Inland Empire
Dairy Manure to Energy
“Cow Power”
Renewable Energy Program

April 2007
IEUA’s Service Area is in Southern California
IEUA Profile: Municipal Water Agency

- IEUA is a public water and wastewater utility

- IEUA supplies imported water, recycled water and collects, treats and disposes of wastewater for six cities and two water districts

- Serves about 800,000 people within a 242 square mile service area

- Owns and operates five wastewater treatment facilities (60 million gallons per day)

- Operates, with Los Angeles County Sanitation Districts, the largest enclosed composter in the state for processing of biosolids

- Produces 185 tons of Class B biosolids per day
IEUA’s Energy Challenges

- Current energy load is 7 MW (average) and 9 MW (Peak); annual energy budget is over $5 million

- IEUA’s energy load is expected to grow 180% by 2010 due to increased wastewater treatment, composting and recycled water pumping

- Energy costs will grow significantly over the next five years. Current rate increases in California included 25% for electricity and 75% for natural gas

- IEUA current self generates 43% of its electricity and 64% of the gas used to produce power – estimated annual savings of $1.2 million
IEUA’s Water Challenges

- Chino Groundwater Basin is one of the largest sources of groundwater in Southern California.

- Water from the Chino Basin supports 1 million people every day.

- The Chino Basin can store up to 500,000 acre-feet of water – equivalent to the available storage in the Diamond Valley Reservoir (Southern California’s largest surface water supply).

- Use of Chino Basin groundwater is key to “drought-proofing” the region and reduces reliance on imported water from northern California during droughts.

- Rapid population growth within IEUA’s service (population to almost double in the next twenty years) makes need to protect and use groundwater resources of paramount importance.
But the Chino Groundwater Basin is also home to the largest concentration of dairies in the nation

- Over 200 dairy farms and over 200,000 cows, heifers and calves
- Produce over 800,000 tons of manure annually
- Agricultural runoff has made many local groundwater reserves unsuitable for direct human consumption without further treatment
- Air quality concerns in rapidly urbanizing area – dust, odor, ammonia and volatile organic compound emissions
- Greenhouse gas concerns – methane and nitrous oxide emissions
- Wastes -- including 38,000 tons of salt per year that seep into the ground and river – that if unmanaged would continue to degrade local waters with salts, nitrogen and other soluble organics
Chino Basin Concern: The Environmental Impact

- $1 Billion Dairy Industry
- 200,000 Cows
- Air emissions
- Salts & Nutrients
- Water Supply
- Wildlife / Wetlands

Orange County
IEUA’s Energy Strategies

- Seven Point Energy Plan implemented since 2001 to minimize IEUA’s energy costs. Key elements include:
  - Incorporate energy efficiency best practices in all operations, including construction of Platinum LEED headquarters
  - Shift all possible peak loads to partial and off-peak periods
  - Reduce dependence on high energy intensity water supplies through conservation and use of local resources
  - Maximize digester gas production and renewable energy generation using existing anaerobic digesters
  - Develop new local energy resources including conversion of dairy manure and other organics to methane gas – 3 MW total expected additional generation within next three years
Dairies located within 1 to 5 miles from RP-1 and RP-5 Manure Digesters
Chino Basin Organics Management Strategy

Dairies

Manure
Wash Water

Biosolids

Biodigester

Green & Food Residuals

Energy
Air Quality

Nutrients
Compost
RP-5 Renewable Energy Project

Manure Digester Phase Overview

- Phase Ia  Plug Flow Digester  500 kW  
  (California Energy Commission,  
  U.S. Natural Resources Conservation 
  Service)

- Phase Ib Expansion & Modification 1,000 kW 
  (California Dairy Power Production Program 
  Grant)

- Phase II European-design Digester 1,500 kW 
  First European design in Nation 
  (California Energy Commission,  
  Milk Producers Council)

Total Planned Digester Energy:  3,000 kW
Renewable Energy Efficiency Project

- Two 1,500 KW engine generator systems
- One 200 kW Organic Rankine Cycle (ORC) for secondary power generation
- One 55 kW Stirling Engine generator
- Thermal Energy Storage for chilled water storage
- Digester and Biogas network connection RP-2, RP5 Complex and Desalter Plant
- Secondary effluent cooling water system
Methane Gas Connections Between Major IEUA Facilities
Current Methane Gas Production: Phase Ib

- Average daily gas production for total grant payback by 12/31/2008
- Average daily gas production for total grant payback by 3/31/2011
- WURD Baseline

Graph showing:
- Digester Temperature (deg F)
- Biogas Production (1,000 Cubic Ft)
- Manure Deliveries (Wet Tons)

Key dates:
- 1/1/2006
- 2/1/2006
- 3/1/2006
- 4/1/2006
- 5/1/2006
- 6/1/2006
- 7/1/2006
- 8/1/2006
- 9/1/2006
- 10/1/2006
- 11/1/2006
- 12/1/2006
- 1/1/2007
- 2/1/2007
- 3/1/2007
- 1/1/2008
- 2/1/2008
- 3/31/2008
- 12/31/2008

Legend:
- Blue line: Manure Deliveries (Wet Tons)
- Red line: Digester Temperature (deg F)
- Black line: Biogas Production (1,000 Cubic Ft)
Co-digestion Results: Commerce Energy/California Energy Commission PIER*

Manure Co-digestion: improved performance

Co-digestion Results: Commerce Energy/California Energy Commission PIER

Manure Co-digestion: **improved gas generation**

![Graph showing RP-1 Digester 4 Biogas Production](image)

- **Observed Acclimated System Average Biogas**
- **Expected Biogas**
- **Baseline**
- **Codigestion**
IEUA TESTS
Digester Gas Flow

Digester #4

- **Manure** (25,700 gal)
- **Cream** (5,850 gal)
- **Salad Dressing** (5,000 gal)
- **Lactose** (4,650 gal)

**Baseline:** Manure Only (22,100 gal)

- **Manure** (28,600 gal) over 2.5 hours
- **Cream** (4,000 gal) over 4 hours
- **Manure** (19,400 gal) over 4 hours
- **Salad Dressing** (1,000 gal) over 4 hours

Time:
- 8:00 AM to 6:00 PM

Digester Gas Flow, cft/hr:
- 0 to 13,000
Findings and Next Steps

- Co-digestion Bench Scale Test Findings:
  - Sludge de-waterability, gas quality, and filtrate quality need to be monitored at full scale
  - Co-digestion of food waste produces more gas than anticipated
  - Different food wastes produce differing gas quality (hydrogen sulfide, siloxane, moisture) which can impact required gas cleaning technology
  - Need to evaluate and upgrade digester gas system to handle gas generation
  - Need to provide additional food waste storage in order to enhance smooth, continuous feed of food waste into digester

- RP5 Phase 1b will continue ramping up manure deliveries and is expected to start receiving food waste by May/June 2007

- IEUA consulting with European experts to design food waste protocol for Phase 1b and Phase II

- RP5 Phase II European Design Digesters will be begin start-up procedures in June 2007

- Recycled Plant No 1 (biosolids digester): Addition of food waste storage and pumping system to enhance digester gas production. IEUA will host a planning charrette in May 2007 to develop a research design that will be incorporated into RP-1 Bench Scale Testing protocol
## Phase 1a Digester Performance

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Performance Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Quality</strong></td>
<td>Manure Processed: 10,264 tons (corral equivalent)</td>
</tr>
<tr>
<td></td>
<td>(7 dairies, estimated 6,250 cows)</td>
</tr>
<tr>
<td></td>
<td>TDS Salt Diverted: 790 tons per year</td>
</tr>
<tr>
<td></td>
<td>Nitrate-N Diverted: 33 tons per year</td>
</tr>
<tr>
<td></td>
<td>Ammonia-N Diverted: 370 tons per year</td>
</tr>
<tr>
<td><strong>Air Quality</strong></td>
<td>Methane Reduced: 75 tons per year</td>
</tr>
<tr>
<td></td>
<td>Nitrous Oxide Reduced: 22 tons per year</td>
</tr>
<tr>
<td></td>
<td>PM 10/2.5 Reduced: Under Study – estimate 86 tons per year</td>
</tr>
<tr>
<td></td>
<td>Ammonia Reduced: 171 tons per year</td>
</tr>
</tbody>
</table>
Environmental Benefits

**Water Quality – Reduce Salt and Nitrates**
- Support Recycled Water/Conjunctive Water Management Programs and regional goal of reducing demand for imported water supplies
- Protect Downstream Water Users
- *If all dairies participated, over 6,000 tons of salt would not enter the groundwater basin (avoided annual desalter costs of $2 million)*

**Air Quality – Reduce Pollutants, Greenhouse Gases, NH₃**
- Achieve Goals of South Coast Air Quality Management District including PM 10/2.5 (Southern California is a non-attainment area under the Clean Air Act), New Composting and CAFO Regulations
- Reduce Greenhouse Gases, and Comply with AB 32 goals as well as generate additional greenhouse gas credits for participating partners
- Reduce Diesel Truck Traffic
- *Estimated annual reductions of 8,000 tons/year of CO2 equivalents valued at $40,000/year.*
Environmental Benefits

Renewable Energy – Increase Self Sufficiency, Green Power
- Help enhance self sufficiency/reduced peak load goals
- Support State’s goals for Renewable Energy Portfolio
- Value of renewable energy is 8 cents/kWh versus 10-13 cents per kWh for off-peak to over 25 cents/kWh on peak. Renewable Energy Credits are valued at $2 mWh and provide an estimated value of $25,000/year.

Regional Soil Quality Benefits
- High quality compost improves low organic soils
- Secondary benefits (NRCS Soil Quality Inst. Web site)
- Digester residual material is blended with compost, avoiding $55,000 in alternative disposal methods

On Farm and Quality of Life Improvements
- Less odors and flies; better neighbors
- Improved herd health

When fully operational, Phase 1b is expected to offset energy costs and generate revenue from the sale of environmental benefits for a value of $1.3 million. The net revenue (savings) is estimated to be $750,000 annually.
Greenhouse Gas Reductions

- Greenhouse gas emission reductions protocol was developed and peer-reviewed under the Commerce Energy/California Energy Commission PIER program.

- GHG reductions due to operation of Phase 1a were certified by Environmental Resources Trust.*

- To date, almost 18,000 tons of GHG reductions have been certified and sold to date.  
  
  * see www.ecoregistry.org
In California, as elsewhere in the nation, there are many opportunities for the use of centralized digesters that process a combination of biosolids, dairy manure, food waste and green waste.

*The Chino Basin anaerobic digester project is a “good example of an innovative community solution to address alternatives to traditional land application of manure that provides a win-win solution for the producer and the environment.”*

Bruce Knight, Former Chief
Natural Resources Conservation Service
Inland Empire Utilities Agency
Leading the Way on Renewable Energy…

- **In the Nation:**
  - Constructed *first* Platinum LEED-rated energy efficient headquarters by a public agency in the nation

- **In California:**
  - Constructed *first* centralized digester in California using a combination of dairy manure and food waste
  - Sold *first* renewable energy credits in California that were generated by “cow power”
  - Sold *first* green-house gas credits in California that were generated by “cow power”
  - Sponsored California’s *first* legislation to authorize “net metering” program for energy generated through “cow power” and was the *first* public agency to use the net metering program
Thank you.

For More Information, please contact
Martha Davis
Executive Manager for Policy Development
Inland Empire Utilities Agency
909-993-1742
mdavis@ieua.org
www.ieua.org