



Impact Bioenergy's mission is to change the paradigm and get food waste to be recognized as a valuable community resource, enable thriving local circular economies, and make a significant impact on the long-term sustainability of our environment.

OVERVIEW

Vashon NAUTILUS

The Vashon Bioenergy Farm (VBF) is a community-scale bioenergy system on Vashon Island, Washington. For every 60 to 80 pounds of "waste" that would otherwise have been long-haul exported, Impact Bioenergy's NAUTILUS generates one gasoline gallon equivalent (GGE). The NAUTILUS "upcycles" up to 8,000 lbs. of commercial food waste per day from the Island Spring tofu factory and local restaurants. This is enough to fuel a small fleet or provide heat & power for more than 40 homes.

The NAUTILUS AD 185 series modular anaerobic digester is a systemic and holistic community solution for colocation at or near a source of organic waste and nearby energy loads. The close proximity conserves energy that would have been expended for transport and processing of materials, and centralized power generation. A lifecycle assessment of the NAUTILUS underscores its carbon-neutral intensity and net-positive energy value propositions (net carbon-negative when utilized as renewable fuel for vehicles).

Energy Generation

The NAUTILUS offers a virtual-pipeline that adds resiliency and augments intermittent renewable energy like solar or wind. Biogas is continually generated and is storable for use when



needed. It can generate heating, cooling, electricity, and vehicle fuel. The VBF NAUTILUS employs a unique integrated biogas upgrading system to generate renewable natural gas (RNG) that is stored with state-of-the-art Adsorbent Natural Gas (ANG) technology where it is compressed to up to 250 psi. With ANG storage, Impact Bioenergy demonstrates economically viable pathways to the lowest carbon intensity fuel that avoids high costs, low storage efficiency, and safety concerns associated with conventional approaches. The VBF fueling station provides up to 125 GGE of CNG vehicle fuel per day.

Probiotic Plant Food Generation

VBF also reclaims over 2,000 pounds of nutrients and 300,000 gallons of water annually for rich, probiotic plant food to promote the healthy growth of the community's own food, flowers, and

At a Glance

MODEL: **NAUTILUS AD185-3**

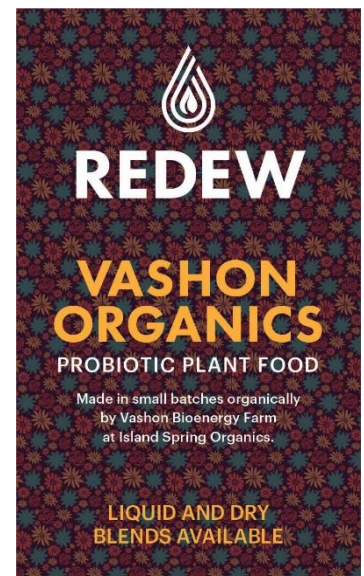
INPUT:
Food Waste: **1,500 tons/year**
8,000 lbs./day

OUTPUT:
Max. Biogas Volume: **21,500 ft³/day**
(600 m³/day)

Max. Generation Capacity:
Electricity: **50kW, or**
Vehicle Fuel: **125 GGE/day**

Plant Food: **950 gallons/day**
ZERO-WASTE generated

landscape. Sold under the name ReDew Vashon Organics Probiotic Plant Food, it enables the replacement of chemically-based fertilizers with locally produced organic fertilizer. Allowed under the USDA National Organic Program, ReDew cultivates more biomass, vigor and nutrient cycling.



OVERVIEW

Microsoft HORSE

The Microsoft HORSE is on the main corporate campus in Redmond, Washington. It provides a zero-waste solution for the cafeteria and catering operations on the campus by recovering the nutrients, energy, water, carbon and organic matter embedded in the food and beverage waste associated with its operations. It enables Microsoft to have a zero-waste approach by generating renewable energy and commercially valuable organic fertilizer while avoiding waste trucking. The HORSE changes the way food, energy, water, traffic, and carbon are managed.

Processing Equipment

The feedstock receiving and preparation tank doses food waste into the digester. The digester is heated and automatically mixed using multiple suction and discharge locations. Digester chambers are partitioned to provide both CSTR and FFR digestion. Heating is automatic using a hydronic heating system. Gas is conditioned for moisture and sulfur removal and then stored in an unpressurized (0.15 psi) storage vessel. Gas is measured, pressure-regulated, and backflow prevented. A manifold is provided to a 200,000 BTU/hr hot water boiler inside the machine. A surplus gas burner with flame arrester and auto-igniter are integrated into the system. The system can convert 1,540 lbs. of food



waste weekly. It is designed for peak renewable energy output of 0.56 million BTU per day. Energy storage is included with the system. It also generates probiotic plant food which can be used on campus to fertigate the landscape. Alternatively, it can be returned to local farms so they can reduce their dependency on chemical-based fertilizers and pesticides.

Process and Residence Time

The design includes a high-capacity food waste grinding system. Feedstock is blended, homogenized, and emulsified in a first stage metering tank. The dosing cycle and volume are adjustable. Digester hydraulic residence time is 30 days. Digestate discharge is automatic based on displacement method. There are two separate manifolds for gas and liquid. Sampling and condensate valves are provided in several locations.

At a Glance

MODEL: **HORSE AD25-1**

INPUT:

Food Waste: **40 tons/year**
1,540 lbs./weekly

OUTPUT:

Max. Biogas Volume: **570 ft³/day**
(16 m³/day)

Max. Generation capacity:

Electricity: **11,400 kWh/year, or**
Hot Water: **1,400 therms/year**

Plant Food: **24 gallons/day**

ZERO-WASTE generated

Why it matters

The U.S. throws away 38 million tons of food every year. If we cut that waste in half through better management and utilization, and if the remaining 19 million tons were processed locally through a distributed network of Impact Bioenergy HORSE and NAUTILUS bioenergy systems, the results would be astounding and transformative. That food waste could generate 9TWh of electricity, enough to power 860,000 U.S. households, or 530 million gallons of gasoline equivalents of CNG vehicle fuel, eliminating fossil-fuels for over 800,000 cars. Additionally, we would reclaim 4 billion gallons of water, enough to fill 6,000 Olympic-sized swimming pools, and capture 26 million pounds of plant food nutrients for use on flowers, vegetables, Landscaping, and crops while displacing chemically-based fertilizers. Expanded globally, this could result in an atmospheric CO₂-EQ reduction of more than 10G Tonnes over the life of the digesters.