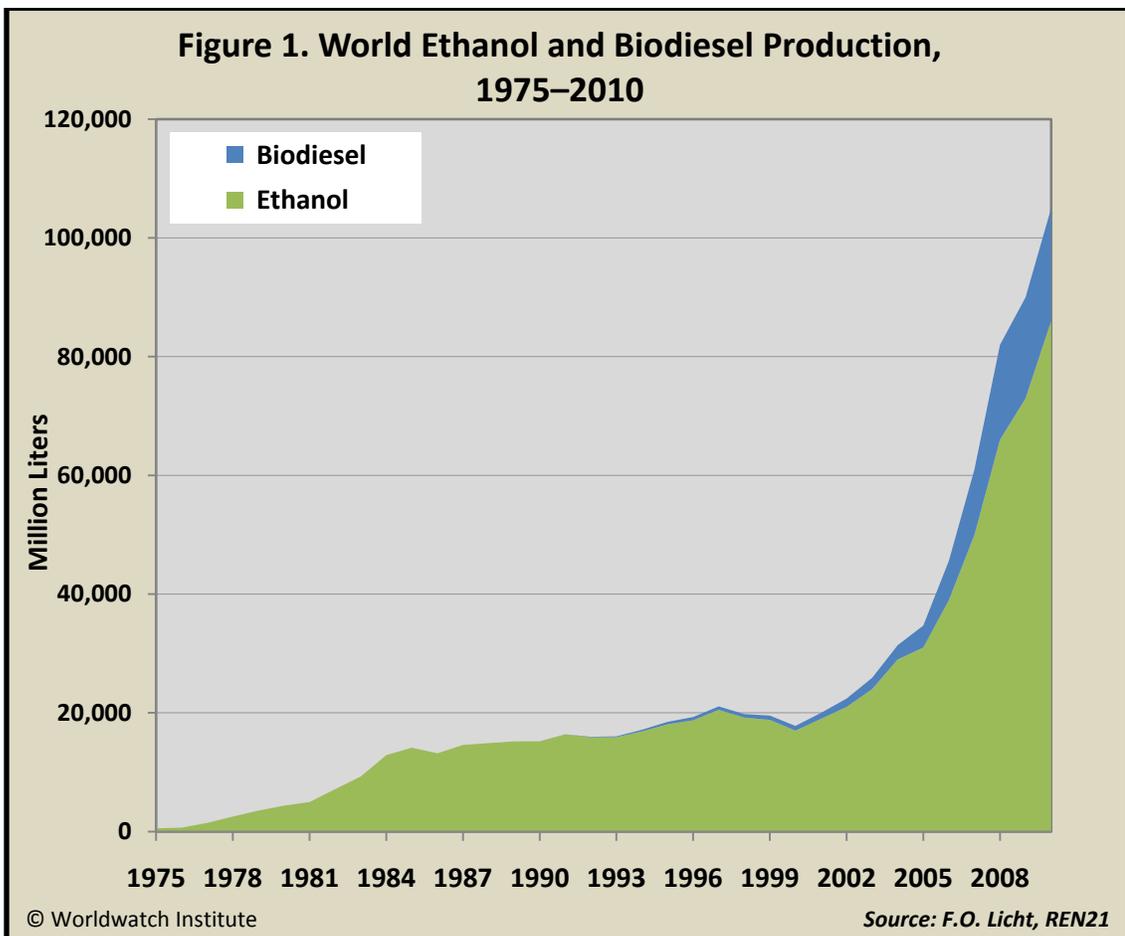


## Biofuels Regain Momentum

By Sam Shrank and Farhad Farahmand | August 30, 2011

**G**lobal biofuel production increased by 17 percent in 2010 to reach an all-time high of 105 billion liters.<sup>1</sup> (See Figure 1.) The increase exceeded the 10 percent growth experienced in 2009, when production was at 90 billion liters.<sup>2</sup> Biofuels provided 2.7 percent of all global fuel for road transportation—an increase from 2 percent in 2009.<sup>3</sup>



The two biofuel alternatives to fossil fuels for transportation largely consist of ethanol and biodiesel. Ethanol is primarily made by fermenting the sugars in corn and sugarcane, while biodiesel is produced from fats and vegetable oils. The world produced 86 billion liters of ethanol in 2010, which was 18 percent more than in 2009.<sup>4</sup> World biodiesel production rose to 19 billion liters in 2010, a 12 percent increase from 2009.<sup>5</sup>

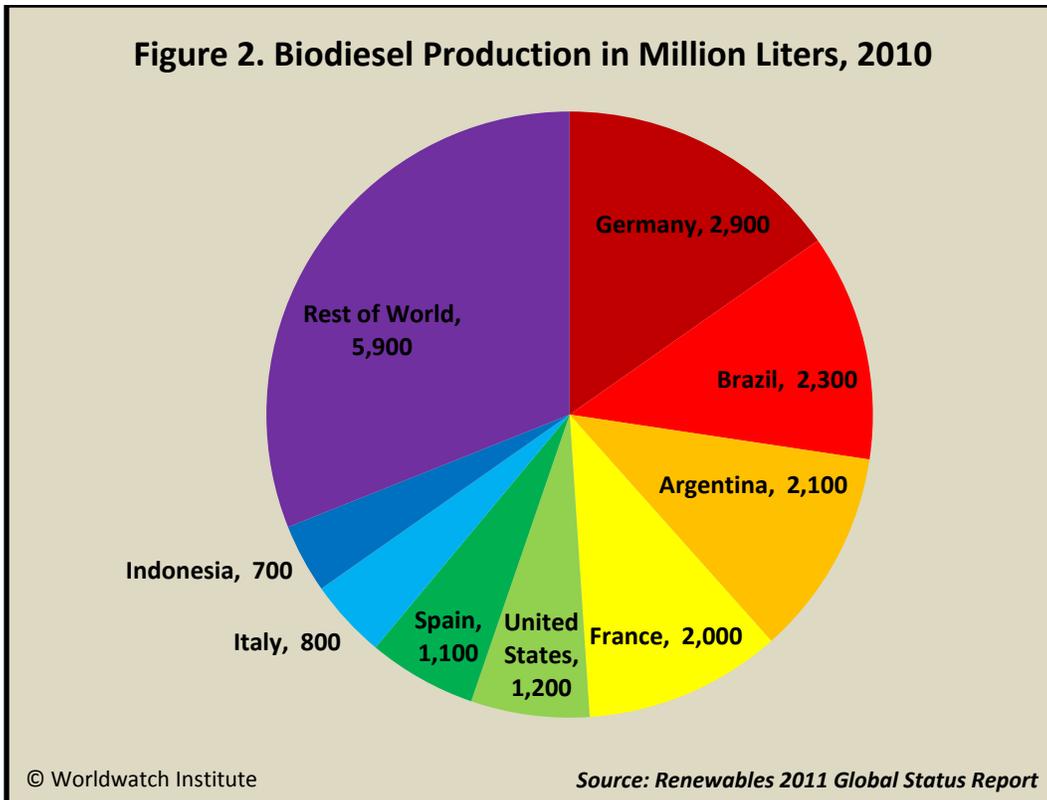
The United States again led the world in ethanol production in 2010 at 49 billion liters, or 57 percent of world output.<sup>6</sup> Brazil was the second largest producer, at 28 billion liters, which was 33 percent of the world total.<sup>7</sup> Distant followers included China, Canada, France, Germany, and Spain, each producing less than 2.5 percent of world supply.<sup>8</sup> No other countries showed significant changes in ethanol production.

In 2010, ethanol production in the United States grew by 8.4 billion liters, equaling the 2009 growth rate of 20 percent.<sup>9</sup> Corn is the primary feedstock for U.S. ethanol, which supplies 4 percent of the nation's road transport fuel.<sup>10</sup> Ethanol-gas blends for U.S. vehicles that are model year 2001 and newer can be as high as 15 percent ethanol (E15), though in most cases the percentage blended is much lower.<sup>11</sup> Because of unsteady production in Brazil, the United States became a net ethanol exporter for the first time, sending a record 1.3 billion liters abroad, an increase of 300 percent over 2009.<sup>12</sup> The largest markets for U.S. exports were Canada, Jamaica, the Netherlands, the United Arab Emirates, and Brazil.<sup>13</sup>

Sugarcane is the only source of ethanol in Brazil, where production rose by 2 billion liters in 2010, a 7 percent increase.<sup>14</sup> This represented a rebound from the 3 percent drop in production in 2009, even as adverse global weather led to rising sugar prices and was economically disadvantageous for sugarcane ethanol production.<sup>15</sup> Sugarcane ethanol supplies 41.5 percent of the energy (48 percent of the volume) for light-duty transportation fuels in Brazil.<sup>16</sup>

The European Union remained the center of biodiesel production, accounting for 53 percent of global output in 2010.<sup>17</sup> Growth slowed there dramatically, however, falling from 19 percent in 2009 to just 2 percent in 2010.<sup>18</sup> The top biodiesel producers worldwide were Germany (2.9 billion liters, a 12 percent increase) and Brazil (2.3 billion liters, a 46 percent increase and responsible for one third of global growth).<sup>19</sup> (See Figure 2.) Other notable producers include Argentina, which increased production by 57 percent to 2.1 billion liters in 2010, and France, whose production fell by 0.6 billion liters to 2.0 billion liters in 2010.<sup>20</sup> Asia produced 12 percent of the world's biodiesel, a 20 percent increase from 2009, mostly from palm oil in Indonesia and Thailand.<sup>21</sup>

**Figure 2. Biodiesel Production in Million Liters, 2010**



The global increase in ethanol output was principally caused by large fuel players in the United States entering the industry in response to high oil prices. Valero, Flint Hills, Sunoco, and Murphy Oil each invested in hundreds of millions of liters of ethanol plant capacity, and Pacific Ethanol returned from the brink of bankruptcy to open four new plants.<sup>22</sup>

Internal dynamics in Brazil also opened the door to U.S. ethanol exports. Unfavorable weather in 2010 drove down the global sugar yield, raised sugar prices, and favored sugar production in Brazil over that of sugarcane ethanol.<sup>23</sup> At the same time, high oil prices led many Brazilians, who drive flex-fuel cars that can run on either fossil fuels or biofuels, to increase their use of ethanol.<sup>24</sup>

The growth of low-cost international competitors from Canada, Argentina, Indonesia, and elsewhere as well as the rising costs of rapeseed oil—the leading biodiesel feedstock in Europe—meant that Europe exploited only 40 percent of its production capacity and relied on imports to meet the rest of its demand.<sup>25</sup> Biodiesel accounts for the majority of biofuels consumed in the region, but many countries may switch from biodiesel to ethanol in the future because of a recent European Commission report on the indirect land use impacts of biodiesel.<sup>26</sup> Ethanol crops have a higher energy content than biodiesel crops, and the report shows that their production may involve lower greenhouse gas emissions.<sup>27</sup> The European Union currently has a 5.75 percent blending mandate for biofuels.<sup>28</sup>

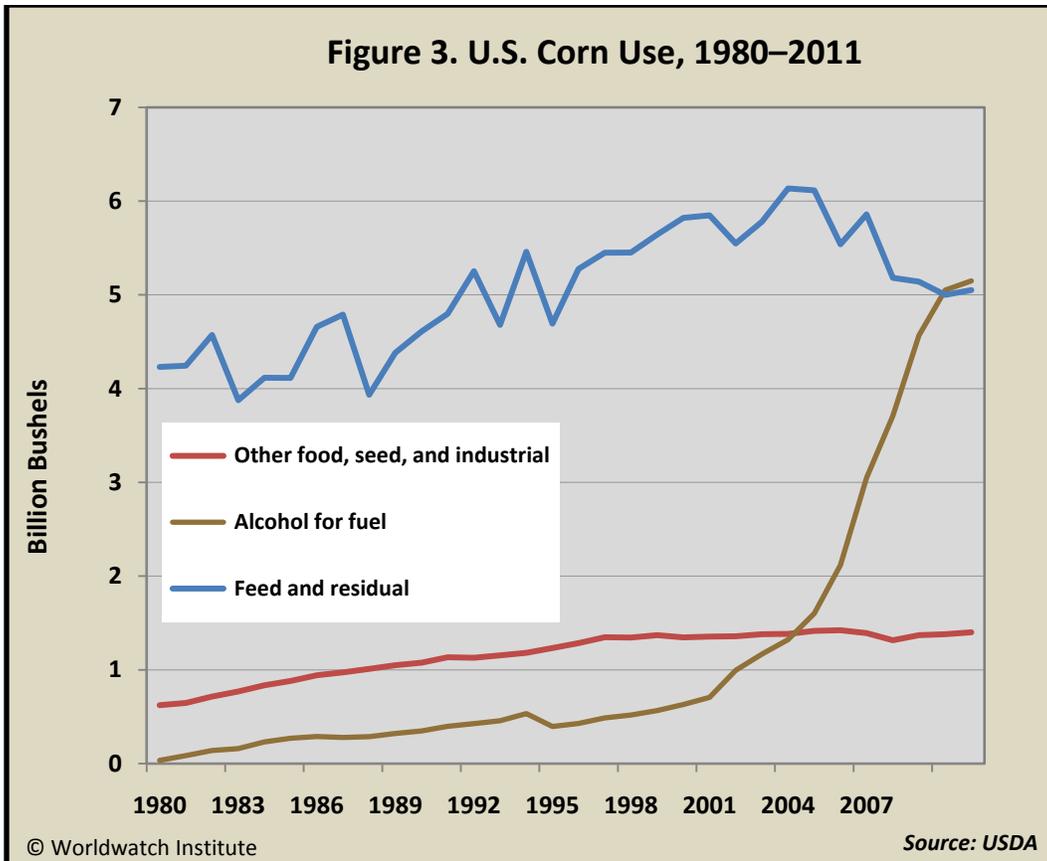
Argentina's biodiesel industry grew in response to a new B7 blending mandate (7 percent biodiesel and 93 percent diesel) as well as to favorable conditions for growing soybeans.<sup>29</sup> Virtually all of the 1.5 billion liters of Argentinean exports, representing 71 percent of total production, went to Europe.<sup>30</sup> Argentina has 19 biodiesel production facilities; Brazil, which has a B2 blending mandate that will be increased to B5 in 2013,

has 64.<sup>31</sup> Argentinean producers continue to invest in facilities, and a mandate as high as B20 could be instituted in the next four years.<sup>32</sup>

Federally, Canada has E5 (5 percent ethanol and 95 percent gasoline) and B2 mandates, and four Canadian provinces have individual mandates up to E8.5.<sup>33</sup> In China, nine provinces require E10 blends; the country produced 2.1 billion liters of fuel ethanol in 2010 despite lacking a federal blending mandate.<sup>34</sup> The other large biofuel producers in Asia include Indonesia, which has an E3 and B2.5 mandate, and Thailand, which has an E10 and B3 mandate.<sup>35</sup>

Many observers continue to look to cellulosic biofuels as an area for future growth, but the U.S. Environmental Protection Agency (EPA) reduced the U.S. production target of cellulosic biofuels for the second straight year.<sup>36</sup> Cellulosic ethanol is made from biomass that is otherwise considered waste, such as woodchips, pulp, husks, and stems, or from low-value crops like switchgrass and jatropha. The final target for 2011 will be 25 million liters rather than the 950 million liters originally required by the Renewable Fuel Standard under the 2007 Energy Independence and Security Act.<sup>37</sup> Cellulosic ethanol can be harvested from degraded land unsuitable for food, and it is often associated with lower greenhouse gas emissions because the crops grown for it are typically stronger greenhouse gas sinks and can convert more efficiently from feedstock to ethanol.<sup>38</sup> The EPA's target reduction reflects the technical challenges and costs of commercializing second-generation biofuels like cellulosic ethanol.<sup>39</sup>

In 2011 ethanol is projected to overtake the animal feeding industry as the largest corn consumer in the United States, helping production margins but shining a brighter light on ethanol subsidies.<sup>40</sup> (See Figure 3). A Senate bill will come before Congress that would cut ethanol production subsidies but maintain tax credits for infrastructure like refilling stations.<sup>41</sup> The University of Missouri's Food and Agricultural Policy Research Institute estimates that eliminating the 54¢ import tariff and 45¢-per-gallon blenders' credit would reduce industry profits by 7 percent and margins by 20 percent.<sup>42</sup> The Renewable Fuel Standard provides a guaranteed market of 50 billion liters in 2012, but the industry nearly matched this in 2010, suggesting that the mandate alone would not support the existing market.<sup>43</sup> The corn ethanol mandate increases to 57 billion liters by 2015.<sup>44</sup>



Brazilian sugarcane ethanol will likely become more prevalent in the United States if American ethanol subsidies and tariffs are removed, but poor weather and aging cane plants indicate that Brazilian sugar yields could fall in 2011.<sup>45</sup> Sugar ethanol is cheaper and more efficient to produce, although there are worries that its production may indirectly lead to deforestation.<sup>46</sup> Brazil's plans to build 103 new mills by 2019 (increasing capacity by 66 percent), the growing number of blending mandates around the world, and a global economic rebound all presage increased Brazilian ethanol production and exports in the coming years.<sup>47</sup>

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## Notes

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- <sup>1</sup> REN21, *Renewables 2011 Global Status Report* (Paris: 2011), p. 32.
- <sup>2</sup> *Ibid.*
- <sup>3</sup> BP, *BP Statistical Review of World Energy* (London: June 2011), p. 3; REN21, op. cit. note 1, p. 31.
- <sup>4</sup> REN21, op. cit. note 1.
- <sup>5</sup> *Ibid.*
- <sup>6</sup> *Ibid.*, p. 31.
- <sup>7</sup> *Ibid.*, p. 32.
- <sup>8</sup> *Ibid.*, p. 75.
- <sup>9</sup> *Ibid.*
- <sup>10</sup> *Ibid.*, p. 31.
- <sup>11</sup> U.S. Environmental Protection Agency, "E15 (A Blend of Gasoline and up to 15% Alcohol)," at [www.epa.gov/otaq/regs/fuels/additive/e15](http://www.epa.gov/otaq/regs/fuels/additive/e15).
- <sup>12</sup> REN21, op. cit. note 1, p. 31; Renewable Fuels Association, *2011 Ethanol Industry Outlook* (Washington, DC: February 2011), p. 27.
- <sup>13</sup> REN21, op. cit. note 1, p. 31.
- <sup>14</sup> *Ibid.*, p. 32.
- <sup>15</sup> *Ibid.*
- <sup>16</sup> *Ibid.*, p. 31.
- <sup>17</sup> *Ibid.*, p. 32.
- <sup>18</sup> *Ibid.*
- <sup>19</sup> *Ibid.*, p. 75; REN21, *Renewables 2010 Global Status Report* (Paris: 2010), p. 56.
- <sup>20</sup> REN21, op. cit. note 1.
- <sup>21</sup> *Ibid.*, p. 32.
- <sup>22</sup> Rohan Boyle, "Latest Developments in Solar, Wind, Biofuels and Marine," *Bloomberg New Energy Finance*, Monthly Briefing, March 2010, p. 6.
- <sup>23</sup> REN21, op. cit. note 1, p. 46.
- <sup>24</sup> Michael McConnell, Erik Dohlman, and Stephen Haley, "World Sugar Price Volatility Intensified by Market and Policy Factors," *Amber Waves* (U.S. Department of Agriculture (USDA)), September 2010.
- <sup>25</sup> European Biodiesel Board, "2009–2010: EU Biodiesel Industry Restrained Growth in Challenging Times," press release (Brussels: 22 July 2010).
- <sup>26</sup> Charlie Dunmore, "Climate Impact Threatens Biodiesel Future in EU," *Reuters*, 8 July 2011.
- <sup>27</sup> *Ibid.*
- <sup>28</sup> Jim Lane, "Biofuels Mandates Around the World," *Biofuels Digest*, 21 July 2011.
- <sup>29</sup> Shane Romig, "Despite Global Hiccups, Argentine Biodiesel Booms," *MarketWatch*, 18 April 2011.
- <sup>30</sup> *Ibid.*; Bryan Sims, "Argentina Increases Biodiesel Mandate," *Biodiesel Magazine*, 13 July 2010 (converted from tons to gallons).
- <sup>31</sup> Sims, op. cit. note 30; Lane, op. cit. note 28.
- <sup>32</sup> Romig, op. cit. note 29.
- <sup>33</sup> Lane, op. cit. note 28.
- <sup>34</sup> *Ibid.*
- <sup>35</sup> *Ibid.*; REN21, op. cit. note 1, p. 86.
- <sup>36</sup> Nuel Navarrete, "E.P.A. Lowers Cellulosic Ethanol Requirement for 2011," *EcoSeed*, 1 December 2010.
- <sup>37</sup> *Ibid.*
- <sup>38</sup> International Energy Agency (IEA), *Sustainable Production of Second-Generation Biofuels* (Paris: 2010), pp. 22–23; Paul Adler et al., "Life Cycle Assessment of Net Greenhouse-Gas Flux for Bioenergy Cropping Systems," *Ecological Applications*, vol. 17 (2007), pp. 675–91; Jorn Scharlemann and William Laurance, "How Green are Biofuels?" *Science*, 4 January 2008, pp. 43–44; David Tilman et al., "Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass," *Science*, 8 December 2006, pp. 1598–1600.
- <sup>39</sup> Navarrete, op. cit. note 36.
- <sup>40</sup> Gavin Maguire, "USDA Report May be Bad for Ethanol," *Reuters*, 12 July 2010; USDA, Economic Research Service, "Corn: Background" updated 18 February 2009, at [www.ers.usda.gov/Briefing/Corn/background.htm](http://www.ers.usda.gov/Briefing/Corn/background.htm).
- <sup>41</sup> Timothy Gardner, "US Senate Deal Would Axe \$6 Bln Ethanol Tax Credit," *Reuters*, 7 July 2011.
- <sup>42</sup> Carey Gillam, "Ethanol Grown Up, Will Withstand U.S. Subsidy Loss," *Reuters*, 17 June 2011.
- <sup>43</sup> Renewable Fuels Association, "Statistics," at [www.ethanolrfa.org/pages/statistics](http://www.ethanolrfa.org/pages/statistics).

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- <sup>44</sup> American Coalition for Ethanol, "Federal Legislation," at [www.ethanol.org/index.php?id=78](http://www.ethanol.org/index.php?id=78).
- <sup>45</sup> Peter Murphy, "Low Yields Put Dent in Brazil Sugar, Ethanol – Unica," *Reuters*, 7 July 2011.
- <sup>46</sup> Michael Grunwald, "The Clean Energy Scam," *Time*, 27 March 2008.
- <sup>47</sup> Katia Cortes, "Brazil to Need \$550 Billion Energy Investment by 2019," *Bloomberg Businessweek*, 29 November 2010.