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On The Road to Hydrogen: Policy Priorities

By the
National Hydrogen Association

The National Hydrogen Association is an industry trade association of more than 70 companies and organizations whose mission is to foster the development and use of hydrogen technologies and to promote the use of hydrogen as an energy carrier. This paper addresses needs, pathways and policies that the NHA feels are important to meeting this mission.

Drivers to Hydrogen

The primary drivers in the U.S. today for moving toward a hydrogen energy future are:

- National Energy Security
- Environmental Stewardship
- Economic Prosperity

The U.S. oil gap continues to grow. The *Transportation Energy Data Book, Edition 21* (Sept. 2001), and the *EIA Annual Energy Outlook* (2002) project declining U.S. oil production, and increasing demand. Projections based on current trends indicate that as much as 70% of the oil consumed by the U.S. will come from imports by 2025. With hydrogen made from a broad array of domestically available sources this will help to diversify our primary energy sources.

Distributed energy resources, such as turbines, advanced gensets and fuel cells, provide opportunities to meet increased power needs without increased transmission infrastructure. These systems can operate independently of the grid and when these systems are operated on hydrogen and/or hydrogen blended fuels, significant reductions in urban air pollution and carbon dioxide emissions will be realized. The

hydrogen powered car also offers the possibility for emissions free and greenhouse gas free transportation. Hydrogen offers a strategic opportunity to meet increasing U.S. energy needs in a highly efficient way without increasing greenhouse gas emissions.

A transition to hydrogen energy systems will facilitate economic growth by reducing our dependence on oil from volatile regions, by reducing our foreign trade balance, by reducing the magnitude of oil price swings while at the same time increasing domestic economic activity. The U.S. has a leadership position in hydrogen manufacturing capability and in advanced hydrogen technology development which can be leveraged into a continuing worldwide leadership position.

The U.S. is well positioned to transition from oil and gas as primary energy carriers to hydrogen. Hydrogen will then be the principal energy carrier, along with electricity, that will be used in all sectors of society and generated from all available feed stocks. The members of the National Hydrogen Association are among the major industries dedicated to creating a hydrogen energy infrastructure, including several major multinational energy suppliers. The NHA, with technical expertise from members including NASA and the industrial gas suppliers with decades of experience supplying and using hydrogen safely, is working hard on developing the safety codes and standards that will enable the hydrogen infrastructure.

The Role of the NHA

A transition to a future hydrogen energy economy requires commitment from many stakeholders, including energy companies, industrial gas suppliers, automotive manufacturers, technology manufacturers, government organizations, universities, and research organizations. The membership of the NHA encompasses each of these

stakeholders which have made a commitment to hydrogen. The strength of the National Hydrogen Association stems from the diversity of its membership and draws upon the expertise of these leading organizations in hydrogen safety, production, storage, distribution, and utilization. This diverse membership enables the NHA to maintain objectivity in our role and commitment to a transition to a hydrogen economy.

The National Hydrogen Association is a natural forum for building consensus, developing viable pathways to a hydrogen economy, act as a catalyst in the development of consensus codes and standards, advocating partnerships, advising government agencies on policies and demonstrations, offering guidance on R&D programs to achieve certain technical objectives, and serving as a clearinghouse for educational information.

NHA Commitment and Proposition

The members of the National Hydrogen Association propose that Congress and the Administration implement a much broader and much more intense Hydrogen Program than exists today. The goal would be to support private sector development and demonstration of every aspect of hydrogen infrastructure and use.

The National Hydrogen Association will work with the government and other groups to organize and coordinate the hydrogen program team. The NHA can act as a point of contact and central facilitator to develop teams to carry out the activities of this program. The NHA can host meetings and workshops to provide a comprehensive view of the technologies and challenges. The organization can work on an educational level, to explain the value and importance of the activities in the program to policymakers, partnering agencies, and American citizens.

In the coming decade, the National Hydrogen Association will continue to share its vision of a world powered by clean, inexhaustible energy sources — through hydrogen. This vision,

which represents a commitment by the organizations represented by the National Hydrogen Association, can help shape national and international energy policy, thus paving the way to a global hydrogen economy.

Transition to a Hydrogen Future

The NHA recognizes the important role of domestic fossil fuel resources including coal, gasoline, natural gas and diesel to transition to a hydrogen economy. In the near-term, a significant portion of hydrogen will be produced from fossil fuel feedstocks. The NHA supports further technological development for these processes aimed at reducing the cost of hydrogen and reducing or eliminating the environmental effects from these methods.

The NHA also supports technological and economic development of renewable energy technologies, and envisions a growing portion of future hydrogen production to come from renewables. The end point would be a diverse portfolio of hydrogen generation technologies and feedstocks, with as much hydrogen production from renewables as is practical. Longer-term continuation of fossil fuel feedstock and even nuclear production of hydrogen are possible if the environmental damage and security issues from these methods could be eliminated or sufficiently mitigated. Ultimately, society and the market will determine the energy mix consistent with its resources, social structure, population, economy, and environmental requirements.

Production & Uses

Technologies are available today for the safe production, storage, and utilization of hydrogen energy. There are, however, certain technical breakthroughs necessary for hydrogen to live up to its full potential. These breakthroughs would enable hydrogen energy to compete economically with technologies operating on conventional fuels. Breakthrough areas include:

- Efficient, economical, renewable energy production;
- High density, on-board storage technologies for transportation applications;
- Higher efficiencies in electrolysis of water; and
- Technologies to reduce the environmental effects of other methods for hydrogen production, such as

carbon sequestration from fossil fuels, and hazardous materials and security issues associated with nuclear energy.

Hydrogen energy technologies are not limited to fuel cells. They also include reciprocating internal combustion engines, turbines, electrolyzers, and other technologies that use or produce hydrogen. Hydrogen's unique properties enable more efficient and environmentally benign application of conventional technologies as well as enabling advanced emerging fuel cell technologies. Applications for hydrogen energy systems include:

- **Portable Power.** Portable power provides significant opportunities for early product introductions into smaller markets. Portable power applications generally tolerate higher energy costs for convenience. Portable markets will decrease the cost of hydrogen technologies for other applications.
- **Stationary/Distributed Power.** Hydrogen can play a role in the generation of electricity on-site, at or near the point of use and at fixed power plants. Distributed power applications provide near-term market opportunities. Stationary power markets are mid-term opportunities for hydrogen and offer increased efficiencies to the grid. Stationary power provides the largest opportunity for CO₂ reductions, along with the reduction or elimination of other greenhouse gases. This is especially true if the stationary power generator is used for combined heat and power (CHP). CHP systems have the potential to substantially increase the efficiency of distributed power generators.

In remote locations without an electrical grid, electricity from solar, wind, tidal, and other renewable sources can be used increasingly in a sustainable world. These sources of electricity are often intermittent and need an energy storage system to meet peak power requirements. Hydrogen produced from off-peak or surplus power

can be used to store energy for delivery—as electricity—when needed. Hydrogen can be used to supply electricity to each home and business by locally sited power plants, such as hydrogen-fueled microturbines, reciprocating engines, or fuel cells, which provide the electricity as well as space heating, with no air or water pollution, in a quiet, unobtrusive manner.

- **Transportation Fuel.** There is strong and growing interest in using hydrogen as a transportation fuel. With the market price of transportation fuels being higher than the market price for other applications this offers a unique opportunity for hydrogen to become cost competitive with conventional fuels. The NHA believes a thrust in the area of transportation will provide the largest, long term opportunity for commercial application of hydrogen energy technologies and contribute to the creation of a hydrogen energy infrastructure. Automobiles provide the best opportunity to engage the public now in the benefits and reasons to move toward hydrogen energy. Buses and fleets, however, can provide an even earlier market, with fewer infrastructure considerations through use of centralized refueling and should be a central part of near term programs.

Commercialization

Hydrogen energy technologies are commercially available today in niche applications, such as space propulsion, power systems, and industrial applications where their unique benefits bring special value. However, using these technologies in early products employing hydrogen as an energy carrier requires economic support to make them commercially viable and affordable.

The National Hydrogen Association believes that the path to commercialization of hydrogen energy systems will be most successful by working together in an industry/government partnership. Neither group can succeed alone. Both have unique strengths.

Industry has the expertise and financial resources to bring new products to the marketplace. But industry must respect the bottom line and the demands of its stockholders to provide short-term return on investment. Industry cannot

finance long-term societal goals such as clean air and reduced dependence on foreign oil.

Conversely, governments do have the resources and responsibility to encourage new technology for the marketplace. Governments have the sole charter to "protect the commons" — in this case, energy security and the environment. Government alone has the long-term staying power and the mission, acting on behalf of all citizens collectively, to develop and promote new technology and new policies that will achieve societal objectives. Working together, government can provide the seed money and regulatory environment to start the process, and industry can provide the marketplace savvy and the large capital investment, once the hydrogen technology development comes within industrial planning horizon time scales.

Economically competitive applications are needed for fuel cells to meet cost and performance targets. When fuel cell technology is mature, it will be able to produce high value power, to improve reliability, power transportation vehicles, and improve communications with applications such as relay stations, personal computers, and cellular telephones. Most importantly, fuel cells offer the possibility of higher energy efficiencies than conventional technologies.

A transition to the hydrogen energy future can begin prior to high volume commercial adoption of the fuel cell. Hydrogen can be used today in fuel cells for backup power applications, reciprocating internal combustion engines for vehicles, as well as turbines and microturbines. Exploiting the unique properties of hydrogen, conventional devices fueled on hydrogen can be designed to be zero or near-zero-emission technologies. The near-term commercialization of hydrogen internal combustion engine vehicles and hydrogen/natural gas or hydrogen/electric hybrids allow a platform for hydrogen energy technology commercialization. This can facilitate public acceptance of hydrogen and provide the beginning of a hydrogen infrastructure. As fuel cell technology development continues, it can find its place faster with a hydrogen infrastructure in place.

Critical Pathways

In addition to the technological breakthroughs mentioned above the National Hydrogen Association believes these other critical pathways are necessary to create knowledge to meet the objectives of transitioning to a hydrogen energy future.

- **Systems Analysis Coordination.** Both the automotive and fuel supply industries have to be concerned with their bottom lines as well as with the environment or oil imports, so the government needs to separately evaluate the societal impact of these hydrogen transportation market penetration scenarios. Hence the need for a coordinated systems analysis encompassing all three entities: vehicles, fuel supply, and society.
- **Hydrogen Use by the Federal Government.** The federal government can and should procure hydrogen energy systems for its own needs. This includes fleet vehicles with hydrogen refueling as well as stationary/distributed power systems for buildings and mobile power applications. Federal use of hydrogen energy technologies provides high visibility for these technologies and an opportunity to educate the public about the benefits of hydrogen.
- **Safety, Handling, and Utilization.** RD&D should be conducted for safety, handling, and utilization of hydrogen fuel by the public and these lessons must be incorporated into the developing codes, standards, and regulations. Safety must be a consideration across the board. The need for safety-related activities is urgent, which is why the NHA is leading the timely development of codes and standards. Participation by permitting agencies and the insurance industry is urged, along with equipment testing programs. The federal government must provide implementation training and barrier reduction downward to local/regional government. The NHA will work with government to develop programs for training and barrier reduction.

- **Coordination of Federal Hydrogen Efforts.** To focus and coordinate federal hydrogen efforts, creation of an Interagency Hydrogen Task Force is urged, with participation by the U.S. Departments of Energy, Transportation, Defense, and Commerce; the U.S. Environmental Protection Agency; the Department of Homeland Security, the National Aeronautics and Space Administration; the National Science Foundation, and the National Park Service. The NHA encourages an Administration mandate to promote the use of hydrogen within agencies in order to assist in the development of hydrogen-related business.
- **Important Role of Education and Information Dissemination.** At the international, national, state, and local levels, efforts should be initiated to encourage strong community programs to develop, to serve market development needs, and to increase the understanding of all stakeholders. Databases and previous research results should be made available as broadly as possible to promote transfer of knowledge, broaden the research experience, and introduce new ways of thinking to established research organizations. It should be recognized that education is a continuum that stretches from creating knowledge to educating in schools, training workers, educating policymakers, and informing the public.
- **Need For Demonstration Projects.** The NHA supports demonstration activities to achieve the goals of transitioning towards a hydrogen economy in stationary and transportation markets and to help understand and develop the hydrogen infrastructure. Demonstration projects, jointly funded by government and industry partnerships, should begin as soon as possible and practical and should be operational in a variety of applications and environments across the United States. The

NHA supports a full and open competition that encourages partnerships, results in a wide range of demonstration parameters, requires safety analysis, and provides a broad array of high-profile educational and information dissemination opportunities.

Hydrogen Policy

The NHA applauds the Department of Energy's National Hydrogen Energy Roadmap. The Roadmap, developed in 2002, is a well-balanced plan with an intelligent transition strategy first relying on conventional feedstocks and optimized hydrogen-fueled conventional conversion devices to pave the way for the introduction of the fuel cell.

The NHA supports the President's Hydrogen Fuel Initiative, announced in his State of the Union address on January 28. This initiative will go a long way toward creating the infrastructure necessary for clean transportation using domestically-produced hydrogen.

The NHA recognizes the need for economic incentives, including tax policies, at the appropriate point in the technology development and early commercialization. The NHA advocates increasing incentives as technologies—such as hydrogen powered near-zero emission vehicles and zero-emission vehicles (ZEVs)—become available for buyers. The NHA advocates incentives (rather than mandates, requirements, or regulations) to accelerate market penetration. This includes voluntary emission credit trading schemes to begin to manage greenhouse gas emissions.

The NHA also supports economic incentives and initiatives involving use of hydrogen for stationary power, portable power, and transportation. The organization pledges to work to make all these visions a reality.