Mexico and the Biofuel Challenge A Critical Balance Sheet

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In the face of the widely recognized phenomenon of man-made climate change[1] and in a context in which easily accessible oil reserves are beginning to peak,[2] energy security is today of major importance for the future. Considering the impact of the transportation sector on the climate, but also on the quality of the air, among other socio-environmental and energy security issues, not only the use of technologies to increase energy efficiency, but also new —in principle more sustainable— forms of fuel have been proposed as an alternative: biofuels.

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This is an important pledge, above all if we consider that the transportation sector was responsible in 2009 for consuming 96 exajoules of energy, almost all of it fossil fuels. In addition, the tendency for the world's vehicular fleet to expand cannot be ignored: it will go from 1.2 billion to 2.6 billion units in 2050.[3] This undoubtedly complicates the sphere of action for reducing net greenhouse gas (GHG) emissions given that, even considering increased vehicular fuel efficiency, the tendency for generating emissions associated with the transportation sector points to an increase: 50 percent more by 2030 and 80 percent more by 2050, in the best of cases, since they could increase by 130 percent by 2050.[4]

Given that it is taken for granted that biofuels emit less GHG, they have been put forward as a potential solution. This notion, however, has been widely questioned not only in terms of the amount of energy required to produce them (ethanol or biodiesel), but also regarding the emissions associated with their life cycle, from production all the way to distribution and combustion. Other problems are also pointed to like competition for the land and water for producing food versus biofuels and the stimulus to the change in soil use to the detriment of ecosystems, which would bring with it the loss of the ability to capture carbon, among other consequences.

Even taking into account the impetus given to biofuels (for example, in the framework of the Sustainable Energy for All Initiative, launched at the Rio + 20 meeting), their potential is limited from the perspective of their contribution to the global energy matrix. It has been estimated that the maximum potential could be 20 to 30 percent of all liquid fuels utilized by the transportation sector.[5] In 2010, biofuels only represented 2.7 percent of the total.[6] In 2010, ethanol production reached 86 billion liters, 17 percent more than in 2009. Production was cornered by the United States (57 percent) and Brazil (31 percent), with the gap between these two countries increasingly widening and clearly reversing the ratio that existed between them just a few years ago when Brazil was the world's largest producer. Biodiesel production, on the other hand, although it has increased 24-fold since 2000, has plateaued in recent years, and in 2010 came to 19 billion liters. The world's top 10 producers accounted for 75 percent of production in 2010: the European Union led with 53 percent of the total, while Asia (above all Indonesia and Thailand) represented 12 percent.[7] Particularly important were Germany, which produced 2.9 billion liters (BL); Brazil, with 2.3 BL; and Argentina, with 2.1 BL.

The Impetus of Biofuels Worldwide

The impetus biofuels are experiencing is particularly derived from the implementation of different initiatives and regulations worldwide, mostly to satisfy the demand of U.S. and European automobile drivers. The European Union, for example, has stipulated that 10 percent of fuel used by its transportation sector in 2020 would be biofuel. South Africa did

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something similar, setting its goal at 2 percent. The United States decided it would produce 136 BL of biofuel by 2022, and China set a goal of 13 BL of ethanol and 2.3 BL of biodiesel per year until 2020.[8] The ethanol/gasoline ratios vary from country to country, since, while in Finland it is E6 (6 percent), in Ethiopia, it is E10. The same is the case of biodiesel, where the mixes are B3 and B5 in Thailand, while in Spain they are B6, with the expectation of reaching B7 in 2012.[9]

According to the Renewable Policy Network for the Twenty-first Century (Ren21), by the end of 2010, 31 national initiatives, 29 state or provincial initiatives, and 19 national tax-break schemes had been identified.[10] Total subsidies to ethanol production per liter of fossil fuel replaced are estimated between US$1.00 and US$1.40 in the United States, and US$1.64 and US$4.98 in the European Union. For biodiesel, they range from US$0.66 to US$0.90 in the United States and from US$0.77 to US$1.53 in the European Union.[11]

Added to these measures are the actions and lobbying efforts of the Global Bioenergy Partnership and the World Bank loan packages,[12] as well as packages from similar banks in Latin America (Inter-American Development Bank, or IDB), Asia (the Asian Development Bank, or ADB), and Africa (African Development Bank, or AFDB). The IDB, for example, has opened up a line of credit for more than US$3 billion, mostly channeled through its Sustainable Energy and Climate Change Initiative (SECCI).[13]

Biofuels in Mexico

The Ministry of Energy, with support from the IDB and the German Agency for Technical Cooperation (GTZ), asked to evaluate the viability of the production and use of biofuels in the transportation sector. The result was a report, "Potenciales y viabilidad del uso de bioetanol y biodiesel para el transporte en México (Potential and Viability of the Use of Bioethanol and Biodiesel for Transport in Mexico), which concluded that sugarcane is the most promising crop for ethanol production in the short term.[14] After studying different inputs for biodiesel, the report concluded that "in all cases the production costs of biodiesel are higher than the opportunity cost of the diesel sold by Pemex."[15] And it added that, in any case, the most competitive crops given the country's conditions are palm trees, sunflowers, and soy beans.

Taking into consideration this background information and these assessments, the Chamber of Deputies passed the Law to Promote and Develop Biofuels (LPDB) on April 26, 2007. After several changes, this law created a Biofuels Commission, a Program to Introduce Biofuels, and Sectoral and Annual Programs regarding the production, storage, transportation, distribution, commercialization, and efficient use of biofuels.[16] It should be pointed out that until now, most of the commercial ventures have involved sugarcane and palm production, the former cultivated mostly in Veracruz, and the latter, in Chiapas.

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In Mexico, estimates put the technical potential for land that could be planted with sugarcane at 2.9 million hectares, almost four times what is currently under cultivation.[17] In terms of the irrigated land that could potentially be used to plant sugarcane to make biofuels, which would have higher yields, the estimate is about 1.2 million hectares.[18] The biggest difficulty is the limited processing capacity, since, until today, only two plantations, La Gloria and San Nicolás, both in Veracurz, have the technology to make ethanol. To this should be added the regulatory protection of the sugar industry that analysts consider makes the production of ethanol unviable.[19]

And, despite this regulatory framework, the stakeholders in the biofuel business, or those who might be interested in being in it, have said that the concrete actions needed to implement research results on an industrial scale, as well as the productive projects themselves, continue to be relatively limited, to a great extent because government financial support is practically non-existent.

Added to this are strong criticisms, above all related to biofuels' potential impacts on the environment and the demand for land and water, among other things. Others point out that the idea of sparking rural development by fostering biofuels is wrong, because what should be focused on is sustainable production of basic foods for reasons both of food security and food sovereignty. While the production of food can be based on the population's general well-being, biofuels, in contrast, benefit in fact mainly private consumers, whether national or foreign (if they are exported).

Biodiesel made of palm oil is part of the aforementioned scenario, plus the fact that the country only produces 0.1 percent of the world's palm oil, and that, according to the National Association of Oil and Edible Lard Industrialists, our country has increased its dependence on the international vegetable oil market.[20] Our imports of palm oil represent 1 percent of the world's total. This, among other reasons, indicates that betting on this fuel is highly questionable and, for the moment, unviable on a large scale for reasons similar to those stated with regard to ethanol, and above all, given the intensive use of palm oil by the food processing industry.

Water and Land: Key Limitations On Biofuel Use in Mexico in 2025

The consumption of liquid fuels in Mexico has increased and, according to the Sener, gasoline consumption is expected to rise 57 percent, and diesel, 43 percent, by 2025.[21] This means that any use of ethanol and biodiesel would have to increase to be significant, at least in terms of climate change mitigation. In the framework of the research project titled "Socio-ecological Viability of the Use of Biofuels: a Review of the Country's Ground Transport Sector," coordinated by this author, estimates were made concluding that the implementation on a national level of an E10 mix (a mix of 10 percent) would require using 3.2 percent of all the country's cultivable land to grow sugarcane.

Assuming an approximately 32-percent increase in crop yield, as Sagarpa suggests, the same mix in 2025 would require 3.9 percent of the country's cultivable land. However, considering the crop's characteristics, estimates of potential cultivable land limit the area to no more than 2.9 million hectares, of which only 1.2 million can be irrigated. Considering that the yields for un-irrigated crops are between 60 and 64 tons per hectare, planting 1.7 million un-irrigated hectares would cover a maximum mix of E11 in 2025. To the contrary, planting 1.2 million irrigated hectares, which could well expect yields of 100 tons per hectare, would be sufficient for an E12 mix; this means that the entire potential for sugarcane crops in the country would barely displace 23 percent of the gasoline demand in 2025.

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The same estimate for the Valley of Mexico Metropolitan Area (ZMVM) shows that an E20 mix for 2025 would require an equivalent of 44 percent of the area's land surface to be planted if yields per hectare increased. This is the dimension of the demand for land of an energy vector like ethanol. With regard to water, the cost of ethanol is clearly high; suffice it to say that the natural availability of water in the ZMVM is about 4 224 gigaliters, which means that with that amount, an E20 mix would barely cover the city's requirements, but it would be slightly short —5 percent— for that mixture in 2025. In other words, to cover one-fifth of ZMVM's gasoline consumption with ethanol made from sugarcane, about half the area's territory and the entire natural water supply would have to be used. Of course, this argument is only for comparative purposes, since it is clear that the concrete impacts will occur in the sugarcane-producing regions where disputes over land and water use could well arise or intensify.

With regard to the production of biodiesel made from palm oil, the results obtained suggest that if current national palm output were all used to make biodiesel, leaving nothing for the food industry, it would only be enough to cover a B11 mix for the ZMVM, since nationally it would not even represent 1 percent of the mix. To achieve a national B5 mix, the land planted with oil palms would have to increase six fold, thus sharpening the demand for land and water. The amount of water required for a B7 mix nationwide would be the equivalent of all the natural water available for the entire ZMVM.

The current yield of oil palms per hectare is low, but it is estimated that it will double by 2025, reaching standards like those in Asia's main palm producing countries. This explains the fact that the projections for 2025 register an increase in the water footprint, while land surface is reduced practically a third. Nevertheless, if this yield scenario is not achieved, the demand for land would increase, although certainly face important limits given other uses for the land, including conservation or ecological balance. This is exactly what has occurred in the world's most important palm-oil producing countries, and is also already starting in Mexico because it is becoming a threat in areas of high biodiversity in Chiapas.

Given all this, the surface area required for a national B20 mix would be the equivalent of the entire area of the states of

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Tlaxcala and Morelos combined. However, if yield/hectare remains completely unchanged, that surface area would double, that is, it would be the equivalent of the states of Querétaro, Morelos, and Mexico City's Federal District together. What is more, if European Union data are correct in the sense that the total emissions associated with first generation biofuels' life cycle are higher than expected —particularly palm, soy, and rapeseed oil create more emissions than petroleum (105-95gr of CO_2e/Mj *versus* 87.5gr of CO_2e/Mj)—, emissions savings in Mexico would be non-existent.[22] On the contrary, they would be more polluting the higher the mix level.

We can conclude, then, that the idea of using biofuels in the country based on first-generation technologies is extremely limited in the best of cases, essentially due to their intensive use of land and water. The potential for biofuels, in the best of cases, then, would only displace 20 percent of gasoline with sugarcane ethanol (the maximum mixture that conventional gasoline engines can use) and not more than 5 percent of diesel with palm-oil-based biodiesel. Naturally, other kinds of inputs can be added that would, however, also have to compete not only for land, but for water.

The possible emissions savings —only in the case of ethanol, since in the case of biodiesel, it would actually be the reverse— does not seem in and of itself to be something that would justify the enormity of the gamble. Neither is the supposed reactivation of the Mexican countryside, since it is a badly focused measure. This is not only because of the kinds of inputs required for producing biofuels and since they are a long way from any attempt at guaranteeing food security in the context of climate change, but also because of the agroindustrial form of cultivation, which, far from favoring the peasantry, tends to benefit big producers.

So, the proposal to use biofuels in Mexico, more than creating clear benefits, presents a negative balance sheet that spreads the impact, complicating it, since it is not limited to the atmospheric and the socio-environmental costs that the oil industry creates. It also involves the use and abuse of water and soil in the sphere of rural production, the potential loss of biodiversity, and the relative erosion of security and food sovereignty.

The alternatives for mitigating climate change in Mexico seem clearer and more justified. They include actions like reducing energy waste (efficiency); developing solar energy, above all thermal; long-term planning of soil use; conserving biodiversity; recovering rivers and soil; improving waste management; and reformulating the regional and national urban transportation system, among other issues associated with reducing the vulnerability of peoples and, therefore, of socio-economic inequalities. VM

FURTHER READING

Edenhofer, Ottmar, Ramón Pichs-Madruga, Youba Sokona, *et al.*, eds., *Renewable Energy Sources and Climate Change Mitigation. Special Report of the Intergovernmental Panel on Climate Change,* IPCC, Cambridge University Press, 2012, http://srren.ipcc-wg3.de/report.

NOTES

[1] S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, et al., eds., "Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change," *AR4-Climate Change 2007, The Physical Science Basis*, IPCC, 2007, http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm.

[2] See www.aspousa.org.

[3] See UN-Habitat, 2011, http://www.unhabitat.org/categories.asp?catid=9, p. 42.

[4] IEA (International Energy Agency), *World Energy Outlook 2009*, Paris, pp. 29, 43.

[5] Eugenio Sanhueza, "Agroetanol ¿un combustible ambientalmente amigable?" *Interciencia* vol. 2, no. 34, Caracas, 2009, pp. 106-112.

[6] Ren21, *Renewables 2011. Global Status Report* (Paris: Renewable Energy Policy Network for the 21st Century, 2011), p. 31.

[7] Ibid., p. 32.

[8] Ibid., p. 60.

[9] In this nomenclature, "E" stands for "ethanol" and "B" for "biodiesel," while the numbers refer to the percent biofuel represents in the biofuel-fossil-fuel mix.

[10] Ren21, op. cit., p. 61.

[11] Ibid., p. 38.

[12] See Garten Rothkopf, *A Blueprint for Green Energy in the Americas. Featuring: The Global Biofuels Outlook* 2007 (Washington, D.C.: Inter-American Development Bank, 2006), and Elizabeth Cushion, Adrian Whiteman, and Gerhard Dieterle, *Bioenergy Development* (Washington, D.C.: The World Bank, 2010).

[13] Masami Kojima and Todd Johnson, *Potential for Biofuels for Transport in Developing Countries* (Washington, D.C.: Energy Sector Management Assistance Programme/World Bank, 2005).

[14] Sener/GTZ/BID, *Potenciales y viabilidad del uso de bioetanol y biodiesel para el transporte en México*, Proyectos ME-T1007-ATN/DO-9375-ME and PN04.2148.7-001.00, Mexico City, 2006, p. 8.

[15] Ibid., pp. 10-11.

[16] See "Ley de Promoción y Desarrollo de los Bioenergéticos" (LPDB), 2008, www.diputados.gob.mx/LeyesBiblio/pdf/LPDB.pdf.

[17] INE, *Análisis integrado de las tecnologías, el ciclo de vida y la sustentabilidad de las opciones y escenarios para el aprovechamiento de la bioenergía en México* (Mexico City: UNAM, 2008), p. 16.

[18] Sagarpa, *Bases técnicas para el fomento a la producción de biocombustibles en el país a partir de caña de azúcar* (Mexico City: Sagarpa, 2010), p. 66.

[19] Ibid., p. 116.

[20] ANIAME, *La palma de aceite en el sureste mexicano*, Reportaje/Métodos Globales Respuestas Locales/Asociación Nacional de Industriales de Aceites y Mantecas Comestibles, A. C., Mexico City, 2006, http://portal.aniame.com/uploads/palmadeaceiteenelsure_61a49_001.pdf, p. 2.

[21] Sener, *Prospectiva de petrolíferos 2010-2025* (Mexico City: Gobierno Federal, 2010).

[22] EurActiv, "Biodiesels Pollute More than Crude Oil, Leaked Data Show," EurActiv, January 27, 2012.