A Biofuels Approach
For the Inter-American Development Bank

by

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Summary

In the wake of the dramatic increase in oil prices over the past year, biofuels are receiving a notable increase in interest from policymakers, investors, and the public alike today. These fuels are made from organic matter and consist of two major types—ethanol and biodiesel.

Ethanol is produced by processing starch- or sugar-based crops, such as corn, wheat and sugar cane, through fermentation. It is used almost exclusively in "spark-ignition" or "Otto-cycle" engines that traditionally use gasoline. In the countries of Latin America and the Caribbean (LAC), these are found primarily in light vehicles. Biodiesel is produced by processing a variety of vegetable oils—include soybean, palm, canola, castor, and jatropha. It is used in "compression-ignition" engines which utilize diesel oil today. In LAC, these are primarily found in heavier vehicles, including trucks and buses, as well as diesel generators.

In addition to the benefits that these fuels provide by their ability to substitute for oil—and hence reduce a nation's vulnerability to high oil prices—they also offer other potential benefits. First, their production and use is generally believed to yield fewer greenhouse gas emissions than oil-based fuels. Second, with a few exceptions, they also produce a lower level of local pollutants. And finally, for countries that have existing sugar industries, ethanol offers an option for producing a higher value-added product rather than relying exclusively on the volatile sugar commodity market.

LAC is attractive for biofuels development for several reasons. First, it is a region rich in biomass resources. Second, it is also the home for one of the largest biofuels producers today—Brazil, which produced 15 billion liters of ethanol in 2005, all from sugar cane (see Figure 2); only the U.S. has an equivalent ethanol production level. While the primary biodiesel producers in the world today are in Europe and the U.S., Brazil has also been a leader in LAC in biodiesel production, initiating a national program in 2004.

Given the potential benefits to the LAC region that a biofuels approach can offer, the Inter-American Development Bank (IDB or the Bank), which serves this geographic area, is contemplating how it might help its member countries reap the benefits of the biofuels potential while minimizing adverse impacts. Such an approach should be developed around four major principles:

- The countries of LAC are not at the same level in their present development and use of biofuels, and hence approaches must be tailored to both their present level of activity as well as their future potential in developing biofuels;
- The major types of biofuels—ethanol and biodiesel—need to be addressed separately because their feedstock is different, they are at substantially different levels of maturity, and they service different vehicle types;
- The risks involved in developing biofuels must be recognized and dealt with in an integrated manner; and

- Fuel production, distribution, and the development of vehicles to use the fuel have to be tackled simultaneously.

The challenges facing expanded biofuels development in LAC can be broken down into three categories: technical, policy-based, and financial. Technical challenges pertain to barriers regarding the introduction of new technologies or new technical approaches. Policy-based challenges refer to policy environments that are either ambiguous or directly contradictory to the development of biofuels. Finally, financing challenges pertain to the lack of access to finance at all stages of biofuels development.

To address these specific barriers, new types of financial instruments by the Bank may be needed in some cases; in other cases, existing instruments are sufficient but should be dedicated to address the barrier.

To address technical barriers, the specific types of IDB assistance proposed are: science and technology loans to develop new production technologies and feedstock for ethanol; assistance in establishing a regional network for investigating the adverse impacts of biofuels; and science and technology loans to develop the next generation of flexible fuel vehicles (which can operate on any mixture of gasoline and ethanol from pure gasoline to pure ethanol).

To address policy barriers, the types of IDB assistance proposed include: a biofuels resource assessment and economic viability evaluation for any potential new entrant into biofuels development among IDB member countries; policy assistance on options to establish domestic markets for biofuels; an assessment of the potential biofuels export market from LAC; assistance in developing capacity in LAC to undertake day-to-day biofuels trading; policy assistance in mitigating adverse impacts for new entrants into the biofuels market; assistance in developing an integrated approach to biofuels production, distribution and use for small country markets; and technical assistance on ways to reduce volatility in oil and biofuels feedstock prices.

To address financing barriers, the types of IDB assistance proposed include: establishment of an equity fund for the Private Sector Department to invest in companies using new biofuels production technologies; establishment of pilot programs for public sector programs and within the Inter-American Investment Corporation to demonstrate the economic viability of newer biofuels implementation techniques; and a flexible approach to the modernization of some state-owned sugar and ethanol industries ranging from investment prior to privatization to full privatization first.

Finally, given the potential benefits for carbon emissions reduction from the use of biofuels, it makes sense to evaluate whether resources from the Global Environmental Facility (GEF) or from the Clean Development Mechanism (CDM) could contribute to the emergence of a biofuels market in LAC. With respect to the GEF, these resources may be tapped to support biofuels development so long as they are consistent with country priorities for use of GEF resources as well as the GEF operational strategy on climate change. As an executing agency of the GEF, the IDB is in an optimal position to

work with its member countries to develop biofuels projects that meet these criteria. With regard to the CDM, credits for bagasse co-generation in ethanol plants (which improve the efficiency of the refining process and reduce ethanol costs) are likely since projects in this area have already been registered, while credits for biofuels production are not as clear since no methodologies for these technologies have yet been approved.

Background

In the wake of the dramatic increase in oil prices over the past year, biofuels are receiving a notable increase in interest from policymakers, investors, and the public alike today. These fuels are made from organic matter and consist of two major types—ethanol (often referred to as bioethanol) and biodiesel.

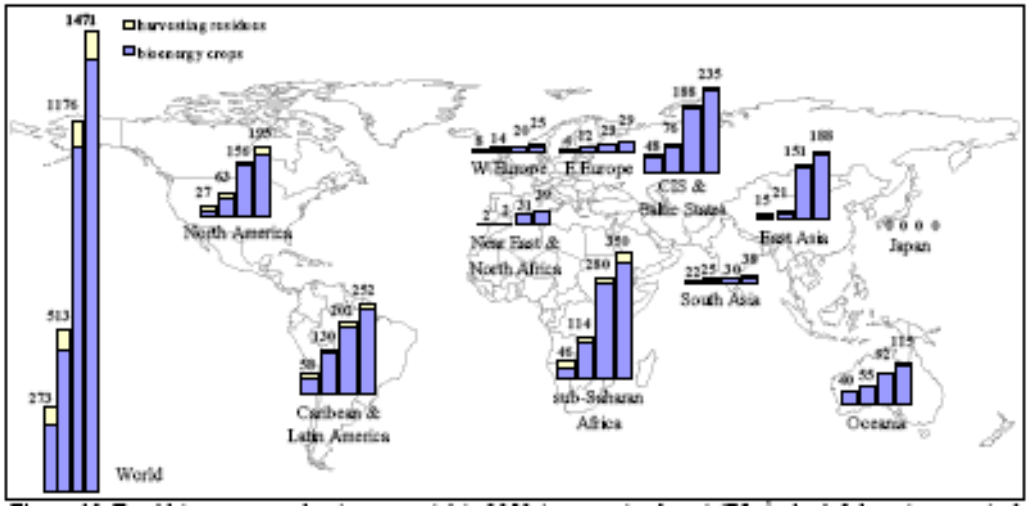
Ethanol is produced by processing starch- or sugar-based crops, such as corn, wheat and sugar cane, through fermentation. It is used almost exclusively in "spark-ignition" or "Otto-cycle" engines that traditionally use gasoline. The predominant types of vehicles that use gasoline today in the world, including in Latin America and the Caribbean (LAC), are light vehicles, which consist primarily of private vehicles and taxis.

Biodiesel is produced by processing a variety of vegetable oils—include soybean, palm, canola, castor, and jatropha. It is used in "compression-ignition" engines which utilize diesel oil today. In LAC, the primary types of transportation vehicles that use diesel fuel today are heavier vehicles, including trucks and buses. In addition, diesel generators are used in the region to generate electricity. Biodiesel could be substituted in either of these applications.

In addition to the benefits that these fuels offer through their ability to substitute for oil—and hence reduce a nation's vulnerability to high oil prices—they also offer other potential benefits. First, their production and use is generally believed to yield fewer greenhouse gas emissions than oil-based fuels. Second, with a few exceptions, they also produce a lower level of local pollutants. And finally, for countries that have existing sugar industries, ethanol offers an option for producing a higher value-added product rather than relying exclusively on the volatile sugar commodity market.

LAC, a region rich in biomass resources, is considered a strong potential future market for biofuels. A recent study by Smeets and Faaij, for example, has identified LAC and Sub-Saharan Africa as the regions with the greatest potential for biofuels production by 2050 under a variety of different circumstances (see Figure 1).

Figure 1: Projected Bioenergy Potentials in 2050 for Four Different Scenarios



Source: Smeets, et.al, "A Quickscan of Global Bio-EnergyPotentials to 2050"

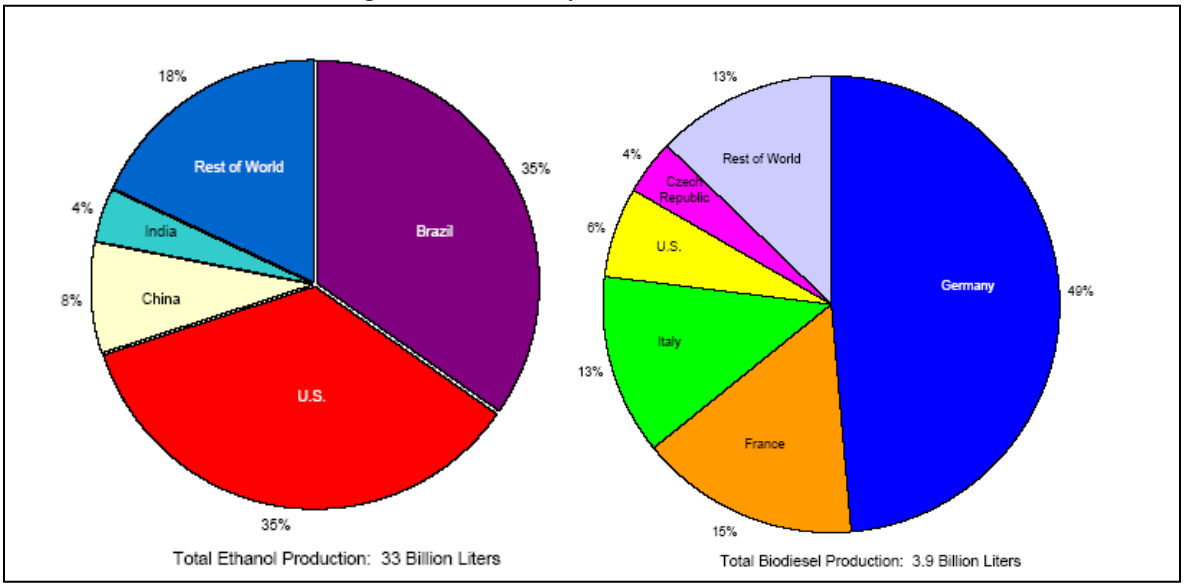
LAC is also the home for one of the largest biofuels producers today—Brazil, which produced 15 billion liters of ethanol in 2005, all from sugar cane (see Figure 2); only the U.S. has an equivalent ethanol production level. Brazil's ethanol for fuel program—Proalcool—was launched in late 1975 in response to the Arab Oil Embargo, which had the effect of tripling the cost of the country's oil imports. At the same time, world sugar prices, which had been rising since the mid-1960s, dropped sharply in 1974. Under such circumstances, ethanol appeared an attractive solution to reduce the country's oil import bill while also processing the country's sugar into a higher value-added product.

The initial focus of the program was to promote the use of a gasoline blend of ethanol consisting of 20 percent ethanol (by volume) and 80 percent gasoline. By 1979, with the second oil price shock, the program was modified to encourage the use of completely ethanol (know as hydrous ethanol) vehicles. At the height of the program, 90 percent of the spark-ignition vehicles produced in the country ran on hydrous ethanol. And by the mid-1980s, ethanol made up almost half of the country's liquid fuel supply.

However, around this time, the program also began experiencing problems tied to the drop in oil prices and the rise in world sugar prices. The government, which had been subsidizing the cost of ethanol so that it remained below that of gasoline, found the level of subsidy required increasingly intolerable and eliminated the price differential. The demand for ethanol subsequently dropped sharply.

In recent years, with the rise in oil prices, demand has again grown in the country, this time by flexible fuel vehicles which can run on any mix of gasoline and ethanol--ranging from all gasoline to all ethanol—and hence offer more flexibility in fuel choice to vehicle users Today, ethanol makes up approximately 40 percent of all transportation fuels used in the country. Demand for flexible fuel vehicles has also risen sharply; by February 2006 they accounted for 70 percent of all new cars sold in Brazil.

Figure 2: Global Biofuels Production, 2005



Source: Renewable Fuels Association; Renewables Global Status Report, 2006 Update

Other countries in LAC with significant ethanol production (although dwarfed by Brazil's output) include Guatemala, Ecuador, Mexico, Nicaragua, and Colombia. In some cases, the governments of these countries have adopted laws to promote domestic demand for this fuel. In Colombia, for example, a law was passed in 2001 requiring a 10 percent ethanol oxygenation for all gasoline in urban centers of more than 500,000.

With regard to biodiesel, the major global producers are in Europe and include Germany, France, Italy; the U.S. is also a significant producer. There are no major producers in LAC, although Brazil initiated a national biodiesel program in 2004. The fuel is initially being produced from castor beans and palm oil, and the program is intended to help boost the livelihood of small farmers.

At present, global production of ethanol is about ten times that of biodiesel. Ethanol production in general is at a more mature stage than biodiesel and hence not surprisingly, it is more cost-effective than biodiesel. At today's oil prices, ethanol produced by both the U.S. and Brazil is cost-effective; in contrast, biodiesel is not.

The challenges facing expanded biofuels development can be broken down into three categories: technical, policy-based, and financial. Technical challenges pertain to barriers regarding the introduction of new technologies or new technical approaches. Policy-based challenges refer to policy environments that are either ambiguous or directly contradictory to the development of biofuels. Finally, financing challenges pertain to the lack of access to finance at all stages of biofuels development.

Principles in Defining a Successful Biofuels Approach

Given the potential benefits to the LAC region that a biofuels approach can offer, the Inter-American Development Bank (IDB or the Bank), which serves this geographic area, is contemplating how it might help its member countries reap the benefits of the biofuels potential while minimizing adverse impacts. The purpose of this report is to put forward a potential prudent biofuels development approach for the Bank to accomplish this. It was developed drawing from written references and interviews with experts and "players" in the biofuels arena, both outside of the Bank as well as inside the Bank (both are listed at the end of the document). Moreover, the report builds upon a previous report on biofuels commissioned by the IDB, *Issue Paper on Biofuels in Latin America and the Caribbean*.

In the next section, several concrete potential activities are proposed within the categories of the major barriers that face biofuels development: technical, policy-based, and financing. Prior to the delineation of these possible activities, however, this section describes the key principles that need to be employed for a successful approach to biofuels development. Specifically, the principles are:

- The countries of LAC are not at the same level in their present development and use of biofuels, and hence approaches must be tailored to both their present level of activity as well as their future potential in developing biofuels;
- The major types of biofuels—ethanol and biodiesel—need to be addressed separately because their feedstock is different, they are at substantially different levels of maturity, and they service different vehicle types;
- The risks involved in developing biofuels must be recognized and dealt with in an integrated manner; and
- Fuel production and distribution and the development of vehicles to use the fuel have to be tackled simultaneously.

1. Differentiating Countries by their State of Development and Capacity for Producing Biofuels

The countries that make up LAC do not share the same characteristics either in their current level of production and consumption of biofuels or in their potential for developing and using such fuels in the future. Therefore approaches applicable to one country may not make sense for another.

Brazil sits in a class by itself. It has been producing ethanol and blending it into gasoline for almost seven decades and, after the launch of it ProAlcool program, has a well-developed distribution system for this fuel. Substantial agricultural research has supported this program, leading to the development of more efficient sugar cane varieties. The country has also developed an extensive vehicle fleet capable of operating on ethanol (presently using flexible fleet vehicle technology), and thus has a significant domestic demand for the fuel, as well as some export demand. Furthermore, Brazil has a well-

developed capital goods industry that is capable of making all the equipment for ethanol-making to supply both the domestic and the export markets. Finally, the country is a leader in the region in the development of biodiesel.

A second class, or grouping, of countries in the region are those with medium-sized domestic fuels markets as well as medium-sized agricultural production capability that could extend to feedstock for biofuels. These include most of the countries of South America as well as Mexico. Many of these countries have some production of biofuels—principally ethanol—although these levels are dwarfed by the production in Brazil. Distribution capability for these biofuels is limited, if it exists at all, as is the existence of vehicles in the countries' fleets capable of operating on biofuels. Nevertheless, the market size of the countries, in terms of transportation fuel demand, agricultural potential to produce biofuels feedstock, and vehicle fleet size, means that these countries could in principle initiate a program on their own to develop biofuels and biofuels infrastructure, although at some point in the future they may recognize the value of integrating their biofuels market with nearby countries to achieve economies of scale.

Within this broad grouping of countries, there are some that are more likely to be candidates for development of biofuels because they have an "excess" of biofuels feedstock which they are currently exporting. Moreover, several of these have additional incentives in that they are also net importers of oil.[1] As shown in Table 1a, for example, countries that export ethanol feedstock and are net importers of oil include Paraguay and Uruguay; they are attractive candidates to develop an ethanol industry.[2] As shown in Table 1b, in contrast, net exporters of biodiesel feedstock and net importers of oil include Paraguay, Peru, and Uruguay. They are attractive candidates to develop a biodiesel industry. Even for those that are not net oil importers, the potential to substitute for domestic oil supply and therefore have more oil available for export could still be a powerful reason for developing a biofuels industry. Argentina, Bolivia, Colombia and Mexico fit into this category for ethanol, and Argentina, Bolivia, Colombia and Ecuador for biodiesel. Additionally, those that are producing feedstock for biofuels, although not as net exports, may see the potential to expand their existing production to accommodate a biofuels industry. For ethanol, Chile and Peru fit into this category as net importers of oil, and Venezuela as a net exporter. For biodiesel, Chile fits into this category as a net importer of oil, and Mexico and Venezuela as net exporters of oil.

[1] The designation of whether a country is a net importer or exporter of oil includes, for simplicity, both crude oil and refined oil products such as diesel and gasoline. Hence, a country could be a net exporter of oil overall and still be a net importer of diesel. This level of detail is not reflected in these tables, but could provide additional incentive, in this case, for a country to want to develop a biodiesel capability.

[2] The information in Tables 1a, 1b, 2a, and 2b is based on 2005 agricultural production and export figures. These figures vary year by year, and hence countries may shift in terms of whether they produce feedstock for biofuels or export feedstock for biofuels.

Table 1a: Potential Candidates as Ethanol Producers for Medium-Sized Country Markets

Increasing Incentive to Develop an Ethanol Industry →				
Characteristic	**Producers of Feedstock for Ethanol; Net Exporters of Oil**	**Producers of Feedstock for Ethanol; Net Importers of Oil**	**Net Exporters of Feedstock for Ethanol; Net Exporters of Oil**	**Net Exporters of Feedstock for Ethanol; Net Importers of Oil**
Countries	Venezuela	Chile Peru	Argentina Bolivia Colombia Ecuador Mexico	Paraguay Uruguay

Source: Issue Paper on Biofuels in Latin America and the Caribbean

Table 1b: Potential Candidates as Biodiesel Producers for Medium-Sized Country Markets

Increasing Incentive to Develop a Biodiesel Industry →				
Characteristic	**Producers of Feedstock for Biodiesel; Net Exporters of Oil**	**Producers of Feedstock for Biodiesel; Net Importers of Oil**	**Net Exporters of Feedstock for Biodiesel; Net Exporters of Oil**	**Net Exporters of Feedstock for Biodiesel; Net Importers of Oil**
Countries	Mexico Venezuela	Chile	Argentina Bolivia Colombia Ecuador	Paraguay Peru Uruguay

Source: Issue Paper on Biofuels in Latin America and the Caribbean

The last class, or grouping, of countries in the region are those with small domestic fuels markets and small agricultural production capability. These include the countries of Central America and the Caribbean. Like the medium-sized country markets, they lack the scale of development of biofuels production, distribution, and vehicle use that is exemplified by Brazil. But unlike the medium-sized countries, they also lack a sufficient market size to successfully initiate a biofuels market on their own. To achieve a minimum economy of scale, they need to work with neighboring countries from the beginning. Such an integration is easier to achieve, needless to say, with Central American countries that share a common land mass than with Caribbean countries separated by water. Using the same methodology as Tables 1a and 1b, among small country markets Table 2a lists potential candidates to develop an ethanol industry, while Table 2b lists potential candidates to develop a biodiesel industry.

Table 2a: Potential Candidates as Ethanol Producers for Small Country Markets

Increasing Incentive to Develop an Ethanol Industry →				
Characteristic	**Net Exporters of Feedstock for Ethanol; Net Exporters of Oil**	**Net Exporters of Feedstock for Ethanol; Net Importers of Oil**		
Countries	Bahamas* Guyana Haiti Suriname*	Barbados Belize Costa Rica Dominican Republic	El Salvador Guatemala Guyana Honduras	Jamaica Nicaragua Panama

*Less than 150,000 tonnes/year

Source: Issue Paper on Biofuels in Latin America and the Caribbean

Table 2b: Potential Candidates as Biodiesel Producers forSmall Country Markets

Increasing Incentive to Develop a Biodiesel Industry →		
Characteristic	**Producers of Feedstock for Biodiesel; Net Importers of Oil**	**Net Exporters of Feedstock for Biodiesel; Net Importers of Oil**
Countries	Dominican Republic Nicaragua* Panama*	Costa Rica Guatemala Honduras

*Less than 150,000 tonnes/year

Source: Issue Paper on Biofuels in Latin America and the Caribbean

2. Addressing Ethanol and Biodiesel Separately

The primary biofuels—ethanol and biodiesel—need to be addressed separately in developing an approach for LAC for several reasons. First, their level of maturity and hence their level of production, distribution infrastructure development and fuel-capable vehicle production capacity are quite different. Ethanol is a much more mature fuel, with production from the region—primarily from Brazil—much greater than that of biodiesel. In addition to ethanol production facilities, Brazil also enjoys an extensive distribution system for high ethanol blends and a market for "flexible fuel vehicles or FFVs. Although this extensive infrastructure required significant investment, incentives and government mandates to establish, it is now considered economically viable because the ethanol produced in Brazil is cost-competitive with gasoline in today's market. Biodiesel, in contrast, is in an earlier stage of development, with production far lagging that of ethanol. Furthermore, at today's price of oil, it is still not cost-competitive with conventional diesel fuel.

Second, the feedstock for ethanol and biodiesel is different. In LAC, the primary feedstock for ethanol is sugar cane, although starch-based crops also have the potential to produce ethanol. In contrast, in LAC, biodiesel's feedstock includes soy, palm oil, jatropha, and castor oil. As a result, the impacts of using these feedstocks are different. Since Brazil's sugar-based ethanol production was initially based in existing sugar cane

growing areas in the southern part of the country, it has not to date been considered threatening to intact native forest areas with extensive biodiversity; there are some concerns, though, that with expansion of demand for ethanol, sugar cane production may extend into more ecologically sensitive areas. In contrast, some of the feedstock for biodiesel (namely soy) in LAC as well as starch-based crops that may be used to produce more ethanol could more immediately and directly threaten biodiversity by being planted in ecologically sensitive areas and they could also vie directly with food production. In addition, other feedstock for biodiesel, namely the oil seed crops of castor beans and palm oil, could potentially be used on degraded lands.

Third, ethanol and biodiesel are used in different types of engines, with ethanol applicable to light vehicles and biodiesel applicable to heavier vehicles. It should be noted, however, that in Europe a new generation of diesel engines are making inroads into the light vehicle fleet, where they enjoy much higher fuel economy than gasoline engines; hence, there may be the potential in the future for using biodiesel in LAC in light vehicles that have compression-ignition engines. Also, an additional potential market for biodiesel exists in many Latin American and Caribbean countries because of the significant use of diesel fuel in stationary generators, on-site electricity generation in manufacturing facilities, and rural electrification in remote sites (all of which are particularly true in Central America and the Caribbean), as well as for marine application by boats.

3. Tackling the Risks of Biofuels Development

Significantly more than any other sustainable energy resource, the development and use of biofuels carries a substantial risk across a variety of fronts. The most sizeable of these is the market risk associated with the volatility of the oil market. The drive to develop alternative fuels parallels the price of oil. When oil prices are high, interest in developing alternative fuels is also high, as is the willingness to invest in the production of such fuels. And when oil prices are low, interest in alternative fuels is also low. Without a sustained period of high oil prices, it is quite difficult to nurture a viable biofuels industry.

To address the oil market volatility, approaches that could be adopted range from better assessments of short and longer term oil price movement to actually adopting policies to establish an oil price floor, below which a tax might be assessed to hold oil prices at that floor level. The latter strategy might be combined with one to establish a variable biofuels subsidy that is initiated when prices fall to the oil price floor and that decreases as oil prices rise.

Added to the problem of volatility in the oil market, is a similar volatility in the commodity markets for the feedstock for biofuels, especially sugar. When sugar prices rise, producers are more inclined to sell the sugar directly, rather than process it into ethanol. Moreover, when these prices are high, they also push up the resulting price of ethanol.

The risk from biofuels feedstock commodity price volatility could be mitigated by investing in agricultural programs to improve the efficiency of production of the feedstock so that their net costs drop and their yields increase. Not only would such an approach assist in the development of biofuels—by lowering the overall range in costs of biofuels—but it would also enable the cost of the feedstock itself to be more competitive in world markets. Hence, producers would have more choices insofar as how much of their crops they sell directly versus how much they convert to biofuels. Such an approach would particularly benefit the sugar industry in some countries in LAC that suffers from poor yields today, which make it difficult to sell its products in the global market.

Additionally, there is the risk associated with the current cost-effectiveness or lack thereof of developing either ethanol or biodiesel. Not surprisingly, more mature biofuels programs that have reached a significant production level enabling economies of scale to be realized are those that tend to produce more cost-effective biofuels. After a decades-long program and a corresponding learning curve, Brazil enjoys the characteristic of being able to produce ethanol at the lowest cost in the world today. With less mature industries and lacking the scale that the Brazilian program enjoys, it is unlikely that emerging ethanol producers in LAC or elsewhere would be able to rival the Brazilian cost structure in the near future.

The situation with biodiesel is even less clear. At today's limited production level, biodiesel is not cost-effective. Moreover, even if oil prices stabilize at their current level, thereby maintaining the incentive to develop a biodiesel market, it is not clear how or when the production costs of biodiesel will come down.

Clearly for emerging biofuels producers in LAC —whether ethanol or biodiesel— the challenge lies in reaching either sufficient domestic demand or sufficient export demand to achieve economies of scale in their biofuels production that would enable their products to be cost-effective.

A first step in this direction could involve establishing a minimum level of domestic demand through the institution of low blending requirements in the transportation fuels now used in LAC countries, initially for ethanol in gasoline and perhaps later for biodiesel in diesel. This low level of blending—generally thought to be no more than a ten percent ethanol blend in gasoline and no more than a five percent biodiesel blend—is small enough where almost no changes in infrastructure or vehicles are generally necessary and where higher prices for these biofuels will have a marginal impact in the overall cost of the blended fuel.

While an important anchor for a market that may see peaks and valleys of demand in the future both domestically or from overseas, the low blending requirement does not by itself address how to reach a production capacity sizeable enough to achieve economies of scale. Such a scale could only be achieved by a greater level of demand. Domestically, this demand could be provided by requiring specific vehicle fleets to use these fuels. These could include government vehicle fleets, private corporate vehicle fleets or taxi fleets. Argentina has used such a strategy to introduce compressed natural

gas (CNG) in its vehicle fleet—taxis operating in Buenos Aires are required to use CNG. The IDB could assist member countries in assessing the risks and benefits from adopting such a fleet strategy.

From an export perspective, the uncertainty regarding future demand for biofuels exports remains high. Without a doubt, the LAC region is perceived as being among the most suitable for growing feedstock for biofuels and refining it. Moreover, 38 countries, states or provinces throughout the world have currently made some type of biofuels commitment, either to meet domestic requirements to substitute ethanol for the MTBE additive now used in gasoline, or to help meet their greenhouse gas reduction quotas. Experts believe these countries cannot meet their biofuels commitment from internal production alone and hence the potential exists for these countries to turn to LAC to meet part of their commitments.[3]

However, the present export market for biofuels in LAC does not reflect this potential. Rather it is fleeting and artificial and thus does not provide a sound basis for would-be exporters to build up their ethanol stock for export. The U.S. is currently the major importer of ethanol due to a recent regulatory requirement that it replace MTBE with ethanol to yield up to a ten percent ethanol blend. This requirement, combined with trade agreements with the Caribbean (Caribbean Basin Initiative) and Central American (Central America Free Trade Agreement) countries that eliminate the import tariff on ethanol, has led to an export flow to the U.S. of ethanol primarily from Brazil. Currently, most of the ethanol refining is completed in Brazil, with the final stage (generally removing the water content in the hydrous ethanol) completed in an appropriate Caribbean or Central American country to be eligible for the tariff forgiveness, and then imported into the U.S. Many question whether this demand from the U.S. will last as that country increases its own domestic ethanol production capability.

To address the potential demand from future export markets, a thorough assessment could be undertaken of what export markets could materialize for LAC and the timeframe in which they could appear. It would also need to address potential barriers that could preclude LAC biofuels from being imported into these markets. In addition, the development of capacity in the day-to-day tracking of and trading in these complex global markets could be encouraged through the establishment of partnerships with entities with expertise in this arena.

In addition to the risks already delineated, there is the possibility that the feedstock and technologies used today to produce "first generation" biofuels, especially sugar- and starch-based crops for ethanol, will be displaced by other feedstock and technologies in the future as the global biofuels industry matures. Many expect, for example, that when ethanol from cellulosic feedstock becomes more cost-effective, it will displace the ethanol feedstock of today because its environmental impacts and land-use requirements will be substantially less, and more countries worldwide have this type of

[3] There is some concern that non-trade barriers, such as setting a standard in European countries for biodiesel based on rapeseed oil largely grown in Europe, would preclude export by LAC of biodiesel based on other feedstock.

feedstock and hence would be able to produce this type of ethanol. Such a development could displace an existing biofuels industry in LAC that uses only "first-generation" technologies.

This risk could be mitigated, at least in part, by investing in refining facilities capable of utilizing a variety of types of feedstock, including sugar- and starch-based feedstock as well as cellulosic feedstock. In addition, investments could be made in enhancing the research capacity in LAC itself to develop new generations of biofuels and biofuels feedstock (such as cellulosic switchgrass) rather than deferring just to developed countries where most of the research is now occurring, and where some types of investigations will not occur on the feedstock side because the particular feedstock is not typically grown in those countries.

A final risk associated with biofuels is that their development on a large scale could produce substantial adverse impacts on the countries that produce them. Air and water pollution may result from unwise agricultural practices in growing biofuels feedstock, the refining of the feedstock into biofuels, and the consumption of the biofuels. Water supply may be threatened, especially in naturally dry regions, because some feedstock crops, such as sugar, require high levels of water. Moreover, soil fertility may similarly be threatened by feedstock crops such as sugar. As noted previously, threats to biodiversity may materialize as new crops are planted in ecologically sensitive areas. Furthermore, threats to food supply may appear as crops used to produce food are dedicated instead to produce biofuels (particularly in the production of starch-based crops for ethanol and such high yield oil crops as soy for biodiesel). Finally, the expansion of feedstock crops for biofuels could exacerbate existing problems of displacing small, poorer family-based farmers in favor of large farm owners that are often companies.

This risk could be mitigated by the IDB from the programming stage onwards by proffering assistance to these countries in how to anticipate and respond to adverse impacts. Furthermore, a regional network could be established to research the challenges offered by these impacts; among its activities could be an assessment of existing "best practices" strategies to ameliorate the impacts, incorporating the experience of Brazil and other countries. Such a network might also work with potential biofuels importers that are concerned about the potential adverse impacts of biofuels production on LAC. Presently, there are calls in some European countries to develop a standard for any biofuels purchased from LAC to ensure they adhere to environmental and land-use criteria; a regional network could work with these concerned parties to help develop a standard that meets present concerns in a manner consistent with the interests of LAC countries.

Finally, investments could be made in improving the efficiency of the entire biofuels cycle, from feedstock production, through biofuels refining, to use, principally by vehicles. This would minimize the total volume of feedstock required, and, with it, the adverse impacts resulting from the use of that feedstock. Table 3 summarizes the risks and the types of responses a "no regrets" strategy for biofuels development could entail.

Table 3: Risks of Biofuels Development and Strategies to Ameliorate Them

Oil Price Volatility
-Policy to reduce uncertainty in price, ranging from better assessments of oil market future to setting an oil price floor, below which a tax is imposed
Biofuels Feedstock Price Volatility
-Investment in improved efficiency of production of feedstock to reduce price and increase yield
Uncertainty In Cost-Effectiveness of and Demand for Biofuels
-Policy to require minimum biofuels mix in gasoline and diesel to establish an anchor for domestic biofuels industry
-Policy to increase demand above minimum mix through increased domestic demand by requiring fleets use higher percentage blend of biofuels
-Investment in thorough assessment of possible future market due to biofuels use commitments globally, and in infrastructure for participating in global trade in biofuels
-Evaluation of possible policy for a variable subsidy on biofuels tied to oil price
Capacity to Handle Innovations in Biofuels Production, Especially Cellulosic Feedstock
-Investment in refineries capable of using a variety of feedstock types
-Investment in research to develop innovations appropriate to LAC
Potential Adverse Impacts from Biofuels Industry Development
-Mitigation assistance by the IDB from programming stage onward
-Investment in "best practices" assessment of mitigation strategies
-Investment in improving efficiency of biofuels use from production through end-use

4. Addressing Biofuel Production, Distribution and Vehicle Development Simultaneously

In the past, when oil prices have spiked, global interest has generally also spiked in creating alternative fuels for oil, especially in the transportation sector, which is almost entirely dependent on oil to meet its fuel needs. During those times, incentives for the production of alternative fuels have flourished; significantly less attention has been paid to the development of the infrastructure to dispense the alternative fuels, much less to the development of vehicles capable of using these fuels. In such an environment, the easiest response for vehicle manufacturers has been to develop more fuel-efficient vehicles, thereby lessening the demand for oil in a less risky manner than depending on an uncertain supply of alternative fuels from almost non-existent distribution dispensing centers.

Brazil was one of the few countries that recognized from the start that to successfully foment the evolution of the transportation sector to a significant dependence on an alternative fuel, a strategy must be devised that gives equal priority to the production of the fuel; the creation of a distribution system through fueling stations; and the development of vehicles capable of operating on that fuel. Brazil's efforts were initially focused on ethanol. The government provided incentives and government

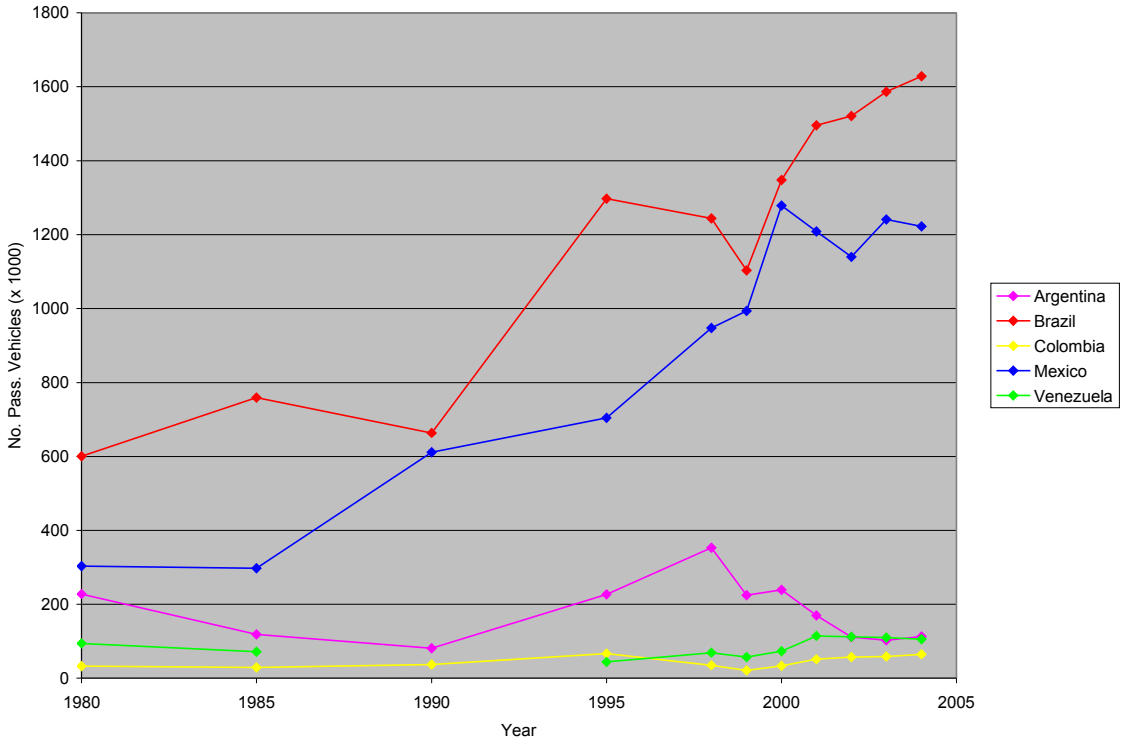
mandates not only for the production of the fuel, but also for distribution of ethanol and ethanol blends and the addition of fuel dispensing stations.

Furthermore, Brazil addressed the development of vehicles capable of using ethanol. In the case of ethanol, the types of adjustments to vehicles that need to be made include changes in the materials used in many hoses and valves in vehicle fuel systems so that they are not degraded by the more corrosive ethanol, and adjustments in the air-to-fuel ratio. Moreover, due to the lesser energy content in ethanol compared with gasoline, there is a fuel economy penalty with ethanol that can be at least partially recovered by operating an ethanol-powered vehicle at a higher compression ratio. Brazil offered incentives to ensure that new vehicles were produced capable of using ethanol blends or hydrous ethanol; these vehicles used different materials in their fuel systems and adjusted the air-to-fuel ratio, but they did not operate at higher compression ratios.

With Brazil enjoying the largest light vehicle production capacity in LAC (see Figure 3), its strategy to foster a transition to ethanol was easier to implement than it will be for many of the LAC countries similarly interested in developing biofuels but without a significant vehicle manufacturing industry to anchor their overall strategy.[4] Nevertheless, these other LAC countries do benefit from the fact that they generally import a significant fraction of their vehicles from Brazil. Thus, if these countries are satisfied with the types of vehicles manufactured by Brazil to use ethanol, they have access at least to a more ready supply of ethanol-capable vehicles for their markets than if they were "going it alone". Furthermore, at least one non-Brazilian manufacturer is confident that if increased demand for FFVs materializes in LAC, it can also be met by exporters of vehicles to this region.

[4] While Mexico also has a substantial production capacity in passenger cars, 75 percent of the vehicles produced are exported to North America.

Figure 3: LAC Countries with Largest Passenger Vehicle Production



Source: International Marketing and Statistics 2006

In the case of biodiesel, the vehicle modifications required are somewhat less than for ethanol. Biodiesel has low temperature start difficulties and is more soluble than diesel; hence, for high biodiesel blends or pure biodiesel, engines need to be adapted to use less soluble materials in their fuel systems and be able to have "cold starts". At this point, there is not sufficient demand for these types of vehicles, either in Brazil or elsewhere in LAC, to warrant the adaptation of diesel engines to high blends of biodiesel.

Potential Elements of an IDB Approach to Foster Biofuels

As already noted, given the benefits that biofuels could bring to the LAC region, it makes sense for the IDB to consider assistance to its member countries in this area, seeking to pursue a prudent approach that minimizes adverse impacts of biofuels development. As part of its normal process of doing business, the Bank has engaged and will continue to engage in assistance in the biofuels sector to its member countries. These may include technical assistance, and public or private sector investments.

Nevertheless, there are specific barriers to biofuels development in LAC where IDB assistance could prove catalytic. To address these specific barriers—which span technical, policy, and financing challenges—new types of financial instruments by the Bank may be needed in some cases; in other cases, existing instruments are sufficient but must be dedicated to address the barrier.

The types of IDB assistance proposed in response to these barriers are described below and listed in Table 4. It is important to note, however, that the Bank does not initiate activities without support by its member countries. Its activities are in response to specific needs by its members. Hence, the activities listed below, while responding to real challenges facing its member countries, would have to be initiated by member country requests.

Furthermore, it is important to note that there is another activity ongoing in Operating Region 1 of the Bank to define an action plan for Brazil in response to a request by the President of that country to establish "Centers of Excellence in Biofuels". Some of the activities proposed in this section could potentially be subsumed within that strategy. [5]

[5] The IDB has hired a consulting group (Garten-Rothkopf) to prepare a more detailed action plan to promote the development of the biofuels sector in Brazil, including the potential establishment of Centers of Excellence in Biofuel Use. A draft of the plan is expected to be ready in December 2006 and will address four key areas: innovation, capacity-building, infrastructure needs, and global markets.

Table 4: Potential Elements of an IDB Approach to Foster Biofuels

Type of Activity	Proposed Activity
Response to Technical Barriers	Science and technology loan to develop new production technologies and feedstock for ethanol
	Assistance in establishing regional network for investigating adverse impacts of biofuels
	Science and technology loan to develop next generation of flexible fuel vehicles
Response to Policy Barriers	Biofuels resource assessment and economic viability evaluation for potential new country entrants
	Policy assistance on options to establish domestic market for biofuels
	Assessment of the potential biofuels export market from LAC
	Assistance in developing capacity in LAC to undertake day-to-day biofuels trading
	Policy assistance in mitigating adverse impacts for new entrants into biofuels market
	Assistance in developing integrated approach to biofuels production, distribution and use for small country markets
	Technical assistance on ways to reduce volatility in oil and biofuels feedstock prices
Response to Financing Barrier	Equity fund for PRI to invest in companies using new biofuels production technologies
	Pilot programs to demonstrate economic viability of newer biofuels implementation techniques
	Flexible approach to the modernization of some state-owned sugar and ethanol industries, ranging from investment prior to privatization to full privatization first
Potential Use of GEF or CDM Resources	For GEF, biofuels projects must be consistent with GEF operational strategy on climate change and individual country priorities
	For CDM, credits for bagasse co-generation in ethanol plants likely; credits for biofuels production not as clear

1. Technical Barriers

Technical barriers refer to barriers regarding the introduction of new technologies or new technical approaches. In LAC, in particular, this offers new challenges because traditionally new technologies or new technical approaches are developed in industrialized countries, where greater public resources are allocated for this purpose, and where corporate research budgets also tend to be higher. However, many of the technical and technology challenges regarding biofuels development and use are first being encountered in LAC because of the advanced state of development of the biofuels industry there, most notably in Brazil. Hence, technological innovation in these areas has to be led by LAC if the challenges are to be successfully addressed.

Technical challenges faced in LAC, and the potential strategy the IDB can play in helping LAC meet those challenges are described below. Needless to say, these activities are concentrated in Brazil, which is clearly the leader in the region in both ethanol and biodiesel use.

A. New Production Technologies and Feedstock for Ethanol

Although production efficiency improvements have already been achieved with ethanol—including in crop production and in conversion to ethanol (using cogenerated electricity from bagasse, a waste material from sugar cane)—in Brazil and similar efficiency improvements can be expected in the biodiesel industry as it develops and matures, the overall efficiency of these fuels is necessarily limited by the feedstock used today. It requires substantial land, and the efficiency of conversion to fuels is low.

In the case of ethanol, many are looking to innovations that would eventually substitute cellulosic material for sugar- and starch-based crops as feedstock. While not cost-effective today, this type of feedstock addresses many of the problems with the current generation of feedstock, including large land-use requirements, geographic limitations where sugar- and starch-based feedstock can be grown, and volatility in feedstock commodity prices. Cellulosic feedstock is available over a much wider range of geographies than the current generation of feedstock; moreover, waste cellulosic material, including crop residues, could serve also as feedstock. And the land requirements for many sources of cellulose, including trees, need not be as extensive as for the current generation of feedstock.

For LAC, the potential for cellulosic feedstock is both a plus and a minus. In the worst scenario, the region risks seeing an industry gradually built up on sugar- and starch-based crops collapse with the introduction of a new generation of ethanol production techniques based on cellulosic feedstock. In the best scenario, the region could be a partner in the development of the new generation of ethanol production techniques, fostering the transition in the region from sugar- and starch-based crop feedstock to cellulosic feedstock.

With its historic leadership in ethanol development and production, Brazil is the obvious candidate to assume a leadership role in fostering the next generation of ethanol development technology. Rather than wait for innovations to be developed in industrialized countries, Brazil could invest in researching these innovations as well.

The IDB could play a major role in this endeavor, using science and technology loans, which it has already successfully employed in Brazil, Argentina, and Chile, as the instrument to foster public-private partnerships in developing the next generation of ethanol production technologies and techniques. This could include ethanol production facilities that are multi-fuel-capable, that is, capable of using both starch-based and sugar-based crops as well as cellulosic feedstock.[6] In addition, research and development could

[6] Some in the US, e.g. Vinod Khosla, believe that cellulosic capacity can be "bolted on" to existing corn-based refineries. IDB could support an assessment of whether this was feasible from a cost standpoint.

address techniques to lower the costs for conversion of cellulosic material to ethanol and how a cellulosic feedstock base—for example, tree plantations—could be fostered without threatening protected lands.

It should also be noted that as research strides are being made in bringing cellulosic ethanol to market, technological improvements are likely to occur as well with the existing feedstock for ethanol, rendering "first-generation" ethanol more competitive with cellulosic ethanol. Hence, it is important that science and technology resources also be used to continue developments in the first-generation feedstock for ethanol. For example, biotechnology strides could render sugar and starch crop strains that are more resistant to disease or that have higher levels of productivity.

B. Regional Network for Investigating the Adverse Impacts of Biofuels

Traditionally, leadership in understanding the adverse impacts of fuel use has come from developed countries which enjoy more public and private sector resources to investigate these impacts and identify mitigation strategies for them. Developed country standards and mitigation technologies have then been transferred to the developing countries of LAC.

But biofuels development upends this model because Brazil is among the world's leaders in biofuels development and use. It is certainly the leader in the deployment of ethanol into its transportation sector and it promises to be among the world's leaders in the deployment of biodiesel. In such a leadership role, the country can ill-afford to wait for leadership in impact assessment by developed countries because its citizens will be encountering these effects much earlier than those of most developed countries.

Thus, it is prudent to develop a regional capacity soon to investigate potential adverse impacts of biofuels. It is important to note that there are already some research facilities with capabilities to investigate certain aspects of the impact of biofuels, both in Brazil as well as elsewhere in the region. This activity should seek to strengthen these existing institutional capacities as well as develop new institutions, as necessary. Equally important is the need for coordination and exchange of information among these institutions. Hence, the overwhelming need is to establish a working *network* of institutions to assess adverse impacts. The impacts work should also address the benefits of biofuels use, including its reduced local emissions and emissions of greenhouse gases.

A regional network would seek to understand the impacts of biofuels and identify mitigation strategies. Mitigation strategies might include regulatory requirements (e.g., maximum emissions limits for aldehydes from ethanol-fueled vehicles), training and information dissemination (e.g., on how to handle a biodiesel spill over time since the fuel degrades faster than diesel), or incentives (e.g., financial incentives for small farmers to engage in biofuels production). The results of this work could then be applied to LAC countries as they develop biofuels industries, as well as outside of LAC.

The IDB could proffer a variety of tools to assist the development of such a network. These include technical assistance, science and technology loans, and equity and debt assistance to private research institutions.

In the environmental realm, there are at least three immediate areas for attention by such a network. The first would address the risk of aldehyde emissions from ethanol combustion. Aldehyde emissions have long been recognized as being higher with ethanol-fueled vehicles than with gasoline-fueled vehicles, and early assessment indicates that today's generation of catalysts, while reducing these emissions somewhat, do not eliminate them. Since aldehydes are recognized carcinogens, investigating this risk further is important. A second area of investigation for the network could be that of NO_x emissions from biodiesel; tests have shown that emissions of this gas may increase in comparison to diesel, while emissions of other regulated pollutants go down. Evaluating this in more detail and determining whether increased NO_x emissions exacerbate local smog problems is also important for such a regional center. Yet another area meriting investigation is the biodegradability of biodiesel. While most agree that biodiesel is more biodegradable than diesel, it obviously does not degrade instantaneously. Understanding biodiesel's level of biodegradability is important to responding to unplanned spills of biodiesel on land or water.

In the agricultural and land-use realm, there are also at least three important areas that a regional network should investigate. The first is to understand the extent to which the production of some types of feedstock for ethanol and biodiesel, most notably starch-based crops and some high yield vegetable oil crops such as soy, could adversely affect the production of food crops. In some cases, the specific crop may be the same but its post-harvest use is different, moving from a food product to a fuel product. In other cases, fuel-based crops that require similar growing conditions as existing food crops could be substituted for those food crops. A second area to investigate is the threat to biodiversity posed by planting biofuel-based crops in areas now characterized by native forests and grasslands that are important homes for indigenous species of flora and fauna. Yet another area to investigate is that of strategies to ensure that any expansion of biofuels production benefits smaller and poorer farmers and rural communities. Early experience in Brazil with its ethanol program highlighted the advantage that larger farmers had over smaller ones; as a result, the country has implemented programs to protect these small farmers in it present ethanol program as well as its new biodiesel program.

The proposed network could also work with biofuels importing countries on standards they might set on biofuels they import from LAC. As already noted, numerous countries in the world have made commitments to use biofuels and there is some movement in some European countries to develop guidelines or certification programs for biofuels so as to limit adverse impacts from their production. The network could monitor such developments and provide information about them to governments and producers in the region.

C. Development of the Next Generation of Flexible Fuel Vehicles

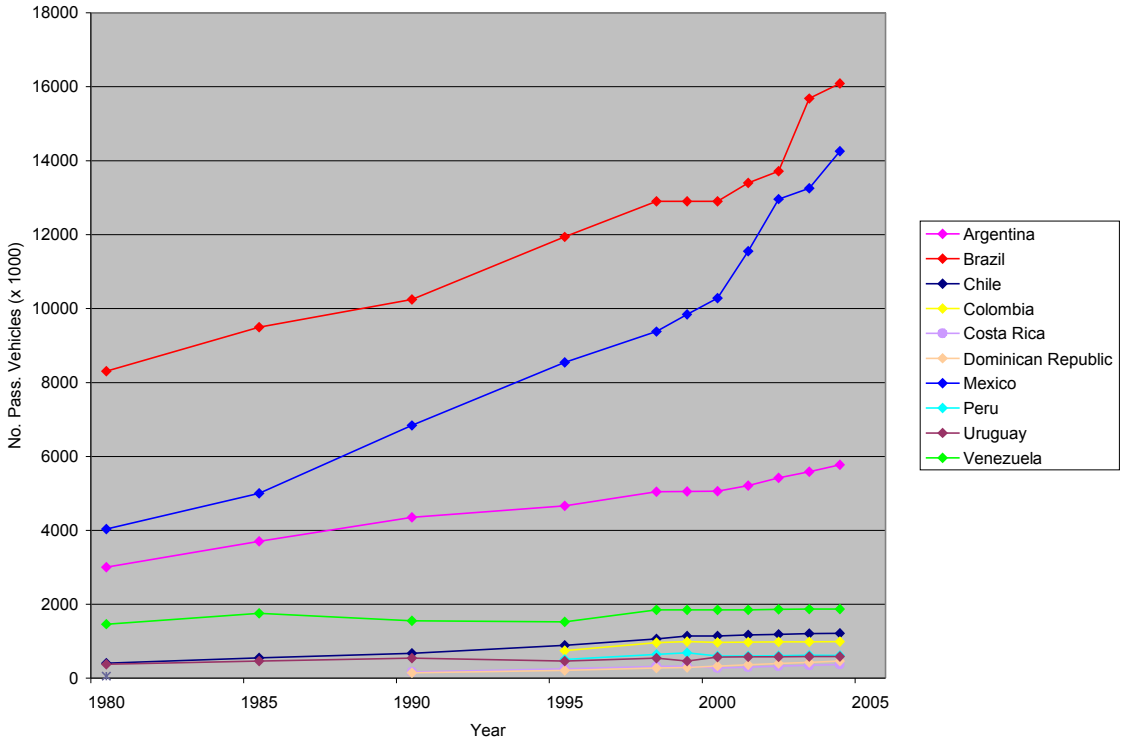
As noted earlier, in response to the volatility of both the oil market and sugar market, the Brazilian government embraced flexible fuel vehicles. These vehicles can run on any mixture ranging from 100 percent gasoline to 100 percent ethanol. Hence, depending on the relative price of oil and ethanol, consumers can opt to fill up with gasoline, ethanol or a mixture of the two. However, since the energy content of ethanol is less than that of gasoline, an FFV fueled by ethanol tends to have a range penalty of 30 percent, that is, its range is 30 percent less than that of an FFV fueled by gasoline.

In a high oil price market, consumers will readily fill FFVs with ethanol because of the cost advantage of ethanol. But, as oil prices drop, not only does the price advantage of ethanol per gallon diminish, it also diminishes because of ethanol's lesser range compared width gasoline. Hence, even with the use of FFVs, demand for ethanol can be expected to vary substantially with the price of oil, with adverse impacts for a young industry seeking a stable market.

The price disadvantage of ethanol per mile driven can be largely overcome because ethanol engines can operate at a higher compression ratio than gasoline engines and thus have higher efficiencies. For FFVs to take advantage of this efficiency gain, they would have to have variable compression engines where the compression ratio drops when gasoline is used and rises when ethanol is used. Prototype variable compression engines have been developed by Saab and Nissan, among others, but with the rationale for introducing FFVs largely absent in most developed country markets, the motivation to bring such engines to commercialization is minimal.

In contrast, in Brazil, the benefits of having such an engine enter commercialization are clear. Not only would such engines help to stabilize the market demand for ethanol, but they would also improve the overall efficiency of biofuels use and hence minimize the level of feedstock needed to produce ethanol. Moreover, with Brazil serving as a significant exporter of passenger vehicles to other countries, the innovations developed in Brazil could eventually expand to other countries (see Figure 4).

Figure4: LAC Countries with Largest Passenger Vehicle Fleets



Source: International Marketing and Statistics 2006

The IDB can play a major role fostering the development of a second-generation FFV. Using a public sector science and technology loans to Brazil, in which the partners could be universities and other research institutions, and the automotive industry, the development of the next generation of FFVs could well be leveraged. In this case, IDB investment would not need to cover the total level of investment required; rather, it could seed investments by others including motor vehicle manufacturers. Moreover, while these FFVs would first be used in Brazil, with Brazil's status as one of the major vehicle manufacturers for LAC, the new generation of FFVs could eventually be used in other LAC countries that are developing ethanol markets, especially those adopting a policy to increase domestic demand for ethanol fuels by requiring use of these fuels in fleets.

2. Policy Barriers

For a biofuels program to work, the policies of LAC countries must support that program. A policy environment that is unclear or contradictory to biofuels development is more likely to maintain the status quo rather than yield a prudent path forward.

A. ***Resource Assessment and Economic Viability Evaluation as a Prelude for Prospective New Countries Interested in Fostering Biofuels***

The potential for developing a biofuels industry in LAC countries is high. Moreover, as many LAC countries see the benefits that a biofuels industry has brought to Brazil, they understandably want to follow suit.

However, it is important that resources not be wasted in LAC countries already grappling with high demands for investment to address a variety of other problems. Biofuels strategies developed by these countries need to be prudent and realistic. IDB can play an important role in this process by addressing the viability of a biofuels development strategy in a member country from the programming process onward. Specifically, as soon as a member country indicates an interest in developing a biofuels market, the IDB could commit to investing in a resource assessment and economic viability evaluation for biofuels for that country. Consultation with key stakeholders should also be an important part of this review, as is already being adopted in Mexico, for example. The outcome of these assessments could then form the basis for additional assistance the IDB could offer the country.

B. Policy Assistance in Options to Establish a Domestic Market for Biofuels

Once an assessment has been conducted for an interested member country on the viability of a biofuels development strategy, and a decision has been made by that country to move forward, the IDB could continue to play a role in helping that country understand its options. As noted earlier, a prudent first step for a country could be to require a low level mix of ethanol and/or biodiesel in its gasoline or diesel fuel. The implementation of such a policy is not trivial, however, especially if the country does not have its own oil refinery, or if existing fuel prices are subsidized. IDB policy assistance could be proffered to advise the country of its options for implementing a low blend requirement, the costs of such a requirement, and the necessary policies that would be needed.

Beyond the decision to require a low percentage mix of biofuels in its transportation fuels, a country may wish to take the next step and increase demand for the biofuels to a level sufficient to begin achieving economies of scale. The IDB could offer policy assistance in defining options for the country to increase this demand. Such options might include a requirement that fleets use the biofuels, as was mentioned earlier; developing biofuels for export; or a step in-between—working with neighboring countries to act as a supplier of biofuels to them.

C. Assessment of the Potential Biofuels Export Market from LAC

For some countries in LAC, a decision to enter the biofuels market will be predicated on an expectation that there will be a substantial export market in the future.

As noted earlier, uncertainty about the future export market remains high even though a substantial number of countries and subnational entities throughout the world have made commitments to use biofuels in the future.

The IDB could play an important role in lessening this uncertainty for LAC countries by supporting, perhaps collaboratively with other LAC-based institutions such as the Economic Commission for Latin America and the Caribbean (ECLAC), a thorough assessment of the implications of these commitments. Such an assessment would evaluate the magnitude of the commitments, analyze the capacity of these countries to meet the commitments domestically, and hence establish a range for projected trade in biofuels over time.

D. Fostering Trade in Biofuels

A critical step in developing markets for biofuels is developing the capacity in LAC to undertake the day-to-day trading in such fuels. The IDB could assist in this regard by encouraging strategic private sector partnerships with entities which have expertise in monitoring market developments and engaging in the associated trade. Technical assistance to define how such private sector partnerships could be fostered would be an appropriate first step.

E. *Policy Assistance in the Mitigation of Adverse Impacts for New Entrants into the Biofuels Market*

This report has already identified potential adverse impacts from the development of biofuels, including environmental impacts and social impacts. For new entrants into the biofuels arena, it is important that these impacts are recognized from the start and procedures put into place immediately to mitigate the impacts, rather than following the learning curve on impacts that Brazil and other early entrants in biofuels use have suffered.

The IDB could play an important role here by assisting member countries in understanding these impacts as soon as they indicate an interest in entering the biofuels market. Among the instruments it could offer is a "best practices" guide on mitigating these impacts, as well as assistance in the development and implementation of appropriate regulations and policies. The regional network discussed earlier could provide an important resource for LAC countries in this regard.

F. Assistance on an Integrated Approach to Biofuels Production, Distribution and Use for Small Country Markets

For small LAC countries, entrance into the biofuels market should be as part of a regional strategy. Their markets are too small to be able to pursue a biofuels development strategy individually, either through domestic use or through exports.

IDB has played a unique role in LAC is supporting the integration of markets among member countries. Its leadership in Plan Puebla Panama (PPP) for Central America and Mexico is well recognized, including its efforts to foster integration of energy infrastructures through SIEPAC. Expanding this effort to include the development and implementation of a regional market for biofuels is a logical next step. IDB could play an important role in supporting the identification of specific policies that would be required to enable a biofuels industry to flourish in this region, as well as being a convener of the countries in the region to discuss cooperative efforts.

A regional biofuels market for Caribbean countries is also critical for their entrance into the biofuels arena. The IDB could play an equally important role in this region by initially supporting a region-wide analysis of the potential for a biofuels market under reasonable assumptions regarding feedstock selection and oil price scenarios. Building upon its experiences in Central America, the IDB could subsequently provide leadership in convening the countries in the Caribbean to define a strategy for a biofuels market for this region and then helping them implement it.

G. Technical Assistance on Ways to Reduce the Volatility in Oil and Biofuels Feedstock Prices

A major stumbling block for the development of a biofuels industry has been the volatility of oil prices and biofuels feedstock prices. This has been a problem encountered worldwide, not just in LAC. Proposals to try to establish a more stable market are emerging once again, primarily in developed countries.

In order for biofuels markets to emerge in LAC countries, they also need more oil price stability. IDB could play a major role in providing technical assistance on strategies to reduce oil price stabilization. The Bank has already begun playing such a role; it has recently commissioned a study, "Estrategia de Estabilización para los Precios del Petróleo en América Central", by Roberto Rigobón of the Massachusetts Institute of Technology to address oil stabilization options for Central America.

On the biofuels side, the Bank could similarly provide technical assistance on strategies to stabilize the biofuels market. The Bank could also play an important role in helping LAC countries determine whether they might want to implement policies to reduce oil and biofuels feedstock price volatility on more than a country-by-country basis, perhaps adopting them regionally or sub-regionally. Again, this was one of elements of the Rigobón analysis.

3. Finance Barriers

In order for a biofuels market to successfully emerge in LAC, access to finance is critical. IDB has a variety of financial instruments that it can and should offer in this endeavor, including technical assistance, public sector investment lending, and private sector debt, equity, and insurance instruments through its private sector windows, the

Private Sector Department (PRI), the Inter-American Investment Corporation (IIC), and the Multilateral Investment Fund (MIF).

Nevertheless, there are gaps in financing instruments that are emerging in which the IDB can play a role. These are described below.

A. Establish an Equity Fund for PRI to Invest in Companies Using New Biofuels Production Technologies

Private companies approach PRI for investment in large projects generally because PRI offers loan attributes that commercial banks do not. These include longer loan terms, political risk insurance, and some reduction on costs. Companies are also approaching PRI for investment in new ethanol refineries using newer technologies than are conventionally used in Brazil; they have found conventional lenders are not willing to risk loans for such projects due to the "technology risk". But the technology risk has proved to be a barrier for PRI as well; it has been unable to make these investments. This represents a major barrier for LAC because it is important that the region invests in and adopts new technologies and technical approaches to biofuels development and use as they emerge.

The International Finance Corporation (IFC), part of the World Bank Group, has responded to the challenge of investing in new technologies by devising a two-stage investment process, a pre-commercialization phase that tests and demonstrates the efficacy of a new technology, and a commercialization phase where the new technology is incorporated into the facility. IFC invests in the equity of the company during the pre-commercialization stage and then follows up with a loan, if needed, in the commercialization phase. It has found the equity investment is a better tool than a loan for managing the technology risk during the pre-commercialization stage because it offers a higher potential for return if the technology proves viable.

Based upon this experience, the IDB should consider the establishment of an equity fund that operates in a similar manner to assist companies looking for investment in biofuels-related facilities that may be using new technologies. In addition, fostering investment by third-party equity sources in companies undertaking new technology pre-commercialization phases, while less direct, could also prove important; IDB is already investigating this possibility in a partnership among PRI, IIC and Region 2 (serving Mexico, Central America and part of the Caribbean).

B. Support Pilot Programs to Demonstrate Economic Viability of Newer Biofuels Implementation Techniques

The Brazilian experience in developing a biofuels market cannot be simply be copied and applied by new LAC entrants into the biofuels market, whether medium-sized or small countries. Growing conditions are different, market sizes are different and vehicle market attributes are different. Hence, it makes sense that the adaptation of

lessons learned in other countries, including Brazil, need to be tested before launching a wide-scale application.

This argues for the creation of loan funds for "pilot programs" to test different approaches both on the public sector side as well as on the private sector side, particularly for the IIC, whose clientele, small and medium businesses, can least afford the risk of investing in new approaches without an initial test of the approach. Phased public sector loans as well as innovation loans may be two Bank instruments that could be tapped for public sector pilot programs. Nevertheless, the process of how to design loans for pilots needs to be assessed more thoroughly; in particular, procedures need to be defined for covering losses if pilots are unsuccessful.

Pilot loans also make sense on the private sector side. IIC, for example, has been approached several times for pilot loans for biofuels, in one case to test the application of sugar cane strains developed in Brazil in other LAC countries. At present, these types of loans do not exist in the Corporation. Nevertheless, the efficacy of these types of loans is high because they can feed a future pipeline. Hence, the creation of a new instrument for IIC to enable it to finance pilot programs makes sense; as with the public sector funds, such an instrument would have to define a process to cover losses if the pilots are unsuccessful.

C. Modernization of State-Owned Sugar and Ethanol Industries

For some LAC countries, principally those in the Caribbean, the sugar industry is still state-owned. In recent years, these countries have exported their sugar to the European Union (EU) at a preferential price, which will shortly expire. Some of these industries are inefficient and antiquated; with the expected cut in the preferential price paid by the EU, their future is not promising. Survivability of the sugar industry in these countries will depend in diversifying the industry into other products such as raw sugar, refined and bagged sugar, ethanol and molasses production, and cogeneration with bagasse (to meet their own electricity needs and sell the rest to the grid).

IDB policy generally requires that these industries first be privatized before they are recipients of IDB investment. However, given the state of some of these industries, they are only likely to be bought at rock-bottom prices, with the new owners not likely to be seasoned agricultural producers. The long term survivability of the sugar industry in these countries could therefore by threatened, despite the benefits it brings to these countries and the potential benefits it could bring to an ethanol industry. A more flexible approach by the IDB could be more effective, involving public-private partnerships in some cases, direct investment in the modernization of the state industry in others, and total privatization of the sector in still others.

At the same time, when privatization does occur, the typical type of remuneration to the government—a one-time payment—may well not be optimal for Caribbean country governments dependent on a regular source of income from this key industry year after year. The IDB could identify different potential structures for remuneration to

the national governments. Such structures could enable national governments to continue to enjoy a regular annual income from the sugar facilities—akin to a royalty fee—instead of a one-time-only payment.

4. Potential Role of GEF and CDM

Given the potential benefits for carbon emissions reduction from the use of biofuels, it makes sense to evaluate whether resources from the Global Environmental Facility (GEF) or from the Clean Development Mechanism (CDM) could contribute to the emergence of a biofuels market in LAC.

With respect to the GEF, these resources may be tapped to support biofuels development so long as they are consistent with country priorities for use of GEF resources as well as the GEF operational strategy in climate change. As an executing agency of the GEF, the IDB is in an optimal position to work with its member countries to develop biofuels projects that meet these criteria.

GEF staff expect that more biofuels projects are likely to be funded which focus on cellulosic rather than first-generation ethanol technologies. They also expect that GEF projects will evolve focusing on the transfer of knowledge from the Brazilian experience, having already supported projects with the Copersucar Technology Center (a private Brazilian sugar and ethanol research institute) to pilot mechanized production of sugar cane, and to develop a pilot biomass gasification project.

With respect to the CDM, prospects are not clear. Two concerns may hamper use of the CDM. First, no methodology has yet been approved for the production of biofuels, either ethanol or biodiesel, although several are in the pipeline. Methodology approval is a critical early step in the process of registering projects for CDM credits. Second, the absence of an international agreement for post-2012 climate policy may weaken the market for CDM credits. On the other hand, if the CDM Board approves the methodologies for biofuels, a CDM market for biofuels could quickly develop and continue through the window for the end of the first phase of the CDM tool scheduled to end in 2012.

Apart from the approval of biofuels methodologies, the CDM has already embraced bagasse cogeneration with an approved methodology and registered projects. Since bagasse cogeneration is an important component for improving the efficiency of ethanol distilleries, gaining CDM credits for this activity alone can cause the overall price of ethanol to drop.

Conclusion

With its unique biomass resources, Latin America and the Caribbean enjoy a substantial potential to develop biofuels to meet its own internal needs as well as to export to other countries in the world. Moreover, it benefits from the long term leadership of one of their own members—Brazil—in this endeavor. Nevertheless, the path is fraught with risks, not the least of which is the volatility of both the oil market and the commodity markets for the feedstock for biofuels. The IDB can play an important role in helping its member countries navigate a path through these risks with the result being the realization of a sustainable biofuels industry.

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Interviews

(Outside of IDB)

Patricia Bliss-Guest, Deputy CEO, Global Environmental Facility (GEF)
Barbara Bramble, International Program Director, National Wildlife Federation
Brian Castelli, Vice-President, Alliance to Save Energy
Keith Cole, General Motors Corporation
Mohammed El-Ashry, Former CEO, GEF
Linda Fisher, Vice President for Environment, Dupont Chemical Corporation
Christopher Flavin and Suzanne Hunt, WorldWatch
Howard Geller, Director, SouthWest Energy Efficiency Project (SWEEP)
Nathaniel Green, Natural Resources Defense Council
Richard Hozier, Climate Change Director, GEF
Robben Johnson, Cargill, Incorporated
Todd Johnson, World Bank

Melinda Kimble and Janet Hall, United Nations Foundation
Luis Kolster, Public Policy Director for Latin America, General Motors Corporation
Oswaldo dos Santos Lucon, Cabinet Office Advisor, Sao Paulo State Environmental Secretariat
Martin Muenzmaier, Director, Federal Governmental Affairs, Cargill, Incorporated
Truman Seamans, Pew Climate Center
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Boris Utria, World Bank, Africa Energy Unit
Dana Younger, International Finance Corporation

(Within IDB)

Leandro Alves, Private Sector Department
Gabriel Casaburi, Finance and Infrastructure Division, Region 1
Christiaan Gischler, Infrastructure Specialist, Region 3
Robert Kaplan, Chief, Environment and Natural Resources Division, Region 2
Lori Kerr, Private Sector Department
Angela Miller, Inter-American Investment Corporation
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Jaime Sujoy, Chief, Regional Operations Department 1
Nicholas Uauy, Finance and Infrastructure, Region 3
Arnaldo Vieira de Carvalho, Sustainable Energy Specialist, Region 2