SCUSA 60 THEME:
"MEASURING PROGRESS AND DEFINING NEW CHALLENGES"

GLOBALIZATION: ENERGY AND THE ENVIRONMENT

Few commodities garner more attention throughout the world than oil. In the last year, energy prices in the United States rose more than 22 percent. Higher oil prices impact the U.S. economy not only directly through higher fuel prices, but indirectly through higher transportation and distribution costs, resulting in a 5.4 percent increase in U.S. consumer prices over the past 12 months. Energy experts expect worldwide demand for oil to grow more rapidly than supply, leading to sustained price increases in the long-run. The true social cost of using fossil fuels is even higher, since burning fossil fuels generates carbon dioxide emissions which contribute to global warming. Moreover, the United States is a large importer of energy, domestically producing only one-third of total U.S. energy consumption. At current market prices, the United States spends more than $700 billion per year on imported oil. Our dependence on foreign oil has generated an ongoing debate about energy security in the United States. The economic and political costs of the United States' continued reliance on fossil fuels -- particularly imported oil -- has triggered efforts by both private industry and the federal government to decrease fossil fuel consumption, promote alternative energy sources, and reduce carbon emissions.

The Energy Security Argument

Energy security is arguably the primary reason U.S. energy policy is targeting a reduction in fossil fuel usage, particularly foreign oil imports. Energy security focuses on the risks to the economy in the short-term from relying on imported oil. The shift from private- to state-ownership of oil companies over the past thirty years is pronounced. In the early 1970s, publicly-traded companies in Europe and the United States controlled three-fourths of global oil production, whereas today state-owned oil companies control three-fourths of oil production.[1] In addition, Organization of Petroleum Exporting Countries (OPEC) member nations control 77 percent of world crude oil reserves.[2] Although the threat of politically-motivated disruptions to world oil supply has been a reality since OPEC's decision to restrict output in October 1973, the economic and political costs of supply disruptions when world oil demand is rapidly increasing is significant. Venezuelan President Hugo Chavez has recently announced that Venezuelan oil company PDVSA will allocate more than one million barrels of annual oil production to China by the year 2012.[3] Venezuela is currently the fourth largest exporter of oil to the United States. Recent tensions between the U.S. and oil-exporting nations such as Iran and Russia further illustrate the potential for political considerations to impact world oil markets. Oil industry analysts argue that supply disruptions are secondary costs compared to the lack of access for Western corporations to explore and extract oil in

[1] Katel (2008), p. 14.
[2] *Ibid*, p. 8.
[3] *Ibid*, p. 15.

these nations.[4] Moreover, many of the oil exporting nations are using sovereign wealth funds to invest petrodollars in U.S. corporations, from computer chip manufacturers to financial institutions. The potential for sovereign wealth funds to influence U.S. financial markets and for profits from these investments to fund terrorist activity are cited as further potential costs of U.S. dependence on foreign oil.

Many market participants and policy analysts, however, assert that reducing U.S. oil imports based on energy security is misguided. First, two of the three largest oil-exporting nations to the United States are Canada and Mexico, both of which are U.S. allies and trading partners. Second, OPEC controls less than half of current world oil production, which suggests the U.S. could turn to non-OPEC sources for oil in the event of a disruption in oil supply by one or two nations. Finally, the costs of reducing dependence on foreign oil, at least in the short-term, would be substantial. If domestic energy sources were more cost-effective, they would be in use currently. In fact, some proponents of free trade argue that energy security arguments open the door for classifying any number of industries, from agricultural commodities to consumer goods, as "strategic" and deserving of protection from imports. Proponents of free markets argue that energy security represents a thinly-veiled attempt to rationalize protectionist policies on the part of the United States, a nation that frequently champions the benefit of free trade.

Environmental Externalities Associated with Fossil Fuel Consumption

Consumption of fossil fuels generates carbon-dioxide emissions, which increase the level of greenhouse gasses in the atmosphere. There is widespread agreement among scientists that "the globe has warmed in the last forty years, due largely to human activities that raise carbon dioxide (CO2) levels in the atmosphere."[5] To reduce the level of carbon dioxide emissions, policy makers have proposed forcing firms and consumers to face the true social cost of the fossil fuels they consume. Most of these proposals focus on targeting a certain reduction in emissions, but differ in the exact design of the policy to achieve the reduction. A significant challenge to effectively reducing carbon dioxide emissions is that carbon dioxide emissions have a global impact, so any policy solution must include the participation of most of the world's economies.

The Kyoto Protocol, adopted by over 180 nations, is an example of a program that adopts an emissions cap with a trading mechanism for carbon credits, commonly known as a cap-and-trade system. Participating countries are divided into Annex I nations (36 developed countries who have agreed to reduce CO2 levels 5.2 percent below 1990 levels) and non-Annex I countries, chiefly developing nations, who are not obligated to reduce emissions but receive carbon credits that can be sold in a market under the Clean Development Mechanism. The ability to purchase carbon credits rather than reduce emissions allows Annex I countries to meet their emissions reductions targets at lower cost, and also provides non-Annex I nations an incentive to reduce emissions. Critics of the Kyoto protocol argue that participating nations are responsible for only 60 percent of worldwide CO2 emissions, demonstrating the legitimate concerns about free-rider problems. The U.S., which currently produces more than 20 percent of global CO2

[4] *Ibid*.
[5] Clemmitt (2006), p. 73.

emissions, is not participating in the Kyoto Protocol. Moreover, many economists have been critical of the Kyoto Protocol, and emissions caps in general, in that these policies do not establish a uniform price or cost of CO2 emissions globally. Developing countries face zero costs of emissions, since they do not need to meet any emissions reduction target. Skeptics of the effectiveness of the Kyoto Protocol doubt that it will have a significant impact on CO2 emissions globally.

Many economists instead advocate carbon taxes, a corrective tax that would levy a constant tax per unit of carbon emissions worldwide. Here again, the effectiveness of carbon taxes relies on near-universal participation to limit the free-rider problem. Under a system of carbon taxation, fossil fuels would be taxed based on their carbon content, regardless of where these fuels are used. Carbon taxes would also raise government revenues that could allow for reductions in other taxes or increased support for alternative energy sources. One criticism of carbon taxes is that they impose an equal cost on all countries of reducing CO2 emissions, regardless of their history of generating CO2 emissions. More importantly, there is considerable debate as to how high this carbon tax should be set initially – estimates range from $35 to $200 per ton of carbon emission – and how the carbon tax should change over time.

Another market-based initiative in the United States is the market for carbon offsets. The carbon offset market allows vouchers that represent reductions in greenhouse gas emissions to be traded on exchanges such as the Chicago Climate Exchange. Analysts estimate the volume of trade in the carbon offset market at $91.6 million in 2006.[6] Proponents of the system point to the offset market as a way for companies and households to achieve emissions reductions efficiently, but critics argue that this market is "so opaque and loosely regulated that it offers consumers 'limited assurance of credibility' according to a recent Government Accountability Office audit."[7] Critics advocate that the U.S. government set clear rules on the types of projects that will be eligible to trade in the offset market and develop a registry for tracking offsets to avoid duplicate sales.

Current U.S. policy efforts to regulate the level of CO2 emissions rely on regulations such as Corporate Average Fuel Efficiency (CAFE) standards imposed on automobile manufacturers. The Energy Independence and Security Act of 2007 called for an increase in the average fuel economy of automobile manufacturers' entire fleets of cars and light trucks to 35 miles per gallon by 2020. Proponents say the increase in fuel efficiency standards was long overdue, while critics argue that imposing fuel efficiency standards does not directly impose a cost on burning fossil fuels. European countries are the only remaining nations without fuel efficiency standards, yet vehicle manufacturers in Europe are currently building and selling 113 vehicle models with average fuel efficiency of 40 miles per gallon or greater.[8] Critics of fuel efficiency standards argue that standards do nothing to address emissions caused by used vehicles, and encourage consumers to retain used vehicles with lower fuel efficiency.[9] European nations achieve

[6] Power (2008).
[7] *Ibid*.
[8] Jones (2007).
[9] Blinder (2008) argues that "cash-for-clunker" programs, in which low-income households are offered a cash incentive to sell older used vehicles to government, can effectively reduce the number of used vehicles with higher emissions in use.

higher fuel efficiency through a combination of higher gas taxes and greater reliance on diesel engines in passenger vehicles. Proponents of market-based solutions argue in favor of policy instruments that raise the cost of fossil fuels to reflect the external costs of CO2 emissions, while critics argue that higher gas prices will not result in significant reductions in fossil fuel consumption.

Policies Addressing Domestic Energy Production

To counteract the growing reliance of the United States on oil imports, two divergent policies have emerged. The first set of policies focuses on increasing domestic production of fossil fuels to increase energy security and lower energy prices. The second set of policies promotes the production of alternative energy sources, particularly renewable fuels. These policies have opposite effects on the level of CO2 emissions.

Increasing domestic production of fossil fuels will result in lower prices of these fuels, but will exacerbate environmental externalities. In September 2008, Congress removed a ban on offshore drilling in coastal areas 50-100 miles off-shore. Recent increases in retail gas prices have also led to a renewed push to overturn the ban on drilling in the Arctic National Wildlife Refuge (ANWR). The federal government estimates that offshore sites hold reserves as large as 11 billion barrels and that an additional 7 billion barrels is contained in ANWR.[10] By 2025, forecasts estimate that these sources could produce approximately one million barrels of oil per day, roughly one-sixth of projected U.S. production but only one percent of forecast world oil production.[11] The impact on future gas prices is expected to produce a modest 1.3 percent decrease, but developing these domestic sources could generate substantial tax and royalty revenues for the federal government. In addition to the small impact on future gas prices, opponents of drilling in these areas point to estimates of environmental damages that exceed $410 billion.[12]

Advocates of increased domestic production also call for greater use of domestic supplies of coal-bed methane gas, shale oil and coal. Coal-bed methane gas is currently being extracted in many Western states, but there are environmental concerns regarding the impact on underground aquifers. Oil trapped in shale rock is another domestic source of energy, but extracting oil from shale uses large amounts of energy and water. Coal, which generates more than half of U.S. electricity, is a low-cost energy source for power generation but is energy intensive to extract and distribute, and generates significant CO2 emissions.

[10] Hahn and Passell (2008).
[11] *Ibid*.
[12] *Ibid.*

Alternative Energy Production in the United States

Since policies to increase the domestic production of fossil fuels do not address the environmental costs of sustained fossil fuel usage, the federal government has implemented policies to increase domestic production of renewable energy sources. Alternative energy production is typically divided by the end use of energy: electricity generation or transportation. Currently, fossil fuels account for more than 70 percent of energy for electricity generation and virtually all the energy usage in transportation.[13] In discussing alternative energy production, several common questions emerge: What role, if any, is there for government subsidization of these technologies? What are the costs and benefits of these alternative energy sources? Are these alternative energy sources scalable (e.g. capable of providing a significant increase in the supply of energy)? Finally, many alternative energy technologies reduce CO2 emissions at the expense of imposing different environmental externalities.

Alternative Energy Sources for Electricity Generation

Nuclear energy currently is used as the energy source for approximately 20 percent of U.S. electricity generation. A relatively low-cost and low-emissions power source that provides consistent power, nuclear energy's construction and liability insurance costs are substantial. In addition, nuclear energy produced with an open-fuel cycle generates the problem of nuclear waste. While technologies exist to recycle nuclear fuel and also to use residual nuclear waste in burn reactors, nuclear power faces widespread resistance due to safety concerns.

Hydroelectric power is the largest renewable energy source for electricity generation in the United States. It is a low-emissions technology and can service both the base load demand and peak load demand, but construction of dams and reservoirs imposes significant environmental costs, and most analysts predict relatively little growth in this power source. Biomass is a form of renewable energy that is used primarily in generating power in industry. Although generating costs for biomass are higher than fossil fuels, it can be used either exclusively or in conjunction with other fossil fuels. Geothermal is another renewable energy source that provides: a continuous source of power; has no fuel costs; and does not require expenditures for storage. One drawback to geothermal electricity generation is that geologic constraints limit the areas that can profitably adopt this technology.

Solar and wind power are renewable energy sources with significant growth potential. The production of solar energy closely aligns with peak load demand, but it is currently not cost-competitive with other power sources for generating electricity. The costs of generating wind power are comparable to those associated with fossil fuels, and wind power has been adopted on a large scale in several European nations, including Denmark, Germany, Portugal and Spain. Wind power requires no fuel and generates no emissions. The federal government currently subsidizes electricity production from wind power at a rate of 1.9 cents per kilowatt hour. In response to the government subsidy and rising oil prices, electricity generation through wind power has grown 30 percent per year over the past two years. Nonetheless, wind power faces challenges to widespread

[13] 2008 Economic Report of the President, p. 170.

adoption. Wind is an intermittent power source, and many of the most attractive areas for producing wind power in the United States are located far from population centers. Transmitting electricity over long distances results in substantial power losses. Finally, some environmental groups have raised concerns about the impact of wind turbines on view sheds and the safety of birds.

Alternative Energy Sources for Transportation

Ethanol production has increased by more than 300 percent in the last eight years, the vast majority of which is produced from corn.[14] Depending on how the corn is grown, the average distance corn is shipped to ethanol plants, and transportation costs of both the ethanol and co-products (e.g. dried distiller's grain, a livestock feed), ethanol as a vehicle fuel can achieve lower CO2 emissions. Initially, ethanol's popularity stemmed from its use as a fuel additive to replace methyl tert-butyl ether (MTBE), but as oil prices rose, the economics of ethanol became more favorable, and the U.S. automobile industry began producing flexible-fuel vehicles that could run on gas-ethanol blends containing as much as 85 percent ethanol. The 2005 Energy Policy Act called for the use of 7.5 billion gallons of renewable fuels by 2012, a demand which, to date, has been largely met by corn-based ethanol. In 2007, the Energy Independence and Security Act increased the renewable fuels mandate to 36 billion gallons by 2022.[15] The ethanol industry also benefits from the ethanol blender's credit of 45 cents per gallon for every gallon of ethanol blended with gasoline, and a tariff of 54 cents per gallon on imported ethanol.[16]

Corn-based ethanol production in the United States has attracted criticism from fiscal conservatives, environmental activists and the scientific community. Corn-based ethanol produces approximately 35 percent more energy than it uses, an energy gain that is much lower than bio-diesel and sugar cane-based ethanol.[17] Expanding ethanol production using corn also impacts the supply of corn for other uses (primarily feed for livestock) and can cause farmers to shift production from other crops (primarily soybeans). Some critics have blamed the growth in corn-based ethanol production for price increases in everything from Mexican tortillas to American beer to rice.[18] Others argue that increases in global prices are caused primarily by crop failures in Australia and rising incomes in Asia and India. Corn-based ethanol is primarily produced in Iowa, Illinois, Nebraska, South Dakota and Minnesota. Since ethanol must be shipped by rail or truck tanker, it is expensive to transport outside the Midwest. Other observers argue that corn-based ethanol is heavily dependent on government subsidies, and the government should reallocate subsidies to second-generation biofuels, such as cellulosic ethanol.

Cellulosic ethanol is produced from biomass sources such as plant waste, wood chips, algae and switchgrass. Cellulosic ethanol stocks are a cleaner source of fuel and

[14] *Ibid*, p. 178.
[15] *Ibid*.
[16] The domestic ethanol industry also benefits from the direct payment to corn growers (equivalent to a per bushel subsidy on historical production levels), but this subsidy benefits all end users of corn by effectively increasing the quantity of corn produced and lowering its market price.
[17] Wang (2005), p. 1. Wang's work also finds that corn-based ethanol results in a 29 percent reduction in CO2 emissions compared to gasoline.
[18] "Mexico's Economy." (2007).

can be produced on marginal agricultural land. Currently, cellulosic ethanol is not commercially viable due to higher production costs and uncertainties regarding the scalability of the technology, but cellulosic ethanol refineries are attracting government funding (approximately $650 million in cost-shares and grants) as well as venture capital financing.[19] Under the 2008 Farm Bill, ethanol fuel from cellulosic sources receives a $1.01 per gallon subsidy.

Biodiesel is produced by blending natural oils and cooking grease from restaurants with diesel fuel. Biodiesel generates significantly less greenhouse gas emissions than pure petroleum diesel, but is viable only because the $1.00 per gallon tax credit for first-use oil and/or $0.50 per gallon tax credit for recycled cooking grease. Globally, the growth in biodiesel production has raised concerns that increased cultivation of oilseeds is crowding out production of food crops.

Alternative vehicles

There are currently four types of alternative vehicles in use in the United States. Some of these vehicles show significant promise in replacing vehicles powered exclusively by internal combustion engines using gasoline, particularly for short daily commutes. Nonetheless, all of these options face technical challenges to widespread adoption and uncertainty over the ability to scale the technology.

Hybrid vehicles use both an internal combustion engine and the battery and electric motor of an electric vehicle. Hybrids have exhibit higher fuel efficiency, particularly in urban driving. First introduced in 2000, hybrid vehicles now constitute 2.1 percent of the U.S. new automobile market.[20] Hybrids have benefited from a federal tax credit on new purchases introduced in 2006, and rising gas prices have helped offset the higher purchase price of these vehicles.

Vehicles powered by compressed natural gas (CNG) are on the road in Germany, and there are approximately 150,000 CNG vehicles in the United States, mainly trucks in corporate and government fleets.[21] Natural gas is a fossil fuel, but per energy unit costs are only 40 percent of gasoline, and natural gas generates fewer CO2 emissions. Technical constraints limiting the adoption of CNG vehicles include: shorter driving ranges, size of fuel tanks, lack of commercial fueling stations, and the lengthy refueling times associated with low-pressure at-home refueling systems.

Plug-in hybrid electric vehicles (PHEV) differ from conventional hybrids in that PHEVs can be recharged with electricity from wall outlets in addition to recharging from braking recovery. In addition to concerns with the existing battery technology, PHEVs draw electricity from the conventional power grid, which results in little reduction in CO2 emissions unless the electricity is produced from a low-emissions power source. An additional concern is the scalability of this technology, particularly the power demands imposed on the existing electricity generation grid.

Finally, hydrogen fuel-cell vehicles represent the use of a chemical reaction to generate electricity in a fuel cell. Hydrogen gas produces no CO2 emissions, but it currently has the highest costs of any alternative vehicle technology. The costs of

[19] Gertner (2008), p. 60.
[20] 2008 Economic Report of the President, p. 181.
[21] *Ibid.*

producing and distributing hydrogen are substantial, and there are significant safety concerns with pipelines and distribution systems for hydrogen fuel.

Conclusion

Oil prices will likely rise in the future, given that world demand is forecast to grow more rapidly than global supply. Rising prices will generate an economic incentive to use alternate fuel sources, and this substitution will be further reinforced by taxes linked to the carbon content of fuels. The appropriate role for government in alternative energy policy is open to debate. In addition to designing policy instruments to reduce CO2 emissions, the government must address: the logic of subsidizing certain alternative energies over others; the design of subsidies and tax expenditures to alternative energy production; and the costs and benefits of these policies.

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