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Recommendations to Restructure Hydrogen Highway for Success

I do not know who laid out the California Hydrogen Highway for the Governor, but it is poorly considered and seemingly designed to fail. It avoids most of the populated areas north of L.A. - THE COAST! These are the areas that are likely to buy these vehicles. Even more than in L.A., San Diego, or S.F. Not just on a per capita basis, but in total. These are the areas where environmental consciousness is highest. People who live on the coast and love the ocean, will fight hardest to prevent off shore oil drilling, and can afford to purchase Fuel Cell Electric Vehicles (FCEVs) upon first deployment. These are where they need to be placed, if you want it to succeed.

Instead you have it going through central California. A mostly economically depressed area, populated by mostly poor agricultural workers with no interest in the environment or alternative energy, just trying to get by and pay their bills, and mostly truck stops, as well as extremely rightwing power brokers not at all interested in alternative fuels!

You avoid Oxnard, Pismo Beach, Santa Barbara, San Luis Obispo, Monterey, Salinas, Santa Cruz, Sebastopol, Santa Rosa, Garberville, Fortuna, Eureka, etc.

On top of that you are offering to fund only 11 stations for $40 million??? For $40 million we could install at least 30, and possibly 40 fueling stations!!! These numbers sound suspiciously like what the major oil companies are requiring based on gasoline sales for a busy station – 1700 kg/day, and a fill-up of 20+ kg or gge (gge - gallon of gasoline equivalent) ??? Did someone forget that a FCEV is at least 3X as efficient (70-90 MPGge. or kg) as a gasoline ICE (Internal Combustion Engine), and no FCEV will ever carry on board more than 7 – 10 kg (gge)? Hence, at best there would need to be only 1/3 that capacity (500 – 600 kg/day) when market penetration reaches 90 – 100%. In the interim, 360 kg/day will more than meet the capacity needed for the role out of FCEVs by the major auto companies. As market penetration increases, stations would be expanded to meet that increased demand.

I propose a new Hydrogen Highway for success. Starting out with 100 stations for under $1 million per station (I have the numbers in the following pages – read on) from San Diego up the I-5 to San Clemente, then Highway 1 - Sepulveda (the longest surface street in the world) to Oxnard, then the 101 up to Eureka, with clusters of 20 in S.D., 30 in L.A., 25 in S.F. Bay area including San Jose, 5 in Sacramento, and the remaining 20 distributed between those cities along 101 and Sepulveda to Eureka and 1 station in Crescent City on the border with Oregon. Hence, your Hydrogen Highway for Success. Along the highest populated areas, in Air Pollution Non-attainment areas where it is most needed, and it connects the highways most used by both Californians and tourists from border to border.

We at HyGen have recruited independent fueling station owners to site these renewable/sustainable hydrogen-fueling stations up and down the coast, and in clusters throughout all of the major cities as well.

For more detail of this concept, with some cost estimates, please read the following concept paper.

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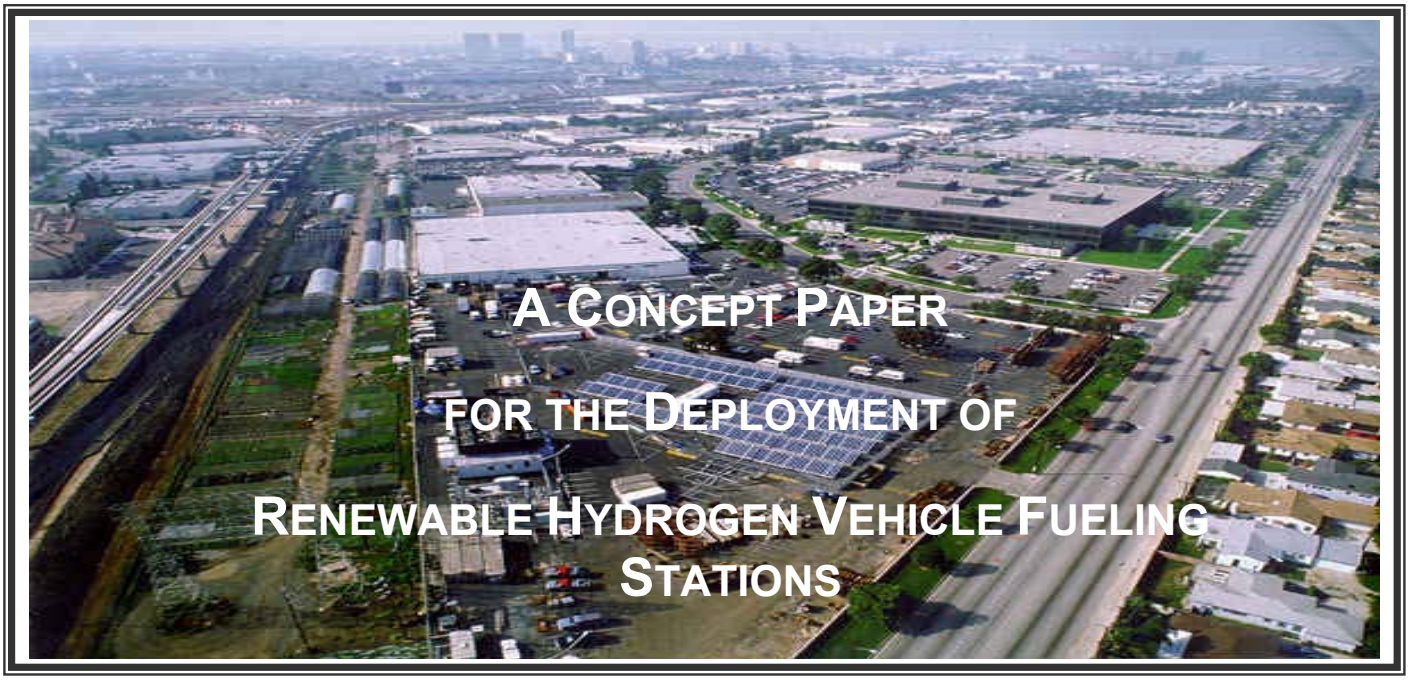
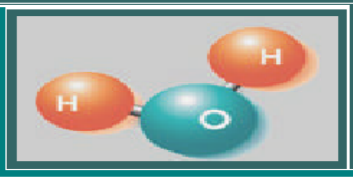
6/16/2009



FOR MORE INFORMATION ON INVESTMENT OPPORTUNITIES IN HYGEN, OR ANY PROPOSED PROJECTS, CONTACT THE COMPANY AT 707-667-5329 AND YOU WILL BE PROVIDED WITH THE NECESSARY DOCUMENTS.

CITY OF SANTA MONICA
RENEWABLE HYDROGEN VEHICLE FUELING STATION



Sponsoring Participants:
- The City of Santa Monica Department of Environmental and Public Works Management - Host & Facility Location Manager and Owner
- South Coast Air Quality Management District, Technology Advancement Office - Facility Funding.
- Air Products, Inc. - Fueling Dispenser Manufacturer, Facility Design, Installation & Project Manager.
- Quantum Technologies - Vehicle Conversions

Additional Participants:
- Proton Energy - PEM Electrolyzer Fueling Station Manufacturer
- HyGen Industries - Program and Project Developer
- Matrix Engineers and Contractors: Facility Construction, and Installation
- Clean Air Now - Public Education & Relations

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I Executive Summary

HyGen Industries ("HyGen" or “HGI”), a California Company, is organized to produce and distribute renewable hydrogen fuel and generation technologies, and systems to meet the ever-increasing demand for cost effective, clean renewable energy and transportation fuel. HyGen will also market the systems that produce, dispense, distribute, and use hydrogen as a fuel.

HyGen's vision is to help establish the world's first pilot commercial scale renewable hydrogen generating and distribution network, which will includes up to 100 hydrogen fueling stations installed at customer convenient locations throughout Southern and Northern California. These facilities will be strategically located at current fueling stations in urban areas and along freeways. These facilities will establish at the commercial level what has already been demonstrated successfully at the 40kW Xerox El Segundo facility (Which the HyGen Team, mostly the same team, that developed the project for Clean Air Now), and the City of Santa Monica Project and Program (which HyGen developed) and the Five City Southern California Program (developed out of the Santa Monica Project) – that hydrogen can be generated increasingly economically and safely using renewable energy in larger systems. Renewable power will be provided by various projects planned i.e., expansion to the Gigawatt (GW) scale through a plan to site large renewable energy (solar, wind) facilities near Albuquerque, New Mexico, where a 2.5GW wind facility is proposed and planned in the desert, as well as facilities proposed and planned in California, and other locations throughout the SW. Renewable power (especially off peak generated renewable power) will be wheeled to power the fueling stations.

This network of fueling stations is intended to capture part of the multi-billion dollar market that is supported by federal, state and local mandates for alternative energy and clean fuels for transportation. These mandates are in effect now and are expected to increase over the next decade. Also, with billions of tax bailout dollars invested in the auto industry with an expected requirement to deploy more efficient, cleaner fuel vehicles – who have already invested billions into hydrogen fuel cell vehicles, funding to support this effort should be more forthcoming than in the past. Whether in low interest loans, cooperative agreements, public/private partnerships, or as grants, why? Because renewable/sustainable hydrogen, the ultimate zero-emission fuel, will exceed all existing federal and state clean air standards, as well as establish a truly sustainable renewable energy and fueling infrastructure, as well as to meet the administration’s goal to be free of Middle East oil within a decade. We plan to work with auto dealerships/manufacturers to offer incentives for fuel purchasing, as well as independent commercial gas stations to site them. Any DOE review committee would view this effort positively.

Currently, our primary start-up market for hydrogen is California (although we are open to deployment elsewhere if the conditions are favorable). However, our goal is to incrementally expand throughout the nation and the world. In order to produce this environmentally benign hydrogen fuel, natural resources such as solar, wind, geothermal, and marine energy will be harnessed. We also propose to advocate that the DOE fund, through the coming energy plan, as well as the recently approved stimulus package, a major mass production facility of developed cutting edge photovoltaic (PV) technologies validated by Sandia and NREL, in order to produce high efficiency PVs (30 – 40%), and low cost PVs at a price that will compete with fossil fuels, i.e., $1.00 - $3.00/watt.

I Executive Summary (continued)

Joining us in this effort through a Business & Strategic Alliance is (and is expanding):

- ✧ Abovo Environmental Systems - Engineers and Contractors,
- ✧ Honda Motor Company,
- ✧ The Energy Coalition,
- ✧ Clean Air Now,
- ✧ Strategic Partners,
- ✧ Los Angeles Community College District (L.A.C.C.D.), and other educational institutions,
- ✧ Independent Petroleum Distributers (To Be Announced in a full proposal for an RFP)
- ✧ as well as equipment manufacturers, experts, scientists, and advocates from the private, government, and non-governmental sectors statewide and nationwide (To Be Announced in a full proposal for an RFP).

Our venture is divided into 2 phases: Start-Up Phase, and Operation Phase. The following highlights major activities that we plan to accomplish for each phase.

The First Phase: Start-up
This phase will involve:

- ✧ completing engineering drawings,
- ✧ signing contracts & securing licensing agreements,
- ✧ signing agreements with power generating equipment manufacturers and/or power purchasing agreements with renewable power generators,
- ✧ completing detailed operational and marketing plans,
- ✧ obtaining financing.

Upon completion of this phase, we will be ready to procure the equipment for and install the up to 100 fueling stations in locations consistent with Governor Schwarzenegger's Hydrogen Highway Program, as well as the D.O.E. and advocates "Hydrogen Infrastructure Cluster" approach which focuses on high density urban deployment which exists along the California Coast via Highway 101. We will also be ready to convert vehicles to run on hydrogen. The vehicles will be converted either through OEM Converters, or directly from the OEM utilizing technology developed by HyGen's team, as well as introduce to the market hydrogen fuel cell electric vehicles (HFCEVS) that OEMs have invested billions developing as per the agreement that they signed with the ARB instead of being required to deploy battery electric vehicles which failed to sell when introduced in the 1990s due to operational and performance limitations. This phase will take 18 months to complete. Some of this work has already been completed.

The Second Phase: Operation
The Operation Phase will take up to two years to achieve with the first year procuring the equipment and one year for installing the fueling stations, and to implement the detailed operational and market development plans completed during the Start-Up Phase. We plan to be in full operation in year 3 of this phase.

I Executive Summary (continued)

In addition, in the full commercialization phase, HyGen plans to invest in generating electricity from renewable sources, supplemented with additional energy from renewable resources, and transmit them via grid to our fueling station customers. We expect to be able to generate hydrogen for retail sale at about $3.00 - $4.00/kg (kilogram = a little more than a gallon of gasoline equivalent = gge), if mass production of PVs is funded, lower energy prices will lower this cost significantly to below $2.00/gge in the full commercialization phase.

Some of this renewable energy infrastructure will be developed at a cost of approximately $600M, capable of carrying 2GW of generated wind and solar renewable energy from the Class 4-5 Wind Zone of New Mexico, to meet a currently-planned construction of a 2GW, 500kV transmission line between Southern California and Phoenix, Arizona providing 2GW of fully-renewable wind energy @ under $0.04 per kw/h, produced internally. Additionally, this 2,000 wind-turbine project will result in approximately 2 Million acres of land under lease in the high-plains chaparral country of New Mexico that will be available at no additional expense, for the purpose of generating collateral solar energy. We believe that this aspect of the vision could be 100% funded through the economic stimulus by funding the mass production of PVs.

Sale from electricity, fees from installing fueling stations will generate millions in revenue from brokering this renewable energy produced and sold for generating the hydrogen, as well as other systems installations expected to be stimulated from this initial network development. We project, conservatively, that revenues will increase at least 5% per year, thereafter.

Employment Estimate: Although the estimate is preliminary and, we estimate to produce over 100 full time and 50 part time (1.5 FTE/Station) permanent jobs for trained technicians to maintain the 100 initial fueling stations throughout California, as well as over 1,000 full time jobs over the duration of the manufacture and installation of the facilities, increasing as the expansion of the network continues to grow.

A curriculum will be developed for educational institutions, which will be invited to participate (especially L.A.C.C.D. and colleges throughout the state and the nation), to train engineering students to install and maintain these facilities, as well as training technicians for day to day maintenance and future project development.

During this phase, we will be monitoring closely the viability of the operation and improving on the systems design of the distributed network concept. Our plan is to be ready for The Full Commercialization Phase implementation by the fourth year of the Operation Phase.

The Full Commercialization Phase constitutes the full-scale deployment and/or expansion of the pilot network into full-scale deployment at all gasoline stations nation wide. Upon the advent of this phase we will ask legislatures to pass regulations requiring all licensed fuel distributers to provide access to their outlets to install these fueling facilities at all locations, whether paid for by themselves or by independent contractors, or the government.

Investment Opportunity
Currently, we are seeking funding for both the Start-Up Phase and the Operation Phase.

I Executive Summary (continued)

Start-Up Phase: $2,200,000 required funding.
If privately funded: Profit and Return on Investment - Upon completion of Phase II, full repayment of debt plus 20% on the principal, and commensurate equity portion of company ownership.

Value Added Benefits to be derived from Start-Up Phase for the Investor:

- Contracts/purchasing agreements from end use customers for system installations, vehicle conversions, and fuel purchases. In normal time, this accomplishment should be bankable at many commercial financial institutions, or for a successful IPO, or second funding phase. However this should be very attractive for federal funding in the Obama Administration Energy and Economic Stimulus Plans.
- Licensing of technologies that will make HyGen uniquely competitive for years to come.
- Contracts from Original Equipment Manufacturers (OEMs) to produce vehicle conversions in mass production for distribution to their natural gas end use customers as well as to the general public, and generation for fueling stations.
- Blueprints and permit approvals for the siting of the fueling facilities, as well as blueprints for remote distribution facilities and/or fueling stations.

Operation (Deployment) Phase): Approx. $100 M required for funding fueling infrastructure.
The second phase funds will be used to procure equipment, construct and install the fueling stations. Also fund general and administrative related expenses, and provide mass production investment credit in companies that provide primary components of the facilities leading to technology ownership.

II PROJECT TECHNICAL SUMMARY

The energy system will produce at least 2.4GWh/day of clean sustainable and renewable power for on-site generating fueling systems for stations to serve Ultra Low Emission Vehicles, Zero Emission Vehicles and Equivalent Zero Emission Vehicles (ULEV/ZEV/EZEVs). Key technical elements to the project are summarized below:

1. **Energy System:** The energy system will utilize up to 2.4 GWh/day of either:
   - ✧ Linear Focus Fresnel Lenses, w/high efficiency semi-conductor solar photovoltaic arrays, or 41% efficient Gallium Arsenide PV Cells from Boeing SpectroLabs, or,
   - ✧ Stirling/Genset solar thermal arrays (or a technically and economically appropriate combination thereof), and/or,
   - ✧ Wind power a grid of wind turbines on-site, or wheeled from another location, purchased from the grid, or generated and put on the grid by our own generation facilities.
   - ✧ Our team will also advocate and participate in projects to deploy, if viable, wave energy generator systems off the coast to provide additional consistent wave energy, or contract for its power.

   Or a combination of or: all of these strategies including the purchase of green tag energy from the grid or from preferred sources.

2. **The Fuel Generation System:** These systems will convert water to hydrogen (and oxygen) through electricity supplied from the renewable sources wheeled to them from remote locations utilizing Proton Exchange Membrane (PEM) Electrolyzers. This will serve the energy needs of the potentially huge Southern and/or Northern California markets. PEM electrolyzers utilize a solid polymer electrolyte rather than a liquid electrolyte, eliminating the need for liquid potassium hydroxide in the electrolyzing process and increasing the efficiency.

   Maximum Possible Fueling Facility Footprint Requirements: Total – 161 sf.

   - ✧ Electrolyzer Footprint: = 82 sf. 15kg/hr (360kg/day, KG – Kilogram = 1.1 Gallons of gasoline equivalent (gge) in energy/KG = 396 gge) 189.24" (15.77/16') L x 62.24" (5.2/5') W x 126.2" (10.5/10') H
   - ✧ H2 Storage foot print: = 50 sf. 144,000 scf @ 6,000 psi. storage – 1 sixpack of tubes – 24,000 scf ea. / = 10' L x 5' W x 4' H.
   - ✧ Compressor Footprint: 10 sf. (20 sf w/back-up) 48" (4') L x 30" (2.5') W x 33" (2.75') H
   - ✧ Dispenser Footprint: 3' x 3' = 9 sf. ?? Dispenser space on island.

3. **Fuel Storage and Transmission System:** HyGen, in conjunction with a fuel storage & systems manufacturer will provide vehicle and energy fueling and storage systems that will be capable to integrate with current natural gas systems, as well as hydrogen vehicles and systems simultaneously. A PEM Electrolyzer Manufacturer will integrate their electrolyzer system into the fueling system. At least 100 fast fill fueling systems will be provided that will have the capability of fueling multiple vehicles in succession in under ten minutes each with either hydrogen, natural gas, or any mixture of either.

II PROJECT TECHNICAL SUMMARY (continued)

Product Description: HyGen Industries will focus on 3 main product lines:

1. Renewable energy and hydrogen fuel for transportation,
2. Integrated Generation Systems for fueling stations, and,
3. Internal Combustion Engine (ICE) conversions.

The following are some general estimates of fueling station costs and ICE vehicle conversion costs (OEM vehicle costs above the OEM standard price), and are based on full scale deployment as outlined below. The estimates for the fueling stations are based on Light Duty Vehicle requirements; however, one can easily extrapolate the requirements for Heavy Duty and mass transit vehicle requirements. The technical specs are, for the most part, identical. Just the volume of hydrogen is different for each vehicle. The cost of the electrolyzer part of the system will likely be higher for a system by system deployment, however, that will be determined on a project by project basis. The cost of the vehicles will be determined by the commitment by the OEM Vehicle Converter and again, on a project by project basis.

Fleet Operated Fueling Station Assumptions and basis for cost figures:	
# of fueling stations:	30
# of vehicles supported at each station:	225.
Average Vehicle mileage (H2 efficiency included)	31mpg equivalent.
Average Vehicle miles traveled/year:	12,000 miles.
@~390 scf of H2 per gal-gas Btu content equivalent	
H2 required for each vehicle @ 50 work weeks:	151,000 scf/yr; 3,020 scf/wk;
	604 scf/day.
225 vehs/station x 604 scf/day required =	136,000 scf of H2/day required.
136,000 scf/day / 24 hrs./day =	5,667 scf/hr needed to be generated.
1,000 Watts (1kWh) of electricity needed to make	
8 scf of H2 by electrolysis of water. 5,667 scf/h / 8 scf/kwh =	708 kW/hr. "system" needed.
Capital cost of electrolyzer:	$.625/Watt.
Breakdown of Fueling Station Costs:	
1. 708 kW/hr x 1,000 Watts/kW x $.625/Watt =	$442,500 electrolyzer cost.
2. Historical cost for fueling island:	$50,000
3. Historical cost for dispenser:	**$125,000**
4. Historical cost for metering system:	$10,000
5. 70,000 scf of storage @ $.65/scf storage =	$45,500
6. Historical cost of installation:	$75,000
7. Contingency @ 10%:	$64,800
8. Total Cost to HyGen for fueling station:	**$812,800**
9. HyGen Fee @ 10%:	**$82,000* Labor & Admin./station**
10. Total Cost of Installed Fueling Station:	**$894,800**

Vehicle Conversion Buy down:

- SCAQMD ULEV Rebate = $3,000.00
- SCAQMD ZEV Rebate = $5,000.00
- Heavy Duty Carl Moyer State Rebate Fund for Heavy Duty Vehicles = $12,0000.00
- GM Quote for Light Duty Vehicle conversion = $5,800.00 over Stock Price.

II PROJECT TECHNICAL SUMMARY (continued)

HyGen's estimate for ICE vehicle conversion is approx. $5,500.00 with full-scale production. Price will vary on small production runs. Demonstration conversions will need to be priced based on engine class, vehicle model, and quantity. New engine classes are considered R&D and will cost considerably more, although there are funding mechanisms in place to achieve this.

OTHER ASSUMPTIONS AND COSTS	
Total capital cost of 30 fueling stations =	***$26,844,000***
Total capital cost of 40 fueling stations =	***$35,792,000.00***
Total capital cost of 100 fueling stations =	**$89,480,000.00**
Cost of electricity at fueling station:	***$0.07*/kWh.* includes profit**
Time for installation of fueling stations:	**2 years from receipt of funding**
1 yr. to manufacture/1 year to install	
Maintenance/operating cost of station:	**0.25 FTE = $15,000/year.**
(less energy cost)	
100 Stations @ 17,000kW-hrs /station/day =	**1.7 gW-hrs /day of electricity total.**
Therefore we need to access *77.917mW/h*-electrical	
(including *10% for compression)* generating capacity for the 30 fueling stations	
77.917mW/h x *$0.07*/kWh x 24hrs/day =	***$130,900*/day for 100 stations. (BP est. 350 days/yr. duty cycle) - $1,309.00/station @ 100% capacity.**
1.7GWhrs./day (70.8MW/hr.) for 100 stations at 100% operation. Start-up minimum: 10% of max. - – 180MWhrs./day (7.5MW/hr.).	***16,992kW/hr. - $118,944/ day for 100 stations max. cap./ $11,894.40 min. cap.***
This works out to *$1,309.00*/day/station to power 225 vehicles.	
Energy Cost/scf = *$1,309.00*/136,000 scf =	***$0.0096258*scf-H2.**
$*$0.009625/scf* x ~390 scf-H2/gal gas equiv. (gge) =	***$3.75*/gge = 3.85/kg H2 (Energy cost)**
+ sys. cost amortization/20 yrs. = $.48/gge,	**$4.23/gge, ($4.34/kg) reduce power cost to 0.04/kwh = $2.625/gge ($2.70/kg)**
Water Consumption: 0.9 lbs h2/gal of H2O. 2.2 lbs = 1 kg - 2.2 lbs. ÷ 0.9 lbs/gal = 2.44 gal. of H2O/KG H2	
360kg/day/staion x 2.44 = 880 gal. max. H2O used/day/Fueling Station @ max. capacity, 88 gal/day @ 10% capacity upon start-up (not factored into cost/kg).	
Sell h2 for $4.50/kg. Potential profit of sale of 13,140,000kg/yr. @ $0.16/kg =	**$2,102,400.00/yr. in net profit b4 tx.**
If funded through energy grant or subsidy, amortization cost /kg will be used for expansion	

These costs are relative to the size of the systems and quantities purchased, but are generally based on our Operation Phase pilot program scale deployment of 30 fueling stations and approximately 6,000 vehicles, although we factor in specs for 100 stations. Scaled up to a Phase 3 Full Scale commercial deployment of several giga-watt systems and over 30 thousand vehicles, the price drops to or below fossil fuel pricing. A larger 100 station pilot program will undoubtedly reduce all item costs significantly.

These figures are conservative and do not take into consideration co-funding or shared investment.

II PROJECT TECHNICAL SUMMARY (continued)

Additionally, in order to facilitate the renewable and sustainability goal of this project, HyGen will be developing power purchasing agreements with renewable power generators around the western U.S. to purchase their currently un-sold, or underused wind power, as well as newly installed wind, solar and other renewable sources. We will also advocate that the D.O.E. fund, in its renewable energy plan, the mass expansion of the manufacturing of Photovoltaic Systems on the multi gigawatt scale in order to lower the costs of proven technologies ready for mass production. Something that only government can do, like building freeways, sewer systems and electric grids. This is what is needed for PV and renewable and sustainable energy systems mass production as well.

As part of our corporate goal, we will continue to conduct media, public and private outreach, and educational activities, as well as develop curricula for job training for engineers and technicians.

We have a name for this Alliance, "S.H.I.P.®"; the "Sustainable Hydrogen Infrastructure Partnership", an alliance involving public/private partnerships involving stakeholders with the goal to deploy renewable/sustainable hydrogen fueling infrastructure.

For more detailed information on HyGen Industries and its Plan
Please contact HyGen Industries

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