

Project Title: Swirl Stove – Swirling combustion for efficient wood burning

Specific FOA Area of Interest: Efficient Wood Heaters

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Names of all team member organizations:

1. MF Fire, Inc.
2. Biomass Emissions Solutions & Testing (B.E.S.T.)

This proposal addresses the large problem of particulate emissions for wood stoves through the use of swirling combustion. Emissions from wood stoves are a result of incomplete combustion. Gaseous hydrocarbons released by the wood fuel fail to be fully oxidized, resulting in the emission of CO, unburned hydrocarbons, and particulate matter. This incomplete combustion is largely a localized phenomenon resulting from inadequate mixing of the fuel gas and oxidizer (air). Swirling combustion is used for mixing combustion air with fuel gasification products to achieve a more complete burn, thereby reducing emissions and increasing efficiency. Never successfully accomplished in wood burning stoves, this novel innovation involves the swirling of inlet air as described in MF Fire's patent application, US 2018 / 0051886 A11.

The proposed technology targets reducing particulate emissions production to below 0.5 g/hr, a 75% reduction over MF Fire's current firebox design (1.9 g/hr) and increasing efficiency to 85%, a 15% increase over MF Fire's current firebox design. The critical success factors in achieving these goals involve effectively inducing and controlling swirling combustion through experimental investigation and iteration proposed herein. Namely, this project will integrate one of several different methods of air injection, and introduce a new balance of primary, secondary, and dilutive catalytic air. Our preliminary studies establish the feasibility of achieving stable swirling combustion of cord wood.

Another critical success factor is development of an affordable design that can be incorporated into a commercially viable product. An affordable option that provides sufficient efficiency will justify replacing an older, more polluting stove. The swirl stove design has the ability to produce non-catalytic stove models to help maintain the affordability of new, lower-emitting wood stoves. It may be possible to combine swirl stove technology with catalytic technology to approach a zero particulate matter emissions wood stove.