered by any mix of ethanol and gasoline (Zarrilli, 2006; Kamimura and Sauer, 2008).

Concentrated ethanol production has major local environmental impacts typical in agriculture, but lower emissions and fewer risks of hazardous materials when compared to petroleum (IAE, 2007). Counter to NGO claims that ethanol causes deforestation and species depletion in the Amazon, the vast majority of Brazil's ethanol production is, according to EMPRAPA, at least 2000 kms away from the Amazon (Goes and Marra, 2008). However, the harvest is still carried out manually, creating a strong demand for temporary, low-skilled labor that have been heavily scrutinized for poor working conditions (Hall et al, 2009; Saint, 1988). Under the ProAlcool program, government subsidies and credit programs favored large-scale farmers and sugar mill owners concentrated in the wealthier and more developed southeast and central regions of Sao Paulo and Mato Grosso, the location of the incumbent sugarcane producers, as opposed to poor Northeast and North regions (Martinelli and Filoso, 2008; Oliveira, 2002). Many workers are illiterate and receive below minimum wage, and few independent small-scale farmers participate in this sector. In response, the Landless Rural Workers' Movement (*Movimento dos Trabalhadores Rurais Sem Terra* – MST), Latin America's largest protest group, emerged in the 1980s to deal with the concentration of land by a few and the expulsion of the poor from rural areas due to agricultural modernization[2]. Brazilian policy-makes have since recognized these detrimental effects on employment and migration, exacerbating social exclusion and only providing poor quality jobs (BBC News, 2007; MST, 2007). Thus, although considered a technical and economic success, the sector has also been under scrutiny for poor working conditions and not providing opportunities for small farmers (Martinelli and Filoso, 2008; MST, 2007).

While the ProAlcool program provided incentives that allowed the industry to become economically competitive, there were no provisions for improving the working conditions of

temporary harvesters. Media and activist pressure were mostly targeted at the government and sugarcane plantations, and more recently at Petrobras. In response, the sugarcane producers are now engaged in social responsibility programs and are investing in education and health for the workers' children, but they are still criticized by the international and national media (BBC News, 2007; Globo, 2007) . Petrobras has also responded by implementing policies that discourage sub-standard labor policies within their supply chain. However, Petrobras CEO Gabrielli de Azevedo (2009) has argued that, while the company takes sustainability seriously, fuel produced from substandard labor practices does not make it into their supply chain.[3] As stated above, Petrobras was opposed to the ProAlcool program, and thus did not play a major role in its development.

Although the environmental impact of sugarcane ethanol remains contentious, most studies suggest it provides benefits over petroleum fuel sources (IAE, 2007), and thus can be regarded as a 'win-win' example (Porter and van der Linde, 1995) when only economic and environmental parameters are considered. However, when social parameters are also included, trade-offs emerge and outcomes become blurred. Currently the sugarcane plantations and refineries do not have the profile to be conducive for an effective activist campaign (these firms are relatively unknown within the country and unknown internationally except by industry insiders). The dominant channel leader, Petrobras, did not play a role in the early development of the sector, but may be expected to a larger role due to its increasingly important profile in the energy industry and largest company in South America.

Like the oil & gas sector, ethanol facilitated energy Brazilian self-sufficiency and allowed the country to become competitive in world markets and at the technological frontier in this area, providing an engine of economic growth. In contrast to oil & gas, it also provided improved environmental attributes through reduced emissions and by being a renewable energy source. However, in spite of having lower barriers to entry, the sector has evolved towards concentration to exploit scale economies, and is now being scrutinized for poor working conditions and exacerbating social exclusion. A major response of the Government was the implementation of social inclusion policies for a Biodiesel production, discussed next.

6. Brazilian Biodiesel Policy

In response to the problems of social exclusion in ethanol and other agricultural sectors, the Federal Government of Brazil initiated an executive inter-ministerial commission for biodiesel production in 2003. It was composed of the Ministry of Mines and Energy, Petrobras, EMBRAPA (which had recently been mandated to improve small farmers' capability development), the National Agency of Petroleum, and the Brazilian Development Bank among other institutions. The National Program of Production and Use of Biodiesel (PNPB, henceforth refereed to as the Biodiesel Program) was launched in December, 2004, with the explicit goals of stimulating the biodiesel market, promoting social inclusion and regional development in poor regions, and to encourage technology research (*Governo Federal do Brazil*, 2008). The Program included mandates to stimulate market demand for biodiesel in the Brazilian energy mix, requiring, a minimum of 2% biodiesel in the national diesel supply between 2008 and 2013 and a minimum of 5% thereafter (Pousa et al, 2007). It also provides research incentives to promote technology development throughout the production chain, and encourages research networks from universities and other research institutions such as EMBRAPA.

A third pillar of the Program is an explicit policy to encourage small farmer participation in the supply chain through the 'Social Fuel Stamp' (*Selo Combustivel Social*), through tax

benefits and special credit to industries that encouraged small producer participation from the poorer North and Northeast regions, particularly for castor and palm seeds from small-scale producers. To receive the Social Fuel Stamp, biodiesel refiners and fuel distributors must purchase part of its feedstock from small farmers, sign commercial agreements with those farmers and provide them with technical assistance. The biodiesel producer can be awarded tax exemptions that range from R$.07 (~US$.03) to R$.218 (~US$.1) per litre, depending on the feedstock and the region in which it is sources, which represents about 4% to 12% of the retail price of diesel in Brazil. To receive the highest tax exemption, the industry must purchase castor or palm oil produced by small farmers in the North, Northeast or semi-arid regions, crops which are more suitable for smaller scale farming because mechanized production is currently cost effective for these crops (Garcia, 2007). The Government estimates that around 100,000 small-scale farming families have participated in the Program, based on contracts presented by biodiesel refiners claiming the Social Fuel Stamp tax rebates (MDA, 2008).

According to Hall et al (2009), the results of the Program have been mixed. Many refiners and distributors were concerned whether farmers were able to produce what had been negotiated, and whether prices of for example soy, palm and castor for biodiesel would remain competitive with other markets. Soybeans for example are commodities with prices that fluctuate with global demand. Palm and castor oil is valued for other industrial purposes, and their production costs are higher than other oils (Garcia, 2007). Furthermore, although the Social Fuel Stamp is relatively simple in theory, in practice there have been some problems between industry and farmers. One representative from a biodiesel refinery stated that some farmers fail to honor contracts and sell the seeds to other buyers, typically as a one-off, short term sale at higher prices: "*…sometimes it is hard to deal with these farmers. Because of their lack of education, they are not used to dealing with contracts and do not understand the advantages of a potential long term and stable business relationship against an unstable short opportunity*". Our interview subjects stated that the level of education and experience in long term planning played an important role in how small farmers responded to biodiesel business opportunities. Distrust between industry and farmers were common. Castor has many applications in the chemical industry, and can thus provide higher prices than other biodiesel feedstock such as soy and palm oil, albeit at much smaller volumes. However, farmers often expect similarly high prices, even though the volume needed for biofuels is much greater and thus may provide greater profitability through economies of scale.

One of the requirements placed on industry to obtain the Social Fuel Stamp is providing technical assistance to small farmers, and many of the programs in Table 3 are also applicable to biodiesel farmers. However, industry executives and EMBRAPA officials stated that many farmers often did not follow advice. For example, since castor plants can be found almost anywhere (including empty lots and landfills), farmers unfamiliar with this crop assumed that specialized techniques were unnecessary, but without proper crop management, productivity is low and of poor quality (Severino et al, 2006a; Severino et al, 2006b). Biodiesel refinery managers stated that the costs for the technical assistance were often higher than the Social Fuel Stamp tax exemptions, and that operational and transaction costs required to manage contracts with thousands of geographically dispersed small farmers also created difficulties. Most of these farmers had no experience with contracts, simple accounting principles or other basic management knowledge such as the benefits of scale economies. Conversely, farmers often complained that the refiners failed to provide useful advice. The president of a chemical company that refines castor oil and a senior manager of Petrobras stated that the social program

for biodiesel will not work, and that it will follow a similar route as ethanol, with only large-scale producers, in spite of these tax incentives. They further suggested that soybeans would likely emerge as the dominant crop, which, in contrast to palm and castor, is highly suitable for mechanized, large-scale production and already had an established supply chain in Brazil (an attraction of castor and palm is that it is currently harvested most efficiently by non-mechanized techniques, making it suitable for small farmers).

In contrast to ethanol, there has been an explicit policy mandate to include independent small-scale farmers through the Social Fuel Stamp, energy mix requirements and research incentives for institutes, which in turn are expected to assist supply chain members, especially impoverished farmers. This includes EMBRAPA for technical data and SEBRAE for basic entrepreneurial and business knowledge. In the past, SEBRAE's activities were focused on capability development with relatively educated entrepreneurs, but were recently mandated under President Lula's social exclusion policies to stimulate entrepreneurial activities within impoverished communities, including biofuels. Senior EMPRABA representatives in one of the poorer regions in Brazil acknowledged that there are fundamental differences between educated and impoverished people, and that there remains major challenges in understanding and encouraging entrepreneurial dynamics within the latter.

Unlike ethanol, the dispersed biodiesel markets have increased transaction costs, leading to a greater role for co-ops and wholesalers. To the best of our knowledge, the wholesalers play only an arbitrage role and do not participate in information diffusion or social programs. The co-ops are typically small operations, but possess relatively sophisticated managerial and technical staff, and act as a bridge between impoverished farmers and the refiners and research institutes. We thus suggest that the co-ops are an important mechanism in the diffusion of technical and basic business knowledge up the supply chain. However, we also suggest that economizing pressures to reduce transaction costs from a widely dispersed supply base and avoid shirking costs encourages sourcing from large-scale farmers, at the expense of the social programs, much like ethanol.

Another factor hindering effective sustainable supply chain dynamics is the relatively limited pressure from activism, which can be partly attributed to the novelty of the industry. At the time of writing, only limited activist regarding for example the expansion of soybean farming into protected areas like the Amazon Rainforest was emerging. Most activism was targeted at the government, and while our interviews with activists groups talked about 'the industry' in a general sense, none made explicit reference to a specific company or large-scale producer. Most of these firms are safely 'buried in the supply chain' (Hall, 2000), where they are only known within the industry and unknown by the general population and internationally. The exception is Petrobras, which possesses the technical competencies, influence over the supply chain and a high national and international profile, and is thus perhaps the key to making the Social Label scheme a success.

Like ethanol, Brazilian biodiesel provides improved environmental characteristics, but current policies are attempting to shape segments of the supply chain to encourage social inclusion. The challenge now being faced is how to encourage take-up by impoverished communities that lack formal training and basic business knowledge, coupled with distrust of industry and policy makers within these communities.

7. Implications and Conclusions

Within recent years, the sustainable development discourse has evolved from mostly an environmental focus towards the more holistic approach that considers the interactions among economic, environmental and social parameters. Another stream of sustainability research emphasizes the need to address impoverished segments of society through government policies that aim to alleviate social exclusion. This paper discussed empirical examples of where these two streams of research have met, specifically the challenges of incorporating impoverished communities into the energy industry.

We found that government policies designed to reduce social exclusion in the energy industry also creates greater transactions costs in the form of dispersed, small volume producers with differences in basic technical and business knowledge. Although Brazilian policy-makers have recognized the importance of providing entrepreneurial opportunities for impoverished communities in biofuels production, there remain considerable economic pressures to economize on transaction costs by avoiding the sourcing of raw materials from illiterate farmers that often distrust industry and government policy, leading to shirking and unreliable supplies. This distrust is perhaps understandable, given that previous attempts at agricultural reform led to social disruption. Numerous interview subjects suggested that government and industry could improve trust by engaging impoverished farmers in early stages of policy development. We further suggest that basic business education targeting impoverished farmers is also needed. However, we also acknowledge that most technical training programs (as for example illustrated in Table 3) were not designed for people lacking prior formal education. Further research is needed in how such programs can be developed for these communities.

The Brazilian upstream oil & gas sector, like those elsewhere, requires major competencies and resources, and as a result sophisticated operators and large integrated multinationals are the key players. Brazilian policy-makers recognized that the country's growing oil & gas sector could provide greater benefits to the population, through for example entrepreneurial opportunities, and a number of government support mechanisms have been developed in the last decade. However, the technically sophisticated, complex and environmentally sensitive nature of the sector creates a strong barrier for participation from poorer, less educated communities. Although the technological and capital requirements for ethanol are lower, there was a strong tendency towards concentration to exploit economies of scale, thus following a similar path as oil & gas, albeit with environmental improvements. Recent biodiesel policies were explicitly designed to provide wider participation, but there remain issues of take-up.

We propose that some sectors like oil & gas have a *propensity,* or natural inclination, to be exclusive due to technological complexity, and attempts at providing wider social inclusion policies may lead to more harm than good. Other sectors, like ethanol and biodiesel have lower technological complexity and thus lower barriers to entry, but there remains a *tendency* to move toward greater economic efficiencies at the expense of environmental and social impacts. We distinguish between the two terms using Simon's concept of satisfycing. A propensity is where the improvement in one parameter (e.g. social inclusion programs) may lead to a decrease in the other parameters (e.g. financial and environmental performance), and thus a less-than-satisfactory outcome – i.e. the net affect is negative. A tendency is where improvements in one parameter may lead to a decrease in another parameter (or relatively small decreases in two parameters), but the overall performance is satisfactory – i.e. the net effect is positive. For example, improvements in the social performance of biodiesel may reduce the financial performance of Petrobras, but not their environmental performance, and may be regarded as a

satisfactory outcome depending of course on the effectiveness of the social programs and degree by which financial performance is affected. With time the social programs may improve and become less costly, thus reducing the financial burden. A similar dynamic emerged with Petrobras' ultra-deep technologies and the ethanol sector's ability to become cost-effective.

The oil & gas case illustrates what Perez (2004) calls a 'top-down approach' that provides developing countries with leading competencies, which in turn can be a driver of economic growth. The biofuels cases provides examples of a 'bottom up approach', where policies are used to identify, promote, facilitate and support wealth-creating activities at all levels and regions of the economy for social inclusion (Perez, 2004). The development of biofuels and petroleum can thus be regarded as complements rather than substitutes, as each provides unique social benefits, whether technological capabilities for economic growth, opportunities for social inclusion, and/or complex combinations of both.

For the upstream oil & gas sector, Petrobras plays a major role in selecting and certifying micro & small firms within the supply chain, and is thus in a position of power for encouraging social and environmental improvement. Without action from Petrobras, the biodiesel social policies will likely fail, and follow a similar path as ethanol with large-scale producers under pressure to reduce labor costs and expand into protected areas. However, like any other company, Petrobras is under economizing pressures, begging the question why they should encourage social programs any more than other energy firms do. We suggest three reasons. First, Petrobras needs to demonstrate their commitment to government policy in order to maintain legitimacy as a national oil company that contributes towards national interests.

Second, by encouraging social improvement within *different* sectors, Petrobras is able to develop an overall better sustainable strategy than if they attempted to improve social and environmental parameters *within* each sector. For example, social programs encouraging impoverished communities to participate within oil & gas may be counter-productive, as the requisite competencies needed to maintain high environmental and financial performance within this sector are likely to be beyond the reach of these communities. By encouraging social programs in biodiesel, a sector with less propensity to be exclusive, Petrobras may be able to improve their overall social performance without jeopardizing their financial and environmental performance. By participating in more than one sector, Petrobras is thus able to find configurations that are more sustainable than if they only explored options within each sector.

Third, although the challenges of incorporating impoverished farmers and micro & small firms within the energy supply chain may seem challenging, there are likely to be long-term benefits that will eventually make such efforts worthwhile. Consistent with Nelson and Winter's (1982) evolutionary perspective on economic change as the driver of, and solution to negative externalities, the development of the Brazilian energy industry involved a series of solutions to specific problems, which in turn created more problems that are now being addressed. During this process, Brazilian firms such as Petrobras overcame significant challenges to become one of the world's most efficient producers in biofuels and deep and ultra-deep oil & gas development. The sectors discussed here are now in a similarly challenging stage, where they are expected to provide wider opportunities for a broader range of people while minimizing their environmental impacts. However, while the difficulties of generating basic business knowledge, trust and business opportunities for impoverished communities and micro & small entrepreneurs , the potential payoff if successful could allow the Brazilian energy industry to continue as one of the world's leading players.

References

Abramovay, R. and Magalhães, R., 2007. O acesso dos agricultores familiares aos mercados de biodiesel: parcerias entre grandes empresas e movimentos sociais. Project Proposal to Regoverning Markets Component 2: Innovative practice in connecting small-scale producers with dynamic markets, Sao Paulo, Brazil.

Almeida, C., 2007. Sugarcane ethanol: Brazil's biofuel success. Avaiable at <http://www.scidev.net/en/features/sugarcane-ethanol-brazils-biofuel-success.html> Accessed August 20, 2009.

Andreassi, T. and Siqueira E. M. R., 2006. The funding of new technology-based firms in Brazil. International Journal of Entrepreneurship and Innovation Management, Vol. 6 (4-5), pp. 369 – 382.

Baldwin, J. and Picot, G., 1995. Employment Generation by Small Producers in the Canadian Manufacturing Sector. Small Business Economics, Vol. 7, pp. 317-331.

BBC News, 2007. 'Slave' Labourers Freed in Brazil. Available at: <http://news.bbc.co.uk/2/hi/americas/6266712.stm> Accessed July 24, 2008.

Behrman, J., Trujillo, A., Gaviria, A. and Székely, M., 2003. Who's in and who's out: social exclusion in Latin America: Inter-Amer Development Bank.

Berg, S., 1988. Snowball sampling. In: Encyclopaedia of Statistical Sciences, edited by S. Kotz and N.L. Johnson Vol.8. New York: Wiley.

Buvinic, M., Mazza, J., and Deutsch, R. (Eds.), 2004. Social Exclusion and Economic Development in Latin America. Inter-American Development Bank and Johns Hopkins University Press, Washington D.C., 2004.

Campos, M. C. and Figueiredo, P. B. D., 2007. A articulação competitiva de empresas no segmento de petróleo e gás: estudo de caso empresa Telejúnior. Master Thesis, FAESA, Vitoria, Brazil.

Commins, P., 1993. Combating Exclusion in Ireland 1990-94: A Midway Report. Brussels: Observatory on National Policies to Combat Social Exclusion, Commission of European Countries.

D'Agosto, M. and Ribeiro, S., 2009. Assessing total and renewable energy in Brazilian automotive fuels. A life cycle inventory (LCI) approach. Renewable and Sustainable Energy Reviews 13(6-7), 1326-1337.

Economist, 2005. The paradox of plenty: the curse of oil. December 24, 2005; 377(8458): 63.

Eisenhardt, K. 1989. Building theories from case study research. Academy of Management Review 14(4), 532-550.

Elkington J., 1997. Cannibals with Forks: The Triple Bottom Line of 21st Century; New Society Publishers: Gabriola Island, BC.

FAO, 2008. United Nations Food and Agriculture Organization. High-level conference on world food security: The challenges of climate change and bioenergy, food security and sustainability – Towards an international framework. Rome, 3 -5 June 2008. Available at: <ftp://ftp.fao.org/docrep/fao/ meeting/013/k2498e.pdf> Accessed on May 24, 2008.

Ferraz J., 1999. A insustentabilidade da revolução verde. Informativo Meio Ambiente e Agricultura (EMBRAPA), 8 (26): 25-28. Available at: <http://www.cnpma.embrapa.br/informativo/mostra_informativo.php3?id=108> Accessed on April 21, 2007.

FIEMG/IEL and SEBRAE, 2006. Federacao das Industrias de Minas Gerais and Serviço de Apoio às Micro e Pequenas Empresas. Diagnóstico da cadeia produtiva da indústria do petróleo e gás em Minas Gerais. Belo Horizonte: DCPP&G-MG - Belo Horizonte: FIEMG/IEL-MG e SEBRAE/ MG.

Fisher R., 1993. Social desirability bias and the validity of indirect questioning. Journal of Consumer Research, Vol. 20, pp 303-315.

Folha On Line, 2006. Lula diz que Brasil auto-suficiente em petróleo é "dono de seu nariz". Available at <http://www1.folha.uol.com.br/folha/dinheiro/ult91u107085.shtml> Accessed on October 12, 2009.

Gabrielli de Azevedo, J.S., 2009. The Greening of Petrobras. Harvard Business Review, Vol. 87, No. 3, p43-47.

Garcia J., 2007. O programa nacional de produção e uso de biodiesel brasileiro e a agricultura familiar na região nordeste. PhD Theses, 2007. Federal University of Paraiba, Brazil.

Gephart, R., 2004. Qualitative research and the Academy of Management Journal. Academy of Management Journal 47(4), 454-462.

Gettleman J., 2006 War in Sudan? Not where the oil wealth flows. New York Times. Available at: <http://darfur.3cdn.net/8a60acf17285e4e852_x8m6bxs29.doc> Accessed on April 03, 2007.

Globo, 2007. Usinas de cana-de-açúcar são multadas em SP. Available at: <http://g1.globo.com/Noticias/SaoPaulo/0,,MUL13689-5605,00.html> Accessed on October 12, 2009.

Goes, T. and Marra, R., 2008. A Expansão da Cana-de-Açúcar e sua Sustentabilidade. Available at: <http://www.embrapa.br/imprensa/artigos/2008/ A%20expansao%20da%20cana-de-acucar%20e%20a%20sua%20sustentabilidade.pdf> Accessed on November 11, 2008.

Goldemberg, J., Coelho, S.T. and Guardabassi, P., 2008. The sustainability of ethanol production from sugarcane. Energy Policy, Vol. 36(6), pp. 2086-2097.

Governo Federal do Brazil, 2008. Biodiesel – Programa Nacional de producao e uso de biodiesel. Historico do Programa. Available at: <http://www.biodiesel.gov.br/> Accessed on June 21, 2008.

Hall J., 2000. Environmental supply chain dynamics. Journal of Cleaner Production, Vol. 8, No. 6, pp 455-471.

Hall, J. and Vredenburg, H., 2003. The challenges of sustainable development innovation. MIT Sloan Management Review, Vol. 45, no 1, 61–68.

Hall, J. and Vredenburg, H., 2005. Managing the dynamics of stakeholder ambiguity. MIT Sloan Management Review, Vol. 47, No. 1, pp 11-13.

Hall J., Matos S. and Langford C., 2008. Social exclusion and transgenic technology: The Case of Brazilian agriculture. Journal of Business Ethics, Vol. 77, No 1, pp 45-63.

Hall, J., Matos, M. Severino, L. and Beltrao, N., 2009. Brazilian biofuels & social exclusion: Established & concentrated ethanol vs. emerging and dispersed bio-diesel. (in press), Journal of Cleaner Production. Available at: <http://www.sciencedirect.com/science/journal/09596526>

Hira, A. and Oliveira, L.G., 2009. No substitute for oil? How Brazil developed its ethanol industry. Energy Policy, Vol. 37(6), pp. 2450-2456.

Hoyos, C and Blas, J., 2008. Security fears over food and fuel crisis. Financial Times, June 20. Available at: <http://www.ft.com/cms/s/0/29cff8ec-3ef4-11dd-8fd9-0000779fd2ac.html?nclick_check=1> Accessed on August 2, 2008.

Humphreys, M., Sachs, J. and Stiglitz J., 2007. Escaping the resource curse: initiative for Policy Dialogue. Columbia, NY.

IAE, 2007. International Agency of Energy. Energy Technology Essentials – Biofuel Production 2007. Available at: <http://www.iea.org/Textbase/techno/ essentials2.pdf> Accessed on July 20, 2008.

Kamimura, A. and Sauer, I.L., 2008. The effect of flex fuel vehicles in the Brazilian light road transportation. Communication. Energy Policy, Vol. 36(4), pp. 1574-1576.

Knight, F., 1921. Risk, Uncertainty and Profit. Boston, Mass: Houghton Mifflin.

Laser, M., Larson, E., Dale, B., Wang, M., Greene, N. and Lynd, L., 2009. Comparative analysis of efficiency, environmental impact, and process economics for mature biomass refining scenarios. Biofuels, Bioproducts and Biorefining, Vol. 3(2), pp. 247-270.

Magrini, A. and Lins, L.S., 2007. Integration between environmental management and strategic planning in the oil and gas sector. Energy Policy, Vol. 35(10), pp. 4869-4878.

Martinelli, L.A. and Filoso, S., 2008. Expansion of sugarcane ethanol production in Brazil: Environmental and social challenges. Ecological Applications, Vol. 18(4), pp 885-898.

Matos S. and Hall J., 2007. Integrating sustainable development in the extended value chain: The case of life cycle assessment in the oil & gas and agricultural biotechnology industries. Journal of Operations Management, Vol. 25, pp 1083–1102.

Mazza J., 2004. Social inclusion, labor markets and human capital in Latin America. In: Buvinic, M., Mazza, J. and Deutsch, R. (Eds.) Social Exclusion and Economic Development in Latin America, Inter-American Development Bank and Johns Hopkins University Press, Washington D.C. 179-200.

MDA, 2008. Ministério de Desenvolvimento Agrário. Portal SAF. Available at: <http://www.mda.gov.br/saf> Accessed on December 20, 2008

Milani, A. and Canongia, C., 1999. Como melhorar a competitividade das pequenas e medias empresas Brasileiras atraves da inteligencia competitiva? Paper presented at I Workshop Brasileiro de Inteligência Competitiva & Gestão do Conhecimento, Brazil.

MST, 2007. Movimento dos Sem Terra. Brazil stages raid against debt slavery at Amazon sugar cane-ethanol plantation. Available at: <http://www.mstbrazil.org/ ?q=slavelaborandethanolinapreports> Accessed on December 2, 2007.

Nelson, R. and Winter, S., 1982. An Evolutionary Theory of Economic Change. Cambridge, MA: Harvard University Press.

Neto, R. S., 2006. Industria e Desenvolvimento na Regiao Norte Fluminense: Crescimento economico e o problema da extrema heterogeinidade economico-espacial do Estado do Rio de Janeiro. In: Carvalho, A. M. and Totti, M. E. F. (Orgs.) Formacao Historica e Economica do Norte Fluminense, FAPERJ and Garamond, Rio de Janeiro, Brazil.

Oliveira J., 2002. The policymaking process for creating competitive assets for the use of biomass energy: The Brazilian alcohol programme. Renewable and Sustainable Energy Reviews, Vol. 6, Nos. 1-2, pp 129-140.

Perez, C., 2004. A Vision for Latin America: A resource-based strategy for technological dynamism and social inclusion. The Global Network for Economics of Learning, Innovation, and Competence Building System (GLOBELICS) Working Paper Series No. 08-04.

Porter, M. E. and van der Linde, C., 1995. Toward a New Conception of the Environment-Competitiveness Relationship. Journal of Economic Perspectives. Vol. 9(4), pp. 97-118.

Pousa G., Santos A. and Suarez P., 2007. History and policy of biodiesel in Brazil. Energy Policy, Vol. 35(11), pp 5393-539.

Rosillo-Calle F. and Cortez L.A.B., 1998. Towards ProAlcool II - A Review of the Brazilian bioethanol programme. Biomass and Bioenergy, Vol. 14, No. 2, pp 115-124.

Saint W., 1988. Farming for Energy: Social Options under Brazil's National Alcohol Programme. World Development, Vol. 10, No 3, pp 223-238.

SEBRAE, 2004. Serviço de Apoio às Micro e Pequenas Empresas. Available at: <http://www.sebraesp. com.br /conhecendo_mpe/mortalidade> Accessed on August 17, 2009.

Seuring, S. and Muller, M., 2008. From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production, Vol. 16, No 15, pp 1699–1710.

Severino L.S., Ferreira G.B., Moraes C.R.A., Gondim T.M.S., Freire W.S.A, Castro D.A., Cardoso G.D., Beltrão N.E.M., 2006a. Growth and yield of castor bean fertilized with macronutrients and minornutrients. Pesquisa Agroepcuaria Brasileira, Vol. 41, No. 4, pp 563-568.

Severino L.S., Moraes C.R.A., Gondim T.M.S., Cardoso G.D., Beltrão N.E.M., 2006b. Yield of castor planted at different row spacing. Revista Ciência Agronômica, Vol. 37, No 1, pp 50-54.

Shepherd, D. A.; Kuskova, V. and Patzelt, H., 2009. Measuring the values that underlie sustainable development: The development of a valid scale. Journal of Economic Psychology, Vol. 30, pp. 246–256

Silvestre, B. And Dalcol, P., 2007 Conexoes deconhecimento e posturas tecnologicas das firmas: evidencias da Aglomeracao industrial de Petroleo e Gas da Bacia de Campos. Revista Gestao e Producao, Vol. 14, pp. 167–185.

Silvestre, B. and Dalcol, P., 2008. Aglomeracao industrial de Petroleo eGas da Regiao produtora da Bacia de Campos - Sistema de Conhecimento, Mudancas Tecnologicas e Inovacao. RevistadeAdministracao da Universidade de Sao Paulo – RAUSP, Vol. 43, pp. 84–96.

Silvestre, B. and Dalcol, P., 2009. Geographical proximity and innovation: Evidences from the Campos Basin oil & gas industrial agglomeration—Brazil. Technovation, Vol. 29 (8), pp. 546-561.

Simon, H., 1969. The Sciences of the Artificial. MIT Press, Cambridge, MA.

Singer E., Hippler H. and Schwarz N., 1992. Confidentiality Assurances in surveys: Reassurance or threat. International Journal of Public Opinion Research, Vol. 4, No. 34, pp 256-268.

Surrey, J., 1987. Petroleum development in Brazil: The strategic role of the national oil company, Energy Policy, Vol. 15(1), pp. 7-21.

Tendler, J. and Amorim, M. A., 1996. Small Firms and Their Helpers: Lessons on Demand. World Development, Vol. 24 (3), pp. 407-426.

WCED, 1987. World Commission on Environment and Development. Our Common Future, Oxford University Press: New York.

Yin, R., 1984. Case Study Research: Design and Methods**.** Beverly Hills, CA., Sage.

Zarrilli, S., 2006. The emerging biofuels market: Regulatory, Trade and Development implications. United Nations Conference on Trade and Development, New York. Available at: <http://www.cgse.epfl.ch/webdav/site/cgse/shared/Biofuels/UNCTAD_DITC _TED_2006_4%20Final%20(3).pdf> Accessed on August 3, 2008.

Tables and Figures

Table 1: Sustainable Development Values (Shepherd et al., 2009)	
Sustainable development values	**Definitions**
Freedom	Men and women have the right to live their lives and raise their children in dignity, free from hunger and from the fear of violence, oppression or injustice. Democratic and participatory governance based on the will of the people best assures these rights
Equality	No individual and no nation must be denied the opportunity to benefit from development. The equal rights and opportunities of women and men must be assured
Solidarity	Global challenges must be managed in a way that distributes the costs and burdens fairly in accordance with basic principles of equity and social justice. Those who suffer or who benefit least deserve help from those who benefit most
Tolerance	Human beings must respect one another, in all their diversity of belief, culture, and language. Differences within and between societies should be neither feared nor repressed, but cherished as a precious asset of humanity. A culture of peace and dialogue among all civilizations should be actively promoted
Respect for nature	Prudence must be shown in the management of all living species and natural resources, in accordance with the precepts of sustainable development. Only in this way can the immeasurable riches provided to us by nature be preserved and passed on to our descendants. The current unsustainable patterns of production and consumption must be changed in the interest of our future welfare and that of our descendants
Shared responsibility	Responsibility for managing worldwide economic and social development, as well as threats to international peace and security, must be shared among the nations of the world and should be exercised multilaterally. As the most universal and most representative organization in the world, the United Nations must play the central role

Table 2: Interview Subjects by Stakeholder Category (Number of Subjects)

Energy industry: senior executives, middle managers, trade association officials	50
Agriculture sector: senior executives, middle managers, farmer association representatives, farmers (9 individual interviews, excluding 4 focus groups totaling 48 participants from impoverished communities)	41
Chemical sector: senior executives, middle managers	7
Government: Brazilian senior officials	22
United Nations (UN) officials: Food & Agricultural Organization (FAO), UN Environmental Program, UN Division for Sustainable Development, Economic Commission for Latin America & Caribbean, UN Development Program	10
NGOs: Greenpeace Brazil, Greenpeace International, Sierra Club, Brazilian Institute for Consumer Defense, Project Tamar, Rede-Petro Bacia de Campos, Rede-Petro MG, National Institute of Petroleum (IBP), National Organization of the Petroleum Industry (ONIP), Industry Federation of Rio de Janeiro (FIRJAN), Pembina Institute for Appropriate Development; Polo Sindical da Borborema (translates as Borborema Farmers Union), Esperanca and Lagoa Seca divisions.	16
Community Representatives	3
Academics	22
TOTAL	171

Table 3: Brazilian Programs to Support the Micro and Small Firms				
Program	**English**	**Portuguese**	**Support Organization**	**Web page**
RHAE	Human Resources Capability Building in Strategic Activities	Capacitação de Recursos Humanos para Atividades Estratégicas	CNPq	http://www.cnpq.br/rhae/index.htm
PBQP	Brazilian Program for Quality and Productivity Improvements	Programa Brasileiro de Qualidade e Produtividade	INMETRO	http://www.inmetro.gov.br/frame14.htm
PACTI	Technological Capability Building Support for the Industry	Programa de Apoio à Capacitação Tecnológica da Indústria	MCT	http://www.mct.gov.br/prog/pacti/Default.htm
PNI	National Program to Support Firms' Incubators	Programa Nacional de Apoio à Incubadoras de Empresas	MCT	http://www.mct.gov.br/prog/empresa/pni/Default.htm
PADCT	Program to Support the Scientific and Technological Development	Programa de Apoio ao Desenvolvimento Científico e Tecnológico	MCT	http://www.mct.gov.br/prog/padct/Default.htm
ADTEN	Program to support the Technological Development in National Firms	Programa de Apoio ao Desenvolvimento Tecnológico das Empresas Nacionais	MCT	http://www.finep.gov.br/programas/
PRIME	The First Innovating Company Program	Programa Primeira Empresa Inovadora	FINEP	http://www.finep.gov.br/programas/programas_ini.asp
INOVAR	The Innovate Project	Programa Inovar	FINEP	http://www.finep.gov.br/programas/programas_ini.asp
IE	Individual Entrepreneur	Empreendedor Individual	SEBRAE	http://www.sebrae.com.br/

[1] On site interviews were conducted in Brasilia, Campina Grande, Foz do Iguassu, Joao Pessoa, Petrolina, Manaus, Porto Alegre, Recife, Rio de Janeiro, Macae, Campos dos Goytacazes, Rio das Ostras, Salvador and Sao Paulo.
[2] See http://www.mstbrazil.org/?q¼about. Accessed December 21, 2008.
[3] BBC News *Hardtalk* with Stephen Sackur interview with Jose Sergio Gabrielli, broadcast 4 February, 2009. Available on-line at http://news.bbc.co.uk/2/hi/programmes/hardtalk/7869663.stm