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ASEMBLON INC.

# MEETING CALIFORNIA ENERGY OBJECTIVES WITH HYDRNOL™

FOR INCLUSION TO DOCKET 08-ALT-1, AB 118 PROGRAM

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# EXECUTIVE SUMMARY

Asemblon scientists have patented a novel approach for storing and delivering hydrogen. By binding hydrogen chemically to an organic molecule, it can be handled like gasoline or diesel through the current distribution infrastructure. Previous approaches to making hydrogen a fueling resource have not been embraced because the benefits of hydrogen were outweighed by the high cost of storing and transporting it in gaseous or cryogenically liquidized form.

Now, the environmental benefits of hydrogen and the ability to store and transport energy generated from multiple sources (wind, solar, biomass, etc.) can be enjoyed economically. Hydrogen is inexpensive to produce. It can be made from natural gas or other feed stocks for ~$1.00 per kilogram in large quantities. Because hydrogen is a light and energetic gas, it must be highly compressed, chilled to near absolute zero, or both to be transported and stored. With Asemblon's HYDRNOL technology, hydrogen can now be chemically attached to the Asemblon molecule and easily removed as needed for energy

When attached to HYDRNOL, hydrogen is stable at normal temperatures and pressures and remains a liquid over a wide temperature range for vehicle and fuel cell applications. It is inexpensive to attach hydrogen to the HYDRNOL molecule. Additionally, relatively little energy is required to release the hydrogen for use.

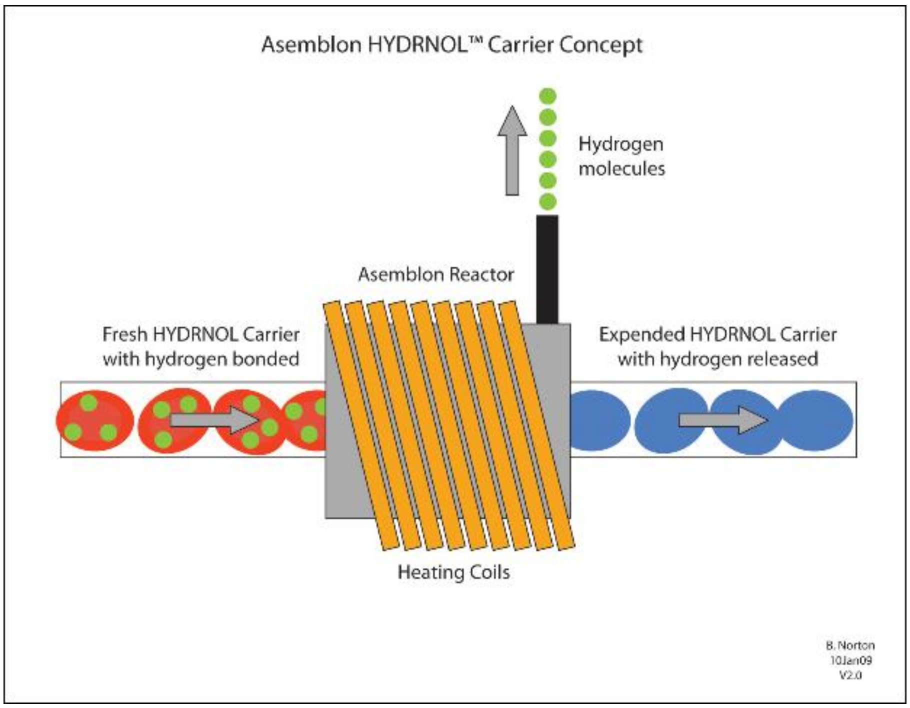


**Figure 1 - Asemblon HYDRNOL Carrier Concept**

While the analogy is not perfect, think of red blood cells that pick up oxygen in the lungs, transport it to the various parts of the body where it is used and then return to the lungs to repeat the cycle. Asemblon's "red blood cell" is a molecule called the HYDRNOL Carrier.

After releasing its hydrogen, the HYDRNOL Carrier is recycled in a well known industrial process (hydrogenation) that adds hydrogen and makes it ready for use again. This cycle can be performed over 100 times.

Asemblon's patented process can deliver hydrogen to a fueling station for about $2.28 per kilogram. A kilogram of hydrogen is equivalent in energy to a gallon of gasoline.

Our scientists have made great strides in perfecting the HYDRNOL process by identifying and developing a series of molecules with higher and higher hydrogen storage capacity based on both weight and volume. This three-year development program has been so successful that Asemblon well exceeds the latest DOE goals for gravimetric capacity. The Department of Energy recognized Asemblon's progress with its Energy Innovator Award in November of 2008.

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# HYDRNOL TECHNOLOGY

The HYDRNOL molecule:

- Has the capacity to store at least 4.7% hydrogen by weight and up to 12% considering molecules that are known, currently identified or being developed
- Can be stored and transported at standard temperature and pressure, reducing the safety concerns pertinent to on-board hydrogen storage
- Is a liquid over the range of -63 °C to 113 °C under ambient conditions, in both its hydrogenated form and its dehydrogenated form, allowing relatively simple integration into the existing infrastructure
- Is produced from a molecular precursor currently regarded as a low value by-product from both biomass and crude oil processing
- Releases hydrogen, as needed, using a catalyst, on board a vehicle or in a static location
- Is recyclable, where a method for adding hydrogen back to the dehydrogenated molecule has been developed but not optimized
- Offers significant advantages over the estimated cost and weight of the storage systems employing liquid hydrogen, compressed hydrogen and metal hydrides

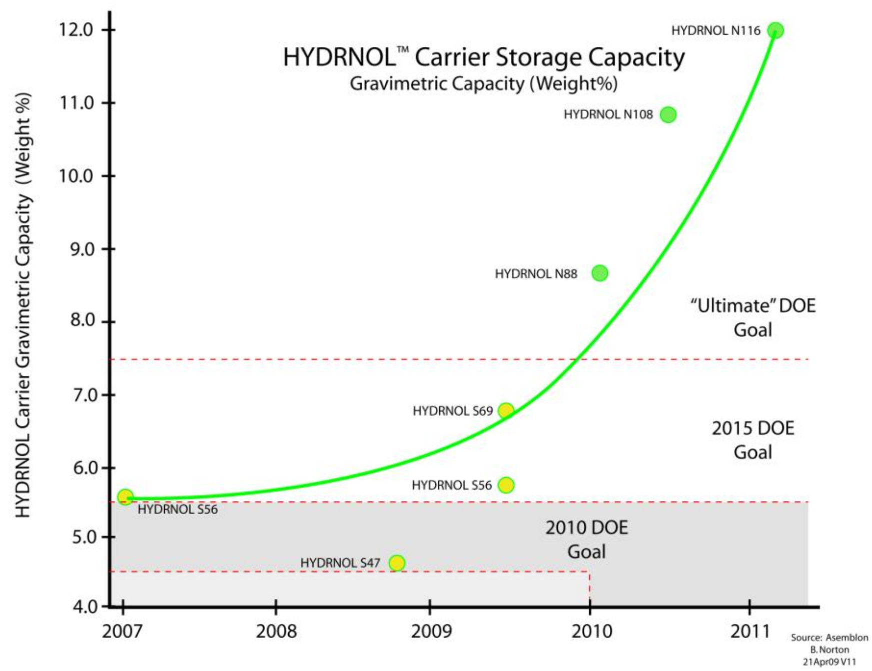


**Figure 2 - HYDRNOL Carrier Storage Capacity**

The HYDRNOL technology can be utilized in myriad energy related applications. Some of them include:

1) **The inexpensive storage and transport of hydrogen** as compared to conventional means (pressurized or cryo tanks and trucks). A regular gasoline tanker truck costs about $150,000/each and can be easily modified to ship HYDRNOL. A pressurized hydrogen tanker truck costs approximately $650,000/each and a cryogenically outfitted hydrogen tanker truck costs in excess of $1.2 Million. In addition, a greater mass of hydrogen can be delivered to a fueling depot per truck than by current standard apparata. The transportation costs and delivery inefficiencies of conventional systems have historically increased hydrogen costs beyond acceptable levels.

2) **The conversion of internal combustion vehicles** already on U.S. roads can be accomplished inexpensively (estimated between $3,000 and $5,000 per passenger vehicle) without factoring in economies of scale or tax incentives. This rapid and cost effective deployment will greatly expand the availability of hydrogen by making use of the existing gasoline dispensing facilities.

   As a result, automobile manufacturers will be assured of a hydrogen dispensing infrastructure for their products much earlier than would be the case if States needed to support the expense of conventional hydrogen fueling stations.

   A pressurized or cryogenically outfitted hydrogen fueling station costs approximately $2.1 million dollars/each. A HYDRNOL station of equivalent hydrogen capacity would cost about $250,000.00. Should a municipality wish to provide pressurized hydrogen for legacy fuel cell vehicles (there are some 200 in California), the HYDRNOL system can be modified for ~$375,000 for 6,000 psi fueling. The cost for re-hydrogenation equipment sufficient to meet the needs of 20 fueling stations at 120 Kg/day is ~$1.3 Million.

   Each retrofit kit will require 1.5 person days of labor to install. Based on our adoption assumptions (set at 40% maximum in 2030), vehicles will be retrofitted at the rate of 675,000 in 2015 to 310,000 in 2030. This will require 4,050 person years of labor in 2015 and 1860 person years in 2030. There should be a 2x factor for support jobs such as dealer personnel and fuel truck drivers. The total labor impact should be an addition of over 8,000 jobs in 2015 and approaching 4,000 jobs in 2030.

   It should be noted that the HYDRNOL fueling approach will be transparent to the end user. A dual tube fueling nozzle, which looks the same as a conventional gasoline fueling nozzle is inserted into the vehicle storage tank. As the customer is filling one side of the dual chamber, bladder, tank using one of the nozzles tubes, 'spent' HYDRNOL stored on the other side is pushed out, concurrently, through the other tube.

Our analyses show that HYDRNOL can be competitively priced, using currently available hydrogen sources estimated at $1.47/Kg. This translates to $2.28/Kg at the pump including the current gasoline tax load. The combined economic effect of compressed hydrogen recurring costs and cap ex required to establish conventional hydrogen fueling capability obviates the advantages of the HYDRNOL system.

There are in excess of 230 million 'legacy' vehicles now operating on U.S. roads; 23 million of them in California alone. The ability to retrofit a large percentage of these vehicles would be the fastest and least costly way to reduce our $CO_2$ emissions. (Please see the Bass Adoption model on pages 19 and 20)

There are very few hydrogen fuel cell vehicles now on the road and, given that the cost of the Honda Clarity in 2020 is anticipated by Honda to be ~$100,000 (Newsweek June 19, 2008), the conversion of existing ICE vehicles offers the fastest and most economical way to introduce hydrogen fueling for transportation.

3) **HYDRNOL can be used to store energy produced by renewable sources** (biomass, wind, solar, etc.). Many of these resources are situated in remote areas which are not in close proximity to transmission lines. A 2 Million gallon tank of HYDRNOL would measure 60 feet (20 m) in diameter and stand 100 feet (33.3 m) tall and will store the equivalent of 8.4 Gigawatts of energy in the form of hydrogen. The economical storage of energy in the form of HYDRNOL provides the ability to "Power Shift"; storing the power that is generated during times of low demand for use when demand and energy prices are highest. This is significant to producers of renewable energy who often are not able to realize their full tax incentives as their output is generated primarily at night and often has to be sold at "off peak" rates. "Peak rates" occur typically 6 to 12 hours later.

4) **Diesel co-combustion allows the use of hydrogen**, released from HYDRNOL, potentially up to a 50/50 mixture without loss of power, thereby reducing diesel emissions (including PM 2.5) by over 50%. This will be especially significant to ports, train yards, and operators of school buses, as the negative effects of diesel emissions on human health are well documented.

   Several ports in the United States are considering mandating that diesel freighters be towed in as 'cold iron' to reduce particulates in densely populated areas. At the dock, commercial vehicles (tractor/trailers, forklifts, shuttle vans) can be economically retrofitted for HYDRNOL or diesel/HYDRNOL co-combustion for about $10,000.

5) **Static storage of power for municipal, commercial or industrial emergency use**. This would include 'Smart Grid' storage or even storage of back up energy for remotely situated cell towers.

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6) **Military applications.** In theater, the logistical cost of one gallon of fuel is between $400 and $800. Hydrogen could be generated "in theater" and stored as HYDRNOL. The result would be a significant reduction in cost and, more importantly, a reduction in loss of life pertinent to fueling convoys.

7) **Economical conversion of fleets** (buses, shuttles, package delivery trucks, etc.) with centralized hydrogen fueling at the end of the day.

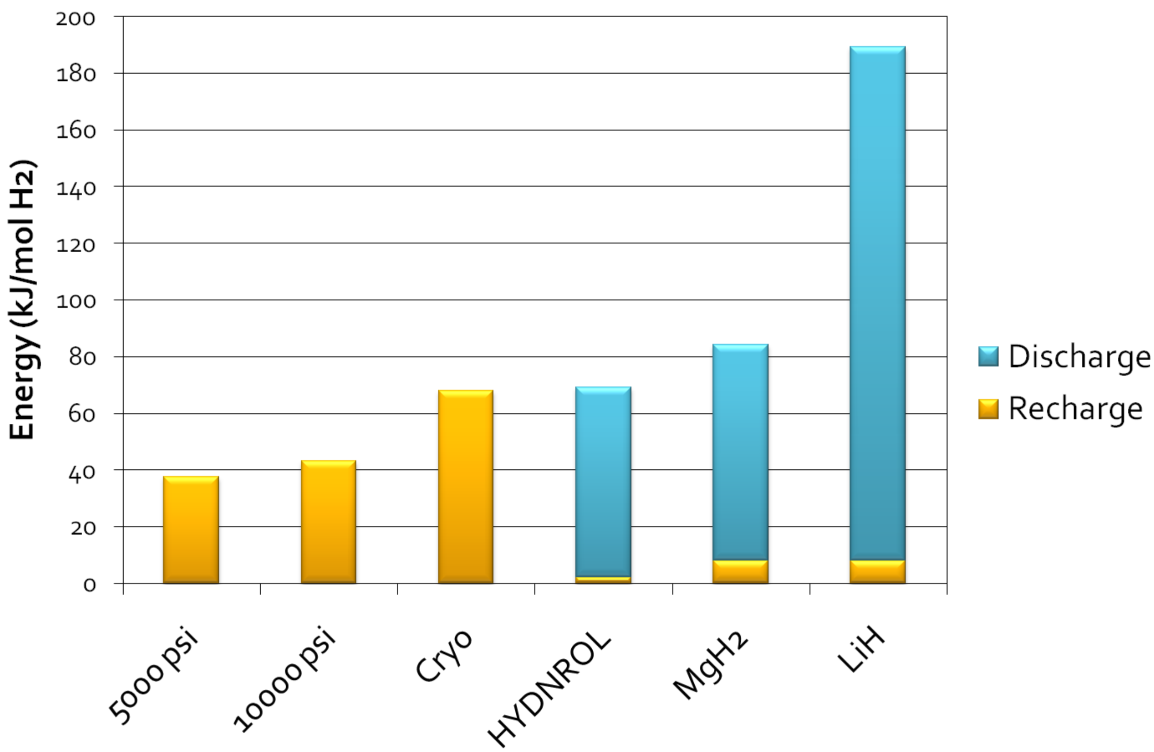


**Figure 3 - Hydrogen Carrier Operational Energy Requirements**

# CALIFORNIA ENERGY OVERVIEW

## ENERGY REQUIREMENTS

According to the CEC Energy Policy Report of 2007, by 2010 renewable energy must supply 20 percent of California's energy needs. The Renewable Portfolio Standard (Senate Bill 1250 Perata, Chapter 512, Statutes of 2006) accelerated the earlier (2002) goal to the 20%/2010 requirement.

This requirement is an acknowledgement that importing energy means exporting California State dollars. The 'loading order' which describes the preferred sequencing of resources to meet California's growing electricity needs specifies that, after energy efficiency and demand response, renewable energy and distributed generation take funding precedence.

The Governor, the CEC and the CPUC have endorsed a further enhanced target of 33% from renewable energy by 2020. This target is to be met with electricity from biomass and established the Bioenergy Action Plan to develop an integrated and comprehensive state policy on biomass.

The CEC report indicates that "so far, however, the RPS results have not kept pace with its mandate, due principally to insufficient transmission infrastructure." The report goes on to say, "A goal of 33% is feasible, but only if the state commits to significant investments in transmission infrastructure and begins now to implement key programmatic changes."

It is well known that transmission lines usually cost about $1Million/mile. Further, the permitting, eminent domain, environmental impact assessments, and construction issues can sum to several years of delay. The 'significant investments' referred to in the preceding quotation can be greatly reduced should HYDRNOL be employed as a storage and transport medium for hydrogen to the point of use. The Draft Committee Report of the Investment Plan for The Alternative and Renewable Fuel and Vehicle Technology Program (pg. 3, para. 3) states, the transition to a diversified, low carbon transportation future will require "*a private capital investment and public finance incentives to foster technology advancement and innovation....it is estimated that $2 billion in government incentives invested between 2008 and 2022 will stimulate more than $40 billion in private investment leading to a mature market roll out of alternative and renewable fuel options in 2050. Between 2008 and 2050 about $100 billion in total market (public and private) investment will be required. The estimates are based on capital cost assumptions, technology research and development needs, infrastructure requirements, manufacturing investments ...*" We respectfully assert that many of these expenses can be greatly reduced and the time to deploy compressed with our approach.

## OFFICE OF ENERGY INFORMATION ADMINISTRATION

A 2008 study based on 2007 data indicated prices per kilogram of Hydrogen by a range of 9 different technologies.

| H2 Pathway | Price per Kg. |
|---|---|
| Central SMR of Natural Gas | $1.47 |
| Distributed SMR of Natural Gas | $2.63 |
| Central Coal Gasification with CCS | $1.82 |
| Central Coal Gasification without CCS | $1.21 |
| Biomass Gasification | $1.44 |
| Distributed Electrolysis | $6.75 |
| Central Wind (Electrolysis) | $3.82 |
| Distributed Wind | $7.62 |
| Central Nuclear Thermochemical | $1.39 |

At minimum, the HYDRNOL technology should be used as a 'bridging' energy transport mechanism until such time as transmission lines can be economically justified and installed.

1) **Possible hydrogen feed stocks**

   California has 262 active and inactive landfills (CIWMB Database 1999). The Sunshine Canyon Landfill alone produces 2.62 BCF of methane/day. Our analysis indicates that this would equate to production of approximately 18,615,000 Kg of hydrogen/year at this site alone (compared to the output of the 11 biodiesel plants currently in operation in California with a combined 2009 theoretical capacity of 87 million gallons). Further opportunities for biomass hydrogen generation can be found at dairies (bovine methane) and even waste water treatment plants. As methane has approximately 20x the effect on Global Warming as does CO2, it is critically important to capture it and optimal to convert it to hydrogen; a multiple positive effect.

   Executive order S-06-06 (April 2006) sets a target for biomass to comprise 20 percent of the State's Renewables Portfolio Standard for 2010 and 2020. In addition, the order states that

California shall produce a minimum of 20 percent of its biofuels within the State by 2010, 40% by 2020, and 75% by 2050.

Wind and solar energy can provide hydrogen through water electrolysis. As many of these facilities are remote, the hydrogen can be captured on the HYDRNOL molecule and transported to the needed location. Solar, and wind providers report that their chief obstacle to investment is the inability to deliver energy when/where needed due to lack of transmission infrastructure. We intend to demonstrate that HYDRNOL can make the economic model work.

**2) Environmental requirements**

California's 26 million registered vehicles consume about 380 million barrels of gasoline (16 billion gallons) and almost 100 million barrels (4 billion gallons) of diesel each year. California is the third largest consumer of gasoline in the world, behind the entire United States and China.

It is intuitive that, for every gallon of combustible petrochemical replaced by a kilogram of hydrogen, there is a 1:1 reduction in emissions. This holds true whether the vehicle is converted to hydrogen only, or if co-combustion with diesel is the preferred option. Currently, commercial vehicle manufacturers are struggling to meet the 2010 diesel emissions goals for new vehicles. There is much discussion that they will simply not be able to meet these goals. Co-combustion of hydrogen (using the HYDRNOL Carrier) with diesel, will allow them to well exceed the pending EPA requirement. This has significant ramifications for the Ports of Long Beach and Long Beach and other areas that have worked very hard to assure compliance, often with unsatisfactory results.

The CEC has recommended that the State increase alternative fuels use in the transportation sector to 9% by 2012, 11 percent by 2017 and 26% by 2022 to meet the AB 1007 goals that reduce petroleum fuels use and greenhouse gas emissions. HYDRNOL can well support these goals.

## HYDRNOL TECHNOLOGY AS IT RELATES TO THE CALIFORNIA ENERGY INVESTMENT PLAN

The key California Energy Commission policy objectives, as stated on page E2 of its Investment Plan for Alternative and Renewable Fuel and Vehicle Technology Program are:

| Objectives | Goals and Milestones |
|---|---|
| GHG Reduction | Reduce GHG emissions to 1990 levels by 2020 and 80% below 1990 levels by 2050 |
| Petroleum Reduction | Reduce petroleum fuel use to 15% below 2003 levels by 2020 |
| Alternative Fuel Use | Increase alternative fuel use to 20% of on-road fuel demand by 2020 and 30% by 2030 |
| In-State Biofuels Use | Increase biofuel use to $1 billion gge by 2010, 1.6 billion gge by 2020, and 2 billion gge by 2050 |
| In-State Biofuels Production | Produce in California 20% of biofuels used in state by 2010, 40% by 2020, and 75% by 2050 |

We fully support the inclusion of multiple technologies in California's energy portfolio in order to achieve its Policy Objectives. And we feel strongly that the use of the HYDRNOL carrier will both support and accelerate these objectives in the following example cases:

1) The reduction of emissions levels can begin with the introduction of HYDRNOL technology in the fueling of fleet vehicles. Fleets are defined as delivery, shuttle, or other vehicles with centralized fueling logistics. The cost to establish the fueling depot is amortized over the number of vehicles for which hydrogen (direct or co-combusted) is provided. As stated earlier, the cost to retrofit vehicles is quickly retrievable and would likely gain Federal subsidy in whole or part. Additionally, the ability to maximize the use of the proposed $20M/year for the next two years in deploying hydrogen fueling stations could allow for the installation of ~160 stations (160 x $250,000 = $40M). The vehicle retrofit function could be performed by automobile dealerships now suffering in our weakened economy.

2) Based on our analysis that hydrogenated HYDRNOL can be sold at $2.28/Kg (energy equivalent to a gallon of gasoline) we expect the adoption of the technology to be robust

especially given California's environmental and renewable energy mandates. This will have a direct effect on petrochemical emissions.

3) We are very confident that using HYDRNOL to capture renewable energies in the form of hydrogen will stimulate investment in the renewable sector. The HYDRNOL technology provides the answer to those challenged with providing competitively priced energies that are traditionally 'off grid'. Many of the alternate fueling approaches have intrinsic technical and environmental challenges. HYDRNOL will assure that all possible resources can be considered in the general discussion.

   The Policy Objectives for California biofuel production are aggressive. Our approach offers a reliable platform by which multiple permutations of biofuel production can adopt a common logistical approach for storage and transport. The result will be a system that approximately mirrors that of gasoline/diesel storage and distribution. This will speed adoption as it will be symbiotic to the already well known distributor/end user experience.

## ASEMBLON'S GOALS FOR HYDRNOL DEMONSTRATIONS POINTED TO COMMERCIALIZATION

As the fundamental technology is well established, we are working with numerous States and Municipalities to locate opportunities to demonstrate scalability of the aforementioned HYDRNOL applications. Our objective is to learn what application will be of the best benefit for each entity, and demonstrate our ability to address that need. Ultimately, we will have provided numerous, and in some cases overlapping, demonstrations of the technology to furnish real world validation of our economic and logistical analyses.

Appendix 1 outlines suggested pilot opportunities where the HYDRNOL technology can be demonstrated, within California. The opportunities are contingent on Asemblon delivering the core technology and the budget numbers are the current best estimate. A detailed timeline and budget will be provided upon request.

## FUNDING MAXIMIZATION AND TAX REVENUE ENHANCEMENT LINKED TO ACCELERATED DEPLOYMENT

The early placement of a hydrogen fueling infrastructure will provide the necessary basis for investment by automobile manufacturers in hydrogen compatible vehicles. There is a disincentive for these manufacturers to provide vehicles which cannot be conveniently fueled as their customer base will require convenience, given well established fueling and driving habits, in order to invest in one of these vehicles.

The traditional time-to-market for automotive innovations is approximately 7 years from idea conception to full commercialization. While several hydrogen related designs (fuel cells, ICE's, hybrids) are in design now, the requisite investment by the auto manufacturers to force their profusion will not occur meaningfully in the absence of the needed fueling infrastructure.

HYDRNOL can economically retrofit existing fueling stations to dispense hydrogen fuel for either hydrogen compatible ICE's (retrofitted, initially) or fuel cell vehicles. Once demonstrated that existing vehicles can be modified for hydrogen use, the fuel is readily available, the fueling experience is essentially identical to that of gasoline fueling, and the energy equivalent price of hydrogen vs. gasoline is cost competitive, the rate of adoption should accelerate much faster than should the State attempt to deploy conventional hydrogen fueling stations (compressed/cryo) at $2.1 Million/ea. It should be noted that we do not assume government subsidy of the HYDRNOL fuel in this model. Any subsidy would further accelerate the adoption.

Given that the State of California has a pool of funds for hydrogen fueling station deployment that was established based on conventional storage and transport, we now offer the opportunity to increase the utility of those funds by approximately 10 times. Further, whatever taxes may be applied specifically to hydrogen fuels will show revenue at a greatly accelerated rate given the aforementioned strategy, thereby contributing to any subsidy the State might offer to further deploy hydrogen stations, provide capital expenditure assistance to biomass-to-hydrogen facilities, or financial support of other renewable energy approaches which may be germane to California's energy and environmental policies and direction.

California is considering enacting a higher Excise Tax on gasoline to both accelerate road projects and to provide funding for alternative energy initiatives. It has been suggested that an increase of $.39 per gallon be made to provide $.06 additional for road projects and $.33 for alternative energy. This would likely price gasoline at $3.00 per gallon and HYDRNOL at $2.49 per kilogram ($2.29 plus $.21 for the build out of the HYDRNOL infrastructure). The attached spread sheet show the effect of both of these taxes assuming that the number of cars on California highways stays fixed at 23 million while the mix of hydrogen and gasoline vehicles changes.

# DESCRIPTION OF TEAMING RELATIONSHIPS TO SUPPORT THE PILOT AND COMMERCIALIZATION EFFORTS

Asemblon fully understands that its expertise is founded in science and that it requires seasoned assistance in engineering, systems integration, logistics, and public relations. As a result we have a well defined Teaming strategy, tied to our scalability demonstration plan that will allocate the appropriate tasks to experts in their respective fields. Further, as we demonstrate each HYDRNOL application, our objective will be to develop consortia in order to sequence each of the components of the product roll out with the others so that all the needed aspects of the system will come on line concurrently.

As an example, we are in discussions with Battelle Energy to optimize our catalysts on a fast track.

Our economic models show increased revenues per kilogram (gallon) to the fueling station owner (above the industry average for gasoline) and, given the low cost to outfit a fueling station, a comparatively rapid return on their investment.

Ultimately, our objective is to license the various aspects of our technology to others better positioned to address the specific needs of their market.

In closing, we offer our sincere thanks for your review and consideration of this proposal. California continues to show genuine leadership in the march toward energy independence and environmental stewardship. The courage and political will shown by California's officials will have significant repercussions for the World far into the future. We believe that HYDRNOL, once demonstrated, will become a significant tool by which the United States can secure itself geopolitically, environmentally, and economically.

Sincerely,

Asemblon, Inc.

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# APPENDIX A

| | | | | |
|---|---|---|---|---|
| | | **HYDRNOL Fueling Station Proposal** | | 5-May-09 |
| | | | | Page 1 of 1 |
| | | | | Version 2.0 |
| **Basic HYDRNOL™ Service Station** | | | **Price** | |
| | **20-Foot Shipping Container** | | | |
| | | Fabrication to Specification | | |
| | | Painting and Graphics | | |
| | **Fuel Bladders (4)** | | | |
| | | Production Bladders | | |
| | | Installation and Testing | | |
| | **Fueling Pumps (4)** | | | |
| | | 1 HP with Soft-start Motor Controllers | | |
| | **Battery Back-up Power System and Conditioner** | | | |
| | | Purchased Parts (batteries, inverter) | | |
| | | Installation and Testing | | |
| | | **Sub-total Basic HYDRNOL Service Station** | 198,650 | |
| **HYDRNOL™ Service Station Accessories** | | | **Price** | |
| | **Renewable Energy Power System** | | 43,000 | |
| | | Purchased Parts (3kW solar, 4 kW wind) | | |
| | | Installation and Testing | | |
| | **Self-Contained Security System** | | 16,000 | |
| | | Purchased Parts (lighting, video, motion) | | |
| | | Installation and Testing | | |
| | | **Sub-total HYDRNOL Service Station Accessories** | 59,000 | |
| | | **Total HYDRNOL Service Station with Accessories** | 257,650 | |
| | | **HYDRNOL 6,500 psi Conversion and Compression Prices CEC April 2009** | | |
| **HYDRNOL™Conversion and Compression Unit** | | | **Price** | |
| | **20-Foot Shipping Container** | | | |
| | | Fabrication to Specification | | |
| | | Painting and Graphics | | |
| | **Triple-stage Compressors** | | | |
| | | Triple-stage Compressor to 6,000 psig | | |
| | | Plumbing, Valves, Controls | | |
| | **Hydrogen Storage Tanks ( 2 at 6,500 psig)** | | | |
| | **Hydrogen Dispensers (5,000 psig)** | | | |
| | | Purchased Parts | | |
| | | Installation and Testing | | |
| | | | 339,500 | |
| **HYDRNOL™Conversion and Compression Unit** | | | **Total** | |
| | **Self-Contained Security System** | | 32,500 | |
| | RFQ | Purchased Parts (lighting, video, motion) | | |
| | | Installation and Testing | | |
| | | **Total HYDRNOL Conversion and Compression Unit** | 372,000 | |
| | | **Total HYDRNOL Conversion and Compression Unit** | 629,650 | |

# APPENDIX B

**Asemblon Pilot Demonstration Proposals**

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Version 2.5

**Proposal 1 - Retrofitted Legacy Vehicles plus 4 HYDRNOL Stations**

| | Qty. | Price | Extension |
|---|---|---|---|
| **HYDRNOL Only Fueling Station** | 4 | 257,650 | 1,030,600 |
| **Legacy Vehicle HYDRNOL HICE Retrofit Kits** | 200 | 5,000 | 1,000,000 |
| | | **Total Proposal 1** | 2,030,600 |

Proposal assumes a geographic entity 20 miles in diameter located close to potential hydrogen feedstocks such as landfill methane, biomethane from cattle or agricultural waste or wind or solar to hydrogen sites.

Participation by an automobile dealership or manufacturer to limit the number of vehicle types to be converted to 2 is essential. Consumers would be asked to pay $3,500 per vehicle.
The cost of a centralized rehydrogenation facility to supply 2,600 kg/day would be $1.9M (Proposal 4)

**Proposal 2A - Fleet Vehicle HYDRNOL Conversion Demonstration**

| | Qty. | Price | Extension |
|---|---|---|---|
| **HYDRNOL Only Fueling Station** | 1 | 257,650 | 257,650 |
| **Diesel HYDRNOL Co-combustion Retrofit Kits** | 10 | 10,000 | 100,000 |
| | | **Total Proposal 2A** | 357,650 |

This proposal could be made to the Ports of Los Angeles and Long Beach, the Los Angeles Unified School District or land-side diesel vehicles in use at the Los Angeles International Airport.

Data would be collected in Phase I and the demonstration project expanded based on favorable emission reductions of nitrous oxides, carbon dioxide and 2.5 particulates (soot). Requires Proposal 4.

**Proposal 2B - Expanded Fleet Vehicle HYDRNOL Conversion Demonstration**

| | Qty. | Price | Extension |
|---|---|---|---|
| **HYDRNOL Only Fueling Station** | 3 | 257,650 | 772,950 |
| **Diesel HYDRNOL Co-combustion Retrofit Kits** | 90 | 10,000 | 900,000 |
| | | **Total Proposal 2B** | 1,672,950 |
| | | **Total Proposal 2A + 2B** | 2,030,600 |

Requires the re-hydrogenation facility outlined in Proposal 4.

**Proposal 3 - HYDRNOL "Smart Grid" Demonstration**

| | Qty. | Price | Extension |
|---|---|---|---|
| **HYDRNOL Storage Tank 10,000 gallons** | 1 | 100,000 | 100,000 |
| **Wind-to-Hydrogen Electrolysis (50 kg/day)** | 1 | 2,500,000 | 2,500,000 |
| **Hydrogen Fuel Cell 250 kW** | 1 | 1,000,000 | 1,000,000 |
| **Dehydrogenation facility** | 1 | 1,000,000 | 1,000,000 |
| | | **Total Proposal 3** | 4,600,000 |

Requires Proposal 4 Central Re-hydrogenation Facility

**Proposal 4 - HYDRNOL Central Re-hydrogenation Facility***

| | Qty. | Price | Extension |
|---|---|---|---|
| **HYDRNOL Re-hydrogenation 2,600 kg/day** | 1 | 1,900,000 | 1,900,000 |

*Annual plant output of 949,000 kilograms would supply all of the above plus expanded demand.

# APPENDIX C

**Bass Adoption Curve for California Legacy Vehicle Market**

| | | | | | | | 27-Apr-09 |
|---|---|---|---|---|---|---|---|
| **Key Assumptions** | | Average Miles/year | 15,000 | | | | Version 2.0 |
| | **Bass Model** | Average Miles per Gallon | 25.2 | CO2/kg SMR | 10 | | Page 2 of 2 |
| **Total Market** | 23,000,000 | Average Miles/kilogram | 32 | Mkg - CO2 SMR | 5,000 | | |
| **Target Penetration** | 40% | Kilograms/fill-up | 5 | CO2/kg Green | 20 | | |
| **Penetration (m)** | 9,200,000 | H2 Required/vehicle | 469 | Mkg CO2 Green | 10,000 | | |
| **Innovation (p)** | 6.00% | Fill-ups/vehicle/year | 94 | Gasoline Tax | 0.06 | | |
| **Imitation (q)** | 10.00% | HYDRNOL Tax Increase | $0.21 | Alternative Tax | 0.33 | | |

| Year | Cars and Light Trucks Cummulative | Cars and Light Trucks Annual | Miles Driven (milliions) | Hydrogen Consumed (Mkg) | HYDRNOL Tax Revenue ($000's) | Gasoline Vehicles (Total - H2) | Gasoline Consumed (M gallons) | Road Improv Tax ($000's) | Alternative Energy Tax ($000's) |
|---|---|---|---|---|---|---|---|---|---|
| **2010** | 0 | 0 | 0 | 0 | 0 | 23,000,000 | 13,690 | 821,400 | 4,517,700 |
| **2011** | 150 | 150 | 1 | 0 | 0 | 22,999,850 | 13,690 | 821,400 | 4,517,700 |
| **2012** | 900 | 750 | 8 | 0 | 0 | 22,999,100 | 13,690 | 821,400 | 4,517,700 |
| **2013** | 5,900 | 5,000 | 51 | 2 | 420 | 22,994,100 | 13,687 | 821,220 | 4,516,710 |
| **2014** | 35,900 | 30,000 | 314 | 10 | 2,100 | 22,964,100 | 13,669 | 820,140 | 4,510,770 |
| **2015** | 589,322 | 553,422 | 4,689 | 147 | 30,870 | 22,410,678 | 13,340 | 800,400 | 4,402,200 |
| **2016** | 1,161,120 | 571,798 | 13,128 | 410 | 86,100 | 21,838,880 | 12,999 | 779,940 | 4,289,670 |
| **2017** | 1,744,910 | 583,790 | 21,795 | 681 | 143,010 | 21,255,090 | 12,652 | 759,120 | 4,175,160 |
| **2018** | 2,333,612 | 588,702 | 30,589 | 956 | 200,760 | 20,666,388 | 12,301 | 738,060 | 4,059,330 |
| **2019** | 2,919,764 | 586,152 | 39,400 | 1,231 | 258,510 | 20,080,236 | 11,953 | 717,180 | 3,944,490 |
| **2020** | 3,495,891 | 576,127 | 48,117 | 1,504 | 315,840 | 19,504,109 | 11,610 | 696,600 | 3,831,300 |
| **2021** | 4,054,887 | 558,996 | 56,631 | 1,770 | 371,700 | 18,945,113 | 11,277 | 676,620 | 3,721,410 |
| **2022** | 4,590,364 | 535,477 | 64,839 | 2,026 | 425,460 | 18,409,636 | 10,958 | 657,480 | 3,616,140 |
| **2023** | 5,096,941 | 506,577 | 72,655 | 2,270 | 476,700 | 17,903,059 | 10,657 | 639,420 | 3,516,810 |
| **2024** | 5,570,440 | 473,499 | 80,005 | 2,500 | 525,000 | 17,429,560 | 10,375 | 622,500 | 3,423,750 |
| **2025** | 6,007,977 | 437,537 | 86,838 | 2,714 | 569,940 | 16,992,023 | 10,114 | 606,840 | 3,337,620 |
| **2026** | 6,407,951 | 399,974 | 93,119 | 2,910 | 611,100 | 16,592,049 | 9,876 | 592,560 | 3,259,080 |
| **2027** | 6,769,945 | 361,994 | 98,834 | 3,089 | 648,690 | 16,230,055 | 9,661 | 579,660 | 3,188,130 |
| **2028** | 7,094,567 | 324,622 | 103,984 | 3,249 | 682,290 | 15,905,433 | 9,468 | 568,080 | 3,124,440 |
| **2029** | 7,383,253 | 288,686 | 108,584 | 3,393 | 712,530 | 15,616,747 | 9,296 | 557,760 | 3,067,680 |
| **2030** | 7,638,057 | 254,804 | 112,660 | 3,521 | 739,410 | 15,361,943 | 9,144 | 548,640 | 3,017,520 |
| **2031** | 7,861,450 | 223,393 | 116,246 | 3,633 | 762,930 | 15,138,550 | 9,011 | 540,660 | 2,973,630 |
| **2032** | 8,056,143 | 194,693 | 119,382 | 3,731 | 783,510 | 14,943,857 | 8,895 | 533,700 | 2,935,350 |
| **2033** | 8,224,938 | 168,795 | 122,108 | 3,816 | 801,360 | 14,775,062 | 8,795 | 527,700 | 2,902,350 |
| **2034** | 8,370,614 | 145,676 | 124,467 | 3,890 | 816,900 | 14,629,386 | 8,708 | 522,480 | 2,873,640 |
| **2035** | 8,495,839 | 125,225 | 126,498 | 3,953 | 830,130 | 14,504,161 | 8,633 | 517,980 | 2,848,890 |
| **2036** | 8,603,115 | 107,276 | 128,242 | 4,008 | 841,680 | 14,396,885 | 8,570 | 514,200 | 2,828,100 |
| **2037** | 8,694,744 | 91,629 | 129,734 | 4,054 | 851,340 | 14,305,256 | 8,515 | 510,900 | 2,809,950 |
| **2038** | 8,772,810 | 78,066 | 131,007 | 4,094 | 859,740 | 14,227,190 | 8,469 | 508,140 | 2,794,770 |
| **2039** | 8,839,177 | 66,367 | 132,090 | 4,128 | 866,880 | 14,160,823 | 8,429 | 505,740 | 2,781,570 |
| **2040** | 8,895,494 | 56,317 | 133,010 | 4,157 | 872,970 | 14,104,506 | 8,396 | 503,760 | 2,770,680 |
| **Totals** | | | 2,299,026 | 71,847 | 15,087,870 | | 330,528 | 19,831,680 | 109,074,240 |