Replacing Fossil Coal with Biocoal Via High Temperature Pyrolysis

A&WMA Decarbonization Conference
Sept 13, 2023

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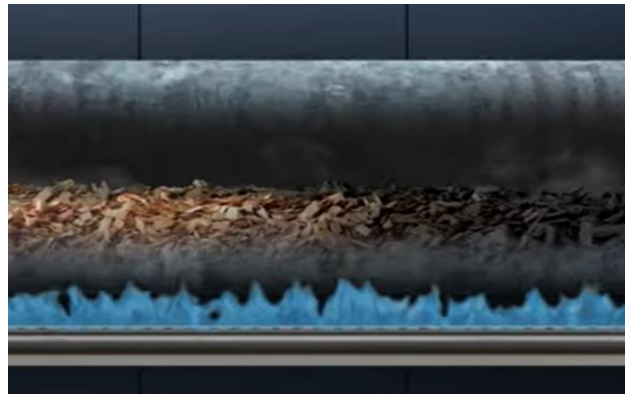
FORWARD LOOKING STATEMENTS

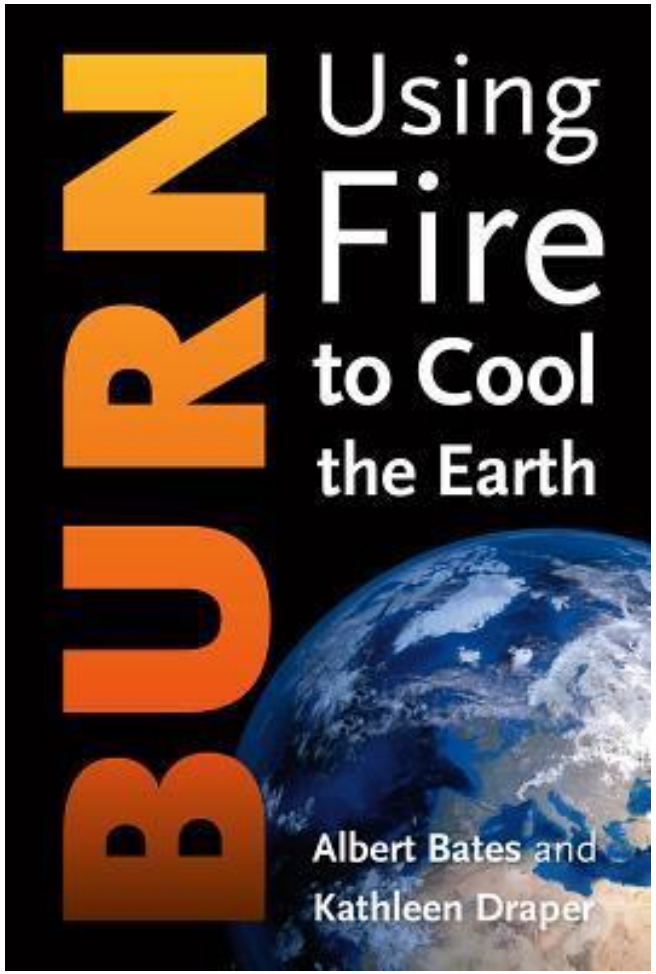
Statements in this presentation, to the extent not based on historical events, constitute forward-looking statements. Forward-looking statements include, without limitation, statements evaluating market and general economic conditions, and statements regarding future-oriented costs and expenditures. Investors are cautioned not to place undue reliance on these forward-looking statements, which reflect management's analysis only as of the date thereof. These forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially. Such risks and uncertainties with respect to the company include the effects of general economic conditions, actions by government authorities, uncertainties associated with legal proceedings and negotiations, competitive pricing pressures and mis-judgements in the course of preparing forward-looking statements.

What is "HTP"? Thermochemical Conversion 101

Attributes	Combustion	Gasification	High Temperature Pyrolysis (HTP)
Amount of Oxygen	Oxygen rich	Oxygen limited	Oxygen free
Source of Heat	Direct Burning of the biomass	Direct Limited burning of biomass/syngas in reactor	Indirect Burning of syngas outside of reactor



Thermochemical Conversion For GHG Reduction 101



HIGH TEMPERATURE PYROLYSIS (HTP) TECHNOLOGY

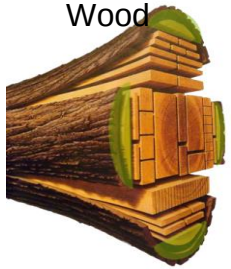
Low-value waste products otherwise destined for landfills or incineration

Hog fuel

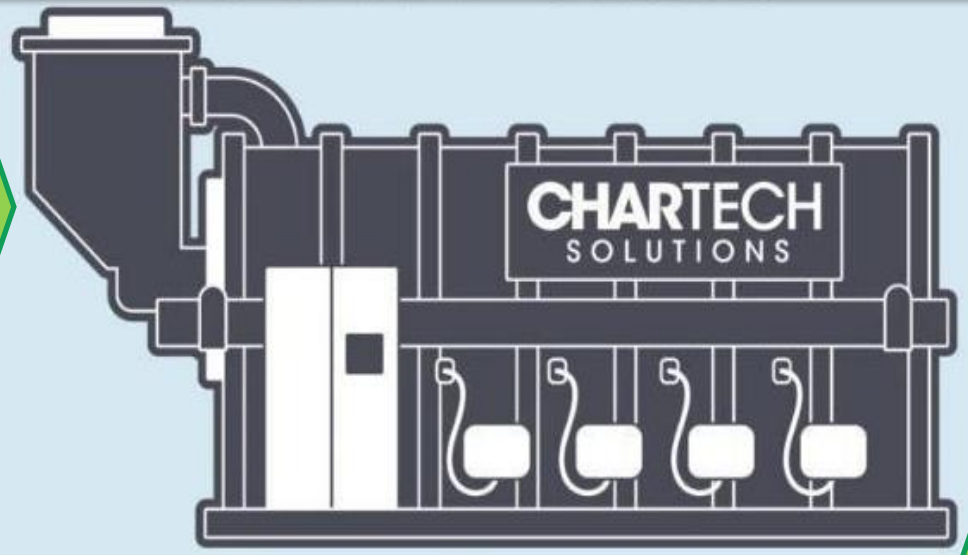
Bark

C&D Waste

Non-Merchantable Wood



Carbon negative, *closed loop, self-sustaining system** externally heats wood waste in the absence of oxygen. Materials do not burn and cannot create harmful emissions or odours.



HTP processes the wood waste to simultaneously *generate two renewable energy co-products.*

Renewable Gas

- Renewable Natural Gas (RNG) or;
- Green Hydrogen

Biocarbons

- Biocoal drop-in replacement for steelmaking coal or;
- Biochar carbon credit generation

*After initial start-up, CHAR HTP is powered by a slip stream of the renewable energy it produces to externally heat the biomass to cause a thermochemical conversion. No incineration possible.

CHAR's Thorold RNG & Biocoal Facility

2 modules would…

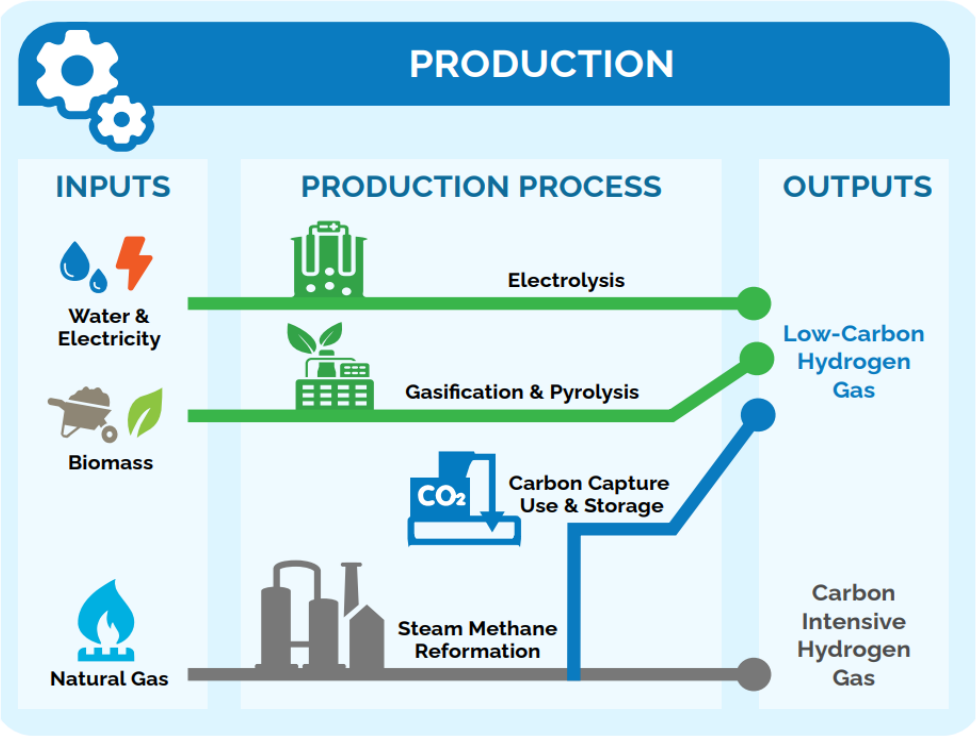
- Replace 25% of Canada's largest steel mill's coal
- RNG for 5,500 homes

CHAR's 50,000 sq feet Thorold facility

- Supply chain accessible by water, rail and highway
- Feedstock provided locally by Walker Environmental

WHAT DO WE MAKE? ALWAYS A GAS & A BIOCARBON

CHAR's HTP co-produces green hydrogen or RNG supporting the Green Energy Transition



GREEN HYDROGEN

OR

Renewable Natural Gas

Carbon negative, pipeline quality gas that is *fully interchangeable* with conventional *natural gas* and can be used in natural gas vehicles with additional upgrading.

RENEWABLE NATURAL GAS

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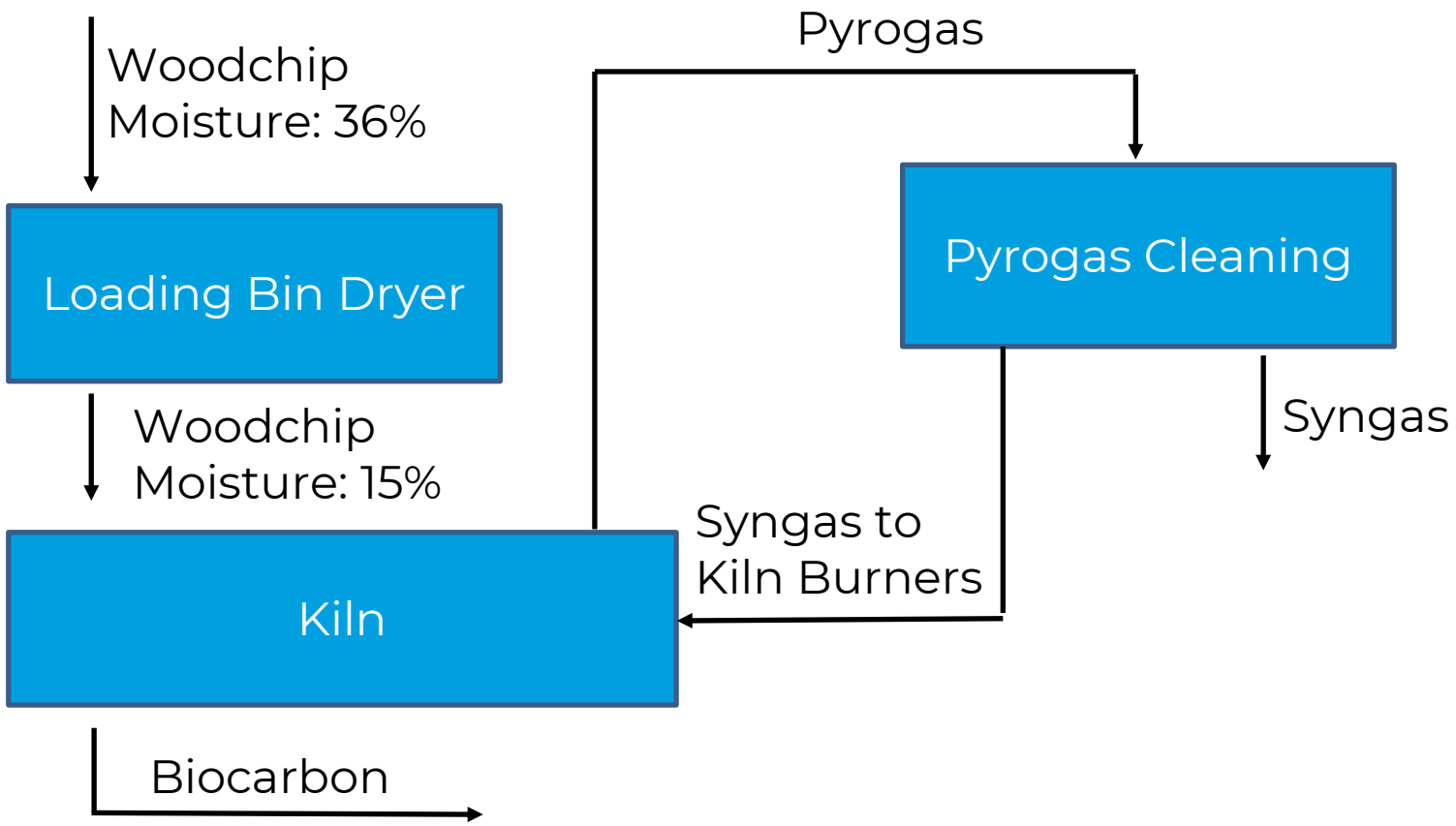
SYNGAS TO RENEWABLE NATURAL GAS PROCESS



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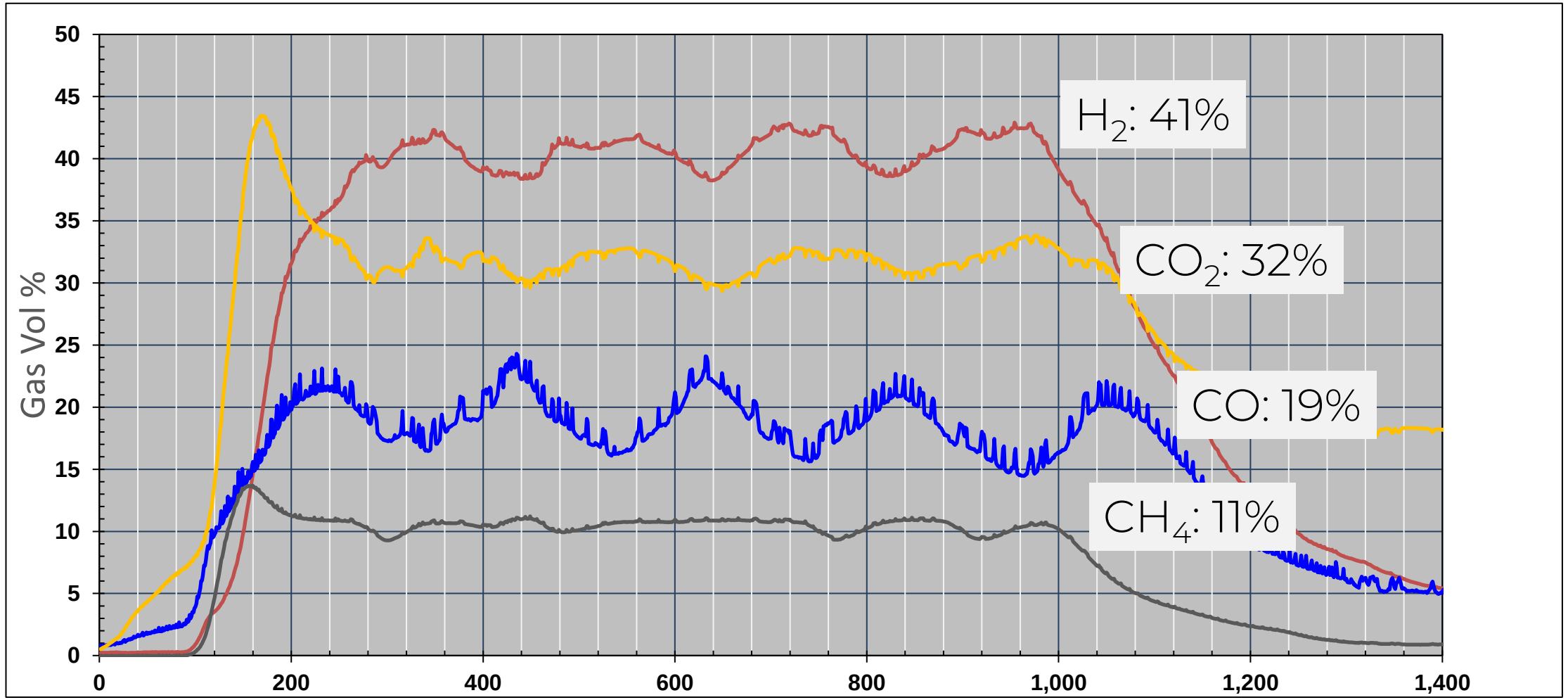
SYNGAS CHARACTERISTICS



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METHANATION CHEMISTRY

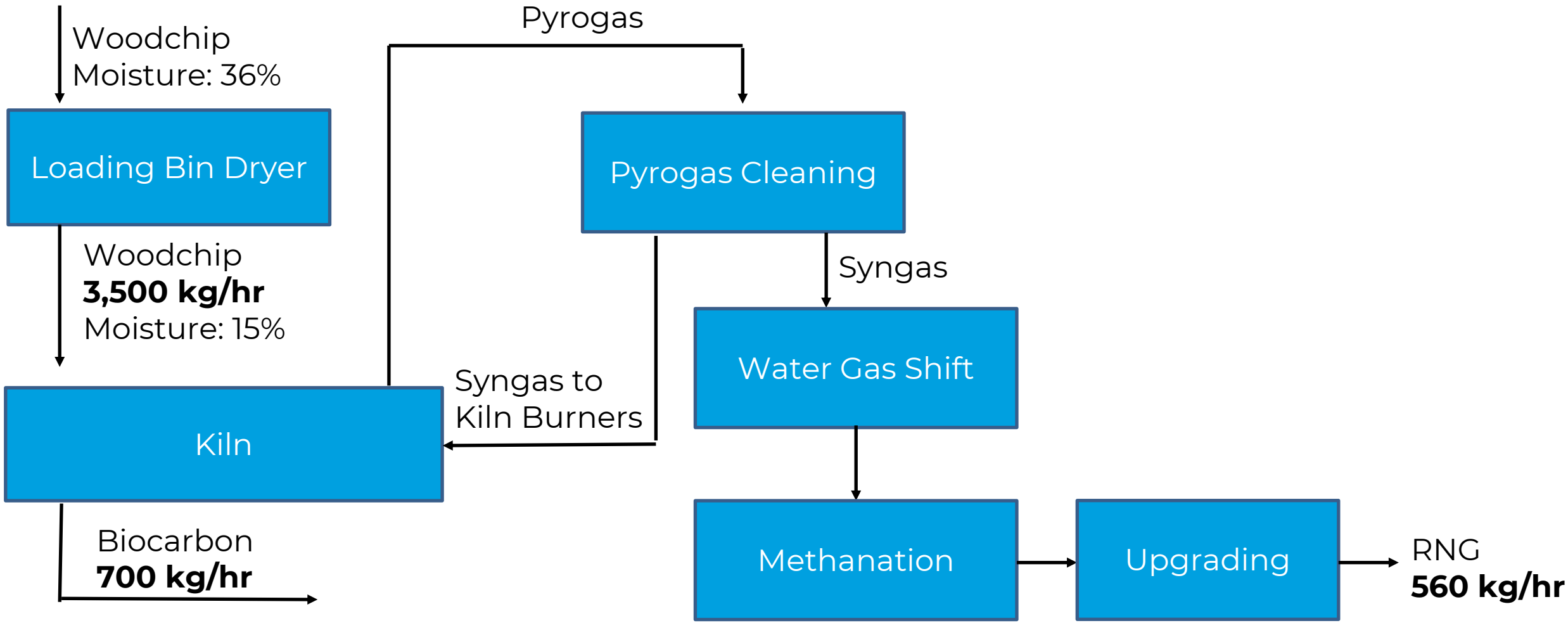
Water Gas Shift

$$CO + H_2O <-> H_2 + CO_2$$

Methanation

$$CO_2 + 4H_2 <-> CH_4 + 2H_2O$$

SYNGAS TO RENEWABLE NATURAL GAS PROCESS



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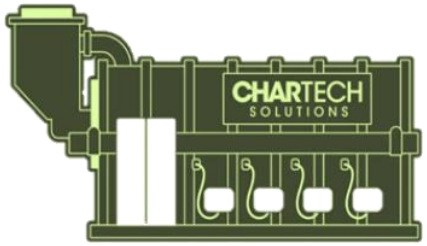
CHAR has TWO Biocarbon Markets



Decarbonize Steel ← → **Carbon Credit Sales**

Biocoal to Replace Fossil Coal

- Developed in collaboration with Canadian steel makers
- Direct drop-in replacement for fossil coal
- Provides a 91% greenhouse gas (GHG) reduction vs. fossil coal
- Steelmaking accounts for 8% of global GHG emissions

Biochar for Carbon Sequestration

- Monetize biochar through carbon sequestration soil remediation CO_2 Removal Certificates (CORCs)
- CORCs are generated through biochar sales & sequestration

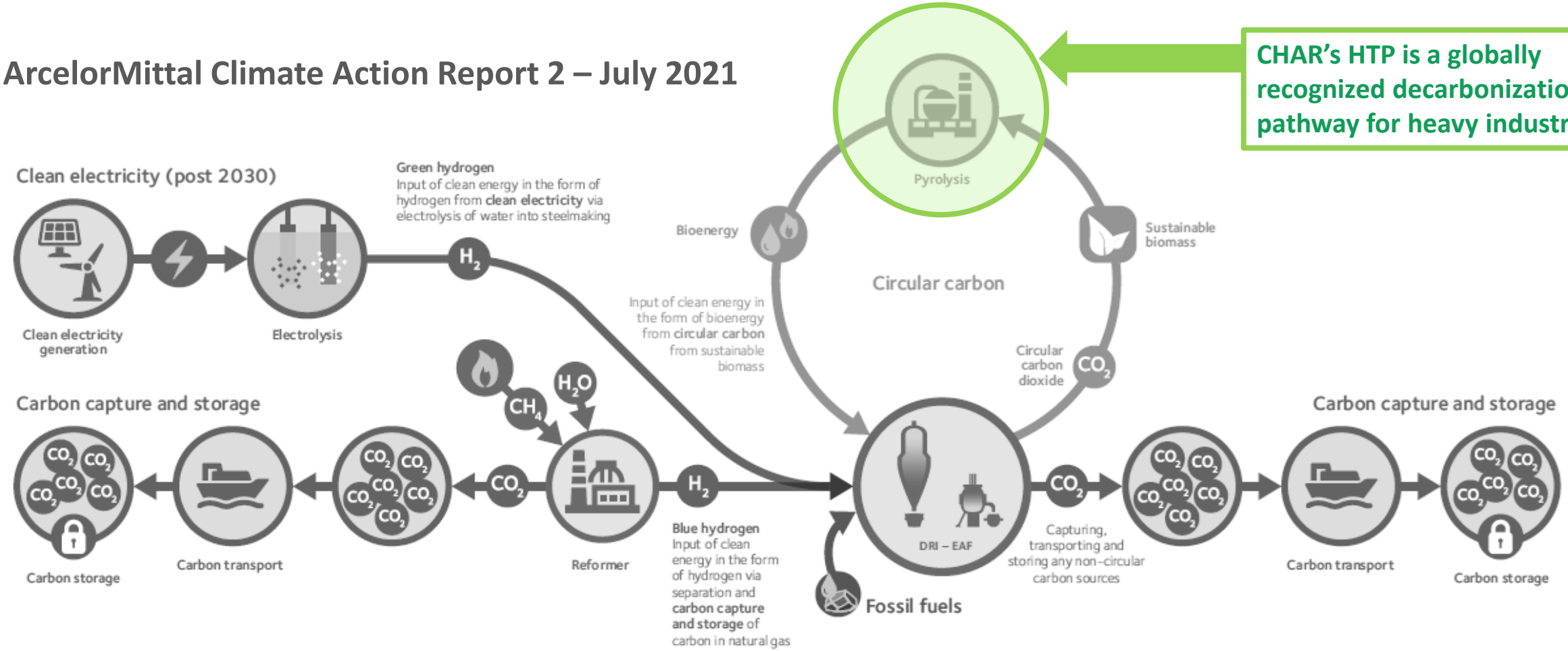
*As of December 2022, CORC price = €139 and;
1 tonne of CHAR biochar = 2.2 CORCs = €305 per tonne
€305 x 5,000 tonnes per module = €1.5 million

Other Biocarbon Markets…

Strategic Place in Steel Decarbonization

ArcelorMittal Climate Action Report 2 – July 2021

CHAR's HTP is a globally recognized decarbonization pathway for heavy industry



Biocoal

Quick Facts:

- 1 tonne coal = 2.9 tonnes GHG (direct consumption only)
- 1 tonne biocoal replaces 1.1 tonnes coal
- 1 tonne biocoal = 0.27 tonnes GHG (lifecycle)
- GHG Pricing = $170/tonne by 2030
- In 2030, 1 tonne of coal will cost an extra $496

CleanFyre v.s. Anthracite Coal:

Fuel	Energy Value	GHG Emissions
CleanFyre	32 MJ/kg (13 000 BTU/lb)	0.27 tonnes of CO_2/tonne
Anthracite coal[1]	29 MJ/kg (12 000 BTU/lb)	2.9 tonnes of CO_2/tonne

- 1 tonne of CleanFyre replaces 1.1 tonnes of Anthracite, reducing net GHG emissions by 2.90 tonnes of CO_2 per tonne of fuel

Biocoal – Key Considerations

Use: Thermal (brown) coal replacement, or metallurgical coal replacement?
If metallurgical, replacing:

- Coke?
- PCI?
- Charge carbon?
- Injection carbon?

Energy Density: Anthracite is 29 MJ/kg (12,000 BTU/lb)

Ash Content: Anthracite is < 5% - limits feedstock choices to generally clean wood

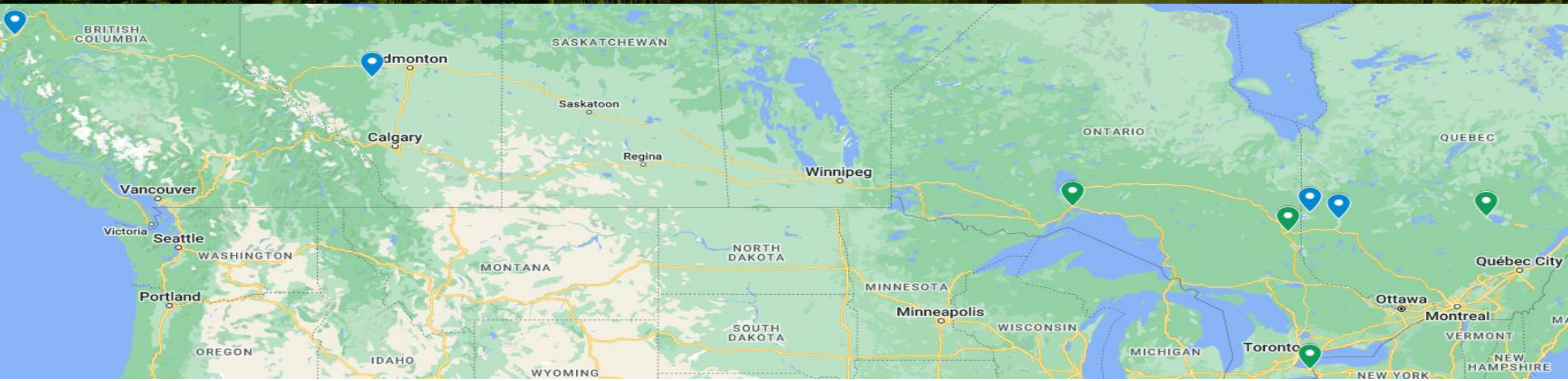
Logistics: As produced, very low density

CARBON INTENSITY FOR RNG FROM HTP

	Base Case		
CI, RNG Only ($gCO_{2,eq}/MJ$)	3.9	3.9	3.9
% Biocoal	80%	100%	80%
% Biochar	20%	0%	20%[1]
CI, Biocarbons ($gCO_{2,eq}/MJ$)	-62.8	-77.3	-61.8
Total CI ($gCO_{2,eq}/MJ$)	**-58.9**	**-73.4**	**-57.9**

- Calculated using GHGenius, 3rd party reviewed
- Calculated on a “lifecycle basis” – includes transportation and preparation (griding) of wood

ADDITIONAL PROJECT PIPELINE



Combined Project Pipeline:

- 3.25M GJ/yr of RNG or Green Hydrogen
  - Gas supply for 36,000 homes
- 65K tonnes/yr of Biocarbon/Biocoal
- 200,000 tonnes/yr of GHG emission removal
- Modular technology to maximize regional impacts

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Thank You!

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