Quantera Energy Resources© Executive Summary

Quantera Energy Resources, Inc.© offers its technology to produce carbon-negative hydrogen at a net rate of less than $0.10 per kilogram plus reduce/eliminate waste landfill use by using carbonaceous wastes as a substrate. Quantera Energy Resources, Inc.© along with its affiliates and associates have been in the waste-to-energy and renewable energy business for over 20 years. Quantera uses a gasification technology similar to that which has been widely used in commercial and industrial applications for more than 60 years for the production of fuels and chemicals.

The unique gasification technology developed by Quantera Hydrogen Gasification© (QHG©) is a proprietary "advance on the art". Our process feeds raw municipal solid wastes (MSW), sewage sludge and other carbonaceous waste streams into a fast pyrolysis/gasification reactor chamber. This reactor operates in an oxygen starved environment at high temperatures that are maintained by the addition of a controlled amount of steam. Under these conditions, rapid chemical reactions occur resulting in complete waste treatment. The outputs from this treatment are hydrogen, a concentrated raw "ore" (slag) derived from the diluted inorganic residues of the MSW, and captured carbon dioxide for sequestration. The carbon-deleted slag is a source of valuable minerals, including strategic rare and precious metals, phosphorous, etc., which are made readily available for isolation and refinement.

Generally for a gasification process, MSW feedstock is dried before being subjected to the pyrolysis stage. Pyrolysis is the thermal decomposition of feedstock into simple molecules in the absence of an oxidizing agent. This process requires an external heat source to generate temperatures in the range of 200°C to 500°C, resulting in a material referred to as syngas (a mixture of hydrogen and carbon monoxide). Generic gasification processes rely on partial oxidation pyrolysis, which use the addition of oxygen or air to drive incomplete combustion of some feedstock in order to maintain temperature. This air/oxygen driven pyrolysis results in a dilution of the syngas with air-derived nitrogen and other undesirable byproducts. In the QHG© fast pyrolysis/gasification process temperature is maintained by using superheated steam from an external source, allowing for a nitrogen gas/oxygen free reaction and the production of concentrated syngas devoid of undesirable byproducts.

The QHG© process can reach temperatures between 1000 to 2000°C, however standard operation falls within the 900 to 1500°C range. This range is important for the quality of the in-process products as syngas composition varies significantly depending on the gasification temperature. Lower temperature (around 600°C) produces more methane as well as tars and particulates. Higher temperature (900°C or greater) allows for maximal hydrogen and carbon monoxide production, while generating insignificant amounts of tar and particulates. After cleaning, the syngas can be used directly as a fuel for electricity generation, synthesis of chemicals and alternate fuels, or further processed to optimize the production of hydrogen. The optimization of hydrogen production involves an additional step called the water gas shift reaction, where the carbon monoxide is converted to carbon dioxide and hydrogen.

The hydrogen yield from the QHG© process is proportional to the amount of carbon in the feedstock. Typical municipal solid waste contains 10% moisture and 36% carbon (wt/wt), which allows for recovery of up to 16.8% (wt/wt) hydrogen. Additionally, our system can be powered by renewable electricity sources; however, a portion of the produced hydrogen (21%) can be recycled to provide the energy for the process. If this is done then the net hydrogen recovered would be 13.26% (wt/wt) of the feedstock.

The Quantera process offers multiple advantages. Unlike steam methane reforming, there is no cost to secure the feedstock, in fact the tipping fee for MSW in Delaware is up to $85 per ton. This tipping fee will be paid to Quantera as income and is projected to be sufficient to meet our operational costs, allowing for hydrogen production at nominally less than $0.10 per kilogram. One ton of MSW will produce from 265 to 320 lbs or 120 to 145 kg of hydrogen, plus approximately 1.3 tons of carbon dioxide to be captured, sold, or sequestered. Since the MSW is 80 to 90% plant based material made from atmospheric carbon dioxide, sequestering the produced carbon dioxide will allow the hydrogen to be considered carbon negative and provide carbon credits which can be sold on the open market. In addition, the elimination of MSW to landfills prevents the uncontrolled release of methane and carbon dioxide into the atmosphere, an advantage in the quest to mitigate climate change. The inorganic residue produced (about 10% wt/wt) is enriched for valuable minerals such as phosphorus and rare earth metals, which have a market value and can be purified through further refinement. The culmination of cheap “greener than green” carbon-negative hydrogen production that is also profitable while simultaneously eliminating landfill problems makes Quantera an unparalleled win-win-win proposition.