



## IMAGINING TOMORROW: ALTERNATE ENERGY FUTURES

Presented by The Northeast Sustainable Energy Association



Clean Energy Award  
Region I: Western MA

Ian Boyd,  
Mohawk Trail Regional High School,  
Buckland, MA

*"The Use of Closed Carbon Cycle  
Biomass Materials for Metallurgical  
Heat"*

My name is Ian Boyd, and I am a freshman at Mohawk Trail Regional High School. I tend to be involved with many things at once, such as this Science Fair. This spring I am a Private in the Tenth Mass., a civil-war reenacting company. I am also Tri-Captain of my junior varsity volleyball team. I am also fascinated with medieval and colonial history, and have recently helped with the excavation of the French and Indian war fort, Taylor's Fort, with Aaron Miller, the chief investigator of the dig site.

At home, I like to blacksmith, an art that I learned from my father who is a professional smith. I have made many reproduction items for myself in my spare time, reproductions of both colonial and medieval items. I also devote a large amount of time to woodworking, my father's previous profession. This summer I plan to use all of my woodworking skills to build an eleven-foot sailboat, with the help of my father, of course.

I have to thank my father for his nearly infinite knowledge of the art of production blacksmithing, and my mother for her outstanding help when it came to the fine details. My younger brother was a great help when it came to keeping the fire stoked when I had to be in the shop carrying out the experiment. I am sure my older brother would have helped greatly with keeping the fires stoked and such, but it is hard to stoke a fire in Massachusetts when you are backpacking through Europe. Without my great family, there is almost no chance I would have been able to excel in this experiment, and I am indebted to them greatly.

**MY PROJECT** for the Science Fair started nearly a year ago, when my father bought a load of coal that was very cheap but had a very poor quality. I was making a few finish pieces at the time, and the coal left a layer of tar on the piece, which was hard to clean off. My father and I talked about the problem, and I started to use charcoal sifted from the ashes of our campfire. I used the charcoal, but it too was of poor quality, so I wanted to try making my own charcoal and experimenting to make a high-quality charcoal from wood that was abundant in New England. When I decided to enter the Science Fair, I had already thought through much of my project, and knew exactly what types of experimentation to do first.



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*“The Use of Closed Carbon Cycle Biomass Materials  
for Metallurgical Heat”*

**ABSTRACT:**

My goal was to find the best type of wood to make charcoal to use as a fuel in metallurgical heating, as a substitute for coal, which is dirty and nonrenewable.

The preliminary step in my procedure was to build a charcoal kiln, a furnace that converts wood into charcoal. The kiln itself was a simple metal drum, which is cut off from oxygen and then heated. The wood does not burn, but smolders, driving off water and other gases. In my case, I feedback the outgases to help run the kiln.

After building the kiln, I used white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), staghorn sumac, white birch (*Betula papyrifera*), poplar (*Populus deltoides*), and stove pellets. After making the charcoal samples, I used 2 kilograms of each sample to make a fire in the forge. I measured the efficiency of the charcoal by heating and drawing to a point 10 cm long x .3 cm wide piece of steels (called a hook blank).

My results were widely ranged, and somewhat surprising. Sugar maple made 105 hook blanks; nearly twice what white birch yielded, which was 56 blanks. Staghorn sumac made 102, which is good because it is a weed tree and grows fast enough that the charcoal can easily be mass produced on a small amount of land. White pine made 32 blanks, and poplar, another weed tree, made only 12. The wood pellets charred but broke down into dust.

For the most part, I concluded that the denser the wood, the better the charcoal it makes, with a few exceptions. Except for staghorn sumac, which should be last, the results show that the less dense the wood, the lesser the quality of the charcoal.