

The Day Cycle

The purpose of this system is to simultaneously produce hydrogen, electricity, oxygen, biofuels/biomass, syngas, and other useful products from waste. The waste feedstocks can be—but are not limited to—municipal solid waste (MSW), sewage, biomass, petroleum byproducts, and medical and toxic wastes. The system is designed to operate without the release of harmful emissions or Green House Gasses, and is based on a unique synergy of proven technologies.

In the first stage the plasma syngas generator is tuned for low nitrogen and carbon monoxide levels while maximizing hydrogen levels. For plasma syngas production there are three general supplies of oxygen or combinations thereof used. The first is pure bottled oxygen in which the carbon in the feedstock is converted into carbon monoxide and the hydrogen contained within the feedstock released. The second option for oxygen is to use atmospheric air in which an elevated nitrogen supply is added to the syngas produced (ambient air is approximately 80% nitrogen and 20% oxygen, all else being traces). The third supply of oxygen is for steam to be added. Our chosen supply of oxygen is for the ambient air to be removed from the plasma chamber. This will be done thru active carbon and HEPA filters before gasification. Only steam will be added for any non-feedstock oxygen. During syngas production this will supply the oxygen for carbon monoxide production and add two hydrogen molecules for every oxygen molecule that is added. By minimizing nitrogen in the syngas a water shift reactor (WSR) becomes more efficient, while more hydrogen is produced.

From there the syngas enters a water shift reactor feed steam by a custom-tuned hydrogen power generator. The hydrogen engine will use the high oxygen and low carbon dioxide output from the algae bioreactor as its air supply. This will yield a high steam and low carbon dioxide output for feed to the WSR. By using a water cooling mist or steam cooling on the intake of the engine, we can stay within operating thermal limits for the engine on mainly hydrogen and oxygen and still be reliable. We can do this and avoid the added nitrogen of atmospheric air from entering the combustion process and hence the system. If a higher output temperature is needed for the steam than the engine can supply, one can burn some hydrogen with bioreactor oxygen in the engine exhaust to raise the steam temperature. If one uses catalyst metals less heat energy is required for the chemical reactions, which could help enable one to 'tune' thermal balances and hence the system.

By using syngas production from waste, combined with steam from a hydrogen engine, we can ship out the hydrogen within the syngas and use the engine hydrogen/steam over and over again in a closed loop. This allows hydrogen and electricity production to take place at the same time. This will be done with the base carbon being things we are currently paying to discard and have disappear.

When one looks at the system we are capturing/converting waste heat from plasma syngas production with waste heat from hydrogen engine combustion to enable a water shift reactor. This provides a recirculating loop of hydrogen from otherwise wasted heat energy, and supplies oxygen through photosynthesis in the bioreactor. Another paradigm to view this through is that hydrogen is added in the plasma syngas production while reused through the hydrogen engine feeding the WSR, and is finally added again when the carbon dioxide becomes a hydrogen-rich biofuel, which is absorbed and stored energy from the sun.

There are five primary ways for hydrogen enrichment/release:

- Plasma with steam;
- Water shift reactor–hydrogen engine loop;
- Carbon dioxide to the algae bioreactor, making hydrogen rich fuel from carbon while releasing oxygen. A photosynthesis enabled biological solar collector.
- Water injection to engine intake.
- Bruce Crower Six-Stroke Engine. This turns waste heat to steam and thus enriches hydrogen production.

There are four primary methods of waste heat recovery/use:

- Low grade steam from the plasma;
- Kalina cycle/Ormet Technologies/UTC Power pure cycle for waste heat integration;
- Engine coolant to binary turbine;
- Water shift reactor enabling $(\text{CO} + \text{H}_2) + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 2\text{H}_2$.

Additional points:

- WSR usage and bioreactor fuel production allowing no waste;
- Waste heat recovery for efficiency advances;
- Oxygen and hydrogen production and spent carbon to fuel;
- All metals and silica within feedstock being recovered in molten discharge.

Whatever biomass is re-fed will reduce MSW or chosen feedstock input to the plasma. Some examples of algae use could be:

- Oil from the algae being converted to biodiesel and Centia biofuels;
- Sugars from algae being fermented and used as ethanol/methanol with gasoline;
- Cellulose/fiber being used as feedstock for fiber, paper, wood pellet production;
- Proteins being used towards animal feed;
- Any byproducts being re-fed into the plasma as a hydrogen-rich feedstock.

This is a system that turns carbon into a solar powered loop for hydrogen!

One note about this system. From a personal side when designing this system I believed and still do that shipping hundreds of billions of dollars a year to other nations just to pollute ourselves and make them rich is not a good idea. This systems turns waste and pollution into today and tomorrows energy and resources. This is being done with things that we have already paid for and gathered from the earth. This system just reuses them as leftover ingredients, like when we baked a cake with grandma.

That's the dream!

Using a basic Mass and Energy Balance we produce for export over the fence the following from one ton of average Municipal Solid Waste:

Hydrogen 112 pounds

Algae 1000 plus pounds up to 50% or more oil

Algae Oil 520 pounds or about 70 gallons or about 55-60 gallons biodiesel

Electricity is self sustaining to positive.

Oxygen 926 Pounds

Plus many other useful resources.

We recirculate the waste heat so it isn't vented, and use it for processes within.