LARGE GRANT ABSTRACT
2022-2023

SEJF large grant requests are for projects that require funding over $35,000. The large grant abstract is designed to introduce a project idea that requires significant funding to the SEJF Committee. Abstract approval is required before submitting a large grant application. For detailed abstract instructions and further information about the program, ask a program representative.

Submit the completed application by emailing a scanned version (including signatures) to Zinta Lucans, the SEJF Grant Program Coordinator. Email: lucansz@wwu.edu.

SECTION 1: Project Concept.

a) **Project Title:** Anaerobic Digestion on Western Washington University's Campus

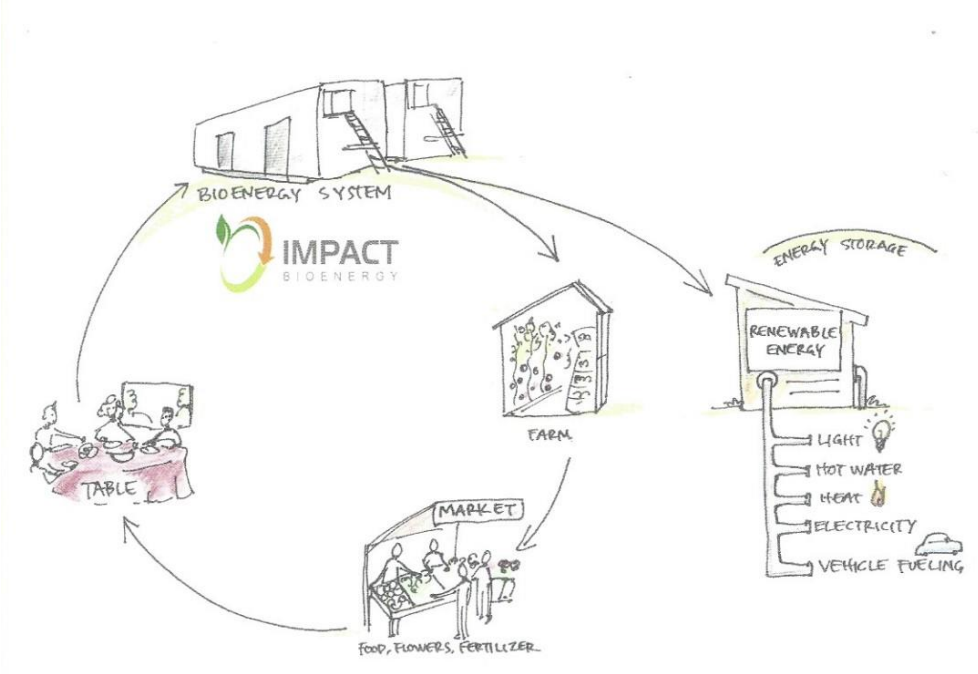

Figure 1 – Diagram showing the anaerobic digestion process from Impact Bioenergy

b) Describe your proposed project:

Food waste is a dynamic and multifaceted problem that occurs on a variety of magnitudes. Every year, around 1/3 of global food production gets discarded somewhere along the line of production, distribution, and consumption. This accounts for about 1.3 billion lbs. of food waste each year (Alam et al., 2022; Dou et al., 2016; Xu et al., 2018). Food waste, if it is not composted or utilized in another way, along with other discarded items make-up what is called municipal solid waste (MSW). MSW production is growing paralelly with increased consumption. This is causing landfills to fill up quickly and increaseing demand for more. According to a phone call with an employee at Recycle and Disposal Services (RDS), Western Washington University alone generates 5.6 million lbs. of municipal solid waste (MSW) annually. The MSW is picked up from campus by Sanitary Services Company (SSC) who brings it to Recycle and Disposal Services which is a transfer location in Ferndale. From there, RDS sends waste collected from Western and the greater Bellingham community to a landfill in Arlington, Oregon called Columbia Ridge Landfill and Green Energy Plant. This landfill was opened in 1990 and scheduled to close in 2031. It currently has 61,551,758 tons of waste in place that will continue increasing until its closure date (US EPA, 2017).

As an effort to divert food waste from the landfill, Western has implemented a comprehensive composting program that is utilized in the residence halls, academic buildings, and the dining halls. Similar to MSW, compost is picked up from WWU regularly by SSC through their FoodPlus! program. Once SSC collects compostable materials from campus, it is transported to Green Earth Technology. Green Earth Technology is an LLC out of Lynden, Washington that commercially composts organic material and produces soil amendments, mulch, planting soil mixes, etc. These products are then publicly sold as Certified Compost at market value (*Composting Services - Whatcom County, WA - Green Earth Technology*, n.d.).

The problems that Western is facing amidst climate change are not unique and like most climate problems, cannot be solved with one solution. Food waste is a spoke in the wheel of several larger problems: natural resource depletion, environmental degradation, food insecurity, continued greenhouse gas emissions, public health crises, and perpetuated social injustices, just to name a few. Though it is important to note that all of these problems will not be eliminated solely through a lens of food waste mitigation, they also cannot be solved without it. The most paramount way in which Western and beyond can reduce food waste and therefore reduce exacerbation of the above problems is through the reduction in comsumption and generation of food waste in the first place. Out of all foodwaste generated in the United States per year, 40% of it is wasted at the consumer level (Dou et al., 2016). Increased efforts to reduce consumption at the consumer level is increadibly important, however, until that happens there is a clear need for creative solutions addressing waste that *is* being generated.

As discussed above, composting is one of these solutions, however composting can not be the end all be all. Another prominent solution that is the premise of this proposal is the implementation of an anaerobic digester on Western's campus to mitigate and repurpose the food waste that is coming out of the residential dining halls.

Anaerobic digestion is the process in which complex microbial communities break down (digest) organic material, such as food waste, without the presence of oxygen. In this process, the material is converted into two byproducts: biogas and digestate. Biogas is composed of methane (CH_4), carbon dioxide (CO_2), hydrogen sulfide (H_2S), water vapor, and other trace gasses. The main component of biogas is methane

(50-70%) which is also the main component of natural gas (Alam et al., 2022; Xu et al., 2018). The similarities in their make-up pose several uses for biogas as a natural gas alternative. Some of these include electricity generation which can be used to power heating and cooling systems, power a generator, charge electric vehicles, etc. It can also be purified into renewable natural gas (RNG) which can be used as propane, or implemented directly into a natural gas piping system. RNG can then be further compressed and used as vehicle fuel or other alternative fuel sources (US EPA, 2019). The other byproduct, digestate, is the organic material that is left over after the digestion process. It is comprised of both liquid and solid components which can be used in tandem, or separately. Digestate is very nutrient rich and is commonly used as a plant fertilizer/soil conditioner (US EPA, 2019).

Anaerobic digestion is growing in popularity as an alternative to composting, another option for landfill diversion, and renewable energy production. More and more anaerobic digesters are being utilized in the United States, though the majority are on a large-scale agricultural level. Popularity for food waste as a substrate is increasing because of the proposed and identified environmental, and financial benefits and incentives, but as of now, only 2% of food waste in the United States is anaerobically digested (Xu et al., 2018).

This project would work in tandem with composting and consumption reduction efforts to increase sustainability, reduce costs to the University, provide valuable education opportunities, and offset emissions. It is important to note that an AD will not be able to completely eliminate the need for continued composting services, but it would provide Western with a different avenue to become a more well-rounded, sustainability minded, innovative, and progressive campus.

Throughout this project there have been collaborations between different departments. The main stakeholders that have been involved in this process include Amanda Cambre and Terence Symonds. Amanda is the Director of Sustainability Integration at Western. She plays a major role in planning, project development, and operational improvement on campus and has been involved in this project since inception in October 2022. Terence Symonds is the Associate Director of University Residences and Facilities. He oversees maintenance and repair activities for residences and dining facilities across campus. Future stakeholders from Western are likely to include Wayne Galloway. Wayne is the Director of Facility Services at WWU and is responsible for custodial operations, pest management, grounds maintenance, and landscaping services. Other important stakeholders have been identified from Impact Bioenergy and communication and collaboration with these stakeholders has also commenced since the early phases of this project. Jan Allen is the Founder and Chief Inventor of Impact Bioenergy and has provided valuable information about their digesters, and the technology of anaerobic digestion as a whole. Michael Smith is the Director of Legal and Business Development at Impact Bioenergy and has also been involved in the project through answering specific questions regarding how anaerobic digestion will fit into the fabric at Western.

Understanding the benefits of a closed loop system supports this need for different strategies and approaches to food waste mitigation. Currently WWU, and most other campuses in the United States, are operating under a mostly linear system. This means that it operates almost exclusively within the linearity of importation and exportation. Food is imported, then food waste is exported. There is hardly any interaction with food waste which perpetuates the harmful mindset of “out of sight, out of mind”. Implementation of an anaerobic digestion would work to break the linearity by recycling Western’s food waste into useful byproducts that will then be utilized on campus. Doing this will decrease Western’s dependency on imports and reduce the quantity of exports.

There are three residential dining halls at WWU: Ridgeway Commons, Fairhaven Commons, and Viking Commons. All of these dining halls serve a varying number of students, with Viking Commons having the highest capacity and Fairhaven Commons having the least. These dining halls work in buffet style where the students select the type of food that they want and the amount. Whatever they do not eat, they send back into the kitchen where kitchen staff separate the food from the garbage and put the organic material into composting receptacles. The point of having dining hall staff sorting the post-consumer food waste is to reduce the amount of cross-contamination in the compost. Food waste is in two cubic yard receptacles that is removed by SSC at varying intervals that depend on the amount of waste production. The Viking Commons have food waste removed 5x a week, and both Fairhaven Commons and Ridgeway Commons have it removed 2x a week. The food waste that is included in this pickup is both pre-consumer waste and post-consumer waste. Pre-consumer food waste includes scraps that are generated that never make it out of the kitchen. This includes vegetable peelings, meat scraps, and expired food. Post-consumer waste consists of what people don't end up eating off of their plates.

The target for anaerobic digestion will be the food waste from a residential dining hall because of the volume and efforts in contamination reduction. The exact volumes of the food waste from each dining hall are subject to variation. Getting precise amounts of food waste is difficult because SSC picks up the waste and charges the University based on the frequency of pickups, not the amount of material. Some inferences can be made about the volumes through utilization of volume-to-weight conversions provided by the EPA. According to the conversion chart, a 2 cubic-yard receptacle when it is full of food waste weighs around 2,736 lbs.
(*Volume_to_weight_conversion_factors_memorandum_04192016_508fnl.Pdf*, n.d.). Based on this same conversion scale, a receptacle that is 75% full would weigh around 2,052 lbs., and a half-full receptacle would weigh approximately 1,368 lbs. So, a probable range of receptacle volume lays somewhere between 1,368 lbs. and 2,736 lbs. per pickup. Looking at Fairhaven Commons, who has organic material picked up twice weekly, it is inferable 2,736-5,472 lbs./week is generated.

This project has focused on working with an anaerobic digester fabrication company called Impact Bioenergy that is based out of Auburn, Washington. Impact Bioenergy's mission is to utilize waste that is adjacent to food systems to allow for communities and urban centers to reduce reliance on fossil fuels and generate renewable energy while saving costs on energy and disposal (*Impact Bioenergy | Distributed Food Waste to Energy Technology*, n.d.). The specific anaerobic digester that is being considered for this project is part of the HORSE series. HORSE is an acronym for High-solids Organic-waste Recycling System with Electrical output. The HORSE series has different sizing capacities: 25 tones per year, 40 tons per year, and 100 tons per year. Based on the amount of food that is coming out of the Farihaven Commons dining hall, as well as financial, and spacing considerations, the HORSE AD40 is the focus. 40 tons of food waste equates to 80,000 lbs. If the dining hall runs at full capacity for 10 months out of the year (full capacity would mean that food waste would be in the range of 2,736-5,472 lbs./week) and half capacity during the two summer months (half capacity would generate betwwen 1,368-2,736 lbs./week) then the HORSE AD40 would be able to digest between 30% and 60% of all generated food waste.

Impact Bioenergy design their digesters to be expandable up to 7x beyond the base model (HORSE AD25). All the components of the HORSE series digesters fit inside of a closed and sealed compartment that is around 150 sq. ft. Expanding would entail adding additional containers that connect to the original but expand the capacity for digestate and biogas storage as well as increased amount of food waste that is able to be digested. The HORSE AD40 incorporates two separate containers so the sizing needs would be around 500 sq.ft.

The HORSE AD40 will come prefabricated with accessories such as biogas and digestate storage, a food grinder, a generator, etc. Additional accessories can be implemented into the design and fabrication process based on the desired utilization of byproducts as outlined by the University. The overall timeline for this project ranges at around 12-months. According to Impact Bioenergy, 1-3 months is spent on planning, permitting, and design, 3-12 months is spent on fabrication, and an additional month is spent on delivery and start-up (*Impact Bioenergy | Distributed Food Waste to Energy Technology*, n.d.). Currently, this project is almost complete with the planning, permitting, and design phase. Full completion of this phase will depend on exact specifications of variables such as byproduct use and location.

Location

Choosing a specific site location will be a collaboration of several between several stakeholders and departments on campus to ensure the location fits all needs of the project.

One proposed located is Fairhaven Commons. It is located at the far south of campus and has a loading dock and a parking lot (lot 29G). The lot is contains eight standard vehicle parking spaces, one space for University vehicles, four accesible parking spaces, and three regular spaces. There is also several spaces for motorcycle parking. If this site is chosen, there would need to be some lot reorganization. Proposed amendments to the current location may include redistribution of motorcyle parking to a different location that has not been determined. Another option is to move the space for the University vehicle and reduce the amount of motorcycle parking without eliminating it. Another ideal asset is that this site is located in close proximity to the Outback Farm which is a potential recipiant of the digestate.

Another possible site for implementation is at the Physical Plant (PP). The PP is located a block south from Buchanen Towers at the intersection of Taylor Ave. and 25th st. The PP is home to the Capital Planning and Development Department and the Facilities Management Department. It is also where the Western utility vehicles are kept and neighbors with the Associated Students Recycling Center. This location is being considered because it has space that meets spacing accomodations for the AD and is in close proximity to [potential] direct utilization of byproducts. Logistics at this location that will need to be considered include how to get food waste from the dining hall to the Physical Plant, and utility hookips for water, sewer, and electricity.

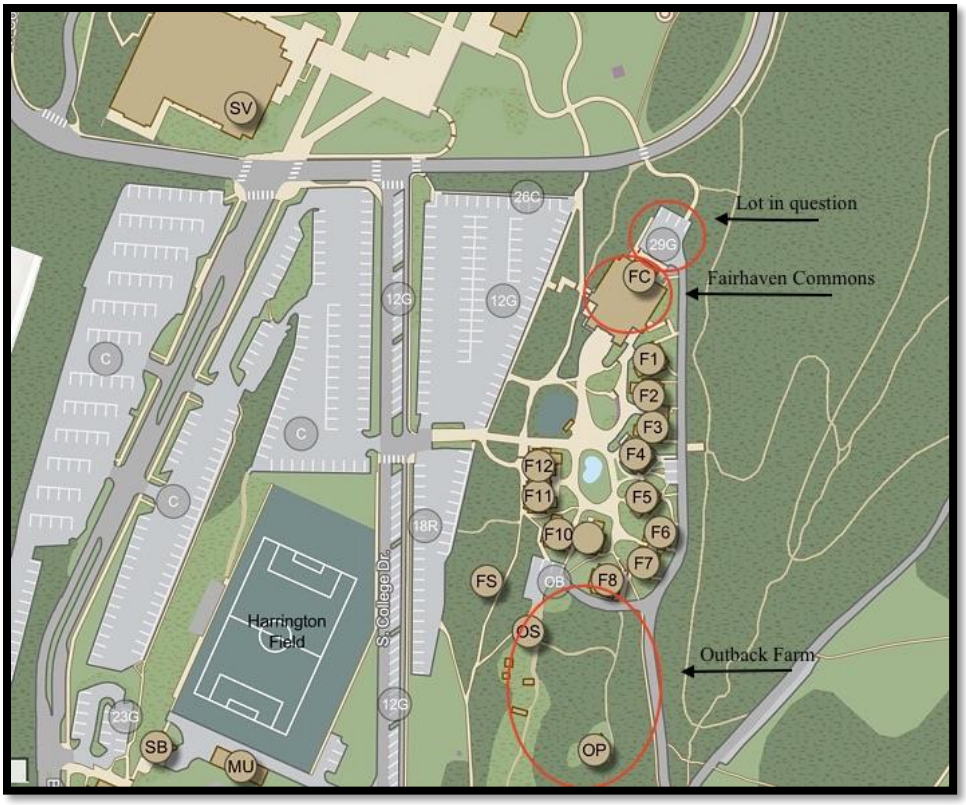

Figure 2 – Snapshot of Southern WWU campus map, Fairhaven

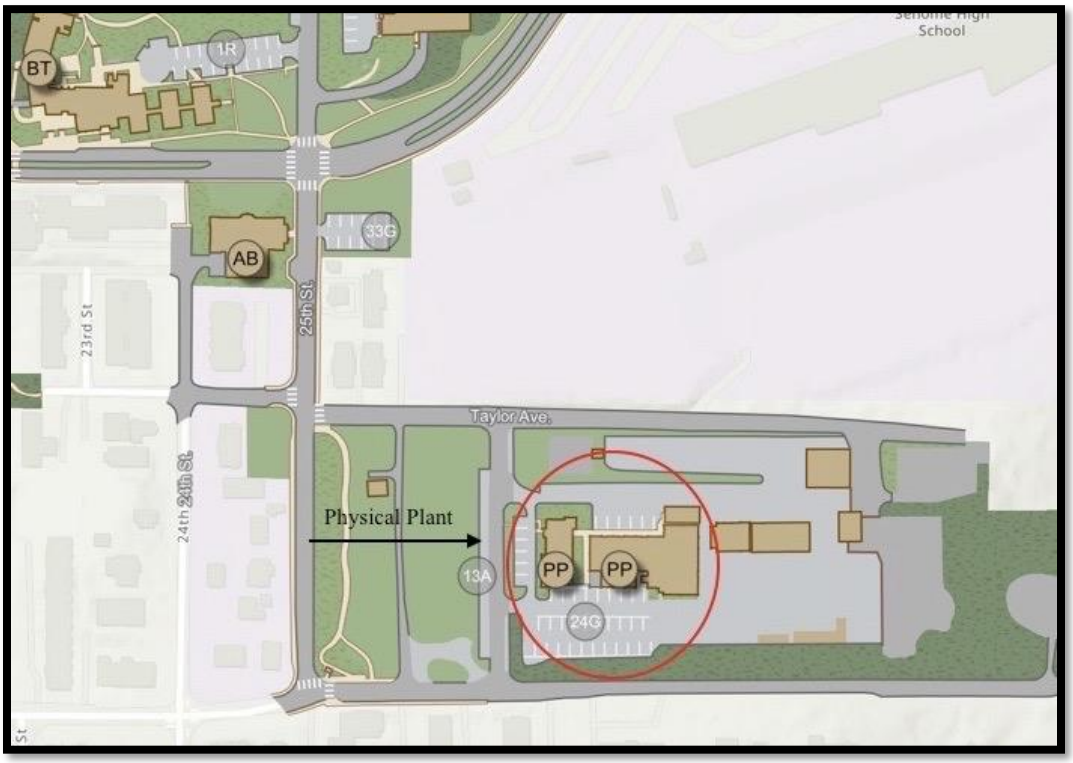

Figure 3 – Snapshot of Southern WWU campus, Physical Plant

Both locations along with others will be further considered during future meetings with WWU teammembers and stakeholders and site visits from Impact Bioenergy. For these locations and any others that are identified, there are mandatory accomodations and requirements that must be met. There needs to be at least 480 sq. ft. of space, accessibility to the digester with a utility vehicle, and connections to utility hookups (water, sewer, electricity). Other considerations that can be ammendable during planning and implementation is proximity to a dining hall and identified methods to move food waste to the digester, and proximity of byproducts to utilization area.

Staffing

Staffing and time considerations for this project is relatively minimal. In correspondance with Jan Allen, Chief Inventor and CEO of Impact Bioenergy, he eluded that time requirements are in the 4-6 hour range per week. 2-4 hours will be spent feeding food waste into the digester, another 2 hours is budgeted for cleaning, datalogging, testing digestate for certain characteristics (pH, etc…), and equiptment care. Additional hours may be needed for transportation of byproducts which, depending on output will be needed twice per week. Once the project is underway, Impact Bioenergy will provide trainings as well as testing and an exam to certify staff as digester operators (J. Allen. Personal Communication, Nov. 10, 2022). It is suggested that the above requirements be filled by a student to increase interaction with the digester and provide experiential and educational opportunities.

Another potential role that can be created in regard to this project is student educator position. This position would be responsible with completing outreach and expanding the focus of the digester beyond those who are directly involved. Potential for this role could include taking current and prospective students on tours of the digester, pursue outreach of the digester through social media integration, and more. This position would be part-time and around 6-8 hours a week.

To ensure project stability and continued momentum, a group of 3-5 students will be encouraged to continue working on this project next year. Both students who are currently working on it, Clara Copley and Sienna Taylor, are graduating. Sienna Taylor is a co-lead for Students for Renewable Energy which is a sustainability-focused club on campus. She will work with students to bring them up to speed on the project and necessary continuations which includes student employment and staffing.

Utilities

Utility accommodations that need to be accessible include water, sewage, and electricity. Water accommodations are minimal and used to clean the digester, wash things down the drain, and be an additive to the substrate to promote digestion if the slurry is too dry. All that is needed is a standard garden hose or irrigation pump hose that can have needed output of 2 gallons per minute. Sewage is a more complex utility requirement because sewage lines are located about 10 feet underground. Sewage needed for proper greywater separation. The digester also needs electrical input. A single phase 240 Volt AC circuit along with a 60-amp electrical service will be utilized to power the grinding, mixing, and heating processes of digestion (J. Allen. Personal Communication, Nov. 2, 2022). It is possible and desirable that the electricity generated from the biogas be recirculated to run the digester. As mentioned before, additional utility utilizations can be requested and incorporated dependent on specific utilizations of byproducts.

Emissions Reductions / Utilization of Byproducts

This project has great potential for emissions reductions at Western. Specific reduction amounts will depend on what specific uses the byproducts used for. Currently, WWU emits around 17,392 metric tons of carbon dioxide equivalent per year (MTCO2e). 67.8% of emissions come from natural gas, 32% comes from steam generation, and the remaining >1% comes from electricity (*Energy Manager*, n.d.).

Biogas:

When biogas is produced through the anaerobic digestion process, it is separated from the digestate and stored in a container. The chemical makeup of the biogas is 50-70% methane, 30-40% carbon dioxide, 5-10% of hydrogen, 1-2% of nitrogen, and trace amounts of water vapor, and hydrogen sulfide (Alam et al., 2022; Xu et al., 2018). If desired biogas utilization is injection into Western's natural gas system to supplement the steam plant, the biogas will need to be upgraded into renewable natural gas (RNG). To do this, the methane content is increased by removing water vapor, carbon dioxide, hydrogen sulfide, and other impurities. Once it is purified, it can be injected into natural gas pipelines (US EPA, 2019). According to Western's Utility Plan that was last updated in 2017, the total campus natural gas usage is 1,919,702 therms per year (equivalent to 191,970.2 MMBTU). The HORSE AD40 has the capacity to generate ~350 MMBTU per year (*Impact-Bioenergy-Solutions-Fact-Sheet.Pdf*, n.d.). If the 350 MMBTU were used fully to offset 350 MMBTU of the total natural gas usage.

Another consideration is to compress the RNG into vehicle fuel and utilize the biogas as a fueling source for campus utility vehicles. The fueling rate for vehicles is 381,000 BTU per hour. The HORSE AD40 has the ability to generate 350 MMBTU of RNG per year which equates to and can supply around 919 hours of fueling annually (*Impact Bioenergy | Distributed Food Waste to Energy Technology*, n.d.).

Another avenue of utilization of biogas is through electricity generation. Biogas can generate mechanical energy through an internal combustion engine that then rotates an electric generator to produce electricity. The HORSE AD40 can generate 102,574 kWh of electricity per year. Utilization of generated electricity can be considered for charging electric bikes and electric vehicles, it can also be used to power portable generators, or to power the backup generator in Fairhaven.

102,574 kWh averages out to about 281 kWh per day. However, this number will vary in practice because not all days of the year will yield maximum biogas electrical output. For reference it takes 75-100 kWh to fully charge an electric vehicle, and 0.4-0.8 kWh to full charge an e-bike. According to information provided by Western, the emergency backup generator rated at 45 KW and is used as indoor flow for emergency lights and fire alarms. It is located in the Fairhaven Administration Building in room 114.

An important note is that WWU purchases energy from the Skookumchuck Wind Facility as part of the Puget Sound Energy's Green Direct program. This means that less than 1% of carbon emissions comes from electricity (*Energy Manager*, n.d.). That being said, the most potential for an anaerobic digester as a means to reduce emissions would best be served as utilization of biogas as RNG, but there is potential for electrical output that should also be considered.

Digestate:

Once the biogas is separated in the digestion process, the remaing material is digestate. The digestate is in both liquid and solid form and to increase shelf life, can be dried through a solar process to allow for storage over the winter months (*Impact Bioenergy | Distributed Food Waste to Energy Technology*, n.d.). Digestate has a lot of potential in the realm of emissions reductions and increased sustainability when looking at it through the lens of an alternative to synthetic fertilizer. It is estimated that the supply chain of synthetic N fertilizer amounts to about 2.1% of total GHG emissions at 1.13 GtCO2e. When synthetic N fertilizer is applied to a landscape, only a certain percentage of it is up taken by the plants. A bit more is used by soil organisms who metabolize the fertilizer and produce N2O, which is a GHG 265x more potent than CO2. The remaining fertilizer is leached from the ground and can make its way to the ground water and lead to damaging processes such as eutrophication and addition of heavy metals into the soil (Menegat et al., 2022). By reducing the amount of synthetic N fertilizer that is applied to campus, it would also reduce the amount of N2O that is released, the amount of fertilizer that is leached into the ground water and decrease Western's contribution to GHG emissions in the agricultural sphere.

As part of an audit from Western's Facility Management Department, it was found that Western purchases an average of 750 lbs. of synthetic fertilizer and around 200 lbs. of organic fertilizer annually (~950 lbs. total). The HORSE AD40 is estimated to produce around 1,822 lbs. of digestate annually. The digestate produced by this AD is estimated to have Nitrogen-Phosphorus-Potassium levels of 2 to 5%, 1 to 5%, and 3 to 9% respectively with an Organic Matter content of 24 to 53% (*Impact Bioenergy | Distributed Food Waste to Energy Technology*, n.d.). Utilization of digestate as a replacement of synthetic fertilizer supports sustainability because it has slow-release nutrients which means that excess nutrients will not be leached or metabolized and released as N2O.

Recirculation of the digestate on campus grounds and in the Outback Farm are ways to support a close-loop system on campus. There are other potential utilizations of the digestate such as selling for market value to generate revenue or partnering with a local farm or landscaping entity. These options will be further discussed in the Cost-Benefit Analysis and decisions regarding specific utilization will be narrowed down as the project progresses.

Cost-Benefit Analysis

A more in-depth cost benefit analysis will be finalized and included in the full grant application. A meeting between the project team and Impact Bioenergy will clarify and finalize location, utility logistics, and utilization of byproducts. Once those variables are narrowed down and specified a more accurate analysis will be conducted using the specific information. There are several opportunities and possible cost savings potential listed below that may change or be further explained farther along in the project.

Another important note that is viable to the cost-benefit analysis is that in some instances maximum revenue contradicts with efforts for sustainability. In this project, it is recommended that digestate be used as a substitute for synthetic N fertilizer to decrease dependency. If the digestate were to be sold at market value on the public market, there is a lot of revenue potential. According to Jan Allen, digestate from an Impact Bioenergy digester can be sold for around $15 per gallon. The HORSE AD40 generates 9,000 gallons of digestate annually, so if all 9,000 gallons were sold at a market value of $15 there is potential revenue of $135,000 per year. In communications with Terence Symonds, he noted that it may be advisable to use the current project to reduce consumption of synthetic fertilizers on campus, but future expansions or additions to the original AD can be focused on accruement of revenue.

- Cost-Benefit analysis
    - Return on Investment
        - Estimated ROI is 6-10 years (according to Impact Bioenergy)
    - Cost savings from SSC pickups
        - Reduction from Fairhaven pickups of 2x weekly to 1x weekly
            - Save around $1,250
        - Expansion of the AD would further reduce and maybe eliminate all SSC pickups
    - Cost savings from reducing need for grease removal from grease inceptor at Fairhaven Commons (Invoice from 2015-2019 fiscal years)
        - Bayside Services contracts with WWU
        - Picks up grease from Fairhaven Commons semi-annually (in June and December)
            - $8,580 price per cleanup
            - 25,633-gallon average but capacity of receptacle is 22,000 gallons – so inceptor is being utilized at 115%
        - WWU is in a two-year contract with Bayside Services that ends 6/30/2023
        - Grease gets taken to Farm Power Northwest in Mt. Vernon where it is digested and used to make electricity/fertilizer
    - Cost savings from redirecting digestate to grounds fertilizer usage
        - ~ 200 lbs of organic fertilizer / year
        - ~ 750 lbs of synthetic fertilizer / year
            - 1 bag of synthetic fertilizer is 50 lbs. and costs $200 dollars
            - ~$3,000 annually
    - Cost savings from selling digestate
        - Market value of ~$15 / gallon
        - Potential to make around 9,000 gallons per year at market value is revenue of $135,000
            - Can be used to further invest in sustainability projects or to offset emissions
    - Cost savings from utilization of biogas as a natural gas alternative
        - To purify into RNG and compress to fuel utility vehicles
            - How much is spent on gas for utility vehicles each year
            - How much can be replaced with biogas?
        - To include into natural gas piping to the steam plant
            - How much is spent on natural gas to use in the steam plant?
            - How much can be replaced with biogas?
    - Cost savings from selling carbon credits
        - Maybe not eligible because Climate Commitment Act says the Act covers businesses who emit over 24,000 tons of CO_2 each year
        - WWU emits around 18,977 tons of CO_2 per year

c) Who is the intended audience?

Implementation of an anaerobic digester would have several different audiences of varying scales. Identified audiences include other universities, the greater Bellingham community, current WWU students, future WWU students, staff, and faculty.

The main audience that this project is intended towards are the students. Present students will be able to interact and learn from this project through educational signage that will be included with implementation. The signage will be placed near the digester so that it will be visible via foot traffic in the area. The signs will include basic information about the anaerobic digestion process, what the byproducts are and how they are being used, and how anaerobic digestion is enhancing sustainability on WWU's campus. Students will also be engaged through incorporation of relevant anaerobic digestion information into course curriculum. Facets of the AD process can be incorporated into a variety of different courses. Some of the broad applications include soil science, energy science, business and sustainability, and agroecology.

Another way in which students will be in audience of the digester is through hands on engagement and experience. There is great potential for internship, independent study, and paid positions that will involve the AD. Another possibility is the incorporation of anaerobic digestion into a focused interest group (FIG)

Future students are also the intended audience of this project. The AD can be incorporated into campus tours to highlight sustainability to prospective students and family. It can also be featured on the WWU's website for future students to learn about prior to visiting campus.

Successful implementation would be able to serve as an example to other universities that are also striving for creative sustainable solutions. By making the work done at WWU accessible and comprehensive, it could serve as a template to other campuses across the country to exemplify ways in which food waste can be used to generate a closed-loop system. Another intended audience is the greater Bellingham community. This audience is similar to that of other campuses. Actions that WWU are taking towards increasing sustainability reflects on Bellingham and vice versa. WWU and Bellingham can learn from one another and collaborate through this project and future projects that may follow.

d) How does this project directly impact the Western student community?

This project will vastly impact the Western student community in several ways. It will affect the students who are eating at one of the four residential dining hall, students who are walking to and from Fairhaven to the main campus, students in sustainability clubs, and students in certain courses.

e) What are the goals and desired outcomes of your project?

- Emissions reduction
- Production of natural gas alternative
- Production of nutrient rich soil conditioner/fertilizer
- Cost savings
- Improved sustainability
- Increase in sustainability oriented educational opportunities

- Provide guidelines on creative climate solutions to other campuses and communities
- Diversion of waste from the landfill

f) How will your project positively impact sustainability at Western?

This project will do a great deal to positively impact sustainability at Western. Anaerobic digestion promotes a closed loop system because the food that is wasted will not leave the facility, it will be recirculated via the anaerobic digestion process and will be reused as biogas or digestate. Then, since the application of the digestate and biogas will remain on campus or be utilized in the immediate community, it will be supporting sustainability and reducing the need of the flow of inputs (natural gas, fertilizer) and outputs (atmospheric CO2 equivalents, food waste).

Since the process of turning food waste into biogas is part of the natural carbon cycle, biogas as an alternative fuel source is carbon neutral. Utilization of a carbon-neutral fuel source is a very potent way in which sustainability at WWU will increase through this project. Digestate application on campus or in the community will also increase sustainability. Application of digestate on campus or through working with local vendors or farms in Bellingham strengthens sustainability because it can reduce dependency on synthetic fertilizers.

Another way in which this project will impact sustainability at Western is through increased avenues to divert waste from the landfill. It is important to note that WWU already composts which is another prominent method for waste diversion. However, composting requires a facility which requires land, space, and resources. Additionally composting, though an important process, still emits greenhouse gasses such as methane and CO2 and is overall and net energy consuming process because more energy is lost via GHG emissions and heat loss than can be recovered (Lin et al., 2018). It is important that WWU maintains contracts with SSC composting services, but anaerobic digestion is a prominent way that sustainability can be increased.

SECTION 2: Project Participants

a. Team information: A team should consist of two to five individuals, including the advisor.

Team Advisor Information (Faculty or Staff) Student proposals must include a staff or faculty advisor. The role of the advisor is to provide assistance and guidance to the team during the development, implementation, and post-implementation stages of the proposal process.

Team Lead: There must be at least one team lead designated for the project. This individual is expected to serve as the communication liaison for the project.

Name	Department/School Students provide major/minor	Position: Faculty/staff/student Students provide expected graduation quarter/year	Western email address
Team Advisor: Lindsey MacDonald	Sustainability Engagement Institute	Staff, Associate Director of Sustainability Engagement Institute	Macdonal6@wwu.edu
Team Lead: Clara Copley	Major: environmental policy Minor: environmental justice	Student W'23	copleyc@wwu.edu
Team Member: Sienna Taylor	Major: environmental policy Minor: Political science	Student S'23	Taylo245@wwu.edu
Team Member: Terence Symonds	WWU On Campus Housing	Staff, Associate Director University Residences, Facilities	symondt@wwu.edu
Team Member: Amanda Cambre	Facilities Management	Staff, Director of Sustainability Integration	cambrea@wwu.edu

a. Potential Project Stakeholders:

Will your project potentially involve labor, include involvement, or require permission from organizations, departments, or individuals on campus or in the community? If so, these will be your stakeholders; please list them below. *Communication with stakeholders is not required for abstract approval.*

Stakeholder	Involvement in Project
Amanda Cambre	Director of Sustainability Integration, WWU
Terence Symonds	WWU Associate Director University Residence Facilities
Tim McLaughlin	Fairhaven Commons Director
Wayne Galloway	Assistant Director – Building Services / Facilities Management
Jan Allen	CEO and Chief Inventor at Impact Bioenergy
Michael Smith	Director, Legal, and Business Development at Impact Bioenergy

SECTION 3: Project Budget

a. **Provide a realistic budget estimate for the project, based upon research into all anticipated costs. Do not itemize estimated costs within the four categories.**

This budget is flexible and subject to minor changes at this point in the project. As specific accommodations such as location, and byproduct usage become cemented the budget will be finalized. This project can be paid for in installments. Impact Bioenergy only requires an installment of 50% to begin fabrication of the digester. It is proposed that an initial installment be granted for $157,000 with the remaining 50% be granted in a later installment in the next fiscal year.

Item	Cost
Materials	$300,000
Labor/contracts (student employment)	$9,000
Promotion	$5,000
Other	$
Total budget estimate	***$314,000***

b. The SEJF program encourages the use of additional funding sources to create a collaboratively funded project; include potential funding sources beyond the SEJF that you will seek.

Funding Source	**Connection to project**	**Potential Funds**
Currently none		

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LARGE GRANT ABSTRACT
PROPOSAL REVIEW PROCESS

Please arrange a meeting with Zinta Lucans, the SEJF Program Coordinator for the Sustainability Engagement Institute, to review your drafted proposal. Once your project proposal is complete, it must be signed and emailed to: lucansz@wwu.edu.

Your completed large grant abstract will be presented to the SEJF Committee for consideration. The SEJF Program Team will provide you with information on the committee's response and decision regarding your request.

Zinta Lucans
SEJF Program Coordinator, Sustainability Engagement Institute, Western Washington University

Signature: _____Zinta Lucans_____ Date: _03/09/2023_

This signature confirms that the application has been accepted for SEJF committee review; it does not indicate funding approval.

Grace Wang
Director, Sustainability Engagement Institute, Western Washington University

Signature: _____ Date: _____

This signature confirms that the application has been accepted for SEJF committee review; it does not indicate funding approval.