

THANK YOU



THANK YOU

Anaerobic Digester Feasibility Study and Business Plan Road Map for Dairy Farms in Florida

Summary of Findings

Florida Dairy Production Conference

April 28, 2009



Project Background

- **In October 2008, the Florida Farm Bureau Federation (FFBF) with 23 collaborating partners received a 2008 USDA VAPG to:**
 - Assess the feasibility of establishing a new renewable energy venture for dairy farms in Florida;
 - Hypothesis - farmers would install commercially-proven, modular, complete mix anaerobic digester technology to convert a mixture of on-farm animal manure and off-farm food waste into distributed renewable electricity and marketable co-products in an environmentally-friendly manner; and
 - Develop a bankable business plan road map to obtain future project funding / financing for the venture or identify barriers.



Why AD Was Examined

- 1. Dairy manure is a leading feedstock for renewable energy generation through newly improved and commercially proven technology.**
 - Dairy waste and energy+green attributes potentially become two new cash crops.
- 2. Marketable co-products (liquid fertilizers, soil amendments, etc.) can become potentially new revenue sources.**
- 3. Using of food waste significantly improves biogas production.**
 - Farmers receive food waste tipping fees – another source of new revenue.
- 4. AD is a solution platform for environmental enhancements (nutrient balance, farm odor reduction, GHG reductions, and local water quality improvements).**



Why AD Was Examined

5. Incentives are needed for renewable energy and rural development. Examples:

- Stimulus package for 2009 and 2010 enhances financing significantly.
- USDA programs – REAP and EQIP
- Key Administration agenda item.
- FL incentives.

6. Dairies can become the model for public private partnership to address renewable energy needs, improve the environment, and build sustainable FL dairies.

The Challenge

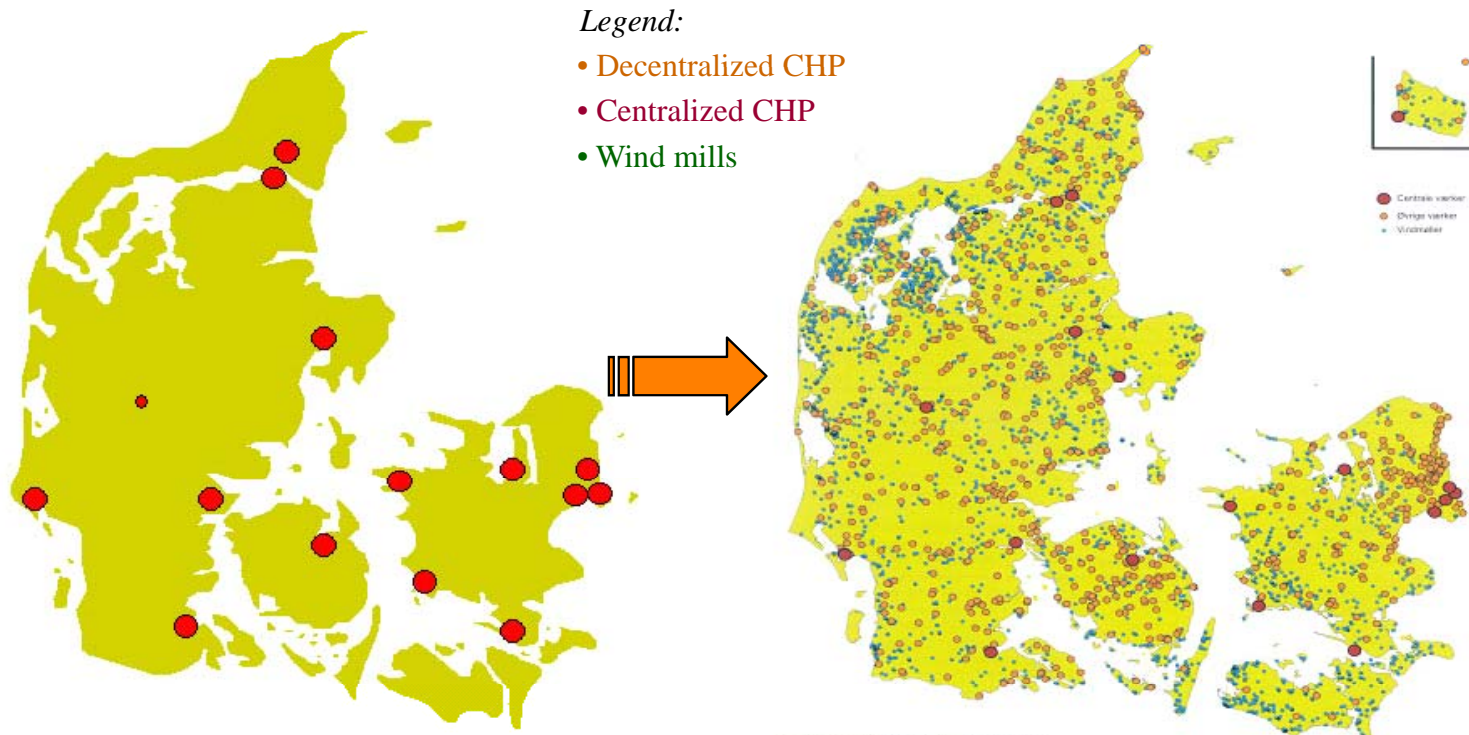
Develop a financially-feasible business model that creates scale for FL dairies to participate in renewable energy through AD.



Impact of Energy Policy on Energy Production, Denmark Example – AD and Policy Contributions

Centralized production in the mid 80's

Decentralized production of today



Cost per m3 (Denmark Example) (\$)

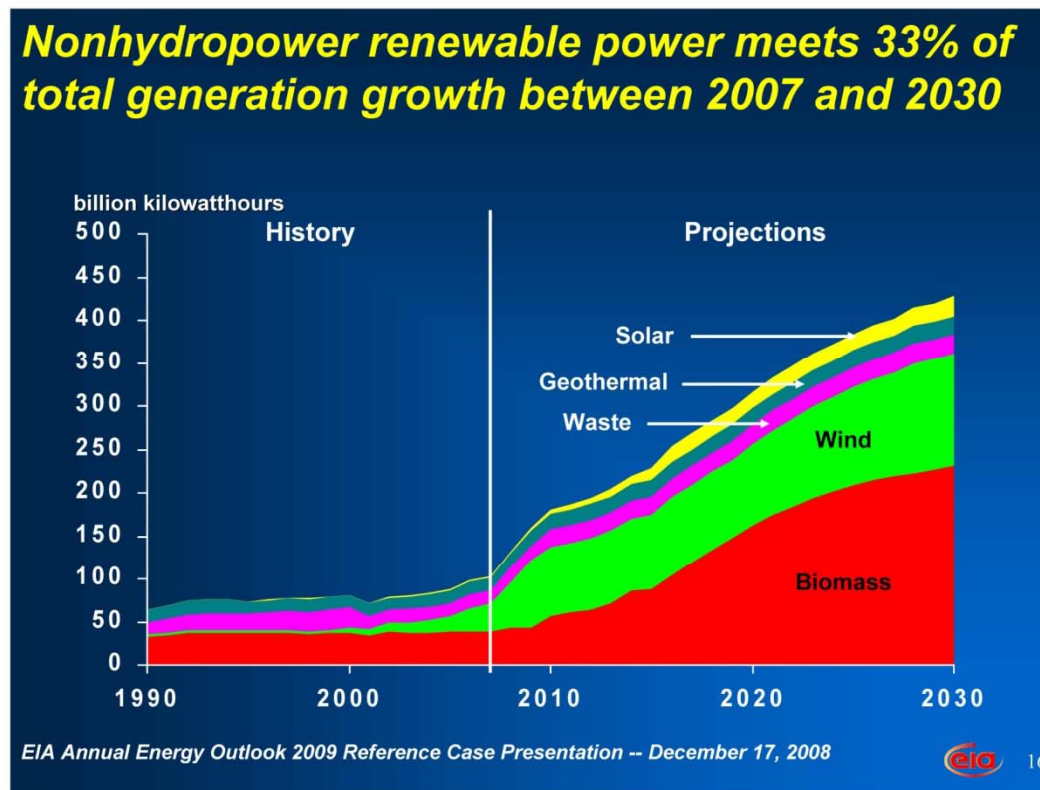
Natural gas	Biogas (pipeline quality)	Biogas (transported)	Biogas (onsite use)
\$.34	\$.77	\$.53	\$.51

Source: Tafdrup, Søren. "Agricultural biogas in the future Danish energy supply" 2008.

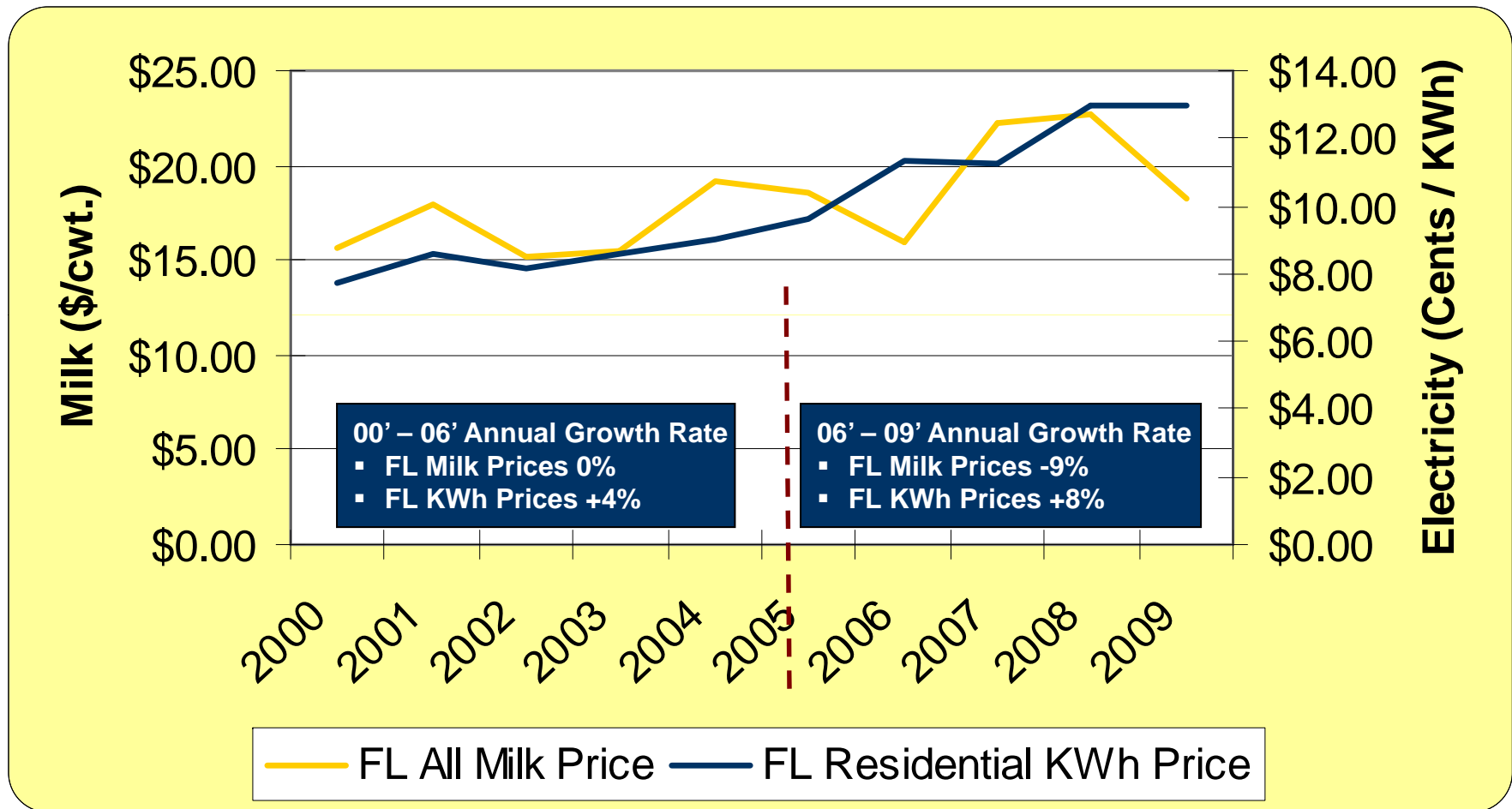


Why AD Was Examined – Renewable Power Markets

- Waste and biomass feedstocks will be a key sources for future renewable energy generation.



Why AD Was Examined – Electricity Prices Outpace Milk Prices in FL



Sources: USDA / AMS. Wisconsin Extension – Milk to all users (http://future.aae.wisc.edu/data/annual_values/by_area/10?tab=prices). EIA and FL PSC

Opportunity vs. Reality

- The opportunity of making renewables from waste is proven. We visited working installations.
- The market for electricity is more favorable than milk.
- Increased environmental concerns can be addressed by AD.
- Incentives are an imperative to financial success – FL and globally.
- What systems could work to make a renewables crop and address environmental concerns?
- How can farmers get funding?
- What incentives have to change to meet the needs?
- How do farm management practices have to change?



Business Models Assessed

1. Model #1: Single Farm AD LLC.

- Individual farmers each install a modular and scaled complete mix CHP AD, and establish an LLC to aggregate the marketing of power, co-products, and to have professional management run day-to-day business operations, including maintenance. Environmental issues are dealt with jointly.

2. Model #2: Community AD (*The Prison Model*).

- A group of farmers invest, with outsiders, in a centralized complete mix CHP AD system sited in proximity to a user of power and co-products, such as a prison, who also supplies food waste and other digestible feedstocks.
- Farmers deliver manure to the central digester and pick up separated solids and liquid to spread on cropland with excess used by prison maybe for energy crop.

3. Model #3: Covered lagoons vs. complete mix CHP AD – directional analysis.

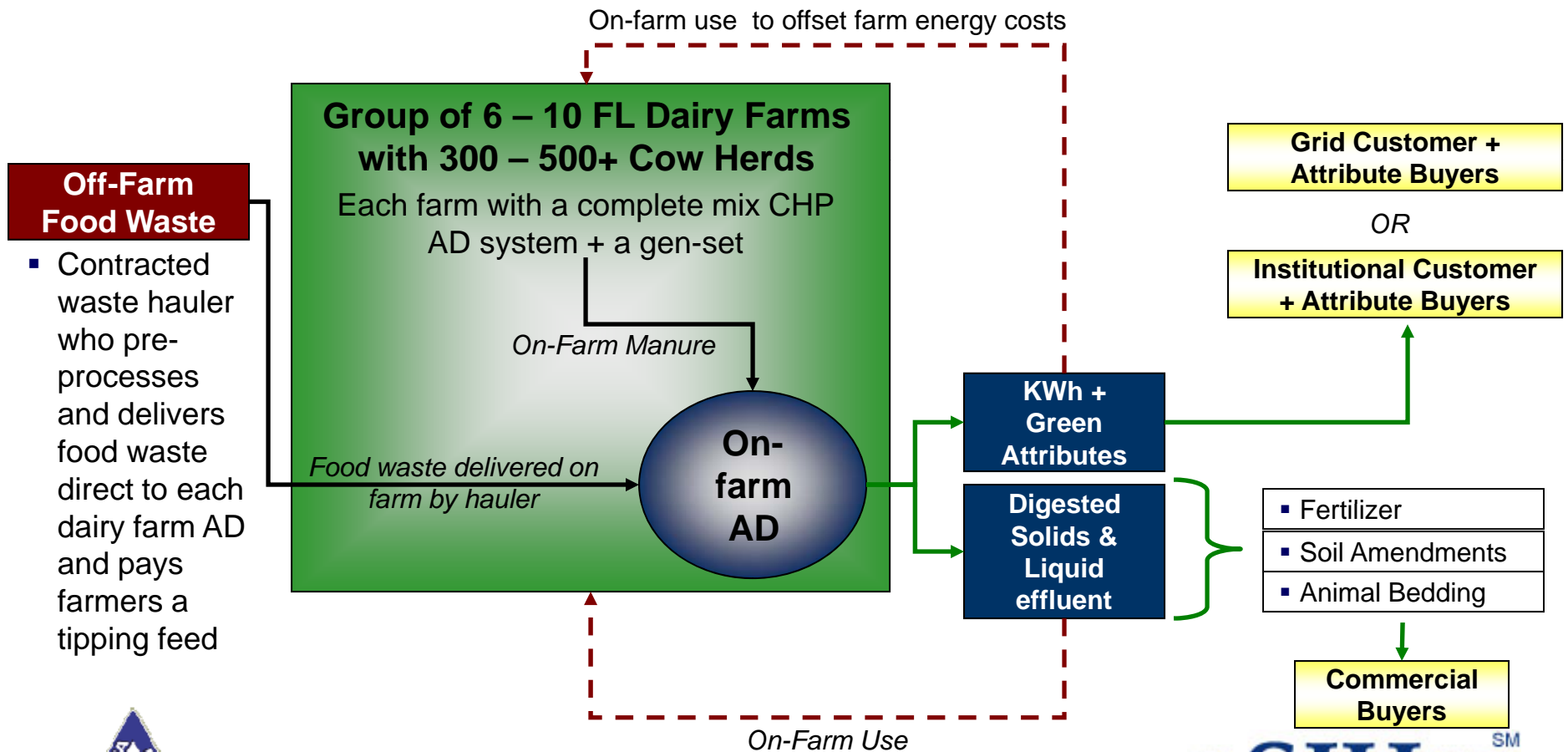
- Simpler but with limitations in energy source and environmental enhancements



Single Farm AD LLC Model

Envisioned Operating Dynamics

- An LLC is formed to professionally manage all business aspects for the farmers, from financing to maintenance to food waste sourcing and product off-take contracts.



Single Farm AD LLC Model – Why an LLC?

If the farmer built and managed AD individually, they would...

- Need to handle all off-take contracts for the energy, attributes, and co-products.
- One AD unit that alone would not be cost-effective as it won't produce enough electricity or co-products.
- Need to arrange, source, and negotiate their own contract for organic food waste, and will likely incur onsite pre-processing costs.
- Need to address nutrient management issues by themselves.
- Need to maintain and repair the unit themselves
- Need to finance the unit with more farm cash
- Need to sell and market all co-products

Individual farms need scale to manage operations, environment, and for financing.



Single Farm AD LLC Model – Why an LLC?

The LLC structure creates scale. The LLC would...

- **Professionally** build, run, and manage the AD unit with **performance guarantee**
- Have part ownership of the modular units to spread operating risks and meet contractual obligations.
- Handle all contracts (aggregates power, REC's, carbon credits, organic waste sourcing, and co-product sales at bulk prices) - scale leads to **better pricing.**
- **Ensure organic waste** deliveries enhancing production of gas / revenue from centralized facility
- Scale to **maximize process design** performance
- Full-time repair person with spare parts in region
- Allow each farmer better access to public and private funding / **financing.**
- Jointly market co-products and access add-on technologies for soil amendments
- Added income, sustainability, and access to constant improvements
- Add more cows with **environmentally approved removal** of effluent streams.



Single Farm AD LLC Model

Summary of Base Case Operating Performance Indicators

- The operating performance results indicate the single farm model is not attractive under the current base case assumptions.

Base Case Operating Performance (Not Attractive)	
IRR	-2.0%
Debt Service Coverage Ratio	0.64x
Simple Payback	>10 yrs.
\$ Return / Cow / Year*	-\$105

To Be Attractive the Single Farm AD LLC Project Needs to Minimally Achieve	
IRR	14%
Debt Service Coverage Ratio	1.46x
Simple Payback	6 yrs.
\$ Return / Cow / Year	\$272

*** Comparatively, the average return in FL for a purchased dairy cow is around \$400 / 5yr avg – but what happens if AD gives you *more cows* and a way to finance environmental improvements?**



Single Farm AD LLC Model – What Needs to Change?

To Be Bankable	
<ul style="list-style-type: none"> Price received / KWh 	<ul style="list-style-type: none"> >\$0.12/KWh + \$0.04/KWh for REC = Blended \$0.16/KWh, or 0.10 / KWh higher than the base case. Need adequate policy incentives – feed in tariff or net metering contract. Currently, these do not exist in FL.
<ul style="list-style-type: none"> Tipping fee for food waste 	<ul style="list-style-type: none"> >\$10/ton, or more than double the base case No established and organized food waste supply industry in FL. Only 6 compost sites. Change in DEP regs for farms. Work on grasses and silage as options.
<ul style="list-style-type: none"> FL Dairy Farm Practices 	<ul style="list-style-type: none"> Alternative approaches to the use of sand bedding and manure flush systems are needed for optimal AD systems. More process research for benefit and cost. Uses of waste heat

Recommend: Complete mix at UofF dairy to work options with State / DEP approval for reg changes to show it works!



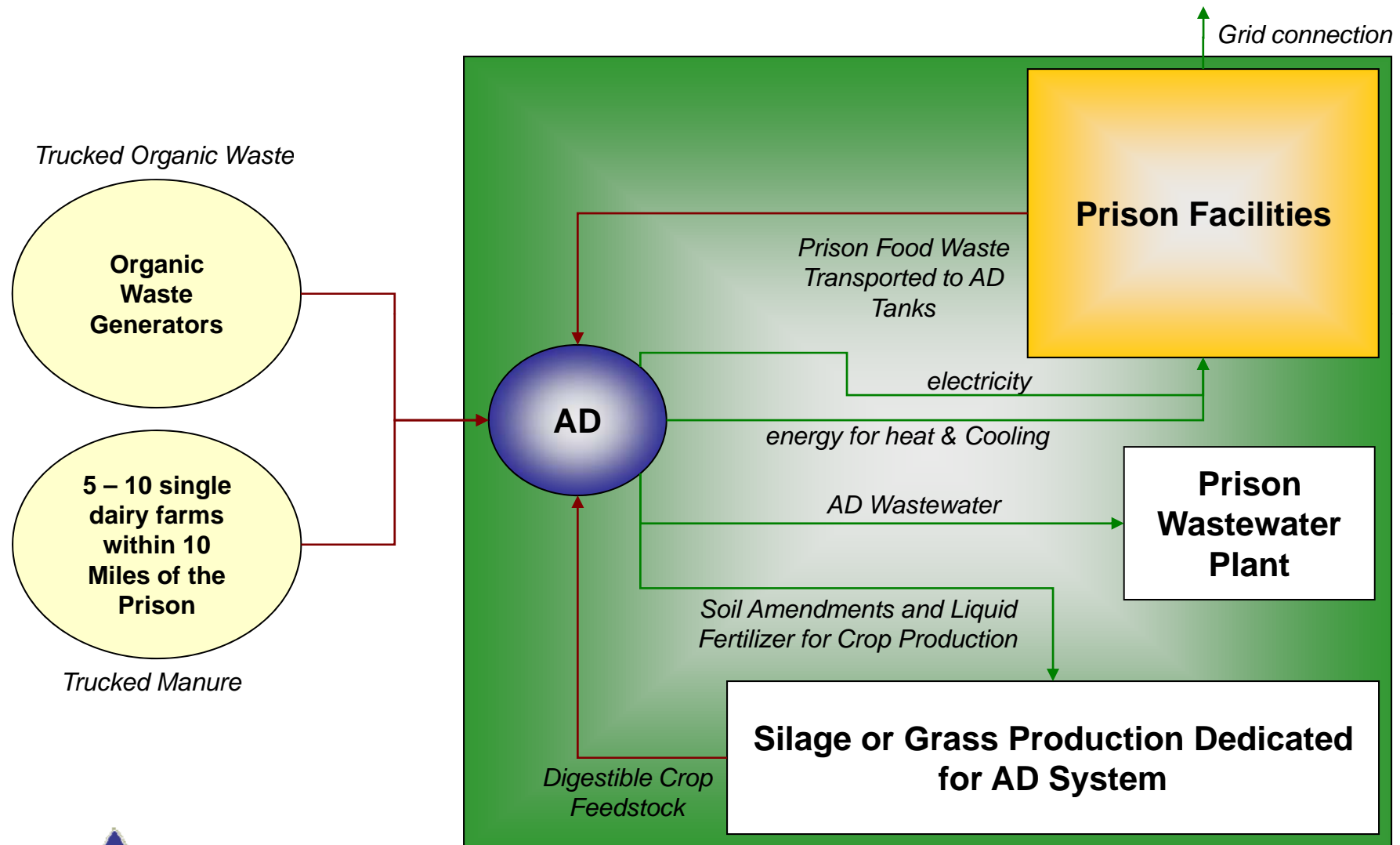
Energy Comparison to Existing Norms of Individual Dairy Farms

	Herd	kW (const.)	kW / Cow
Blue Spruce Farm	950	148	.16
Green Mountain Dairy	1,050	208	.20
Montagne Farms	680	159	.23
Berkshire Cow Power, LLC	1,500	399	.27
Maxwell's Neighborhood Energy, LLC	850	199	.23
Gervais Family Farm	950	89	.09
AgStar Average (Plugflow)	1,809	388	.20
AgStar Average (Complete Mix)	1,069	325	.29
Proposed CM w/ food waste system	350	210	.60

#These are VT farms and data from VT Dept of Ag, AgStar data, and SJH estimates



Community AD (Prison Model) Envisioned Operating Dynamics



Community AD (Prison Model)

Summary of Base Case Operating Performance Indicators

- The operating performance results indicate the Community AD (Prison Model) is not attractive, but path is clearer today. Key change – power contract and use of waste heat to cool prison.

Base Case Operating Performance (Not Attractive)	
IRR	3.0%
Debt Service Coverage Ratio	0.86x
Simple Payback	>10 yrs.
\$ Return / Cow / Year*	-\$63

To Be Attractive the Prison AD Project Needs to Achieve the Following <u>Minimum</u>	
IRR	21%
Debt Service Coverage Ratio	1.69x
Simple Payback	5 yrs.
\$ Return / Cow / Year	\$400

*** Comparatively, the average return in FL for a purchased dairy cow is around \$400 / 5yr avg – but what happens if AD gives you more cows and a way to finance environmental improvements?**



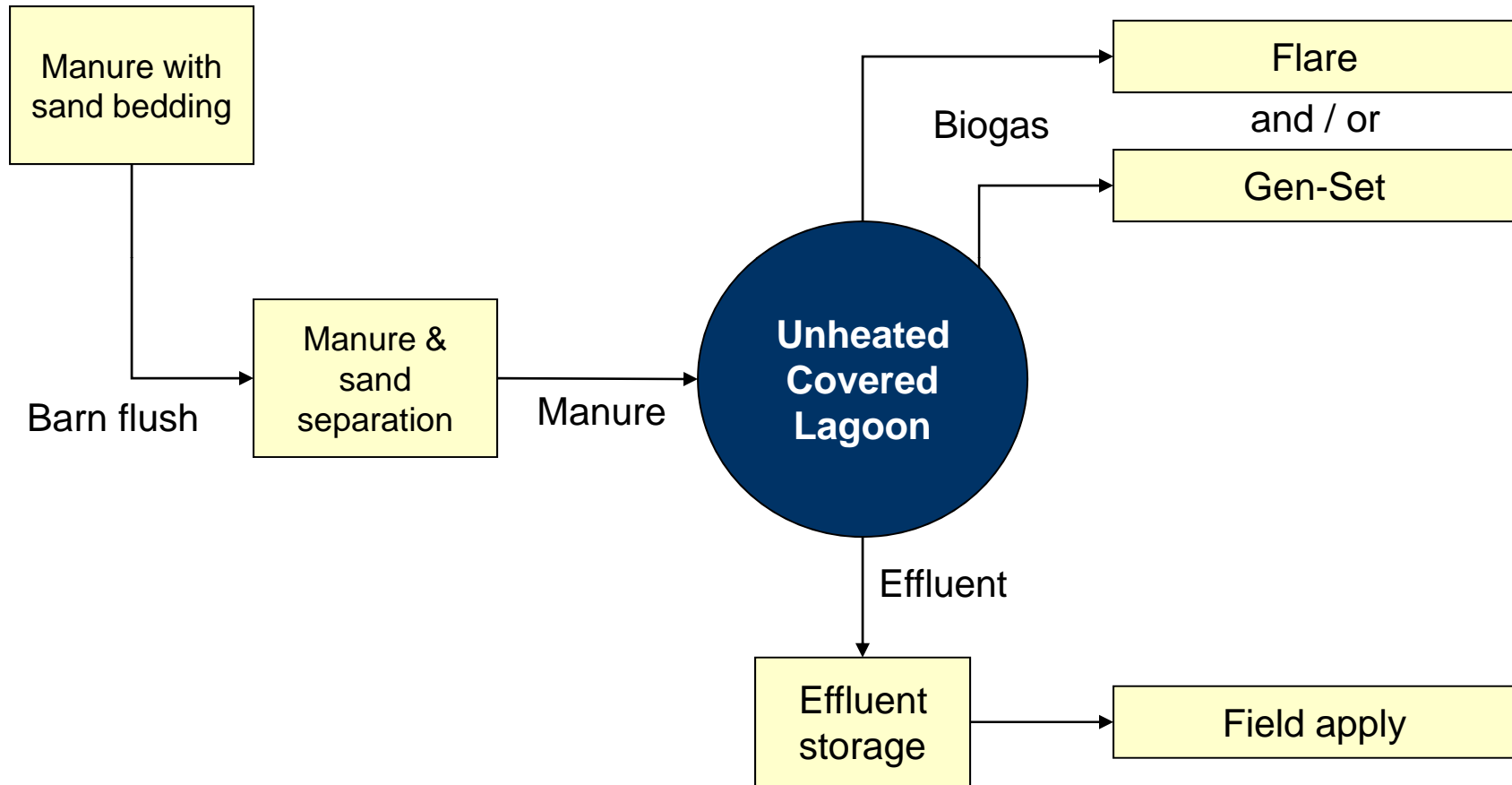
Community AD (Prison Model) – What Needs to Change?

To Be Bankable	
<ul style="list-style-type: none"> Price received / KWh 	<ul style="list-style-type: none"> Need long-term contract from the prison for >\$0.12/KWh + \$0.04/KWh for REC (Blended \$0.16/KWh), or 0.10 / KWh higher than base case. Use “waste heat” for cooling at prison – sell at retail price.
<ul style="list-style-type: none"> Tipping fee for food waste 	<ul style="list-style-type: none"> Need long-term sourcing contract with the prison and/or another source for 137k ga/day of food waste - tipping fee >\$10/ton, or double the fees used in the base case.
<ul style="list-style-type: none"> FL Dairy Farm Practices 	<ul style="list-style-type: none"> Alternative farm management approaches to the use of sand bedding and manure flush systems are needed. Added process research. Work on silage and grass as feedstock.

Recommend: Complete mix at UofF dairy farm to work options with State / DEP approval for reg changes to show it works!



Covered Lagoon Example – Operating Dynamics



Complete Mix CHP AD vs. Covered Lagoons

	Complete Mix	Covered Lagoon
Design	Turn-key, Modular, scalable, movable asset	Fixed, non-recoverable asset
Feedstocks	40 / 60% manure: food waste	100% manure and recycled flush water
Cost	\$2,200,000	\$550,000
kW (net)	310	61
Farm Usage (kWh/year)	1.5 million	1.5 million
Electricity Produced (kWh)	2.7 million	534,000
Electricity income/avoided cost (kWh and RECs)	\$434,496	\$85,653
Other Income (tipping fee, \$10/ton)	\$115,000	0
Bedding cost reduction	use digested solids	use recovered sand

Total Revenue	\$549,496	\$85,653
O&M	\$173,000	\$43,700
Income after Expenses	\$376,496	\$41,953
Simple Payback (years)	6	13



Why Complete Mix CHP AD vs. Covered Lagoons

- **Commercial products for both technologies exist, but...**
 - Even under favorable conditions a covered lagoon takes 10+ years to payback.
 - A covered lagoon will not generate enough electricity to match the farm's load.
 - A covered lagoon fails to open up new sources of income (tipping fees, separated solids) and does little to modify farm water use.
 - Covered lagoons provide less odor reduction, use more water as require greater water cleaning, and limit a farms nutrient management options (i.e, remove less nutrients)

Covered Lagoon digesters are a 'small step' with few business and environmental rewards / benefits

Complete Mix digesters are a 'large step' with many business and environmental rewards / benefits










Overall Conclusions

- **Both the Single Farm LLC AD and the Community (Prison) model using commercially-proven, turn key, modular AD technology could be attractive but...**
- **Environmentally strong benefits for issues now and future.**
- **Both models can be bankable distributed power / environmental enhancement ventures for independent dairy farmers to:**
 - Make manure a new revenue generating cash crop for the farm and create new farm revenue sources via tipping fees and future co-product sales – sustainable diversification;
 - Reduce environmental pressures by significantly improving air quality via odor reduction, and water quality via displacement of P and more efficient use of N or with water removal to waste water.
- **However there are certain barriers to be resolved before moving forward. Demonstration research needed to address all of these and inform policy changes with proof.**



Conclusions - Challenges to Overcome

Criteria for Success	Florida Today	Challenges to Overcome
1. A group of 6 – 10 dairy farmer-investors who each meet the following:		This group needs to be identified.
a. 300 – 500 milking cows		
b. Scrape manure collection		Majority use flush that increase moisture content and decrease AD efficiency. U of F work on options and costs/benefits
c. Store manure at 7% TS content		Average <1% TS content of stored manure in FL today. Need U of F work to increase TS % with change in practices.
d. Use organic materials to bed cows (no sand)		Majority use sand that reduced complete mix AD and harms systems. U of F work for alternatives to switch from sand to digestible bedding materials.
e. Have current or future environmental issues (water, air, manure spreading)		Ongoing environmental pressures increase with new spreading regulations.
f. Have access to three-phased power in close proximity to the farm		Most, if not all, farms have available









Does not meet criteria

Meets criteria

Needs TBD



Conclusions - Challenges to Overcome (cont.)

Criteria for Success	Florida Today	Challenges to Overcome
2. Long-term power purchase agreement(s) @ a blended (KWh+Recs) rate >\$0.16 / KWh		Requires policy change in feed in tariff or net metering contract to meet objectives for bank
3. Adequate net metering and intent by state legislative body to promote renewable power		FL net metering / policies, RPS, carbon credits are not adequate today
4. Have an organized food waste hauling contracts. Solid waste is only category.		Industry does not yet exist in FL. Needs DEP reg alternation to make food waste and AD acceptable.
5. Incentives / allowances for the diversion of food waste from generators to farms		
6. Receive food waste tipping fees >\$10 / ton		Only solid waste exists today and is \$20 to \$25 per ton without separation.
7. Access to equity and capital		TBD and will be subject to meeting other key success criteria.
8. Have strong support from Farm Bureau and Collaborators		Without doubt FL dairies have this
9. Vibrant dairy economy		Milk prices are low today with signs of recovering

Does not meet criteria

Meets criteria

Needs TBD



What is Needed for the Ideal Market to Enter?

Farms

Scrape facilities

Use, or willing to switch to organic bedding

Truck Access (25 ton loads)

3 phase power service

Existing heat demand and waste heat user

350-1,000 cows, or ability to aggregate

Fields with slight or no slope

Desire to control odor or environmental challenge

Organics

Existing waste hauler

Allowances and incentives for organic waste diversion

Market size and current Cost of disposal

Proximity

Co-products

Organic fertilizer market

Soil amendment market

Energy

Utilities

Workable net metering or feed-in tariff

Sale of excess electricity at close to retail

Interconnection requirement

Long term utility contract

Attributes

Not bundled with energy

Cash Market

Funding

Grant Programs

Short turn around for equity

Loan Programs

Construction loans

Equipment loans

Bonds



Recommendations

- 1. Proceed with University of Florida dairy farm facility to prove out changes in policy, regulations, farm management, nutrient management, and organic waste sources.**
- 2. Lobby for policy solutions to get revenue enhancements with environmental solutions.**
 - Workable net metering, Feed-In Tariffs actions at $> \$0.16/\text{KWh}$ (KWh+Rec's).
- 3. Support the development of an organized organic food waste sourcing and hauling system with tipping fees of \$10/ton.**
 - Work with DEP for allowances to divert food waste from generators to farms.
 - Development work at UofF on organics – food and forage
- 4. Develop a financeable plan using a group of 4 – 10 single FL dairy farmers using scrape and non-sand bedding with grant programs. Timing.**



Recommendations

5. **Work with State Corrections on plan for the community (prison) AD model using State contracting.**

6. **U of F development efforts :**

- Demonstrate alternatives to the traditional use of sand bedding to enhance AD efficiency.
- Demonstrate scrape collection and economics.
- Demonstrate the availability, logistics and transportation, preparation of off-farm sourced organic food waste feedstock.
- Demonstrate the availability, production, harvesting, logistics of alternative feedstocks, grasses and silage, that can mitigate feedstock supply risks.
- Demonstrate plant for farm nutrients.

The University of Florida has already submitted a pre-application to USDA / DOE. Also need State Stimulus funding.



Recommendations - University of FL Dairy Site

- University of Florida co- invests in a complete mix CHP AD system on its dairy farm.
- U of FL demonstrates economics, regulatory change model, outside equity model, feedstock options, nutrient planning, and herd management enhancements.**

	University of Florida
Design	Mesophilic, Complete Mix
Feedstocks	40 / 60% manure/ food waste & ag. products
Project Cost	\$2,700,000
kW (net)	310
Farm Usage (kWh/year)	1.5 million
Electricity Produced (kWh)	2.7 million
Debt/Equity ratio	60/40
Fulltime personnel	1
Energy Income (at \$.06/kWh + RECs \$.04/kWh)	\$281,000
Tipping Fee Income (at \$5/ton)	\$45,000



Take Aways

1. AD can be a **cash crop** and environmental solution for dairy.
2. **Technology works.**
3. **Policy changes** – **power rates**, contracts, and DEP for waste are key changes. They make it bankable.
4. **Next step from our work**
 1. Put up a **working model** on U of F where all the above will be allowed to work. “Show me the money!!!” This will beget policy changes.
 2. Maximize efforts with VAG and grants for farms.



Thank You

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