Hydrothermal Processing (HTP)

Presentation to

James Oyler, President
Genifuel Corporation
7-9 October 2019
Background

Process developed over 40 years by the US Dept. of Energy at Pacific Northwest National Laboratory; Genifuel formed 2006 and works closely with PNNL
Use With All Kinds of Wastes

- Wastewater Solids
- Drink and Food Processing
- Animal Waste
- Chemical Waste
- Organic MSW

And many others, including co-processing
Clear Disposition of Outputs

<table>
<thead>
<tr>
<th>HTL Stage</th>
<th>CHG Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids with</td>
<td>Methane</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Water</td>
</tr>
<tr>
<td>HTL Oil</td>
<td></td>
</tr>
<tr>
<td>Effluent Water</td>
<td></td>
</tr>
</tbody>
</table>

Genifuel
Highly Efficient Process

>85% of feedstock carbon to oil and gas—
15% of produced fuel energy runs the process

Water is sterile, clear, and conserved; contains plant nutrients
Outputs Convert to Finished Fuels

Biocrude is upgraded and refined, or blended directly with diesel fuel

Renewable Natural Gas goes into gas pipeline—no sulfur or siloxanes
HTP Technical Status

• Process clearly works and scales well
  – Hundreds of tests on dozens of feedstocks
  – Extensively published in journals and DOE publications

• Quality of raw and upgraded HTL oil fully documented

• CHG process works and provides the “cleanup” step
  – CHG catalyst life needs further improvement

• The remaining step to full commercialization is to show industrial reliability in 24/7 operation at operating sites
Project 1: Processing Algae Since 2017
Project 2: Containerized System, 2019

Onsite tests with various wastes—e.g. dairy cow manure
Project 3: 2020 Startup

Wastewater Processing
Vancouver, Canada
2 dry metric tons per day

Metro Vancouver;
Refining Partner
is Parkland Fuel
Project 4: 2021 Startup

Central Contra Costa Sanitary District, Martinez, CA
3 dry metric tons per day
## Regulatory Status Proceeding Well

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEQA</td>
<td>California Environmental Quality Act will use existing permit</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Information provided and preliminary meeting scheduled</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Testing shows no adverse environmental effects but UV issues</td>
</tr>
<tr>
<td>Site</td>
<td>Soil samples taken; no current issues</td>
</tr>
<tr>
<td>Blowdown Solids</td>
<td>Take to fertilizer manufacturer</td>
</tr>
<tr>
<td>Fuel Credits</td>
<td>Eligible for D3 RINS and LCFS—Carbon Index 23</td>
</tr>
</tbody>
</table>

Plus 21 other regulatory requirements
Raw and Hydrotreated HTL Oil

Raw HTL Biocrude  Upgraded HTL Oil
# Upgraded Oil Very High Quality

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Upgraded Product</th>
<th>Biocrude</th>
</tr>
</thead>
<tbody>
<tr>
<td>H:C Ratio</td>
<td>Mol ratio</td>
<td>2.03</td>
<td>1.6</td>
</tr>
<tr>
<td>O</td>
<td>Wt%</td>
<td>1.0%</td>
<td>6.2%</td>
</tr>
<tr>
<td>N</td>
<td>Wt%</td>
<td>&lt;0.05%</td>
<td>4.7%</td>
</tr>
<tr>
<td>S</td>
<td>ppm</td>
<td>9</td>
<td>11,000</td>
</tr>
<tr>
<td>TAN</td>
<td>mgKOH/g</td>
<td>&lt;0.01</td>
<td>59</td>
</tr>
<tr>
<td>Density</td>
<td>g/cm³</td>
<td>0.79</td>
<td>0.98</td>
</tr>
<tr>
<td>Viscosity</td>
<td>cSt @ 40°C</td>
<td>2.7</td>
<td>400</td>
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</table>
HTP Addresses PFAS, PPCP

• HTL substantially destroys PFAS (per/poly-fluorinated alkyl substances)
• HTL substantially destroys PPCP (pharmaceutical and personal care products)
• Final certification awaits publication of standards and testing methods
Acknowledgements
Thank You!