



Anaerobic Co-Digestion on Dairies in Washington State

The solid waste handling permit exemption

WASHINGTON STATE UNIVERSITY EXTENSION FACT SHEET • FS040E

This factsheet briefly reviews the role of co-digestion within anaerobic digestion (AD), explains the potential regulatory concerns, and details the solid waste handling permit exemption conditions. An overview of other major regulatory requirements for AD facilities operating on dairies is also provided.

Anaerobic digestion facilities that digest dairy manure have begun to co-digest pre-consumer organic wastes (such as food-processing wastes) to increase biogas productivity, improve digester performance, and increase revenue. Legislation passed in Washington state in 2009 provides that AD operations located on or near dairies that co-digest organic wastes with manure may qualify for an exemption from obtaining a solid waste handling permit provided they follow specified guidelines designed to address nutrient management and other potential concerns. Co-digestion that is not in compliance with the requirements could jeopardize the digester's conditional exemption from a solid waste handling permit or obligate the Washington State Department of Ecology ("Ecology") to regulate the dairy farm as a solid waste disposal site.

Anaerobic Digestion and the Role of Co-Digestion

Anaerobic digestion is increasingly used to treat livestock manure on concentrated animal-feeding operations (CAFOs) across the United States. An AD system creates an environment without oxygen (anaerobic) in which naturally occurring microorganisms convert complex organic materials in manure and other feedstock to methane-rich biogas, a source of renewable energy (US-EPA 2006) (Figure 1).

Typical residence times in standard manure and municipal digesters are on the order of 15–25 days. The process is carried out at a controlled temperature, usually 35°C or 55°C (95°F or 131°F) with increased temperature allowing for lower residence times.

The process can reduce greenhouse gas (GHG) emissions, diminish odors, stabilize waste, and decrease pathogen counts (Martin and Roos 2007; US-EPA 2004; US-EPA 2005; US-EPA 2008). In addition to biogas, AD generates fiber and

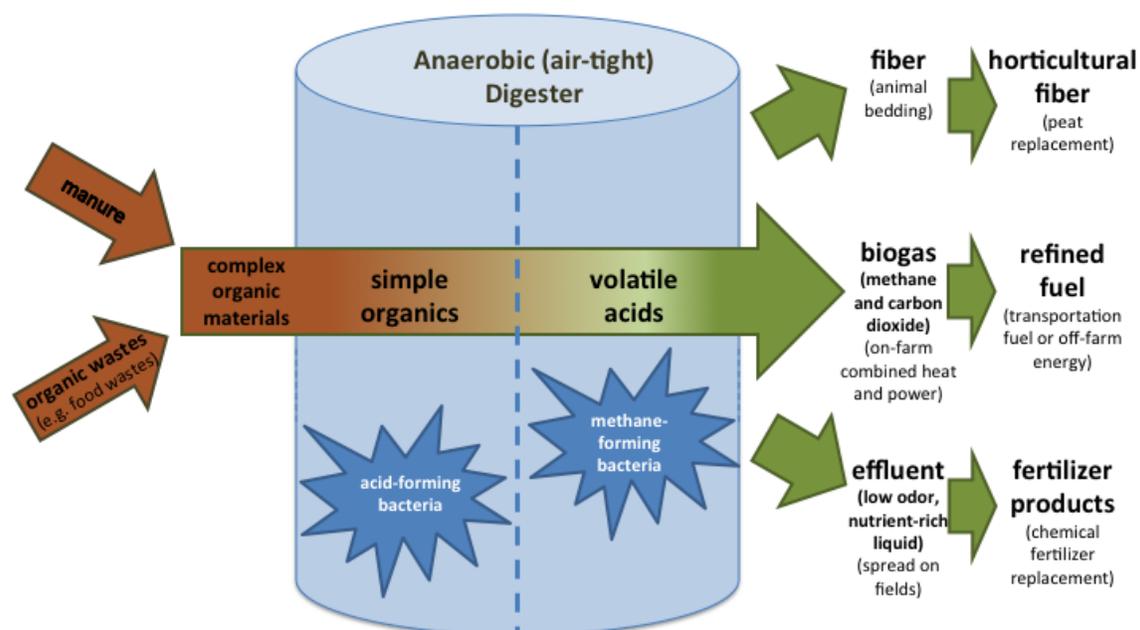


Figure 1. Overview of anaerobic digestion.

a liquid effluent. With additional processing, the fiber can become a peat-moss replacement suitable for the nursery and horticultural industries (U.S. Patent and Trademark Office 2006).

Meanwhile, ongoing research aims to concentrate the nutrient-rich liquid effluent into fertilizer products (U.S. Patent and Trademark Office 2009; 2011). These byproducts have the potential to provide additional GHG mitigation, enhance revenues, solve nutrient-overload issues, and increase AD adoption rates.

As technologies have matured, many AD projects have begun to co-digest pre-consumer food-processing wastes with the manure—a process that has been shown to enhance digester performance and notably increase biogas production (Frear et al. 2009). If the organic wastes would have otherwise been landfilled, co-digestion may also create additional reductions in GHG emissions by collecting methane (a powerful GHG).

As a result of the benefits that AD provides, more than 135 dairy farms nationwide were operating digesters as of April 2011 (US-EPA 2011). In total, these digesters were processing manure from approximately 266,000 wet cow equivalents (WCE), providing an installed generating capacity of 52.8 megawatts (MW) of electricity, and reducing GHG emissions by more than 860,000 metric tons (MT) of carbon dioxide equivalent per year (CO₂e/yr) (U.S. EPA 2011). In Washington state, the six dairy anaerobic digesters operating in 2011 were processing manure from approximately 11,650 WCE, providing an installed generating capacity of 4.05 MW, and reducing GHG emissions by 44,870 MT CO₂e/yr (C. Kruger, *personal communication*; US-EPA 2011).

A **wet cow equivalent** (WCE) is defined as a mature milking Holstein with a dry matter intake of 53 lbs or more per day. Dry cows and heifers that are 18 months or older account for approximately 0.5 WCEs each.

The **CO₂e**, or **carbon dioxide equivalent**, expresses the total global warming potential in terms of the radiative forcing of CO₂. CO₂e is the international standard used to express GHG emissions or emissions reductions across all GHGs. MT = metric ton (1 MT = 1 Mg = 1,000 kg).

The Economics of Co-Digestion

Co-digestion significantly enhances AD project economics through additional biogas production and tipping fees paid by the generator of the organic wastes to the digester owner. Various commercial- and laboratory-scale studies have shown that, depending upon the type, concentration, and flow rate of the organic wastes used, biogas production can be enhanced by as much as 25%–

400% (Alatrisme-Mondragon et al. 2006; Braun et al. 2003). An economic analysis of an AD facility installed on a 700-cow dairy in northwest Washington state showed that co-digestion with 16% organic wastes more than doubled biogas production and almost quadrupled annual digester revenues compared to a manure-only baseline, with 72% of all receipts directly attributable to the addition of organic wastes (Bishop and Shumway 2009; Frear et al. in submission). It is also possible that, in the future, digester owners who co-digest organic wastes will be able to earn income through additional GHG emissions offset credits.

Concerns with Co-Digestion

Although co-digestion can provide operational, environmental, and economic benefits, organic wastes do result in an import of additional nutrients to the farm, where they can exacerbate existing nutrient management concerns. Most dairies manage the nutrients in manure (or digester effluent) by applying it to land, where the nutrients are taken up by crops. In Washington state, all licensed dairies operate under nutrient management plans (NMPs) that ensure nutrients are fully used by crops and do not degrade water quality. Analysis of national data suggests that in the year 2000, roughly 75% of dairies with more than 300 animal units (AU) were spreading manure at rates in excess of crop nitrogen needs, and roughly 96% were spreading manure at rates in excess of crop phosphorous needs (Ribaudo et al. 2003). More recent data indicate that larger operations apply manure to cropland at rates that are more than three times higher than smaller farms, suggesting that excess nutrient applications are still an issue, particularly for large operations (MacDonald and McBride 2009).

Case study evidence that co-digestion can magnify nutrient management issues is available from research completed at a Washington state dairy. Co-digestion with organic wastes caused total nitrogen increases of 57% compared to baseline AD operations, with smaller increases in ammonia and phosphorous (Figure 2) (Frear et al. 2010).

There are also concerns that contaminants (such as materials containing prions) or pathogens arriving with the organic wastes could inhibit the AD process, limit the use of AD products, or create a possibility for negative public health impacts. Many national and state governments are in the process of developing laws, rules, and guidelines to govern co-digestion (Washington State Department of Ecology 2009).

Washington's Dairy Digester Legislation: Solid Waste Handling Permit Exemption for Dairy Co-Digestion Facilities

In Washington state, Ecology and local health departments have regulatory oversight for AD co-digestion facilities under the solid waste statutes. Legislation passed in 2009 (RCW 70.95.330) provides a solid waste handling permit exemption for some anaerobic digesters located on or near dairies that co-digest pre-consumer organic wastes with manure. This exemption applies only to dairy manure

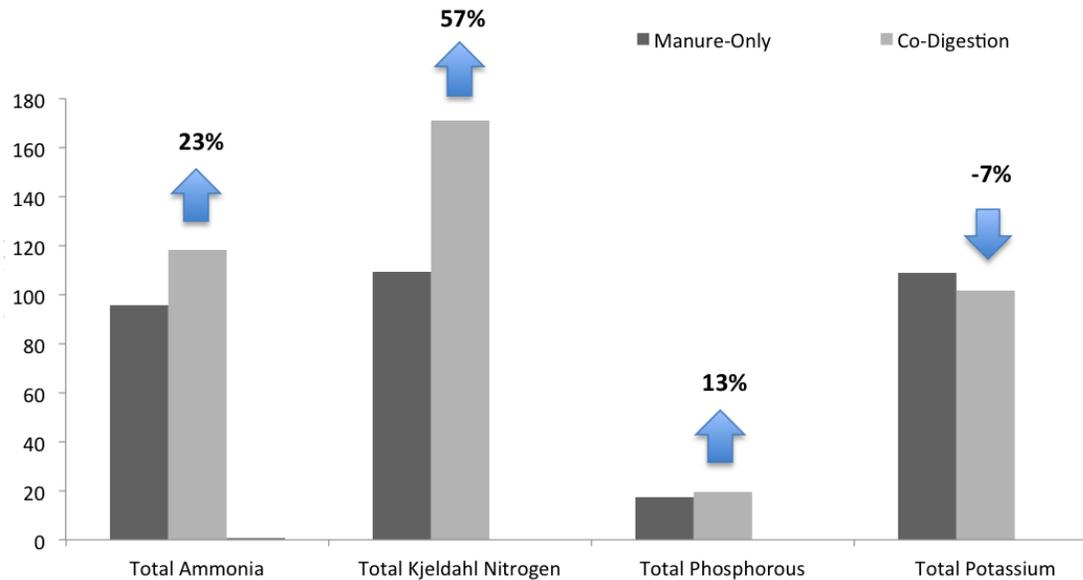


Figure 2. Modeled nutrient impacts of co-digestion with 16% organic wastes on a dairy in northwest Washington.

co-digestion facilities. It does not apply to other farm operations, even when their NMPs include all the same elements. Non-dairy AD facilities will need to obtain a solid waste handling permit from their local health department in order to import organic wastes for co-digestion.

To qualify for the solid waste handling permit exemption, operators must meet certain conditions, including the following:

1. Notice of intent to operate is filed with Ecology or the local health department at least 30 days before startup <http://www.ecy.wa.gov/biblio/ecy070356.html>.
2. The NMP is current (see below).
3. Only the specified pre-consumer organic materials are co-digested, and these materials make up 30% or less of the digester feedstock.
4. Digester feedstock and digestate are handled in a manner that protects surface and ground water and controls nuisance odors and vectors.
5. Digested solids can be:
 - a. returned to the dairy and managed under the updated NMP,
 - b. sent off-site after passing compost quality standards,
 - c. sent to a permitted or conditionally exempt compost facility, or
 - d. managed in an alternate manner approved by Ecology.
6. Digested liquids can be:
 - a. returned to the dairy and managed under the updated NMP, or
 - b. managed in an alternate manner approved by Ecology.
7. An annual report is submitted to Ecology or the local health department <http://www.ecy.wa.gov/biblio/ecy070355.html>.

Local health departments include city, county, city-county, or district public health departments. For a map and contact information for local health departments in the state of Washington, see <http://www.doh.wa.gov/LHJMap/LHJMAP.htm>.

8. Ecology or local health department inspections are allowed.

Specific details on the exemption requirements are comprehensively described in “Guidelines for Operating an Anaerobic Digester Exempted From Solid Waste Handling Permit” published by Ecology (WSDOE 2009) and available at <http://www.ecy.wa.gov/biblio/0907029.html>.

Ecology provides oversight for exempted AD facilities, while the Washington State Department of Agriculture (WSDA) provides oversight for dairy operations and ensures compliance with nutrient management requirements. The two agencies communicate as needed to ensure that requirements for AD facilities are met. AD owners or operators should contact Ecology to determine whether their operation can qualify for the solid waste handling permit exemption.

Digestate is defined in RCW 70.95.330 as both solid and liquid substances that remain following anaerobic digestion of organic material in an anaerobic digester.

For more related definitions, visit <http://apps.leg.wa.gov/rcw/default.aspx?cite=70.95.330>.

Other legislation provides tax exemptions for digester construction, maintenance, and repair. Refer to RCW 82.08.900 for details.

Nutrient Management Plan Update

To retain a solid waste handling permit exemption for both the digester operation and the dairy, any dairy farms planning to implement co-digestion must have their NMP updated to describe the way manure, organic wastes, and subsequent digestate will be properly collected, stored, transported, and utilized. Plans must be developed by a nutrient management planner, approved by the local conservation district, and verified by WSDA.

The plan must identify any changes in farm-level nutrient balance that will occur from imported feedstock, and specify how the additional nutrients will be used. Alternatively, when the digester and dairy are separate operations, the plan can identify limits on digestate volume sent back to the dairy. In this case, the contract between the digester and the dairy should detail the digestate volumes that can be returned to the dairy.

Other Anaerobic Digester Permits and Regulations

All AD facilities, including those that incorporate co-digestion, must operate in compliance with all applicable regulations. The Washington Governor's Office of Regulatory Assistance (ORA) is available to help AD project developers understand regulations that apply. (Visit <http://www.ora.wa.gov/> for more information.) Depending on the specific AD context, some key requirements may include the following:

- **New or modified sources of air pollution in the state of Washington require an air permit prior to beginning construction and operation** (Clean Air Act, Chapter 70.94 RCW; New Source Review WAC 173-400-110). Air permits (Notice of Construction or Orders of Approval) regulate criteria pollutants such as particulate matter, sulfur dioxide, and nitrogen oxides, and also toxic air pollutants such as ammonia and hydrogen sulfide. Find more information at <http://www.ecy.wa.gov/air.html>.
- **Water quality permits are required for discharges to surface and ground water** (RCW 90.48.160). Operators, including digesters and participating dairies, must manage their operations to ensure that they do not discharge to surface or ground water. When discharge is unavoidable, water quality permits are required prior to any discharge. Find more information at <http://www.ecy.wa.gov/programs/wq/permits/index.html>.
- **Anaerobic digesters located on licensed dairies need to be covered under the dairy's nutrient management plan** (Chapter 90.64 RCW). As previously mentioned, the Dairy Nutrient Management Act (NMA) requires all licensed dairies to develop, update, and implement NMPs, register with WSDA, allow regular inspections, and keep

records verifying that the NMP is being followed. These records can also show that discharges are not occurring, thus avoiding the need for water quality permits. More information can be found at <http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/>.

- **Local or county planning agency requirements for the planned anaerobic digesters must be satisfied.** Requirements may include permit approvals for building, grading, water systems, shorelines, right-of-way, utilities, site plans, septic systems, floodplains, zoning, and others. Check with your local government for more details.
- **The State Environmental Policy Act (SEPA) may require review of the environmental impacts of the planned digester by a local or state agency** (Chapter 43.21C RCW). State policy requires state and local agencies to consider the likely environmental consequences of the decisions they make, including decisions to approve or deny license applications or permit proposals. Find additional information at <http://www.ecy.wa.gov/programs/sea/sepa/e-review.html>.

Contact Information

Washington state dairy producers and AD operators can contact the following agencies for more information:

Washington State Department of Ecology
Waste 2 Resources Program, Solid Waste Handling
Permit Exemption
Kara Steward, Environmental Specialist
360-407-6250
kara.steward@ecy.wa.gov
PO Box 47600
Olympia WA 98504-7600

Washington State Department of Agriculture
Dairy Nutrient Management Program, Dairy Nutrient
Management Plans
Nora Mena, Program Manager
360-902-2894
nmena@agr.wa.gov
2nd Floor, Natural Resources Bldg
1111 Washington St. SE
Olympia WA 98504

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- United States Patent and Trademark Office. 2011. Combined nutrient recovery and biogas scrubbing system integrated in series with animal manure anaerobic digestion; Anping Jiang, Tianxi Zhang, Shulin Chen, Craig Frear. USPTO Patent Number 7,909,995, accepted date 03/22/11, priority data 06/03/08.
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By **Georgine Yorgey**, Environmental Program Coordinator, Washington State University Center for Sustaining Agriculture & Natural Resources (CSANR), Wenatchee; **Chad Kruger**, Director, Washington State University Center for Sustaining Agriculture & Natural Resources (CSANR), Wenatchee; **Kara Steward**, Washington State Department of Ecology; **Craig Frear**, Assistant Research Professor, Washington State University Center for Sustaining Agriculture and Natural Resources (CSANR), Pullman; and **Nora Mena**, Washington State Department of Agriculture.

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