

CPA# 5862392
2016 Commercial Food Waste Grant
Final Report

Grant Information	
<i>Grantee:</i>	Impact Bioenergy
<i>CPA Number:</i>	5862392
<i>Project Title:</i>	Vashon Island Distributed Bioenergy Feasibility & Possible Demonstration
<i>Report prepared by (name):</i>	Srirup Kumar
<i>Date report prepared:</i>	December 31, 2018
<i>King County Solid Waste Division Grant Manager:</i>	Karen May

Project Information

Provide an overall summary of the tasks and accomplishments of the project, based on project goals and objectives as outlined in the grant Scope of Work and Timeline. Capsulize information about the project that will allow county staff and potential interested businesses to learn key information about the project. Include the following:

- *a quantitative and qualitative assessment of the results and impacts of the project (including milestones achieved and results for other measurable deliverables)*
- *internal and external factors that contributed to or impeded the success of the project (what worked, what did not).*
- *an assessment of the potential for replicability and sustainability of the project by other commercial entities*
- *overall lessons learned.*
- *an assessment of the success of the Equity and Social Justice element of the project, if applicable*

Your grant manager will contact you if more information is needed.

Project Summary

The goal of this grant is to demonstrate a highly-repeatable cooperative model for community scale, micro-anaerobic digestion (AD) of non-residential food “waste” (FW) called Community Supported Biocycling (CSB). Economic viability, much more so than technical viability, is the biggest uncertainty hampering repeatability of decentralized AD since individual projects are typically dependent on sustainable and marketable value streams. Per **Figure 1 – Truly Local Closed Loop for Food “Waste”** items in red represent the highest potential value streams.

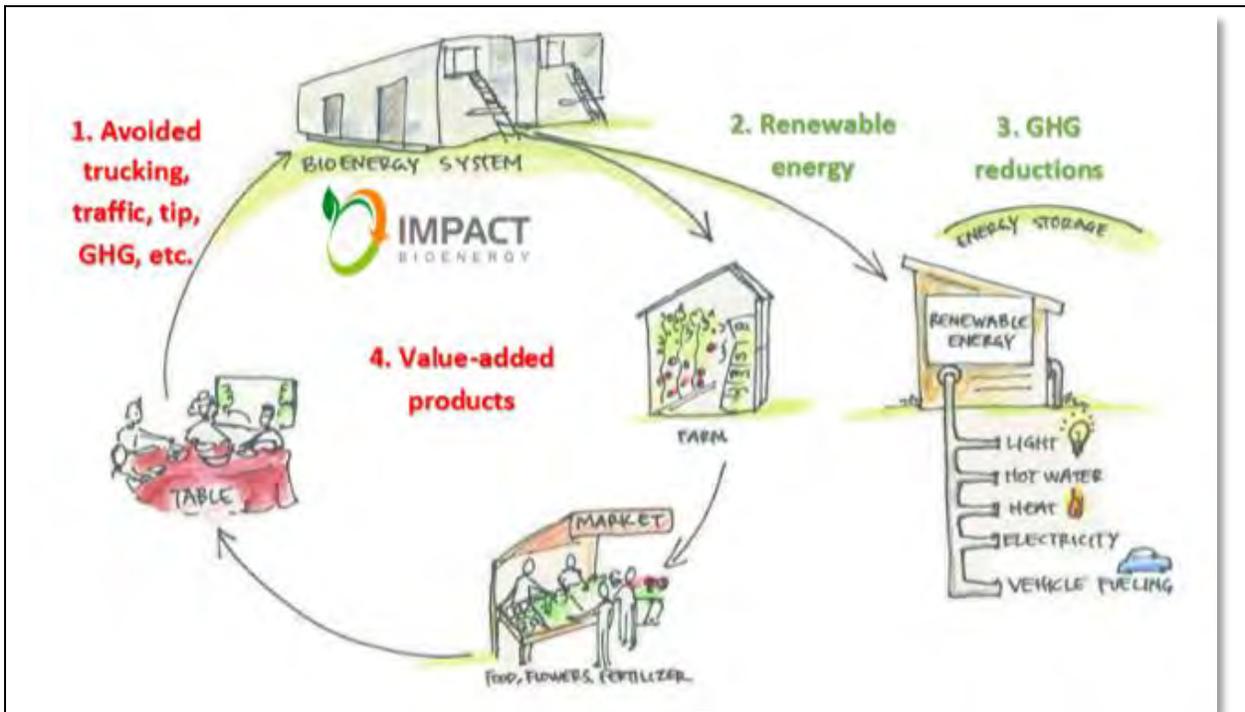


Figure 1 – Truly Local Closed Loop for Food “Waste”

Task Summary

1. In collaboration with Zero Waste Vashon (ZWV), evaluate FW resources that may be directed to micro-AD from commercial generators on-island, including food processors like the tofu factory, grocers, school district, community festivals, farmers, churches, food banks, etc. The objective is to define feedstocks and project quantities that could be directed to community AD.
 - Accomplishments: approx. 26 generators were surveyed; total FW is projected to be **approx. 980 tons per year of which 950 is estimated** to be generated from five top generators shown below in **Figure 2 – FW Resources Most Practicable for Community AD** (note: figures are in tons per year).

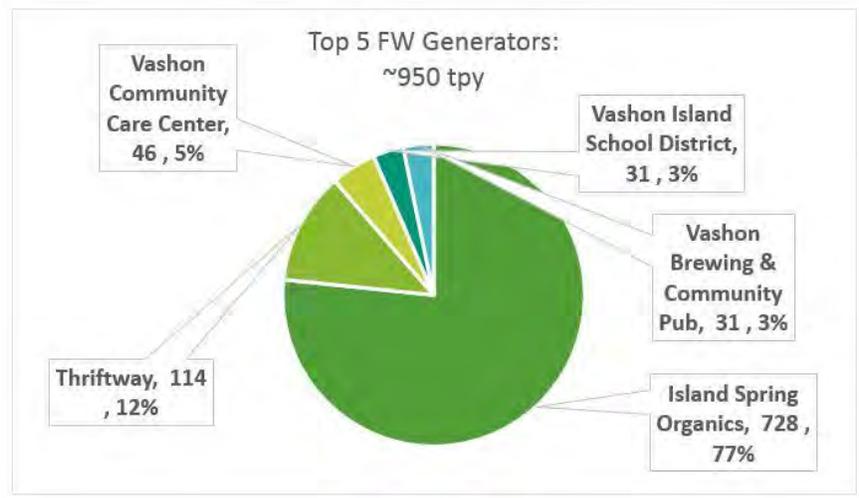


Figure 2 – FW Resources Most Practicable for Community AD

- Accomplishment: validated basic feasibility via potential feedstock assessment, per **Figure 3 – Vashon Bioenergy Farm Baseline SSO**; determined at least 900 tons of pre-consumer SSO can be practicably “biocycled” at **Vashon Bioenergy Farm (VBF)**, put towards the local bio-economy:

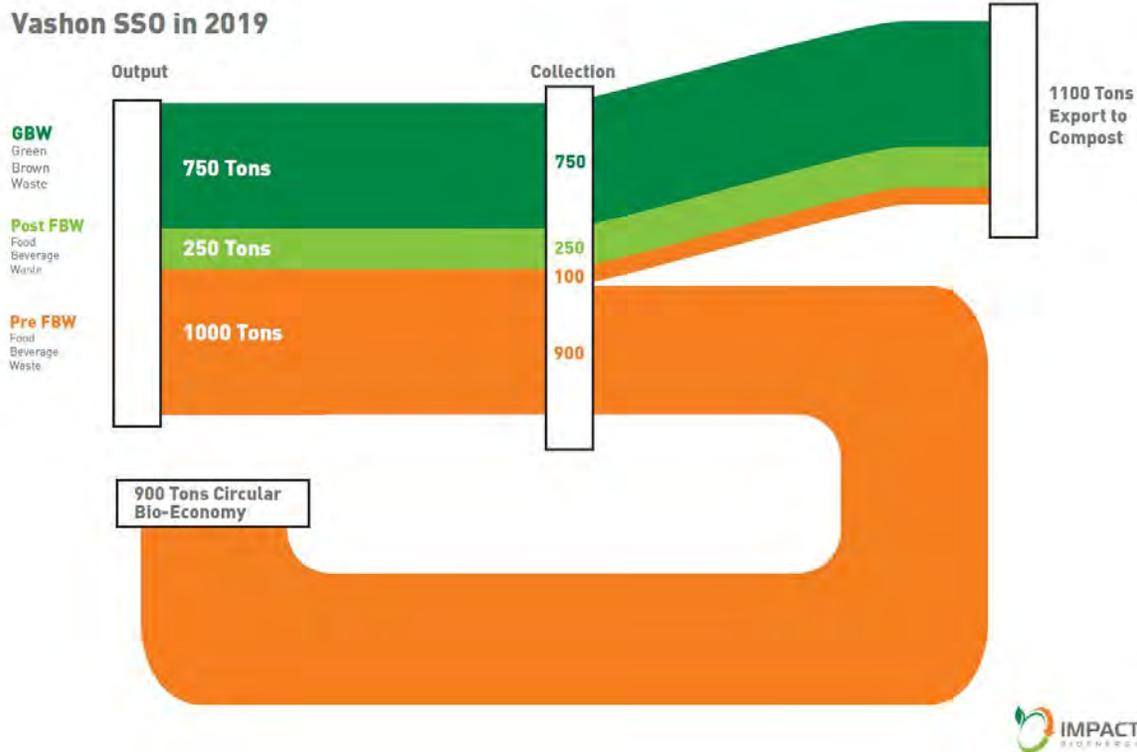


Figure 3 – Vashon Bioenergy Farm Baseline SSO

2. Evaluate the creation of a software tool to facilitate diversion of edible and inedible FW from disposal, allowing cooperators of the system to exchange food, feedstock, fertilizer and fuel.
 - Accomplishment: after testing a custom CSB/co-op marketplace on the [ShareTribe](#) platform, limitations were identified, however it was determined that the core micro-AD technology and business model needed to be demonstrably proven before developing a co-op system. It was also concluded that diversion software is not, and should not be an Impact Bioenergy (IB) core competency and should therefore be left to [subject matter experts](#) in application development for FW recovery and diversion. One such example is [Food Cowboy](#), per **Figure 4 – Food Cowboy Value Proposition**, which created and develops a mobile app, and maintains a database to connect FW to the most beneficial user(s).
 - i. Notably, Vashon Island is home to two ‘farm-to-table’ platforms including: (1) [Vashon Fresh](#) - a project of the Vashon Island Growers Association (VIGA) whose mission is to promote farming, access to healthy food, and sustainable agricultural economy; and (2) newly founded [Farmify](#)



Figure 4 – Food Cowboy Value Proposition

- Accomplishment: in order to streamline the operating system and enable potential co-ops for IB Distributed Bioenergy Solutions, a robust and secure end-to-end 'Internet of Things' (IoT) would be ideal, but not be necessary for the success of VBF since it is premised on being **truly local** – that is, the systems is sited within a short proximity of SSO and beneficial users of coproducts. The IoT platform will be geared towards: (1) automation of key performance indicators, (2) streamlined billing for merchant facilities, (3) enhanced human-to-microdigester interface, (4) improved security, and (5) the user experience with remote issue identification (alerts), and proactive controls for troubleshooting and fail-safes.
3. Investigate the overall feasibility of community scale AD on Vashon, focusing on the following six key areas:
- I. Determine a specific site to locate IB's micro-AD
 - Accomplishment: partnered with Island Spring Organics a certified organic tofu factory where the demonstration project is being sited.
 - Accomplishment: During the 4th quarter of 2018, site integration commenced with AD equipment. Key components such as the primary and secondary AD tanks, and integrated biogas upgrading equipment were delivered and placed at Island Spring Organics in September. VBF ribbon cutting, commissioning and bioreactor ramp-up are expected in Q1 2019.
 - II. Secure dedicated funds/project financing for IB's micro-AD
 - Accomplishment: founded Vashon Bioenergy Farm, LLC, per **Figure 5 – VBF Project Financing Model**; a demonstration AD project has been made possible with grant funding from Gov. Inslee's Dept. of Commerce Clean Energy Fund and a loan from Washington State Housing Finance Committee's Sustainable Energy Trust, whereby IB has designed and built, and will own, operate and maintain, the first AD 185-2 RNG series NAUTILUS microdigester.

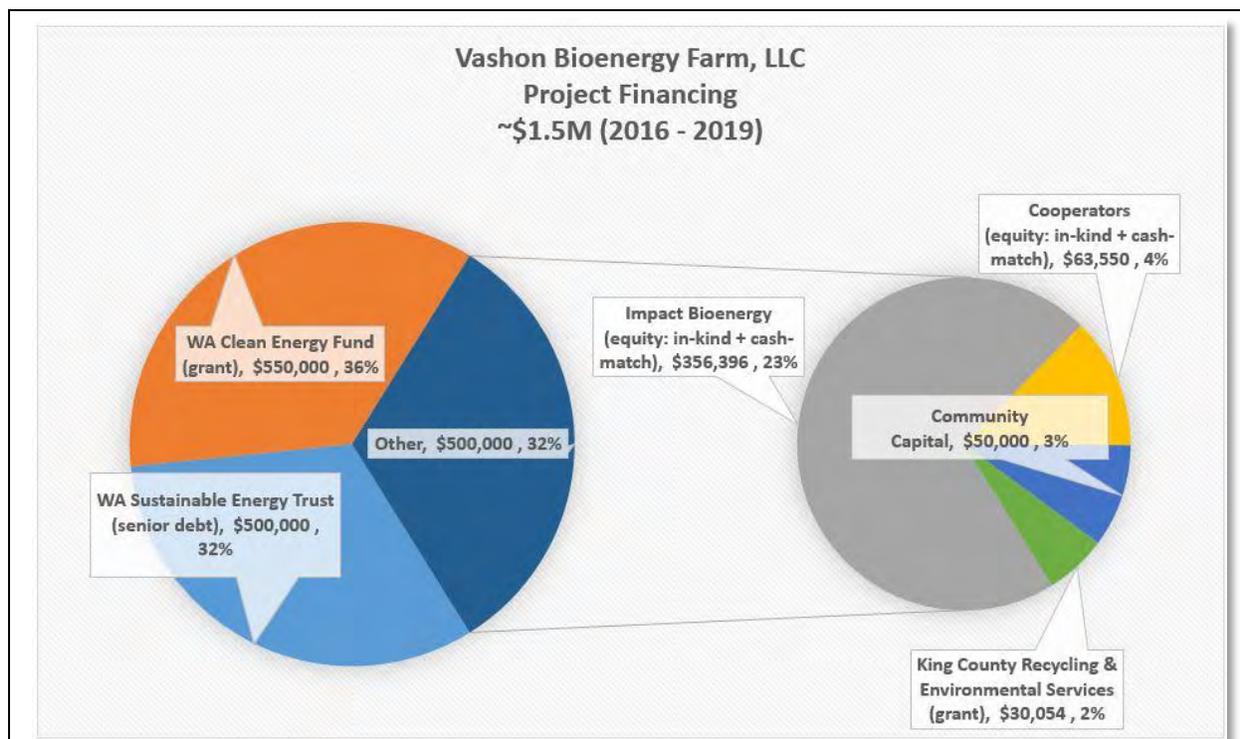


Figure 5 – VBF Project Financing Model

- III. Source feedstock most amenable for continuous AD and determine fair market value for collection and tipping.
- Accomplishment: Island Spring Organics (ISO) is the critical/anchor feedstock tenant, per **Figure 2 – FW Resources Most Practicable for Community AD. ISO will provide the bulk of feedstock to enable the demo and even if other SSO sources do not prove practicable, at least a 12-month demonstration would still be carried out.**
 - Accomplishment: led a cross-sector meeting with leaders from SWD, ZWV and IB, at King County SWD headquarters on September 5, 2018 regarding further analysis on VRTS true costs per ton SSO; SWD estimated direct true costs to be approx. \$172 per ton versus IB's estimate of \$147; 17% delta above IB's estimate is due to higher than estimated ferry fees; SWD and VRTS true SSO costs were further analyzed by SWD and true costs turn out to be almost 50% higher than estimated by IB or approx. **\$220 per ton, per Figure 6 – SWD VRTS True Costs Exporting SSO**, and costs are assumed to escalate at approx. 5% per year.
 - Accomplishment: established a significant potential savings mechanism whereby VBF would **practicably convert tonnage on-island**; project stakeholders would like to participate in the savings that may be enabled
 - I. For example, per **Figure 7 – VRTS Metered Recycling Efficiency Transaction Snapshot**, presuming 1000 tons of practicably captured SSO, there may be approx. \$155,000+ worth of savings to share in 2019, and over \$1,000,000 during the next 5 years via a **Metered Recycling Efficiency Transaction savings.**

	VRTS			\$ /ton
	tons	trips	total monthly cost	
Jan	82.71	14	\$ 12,724.81	\$ 153.85
Feb	57.70	16	\$ 12,222.62	\$ 211.83
Mar	98.88	26	\$ 20,184.16	\$ 204.13
Apr	70.73	18	\$ 14,116.95	\$ 199.59
May	78.42	24	\$ 17,821.74	\$ 227.26
Jun	70.97	22	\$ 16,278.95	\$ 229.38
Jul	77.02	28	\$ 19,880.42	\$ 258.12
Aug	63.09	24	\$ 16,855.95	\$ 267.17
Sep	68.46	26	\$ 18,267.70	\$ 266.84
Oct	61.47	18	\$ 13,533.57	\$ 220.17
Nov	68.59	17	\$ 13,445.41	\$ 196.03
Dec	0	0	\$ -	\$ -
totals	798.04	233	\$ 175,332.28	\$ 219.70
costs	\$ per trip		\$ 536.72	
	tip/ton		\$ 63.00	
	actual cost per ton		\$ 219.70	

Figure 6 – SWD VRTS True Costs Exporting SSO

Year	SSO Rate	SSO tons	Total Cost of SSO	Total Tipping Revenue	Deficit/TBD Savings
2016	6.02%	570	\$ 125,231	\$ 42,750	\$ (82,481)
2017	8.04%	802	\$ 167,812	\$ 60,150	\$ (107,662)
2018	8.73%	871	\$ 191,272	\$ 65,294	\$ (125,977)
2019	10.04%	1001	\$ 230,960	\$ 75,088	\$ (155,872)
2020	11.04%	1101	\$ 266,759	\$ 86,727	\$ (180,032)
2021	12.14%	1211	\$ 308,107	\$ 91,063	\$ (217,044)
2022	13.36%	1333	\$ 355,864	\$ 91,063	\$ (264,800)
2023	14.69%	1466	\$ 411,022	\$ 91,063	\$ (319,959)

Figure 7 – Metered Recycling Efficiency Transaction Snapshot

- IV. On-board an AD operator on-island
 - Accomplishment: vetted prospective operators available on-island and identified two fitting candidates, one of which is engaged and will be trained as lead operator in 2019, estimated at 0.5 FTE.

- V. Develop a plan for value-add products from digestate
 - Accomplishment: coordinated randomized and replicated growth trials with ZWV; supplied digestate from one of IB's existing micro-AD plants (HORSE at Fremont Brewing) for the 2017 Waste-to-Garden project; received encouraging feedback per results shown in **Figure 8 – Summary of 2017 W2G Results**, digestate performed on par or better than worm castings, a proven premium soil amendment.



Figure 8 – Summary of 2017 W2G Results

- Accomplishment: partnered with Vashon Maury Land Trust and their Matsuda Farm lead farmer to continue with more rigorous, multi-year growth trials starting in 2019. The Land Trust is building a farm-to-school and food bank pipeline of healthy organic food. The objective with respect to this demonstration is to build empirical evidence to establish minimum average wholesale and retail benchmarks for the following value-added products, in turn enabling a repeatable model that can be adapted to rural, suburban and urban settings. One or more of the following value-add products may be developed further into WSDA certified organic soil amendments:
 - i. Filtrate (e.g. light/filtered digestate for drip irrigation)
 - ii. Liquid emulsion (e.g. branded '**ReDEW Vashon Organics: Probiotic Plant Food**')
 - iii. High solids humus (e.g. de-watered digestate solids)
 - iv. Concentrated liquid digestate (e.g. similar to 'Alaska Fish Fertilizer')
 - v. Dried digestate that can be bagged, stored, and shipped more easily

VI. Develop a plan for value-add coproducts from biogas

- Accomplishment: in order to demonstrate economic viability of micro-AD, the highest value energy pathway was determined to be upgrading of biogas to renewable natural gas (RNG) for vehicle fueling; annual production capacity is estimated to be approx. 20,000 diesel gallon equivalents per year of RNG (the lowest emission and only net-negative carbon fuel available). RNG will also be used for power generation and can be strategically stored for peak use and disaster response, therefore driving security, independence and resiliency in the local community.
- Accomplishment: introduced RNG fueling opportunity to SWD leaders, follow-through demonstration and collaboration with KC expected through 2019.

Conclusion, Assessment of Repeatability & Lessons Learned

It is a prolonged maturation cycle to bring a completely new production system into the market and generate sustainable revenue streams. This grant has served as a seed to help implement a road map of sorts for project developers, system operators and owners to emulate and leverage lessons learned.

On one end, IB has designed and built, and will own, operate and maintain VBF as a working business and “franchise-able” model for hyperlocal organics conversion to organic soil amendments and the lowest carbon intensity fuel. The emphasis is specifically on developing scalable, decentralized and replicable methods to generate revenue from the sale of value-added products from micro-AD.

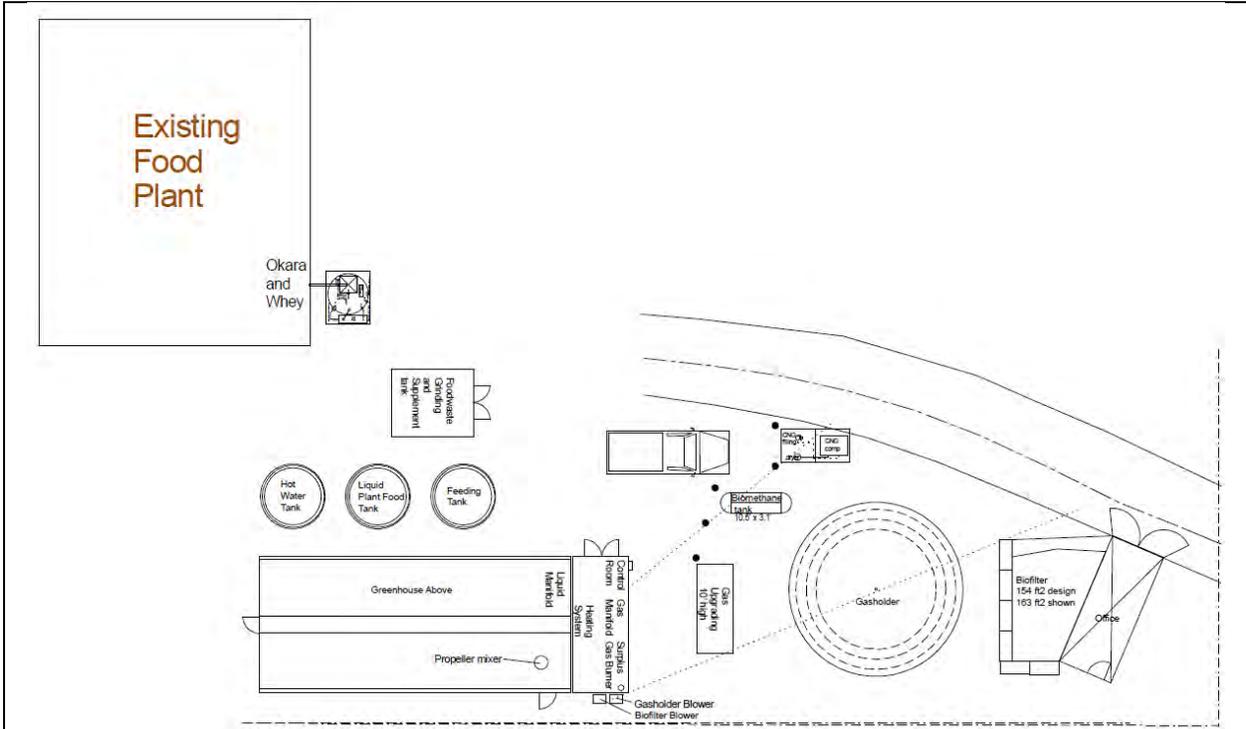
The primary goal is to demonstrate economic viability by generating real world data. In order for co-products to be used beneficially within the community, thereby avoiding trucking, exportation of bioresources and importation of soil amendments, fuel and energy, and the associated greenhouse gas emissions and loss of soil fertility, more certainty is needed regarding the applicability, short and long-term efficacy, shelf stability and fair market value of coproducts.

Returning water, nutrients, carbon, and beneficial microbes to the soil goes a long way toward supporting farm-to-table food production and King County’s Kitchen Cabinet and Local Food Initiative to better connect local farmers and communities. This project is trying to build reliable data to show how digested food waste has a local market and can strengthen the Local Food Initiative while forwarding several strategic initiatives.

Provide any other information that the grant manager should know about this project.

In reality, this project is just getting started. Micro-AD system startup is on track for February 2019. Throughout 2019 we will generate key lessons operating and performing rigorous year-round growth trials. Coproducts will be beneficially used by cooperators including, but not limited to Island Spring Organics, Vashon Land Trust, Matsuda Farm and IB. Outreach and education will be greatly expanded via collaboration with ZWV. The learning community will be tapped and leveraged to tackle a wide spectrum of regionally-relevant issues ranging from climate change, wildlife and wild spaces, energy independence, agriculture, food production, food justice and activism using a variety of formats that are sure to inspire action.

IB aspires to further develop CSB as **a public-private partnership that drives more producer and consumer responsibility**. IB has high hopes that SWD will follow the demonstration project closely and consider micro-AD processing on-site at VRTS and beyond.



VASHON BIOENERGY FARM

Figure 9 – VBF Site Dec 30 2018 Plan



Vashon Bioenergy Farm NAUTILUS Core

Provide feedback on your experience with this Commercial Food Waste grant program. Do you have suggestions for how to improve the program?

More cross-functional collaboration and support from SWD would be great. For example, this project is so relevant to the KC Ag Program so they should have been more involved but we only made contact with them recently, during summertime and just now discussing options.