VERMONT NRCS CONSERVATION INNOVATION GRANT
Quarterly Progress Report

Grantee Entity Name: Meach Cove Real Estate Trust	
Project Title: Fuel from the Field to the Flue: Grass pellet heating equipment combustion optimization project.	
Agreement Number: 69-1644-11-08	
Project Director: Christopher W. Davis	
Contact Information	Phone Number: (802) 985-9218 E-Mail: cdavis@meachcovefarms.org
Three Month Period Covered by Report: July 1, 2015 – September 30, 2015	
Project End Date: 9/20/2015	

A. Project Status

1. *Summary of progress, including the results to date and a comparison of actual accomplishments with proposed goals (milestones) for the period and, where project output can be quantified, a computation of the costs per unit of output.*

During this period the Project Director continued to run various grass species and wood/grass blended pellets through the **Evoworld** 350C (Evo) biomass boiler and record the emission data. In October the Project Director worked with Christopher H. Callahan, a UVM Extension engineer, to optimize the combustion process while burning wood pellets, and 100 % switchgrass pucks. The Project Director is working to schedule additional days with Mr. Callahan to continue testing the other species and grass/wood chip blends that have been made into 2" pucks. The Project Director will apply the optimized boiler settings to re-testing the pelletized forms of the primary grass species investigated under this grant.

During this reporting period Adam Dantzscher worked with the BHS "slugger" densification machine to produce 2" diameter pucks of several grass species grown on the Meach Cove property, as well as 50/50 blends of these same grasses and wood chips harvested from limb and trunk wood grown on the Meach Cove property. Adam also made several hundred pounds of *Miscanthus* he received from Arkansas into "pucks".

The test result data obtained with the Wohler emission analyzer for each test run has been entered into an Excel spreadsheet designed to represent the data in a clear and easy to read format that is similar to the data reports created for the **BERC** "*Technical Assessment of Grass Pellets as Boiler Fuel in Vermont*" released in January, 2011.

Grass Species grown and tested to date:
One-cut, cool-season, native grasses (mulch quality hay)
Cave n' Rock switchgrass blend
Reed canary grass

Other grass species or blends that will be tested in the next month:
50% One-cut, cool-season, native grasses (mulch quality hay) and
50% wood chips (no leaves)
50% Cave n' Rock switchgrass blend and 50% wood chips (no leaves)
50% Reed canary grass and 50% wood chips (no leaves)
100% *Miscanthus*

The Testing Method used:

Each test run was started with the Evoworld boiler and buffer tank at the ambient building interior temperature. Starting with wood chip and pellet settings provided from Evoworld we made adjustments to the air and fuel feed rates and measured the emissions with a Wohler model A 500 combustion emission analyzer capable of measuring flue gas temperature, O2, CO, CO2, SOX, NOX, and calculating the efficiency and excess air. Flue particulate samples were taken using a Wohler hand operated smoke test pump and filter paper.

Open Houses held:

With assistance from Amy Overstreet, USDA Public Affairs Officer, Bob Kort, CIG Grant Program Manager, Rachel Carter from the Vermont Sustainable Jobs Fund, and Sid Bosworth, UVM Extension Service Agronomist, a mailing list was created along with an invitation poster advertising the two open houses which were held on October 23 and 24 at the Biomass Building at Meach Cove Farms. Approximately 20-24 people came on each day.

Other media coverage:

Local coverage of the project was reported in the Shelburne News, and aired on Monday, October 26 on ABC TV channel 22/ Fox 44 news . WCAX TV Channel 3 in Burlington taped an episode of *Across the Fence* explaining the project that will air on Thursday, November 5. All of these video reports are linked to the Meach Cove Farms website www.meachcovefarms.org under the Biomass Project section.

2. *Current problems or unusual developments or delays.*

As stated in the previous quarterly report, some of the grass species in the 1/8" pellet form have become a molten ash that cools into a hard crust layer in the boiler following cooling after the burn has been completed. The Project Director will work with Chris Callahan and others to come up with options for dealing with this rigid ash byproduct so that the **Evoworld** biomass boiler can operate for continuous cycles when fueled with the various species of grass in a 1/8" diameter pellet form.

The Project Director continues to spend time learning how to operate the boiler efficiently on wood pellets and he is using this knowledge to make changes to the boiler fuel and air

mixtures to optimize the combustion performance of the various grass pellet samples that will be tested as part of this project. The Project Director intends to provide the **Evoworld** company with notes and text that they may consider adding to their operator's manual for this boiler.

3. *Reasons why goals and objectives were not met, if appropriate.*

   The goals for this project were met.

4. *Additional pertinent information including, where appropriate, analysis and explanation of cost overruns or high unit cost.*

   The project is being completed within the budget submitted.

5. *Any funded or unfunded time extensions.*

   The project time extension was granted until September 20, 2015.

6. *Any changes to the project's original objectives, methods, or timeline with a summary of the justification for the changes.*

   As more time is spent working to improve the settings to optimize grass fuel combustion it may be possible to have the **Evoworld** boiler operate as it is designed without modifying the boiler. Based on the test burns conducted as of this date there may be a need to modify the ash cleaning feature for the ventilated portion of the grate to facilitate better cleaning when some species of grass pellets are burned.

7. *Lessons learned that inform future project activities or broader efforts in the project's topic area.*

   After only a few weeks of running test burns with the various species of grass pellets it is clear that this model **Evoworld** biomass boiler can handle the combustion of the species of grass tested to date without special modifications of the boiler as it was fabricated. Over time the efficiency and emission profile of the various grasses is expected to improve as the Project Director becomes more familiar with the capabilities of the **Evoworld** biomass boiler and the impact of the various settings. Running more tests will produce more emission data for analysis. Using the expanding database the Project Director and his collaborators should be able to make fact-based statements regarding the viability and costs of burning the grass species that Meach Cove Farms and the UVM Extension Service have demonstrated can be grown successfully in Vermont. The data to date has shown that some grasses burn with emissions that compare with premium wood pellets.

   In early test runs as we learned how to optimize the combustion burning 2.0" diameter **100% switchgrass pucks** the data resulted in **higher than wood pellet levels** for O2, CO, CO2, flue particulates (smoke test) and not surprisingly a lower percent efficiency calculation.

The most recent runs with **100 % switchgrass pucks** when compared to wood pellets the data showed lower CO, CO2, significantly lower particulates (7 vs. 9 smoke test) and a similar percent efficiency calculation (79.0 % vs. 81.3%).

Testing to date with **100% switchgrass pellets had less desirable (higher) values** for O2, CO, and excess air, a lower calculated efficiency but a slightly lower particulate smoke test result than the switchgrass 2.0" diameter pucks.

The **reed canary grass pellets** tested to date had data similar to the switchgrass pucks.

The **hay pellets** made by Enviro Energy LLC had similar O2, CO2, calculated efficiency and NO, but significantly higher CO and percent exhaust air when compared to switchgrass pellets, pucks, or premium wood pellets.

8. *Work to be performed during the next three month period.*

- **Future testing** will include Miscanthus giganteus grass, blends of the grasses already tested with trunk and branches (no leaves) wood chips. If possible we would like to experiment with densifying air and sun-dried lake harvested weed species.

- Work out the modifications to the **Evoworld** boiler software and operation set up to allow continuous heating cycles burning the various grass species in the 1/8" pellet forms.

- Post the preliminary data and other related information on the Meach Cove website.

B. Project Results

1. *Any preliminary results that can be used by NRCS for practice standard revisions, new practice standard adoption, policy changes, program revisions and training opportunities.*

It is possible that the data produced by this project will have a positive impact on several agricultural practices and standards in Vermont.

A preliminary list includes:

- Providing demonstrated proof that there is a viable and economical boiler under 500,000 BTU/hour capacity produced in the U.S. with UL and ASME certifications that can burn several different biomass fuels with combustion emission levels that are similar to premium wood pellets.

- Providing emission data for a variety of grass fuels which should aid in the decision on which species of grass others might consider to use as a fuel.

- Perform enough testing of one-cut, cool-season native grasses (mulch quality hay) to be able to optimize the combustion emissions to see how they compare to the species of grass grown specifically for boiler fuel.

- Providing costs to accompany any recommendations for which grass and which size of pellet or puck another operator might consider selecting to use as a fuel.

- Providing a resource list of people or companies that could assist another operator who is considering combustion testing of other forms of biomass or biomass blends, or someone who is considering purchasing and operating an **Evoworld** biomass boiler with grass fuel.

2. *Products, software tools and/or technologies currently ready for adoption and/or transfer.*

   The data and information collected and disseminated as a result of this work will allow **Evoworld** wood chip boilers, that are manufactured in capacity sizes ranging from 25 KW to 500 KW, will represent viable choices for any business owner or farmer who wishes to install one and burn grass pellets or pucks.

   The cost comparisons for the production, processing and manufacture of either pellets or pucks from the species of grass tested as part of this project will help potential adopters of this process to decide how best to proceed for their application and budget.

3. *Potentially promising products, software tools and/or technologies not yet ready for adoption and/or transfer, and a description of what is needed to reach that maturity.*

   Continuing to work on densification and combustion testing of additional grass species or blends of biomass in the pellet and puck forms should lead to more cost effective and trouble free fuels for use by business, farm and small industrial consumers.

4. *Identification of any new data or research needs to inform broader efforts in the project's topic area.*

   The Project Director will cite any sources of new data or research in the final report that is filed and post links to that information on the Meach Cove Farms website, www.meachcovefarms.org/biomass.html.

5. *Project activities that have been featured on recipient or partner websites and success stories that could be amplified by NRCS.*

   The **Vermont Sustainable Jobs Fund** website for energy projects at www.vsjf.org

The **University of Vermont Agricultural Extension Service** website at http://pss.uvm.edu/vtcrops/?Page=energycrops.html

Meach Cove Farms wishes to thank the following for their involvement in this project. We look forward to working with these individuals, institutions and others in the future.

The Meach Cove Farms crew: Barbara Mercure, Gary Marshall, Jack McGuire, Jesse Addis, & Richard Lawrence
Sid Bosworth, UVM Plant & Soil Science Dept., Extension Agronomist
Bob Kort, USDA – NRCS, Civil Engineer, CIG Program Manager
Amy Overstreet, USDA – NRCS, Public Affairs Officer
Christopher W. Callahan, P.E., UVM Agricultural Engineering
Adam Dantzscher
Lou Okonski, Troy Boiler Works
Evoworld, Austria
Wohler, USA
Ellen Kahler, Vermont Sustainable Jobs Fund
Jerry H. Cherney, Cornell University
Michael J. Newtown, P.E., Camino School of Engineering, SUNY, Canton, N.Y.
John N. Kidder, Vermont Technical College, Randolph, VT
Gerry and Betty Guillemette, Shelburne, VT

C. EQIP Requirements

Provide the following in accordance with the Environmental Quality Incentives Program (EQIP) and CIG grant agreement provisions:

1. *A listing of EQIP-eligible producers involved in the project, identified by name and address;*

   The primary EQUIP-eligible producer for the project is:

   Meach Cove Real Estate Trust
   P.O. Box 309
   Shelburne, VT 04582

2. *The dollar amount of any direct or indirect payment made to each individual producer or entity for any structural, vegetative, or management practices. Both biannual and cumulative payment amounts must be submitted.*

   There are no ($00.00) direct or indirect payments for structural, vegetative or management practices under this project.

3. *A self-certification statement indicating that each individual or entity receiving a direct or indirect payment for any structural, vegetative, or management practice through this grant is in compliance with the adjusted gross income (AGI) and highly-erodible lands and wetlands conservation (HEL/WC) compliance provisions of the Farm Bill.*

   The Project Director, Christopher W. Davis, certifies that there will not be any direct or indirect payments made to an individual or entity for any structural, vegetative or management practices through this grant. The AIG and HEL/WC provisions do not apply to this project.

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