

## **The Global Problem**

Energy is one of the critical constraints of global economic expansion. The current paradigm involves very heavy reliance on crude oil and its distillates for a wide range of applications. The results of the *status quo* are a commitment to oil exploration, drilling, production, and transportation in and from geopolitical areas often hostile to democratic institutions. Whether it is driven by reality or speculation, the recent upward spiral of oil prices also impedes healthy economic growth. The negative environmental impact of the entire process from acquisition to refining to final consumption is another major drawback to the reliance on oil as the primary source of the world's energy.

## **The AlGalCo Solution**

AlGalCo is an Indiana domiciled Limited Liability Corporation established in 2006 to commercialize a hydrogen **on demand** strategy as one viable alternative source of energy. Hydrogen gas generated from water is a clean, economical and readily available source of fuel. Historically, a major obstacle to the deployment of hydrogen as an alternative fuel has been the difficulty of storing and distributing such an ethereal gas. AlGalCo has solved the distribution and storage issues associated with hydrogen gas by generating the gas **on demand at the point of use**. AlGalCo's strategy is enabled by its exclusive license to patented technology discovered at Purdue University by Dr. Jerry Woodall, National Medal of Technology Laureate. Gas production is achieved by simply adding water to a solid alloy of two plentiful and innocuous elements: aluminum and gallium.

## **Milestones Achieved to Date**

AlGalCo has confirmed three critical commercialization elements: the process works, the output of the process is controllable and is sufficient for commercial purposes, and it is economically competitive.

1. The process works. Hundreds of laboratory experiments during the last three years consistently demonstrate that adding ordinary water to an alloy of aluminum and gallium does indeed create hydrogen gas.

2. Commercially feasible. AlGalCo has developed a compact second generation demonstration system that:

- produces hydrogen when water is added to the gas reactor,
- starts and stops gas production by controlling the flow of water between tanks using near-atmospheric pressure differentials, i.e. no high pressures or vacuum required, and
- generates gas at a rate sufficient to power an “off-the-shelf” one kilowatt Honda generator on a continuous basis.

3. Economically viable. New infrastructure to accommodate hydrogen produced by our process is not required and all relevant materials and equipment are readily available.

- Every part of the demonstration system was purchased at commercial retail stores at standard, off the shelf pricing.
- Only one very minor adjustment to the Honda generator is necessary in order to bypass the carburetor and feed the hydrogen directly from the gas reactor into the generator.
- Standard industrial grade aluminum comprises 95% of the alloy. The other component of the alloy is impure industrial gallium which, ironically, is produced as a by-product of aluminum production. The gallium is not consumed in the reaction and is easily recycled.
- Dr. Woodall estimates the cost of power generation using the impure gallium alloys to be equivalent to gasoline at \$3.50 per gallon. .

### **Strategic Market Penetration**

Although we believe our process has the long-term potential to address the global energy crisis, AlGalCo is not in a position to enter that market immediately and directly. Therefore, we have developed an incremental strategy that allows us to progress toward that ultimate goal in technologically sustainable and financially profitable steps.

In keeping with this incremental strategy, AlGalCo’s first product will be an emergency, portable in-home generator for medically fragile consumers. According to Rural Electrical Membership Co-ops (REMC) interviewed in the state of Indiana, approximately 1.5% of all Hoosiers (90,000 persons) are classified as medically fragile, i.e. reliant on some sort of electrically-powered appliance, device, or life support system.

During a power outage, these 90,000 consumers assume higher mortality risk if their medical devices are not adequately supplied with electric power. Electric utility companies also bear a responsibility to restore power to these customers immediately even though they may be located in isolated areas with a low priority for service restoration in a broad emergency situation like a major storm. AlGalco's technology is ideally suited for this contingency.

- Our alloy can be safely stored indefinitely immediately adjacent to any medical devices. "Hydrogen" stored as water and a solid alloy of aluminum and gallium eliminates the need for high pressure storage of hydrogen gas.
- Hydrogen can be burned indoors in **our gensets during** emergency situations because it does not produce carbon monoxide or other toxic gases; water vapor is the combustion product.
- When primary power is interrupted, water begins to flow onto the alloy and the production of hydrogen gas begins. When primary power is restored and emergency power is no longer needed, the flow of water is automatically stopped, the hydrogen generation reaction ends, and the emergency generator shuts down.

AlGalCo has produced and tested an initial prototype system. The second generation one kilowatt genset prototype is available for demonstration as of June 27, 2008. Numerous additional applications will follow the successful launch of the one kilowatt genset. An important strategic advantage of our technology is that it can either be scaled up or down from the capacity of the initial product.

The next scaled-up product offering would be five to fifteen kilowatt gensets to provide emergency power for an entire home. This requires only incremental steps in our hydrogen on demand technology. The Purdue research team is also developing larger scale applications to serve the non-emergency heating and cooling needs of entire homes and other space heating/cooling applications. Implementation of this second set of "scaled-up" products will involve the use of waste heat from the hydrogen generation and combustion processes and the incorporation of a heat pump into the system. The entry into the non-emergency power market is a tipping point for AlGalCo because this is the point at which we will be able to address the global energy issue identified at the outset of this summary.

It is also possible to scale down the size of future applications. AlGalCo is already collaborating with other companies attempting to adapt our technology to replace batteries as a means of storing energy. One pound of alloy yields 2.2 kilowatt hours of energy. In contrast, the energy density of the most advanced lithium ion batteries is dramatically less. The implications of a greater than ten times increase in energy storage capacity for lap top computers, golf carts, and marine applications are profound.

**Another very promising application is for water purification in emergency situations. After a flood or major storm, non-potable water can be used to react with the alloy. The heat of the reaction and burning the resultant hydrogen will convert the non-potable water to steam which can then be condensed and consumed by survivors. No other source of energy is required to actuate the process outside of that already contained in the alloy. Clean water would not have to be delivered into the disaster zone, just the alloy.**