

DOCKETED

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Request Review and Consideration on Alternative Concept for the Renewable Hydrogen Transportation Fuel Production Program

Additional submitted attachment is included below.



PowerHouse Energy Americas Zero Emissions Ultra-high Temperature Gasification Renewable Hydrogen Transportation Fuel Production Draft Solicitation Concepts

Introduction:

Powerhouse Energy Americas is pleased to submit for review and consideration an alternative concept for the CEC Renewable Hydrogen Transportation Fuel Production Program. We believe the Zero Emissions Ultra-high Temperature Gasification Technology provides the highest quality and quantity hydrogen conversion process available today. The ZEG Technology, successfully in operation in Europe, would provide California a state-of-the-art gasification technology that is in concert with California's goals and comments to lead the nation in advanced and renewable energy and fuel solutions. We believe this technology is conspicuously missing from the CEC's demonstrations of solutions.

Powerhouse Energy Americas Background Knowledge and Capabilities Re: Subject

- ▶ **Powerhouse Energy Americas and Strategic Partners have the capability to provide and support state-of-the art:**
 - ▶ On-Site Power Generation
 - ▶ Waste-to-Energy (WTE)
 - ▶ Waste-to-Fuel
 - ▶ Waste-to-Hydrogen
 - ▶ Waste/Waste Water Management
- ▶ **Management has over 200 years of combined experience and industry knowledge and over 400 on-site systems installed.**
- ▶ **Manufacturing and Proving Hydrogen Refueling Station to Sunline Transit, CA**
- ▶ **Large US and global market for small to large scale cost effective Hybrid-Solar, Renewable Energy, Waste to Energy, Waste to Hydrogen and Waste to Liquid Fuels Systems, with estimated worldwide market \$28.8 B by 2018.**

Highlights of Zero Emissions Gasification: Technology

Powerhouse Energy Americas WTE Technologies:

- ▶ enable energy recovery from municipal waste streams that would otherwise be directed to landfills and incinerators; or from renewable and alternative fuels such as biomass, brown coal, tires, and plastics to create syngas for power generation or reformed into hydrogen and liquid fuels for transportation- CalRecycle approval for landfill divergent energy technology
- ▶ Produced in 5 Ton per day modules, 25 Ton Per Day Modules, 100 Ton per Systems.
- ▶ Multiple modules can be chained to meet any scale.
- ▶ Proven in Germany, Australia, with Beta Commercial System operating in England.
- ▶ Certified for use in California (strictest environmental regulations) and is EU certified for over 23 waste streams and feedstocks. EPA review with no air quality permit needed for closed loop hydrogen system.

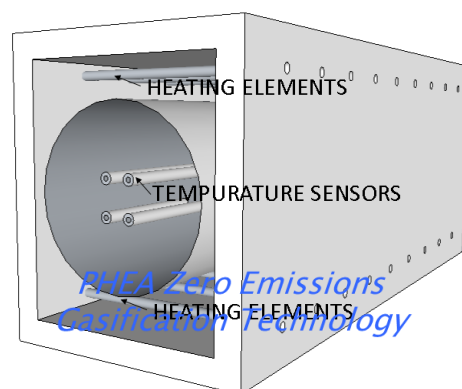


- ▶ Wide range of feedstocks: Waste water sludge, MSW, Organics, Woody Biomass, Plastics, animal waste and Tires.

Zero Emissions Gasification: Process

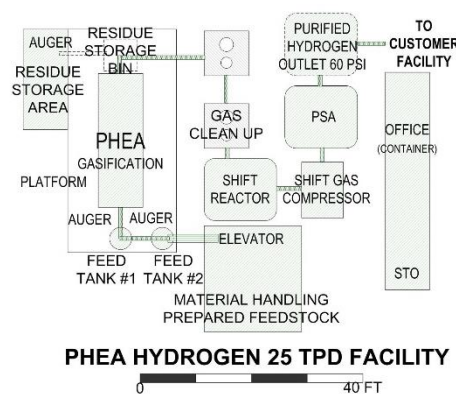
A Carbon Neutral Waste-to-Energy Process

- Ultra-high temperature electric gasification is the destructive distillation of organic materials
- Distillation process involves the application of intense, indirect thermal energy, in the absence of oxygen, which reduces the material to a combustible gas and a hazard-free, non-leachable inorganic recyclable material
- No harmful emissions (closed loop-no smoke stack)
- Gasification of waste streams from waste water sludge, woody biomass, manure, chicken waste and paper that are recycling carbon from the source
- Low energy consumption in process compared to hydrogen fuel product.



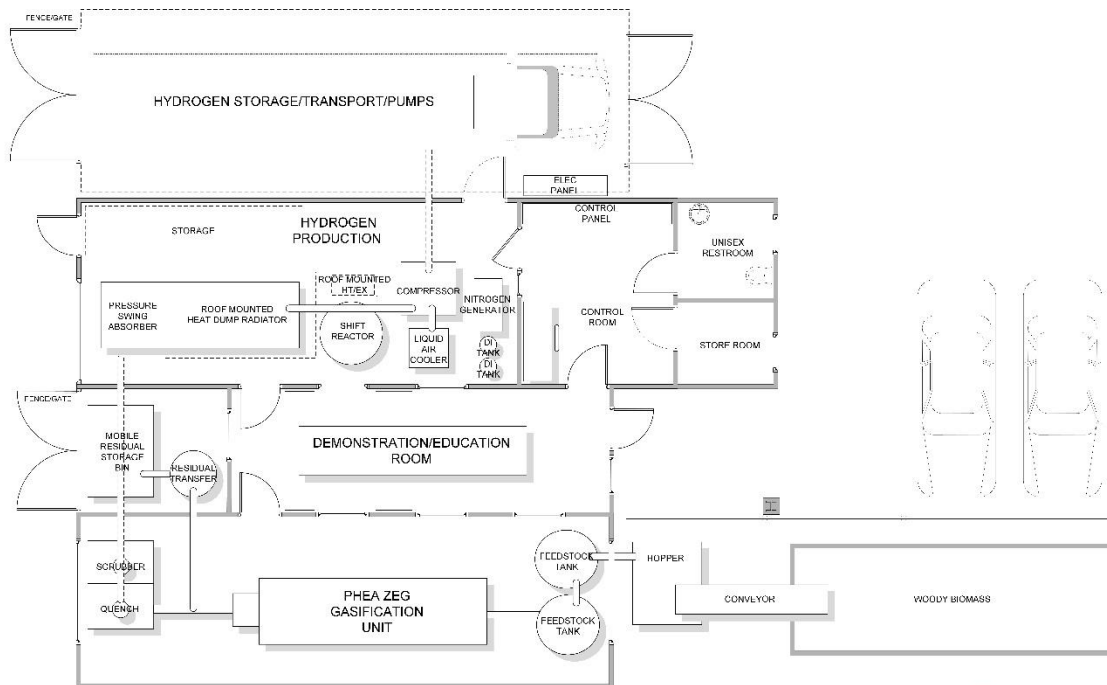
Zero Emissions Ultra-high Temperature Gasification System (ZEGS): Capabilities

- Onsite production of Hydrogen at purity of 99.999%.
- Design sizes of 450 million cu-ft per year to 3,600 million cu-ft per year.
- Reduced operational cost with few moving parts and 95+% conversion of solid material.
- Receive additional competitive lower-cost hydrogen production & reserves
- Reduced carbon footprint
- Develop Green, Renewable Energy & Recyclable Resources
- in line with Green Energy Corporate Mandates



Anticipated Advantages of this Concept

- No air or water emissions (Closed-loop, no smokestack, no odors).
- Meets all state and federal & international emissions & safety regulations.
- Gasifies ALL carbonaceous materials introduced into the Gasifier.
- Most efficient & economical method for converting solid waste into Hydrogen.
- ZEGS are scalable from 5 tons per day (300kg/day @ 99.999%) to 25 tons per day modules (1,500kg/day @ 99.999%).
- ZEGS plants have a small footprint, are community friendly and can be located inside an existing or new Facility.
- Tax and other incentives may apply.
- Operates 24 hrs per day 7 days per year with low maintenance.



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**PHEA ZERO EMISSION GASIFICATION SYSTEM
DEMONSTRATION/EDUCATION CENTER**

8.11.17



California Biomass Availability

One of the requirements within the Hydrogen Program is that it be renewable. The planned offering will utilize agricultural waste biomass that is abundantly available through out California. One source, walnuts shells, are available in excess of 300,000 tons. Almond trees, removed for grove renewal, are another source of biomass that is available. A third source of biomass are the dead trees removed from the Sierras creating a nearly unlimited supply.

Utilizing biomass “green waste” also has the benefit of having various moisture levels available in the feedstock that reduces the need for added water (H₂O) with the H₂ being the desired element. The gasification process does not need pure water so recycled water is an acceptable, reducing demand for higher quality water that may utilized elsewhere.

With California’s abundant sun and growing conditions, Biomass will be available and renewable. In essence, the Biomass becomes stored solar energy.

Financial Benefits

A current solar electrolyzer to hydrogen using \$0.07/kW grid power can produce purified hydrogen at 1,000psi in the range of \$4-\$5 per kg using a 1,500kg/day plant. Preliminary calculations of the current zero emission gasification reformer in the same size can produce the purified hydrogen at 3,500 psi in the range of \$3-\$4 per kg with a 6 year capital recovery. If the waste feedstock is taken for disposal instead of the dump a fee is collected and the payback is 5 years. The gasification reformer operates on a 24 hour schedule. If the solar and battery storage were added to operate the electrolyzer over 24 hours per day the capital cost and hydrogen cost will double. This assumes no incentives for either concept.

We think there is a strong case for expanding the renewable hydrogen technology beyond electrolyzers or digesters that only use a portion of their potential energy taking 20 days for a mixed bed reaction. Several counties in the US and countries outside the US are proceeding with the technology for power generation.