REVIEWS & RECONSIDERATIONS

The Methanol Alternative

Robert Zubrin

Any serious energy policy must deal with three critical issues. First, economic: The policy must provide an energy resource base sufficient to allow for continued worldwide economic growth for the foreseeable future. Second, environmental: The policy must be compatible with the long-term flourishing of life on Earth, including human life and civilization. And finally, strategic: The policy must ensure that control of the Earth's energy resources, and thus its future, lies in the hands of free societies committed to human progress, and taken away from tyrannical and terrorism-promoting states.

Beyond Oil and Gas: The Methanol Economy
By George A. Olah, Alain Goeppert, and G. K. Surya Prakash
Wiley-VCH ~ 2006 ~ 290 pp.
$29.95 (hardcover)

George Olah, recipient of the 1994 Nobel Prize in Chemistry, is one of the giants of twentieth-century science, and his coauthors are solid technical men. Together they have written a profoundly important book on energy policy, laying out the basis for a technically achievable approach to all three dimensions of the energy problem.

There is no shortage of energy experts with grand designs and proposals—from technophile dreams of an unworkable "hydrogen economy," to Malthusian calls for enforced economic limits through conservation, to socialist schemes for creating massive government-subsidized synthetic-fuel industries, to the libertarian faith in the Invisible Hand. Compared to such misguided alternatives, the competence and rationality of *The Methanol Economy* is refreshing.

The authors begin by describing the dimensions of the worldwide energy problem: Even as our reserves of fossil fuels have grown in recent decades, the demand is growing faster, and as more of the world modernizes, a global energy "crunch" looms. From here, they turn their attention to renewable energy sources and nuclear power, and then they offer a thorough

Copyright 2006. All rights reserved. See www.TheNewAtlantis.com for more information.

refutation of the technical feasibility of the "hydrogen economy." This widely-touted panacea cannot work because it takes more energy to produce hydrogen than it yields, because hydrogen is an excessively low-density medium for storing chemical energy, and because an entirely new multi-billion-dollar fuel distribution infrastructure would have to be created to support hydrogen vehicles before any could be sold.

The heart of the book outlines a proposed technical solution to the energy problem. The authors don't propose new ways of *generating* energy, arguing that "all feasible alternative and renewable energy sources must be considered and used," nuclear energy "above all." Instead, they focus on "the challenges of how to store and best use energy."

The authors dub their proposal the "methanol economy." Methanol is commonly known as "wood alcohol" because it can be produced from wood; it can also be made from coal, natural gas, methane hydrates, any type of biomass, or urban waste. It can be used as fuel for internal-combustion engines, and eventually in fuel-cell vehicles. It can also be used as feedstock for producing dimethyl ether, an excellent fuel for non-polluting diesel engines. In short, it is a convenient medium for storing energy and is easily transported and dispensed as a fuel.

Integrating methanol into our energy system would have numerous benefits in the not-so-distant future. As the authors point out, it would make the transportation of liquid natural gas much safer by converting it to less-hazardous liquid methanol before shipping it. Methanol could also be used to produce plastics, synthetic fabrics, and many other non-fuel products currently made from petroleum.

Importantly, methanol can also be produced (in conjunction with an auxiliary electricity source, like nuclear power) by chemically recycling carbon dioxide, which can be found naturally in the air or readily captured from atmosphere-polluting industrial emissions. The methanol produced can, in turn, be used to produce synthetic hydrocarbons and other products now obtained from fossil fuels. If successfully tapped, methanol "has the ability to liberate mankind from its dependence on fossil fuels for transportation and hydrocarbon products," while reducing the amount of carbon dioxide pumped into the atmosphere.

Consider ethanol as a comparison. The commercial competitiveness of ethanol is somewhat confused by the complex influences of a variety of subsidies and tariffs. By contrast, methanol is currently selling—*without any subsidy*—for about $0.80/gallon. Given that methanol's energy content is about half that of gasoline, that price is the equivalent, in energy

Copyright 2006. All rights reserved. See www.TheNewAtlantis.com for more information.

terms, of gasoline for $1.60/gallon. In other words, we can produce a useful and economically viable vehicle fuel, using a huge domestic and Western hemispheric resource base, at prices lower than gasoline.

So if the economic and strategic questions can be answered, that leaves the matter of methanol and the environment. The authors deal with environmental concerns in a cool, thorough, and methodical fashion. Unlike ethanol, which is edible, methanol is toxic—but so is gasoline. However, unlike gasoline or petroleum, methanol is soluble in water and readily biodegradable by common bacteria, so spills of methanol, whether from defective pumping stations or shipwrecked tankers, would have no long-term environmental impact. Furthermore, as the authors demonstrate, the toxicity of methanol is commonly overstated. In point of fact, methanol is present naturally in fresh fruit, and so low doses of methanol have always been a normal part of the human diet. Unlike gasoline, methanol is not a carcinogen or a mutagen, and the pollutants and other emissions from methanol-powered internal combustion engines are far more benign than emissions from their gasoline-driven counterparts. (Automobile emissions could even be reduced to zero with methanol-based fuel cells.) And if methanol is produced from carbon dioxide or from biomass, its use in place of petroleum acts to counter man-made global warming as well. "Compared to gasoline or diesel fuel," the authors conclude, "methanol is clearly environmentally much safer and less toxic."

The book's greatest shortcoming is in its policy recommendations. It has none. While describing the technological basis for a future world of progress, freedom, economic development, and an acceptable environment, the authors offer no plan for how to make it happen. Given the highly technical and scientific orientation of the authors, this is perhaps understandable, but it is unfortunate.

Indeed, by focusing on the best technical solution without regard to policy implications, the authors sail past essential matters without stopping to seize them. This is most evident on the subject of Flexible Fuel Vehicles (FFVs), automobiles that can operate with gasoline and/or various mixtures of gasoline and alcohol. The most common FFVs in the United States are E85 or M85, meaning that they can function with up to 85 percent ethanol or methanol and 15 percent gasoline. On the subject of FFVs, Olah and his colleagues say:

> Although the flexibility of the FFVs represent a powerful means to circumvent the fuel supply conundrum, and also a way to build up the demand for methanol, it must be borne in mind that this is only a compromise....

Copyright 2006. All rights reserved. See www.TheNewAtlantis.com for more information.

> In the long term, the use of cars optimized to run only on methanol (M100) would be preferable, and would also greatly facilitate the transition to methanol-powered fuel cell vehicles.

Yet without the short term, there is no long term. The authors are correct that, in the abstract, "cars optimized to run only on methanol" would be preferable. But such cars would find no buyers today—because there are no pumps to fuel them, nor will there be, until millions of such cars are on the road. Thus the FFVs, which can run on a combination of gasoline, methanol, and/or ethanol, are not "only a compromise." Rather, they are the key transitional technology that can make the methanol economy a reality.

Manufacturing a car as an FFV requires only the use of a corrosion-resistant fuel line and a change in the programming of the chip controlling the car's electronic fuel injector. Thus FFVs can be produced—and currently *are* being produced in two dozen models, amounting to about 3 percent of total automobile sales in the United States—with essentially no price differential between them and comparable models that only use gasoline. As a result, there is no downside to making flex-fuel capability the standard. If it were required that *all* new cars sold in the United States had to be FFVs, there would be 50 million automobiles capable of burning methanol on the road in the U.S. within three years. Under such conditions, with methanol producible for a fraction of the cost of gasoline, the methanol pumps would appear soon enough, and the methanol economy envisioned by Olah and his collaborators would soon follow.

But one should not complain too much about the book's omissions, since it maps out a viable technical approach for addressing our energy problems. They have shown us where to go; now it is time for policymakers to help get us there.

Robert Zubrin*, an aerospace engineer, is president of Pioneer Astronautics, a research and development firm.*

Copyright 2006. All rights reserved. See www.TheNewAtlantis.com for more information.