Turning Green into Gold
Lessons Not Learned, Energy 101

B. Alan Whitson, RPA

"Our growing dependence upon foreign oil sources has been adding to our vulnerability for years and years, and we did nothing to prepare ourselves for such an event as the embargo of 1973." President Gerald Ford, 1975.

It has been 34 years since the First Oil Embargo and we still do not have a cohesive common sense approach to energy in the United States. Energy is at the heart of the top three issues confronting Americans today: our economy, our national security, and our environment.

America has tackled major problems in times past; but this problem may be the most important and most difficult test of our nation's competence. Yet, it is a huge opportunity to transform our economy, employ thousands of Americans, ensure our national security and protect our environment.

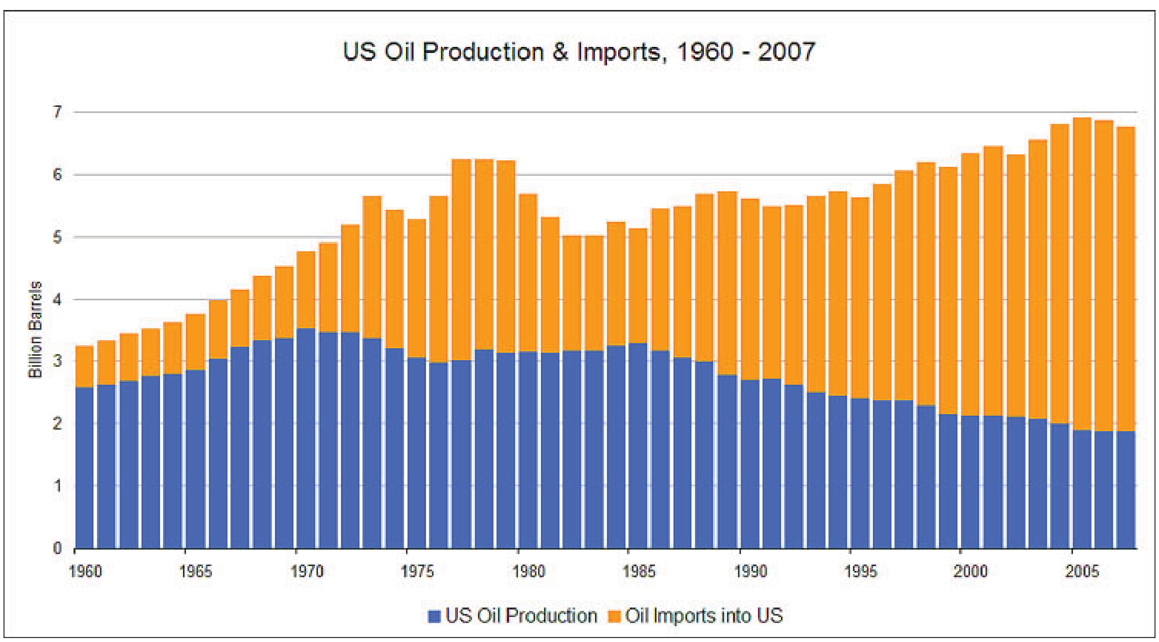
The first hurdle we must overcome is that most Americans, including our politicians, don't understand energy, where it comes from, how it's produced, how we use it, its influence on geopolitics, its environmental impact, or how to manage it.

Doubt this? Just consider the following. When asked "how is most U.S. electricity generated?" One in five Americans thought it was "hydroelectric" (hydro is 3%), 26% answered "don't know," and just 33% had the correct answer "burning coal." Only 48% of American's could name one form of renewable energy unaided. Did you know we import more oil from Canada than we do from Saudi Arabia?

To work our way out of this mess, will require us to understand the issues and openly discuss the trade-offs, not yell slogans at each other. We need to make rational decisions based upon hard data and solid science rather than fear, myth or political rhetoric. This calls for some basic education about energy. That's the purpose of this series. To give you data and context, so you can analyze what the politicians, technocrats and lobbyist are proposing. The easiest way to accomplish this objective is to break the subject into three parts; oil, electricity, and the possible solutions.

Understanding Oil

The problem with oil is our unhealthy dependence on foreign oil. This is dangerous, and it is a serious threat to the future of our nation. Every year we import increasing amounts of oil. In 1973, the United



States imported about 24% of our oil. By 1990, at the start of the first Gulf War, it had reached 42%. Today, we import 60% of the oil we use.

As shocking as these numbers are, they obscure the magnitude of the problem. In 1973, the United States imported 2.3 billion barrels of oil; by 2007 this had increased to 4.9 billion barrels a year, a 115% increase.

What do we do with all this oil? Transportation consumes 69%, industrial uses take up 24%, residential uses 5%, commercial uses 1.5%, and electrical power generation 1.4%. Overall the United States, with less than 5% of the world's population, uses almost a quarter of the world's oil to produce 21% of the world's GDP.

Every year since 2005 world oil production has slipped, even with three years of record breaking price increases. Right now the world produces about 85 million barrels of oil a day, but global demand exceeds 86 million barrels a day. Demand for 2009 is expected to grow by another 1.4 million barrels a day. The harsh reality is that the world's growing demand for oil will not abate. There are two reasons for this:

>the economies of countries all over the world continue to expand

>the world's population is projected to increase 47% over the next 25-years.

Most Americans don't realize that much of the world's oil is controlled by government owned oil companies, not by the so called "Big Oil" companies. Forty years ago, much of the world oil reserves were controlled by public, investor-owned oil and gas companies, many of them based in the United States. Today, 77% of the world's oil reserves are owned by national oil companies formed during the past 30+ years. Only 6% of world-wide reserves are now held by investor-owned oil companies.

Then there is the issue of the money. Right now the spot price for crude oil is bouncing around $140 dollars a barrel. Some analysts are forecasting $250 dollars a barrel by the end of 2009. (Chart 2) This year, the U.S. will spend almost $700 billion dollars on imported oil, more than four times the annual cost of the war in Iraq.

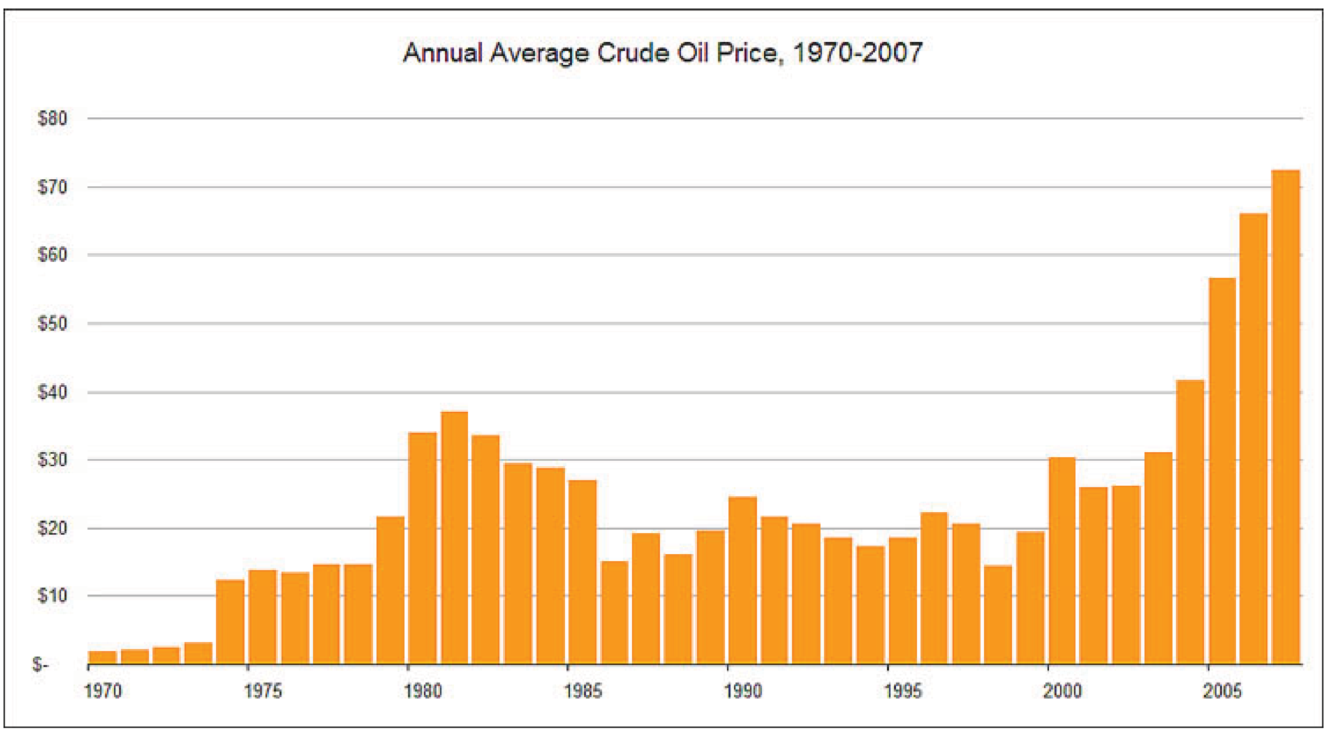
If we don't address this situation, over the next 10 years the U.S. will burn through almost $10 trillion dollars importing foreign oil. That's $10 trillion dollars coming out of the U.S. economy and going to the coffers of foreign countries, many of which are considered hostile to the U.S.

If you haven't done so already, it's time to ask yourself: Do you think it is a good idea to put your economic future into the hands of the leadership of these countries: China, Iran, Mexico, Nigeria, Saudi Arabia, Russia, and Venezuela?

It's Politics as Usual

Speaking of national leadership, neither major candidate for president seems to have a viable energy solution. As the race tightens, both candidates are taking increasingly irresponsible populist stances to curry favor with voters.

During a speech in Raleigh, N.C., Senator **Barack Obama** promised, "I'll



make oil companies like Exxon pay a tax on their windfall profits, and we'll use the money to help families pay for their skyrocketing energy costs and other bills."

Let's turn back the clock 30 years to when President **Jimmy Carter** passed a windfall profits tax. This tax put American oil companies at a major competitive disadvantage to their foreign competitors, effectively ending domestic energy exploration, and making Americans more dependent on foreign oil.

Returning to Senator Obama's windfall profit tax idea; why stop with oil companies? Oil and gas companies make about 7.4 cents in gross profit per dollar of sales. Shouldn't we put a windfall profits tax on industries that have bigger margins? According to the Census Bureau, for the first quarter of 2008, the average for all manufacturing companies excluding automobiles was 8.4 cents per dollar of sales; computer equipment manufacturers made 13.7 cents per dollar of sales, electrical equipment manufacturers made 14.5 cents per dollar of sales, and chemical companies took in 15.7 cents per dollar of sales. Microsoft's margin is a whopping 27.5 cents per dollar of sales.

Some say it's not the profit margin that counts, but the huge amount of money earned by the oil and gas industry that's the problem. Why not target other industries too? Oil and gas companies took in $86.5 billion in profits last year. At the same time, information technology companies made $103.4 billion, retailers rang up $137.5 billion, and the financial services industry walked away with $498.5 billion in profits.

While Senator **John McCain** does not support a windfall profits tax, his solutions aren't any more viable than Senator Obama's. In May, he talked up a gas tax holiday which would give drivers an incentive to burn more gasoline; at the same time he was openly hostile to the supply side saying: "We should look at any incentives that we are giving." Clearly, Mr. McCain fails to understand that, in a time of tight supply and high prices, one wants to encourage production not consumption.

"Incentives" is Washington-speak for tax breaks. So how much income tax do the oil companies pay? According to the Energy Information Administration (EIA), the total income taxes paid by the top 27 energy companies has increased 187% between 2004 and 2006, increasing from $48.4 billion to $90.4 billion. But how does that compare to other industries? The oil industry's 2006 income tax expenses as a share of net income before incomes taxes average 40.7%, compared to 22.1% for U.S. manufacturing companies.

A few weeks ago Mr. McCain said, "I'm very angry, frankly, at the oil companies not only because of the obscene profits they've made, but their failure to invest in alternate energy."

But oil companies have invested in alternative energy. According to a study by the Institute for Energy Research (IER) and the Center for Energy Economics (CEE) from 2000 to 2005, $46 billion has been spent researching alternative energy in North America. A total of 26% ($12.2 billion) of that money came from the oil industry, which is five times more than the $2.4 billion invested by the federal government. This makes the oil industry one of the nation's largest investors in wind, solar, geothermal, and landfill digester gas.

The oil industry also invested $86 billion toward the ability to upgrade inferior grades of oil (tar and oil sands, heavy oil) into refinery feedstock, and

U.S. Oil & Gas Resources

	Crude Oil Billion Bbl	Natural Gas Trillion C Ft
Lower 48 Onshore	11.7	145.9
Alaska Onshore	18.8	85.1
Alaska Offshore	26.6	132.1
Pacific Offshore	10.5	18.3
Gulf Offshore & Deepwater	44.9	232.5
Atlantic Offshore	3.8	37.0
Total	116.3	650.9

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to turn waste and residue hydrocarbons (gasification including hydrogen production) into high-value products, a natural extension of the industry's expertise. Of the $135 billion spent on emerging energy technologies in the North American market by U.S. companies and the Federal government – 73% has come from oil companies!

Biofuels

It has become very popular to argue that the U.S. should emulate Brazil's success with its biofuels industry. The lessons to be learned from Brazil are not exactly what many might think. Although ethanol production has been a factor in Brazil's attainment of energy independence, the real answer has been a significant ramp up in off-shore crude oil production.

The off-shore operations of Petrobras, Brazil's national oil company, in the Albacora Leste field in the northern part of the Campos Basin are producing 2+ million barrels per day; sufficient to cover their domestic market's daily consumption of 1.8 million barrels per day.

Currently the U.S. produces slightly more ethanol than Brazil. The demand for gasoline and ethanol in Brazil is about 6.2 billion gallons; ethanol makes up 25% of that amount. However, the combined demand for gasoline and ethanol in the U.S. is about 140 billion gallons – 23 times the demand in Brazil. Producing ethanol is consuming one-third of the U.S. corn crop. This percentage is projected to grow due to a significant ramp-up in the renewable fuels mandate included in the 2007 Energy Bill enacted by Congress.

The Federal Reserve Bank's February 2008 *Monetary Policy Report* to Congress reveals that: "Last year's increase in the PCE price index for food and beverages, at 4.5%, was the largest in nearly two decades. Food prices accelerated in response to strong world demand and high demand for corn for the production of ethanol."

Offshore Drilling

The defining moment for U.S. offshore drilling came on January 28, 1969, when Union Oil's Platform A off the coast of California suffered a blowout. For 11 days, 5,000 barrels of oil flowed daily from the rig. This incident sparked the first Earth Day, creation of the EPA, the offshore drilling ban, and major improvements in offshore drilling technology.

Yet, this tragedy could have been avoided. Federal standards at that time required such sites to be fitted with a well casing, the steel lining that helps prevent blowouts, to at least 300 feet below the ocean floor. The federal agency regulating offshore drilling, the United States Geological Survey waived federal safety regulations allowing Union Oil to install a casing 61 feet shorter.

Natural seepage of crude oil and natural gas off California's coast is among the most active in the world. Ironically, crude oil seeping into the sea from Coal Oil Point, by the University of California Santa Barbara, is roughly 55,000 barrels of oil a year – the size of the 1969 Santa Barbara spill. Moreover 1.8 billion cubic feet of natural gas seeps into the atmosphere each year. Studies reveal this natural seepage has been largely reduced by offshore oil production. A 1999 study confirmed that over the past 22 years, there has been a 50% reduction in natural gas seepage within one kilometer of Platform Holly.

The current performance of offshore drilling is shown by the January 2007 report: *Pipeline Damage Assessment from Hurricanes Katrina and Rita in the Gulf of Mexico* written by **Det Norske Veritas** for the Minerals Management Services. There are 42 million acres under lease for oil and gas exploration in the Gulf of Mexico Oil Reserve. The GMOR includes: 86 exploration wells, 3,917 producing platforms, 33,600 miles of pipeline, and 153 active companies. It accounts for 30% of U.S. oil production, and 22% of U.S. natural gas.

Federal regulations require the reporting of any oil spill of one-barrel or larger. During the hurricanes and aftermath, 124 spills were reported, 52 from platforms and 72 from pipelines, totaling 17,700 barrels or an average of 143 barrels per spill. While every oil spill is a concern, hence the very low reporting level, this needs to be examined in context of the 548 million barrels of oil that are produced and shipped from the GMOR each year. In the time frame surrounding Katrina and Rita, normal oil production would have been 166 million barrels of oil. So the volume of oil spilled equates to .01% of the GMOR crude oil production during that period.

The 106 page DNV report states: "Offshore environmental impacts as a result of hurricane events in the GOMR have typically been minor due to the downhole safety valves at wells and operating practices conducted by the oil and gas industry with respect to platforms and pipelines in advance of approaching hurricanes, and the Oil Spill Response Plans that are developed by operators and submitted to the MMS. The impacts from Hurricanes Katrina and Rita were typical of this historical experience. While cleanup was required. The volume of oil spilled and impacts to shore from the offshore infrastructure were categorized as minor."

U.S. Oil & Gas Resources

The real question is how much oil and gas does the U.S. control and have we discovered all of it? According to federal government estimates, there are 116.3 billion barrels of oil under U.S. soil, enough oil to power more than 65 million cars for 60 years. We have 650.9 trillion cubic feet of natural gas, enough to heat 60 million homes for another 160 years.

Over 85% of the coastal waters adjacent to the lower-48 states (up to 200 miles from shore) are off-limits to oil and natural gas exploration. Additionally, 83% of the most promising, technologically available U.S. onshore areas are off-limits or accessible only with significant restrictions.

Is there more oil and natural gas out there? Both U.S. and foreign oil and gas companies think so, and they are risking large sums of capital to find out. Currently in the Gulf of Mexico, McMoRan Exploration is seeking to find natural gas in one of the world's deepest dry holes – Blackbeard. Last August, McMoRan paid $1.1 billion for Blackbeard and a package of shallow Gulf of Mexico assets. In 2006 Exxon Mobil bailed out of Blackbeard after drilling to more than 30,000 feet and coming up dry. Last week McMoRan said it is now drilling below 32,550 feet, the deepest on record and going deeper. If they reach 35,000 feet, it will cost about $75 million.

Key Take Aways

>Oil is going to remain a major world fuel source for years.

>The majority of world's oil supply is now under the control of foreign countries. This is significantly changing the rules of the game.

>The U.S. must reduce it addiction to foreign oil. The economic and geopolitical downside is too great to ignore.

>The political pastime of vilifying oil companies is misguided and counterproductive.

>Existing U.S. oil reserves are an essential part of the solution and cannot be ignored.

>While exploration needs to be encouraged, high standards for environmental performance must be rigorously maintained and enforced.

>Biofuels can be part of the solution, but the costs and benefits need to be fully weighted.

>Using food stock to make fuel raises serious economic and ethical questions, especially in light of a booming world population.

Part 2 of this series will dig deep into electricity, types of fuel, distribution, new technologies and some insight into how we got to where we are. In Part 3, the focus will be on the action plan. A no hold barred look at the issues; from Al Gore to T. Boone Pickens, from French nuclear power plants to Texas wind farms, from Energy Star and LEED to tax policy. ■

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Lessons Not Learned, Energy 101 – Part Two

Electricity is our most widely used form of energy. It touches every aspect of our lives. Yet, despite the importance of electricity to us, few people understand the generation, transmission and distribution of electricity.

This is understandable since much of the discussion about electricity in the United States is so highly technical that even an electrical engineer can feel intimidated. Another factor is the quantity, quality and complexity of the information. The purpose of Part Two is to give you enough background information and context on electricity so that Part Three can focus on the possible solutions to our energy problems.

While electricity occurs in nature, to be useful it must be manufactured or "generated." Electricity is a secondary energy source; this means we get it by converting a primary energy source, such as coal, natural gas, oil, nuclear, and other natural sources. Although the energy sources used to make electricity can be renewable or non-renewable, electricity is neither renewable nor non-renewable.

Most of the electricity in the United States is generated by converting mechanical energy into electrical energy. Typically, this is done by using turbines. A turbine converts the kinetic energy of a moving fluid (liquid or gas) into the mechanical energy that turns a shaft connected to the electric generator. Overall, this process is about 35 percent efficient. This means for every 100 units of energy used to create electricity only 35 units become usable electrical energy.

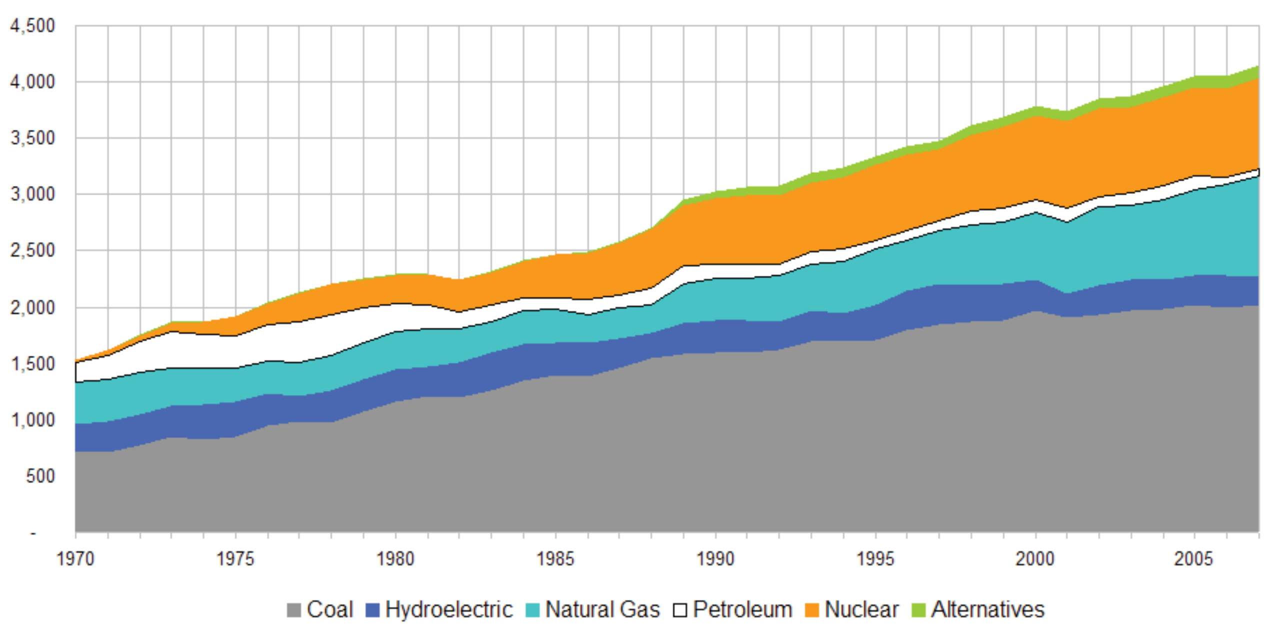
Interestingly, most of the debate about energy is not about how to increase the efficiency and reliability of the generation, transmission, and distribution of electricity; the debate is focused on the fuel types used to generate electricity. While the mix of fuel types has been altered over the years due to changes in political, economic and environmental forces, we continue to use more electricity every year.

The nation's electric utilities have over 140 million customers in three broad sectors: Residential (122 million customers; 37% electricity sales); Commercial (17 million; 35% sales); and Industrial (<1 million; 28% sales). From 1970 to 2006, these sectors have increased their electricity use by 165%.

Looking Forward

The Energy Information Administration has forecasted that the nation's total electricity consumption will grow from 3,814 billion KWH in 2006 to 4,972 billion KWH in 2030 – a 26% increase. This reflects an average an-

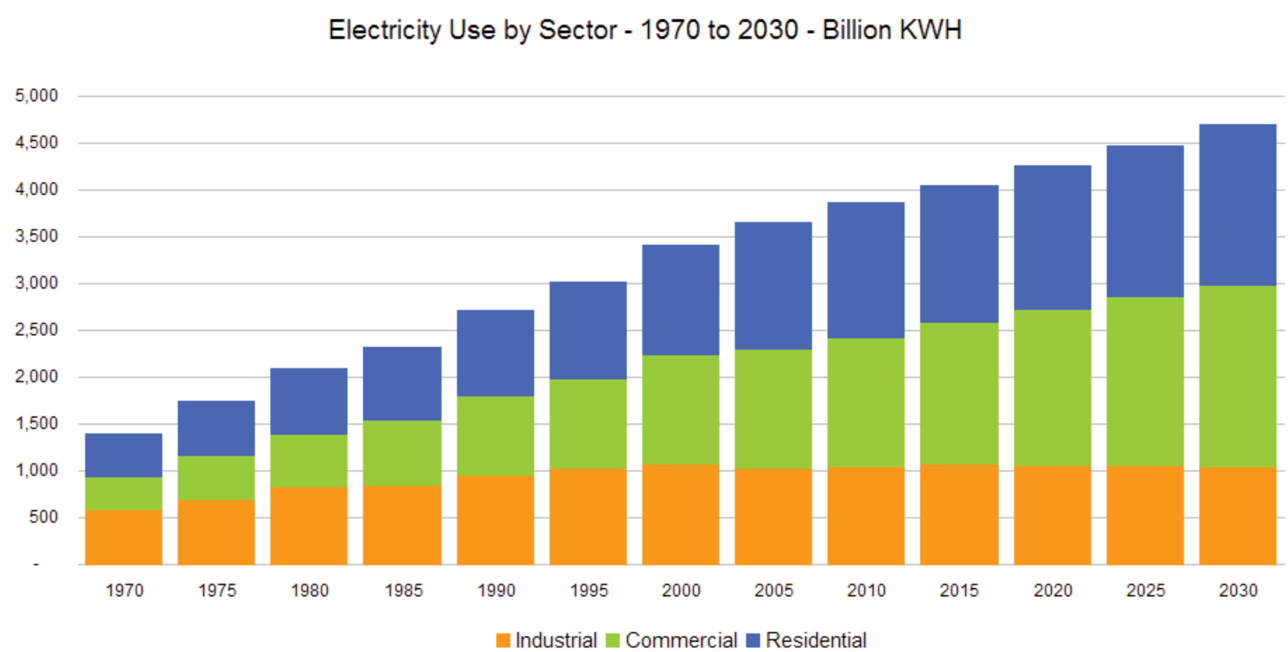
Electricity Generation by Fuel Type - Billion KWH

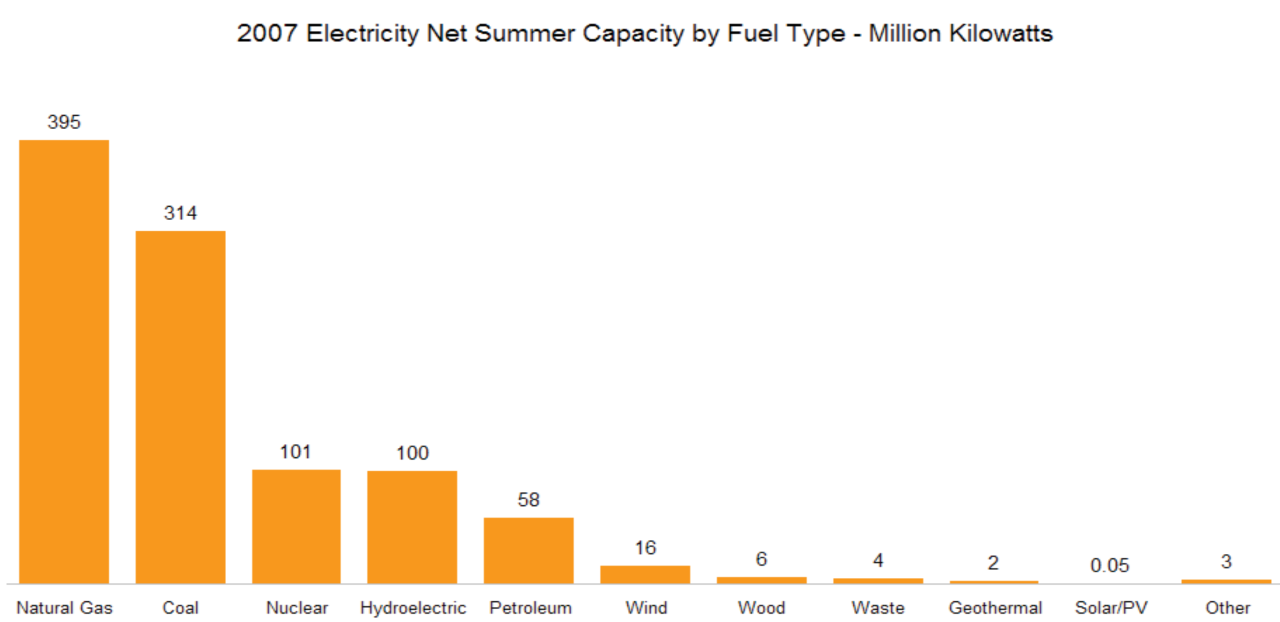


nual increase of 1.1%. By comparison, electricity use grew by annual rates of 4.2%, 2.6%, and 2.3% in the 1970s, 1980s, and 1990s, respectively. The EIA forecast assumes slower economic growth, the imposition of new efficiency standards, and higher electricity prices.

> *Coal*, continues to be the fuel of choice for generating the majority of electricity used in the United States. In 2006, 49% of the country's electricity was generated by burning coal. By 2030, coal will account for 54% of electricity generation – 2,787 billion KWH, a 42% increase.

> *Nuclear power* generated 19% of the nation's electricity in 2006. While the number of nuclear power plants in the United States has declined, the amount of electricity generated by nuclear power continues to rise. By 2030, nuclear power will account for 18% the nation's electricity – 917





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KWH, a 17% increase as new nuclear power plants are projected to come online.

> ***Natural gas***, besides being burned to turn water into steam, it is also burned to produce hot combustion gases for gas turbines used to generate electricity. Gas turbines have become the most common fuel type for plants used to meet peak demand loads. (See Chart 3) In 2006, 19% of the nation's electricity was generated by burning natural gas. By 2030, natural gas will account for 9.8% of electricity generated – 504 billion KWH, a 31% decline reflecting its higher cost.

> ***Hydroelectric***, is the responsible for 7% of the nation's electricity in 2006. There are two types of hydroelectric systems used to produce electricity. First, flowing water collects in a reservoir behind a dam; the water flows through a pipe called a penstock and turns a turbine to drive the generator to produce electricity. The second is called run-of-river, this uses the force of the river's current to turn a turbine blades to produce electricity. By 2030, hydro will account for 6% of U.S. electricity – 299 billion KWH, an increase of 5%.

> ***Petroleum*** or residual fuel oil is the petroleum product used by electric plants. The use of petroleum to produce electricity has declined steadily since 1978. In 2006, petroleum generated less than 2% of all electricity in United States. By 2030, petroleum will account for just over 1% of the electricity generated – 57 billion KWH, almost a 3% decline.

> ***Wind Power*** is the conversion of the energy contained in wind into electricity. Wind power, produced less than 1% of the nation's electricity in 2006. Nevertheless, it is expected to expand rapidly due to government incentives. By 2030, wind power could provide 2.4% of the nation's electricity – 123 billion KWH, a 378% increase.

> ***Geothermal Power*** comes from heat energy buried beneath the earth's surface. In areas where enough heat rises close enough to the surface to turn underground water into steam, it can be tapped to drive steam-turbine plants. This energy source generated 0.4% of the electricity in the country in 2006. By 2030, the use of geothermal is forecasted to provide 0.6% of the nation's electricity – 31 billion KWH, a 109% increase.

> ***Municipal Waste and Biomass,*** includes the incineration of wood, municipal solid waste (garbage), and agricultural waste. In 2006, this accounted for about 1% of the electricity generated in the United States. By 2030, municipal waste and biomass will account for 2% of the electricity generated – 102 billion KWH, a 400% increase.

> ***Solar power*** as a method of generating electricity faces a number of challenges. It is one of the most expensive ways to produce electricity, and it is only available when the sun is shinning. In 2006, less than 0.01% of the nation's electricity came from solar power. By 2030, solar power will account for 0.06% of the nation's electricity – 3.2 billion KWH, a 5,400% increase.

Key Take Aways

> Coal and nuclear power will continue to be major fuel sources for the United States.

> While the 2006 to 2030 growth forecast for alternative energy is an impressive 154%, alternative energy will only provide 6.2% of our 2030 electricity needs.

> 93.8% of our electricity in 2030 will be generated by conventional fuel sources.

> Electricity use between 2006 and 2030 is expected to grow by 26%.

> Conservation and improved efficiency is still the most cost effective way to provide future generation capacity. ■

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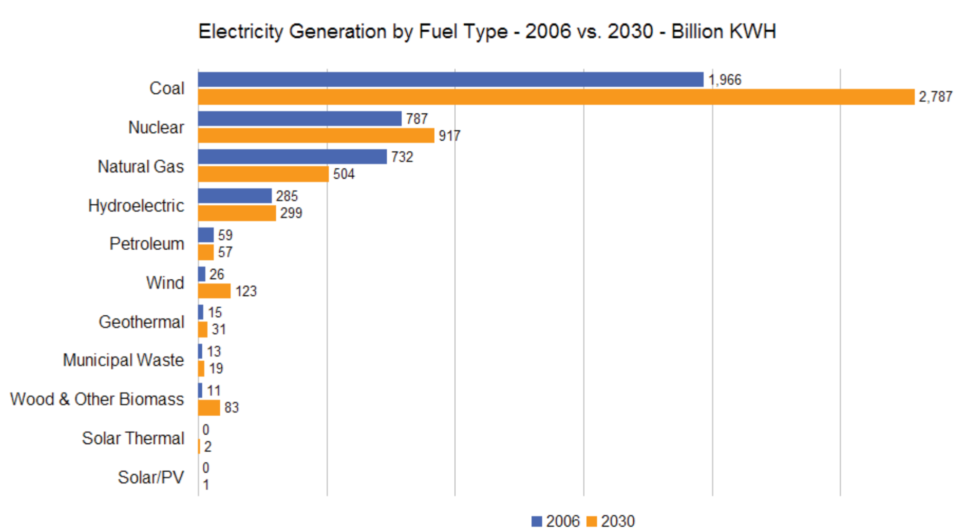

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Lessons Not Learned, Energy 101 – Part III

by B. Alan Whitson, RPA

Partisan politics, special interest groups and pork barrel spending have driven America's energy policy for 35 years. As a result – we are endangering our national security, threatening our economic future, and wasting our natural resources. It's time for this nonsense to stop. There's lots of information to get a handle on. Here's a stab at it.

Nonsense

Making ethanol from corn wastes taxpayer's money, drives up food prices and damages the environment. The stated intent is to reduce oil imports. Instead:

>Producing and shipping ethanol uses almost as much fossil fuel as it saves.

>It takes 1.3-gallons of ethanol to replace 1-gallon of gasoline.

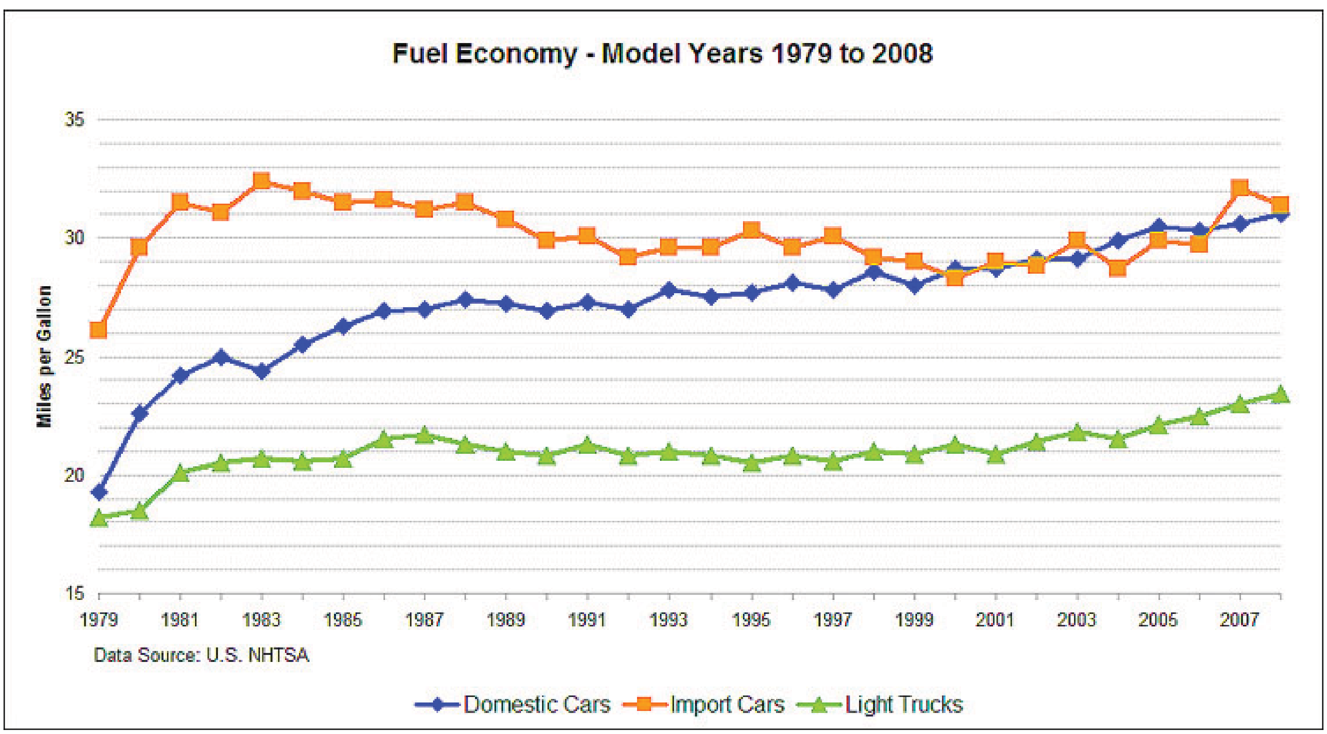
>Ethanol costs twice as much as gasoline

Can this really be the fuel of the future? Nearly 30 years ago, **Stephen Chapman** challenged the viability of ethanol from corn in the *New Republic*. In 2008, a *Time* cover story called ethanol a "scam." Yet, President Clinton created a plan to make ethanol an anti-smog fuel additive. President Bush went even further with a 9-billion-gallon-a-year ethanol mandate. So what is keeping ethanol alive? Politics. For one thing, getting the farm vote is believed to be an essential step in winning the race to the White House and the race begins in Iowa.

More Nonsense

Ethanol is an easy target. The next is something that most of the country is calling for and is ready to throw rotten tomatoes at politicians who don't support it: **Corporate Average Fuel Economy** (CAFE). This law fines an automaker if its customers buy vehicles that have a fuel economy lower than a specific standard. Currently, the CAFE standard is 27.5 miles per gallon for automobiles and 22.2 miles per gallon for light trucks. In 2011, new standards will start to phase in. By 2020, automakers must achieve average fuel efficiency across their fleets of 35 miles per gallon.

Higher fuel efficiency, of course, is a good goal and 87% of American voters support it. But many think CAFE is a poor way to get it and there is significant evidence they are right. According to **Bob Lutz**, General Motor's Vice Chairman and the person behind the new **Chevrolet Volt**, the new CAFE standard will push car prices up by $4,000 to $10,000 per vehicle, or an average $6,000 per vehicle," although the increase will not come all at once."



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To understand what is wrong with CAFE you need to understand how it operates. The best place to start is with an analogy. Let us say Congress wants to address America's obesity problem, so it passes a law that penalizes retailers if their customers buy clothes in any size other than small. Who thinks this is going to work?

Furthermore, American automakers build cars worldwide. Some of the smaller fuel-efficient cars are manufactured overseas and then imported into the America. Yet American automakers cannot include the cars they import into America with the cars they build domestically in calculating their CAFE numbers.

When Congress created CAFE it failed to consider how consumers make buying decisions. Fuel economy is a major consideration for many consumers. Dollars and cents, however, not miles-per-gallon drive behavior. Oil was well above $30 a barrel in 1980 then it began a slide to under $10 in late 1998, interrupted only by a price spike after Iraq invaded Kuwait in 1990. This price decline more than offset the lower fuel economy of trucks, and many consumers put the issue of fuel efficiency on the back burner.

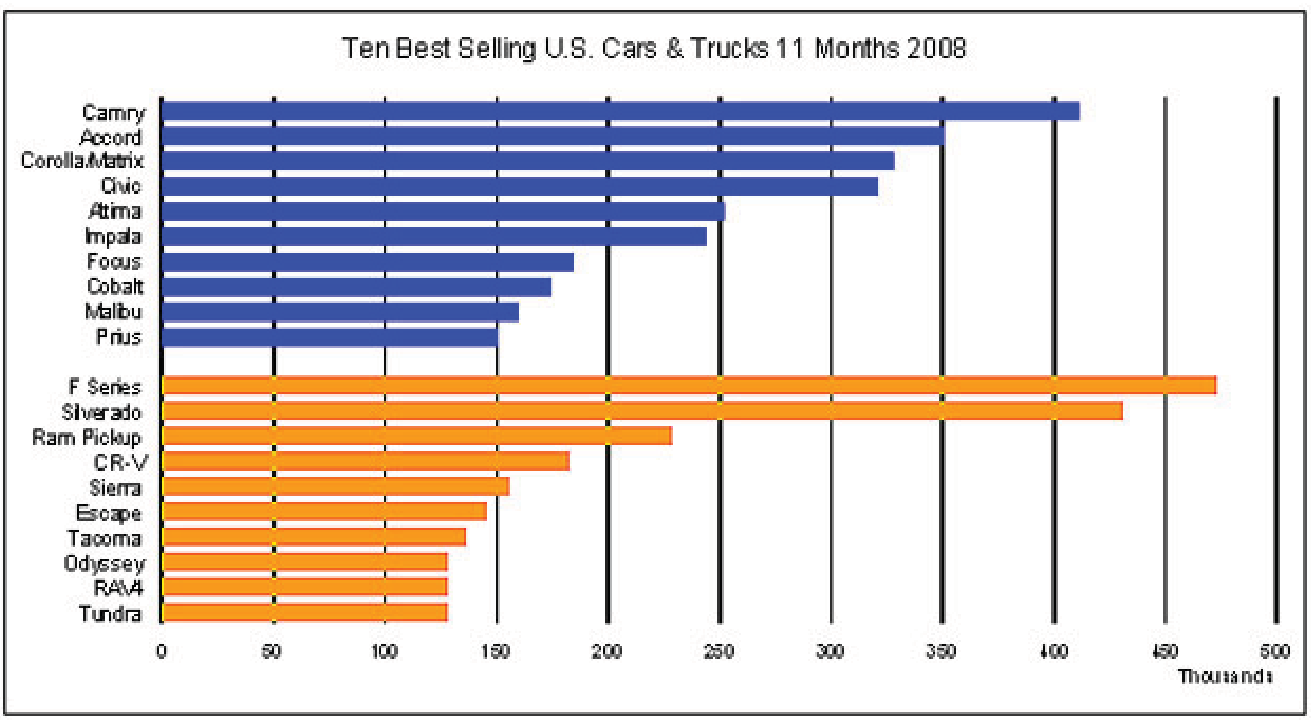
Since 1979, trucks went from 10% of all new vehicles sold to the dominate share of the market. A major factor in this shift was that trucks are much cheaper than cars. CAFE contributed to this shift: as cars got smaller and more expensive to meet increasing fuel economy standards, trucks and SUVs offered consumers more space and better-perceived value. Because of this shift, overall fuel economy rose to a peak of 26.2 miles per gallon in 1987 then dipped to 24.5 miles per gallon in 2001. Currently, it stands at 26.8 miles per gallon.

(The fuel economy rules apply to foreign brands too. Aston Martin, BMW, Daimler, Ferrari, Maserati, Porsche, and Volkswagen elect to pay the CAFE fines rather than build cars at a loss to please Washington. Recently, Daimler paid one of the largest CAFE fines in history, $30 million or $118 per car.)

Automakers, of course, eagerly embraced the public's new love affair with trucks, since the profit margin for trucks was much larger than it was for small cars. Quickly, metallic paint, plush carpet, six-way seats, leather interior, and sound systems became the norm for trucks, no longer stripped-down work vehicles.

Although new vehicle sales in December 2008 were off 37%, the home construction industry was in the dumps and $4 gasoline still fresh in consumer's minds, the top two sellers were the Ford F-Series and the Chevrolet Silverado (The Dodge Ram took number eight.) Overall sales for 2008 were down 18%, and two of the top four selling vehicles were Ford F-Series, Chevrolet Silverado.

Fuel Taxes: Unappealing good sense
From a standpoint of effective energy policy, it makes more sense to influence the behaviors of all drivers, than dictating the design of new cars and trucks. The best way to do this is a fuel tax. In Europe, a policy of high fuel taxes was a key driver in getting con-



sumers to buy fuel-efficient vehicles. In Holland, gasoline sells for more than $10 a gallon, with $5.57 of that going to taxes. In Britain, even with its sizeable North Sea oil production, gasoline sells for $8.71 a gallon. While European consumers undoubtedly don't like higher fuel taxes any more than American consumers, they have adapted and their economies survive.

In 1990, President George H. W. Bush's administration considered a sizeable gas tax increase. It was pared down to 5 cents a gallon after a number of Republican members of Congress broke with the president. William K. Reilly, who ran the Environmental Protection Agency at the time said, "This was a stark lesson and people decided the gas tax was the third rail of public policy."

In mid-2008 when gasoline prices were closing in on $5 per gallon, consumer behavior changed overnight. Carpooling, use of public transportation, and sales of fuel-efficient vehicles skyrocketed. In June 2008, Ford Motor reported that sales of its full-size F-series pickup (15 MPG Combined) – the country's best-selling vehicle for 26 consecutive years – dropped 40%. (On July 11, 2008, crude oil peaked at $147.27 a barrel. On December 30, crude oil closed at $39.14 a barrel – a price not seen since 2005. The U.S. average price for regular gasoline has fallen to $1.62 per gallon – one year ago, it was $3.04.)

These events provide us with evidence of what works. Just imagine how much better off America would be today if any of our Presidents and Congress had shown some courage and foresight and replaced CAFE with a gas tax.

America Deserves a Common Sense Approach to Energy

The First Oil Embargo was 35-years ago, and we now import twice the amount of foreign oil as we did in 1973. Every administration since Richard Nixon has promised action. Instead of results, we've gotten vile partisan politics, special interest groups fighting each other, and billions in pork barrel spending. Making matters worse is that the issue of CO_2 emissions has sidetracked us from the very real problems America needs to deal with: the addiction to foreign oil and the reinvention of our energy infrastructure.

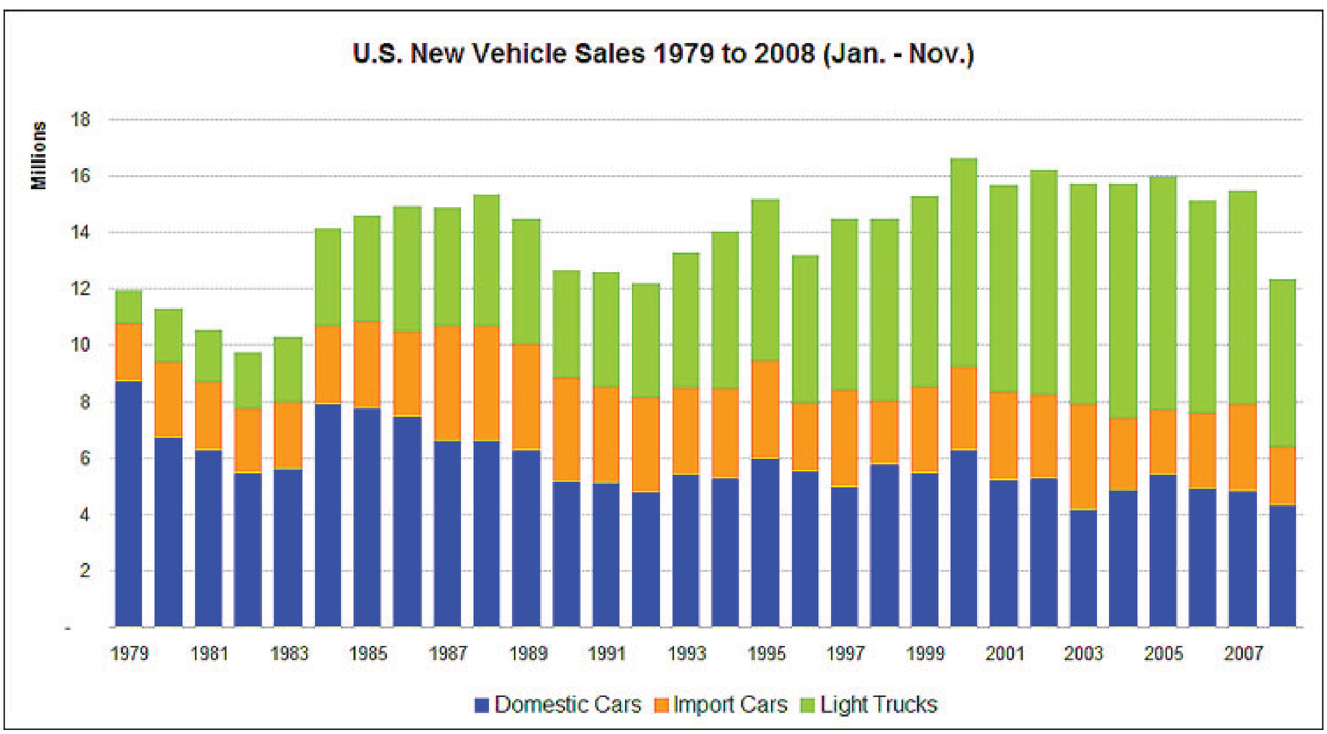
America is beyond the point of needing a comprehensive, coherent and effective energy policy. We need to take action and start getting results now. There are four factors that will influence our ability to get it done: Our Goals, Global Context, Strategic Issues, and Tactical Issues.

Our Goals

The goals are simple, straightforward and complementary:

>**Ensure our national security** - By overcoming America's addiction to foreign oil through energy independence.

>**Revitalize our economy** - The move to energy independence and more sustainable energy sources can employ thousands of Americans and propel our economy to new heights.



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>**Protect our environment** - We cannot expect other nations to change their environmental behavior unless we provide a positive example, make available new technology and innovation, and show them how to profit by changing their ways.

Global Context

Energy is a global issue, and America must address its energy use within a global context. The recently released International Energy Agency's ***World Energy Outlook 2008*** indicates that world demand for energy will increase 45% from 2006-2030. As a group, non-OECD countries are expected to account for 87% of the increase in world demand; their energy consumption surpassed that of the 30 OECD countries in 2005. **[Footnote see List OECD nations?]**, China and India are expected to be responsible for over half of the increase, with Middle East countries accounting for 11% of the increase.

Global oil demand is projected to rise from 85 million barrels per day in 2007 to 106 million barrels per day in 2030 with the increase coming from non-OECD countries. Global demand for coal is increasing twice as fast as that for oil. Coal's share of energy demand is expected to rise from 26% in 2006 to 29% in 2030. Electricity generation in China and India will account for 85% of the global increase in coal consumption. While nuclear power output is expected to climb, it is estimated that its share of global electricity generation will go from 6% in 2006 to 5% in 2030. Hydroelectric output is also expected to increase, even as its share is estimated to drop from 16% to 14%. Non-hydro renewables are expected to increase from 1% in 2006 to 4% in 2030.

In light of these estimated increases in energy demand, it is sobering to realize that over half of projected investment in global energy from 2007 to 2030 will be needed to maintain the current level of supply capacity. Among other things, much of the world's existing infrastructure for supplying oil, gas, coal and electricity needs to be replaced by 2030.

We need to face reality. Even if America were 100% energy independent, the rest of the world would have energy problems. Energy is a political weapon. Petro-dictators have used energy to intimidate other countries into foreign policies of apathy, accommodation, and appeasement rather than doing what is morally right. Iran, Russia, Saudi Arabia and Venezuela use their oil and natural gas supplies as a big stick to get what they want. Many of America's foreign policy failures can find their roots in our addiction to foreign oil.

The population explosion in India and China is steadily pushing those countries to the edge. Japan, the world's third largest economy, is only 16% energy self-sufficient (and lest we forget, Japan's energy needs were one of the factors leading to the bombing of Pearl Harbor and the entry of the U.S. into World War II). The rest of Asia is a political and religious powder keg with a short fuse. Africa is a nightmare of epic proportions. Other than Brazil, Latin America is a basket case. Europe gets much of its oil and natural gas from the Middle East and Russia. Both of these sources are unstable and hostile. Iran is about two years away from its stated objective of launching a nuclear attack against Israel. Russia is growing bolder and more aggressive in pushing around former Eastern Bloc nations. The ripple effect could be horrific.

Strategic Issues

Many hope that the eco-politician who says renewable energy sources can meet all of America's energy needs in 10-years is right. Yet deep down we know that's not going to happen. Hope is what you do when you have no control. A strategy consists of the actions and tactics that convert visions into results. Wisdom is knowing the difference between positive attitudes and positive actions and the flaw of relying on one without the other. Energy is a complex issue, but the following elements create a framework for making the necessary strategic decisions:

>*Action Now* – Politicians have failed us too many times over the last thirty-five years. Without visible signs of action or some sense of progress, Americans will lose confidence in our nation's ability to overcome our energy challenges.

>*Long-Term Commitment* – Overcoming America's addiction to foreign oil isn't going to happen overnight. Developing and installing a sustainable energy infrastructure will take more than 10-years. If we don't start, we will never finish.

>*Maximize Efficiency* – Dollar for dollar, energy efficiency is the most effective tool in our toolkit. Encouraging energy efficiency reduces the demand on existing resources and it lessens the size, cost, and time needed to develop and implement sustainable solutions.

>*Regulatory Rigor* – We must maintain a strong and effective enforcement of our regulations for health, safety and environmental protection.

>*Short-Term Trade-Offs* – The all-or-nothing mindset of many on all sides of energy issues has stymied America's efforts in the past. Some steps in the transformation process are less than optimal, but we need them to buy time until technological or implementation issues are resolved. We need sensible solutions now.

>*Economic Insurance* – During this transition, we should use America's vast energy resources to ensure our national security and protect our economy from price shocks and interruptions in the global energy markets.

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Royalties, fees and taxes can provide funding for new sustainable energy sources. Ask yourself, "Which is the more responsible course of action? Use America's energy resources, or, take trillions of dollars out of our economy and putting them into the coffers of foreign countries, many of which are hostile to America."

>*Invest in Our Future* – We need to invest in research & development at all levels in our society. R&D tax credits, government funding, private foundations, investors and back yard inventors need to be encouraged. Once new technologies are developed and implemented in America, they can be exported to the rest of the world. Congress should avoid trying to pick the winners and losers; incentives should be based on objective performance metrics rather than the skill of lobbyists. Experience shows that our free market system works better than any alternative when we assure a fair and level playing field.

>**Realism –** The intense frenzy about global warming has caused us to lose sight of our problems. We need to balance human needs, environmental concerns, and economic realities. Our ultimate goal isn't to reduce CO_2 emissions as such, but to ensure our national security, improve the quality of life and protect the environment. Drastic climate policies- may or may not work, but we can help more people, at a lower cost, with greater success by pursuing a down to earth approach focusing on immediate problems such as hunger, poverty, malaria, AIDS, safe drinking water and clean air.

Tactical Issues

America is the world's largest energy producer, consumer, and net importer. We rank first worldwide in known reserves of coal, sixth in natural gas, and eleventh in oil. Success in reaching our goals will depend upon initiative, innovation, and our wisdom to use effectively and efficiently the fuel sources and technologies we have at our disposal.

Energy Demand – On a per capita basis, America's energy use is declining. Even so, our overall energy demand is increasing due to a growing population. America's demand for liquid fuels is expected to increase 30% from 2006 to 2030, with electricity demand growing 41% in this period. Energy demand from commercial buildings is projected to grow faster than the square-footage added.

Oil & Natural Gas – Oil and gas is the lifeblood of our economy and currently there is no substitute. Our transportation system accounts for 69% of all oil used, and natural gas provides 22% of our electricity. Proponents say, "Drill, Baby, Drill." Opponents say, "We can't drill our way out of this problem." Both are wrong. This is the glass is half-full or is it half-empty argument. What we need to do is to find something else to put into the glass. Just as whale oil was replaced by kerosene, which was later replaced by electricity, oil and gas will be replaced by new sustainable energy sources. In the meantime, we should use our vast oil and natural gas resources as a way to fund development of new technologies, and protect our national security and economy.

Boone Pickens makes a sound case: use America's natural gas to replace foreign oil. Natural gas currently powers trucks, buses and fleet vehicles all across America, so adoption is straightforward. Other energy sources such as wind and nuclear could be used to make electricity. These two elements, when combined, would greatly reduce America's need for foreign oil.

Bio Fuels

Forget corn. Our future fuels need to come from more practical feedstocks. In addition, we shouldn't waste time and money with fuels that have lower energy yields than gasoline. This leaves four fuels that equal or exceed the energy yield of gasoline.

>*Algal biodiesel* uses genetically modified strains of algae grown in enclose bioreactors and fed waste CO_2 from coal-fired power plants, cement kilns or breweries. While algae can produce more oil per acre than soy or palm, growing and processing algae at this scale presents challenges, but a number of U.S. facilities are slated to come online in 2012. This fuel yields 103% of the energy of gasoline.

>*Green gasoline* uses the simple sugars converted from cellulose or sugarcane. The simple sugars are reacted over solid catalysts to remove oxygen and form high-energy hydrocarbons. From here, the process is much like traditional oil refineries. **Virent**, backed by Shell and Honda, hopes to have its gas available in 2012. This fuel yields 100% of the energy of gasoline.

>*Designer* hydrocarbons are another source: scientists essentially trick microorganisms such as E. coli and yeast into converting simple sugars into diesel, gasoline or jet fuel instead of fats or alcohols by swapping out natural genes with synthetic genes. The microbes ferment the sugars in slurry, similar to traditional ethanol production. Since the finished fuel doesn't mix with water, the hydrocarbons are separated by centrifuge without expensive distillation. The first commercial plant is in Brazil and diesel production should start in 2010. This fuel yields 106% of the energy of gasoline.

>*Fourth generation fuel* uses genetically engineered algae that turns CO_2 into oil and continuously excretes this oil directly into the surrounding water. This simplifies the harvesting process since the previous generation of algae stores the oil within its cell walls; this new process eliminates the drying and extraction process. The oil is then processed into biodiesel. If this can be

done at a large scale, it provides a new paradigm. **Synthetic Genomics** seeks to have commercial quantities of biod-iesel on the market within five years, although no plants have been built. This fuel yields 103% of the energy of gasoline.

Coal – It's cheap, plentiful, and energy rich. It's also dirty and releases minerals such as mercury, arsenic, silicon, calcium, chlorine, and sodium, as well as metals such as aluminum, iron, lead, magnesium, titanium, bo-ron, chromium. Coal is used to create 49% of America's electricity. In 2006, there were 616 coal-fired facilities with 306.6 GW of generating capacity. By 2030, capacity is expected to increase by 13% to 346.2 GW. On the down side, advancements in implementing clean coal technologies have stalled for a host of reasons – most of them politi-cal. Moreover, even if America didn't use coal, emissions from burning coal in China and India quickly find their way into America.

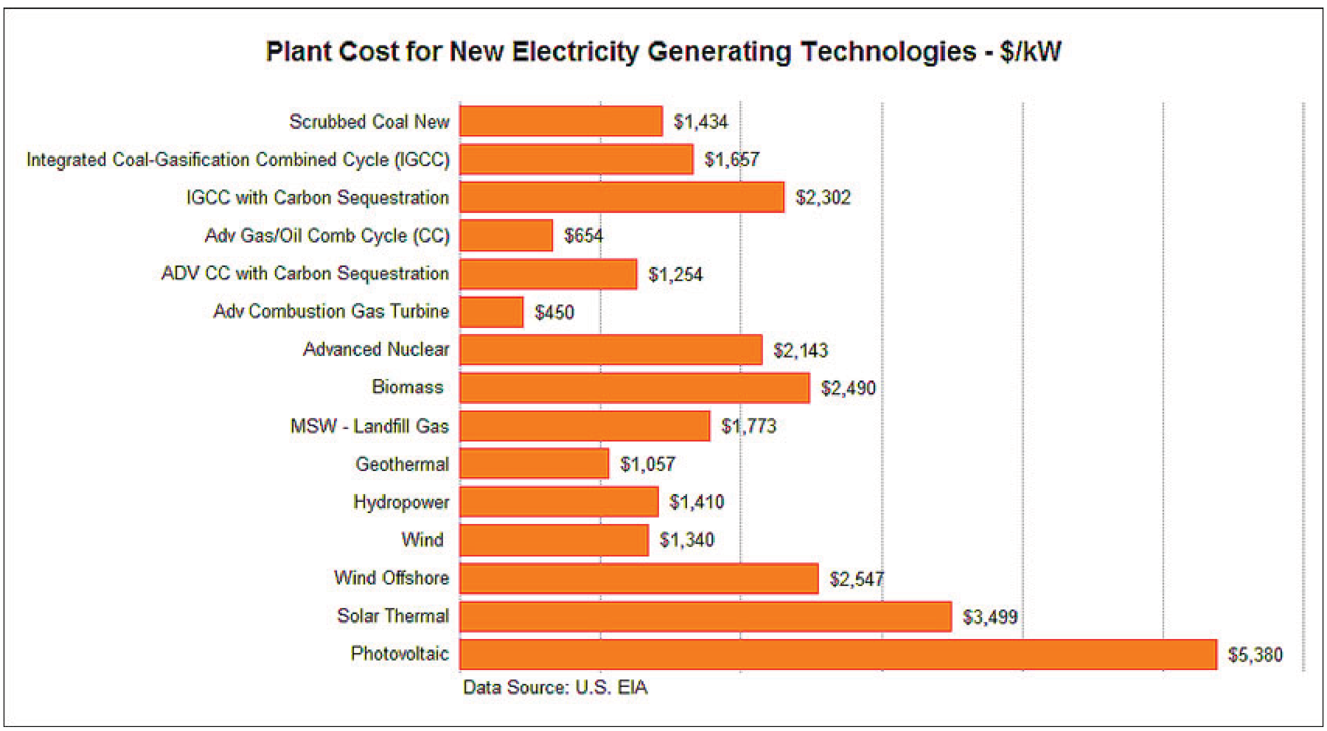
Nuclear – Once again, fear and politics is getting in the way of real solutions. The Chernobyl nuclear plant disaster in the former Soviet Union turned the public away from nuclear energy. What most people don't real-ize is that disabled safety systems, unauthorized reactor experiments, irresponsible management, and inferior equipment – hallmarks of the Soviet Union – were responsible for this tragedy. Worldwide there are 443 operating nuclear power plants. The top four countries using nuclear power are U.S., France, Japan and Germany. Many Americans may be surprised to learn that France gets 80% of its electricity from nuclear reactors.

Currently, 104 operating nuclear reactors in 65 facilities located 31 states provide about 20% of America's electricity. Applications for 17 nuclear plants in the U.S. are pending. The EIA reports that nuclear power provides 110.6 GW of generating capacity, and it will reach 112.2 GW by 2030.

Dealing with nuclear waste is an issue that demands more research and development. Reprocessing spent fuel rods can recover up to 95% of the uranium and plutonium for use in new fuel rods. This reduces the long-term radioactivity in the remaining waste and reduces its volume by 90%. Britain, France, Russia, Japan, China and perhaps India reprocess spent fuel from nuclear reactors. Contrary to popular belief, burning coal re-leases more radioactive waste into the environment than nuclear power. The effective dose equivalent of radiation from coal-fired plants is 100 times that of nuclear power plants.

Hydro – FDR put thousand to work during the Depression to build dams. Currently waterpower is America's fourth largest source of electricity, pro-viding about 6% of our electric power. The expansion potential at existing hydroelectric facilities, at dams without powerhouses, at new small- and low-power developments, and from ocean wave energy and hydrokinetic technol-ogies is estimated to be 23.0 GW. This could increase to 85.0 to 95.0 GW if economic incentives and regulatory processing were improved.

Wind – In 2007, America held the



number two spot in the world with 16.8 GW (17.9%) of total installed wind capacity, and the number one spot in new capacity added with 5.2 GW, double the 2006 number. In 2008, 5 to 6 GW of new capacity came online. New wind projects account for 30% of America's new power-producing capacity.

The Department of Energy (DOE) recently estimated that wind could provide 20% of the nation's electricity by 2030. Under this 20% wind scenario, new wind power installations would increase to more than 16 GW per year by 2018 and continue at that rate through 2030. Currently, wind power generates about 0.8% of America's electricity.

Biomass – Bioenergy or biopower is one of the products of resulting from processing biomass, the waste material from farms, forests and urban centers, and converting it to energy, as opposed to putting the waste into landfills. The current output is roughly 10 GW of power and growing. About 6 GW is powered with clean wood and wood waste, and most of this energy is generated and consumed "behind the meter," primarily by the forest products industry. The energy intensive pulp and paper industry is currently more than 50% energy self-sufficient because of its use of waste from the papermaking process.

Biopower also includes landfill gas and anaerobic digester gas (ADG). These applications turn waste methane from a liability onto power. With more than 1.2 GW in production, landfill gas-to-power exceeds the total output of the nation's photovoltaic capacity. The ADG opportunity, based on animal waste, biogas from sewage treatment plants, and food waste is largely untapped. German ADG facilities not only produce energy, but also a high value, odorless fertilizer used on nearby farms in the form of post-fermentation residue.

Municipal waste to energy plants are another source of bioenergy, since 75% of municipal waste is biomass. Currently 90 waste-to-energy facilities generate nearly 3 GW of electricity. Wood and waste provide 0.93% and 0.04% respectively of America's electricity.

Geothermal – America continues to lead the world in geothermal power installations, with an installed base of 2.9 GW as of May 2007. California is the home of most of these installations at 2.5 GW. If all the geothermal projects under construction come online, capacity will increase 13%, and if all the projects under development come to fruition, capacity would increase 76%. Geothermal offers utilities the advantage of steady non-intermittent power making it ideal for base-load operations. Currently, geothermal power provides 0.36% of America's electricity.

Solar – For centuries, people have captured the sun to heat water for bathing, cleaning clothes, and heating homes. Today's solar thermal systems use the sun to produce hot water for homes and commercial applications reducing the need for gas or electricity to heat water.

We can also use the sun to create electricity. Invented by Bell Laboratories in 1953, **photovoltaic** (PV) systems convert solar energy directly into DC electricity. Many PV industry pundits proclaim PV will be the future's primary energy source. This reality is challenged by intermittent daytime-only electricity output and very high cost. Despite efforts to make PV cheaper, today's market price to produce a PV module is between $4.50 and 5.50 per watt. Rather than getting cheaper, prices for PV have been rising at 5% to 9% a year since 2001. For PV to become competitive without massive government grants and subsidies, this price must drop to below $2 per watt. Contrary to the hype, PV will remain a nano-niche solution unless a major technological breakthrough occurs that dramatically lowers manufacturing costs or increases output. Currently, PV provides 0.01% of America's electricity.

A third solar alternative is **Concentrating Solar Power** (CSP), which concentrates sunlight with mirrors to create heat, then uses this heat to create stream to drive turbines and electric generators. There are four major CSP technologies: Parabolic Trough, Fresnel Mirror, Power Towers, and Dish/Stirling and Concentrating PV (CPV).

Parabolic trough is a proven technology and experts indicate the electricity costs to be $0.10/kWh or less. However, power towers, with their higher efficiencies and capacity factor of 65%, may be able to achieve electricity costs of $0.07 to $0.08/kWh.

Wind proponents say that CSP isn't cost-competitive with wind power. Utilities say reliability, not cost, is the critical issue. Wind output is intermittent and usually blows at night, while CSP produces power during periods of high demand.

CSP fits well into America's electric system. First, it's dispatchable. When combined with thermal storage, CSP can provide electricity when the sun isn't available, and hybridization with natural gas can provide a stopgap heat source when there isn't enough sun. Second, utilities are familiar with solar steam generation, and CSP uses the same power block as fossil fuel based technologies. Third, it's suitable for utility scale applications of 100 MW or more. Fourth, stable and known costs with zero emissions offer a hedge against natural gas's price volatility and future carbon caps.

The best news about CSP is the quantities of electricity it can produce. According to a report from the American Solar Energy Society, "… analysts evaluated the solar resource in the Southwest and … found that CSP could provide nearly 7,000 GW of capacity, or seven times the current total US electric capacity." California, Arizona, Nevada, New Mexico, Colorado, parts of Utah, and Texas could be tapped for CSP facilities.

CSP is a global opportunity; the Trans-Mediterranean Renewable Energy Cooperation (TREC) has calculated that, almost all of electricity the world now uses could be generated in less than 1% of the Sahara desert (about 25,000 square miles or the size of West Virginia) if it were covered with CSP facilities. An area, one-fifth that size could provide the European Union all the electricity it's now using. Another benefit of CSP is that the waste heat from steam turbines could be use for desalination of seawater. The mirrors in the solar field could provide shaded areas suitable for growing food crops and other produce on land that is now unproductive.

Transmission Grid - Over the last three decades, the investment in America's high-voltage transmission grid has been slim. Yet, the demand for electricity doubled in this period. Deregulation exacerbates the problem as power producers send electricity hundreds of miles to the highest bidders over a patchwork system of wires and switch gear never designed for this type of use. The load can overwhelm the system, as when a power line near Cleveland failed on August 14, 2003. This single failure created a cascading series of overloads that plunged 40 million people in eight states and 10 million people in the province of Ontario into a blackout lasting up to seven-days.

The demand for renewable energy is creating another reason to enhance our transmission grid. These new sources of electricity aren't where the old generating plants are; they may be 500 to 1,000 miles away. It will take 22,000 miles of 765,000-volt transmission lines to create a national grid. This grid will be able to move about 25% of our current electricity consumption over great distances. Line losses are modest, as very high voltage lines are more efficient than lower voltage systems. Building the grid will cost $75 billion, adding a transmission cost of 0.3 cents per kilowatt-hour to the retail price of electricity, which currently averages about 9 cents.

With an enhanced grid and by pooling the nation's supply and demand, cheap electricity can follow demand across the country and around the clock. This can lower the capital cost of electricity by utilizing billion-dollar power plants over more hours of the day. Some industry analysts estimate that this can reduce the average cost of electricity between 30% and 50%. Moreover, by providing cheap access to cheaper power, the grid can accelerate the adoption of other technologies such as plug-in hybrid cars that recharge at night.

Bottom Line

The key obstacle to the rapid implementation of these strategies, tactics and technologies is a lack of awareness and understanding by the media, investors, decision makers, politicians and the public. The consequences: our politicians continue to make inappropriate decisions and fail to provide appropriate incentives, effective regulation and enforcement. Of course, that's how we got into this mess in the first place.

Even so, we should be optimistic about America's future. We have in place or within our grasp sustainable energy technologies that can ensure our national security, revitalize our economy and protect our environment. The implementation issues are clear-cut since energy companies are comfortable with many of these technologies. Clearly, there is room for price reductions as these technologies improve, mature, and the economics of scale begin to take hold.

While the investments will be large, so will the return on those investments. Some will say America cannot afford it, especially in these tough economy times. Yet, the cost of not doing this is too high. Our choice is simple: restore America to its prime or let it devolve into a subprime nation.

Now is the time to reinvent America's energy infrastructure. Success requires that we fully engage in the process of change at the local, state and federal level. We must move beyond the partisan politics, scientific groupthink, special interest groups, and pork barrel spending that has shaped America's energy practices in the past. As professionals in the design, construction and real estate industry, we have an important role in revitalizing America's energy infrastructure. If we fail, we will have no one to blame other than ourselves. ■

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*[OECD Countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. The World Bank describes 27 as high-income countries. Members, Poland, Mexico and Turkey, are upper middle-income economies.]