

CHAR
technologies

Pyrolysis for Biosolids Management



LIFT Technology Scan: Pyrolysis – October 19th, 2020

CHAR Technologies Ltd

- Publicly traded on the TSXV, ticker 'YES'
- Two divisions:



- Environmental Engineering Services & Compliance



- Advanced Industrial Clean Technologies for:
 - Clean Air
 - Clean Water
 - Organic Waste Reduction & Renewable Energy



Acid Mist Scrubber:
Chilean mining operation



Reverse Osmosis Plant:
Canadian food & beverage manufacturer



Membrane Bioreactor:
First system in the world to upgrade effluent water for reuse in production in compliance with Federal Food Regulations in beverage manufacturing

Digestate Value-Add?





Feedstock

Low value digestate
or compost



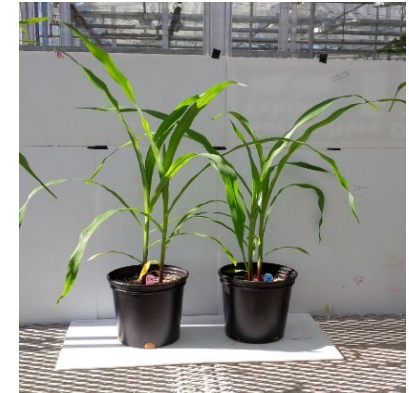
Production

High Temperature
Pyrolysis (in the
absence of oxygen).
The secret sauce (IP
protected)



Use

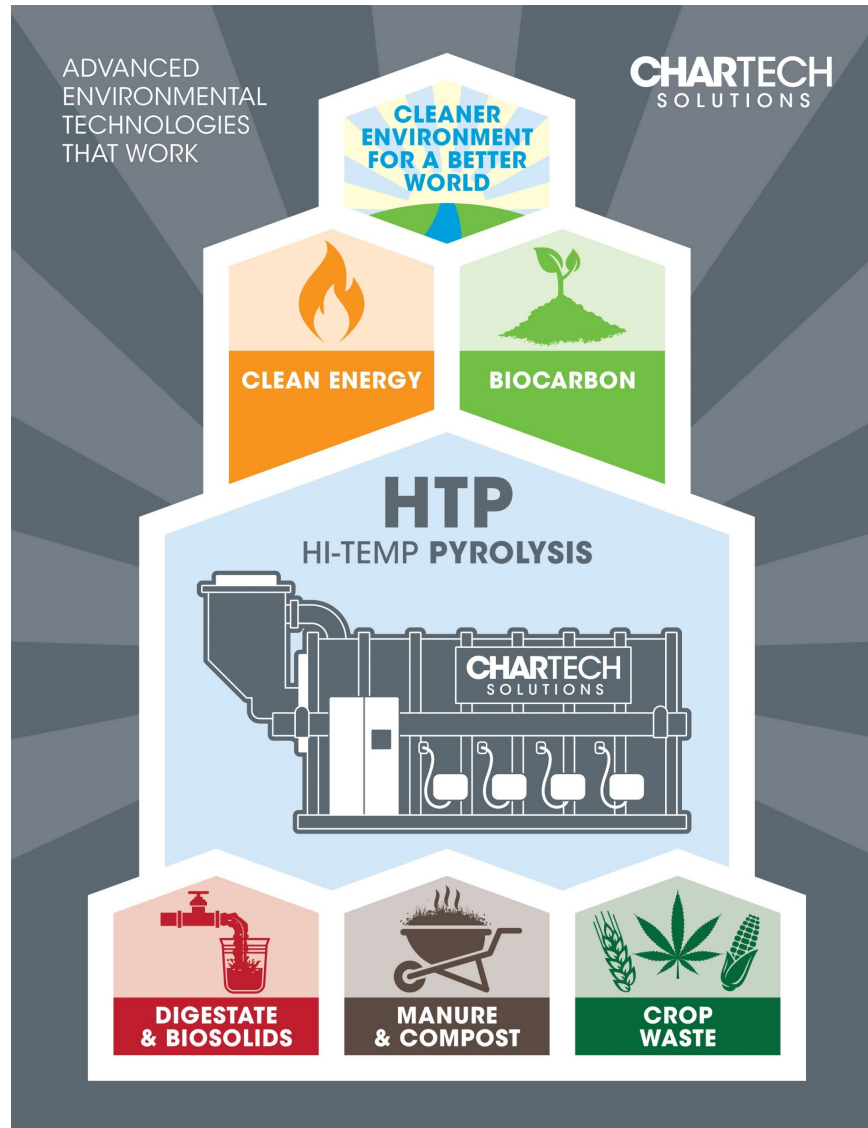
Simple vessel to
allow for gas to
flow through
SulfaCHAR



End-of-Life

Sulfur-rich biochar
for soil application.
University of
Guelph validated
enhanced growth
of corn using
SulfaCHAR

High Temperature Pyrolysis





Watch the video: <https://youtu.be/-UDjNEO6WcE>



Carbon Negative – Reduces net greenhouse gas (GHG) emissions

Reduce Mass - Reduces organics waste mass by up to 90%

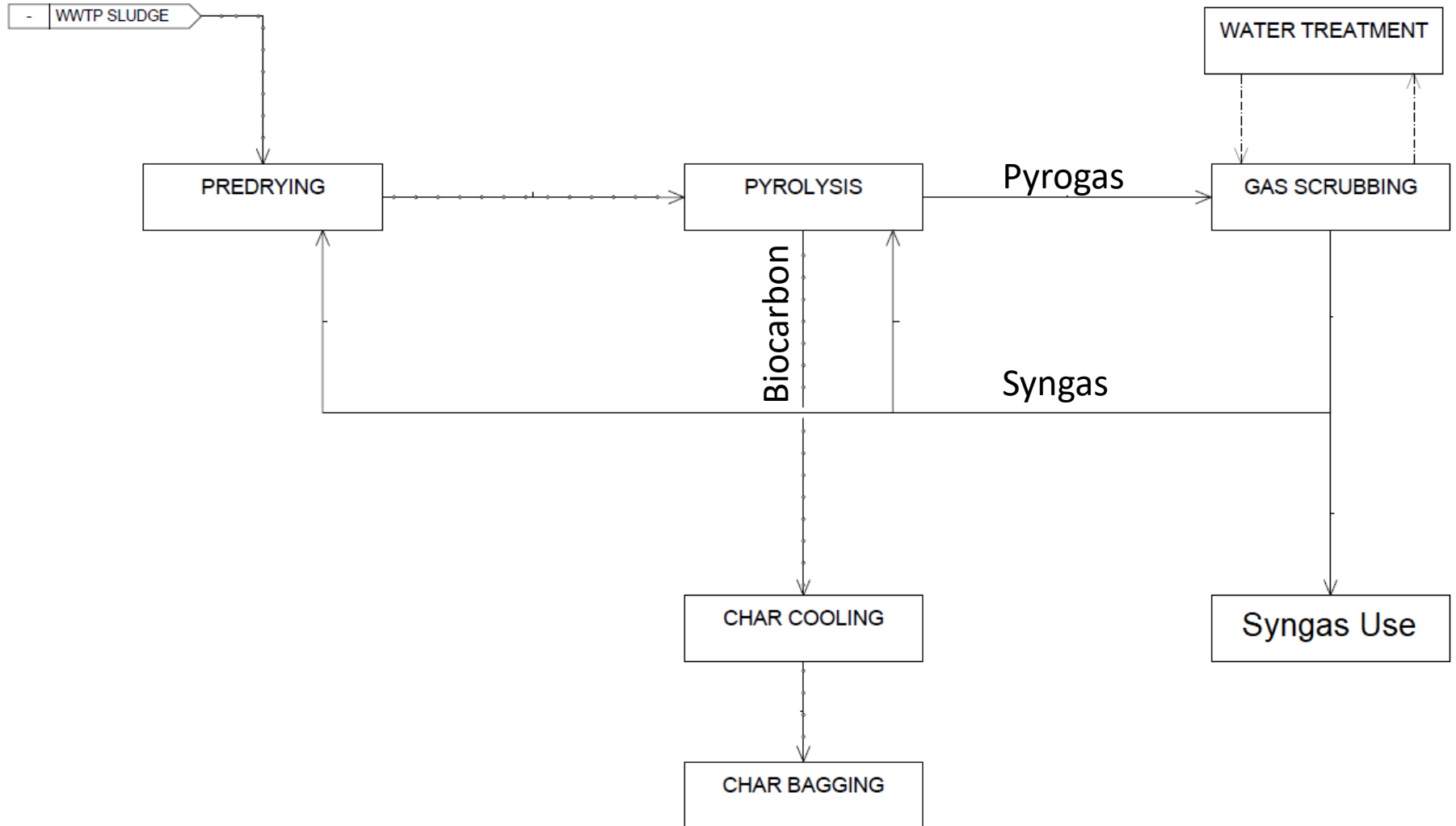
Energy Generation - Pyrolysis gas fuels the system, and generates energy

Value-Added Outputs – Low-value organic waste streams converted into high value biocarbon products

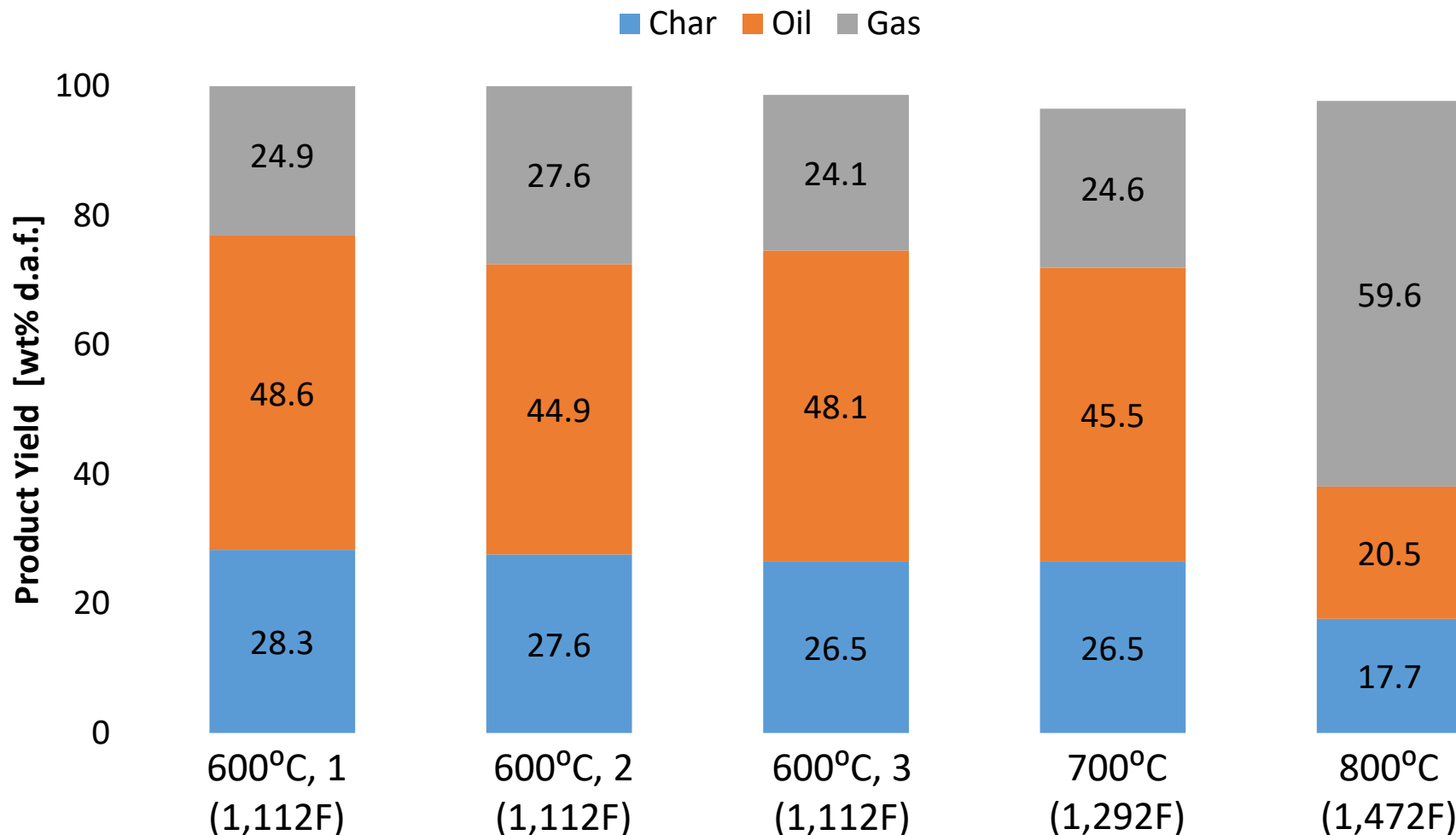
CHAR HAS MULTIPLE PROCESS PATENTS FOR VALUE-ADD PRODUCTS FROM ORGANIC WASTES:



Pyrolysis Process



Untreated Product Yields

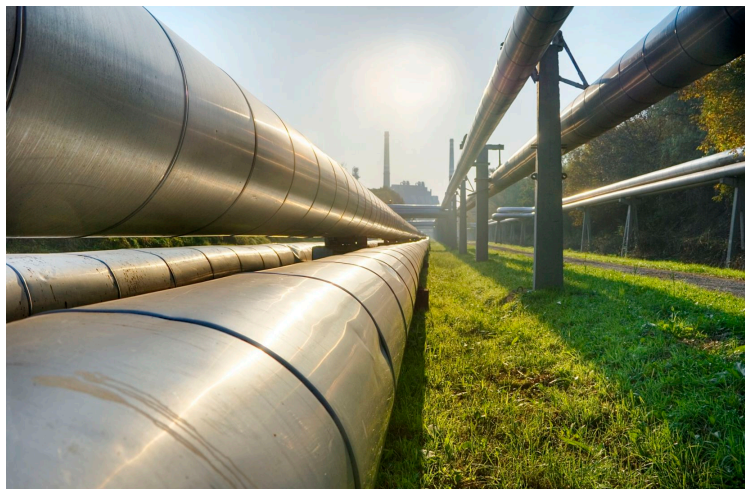


Species	Biosolids	Digestate
Helium	0.66 ± 0.03	0.75 ± 0.15
Hydrogen	18.0 ± 1.3	17.5 ± 1.1
Carbon Dioxide	18.8 ± 0.5	19.0 ± 0.5
Methane	22.0 ± 0.9	22.5 ± 0.5
Ethane	1.7 ± 0.1	1.5 ± 0.1
Ethylene	5.0 ± 0.1	4.5 ± 0.15
Acetylene	0.04 ± 0.01	0.02 ± 0.01
Oxygen	0 ± 0	0 ± 0
Nitrogen	15.1 ± 2.9	15.6 ± 1.7
Carbon Monoxide	17.4 ± 0.7	17.4 ± 0.7
Propane/Propylene	0.53 ± n.d.	0.2 ± n.d.
All others (C4+)	0.77 ± n.d.	0.97 ± n.d.
Average Molecular Weight (g/mol)	24.08	24.22
Gross Calorific Value (MJ/kg)	16.7	16.3

Syngas – Net Energy

- Syngas is cleaned, and some reused in the system burners
- Net available syngas (after some used for system heat):
 - 10 MJ gas/kg biosolids (dry)
 - 8.6 MMBTU gas/ton biosolids (dry)
- 50,000 TPA (dry) gives 430,000 MMBTU





- Renewable Natural Gas (RNG) is methane produced from organic matter, which can be injected directly into the Natural Gas pipeline
- RNG targets & mandates exist (examples below)
- First-generation RNG comes from anaerobic digestion biogas plants
- Pyrolysis is a second-generation technology
- Recent study shows 82% of RNG in Québec will need to come from Second Generation RNG (Énergir)

Jurisdiction	RNG Target	Utility
California	20% by 2030	SoCalGas
Vermont	20% by 2030	Vermont Gas
British Columbia	15% by 2030	FortisBC
Québec	5% by 2025	Énergir



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Other Uses:

Odour Control

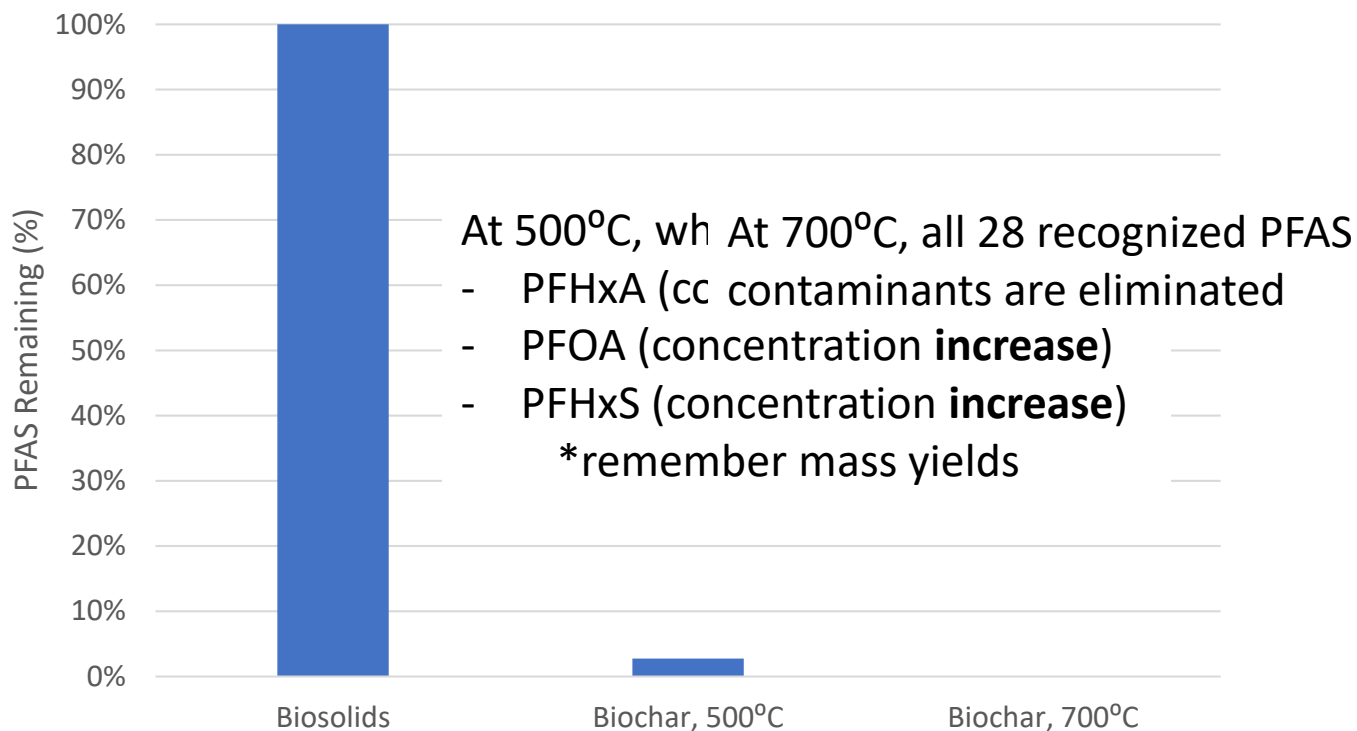
Water Treatment (Phosphorous)

Biochar (700°C)

Fertilizer Analysis	
Nitrogen (Total)	2.18%
Phosphorous (avail P ₂ O ₅)	5.3%
Potassium (Soluble K ₂ O)	0.5%

Ash Analysis (wt.%)	
SiO ₂	17.4%
Al ₂ O ₃	4.0%
TiO ₂	0.07%
Fe ₂ O ₃	17.8%
CaO	10.4%
MgO	2.7%
Na ₂ O	0.6%

Presented in Aggregate of 28 Recognized PFAS Contaminants



Base Business Case

Parameter	Total
Digestate Quantity (TPY)	40,000
Moisture Content	65%
Dried Sludge Quantity (TPY)	14,000
Biocarbon Production (TPY)	5,600
Quantity Reduction	86%
Net Thermal Power (MMBtu/hr)	6.3

Parameter	Factor	Total
Tip Fee Avoidance	\$50/ton	\$2,000,000
GHG Avoidance	\$TBD	\$TBD
LCFS Credit, additional	\$4 - \$7+/MMBTU	\$TBD
Biocarbon Sale/Value	\$250/ton	\$1,400,000
Natural Gas offset savings	\$4/MMBTU	\$200,000
Total:		\$3,600,000



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WRF LIFT ASK:

- Full-scale demonstrations and installations
- We have full lab capabilities to run small scale and tote bag scale tests/validations

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