INTEGRATING AN ECONOMICALLY VIABLE SOLUTION WITH INCREASING AIR QUALITY CHALLENGES

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AGRICULTURAL WASTE SOLUTIONS, INC.

AUGUST, 2010

AWS Site at Inland Empire Utilities Agency (IEUA)

Site of 650 ton/day Dairy Waste Digester

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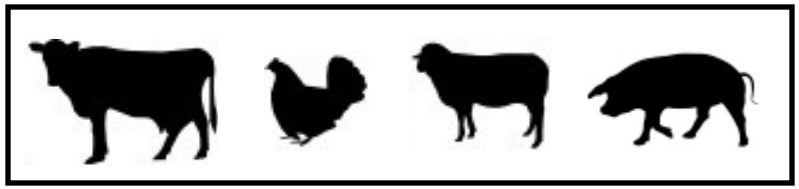
AWS Process



Growing Barn

Reusable Flush Water

Flushed Animal Waste

Solids Recovery Module (“SRM”)

Separated Solids

Gas Production Module (“GPM”)

Syngas

Energy Production Module (“EPM”)

Renewable Diesel

Electricity and/or

Heat and/or

Treated Water

Storage / Irrigation System

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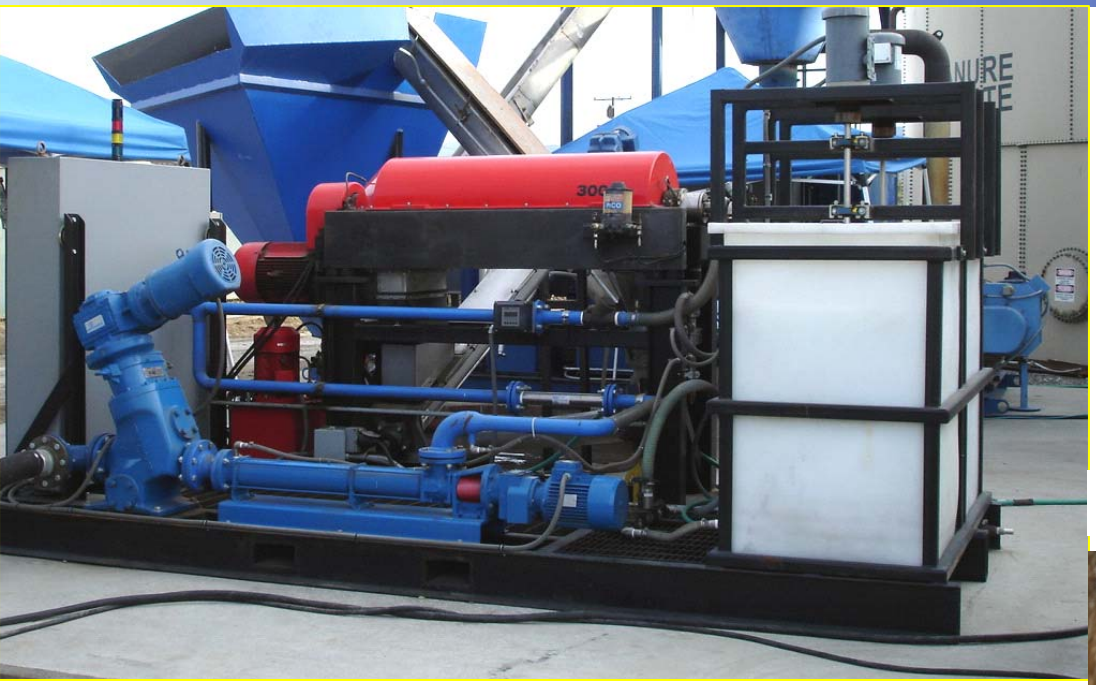
AWS Waste-to-Energy System

- Patented process: early, effective separation traps nutrients, abates odors and GHG emissions, increases energy value
- Real-time, closed-loop process reduces size, costs, and storage
- Meets standards for South Coast Air Quality Management District ("SCAQMD" – the most stringent air quality district)
  - PM: 0 lbs/MMBTU/hr., SO_X & VOC: 0
  - NO_X: < 30 PPM at 3% oxygen (actual = 20 PPM @ .75 ton/hr.)
  - CO: < 100 PPM (actual = 0 PPM @ .75 ton/hr.)
- First SCAQMD permit for animal waste gasification
- High-Btu gas, chemical composition/ratios promote excellent conversion to renewable diesel fuel
- > 75% GHG emission reductions
- 3 year ROE on projects above 3 tons/hour

AWS Solids Recovery Module – On Farm



Skid mounted for on-farm installation

Input TSS=8470 m/l **Output TSS = 96 mg/l**

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AWS Solids Recovery Module Trials

Trials conducted on swine and dairy wastes

Type	Species	TKN	NH3N	TP	COD	TS	TSS	K	CU	ZN	Moisture
Lagoon	Swine	62%	31%	85%	85%	81%	99%	38%	99%	99%	61%
Lagoon	Dairy	64%	35%	87%	90%	83%	99%	36%	93%	99%	63%
Fresh	Swine	71%	40%	93%	97%	85%	99%	51%	99%	99%	72%
Fresh	Dairy	70%	56%	91%	91%	81%	97%	42%	90%	99%	72%
Average Reductions		67%	39%	90%	92%	82%	99%	40%	95%	99%	67%

- Removals of 90% P, 67% N, 40% salts, 99.5% metals, 97% COD
- 99% of total suspended solids removed
- Solids moisture = 67%
- Chemical = $38/cow/yr., Electricity = $13/cow/yr.

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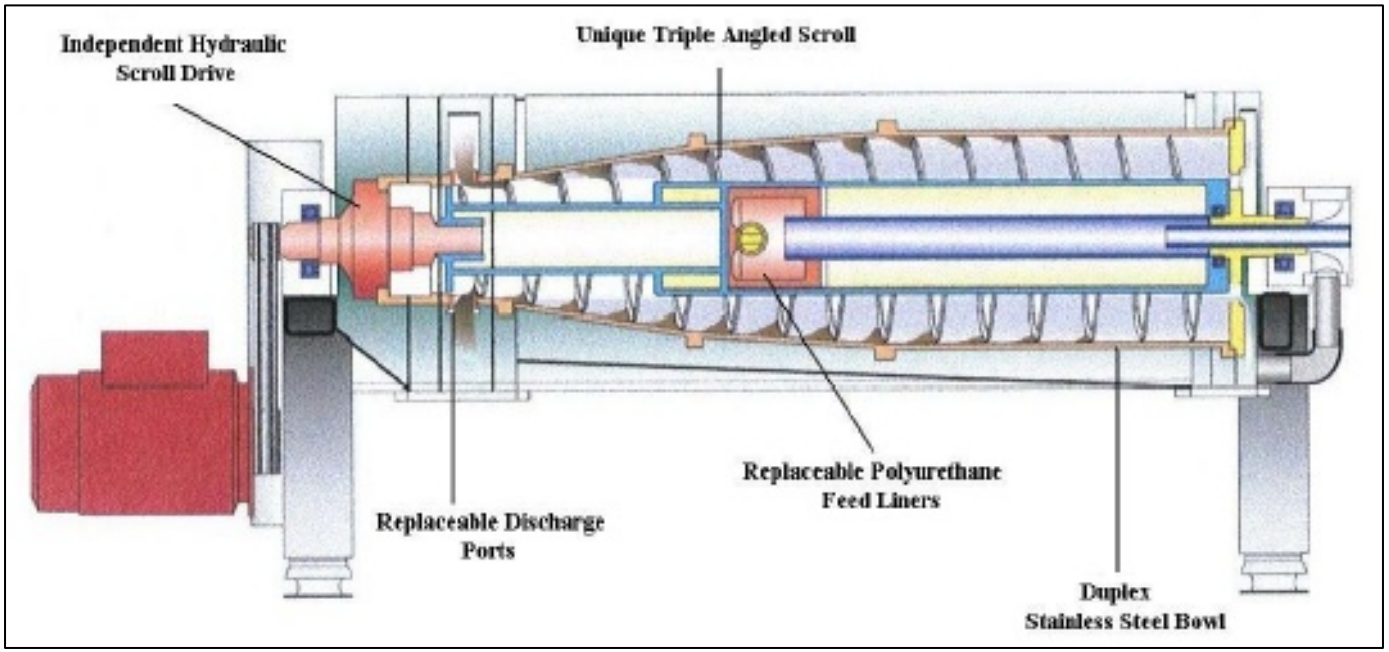
AWS Solids Recovery Module



- Higher speeds (4500 rpm), higher “G” force (3400), scroll can lead/lag
- Higher compression, lower torque due to 2 conical design, 3 angle scroll
- Auto adjust for torque load, pressure – changes in feed material
- Continuous cleaning, very low maintenance, automated control panel
- Higher removal of smaller particle sizes, drier solids

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AWS Gas Production Module – On Large Farm or Centralized

- Converts > 90% of input solids into bio-syngas, leaving < 10% marketable ash
- Indirect heating: Does not mix flue & combustion gas, no air, continuous feed/ash discharge
- High Btu bio-syngas (CxHy, CO, H2, CO2, N) drives electricity/heat generation or conversion to diesel
- Low NO_X burner: < 9 PPM above 3 MMBtu

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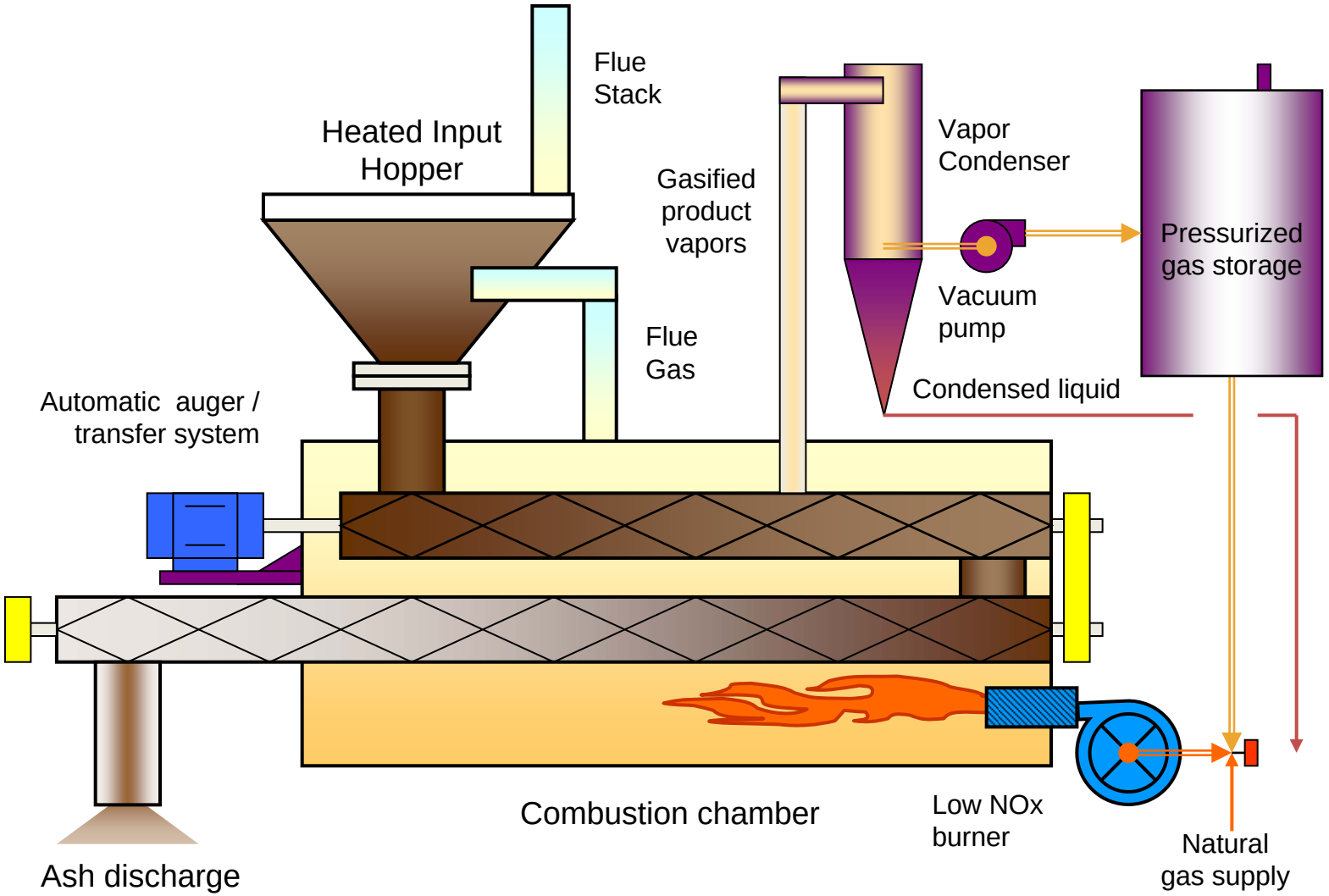
AWS Gas Production Module



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AWS Liquid Fuel Module - On Large Farm or Centralized

Fischer - Tropsch Process Steps

1) Clean gas to remove H2S, CO2

2) Gas saturated w/steam, heated and pressurized to reform into H2, CO;

Higher Btu gas means more H2 and CO = more diesel produced

$CH_4 + H_2O = CO + 3H_2$

$C_2H_6 + 2\,H_2O = 2\,CO + 5H_2$

$C_3H_6 + 3\,H_2O = 3\,CO + 7H_2$

… and the process continues

3) Gas cooled, pressurized, bubbled through heated slurry with catalyst

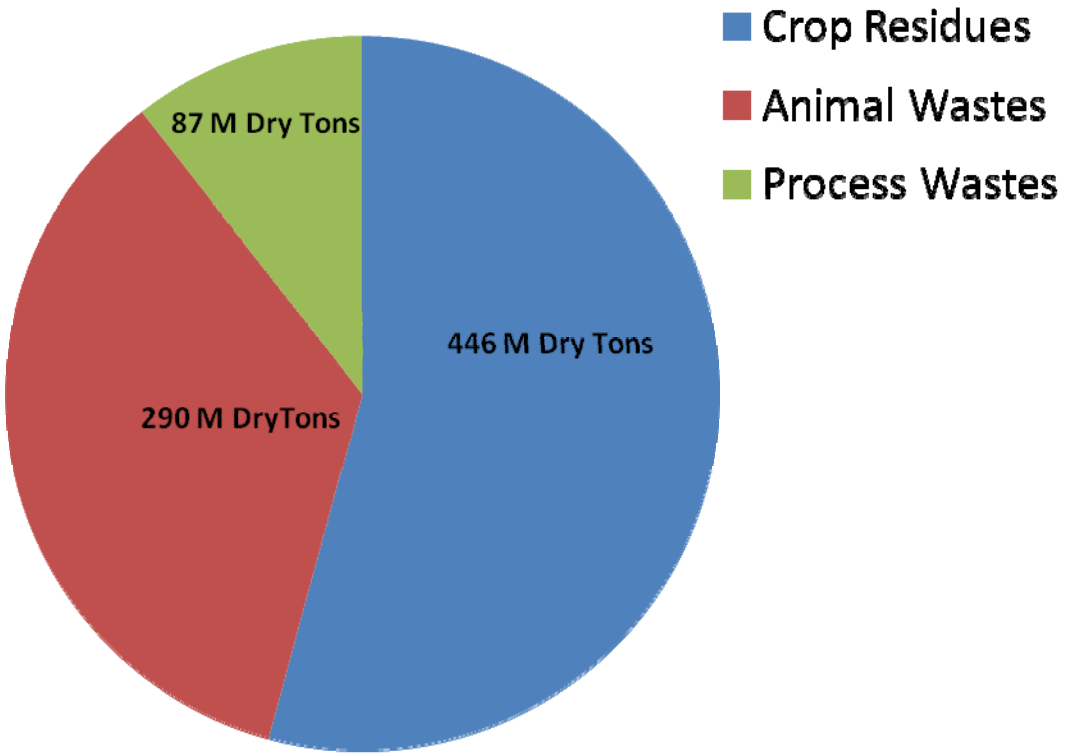
4) Gas converted into ~65% biofuel, ~35% gas

5) Residual gas re-circulated to make more fuel or for other gas needs

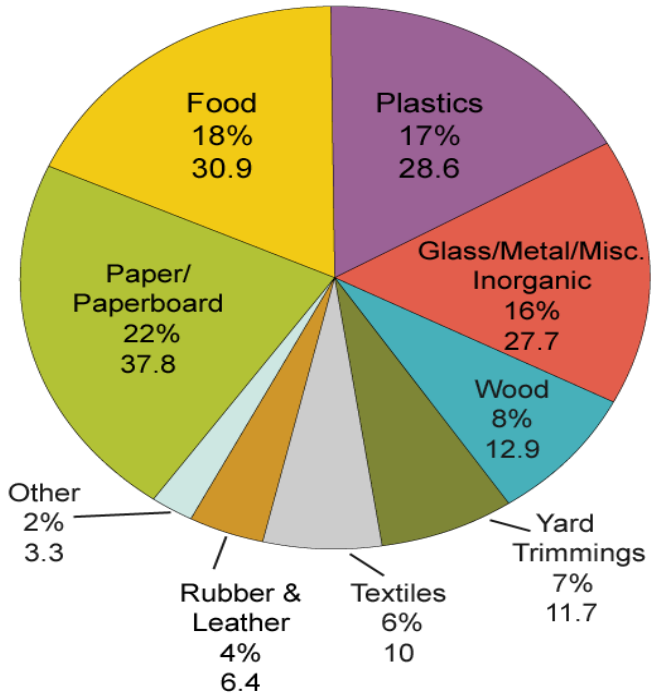
Why Choose Renewable Diesel?

- AWS bio-syngas is an excellent, high-yield feedstock
- F-T is 80 year-old process, economically viable for farms
- Best economic returns versus electricity/heat and gas
- Most utilized energy form in agricultural areas
- Demand > supply, revenues $3 - $4 per gallon with credits
- Cleanest burning diesel = lower emissions of sulfur, nitrogen oxides, carbon dioxide, particulates
- Easily stored, transported, and marketed (locally)
- No utility interconnects or regulated energy pricing
- EISA requires 8x current biomass-based diesel by 2022

Annual U.S. Agricultural Wastes



Content of MSW Landfilled or Burned, 2007
(Millions of tons, total: 169.2)



Source: U.S. Environmental Protection Agency, Municipal Solid Waste in the United States: Facts and Figures (2007). http://www.epa.gov/waste/nonhaz/municipal/msw99.htm#links

<u>Agricultural Wastes with 50% Availability</u>

5.5% of total US fuel demand with negative GHGE, very low use of carbon resources, no additional crop land (reduced), no impact on food supply

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EISA Renewable Fuel Requirements

EISA Renewable Fuel Volume Requirements (billion gallons)

Year	Cellulosic biofuel requirement	Biomass-based diesel requirement	Total Advanced biofuel requirement	Total renewable fuel requirement
2008	n/a	n/a	n/a	9.0
2009	n/a	0.5	0.6	11.1
2010	0.1	0.65	0.95	12.95
2011	0.25	0.80	1.35	13.95
2012	0.5	1.0	2.0	15.2
2013	1.0	a	2.75	16.55
2014	1.75	a	3.75	18.15
2015	3.0	a	5.5	20.5
2016	4.25	a	7.25	22.25
2017	5.5	a	9.0	24.0
2018	7.0	a	11.0	26.0
2019	8.5	a	13.0	28.0
2020	10.5	a	15.0	30.0
2021	13.5	a	18.0	33.0
2022	16.0	a	21.0	36.0
2023+	b	b	b	b

[a] *To be determined by EPA through a future rulemaking, but no less than 1.0 billion gallons.*

[b] *To be determined by EPA through a future rulemaking.*

Assuming 50% feedstock availability:

- Agricultural crop residues could produce17 billion gallons of cellulosic ethanol

- Animal and process wastes could produce 12 billion gallons of renewable diesel

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AWS System versus Digester Technology

Digestion is the only waste-to-energy system in significant use today, although adoption has been limited

	Digester	AWS System
Solids Remaining in Treated Water	10%	2%
Minimum Liquids Required in System Input	92%	0%
Gas Volume Produced	x	2x
Approximate Btu per Cubic Foot of Gas Produced	400 – 600	800 – 1100
Power Produced	x	3-4x
Cost of 1 kWh of Electricity	$0.087	$0.023
Footprint of Land Used	Up To 2 Acres	25 x 35 Foot Pad
Other Byproducts	33% Slurry (needs to be treated)	< 5% Ash (can be sold)

Digester statistics based on the Western United Dairyman's Report (Aug. 2005) regarding 16 digesters in use in the dairy industry

AWS statistics based on the Demonstration System in Chino, CA

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GHG Emissions

AWS 4 ton/hour system (3,750 dairy cows – 6 farms)

Compared with protocol developed by IEUA under Commerce Energy/California Energy Commission PIER Program

Methane Baseline	8138 tons/yr. CH4
AWS Reduction	- 6006 tons/yr. CH4 CO2E
Nitrous Oxide Baseline	6210 tons/yr. N2O CO2E
AWS Reduction	- 5084 tons/yr. N2O CO2E
Total AWS Reduction	11,090 tons/yr. CHG CO2E(77.3%)

Manure Baseline: transportation, land application, lagoons, composting, leaching/runoff, milking barns, corrals

AWS Renewable Diesel System Returns

System Size:	1 ton / hour	2.5 tons / hour	7.5 tons / hour	11 tons / hour
Cost Per Gallon (w/o tax credits)	$3.00 - $3.50	$1.90 - $2.25	$1.30 - $1.45	$1.25 - $1.40
Years Payback on Equity	11-14	3-5	2-3	1.5-2.5
Annual Return on Capex	7 - 9%	20 - 30%	35 - 50%	45 - 65%

Basic Assumptions: 1) Capex life = 20 years with 70% debt for 10 years, 2) Ash revenues included, no carbon credits 3) No manure abatement revenue or cost of manure is included, 4) Diesel costs do not include tax credits; biodiesel credits are included in revenues 5) no other tax credits or governmental benefits included, 6) gas by-product re-circulated to produce higher diesel volumes

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AWS Projects Under Development; Project Financing

California

- Western Riverside County Agricultural Coalition (WRCAC)26 dairies - 35,000 cows in San Jacinto Watershed
  - Awarded California Energy Commission Grant PON-09-604 (Alternative and Renewable Transportation Fuels)
  - As a group, WRCAC must meet critical reductions in groundwater, surface water, air emissions, nutrients and salts by 2012 or all 26 dairies will lose their CAFO permits
- 4800 dairy - San Joaquin Valley

Colorado—20,000 beef feedlot (1 of 6)

Utah—1 million hen poultry layer farm

Thank You!