



# Unlocking the Market Potential of Small Scale Energy from Waste

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# Small Scale Waste Production

## The Challenge



Farms



Hospitals



Industrial  
Parks



Military  
Installations



Mining  
Sites



Remote  
Communities



Resorts



Ships

Globally, there are **MILLIONS** of small-scale waste producers who:

- Are far from centralized waste facilities
- Want sustainability
- Want independence
- Want added revenue
- Are actively searching for a viable solution

**NONE** are environmentally or cost-effectively served by the current thermal waste-to-energy (WTE) market

# WTE has Focused on Large-Scale Market is Primed for a Small-Scale Solution



**Waste-To-Energy (WTE)** today has concentrated on large scale waste producers and centralized facilities.

Producers with <4 tons of daily waste must transport it — few flexible on-site solutions are available.

Thermal conversion technology has not adapted to the small-scale market and the move toward distributed energy generation.

# Our Vision

In our world, any organization or community has the capability to generate energy on-site. No matter how small or remote, Cogent users can turn their local waste into clean, sustainable energy. In our world, carbon-based waste is a valuable renewable energy source.

# Our Game Changing Solution

## The HelioStorm™ Gasifier

5x

The HelioStorm™ processes at 3,000°C to 10,000°C, **5-15x hotter** than competitors.



This **vaporizes carbon**, turning up to 4 tons of waste per day into **remarkably clean synthesis gas (syngas)**, on-site and on-demand.



As part of an end-to-end system, Cogent Energy's proprietary HelioStorm gasifier opens up WTE capabilities for millions in **untapped markets**.

# What Makes HelioStorm Gasifier Different?

## Unprecedented Molecular Approach – Ionic Gasification:

- Gasification produces energy rich CO and H<sub>2</sub>
- Not combustion (aka incineration) that produces heat, CO<sub>2</sub> and water vapor
- 10,000°C reached in plasma reaction zone
- 2x hotter than sun's surface
- 5-15x hotter than competitive units
- **Carbon vaporizes**—completely breaks down into gaseous carbon atoms

## Instant Reaction Times:

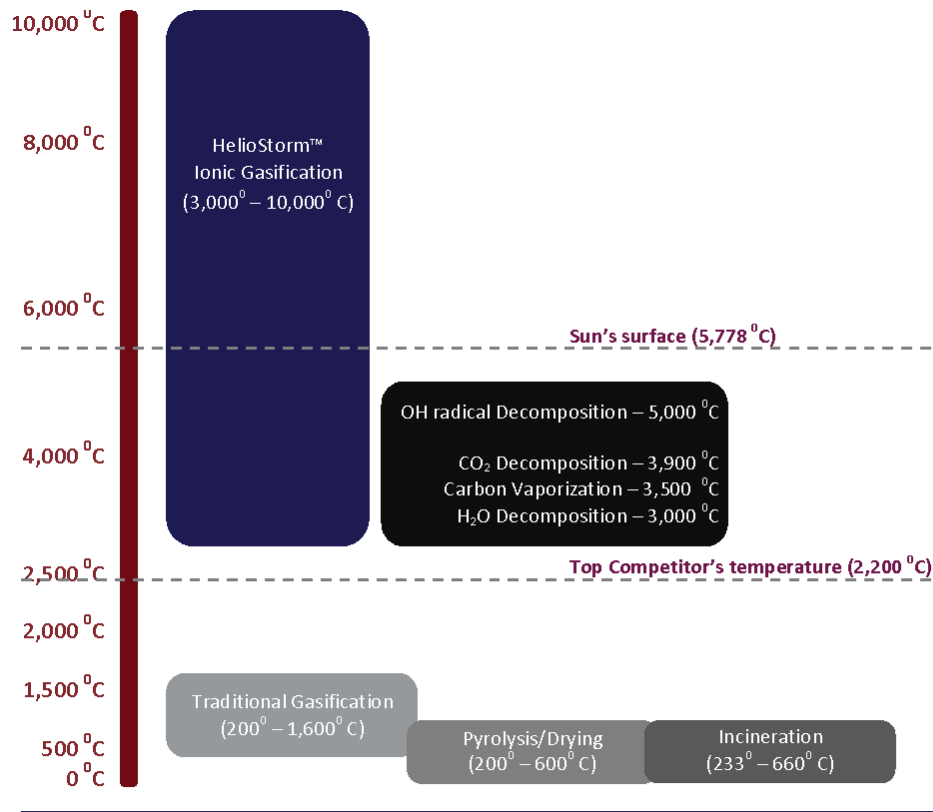
- Trash is fully **immersed** in hyper-hot plasma zone—not indirectly heated
- Complete conversion into syngas—virtually no by-products or long-chain hydrocarbons
- Syngas is proven clean— no production of toxins or harmful elements
- One step—syngas ready to use with little or no additional processing needed

## WTE Breakthrough for Small Scale Markets:

- Small quantities (4 tons) of feedstock
- Surplus energy due to minimal power needs
- On-site usage: compact ~100 sf (end-to-end system can be housed in 3,000 sf)
- On-demand usage—power up/down in minutes vs. hours
- Scalability—meet increased need by adding additional modules

# Proven Scientific Advantages

## Processing Zone Temperatures for WTE Technologies



## Hyper-high Temperatures

- 10,000°C at the core - entire interior of the processor is a plasma reaction zone
  - 5-15x hotter than competitive solutions (traditional gasification, incineration, pyrolysis\*)
  - Zone contains hyper-energetic gaseous ions, accelerating conversion process

Once immersed in the Ionic Gasification zone, waste **spontaneously and completely breaks all the way down to individual atoms**

## Vaporizes Waste

- Vaporizes **all feedstock**, including carbon
- **Transforms water** into high-energy oxygen and hydrogen radicals
  - Does not produce steam

\*thermal decomposition

# Proven Scientific Advantages

## Modular design

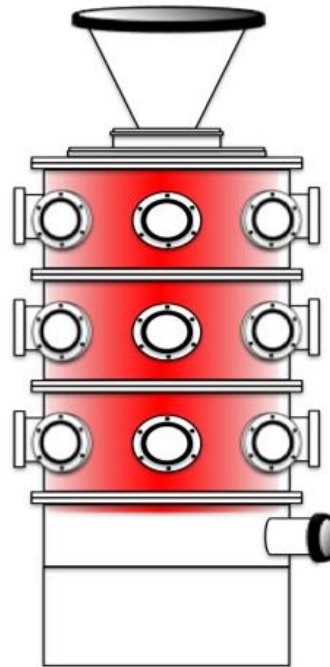
- Creates a **cascade of energy** within the plasma reaction **field**
- Innate reaction **reduces power consumption** and **generates a surplus** of energy product

## Clean end-products:

- Resulting **syngas is clean** and **ready to be used**
- Requires little to no additional processing
- Independent 3rd party tests at the Idaho National Laboratory have shown the syngas to be free of
  - Long-chain hydrocarbons
  - Contaminant chemicals, emissions, pollutants

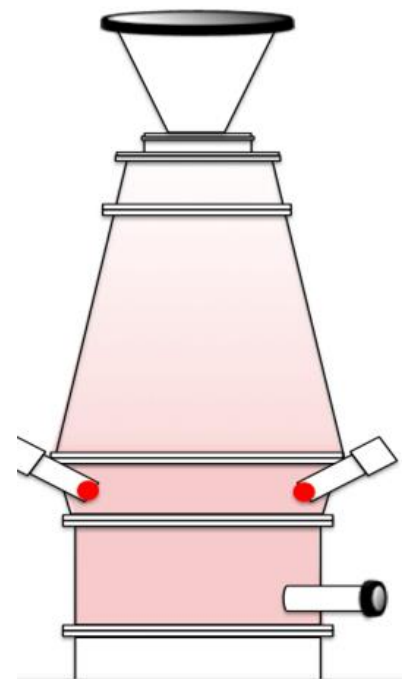
## HelioStorm Gasifier

- Up to 10,000°C
- Plasma field fills internal volume
- Waste is immersed in intense heat



## Traditional Gasifiers

- Max temp 1,600°C
- Plasma torches heat the ambient environment



# Independently - Verified Test Results

Sample			% Concentration (normalized without Carrier Gas)					CO/H <sub>2</sub> Ratio
Material		Moisture	H <sub>2</sub>	O <sub>2</sub>	CO	CO <sub>2</sub>	CH <sub>4</sub>	
Woody Biomass Feedstock (Reference material provided by INL Biomass Feedstock National User Facility)	4 mm	10%	40.4%	3.3%	52.2%	4.1%	0.0%	1.29
		30%	36.9%	10.9%	48.2%	3.9%	0.0%	1.31
		50%	25.7%	21.3%	38.2%	14.7%	0.0%	1.49
	6 mm	10%	45.4%	2.0%	49.8%	2.8%	0.0%	1.10
		30%	48.3%	1.2%	47.8%	2.7%	0.0%	0.99
		50%	48.1%	3.5%	42.0%	6.4%	0.0%	0.87
Feedstock with Particle Size Distribution (Feedstock provided by INL Biomass Feedstock National User Facility)	Woody Biomass	Fines	48.9%	0.0%	49.6%	1.5%	0.0%	1.02
		> 6 mm	45.5%	2.9%	50.3%	1.3%	0.0%	1.11
	Corn Stover	Fines	44.7%	3.6%	49.2%	2.4%	0.0%	1.10
		> 6 mm	48.3%	0.0%	50.0%	1.7%	0.0%	1.04
Bio-Oil with Steam rex (Provided by NREL Bioenergy Facility)			58.1%	0.0%	29.0%	12.9%	0.0%	0.50
Ground Animal Feed			48.1%	0.0%	48.9%	3.0%	0.0%	1.02
Simulated MSW (Metal Shavings, glass and plastic shards, animal feed, woody and cellulosic biomass)			47.0%	3.2%	44.6%	5.1%	0.0%	0.95

Averages

45.03%

3.99%

46.14%

4.81%

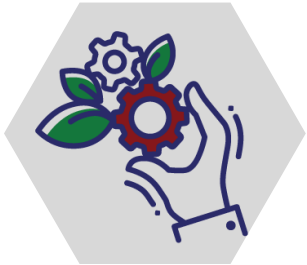
0.00%

# Flexibility Maximizes Potential Applications



## Feedstock Agnostic

- Process any type of waste or feedstock, no sorting required
  - Biomass
  - Municipal solid waste
  - Hazardous and toxic waste (e.g., waste coal)
  - Medical waste
  - Plastics



## Clean Syngas Converts to:

- Electricity:
  - More surplus electricity per ton of feedstock than other small-scale solutions
  - Nearly equivalent electricity per ton as large scale gasifiers
- Liquid fuels
- Valuable chemicals



## Non-Intermittent, Dispatchable Power (aka On-Demand Power)

- A system using the HelioStorm can serve as a primary or secondary source of power for a stable microgrid.

# A WTE Breakthrough for Untapped Markets



# Expressed Interest in HelioStorm Installations 2016-2018



# Acknowledged Innovation



## U.S. Navy, Small Business Innovation Research (SBIR) Grants

Selected for **Phase I Award** in partnership with Creare, engineering R&D firm.

- Demonstrated efficacy of small-scale WTE.
- Tests on solid wastes resulted in remarkably clean syngas capable of powering existing military generators, without creating hazardous by-products.

Selected for **Phase II Award** with Creare to fabricate complete WTE system (expected completion Q1 2019).

- System will convert up to 4 tons per day of mixed waste.
- Used in standard military generators, will produce ~800kWh of net electricity per waste ton.



## U.S. Department of Energy

One of seven projects selected as a High Impact Project for U.S. grid modernization

- [National Renewable Energy Laboratory's \(NREL\) Energy Systems Integration Facility](#) (Golden, CO)

Awarded Small Business Voucher to partner with Idaho National Laboratory, one of the nation's premier technology and science labs. One of 37 projects selected nationwide from pool of 700 applicants.

- [Bioenergy Project: Optimizing Bioenergy Feedstock Preparation and Formats for Use in Small-Scale Gasification Systems](#)
- Awarded User Facility Agreement at Idaho National Laboratory to study size and moisture content of feedstocks for the HelioStorm.

# Acknowledged Innovation

*“WTE can be an important part of small-scale and microgrid energy systems. Cogent’s collaboration at the ESIF supports our mission to advance the critical science and technology needed to modernize our nation’s electricity grid infrastructure for a more secure and resilient energy future.”*

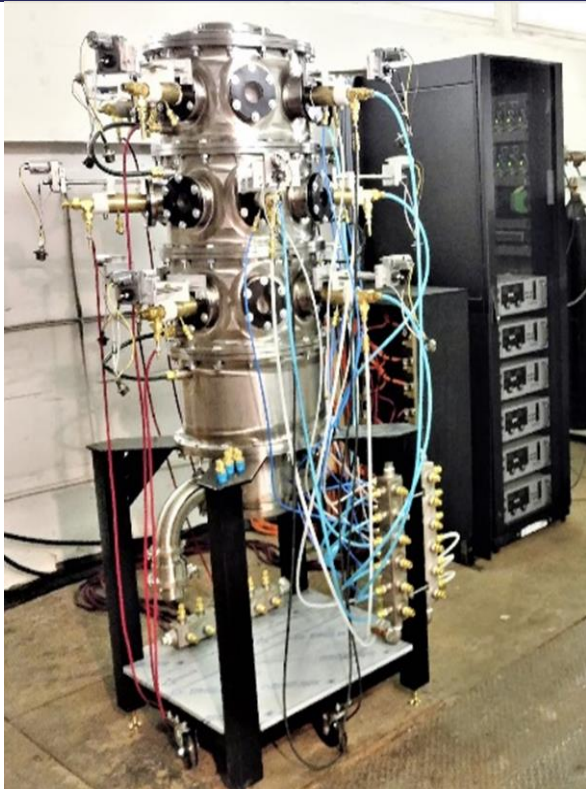
Bryan Hannegan, former Associate Laboratory Director for Energy Systems Integration at NREL.

*“When INL analyzed Cogent’s syngas, we looked for hydrocarbons. None were identified, suggesting they were either absent or below the detection limit. This suggests that it is a clean product.”*

Kevin Kenney, Director, INL Bioenergy Program



# Proprietary Technology

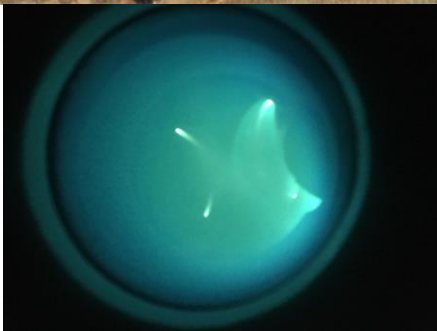
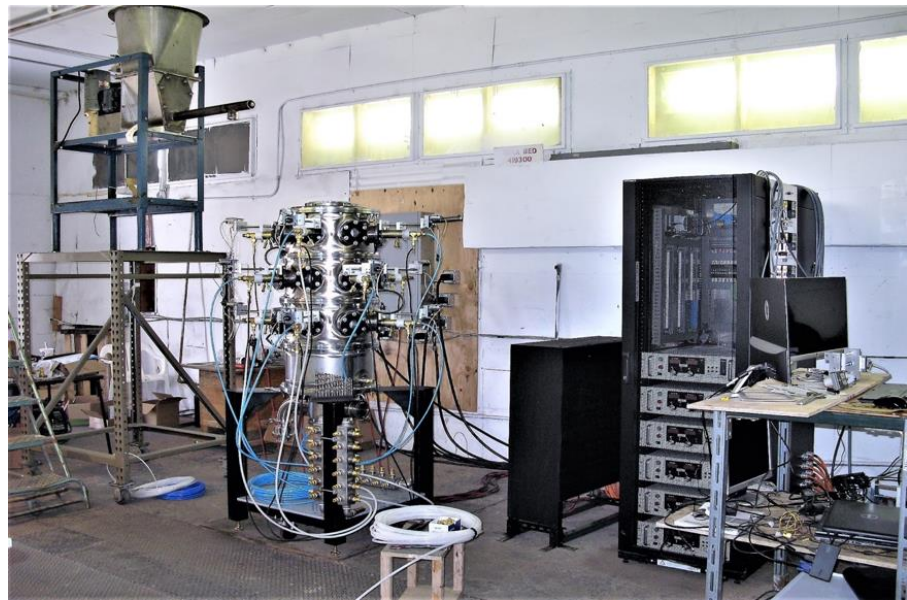


## Exclusive Licenses - Idaho National Laboratory

- Exclusive licensee of the underlying patents for the HelioStorm technology developed at the U.S. Department of Energy's Idaho National Laboratory

## Patents Pending

- Intellectual property developed during Cogent's pre-commercialization phase is patent-pending



# Commercial-Scale Demonstration Unit Technology Status

## **R&D Unit Operational Since Mid-2016**

- Modular design enables testing of overall operations and individual subsystems
- Several generations of electrodes tested
- Multiple power supplies tested
- Safety features implemented and enhanced
- Stable, repeatable plasma field generation process established

## **Numerous Successful Gasification Test Runs**

- Hybrid Poplar, Bio-oil, MSW
- Moisture content up to 50%
- Feedstock & residues analyzed by INL & Hazen Labs
- Syngas analyzed by INL & Atlantic Analytical Labs

## **Second Unit for US Navy Constructed and Undergoing Shakedown Tests**

- Demonstration Unit for US Navy SBIR in partnership with Creare
- Full three-module design
- Implements latest designs for modules, electrodes, cooling, automation, data acquisition
- Includes integrated feeder/hopper, scrubber, electricity genset

# Creating a New Market for Waste Management Value Proposition

## **Cogent's Unique Value Proposition**

- Capital costs per kW < large scale thermal gasification projects
- Economically competitive at a small scale (faster cash payback, higher IRR, better NPV)
- No harmful emissions
- On-site processing
- In target markets, delivered COE significantly lower than retail rates

## **Market Value – Currently \$30b+, globally for large scale**

- Cogent believes new untapped market potential will grow to be bigger than current market

## **Market Penetration**

Cogent is developing strategic partnerships in the largest markets and creating a sustainable option for the emerging markets

- US, China, UK, EU, India
- Sub Saharan Africa, SE Asia

# Creating a New Market for Waste Management Value Proposition

## Verticals



Farms



Hospitals



Industrial  
Parks



Military  
Installations



Mining  
Sites



Remote  
Communities



Resorts



Ships

## Targeted Regions



# Contact Information

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