



Central Valley Summit

Alternatives to Open Field Burning of Agricultural Wastes

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Jim Stewart

Vice-President – Business Development

Technikon

Chairman of the Board,

BioEnergy Producers Association





About Technikon

A renewable energy consultancy and project developer, formed in 2000 by spinning off the Department of Defense environmental and energy testing center at McClellan Air Force Base.

Beginning in 2006, and for seven years, this 60,000 square foot Testing Center focused its activities on renewable energy, assisting the DOD, Army, Air Force and private companies in the development of gasification and waste-to-liquid fuel technologies.

Technikon helped companies generate \$35 million in funding for technology development.



Technikon – Current Projects

- Developing eco-industrial sites in Mississippi, Alabama and California, focused on used oil re-refining and/or renewable diesel production.
- Engineering consulting on a project to demonstrate MSW conversion to rock wool, and to methanize the associated syngas for sale as pipeline quality renewable natural gas.
- Engineering support for \$110 million municipal solid waste to electrical power project being developed in Canada.
- R&D on the upgrading of biochar for use as activated carbon.
- Through a partnership with Keramida Environmental, supporting Air Permit applications, and consulting in Environmental, Health and Safety.

BioEnergy Producers Association

An advocate for legislative and regulatory change enabling the introduction of conversion technologies in California.

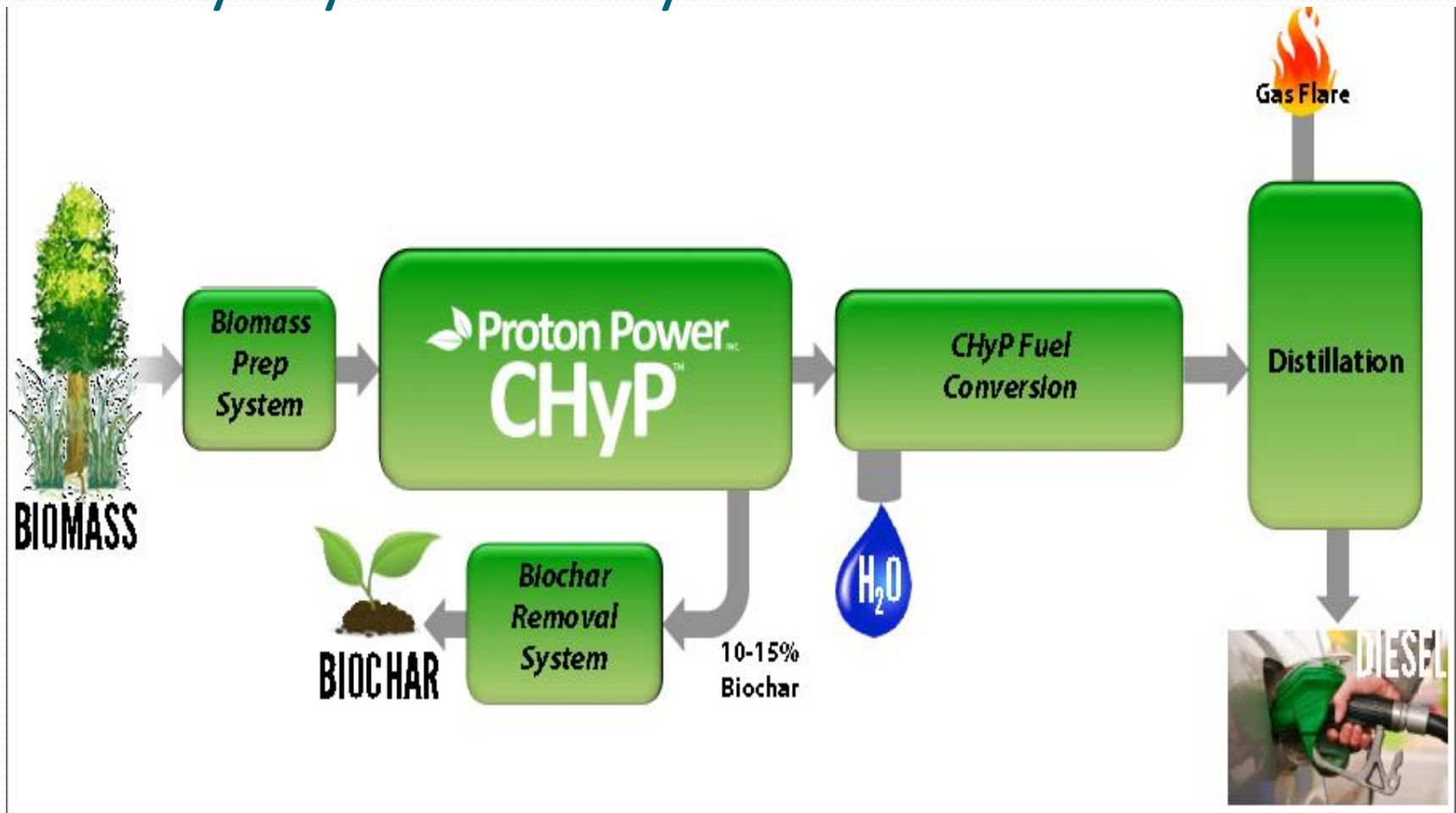
Current municipal solid waste statute:

- Includes a definition of gasification that is universally acknowledged to be scientifically inaccurate.
- Requires the entire gasification-related manufacturing process, including the bioenergy production step, to have zero emissions.
- MSW, when used to produce renewable energy, chemicals and other biobased products does not qualify as landfill diversion.

These provisions do not apply to cellulosic wastes.

Proton Power

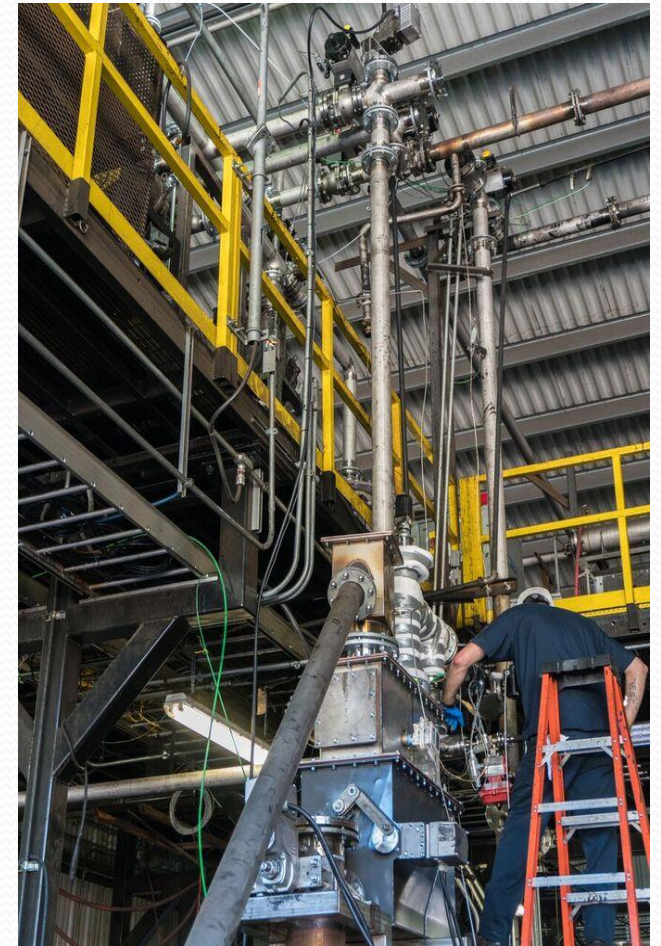
Pyrolysis Pathway to Renewable Diesel



Proton Initial Demonstration Plant



10 ton/per/day demonstration plant operated for more than two years, on average producing 90 tons of renewable diesel per dry ton of biomass.



80 Feedstocks Successfully Tested, Including:

- Miscanthus
- Switchgrass
- Railroad Ties - Borate, Creosote & QNAP coatings
- Green Urban Waste - Yard Trimmings
- Cotton Gin Trash
- Municipal Solid Waste - Compost & Autoclave
- Palm Fronds
- Palm Kernel Shells
- Hickory
- Bagasse
- Pine Bark
- Virginia Pine
- Cedar
- Grass Hay
- Mesquite
- Various Oaks
- Carpet Wastes
- Almond Wood
- Agricultural Crop Residues
- Corn Stover
- Spruce
- Bamboo
- Poplar
- Mixed Paper
- Wood pellets

Commercial Plant – Rockwood, Tennessee



Now completing construction. Will convert 225 t/p/d of cellulosic waste to 7.2 M gallons per year of Renewable Diesel and 12,200 tons of biochar.



Pyrolysis Unit Installation
24 units, each with two Pyrolysis Tubes
Capacity per unit: 10.5 tons/per day



Fuel Production Module

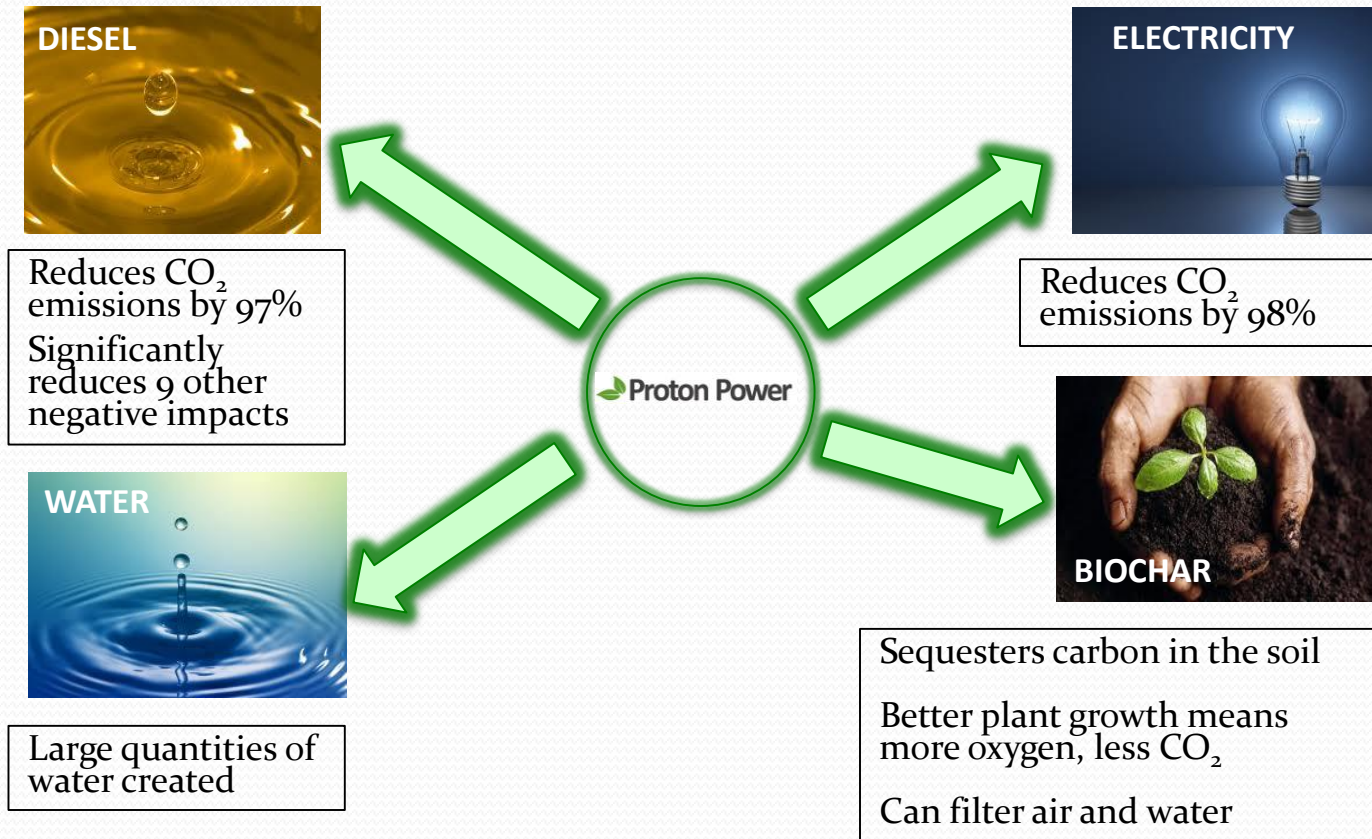
Scale-Up through replication of basic operating unit

One unit comprises eight pyrolysis tubes plus syngas conversion and distillation. A single unit will consume 75 tons of biomass per day.



A Proton Power plant looks like a normal manufacturing facility, not like a major refinery.

Proton Power and the Environment





Proton Power

- Fuel Meets ASTM D975 standards for petroleum diesel.
- EPA Product Evaluation and Registration Completed
- U.S. Navy certification in progress.

Proton Number Synthetic Diesel as produced – Compared to ASTM Specs for No. 2 Diesel

Test Dated 14 April 2017 by SGS North America Inc. – Oil, Gas & Chemical Services Lab

Property	Results	ASTM Method	Min	Max
Cetane Index	79 Rating	D976	40	----
Flash Point	167 °F	D93	126 °F	----
Distillation Petroleum Test at 90% Recovery	575 °F	D86-12	540 °F	640 °F
Kinetic Viscosity @ 104 °F	3.132 cSt	D445	1.9	4.1
Carbon Residue	0.05%	D524	----	0.035%
Sulfur	2.4 ppm	D5453	----	15 ppm
Lubricity	364 µm	D6079	----	520 µm
Sediment and Water	<0.1 %	D2709	----	0.05 %

Carbon Intensity Calculations - Diesel vs. Proton Power (PPI)

- Diesel 94.29 gCO₂eq/MJ
- PPI Wood Residue 8.00 gCO₂eq/MJ
- PPI Wood w/biochar 2.92 gCO₂eq/MJ

Study by (S&T)²

- An essentially carbon negative process.
- Achieves a 97% reduction in GHG emissions as compared to petroleum diesel.

CO₂ Reduction

7.2 Million Gallon per year Plant

CO ₂ Reduction	9/13/17
System capacity	7,200,000gal/yr
System uptime	90%
Actual production	6,480,000gal/yr
Low sulfur diesel HHV	138,489Btu/gal
Low sulfur diesel HHV	146.1MJ/gal
Energy content of diesel produced	946,728,000MJ/yr
Carbon intensity - petro diesel	94.29g CO ₂ /MJ
CO ₂ produced - petro diesel	89,266,983,120g/yr
CO ₂ produced - petro diesel	109,333tons/yr
Carbon intensity - PPI diesel	2.92g CO ₂ /MJ
CO ₂ produced - PPI diesel	2,764,445,760g/yr
CO ₂ produced - PPI diesel	3,047tons/yr
CO ₂ reduction	106,286tons/yr

Renewable Diesel currently generates California producer revenues in the area of \$4.15 per gallon.



This includes the current spot prices of Ultra Low Sulfur Diesel, and the value of D7-equivalent RINs and the low carbon fuel standard credit.

PPI Biochar-facilitated Growth



Graphene in PPI Biochar

Impedance Spectroscopy Results Almond Biochar

Theory:

The capacitance of double layer symmetric capacitance is determined by the formulae:

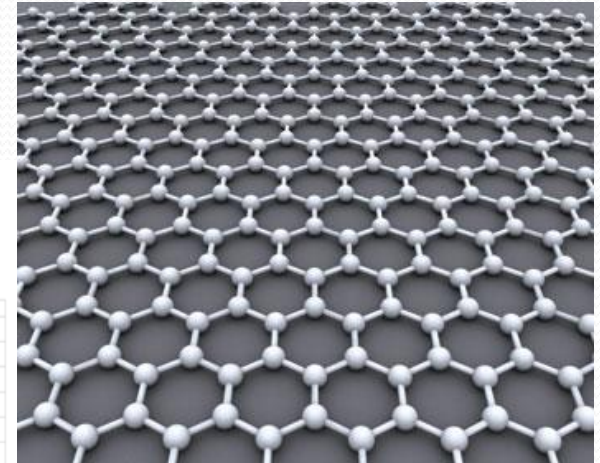
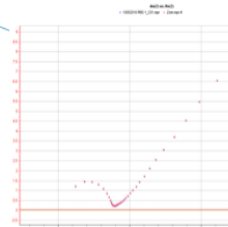
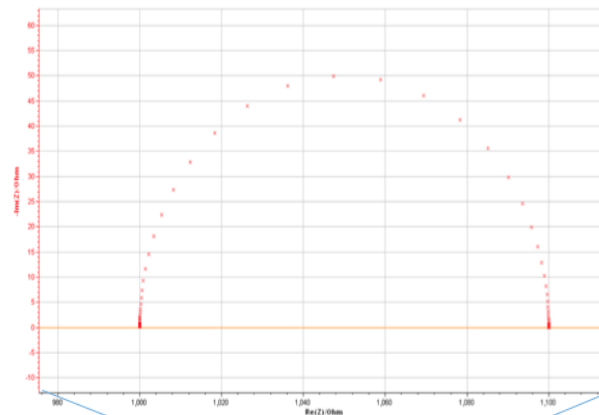
$$C_{dl} = \frac{1}{2\pi f_{max} R_{ct}}$$

where C_{dl} is the double-layer capacitance of the material; f_{max} , the frequency at maximum value of real part; R_{ct} , the high frequency value-low frequency value.

From the results,

The C_{dl} has been determined to be **0.8901 F** for a **0.0041 g** of biochar coating. This results in a **217 F/g** capacitor performance

Z fit for the Almond Biochar



Graphene Structure



Biochar

Excerpted from Proton Power Graphene Analysis

the Wonderful company™







bwalden@technikon.us

916-929-8001

jstewart@technikon.us

323-650-5096

www.technikon.us

