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Cal Tech's Observations On Hydrogen Leakage

After reviewing the excellent paper "Potential Environmental Impact of a Hydrogen Economy on the Stratosphere," published in *Science* (June 13, 2003) by four Cal Tech researchers, Harry Braun has made the following observations:

1. Given that stratospheric ozone depletion is one of the most serious environmental problems, the observations of the Cal Tech researchers deserve serious analysis and peer-review by other atmospheric chemists and scientists. However, as the Cal Tech investigators point out in their paper, the primary factor impacting stratospheric ozone depletion is release of anthropogenic (i.e., man-made) chlorofluorcarbon molecules, not molecular hydrogen.

2. The Cal Tech researchers assumed that with a 10 or 20 percent leakage of hydrogen, it could increase the amount of molecular hydrogen in the stratosphere by a factor of 2 or 3. This could then increase the amount of water in the stratosphere, which could then cool the lower stratosphere, which could then slow the recovery of the stratospheric ozone levels as chlorofluorcarbon emissions are reduced.

3. It is reasonable to assume a 10 to 20 percent leakage of hydrocarbon fuels like gasoline because there is no air-tight seal on gasoline pumps that prevents the fumes from escaping into the atmosphere. Hydrogen pumps, by contrast, must utilize an air-tight seal that prevents any serious amounts of the hydrogen from escaping during refueling. The Cal Tech researchers acknowledge this point in their paper when they state much more research needs to be done on determining what the actual hydrogen emissions will be, and that with proper engineering specifications, such emissions could be reduced to negligible levels.

4. The Cal Tech researchers also point out in their paper that any increase in molecular hydrogen may never even reach the stratosphere because the dominate hydrogen sink on the earth is the earth itself, which absorbs molecular hydrogen like a sponge. Although it is known that hydrogen is an important microbial nutrient, the Cal Tech researchers acknowledge that the molecular mechanisms involved in this hydrogen uptake in soils are poorly understood, and that this absorption process alone could entirely compensate for any increased amounts of hydrogen generated from future anthropogenic sources.

5. The Cal Tech investigators acknowledge that much is still unknown about the global "hydrogen cycle" -- but one thing that is known is that every green plant on the earth is a solar hydrogen machine, and this hydrogen energy system has been successfully operating life on the earth for over 3.5 billion years -- without doing any damaging the stratospheric ozone layer. Indeed, the formation of the stratospheric ozone layer was the direct result of photosynthetic hydrogen production processes that released large amounts of free oxygen into the atmosphere that was needed to form the stratospheric ozone layer in the first place.

6. While the Cal Tech observations deserve careful consideration, they are far too speculative to be used as a basis maintaining the human communities addiction to fossil and nuclear fuels that have much more profound environmental and supply problems. The solar hydrogen energy system, by contrast, has been successfully used by the earth's microbes and protein-scale nanobes on a global-scale for the past 3.5 billion years -- with no pollution or depletion of natural resources. Given this impressive track record, the solar hydrogen energy system is the only energy option that has been proven to be both inexhaustible and completely compatible with the earth's biological life-support systems.