Hydrogen and Fuel Cells:

Essential Components of the "New Energy Economy"

Hydrogen has a remarkable ability to integrate all the elements of the "New Energy Economy." Hydrogen enables continuous use of energy from intermittent renewables; it can replace oil and natural gas in many applications; it can be produced using a wide variety of energy resources; and, as a recent landmark National Academy analysis[1] has shown, it is vitally important in reducing CO_2 emissions and eliminating our dependence on foreign oil.

U.S. leadership in the commercial application of clean hydrogen technology will strengthen our economy and create large numbers of high quality "Green Jobs."[2] Other nations are aggressively pursuing hydrogen and fuel cell technologies; we need to act quickly to *ensure a U.S. leadership position.* Fuel cell technology in vehicle applications, for example, can help rejuvenate and transform our automobile industry and create many hundreds of thousands of "Green Collar Jobs."

Hydrogen is a widely used commodity in our economy today. Hydrogen is used in making gasoline and diesel fuel, food products, chemicals, semiconductors, metals, and more. It is safely transported by pipelines and trucks all around the nation every day.

Fuel cell forklifts are safely moving goods in airports and distribution centers across America.

This hydrogen fueling station in Oakland, CA fuels both buses and autos.

Hydrogen can become a valuable green energy carrier, complementing green electricity. Producing hydrogen offers an important way to store electric energy generated from intermittent renewable sources such as solar and wind, so the energy can be used later in a variety of applications. It is an enabling technology for renewable energy.

We can domestically produce all the hydrogen we need in a number of ways. Hydrogen can be produced from natural gas, from biomass, from coal with sequestration, and by electrolysis of water with electricity generated from nuclear and renewables. DOE and industry agree hydrogen can be produced and delivered today by distributed natural gas reforming at a cost of $3.00/gallon of gasoline equivalent. Given the high efficiency of fuel cells, that translates to a cost of $1.50/gallon of gasoline on a per mile driven basis for the consumer (see the recent National Academy report[1] for details).

We can use hydrogen either in clean, efficient fuel cells, or wherever oil and natural gas are currently used. Hydrogen fuel cells produce electricity and heat with high efficiency and zero emissions; the only output is pure water. Burning hydrogen instead of fossil fuels in engines, burners, turbines, and furnaces eliminates CO_2 emissions and reduces other emissions.

By using hydrogen and fuel cells in light vehicles we can reduce the fleet's gasoline consumption to nearly zero by 2050 and reduce the CO_2 the fleet generates by 85% from current levels.[1] Hydrogen and fuel cells are clearly key elements of the nation's strategy to cut CO_2 emissions to 80% below 1990 levels by 2050 and secure our energy independence. But we must continue to invest in technology development and begin the commercial deployment of hydrogen vehicles no later than 2015 in order to reach the target CO_2 reduction by 2050 (again see the National Academy report[1]). Similar positive impacts on energy security and climate can be achieved by using hydrogen and fuel cells in other transportation and stationary power applications.

Hydrogen and fuel cell technology is safe and ready for commercial use today. Hydrogen and fuel cells are already being used in special applications: buses and small fleets of cars, back-up power, forklifts, and soon in cell phones and laptops. A broad-based public education program on the benefits and safety of hydrogen applications will help speed the transition to widespread use of hydrogen as an energy carrier.

Huge technical strides have been made over the last few years as a result of both DOE and industry sponsored research, development and demonstration, dramatically reducing earlier barriers to commercialization. While work to lower costs and improve durability continues, today's fuel cell vehicles have largely overcome range and performance barriers and are at least two times more efficient than gasoline cars. Nine automakers have recently toured their latest pre-commercial hydrogen vehicles to 31 cities in 18 states across the country as part of the **Hydrogen Road Tour**. The response from people who saw and drove these hydrogen/fuel cell cars was extraordinarily positive. This is *today's* technology, not some future dream.

But to get hydrogen and fuel cells into millions of cars will cost more than industry alone can afford – substantial and durable government incentives are needed, along with active coordination. The National Academy report[1] estimated the government price tag at $55 billion over a 15 year period (until the whole hydrogen vehicle/infrastructure system becomes cash flow positive in 2023) – less than government has committed to several other energy options. Importantly, the National Academy report estimated that the government's share of infrastructure costs would be only $8 billion of that total – suggesting that building out the needed hydrogen infrastructure is not as challenging a hurdle as some had believed.

The Hydrogen and Fuel Cell Technical Advisory Committee[3] urges national leaders to put a high priority on bringing hydrogen and fuel cells into full commercial use. This clean energy technology must be a critical part of the "New Energy Economy" that will become a legacy of our time.

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[1] *Transitions to Alternative Transportation Technologies—A Focus on Hydrogen*, National Academy of Sciences, National Research Council, Committee on Assessment of Resource Needs for Fuel Cell and Hydrogen Technologies, July 2008. Available from the National Academies Press: http://www.nap.edu.

[2] In July 2008, the U.S. Department of Energy published a report titled *The Effects of a Transition to a Hydrogen Economy on Employment in the United States*. The study estimated that up to 675,000 new jobs could be generated by 2050. The report is available at http://www.hydrogen.energy.gov/pdfs/epact1820_employment_study.pdf.

[3] The **Hydrogen and Fuel Cell Technical Advisory Committee (HTAC)** was created by Congress in the Energy Policy Act of 2005. The Committee has adopted a **Vision Statement** that may help guide decision makers as they consider the options for the nation's energy future:

> Our vision of the future is that hydrogen will become a universal and economically competitive energy carrier, progressively substituting for carbon-based fuels over time, to meet the needs of the planet. Hydrogen will be produced from a number of sources, increasingly with the lowest possible carbon impact. To realize this vision, the nation must aggressively bring to the market the hydrogen-based technologies that are available now and those that will be developed in the future. HTAC's role is to aid the nation in developing a policy framework that takes into account the technical, political, social, cultural, environmental and commercial requirements for the hydrogen transition.