INTERSTATE TRAVELER LLC.

Office of the Chief Technical Officer

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Representative Bill Rogers
1085 Anderson Building
Lansing, MI 48933

RE: Solar-Hydrogen energy benefits and safety

Dear Representative Rogers,

Thank you for this opportunity to give testimony regarding the Interstate Traveler (HyRail) project currently before your committee.

Interstate Traveler provides many benefits and to address them all would result in testimony of great length. Hence, in the interest of brevity, please let me concentrate on the most important aspect of the system, its energy source. The unique HyRail system represents a major change in the energy paradigm that powers current mass transportation systems such as light rail and subways.

Current systems use fossil based fuels that are inherently dangerous to the environment, costly, decreasing in reserve supply, and subject to upcoming carbon cap and trade costs. This situation is precarious and unsustainable.

The HyRail, on the other hand uses no "fuel" per se, but rather gathers energy directly from the sun and uses a portion of such solar radiation directly, during daylight hours, to power the transportation system that is an integral part of our combined design.

A second portion of the gathered energy is stored by electrolyzing (electrochemically separating) water and storing the resulting

hydrogen and oxygen gasses for use in turbine powered electric generators to provide electricity for system operation during non-sunlight hours. Finally, the remaining electrical power is shared with other traveler stations that may need supplemental electricity and if such a need is met, the power is sold to the primary grid to power homes and businesses.

There has been a long history of misconceptions about the safety of hydrogen and its viability as an energy storage medium. Let me address these two concerns briefly in order.

Hydrogen gas, when properly stored, is one of the safest energy storage media available. Liquid fuels such as petroleum diesel oil and gasoline are heavier than air and fall to the ground if spilled. They then spread out and present a large-area fire hazard that persists for as long as the liquid or its vapors are present. Hydrogen on the other hand is the lightest gas in the known universe and when released accidently it dissipates in a column straight up. Absent some ignition source, no other reaction occurs. The gas vents into the atmosphere and dissipates upward. Hydrogen gas is neither toxic nor is it a pollutant. If vented, it literally goes straight up through all layers of the atmosphere and out into space with no negative consequences.

The Hindenburg disaster frequently is cited as a case study on the dangers of hydrogen. However, far from being an example of the dangers of hydrogen, the Hindenburg is an example of the inherent safety of hydrogen even when unexpectedly released, as it was on the ill fated airship.

The butyrate doped skin of the Hindenburg was the culprit in the crash; it was painted with an aluminum colored combustible dope which was electrically non-conductive. The skin of the ship caught fire from a backfire of one of the diesel engines used to maneuver the ship. The ionized path of the backfire allowed a rapid dissipation of a static charge on the skin that started the fire.

The hydrogen became involved only when the gas ballonets ruptured and it then contributed to the fire equation. Furthermore, despite there being thousands of cubic feet of hydrogen released directly into an ongoing fire, the fire did not behave differently than any fire with the same amount of fuel just because hydrogen was present.

Over half of the people on board survived without a scratch and of those who perished, most died from burns or impact from falling debris that was also burning. Hydrogen, by itself, was not a cause of ignition or explosion but it did add fuel to the already ongoing fire. (source: *The Freedom Element*, Addison Bain, Ph.D.). While Hydrogen contributed to the heat and fire the same could be said of any fuel like the skin and the Diesel oil used to power the engines. The only difference is that heavier than air fuels fall downward until they oxidize and ignite while lighter than air fuels dissipate upward unless contained by a physical structure. This aspect tips the safety equation quickly in favor of Hydrogen over liquid fuels. In summation on this point, we feel that, in our system, Hydrogen is the safest method of energy storage available.

Please allow me to testify briefly as to why I reference Dr. Bain and also offer a brief resume of my own qualifications to speak on this subject.

Doctor Addison Bain was responsible for the design, safety and efficiency of the hydrogen system used at Launch Complex 39 at the Kennedy Space Center. This is the facility that the current Space Shuttle (STS) and the Future Ares 1X and Constellation vehicles launch from. Dr. Bain's hydrogen fueling design has been in use for decades with great stability and efficiency. He will be consulting with us on system safety and design as we move forward.

I am intimately familiar with aerospace vehicles that use hydrogen propulsion and have a 21-year history working on aerospace systems, 14 of those years working directly on the space shuttle program.

I was the senior motion analysis and high speed imaging specialist at McDonnell Douglas Missile systems from 1988 to 1993 and am now an imaging systems designer and instrumentation specialist at the Kennedy Space Center. My specialty is designing equipment to acquire flight data images at high frame-rates and under the pad conditions present when the world's largest and most powerful hydrogen powered vehicle starts its journey. I have designed equipment to withstand this environment while operating safely in hydrogen rich environments.

I have worked closely with propulsion and support systems engineers to ensure safe and correct operation of critical launch components like the Gox vent line and fuel ullage identification systems.

I have been responsible for the electrical compliance of my designs with the National electrical code as it pertains to a hydrogen (C1 Div2 Group B) rated environment. None of my systems has ever experienced a failure (since1995).

Over the time I have worked in intimate contact with this Hydrogen powered vehicle and I have not heard of a single accident associated with the hydrogen systems. I also conduct independent research in my own laboratory on hydrogen energy systems and am currently working on a system design for optimal electrolysis of seawater specifically for maximum hydrogen production (and on an electrode that will perform this operation without corroding or losing efficiency).

In conclusion on the safety point, please allow me to put my testimony in perspective.

Between the space center system and the Interstate Traveler HyRail system a simple comparison can be made.

At the Kennedy Space Center we store and transport 850,000 gallons of liquid hydrogen with the LC39 system, which is equal to 96,000,000 cubic feet of hydrogen gas. Interstate Traveler stores only 1/300 of that amount at each our three mile waypoint stations. The amount we propose to store at each station is a very manageable amount and with state of the art monitoring this amount can be stored with very high degree of safety.

My last topic is Hydrogen as a sustainable and renewable energy storage medium.

Hydrogen, if used correctly, is the most efficient method available anywhere in the known universe. All “fuels” currently used are hydrocarbons and are sometimes referred to as “fossil fuel” or “Dinosaur Juice”. All of the energy potential in a hydrocarbon comes from the hydrogen content that was instilled into its hydrocarbon matrix over thousands of years by a slow and inefficient chemical processes.

No hydrocarbon can be manufactured in a sustainable manner; all hydrocarbon fuels require far more energy to create than they return and ALL pollute in proportion to their carbon content to the available Hydrogen. Starting with Methane (CH_4) the ratio is one polluting carbon to 4 non polluting Hydrogen energy carriers.

Moving up the alkane progression to ethane (a component, with methane, of natural gas, C_2H_6) and continuing by adding 1 carbon and 2 hydrogen atoms for each step up the alkane progression. The ratio of pollutant to energy carrier goes from 1:4 (methane) to 1: 2.25 (Octane gasoline $C_8 H_{18}$). Biodiesel, ($C_{20} H_{40} O_2$) as well as all other manufactured alcohols and simple alkane hydrocarbons produce ratios of pollutant to energy in direct proportion to the amount of carbon present as shown in the above example making them all damaging to the environment and thus, subject to carbon credit costs.

The property that makes hydrocarbons so attractive is that the chemical storage of hydrogen by chemically bonding with carbon makes it easy to store and use. As mentioned above, the hydrocarbon bond requires huge amounts of energy to create.

Only hydrocarbons already in existence are viable for use as a "fuel".

A "fuel" is a source of energy that does not use more energy to acquire than it produces when used and only already existing hydrocarbons are in this category. When global stores of hydrocarbons are depleted, mankind walks and starves unless we have fully developed alternatives.

Hydrogen in its pure gaseous state is an energy-storage medium. In this use purity is the key. The energy required to split water and provide hydrogen is more than you get back when you convert hydrogen back into energy by any means. This makes it viable for our purpose only if the energy to split the water comes from an external and cost free source. The solar arrays which the HyRail uses for this purpose fit this limitation and make the system viable.

Far less energy is required to split water electrochemically than it takes to make a hydrocarbon, even a simple one like methane.

The first problem is; where you get the Hydrogen to make the hydrocarbon? Hydrogen does not exist freely in nature; it is always bound by covalent bond to another atom like carbon (Hydrocarbon) or oxygen (water). To create a hydrocarbon from component parts you first have to disassociate water and then bond the resulting hydrogen with the carbon before it escapes as a gas. The sea diatoms, dinosaurs and the plants around them did the first part of the operation for us biologically eons ago. Nature then trapped the hydrogen and infused the energy over millions of years to form the hydrocarbon bond first as Methane from diatom, dinosaur and plant decomposition and subsequently into the longer hydrocarbon chains we know as natural gas, oil, and coal.

Of course the time and energy this progression takes, makes continued reliance on hydrocarbons impractical. Since Hydrogen does not exist in nature all by itself and is the only non-polluting, chemical means of storing energy, finding a way to use it efficiently is the key to our future.

The above reality shows clearly why Interstate traveler IS the answer to the energy questions we are all asking. By employing the free and powerful energy from the sun and using the economies of scale our large rail network will provide we can gather and use the suns energy and hydrogen's storage potential to provide the solution to our energy crisis and do so without continuing our slide to the environmental tipping point.

I wish to thank you for allowing me to testify and am standing by to answer any questions you may have.

I may be reached at 407-694-1394.

Sincerely,

Adam J Nehr III