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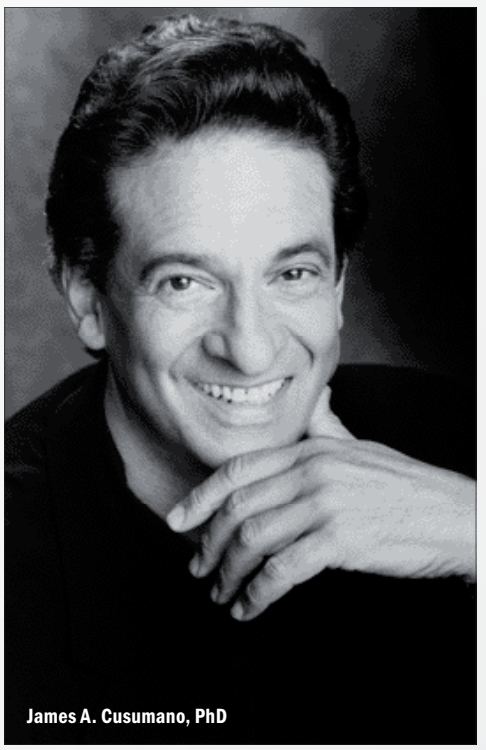
The Energy-Climate Crisis is Your Business

Part III: A Workable Solution[1]



James A. Cusumano, PhD

"There is a kind of optimism built into our species that prefers to live in the comfortable present rather than confront the possibility of destruction. It may happen, but not now, and not to us." *Richard Fortey, Paleontologist and Author*

THE STARTING POINT

Most knowledgeable politicians and scientists agree that a viable solution to the rapidly emerging energy-climate crisis can only occur through commitment and leadership by the United States. This premise is the basis for a recent book, "Freedom From Mid-East Oil," of which I was a coauthor.[2] In this book, we demonstrate that using proven technologies, the U.S. and the rest of the world can free itself from its dependence on OPEC[3] oil, and do so while addressing the challenges of climate change. We call our strategy the PROMETHEUS PLAN because it was the Greek mythological god, Prometheus who provided humanity with its energy through the gift of fire. If implemented immediately, by 2015 this plan would free the U.S. from all OPEC oil imports – projected to be 5 million barrels a day (MBD) by then. In Part III of this series, I summarize the PROMETHEUS strategy, as these results are applicable, globally.

A PROMISING OUTCOME

As pointed out in Part II of this series, the natural inclination of many politicians and some corporate executives is to expand on what they know – fossil fuels and nuclear power – to generate transportation fuels and electric power. This, I believe, would have serious non-retractable consequences, which are discussed in Parts IV and V of this series.

The second approach for the U.S. to achieve freedom from OPEC oil by 2015 and emission-free energy before 2050 requires strong political leadership, courage spawned by deep conviction, and project implementation in an Apollo or Manhattan Project mode of action, starting immediately. It is based on existing technologies and/or their immediate extension, i.e. no major scientific or technological discoveries are necessary.[4]

One can envision a series of technologies, various combinations of which could simultaneously address the global energy and climate crises. For example, in Figure 1, any combination of seven of the technologies summarized there could provide our global energy needs, while reducing CO_2 levels to an acceptable level.[5] My choices of specific carbon reduction "wedges" in this figure are: 1. Increase efficiency of vehicles; 2. Reduce use of vehicles; 3. Increase efficiency of buildings; 4. Replace coal power with wind power; 5. Replace coal power with solar power; 6. Use wind to generate hydrogen for fuel-cell cars; 7. Replace fossil fuels with biomass fuels. Specific recommendations for a U.S. program to transition to clean energy sustainability are as follows:

Transportation

- Since transportation accounts for 27 % of all emissions in the U.S, by law, raise automobile fuel efficiency from the current average of 22 per gallon (mpg) to 40 mpg by 2015, and beginning in 2015, mandate fuel mileage at progressively increasing levels, from 40 mpg in 2015 to 100 mpg by 2025.
- In 2009, through tax incentives encourage the production and purchase of hybrid – and plug-in hybrid drive cars and trucks, which have very low emissions (see Figure 2).
- By 2010, through tax incentives and loan guarantees, transition to large-scale production of plug-in hybrids, which have an average fuel consumption of 100 mpg.
- Through a combination of tax incentives, loan guarantees and guaranteed purchase, establish a thriving bio-ethanol industry, initially and only moderately corn-based, but rapidly expanding (by 2015) to sugarcane and primarily, to large-scale cellulosic ethanol. Corn technology is simply a means to get started, to obtain commercial experience relevant to the fuel market, and move rapidly to higher-efficiency, lower-cost and CO_2 emitting fuels based on biomass and cellulose.
- Starting in 2009, through a combination of tax incentives, loan guarantees and guaranteed purchase provide a strong market incentive for massive commercialization and expansion of the most cost-effective, lowest emissions biodiesel technologies.
- Starting in 2009, through tax incentives and loan guarantees, encourage production and purchase of flex-fuel diesel-powered cars and trucks that can also run on biodiesel and are based on the most advanced European diesel technology. The latter has evolved over decades to produce the lowest emissions and the highest performance diesel vehicles, worldwide.
- By 2015, through a combination of tax incentives, loan guarantees and guaranteed purchase, provide a strong market incentive for developing and commercializing the production and use of aviation biodiesel, which initially may be a blend of biodiesel and standard jet fuel, but by 2020 would be totally biodiesel based. Similar actions should be implemented for rail and ship transportation fuels.
- By 2010, through a combination of tax incentives, loan guarantees and guaranteed purchase, provide a strong market incentive for commercializing longer-chain alcohol and hydrocarbon bio-fuel technologies that fit the existing fuel distribution infrastructure, e.g. bio-butanol,[6] algae-to-biodiesel,[7] and biomass-to-gasoline-like hydrocarbon fuels.[8]
- By 2010, mandate by law, fuel-saving tires on large trucks as well as the use of small auxiliary power units for heating and refrigeration, to be used when the trucks are parked, but still in operation.[9]
- Between 2015 and 2020, phase in fuel-cell cars and trucks that are compatible with the electric grid, with long-term price incentives to sell power to the grid when not in vehicular use. In time (circa 2030), this technology will likely support the largest fraction of vehicular transportation.
- By 2015, optimize the interface of advanced wind and solar power generation systems with modern electrolysis technology to generate pure hydrogen from water. Hydrogen is a means of storing electricity, as it can be converted at will, to electricity in fuel-cell powered vehicles, and it can also produce electricity when needed in modern fuel cell power plants.
- Accelerate transition to the Hydrogen Economy, which by 2050 should be a major component of global power generation.

• Deploy existing technologies to achieve initial commercialization of direct-burn hydrogen internal combustion engines[10], hydrogen fuel cell cars and plug-in hybrid/hydrogen fuel cell cars by 2015 (see Figure 3).

• By 2015, to enhance fuel economy and provide a more effective vehicle for hydrogen fuel-cell power, provide tax incentives and loan guarantees to automobile companies to manufacture light-weight cars made from ultra-strong fiber-reinforced advanced materials. Such automobiles are safer than current steel-based construction, and in addition to higher energy efficiency, they provide substantially higher social and economic benefits by decreasing the number of injuries and fatalities in automobile accidents.

• Following California's example, develop a local and national hydrogen infrastructure to achieve widespread commercialization of stationary and mobile hydrogen fuel cells by 2015.

• Transition away from tax incentives for oil and other fossil fuel production, e.g. production and depletion tax credits, and

Figure 1: Carbon emissions can be stabilized and then reduced if we make changes now. The stabilization "wedges" shown in this figure could be realized by 2050 so as to maintain emissions at the present day level. Each of the technologies listed on the right represents one "wedge," capable of reducing carbon emissions by 25 billion tons by 2050. Seven wedges are required to maintain current emission levels.

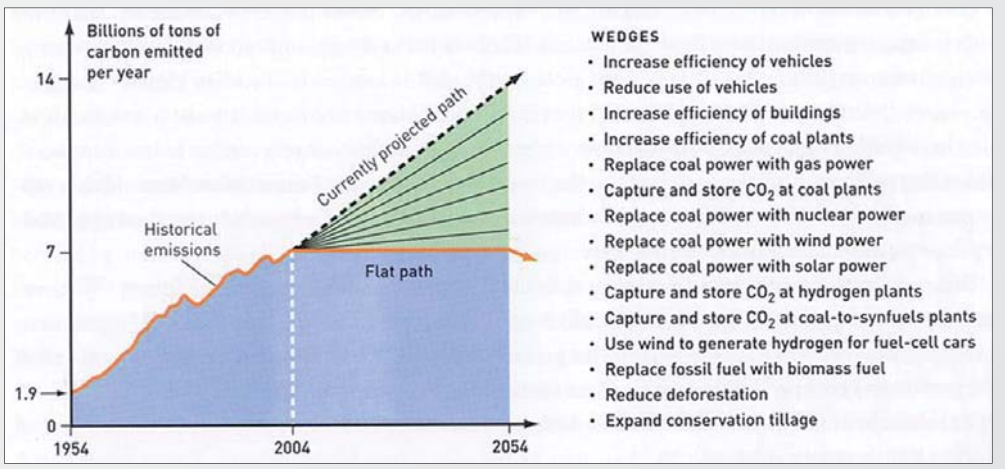



Figure 2: Toyota's high-performance VOLTA, a plug-in gasoline hybrid vehicle

move toward renewable energy incentives for all environmentally and economically acceptable energy sources.

• Reduce barriers to construction and operation of necessary energy infrastructure, especially for the generation and transmission of distributed and/or renewable resources used in powering plug-in hybrid vehicles and hydrogen-generating stations.

The results of the PROMETHEUS analysis for the transportation sector in 2015 are shown in **Table 1**. These targets are conservative and achievable with minimal disruption.

Current Technology Oil Savings in Millions of Barrels of Oil Per Day (MBD) by 2015

Oil Saving Measures	MBD
Raise fuel efficiency in new automobiles through incentives and standards to achieve a fleet average of 40 mpg by 2015	1.6
Accelerate oil savings in all vehicles through: • Fuel-efficient replacement tires and motor oil • Efficiency improvements in heavy-duty trucks	 0.5 1.0
Accelerate oil savings in industrial, aviation, and residential sectors	0.3
Accelerate growth of biofuels industry through expansion and standards for: • Bio-ethanol, mainly E85[11] from corn and sugar feedstocks • Bio-diesel, mainly B20[12] from vegetable oil feedstocks	1.4
Total Oil Saved by 2015:	**5.0**

The PROMETHEUS PLAN would achieve the following additional benefits in the U.S. transportation sector by 2015:

- Decreases transportation greenhouse gases by 20 %
- Saves $183 billion per year in trade deficit at a price of $100 per barrel oil
- Increased fuel efficiency saves 1.6 MBD oil, or $58 billion per year for $100/barrel oil
- Produces non-fossil fuels at $1.50 per gallon (in constant dollars)
- Achieves massive implementation of 20 % Renewable Energy Standard
- Stimulates the agriculture and biofuels business sectors
- Saves or creates nearly 2 million jobs
- Produces and sells at least 1 million hybrid electric vehicles
- Produces and sells at least 100,000 hydrogen fuel cell vehicles

Power Generation

The best science and technology show that there is no single "silver bullet" to solve the energy-climate crisis. It will require a combination of several clean, efficient energy sources. Each has its own possibilities and challenges – there is no free lunch! However, all are significantly safer, cheaper, and better for humanity than fossil fuels and nuclear power.

The following recommendations, in concert with those presented above, could lead to emissions-free energy generation by the year 2050:

■ Power generation accounts for 25% of our global CO_2 emissions. In 2009, through a combination of tax incentives, loan guarantees and guaranteed purchase incentives rapidly build and deploy wind and solar power energy plants. Both are significantly underestimated as to their potential positive impact and overall contribution to addressing energy security while mitigating climate change.

• Compared to modern coal combustion plants, which currently provide electricity at about 5 cents/kilowatt-hour (kWh), emissions-free photovoltaic solar power could achieve 8 cents/kWh within the next several years, and when manufacturing technology is optimized its costs on a large scale could be competitive with the cleanest coal plants.[13] Furthermore, solar and wind power are modular in design and therefore, unlike coal and nuclear plants, additional incremental capacity is readily added when needed. They are also much more amenable than coal and nuclear power to the construction and operation of small distributive power stations, a more efficient energy strategy than large, capital-intensive, central-generating facilities. These features have already been recognized through significant investments by credible Fortune 500 energy companies such as GE, BP, FPL Group, and Shell Oil.

• Tax incentives, loan guarantees and guaranteed purchase should also target the building of large scale photovoltaic systems, as well as Concentrated Solar Power (CSP) plants. CSP technology uses computer-controlled mirrors to focus the sun's rays on a circulating molten-salt heat-exchange system, which can generate clean electricity long after the sun sets. It currently costs 17 cents/kilowatt-hour (kWh), but is projected to fall rapidly to 8 cents/kilowatt-hour (kWh) with further commercial experience.[14]

• Increase tax incentives, loan guarantees and guaranteed purchase incentives for wind power. Currently, with modest tax incentives, wind power at 4 cents/kWh is competitive with electricity from coal, natural gas, and significantly cheaper and safer than nuclear power.

■ According to the U.S. Department of Energy, buildings account for approximately 50% of all greenhouse gas emissions and energy consumed in the U.S. About 76% of all power-plant-generated electricity is used to operate buildings. Therefore, in 2009, provide tax incentives and loan guarantees to convert old construction (commercial buildings and homes), and impose a legal requirement for new construction, to incorporate high-energy efficiency, using existing technologies.

■ By 2012, provide tax incentives, loan guarantees and guaranteed purchase incentives for the large scale manufacture of hydrogen fuel cells for small and medium size distributive power units that can power small towns, large buildings, industrial facilities, etc. Over the last decade, there have been numerous commercial examples of projects where fuel cells have provided reliable, high-quality, clean power for buildings and businesses.[15]

■ By 2010, establish an appropriate and fair carbon tax structure. Carbon cap and trading is politically attractive and in theory, driven by market forces. But a carbon tax is more effective and more immediate, leaving little room for unfair play and system manipulation.[16]

■ Require utility companies to develop a plan to upgrade the existing national power grid so it can be operated on a distributed generation, distributed use basis, which can provide a means of accessing excess consumer-generated power and moving distributed power where and when it is necessary. The future will be best served by a concerted transition from massive, large-scale power plants to small, efficient distributed generators, such as fuel cells, micro-turbines, cogeneration systems, wind turbines, solar energy generators, and the like. Like the internet, which is an efficient system for information and knowledge distribution, the grid will become an efficient system for energy distribution.

Tax incentives are critical and nations must take the long view so that investors do not hesitate to commit funds. If there are concerns about the use and viability of tax incentives as outlined above, we need only take a look at the petroleum industry, which is mature at well over 100 years old. The U.S. spends more than an estimated $20 billion per year to subsidize fossil fuels, and worldwide, the level is estimated at a staggering $200 billion per year; and these figures do not include the $50 billion per year that the U.S. spends on military operations in the Persian Gulf to ensure security of oil from the Middle East.[17] These figures also do not include the cost of the Iraqi War, which currently is more than $500 billion and estimated to be more than a few trillion dollars when all external cost factors are taken into account. What would a small percentage of these funds do for global sustainability if directed at commercializing clean, alternative energy systems?

We must also consider that future potential damage and devastation due to climate change and to a rapidly diminishing level of global energy security are nearly incalculable, although several respectable studies such as the Stern Report[18] have made good estimates. Stern and his colleagues found that if we continue with the status quo, resulting damages could ultimately absorb as much as 20 percent of our global GDP, whereas doing something now, such as the PROMETHEUS PLAN and its extension to 2050, could cost as little as 1 percent of our global GDP.

Addressing the interconnected crises of energy security and climate change presents humanity with the single most significant challenge since the birth of civilization. Interestingly, it also provides a once-in-all-generations opportunity to work together on a common critical problem, one that threatens our deepest most precious interests. Since thousands of well-informed scientists concur that these challenges are breathing down our neck, we might ask how much is it worth to us to do something truly meaningful? What kind of future do we want for ourselves,[19] our children and theirs, and theirs...? Think about it, but not too long, please, while there's still time for a reasonably happy ending.

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Figure 3: Honda recently began leasing its Fuel Cell car in California. It has a 270-mile range with an efficiency equivalent to 74 miles per gallon. Water is the only emission from its tailpipe.

[1] Parts I and II of this series outline the Global Energy Security Climate Change issues, respectively. See Prague Leaders Magazine, Nos. 1 & 2, 2008.
[2] Jerry B. Brown, Rinaldo S. Brutoco and James A. Cusumano, "Freedom From Mid-East Oil," World Business Academy Press, Ojai, California, 2007
[3] Organization of Petroleum Exporting Countries
[4] Jerry B. Brown, Rinaldo S. Brutoco, and James A. Cusumano, op. cit., see the Prometheus Plan and its extensions, Chapter 8.
[5] S. Pacala and R. Socolow, "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science, 13 August 2004, 968–72.
[6] Bio-butanol is a 4-carbon alcohol made by fermentation. Unlike 2-carbon ethanol it is more compatible with gasoline and has higher energy content.
[7] Algae-to-biodiesel – see for example, http://news.cnet.com/8301-11128_3-9933355-54.html.
[8] When biomass is gasified at high temperatures it can be converted into synthesis gas, a mixture of hydrogen and carbon monoxide. The later may then be converted over a catalyst by know technology to transportation fuels such as diesel fuel.
[9] Where possible, these units should be powered by alternative energy sources such as bio-diesel and fuel cells.
[10] BMW is just about to do a limited release of a hydrogen internal combustion engine powered automobile.
[11] E85 is 85% bio-ethanol + 15% gasoline
[12] B20 is 20% bio-diesel + 80% petro-diesel
[13] Jeffery D. Sachs, "Climate Change after Bali," Scientific American March 2008, p. 22
[14] Ibid.
[15] For example, in 1997, after losing millions of dollars in a single day, due to a power outage, First National Bank of Omaha, one of the largest credit card processors in the U.S., installed hydrogen fuel cells as their primary power source, and now maintain the grid as their backup source of power. This system has worked flawlessly for more than a decade.
[16] Jerry Brown, Rinaldo B. Brutoco and James A. Cusumano, op. cit., p. 145 for an analysis of carbon cap and trade versus carbon tax.
[17] "Boiling Point," Ross Gelbspan, Basic Books, 2004, p. 185.
[18] Nicholas Stern, "The Economics of Climate Change—The Stern Review," Cambridge University Press, 2007.
[19] Actuarial tables tell us that 70% of the people alive today will be alive in 2050.

About the Author: James A. Cusumano is Chairman and co-owner of Chateau Mcely (www.ChateauMcely.Com), chosen in 2007 by the European Union as the only "Green" 5-star luxury hotel in Central and Eastern Europe. He is a former Research Director for Exxon, and subsequently founded two public companies in California's Silicon Valley, one in clean energy generation, the other in pharmaceuticals manufacture via environmentally-benign, low-cost, catalytic technologies. While he was Chairman and CEO, the latter – Catalytica Pharmaceuticals, Inc. – grew in less than 5 years, to a $1 billion enterprise with 2,000 employees. He is co-author of "Freedom from Mid-East Oil," recently released by World Business Academy Press (www.WorldBusiness.Org) and can be reached at Jim@ChateauMcely.Com.

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