

Oregon Biogas Facility Permitting Guide



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Final Report

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UNIVERSITY OF OREGON



Community
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Workshop

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Table of Contents

SECTION 1: INTRODUCTION	1
SECTION 2: BIOGAS FACILITIES — AN OVERVIEW	3
ANAEROBIC DIGESTION TECHNOLOGY	3
SECTION 3: BIOGAS FACILITY PERMIT REQUIREMENTS IN OREGON	7
PRELIMINARY QUESTIONNAIRE TO DETERMINE PERMITTING REQUIREMENTS.....	8
PERMIT GUIDE.....	12
SECTION 4: CASE STUDIES	27
KONYN DAIRY, EUGENE OR	27
LOCHMEAD DAIRY, JUNCTION CITY, OR.....	29
APPENDIX: GLOSSARY	32



SECTION I: INTRODUCTION

Biogas, derived from anaerobic decomposition of organic matter, is a small but growing source of energy in Oregon. Given Oregon's strong agricultural sector, there is the potential to close the loop on the nutrient cycle while increasing energy production through development of biogas projects within the state. However, there are a number of challenges, such as permitting, financing, and neighbor opposition that can hinder development of biogas facilities. The purpose of the Biogas Facility Permitting and Siting Guide (the Guide) is to provide agricultural developers, farmers, third party energy developers, or anyone interested in developing a biogas facility with the information they need to do so in Oregon.

The production of biogas uses agricultural and municipal organic by-products to produce renewable energy that can be used to generate electricity or renewable natural gas (RNG) for transportation fuel; furthermore value added products such as heat and organic fertilizers are produced locally. The development of biogas has the potential to improve Oregon's renewable energy portfolio. While numerous renewable energy or bioenergy technologies exist, this guide focuses on the anaerobic digestion (AD) technology—specifically co-digestion of organic feedstocks.

Oregon is committed to increasing the portfolio of renewable energy, and biogas is an important renewable sector. Biogas is a growing and diverse industrial sector of the Oregon economy, as well. It provides living wage jobs in both rural and metropolitan areas of Oregon. According to a survey by the Oregon Department of Energy, there were more than 75 existing bioenergy facilities in Oregon in 2010, including three biogas facilities (with another 29 facilities in the planning or construction phase – six of which are biogas facilities),¹ Although the biogas industry is a small component of the bioenergy market in Oregon, it is growing and provides opportunities to develop a market for agricultural waste while creating multiple end products including electricity and fertilizers.

A biogas facility produces gas from the anaerobic decomposition (digestion) of organic matter (typically agricultural organics and manure, but also food and food processing waste, biosolids, etc.) in a digester. The gas, released during combustion, is a mixture of methane and carbon dioxide. The gases can be combusted in a combined heat and power (CHP) system to generate electricity to sell to the grid, while other benefits include generating heat and the production of a high-nutrient fertilizer.

The purpose of this guide is to explore some of the most common issues related to the siting and permitting process,² and identify some of the common

¹ Oregon Department of Energy. (2010). *2010 Biofuel Impact Study*.
http://www.oregon.gov/ENERGY/RENEW/Biomass/docs/Biofuels_Impact_Study_Final.pdf.

² Each County will have different rules and regulations related to the permitting of biogas facilities. This guide does not identify all of the different rules and regulations regarding biogas facilities in the 36 counties in Oregon. Instead, it highlights the types of questions that most of these counties will have about the proposed facility.

challenges for the development of biogas facilities in Oregon. The guide is designed to assist developers, farmers, and other interested parties with biogas development, though much of the information may serve a broader audience including land use planners and others who permit these facilities.

The rest of this guide is organized into the following sections:

- Section 2: Biogas Facilities: An Overview
- Section 3: Biogas Facility Permit Requirements in Oregon
- Section 4: Case Studies
- Appendix A: Glossary

SECTION 2: BIOGAS FACILITIES — AN OVERVIEW

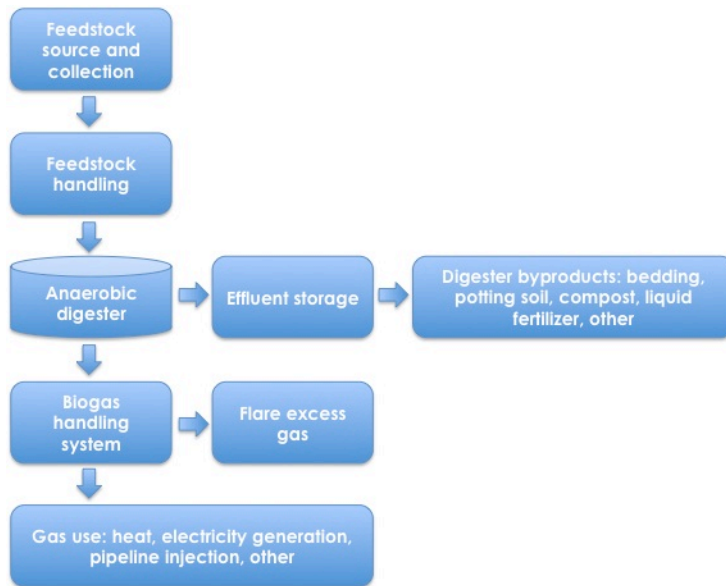
This section provides an overview of anaerobic technology used in biogas facilities and the basic steps necessary to develop a biogas facility.

Anaerobic Digestion Technology

This guide focuses on the development of biogas facilities that use anaerobic digestion technology. Anaerobic digestion is a biochemical process in which bacteria break down organic waste in an oxygen free environment.³ During the process, the bacteria produce biogas, composed primarily of methane (CH₄) and carbon dioxide (CO₂). The energy content of biogas depends on how much methane it contains.⁴ Biogas can then be used to produce electricity and heat.⁵ The solid portion of the feedstock that remains is called *digestate*. It is rich in nutrients and can be further conditioned to produce high value products such as fertilizer.

Anaerobic digestion occurs in the following stages shown in Figure 1.⁶

Figure 1. Biogas recovery systems



Source: Adapted from US EPA, <http://www.epa.gov/agstar/anaerobic/ad101/index.html>

³ United States Environmental Protection Agency. (2010). Anaerobic Digestion. Retrieved from <http://www.epa.gov/agstar/anaerobic/index.html>.

⁴ Oregon Department of Energy. (2010). Biogas Technology. Retrieved from <http://oregon.gov/ENERGY/RENEW/Biomass/biogas.shtml>.

⁵ Access Washington. (2011). Anaerobic Digestion. Retrieved from <http://www.bioenergy.wa.gov/AnaerobicDigestion.aspx>.

⁶ Access Environmental Protection Agency. (2012). AD 101: Biogas Recovery Systems. Retrieved from <http://www.epa.gov/agstar/anaerobic/ad101/index.html>.

Factors such as temperature, pH, water/solids ratio, carbon/nitrogen ratio, mixing of the digesting material, and the particle size of the material being digested affect the rate of digestion and biogas production.

Types of Anaerobic Digestion

COVERED LAGOON DIGESTER (TRADITIONAL DIGESTER)

This inexpensive technology consists of a manure storage lagoon with a cover that traps gas produced during decomposition of the manure. Feedstocks are generally 0.5 to 2 percent solids. The lagoons have a low processing rate, require a large footprint and are not heated, thus they are most appropriate for large sites in areas with elevated year round temperatures (such as Western Oregon). Retention is usually 30 to 45 days, or longer for larger lagoons. Figure 2 shows a picture of a covered lagoon digester in Pennsylvania.

Figure 2. Covered lagoon digester



Source: www.biogas.psu.com/coveredlagoon.html

PLUG-FLOW DIGESTER

Plug-flow digesters are suitable for ruminant animal manure that has a solids concentration of eleven-percent to thirteen-percent. A typical design for a plug-flow system includes a manure collection system and a mixing pit in the digester itself. In the mixing pit, the addition of water adjusts the proportion of solids in the manure slurry to the optimal consistency. The digester is a long, rectangular container, usually built below-grade, with an airtight, expandable cover. Manure is retained between 15 to 20 days. These systems have moderate capital and operational costs and require periodic cleaning which requires downtime. Figure 3 shows a picture of a plug-flow digester in California.

Figure 3. Plug-flow digester



Source: <http://jenkins.ucdavis.edu/previous/August2005/August2005.html>

COMPLETE MIX DIGESTER

A complete mix digester converts organic waste to biogas in a heated, insulated tank above, or below, ground constructed from concrete, steel, or fiberglass. A mechanical, or gas, mixer keeps the solids in suspension. This type of digester processes manure with three to ten percent solids in a ten- to twenty-day time period. Complete mix digesters are generally more expensive to construct and to operate than other digesters, however, the system is more stable and produces energy more reliably. Figure 4 shows a complete mix digester.

Figure 4. Complete mix digester

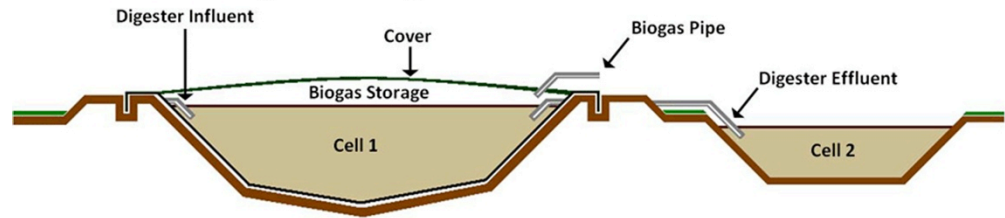


Source: <http://www.biocycle.net/2012/05/renewable-energy-solution-for-cheese-producer/>.

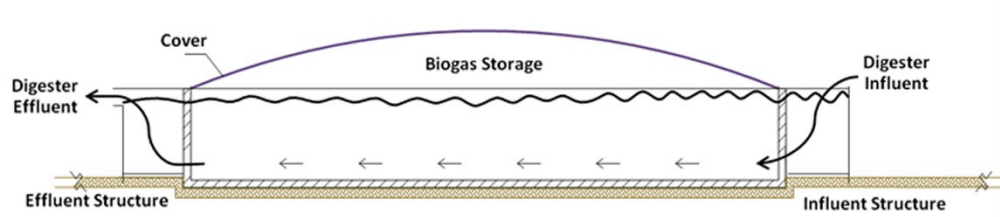
Figure 5. shows how each of the three types of digesters work.

Figure 5. Biogas Digesters

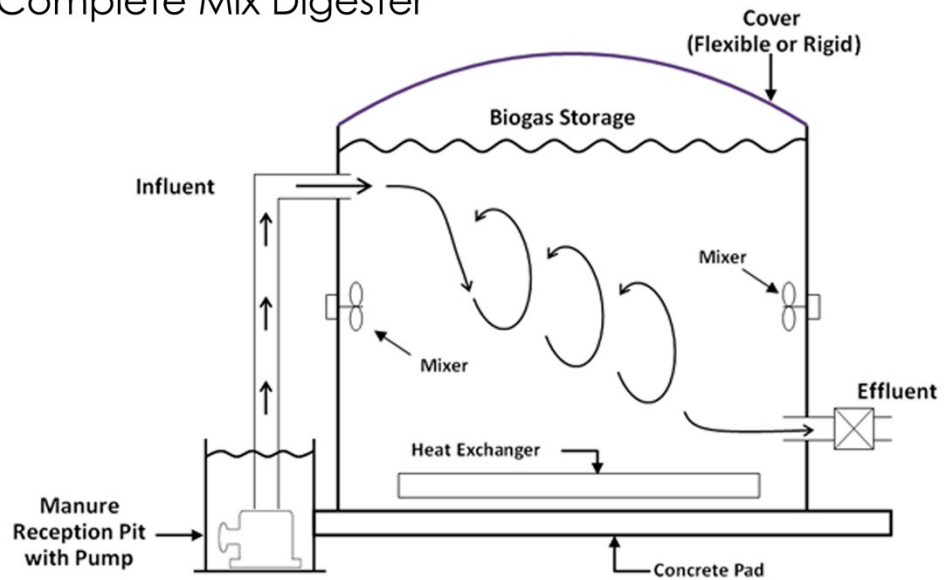
Covered Lagoon Digester



Plug-Flow Digester



Complete Mix Digester



Source: Adapted from US EPA, <http://www.epa.gov/agstar/anaerobic/ad101/index.html>

SECTION 3: BIOGAS FACILITY

PERMIT REQUIREMENTS IN OREGON

Permitting can be a long, involved, and expensive process to biogas facility development. Developers should identify the required permits, the regulating agencies, and criteria for approval long before the development begins. This section identifies the permits that may be required for a biogas facility.

Multiple challenges can arise during the permitting process. First, permitting can be a confusing process. To avoid confusion, we recommend that biogas facility developers make use of the resources available. Even if a developer only has a back of the envelope idea, he or she can usually consult with staff at the local jurisdiction who would issue permits for the facility. If preliminary plans exist, permitting staff can highlight issues that may inhibit the permitting process. For permitting on the state level, developers can consult with Oregon Department of Energy's (ODOE) Regional Solutions Team (RST).

Another challenge is that the length of time required to obtain permits can hinder other phases of development. We recommend that developers apply for a Land Use Compatibility Statement (LUCS) with the local planning department first, then apply for other permits simultaneously. Most Department of Environmental Quality (DEQ) permits require a LUCS as part of the application.

An additional challenge to the development of biogas facilities is that they are not defined within existing regulations such as the land use code. Developers may have to prove that the biogas technologies are similar enough to approved land uses, for example, sited with a compost operation, landfill, or farm. Developers should understand the land use appeal process and be prepared to hire an attorney if necessary.

So that agencies are better prepared to deal with biogas facilities, we recommend that local, state, and federal agencies work together to standardize definitions for AD terminology. Without standardized definitions, staff may have difficulty determining which category of permit a developer should apply for. For example, agencies classify different activities as composting because they do not have a common definition for composting. Creating a common language will help agencies learn how to permit new technologies and will make the process more straightforward for developers.

Other considerations for biogas facility siting:

- In 2012, DEQ was working on a new solid waste permit for biogas facilities. Biogas facilities are currently covered under a solid waste treatment facility permit, which is a stretch of the definition and the fees are too high for the use.

- Quantity of waste brought to the site that would trigger the need for a solid waste permit is not standardized.
- Similarly, the level of water pollution that would no longer be covered under a CAFO that would trigger a water quality permit is not standardized.

Preliminary Questionnaire to determine Permitting Requirements⁷

The first step in the permitting process is to determine the governing jurisdiction of the selected site, i.e., determine what county administers permits for the selected site. There are several permits that will be required at the county and state level including land use, transportation, water quality, and air quality.

The questions in this section will help you determine what types of permits may be required for the proposed biogas facility.

1. How much electricity does the facility produce?
 - Greater than 25 megawatts.
 - The facility is subject to state energy facility siting regulations.⁸ This guide is not intended for facilities of this capacity.
 - Less than 25 megawatts.
 - The facility is NOT subject to state energy facility siting regulations. (Go to question #2).

2. Will the facility sell electricity to the grid or sell byproducts from the anaerobic digestion process?
 - Yes.
 - Selling electricity to the grid and selling byproducts from the anaerobic digestion process may be considered commercial uses (this definition may be different on a county-by-county basis). (Go to question #3).
 - No.
 - The developer is not engaging in a commercial use. (Go to question #3).

3. Is the property within an Urban Growth Boundary (UGB)?
 - Yes

⁷ This section is provided for informational purposes only and may not include all of the requirements of local jurisdictions, the state, or the federal governments. Developers of biogas facilities should check with the appropriate agencies to ensure that they comply with all permitting requirements.

⁸ Refer to the Oregon Department of Energy (ODOE) website on energy facility siting: <http://www.oregon.gov/ENERGY/SITING/process.shtml>

- The use will be subject to the local (city) development code within the UGB. (Go to question #4)
 - No
 - The use will be subject to local code (county) for land outside of the UGB. (Go to question #4)
4. How is the property zoned?
- Agricultural Land
 - Apply for a special or conditional use permit for a commercial use in conjunction with a farm use. Some limitations may apply—call a local county planner to identify any limitations.
 - Industrial
 - Since most Oregon jurisdictions do not include biogas as a permitted use on industrial land, the county will need to determine if the proposed use is ‘similar enough’ to a permitted use. If the county found biogas production to be ‘similar enough’ to permitted uses, it is likely that the use would be permitted outright.
 - Commercial
 - Some jurisdictions consider biogas facilities “energy facility” which may be allowed in their commercial zones. Most jurisdictions do not include development of facilities similar to biogas in commercial zones. Check with your local jurisdiction.
 - Residential
 - Most jurisdictions do not include development of facilities similar to biogas in residential zones. Check with your local jurisdiction.
5. Will the proposed use force a significant change⁹ in, or cost of, accepted farm or forest practices on surrounding lands devoted to farm and forest use?
- Yes.
 - The use is NOT allowed by ORS 215.296(i). Do not proceed.
 - No.
 - The use is in accordance with ORS 215.296(i). Proceed.

⁹ A useful yardstick in the determination of when a use has “significant impact” is whether the proposed use would have adverse impacts significantly greater than those permitted outright within the zoning district of the proposed use.

6. Is the proposed use in conjunction with an operating livestock operation?
- Yes
 - The Oregon Department of Agriculture (ODA) will determine whether or not the use is covered under the farm's Confined Animal Feeding Operation Permit (CAFO)¹⁰. Go to question #7.
 - No
 - The use is required to apply to the DEQ for a Solid Waste Treatment Facility permit. Go to question #8.
7. Is the use covered within the livestock operation's CAFO?
- Yes
 - The developer is not required to apply to the Department of Environmental Quality (DEQ) for a Solid Waste Treatment Facility permit.
 - No
 - The developer is required to apply to the DEQ for a Solid Waste Treatment Facility permit.
8. Does the proposal involve any new residential dwellings?
- Yes
 - The dwelling must comply with ORS 215.236.
 - No
 - Continue to question #9.
9. Do proposed structures meet all property line setbacks?
- Yes
 - Continue to question #10.
 - No
 - The facility will not comply with local code.
10. Are the proposed structures within a riparian setback zone?
- Yes.
 - The facility must comply with the local jurisdiction's requirements for development within a riparian setback.
 - No
 - Continue on to question #11.

¹⁰ Bringing in waste from off-site may not be covered by the farm's CAFO.

11. Are proposed structures located within a flood hazard area?
- Yes.
 - The facility may have to obtain a flood elevation certificate from the local jurisdiction.
 - No.
 - Continue on to question #12.
12. Is the location of the development identified as a unique wildlife habitat site?
- Yes
 - The County may protect the areas or resources from the adverse effects of new uses allowed by the planning or zoning changes per ORS 215.791.
 - No
 - Continue on to question #13.
13. Are there wetlands on the site?¹¹
- Yes
 - The Oregon Department of State Lands (DSL) requires that a wetland delineation be conducted to determine the regulated boundaries of the wetlands.
 - No
 - Continue to question #14.
14. Are proposed structures adjacent to wetlands per the National Wetlands Inventory Map?
- Yes
 - The DSL must be notified and all construction including grading, excavation and cleanings must be done so as not to disturb the wetland area as per ORS 215.418.
 - No
 - Continue to question #15.
15. Does the lot currently have vehicular access?
- Yes
 - Continue on to question #16.
 - No
 - The property must have vehicular access that is compliant with the local code. The developer must

¹¹ The developer can request a jurisdictional determination from the Department of State Lands {DSL} using forms available on the DSL website: www.oregonstatelands.us/DSL/WETLAND/wetlandeduc.shtml.

receive a grant of access from the agency that maintains the road that he or she proposes to access. The developer should determine whether the road is maintained by the city, county, or state. Go to question #16.

16. Has a traffic impact analysis been conducted?

○ No.

→ Depending on the number of trips that the facility would generate, the local agencies and/or the Oregon Department of Transportation (ODOT) may require a traffic impact analysis (TIA). The numbers of trips that triggers a TIA varies depending on the regulatory agency.

Permit Guide

Based on the answers to the questions listed in the previous section, biogas facility developers should have a sense of the types of permits that they may be required to apply for. Table 1 is an overview of these permits. The rest of this section describes in greater detail when these permits are required and from which agency.

The typical first step is to obtain an approved Land Use Compatibility Statement (LUCS) from the local land use planning department. The Department of Environmental Quality (DEQ) requires a completed LUCS before beginning to process a permit. After receiving a completed LUCS, the developer applies for all of the required permits concurrently if it is feasible. Applying for permits concurrently significantly reduces the length of time it takes to go through the entire permitting process.

Table 1. Overview of permits for Biogas facilities in Oregon, 2012

Permit Name	Permitting Agency	When it is required	Additional comments
Local Permits			
Building Permit	Local land use planning department	When constructing or remodeling a building	
Land Use Compatibility Statement (LUCS)	Local land use planning department	Required for most DEQ permits for biogas facilities	Required for DEQ permits
Environmental Permits			
Air Quality Title V Permit	Department of Environmental Quality (DEQ)	LUCS required when permit modifications or renewals involve: (1) physical expansion on the property or proposed use of additional land, and/or (2) any physical change or change of operation of an air pollutant source that results in a net significant emission rate increase.	LUCS required
Air Contaminant Discharge Permit (ACDP)	Lane Regional Air Protection Agency for Lane County, DEQ for rest of the state		
Solid Waste Compost Facility	DEQ	LUCS required when permit modifications or renewals involve alterations, expansions, improvements or changes in method or type of disposal at a solid waste disposal site.	LUCS required
Solid Waste Treatment Facility Permit	DEQ	Not required when the facility already has a CAFO, NPDES permit.	
Water Quality General Permit	DEQ	LUCS required when permit modifications or renewals involve: (1) a significant increase in discharges to water, and/or (2) a relocation of an outfall (discharge) outside of the source property.	LUCS required
National Pollutant Discharge Elimination System (NPDES)	DEQ	When the activity involved "point source" discharges of pollutants to surface waters. A permit may also be required for pollution discharged in stormwater runoff	
Water Pollution Control Facilities (WPCF)	DEQ	This permit is required if there is discharge of wastewater to the ground.	
Water Use Rights	Water Resources Department (WRD)	Most water users must obtain a permit or water right to use water from any source	
Removal-Fill Permit(s)	Department of State Lands (DSL) and the US Army Corps of Engineers (USACE)	Site development that involves removing or filling 50 cubic yards or more of material in most waters of the state, or removal or fill in "essential salmon habitat" or scenic waterways	DSL and USACE use a joint permit form, but process the permits separately.
401 Water Quality Certification (WQC)	DEQ	If USACE determines that a removal-fill application requires a permit and results in a discharge, a 401 WQC permit is required	LUCS required
Transportation Permits			
Access Mangement Permit	Oregon Department of Transportation (ODOT)	If access to te facility is from a state highway, ODOT requires an access permit.	LUCS required; either a Grant of Access or an Indenture of Access is required
Other Permits			
Boiler Permit and Operator License	Building Codes Division and the Oregon Department of Consumer and Business Services	Permits are required for boiler installation, alteration, and repair. Boiler operators must have an operation license.	

Source: Community Planning Workshop, 2012.

Land Use Compatibility Statement

The Oregon Department of Environmental Quality (DEQ) must ensure that proposed land uses are compatible with local land use plans. Thus, the DEQ requires that business owners submit a signed Land Use Compatibility Statement (LUCS) along with applications for DEQ permits.

A Land Use Compatibility Statement (LUCS) is a document signed by a local land use planner, which confirms whether or not a proposal is consistent with local land use requirements. The local government must declare that a proposed land use is compatible with the local land use plan before the DEQ can process an application and issue a permit. The city or county planning department can provide assistance with the LUCS. Table 2 describes the types of activities that may trigger a LUCS and Table 2 describes how to apply for a LUCS.

Table 2. When is a LUCS Required?

When applying for:	When permit modifications or renewals involve:
Air Quality Title V Permit	Physical expansion on the property or proposed use of additional land Any physical change or change of operation of an air pollutant source that results in a net significant emission rate increase
Solid Waste Compost Facility Registration or Permit	Alterations, expansions, improvements or changes in method or type of disposal at a solid waste disposal site
Water Quality General Permit	A significant increase in discharges to water A relocation of an outfall (discharge) outside of the source property
401 Water Quality Certification	Activities that require a removal-fill permit and results in a discharge
Access Management Permit	Building or upgrading of private approach roads with vehicular access to a state highway

Source: Community Planning Workshop, 2012.

HOW TO APPLY

There are a number of steps that must be taken to successfully obtain a LUCS.

- First, the applicant must complete Section 1 of the LUCS and submits it to the appropriate city or county planning office.
- Second, the city or county planning office completes Section 2 of the LUCS to indicate whether the activity or use is compatible with the comprehensive plan and land use regulations, attaches written findings

supporting the decision of compatibility, and returns the signed and dated LUCS to the applicant.

- Third, the applicant can then submit the completed LUCS and any supporting information provided by the City or County to DEQ along with the DEQ permit application or approval request.

CRITERIA FOR APPROVAL

The land use planner reviewing the LUCS will base his or her decision on the project's compliance with the local comprehensive plan, zoning regulations, and past land use approvals. The planner reviews the proposal to ensure the proposed use:

- Is consistent with the comprehensive plan; or
- Is permitted in the applicable zone; or
- Received proper land use approvals (if required) and if so, is consistent with approvals.

The planner then attaches the applicable zoning ordinance or applicable land use approvals to the LUCS and provides findings describing how the proposal is consistent with the comprehensive plan, ordinance, or land use approvals.

If the proposal is not consistent with the local comprehensive plan, zoning regulations, and past land use approvals, the planner provides findings to that effect and additionally notes what steps, if any, must be taken for the proposal to become consistent.^{12, 13}

¹² Oregon Department of Environmental Quality. Land Use Compatibility Statement (LUCS). Retrieved from <http://www.deq.state.or.us/pubs/permithandbook/lucs.htm>

¹³ S. Ochs, personal communication, October 28, 2010.

TRAFFIC IMPACTS

The local public works department can help an applicant determine which agency has jurisdiction over the roads that provide access to his or her site. The road classification will determine whether the jurisdictional entity is the City, County, or Oregon Department of Transportation (ODOT). It is unlikely, but possible that the road access may be under federal jurisdiction via the US Forest Service (USFS), Bureau of Land Management (BLM), Army Corp of Engineers (USACE) or other agency.

Some roads are regulated by more than one agency. For example, if access to a facility is from a county road within the Eugene UGB, city code also applies. The city access management code may place restrictions on the number and location of access points a development is allowed based on the type of street the site is located on (i.e. collector, arterial etc.), where it is located, and how the property will be used. If access to the facility is from a state highway, ODOT will require a separate access permit, which is described in greater detail below.

ODOT requires submittal of a Traffic Impact Analysis (TIA) in conjunction with an application for an approach permit when trips generated on a property exceed a certain threshold. A TIA is required when the average daily volume of trips generated on a property is greater than 1,000 vehicles per day (vpd). A TIA is also required when the average daily volume of trips generated on a property is more than 400 but fewer than 1,001 vpd and the average annual daily traffic (AADT) on the highway is greater than 5,000 vpd on a two-lane highway, 15,000 vpd on a three-lane highway, 10,000 vpd on a four-lane highway, or 25,000 vpd on a five-lane highway.

Depending on the number of trips that the proposed development will generate, the local jurisdiction may require a traffic impact analysis. The City of Eugene requires a traffic impact analysis for developments that generate 100 or more trips. In Lane County, the threshold is 50 trips.

Access Management Permit

The Oregon Department of Transportation (ODOT) requires an approach permit for private approach roads with vehicular access to a state highway. Before a permit to construct an approach is issued, the abutting property must have access rights to the abutting highway. If the abutting property does not have a right of access, one of two types of access permits are issued (ODOT will inform applicant if there is a need to submit either application): (1) A Grant of Access is required when ODOT retains access control along a property's frontage and no right of access currently exists between the property abutting the highway and the highway; (2) An Indenture of Access is required when ODOT retains access control along a property's frontage but the property has a Reservation of Access and the property owner wants to change the location, width, or use restrictions of an existing Reservation of Access.

HOW TO APPLY

The applicant will need to submit an application for State Highway Approach. The applicant should be prepared to provide the following materials and information:

- Site Plan and Vicinity Map approved or currently being reviewed by the local government
- Land Use Compatibility Statement (LUCS) signed by the local government
- Current county tax lot map for the property served by the approach
- Recorded easement(s), if the property has an existing easement(s) for access to the property
- Existing state or local government approach permits for the property
- Highway name, route number, milepoint and side of highway (i.e., north, south, east or west)
- Proposed turning movements to be allowed on the approach¹⁴
- Separate applications are required for Grant of Access and Indenture of Access rights. Check with ODOT for more information.

Solid Waste Treatment Facility Permit

The Oregon Department of Environmental Quality (DEQ) issues Solid Waste Disposal Site Permits. A solid waste treatment facility permit is a subcategory of a solid waste disposal site permit. In 2012, the DEQ was in the process of creating new rules around conversion technology facilities, such as biogas facilities, but under current rules, a biogas facility that receives solid wastes is permitted as a solid waste treatment facility.

EXEMPTIONS

A solid waste treatment facility permit is not automatically required for a biogas facility on a farm that is operating under a Confined Animal Feeding Operation (CAFO), National Pollution Elimination Discharge System (NPDES) permit. As long as the farm is operating the biogas plant as a farm use, to manage farm manures and wastes, a DEQ permit may not be required. Farm-based biogas plant operators should contact their ODA CAFO permit manager to discuss the regulatory implications of the biogas plant, including receipt of off-farm wastes.

If, however, the facility will receive significant amounts of solid wastes from off-site, the ODA may determine that the waste treatment activity is considered a commercial use that is no longer covered by the CAFO. At this point the ODA will consult with DEQ, and DEQ may require the entrepreneur to obtain a solid waste treatment facility permit.

¹⁴ Oregon Department of Transportation. ODOT Access Management. Retrieved from <http://www.oregon.gov/ODOT/HWY/ACCESSMGT/formsandpublications.shtml>

HOW TO APPLY

For application forms, information on the requirements for each plan, and contact information for regional solid waste permit coordinators go to <http://www.deq.state.or.us/lq/sw/permittreatmentinstructions.htm>.

Composting Facility Permit

If a developer intends to compost the solid byproducts of the anaerobic digestion process onsite, the developer will also need a composting facility permit. The composting facility permit is another subcategory of the solid waste disposal site permit administered by the DEQ.

HOW TO APPLY

For application forms, go to <http://www.deq.state.or.us/lq/sw/permitcompinstructions.htm>.

Air Contaminant Discharge Permit (ACDP)

The Lane Regional Air Protection Agency (LRAPA) issues ACDPs for facilities in Lane County. DEQ issues ACDPs for the rest of Oregon. DEQ has a tribal liaison that coordinates with tribal nations.

HOW TO APPLY

The first step in applying for an ACDP is to collect information about equipment sizes and production activities at the proposed facility and enter the information on the appropriate air quality application forms. It may be helpful to set up a pre-application meeting or to have a draft of the application forms reviewed by an air quality regulatory representative prior to formal submittal. The following are examples of items, quantities, and parameters that may be needed in filling out the ACDP application forms:

- Electrical power engine generator size in kilowatts (kW) and/or brake horse power (hp)
- Engine manufacture date
- Maximum amount of fuel and type of fuel used per hour and per year (gallons/yr or millionBtu/yr)
- Emission rates from manufacturer (if provided)
- Anaerobic digester size and type
- Excess biogas flare capacity and type
- Storage tanks utilized (size in gallons, roof type)
- A site plan of the operation
- Raw materials used (feedstock)

After gathering information about the production activities at the facility, the applicant completes the permitting forms. If the applicant intends to take credit for pollution prevention measures, he or she submits an additional form describing any control devices at the facility. The applicant must also obtain a signed Land Use Compatibility Statement (LUCS) from the affected local government approving the proposed land use with the local land use plan before DEQ or, if in Lane County, LRAPA can process and issue a permit.

FEES AND PERMIT TYPE

The next step in applying for an ACDP is to determine which type of permit is appropriate for the facility. The air quality division of the DEQ or LRAPA in Lane County will make this determination in accordance with applicable permitting rules. The permit type will vary according to the source and quantity of emissions. The length of the permit term and both initial and annual fee amounts will vary based on the type of permit. Initial and pro-rated annual fees commence upon the date of application.

TIMELINE FOR ISSUANCE

Air quality regulations require the owner to obtain an issued ACDP prior to beginning construction of a new facility. Regulatory representatives estimate that it often takes four to six months to issue a new permit. Issuance of a new permit involves at least a 30-day public comment period and may take longer if a hearing is requested by ten or more individuals or a group representing ten or more individuals.

PERMIT RENEWAL AND MODIFICATIONS

The DEQ and LRAPA also require applications for permit renewals and modifications. No fees are charged for permit renewals that do not involve changes or modifications to the facility. Permit terms are typically five years. Modifications may include non-technical modifications, such as a change of ownership, or technical modifications, such as an increase in facility-wide emissions. The DEQ and LRAPA should be consulted to provide advice as to whether or not the proposed change requires a permit modification.¹⁵

Water Permits

The type of water quality permit required depends on what is being discharged and where it is going. Developers can contact the regional DEQ office to determine if the proposed activities will require a water quality permit. Contact information for regional offices is available at <http://www.deq.state.or.us/about/locations.htm>.

Under certain conditions, a developer would not need a DEQ water quality permit. Instead of discharging wastewater to the ground, a developer can recycle wastewater and eliminate extra rinsing steps. For example, developers may wish to utilize land-application of wastewater, rather than discharging to the ground, which would eliminate the need for a water quality permit.

¹⁵ Oregon Department of Environmental Quality. Air Contaminant Discharge Permits (ACDP). Retrieved from <http://www.deq.state.or.us/air/permit/acdp/acdp.htm>

If wastewater cannot be recycled, developers should explore the possibility of discharging to the sewer system. Facilities that discharge industrial wastewater to the sewer system are not directly regulated by DEQ. Discharging to the sewer system will require approval from the local sanitary authority and may require local permits and fees.¹⁶

For operating farms, it is possible that the water quality issues could be covered within a CAFO permit. ODA will determine at which point water quality issues are no longer covered by the CAFO. At this point the ODA will consult with DEQ, and DEQ may require the developer to obtain a Water Pollution Control Facility permit (WPCF).

National Pollutant Discharge Elimination System (NPDES)

A biogas facility is more likely to require a WPCF than a NPDES, but if the activity involves “point source” discharges of pollutants to surface waters, the developer must apply for a NPDES permit. “Point source” includes pipes, culverts, ditches, catch basins or any other type of channel – natural or man-made.

Certain industries and activities also require NPDES permits for stormwater runoff. Ensuring that stormwater is clean can prevent the need for a permit. NPDES stormwater permits are not automatically required, but if complaints and concerns about pollution from a facility arise, the DEQ may require the developer to obtain a permit.

HOW TO APPLY

For a new facility, the applicant must submit a LUCS signed by the local land use authority, a Stormwater Pollution Control Plan and Checklist, and payment for the new permit application and first year’s annual fee. For renewal applications, a LUCS is only required if the facility has undergone major changes.¹⁷

For more information and for application forms, go to <http://www.deq.state.or.us/wq/wqpermit/stminfo.htm>

Water Pollution Control Facilities (WPCF)

The WPCF permit is for the discharge of wastewater to the ground. WPCF permits are issued for wastewater lagoons, onsite sewage disposal systems, and underground injection control systems. This permit is intended to prevent discharges to surface waters, protect groundwater from contamination, and prevent nuisance conditions such as odors and mosquitoes.

HOW TO APPLY

The developer provides the following information on a WPCF permit application:

¹⁶ Oregon Department of Environmental Quality. Water Quality Permit Program Frequently Asked Questions. Retrieved from <http://www.deq.state.or.us/wq/wqpermit/permitfaqs.htm>

¹⁷ Oregon Department of Environmental Quality. NPDES Stormwater Permit Application Forms and Permit Fees Retrieved from <http://www.deq.state.or.us/wq/wqpermit/stminfo.htm>

- Description of the proposed facility
- Type of wastewater
- Primary method of wastewater treatment and disposal
- Other DEQ permits issued or applied for
- Location of facility relative to boundary of a municipal sanitary sewage system

INDIVIDUAL VS. GROUP WPCF PERMITS

Developers can ask DEQ whether they should apply for a group or individual permit, but it is highly unlikely that a group permit will be available for a biogas facility. An "individual permit" is for discharges from a specific facility. An individual permit is more expensive than a general permit because it takes more time to review and inspect. It often requires more frequent monitoring for a greater variety of pollutants. Individual permits are usually issued for a period of five years.

For application forms go to
<http://www.deq.state.or.us/wq/wqpermit/indinfo.htm>.

Water Use Rights

All water is publicly owned in the state of Oregon. With some exceptions, water users must obtain a permit or water right from the Water Resources Department (WRD) to use water from any source, whether it is underground, or from lakes or streams. Exceptions include the use of ground water in quantities of up to 5,000 gallons per day for commercial or industrial use. Landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from the Department. Water delivered by a municipality would be covered under the municipality's rights. Many streams and ground water sources are closed to new appropriation. Permit issuance takes at least six months.

HOW TO OBTAIN RIGHTS

1. **Consult with the Water Resources Department**, either in Salem or at the Local Watermaster's office. Submit an application to the WRD. The applicant should be prepared to submit a map that meets the standards specified on the application. WRD also requires applicants to submit a Land Use Information Form completed by a local government planning official in the jurisdiction where the water right will be used. Both the application and the Land Use Information Form are available online at http://www.wrd.state.or.us/OWRD/PUBS/forms.shtml#water_right.
2. **Once a permit is granted, construct a water system complying with all permit conditions and begin using water.** In most cases the use must be initiated within five years of permit issuance. An extension of time may be granted if the applicant meets certain criteria.

- 3. Hire a certified water rights examiner to complete a water use survey.**
The examiner should submit a report detailing how and where water is being applied and a map to the WRD. A water rights certificate is issued based upon the report finding that water is being used according to the provisions of the permit.¹⁸

Building Permit

Building permits are required for new commercial construction. The developer should contact the county building department regarding building permits. As each project is unique, requirements vary depending on the project.

HOW TO APPLY

After preparing building plans, the developer submits them to a planner or building department official. In Lane County, for example, land use requirements are reviewed within the building permit process. Some counties have a separate site review prior to the building permit process. The local agency will verify that the use is appropriate for the current zoning and whether or not a land use application is required.¹⁹

The developer should incorporate the following information into building plans:

- Site accessibility
- Building construction
- Building area
- Building occupancy
- Plumbing fixture count
- Ventilation requirements
- Fire prevention systems (sprinkler, fire alarm, smoke detector, and standpipe)
- Compliance with Oregon Energy Code

After the local building department has reviewed the plans, they will inform the developer of the required inspections. Upon approval, the developer will have a specified amount of time to begin construction. In Lane County, construction must begin within 180 days after the permit is issued. If the permit expires, the developer may have to renew the permit and pay additional fees.²⁰

¹⁸ Oregon Water Resources Department. Water Rights. Retrieved from <http://www.wrd.state.or.us/OWRD/WR/index.shtml>

¹⁹ K. Whitmill, personal communication, May 2, 2011.

²⁰ City of Eugene Building and Permit Services. Building and Permit Services. Retrieved from <http://www.eugene-or.gov/portal/server.pt?open=512&objID=225&PageID=0&cached=true&mode=2&userID=2>

Removal-Fill Permit

Site development that involves removing or filling 50 cubic yards or more of material in most waters of the state, or any volume of removal or fill in designated “essential salmon habitat” or state scenic waterways, requires a removal-fill permit from the Department of State Lands (DSL). Many projects that require a DSL removal-fill permit also require a separate federal permit from the US Army Corps of Engineers (USACE). DSL and the Corps use a Joint Permit Application form. USACE and DSL process the applications separately. The joint permit application is on the U.S. Department of State Lands website at: http://oregonstatelands.us/DSL/PERMITS/forms.shtml#Permit_Forms or U.S. Army Corps of Engineers website at www.nwp.usace.army.mil/regulatory/home.asp.

“Removal” is defined as taking or moving inorganic substances from the bed or banks of a waterway. “Fill” is defined as depositing any material in the bed or banks of a waterway. “Waters of the state” are defined as natural waterways including all tidal and nontidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, including that portion of the Pacific Ocean that is in the boundaries of this state, on private and public land.

The first step in determining if a removal-fill permit is required is to determine if wetlands or other waters exist on the site. A jurisdictional determination may be requested from DSL using forms available on the DSL website (www.oregonstatelands.us/DSL/WETLAND/wetlandeduc.shtml).

There is no fee for this service. If wetlands or waters are determined to exist on the site, then a wetland delineation is required to determine the regulated boundaries of the features. Wetland delineation reports are prepared by consultants and submitted to DSL for review and approval. Review takes up to 120 days and requires a fee. The local Planning Department may also have some mapping resources available including National Wetland Inventory or Local Wetland Inventory maps. While these maps may be helpful for general planning purposes, they are not a replacement for a DSL determination. The local planning department can also explain whether or not there are local land use restrictions on where development can occur.

HOW TO APPLY

Once the wetland/waterway boundaries are known, the removal fill application process may begin, including the following steps:

1. **Request a pre-application meeting with all pertinent agencies.** Individuals working on new or complex projects that need removal-fill permits should request a pre-application meeting at the conceptual design stage. Agencies to invite may include USACE, DSL, DEQ, and Oregon Department of Fish and Wildlife (ODFW). If listed species are known or suspected to occur near the project site, National Marine Fisheries Service (NMFS) or US Fish and Wildlife Service (USFWS) may also need to be involved in the pre-application meeting. The pre-application meeting can be used to: (1)

determine which type of state and federal permits will be appropriate; (2) identify specific issues that may need to be addressed in the application; (3) review alternative designs to avoid or minimize impacts; and (4) review mitigation concepts.

2. **Submit Joint Permit Application materials to USACE and DSL.** The DSL website provides materials and instructions for completing the application. Staff members are available, by email or phone to answer application and process questions during the design development phase of the project. Be prepared to provide the following information and materials for a Joint Permit Application:

- Location of the project on the waterway
- Tax map and lot number
- Proposed volume, area, and type of removal/fill activity
- Purpose and need for the project
- State or federally listed species on the site
- Information about cultural and historic resources on the site
- Project drawings
- Recent aerial photo
- Analysis of alternatives for achieving the purpose of the project
- Description of measures to minimize impacts
- Description of natural resources in the project area
- Site restoration or rehabilitation plan (if there are temporary impacts)
- Mitigation plan (if there are permanent impacts to wetlands or waters)
- Affidavit from local planning office verifying that project is consistent with the local comprehensive plan and zoning ordinances²¹

For DSL, the application submittal to permit decision timeline is typically 120 days. The federal permit process will take substantially longer when an Endangered Species Act Consultation is involved.

Water Quality Certification (WQC)

If USACE determines that a removal-fill application requires a permit and results in a discharge, the applicant must apply for a DEQ 401 Water Quality Certification (WQC).

²¹ Oregon Department of State Lands. Removal-fill Permit Application. Retrieved from <http://www.oregon.gov/DSL/PERMITS/appformhelp.shtml>

HOW TO APPLY

To obtain a DEQ 401 WQC, the applicant must submit the following information to DEQ:

BASIC INFORMATION

- Description of existing and proposed water quality impacts
- Complete written description of activity
- Names of affected waterways, lakes, or other water bodies
- Land Use Compatibility Statement (LUCS)

WATER QUALITY INFORMATION

- Demonstration that the activity complies with applicable Clean Water Act provisions, Oregon Water Quality Standards, and other state law requirements
- Copies of environmental information submitted to the federal licensing or permitting agency
- Identification of waterway(s) impacted by the project including wetlands and tributary streams
- Confirm the status of waterways impacted by the project (DEQ evaluates water quality and assigns a status to bodies of water in Oregon)
- Identification of potential impact to ecological integrity of critical habitat or special water quality values that are vital to the unique character of those water bodies
- Evaluation of potential water quality standard violations
- Identification of measures to prevent or mitigate violations

MITIGATION PROPOSAL

The applicant must submit a proposal for mitigating impacts to water quality functions. The intent of this proposal is to ensure that water quality functions are repaired or replaced in the immediate area of the project's impact.

For more information and application forms go to <http://www.deq.state.or.us/wq/sec401cert/process.htm>

COMMON HOLDUPS

- Applicant did not submit water quality information
- Applicant did not submit an approved LUCS

- Applicant assumed that USACE or DSL sent the application materials to DEQ²²

Boiler Permits and Operator Licenses

Facilities that include boilers must obtain a Boiler Permit. These permits are required for boiler installation, alteration, and repair. The operators of these boilers must obtain an Operator License. Inspections for Operator Licenses are conducted by the state, or insurance companies, on either a one or two-year cycle²³ The Building Codes Division (BCD) of the Oregon Department of Consumer and Business Services oversees Boiler Permits and Operator Licenses.

For more information, and application forms, go to <http://www.cbs.state.or.us/external/bcd/programs/boiler.html>

²² Oregon Department of Environmental Quality. Water Quality: Section 401 Certification. Retrieved from <http://www.deq.state.or.us/wq/sec401cert/removalfill.htm>

²³ Oregon Department of Consumer and Business Services. Boiler and Pressure Vessels Program. Retrieved from <http://www.cbs.state.or.us/external/bcd/programs/boiler.html>

SECTION 4: CASE STUDIES

This section describes two case studies of biogas facility development projects: Konyn Dairy and Lochmead Dairy. These case studies illustrate primarily the land use entitlement permits, as well as some of the common challenges of planning for a biogas facility.

Konyn Dairy, Eugene OR

On July 2, 2009, Dean Foor, managing member of Konyn Dairy Biogas, submitted an application for a Special Use Permit for a Commercial Use in Conjunction with Farm Use to the Land Management Division of Lane County's Public Works Department.

- **Size:** 96.5 acres
- **Plan Designation:** Agricultural
- **Zoning:** Exclusive Farm use (E40)
- **Project Description:** To “install an anaerobic digester at an existing dairy farm to improve manure management and produce renewable energy”
- **Proposal:** Would generate more than 100% of sites energy needs
- **Application:** Conditional Use Permit, commercial activity of selling excess electricity back to the utility company
- **Decision:** Application withdrawn

The subject tract is located on N. Coburg Road in Eugene, Oregon. It is within an Exclusive Farm Use (E40) zone. The surrounding land is also zoned E40, except for properties to the south, east, and southeast that are zoned Rural Residential (RR1 and RR5).

The applicant proposed to construct a mixing tank, two hydraulic digesters, with the possibility of a third over time, a post-digester, and a combined heat and power (CHP) unit. Biogas would be produced from manure, ryegrass straw, and food processing waste (fats, oils and greases). All of the manure used would be produced on-site. The ryegrass straw would be collected from surrounding farms, and the grease products would be generated by restaurants located to the north. On average, the plant would require delivery of one 20-ton semi-truck of straw per day and between two and three 6,000-gallon tankers of food processor waste per week. The plant would occupy about four acres of the existing subject tract.

An estimated 1.4 megawatts of electricity would be produced per year, all of which would be sold to the Emerald People's Utility District (EPUD). Fiber co-product would be marketed as a compost amendment, and liquid effluent would be used as agricultural fertilizer.

The Lane County Land Management Division found the initial application to be incomplete because it lacked:

- A site plan that meets the requirements of the “How to Prepare Your Site Plan” handout, and
- A description of the various components of the proposed development.

Upon receiving a complete application, the Lane County Land Management Division evaluated the proposal for consistency with the requirements of Lane Code 16.212(4)(c) and 16.212(10)(a)-(g). Staff findings are as follows.

Commercial

- The proposed activity qualifies as a commercial activity in conjunction with farm use;

Building

- As the proposal does not involve any new dwellings, LC 16.212(10)(a) is not applicable;
- The proposed facilities meet all property line setbacks, consistent with LC 16.212(10)(b);
- As the property is not located within the Eugene-Springfield Metropolitan Area General Plan Boundary, the Eugene and Springfield Urban Growth Boundary, 100 feet of Class 1 stream, nor a riparian setback, the proposal is in compliance with LC 16.212(10)(c) and (d);

Agricultural lands

- The proposed use would not force a significant change in accepted farm or forest practices on surrounding lands devoted to farm and forest use in accordance with LC 16.212(10)(f). The impacts that staff assessed to make this determination were odor, traffic, noise, risk of explosions, pathogens, and water use; and
- The proposed use will not significantly increase the cost of, and may actually benefit, accepted farm practices in the area in compliance with LC 16.212(10)(g).

On January 7, 2010, an associate planner with the land management division forwarded letters from neighboring property owners and public agencies to the applicant, and suggested that the applicant address the issues in detail. The issues included:

- The suggestion that the proposed use should be permitted as a utility facility, composting facility, or commercial utility facility instead, because of the quantity of electricity produced;
- Concerns that materials would be brought in from off-site; and
- Concerns over impacts on the surrounding area including odors and traffic.

On August 6, 2010, the applicant cancelled the permit because “the proposed biogas plant will no longer be built at the location.” As such it is not known how the applicant would address the issues noted above. Future applications should consider these questions when applying for a biogas facility.

Lessons Learned...

Permitting a biogas facility is a complex process. Counties across the state define a biogas facility differently. It goes without saying that if a biogas facility is deemed an allowed use, then the permitting process is going to be much more straight forward. If it is not an outright permitted use, or something allowed as a special use, then the permitting process becomes complex and costly.

In addition, it is important to read over the application materials and applicable criteria carefully—incomplete applications may lead to costly delays. Furthermore, outreach to neighbors is critical to address concerns and build support for biogas projects. Some of the most common concerns of neighbors are increased traffic, odor, and noise, and safety concerns. Proposers of biogas facilities will have to address the concerns of neighbors either with proactive outreach or in response to the permitting agencies inquiries.

Lochmead Dairy, Junction City, OR

On December 3, 2008, RES Agriculture and Lochmead Dairy Farms LLC submitted an application for a Special Use Permit for a Commercial Activity in Conjunction with Farm Use to the Land Management Division of Lane County’s Public Works Department.

- **Size:** 333.3 acres
- **Plan Designation:** Agricultural
- **Zoning:** Exclusive Farm use (E40)
- **Project description:** to enhance “the existing open anaerobic lagoon manure management system with a closed loop manure management system that utilizes anaerobic digester tanks that will reduce odors, create a cleaner byproduct and harness a renewable energy source”
- **Proposal:** Would generate more than 100% of sites energy needs
- **Application:** Conditional Use Permit, commercial activity of selling excess electricity back to the utility company
- **Decision:** Approved

The 333.3 acre subject tract is located at Highway 99 W and Hulbert Lake Road in Junction City, Oregon. The Lane County Rural Comprehensive Plan designates the property as Agricultural. It is zoned Exclusive Farm Use, (E40) zone. A portion of the property is within the Commercial Airport Safety Combining Zone (/CAS) and a portion contains wetlands.

The applicants proposed to construct two 47'-6" tall anaerobic digester tanks, a 25' tall biogas storage structure, and two shorter storage/control buildings that would be tied into the existing manure management system. The anaerobic digesters would be used to dispose of manure from the dairy cows that live on the property and are part of the Lochmead Farms dairy operations. Remaining solids would be used on the farm as organic bedding for the dairy cows and as fertilizer. The anaerobic digestion process uses heat and microbes to break down the manure into biogas, which can then be combusted to produce electricity. Because the applicants anticipated generating greater than 100% of the energy needed for the farm, they applied for a conditional use permit to engage in the commercial activity of selling excess electricity back to the utility company.

The Land Management Division found the initial application to be incomplete because it lacked:

- A scaled site plan showing the whole parcel and all structures
- Labeling and clarification concerning the bioreactors
- Information on the quantity, height, and dimensions of the bioreactors
- A site plan showing a side view of the bioreactors

On December 30, 2008 the Land Management Division accepted the application as complete. They evaluated the proposal for consistency with the criteria found in Lane Code 16 212(4)(c) and the applicable development standards of Lane Code 16 212. Staff findings were as follows.

Commercial

- The proposed use (selling excess electricity produced from manure to the local electric company) complies with LC 16 212(4)

Building

- Lane County will be responsible for issuing and inspecting building permits for the structures and tanks
- As the proposal did not involve any new dwellings, it complied with LC 16.212(10)(a)
- The proposed structures meet all property line setbacks, consistent with LC 16.212(10)(b)
- As the applicants did not propose any structures within 100 feet of Class 1 streams, the proposal is in compliance with LC 16.212(10)(c) and (d)
- As the applicants did not propose any signs, the proposal is in compliance with LC 16.212(10)(e)
- The proposed structures comply with the development criteria of LC 16.245 Commercial Airport Safety Combining Zone

- The proposed structures will not be located within a Flood Hazard Area, in compliance with LC16.244
- As a condition of approval, the applicant should notify the Division of State Lands and ensure that all construction, including grading, excavation and clearings, be done so as not to disturb the wetland area because the applicant has proposed building structures adjacent to wetlands per the National Wetlands Inventory Map
- The Oregon Department of Transportation (ODOT) had no comments on the subject property access to Hwy 99W

Environmental

- The Department of Environmental Quality (DEQ) and the Department of Agriculture (USDA) will be the regulating agencies overseeing any issues with the digesters, water quality, or air quality
- The development location has not been identified as a unique wildlife habitat site, in compliance with LC 16.005(4)

Agricultural Lands

- The Department of Agriculture approved the anaerobic digester facility, with the condition that the applicants update their animal waste management plan within 12 months after digester startup
- Although the applicants did not propose bringing in additional waste from off-site to put in the digesters, the DEQ will require the applicants to submit a solid waste disposal permit if they change their plans in the future

Thus, the Lane County Land Management Division found the proposed Special Use Permit for a commercial use in conjunction with a farm use to be in compliance with Lane Code 16 212(4)(c), and approved the proposal with the conditions described above.

Lessons Learned...

The determination that this is a farm-related commercial use, coupled with siting the facility out of environmentally sensitive areas (wetlands, waterways, or in unique wildlife habitat sites) made this a relatively straightforward proposal. An incomplete proposal did delay the application by almost a month, so it is important to pay attention to all of the permit requirements.

APPENDIX: GLOSSARY

Bioenergy - Bioenergy is renewable energy made available from materials derived from biological sources. In its most narrow sense it is a synonym to biofuel, which is fuel derived from biological sources. In its broader sense it includes biomass, the biological material used as a biofuel, as well as the social, economic, scientific and technical fields associated with using biological sources for energy. This is a common misconception, as bioenergy is the energy extracted from the biomass, as the biomass is the fuel and the bioenergy is the energy contained in the fuel. (<http://encyclopedia.thefreedictionary.com>).

Biofuel - Fuel produced from renewable resources, especially plant biomass, vegetable oils, and treated municipal and industrial wastes. Biofuels are considered neutral with respect to the emission of carbon dioxide because the carbon dioxide given off by burning them is balanced by the carbon dioxide absorbed by the plants that are grown to produce them. The use of biofuels as an additive to petroleum-based fuels can also result in cleaner burning with less emission of carbon monoxide and particulates. (<http://encyclopedia.thefreedictionary.com>).

Biogas - Biogas is a mixture of methane and carbon dioxide produced by the anaerobic decomposition of organic matter such as sewage and municipal wastes by bacteria. It is used especially in the generation of hot water and electricity. (<http://encyclopedia.thefreedictionary.com>).

Biomass - Renewable organic materials, such as wood, agricultural crops or wastes, and municipal wastes, especially when used as a source of fuel or energy. Biomass can be burned directly or processed into biofuels such as ethanol and methane. (<http://encyclopedia.thefreedictionary.com>).

Fossil fuel - A hydrocarbon deposit, such as petroleum, coal, or natural gas, derived from the accumulated remains of ancient plants and animals and used as fuel. Carbon dioxide and other greenhouse gases generated by burning fossil fuels are considered to be one of the principal causes of global warming. (<http://encyclopedia.thefreedictionary.com>)

Power - A watt is a unit of power defined as a one joule per second. A kilowatt (kW) is 1,000 watts and a megawatt (MW) is 1,000,000 watts. In tangible terms, a typical American household will consume an average of approximately 1 kW per year, so a megawatt could power approximately 1,000 households (778 according to US Department of Energy Statistics).