Address

by

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at

Ministerial Meeting

of

International Partnership for a Hydrogen Economy (IPHE)

at

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I would like to begin by quoting Jules Verne from his 1876 Mysterious Island wherein he says and I quote "I believe that water one day will be employed as fuel, that hydrogen and oxygen, which constitute it, used singly or together, will furnish an inexhaustible source of heat and light of an intensity of which coal is not capable…." end quote. He goes on to say and I quote " water will be coal of the future" … end quote.

Those prophetic pronouncements are upon us with the 21st century being termed as the Hydrogen Century. Based on current road maps developed by its votaries, Hydrogen could become the world's leading energy carrier by 2040 with commercial transport and utility applications, and the necessary supply infrastructure, beginning to take root as early as 2020. The de-carbonization of energy systems has evolved from the 10:1 carbon-to-hydrogen ratio of wood to 1:4 in the case of natural gas. Hydrogen shall complete this journey, as it contains no carbon.

Serious concerns relating to energy security, depleting fossil fuel reserves, green house gas emissions and air quality are driving this transformation effort. There is a sense of urgency today to find alternative energy sources, as oil and gas production are expected to peak by 2015 and 2020 respectively. It is a fact that known coal-based energy reserves are about three times larger than the known oil and gas based energy reserves. More importantly, the estimated, ultimately-recoverable, coal-based energy reserves could be 15 times the recoverable oil and gas based energy reserves. Thus a coal based synthetic fossil fuel system could potentially prolong the life of the current fossil fuel system. However, the coal based synthetic fuel system is the worst from the point of view of environmental sustainability while the solar-hydrogen energy system of the future is environmentally the best, and practically infinite in terms of reserves.

While sharing the concerns of the environmentalists, I believe that, as things stand, clean coal technologies will play a critical role in the transition to a hydrogen economy. I also believe that the pre-eminence of hydrogen as the safe and environmentally sustainable "forever-fuel" remains unchallenged and the solar-hydrogen system will be pursued aggressively as the future energy system of our planet. Having said this, I take note of the work being done in competing options such as cold fusion, super conductivity and renewable energy for the utility sector. These, along with hybrids, super batteries, solar cars etc. for the transportation sector, are currently being researched extensively and, if successful, could change the energy landscape of the future.

Another dimension of the Hydrogen Economy that is often not openly aired is the fact that many hydrogen and hydrogen related technologies fall within the domain of dual-purpose technologies and their cross-border movement is strictly controlled. However, such restrictions are at variance with the need to promote international cooperation in hydrogen technologies, as evinced by the objectives of this initiative and especially this meeting.

India's energy concerns are far more acute compared to other major consumers of energy in the world. Energy is critical to economic growth and improvement in quality of life. The per capita energy consumption in India is only half that of China and a mere 6% of that in the US. Even under the most aggressive estimates of energy efficient growth, India would need to grow its energy consumption by 4.5% to 5% annually for the next 15 to 20 years if it is to sustain an economic growth rate of 7-8% per annum. Sustained growth at this level in the first two decades of the twenty first century is essential for India to attain its objective of eradicating poverty and providing an adequate standard of living for all its people. With limited domestic hydrocarbon resources and depleting world resources of hydrocarbons, India's energy imports are expected to rise to twice the current levels within the next ten

years. This would push India's import-dependence for commercial energy to around 45% compared to the current level of around 30%. What is worse is that this would happen around the same time that world hydrocarbon production peaks and prices begin to rise. Clearly one should question the sustainability of business-as-usual in India's energy sector. It would not be an exaggeration to say that India's very future depends on seeking viable alternate energy options that include nuclear, renewables, clean coal technologies, coal based synthetic fuel systems and solar energy hydrogen systems.

Although significant developments have taken place towards realizing the Hydrogen Vision, daunting technical, economic and institutional challenges remain in every element of the Hydrogen value chain, spanning production, transportation, storage, conversion and application. Efficiencies, yields and specific costs of current technological solutions need to be improved by a factor of 1.5 to 30 times to make the Hydrogen Economy competitive against current alternatives for the transport and energy utilities. This cannot be done without developing significant new processes and technologies even if one takes into account the narrowing of the gap with the passage of time, as the environmental costs of current alternatives are internalized and fossil fuel availability goes down.

India, currently the sixth largest energy consumer in the world, is likely to become the fourth largest within ten years. Hence India needs to be part of the global coalition leading technological advances in the field of energy. In fact, I believe that India could play a critical role in helping realize the US led OECD vision of a carbon free Hydrogen Economy. Thus India, as an active player, can contribute meaningfully to hydrogen research aimed at overcoming the technical and economic barriers to actualizing the hydrogen economy.

There are, however, distinct differences in the drivers for a hydrogen economy in India and in the US. With half its population still without access to electricity, India's motivation for a Hydrogen economy is largely driven by the demand for distributed power generation and demand for energy to fuel industrial growth. In the US, on the other hand, the automobile sector is the primary driver for a hydrogen economy. Within the automotive sector, India's quest for a hydrogen fuelled vehicle is driven more by the two-wheeler and three wheeler segment, that is likely to achieve commercialization based on metal hydride storage and direct combustion of hydrogen ahead of fuel cell based cars and buses. Despite such differences, the basic building blocks to be developed through research remain essentially the same.

Clearly we are still some way from the hydrogen economy of our vision. Rough estimates suggest that some 50 to 100 billion dollars, mostly from the private sector in OECD countries, will be invested in the development and commercialization of the various sub-elements which constitute a Hydrogen Economy. The OECD governments are expected to play a key role in catalyzing these investments by funding and supporting 15-25% of the hydrogen research initiative. The role for India in realizing the hydrogen economy becomes evident when one recognizes that its large and, if I may add, renewable pool of research personnel, and the vast network of research laboratories, could support the above effort at a fraction of the cost.

The Ministry of Non-conventional Energy Sources, The Department of Science and Technology and CSIR are currently running several research projects including development of prototypes. More recently, the Oil majors have also started exploring their role in a hydrogen economy and have commenced assessing the various opportunities. With the growing financial muscle and global presence of some of our public sector and private sector companies, India will pursue strategic tie-ups and/or investments in start-ups engaged in

researching various elements of a Hydrogen Economy. These participations could then be leveraged to outsource some of the basic research to labs in India to bring down R&D budgets and speed up development. After its success in IT such a model is gaining ground in biotechnology, medical and pharmaceutical industry and could very well apply to the ongoing research in Hydrogen technology. The present initiative suggests that US policy would facilitate such a strategy and, I believe, that IPHE could become a forum to promote the harnessing of hydrogen to meet global energy needs.

In conclusion, I would like to stress the commonality of interest and say that a partnership based on mutual appreciation of individual strengths and an equitable sharing of the research effort is needed among nations to realize the vision of the hydrogen economy by the first half of this century. IPHE is the first step in this direction.

Thank you.