



BIOGREEN



**NORRIS THERMAL
TECHNOLOGIES**

global equipment solutions



Presented by: Daron (Chuck) Norris
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Innovative and sustainable solutions for industry



Products dedicated to sustainable solutions for industry

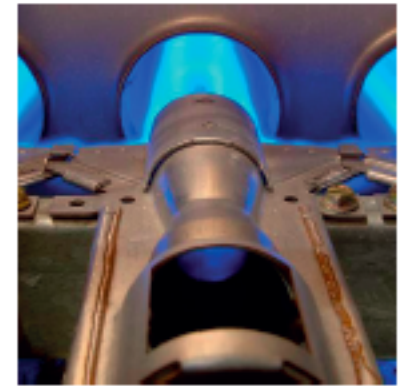
Since 1965

→ **Safesteril[®]**
Thermal treatment for food industry

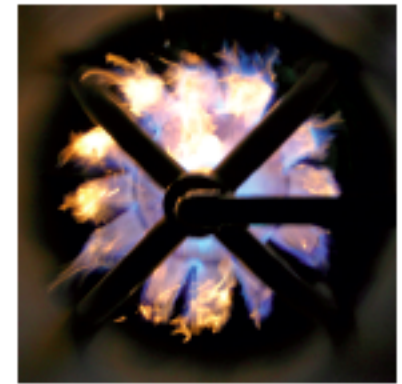
→  **BELTOMATIC**
DRYERS • ROASTER • COOLERS
Drying and cooling of bulk products

→  **Biogreen[®]** ✓
Thermochemical conversion of biomass and waste





TORREFACTION
PYROLYSIS
GASIFICATION





END OF LIFE TIRES



MSW (RDF)



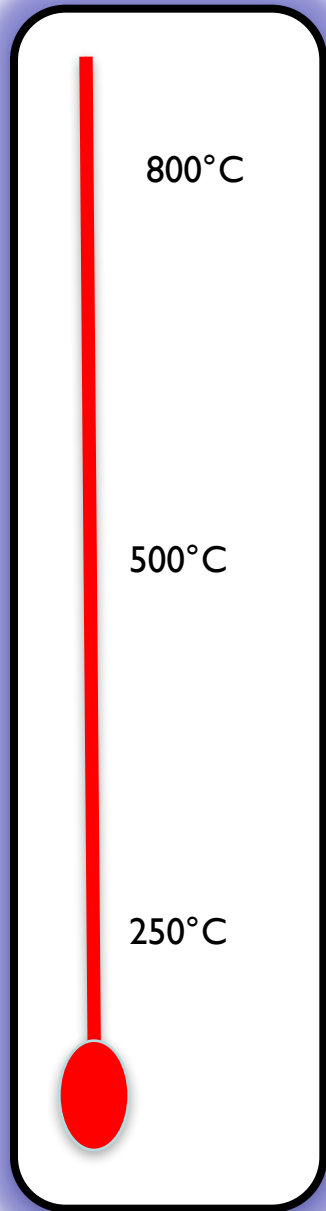
SLUDGE (Sewage, Digestat, Manure)

PLASTIC (MSW, Car fluff)



BIOMASS (Forest, Crops)





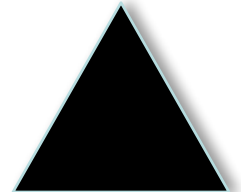
Gasification 600-900°C
Main product is syngas
Yield between 50 and 85%



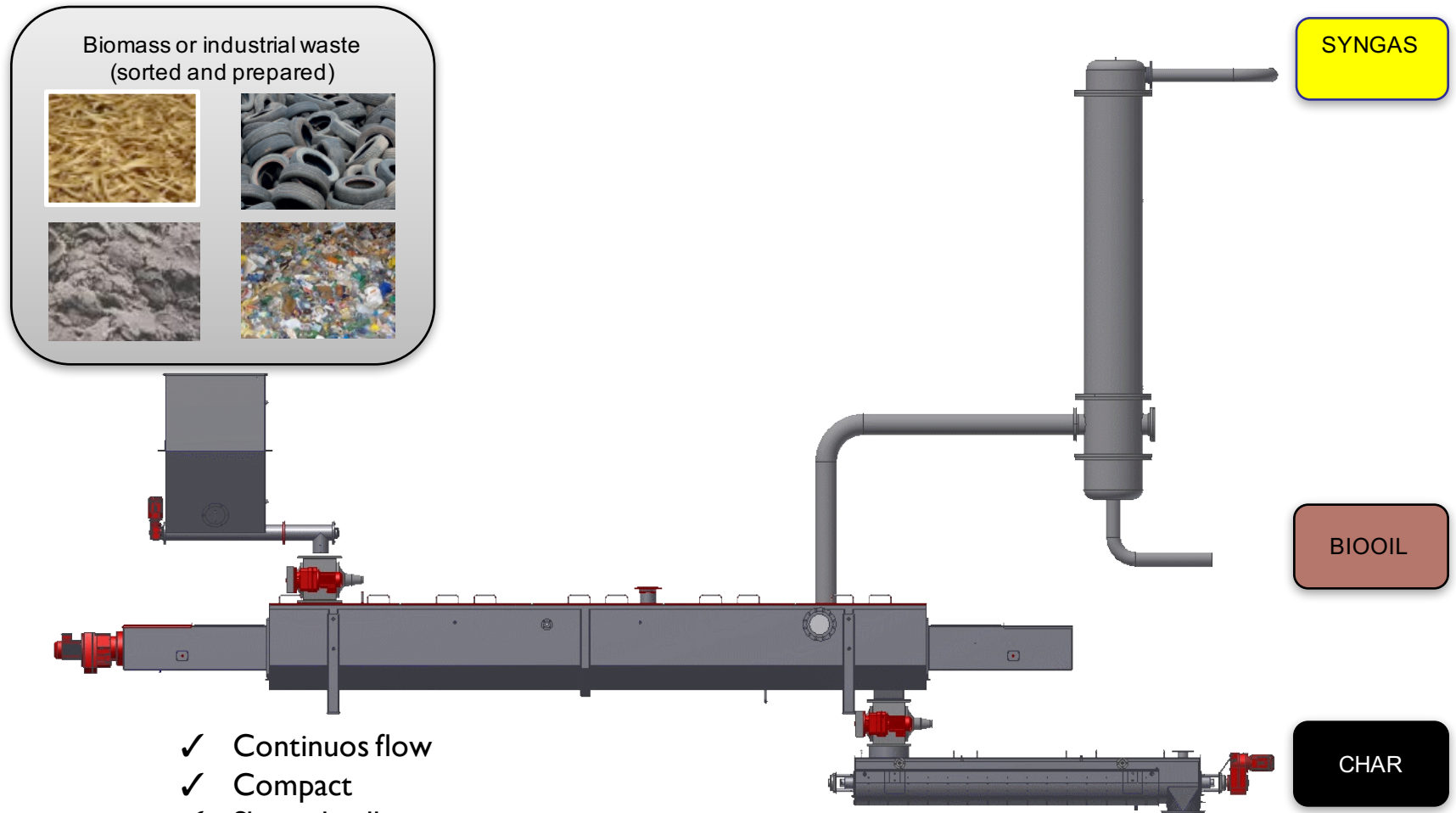
Pyrolysis 300 → 550°C
Main products are biooil and biochar
Yield of Biooil 30 to 60%
Yield of Biochar 25 to 35%



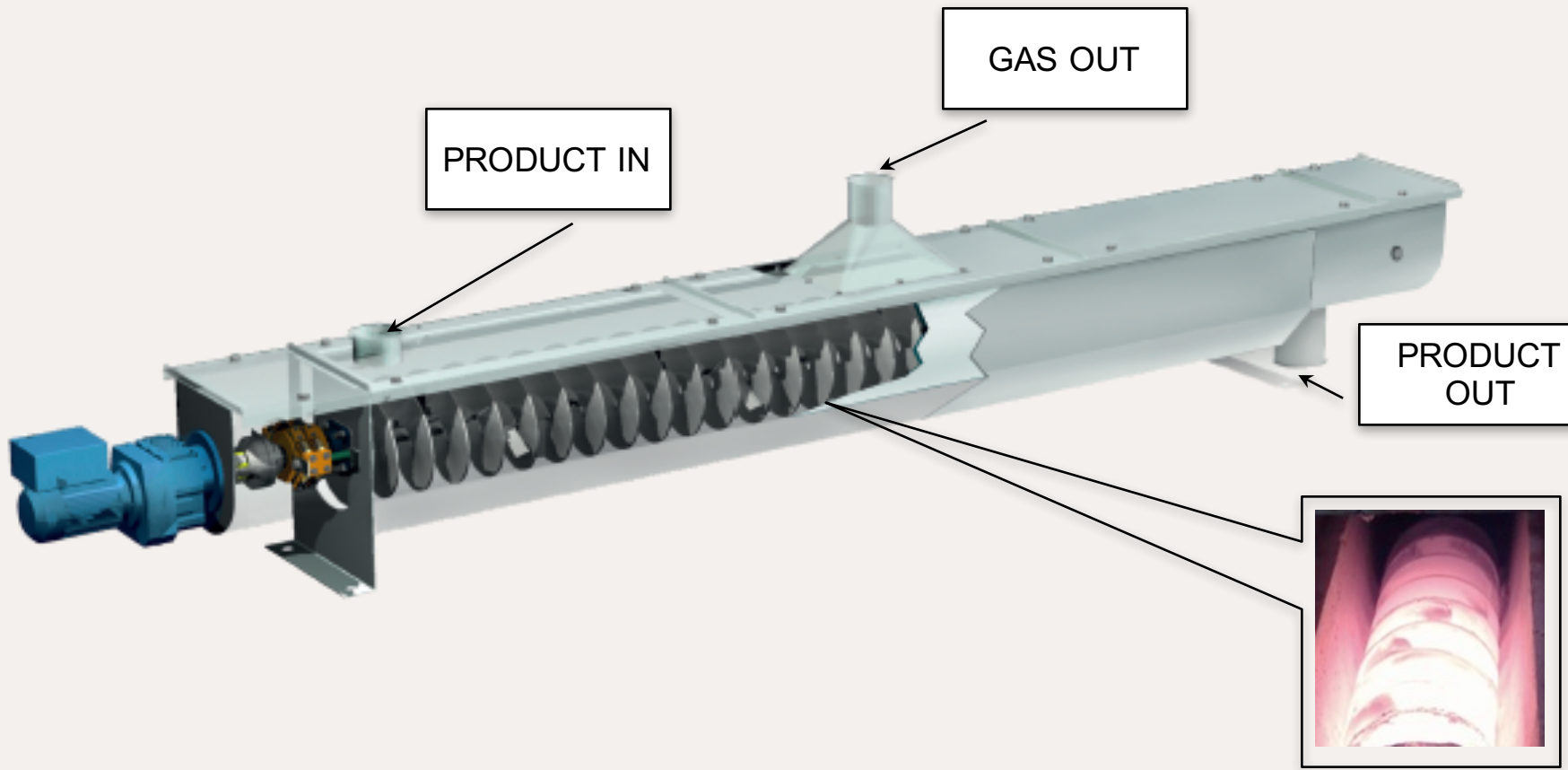
Torrefaction 250 → 280°C (*only for biomass*)
Main product is biocoal
Yield between 70 and 80%



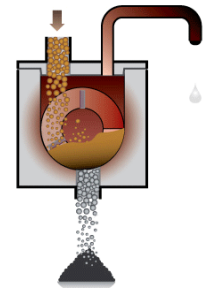
<https://youtu.be/OPzcAmNZQ3g>



- ✓ Continuous flow
- ✓ Compact
- ✓ Short dwell time
- ✓ Easy monitoring
- ✓ Low maintenance
- ✓ Industrial design and proven technology (first unit plant constructed in 2003)



Capacity up to 3m³/h per module
(depends on feedstock)





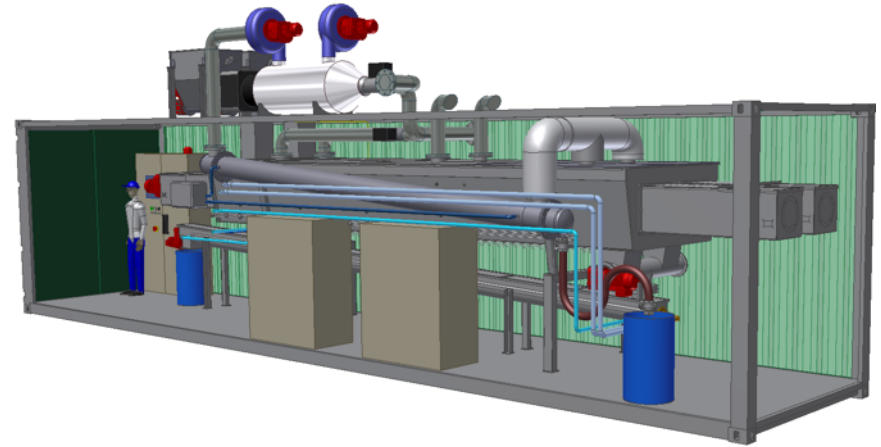






>1.5 ton per hr tobacco waste
1st use is Biochar for coal replacement
2nd use is soil amendment land application

Biogreen® 40ft CONTAINER UNIT MOBILE UNIT (France)





- 10-50 lbs hr
- Thermal Oxidizer
- Condenser
- Fully automated
- Data logging all inputs/outputs
- Rent, lease, toll, r&d



Designed for torrefaction, pyrolysis, or gasification

½ ton to 1 ton per hr

Pre wired easy setup (8-12 hr install)

Customizable layout (u shape, L, inline)

Fully automated

Data logging of time, temp, flow, pressure, and gas analysis taken from several locations across the process.

Available for rent, toll, lease, or R&D



Waste to Wisdom Project
www.wastetowisdom.com



Waste to Wisdom Project

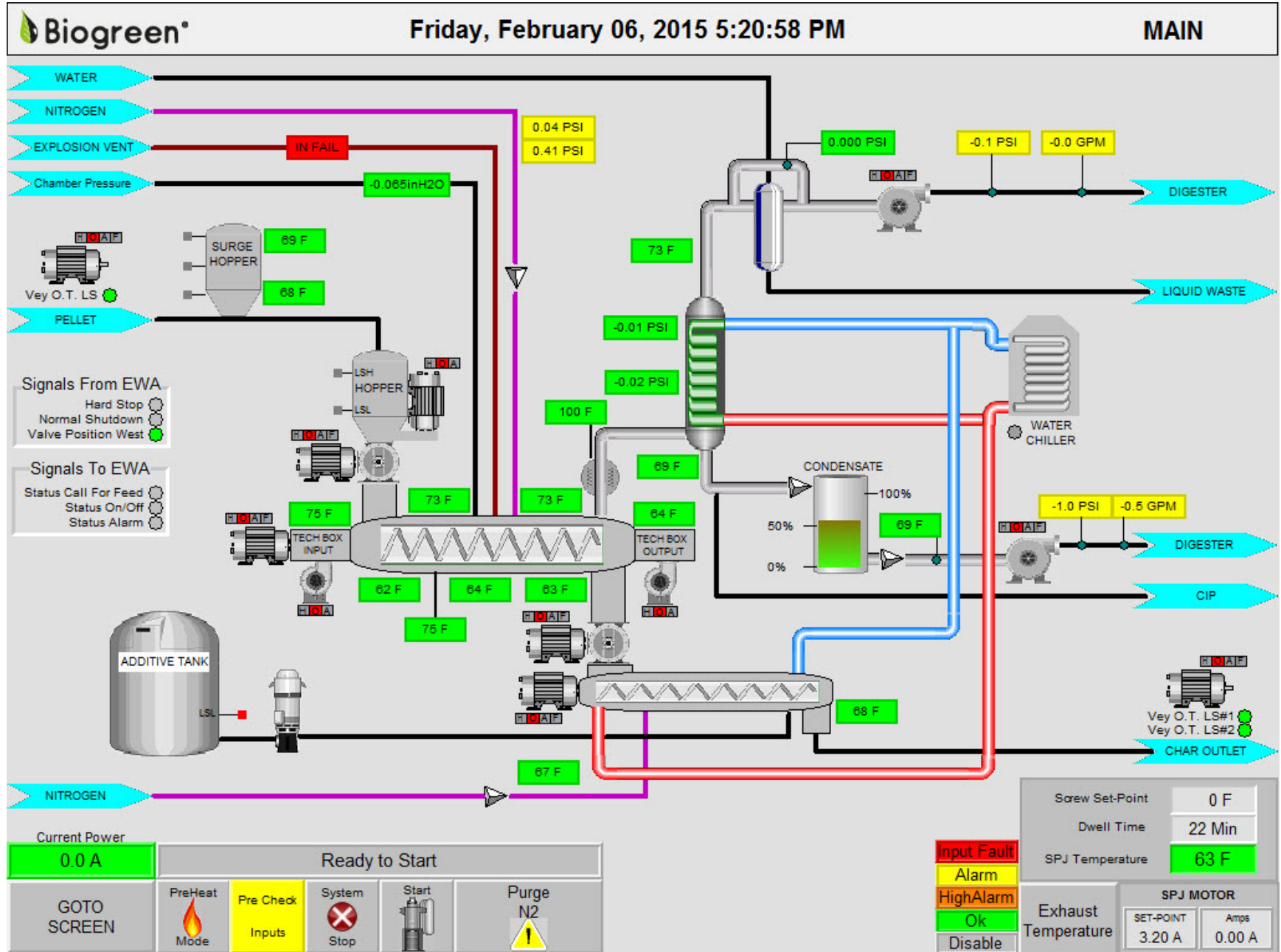
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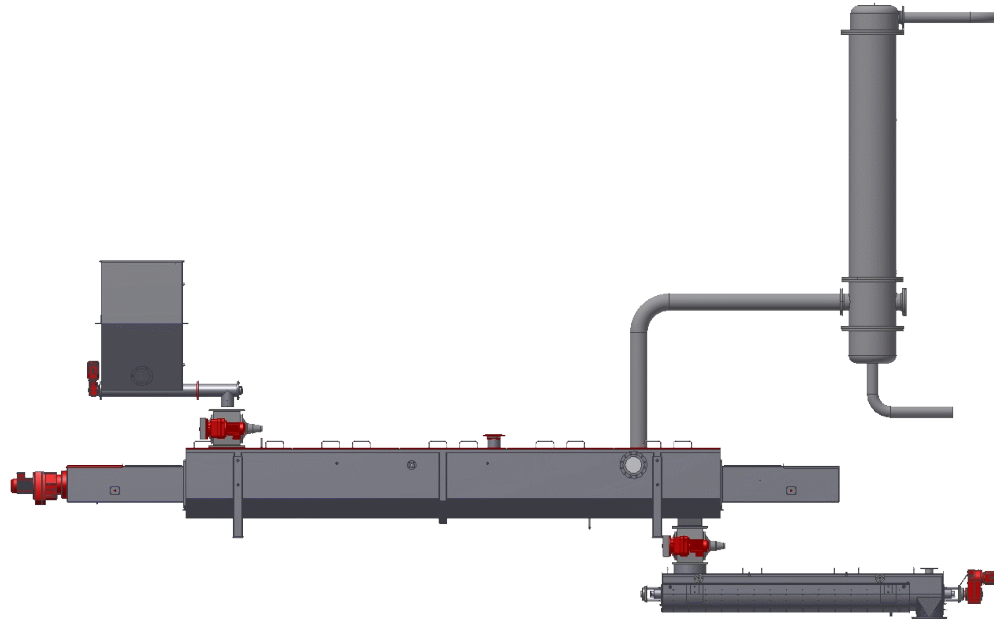
Residence Time	Temperature Setpoint	Feedstock Moisture Content	Feedstock Input Rate, lb/hr	Feedstock Input Rate	Torrefied Output Rate	Observed Color of Torrefied Output	Average Electric Power, Total	Average Electric Power, Heating Only	Specific Electricity Usage kWh/lb torrefied biomass	Feedstock Analysis		
										Ash Content	Volatile Matter	Fixed Carbon
min	°C	wet basis	wet basis	bone dry	bone dry		kW	kW		dry basis	dry basis	dry basis
10	425	12%	1104	969	767	Light/Medium	151	130	0.20	0.0336	0.8074	0.159
10	425	9%	1129	1027	710	Medium/Dark Brown	155	132	0.22	0.0336	0.8074	0.159
20	350	22%	608	476	403	Light	81	73	0.20	0.0336	0.8074	0.159
20	350	12%	512	450	309	Medium/Dark Brown	68	61	0.22	0.0336	0.8074	0.159
20	400	19%	535	434	282	Medium/Dark Brown	91	78	0.32	0.0336	0.8074	0.159
20	400	13%	517	452	183	Dark (Char)	70	59	0.38	0.0336	0.8074	0.159

.20 to .38 of \$0.088 kwh = 1.76 cents to 3.34 cents per lb of product.
NOT OFFICIAL RESULTS

Waste to Wisdom Project
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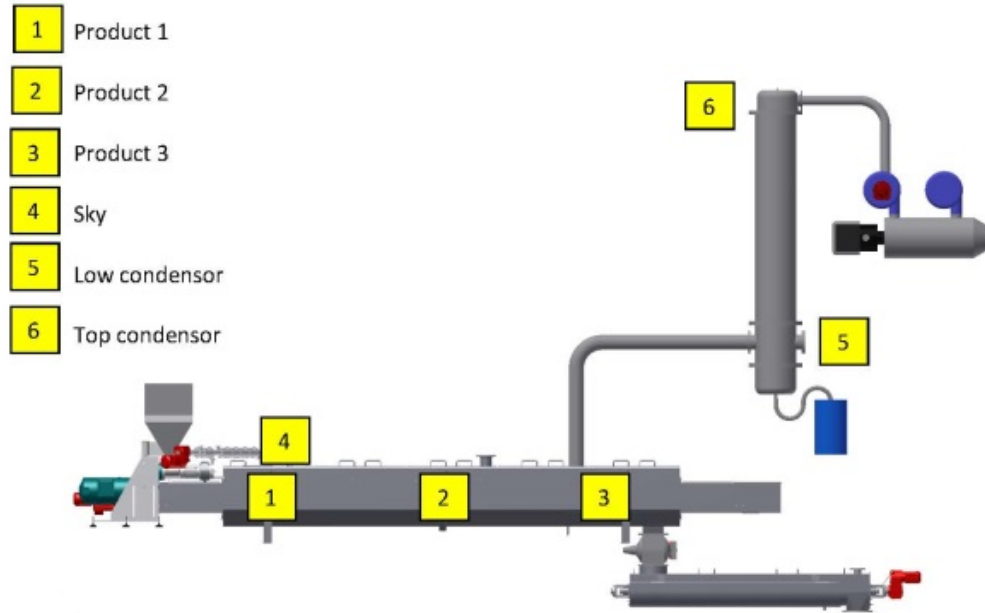


Spirajoule (applications < 300°C)

→ 70 UNITS (35 countries)

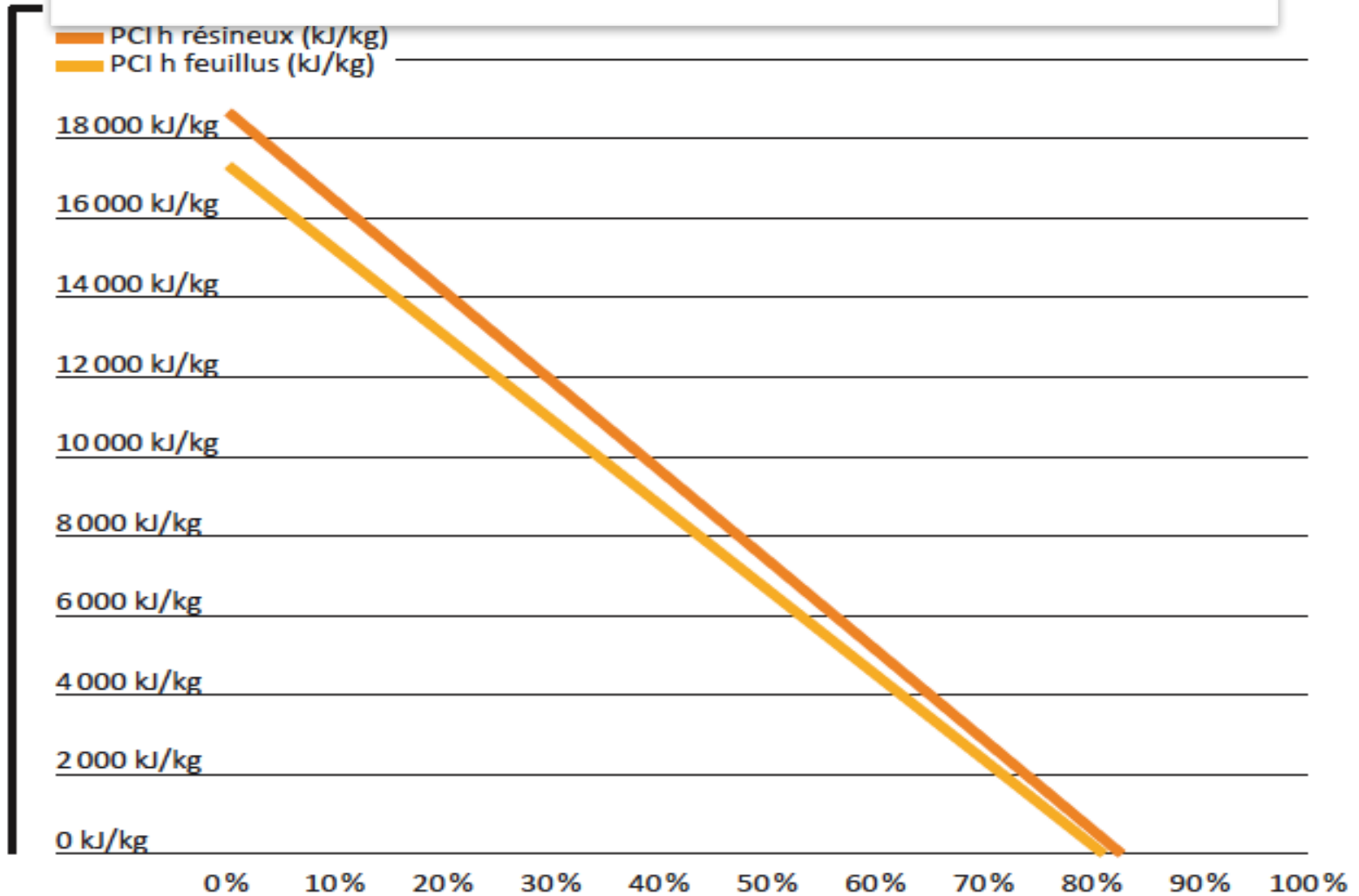
Biogreen (applications > 400°C)

- 3 R&D units (F, Spain, USA)
- 2 customer test units 200 lbs/d (F & Malaysia)
- 5 units 6 to 10 t/d (F, Israel, Dubai, USA)
- 1 units 20 t/d (Indonesia)
- 5 containerized units (Hollande, Malaysia, F, USA, Italy)

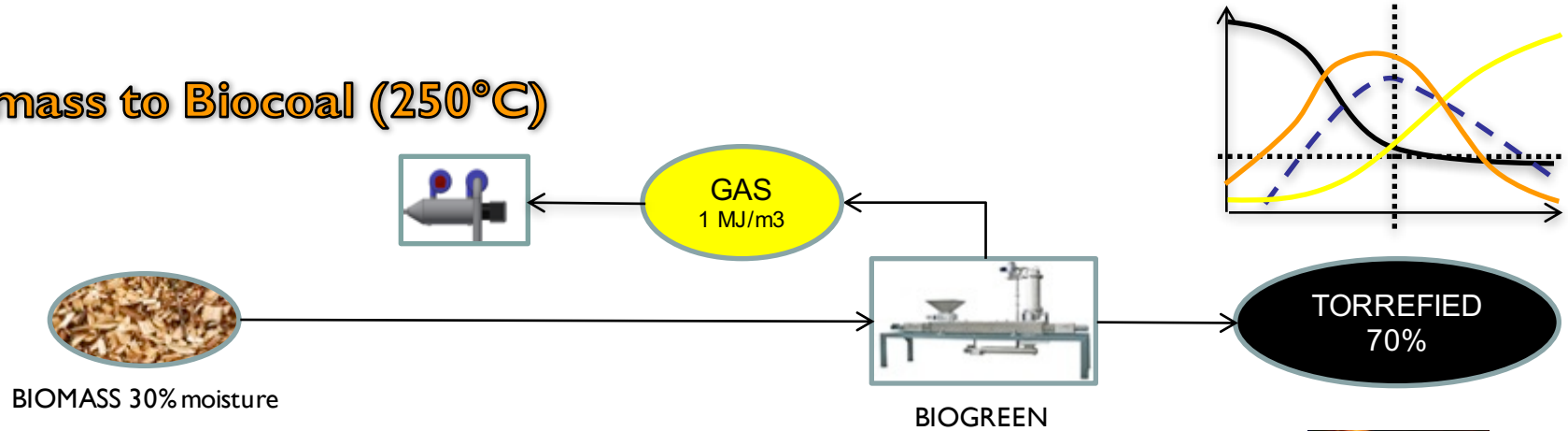

Syngas analysis

CO (%)	CO ₂ (%)	CH ₄ (%)	C _n H _n (%)	H ₂ (%)	O ₂ (%)	PCI (MJ/m ³)
43.33	32.97	18.77	1,36	2.03	0.03	13.3

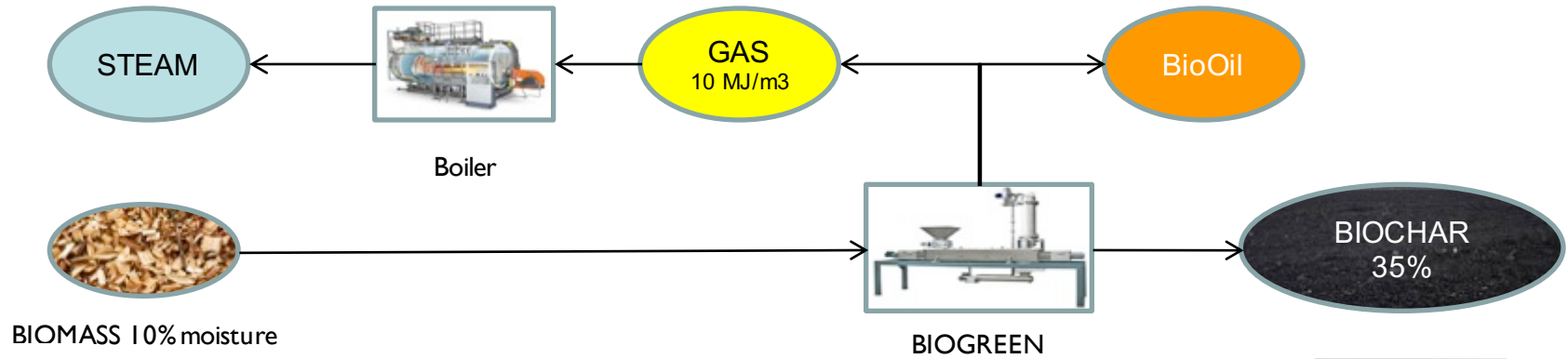
LHV VS %MC



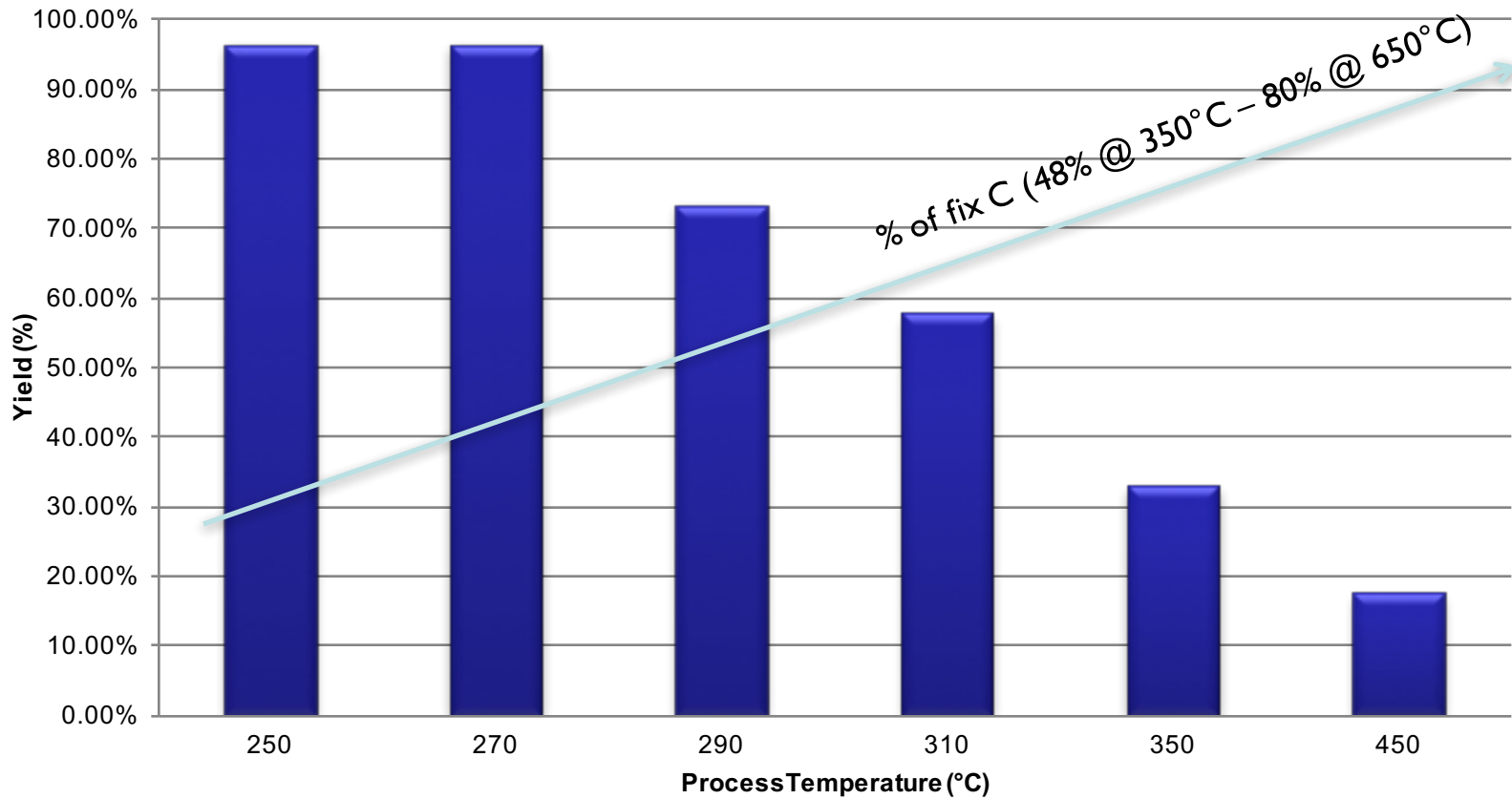
Biomass to Biocoal (250°C)



Biomass to Syngas / Biochar (500 - 700°C)

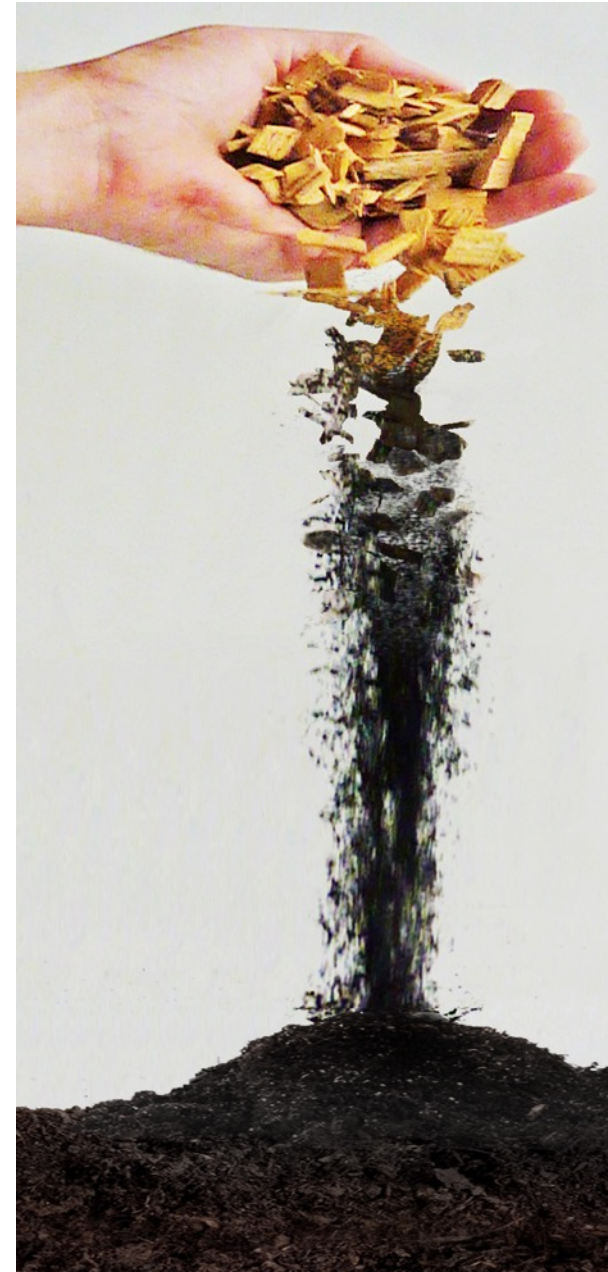


CHAR YIELDS (% of Dried feedstock)



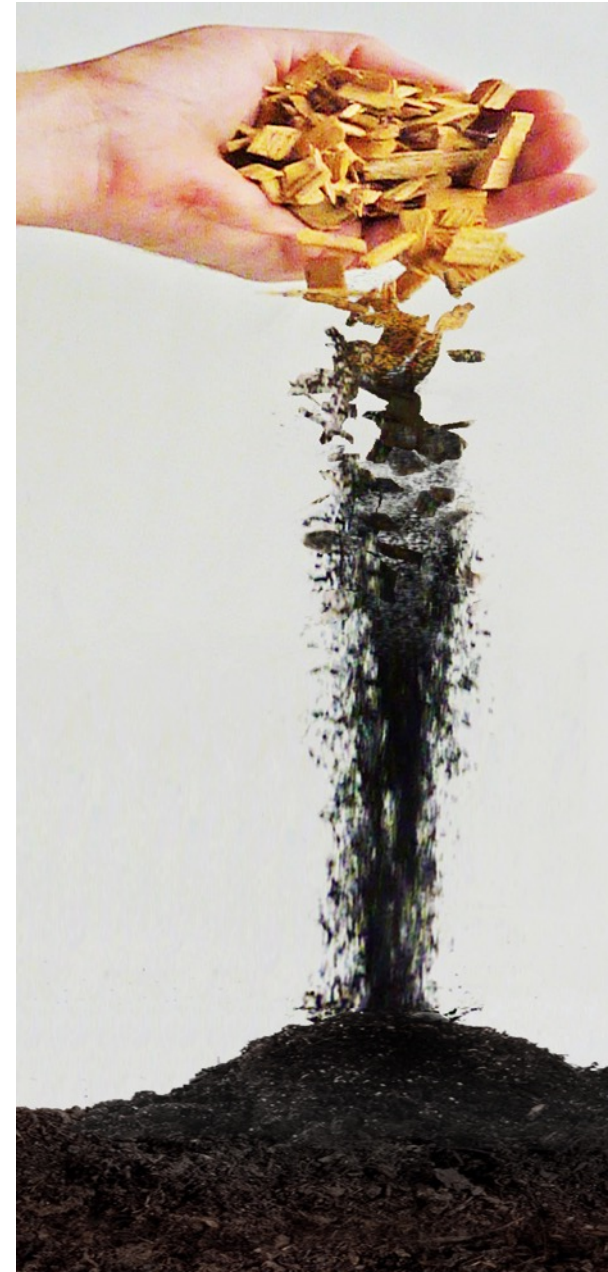
Example of biomass studied:

- ✓ Wood
- ✓ Straw
- ✓ Miscanthus
- ✓ Palm Kernel shell
- ✓ Tea
- ✓ Coffee waste
- ✓ Vetyver (essential oils distilled from roots)
- ✓ Digestat
- ✓ Sewage sludge
- ✓ Vineyard residue
- ✓ Tobacco waste



Summary

- ✓ Operator friendly and safe
- ✓ Proven technology
- ✓ Precise and repeatable
- ✓ Superior Controls and Automation
- ✓ Energy efficient
- ✓ Fast and expedited installation
- ✓ Compact size
- ✓ Low maintenance
- ✓ Complete integration with other equipment manufactures for a total turn key package
- ✓ We are now MADE IN THE USA!



CONTACT



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