



Torrefaction

A Woody Biomass Companion to Coal

TORREFACTION, the old coffee bean roasting process, is being touted by some as verging on making woody biomass the perfect renewable match with coal. Torrefied wood is superior to chips and pellets for use in electrical generation because it looks and acts much like coal including a similar Btu value (10,000/lb vs. an average 11,500/lb for coal), is easily pulverized and water resistance.

Torrefaction removes moisture from raw biomass by charring the wood in the absence of oxygen at temperatures ranging from 390 to 650 degrees Fahrenheit. The lignin and cellulose become brittle, much like coal, while the remaining volatile organic compounds, like pinene and turpene, generate process heat thus less smoke associated with burning. The yielded pellets or briquettes range from 66 to 75 percent of input wood.

ACCESS TO FIBER, CAPITAL AND DEMAND HURDLES = TWO-YEARS FROM MARKET

Experts, including Luis Cerezo of Electric Power Research Institute (EPRI), estimate that U.S. and European manufacturers are about two-years from turning success in the lab and small pilots into commercially viable "biocoal." Hurdles include the cost and access to sustainable feedstock, investment capital and utility demand for product.

SIXTY U.S. AND EUROPEAN COMPANIES IN THE RACE

Several U.S. companies are experimenting with equipment on a smaller scale. This approach is driven by a) desire to match fiber need with forest capacity; b) reduce complexity of fiber access; and c) unsettled perceptions of wood use as a renewable energy source. All proposed facilities are at varying stages of commercialization and face the same primary challenge - a dearth of investment capital for near-term renewable energy technology. Agri-Tech Producers of South Carolina and HM3 Energy of Oregon are part of the Woody Biomass Joint Venture portfolio. Only one U.S. company, **Renewable Fuel Technologies** of California, has released notice of a commercial scale test burn with torrefied wood in a public utility.



Torrefied Wood

SCALE, CONFIGURATION AND COSTS VARY BUT ENTREPRENEUR RISKS THE SAME

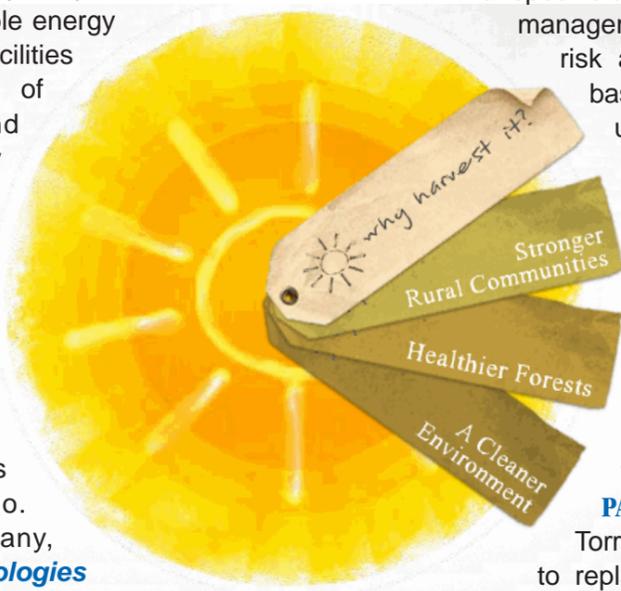
Scale and configuration of equipment differs primarily in size (ranging from 1 to 6 ton/hour), mobility, conveyor systems, inside or outside burners and ash removal. All units need backup energy (e.g. natural gas) to ignite the process and control temperatures throughout, but process heat is primarily generated by gases produced from the conversion process.

Commercial unit cost projections vary widely in that 1 to 6 ton/hour spectrum, ranging from \$50K to \$3 million. The U.S. product price is projected at \$150 to \$200/ton versus **average U.S. coal at \$59/ton**. The European market for torrefied wood is claimed to be on average \$270/ton. As an additional benefit, torrefied wood is an acceptable direct soil amendment.

U.S. entrepreneurs in this field report that perfecting the technology is less of a barrier than attracting investment capital and producing a large enough test-burn to provide data that the product is sound, efficient and compatible with specific boiler needs. Money and utility managers are at this moment quite risk adverse to woody biomass-based technology due to unknowns such as cost and reliability of fiber; the politics of renewable energy; the EPA emissions limitations and climate change; and conflicting science around carbon accounting and potential environmental impacts.

TORREFIED WOOD NO PANACEA BUT WORTH A LOOK

Torrefied wood is not expected to replace coal, but there is hope that it could in certain places enhance the environmental performance of coal-fired facilities, or provide new means to use the oldest of energy sources more efficiently. The potential gains for forest health, forest retention and domestic jobs all make further study wise.



The U.S. Endowment for Forestry and Communities and the National Association of State Foresters have a shared interest in advancing sustainable forestry in the U.S. This brief is intended to inform public dialogue on sustainable markets and forests.

Known U.S. Companies Pursuing Torrefaction

Agri-Tech Producers
South Carolina

CNFBiofuels
California

Earth Care Products
Kansas

EcoFuels
North Carolina

HM3 Energy
Oregon

Integro Earthfuels
North Carolina

New Earth
Washington

Renewable Fuel Technologies
California

Terragreen Energy
Pennsylvania

Torrefaction Technologies
Maine

Wyssmont
New Jersey

Zikha Biomass
Texas

Follow the Woody Biomass Joint Venture

The Woody Biomass Joint Venture, a partnership between the U.S. Endowment for Forestry and Communities and USDA Forest Service, encourages advancement of near-term technologies and new procurement model development to promote sustainable uses of woody biomass. We seek out organizations with proven promise, stimulate new sets of networks and disseminate rapid learning.

