

USAWC STRATEGY RESEARCH PROJECT

BUILDING ALTERNATIVE-ENERGY PARTNERSHIPS WITH LATIN AMERICA

by

Mr. David Bernreuther
United States Army Civilian Corps

Professor Joseph R. Nunez
Project Adviser

This SRP is submitted in partial fulfillment of the requirements of the Master of Strategic Studies Degree. The United States Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, 3624 Market Street, Philadelphia, PA 19104, (215) 662-5606. The Commission on Higher Education is an institutional accrediting agency recognized by the United States Secretary of Education and the Council for Higher Education Accreditation.

The views expressed in this student academic research paper are those of the author and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the United States Government.

United States Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 MAR 2007		2. REPORT TYPE Strategy Research Project		3. DATES COVERED 00-00-2006 to 00-00-2007	
4. TITLE AND SUBTITLE Building Alternative-Energy Partnerships with Latin America				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) David Bernreuther				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army War College, Carlisle Barracks, Carlisle, PA, 17013-5050				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT See attached.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 22	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

ABSTRACT

AUTHOR: Mr. David Bernreuther
TITLE: Building Alternative-Energy Partnerships with Latin America
FORMAT: Strategy Research Project
DATE: 30 March 2007 WORD COUNT: 5966 PAGES: 22
KEY TERMS: Mexico, Oil Imports, Oil Dependency, Ethanol, Bio-diesel, Security
CLASSIFICATION: Unclassified

The world faces a significant energy problem with global demand rising and reserves declining. As both the largest consumer of energy and a major promoter of global economic stability, the United States is obviously affected by these developments. Beyond their direct economic consequences, high energy prices and potential shortages provide a pretext for unstable regimes to develop nuclear power (and potentially weapons), foster terrorism, impede global economic growth, and endanger stability. Concurrently, the U.S. faces a range of strategic challenges in Latin America including poor economic environments which promote problems including illegal immigration, drug trafficking, and instability. This project examines a concept to help mitigate both challenges – strengthening partnerships between the U.S. and its Latin American neighbors so they can become viable sources of alternative energy. This initiative would simultaneously help mitigate both America's energy concerns and improve relations with our Latin American neighbors.

BUILDING ALTERNATIVE-ENERGY PARTNERSHIPS WITH LATIN AMERICA

America is addicted to oil ... often imported from unstable parts of the world. ...Tonight, I announce [a] great goal: to replace more than 75 percent of our oil imports from the Middle East by 2025. By applying the talent and technology of America, this country can dramatically improve our environment, move beyond a petroleum-based economy and make our dependence on Middle Eastern oil a thing of the past.

—President George, W. Bush
State of the Union Message
Jan 31, 2006

In his television series "Connections" and associated books technological historian James Burke presents historical examples of how seemingly mutually-exclusive problems have been solved with a single solution. Burke portrays economic progress as the synergistic combination of new and old technologies inspired by the economic, strategic, and social conditions at a point in time. In pragmatic terms, adversity has inspired innovative thinkers to find synergistic solutions to seemingly unrelated problems. Burke shows how this optimistic outlook applies to technological and economic development; it is further possible to see its application extended to national strategy and foreign policy. The National System of Interstate and Defense Highways initiated during the Eisenhower administration is an example. The program provided an economic boost to a country recovering from a depression and world war by providing jobs and a better transportation system. Simultaneously, it strengthened the nation's military and diplomatic leverage by providing strategic military transportation capabilities. This work advocates a similarly synergistic solution to mitigate two seemingly dissimilar strategic dilemmas currently facing the United States - its dependency on imported oil and improving relations with Latin America.

The United States and other industrial nations began replacing coal with oil as their primary fuel early in the 20th century because it is fungible, more portable, cleaner burning, and a dense energy source. Cheap and plentiful oil became the lifeblood of the American, and other, economies. For many years this dependence was strictly a domestic concern as the United States was self-sufficient in oil production. However, since the 1970s America has become dependent on external oil sources. In the new century, the supply and price of this imported oil has arguably replaced communism as the primary threat to United States security. A recent article described oil as an "elephant in the foreign policy living room"¹ driving American global strategy and foreign policy. America's dependence on imports is the primary reason for oil's prominent position in its strategy and policies but not the only one. The American economy

is strongly tied to the global economy – with 20% of economic activity attributable to imports or exports.² The economies of many American key trading partners are also heavily dependent on imported oil. Further, the national interests of the United States are best served when the world as a whole is stable, enjoys economic growth, and human development progresses. Rising energy prices imperil global stability and growth, thereby threatening America's national interests. Disruption of oil supplies could cause acute damage to the global economy and endanger the ability of many states to provide food and other essentials to a growing populace. Consequently, as the world's leading economic power, the United States is both dependent on a safe supply of oil for itself and also for its numerous economic partners.

Oil is also prominent in American strategy and policies because it is an underlying factor in other strategic concerns, primarily enabling terrorism and empowering the antagonistic regimes of several states. Higher oil prices, and the threat of future shortages, are empowering oil-producing states with anti-United States regimes such as Venezuela and Iran. Both have seen dramatic economic benefits from recent rises in oil prices. The CIA estimates that Iran, for example, has amassed \$60B in foreign exchange reserves.³ Further, both regimes have gained diplomatic leverage as states throughout the world seek their favor to gain access to future oil supplies. Iran and North Korea have both used current and projected future oil shortages as a pretext to develop nuclear programs. Both the Middle East and North East Asia have been destabilized by the possibility that these states could possess nuclear weapons in the future. A capability that North Korea already claims to have tested.

The extent to which oil has become the prominent issue in American strategy is demonstrated by the extent of military and diplomatic might that is being focused on maintaining stability and security in oil producing regions. America's extensive interests in the Middle East have compelled it to overtly employ various elements of power to include the military overthrow of Iraq. The point is also illustrated by the manner in which the current administration has dealt with the three primary members of the "axis-of-evil". Iraq, an oil producer was invaded. Iran, also an oil producer has been treated sternly. Meanwhile, North Korea, the member which is not an oil-producer has been offered de-facto concessions to cease its nuclear program and American forces in South Korea continue to be reduced.

Although oil is the primary driver of American strategy, the United States cannot afford to lose sight of the importance of its interests and roles elsewhere in the world. In the Western Hemisphere, the United States faces a range of strategic challenges in Latin America, to include poor economic environments which promote illegal immigration, drug trafficking, and hostile

regimes. As will be examined later, an opportunity exists for America to help its neighbors with some of these challenges while concurrently developing alternative energy sources.

Strategic Economic Concerns

The population of the United States recently reached the 300 Million mark, an impressive milestone, yet still less than 5% of the 6.5 Billion inhabitants of the earth. This relatively small population generates the world's single largest economy comprising nearly one third of the world's Gross Domestic Product (GDP).⁴ Economically inexpensive fuel drives the American economy and oil is the largest single source, providing 40% of total demand.⁵ By far, the United States is the world's largest oil consumer using in excess of 7.5B barrels annually - 25% of world consumption.⁶ Oil is particularly important as it provides virtually all (96%) of the fuel used for transportation. Since the oil crisis of the early 1970s, improved efficiencies and conservation have helped to reduce the relative amount spent on oil. Oil as a portion of gross domestic product (GDP) has decreased 50% since 1973.⁷ Regardless, oil remains America's primary energy source and is vital to the domestic economy as well as those of many trading partners around the world.

The United States is still a major oil producer, trailing just Saudi Arabia and Russia. However, domestic production peaked in the early 1970s and has failed to keep up with growing demand. Since 1993 America has imported more oil than it produces⁸ and today roughly 60% of the oil used in the United States is imported.⁹ Oil imports are the largest contributor to a growing foreign trade imbalance. The trade imbalance in 2005 equated to \$2,700 for each man, woman and child. Oil imports represents most of this imbalance, at recent prices (\$55 per barrel) they cost every American \$1,400 a year.

United States oil imports cannot be offset by expanding domestic production, as we possess just 2.5% of the world's proven oil reserves. Even if the controversial Alaskan National Wildlife Reserve were tapped it would only provide 7% of the oil consumed annually.¹⁰ Some alternative petroleum sources such as tar sands and gasified coal are abundant in the United States and Canada. However they are also much more expensive to process and, therefore, come at a significant economic cost. They also pose major environmental hazards. Both are obtained by mining, a technique generally harder on the environment than pumping oil. Further, coal is still an environmentally dirty fuel. Faced with these impediments to increasing domestic energy sources it is most likely that the United States' dependence on imported oil will continue to grow.

Alternative fuels may also help offset some demand, but again only with significant technological advances, which will take time, and costs. A good example is hydrogen powered fuel cells for cars. Hydrogen is an explosive gas; a substantial new infrastructure will be needed to safely store, distribute, and dispense it. One estimate places the cost for the network of special gas stations to be \$180B,¹¹ yet the stations represents just one of the infrastructure elements that would be needed. It is also important to note that hydrogen is not an energy source, rather a means to convey energy from another source. Hydrogen has to be extracted from water or other compounds. Doing so requires another energy source, currently it is usually done with coal. While this would shift the primary fuel from oil to coal, a fuel that is cheap and plentiful in the United States, it does not address the environmental concerns with coal nor is coal renewable.

Ethanol, usually produced from corn, is a more promising alternative fuel and is receiving much recent interest. Cars in the United States already routinely use a 15% ethanol/85% gasoline blend. Ethanol can be used within the existing gasoline infrastructure with far fewer changes than other alternative fuels. Still, the costs of expanding ethanol use will be significant. Critics argue that it requires more energy to grow, distill, and distribute ethanol than it provides.¹² Pessimistic estimates claim more energy is consumed producing ethanol than is produced. Optimistic estimates concede that corn ethanol produced in the United States yields just 30% more energy than used.¹³ In either case, like hydrogen, ethanol main virtue is not as an energy source, rather as a convenient transfer medium for energy from other domestic sources like coal. Despite the challenges associated with ethanol production in the United States has broad political support and is expanding rapidly.

For the long term, strategists should be concerned with this trend. Moreover, expanding domestic ethanol production as it is currently being done may create new problems. As will be explained, using current ethanol technology, the United States can only offset a portion of its energy needs without creating other, graver, problems. The contribution it can make to the overall problem may not justify the investment and attention it is receiving.

It is important to understand that a complete conversion replacing gasoline with ethanol for all United States transportation is impractical with current technology. The entire continental United States would have to be planted with corn. So, at best, only a fraction of oil demand can be replaced with corn ethanol. Distribution and expanding the use of ethanol are problematic. As it is more corrosive and more easily diluted by water than gasoline, it cannot be pumped through the existing interstate pipeline system. Rather, it is trucked. The additional costs and danger of trucking ethanol limits how far it can be distributed from the production plants, most of

which are in the upper mid-west. Substantial investment in a pipeline system able to handle ethanol would be necessary to enable more complete distribution throughout the country. Additional costs would be incurred to convert the 200 million American vehicles to use more ethanol than the current 15/85 ethanol/gasoline blend.

For international strategists, the importance of corn as a food product carries additional, possibly more significant, challenges. Diverting United States farmland to corn for ethanol production will squeeze food production, further stress topsoil, and raise corn prices. One estimate indicates that the ethanol necessary to fuel a sport utility vehicle a single time diverts the same amount of corn needed to a person for a whole year.¹⁴ It is not clear if it would be possible to increase the amount of corn to meet both food and energy consumption. Increasing demand for corn, both as a source of food and for ethanol, have already caused corn prices, and the price of farmland, to rise significantly in the last several years. The problem can only get worse, as the Department of Agriculture is predicting consumption of corn (just as a food source) will grow substantially (37%) by 2050. While more land is available, it is becoming more expensive and the way corn is grown will limit how much it will help expand total production. Corn is an environmentally harsh crop that requires more than twice the fertilizer used to grow other crops and more fuel as well.¹⁵ Despite heavy use of fertilizers, growers must routinely rotate their corn crops to soybeans every third year to restore the soil. Corn yields drop 10-20% the first year the soybean rotation is skipped and decline further until it is done. Consequently, the amount of corn that can be obtained from any new land will be limited by the need to rotate crops. If corn prices continue to stay high, more farmers are likely to skip the soybean rotation in order to grow corn. Consequently, yields will decrease; placing additional upward pressure on prices while soybean production declines.

Some strategic consideration is also warranted to the corn which the United States exports. Every year \$6B in corn is exported. These exports help feed the rest of the world, thereby helping maintain stability and economic growth, as well as improving American's standing with the global community. Of course, corn exports also help moderate the foreign trade imbalance by \$6B.¹⁶ If America begins to divert corn that is normally exported to make ethanol it would decrease the world food supply (and the benefits that ensue) and add to the trade imbalance.

Such problems are not limited to corn-based ethanol. A recent initiative to use palm oil from Thailand to produce electricity had to be suspended when increased demand for the oil drove up prices and threatened adequate food supplies.¹⁷ The challenges involved with these and other alternatives limits impact on oil imports for years to come. To have a substantive

impact on global oil consumption, a variety of alternative energies from a diversity of geopolitical sources must be researched and developed. To avoid trading one problem for another, a balance must be sought between energy needs, food supplies, and ecological concerns.

The price of oil and its economic impact is also a strategic concern. Estimates vary, but as little as 40 years of supply remain in global reserves.¹⁸ Meanwhile, by 2030 world oil demand will increase by nearly half.¹⁹ To provide adequate supplies new sources need to be developed, yet oil production may have already peaked in many leading oil producing countries.²⁰ Generally, the world's best oil fields, those easiest to access and therefore cheap to develop and exploit, have already been tapped. Any new fields will tend to be more difficult to find and then more expensive to develop and exploit. Saudi Arabia is the world's leading producer and holds the world's largest reserves. Saudi Arabia helps moderate prices and supplies for its own long-term interests.²¹ While helpful in the short term, it is uncertain how long the Saudis can continue this practice. Furthermore, the United States and global economies are at risk placing so much reliance on a single supplier.

Strategic Security Concerns

The strategic implications of America's dependence on foreign oil go beyond its economic significance or the limitations of alternative fuels. Additional challenges are presented by the stability and disposition of the individual countries and regions in which most of the world's oil is produced. Much of the world's oil production and reserves are in the control of adversarial regimes or from countries which are more stable themselves but located in instable regions. Nearly half (45%) of United States oil imports come from the Middle East, North Africa, or other insecure regions. The largest of these suppliers is Venezuela, the third largest supplier providing 10% of oil imports²². Venezuela provides a good example of how it would be in America's best interest to cultivate alternative energy sources. The United States' relations with Venezuela's communist government, led by Hugo Chavez, have been tense throughout his term and will probably continue to be the same.²³ In the short term, American oil supplies from Venezuela are probably secure, as they are vital to the Venezuelan economy. Any disruption would hurt Venezuela as much or more than the United States. However, in the long term it is probable that other countries, such as China, will be providing Venezuela with a broader customer base, one that may be robust enough that Venezuela could afford to cut shipments to the America.

Beyond securing its own needs, the United States must be concerned with security of supplies for its allies and trading partners. Vital U.S. allies and trading partners, particularly

Japan, South Korea and Western Europe, are also heavily dependent on energy imports. Japan is the world's third leading consumer of oil (2B Barrels annually), all of which must be imported.²⁴ Similarly, South Korea imports most of its oil. Western Europe is able to obtain much of its oil locally from the North Sea fields of Norway and the United Kingdom. However, these fields are in decline and imports are increasing. Increasingly, Europe is dependent on energy from more perilous regions including Russia, the Caspian Sea, North Africa and the Middle East.²⁵ The seriousness of the problems that can arise from these dependencies was illustrated recently by a disagreement between Russia and Belarus, a disagreement which almost caused natural gas supplies to Europe to be disrupted.²⁶ Similar stability concerns apply to the west African regimes of Nigeria and Angola.²⁷

Much of this oil originates from the Middle East, a particularly volatile region. The region is the world's leading supplier of oil; five of the world's top 14 oil producing nations are located there. The Kingdom of Saudi Arabia, for example, has the world's largest oil reserves which are easy and inexpensive oil to tap. The Kingdom remains a staunch ally and stable producer, however American strategy cannot ignore that it is located in the middle of a highly volatile region and also faces growing internal demographic and political tension.²⁸ It is not certain if in the future the Kingdom will remain the stable ally and supplier it has been. Heavy U.S. involvement in the Middle East, e.g. Iraq, increases the risks. A significant misstep on our part (e.g. our handling of the situation in Iraq or with Iran) could alienate the Kingdom or other nations of the region. Even if Saudi Arabia remains stable and allied to the United States, its location in such a precariously region puts it at risk. Much of its oil production industry is centralized. A single terminal on the Persian Gulf handles nearly all oil exports and two thirds of the refining is done at one facility.²⁹ These locations provide potential targets for terrorism or other attack. External threats, such as Iranian hegemony, also potentially threaten Saudi Arabia and the other suppliers in the region particularly Iraq, Kuwait, and the Gulf States.

Geography adds to the complexity of securing the world's oil supply. Most of the Middle East's oil must pass through the Straights of Hormuz, where it is vulnerable to Iranian or terrorist interference. Similarly, the Strait of Malacca represents another vulnerable chokepoint for oil distribution. In this case oil which is headed to Japan, China, and other east-Asian countries. Most of Japan's oil (80%) and all of South Korea's supplies come from the volatile Middle East, generally these pass through the Strait.³⁰ The Caspian Sea is also a region with significant petroleum reserves and serious geographic perils.

Potential Point of Contention

America's oil dependency is further complicated by the growing significance of Chinese and Indian oil consumption. Relations between the United States and these two potential peers have often been stressed. American support of Taiwan, for example, is a long standing point of contention with China. Similarly, American support of Pakistan has made congenial relations with India more challenging. As the economies and global influence of these two powers grow, competition for oil could put them into an adversarial position with the United States.

The economies and middle-classes of both China and India are growing steadily and with it, their consumption of oil. Much of the world's growth in oil demand over the next two decades will occur in these two countries - 43% of the anticipated increase.³¹ China is already the second largest oil consumer, trailing only the United States with 7.6% of world consumption. By 2011 Chinese oil consumption will grow 27%, and China will need to import over half (58%) of its oil.³² India is still a relatively small oil consumer. While home to more than 15 percent of the world's population, India still accounts for just 3% of total world oil consumption. However, India's energy needs are rising sharply - last year consumption increased 10%. More significantly, India is already highly dependent on oil imports. It currently imports 70%, a fraction expected to grow to 80% by 2020.³³ Oil imports are particularly significant to the Indian economy, accounting for one third of all imports.

Like the United States and its allies, China and India recognize that their current and future economic well-being are tied to adequate and secure oil imports. Should global oil production falter or be disrupted by regional turmoil, the United States and its allies could find themselves in contentious competition with China or India for the remaining supplies. Both countries are taking steps to mitigate their future vulnerability to disruption. By developing alternative sources. India, for example, recently signed a treaty with United States that will allow her to acquire American technology for nuclear power generation.³⁴ Meanwhile China recently paid \$1B for the rights to explore for oil in deep water areas off of Angola.³⁵ More troubling is that both countries are modernizing and strengthening their navies. Potentially they could challenge the United States and its allies in projecting force to the Strait of Malacca and throughout the region.³⁶ Future competition for global oil sources could escalate tensions with these growing powers.

As summarized above, developing alternative energy sources is in the best interest of the United States. A diversity of energy sources mitigates the potential problems that could occur should one, or a handful, of sources be disrupted. Increasing global energy supplies mitigates the threat that shortages would threaten global development and stability. Similarly they would

mitigate the chances that the United States finds itself in an adversarial position with countries like China and India over energy supplies. Next this work examines how Mexico, and the rest of Latin America, hold great potential as a new source of renewable energy. It is in the best interest of the United States to help its Latin American neighbors to develop this energy source.

Mexican Economic Transition

With a population of 107 million, Mexico is the most populous Spanish speaking country in the world. Over the past century Mexico's economy has seen the extremes of vibrant growth and desperate recession. From the 1920s to the 1960s the economy experienced what historians have referred to as the "Mexican Miracle" - growing impressively despite the adversity of the Great Depression and World War II. However the economy stagnated during the 1970s and 1980s.³⁷ By 1982 the country was unable to pay its debts.³⁸ Difficulties continue and in the middle 1990s it became necessary to devalue the peso and the economy fell into a severe recession.³⁹ Numerous economic reforms were taken to include opening the economy to more foreign trade. Since that time international trade agreements have been reached with over 40 countries located around the world. Mexico has entered into more trade agreements than any other country, opening nearly 90% of the economy to foreign trade.⁴⁰ Perhaps the best known is the North American Free Trade Agreement (NAFTA), of which the United States and Canada are also party. The impact of these free trade agreements, including NAFTA, has generally been positive, but the potential benefits have not reached all segments of Mexican society.

Oil production is a major component of the Mexican economy and of great strategic importance to the United States. Mexico is the United States' second largest supplier of oil, providing 12% of oil imports or 8% of total consumption.⁴¹ Its reserves (24B Barrels)⁴² are larger than those of the United States or Canada. Mexican total oil production is about 1.7B Barrels per year, 10th largest in the world of which 700M Barrels⁴³ goes to meet Mexico's domestic needs. The balance is exported, generating sales of roughly \$55B (at \$55/bbl). Yet as the Mexican economy modernizes its domestic consumption is growing. The supply balance is aggravated by declining production in the main oil field and a lack of adequate investment in new fields.⁴⁴ Eventually, like the United States, Mexico could become a net importer of oil. Worst-case scenarios estimate this could occur as early as 2010.⁴⁵

The strategic importance of Mexico's economy to the United States goes beyond the oil it produces. The economies of the two nations are deeply intertwined and interdependent. Nearly all Mexican exports (87%) go to the United States, while over half of imports (55%) are from the United States. About one in seven American exports goes to Mexico, making it the

second largest recipient (second only to Canada). Imports from Mexico to the United States are similarly significant - one in nine imports come from Mexico, exceeded only by those of Canada and mainland China.⁴⁶ Consequently, the two economies are strongly linked and so a healthy Mexican economy is vital to a healthy U.S. economy.

Once again the Mexican economy is growing. Economic reform, political stability, and increased foreign trade have fostered economic recovery since the financial crisis of the mid-1990s. Average growth from 1995 to 2002 exceeded 5%. Recent growth has been more modest, 3% per year but this still compares well to the United States rate of 3.4%. By 2005, Mexico's total Gross Domestic Product (GDP) exceeded \$1 Trillion, the 13th largest in the world. Further, the budget deficit has been reduced and foreign debt is now less than one fifth of the economy. This compares well to the U.S. federal deficit, which is 60% of GDP. Mexico, along with Chile, currently has the highest credit rating of Latin American countries.

The benefits of financial growth are still accruing into Mexico's populace. Unemployment is down to 3.6%, lower than the 4.5% in the United States.⁴⁷ The economy is so healthy that it now attracts immigrants, both legal and illegal, from throughout the rest of Latin America. Growth since the financial crisis and recession of the mid-1990s has reduced the poverty rate from 50% to 17%. However, growth has been uneven - more than half of all income goes to the top 20% of workers. Some districts, generally in the Federal District around Mexico City and northern Mexico, have prospered much more than others. In these regions economic, educational and life expectancy – as measured by the United Nation's Human Development Index – is on par with those of leading economies like Germany. In contrast, many regions have lagged, for example the southwestern state of Guerrero has a ranking equivalent to Malawi's.

Poverty still occurs throughout Mexico, but the urban population has benefited the most from growth in the manufacturing, service, and tourism industries - the poverty rate amongst the urban population has been cut to 11%. Poverty and other social problems remain much more severe in rural regions where more than a fourth of the population still lives in poverty.⁴⁸ In these regions agriculture is often the leading industry. Agricultural wages have not kept step with the rest of the economy. Nearly one in five Mexican workers are employed in agriculture, yet they represent just 4% of the economy. The problem is particularly severe among the Amerindian minority of the south.

Despite their low cost wages, Mexico's farmers have difficulty competing in an internationally open economy, as most are sustenance farmers utilizing older growing methods and lacking automation. In contrast, nearly 75% of U.S. agricultural income is generated by

large commercial operations and U.S. farmers receive substantial (\$16B) subsidies.⁴⁹ Competing against cheaper imports and lacking the necessary capital and training to modernize, many Mexican farmers find themselves economically trapped - unable to make a living farming, yet lacking the skills to pursue another vocation. This problem has been mitigated for some farmers by the dramatic rise in world corn and sugar prices over the last year. However, while many farmers are benefited from higher prices, Mexico's poor are being hurt by the sharp rise in food prices that it has caused.

The plight of these struggling workers is a strategic concern to the United States for two reasons. Most apparent is that poverty in Mexico promotes illegal immigration to the United States. Illegal immigration has become a serious political, social, and economic concern in the United States. The Department of Homeland Security estimates the number of illegal immigrants to be around 10.5 million. Most have come from Mexico (6 million) and Central American (1 million).⁵⁰ Despite economic progress in Mexico, illegal immigration has increased – the population of illegal immigrants in the United States has increased nearly 25% since 2000. Most illegal immigrants accept work and living conditions that most American citizens would not and the economic benefits to them and their families are worth the dangers and distress. Remittances from workers in the United States back to their homes in Mexico equal \$12B a year - providing the second largest source of foreign income.⁵¹ Offering more domestic economic opportunities to Mexico's poor is essential for the United States to reduce the economic pressure to illegally immigrate.

The United States also needs to be concerned with the political instability and violence that results from a large impoverished and disenfranchised Mexican population. The amount of traffic between the two countries and the large shared borders makes it possible for social and legal problems in Mexico to threaten the United States homeland. Trafficking of illegal drugs is a major problem throughout Mexico. Mexico is a major conduit for smuggling illegal drugs into the United States including 90% of the cocaine smuggled from Columbia. These drugs are coming through Mexico via routes controlled by drug cartels.⁵² Beyond the social damage and crime these drugs create within the United States, they create instability and violence in Mexico. Drug cartels operate above the law in many areas of the country. Their violence permeates and intimidates the entire country; in 2006 alone over 2,000 were murdered in gang warfare between rival cartels.

If not addressed, the violence and corruption that is threatening Mexico could spill over into the United States. In response to the violence, and at the urging of President Bush, the Mexican government has begun to crack down on the cartels in hopes of curbing the violence

and restoring order.⁵³ The severity and scope of Mexican poverty has also fomented anti-government movements, notably the Zapatistas movement in these southern states. These threatened the stability and economic development of the country. They also provide potential allies and safe-harbors for terrorists. A population that is economically better off and able to view the future more optimistically would be less tolerant of the crime, violence, and insurrection that currently threatens Mexico and the Central American region.

Recommendation

The well being of the United States is strongly bound economically, socially, and geographically to Mexico and the rest of Latin America. Consequently, it is vital for the United States to help its Latin American neighbors with the challenges summarized above. Fortunately there is strategic initiative which the United States can support that would help in this endeavor while simultaneously helping address the strategic challenges regarding its own dependency on imported oil. That is to help its Latin American neighbors develop their potential as sources for renewable energy such as ethanol and bio-diesel. Latin America is a favorable region for growing crops that can be converted into ethanol or bio-diesel. Either fuel can be readily used in the petroleum infrastructures of the countries themselves or exported to the United States. Regardless if new Latin American bio-energy is used locally or exported; it would benefit U.S. interests (and concerns) by moderating global energy concerns.

Brazil has already demonstrated success using sugar cane as a source for making ethanol and utilizing it as a viable alternative energy. Like Brazil, Mexico and many of its neighbors possess many of the geographic features that enable renewal energy industries – available arable land, adequate water, inexpensive labor, and a warm climate. In addition the two crops most often used for ethanol production, corn and sugar cane, are already grown. This means they already possess a knowledgeable workforce and the infrastructure to produce these crops immediately.

Sugar cane is a more efficient crop than corn for producing ethanol and Brazil's successful ethanol industry is based on it. Mexico and much of Central America are among the low and medium cost producers of sugar cane in the western hemisphere according to research done by the United States Department of Agriculture.⁵⁴ Production, and consumption, of sugar has grown steadily in Mexico for nearly 50 years. Yet exports have remained relatively steady and net income has declined. Like so much of Mexican agriculture, the sugar industry is divided amongst a large number of small growers – nearly all growers cultivate more less than 15 hectares of land. In contrast, the average American sugar grower farms over 400 hectares.⁵⁵

Like corn growers, Mexican and Central American sugar growers would benefit from the increased demand that would result from producing ethanol fuel.

Economic benefits of producing ethanol can be realized quickly in Mexico. While ethanol production can be implemented soon, in the long term it would be advantageous to help the region transition to other crops. Crops that can be used to produce bio-diesel. Bio-diesel is a more efficient fuel to produce than is ethanol since it doesn't require the same energy-intensive distillation process. Bio-diesel can be produced from a number of oil-bearing crops. One of the most promising is algae whose net energy yields are exceptionally high. Algae is relatively simple to grow its basic requirements being water and sunlight, both of which are readily available in much of Mexico and the rest of Central America. Switching to bio-diesel would require more training and new infrastructure than ethanol, but holds great promise as a more efficient and less environmentally-stressful renewable energy source.

On their own initiative, Central American countries have begun to invest in renewable energy.⁵⁶ However, none of these countries possess the same technical expertise or investment capital available within the United States. Their progress in developing renewable energy sources would benefit from the expertise and capital that the United States can offer. As discussed, the United States would benefit directly and indirectly by establishing additional energy sources. Moreover as the energy would be in close proximity to the homeland and from regimes which are relatively friendly and stable. Given the immediate and long term implications of the global energy situation, these benefits alone justify a significant United States effort to help Mexico and other friendly countries to develop renewable energy sources. What gives this initiative special merit are the additional benefits that derive from aiding the people and economies of these countries. The initiative also yields benefits from helping to extend greater economic opportunities throughout Mexico's populace such as reducing illegal immigration, supporting a symbiotic economy, and reducing discord and crime. It also provides a great opportunity for the United States to contribute to the social well-being of others throughout the world. An honorable role that Americans aspire to and also one that would contribute to the countries good-standing in the world community.

Conclusion

As the world's leading nation, the United States shoulders many demanding and complex challenges. Rarely do potential solutions offer the multiple benefits that can be achieved by helping Mexico and Central America develop renewable fuel industries. The United States

should make a substantive investment to this end as a key element of both its National Energy Strategy and Foreign Policy.

Endnotes

¹ COL John Amidon, "Needed Now: A National Energy Security Manhattan Project," *Air Force Quarterly* 39 (October 2005): 1; available from <http://www.au.af.mil/au/aunews/archive/apr/Manhattan.html>; Internet; accessed 30 March 2007. Hereafter cited as Amidon, AFQ.

² Central Intelligence Agency, "Economy, United States," in *The World Factbook* (Washington, D.C.: U.S. Government Printing Office, 2007); available from <https://www.cia.gov/cia/publications/factbook/geos/us.html#Econ>; Internet; accessed 30 March 2007.

³ Central Intelligence Agency, "Economy, Iran," in *The World Factbook* (Washington, D.C.: U.S. Government Printing Office, 2007); available from <https://www.cia.gov/cia/publications/factbook/geos/ir.html#Econ>; Internet; accessed 30 March 2007.

⁴ International Monetary Fund, "World Economic Outlook Database, September 2006," available from <http://www.imf.org/external/pubs/ft/weo/2006/02/data/index.aspx>; Internet; accessed 30 March 2007. Also available from "List of countries by GDP", Wikipedia.org, http://en.wikipedia.org/wiki/List_of_countries_by_GDP_%28nominal%29; Internet; accessed 30 March 2007.

⁵ U.S. Energy Information Agency, "U.S. Primary Energy Consumption by Source and Sector 2004," available at "Energy Basics 101"; available from <http://www.eia.doe.gov/basics/energybasics101.html>; Internet; accessed 30 March 2007.

⁶ U.S. Energy Information Agency, "World Petroleum Consumption (Table 11.10)," in *Annual Energy Review 2005* (Washington D.C.: U.S. Energy Information Agency, 2005); available from <http://www.eia.doe.gov/emeu/aer/pdf/pages/sec11.pdf>; Internet; accessed 30 March 2007.

⁷ Howard Geller, *Strategies for Reducing Oil Imports: Expanding Oil Production vs. Increasing Vehicle Efficiency*, Report No. E011 (Washington, D.C.: American Council for an Energy-Efficient Economy, April 2001); available from <http://www.aceee.org/store/proddetail.cfm?CFID=3399&CFTOKEN=72655700&ItemID=86&CategoryID=7>; Internet; accessed 30 March 2007.

⁸ U.S. Energy Information Agency, "Energy Timelines," available from <http://www.eia.doe.gov/kids/history/timelines/index.html>; Internet; accessed 30 March 2007.

⁹ U.S. Energy Information Agency, "Overview of U.S. Petroleum Trade (Table 1.7)," in *Monthly Energy Review* (Washington, D.C.: Energy Information Agency, March 2007), available from http://www.eia.doe.gov/emeu/mer/pdf/pages/sec1_15.pdf; Internet; accessed 30 March 2007.

¹⁰ "Study: ANWR oil would have little impact," *Associated Press*, 16 March 2004 [newspaper online]; available from <http://www.msnbc.msn.com/id/4542853>; Internet; accessed 30 March 2007.

¹¹ Michael Briggs, "Wide scale Biodiesel Production from Algae," August 2004; available from http://www.unh.edu/p2/biodiesel/article_alge.html; Internet; accessed 30 March 2007.

¹² Roger Segelken, "CU agricultural ecologist continues criticism of corn-based ethanol," *Cornell Chronicle* 35, (14 August 2003) [on-line journal]; available from <http://www.news.cornell.edu/chronicle/03/8.14.03/Pimentel-ethanol.html>; Internet; accessed 30 March 2007.

¹³ Hosein Shapouri, James A. Duffield, and Michael Wang, *The Energy Balance of Corn Ethanol: An Update*, Agricultural Economic Report Number 813 (Washington, D.C.: U.S. Department of Agriculture, July 2002); available from <http://www.transportation.anl.gov/pdfs/AF/265.pdf>; Internet; accessed 30 March 2007.

¹⁴ Lester R. Brown, "Starving the People To Feed the Cars," *Washington Post*, 10 September 2006 [newspaper on-line]; available from http://www.washingtonpost.com/wp-dyn/content/article/2006/09/08/AR2006090801596_pf.html; Internet; accessed 30 March 2007.

¹⁵ Ted Covey, et. al, "Figure 6: Fertilizers and fuels: Share of total expenses by farm type," *Agricultural Income and Finance Outlook*, AIS-84 (Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, November 2006); available from <http://usda.mannlib.cornell.edu/usda/ers/AIS/2000s/2006/AIS-11-30-2006.pdf>; Internet; accessed 30 March 2007.

¹⁶ Nora Brooks, *U.S. Agricultural Trade Update*, FAU-122 (Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, February 2007) available from <http://usda.mannlib.cornell.edu/usda/current/FAU/FAU-01-11-2007.pdf>; Internet; accessed 30 March 2007.

¹⁷ Carl Mortished, "Concern for rainforest forces RWE to scrap palm oil project," *Times Online*, 1 January 2007; available from <http://business.timesonline.co.uk/article/0,,9072-2525637,00.html>; Internet; accessed 30 March 2007.

¹⁸ Society of Petroleum Engineers, "How Much Oil and Natural Gas is Left?"; available from http://www.spe.org/spe/jsp/basic/0,,1104_1008218_1109511,00.html; Internet; accessed 30 March 2007.

¹⁹ U.S. Energy Information Agency, "Chapter 3: World Oil Markets," available at *International Energy Outlook 2006*"; available from <http://www.eia.doe.gov/oiaf/ieo/oil.html>; Internet; accessed 30 March 2007.

²⁰ "The end of oil is closer than you think," *Guardian News and Media Limited*, 21 April 2005; available from <http://www.guardian.co.uk/life/feature/story/0,13026,1464050,00.html>; Internet; accessed 30 March 2007.

²¹ Jad Mouawad, "Saudi Officials Seek to Temper the Price of Oil," *New York Times*, 28 January 2007; available from <http://www.nytimes.com/2007/01/28/business/28oil.html?ex=1256360400&en=ad01f6985e2d69bd&ei=5035&partner=MARKETWATCH>; Internet; accessed 30 March 2007.

²² U.S. Energy Information Agency, "U.S. Imports by Nations of Origin,"; available from http://tonto.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_m.htm; Internet; accessed 30 March 2007.

²³ "Venezuela's Chavez says state to take majority control of oil operations in May," *Associated Press*, 1 February 2007 [newspaper online]; available from <http://www.ihf.com/articles/ap/2007/02/02/business/LA-FIN-Venezuela-Nationalizations.php>; Internet; accessed 30 March 2007.

²⁴ Central Intelligence Agency, "Economy, Japan," in *The World Factbook* (Washington, D.C.: U.S. Government Printing Office, 2007); available from <https://www.cia.gov/cia/publications/factbook/geos/ja.html>; Internet; accessed 30 March 2007.

²⁵ Fiona Hill, "Beyond Co-Dependency: European Reliance on Russian Energy," *Brookings Institute, United States-Europe Analysis Series* (July 2005); available from <http://www.brookings.edu/fp/cuse/analysis/hill20050727.htm>; Internet; accessed 30 March 2007.

²⁶ Tony Halpin, "Last-minute deal averts new year gas war," *Times Online*, 01 January 2007 [newspaper on-line]; available from <http://www.timesonline.co.uk/article/0,,3-2525756,00.html>; Internet; accessed 30 March 2007.

²⁷ Central Intelligence Agency, "Angola," in *The World Factbook* (Washington, D.C.: U.S. Government Printing Office, 2007); available from <https://www.cia.gov/cia/publications/factbook/geos/oa.html>; Internet; accessed 30 March 2007.

²⁸ "The US-Saudi relationship: Oil supply at the expense of US security and moral values," *Atlantic Review* (28 October 2005) [journal on-line]; available from <http://atlanticreview.org/archives/153-The-US-Saudi-relationship-Oil-supply-at-the-expense-of-US-security-and-moral-values.html>; Internet; accessed 30 March 2007

²⁹ COL John Amidon, "Needed Now: A National Energy Security Manhattan Project," Briefing to Headquarters U.S. Air Force, 21 March 2006.

³⁰ U.S. Energy Information Agency, "International Petroleum Monthly," available from <http://www.eia.doe.gov/emeu/ipsr/t49.xls>; Internet; accessed 30 March 2007.

³¹ U.S. Energy Information Agency, "Chapter 3: World Oil Markets".

³² Erica S. Downs, "How Oil Fuels Sino-United States Fires," *Business Week* (4 September 2006) [journal on-line]; available from <http://www.brookings.edu/views/op-ed/fellows/downs20060904.htm>; Internet; accessed 30 March 2007.

³³ Parwini Zora and Daniel Woreck, "India joins the scramble for oil," *World Socialist* (12 April 2005) [journal on-line]; available from <http://www.wsws.org/articles/2005/apr2005/ind1-a12.shtml>; Internet; accessed 30 March 2007.

³⁴ "US approves Indian nuclear deal," *BBC News*, 9 December 2006 [newspaper on-line]; available from http://news.bbc.co.uk/2/hi/south_asia/6219998.stm; Internet; accessed 30 March 2007.

³⁵ David Teather and Angela Balakrishnan, "Year of the bull 2006," *Guardian Unlimited*, 29 December 2006 [newspaper on-line]; available from <http://business.guardian.co.uk/comment/story/0,,1980026,00.html>; Internet; accessed 30 March 2007.

³⁶ Dan Blumenthal and Joseph Lin, "Oil obsession - Energy appetite fuels Beijing's plans to protect vital sea lines," *Armed Forces Journal* (June 2006) [journal on-line]; available from <http://www.armedforcesjournal.com/2006/06/1813592>; Internet; accessed 30 March 2007.

³⁷ Gerardo Nebbia, "Mexico's ruling party fragmenting," *International Committee of the Fourth International* (8 April 1999) [journal on-line]; available from <http://www.wsws.org/articles/1999/apr1999/mex-a08.shtml>; Internet; accessed 30 March 2007.

³⁸ Jared E. Hazelton, "The Peso Devaluation in Retrospect," available from <http://www1.lanic.utexas.edu/cswht/paper2.html>; Internet; accessed 30 March 2007.

³⁹ Central Intelligence Agency, "Mexico" in *The World Factbook* (Washington, D.C.: U.S. Government Printing Office, 2007); available from <https://www.cia.gov/cia/publications/factbook/geos/mx.html>; Internet; accessed 30 March 2007.

⁴⁰ Gisele Henriques and Raj Patel, *NAFTA, Corn, and Mexico's Agricultural Trade Liberalization* (Silver City, N.M: International Resource Center, Americas Program, 13 February 2004); available from <http://www.irc-online.org/americaspolicy/pdf/reports/0402nafta.pdf>; Internet; accessed 30 March 2007.

⁴¹ U.S. Energy Information Agency, "U.S. Imports by Nations of Origin,"; available from http://tonto.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_m.htm; Internet; accessed 30 March 2007.

⁴² U.S. Energy Information Agency, "North America – The Energy Picture, June 2002," available from <http://www.eia.doe.gov/emeu/northamerica/engsupp.htm>; Internet; accessed 30 March 2007.

⁴³ U.S. Energy Information Agency, "North America –Energy Demand,"; available from http://www.eia.doe.gov/emeu/northamerica/engdemd.htm#_VPID_1; Internet; accessed 30 March 2007.

⁴⁴ Igor Greenwald, "Hubbert's Peak Theory Points to Dwindling Oil Supply," *Smartmoney* (16 February 2007) [journal on-line]; available from <http://www.smartmoney.com/decode/index.cfm?story=20070216>; Internet; accessed 30 March 2007.

⁴⁵ Amidon, AFQ.

⁴⁶ U.S. Census Bureau, "Foreign Trade Statistics," available from <http://www.census.gov/foreign-trade/statistics/highlights/top/top0701.html>; Internet; accessed 30 March 2007.

⁴⁷ Central Intelligence Agency, "Economy, United States".

⁴⁸ Central Intelligence Agency, "Economy, Mexico".

⁴⁹ Ted Covey, et. al, "Figure 12: Net value added by farm typology," *Agricultural Income and Finance Outlook*, AIS-84 (Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, November 2006); available from <http://usda.mannlib.cornell.edu/usda/ers/AIS/2000s/2006/AIS-11-30-2006.pdf>; Internet; accessed 30 March 2007.

⁵⁰ Michael Hoefer, Nancy Rytina, and Christopher Campbell, *Estimates of the Unauthorized Immigrant Population Residing in the United States* (Washington, D.C.: U.S. Department of Homeland Security, January 2005); available from http://www.dhs.gov/xlibrary/assets/statistics/publications/ILL_PE_2005.pdf; Internet; accessed 30 March 2007.

⁵¹ Luis Alonso Lugo, "Remittances are Mexico's biggest source of income, says Fox," *Associated Press* 24 September 2003; [newspaper online] available from <http://www.signonsandiego.com/news/mexico/20030924-2051-us-mexico.html>; Internet; accessed 30 March 2007.

⁵² Héctor Tobar, "Drug smugglers reroute shipments via Central America," *Los Angeles Times*, 4 March 2007 [newspaper on-line]; available from <http://www.latimes.com/news/printedition/front/la-fg-centam4mar04,1,5727242.story?coll=la-headlines-frontpage>; Internet; accessed 30 March 2007.

⁵³ Jeremy Schwartz, "Drug war rips apart Mexico," *Kansas City Star* 4 March 2007 [newspaper on-line]; available from <http://www.kansascity.com/mld/kansascity/news/16829174.htm>; Internet; accessed 5 March 2007.

⁵⁴ Stephen Haley, "U.S. Sugar in the FTAA," in *U.S. Agriculture and the Free Trade Area of the Americas*, Agricultural Economic Report Number 827 (Washington, D.C.: United States Department of Agriculture, Economic Research Service, March 2004); available from <http://www.ers.usda.gov/Briefing/Sugar/sugarpdf/U.S.SugarInTheFTAA.pdf>; Internet; accessed 30 March 2007.

⁵⁵ Economic Research Service, *Sugar and Sweeteners Overview – Mexico Outlook*, SSS-246, (Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 30 May 2006); available from <http://www.ers.usda.gov/Briefing/Sugar/sugarpdf/SSS246Mexico.pdf>; Internet; accessed 30 March 2007.

⁵⁶ Eliza Barclay, "Stuck in the Middle with Fuel: As its neighbors back biofuels, Central America gears up for business," *GRIST* (December 2006); available from <http://www.grist.org/news/maindish/2006/12/14/barclay/Index.html>; Internet; accessed 30 March 2007.