

Using Torrefied Wood for Electricity, Briquette & Pellet Production

By

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Torrefaction: A Technology to Densify & Enhance Biomass

- **Untreated biomass may be 50% water, it's bulky and it's not the most efficient or useable fuel or bio-feedstock. Torrefaction:**
 - Drives off most of the water
 - Reduces the bulk
 - Makes a better co-fire feedstock to burn with coal
 - Makes superior briquettes and pellets
- **Mobile torrefaction, applied at the point of harvest:**
 - Reduces transportation costs of biomass, per BTU
 - Produces a more valuable biomass shipment



Torrefaction: Adding Value and Reducing Transportation Cost/BTU

- Untreated Biomass:
 - Bulky
 - Moist
 - Fibrous
 - Perishable
 - Waste
 - Expensive to transport
- Torrefied Biomass:
 - Dense, If Pelletized, Etc.
 - Dry & Water Resistant
 - Easily Crushed
 - Does Not Rot
 - Valuable Fuel
 - Energy Dense

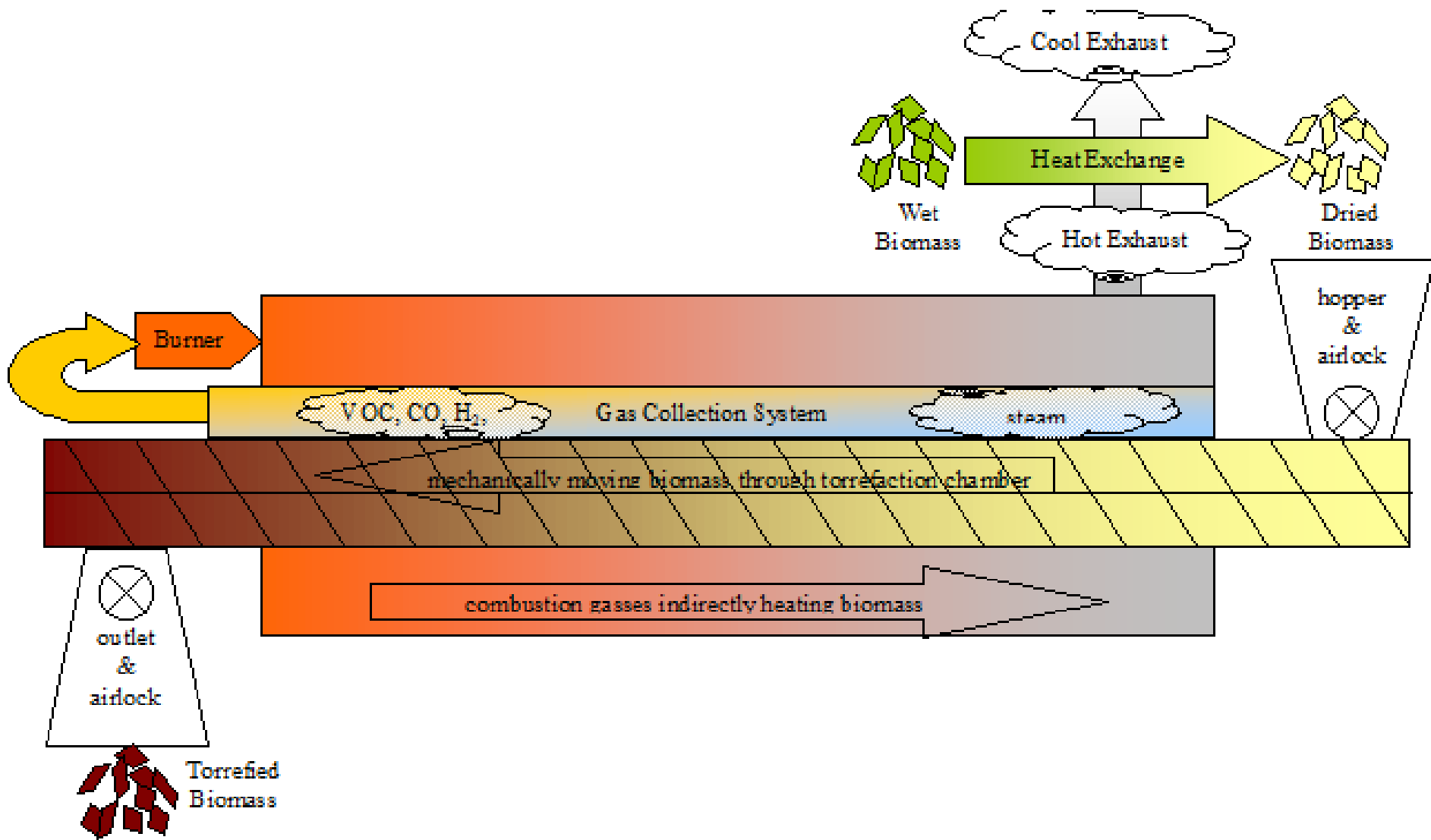


The Process of Torrefaction

- Heating (300-400^o C) wood, in a low-oxygen environment, liberates water, volatile organic compounds (VOC's), and hemicellulose (HC) from the cellulose and lignin.
- The VOC's and HC are combusted to generate 80% of the torrefaction process heat.
- The remaining and warm lignin acts as a binder when the torrefied wood is pelletized.
- Torrefied wood can easily replace coal in combustion or be a feedstock for further pyrolysis or gasification for combined heat and power or Fischer-Tropsch liquids.



Conceptual Schematic of Torrefaction Machine



Making Electricity With Torrefied Wood

- Torrefied wood is a much better fuel for co-firing with coal than untreated wood.
- Torrefied wood can be ground to a particle size, similar to that of pulverized coal, with the same or less energy use.
- Untreated wood requires many times the energy use, in grinding (by a factor of 7.5 to 15), to achieve a similar particle size.



Pelletizing & Briquetting Torrefied Wood

- At torrefaction temperatures, the lignin in wood becomes plastic and can actually become a binder of individual wood particles.
- Pellets made from torrefied wood may withstand 1.5 to 2 times the crushing force of normal wood pellets.
- Torrefied pellets show little water uptake on immersion (7-20% of mass), unlike normal pellets.
- University research in the 1930's and 1940's details benefits of torrefied wood pellets.



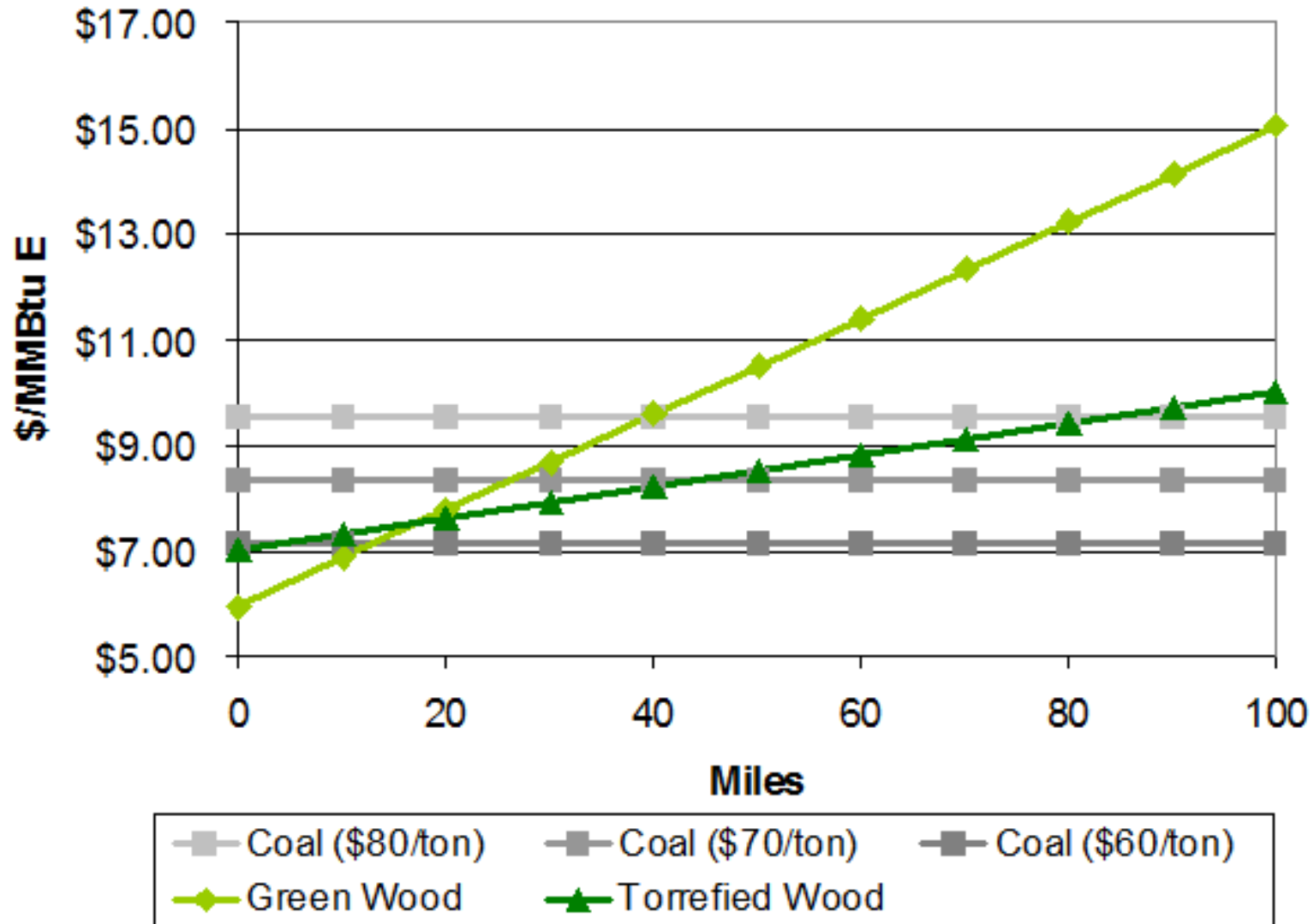
Torrefied Wood's Advantages As A Co-Fire Fuel With Coal

Assumptions used in the following chart:

- Coal is valued at \$60-\$80 per ton delivered price
- Torrefied wood (11,000 BTU/lb.) has a heating value nearly that of coal (12,000 BTU/lb.)
- Torrefied wood generates electricity with a similar efficiency to coal (35% fuel to electricity)
- Untreated wood has a lower efficiency of conversion (23% fuel to electricity)
- Wood can be processed into chips at a cost of about \$15/green ton
- Transportation costs for chips and/or torrefied wood are about \$0.23 per ton, per mile



Fuel Cost per MMBtu Electricity by Distance to Plant



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