**SUMMARY AND CRITIQUE OF JIM OHI’S “EHANCING STRATEGIC MANAGEMENT OF THE HYDROGEN OPTION: SCENARIO PLANNING BY THE DOE HYDROGEN TECHNICAL PANEL” WITH EMPHASIS ON THE “BRAVE CLEAN WORLD APPROACH”**

NPRE 470A

Homework Problem 1-1

In his 2001 paper “Enhancing strategic management of the hydrogen option: scenario planning by the DOE hydrogen technical advisory panel”, Jim Ohi defines four scenarios for deployment of the hydrogen economy: New War, Old Weapons (Quadrant A), Brave, Clean World (Quadrant B), Hydrogen Genie (Quadrant C), and Hydrogen in a Bottle (Quadrant D). Ohi plots these strategies on a grid, with the y-axis being the level of social activism and concern and the x-axis being the rate of hydrogen technology development as shown below:



For the “Brave, Clean World” (BCW), Ohi lists the end-state of this scenario less explicitly than he does “New War, Old Weapons”. Based on Ohi’s grid, BCW should share the end-state technological goals of his “Hydrogen Genie” scenario:



Notice that Ohi’s table is focused on road transportation. Perhaps Ohi assumes that achieving the carbon neutral and hydrogen economy implies achievement of the same for stationary, electrical, and other portable energy needs. For my discussion I would like to make some changes to Ohi’s table 1) substitute “less-depletable” for “renewable” (this allows the nuclear option), 2) set hydrogen costs to a less ambitious 10% higher than petroleum fuels, and 3) in 2050, we may want to be back to applying excise taxes for highway infrastructure support, even for carbon neutral fuels.

Brave, Clean World (BCW) is further characterized by a high level of social concern and activism, perhaps the most difficult part of BCW to maintain and achieve, yet something necessary to achieve BCW.

The justification for such aggressive goals, policy, and actions can best be summarized as follows:

Growing global energy consumption cannot be met with existing fuels and energy technology.

Achievement of such goals cannot be met with current levels of social concern and activism

Low-cost fossil fuel reserves are being depleted. Domestic crude oil reserves and natural gas reserves cannot supply our (United States) current needs. Existing wind, solar, and bio-fuel technology cannot cost-effectively meet our future needs.

The oil and natural gas we import often comes or must be transported through politically unstable regions. Solar, wind, bio-fuels, and geo-thermal offer domestic supplies plus limiting our imports to more stable regions.

The required R&D effort cannot be met in time without tax incentives and government funded R&D. Without carbon taxes and other incentives and regulations, energy consumers will not choose carbon neutral, less depletable energy.

Most importantly, to avoid the high costs and damages due to climate change, we need to immediately begin reducing emission of greenhouse gases into the atmosphere. By 2050, we need for such emissions to be negligible. Even with such immediate reductions in emissions, most climate researchers think that we will see at least see a 2 degree rise in average global temperature in this century.

If one accepts that carbon emission reduction takes large priority over energy security and other justifications for BCW, one should start with the following policies, not limited to just the hydrogen economy:

Immediate implementation of a carbon tax. This tax would start low and gradually increase. Hopefully within ten to twenty years tax-free carbon-neutral fuels would be competitive with taxed carbon fuels. Monies from the carbon tax can be used to fund clean energy research and to offset lost revenues from tax credits and other incentives.

Adopt tax incentives and grants for energy consumers to adopt more energy efficient technologies and adopt carbon-neutral energy sources. Tax credits and deductions for items like home insulation, energy efficient windows, and energy efficient appliances have existed on and off since the 1970s. Such incentives could be extended to items like hybrid cars, hydrogen-powered cars, or other non-carbon fueled cars. Comparable credits can also be offered for commercial and industrial adaptation of clean energy, like power plants replacing carbon fueled technology with wind, solar, or geothermal or an office building installing a partial solar heating system.

Incentives for private sector research: Tax credits and broader tax deductions for research in improved energy efficiency clean carbon-neutral energy sources, and less depletable energy sources. Consider liberalized tax credits and deductions for corporations and individuals that donate money to universities and not-for-profit institutes doing research in energy conservation and clean energy production.

Government funded research: With BCW, this means multiple Manhattan-type projects covering a broad spectrum and many aspects (production, storage, and distribution) of energy technologies, with specific goals. An example: develop by 2030 a method of hydrogen production using solar energy that provides hydrogen at production site for $3.00 (2010 dollars) gallon gasoline equivalent (gge).

Specifically, for hydrogen, this includes:

Creation of uniform national standards for the safe use, storage, and distribution of hydrogen.

We need to avoid the quagmire of numerous state and local standards. Such national standards should pay close attention to standards adopted in other countries. This can gain international economy of scales for hydrogen and other clean-energy technology. Such standards should also be “technology flexible”, to permit deployment of new technologies as they become available.

Development of the cheapest possible technologies for the carbon-neutral production, storage, distribution, and utilization of hydrogen.

As mentioned earlier, this could mean exploring multiple technology alternatives in multiple Manhattan-style projects with target dates and cost goals.

The DOE has often used gallon gasoline equivalent (gge) in setting costs for use of hydrogen in motor vehicles. Similar “equivalents” can be created for electricity, heating, etc.

Additional details on types of projects, their goals and deadlines, may be found in part 2 (Problem 1-2) of this assignment.

Research and development in the above list, will be a combination of government funded research plus private research efforts encouraged by previously mentioned tax incentives. Adoption of hydrogen and other clean energy technology by energy consumers will rely primarily on taxation of non-carbon neutral energy plus some grants and tax-incentives. Additional support for consumer adaptation can come from heightened public awareness of the need for clean, less depletable energy plus regulations aimed at curtailing carbon based energy.

The more difficult task for Brave, Clean World (BCW) is developing the high level of social concern and activism demanded by this scenario. We need to address the problem of science illiteracy in the United States. This is not just a problem in terms of funding science education; it is a problem that percolates throughout the American and many other cultures. This is a problem that manifests itself in, and also rooted in, the widespread belief among Americans in religion, “alternative” medicine, folk technologies, quick fixes, fads, astrology, and being “popular” instead of substantive. **Some** policies that may help in this arena:

Raising standards for secondary level high school educators. High-school level teachers need up-to-date knowledge on the subjects they teach beyond that of the courses they teach.

Requiring at least three years of science in secondary school.

Increasing the level of science literacy in primary school teachers. Require more science education and literacy for elementary teacher certification. Provide workshops for better training in science for primary school teachers

Require practicing teachers at all levels to attend and complete workshops that keep their science knowledge up-to-date and understand just what science is and what valid science is.

This may mean setting federal standards for teachers and schools. This probably means expanding federal financial support for teacher training and education.

These goals will take some years to achieve; else we would create a severe shortage of school teachers and increased level of people failing to finish high-school. This also treks into the sensitive area of religion-related schools and teacher and student religious beliefs.

Interested public and private parties should organize and support, for the general public, workshops, presentations, public awareness campaigns and other media not only with regard to scientific content, but also with regard to just what science is and what is valid science. I discuss this more in part 2 (Problem1-2) of this assignment.

Unfortunately, for students, such goals often fall into the “you can lead a horse to the trough, but he may not choose to drink” issue.

Predicting when we can accomplish these goals with this or any scenario is iffy. In this essay I have used Ohi’s date of 2050. Breakthroughs can happen, but are unpredictable. Solar cells and collectors, and hydrogen fuel cells have been around for over a century. They are getting cheaper, but they are still more expensive in terms of both capital and operating costs than fossil fuel power. The hope with the aggressive “Brave, Clean World” approach is that with government funding, regulation, and incentives we can accelerate the delivery date for clean, carbon-neutral energy technology.

In Part 2 (Problem 1-2) of this assignment, we examine the DOE time-frames regarding the hydrogen economy. These time-frames have consistently been moved to latter dates. “Brave, clean world” is still a decades long approach. Such commitments in American politics are rare. Sadly, the longest American commitment in the twentieth century was to the “Cold War”. Despite the fall of the Soviet Union residual threat from Russia’s nuclear arsenal still remains and Cold War fears have now been replaced by the fear of international terrorism and economic uncertainty. I used the metaphor of the Manhattan project in this essay. Other government success stories include the entirety of World War II itself, the interstate highway system and the Apollo project. The interstate highway system was less ambitious, and did not involve much in the way of “not there” technology. World War II, including its collateral technological developments, was done in the context of a threat very visible to rank-and-file Americans with a commitment of less than five years. The decade plus long Apollo project was done in the context of the cold-war and focused on the delivery of a few space vehicles to take a few men to the moon at great expense and safety well below accepted workplace and household norms. The Manhattan project, done in the shadow of World War II, involved the delivery of a small number of two versions of one product: the atom bomb. Again, a high unit cost was acceptable.

Brave, Clean World involves providing mass quantities of carbon-neutral less depletable energy at a unit cost competitive with today’s carbon-based sources with technology that does not yet exist. Its achievement requires multiple Manhattan like projects. Climate-change may be too gradual for it to ever invoke much concern in the public. Climbing energy-prices may be the best alert to the public about the need for alternative energy. Abrupt price increases have generated the most concern. Otherwise, the issues of climate change and the need for alternative energy sources are not as visible to the public as are the needs of a war. For the United States, an aggressive “Brave Clean World” technology will be a difficult sell and commitment in these times of large state and federal budget deficits, distrust of regulations, distrust of politicians and business leaders, and general science illiteracy. Forty years may even be an optimistic time frame. Perhaps this is why Ohi did not give BCW much attention in his paper.

**REFERENCES**

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