Most people (at least outside Washington and academia) understand there is an unbreakable relationship between supply and demand. If demand increases more than supply, prices rise. Through the 1970s, demand increases over time were met with supply increases. But that era of elastic supply to meet demand has been coming to an end for commodity after commodity, particularly oil, over the last four decades. Governments have papered over this reality by increasing the supply of the only commodities at their command—fiat money and the debt that emerges from the wicked womb of fiat money.

Now these two realities—debt increase and commodity-supply decrease—are colliding. Southern European countries, including Greece, Italy, Spain and Portugal, are the first nations in the "developed world" to be squeezed by the pincers of debt increase and commodity-supply decline. Soon, the "developing world" will be caught too.

But America appears to have the resources that might help it avoid the coming economic reckoning. Note the word "might." While the resources exist, their advantageous exploitation will require enormous political resolve. But if America can summon that resolve, the United States once again can become the powerhouse of the world, both literally and figuratively.

In contemplating the economic and technological progress of human society, note that such progress is characterized by increasing complexity and specialization. You do not have to grow your own food. Indeed, 97 percent of Americans do not. We leave it up to the fewer and fewer farmers. You can enjoy a meal at your home in Bethesda, Boston or Baton Rouge with tilapia from Brazil, chardonnay from California, brie from France, clementines from Spain and spring lamb from New Zealand, all delivered fresh to your door. You only have to answer the bell and place the food on the table. You do not have to make your own clothes, as Far East manufacturers do that. In fact, you do not have to leave your house to purchase anything. Just order it on the Internet, and Amazon or Zappos or Petsmart delivers it, via FedEx or UPS.

The level of organization, specialization and complexity exemplified by "just-in-time" delivery of goods and services is based largely on man's exploitation of an "energy surplus." This concept requires a full understanding. If it took one measure of energy to produce an equal measure of energy, everyone would spend all of his or her time and effort producing the next unit of energy. There would be no time to create anything beyond the basics. That was the caveman's problem. He enjoyed no energy surplus. He had to spend all of his time finding food, the only "energy" of his day. He had no time to specialize. Thus, society could not become complex. It could not produce doctors or authors or musicians or lawyers or politicians. Everyone was a hunter or a gatherer. Mathematically, we could say that there was a one-to-one ratio of energy found to energy that could be used.

Then fire was domesticated. A cave dweller could gather wood and burn that wood to keep warm and to provide light at night. Having a source of light at night allowed the caveman to become an artist. He hunted during the day and painted his cave walls at night. Around the fire, he told stories of the hunt. Those stories instructed the next generation how to hunt and gather more productively. Animal skins could be sewn into clothing at night, with the light from the burning wood, the new fuel. Bows and arrows could be manufactured to improve the efficacy of the hunt. As the energy unlocked by burning wood allowed for the smelting and forging of metal, spears could be made more lethal, further improving the hunt.

As a result of better tools and weapons, some folks were freed from the hunt. They pursued and perfected other tasks, like planting, weaving and harvesting. People also lived longer. Further specialization ensued—soldiers, surgeons, medicine men—adding to the complexity of society. This increased specialization and complexity was a direct result of surplus energy, from both more food and wood as fuel.

Then, about three hundred years ago, society experienced another great leap ahead with the use of coal. As was the case first with food, then with wood, the use of coal facilitated more societal complexity, more societal specialization and more leisure.

But the greatest leap of all began with the use of oil and its refined products. In 1901, the age of oil began in earnest.

With the energy produced from one barrel of oil, one hundred new barrels could be secured and made available for a use other than finding more oil. That is a formidable energy surplus, one hundred to one. That surplus allowed the modern world to evolve.

In 1900, 38 percent of Americans were farmers. One hundred years later, only 3 percent of Americans were farmers. But the output produced by that 3 percent was nearly three times the output produced by thirteen times as many people a century earlier. Mechanized agriculture, using fossil-fuel-based fertilizers and machines running on the refined products of oil and produced by employing fossil fuels to generate electricity, freed people to leave the farms and move to cities. There, they worked in factories powered by easily produced energy from fossil fuels. Others used their freedom to design new products and new techniques to make life cleaner, easier, healthier, richer.

The work week declined from eighty hours to forty hours. The "weekend" was invented, and leisure activities evolved. Telecommunications were invented and constantly improved. More people were freed to specialize even further. Now, we have brain surgeons, some of whom are so specialized they must study until they are forty-five years old (five years beyond the life expectancy of a caveman) before they can practice their life-saving art. Specialization like that, on such a scale, simply could not occur without the freedoms generated by an energy surplus.

In effect, society has leveraged the fact that for most of the last one hundred years, it took a small increment of energy to find and produce substantially more energy. This can be called "energy leverage"—the relationship between energy expended to find and exploit more energy and the additional energy made available through that energy expenditure. Abundant, cheap energy—what we can call a high degree of energy leverage—fueled increased societal complexity and specialization. But now that high energy leverage is ending, and ending quickly, the energy expenditure required to generate new energy is increasing at a very high rate.

Another way to examine the relationship between energy employed to find or produce more energy and that energy found or produced is "EROEI," energy return on energy investment. Over the years, as the "easy oil" began to be depleted by galloping world consumption (now eighty-six million barrels each day), it began to take more and more energy to find and produce energy. The EROEI fell to twenty-five to one in the 1970's. It fell to ten to one by 1990. Today, it is less than four to one.

We are running up against an energy limit (remember the caveman). It is taking more and more of the previously secured energy to produce the next units of energy needed to keep the machine of modern, complex society properly greased and fueled up. Today, fewer than four barrels of oil in five are surplus, as opposed to ninety-nine barrels out of one hundred at the dawn of the age a century ago. Energy is becoming more expensive to produce in terms of energy expenditure. We can sum it up by saying we have had to drill deeper and deeper to find smaller pools of conventional oil. (That's why BP was drilling eighteen thousand feet down in the Gulf of Mexico.) Energy leverage was a blessing when it was high (a large EROI). It gave us the modern world. But it will be a curse as it continues to decline (a small EROI). That decline could take away the modern world.

Energy leverage works much like financial leverage. Say you borrow most of the money necessary to purchase an asset—a shopping center, for example. If that shopping center increases in value, you achieve a high rate of return on the small amount of your own money invested in the deal. There, leverage was beneficial. But if the value of the shopping center declines, your equity is wiped out when the bank forecloses on your loan. Then, leverage was a detriment. As the energy expenditure necessary to find and produce the next unit of energy continues to increase—i.e., as our energy leverage (EROI) declines—our way of life and our complex, specialized society get wiped out. We are forced to live smaller, simpler lives with fewer luxuries and fewer opportunities.

The problem of rapidly declining energy leverage is intertwined with another seemingly intractable problem of our age—debt. Mountains of debt. Debt piled so high that many economists (not employed by, or sympathetic to, the Federal Reserve) believe it cannot be repaid unless we either enslave, through confiscatory levels of taxation, our children and grandchildren (and their children and grandchildren) or create sufficient fiat money to "monetize" the debt, thereby reducing its value. Each of those policy paths can be avoided. Indeed, solving the energy dilemma provides a way to solve the debt conundrum.

Part 2

Massive, unprecedented debt burdens have been building up in America since the middle of the 1960s to facilitate ever-increasing social and military spending. The U.S. debt clock shows that the country has $117 trillion in unfunded liabilities. That total is in addition to the $20 trillion official debt when the liabilities of the nationalized Freddie Mac and Fannie Mae are included.

Indeed, similar debts exist for most Western economies, which did not distinguish between self-liquidating debt, incurred to fund projects that pay back the debt out of net revenues generated by the project, and debt incurred to facilitate consumption.

The only way to repay all of the debt incurred is to expand the economy. But the rate of economic growth required to pay the debt, even to pay all of the interest incurred on the debt, would be substantially higher than we ever have reached before for any extended period.

The U.S. gross domestic product (GDP), essentially all the goods and services produced every year, has grown at the inflation-adjusted rate of about 3 percent annually over the last one hundred years. As a result of that rate of exponential growth, the U.S. economy doubled in size about every twenty-four years. U.S. debt, however, has grown from $400 billion in 1920, in inflation-adjusted dollars, to $20 trillion today. That growth rate exceeds 5 percent per year, on average. But that average rate of debt growth over the last ninety years includes years in which there were surpluses or the debt's rate of growth was de minimis. Today, the growth rate of the national debt is approaching 20 percent per year. According to CBS News's August 22, 2011, "Political Hotsheet":

The latest posting by the Treasury Department shows the national debt has now increased $4 trillion on President Obama's watch.

The debt was $10.626 trillion on the day Mr. Obama took office. The latest calculation from Treasury shows the debt has now hit $14.639 trillion. It's the most rapid increase in the debt under any U.S. president.

The national debt increased $4.9 trillion during the eight-year presidency of George W. Bush. The debt now is rising at a pace to surpass that amount during Mr. Obama's four-year term.

As of May 10, 2012, the official debt was $15.712 trillion, not including the $6 trillion in Freddie Mac and Fannie Mae debt.

Even more startling is the fact that this rate of debt growth excludes the even more rapidly rising unfunded liabilities of Social Security, Medicare and Medicaid and unfunded state-pension liabilities. When the $57 trillion present value of these unfunded liabilities is added to the "official debt," the rate of debt growth is more than twice GDP growth over the last ninety years. To repay the debt, even just to pay the mounting interest on that debt, we have to produce not only all we currently do to satisfy current demand for goods and services—we must produce much more. Take an average family, which must work to earn enough money to pay all its bills for food, clothing, heat, power and transportation. That is its current consumption. It also must pay the mortgage and credit-card bills for past consumption. If the credit-card and mortgage balances are too large, the family can never work enough hours to pay for current consumption and to pay off its debts. It has run up against the limit of time.

Similarly, if the world cannot produce enough surplus energy to expand the economy, meaning increased complexity and even greater specialization, the debt can never be repaid. It will have run up against the limit of energy. Stated another way, the economy would have to grow, ever faster, to pay off both past debt (official national debt incurred through past consumption) and accumulating, currently incurred debt for future consumption (unfunded Social Security and Medicare liabilities and unfunded state-pension obligations). But it wouldn't be possible to produce enough conventional energy to do so.

In that event, society no longer would be able to afford the pharmaceutical research to invent that new drug to keep some folks healthy or even alive. It no longer would be able to fund research institutions and universities to develop the next big breakthrough. Society would not be able to spend scarcer resources on new technology. As a result, that technology would not be created. Food would become increasingly expensive to produce, so fewer mouths would be fed. The portion of work hours necessary to purchase food and other basics would increase. We are seeing that now throughout the Middle East. World food prices have skyrocketed, as commodity inflation, which reflects both reduced supply and increased demand, not to mention the central banks' money printing, has put even one meal a day beyond the reach of many people there. Society will devolve along the same path on which it developed. This scenario is inevitable unless a new source of cheap, surplus-producing energy can be exploited quickly.

But America may be blessed in this regard. Between our two shining seas there lies the world's greatest bounty of oil and natural gas. Only in the last few years has this magnificent bounty begun to be realized.

"We have the technology." That line from the opening narration of The Six Million Dollar Man, the mid-1970s television series, is true when it comes to our ability to extract oil and natural gas from geologic formations once believed to be impenetrable. Let's examine America's aggregate-energy supply and demand.

Question: How much oil is consumed to run America's transportation system? Answer: Nearly twenty-one million barrels (at forty-two gallons per barrel) every day. The United States, the world's largest economy, uses 25 percent of the world's daily output of nearly eighty-six million barrels.

Of the twenty-one million barrels used every day in the United States, twelve million are imported. Of this imported oil, some 10 percent comes from Saudi Arabia. Canada actually provides nearly 20 percent of U.S. imports. Mexico accounts for another 10 percent. But Mexican production is rapidly declining, so Mexican exports to the United States are likely to diminish substantially over the next five years. Nigeria and Algeria, along with the Persian Gulf States of Qatar and the UAE, account for about 30 percent. Hugo Chavez's Venezuela provides about 9 percent. The Venezuelan portion, however, is likely to diminish also over the medium term because Chavez has nationalized the petroleum industry. He has extirpated Western oil companies and their expertise. As a result, Venezuela is unable to maintain production levels despite having plentiful reserves.

Of the 60 percent of America's oil that is imported, how much actually is "dependable"? For a long time, it appeared Canadian exports to the United States were a "lock." That no longer is true because the Obama administration nixed the Keystone XL pipeline. The Canadians have turned their gaze 90 degrees west, to their customer of the future, China. As noted, Mexico and Venezuela are in decline. The 9 percent portion provided by Nigeria is problematic because that country's oil facilities are subject to constant rebel attack. The supply of Middle East oil, whether from Saudi Arabia or other Gulf States, also presents a practical concern. The flow of that oil could be disrupted for many months if fewer than a dozen tankers were sunk in the Straits of Hormuz, the narrow sea-lane used by the world's supertankers to reach the Indian Ocean from the Persian Gulf.

That would be exceedingly easy for Iran to do. With the level of current tension in the Persian Gulf region, ratcheted up by the potential for a hot war between Iran and Israel, oil prices already have been affected. But it is not only tension between Iran and Israel that threatens the oil supply from the Middle East. For years, al-Qaeda has dreamed of blowing up Saudi oil-transfer facilities on the Persian Gulf.

So, except for imports from Canada, assuming Canada continues to send a hefty portion of its crude production south despite the Keystone-pipeline debacle, up to 80 percent of America's imported oil supply is in potential jeopardy on any given day. As a result, more than half of America's daily transportation-fuel requirements could disappear. This would be akin to what happened in the 1970s, when the Arab states boycotted oil sales to the United States: immediate price hikes for fuel, gasoline rationing, spikes in unemployment and serious recessions. In the 1970s, the United States produced more than 60 percent of its own oil supply and imported less than 40 percent. Today, those figures are reversed.

In a nutshell, the U.S. economy would grind to a halt if a supply disruption occurred. Not only would gasoline and diesel prices spike, but the cost for all goods and services also would rise substantially, as elevated prices and diminished supplies rippled through the economy. Layoffs would mount. Of course, with layoffs come tax-revenue declines at both the state and federal levels, and the requirement for more government spending on the newly unemployed.

Are we doomed? Maybe. But there is a simple way out of this transportation-fuel conundrum: There are ample fuel resources right here in the United States, some already being brought on line. I'm not talking about agricultural output that can be converted into ethanol. As much energy is consumed in growing (diesel for tractors) and drying the crops (natural gas) as is produced by burning the ethanol in motor fuel. Corn ethanol has been nothing other than a political scheme to buy the votes of farmers and finance the political contributions of crony capitalists who benefit from government ethanol mandates and who receive the ethanol-refining subsidies. Of course, those subsidies require further tax increases, more government borrowing or more government money printing. Hence, increased ethanol production and increased ethanol subsidies are irrational.

Part 3

The United States sits on top of the world's largest supply of natural gas. In the last half-dozen years, the often-demonized oil companies have perfected two technologies that can deliver that clean-burning resource in quantities sufficient to replace imported oil as a transportation fuel. Significantly, natural gas can increase fuel economy, reduce greenhouse gases and do it all for a substantially lower cost per gallon than a gasoline (or diesel) equivalent.

How does this natural-gas revolution work? Since the early 1950s, geologists have known there are massive deposits of natural gas within nearly impenetrable shale formations in several areas of the country, including the Barnett Shale in Texas, the Haynesville Shale in northwestern Louisiana and eastern Texas, the Marcellus Shale along the Appalachian chain in West Virginia, Ohio and Pennsylvania, and the Fayetteville Shale in Arkansas.

Despite their continued demonization by politicians and the press (including conservative Bill O'Reilly on the Fox cable channel), oil companies have been innovating—inventing technologies and techniques to bring that otherwise unrecoverable shale gas to the market.

The first technique is called "horizontal-directional drilling." Based on satellite imagery, ground-penetrating radar studies and other geotechnical-imaging techniques, well locations are chosen above shale formations. Wells are drilled into the shale formation thousands of feet deep, and when the drill reaches a gas- (or oil-) bearing level, it makes a 90-degree turn into the resource-rich area.

Then, the second new production technology is applied: to facilitate the flow rate and create an economically viable production well, the shale is fractured. This is done by injecting pressurized steam and "fracking fluids" down the well. Then, ceramic pellets or sand particles are forced into the fractures to maintain the space necessary for the gas or oil to flow.

Beneficial modifications to fracking technology are being developed rapidly. For example, one methodology adds fibers to the mix of hard, small grains used to hold open the cracks in the shale. The fiber promotes more flow for a longer period of time, improving "conductivity." Another system employs specialized pipe fittings. Much like valves, the pipe fittings, when activated, can crack a vast volume of petroleum-reserve rock. This process also uses about half the water of conventional fracking and requires much less time to complete. As a result, fracking costs, and therefore per-barrel prices, can be reduced. Another new development has eliminated the need for water in the fracking process. It employs liquefied petroleum gas (LPG) as the fracking medium. A mix of LPG gel and sand is pumped deep into the shale formation (often more than a mile underground). The heat at such extreme depths causes the propane gel to heat up and vaporize. The propane, in gaseous form, returns to the surface with the natural gas and is then recaptured and recycled.

As a result of the horizontal-directional drilling, fracking technologies and their continuous improvements, nearly two quadrillion cubic feet of clean-burning, domestic natural gas has become available to the U.S. market. That is the number two followed by fifteen zeroes. How much natural gas is that?

The United States currently consumes twenty-three trillion (i.e., twenty-three followed by twelve zeroes) cubic feet of natural gas per year, using it to generate electricity, manufacture products, and heat businesses and homes. Nearly all of that gas is produced domestically and transported safely, efficiently and economically through underground pipelines. With two quadrillion cubic feet of available supply, the United States has more natural gas than it can use in nearly ninety years at the current rate of consumption.

Currently, only 1.5 percent of the natural gas produced in the United States is used as vehicle fuel. With the new supplies of natural gas, that can change dramatically. New shale-gas supplies can be used to fuel cars, trucks, trains and ships, as well as airplanes. It is easy to visualize natural gas fueling buses or cars. There are natural-gas buses and taxis operating in Washington, D.C., and in many other large cities in the country.

But how can natural gas power trucks and trains and airplanes? It is quite easy. Natural gas can be refined into diesel and jet fuel. In fact, refineries to synthesize diesel from natural gas are already in operation.

With oil prices having risen above $100 per barrel and natural-gas prices having fallen to generational lows (below $2.50 per MCF), the ratio of oil price to natural-gas price now stands at a forty-year high. The economics of converting cheap natural gas into highly valued diesel fuel for trucks or into scarce jet fuel are compelling. No subsidies are needed to build that industry, and no food is consumed in the process.

How much imported oil actually can be replaced with domestically produced natural gas? According to the Department of Energy's Energy Information Administration (EIA), 6000 cubic feet of natural gas has the same energy content as a 42-gallon barrel of oil or of the gasoline or diesel fuels produced from that barrel of oil. Second, what volume of natural gas would be needed to offset the 12 million barrels of oil the United States imports each day? That figure can be determined by multiplying 12 million barrels by 6,000 cubic feet per barrel. That yields 72 billion cubic feet of natural gas. So seventy-two billion cubic feet of natural gas would be needed each day to replace the fuel now being refined from imported oil to power roughly 60 percent of the U.S. fleet of cars, trucks, busses, trains, planes and ships. How much natural gas is that in a year? Multiply 72 billion cubic feet per day times 365 days per year. The result is 26.2 trillion cubic feet of natural gas. Although that figure sounds large, the reserves of domestic natural gas are in the range of 2 quadrillion cubic feet. So how many years' supply of natural gas is that? Before we do more math, we must recall that the United States already uses 23 trillion cubic feet of natural gas annually. Therefore, in order to fuel the transportation requirements now being met by imported oil, as well as to continue providing the natural-gas-fired electric power we already consume, we must add 26.2 trillion and 23 trillion. That sum is nearly 50 trillion cubic feet. If we divide the 2 quadrillion cubic feet of reserves by 50 trillion cubic feet per year, we find that the reserves would last forty years.

Without importing another drop of oil, the United States could operate the 60 percent of its transportation fleet now powered by imported oil, as well as continue to use natural gas for its current uses, for forty years. That gives America forty years for new technology to improve the efficiency and reliability of alternative-motive power, such as hydrogen fuel cells and electric batteries. That gives the country forty years to scale up economic production of infinitely renewable synthetic oil from algae and other biological sources. (That solution entails converting sunlight, brackish water and carbon dioxide from the ambient air into “green crude” via engineered algae. That green crude can be refined into gasoline, diesel and jet fuel usable in existing car, truck and jet engines.)

At the current price of oil, about $100 per barrel, the United States is sending more than a billion dollars every day—or more than $400 billion dollars a year—to foreign oil suppliers. At the current import rate and price, over forty years, $16 trillion (in 2012 dollars) will to be sent to foreign oil suppliers. That sum is more than the official, outstanding national debt.

That $16 trillion figure does not take into account the nearly certain probability that oil prices will rise as supplies grow more scarce and demand continues to rise. Remember, there are two giant and rapidly growing economies, India and China, that used relatively little oil as recently as ten years ago. The more than 2.3 billion Chinese and Indians are increasing their oil consumption at annual rates in excess of 5 percent. That exponential growth rate means that Indian and Chinese oil consumption will double in just fourteen years.

But the U.S. natural-gas reserves mean that the United States will not have to compete with India and China for oil. It will not be forced to pay ever-higher prices for scarcer and scarcer oil. Indeed, the $16 trillion that otherwise would have been sent to foreign oil suppliers will stay home. Those dollars will circulate in the U.S. economy, creating millions of high-paying industrial jobs in drilling, engineering, pipeline construction and refining. Those jobs will create enough earning power that employees will be able to improve their living standards, increasing their purchases of goods and services such as houses, cars, furniture, appliances, electronics, health care and education.

The economic benefits of that $16 trillion would multiply as the economic pie grows. It would be a real “stimulus package," not another government program to take from one unpopular group to give to a more favored constituency. Unemployment and welfare payments would be reduced. Tax revenues would increase. Deficit reduction would be possible. The dollar could be saved. The stock market would rise as corporate profits increased in a sustainable way. Retirement plans would be rebuilt. The standard of living for all Americans would improve. Societal rifts would diminish. America’s strength would be rebuilt.