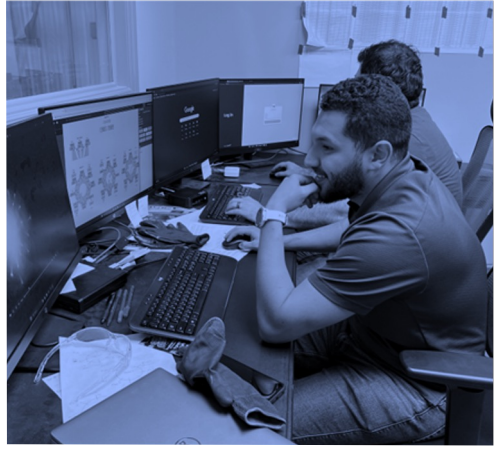


NEW ENGLAND WATER ENVIRONMENT ASSOCIATION
NEWEA
WORKING FOR WATER QUALITY

HEARTLAND
WATER TECHNOLOGY

HELIOSTORM

LTC Dry

Biosolids Conversion

PERFORMANCE • RESULTS • CERTAINTY

Heartland Water Technology

Heartland Concentrator™

Decades of proven performance

Award-winning, globally recognized solution

COVAP: Cogen using waste-heat from engines

ROVAP: Evaporating RO concentrate

Established 2008

Hudson, MA

Technology Center

Murfreesboro, TN

Services

Wastewater Treatment

(Assured PFAS Separation™)

Waste Conversion

(Assured PFAS Destruction™)

HelioStorm™ Gasifier

Ultra-high temperature ionic gasifier

20 years in development at Idaho National Labs

Launching for Residuals in 2023

Provides Assured PFAS Destruction™

Ultra-High Temperature Ionic Gasification

DESTRUCTION RANGE

Electrically-driven

Multiple Plasma Arcs

3,000 – 10,000°C

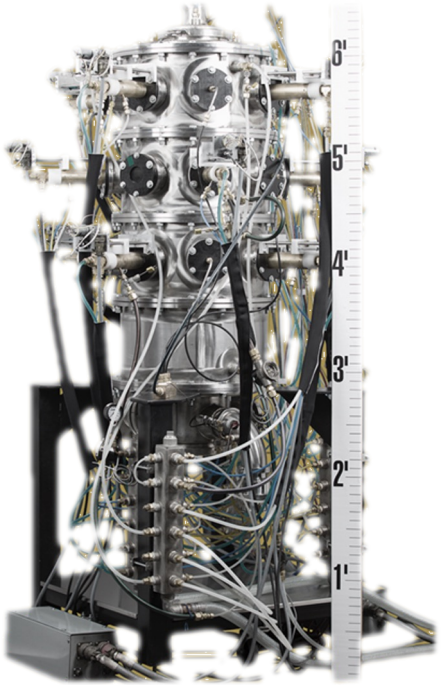
VERSATILE

HelioStorm™ can accept a range of feedstocks and generate multiple materials eligible for beneficial reuse

TAR-FREE SYNGAS

Tar-free syngas is used to generate electricity for the needs of HelioStorm™ *without the need for a thermal oxidizer*

HELIOSTORM™



SCALABLE

Small project footprint (80’ x 80’)

Multiple units combine to accommodate any facility output

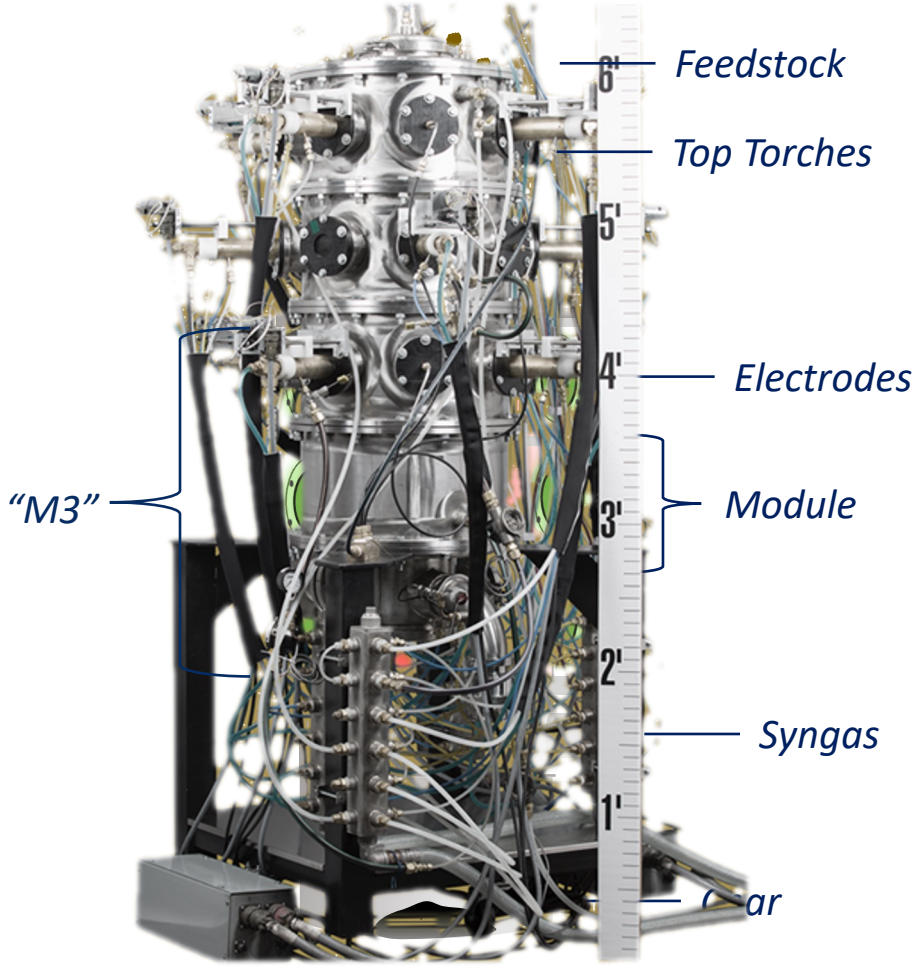
CHAR

HelioStorm™ generates PFAS-free char that is eligible for beneficial reuse or wide range of other outlets and applications

HELIOSTORM™

A **scalable**, **multi-purpose**, **ultra-high-temperature** electric driven gasifier/pyrolizer with key features and operations:

- Ionic field created by paired electrodes that produce an electric arc, filling the entire internal volume of the gasifier
- Multiple electrode pairs per module create an ultra-high temperature electric field
- Multiple modules can be stacked for optimized production
- Feedstock falls through, fully immersed into an ultra-high-temperature reaction zone, disassociating into individual atoms and ions
- Design of stacked modules creates a cascade of energy that reduces total input power

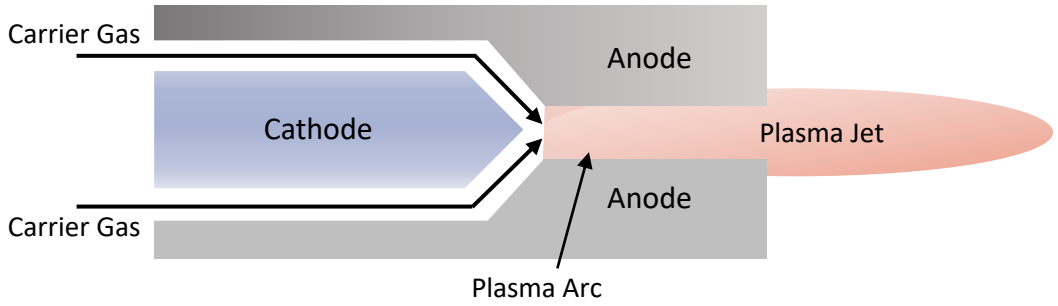


HELIOSTORM™

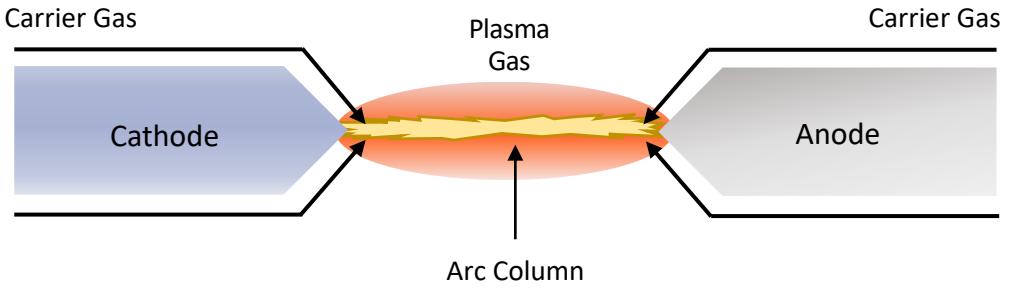
Hybrid Plasma Design

- Traditional Conventional Torch used for *preconditioning* of feedstock
- Free-burning generated between electrodes is unconfined, filling the entire diameter of the reaction cylinder – this live arc has a measurable voltage and carries current
- Ultra-high temperature is created by the arc, bringing feedstock into direct contact with the plasma

CONDITIONING PLASMA *TORCH*



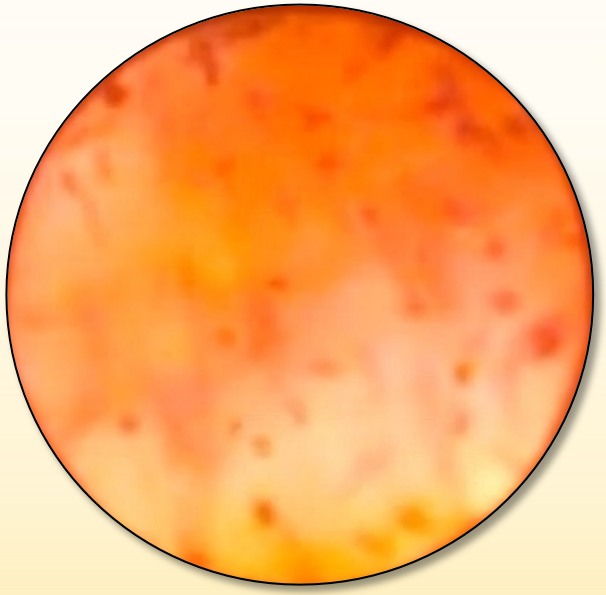
DESTRUCTIVE PLASMA *ARC*
(3,000 – 10,000°C)



HELIOSTORM™

IGNITION

CONVERSION

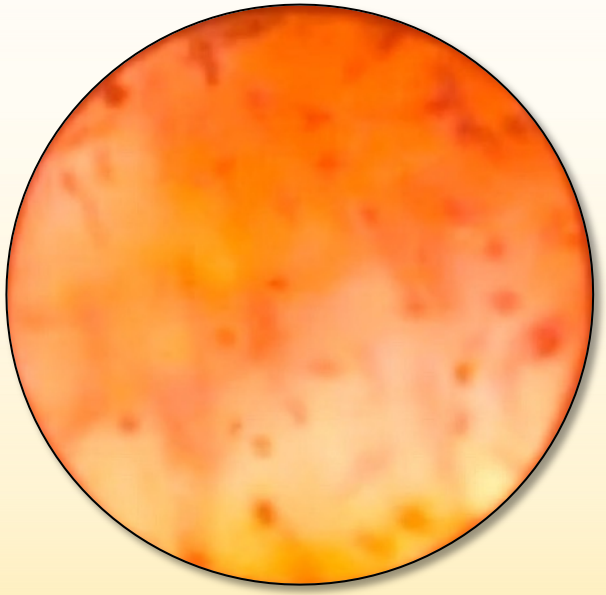


Municipal Biosolids → Syngas + Char

HELIOSTORM™

IGNITION

CONVERSION

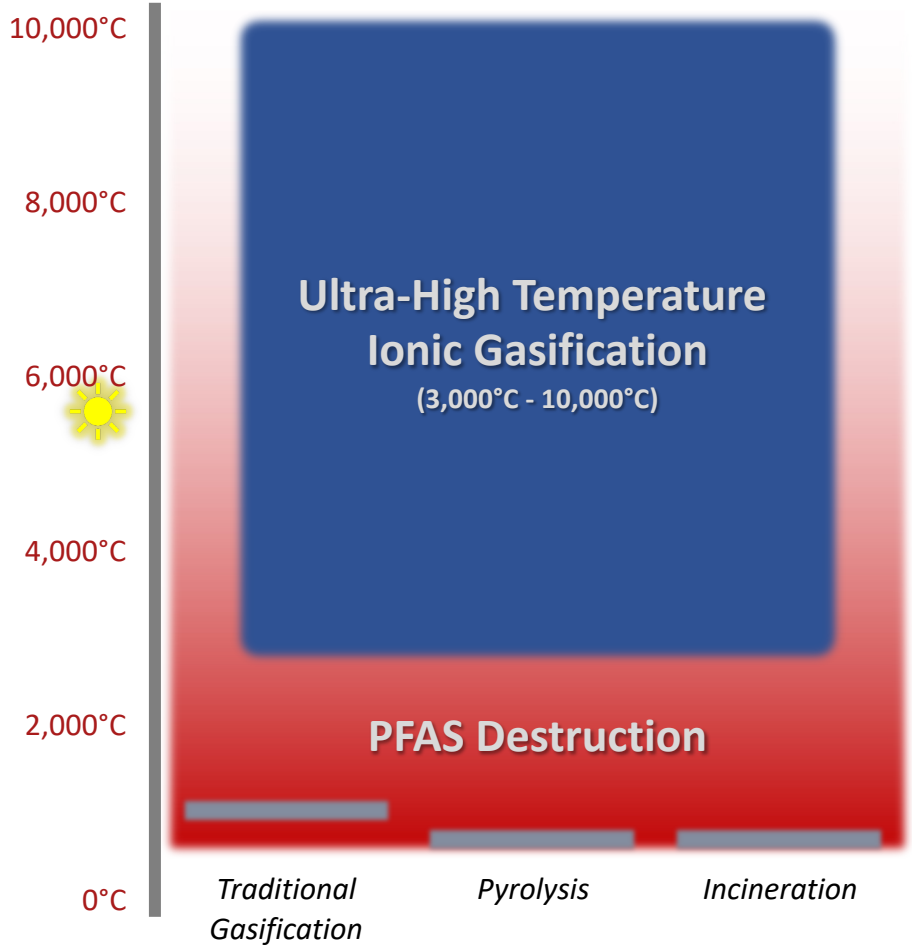


Municipal Biosolids → Syngas + Char

PFAS Destruction

ULTRA-HIGH TEMPERATURE IONIC GASIFICATION

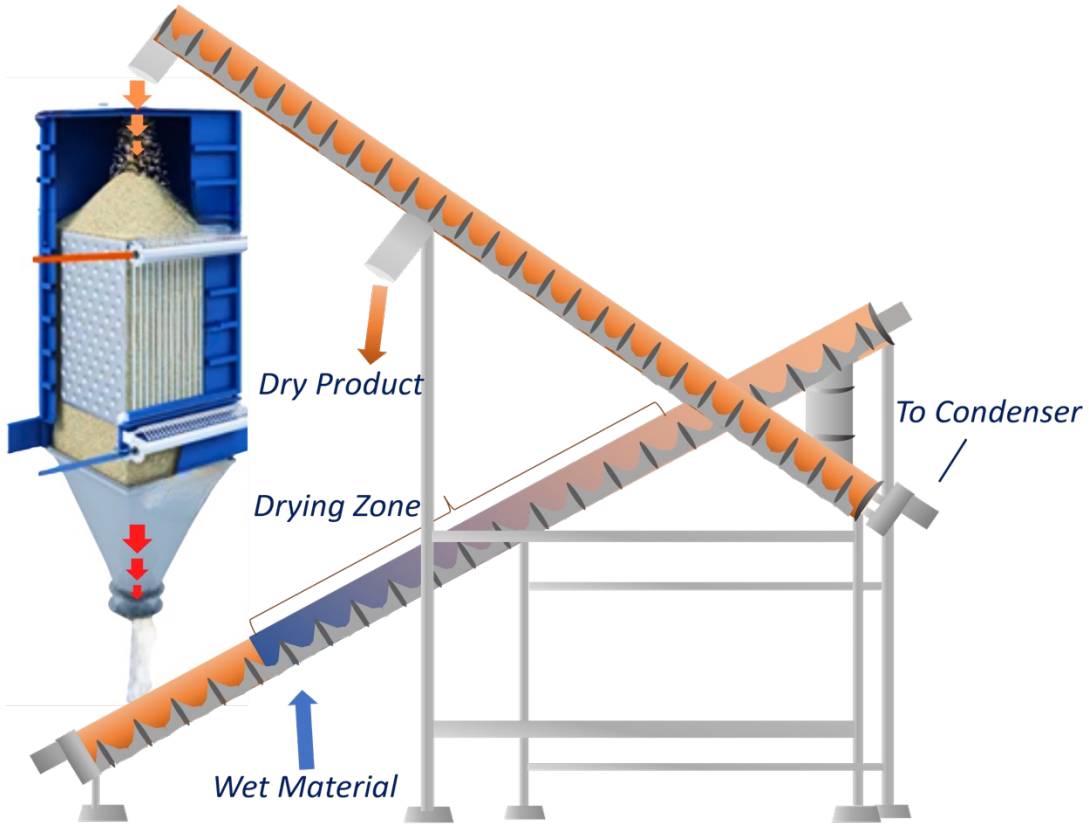
- Entire interior of the processor is an ultra-high temperature reaction zone
- Processing zone contains hyper-energetic gaseous ions, accelerating conversion process
- Vaporizes all feedstock, including carbon
- Transforms water into high-energy oxygen and hydrogen radicals and ions, rather than lower-energy steam
- Waste completely breaks down to individual atoms and ions generating a consistent tar-free syngas with no by-products or toxin production



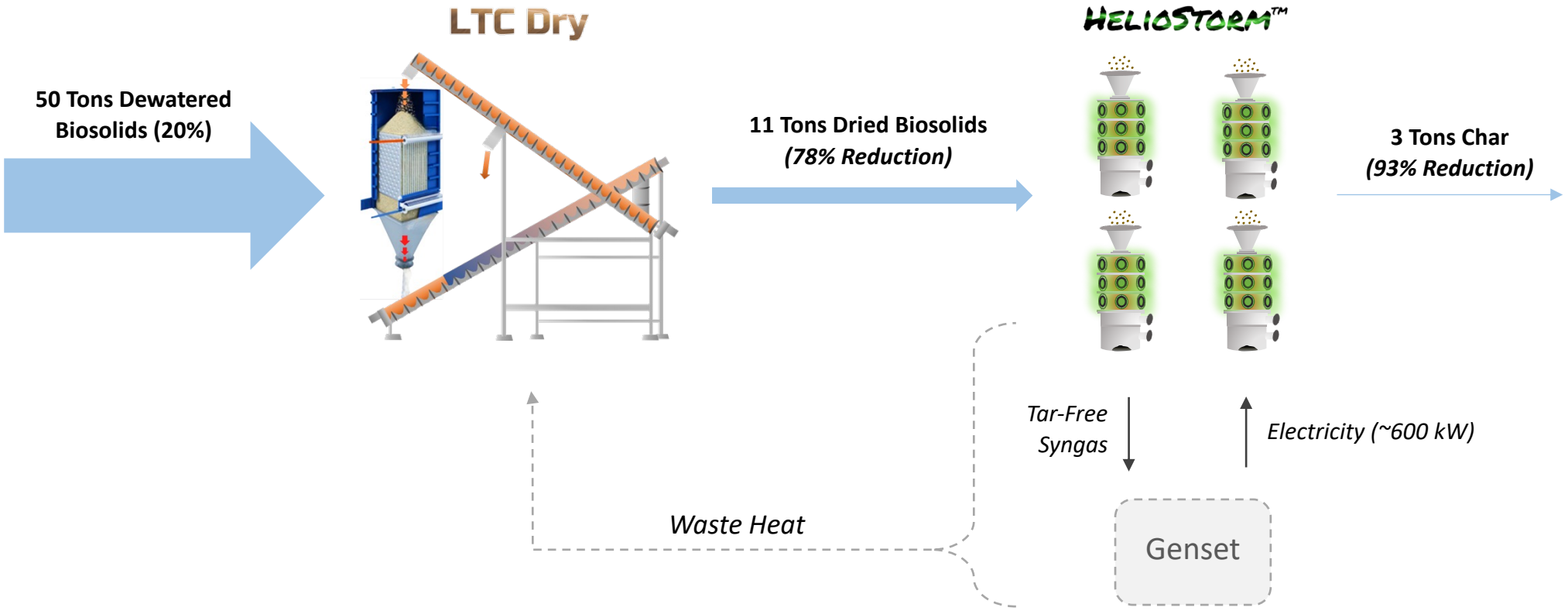
LTC Dry

LOW TEMPERATURE CONDUCTIVE HEATING

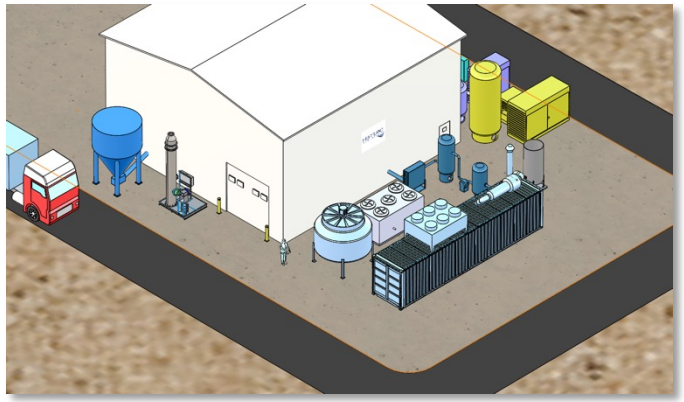
- **Low Operating Temperatures:** Low heat requirement due to dry matter conductive heating operated at low pressure
- **Enhanced Thermal Efficiency**: Designed to utilize low temperature waste heat sources from electrical cogeneration systems
- **Low Emissions**: Less odors & volatiles due to lower operating temperature
- **Simple Design**: Less risk, maintenance, and operational costs with minimal rotating equipment
- **Improved Safety**: Reduced operator exposure due to low operating temperatures

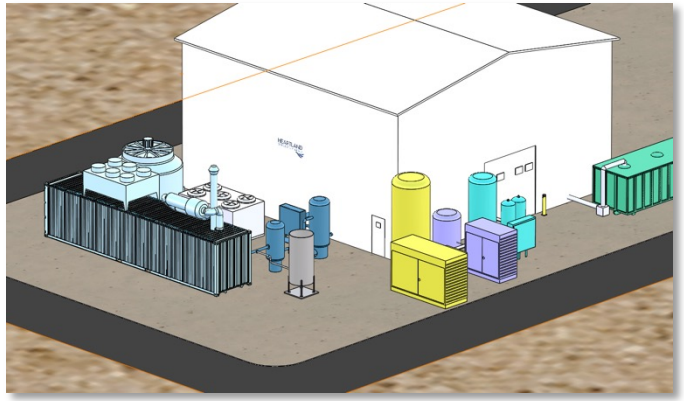


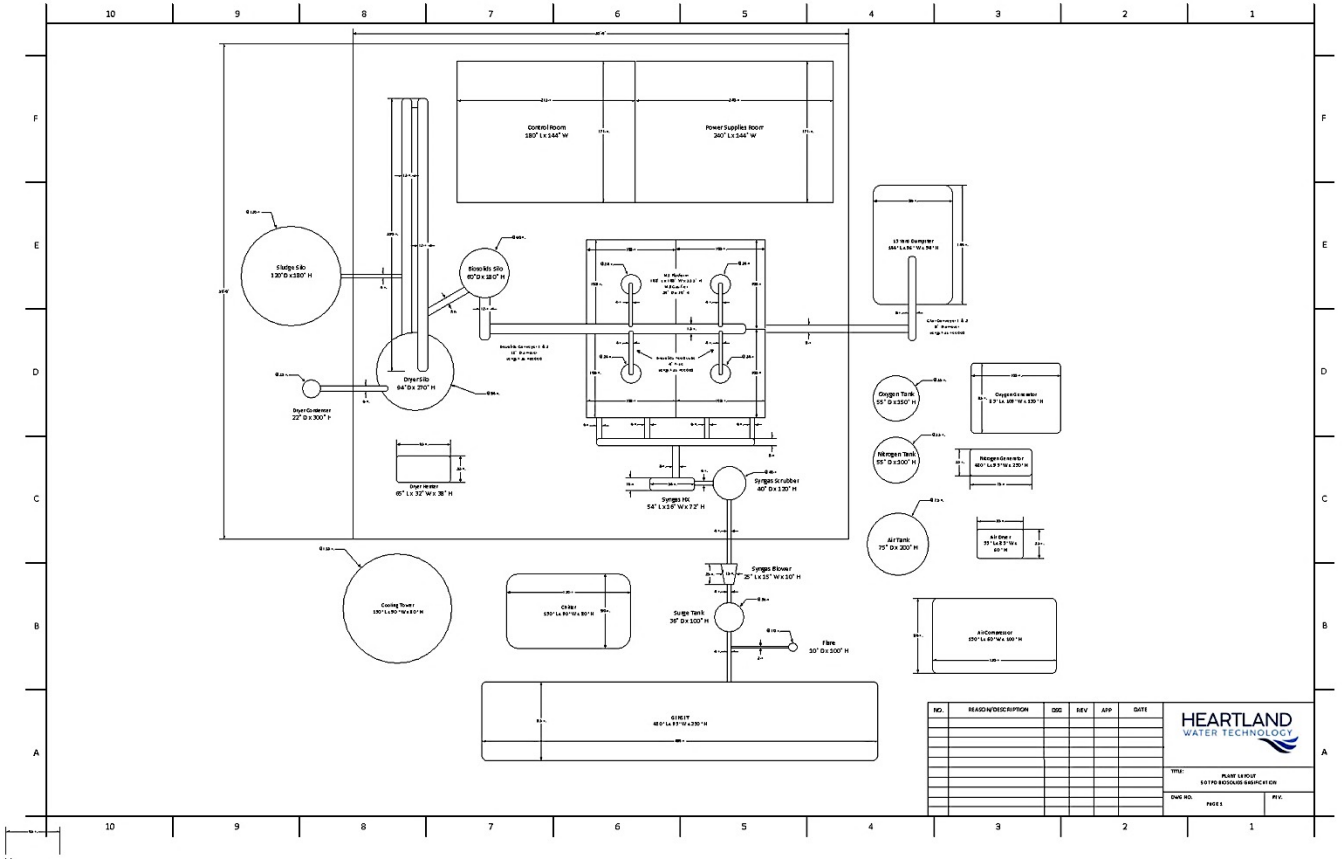
Typical 93% Feedstock Reduction



Plant Footprint (50 wt/d, 80’ x 80’)



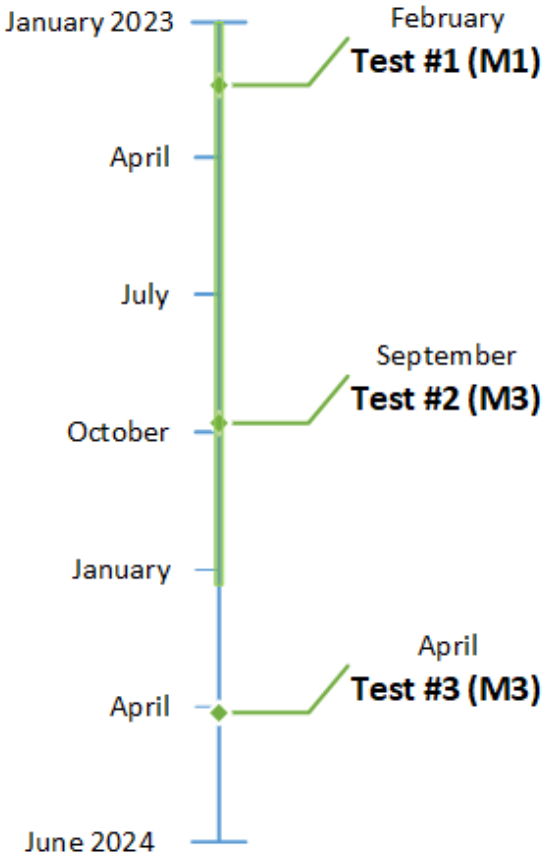




Plant Footprint

Assured PFAS Destruction

- Undertaking a prescriptive, multi-stage analytical protocol to demonstrate PFAS destruction
- First test round completed Q1 on single module “M1” – *results exceeded expectations*
- Subsequent tests completed Q3 on “M3” commercial-scale platform – developing White Paper
- Extended performance testing
- Hosting clients now



PFAS Validation

Test 1

MONTROSE ENVIRONMENTAL

- DRE (destruction and removal efficiency) of PFAS using **M1**
- Biosolid feedstock **spiked with AFFF**
- **Mass balances** performed on biosolids, syngas, char, and AFFF
- DRE results of the pilot testing indicate a **greater than 99% destruction rate** in PFOS, 6:2 FTS, and 8:2 FTS, and a **95% destruction rate** for PFOA.
- ***Exceeded expectations***

Test 2

Pace Analytical® LIFE SCIENCES

- Char testing using commercial-scale M3 HelioStorm
- Results indicate non detect for PFAS compounds tested
- Method 537

Test 3

mostardi platt

- Testing of **commercial-scale** HelioStorm in TN Tech Center
- **FTIR Testing**: fluorine compound in syngas
  - **Did not detect any fluorine compounds** including HF, CF_4 C_2F_6 or SF_6
  - Likely being **captured by the char** but will be confirmed by solids testing

High Purity Syngas

Hydrogen Purity

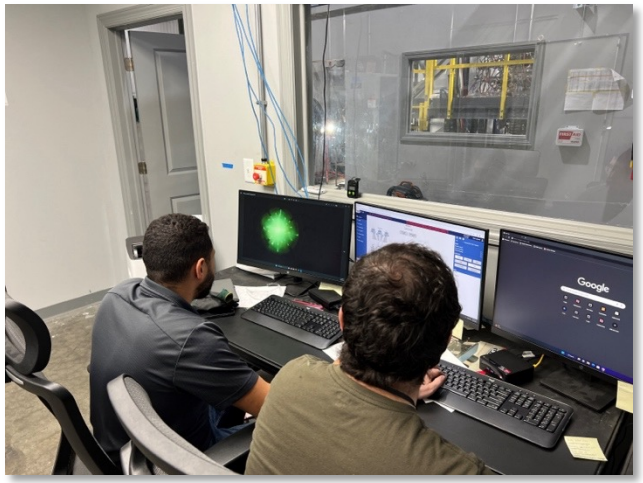
- HelioStorm is equipped with online gas analyzers to continuously monitor the syngas for H_2, CO, H_2S, CH_4, N_2, and CO_2

FTIR Emission Testing

- Samples were collected in November 2023 after running on dried municipal biosolids and sent to a 3rd party laboratory for FTIR gas phase testing.
- The results show that HelioStorm syngas is also free of HF, HF, HCL, CF_4, C_2F_6, and SF_6 compounds reducing downstream air pollution control equipment.

Compound	Detected Concentration
HF	*No Trace*
HCL	*No Trace*
CF_4	*No Trace*
C_2F_6	*No Trace*
SF_6	*No Trace*

Heartland Technology Center



Murfreesboro, TN

Commercial-scale Gasifier:

Facilitates client feedstock evaluation

Delivers complete analytical data capture to assess performance against Utility KPIs

Validates performance at a commercial scale

Project Delivery

BUILD

Full Project Development

Tailored to Customer KPIs

Heartland Team

Permitting

Construction

Commissioning

OWN

NO Client Capital

Long-term Cost Guarantee

Cradle-to-Grave responsibility

OPERATE

NO Client Staffing

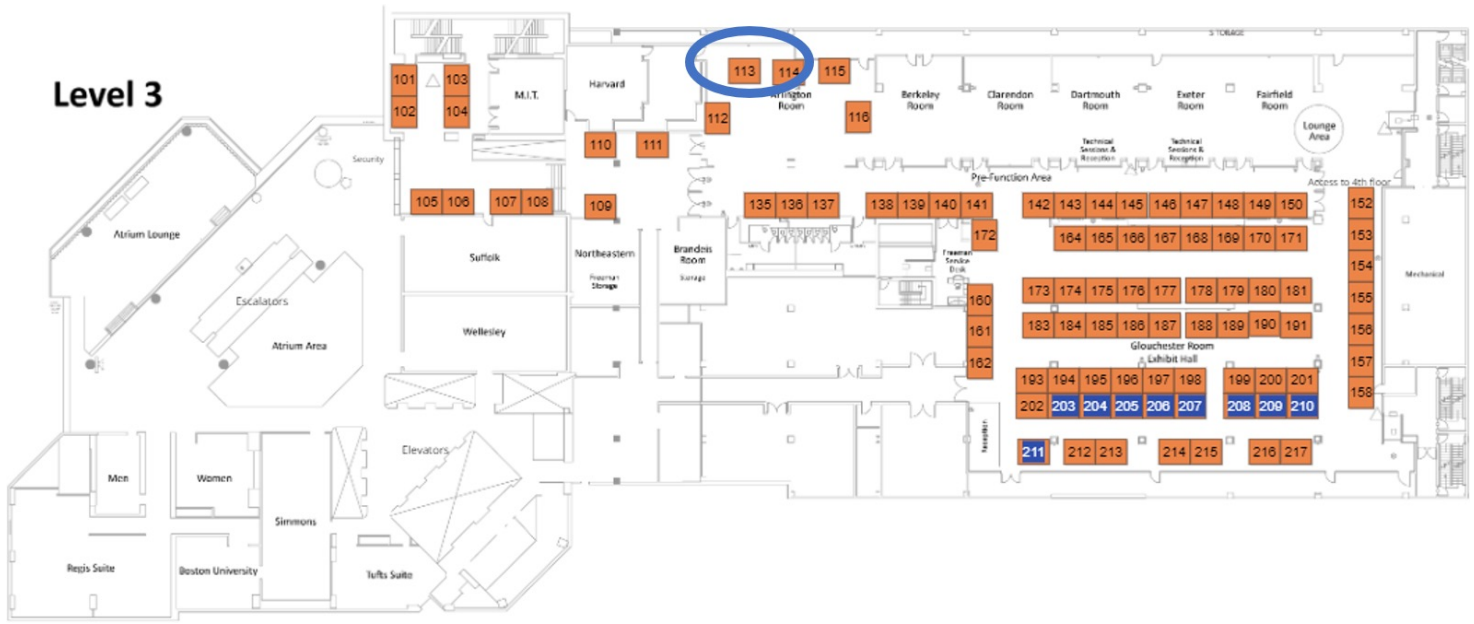
NO Client Training

Assured PFAS Destruction

Heartland Personnel

Optimal O&M

Booth 113



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