# THE EVOLUTION OF THE BRAZILIAN REGULATION OF ETHANOL AND POSSIBLE LESSONS FOR THE UNITED STATES

DAVID N. CASSUTO* & CAROLINA GUEIROS**



## INTRODUCTION

The oil shocks of the 1970s propelled the search for alternative fuel sources by oil-dependent but petroleum-poor countries. Renewable energy programs, energy conservation plans, nuclear power, natural gas, and coal projects all flourished. Environmental concerns over air quality in large cities, and the significant role motor- vehicle emissions played in creating urban air pollution, generated interest in alternative energy. The United States and Brazil—then the two largest producers and consumers of ethanol in the world—focused intensely on biofuels as a substitute for

* Professor of Law, Pace Law School. Director, Brazil-American Institute for Law & Environment (BAILE). Visiting Professor of Law, Federal University of Bahia, Brazil. Class of 1946 Distinguished Visiting Professor of Environmental Law, Williams College. The authors gratefully acknowledge the excellent research assistance of Jessica Witmer (Pace Law School Class of 2013).

** LLM Pace Law School, 2012. J.D., Universidade Federal do Pará. Attorney, Silveira, Athias, Soriano de Mello, Guimarães, Pinheiro e Scaff Advogados, Belém, Brasil.

oil,[1] whilst other countries—such as Japan and European Union members—focused more on nuclear energy and other methods of power generation.[2] This state of affairs remained until the 1980s, when oil prices dropped significantly, causing a temporary loss of interest in petroleum substitutes. However, from the 1980s onward, climate change emerged as a significant concern. The 1992 United Nations Framework Convention on Climate Change[3] symbolized the international consensus about the need to address climate change, and the 1997 Kyoto Protocol[4] was the first concrete international effort in that direction.[5] This new focus on climate change revived the discussion about the need for alternative energy sources. In addition, during the 2000s, oil prices spiked anew; they went from less than US$30 to more than US$70 per barrel.[6] Political and social instability in areas of oil abundance, combined with the widespread belief that oil extraction would peak in ten or twenty years and then decline, contributed to this price volatility.[7]

---

1 *See* Mark S. Langevin, *Renewable Cooperation? Reflections on United States-Brazil Cooperation on Biofuels*, AM. DIPL. (Nov. 2008), http://www.unc.edu/depts/diplomat/item/2008/1012/comm/langevin_biofeul.html.

2 Rogério Cezar de Cerqueira Leite & Manoel Régis L. V. Leal, *O biocombustível No Brasil*, 78 NOVOS ESTUDOS - CEBRAP 15 (2007), *available at* http://www.agencia.cnptia.embrapa.br/Repositorio/03_000fxggj1i702wyiv80soht9h0kawrk0.pdf.

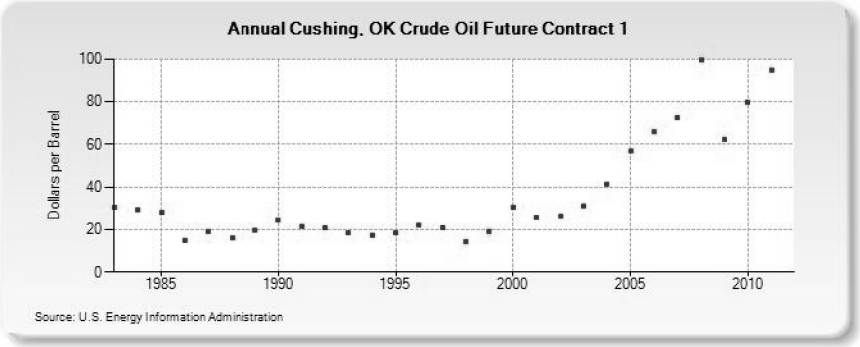
3 *See* United Nations Framework Convention on Climate Change, May 9, 1992, 1771 U.N.T.S. 107, 165, S. Treaty Doc No. 102-38, U.N. Doc. A/AC.237/18 (Pt. II)/Add.1, 31I.L.M.849 (1992).

4 *See* Kyoto Protocol to the United Nations Framework Convention on Climate Change, 37 I.L.M 22 (1998), Dec. 10, 1997, U.N. Doc. FCCC/CP/1997/7/Add.1.

5 *See Background on the UNFCCC: The International Response to Climate Change*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/items/6031.php.

6 Leite & Leal, *supra* note 2.

7 *Id.*




Cushing, OK Crude Oil Future Contract 1 (Dollars per Barrel)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1980s | | | | 30.66 | 29.44 | 27.89 | 15.05 | 19.15 | 15.96 | 19.58 |
| 1990s | 24.50 | 21.50 | 20.58 | 18.48 | 17.19 | 18.40 | 22.03 | 20.61 | 14.40 | 19.30 |
| 2000s | 30.26 | 25.95 | 26.15 | 30.99 | 41.47 | 56.70 | 66.25 | 72.41 | 99.75 | 62.09 |
| 2010s | 79.61 | 95.11 | | | | | | | | |

- = No Data Reported;—= Not Applicable; NA = Not Available; W = Withheld to avoid disclosure of individual company data.
Release Date: 1/19/2012
Next Release Date: 1/25/2012

Biofuels, which are fuels made from biomass materials[8] that are usually blended with fossil fuels—gasoline and diesel—emerged into this turbulent landscape, offering the promise of partially or completely supplanting fossil fuels. However, they can also be used on their own for transportation or energy generation.[9]

This article will focus on the Brazilian experience using ethanol as a substitute for gasoline for motor-vehicle fuel. Part I offers a brief discussion of the nature and role of biofuels. Part II details the development of ethanol regulation in Brazil, from its inception during the era of military dictatorship through the present. Part III discusses the environmental issues and criticisms concerning ethanol production and

[8] *Biofuels: Ethanol and Biodiesel Explained*, U.S. ENERGY INFO. ADMIN. (March 19, 2012), http://www.eia.gov/energyexplained/index.cfm?page=biofuel_home.

[9] *Id.*

how they apply to the Brazilian model. Part IV analyzes the Brazilian experience and explains why it would be very difficult or impossible to replicate in the United States. Overall, this article portrays the difficulties and challenges the United States will face in trying to follow the Brazilian model.

## I. BIOFUELS: NATURE AND ROLE

Presently, the most commonly used biofuels are biodiesel and ethanol. Biodiesel is a renewable fuel produced from agricultural resources such as vegetable oils—including soybean, canola, and sunflower—as well as recycled cooking oils and animal fats.[10] Biodiesel can be used in any diesel engine; no adaptations are necessary.[11] Ethanol, on the other hand, is a renewable fuel made from plants. Ethanol is produced by fermenting plant sugars from corn, sugar cane, and other starchy agricultural products, as well as cellulosic materials in agricultural wastes (e.g., waste woods and corn stalks).[12] Ethanol can be mixed with gasoline and mass-marketed. Indeed, any gasoline-powered engine manufactured after 1980 in the United States can run on a blend of 90 percent gasoline and 10 percent ethanol ("E10"). However, only flex-fuel vehicles (which are not widely available in the United States) can operate with a blend of gasoline containing more than 10 percent ethanol.[13] In principle, biofuels have a lighter environmental footprint than fossil fuels. Plants absorb carbon dioxide from the air as they grow. As a result, the carbon dioxide released from biofuel combustion does not represent a net addition of greenhouse gases released to the atmosphere.[14] Biofuels also burn cleaner than fossil fuels because they are created from nontoxic and biodegradable substances.[15]

Thus, there are both economic and environmental reasons why incentivizing the production and consumption of these fuels seem an

---

[10] *EPA Technical Highlights: Biofuels*, U.S. ENVTL. PROTECTION AGENCY (EPA), at 1, *available at* http://www.epa.gov/otaq/renewablefuels/420f10009.pdf.

[11] *Biofuels: Ethanol and Biodiesel Explained*, *supra* note 8.

[12] *EPA Technical Highlights: Biofuels*, *supra* note 10.

[13] *Biofuels: Ethanol and Biodiesel Explained*, *supra* note 8.

[14] ARTHUR RODRIGUES, ETANOL: ASPECTOS JURIDICOS, ECONOMICOS E INTERNACIONAIS 16 (2011).

[15] *See Biodiesel and the Environment*, U.S. ENERGY INFO. ADMIN. (March 19, 2012); http://www.eia.gov/energyexplained/index.cfm?page=biofuel_biodiesel_environment; *Ethanol and the Environment*, U.S. ENERGY INFO. ADMIN. (March 19, 2012), http://www.eia.gov/energyexplained/index.cfm?page=biofuel_ethanol _environment.

appealing policy choice for countries. On the economic front, biofuels could potentially diminish dependence on oil imports, offer more security in the continuity of oil supply, and improve the balance of trade.[16] In the environmental realm, biofuels could help minimize air pollution and greenhouse gas emissions.[17] However, as production and use of biofuels have mushroomed, the sought-after environmental economic benefits have been elusive.[18] For example, because planting, harvesting, transporting, fertilizing, and converting biomass into fuels requires energy (much of which derives from fossil-sources), calculating the carbon footprint of biofuels has proven to be a complex endeavor.[19] Indeed, some argue that biofuels offer no improvement at all over fossil fuels.[20] In addition, burning ethanol may increase airborne concentrations of formaldehyde and acetaldehyde into the air, thus increasing local pollution and health risks.[21] Finally, rising food prices and the undesirable expansions of agriculture into conservation areas are possible results of the growing pressure to produce ever-increasing volumes of biofuels.

## II. THE DEVELOPMENT OF ETHANOL REGULATION IN BRAZIL

The first official policy adopted by the Brazilian government to incentivize the nation's production and consumption of ethanol was Proalcool (National Ethanol Program). It was launched in 1975 by Decree n. 76.593, mandating the addition of ethanol to gasoline for use in motor vehicles.[22] There was no fixed percentage for the blend. Rather, Petrobras (Petroleo Brasil S/A)—a federally owned company that held a monopoly on oil exploitation, production, refinement, and transportation in Brazil until 1997—was directed to buy ethanol and add it to gasoline.[23] The federal government awarded financial incentives to companies

---

[16] *Economics of Biofuels*, EPA (Aug. 20, 2012), http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Biofuels.html.

[17] Leite & Leal, *supra* note 2.

[18] D.A. Walker, *Biofuels – For Better or Worse?*, 156 ANNALS OF APPLIED BIOLOGY 319 (2010).

[19] RODRIGUES, *supra* note 14.

[20] Walker, *supra* note 18, at 319 – 20.

[21] Mark Shwartz, *Ethanol Vehicles Pose Significant Risk to Health, New Study Finds*, STANFORD U. NEWS (Apr. 18, 2007), http://news.stanford.edu/news/2007/april18/ethanol-041807.html.

[22] Decreto No. 76.593, de 14 de Novembro de 1975, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 7 (Braz.).

[23] Lei No. 9.478/97, de 7 de Agosto de 1997, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 06.08.1997 (Braz.).

producing ethanol in order to guarantee that ethanol supply would meet the demand generated by the program.[24]

The Yom Kippur War of 1973 had a devastating impact on oil prices.[25] The price of oil jumped from US$2 to US$12 per barrel in 1973,[26] causing an international crisis known as the first oil shock.[27] The crisis deeply affected the Brazilian economy, which at the time imported 80 percent of its oil.[28] The Brazilian government—then a military dictatorship[29]—felt compelled to remedy the country's widely off-kilter balance of trade and help bring inflation under control.[30] The government was determined to invest in and develop renewable energy sources.[31] Of the options discussed—diesel oil, coal and ethanol[32]—ethanol presented the most promise and garnered the most support.[33] Proalcool was put into place by presidential decree in 1975.[34] It promised to diminish Brazil's dependence on foreign oil, aid national economic and scientific development, and generate employment and income.[35] Following the creation of Proalcool, ethanol regulation and development in Brazil can be divided into four phases.[36]

### A. FIRST PHASE: 1975–1979

During the first phase, Brazil's focus was on producing anhydrous ethanol to be blended with gasoline.[37] The aim was to reduce

---

[24] Decreto No. 76.593, de 14 de Novembro de 1975, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: arts. 5,6 (Braz.).

[25] Ednaldo Michellon et al., *Breve Descrição do Proálcool e Perspectivas Futuras para o Etanol Produzido no Brasil*, XLVI CONGRESSO DA SOCIEDADE BRASILEIRA DE ECONOMIA, ADMINISTRAÇÃO E SOCIOLOGIA RURAL (Rio Branco — Acre, Julho 20 – 23, 2008) *available at* http://www.sober.org.br/palestra/9/574.pdf.

[26] *Id.*

[27] Euclid A. Rose, *OPEC's Dominance of the Global Oil Market: The Rise of the World's Dependence on Oil*, 58 THE MIDDLE E. J. 424 (2004).

[28] Pery F. A. Shikida & Carlos José C. Bacha, *Evolução da Agroindústria Canavieira Brasileira de 1975 a 1995*, 53 REVISTA BRASILEIRA DE ECONOMIA, RIO DE JANEIRO 69, 70 (1999).

[29] Brazil was under a military dictatorship from 1964 until 1985, when a peaceful transition was made to a civilian democratic government.

[30] Michellon et al., *supra* note 25.

[31] *Id.*

[32] Shikida & Bacha, *supra* note 28.

[33] Michellon et al., *supra* note 25.

[34] *Id.*

[35] Shikida & Bacha, *supra* note 28, at 73.

[36] *See* Michellon et al., *supra* note 25.

[37] *Id.*

petroleum imports and, thereby, the ballooning trade deficit.[38] Brazil had spent US$8.36 billion on oil imports between 1974 and 1976, while spending only US$1.4 billion between 1972 and 1974.[39] Proalcool's initial goal was to produce 3 billion liters of ethanol by 1980, up from less than a billion liters per year in 1975.[40]

The government boosted ethanol production by offering loans and subsidies to the energy sector.[41] It also determined that Petrobras would buy a minimum annual volume of ethanol,[42] as well as transport, distribute, and blend it with gasoline.[43] The government would set the price of ethanol through the Instituto do Acucar e Alcool (IAA)—an agency tasked with regulating the sugar and ethanol sector, defining export quotas, and subsidizing the industry.[44] Decree n. 80.762/77 (adopted in 1977) superseded the 1975 Decree and established parity between ethanol and sugar prices.[45] During the following ten years, US$16 billion was invested in genetic research to improve sugar cane yield, subsidize the ethanol sector, and underwrite low-interest financing for new agricultural machinery.[46]

Ethanol production initially occurred in distilleries adjacent to working sugar mills.[47] This arrangement arose because the sugar industry was already well established in Brazil.[48] The industry had recently modernized and expanded both because of the IAA's programs, and because excess sugar cane was available due to sugar prices decreasing internationally.[49]

The ethanol era's first phase ended with this stage of Proalcool's expansion. Growth slowed due to uncertainties caused by fluctuations in international sugar prices and the auto industry's doubts regarding the

---

[38] *Id.*

[39] Shikida & Bacha, *supra* note 28, at 70.

[40] RODRIGUES, *supra* note 14, at 16.

[41] Michellon et al., *supra* note 25.

[42] RODRIGUES, *supra* note 14, at 16.

[43] Michellon et al., *supra* note 25.

[44] Giuliano Guandalini and Chrystiane Silva, *A Dupla Conquista*, REVISTA VEJA (Feb. 2006), http://veja.abril.com.br/010206/p_090.html.

[45] Decreto No. 80.762/77, de 21 de Novembro de 1977, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 6 (Braz.).

[46] Guandalini & Silva, *supra* note 44.

[47] Vanessa M. Cordonnier, *Ethanol's Roots: How Brazilian Legislation Created the International Ethanol Boom*, 33 WM. & MARY ENVTL. L. & POL'Y REV. 287, 295 (2008).

[48] *Id.* at 289 (noting that the sugar industry had been well established in Brazil since colonial times).

[49] Michellon et al., *supra* note 25.

program's viability.[50] Nevertheless, in 1978, ethanol-fueled automobiles debuted.[51] Jobs and industry growth soon followed.[52]

### B. SECOND PHASE: 1979–1986

In 1979, a new conflict in the Middle East—this time a war between Iran and Iraq—contributed to oil prices escalating even further. Prices exceeded US$30 a barrel.[53] This price spike, known as the second oil shock, initiated Proalcool's second phase. Brazil's government began prioritizing production of hydrated ethanol for consumption due to the recent development of motor vehicles fueled exclusively by ethanol.[54]

In 1979, the 1977 Decree was superseded by Decree n. 83.700/79, and major automobile manufacturers signed an agreement with the Brazilian government setting massive production goals for ethanol-fueled cars.[55] Sugar cane production expanded and ethanol began to be produced in autonomous distilleries.[56] Proalcool's production goal increased to 10.7 billion liters by 1985, up from the 5.5 billion liters previously set for 1980.[57]

Along with increasing production, the government also implemented extraordinary measures to spur the purchase of ethanol-only vehicles.[58] The idea was to overcome consumer reluctance and distrust of the new car and fuel.[59] A minimum blend of 20 percent anhydrous ethanol was set for all gasoline consumed in the country, installation of hydrated ethanol pumps in gas stations became mandatory,[60] taxes on industrialized products and motor vehicles were reduced for ethanol-only engines,[61] and ethanol-fueled taxis were granted a tax exemption.[62] Furthermore, the price of ethanol could not exceed 65

---

50 *Id.*
51 *Id.*
52 *Id.*
53 Shikida & Bacha, *supra* note 28, at 73.
54 *Id.*
55 Cordonnier, *supra* note 47, at 298
56 Shikida & Bacha, *supra* note 28, at 73.
57 RODRIGUES *supra* note 14, at 17.
58 RODRIGUES *supra* note 14, at 18.
59 Cordonnier, *supra* note 47, at 298.
60 RODRIGUES, *supra* note 14, at 17.
61 Imposto sobre Produto Industrializado — IPI (Tax on Industrialized Products) and Taxa Rodoviária Única (currently equivalent to IPVA).
62 Michellon et al., *supra* note 25.

percent of the price of gasoline.[63] In 1980, 28.5 percent of all motor vehicles sold in Brazil were ethanol-only.[64] By 1984, that percentage increased to 88.5 percent.[65]

This second phase represented the peak of the biofuel program's expansion, as well as the beginning of its downfall. The Brazilian government succeeded in establishing ethanol as a viable substitute for fossil fuels. Its goals of ethanol production, consumption, and price parity with gasoline had all been attained. However, in 1985 oil prices stabilized and sugar prices and ethanol prices began to rise.[66] As a result, the economics of ethanol came into question.[67] This resulted in reduced investments in Proalcool from 1985 onward.

### C. THIRD PHASE: 1986–2003

The third phase was marked by crisis. Proalcool's mandatory and subsidized nature guaranteed its initial success, but also condemned the program to long-term unsustainability.[68] In 1985, the military dictatorship ended. The subsequent transition to democracy saw the government begin to prioritize the need to control inflation and equalize the balance of trade.[69] In 1986, international oil prices decreased and stabilized, and Brazil's dependence on foreign oil decreased as the country began relying more on domestic petroleum supplies.[70] As a result, incentives to expand ethanol production were cut and the government reduced subsidies to existing ethanol plants.[71]

The decrease in federal support for ethanol revealed a dangerous imbalance in the supply of and demand for the biofuel.[72] The program became discredited while high international sugar prices and lower government incentives spurred the ethanol industry to turn to sugar production.[73] However, tax incentives for ethanol-fueled vehicles

---

63 Shikida & Bacha, *supra* note 28, at 75.
64 *Id.* at 80
65 *Id.*
66 RODRIGUES, *supra* note 14, at 17.
67 *Id.*
68 Guandalini & Silva, *supra* note 44.
69 Michellon et al., *supra* note 25.
70 Guandalini & Silva, *supra* note 44.
71 *Id.*
72 Shikida & Bacha, *supra* note 28, at 80.
73 Michellon et al., *supra* note 25.

remained and ethanol prices dropped lower than gasoline prices.[74] Thus, even though production stagnated, ethanol consumption continued to increase.[75] By 1986, the volumes of ethanol and gasoline consumed in Brazil were practically the same,[76] and 90 percent of vehicles traded were ethanol-only.[77] This led to a critical crisis in supply. In 1989, Brazil began importing ethanol.[78]

In 1990, the ethanol sector was deregulated and the once powerful IAA was extinguished.[79] By 1994, only 12.2 percent of motor vehicles sold in Brazil were ethanol-only.[80] This downturn reflected a lack of consumer confidence, which in turn stemmed from hardships faced by owners of ethanol-only vehicles during the supply crisis.[81] In 1998, ethanol-only vehicle production was discontinued.[82]

Despite the halt in production, the legislature enacted an important pro-ethanol law.[83] Law n. 8.723/93 mandated reductions in pollutants emitted by motor vehicles and established a mandatory blend of 22 percent ethanol for all gasoline sold in Brazil.[84] This represented an important shift in the federal ethanol policy. For the first time, ethanol production was incentivized for environmental rather than economic reasons.[85] This new law determining the mandatory blend was the main reason why ethanol production continued in Brazil during the 1990s.[86]

Financial difficulties and the failure of governmental policies during the 1990s resulted in the end of subsidies and government incentives as well as the private sector's efforts to revitalize and adapt the industry to the new economic reality.[87] The industry had to be

---

[74] *Id.*

[75] *Id.*

[76] *Id.*

[77] RODRIGUES, *supra* note 14, at 17.

[78] Shikida & Bacha, *supra* note 28, at 79.

[79] Guandalini & Silva, *supra* note 44.

[80] Shikida & Bacha, *supra* note 28, at 80.

[81] André Tosi Furtado & Mirna Ivone Gaya Scandiffio, *A Promessa do Etanol no Brasil*, VISAGES D'AMÉRIQUE LATINE, no. 5, Sept. 2007, at 95, 97.

[82] RODRIGUES, *supra* note 14, at 17.

[83] Lei No. 8.723/93, de 28 de Outubro de 1993, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 9, de 29.10.1993 (Braz.) original redaction, before amended by Lei No. 10.203/01.

[84] *Id.*,

[85] HELINI SILVINI FERREIRA & JOSE RUBENS MORATO LEITE, BIOCOMBUSTIVEIS: FONTES DE ENERGIA SUSTENTAVEL? CONSIDERACOES JURIDICAS, TECNICAS E ETICAS 126 – 27 (2010).

[86] *Id.* at 126.

[87] Luis Fernando Paulillo et al., *Álcool combustível e biodiesel no Brasil - quo vadis*, 45 REV. ECON. SOCIOL. RURAL 531,542 (2007).

modernized in order to maintain Brazilian ethanol's competitiveness in internal and external markets.[88] Agriculture was mechanized, scientists experimented with new variations of sugar cane, strategic mergers and acquisitions were carried out, and mills and distilleries were modernized.[89] Many private institutions arose as well. For example, Brasil Alcool (BA) and (Bolsa Brasileira de Alcool (BBA), which sought to remedy the excess of ethanol in the market and attain better prices for the product; while Uniao de Agroindustria Canavierira de Sao Paulo (UNICA) and Associacao Paulista da Agronindustria Sucroalcooleira (SUCROALCOOL), began to gather and represent a large part of the industry in the country.[90]

The federal government also created a new agency, Agencia Nacional do Petroleo (ANP), in 1997 to regulate and monitor the exploitation, production, refinement, transportation, distribution, retail, imports, and exports of oil, derivative substances, natural gas, and ethanol.[91] Finally, in 1999, ethanol prices became subject to free market rules and were no longer set by the government.[92]

### D. FOURTH PHASE: 2003–PRESENT

After its rise and fall, it seemed like Proalcool and the Brazilian ethanol experience had failed. However, a new rise in international oil prices, and increasing international awareness about climate change, as well as the development of flex-fuel engines in Brazil, gave Brazilian ethanol a new push. [93] The spike in oil prices caused by instability in the Middle East revived the discussion about fossil fuel substitutes and alternative energy sources.[94] The 1997 Kyoto Protocol also called attention to alternative energy sources, specifically regarding the need to reduce greenhouse gas emissions.[95] However, it was the development in 2003 of a commercially viable flex-fuel engine that could run on

---

[88] *Id.* at 543

[89] *Id.*

[90] Michellon et al., *supra* note 25.

[91] Lei No. 9.478/97, de 6 de Agosto de1997, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 07.08.1997 (Braz.).

[92] Ministerio da Fazenda's Portaria No. 64 (1996).

[93] Guandalini & Silva, *supra* note 44.

[94] *Id.*

[95] *See* Kyoto Protocol, *supra* note 4.

gasoline, hydrated ethanol, or any blend of gasoline and anhydrous ethanol that truly propelled ethanol back into dominance. [96]

The Brazilian flex-fuel engine runs on any combination of anhydrous ethanol and gasoline blend, as well as on pure hydrated ethanol.[97] By contrast, flex-fuel vehicles produced in other countries operate on a blend of a maximum of 85 percent ethanol.[98] Brazil's flex technology dissipated fears about the unavailability and price of ethanol and gave Brazilian drivers the ability to fuel their vehicles with either ethanol, gasoline, or both.[99] For these reasons, the flex-fuel vehicle was a big success, significantly increasing the national demand for ethanol.[100] Flex-fuel vehicles became ubiquitous, with half of the 30,000 gas stations in the country offering hydrated ethanol.[101] By 2006, seven in every ten vehicles sold in Brazil had flex-fuel engines.[102]

### E. CURRENT LEGAL FRAMEWORK

At present, there is no legal framework specifically aimed at regulating ethanol in Brazil. Production and consumption is governed primarily by the National Energy Policy (Law n. 9.478/97), under its general regulation of biofuels.[103] In the current regulatory landscape, Agencia Nacional do Petroleo ("ANP"), the National Petroleum Agency, is the main regulatory agency for any activity regarding biofuels.[104] The Ministry of Agriculture, Livestock and Provisions (Ministerio da Agricultura, Pecuaria e Abastecimento ("MAPA"), and the Interministry Commission of Sugar and Ethanol (Comissao Interministerial do Acucar e do Alcool, or "CIMA") play strategic roles in defining the percentage of the mandatory blend of ethanol to gasoline on federal land.[105] Tax incentives also form an important component of the regulatory environment.

---

[96] Guandalini & Silva, *supra* note 44.

[97] SUANI T. COELHO, UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT, Feb. 7 – 9, 2005, *Biofuels: Advantage and Trade Barriers*, at 12, (Feb. 4, 2005).

[98] *Id.*

[99] Guandalini & Silva, *supra* note 44.

[100] *Id.*

[101] *Id.*

[102] *Id.*

[103] Law No. 9.478/97, *supra* note 91.

[104] *Id.*

[105] Decreto No. 3.966/01, de 11 de Outubro de 2001, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 1, de 10.11.2001 (Braz.).

The National Energy Policy (Law n. 9.478/97) was amended in 2005 by Law n. 11.097/05 to include biofuels in the national energy matrix and to set the increment of biofuels production and use.[106] In its current form—shaped more recently through amendments introduced by Law n. 12.490/11—the National Energy Policy aims to ensure a national supply of biofuel, as well as to promote Brazil's competitiveness in the international biofuels market.[107] The policy also incentivizes energy generation from biomass and residues from biofuel production, classifying them as complementary sources to hydroelectric energy.[108] The policy expressly declares biofuels use to be part of the national strategy to mitigate greenhouse gas emissions, as well as to curb air pollution from the transportation and energy sectors.[109]

Law n. 11.097/05 changed the ANP's name from Agencia Nacional do Petroleo (National Petroleum Agency) to Agencia Nacional do Petroleo, Gas Natural e Biocombustiveis (National Agency of Petroleum, Natural Gas and Biofuels).[110] Moreover, Law n. 11.909/09 and Law n. 12.490/11 added the regulation, authorization, and operative oversight of any activity related to the production of biofuels to the ANP's jurisdiction,[111] making it the regulatory agency most responsible for biofuels activities in Brazil.

Law n. 8.723/93, which determined reductions in the amount of air pollutants emitted by motor vehicles, was amended once more in 2003.[112] Law n. 10.696/03 kept the mandatory percentage of ethanol to be blended with gasoline in the national territory at 22 percent but stipulated that the president could elevate the percentage to a maximum of 25 percent or lower it to a minimum of 18 percent.[113] In 2001, Presidential Decree n. 3.966/01 delegated the power to elevate or lower the mandatory percentage of ethanol to the Ministry of Agriculture, Livestock and Provisions, following approval of the Inter-ministry Commission of Sugar and Ethanol.[114]

---

[106] Law No. 9.478/97, *supra* note 91.
[107] *Id.* art. 1 (XIII & XV).
[108] *Id.* art. 1 (XIV).
[109] *Id.* art. 1 (XVIII).
[110] *Id.* art. 7.
[111] *Id.* art. 8 (VII & XVI).
[112] Lei No. 10.696/03, de 2 de Julho de 2003, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 18, de 03.07.2003 (Braz.).
[113] Lei No. 8.723/93, *supra* note 83, art. 9.
[114] Decreto No. 3.966/01, *supra* note 105, art. 1.

In 2007, MAPA Ordinance n. 143/2007 raised the mandatory percentage in the blend to 25 percent.[115] In 2010, MAPA Ordinance n. 07/2010 lowered the percentage to 20 percent for ninety days in the beginning of 2010.[116] Currently, the percentage is 20 percent, per MAPA Ordinance n. 678/2011.[117]

In addition to the industry advantages created by the mandatory blend, there also exist significant tax incentives for ethanol production in Brazil.[118] While there are four taxes on ethanol, the same four taxes are charged on gasoline, but at much higher rates.[119] Increasing gasoline taxes indirectly incentivizes ethanol consumption and production.[120] For example, the rate of the Contribution on Intervention in the Economic Domain (Contribuicao de Intervencao no Dominio Economico, or "CIDE") on the imports and internal sales of gasoline is R$860 per cubic meter, while ethanol imports and internal sales are charged only R$37.20 per cubic meter.[121] Clearly, ethanol users enjoy substantial savings.

While the government's principal focus with respect to ethanol involves incentivizing and regulating the production of ethanol for motor vehicles, production for the energy sector is also implicated.[122] Ethanol producers may—if all legal requirements are fulfilled—use sugarcane residue (bagasse) from their operations to generate energy, a measure that is supported by the Incentive Program for Alternative Energy Sources (Programa de Incentivo as Fontes Alternativas de Energia Eletrica, or "PROINFA").[123] PROINFA was launched in 2002 by Law n.

---

[115] Portaria No. 143/2007/MAPA, Article 1, de 29 de Junho de 2007, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] (Braz.).

[116] Portaria No. 7/2010/MAPA, Article 1, de 12 de Janeiro de 2010, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] (Braz.).

[117] Portaria No. 678/2011/MAPA, de 1 de Setembro de 2011, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] (Braz.).

[118] RODRIGUES, *supra* note 14, at 126.

[119] The Contribution on Intervention in the Economic Domain (Contribuicao de Intervencao no Dominio Economico - CIDE), the Contribution to Programs of Social Integration and Building of Public Servant's Estate (Programas de Integracao Social e de Formacao do Patrimonio do Servidor Publico — PIS/PASEP), the Contribution to the Financing of Social Security (Contribuicao para o Financiamento da Seguridade Social — COFINS), and the Tax on the Circulation of Goods and Services (Imposto sobre Circulacao de Mercadorias e Servicos — ICMS).

[120] RODRIGUES, supra note 14, at 126.

[121] Lei No. 10.336/01, de 9 de Dezembro de 2001, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 1, de 20.12.2001 (Braz.).

[122] RODRIGUES, *supra* note 14, at 126.

[123] Law No. 10.438/02, de 26 de Abril de 2002, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 29.04.2002 (Braz.).

10.438/02, and was intended to increase the participation of alternative energy sources in the national system of energy production and transmission (Sistema Elétrico Interligado Nacional, or "SIN").[124] The program was divided into two phases. Phase 1 had an initial goal of generating 3,300 megawatts (MW) of energy from those renewable sources contemplated by the program (wind, small hydroelectric projects, and biomass) by 2008.[125] Phase 2 sought to achieve an even more ambitious goal: to make possible that in twenty years' time, 10 percent of all energy consumed in the country would derive from projects affiliated with PROINFA.[126] According to the Brazilian government, Phase 1 was implemented successfully, with the generation of 3.299,40 MW of energy from alternative sources.[127] However, some critics argue that Phase 1 was never actually implemented—contracts were signed, but many projects did not generate energy due to various problems.[128] Phase 2 seems to have been abandoned, with no apparent effort or planning from the government for its realization.[129]

## III. ENVIRONMENTAL ISSUES

Ethanol development has helped Brazil overcome a historical dependency on foreign oil, allowing it to completely cease oil imports.[130] This wholesale integration of ethanol has enabled the most successful alternative to fossil fuels for transportation currently known.[131] The initiative is also an important part of a national effort to curtail greenhouse gas emissions and diminish air pollution from motor vehicles.

Ethanol supporters maintain that ethanol offers significant environmental advantages over fossil fuels.[132] They argue that planting

---

[124] *Id*. art. 3

[125] *Id*. art. 3(I)(a).

[126] *Id*. art. 3(I)(b).

[127] *Profina*, MINISTERIO DE MINAS E ENERGIA, http://www.mme.gov.br/programas/proinfa.

[128] *Adeus Profina*, BRAZIL ENERGIA (Feb. 2, 2010), http://www.energiahoje.com/brasilenergia/noticiario/2010/02/02/403330/adeus-proinfa-2.html.

[129] *Id.*

[130] The exploitation of the country's vast oil resources had a significant role in this process. In 2006, with the inauguration of Petrobras' platform P-50, Brazil achieved oil independence — the national oil supply became available in sufficient quantities to meet the internal demand. *Lula anuncia auto-suficiência do Brasil em petróleo amanhã*, FOLHA ONLINE, (Apr. 20, 2006), http://www1.folha.uol.com.br/folha/dinheiro/ult91u107023.shtml.

[131] Guandalini & Silva, *supra* note 44.

[132] RODRIGUES, *supra* note 14.

sugarcane absorbs carbon dioxide from the air and, as a result, carbon dioxide released when ethanol is burned does not contribute to net greenhouse gas emissions.[133] They also maintain that ethanol is nontoxic and biodegradable and burns cleaner than gasoline,[134] thus improving local air quality.[135] These claims have come under increased scrutiny in recent years.[136]

Critics argue that large-scale ethanol production raises food prices and strains food supplies due to the diversion of agricultural resources to produce fuel instead of food.[137] They note that the United States has experienced higher food prices due to its ramping-up of corn ethanol production.[138] However, Brazil has produced ethanol (from sugar) in gradually increasing volumes for more than thirty-five years without experiencing such effect.[139]

A possible answer as to why food prices have not risen in Brazil is that there are still vast areas available for planting other crops.[140] There are 355 million hectares in Brazil suitable for agricultural activities.[141] Of those 355 million hectares, only 90 million are appropriate for planting sugarcane, and only 7.2 million hectares are actually under plow.[142] Half of that total is dedicated to sugar production, not ethanol.[143] Thus, theoretically there are 77 million hectares available and suitable for sugarcane cultivation in Brazil without putting pressure on the spaces dedicated to other crops.[144]

Another criticism of the ethanol industry is that increased demand for ethanol forces farming expansion, which in turn leads to conversion of protected areas to agricultural uses.[145] This potential poses a special concern for Brazil because of the threat of encroachment of

---

[133] *Id.*

[134] U.S. ENERGY INFO. ADMIN., *supra* note 15.

[135] *Id.*

[136] RODRIGUES, *supra* note 14, at 8.

[137] *Id.*

[138] *Id.* at 9.

[139] Guandalini & Silva, *supra* note 44.

[140] *Biocombustiveis e alimentos*, REVISTA VEJA (Apr. 2008), http://veja.abril.com.br/idade/exclusivo/perguntas_respostas/biocombustiveis_alimentos/index.shtml.

[141] *Id.*

[142] *Id.*

[143] *Id.*

[144] *Id.*

[145] RODRIGUES, *supra* note 14, at 12.

sugarcane plantations into the Amazon region.[146] However, the threat to the Amazon may be overstated.[147] The Amazon climate is not ideal for sugarcane cultivation.[148] Consequently, ethanol production is unlikely to expand into the region, particularly with so much other suitable land available elsewhere. In addition, technological improvements have boosted ethanol productivity.[149]

Still, there remains a very real indirect threat to the Amazon. Higher demand for ethanol could force people and industries displaced by sugar to move to the Amazon.[150] This would create the same result (increased deforestation) as the expansion of sugar cultivation into the region.[151] To protect against such eventualities, Brazil has enacted very strict limits regarding how much land in the Amazon—and every other rural region of the country—can be used for any activity other than sustainable management of the native forest or vegetation.[152] The Forest Code (Law n. 12.651/12) establishes a percentage of native forest or vegetation that must be kept in every rural property in the country.[153] The percentage varies depending on the region and native vegetation. For the Amazon, 80 percent of the property must be covered with the native forest, and for those in "cerrado"[154] areas of the Amazon region, the percentage is 35 percent.[155] For properties in any other forest or native vegetation area in Brazil, 20 percent of the property must be covered with native species; and for any other rural property in Brazil, 20 percent of the possession must preserve whatever original vegetation exists in the area.[156]

Consequently, the law restricts the amount of land that can be converted to sugarcane or any other crop due to increasing ethanol demand. In the Amazon, for example, only 20 percent of any rural property can have the original forest suppressed in order to plant

---

[146] *Id.*

[147] *Id.*

[148] *Id.*

[149] *Id.* at 11.

[150] *Id.* at 12.

[151] *See* Daniel A. Farber, *Indirect Land Use Change, Uncertainty, and Biofuels Policy*, U. ILL. L. REV. 381, 389 (2011).

[152] Lei No. 12.651/12, de 25 de Maio de 2012, DIÁRIO OFICIAL DA UNIÃO [D.O.U.]: art. 12, de 28.05.2012 (Braz.).

[153] *Id.*

[154] Vegetation of the Brazilian interior.

[155] Law No. 12.651/12, *supra* note 152, art. 12(I)(b)

[156] *Id.* art. 12(II).

sugarcane. [157] However, enforcement of these laws presents significant challenges, especially in the Amazon, where the vastness of the area and the difficulties of accessing remote areas pose significant obstacles to the effectiveness of the Forest Code.

Thus, although the criticism that a high demand for ethanol will force agricultural expansion into protected areas is not wholly accurate in the Brazilian case, inadequate enforcement means that threats to protected areas by agricultural interests do indeed exist. Ethanol critics also argue that using ethanol for transportation may result in more greenhouse gas emissions than using oil because more energy from fossil fuels gets used in the production and distribution of ethanol than the biofuel could actually generate.[158] This criticism has substantial merit. Depending on the production method and the source plant, greenhouse benefits of ethanol vary greatly.[159] In the case of Brazilian ethanol, however, the balance on a well-to-wheels basis—from the extraction of the fuel used in agriculture to combustion in a motor vehicle—is positive; it results in significant reductions of greenhouse gas emissions.[160] Hydrated and anhydrous ethanol consumption by motor vehicles in Brazil generated substantially less greenhouse gas emissions from the national fleet than if pure gasoline had been the only fuel used. For example, from 1990 to 1994, avoided carbon dioxide emissions[161] totaled between 42 percent and 46 percent[162] of the potential carbon dioxide emissions.[163] During the same period, avoided emissions from other greenhouse gases were also significant, varying from 6 percent to 17 percent in comparison with hypothetical emissions.[164] These savings resulted in substantial part from the fact that most sugarcane mills in the

---

[157] *Id.* art. 12(I)(a).

[158] Farber, *supra* note 152, at 385 – 86.

[159] *Id.*

[160] *Id.*

[161] The avoided emissions are defined as the difference between the emissions from a hypothetic scenario where the national fleet consumes only pure gasoline, and the emissions from the actual scenario, where the fleet is formed by vehicles consuming a blend of gasoline and anhydrous ethanol as well as hydrated ethanol. MINISTÉRIO DA CIÊNCIA E DA TECNOLOGIA, *Primeiro Inventário Brasileiro de Emissões Antrópicas de Gases Efeito Estufa — Relatórios de Referência — Emissões de Gases de Efeito Estufa por Fontes Móveis, no Setor Energético* 39 (2006), *available at* http://www.mct.gov.br/upd_blob/0008/8848.pdf (First Brazilian Inventory of Anthropic Greenhouse Gases Emissions — Reference Reports — Greenhouse Gases Emissions from Mobile Sources of the Energy Sector).

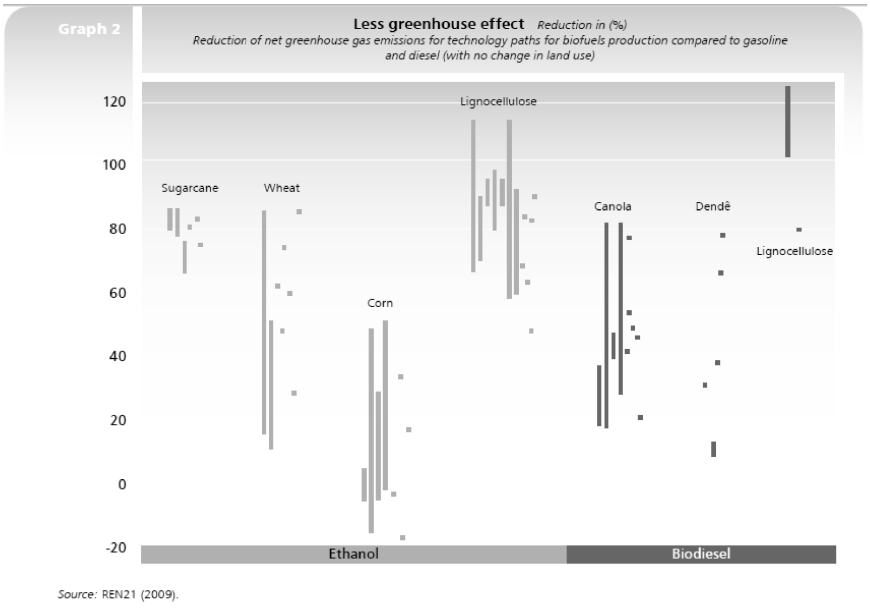
[162] *Id*. at 40.

[163] The hypothetic emissions are defined as those resulting from a hypothetic scenario where the entire national fleet consumed only pure gasoline. *Id*. at 39.

[164] *Id*. at 40.

country are self-sufficient in energy generation. Sugarcane bagasse is used to generate the energy necessary to the production process.[165]

In 2008, the OECD issued a study comparing the amount of greenhouse gases emitted during the lifecycle of different biofuel source plants.[166] Sugarcane ethanol resulted in an average of 85 percent less emissions than gasoline, and even 100 percent in cases where mills used crop residues to generate the electricity to power the operation.[167] In comparison, ethanol from wheat provides reductions between 30 percent and 50 percent, and ethanol from corn yields an average of 20 percent less emissions.[168]




[165] COELHO, *supra* note 97, at 18

[166] ADRIANO PIRES & RAFAEL SCHECHTMAN, ETANOL E BIOELETRICIDADE: A CANA-DE-ACUCAR NO FUTURO DA MATRIZ ENERGETICA 196 (2010) ( considering different technologies that can be used in production and did not consider possible changes in land use).

[167] *Id.*

[168] *Id.*

## IV. CONCLUSION: POSSIBLE LESSONS FOR THE UNITED STATES?

The development of ethanol in Brazil has helped the country overcome a historical dependence on foreign oil while curbing its greenhouse gases emissions and diminishing local air pollution. After the supply crisis and the price volatility made ethanol an unreliable choice for the Brazilian consumer toward the end of the 1980s and throughout the 1990s,[169] high international oil prices in the 2000s remade it an attractive option once again.[170] Perhaps the single most important factor in the resurgence of the ethanol sector was the development of flex-fuel technology, which permitted Brazilian consumers to fuel their vehicles with ethanol or gasoline every time they go to a gas station.[171] That freedom of choice eased the volatility of the market and provided consumers with the certainty that they could always choose the least expensive fuel alternative.

Most of the prevailing critiques of the ethanol sector regarding environmental issues do not apply in the Brazilian case, primarily because of the peculiarities of sugarcane ethanol production in the country.[172] The overall success of Brazil's ethanol program has resulted in calls for its replication abroad, including in the United States. However, reproducing Brazil's ethanol success in the United States would be virtually impossible.

First, the Brazilian option to heavily invest in ethanol was made during a military dictatorship.[173] No dissent was permitted, and consequently, prices could be manipulated and a high degree of governmental intervention tolerated. Ethanol prices were controlled, ethanol pumps were mandatorily installed, Petrobras was obliged to buy

---

[169] Guandalini & Silva, *supra* note 44.

[170] *Id.*

[171] *Id.*

[172] *Biocombustiveis e alimentos*, *supra* note 140.

[173] Shikida & Bacha, *supra* note 28, at 70.

a percentage of the production, etc. [174] These measures would not only be impossible to implement in a democratic system such as the one in the United States, they would also likely fail under the current Brazilian democratic regime.

Second, the United States lacks the infrastructure and the market for widespread ethanol consumption in motor vehicles. The facts that most gas stations in Brazil have pumps for hydrated ethanol and that most people own flex-fuel vehicles are key to the success of Brazilian ethanol.[175] In the United States, gas stations would likely be very reluctant to install hydrated ethanol pumps until demand existed. Consumers, on the other hand, would be deterred from investing in flex-fuel vehicles until there was infrastructure in place with which to purchase flex fuel. The ensuing stalemate creates an environment where the rapid growth of a flex fuel vehicle market becomes highly unlikely.

Third, and most importantly, Brazil produces ethanol from sugarcane, while the United States produces ethanol from corn.[176] Ethanol from sugarcane is cheaper and more energy efficient than corn ethanol, and its mass production does not cause the same impact on food markets in Brazil as ethanol from corn did and does in the United States.[177]

Corn ethanol is also more expensive to produce than both gasoline and Brazilian sugarcane ethanol.[178] The low cost of sugarcane ethanol production allows Brazilian ethanol to compete with gasoline without the substantial subsidies used until recently[179] by the United States to make corn ethanol competitive.[180]

Corn ethanol production is also energy-intensive.[181]It may require more energy to produce and distribute then it is capable of generating.[182] This significantly diminishes the possible greenhouse gas

---

[174] *Id*. at 74.

[175] Guandalini & Silva, *supra* note 44.

[176] *Biocombustiveis e alimentos*, *supra* note 140.

[177] PIRES & SCHECHTMAN, *supra* note 166, at 196.

[178] Nancy I. Potter, *How Brazil Achieved Energy Independence and the Lessons the United States Should Learn from Brazil's Experience*, 7 WASH. U. GLOBAL STUD. L. REV. 331, 348 (2008).

[179] Robert Pear, *After Three Decades Tax Credit for Ethanol Expires*, N.Y. TIMES, Jan. 1, 2009, at A.

[180] It is worth noting that U.S. sugar growers have not yet seriously tried to produce ethanol because the highly controlled U.S. Sugar Import Program makes raw sugar prices more advantageous. *See* David Adams, *Sugar in the Tank*, FORBES.COM (Nov. 16, 2005), http://www.forbes.com/2005/11/15/energy-ethanol-brazil_cx_1116energy_adams.html.

[181] Farber, *supra* note 151, at 385 – 86.

[182] *Id*. at 385.

emissions benefits.[183] By contrast, sugarcane ethanol results in an average of 85 percent less emissions than gasoline, and can reach 100 percent in cases where mills are energy self-sufficient.[184] Furthermore, corn is a "major food crop" and livestock food,[185] and most usable farmland in the United States is already in production.[186] Consequently, any substantial diversion of corn to ethanol production will almost certainly affect food prices.[187] Brazil, on the other hand, has vast lands available and suitable for planting sugarcane without displacing other crops. For all of these reasons, if the United States were to pursue ethanol as a substitute for gasoline on the same scale as Brazil did, and if it were to do so with an eye toward real environmental gains and minimizing impacts on the food supply, it would have to seek source plants other than corn.

There are other alternative feed sources for ethanol under study.[188] The most promising of these is cellulosic ethanol.[189] Cellulosic ethanol is produced by breaking down cellulose in woody fibers such as trees, grasses, and crop wastes.[190] These sources require less energy, fertilizer, water, and can also be cultivated on lands not appropriate for growing food.[191] However none of these cellulosic ethanol alternatives are yet commercially viable.[192]

In sum, the hard lesson for the United States to learn from the Brazilian model is that while the results are worthy of emulation, the methods of achieving it were unique. Thus, the methods used in Brazil are not necessarily desirable and the results are simply not replicable here.

---

[183] PIRES & SCHECHTMAN, *supra* note 166, at 206.

[184] *Id.* at 196.

[185] Farber, *supra* note 151, at 383.

[186] Potter, *supra* note 178, at 347.

[187] Pear, *supra* note 179.

[188] U.S. ENERGY INFO. ADMIN., *supra* note 15.

[189] RODRIGUES, *supra* note 14, at 7.

[190] U.S. ENERGY INFO. ADMIN., *supra* note 8

[191] *Id.*

[192] Andy Parris, *Light Vehicle Alternative Fuels and Fuel Economy Related Technologies*, INT'L TRADE ADMIN. 3 (Sept. 10, 2009), *available at* www.trade.gov/mas/manufacturing/oaai/. . ./tg_oaai_003663.pdf.