Civilian Research Project

A Crude Reality: Exploring the Interdependencies of Energy (Oil), the Macro-Economy, and National Security

by

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"Except for our own Civil War, this [the war on terror] is the only war that we have fought where we are paying for both sides. We pay Saudi Arabia $160 billion for its oil, and $3 or $4 billion of that goes to the Wahhabis, who teach children to hate." (Jim Woolsey, former CIA Director)

In 2008, the United States imported 4.7 billion barrels of crude oil to satisfy the nation's fuel needs. The average price per barrel of imported oil in 2008 was $92.61 billion. This works out to $1.19 billion per day for the year, an incredible $434.35 Billion per year.[i] This represents, in the global macroeconomic prism, the largest transfer of wealth in the history of the world.

A coherent and achievable national energy transformation strategy is required in order to ensure a vibrant, stable and sustainable economy. An economy that secures capital wealth internally, supplies the energy required to meet consumption demands for growth and by extension permits the tax basis to sustain the world's best military.

A Spectrum Wide Energy Exploitation Policy (SWEEP) optimizing our own natural resources in the near term (oil, natural gas, coal, nuclear, wind, solar, hydro, geothermal and synthetics), and displaces the oil based economy with a long term energy transformation plan based on renewable energy, is vital to a prosperous, free and secure America.

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A CRUDE REALITY: EXPLORING THE INTERDEPENDENCIES OF ENERGY (OIL), THE MACRO-ECONOMY, AND NATIONAL SECURITY

by

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ABSTRACT

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A CRUDE REALITY: EXPLORING THE INTERDEPENDENCIES OF ENERGY (OIL), THE MACRO-ECONOMY, AND NATIONAL SECURITY

This paper will explore the relationships among energy (with a focus on oil), the macro-economy, and energy security. Research will investigate the following premise: the United States's national security depends upon three interdependent macro-elements.

1. Energy: accessible, reliable, stable, and affordable energy resources.
2. Economy: a growing and vibrant economy.
3. National defense: sustaining the world's most capable and effective military.

The research presented in this paper will entertain and test the validity of an overarching point of view: meeting the challenges of our oil-based energy demands will determine our economic well-being and fuel the growth necessary to compete in an ever-shrinking and interrelated global environment. If energy is the catalyst to ensure a prosperous economy, then that prosperity is the foundation enabling a tax base required to sustain the world's strongest military. Funding the preeminent armed forces on the globe affords the United States the possibility of securing its national defense and protecting its allies and their interests around the world. But failure to secure its energy future will drag down the economy, prosperity with it, and ultimately jeopardize national security. An energy-deficient nation will succumb to economic degradation, dwindling wealth, and find it is unable to afford a capable national defense. This paper will illustrate the relationship between national energy dynamics, the macro economy, and ultimately, U.S. national security.

The Energy State of Play: An Overview

To begin, let's frame the current energy situation and examine several pertinent facts related to energy. What is energy? Energy is defined as "the ability to do work." [2] Essentially, our ability to do anything requires energy. Energy has several forms: thermal, radiant, kinetic, electrical, chemical, nuclear, and gravity and is manifest as either potential energy (stored) or kinetic energy (working energy). Energy powers every economic activity we perform. It fuels our ships, planes, trains, automobiles, and factories. It heats and cools our homes, refrigerates our food, lights our world, and powers our many machines and appliances. The energy required to perform these functions is derived from various resources. The chart below (fig. 1) illustrates the current types and allocation of resources that provide energy for the United States.[3]

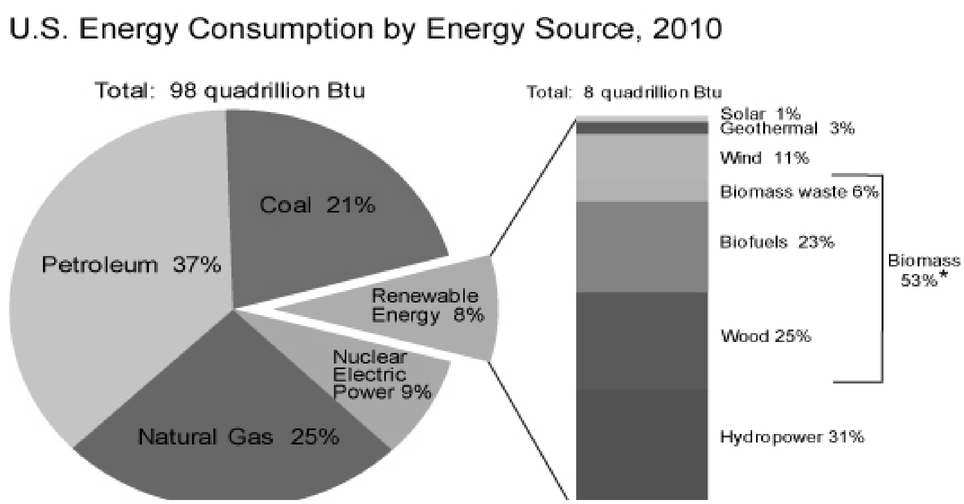


Figure 1. U.S. Energy Consumption by Energy Source.

Source: U.S. Energy Information Administration, Monthly Energy Review, Table 10.1 (June 2011), preliminary 2010 data.

While there is no perfect way to categorize energy resources, for the purpose of this paper, lets categorize energy into two distinct groups: renewable and non-renewable. Renewable resources are those easily replenished; non-renewable sources are finite and gone once consumed. Coal and oil are examples of non-renewable resources; the wind and sun are examples of renewable resources. As you can see from figure 1, the United States's energy consumption footprint is heavily reliant on non-renewable energy resources, mostly fossil fuels. In 2010, fossil fuels accounted for more than 83% of the entire U.S. energy demand. Renewable energy resources accounted for less than 9% of our total energy consumption, and transportation fuels accounted for 28% of our overall energy demand.[4]

While these resources are used for many purposes, generally, the vast majority of petroleum is used to fuel our transportation systems, and the vast majority of all other resources are used to provide electricity and other, non-transportation-related energy functions.[5] Resources that provide the majority of our electricity needs are supplied mostly via domestic resources. Also of note, while the United States is the third largest oil producer in the world, its overall demand relies heavily upon oil imports. While oil is but a portion of our overall energy demand, it represents 90% of our transportation fuel requirements, and it is our most volatile energy resource. Imported oil is a major source of uncertainty to our economic well-being as a nation. Because of this, this paper will focus our attention on imported oil rather than on the more stable and available domestic energy resources such as coal, natural gas, hydroelectric, nuclear, and renewable.

As we explore sources of our oil, a full 49% of our oil is imported.[6] Of that, 80% is supplied by unstable governments, unfriendly countries, or volatile regions in general. The United States consumes approximately 18.77 million barrels of oil per day. This translates to

6.85 billion barrels of oil per year.[7] The chart below (fig. 2) describes the products made from each barrel of oil. At 80% per barrel, clearly gasoline, jet fuel, and diesel fuel make up the

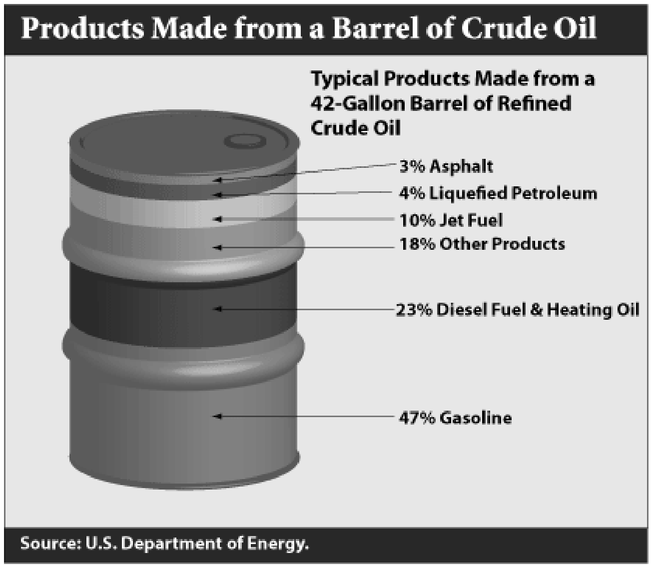


Figure 2. Products Made from a Barrel of Oil

majority of products produced from a barrel of oil.

Roughly 80% of every barrel of oil is used to produce products to fuel our transportation systems that rely heavily on gasoline and diesel (does not include pipeline modes of transportation). In fact, 90% of all U.S. transportation is fueled by oil products (see fig. 3 below).

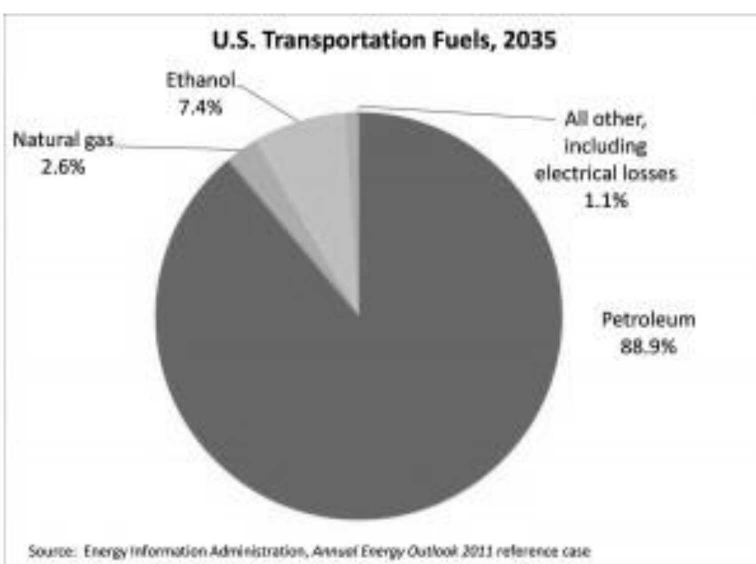


Figure 3. U.S. Transportation Fuels

Transportation modes and methods are therefore key factors to understanding why oil is so crucial, not only for fueling transportation, but also for the economy as a whole. Our transportation systems are overwhelmingly powered by internal combustion engines. All other forms of transportation power account for less than 1.1% of our total demand. Electric cars are a notable example of this, but have yet to gain traction with the consumer base in any meaningful numbers.

Of course, this means that just about all goods and services produced up and down the supply chain require transportation, not to mention the cost of products that require petroleum in the manufacturing process. Under our current transportation energy-resource mix, the entire economy can be affected by fluctuations in the price of oil. As the cost of transportation fuels rise, so does the end-price of almost all goods and services.

Additionally, investments in internal combustion engine modes of transportation along with trillions of dollars invested in the oil-based energy infrastructure (gas stations, pipelines, oil tankers, drill rigs, and refineries) are certain to exacerbate a very slow transition to other forms of transportation. This is not to say altering our future transportation modalities and associated energy mix will not evolve into a dramatically different scenario.

Understanding Historic Trends and Shifts in Energy

Using history as our guidepost, we can see dramatic shifts in energy sources over time. The chart below (fig. 4) reveals that total energy consumption and demand have significantly increased over time, in addition to an increasing array of viable energy resource options. Not surprisingly, demand and consumption naturally align with the increasing population,

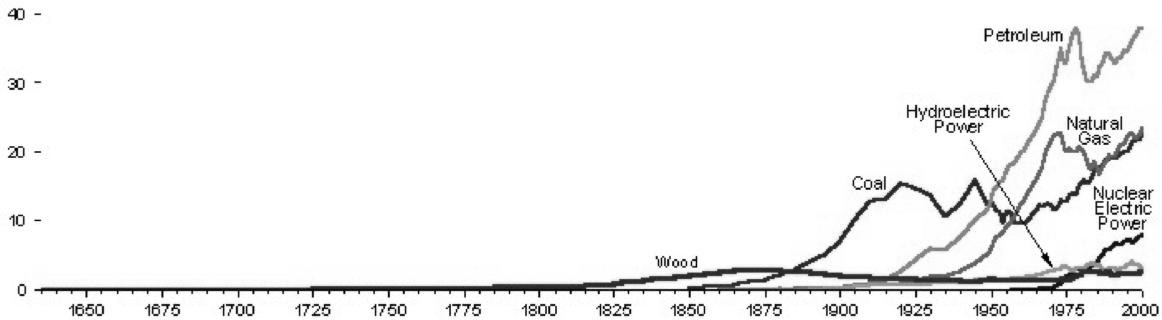


Figure 4. Energy Consumption by Resource 1635-2000 (in Quadrillion Btu
Source: http://www.eia.doe.gov/emeu/aer/eh/intro.html

urbanization and productivity and begin a protracted upward surge with the Industrial Revolution. This chart illustrates a tremendous growing appetite for energy over time and is projected to continue on this trend line well into the future.[8] Total energy consumption has grown from fewer than 5 quad Btu in 1900 to more than 110 quad Btu in 2012.[9]

Historic shifts in energy sources have evolved over time. For example, whale oil was displaced by petroleum products such as kerosene for lighting; this in turn was displaced by electricity that is generated from coal and other fossil fuels. Today, we are witness to green initiatives that may have the potential to displace coal and fossil fuels for the generation of electricity using renewable energy sources, such as wind, solar, hydro, and nuclear. Another energy trend is clearly illustrated by the transition from wood-burning as the primary source of cooking and heating to electricity generated by coal and natural gas or directly burning natural gas at the consumer terminal.

Regarding energy trends related to transportation, again, history provides salient examples. The shift from horse-drawn carriages to the internal combustion engine is a dual example illustrating transportation modes as well as energy sources. Depending on how we view this shift, the horse is not only considered a mode of transportation but also a renewable energy source. Viewed another way, the horse is a transportation mode, and the hay required to fuel the horse is the energy source. Either way, the internal combustion engine and its reliance on petroleum-based fossil fuels changed the world forever. Yet another example is evident as the world transformed from the age of the sail to the industrial age and the steam engine. The steam engine, powered by coal, displaced wind as the primary energy source for shipping.

What conclusion can we draw from these historical examples and what predictions can we make regarding them looking to the future? First, none of these transitions and shifts occurred quickly. Energy paradigm changes took time as displacement of one energy resource overlapped the transition to alternate energy resources over time. Second, the new technology was the driving force of change. Invention led to applied application and innovation. Third, each change evolved from lesser btu per unit to higher btu per unit sources of energy. Simply stated, we developed the use of more robust and effective energy sources. Finally, these shifts occurred as part of the natural order of economic and technological progression within the context of the free-enterprise, free-market system. In other words, there was not a master plan or grand design that brought about the inventions and innovations. Rather, it was technology and demand for better, faster, stronger, more efficient, and more productive methods and modes to which the free markets, technology, innovation, and consumer demand responded.

The assertion of free markets, outlined above, was challenged by competing concepts that emerged around oil, private energy monopolies, and government-regulated energy monopolies. The architecture and structure of the American economy around the turn of the nineteenth century was abound with monopolies like Standard Oil (the Rockefeller empire) and the Edison Electric Utility. The mere fact that a monopoly may have precluded competition does not discredit the idea that free enterprise and ensuing patents in the free market ushered in the new energy paradigms such as the shift candles to light bulbs powered by electricity. Regardless, the assertion of free markets is meant to illustrate that the private sector, for the most part, supplied the invention and innovation as the catalyst driving the possibility of change.

In light of all this, it should be noted that all these shifts occurred within the framework of affordability via an economy of scale that entailed huge infrastructure and distribution networks. Additionally, each transition displayed the elements of cost and price affordability in comparison with the previous energy source. Again, this was a key component of free-market activity, encouraging transition within the boundaries of cost, price, and return on investment. Anecdotally, transition and shifts may be prohibitive if the transition cost precludes a return on investment, is unattainable due to impractical implementation (economy of scale), or is unaffordable for the consumer base.

Looking to the Future and a New Energy Transition Paradigm

Historic trends do not necessarily predict future outcomes, especially regarding the next generation of energy transformation. Market-based solutions may not be the path forward. Why? Two words: global warming. According to Mats Larsson, author of *Global Energy*

Transformation, “Market-based solutions, such as the Kyoto protocol, are probably too slow, and unfocused, to facilitate change at the rate that we need now. We probably need to drive both technology development and the implementation of technology at a faster rate.”[10] He is not alone in calling for a centrally planned change to evade skyrocketing oil prices and to escape the potentially disastrous effects of global warming. This paper will not explore global warming. That is a topic worthy of its own focus; however, it is worth noting that the playing field for transition may involve different players and follow different rules than the historic precedent has. Essentially, the argument is to transition economies away from the use of fossil fuels by centrally planned government investments into green renewable technologies at an extraordinarily rapid pace. Historically, there have been successful government-led transitions in times of urgency. We can note the industrial-base transition during World War II, the Apollo space program, the Marshall Plan to rebuild Europe, and the transition into global financial mechanisms. Larsson points to these in support of urgent, government-led transformation of the energy sector.

In regard to the American transportation network, so heavily dependent on oil, renewable energy alternatives do not immediately exist on a large enough scale. Additionally, the technologies are too immature for immediate implementation even if such a scale of alternative resources existed. To visualize this perspective more clearly, here are some data points:

1. Global production of oil amounts to 85 million barrels per day.[11]
2. If all U.S. cars and trucks were to be fueled by grain-based ethanol, all the land in the country would have to be used to grow grain, and there would be no land

left over to live on and no grain left to eat.[12] This would also send food prices soaring.

3. If all U.S. cars and trucks were fueled by electricity (batteries), 500 new nuclear plants would be needed. The entire world currently has approximately 400 nuclear plants today.[13]
4. If all EU cars and trucks were run on cellulose-based bio-fuels, 100 large plants for production of bio-fuels would be required, each requiring 450 trucks full of wood per day.[14] Extrapolated across the globe, we would literally have to deforest the planet in the process. This would also increase the price of building materials.

The realities of oil dependency as it relates to our transportation systems will not be easily overcome. That is not to say they will not be overcome in time, but this is why dealing with oil accessibility, exploration, extraction, distribution, and reliability is so important in the short-term to mitigate economic disruption while viable alternative solutions are developed. This may be our most pressing and immediate national security concern for the next 20 years. Securing reliable oil supplies is crucial to sustaining economic growth until a technologically feasible, practical, and affordable alternative emerges. In short, we must effectively deal with energy security now while simultaneously and aggressively investing in new technologies and energy sources to displace oil. The following section will explore the economics of oil.

The Economics of Oil

The price of oil directly determines the price consumers and industries pay for gasoline. Because our transportation networks are heavily dependent on fuels derived from oil, the price of oil affects every link of the economic supply chain. High gasoline prices hit consumers hard. This, in turn, reduces disposable income for individuals to spend on a vast array of other consumer items, which adversely affects the demand for other goods and services. The reduction in consumer demand has a causal effect, as well, reducing the production of goods and services commensurate with lower consumer demand.

The cycle continues. As demand for goods and services diminish, so does the need for employees to produce these goods and services. Layoffs ensue, raising the unemployment rate. The strain of higher unemployment and lower sales tax revenue produces budgetary stresses on all levels of government, which have to contend with the higher demands for social programs such as unemployment compensation, the Supplemental Nutrition Assistant Program, job training, and medical coverage.

Further down the spiral of deleterious effects, higher unemployment leads to shrinking government revenue. This occurs not only from reduced income and payroll taxes from a diminished labor force, but also from businesses, industries, and corporations. The diminished labor force affects every level of government because revenue from sales taxes, income taxes, FICA taxes, and corporate taxes shrinks across the board. Housing markets are also affected, as recession sets in, generating lower property-tax revenue as the value of property declines.

Compounding all of this, high fuel costs contribute to increased prices for a host of other goods and services because almost everything requires distribution via some form of transportation, to say nothing of the many products that require petroleum in their manufacturing processes. This further reduces consumer buying power as the price of just about everything rises, triggering inflation across vast cross-sections of the consumer price index.[15]

Oil Prices and the GDP

While the chain of events described here certainly constitutes the basics of the supply and demand equation principles, are the effects of high oil prices overstated? Do high oil prices really affect the macro-economy so negatively? The economy is a dynamic and multifaceted, interdependent network of enterprises, and clearly no one factor rules all others. However, according to the International Monetary Fund (IMF) and the World Trade Organization (WTO), a $10-a-barrel increase in the price of oil reduces U.S. gross domestic product (GDP) growth by 0.5 percentage points.[16] Goldman Sachs postulates a more conservative equation in which GDP growth is reduced by 0.2 percent for every 10 % increase in oil for the first year and a 0.4 % reduction in GDP growth for the second year.[17] Although calculating the effects of oil prices on

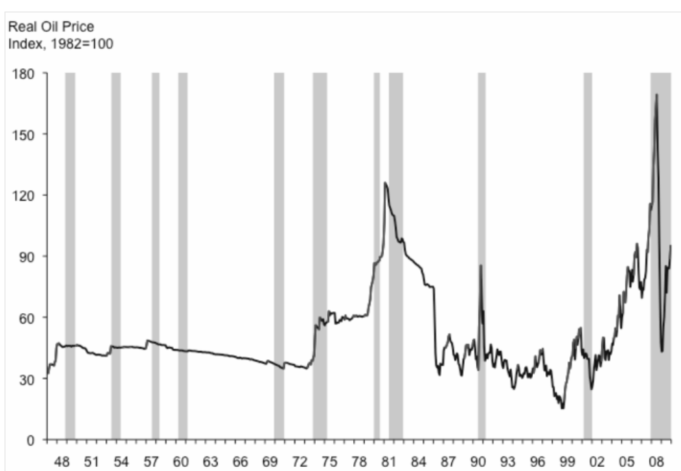


Figure 5. Oil Prices and Recession Correlation

GDP growth is not an exact science, we can certainly acknowledge that steep increases in the price of oil amounts to serious economic losses. Each .5 GDP decline translates to hundreds of billions of dollars of lost economic activity. The chart above (fig. 5), presented by Stephen

Brown (Federal Reserve Bank of Dallas) during the Energy Information Administration 2008 Energy Conference, shows a strong correlation between the GDP and oil prices. Notice that the majority of the recession periods, indicated in gray vertical bands, are preceded by rising oil prices. Furthermore, higher oil price shocks seem to correlate to longer recession periods and greater loss of GDP. The future of the U.S. economy, among other things, is dependent on the price of oil, at least for the near future. In the next chart below (fig. 6), the recent recessions are plotted along with the price of oil and the resulting GDP. The standard of living declines for

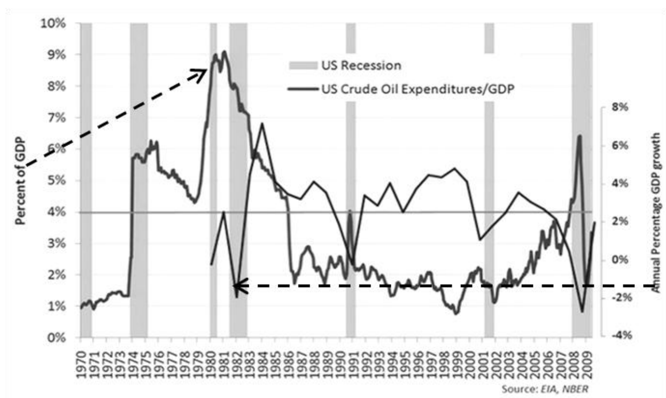


Figure 6. Oil Prices, Recession and GDP Correlation

both consumers and business when oil prices rise.[18] The chart illustrates the correlation between oil price shocks and the resulting GDP plunge, and more specifically, annual crude oil expenditures per GDP over time and the correlated effects on the annual GDP. Clearly, the correlation between oil expenditures/GDP (cost of oil) and GDP is at least suspiciously correlated if not causal.

As detrimental as all this seems, there are factors attenuating the effects of oil-price shocks on the economy. We are less susceptible to inflation and the layoff cycle than we were in previous years. As compared to the oil shocks of 1979, a period that sent the U.S. economy into a tailspin, the U.S. economy is roughly two times larger, generating a significant amount of increased productivity and output per barrel of oil consumed. All the while, America's overall oil consumption rose only slightly, from approximately 17.4 million barrels per day in 1979 to about 17.8 million barrels per day in 2009. [19] Today, producing a dollar of GDP requires approximately 40% less energy than it did 25 years ago.[20] Otherwise known as energy intensity, energy inputs today are proportionally smaller in relation to output. Simply, we produce more with less. Consequently, the economy is able to absorb higher oil prices with fewer harmful effects. The chart below[21] (fig. 7) shows the close correlation between the consumer price index (CPI) and oil prices; as oil prices rise, the CPI rises in almost exact measure, as mentioned

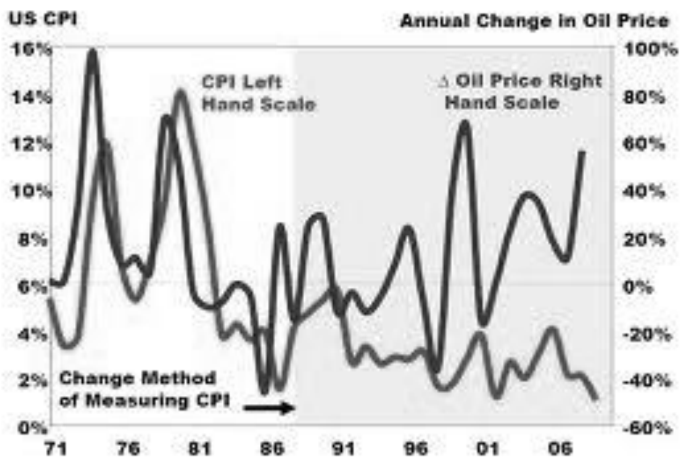


Figure 7. CPI and Oil Prices
Source: http://www.marketoracle.co.uk/Article12165.html

earlier. However, a closer look reveals what may be a dampened effect attributed to lessening energy intensity. While a clear correlation exists within the sample period, 1971 to 2008, we can see less intense volatility in the CPI with oil price fluctuations in the more recent years. Some of this difference is likely the result of government changes in how the CPI is calculated, but some portion is also the result of more efficient use of oil-based energy, behavior changes, and energy intensity changes.[22] One excepted period is noticeable on this chart: post-2007. Here we see spiking oil prices and lowering CPI. This could be the result of the global financial crisis and a domestic recession period that is only rivaled in scope and intensity by the Great Depression. Other structural economic effects of this recession period, such as the housing collapse, high unemployment, a tight money supply, and the financial market freefall, along with significantly reduced production and output could be factors contributing to a lower CPI in the midst of an oil shock.

Oil Prices-Supply and Demand Dynamics

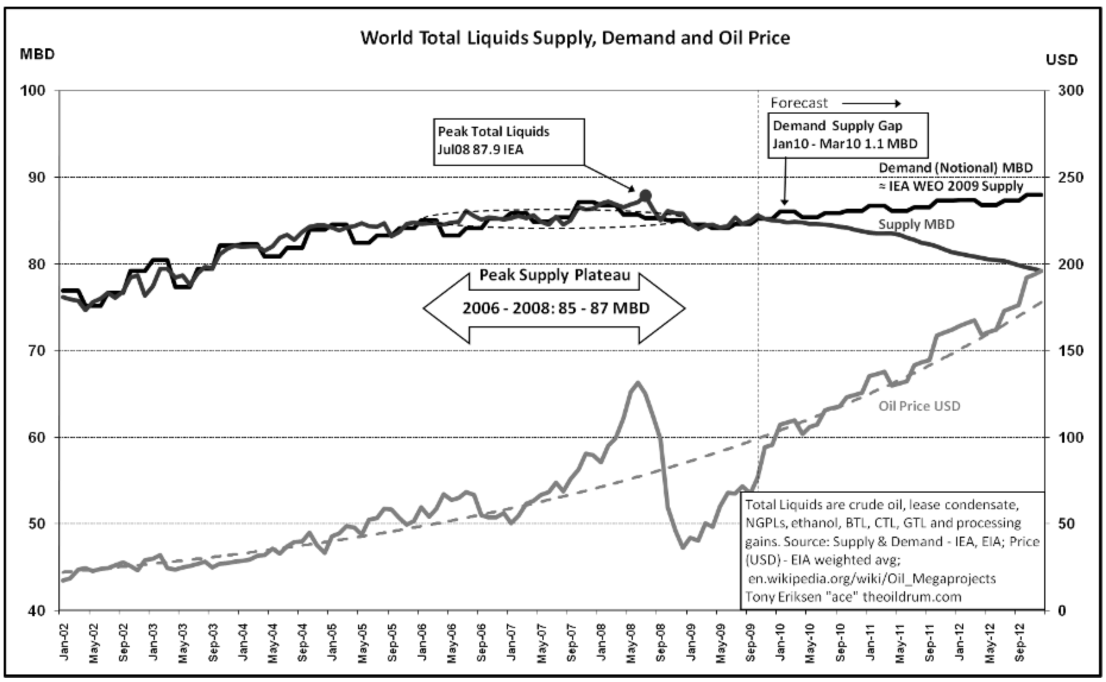


Figure 8. World Supply, Demand and oil Prices

Global oil production and price, at its core, is a commodity-driven proposition based on aggregate world supply and demand. Similar to the majority of goods and services available in the free market, supply and demand is the most significant factor in determining the price of oil. So, for example, even while the United States is producing more domestic oil than ever before, stagnant world supply against the backdrop of increasing world demand continues to drive domestic oil and prices higher. The chart above (fig. 8) from EIA statistics[23] shows oil supply and demand during the 2003–2007 period. Since 2007, supply has remained relatively constant at approximately 85 million barrels per day, while demand has trended upward, now around 88 million barrels per day.[24] The chart shows a continuous upward trend line in global demand but a relatively constant and flat supply line. Today we are faced with a trifecta of conditions, rising prices, increasing demand, and stagnant supply. The right hand side of the chart illustrates predictions of a future condition that is even worse as prices continue to climb and supply begins to diminish. Global energy demands will continue to rise as the developing economies of countries like Brazil, Russia, China, and India continue to grow and steward hundreds of millions of people into improved economic conditions. What about those evil oil companies gouging the American consumer? While the intention of oil companies may be profit-driven, as we have shown, these companies do not set the price of oil, markets do, based on supply and demand as well as other factors such as, speculation, unrest in regions, conflict or the threat of conflict, and natural disasters.

As mentioned earlier, the vast majority of petroleum is used to fuel our transportation systems.[25] Resources that provide the preponderance of our electricity are supplied via domestic resources, which allow us to enjoy relatively reliable access, dependable supply, and consequentially more stable costs and prices throughout the supply chain.[26] Non-oil, domestic energy sources are influenced less by global supply and demand as these domestic sources primarily supply the domestic market and are abundant relative to domestic demand. Also of note, while the United States is the third largest oil producer in the world, our overall demand relies heavily upon oil imports. Consequently, costs and prices throughout the supply chain for oil are relatively volatile. They are subject to a host of supply, access, distribution, speculation and reliability issues.

The chart below (fig. 9) displays a ten-year upward trend line not only for the price of gasoline in the United States, but a significant increase in volatility as well. This upward price trend

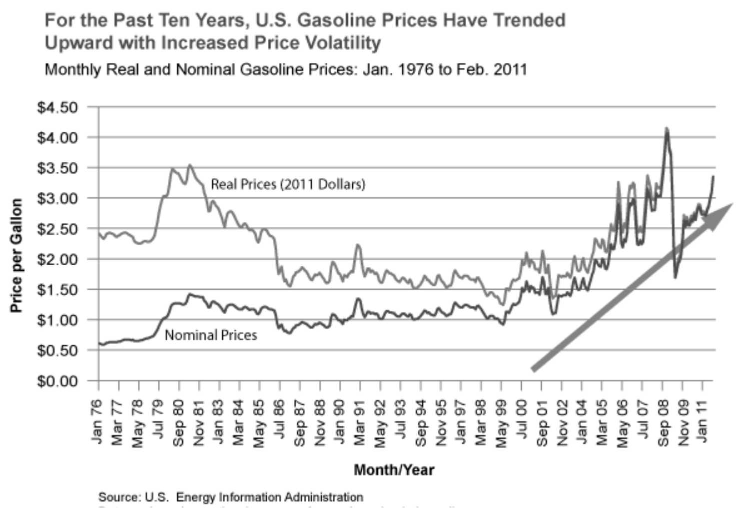


Figure 9. 10 Year Upward Trend in Gasoline Prices

reflects increasing demand against the backdrop of a flat supply, as mentioned earlier. Increased volatility during this same time frame is the result of a host of disruptions, perceived or otherwise. This ten-year upward trend line suggests an entrenched fundamental change in gas price-and-supply dynamics as opposed to previous upward trends that could be blamed on just another intermittent or temporary volatility in a commodity market.

Oil price shocks are potentially detrimental to the economy. Reliance on imported oil is a major source of disruption to our economic well-being and a national security concern as it relates to availability. Denial of world oil flow from the Middle East, for whatever reason—most arguably a regional conflict or an OPEC-driven supply reduction—would cause irreparable damage to world economies. The graph below (fig. 10) displays the negative effects geopolitical events have had on the price of oil.

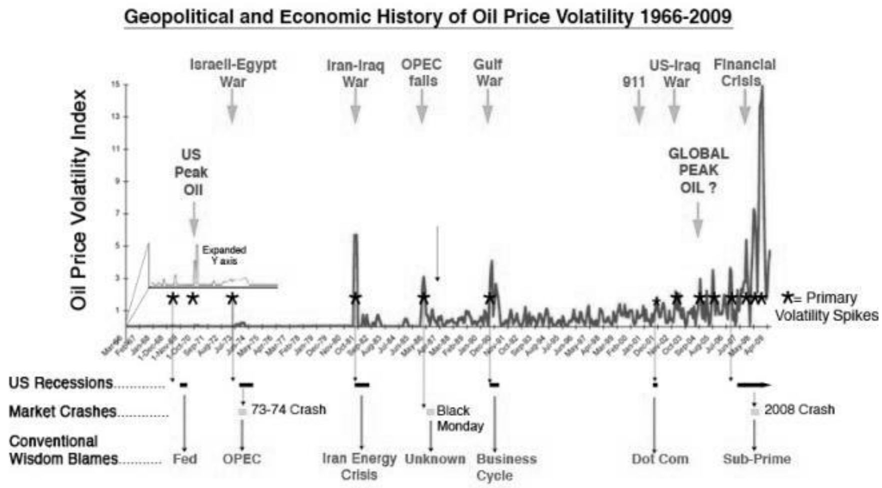


Figure 10. Geopolitical and Economic History

So, energy independence is the solution to oil shocks and stable prices . . . isn't it? Energy independence may be achievable within the context of a broader "total" energy program that is tied to emerging renewable technology initiatives and not to oil exclusively. Given that oil is a global commodity, viewing the oil supply in domestic isolation will not alleviate the potential volatility or price shocks. Exploiting significant domestic oil supplies may however contribute to increased global supply thereby reducing price and supply pressure to some degree. Also, given the right policy mix, an increased domestic supply will play a role in energy security in that we will have a larger pool of oil available to mitigate potential imported oil disruptions. In the section that follows, we will discuss the importance of this strategy as a national security matter. For the time being, let's take a sharp look at domestic reserves and evaluate supply side dynamics.

Domestic Oil Available

To understand how much oil reserves the United States has available for extraction, we first have to understand the price dynamics of affordability of proceeding with such extraction.

Proved reserves are those amounts of oil, natural gas, or coal that have been discovered and defined at a significant level of certainty, typically by drilling wells or other exploratory measures, and which can be economically recovered.[27] The Congressional Research Service (CRS), in its report to Congress in 2008, "U.S. Fossil Fuel Resources: Terminology, Reporting, and Summary," depicts reserves using the pyramid shown below (fig. 11).

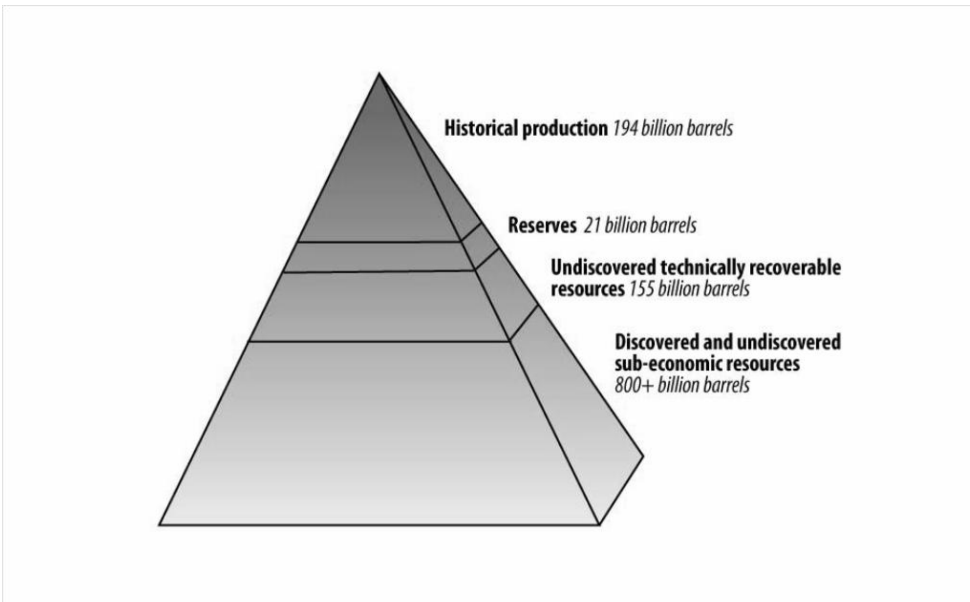
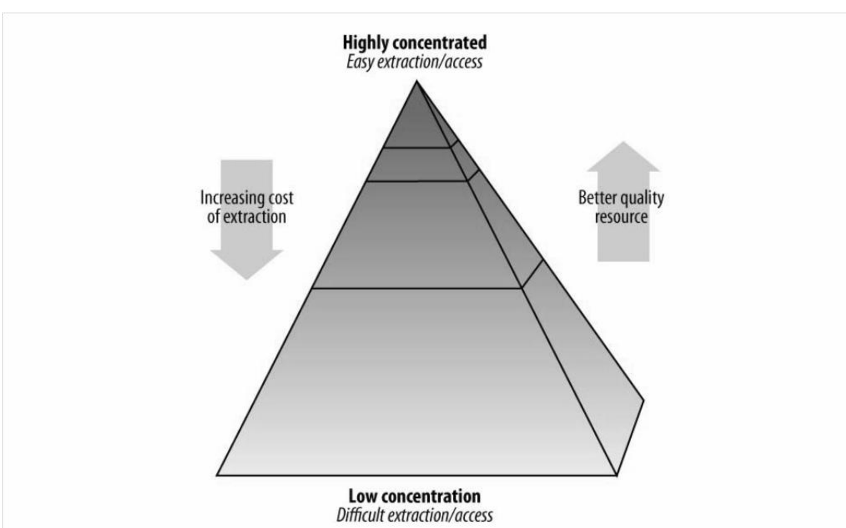


Figure 11. Domestic Oil reserves

Source: Historical production and proved reserves figures are from Energy Information Administration, undiscovered technically recoverable resource value is from U.S. Geological Survey, and discovered and undiscovered sub-economic resources uses the lower estimate for oil shale resources from RAND.

This means that as world oil prices increase, the actual economically extractable "proven"



reserve may actually grow, even without new oil field discoveries. Therefore, the term reserve is a dynamic word, not a static statistic.

Given this view of determining reserves, what does the United States actually have? This is difficult to determine with certainty. Wide variations are reported, and politicians from all persuasions use statistics and terms to suit their own agendas. The chart below (fig.12)

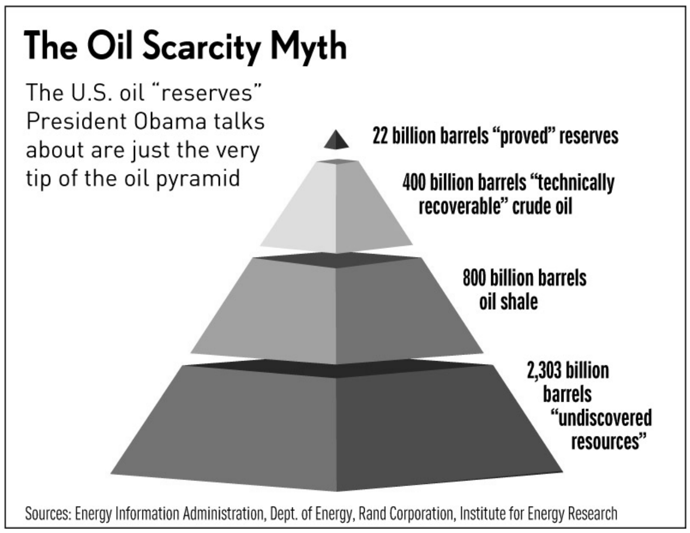


Figure 12. Oil Reserves....Fact or Fiction?

illustrates accurate data estimates along the pyramid but is clouded by competing political narratives. One extreme contends we have plenty of oil (2.3 trillion undiscovered resources), and another extreme proclaims we only have 22 billion barrels of reserves. The truth most likely resides somewhere in the middle. However, with oil prices currently topping $100 per barrel, many analysts believe a good portion of another 400 billion barrels of crude oil and much of the 800 billion barrels of oil shale are economically recoverable today. According to the Department of Energy, undeveloped domestic oil resources still in the ground (in-place) total 1,124 billion barrels. Of this large in-place resource, 400 billon barrels are estimated to be technically recoverable. [28] According to a Rand Corporation study, *In Search of Energy Security:*

Will New Sources and Technologies Reduce Our Vulnerability to Major Disruptions? between 500 billion and 1.1 trillion barrels of oil are technically recoverable from high-grade oil shale deposits located in the Green River geological formation. The study estimates 800 billion barrels, three times the size of Saudi Arabia's known oil reserves, may be recoverable. If recoverable, this amount would be enough oil to meet 25% of America's current oil demand for the next 400 years.[29] Of course, there are a multitude of government policy issues, environmental concerns, and capital investment issues among others to consider before moving in such a direction. The point here is to understand what our national resource prospects truly are. In theory, increased domestic production could contribute to increased global supply thereby reducing oil prices. However, in terms of national security, simply having reliable, accessible domestic oil production is a way to mitigate reliance on imported oil and potential supply fluctuations or outright oil denial.

The Dollar and Oil Prices

A simple yet often overlooked fact is that a weak dollar means it takes more dollars to purchase a barrel of oil. The weaker the dollar, the more it takes to purchase the same amount of oil. As the dollar has continued its downward trend over the last ten years, the price of oil has continued to trend upward over the same time span. Combine this fact with a stagnant supply and increasing demand over that same time period, and we have the makings of rising oil prices. As depicted by the chart below (fig. 13), the dollar has been on the decline from its relative strength in the late 1990s. Since then, the trade- weighted value of the dollar has been on the decline, and correlated oil price have been on the upswing. The trade-weighted index, which peaked around 130 early in 2002 (on a 1997 benchmark of 100), hit bottom at just over

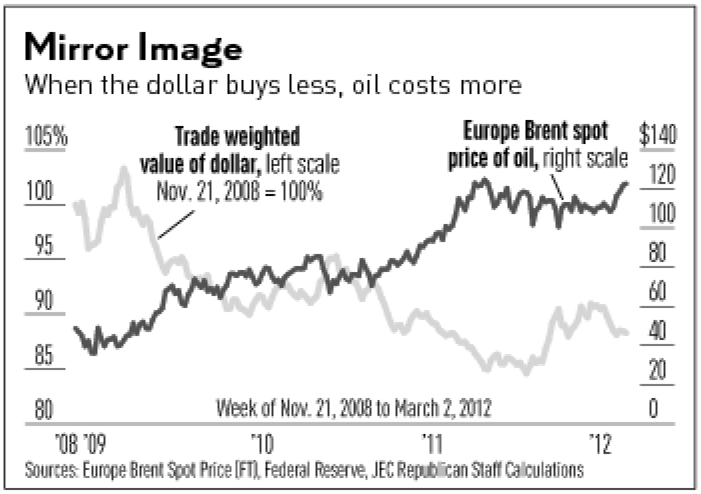


Figure 13. Strength of the Dollar and Oil

95 in July 2008. In that same month, Brent Crude hit an all-time high of $149.17. Later that year, the financial crisis sent oil prices back down briefly, but very soon after, prices began soaring again. By the end of March this year, Brent Crude stood at $124. [30]

Home-Grown Investment

Another significant issue to consider is the alarming fact that the United States spends approximately $430 billion for imported oil.[31] In doing so, we are depriving our own economy of much needed capital infusion. In 2008, the United States imported 4.7 billion barrels of crude oil to satisfy the nation's fuel needs. The average price per barrel of imported oil in 2008 was $92.61. This works out to $1.19 billion per day for the year, an incredible $434.35 billion per year. Viewed through the global macroeconomic prism, this represents what may be the largest transfer of wealth in the history of the world.

Imagine a scenario in which instead of importing oil and transferring hundreds of billions of dollars per year, we develop an energy strategy that invests these dollars in our own economy. A study by Wood Mackenzie, an energy consulting firm, found that U.S. policies encouraging the development of new and existing oil resources could, by 2018, increase domestic oil and gas production by millions of barrels a day and support a million new jobs.[32] The economic benefits detailed in this study only illustrate tax revenue and jobs directly related to the energy industry. However, second-and third-order effects would create jobs and increase economic activity and associated tax revenues across a wide array of other business sectors as well. Resurgence in domestic oil production, based on the potential oil reserves estimated by the EIA, the US geological survey, and other credible sources would have a profound positive effect on the American economy. These include:

1. A decline in domestic oil production would be reversed, creating an array of well-paying jobs, both directly and indirectly connected to oil production. We are actually seeing this effect today in the rise of the US domestic production output.
2. State and local treasuries would gain billions of dollars in tax revenue and royalties.
3. Federal government treasuries would experience a windfall of revenues from leases as well as direct and indirect taxes associated with expanding oil and non-oil payrolls.
4. The benefits of developing the oil shale industry alone would be significant. An output of three million barrels per day could generate profits of approximately $20 billion per year. Production at this rate could cause oil prices to drop by three to five percent, saving American oil consumers roughly $15 billion to $20 billion annually. A multimillion-barrel per day oil shale industry could also create several hundred thousand jobs in the United States.[33]
5. Positively affect the national trade deficit.

6. Decrease wealth transfers to less-than-friendly countries and regions', reducing what is tantamount to funding our enemies.

Geopolitical Dynamics

Global energy demands will continue to rise as the developing economies of countries like Brazil, Russia, China, and India continue to grow and consume ever-more oil to satisfy improved standards of living and to sate economies transitioning to industrial and manufacturing powers. Successful competition for scarce resources will become ever more paramount to ensure economic growth and quality of life. Today, more than 78% of the world's

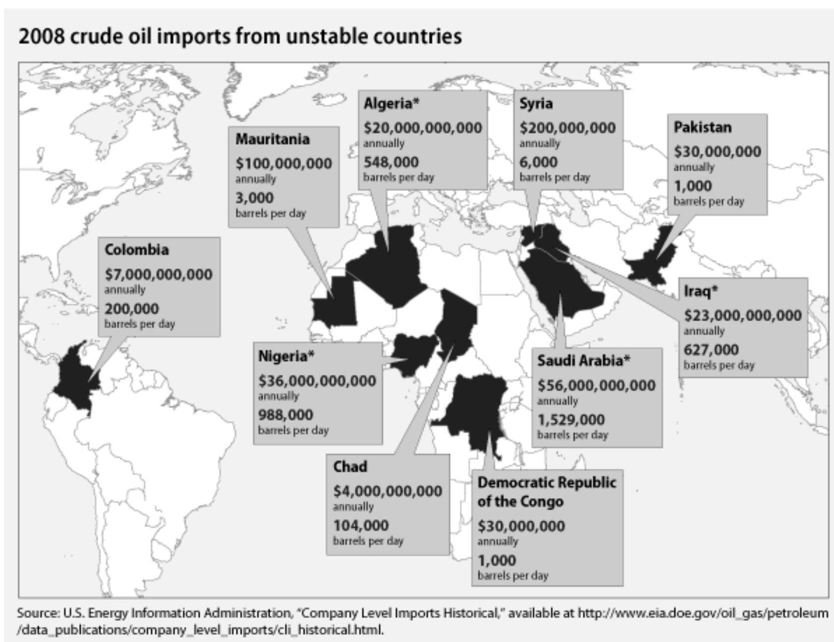


Figure 14. Unstable Regions and Oil

proven oil reserves are found within OPEC member states.[34] Many of these OPEC member states are either hostile to the United States, have unstable governments, or are located in unstable and geopolitically volatile regions of the world.

The U.S. military footprint in the Middle East is enormous. This is so for many reasons, but most notably because of the inextricable need to ensure the free flow of global oil supplies. The U.S. military and political presence may reduce production disruption by providing sufficient counter measures to reduce regional conflicts and to ensure secure shipping lanes. There is no suggestion the United States is heavily involved in the region to "take" the oil or involved in any nefarious conspiracy to plunder oil; rather, security and stability in this region are paramount to regulating world oil supply and ultimately fostering stable world economies. The United States's 2010 National Security Review supports this point of view, "As long as we are dependent on fossil fuels, we need to ensure the security and free flow of global energy resources. But without significant and timely adjustments, our energy dependence will continue to undermine our security and prosperity."[35]

Do we, as a nation, really embrace a national energy policy that places our economic health and national security at the whims of hostile nations, cartels, and the volatility of unstable regions? Look no further than today's headlines that document nations such as Iran threatening to cut off world oil supplies by blockading the Strait of Hormuz. Venezuela has also entertained the "oil as a weapon" strategy against the United States in recent months. Indeed, OPEC has historical precedent for using oil in that capacity, as evidenced by the petroleum embargo that led to the 1973 energy crisis. This embargo resulted in long gasoline lines and fuel rationing, sending the U.S. economy into a tailspin.

Significantly developing domestic oil supplies and instituting a long-term energy policy that leverages a spectrum of wide resources, a policy that fully develops domestic energy resources: oil, coal, natural gas, nuclear, solar, wind, hydro-electric, geothermal and emerging other emerging technology will contribute to a more energy independent America. This, along with renewable energy technology incentives and policies that maximize efficient energy use and conservation, may help relieve us of our imported oil addiction. Our current dependence on imported oil is a serious national security concern because interruptions to supply can cause grave damage to our economy. Imported oil requires a sustained military footprint to secure distribution channels and may require the continued deployment of our military forces.

Reducing our dependence on imported oil by investing would-be exported oil dollars into our domestic energy sector will contribute to more reliable and accessible energy resources. This is fundamental to fueling prosperity necessary for a tax environment able to sustain the world's finest military. In turn, a capable military is essential to our national security. Reviewing the situation: the Unites States's national security outlook depends upon three macro functions mentioned earlier: reliable, stable, and affordable energy availability; a growing and healthy economy; and a strong and capable national defense. Ultimately, our national security directly depends on our ability to properly secure our energy future. A national energy deficiency foretells a bleak and dark future. What to do?

A Path Forward: Recommendations

SWEEPing Transformation

As a nation, we should develop and institute what I coin a spectrum-wide energy exploitation policy (SWEEP). SWEEPing change is required immediately to effect an energy transformation related to oil consumption via our transportation modalities. Transformation is required to avoid the inevitable clash over global oil supplies as global demand continues to grow and outpace supply. SWEEP is a deliberate, government-led initiative to design a partnership with industries and consumers that invokes short-, mid-, and long-term energy transformation objectives and goals across the entire spectrum of energy resource capacities—both non-renewable and renewable—to affect behaviors, technologies, and efficiencies. This initiative would establish an overarching energy transformation board to manage a research and development effort on a scale similar to the Manhattan Project. The Energy Transformation Board (ETB) would organize as a separate entity within the Department of Energy (DOE) and leverage and synchronize existing national laboratory infrastructure and other organizations currently within the DOE. This board would consist of energy experts and scientists from academia, industry, and government, among others. The board will evaluate promising technologies and synchronize resources to expedite development and recommend policy initiatives to rapidly affect energy transformation. The ultimate objective is transformation away from oil to alternate energy sources.

For the short- and mid-term, the objective is to exploit domestic fossil fuel resources to rapidly ensure energy security in an effort to mitigate potential disruptions or denial of supply, while simultaneously investing in near-term conservation and efficiency policies. For the mid- and long-term, the focus will be on technologies geared to shift demand away from fossil fuels, specifically oil. It should be noted that moving away from oil cannot be done in isolation to developing other energy sources and requires a total or spectrum-wide initiative. Given current technologies and feasible solutions to displace oil and internal combustion engines, alternate transportation modalities and technologies are required that utilize alternate energy resources and outputs, for example, electricity. For those who argue a position to just move away from oil immediately, we have shown why this is not a short-term proposition. Additionally, if we institute the right national policy initiatives, exploiting increased domestic oil production does not have to necessarily be at odds with long-term initiatives to move away from fossil fuels. These initiatives, combined with what will eventually be market-driven supply and demand pressures making oil less attractive, have the potential to speed along the transformation. Like it or not, our economy is tied to oil for the near- and mid-term future. The SWEEP initiative would establish an overarching department employing a set of operating rules, tenants, and principles to use as a guidepost. These are:

1. Market-driven solutions and free enterprise are preferable to government-mandated, technological solutions. We can't afford to pick winners and losers in technology and resources. Bottom-up technology evaluation and top-down resourcing—avoid top-down imposition of technology development.
2. Government investment is required to level capital expenses and non-recurring engineering costs associated with technology development in the private sector. Government investments should be tied to the demonstrated technology readiness levels (TRL) on a competitive basis.
3. A given technology prospect should be tied to verifiable specification standards and goals with regard to implementation and production.
4. Mid- and short-term technological advancement should be developed with the idea of niche solutions and sub-markets for implementation. In other words, an all-or-nothing revolutionary transformation of technology is not required, but rather incremental changes or improvements of existing technology and niche solutions may be preferred for targeted sectors. For example, using more efficient engines or

transforming fleets like long-haul trucks, rail, and shipping to alternate fuels like natural gas.

5. Use federal government institutions and organizations as agents of change related to transformation.
6. Conduct continuous evaluations, assessments, and integration of cutting-edge technologies as they emerge. Do not allow sunk costs in research and development that would drive out promising newer technologies.
7. Focus effort on consumer affordability and value incentives to create a market-driven demand for change within the consumer base instead of solely attacking the production and supply side of the equation to assume all the risk of change.
8. Implement a national education initiative similar to efforts employed for science and engineering during the Apollo space program. Transform the narrative from the effects of global warming to national security, continued prosperity, household economics, patriotism, health, and technology. Simply educating the masses on the dooms of global warming is not a solution or a tangible initiative with a measurable outcome. Let the science drive the narrative for education not the politics or policy agendas.
9. Institute policy integration and implementation that fuse various efforts toward broader sector objectives, efficiency, and behavior incentives. These could include:
    a) energy efficiency resource standards;
    b) climate change policy;
    c) congressional authorizations and appropriations;

d) building codes;

e) appliance standards;

f) household retrofit incentives;

g) fuel economy standards;

h) utility regulation and standards; and

i) education and marketing programs.

Overarching objectives include:

1. reduce energy consumption;
2. increase energy efficiency across the energy spectrum;
3. increase use of renewable and alternative energy supplies;
4. provide assured access to sufficient energy supplies;
5. reduce adverse environmental impacts; and
6. deliberately move away from oil.

For the purposes of illustrating solution sets, we will break down SWEEP into short-term: present to 2022; mid-term: present to 2032; and long term: present to 2052. The suggestions outlined below are not meant as an all-inclusive solution. There are thousands of technology efforts, research efforts, improvement possibilities, and policy considerations. Instead, the suggestions below are some generic efforts that could be reasonably developed and implemented based on the current energy situation.

Short- to mid-term solution sets:

1. Mandate more aggressive incremental energy efficiency standards for new car production and engines.

2. Institute statewide vehicle inspection programs that measure emissions and fuel economy. Tie the inspections to tax incentives and programs such as cash-for-clunkers. Get the offending vehicles off the road. Use a portion of inspection revenue to fund national technology investments.
3. Establish vehicle registration fees commensurate with vehicle fuel economy and weight.
4. Federally subsidize fuel pump conversion to smart pumps that charge fuel prices and fuel taxes above and below market value (sliding scale) based on new federal fuel efficiency and emission standards. Smart pumps would need to read smart inspection labels for embedded information.
5. Implement tire inflation detection and auto inflation systems for new automobile production.
6. Dramatically increase tax code incentives for energy-efficient residential homes and appliances (windows, insulation, energy efficient heating and cooling systems, smart thermostats), as well as provide incentives for electric and more energy-efficient automobiles.
7. Double the size of the national petroleum reserve to mitigate the effects associated with emergency conditions.
8. Mandate that U.S. military installations transform to alternative energy mixes for heating, cooling, and electricity generation such as solar, wind, natural gas, bio fuels, and other achievable alternatives. This would serve as an incubator for innovation and seed domestic industry.

9. Mandate more aggressive incremental commercial building and construction standards for energy efficiency.
10. Invest in rebuilding the interstate highway system and local road networks using improved materials and construction techniques.
11. Continue aggressive investment in battery technologies.

Mid- to long-term solution sets

1. Implement mandated transformation of all government mass-transit systems to natural gas, electric grids, or electric motors, including trains, buses, trolleys, subways, and shipping.
2. Build more nuclear power plants, starting now.
3. Heavily invest in hydrothermal-drilling technology to replace traditional drill bits for deep drilling in support of thermal energy production. Invest in thermal energy plants and new technology to support plants in other than thermal zones.
4. Federally subsidize power-plant and power-grid conversion to smart grids with smart tools for producers and consumers. Consumer awareness is an effective means to supplement behavior changes and can be tied into the education initiative mentioned above.

Long-term solution sets:

1. Exploit solar resources by aggressively investing in solar technology development and employing a massive solar energy infrastructure.
2. Exploit wind resources and employ a massive wind-power infrastructure.

3. Invest in developing geothermal energy potential on a grand scale. New drilling technologies are the key to making this affordable.
4. Implement a global carbon tax for all imports. This tax effort should establish a baseline mean for energy intensity used to produce an item. Importing countries would apply a carbon import tax based on a relative sliding scale determined by the WTO via an international trade agreement. This tax will contribute to natural and market incentives for nations to reduce emissions associated with the production of goods. In short, items produced with lower intensity and lower emissions are subject to lower taxes and are essentially less expensive and more competitive in global trade.
5. Continuous evaluations, assessments, and integration of cutting-edge technologies as they emerge.

Conclusion

Our economic well-being and prosperity depend on our nation's ability to secure our energy future. An energy future relying on oil, as the basis to fuel our transportation systems and the economy, is fraught with uncertainly and volatility. High oil prices and associated rising gasoline prices express a dramatic negative effect on the nation's economy, dragging down prosperity. Imported oil introduces even more uncertainty as global oil resources are interconnected via unstable regions or subject to the whims of cartels, unstable and even hostile governments. These factors combined with what appears to be an irreversible trend amalgamating stagnant supply, increasing demand and rising prices along with weakening global financial institutions and a declining dollar all contribute to the necessity to transform our energy sector away from oil. Finding a viable alternative to oil is paramount to ensure a prosperous future. In the mean time, our nation's greatest national security concern may very well be energy security. We must begin a deliberate, national level, effort to move away from oil and transform our energy sector with urgency. Continued reliance on oil will inevitably lead to potential conflict in competition for increasingly sought after oil resources.

A report commissioned by Dick Cheney in 2001, *Strategic Energy Policy Challenges for the 21st Century,* foretells an inevitable energy crisis requires "a reassessment of the role of energy in American foreign policy." former CIA Director R. James Woolsey said, "I fear we're going to be at war for decades, not years. Ultimately we will win it, but one major component of that war is oil."[36]

If we are going to avoid oil dependency and all the potentially negative ramifications it entails, transformation requires SWEEPing change in our approach to energy resources in order to secure a prosperous tomorrow.

Endnotes

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