

# **Clean Energy Development for Thurston County**

## **Phase 1: South County Community Digester Project Opportunities**

Update: May 9, 2016



**Energy Program**

WASHINGTON STATE UNIVERSITY

[www.energy.wsu.edu](http://www.energy.wsu.edu)

# **Public Meeting**

## **Monday, May 9, 2016**

- **Introduction**
- **Outcomes and Results**
- **Next steps**



**Energy Program**

WASHINGTON STATE UNIVERSITY

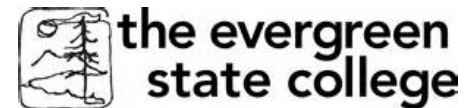
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# Presenter and AD-TAG

**WSU Energy** – feasibility study lead and presenting partner

## **AD-TAG (Anaerobic Digester – Technical Advisory Group)**

- Thurston County
  - Public Works, Solid Waste
  - Resource Stewardship, Water Resources
  - Sustainability
- The LOTT Clean Water Alliance
- Puget Sound Energy (PSE)
- The Evergreen State College (TESC), Sustainability



# Background & Timeline

- March 2013: “Get the Scoop on Cow Poop” community forum organized by Commissioner Sandra Romero & WSU Ag Extension
- Feb 2014: Bio-Digester public presentation
- March 2014: Commissioner’s office engages County Sustainability to partner with WSU Energy
- 2014 – 2015: Series of roundtable discussions coordinated by Thurston County and WSU Energy
- March 2015: Funding partners identified and planning begins for potential Anaerobic Digester feasibility study; AD-TAG begins to form
- July 2015: MOU signed by AD-TAG partners to contract with WSU Energy to conduct a 9-month feasibility study.
- Nov 2015: WSU Energy reports to AD-TAG about the resource inventory
- May 2016: WSU Energy reports on the results and conclusions of the Phase 1 feasibility study

# Report Objectives

## (Phase 1 Feasibility Study)

Determine if an Anaerobic Digester could:

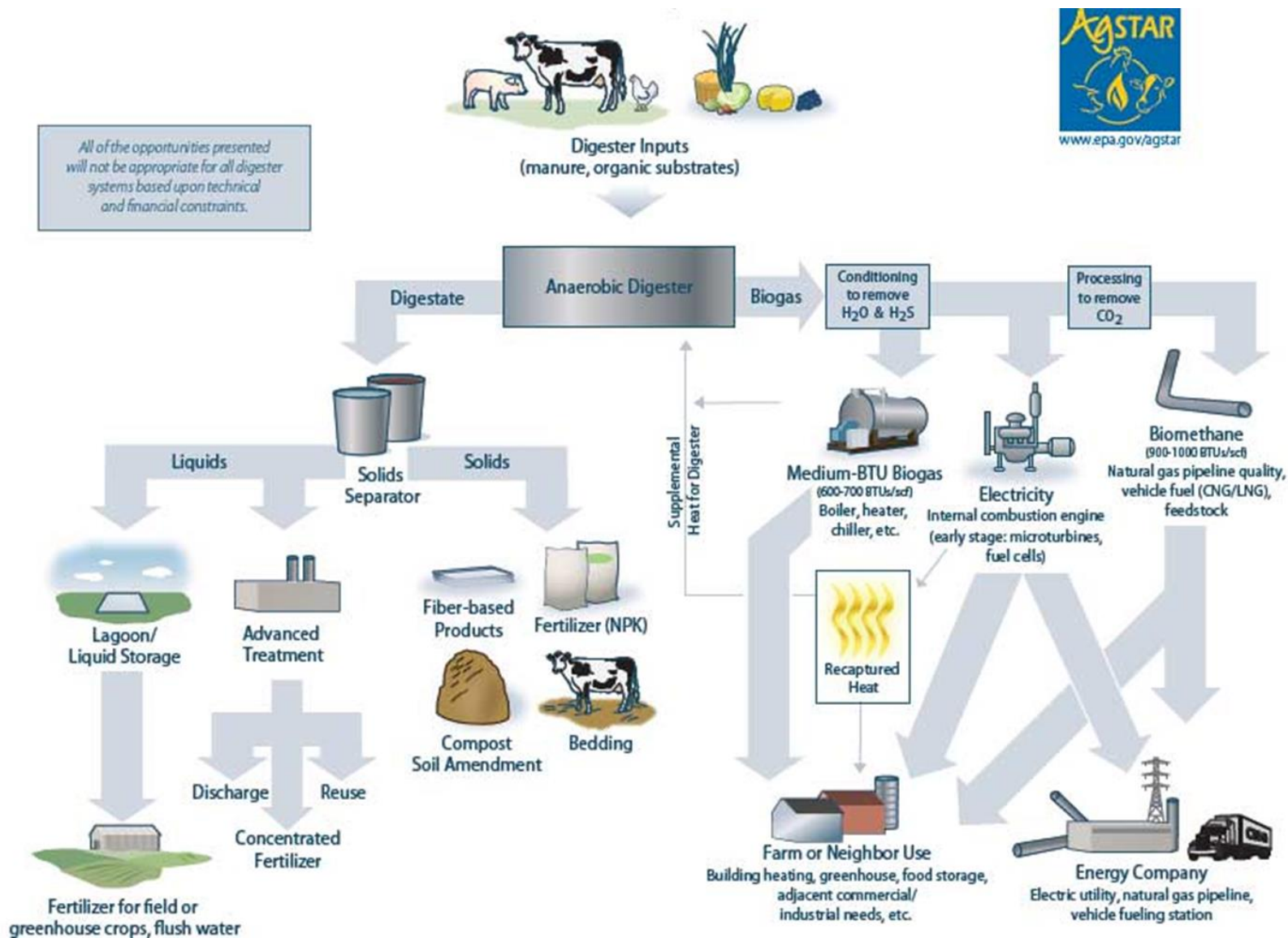
- Reduce odor from dairy farms;
- Produce clean, renewable energy from local resources;
- Produce other marketable commodities, such as clean fertilizer from local resources;
- Improve the natural environment and grow the local economy

- 1) **Organic Resources Inventory:** what is available locally to provide feed-stock for an anaerobic digestion (AD) project
- 2) **Anaerobic Digestion Feasibility:** evaluate technical and economic feasibility of an AD project in south county
- 3) **Community Involvement:** meet with stakeholders and potential partners to discuss benefits of AD developments

# What is anaerobic digestion and biogas?

COMPOSTING	ANAEROBIC DIGESTION
Aerobic (Oxygen)	Anaerobic (No Oxygen)
Balance carbon and nitrogen Balance moisture Volume Time and temperature	Balance carbon and nitrogen Balance moisture Volume Time and temperature
Produces compost	Produces solid and liquid soil amendments
Emits carbon dioxide + trace gases	Produces biogas: methane (50-70%) + carbon dioxide (30-49%) + trace gases (1-2%)

# Typical Digester Flow



# PART 1:

## ORGANIC RESOURCES INVENTORY

- **Dairy** – 12 farms (4 large), 4,000+ cows, 92,000 wet tpy
- **Poultry** – 3 area farms, liquid manure, egg breakage, other residuals; 5,500 tpy
- **Municipal** – food scraps, yard debris, fiber, etc. (WARC); 27,000 tpy recovered + 53,000 tpy landfilled
- **Industrial food** – est. 3,000-7,000 tpy
- **Fish/seafood** – inconclusive
- **FOG** – est. 230 tpy
- **LOTT scum** – volumes vary; processing red flags

tpy = tons/year

# WA Rule for Co-Digestion

## RCW 70.95.330

- Manure-only digestion OK
- Co-digestion allowed:  
up to 30% by volume can  
be source-separated, pre-  
consumer food-processing  
wastes; when digester  
contains at least 50%  
livestock manure
- Solid waste handling permit required for greater co-  
digestion or when handling residential, commercial solid  
waste collection streams



# Livestock Manure

## DAIRY MANURE



- Odor has subsided, but manure hauling still common
- Two dairies with creameries
- Environmental pressures on manure mgmt & storage
- Nitrogen & phosphorus pass through digesters

## POULTRY MANURE



- Dry manure sold as fertilizer
- Wet manure good biogas potential
- Some waste goes to rendering or composting
- High nitrogen inhibits AD; balance with other materials

# Allowed Co-Digestion Materials

## FOOD PROCESS RESIDUALS

- Pre-consumer food residuals materials; clean of contaminants
- Compete based on cost and convenience
- Liquid beverage, brewery, egg breakage candidates
- Variable nutrients
- Beware seasonal sources

## FOG – Fats, Oils, Greases



- Very high biogas yields/ton
- Potential for contamination
- Nutrient loading varies significantly
- Processing challenges/costs

# Municipal Solid Waste (MSW)

- Residential and commercial collections require solid waste handling permits
- Current collections include yard debris with pre- and post-consumer food scraps
- Residuals from groceries & food service not exempt
- High potential for contamination
- Current costs = \$54-\$85/ton
- **Waste and Recovery Center (WARC)** could possibly host a digester on solid ground
- However, landfill gas is falling quickly
- MSW digestion not in any work plan
- More interest in diversion of materials away from WARC

# Thurston County Biogas Resources

Material	Tons/yr	Methane (MMBTU/yr)	Power (kWh/yr)	RNG - Fuel (GasGalEquiv/yr)
Dairy manure	92,000	57,086	4,818,000	444,000
Poultry manure	2,912	5,232	441,000	41,000
Other poultry	2,376	19,692	1,662,000	153,000
Food MSW: current collection	1,589	10,124	854,000	78,000
Food MSW: higher collection	5,578	35,540	2,999,000	277,000
Food processing	3,260	20,771	1,753,000	162,000
Food campus	982	6,257	582,000	49,000
Brewery	200	545	46,000	4,000
FOG	230	3,006	254,000	23,000

# PART 2:

## ANAEROBIC DIGESTER FEASIBILITY

### Farm-Based vs. Community Digester

- Feasibility studies force us to look at the big forest *and* at the individual trees
- They provide focus; consider and narrow different alternative solutions
- Formalize decision-making processes
- Address and mitigate risks
- Identify potential fatal flaws
- Document the analyses needed by partners

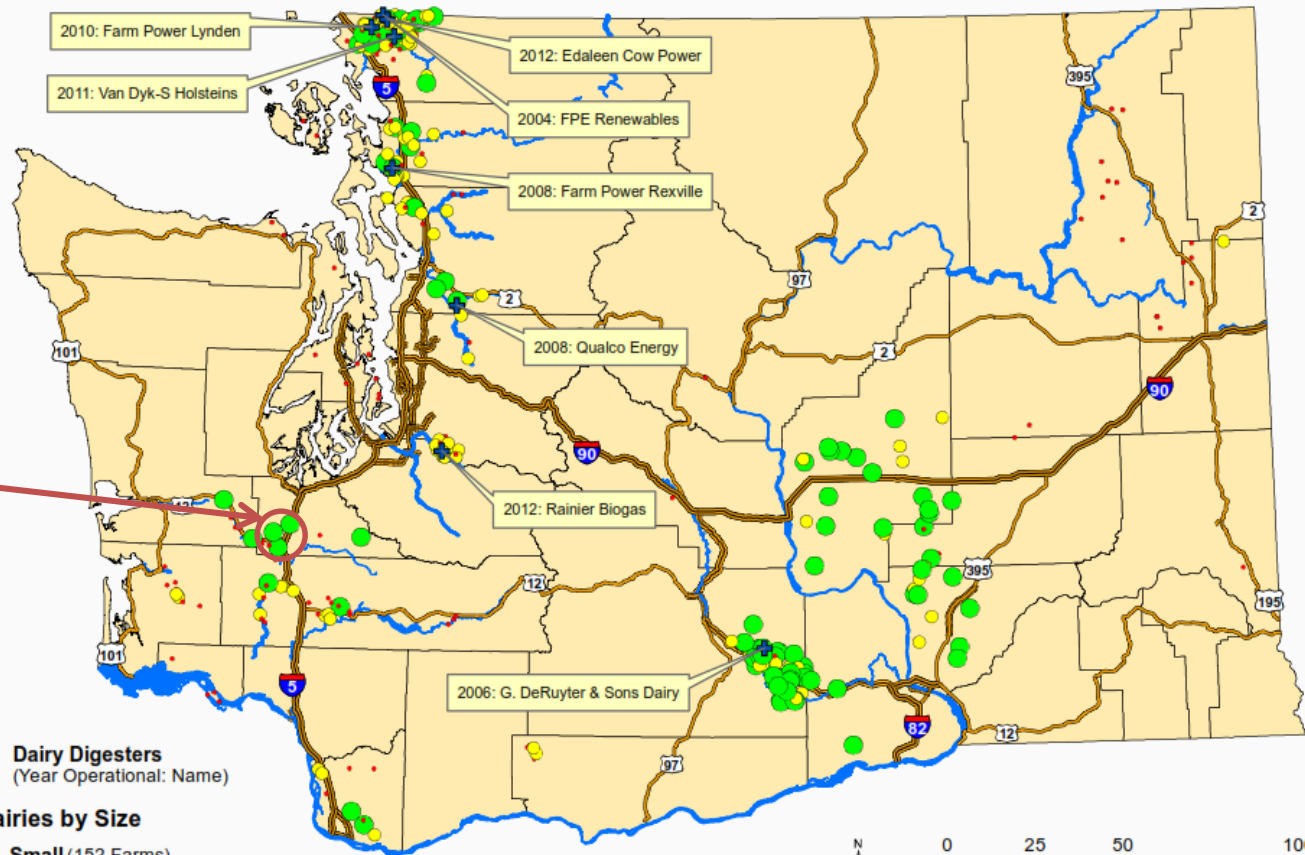
# Manure Digester Systems



Digester systems more commonly associated with manure-based, lower solids projects. Plug-flow digester (left), complete mix digester (center), and covered lagoon digester.

# Washington Dairy Digesters

## Washington Cow Dairies and Digesters, 2014



+ Dairy Digesters  
(Year Operational: Name)

### Dairies by Size

- **Small** (152 Farms)  
1 to 199 mature animals
- **Medium** (134 Farms)  
200 to 699 mature animals
- **Large** (102 Farms)  
700 or more mature animals



Source: Washington State Department of Agriculture,  
Dairy Nutrient Management Program, 2014 Registration

AGR PUB 603-455 (N/3/15)

# South Thurston County Options

## Farm-scale digester

- Single dairy
- Targeted community involvement
- Biogas to green power
- Similar to existing digester projects in WA

## Community digester

- Multiple dairies
- Broader community involvement
- Biogas to green power OR transportation fuel
- Add nutrient recovery for fertilizer production

# Digester Revenue Sources

Revenue source description
ENERGY: electricity, renewable natural gas, or vehicle fuel
Heat surplus: digester, on-farm use, greenhouse, etc
Tipping fees, for accepting outside materials
Co-digestion: additional gas production
Digester solids (fiber): bedding, compost, value-added products
Digester liquids: land application – irrigation fertilizer
Biofertilizers: nitrogen and phosphorus recovered from liquids
Renewable energy or fuel credits
Carbon credits from greenhouse gas reductions
Water quality credits

# Potential Partners

## Leading partnership opportunities

One or more dairy producers

Poultry producers (Briarwood and/or Steibrs)

Chehalis Tribe (Great Wolf Lodge, Lucky Eagle Casino, new hotel, and possibly the tribal village)

Dept. of Corrections (Maple Lane & Cedar Creek) the department's commitment to sustainability could involve clean energy, food production, or food waste diversion

Food processors or breweries

Grease trap waste collection companies

Grand Mound wastewater treatment facility

# Elements of Partnerships

- Active vs. passive participation
- Space, site, location for digester/activities
- Provide input feedstocks
- Off-take agreements for green power, fuel, or other digester products
- Access to capital and grants



# 1. Farm-Based Digester

## Concept Description

Single dairy farm location

Co-digest up to 30% food & FOG substrates

Plug-flow or continuous mix digester

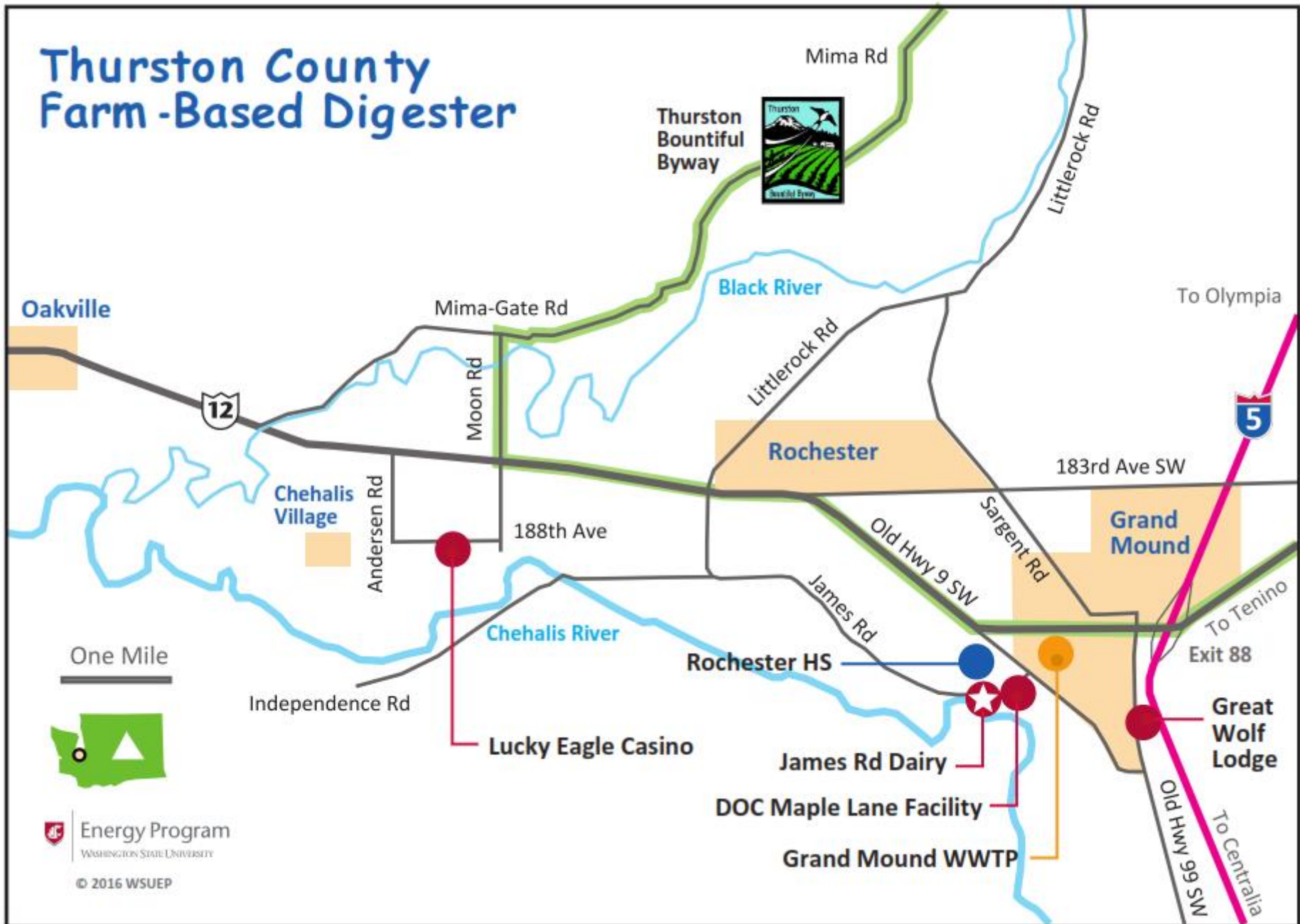
Renewable electricity, supplied to grid-PSE

Surplus heat to offset farm propane costs

Digested fiber solids used as bedding and/or sold as value-added product (e.g., peat replacement)

Digested liquid nutrients applied to broader acreage

# Thurston County Farm-Based Digester



# Farm-Based Digester



# Farm-Based Digester



# Farm-Based Digester

INPUTS		
Manure, 1 farm (1,500 cows)	30,000 +	tons/yr
Pre-consumer food, up to 30% <ul style="list-style-type: none"> <li>• 27 tons/day</li> <li>• 3 to 4 truckloads</li> </ul>	10,000+	tons/yr
Digester volume (21 days retention)	1.25 million	gallons
COSTs		
Total Capital Costs <ul style="list-style-type: none"> <li>• Digester system (\$2.09mil)</li> <li>• Power systems (\$1.63mil)</li> </ul>		\$3.72 million
Annual O&M Costs <ul style="list-style-type: none"> <li>• Digester (\$75K)</li> <li>• Power system (\$117K)</li> <li>• Other (\$159K)</li> </ul>		\$352,000

# Farm-Based Digester

OUTPUTS			REVENUES
Electricity (700 kW genset)	4,687,000	kWh/yr	\$333,000
Renewable energy (RECs)	4,687	credits/yr	
Surplus heat propane offset	6,000	gal/yr	\$9,000
Liquid effluent containing <ul style="list-style-type: none"> <li>• nitrogen</li> <li>• phosphorus</li> </ul>	317 62	tons/yr tons/yr	\$54,000
Digested fiber solids (composted)	8,213	yards <sup>3</sup> /yr	\$53,000
Carbon credits	5,250	credits/yr	\$55,000
Materials processed (tip fees)	~10,000	tons	\$271,000
WA renewable energy rebate			\$5,000
TOTAL REVENUES			\$780,000

# Farm-Based Digester

FINANCIAL SUMMARY		
Annual Earnings (Rev-O&M): before interest, tax, depreciation and amortization (EBITDA)		\$429,000
Net Present Value (10 year)		-\$231,000
Tax credit incentives		> \$100,000
Potential grants		> \$1 million
Simple payback		8.65 years
Grant-supported payback		3.72 years

## 2. Community Digester

### Concept Description

Multiple dairies (manure transported via truck or pipeline)

On-farm or off-farm location

Co-digest up to 30% food & FOG substrates

Consider cost-benefit of a solid waste handling permit

Produce grid-connected green power OR stand-alone RNG fuel

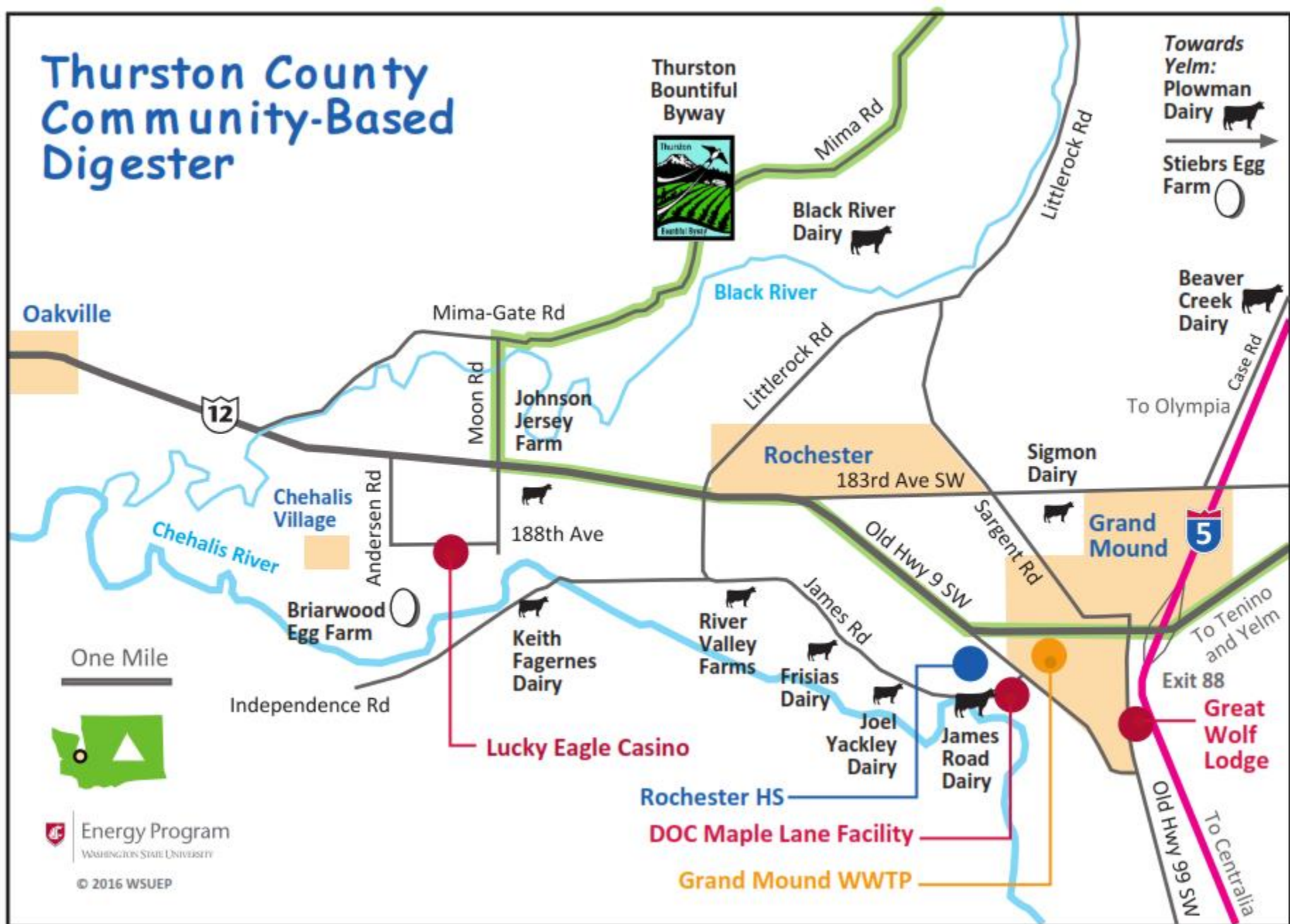
Fuel supply for project vehicles and local shuttle fleet

Fiber solids: bedding and/or sold for value-added agri product

Nutrients: land applied and recovered as fertilizer product

Consider co-location with other projects (e.g., biomass CHP)

# Thurston County Community-Based Digester



# Community Digester

Dane County, WI



Exeter, ME



Aumsville, OR



JC Biomethane, OR

# Community Digester



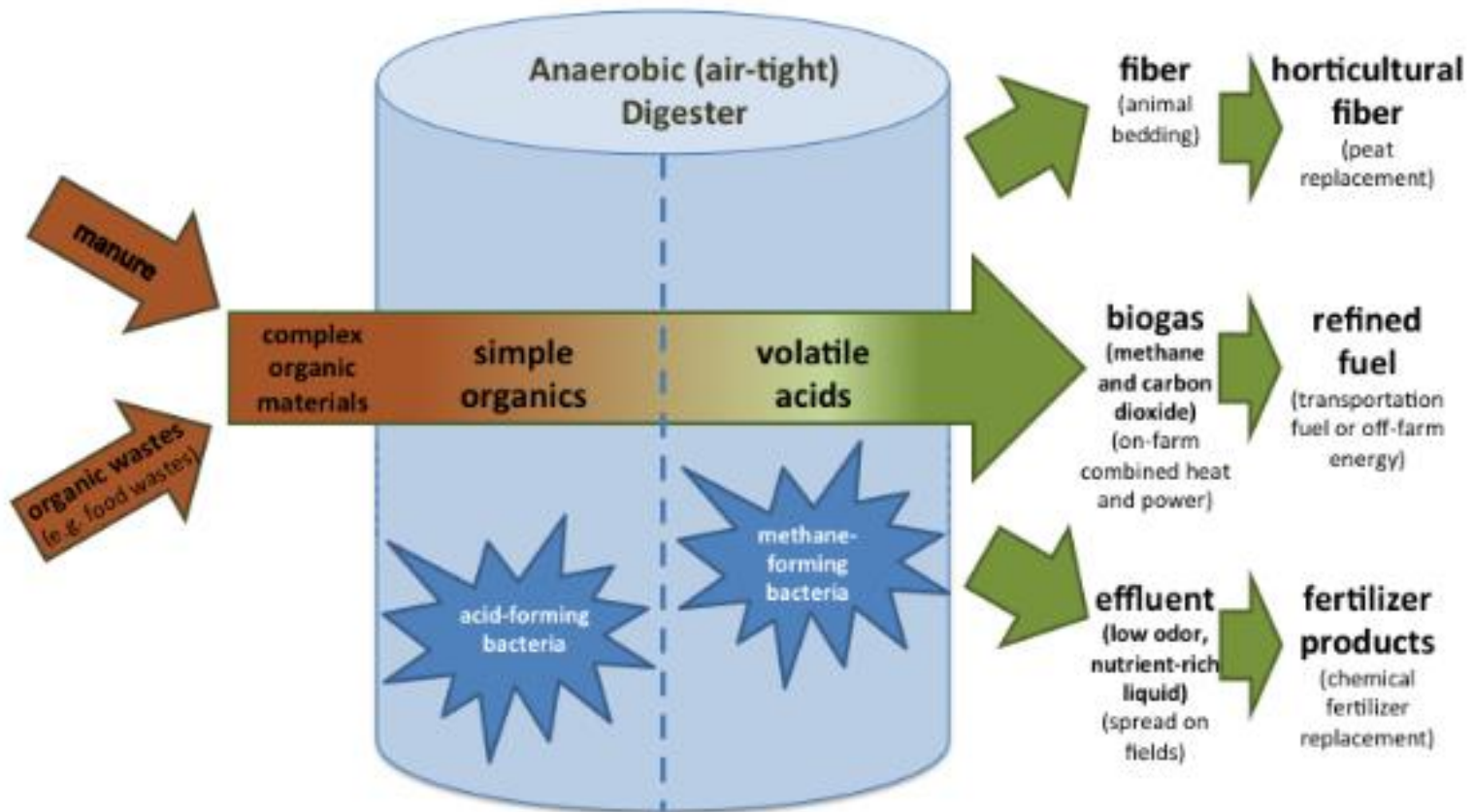
Seebreeze Dairy, BC

# **Additional Partner Options**

## ***(for the community digester)***

- Grease trap waste collectors
- Area food and fish producers (organic and conventional), including greenhouses
- Colleges, schools, or other institutions (JBLM)
- LeMay/Pacific/Waste Connections
- LOTT Clean Water Alliance
- Water Resources Program/Dept. of Ecology

# Expanding Markets



# Community Digester

## Renewable power (CHP)

- Lots of WA experience
- Tied to utility offer
- Low efficiency without uses for heat
- Preference in USDA grants
- I-937 credit and bonus (<5 MW)

## Renewable fuel (RNG)

- Still need to heat digesters
- Direct use is great
- Pipeline = flexibility
- High efficiency of natural gas equipment and vehicles
- Left out of USDA grants
- Fuel credit = \$0.50/GGE
- Valuable renewable fuel credits

# Community Digester

INPUTS		
Manure, multiple farms (3,525 cows)	80,000 +	tons/yr
Pre-consumer food, up to 30% <ul style="list-style-type: none"> <li>• 70 tons/day</li> <li>• 6 to 8 truckloads</li> </ul>	25,000+	tons/yr
Digester volume (21 days retention)	3.0 million	gallons

COSTs	Power	Fuel
Total Capital Costs <ul style="list-style-type: none"> <li>• Digester system (\$5.86mil)</li> <li>• Power systems (\$2.90-3.65mil)</li> </ul>	\$8.76 million	\$9.51 million
Annual O&M Costs <ul style="list-style-type: none"> <li>• Digester (\$1.93-293K)</li> <li>• Fuel-Power systems (\$256-351K)</li> <li>• Nutrient recovery (\$757K)</li> <li>• Other (\$270-924K)</li> </ul>	\$1.57 million	\$2.23 million

# Community Digester-Power

OUTPUTS			REVENUES
Electricity (1800 kW genset)	11,630,826	kWh/yr	\$825,000
Renewable energy (RECs)	11,630	credits/yr	
Surplus heat		MMBTU/yr	\$51,000
Recovered fertilizers <ul style="list-style-type: none"> <li>• nitrogen fertilizer</li> <li>• phosphorus fertilizer</li> </ul>	1,499 3,385	tons/yr tons/yr	\$573,000
Digested fiber solids (composted)	19,299	yards <sup>3</sup> /yr	\$125,000
Carbon credits	8,813	credits/yr	\$111,000
Materials processed (tip fees)	~25,000	tons	\$637,000
WA renewable energy rebate			\$5,000
TOTAL REVENUES			\$2.33 million

# Community Digester-RNG Fuel

OUTPUTS			REVENUES
Renewable CNG fuel	800,000	DGE/yr	\$1,599,000
Renewable fuel credits (RINs)	1.34 mil	credits/yr	\$1,008,000
Recovered fertilizers			
• nitrogen fertilizer	1,499	tons/yr	
• phosphorus fertilizer	3,385	tons/yr	\$573,000
Digested fiber solids (composted)	19,299	yards <sup>3</sup> /yr	\$125,000
Carbon credits	8,813	credits/yr	\$88,000
Materials processed (tip fees)	~25,000	tons	\$637,000
WA renewable energy rebate			\$5,000
TOTAL REVENUES			\$4.04 million

# Community Digester Summary

FINANCIAL SUMMARY	Power	Fuel
Annual Earnings (Rev-O&M): before interest, tax, depreciation and amortization (EBITDA)	\$756,000	\$1.8 million
Net Present Value (10 year)	-\$2.63 million	\$5.12 million
Net Present Value (10 year) RINs stop		\$1.43 million
Net Present Value (20 year)	\$1.52 million	
Tax credit incentives	> \$100,000	
Potential grants	> \$1 million	\$0.5+ million
Simple payback	11.6 years	5.3 years
Grant-supported payback	6.5 years	4.7 years

# Summary Comparison

	FARM-BASED	COMMUNITY Power	COMMUNITY Fuel
Cows	1,500	3,525	3,525
Volume	1.25 mil gal	3.0 mil gal	3.0 mil gal
Capital	\$3.72 mil	\$8.76 mil	\$9.51 mil
O&M	\$0.35 mil	\$1.57 mil	\$2.23 mil
Revenues	\$0.78 mil	\$2.33 mil	\$4.04 mil
Earnings	\$0.43 mil	\$0.76 mil	\$1.80 mil
NPV (10 yr)	-\$0.23 mil	-\$2.63 mil	\$5.12 mil
Simple Payback	8.7 yrs	11.6 yrs	5.3 yrs
with Grants	3.7 yrs	6.5 yrs	4.7 yrs

# Financing Considerations

- Tax obligations of ownership group (i.e., ability to use tax credits)
- Bank relationship(s)
- How will the grants be managed?
- Consider option for partner to own or develop energy or fuel production
- Consider forward sale for carbon credits

# Permitting Summary

- Start with the County Planning Dept.
  - Land-disturbing, construction
  - Shoreline permit
  - Flood hazard zone permit
- ORCAA – air quality permit for genset
- Ecology – solid waste exemption
- WSDA – nutrient management planning

# Questions?

