

Issue Paper

Waste Woody Biomass to Biochar- A Solution for Our Time

Problem Statement:

California is waging a losing battle against the three largest issues of our time: severe catastrophic forest fire, drought and climate change. Governor Brown recently linked these issues pointing out that with climate change comes drought and with extremely dry conditions come extremely large hot burning fires. California is pouring money into programs that combat each of these issues. CAL FIRE will soon administer \$9.5 million in grants through the State Responsibility Area (SRA) Fire Prevention Fund (FPF) for fuels reduction projects in drought areas, this is just a portion of the \$75 million collected every year to fund such projects. Over \$900 million dollars have been allocated for California's Greenhouse Gas Reduction Fund (GHGRF), \$24 million of that is specifically earmarked for fire risk reduction and improving forest health. Finally, proposition 1, a \$7.45 billion dollar water bond was approved by California voters to implement water projects across the state. These projects will include: multi-benefit watershed projects, enhanced stream flows, watershed restoration, storm water management and water storage investment. Money is available to fund projects that target California's three big issues; the problem at this time seems to be funneling these funds to projects that can address these issues simultaneously and can have a long-term regional, statewide and even global impact.

Woody Biomass to Biochar- A Promising Solution:

Biochar is a soil amendment that can be created from a multitude of woody feedstock sources. Biochar is essentially pure carbon created through a process called pyrolysis in which heat is added to wood in the absence of oxygen driving off the volatiles in the form of syngas and leaving the solid black charcoal behind. Biochar has many benefits as a soil amendment including reducing fertilizer use and run-off into streams and tributaries, increasing microbial activity in soil and ultimately improving crop yields. Most important is biochar's ability to retain water therefore reducing on farm water needs; and the fact that biochar is an extremely stable form of carbon that when buried stores carbon in the soil for hundreds to thousands of years. If biochar were used on a large-scale state wide, these two characteristics could directly impact climate change and drought in California (not to mention the economic gains to farmers from reduced water and fertilizer use and increased yield).

Woody biomass feedstock can come from an array of different sources, but many forests throughout California have a build up of excess woody biomass that in combination with dry conditions has created an extreme fire hazard throughout the state. In addition, overcrowded forest stands suck up more water than well spaced forests reducing the amount of water flowing into streams and tributaries that would otherwise be available for fish and people alike. While the negative impacts of excess woody biomass are well known, landowners must use time and resources to clear brush and thin over crowded stands- a process that is expensive with few financial benefits in the short run. Many of the California funded fuels reduction projects remove biomass and create brush piles that are often burned on-site, releasing carbon and particulate matter into the atmosphere and often causing damage to the soil. Rather than being burned, this waste woody biomass could be converted in biochar and sold as a soil amendment, a model that would simultaneously address fire risk reduction, reduce on-farm and in-forest water use and bury tons of carbon that would otherwise be released into the atmosphere. Revenue created from the sale of biochar could potentially pay for the biomass removal and conversion process, allowing this model to address the three biggest crisis facing California in an economically viable way.

The RFFI Biochar Demonstration Project:

In July of 2015 the Redwood Forest Foundation Inc. (RFFI) in collaboration with the Mendocino County Woody Biomass Working Group (WBWG), Humboldt State University's Schatz Energy Research Center

(SERC) and other project partners completed the RFFI Biochar Demonstration Project. The project purpose was to explore the economic viability of converting excess woody biomass from overcrowded forests into biochar. The demonstration consisted of the following steps:

1. Purchase a unit that converts woody biomass into biochar;
2. Thin excess tanoak from an overcrowded forest stands in the 50,000 acres Usal Redwood Forest;
3. Transport, chip and dry the tanoak biomass;
4. Convert the woody biomass into biochar using the T-1000 Thermal Conversion Unit;
5. Sell the biochar as locally as possible;
6. Complete an economic analysis to determine commercial feasibility;
7. Facilitate project replication throughout the region

Each of these steps is extensively documented at <http://www.rffi.org/Biochar.html>.

The project demonstrated that at current market prices, biochar sales can completely pay for the cost of removing excess woody biomass and converting it to biochar. Through the demonstration project, RFFI created a replicable model to combat catastrophic wildfire, drought and climate change in an economically feasible way.

¹Economic Results:

June Best Day Cost/ lb. of Biochar Produced: \$1.18

June Average Cost/ lb. of Biochar Produced: \$1.49

Price per /lb. received for Biochar: \$1.50

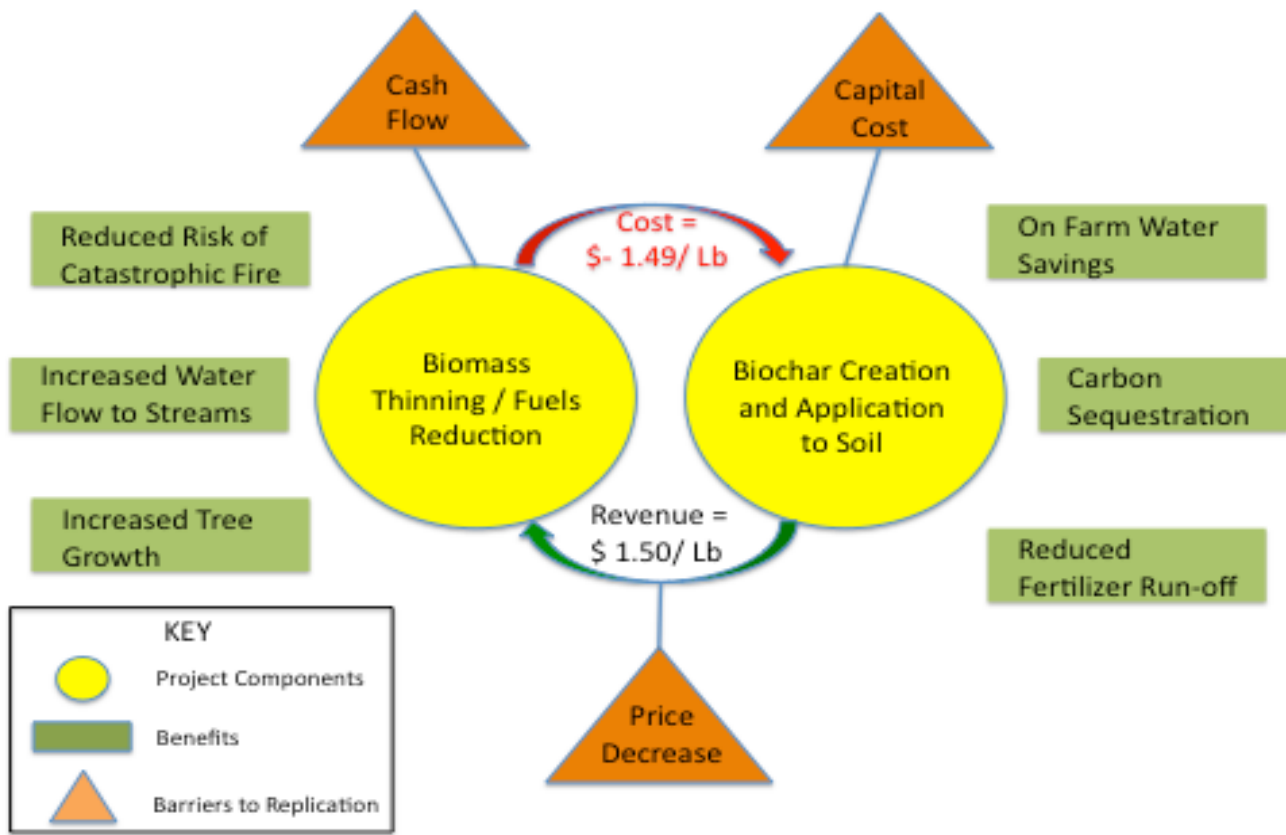
The demonstration project found that 1 Bone Dry Ton (BDT) of biomass creates 214 lbs of biochar, which sold in the RFFI demonstration project for \$1.50/lb creating a gross revenue of \$321/ BDT of biomass. This can be compared to 1 BDT converted to electricity, which even with a subsidized market price of \$.124/ kWh will gross \$124/BDT².

All variable, fixed and project management costs can be covered by the sale of biochar, however the demonstration found three major barriers to project replication. First, profit margin per unit of biochar produced is too low to payback the capital costs (biochar conversion unit purchase) in a reasonable amount of time. This makes it difficult for entrepreneurs to want to invest in such a project. Second, the biochar market is seasonal and production continues throughout the year. This creates a major cashflow problem for small businesses. Huge amounts of money have to be spent before a pound of biochar can be sold. Finally, the long term market price of biochar is unclear. If the project is replicated on a large scale, supply will naturally drive the market price down unless demand keeps pace. The diagram below outlines the project benefits, economic results and barriers to project replication.

¹ Costs include logging, skidding, loading, chipping, transportation, drying, equipment operation, diesel, propane, maintenance, project management, book keeping, and lease cost.

² Based on starting purchase price of biomass electricity under California's SB1122; assumes 1 ton of biomass will run a 1 MW plant for 1hr.

ISSUES OF OUR TIME: CATESTROPHIC FIRE, DROUGHT, CLIMATE CHANGE



Policy Discussion:

California has billions of dollars to try to address severe wildfire, drought and climate change. The state could direct funds and policy to each of the areas identified as barreirs to project replication and help spur the creation of woody biomass to biochar projects throughout the state. For example, the biochar conversion unit used in the demonstration project cost \$250,000 and other cheaper technologies are available. The state could decide to simply buy these machines for non-profits and even for profit landowners that live in high fire risk areas. A no interest loan account could be put in place for projects to obtain cash needed to operate before biochar can be sold. Farm certification programs that encourage water use reduction and recognize biochar as part of the certification could grow demand for biochar as supply increases. Finally, subsidies could be given to small farmers to help purchase biochar at a price that allows biochar producers to cover their costs of production. These subsidies are easily justifiable because of the public benefit created by large scale carbon sequestration and reduced on-farm water use from burying biochar.

Conclusion:

Based on the results from the RFFI biochar demonstration project, woody biomass to biochar projects can simultaneously address the three biggest crisis facing California in a relatively low-cost way. Rather than pouring billions of dollars into projects that take a siloed approach to these issues and that have no short-term economic viability, this model shows that well-placed capital and policies that promote on-farm water reduction can help spur woody biomass to biochar projects throughout California. California can continue to fund one-time fuels reductions projects that will never keep up with biomass accumulation or decide to put one-time resources towards a solution that can be self-sustaining.