2017 CEED FUND PROPOSAL QUESTIONNAIRE

Vermont Enhanced Maple Sap Preheater Program

Organization Name:	EnSave, Inc.
Mailing Address:	65 Millet Street, Suite 105
Contact Name:	Craig Metz, CEO
Primary Phone #:	(802) 434-1826
Cell Phone #:	(802) 578-8807
Email Address:	craigm@ensave.com

1. Proposal Narrative

Program Summary

Maple syrup production is one of Vermont's cherished agricultural sectors and an important driver of the state's economy. In addition to delivering between $317 million and $330 million in annual economic benefits to the state and contributing at least 3,100 full time equivalent jobs (Becot et al. 2015), the maple industry enhances Vermont's image as a source of pure, sustainably produced agricultural products, provides tourism opportunities, and preserves the state's working landscape. Many commercial Vermont maple producers are investing in their businesses by installing energy-saving technologies such as reverse osmosis systems, but a significant opportunity remains for maple producers to save fuel and reduce greenhouse gas emissions through the use of steam-enhanced sap preheaters.

An enhanced sap preheater utilizes waste heat from the flue pan to preheat incoming sap to approximately 190-200 degrees Fahrenheit and uses an auxiliary blower to force air into incoming sap, which concentrates the sap before entering the flue pan. The net result is an increase of 65-75% in evaporation rates (sap throughput) and a corresponding 40-47% reduction in fuel usage resulting from reduced evaporator runtime (Winship 2001; MFEP 2012; NRCS 2014).

EnSave has been delivering the Enhanced Maple Sap Preheater Program through the 2016 CEED fund, and the program has been a resounding success. The program was fully subscribed with 18 applicants by May, 2016 and currently maintains a wait list of interested maple producers. The program has demonstrated a clear demand and interest in this technology, and the program's incentives are greatly accelerating the adoption of this technology among Vermont's maple producers. As an added benefit to the energy and productivity savings, over 75% of applicants have chosen Vermont manufacturer to fabricate their enhanced pre-heater, helping support Vermont's manufacturing sector and recirculate money within Vermont's economy.

For the 2017 CEED, EnSave proposes incentivizing a minimum of 26 enhanced maple sap preheaters in legacy CVPS territory, delivering approximately 3,717 MMbtus in annual energy savings. The program cost is $467,360 including customer incentives and contributions, delivering a 4.0 NSB ratio.

Implementation Plan

Marketing Plan

EnSave will reach maple producers through several means, which were determined to be successful during the 2016 program year:

- Outreach to Vermont's maple community, including the Vermont Maple Sugar Makers' Association, Addison County Maple Sugarmakers' Association, and Proctor Maple Research Center
- Outreach to manufacturers of enhanced maple sap preheaters
- Outreach to Vermont maple equipment suppliers of enhanced sap preheaters (approximately 14 throughout the state) to inform them of program details
- Outreach to maple producers to introduce the program and explain the benefits of the technology
- Outreach through online maple forums frequented by Vermont maple producers
- A series of mailings to targeted customers highlighting the potential savings and how to participate in the program
- Hosting one or more seminars/webinars to introduce the technology to groups of customers or attending an existing industry event to promote the program
- Attendance at industry events such as the Addison County Maple Sugar Makers Seminar, and the Leader Evaporator open house

Our marketing effort will begin after all contractual and programmatic details have been developed with Green Mountain Power, with an estimated start in January 2017.

Customer Application/Enrollment Process

Once a customer learns of the program, they will fill out a simple application listing contact information, Green Mountain Power account number, number of maple taps, make and model number of the evaporator, type and quantity of fuel used during the last maple sugaring season, and quantity of maple syrup produced during the previous maple sugaring season. Additional information will also be gathered to determine whether they have a reverse osmosis system, existing preheater, and other relevant technical information. Customers will also submit a quote for an enhanced sap preheater with their application. This information will allow EnSave to complete an NSB calculation for each customer, which will be presented to

GMP for final approval. Any customers who do not qualify will be presented with information about Efficiency Vermont's incentives for agriculture.

Once approved, EnSave will work closely with the customer, the equipment manufacturer, and the installing technician to schedule and track the installation. EnSave will issue an incentive payment to the customer following receipt of the installation invoice and a site inspection of the project. During the site inspection, EnSave will inform the customer of other energy efficiency incentive programs that may exist through Efficiency Vermont and/or Vermont Gas, and will follow up with those entities about any energy efficiency opportunities immediately seen on site. In the 2016 program, EnSave provided Efficiency Vermont program information to all program participants.

While EnSave does not have an exclusive relationship with any particular manufacturer, we have developed relationships with the major manufacturers and vendors of this technology. Leader Evaporator of St. Albans, VT – one of the major manufacturers of maple production equipment and the industry leader in steam-enhanced maple sap preheater sales – has been a strong ally and supporter throughout the 2016 program (see attached letter of support provided by Leader Evaporator). Additional vendor relationships developed over the course of the 2016 program include Lapierre Equipment (Orleans, VT), CDL (Swanton, VT), The Maple Guys (Wilton, NH), and Bascom Maple (Alstead, NH).

Program Implementer

The program will be implemented by EnSave, Inc., a Richmond, VT-based firm with a national presence as a leading designer and implementer of energy efficiency programs for the agricultural and food processing sectors. In addition to running turn-key agricultural incentive programs for energy utilities and state agencies, EnSave is also a technical service provider with USDA to provide farm energy audits, renewable energy assessments, energy project feasibility studies, and implementation services throughout the country.

We currently serve as a program administrator and technical reviewer for several commercial and agricultural energy efficiency programs nationwide. In addition to the recent CEED programs for the Maple Sap Preheater and Ozone Laundry, our current work includes specialized engineering, consulting, and project management services for a diverse range of clients ranging from small non-profit organizations to some of the nation's largest utilities.

The company began in 1991 with energy auditing and measure implementation services for Vermont electric utilities and rural electric cooperatives prior to the establishment of Efficiency Vermont. Since then, we have worked closely with Efficiency Vermont on several agricultural and commercial projects.

We have extensive experience managing energy efficiency programs and have successfully implemented strategies to encourage hard-to-reach agricultural and small business customers to install energy efficiency measures. We understand how to reach Vermont's maple producers and generate energy savings that would otherwise not be realized.

Costs and Benefits

The program will cost $467,360, including customer incentives and contributions. GMP's investment will be $420,160. The program will deliver approximately 3,717 MMBtus in annual energy reduction resulting from fuel oil savings among 26 participants, equating to 26,652 gallons of fuel oil per year.

EnSave will provide an incentive to the customer of $9,000 per unit, not to exceed 100% of the cost. Based on the results of the 2016 program, we found this incentive level to be ideal for stimulating program enrollment while maintaining a high NSB ratio. Additional program benefits will be realized by supporting the Vermont maple economy as well as local manufacturers and metal fabricators.

Measurement and Quantification of Benefits

EnSave has developed a calculator to determine energy savings based on specifications provided by two manufacturers of enhanced sap preheaters. This calculator is based on a maple production energy calculator developed by Chuck Winship and published by Cornell University Extension (Winship 2001). In addition to calculating enhanced preheater energy savings, EnSave's calculator takes into account energy saved by preheating water as well as additional energy used by the auxiliary blower.

Our savings estimate of 40% is in line with savings published by the USDA NRCS and the Massachusetts Farm Energy Program Maple Best Management Practices Guide (MFEP 2012; NRCS 2014). Enhanced sap preheater systems typically improve evaporation rates by 65-75%, thereby reducing evaporator runtime.

We have calculated the average energy savings for maple producers without reverse osmosis to be 75.54 MMBtus per year, corresponding to 543.43 gallons of fuel oil per year, based on an average farm size of 992 taps. The calculated average energy savings for maple operations with reverse osmosis is 158.95 MMBtus per year, corresponding to 1,143.51 gallons of fuel oil per year, based on an average size of 6,114 taps.

The average number of taps per participant is based on the results on the 2016 program. Based on the size of maple operations in the queue for the 2017 program, we anticipate that these numbers are conservative. Thus, it is likely that the final program NSB ratio will be higher than the 4.0 estimate.

Table 1 provides an overview of estimated key program participation figures based on the assumptions listed above, as well as those listed under Question 8 of the Proposal Questionnaire.

Table 1. Estimated Program Participation and Average Cost/Savings Figures

Type of Installation	Number of Installs	Average Total Cost per Project	Average Annual Fuel Savings per Participant (MMBtus)	Average Annual Fuel Savings per Participant (gallons of fuel oil)	Maximum CEED Customer Incentive
Maple producer with RO	21	$11,200	158.95	1,143.51	$9,000
Maple producer without RO	5	$9,200	75.54	549.50	$9,000

Table 2 provides an estimated average simple payback period for enhanced sap preheaters both with and without the incentive. Payback figures assume an average fuel oil cost of $2.00 per gallon.

Table 2. Estimated Average Simple Payback Period for Enhanced Sap Preheaters

Type of Installation	Simple Payback without CEED Incentive (years)	Simple Payback with CEED Incentive (years)
Maple producer with RO	4.9	1.0
Maple producer without RO	8.4	0.2

Logistics of Data Collection, Tracking, and Results Reporting

We will collect baseline data on the current sap processing system, as well as fuel usage and syrup production data from the most recent maple sugaring season.

Additionally, we will track all marketing and outreach activities and will report our actions to GMP on a monthly basis. Once customers are enrolled within the program, we will record all pertinent contact and project information in a tracking system to be shared with GMP as part of our monthly reporting.

Metrics for success include number of sites reached, total number of sites approved and installed at certain milestone dates, total energy saved, and total NSB.

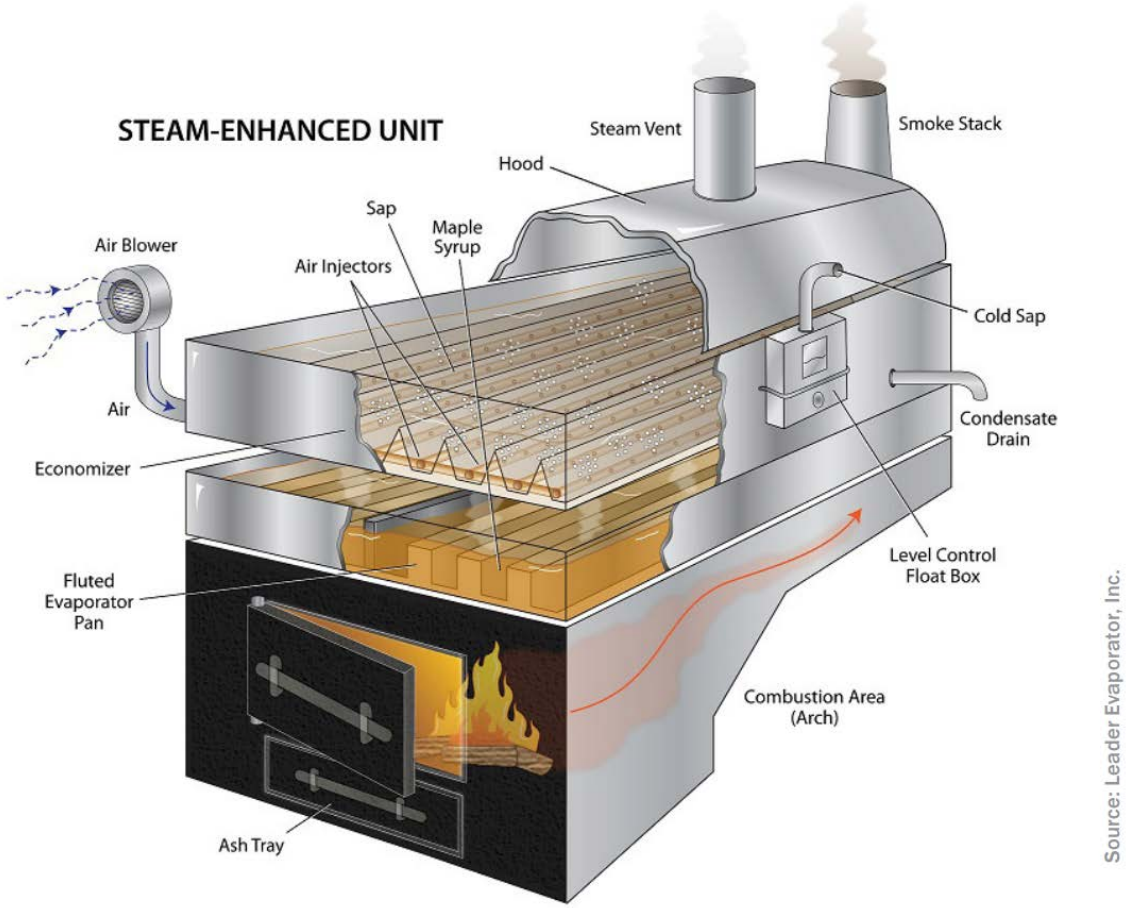
2. Proposal Questionnaire

Program and Customer Information

1. What type of project is being proposed?

The Enhanced Maple Sap Preheater Program seeks to improve the evaporator efficiency of medium to large sized maple operations through the installation of enhanced sap preheaters. An enhanced sap preheater utilizes waste heat from the flue pan to preheat incoming sap to approximately 190-200 degrees Fahrenheit. The technology uses an auxiliary blower to force air into incoming sap in order to concentrate it before entering the flue pan. The net result is an increase of 65-75% in evaporation throughput and a reduction in fuel usage by approximately 40-47%. While this technology has been commercially available since the 1990s, there remains substantial opportunity for Vermont maple producers to install this equipment. Figure 1 provides a basic illustration of the enhanced sap preheater (often referred to by brand names such as Piggyback™, Steam Away™, or Sap-Raider).

Figure 1. Enhanced Sap Preheater Cross Section



2. Which customer segment(s) is targeted?

The program targets medium to large sized commercial maple producers using fuel oil. The program will target maple producers regardless of whether they are using a reverse osmosis (RO) system or not. While producers using RO consume substantially less fuel than those without RO (approximately 60-65% less), an estimated 39-43% reduction in fuel usage can still be realized by installing an enhanced preheater in addition to RO (Winship 2001; MFEP 2012; NRCS 2014).

To maximize net societal benefits (NSB), the program will target an average of 992 taps for non-RO maple operations and an average of 6,114 taps for maple operations with RO systems. Tap numbers are based on averages from 2016 program participants, and it is likely they the actual averages will be higher based on the size of maple farms on the waiting list.

Based on discussions with Vermont-based maple equipment manufacturers, distributors, and researchers, it is estimated that between 60-80% of producers with 1,000 taps or more are equipped with RO systems. In the 2016 program, 15 of the 19 approved applicants (79%) already had RO installed. We assumed 80% for the 2017 program.

3. How many customers will participate?

We estimate that a minimum of 26 maple producers will participate in the program.

4. Which geographic areas of the legacy CVPS service territory will be served?

The program will be available to all maple producers in the legacy CVPS territory. We expect most participation to come from Windsor, Addison and Rutland counties—mirroring the participation of the 2016 program.

Investment and Benefits Information

5. What is the investment schedule being proposed?

EnSave will provide an incentive to the customer of $9,000 per unit, not to exceed 100% of the invoiced cost.

6. When are customer benefits first achieved?

Customer benefits will be achieved during the first sugaring season of operation. Assuming the program is approved for funding in January 2017, we anticipate installing 1-5 units prior to the start of the 2017 sugaring season, which means some benefits will be realized in 2017. Energy savings for maple producers who install after the 2017 season shall be realized starting in 2018.

7. What are the Net Societal Benefits (NSB) that will be achieved per dollar invested?

The NSB for the program is 4.0.

This estimate is conservative in that it does not account for expansion of maple farms over the lifetime of the equipment or the expected increased average sap production per tap over next 25 years. The majority of participants in the 2016 program relayed that they were planning to expand their maple operations in 2017 and beyond (often substantially). The installation of maple sap pre-heaters will expedite this expansion by increasing their throughput capacity, thus resulting in even greater energy savings over the lifetime of the enhanced sap preheater.

8. How will the NSB be calculated?

The NSB will be calculated using the Vermont Statewide Field Screening Tool (Version 2016A), provided by Green Mountain Power through the CEED website. Our calculations assume the following:

- Average sap throughput increase of 65% (industry estimates range from 60% - 80%)
- Average fuel savings of 40% from enhanced sap preheater (industry estimates range from 39% - 47%)
- All program participants will use fuel oil as their source of evaporator heat
- Average evaporator efficiency of 70%
- Average of 4.1 gallons of fuel oil used to produce 1 gallon of syrup for producers without RO, and an average of 1.4 gallons of fuel oil used to produce 1 gallon of syrup for producers with RO
- Average sap yield of 14.3 gallons per tap per season (estimates typically range from 15 to 20 gallons)
- Average syrup yield of 0.333 gallons per tap per season over useful life of equipment (averages for 2013, 2014, 2015, and 2016 in Vermont were 0.35, 0.31, 0.31 and 0.41 respectively; these figures factor in smaller producers (under 1,000 taps), which tend to have lower production efficiency per USDA. Average production per tap has been steadily increasing over the past 20 years per UVM and USDA research)
- Average effective useful life (EUL) of 25 years (based on industry expert knowledge, and the EUL of similar measures in the 2014 Database for Energy Efficient Resources (DEER), including High Efficiency Furnaces and High Efficiency Boilers)
- Average maple producer size of 992 taps for producers without RO (based on 2016 participants)
- Average maple producer size of 6,114 taps for producers with RO (based on 2016 participants)
- Average auxiliary blower size of 1.5hp
- Average installed cost of $11,200 for participants with RO, and $9,200 for participants without RO (labor and materials, based on 2016 program participant invoices)

Enhanced sap preheaters are not included in Vermont's Technical Resource Manual (TRM), so the above estimates are based on conversations with industry experts, University publications, and published estimates from other engineering firms.

9. What % of NSB will the program achieve in electric benefits?

We do not anticipate that any participating producers will be using electricity as a primary energy source for producing maple syrup. A small amount of additional electricity will be used by each participant to run the auxiliary blower on the enhanced sap preheater. These blowers will range from 1hp to 5hp, with the majority being 1hp. Our calculations are based on all participants using fuel oil for their primary energy source.

10. What are other non-electric benefits?

The primary benefit of this program will be a reduction in fuel oil usage for Vermont maple producers. We estimate a conservative reduction of 40% in fuel oil usage per unit installed. Estimated fuel savings from USDA NRCS, Cornell Cooperative Extension, and GDS Associates (via the Massachusetts Farm Energy Program) range from 40% to 47%, based on an evaporation efficiency increase of 65-75%. Reduction in fuel oil usage will result not only in energy cost savings, but also reduced particulate matter and greenhouse gas emissions.

Per the USDA COMET-Farm tool (http://cometfarm.nrel.colostate.edu/QuickEnergy) and U.S. Environmental Protection Agency's eGRID 2010 database, the energy savings will also yield the following greenhouse gas emission reductions:

Table 3: Annual Greenhouse Gas Emission Reductions

USEPA eGRID 2010	CO_2	N_2O	CH_4	SO_2	NO_x
Annual greenhouse gas emission reductions in pounds	596,389.63	12.93	74.03	7.60	479.74

In addition to benefits derived from fuel savings, enhanced sap preheaters bring other substantial benefits to maple producers. Increasing sap evaporation rates can increase the capacity of sugarhouses and provide a corresponding decrease in labor requirements because the same amount of syrup can be produced in less time. Additionally, enhanced sap preheaters produce an abundance of hot water heated to approximately 180-200 degrees, which eliminates the need to use fuel oil for heating water.

Start-Up Information

11. Is this a new or established program?

This is an extension of a successful 2016 CEED program.

12. How does this program meet the "But/For" test?

While enhanced sap preheaters result in substantial fuel savings, they require a significant investment due to their custom fabrication. Aside from very large maple syrup producers, the market penetration for enhanced sap preheaters is fairly low (based on conversations with numerous equipment manufacturers, distributors, and retailers). This may be attributable to a lack of awareness of production efficiency or fuel savings potential, lack of capital to invest in enhanced sap preheaters (due to size of operation, or capital tied up in reverse osmosis upgrades), or simply producers not being aware of the technology. By providing education about the technology, outreach to the Vermont maple community and incentives to customers, this program will address these barriers to implementation and substantially improve market penetration.

There are currently no financial incentives offered through Efficiency Vermont or Vermont utilities for enhanced sap preheaters, and enhanced sap preheaters are not included in Vermont's Technical Resource Manual (TRM). While USDA NRCS has developed a standard for enhanced sap preheaters in some states (Conservation Practice Standard 372 – Combustion System Improvement, Enhanced Preheater), this practice is not currently funded by Vermont NRCS. Without this CEED program, it is highly likely that the producers who participate in the program will not install an enhanced sap preheater due to economic or knowledge barriers.

13. What are the expected costs of the program? (see cost table below for additional guidance)

The expected total program costs are $467,360 which includes customer incentives and contributions. The total GMP investment is $420,160.

14. ***Can the program be easily scaled up or down within 2017 to use the remaining CEED funds if necessary?***

This program can be easily scaled up or down to accommodate remaining CEED funds. Because customers tend to place orders for pre-heaters in the fall or spring, we will know fairly early in the program whether the program is on track to deliver its projected number of installs. We are also confident of being able to close out the program prior to December 31, 2017. The program can be scaled up by offering additional incentives to applicants on the wait list, or by providing additional funds from programs that may not reach their goal. In the 2016 program, we were able to serve an additional maple producer with leftover incentive funds, as some producers did not use the full $9,000 incentive budgeted for them.

15. When is the proposed start date of the program?

The proposed start date is January 1, 2017.

16. How long will customer benefits persist after the initial benefit is achieved (in years)?

We estimate that customer benefits will persist for at least 25 years after each installation (the estimated effective useful life). Based on conversations with maple industry experts, enhanced sap preheaters are built to last, and each expert we spoke with was aware of numerous enhanced preheaters installed in the early to mid-1990s that are still in operation. This is in part due to the fact that each unit is custom fabricated on site. Also, resources such as the 2014 Database for Energy Efficiency Resources (DEER) list an effective useful life of 20 years for high-efficiency boilers and furnaces that operate daily, but the sap preheater only operates about 150 hours per season, so there is very little wear and tear on the units.

17. How will program results be measured and evaluated?

Program results will be measured and evaluated based on the NSB of each project and feedback from each participant. Upon participant enrollment in the program, we will gather the following input data from each maple producer:

- Number of taps in the most recent maple season, and anticipated taps for next season
- Gallons of fuel oil used in the most recent maple season
- Gallons of syrup produced in the most recent maple season
- Whether there is an existing (non-enhanced) preheater or RO system

This data will be used to perform site specific calculations for energy savings. Each project will be evaluated with the NSB calculator using site specific energy savings and project costs, and will receive a site inspection upon installation to verify that the equipment is installed.

Additionally, we will survey all participating customers to document how they learned of the program, why they chose to participate, and overall satisfaction with EnSave's administration of the program. EnSave will share its program results with Green Mountain Power and the Vermont Department of Public Service and discuss any modifications prior to the launch of the program.

18. How will program costs and benefits be reported to GMP?

EnSave will report program costs and benefits to Green Mountain Power on a monthly basis using a spreadsheet and narrative reporting tool. Copies of all applications, quotes, installation verification, and invoices will be made available to GMP.

19. How often will reports be provided to GMP?

EnSave will report program progress on a monthly basis for the duration of the program.

Direct Cost Breakdown

Cost Element	*Start-Up Costs*	*Total Program Costs*
Planning & Reporting	$	$35,370
Admin	$	$31,647
Tech Assistance	$	$39,094
Incentives	$	$234,000
Marketing	$	$80,049
Information Technology	$	$0
Participant Share of Costs	$	$47,200
Total Costs	**$**	**$467,360**

Additional Comments

The 2016 CEED Enhanced Maple Sap Preheater program has been a resounding success, and we have received nothing but positive feedback from program participants. Our program manager regularly receives testimonials from maple syrup producers praising GMP for funding this program, and the streamlined process. We had originally anticipated an NSB of 2.2 for the 2016 program, and were able to successfully deliver an NSB of 4.9 while reaching program milestones ahead of time and serving one more producer than originally anticipated. This program is truly a win-win for Vermont maple producers, maple equipment manufacturers, and GMP. We hope to continue this success and deliver similar results in 2017. Please find the attached letters of support from the Vermont Maple Sugar Makers' Association and Leader Evaporator. Additional 2016 program participant testimonials are available upon request.

Works Cited

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August 26, 2016

Shawn Enterline
Green Mountain Power
163 Acorn Lane
Colchester, VT 05446

RE: EnSave Enhanced Maple Sap Preheater Proposal

Dear Mr. Enterline:

I am writing on behalf of Leader Evaporator in support of EnSave's proposal to continue the Enhanced Maple Sap Preheater program in 2017.

This program provides an enormous benefit to Vermont's maple industry. Maple producers are very grateful for this program as it provides them an opportunity to enhance their operations while also saving energy. Throughout the program, EnSave has been very helpful and they have made participation very easy for our producers. This program also supports us as a Vermont manufacturer, by reducing the ultimate cost of our products and allowing us to sell more units than usual.

Extending this successful program into 2017 will allow more maple producers to participate and begin seeing the benefits of enhanced maple sap preheaters in the next sugaring season. We hope Green Mountain Power will continue its support of Vermont maple producers.

If you have any questions concerning my support, please contact me at (802) 868-5444.

Sincerely,

Tim Combs
Sales
Leader Evaporator
(802) 868-5444

VERMONT MAPLE SUGAR MAKERS' ASSOCIATION
189 VERMONT ROUTE 15, JERICHO, VT 05465
PHONE: 802-858-9444
WWW.VERMONTMAPLE.ORG

August 26, 2016

Shawn Enterline
Green Mountain Power
163 Acorn Lane
Colchester, VT 05446

RE: EnSave Enhanced Maple Sap Preheater Proposal

Dear Mr. Enterline:

I am writing on behalf of Vermont Maple Sugar Makers' Association in support of EnSave's proposal to continue the Enhanced Maple Sap Preheater program in 2017.

The VMSMA represents over 1000 maple syrup producers and related businesses in the state of Vermont and this program provides an enormous benefit to Vermont's maple industry. Our members are very grateful for this program as it provides them an opportunity to enhance their operations while also saving energy. Maple syrup production has undergone a bit of a renaissance lately, with production expanding in Vermont and across all maple-producing states. This has driven the cost of the specialized equipment used in maple syrup evaporation higher, making a program like this all the more valuable to Vermont's many producers. Throughout the program, EnSave has been very helpful and they have made participation very easy for our producers.

Extending this successful program into 2017 will allow more maple producers to participate and begin seeing the benefits of enhanced maple sap preheaters in the next sugaring season. We hope Green Mountain Power will continue its support of Vermont maple producers.

If you have any questions concerning my support, please contact me at (802) 498-7767.

Sincerely,

Matt Gordon
Executive Director
Vermont Maple Sugar Makers' Association