Innovative Energy Management Proves that it Pays to be Green

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Los Angeles County Sanitation Districts
Energy Recovery Engineering Section

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Who Are the Districts?
Our Mission Statement

SANITATION DISTRICTS OF LOS ANGELES COUNTY

To protect public health and the environment through innovative and cost-effective wastewater and solid waste management and, in doing so, convert waste into resources such as recycled water, energy, and recycled materials.
Joint Water Pollution Control Plant (JWPCP)
Districts’ Solid Waste Facilities

1. Calabasas Landfill
2. Mission Canyon Landfill
3. Scholl Canyon Landfill
4. Puente Hills MRF
5. Puente Hills Landfill / Recycle Center
6. South Gate
7. DART
8. SERRF
9. Mesquite Regional Landfill
Puente Hills Landfill
(Closed in 2013)
Overview and Details of the Districts Energy Program

- Develop renewable energy resources
- Minimize energy usage
- Minimize energy costs
- Demonstrate new technologies that reduce air emissions
Annual Savings from Districts Energy Management Program

- Develop renewable biogas resources to serve our facilities
  - $19 million in avoided electricity purchases
  - $45 million in outside electricity sales
- Minimize energy usage - $5 million
- Minimize energy costs - $1 million
- Demonstrate new low emission technologies - Priceless
1. Develop Renewable Energy Resources

- Biogas power engines provided electrical self-sufficiency at our largest wastewater treatment plant in 1939
Energy Production and Sales

121 MW
Produced from Landfill Gas, Digester Gas, and Refuse Combustion
Anaerobic Digestion in Wastewater Treatment
Landfill Gas Collection Well
Energy Potential of Digester and Landfill Gas

● Digester gas
  – Approx 0.2% of LA County’s demands met from digester gas
  – This will double in 2016 with new City of LA project under construction
  – Used largely on-site for treatment plant loads

● Landfill Gas
  – Currently provides 1% of electricity in California
  – About half of nationwide potential has been developed
## Energy Production Facilities at LA County Sanitation Districts

<table>
<thead>
<tr>
<th>Facility</th>
<th>Average Production</th>
<th>Fuel/Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puente Hills Gas-to-Energy Phase I</td>
<td>44 MW</td>
<td>Landfill Gas/Steam Boilers</td>
</tr>
<tr>
<td>JWPCP Total Energy Facility</td>
<td>20 MW</td>
<td>Digester Gas/Combined Cycle</td>
</tr>
<tr>
<td>Puente Hills Gas-to-Energy Phase II</td>
<td>4 MW</td>
<td>Landfill Gas/IC Engines</td>
</tr>
<tr>
<td>Spadra Gas-to-Energy</td>
<td>4 MW</td>
<td>Landfill Gas/Steam Boiler</td>
</tr>
<tr>
<td>Calabasas Landfill Gas-to-Energy</td>
<td>5 MW</td>
<td>Landfill Gas/Simple Cycle Turbines</td>
</tr>
<tr>
<td>Commerce Refuse-to-Energy</td>
<td>9 MW</td>
<td>Municipal Solid Waste/Mass Burn</td>
</tr>
</tbody>
</table>
Puente Hills Gas-to-Energy Facility

- Existing power sales contract w/ SCE expires in 2016
- Recently finalized agreement for power sales from 2017-2030; allows investment in lifetime extension projects
- Landfill closed in 2013; gas will decline 3-7% per year
Total Energy Facility at JWPCP

- 20 MW digester gas-fired combined cycle
- Serves plant loads
- Typically operated with slight export for plant reliability
- Full islanding capability
Puente Hills Gas-to-Energy Facility Phase II

- Started in 2005
- Has displaced $28 million in electricity purchases
- To be shut down by May 2015
  - Declining landfill gas production
  - Cost of compliance SCAQMD Rule 1110.2
- Evaluating conversion to natural gas
Spadra Gas-to-Energy Facility

- Landfill closed in 2000
- 10 MW capacity, now operating at 4 MW due to declining gas flow
- Revenue currently covers operating costs
- Revenue will no longer cover operating costs starting as early as 2015
- No viable options to sell power elsewhere at higher price
Calabasas Landfill Gas-to-Energy Facility

- Started operation in 2010
- Design 11 MW, limited to 5 MW by gas supply
- Reduced waste tonnage has limited gas production
- Operates as a merchant plant, selling power under one-day to three-year agreements
Commerce Refuse-to-Energy Facility

- Processes 350 tons/day of solid waste to produce 10 MW electricity
- Selling power under favorable 30-year power purchase agreement with SCE – average 11.5 cents/kWh.

- Power price will drop to 5-7 cents/kWh after the end of agreement in December 2016
- Currently evaluating the future of the facility
Generating Value from Biogas

- Methane generated by anaerobic bacteria in landfills and wastewater treatment digesters needs to be collected and destroyed.
- Challenge: flares are cheap and easy to run, power plants are expensive and harder to run.
  - Capital expense
  - Operating expense
  - Higher skill levels required
  - Gas cleanup
  - Commercial issues
  - Regulatory issues
## Electricity Pricing

<table>
<thead>
<tr>
<th>Option</th>
<th>Commodity Value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity, on-site usage</td>
<td>12-15 cents/kW-hr</td>
<td>Avoids retail purchase, transmission and distribution costs</td>
</tr>
<tr>
<td>Electricity, deliver to grid at market price</td>
<td>5-8 cents/kW-hr</td>
<td>Selling wholesale power at lower price</td>
</tr>
<tr>
<td>Cost to generate power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbines</td>
<td>7-9 cents/kW-hr</td>
<td>Includes capital recovery and O&amp;M. Smaller projects have larger per kW-hr costs.</td>
</tr>
<tr>
<td>Engines</td>
<td>5-9 cents/kW-hr</td>
<td></td>
</tr>
<tr>
<td>Microturbines</td>
<td>8-12 cents/kW-hr</td>
<td></td>
</tr>
<tr>
<td>Fuel cells</td>
<td>16-20 cents/kW-hr</td>
<td></td>
</tr>
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</table>
Biogas-to-Electricity Development: Challenges

● Market Issues
  – Hard to get a high enough price to pay for small projects
  – Under current PUC rules, Renewable Energy Credits for on-site generation have little value

● Emission regulations
  – New emission requirements have removed more common and older engines as an inexpensive option in many areas
  – Compliant engines now commercially available but at overall higher cost
Biomethane Production as an Alternative to Electricity

- Digester gas can be purified to natural gas standards
- Inject into pipeline for sale-significant interconnection costs
- Use or sell locally as vehicle fuel-bypasses interconnection issue
- Potential financial benefits
  - Vehicle fuel worth 4x more than natural gas
  - Renewable incentives for vehicle fuel are higher than renewable power incentives
- No significant local air emissions or major permitting issues
Pipeline Injection Example

- Point Loma Wastewater Treatment Plant
- Only pipeline injection project in California
- Started operation in 2013
- Fuel is directed to fuel cells owned by UC San Diego and City of San Diego
Renewable Power Opportunities at the Districts

- Solar power starting to make sense financially
- Food waste recycling by anaerobic digestion at wastewater treatment plant
  - Demonstration project under way
- Six sites with small quantities of gas (250 kW to 3 MW)
  - Very difficult to identify financially viable projects in this size range
2. Minimize Energy Usage
Energy Efficiency Management Program

- Full time Project Engineer position created in 2006
- Coordinates Districts’ Energy Efficiency Efforts
- Takes Advantage of Utility Energy Efficiency Rebate Programs
- Document Efforts of Design and Operations
- Investigates New Technologies
- Design Project Review for Energy Efficiency
- Reviews Utility Bills
Energy Efficient Design: Los Coyotes WRP

- Conversion From Course Bubble to Fine Bubble Diffusion
  - Energy Savings – 2.6 million kWh/year
  - Cost Savings – $350,000/year
  - Rebate Incentive – $209,119

- Replace Pumps and Motors, Install VFDs
- Two 60 HP Sludge Pumps, Two 300 HP Influent Pumps, Two 200 HP Effluent Pumps
  - Energy Savings – 4.1 Million kWh/year
  - Cost Savings – $550,000/year
  - Rebate Incentive – $326,240
Los Coyotes WRP
Measurement & Verification

- Energy Usage Reduced by 639 kWh/MG
- At 30 mgd, 7.0 Million kWh/Yr Reduction, $840,000/Yr

![Electricity Usage Rate Chart]

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Electricity Usage Rate, kWh/MG</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/04</td>
<td>1,906</td>
</tr>
<tr>
<td>04/05</td>
<td>1,829</td>
</tr>
<tr>
<td>05/06</td>
<td>2,045</td>
</tr>
<tr>
<td>06/07</td>
<td>1,825</td>
</tr>
<tr>
<td>07/08</td>
<td>1,457</td>
</tr>
<tr>
<td>08/09</td>
<td>1,406</td>
</tr>
<tr>
<td>09/10</td>
<td>1,559</td>
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</table>
Replacement of Aging Equipment: JWPCP
Centrifuge Replacement

- Four new 300 gpm high speed centrifuges installed
- Allowed Operations to shut off 8 low speed centrifuges (more than 30 years old)
- Energy savings – 3.1 million kWh/year, $280,000/year
- Cost of project – $2.75 million
- Rebate Incentive – $315,345
- Payback period – 8.7 years
Installation of Higher Efficiency Equipment:
JWPCP Gallery Lighting

- Replaced 977 High Pressure Sodium Fixtures
- Energy Savings – 959,000 kWh/year
- Financial Savings – $130,000/year
- Rebate Incentive from SCE – $51,351
- Contract Price – $249,500
- Simple Payback – 18 Months
JWPCP Gallery Lighting Result: Improved Working Conditions

**BEFORE:**
High Pressure Sodium
189W Per Fixture
1,620,000 kWh/yr

**AFTER:**
T8 Fluorescent
69W Per Fixture
660,000 kWh/yr
Tracking Energy Efficiency Savings

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 06/07</td>
<td>300</td>
</tr>
<tr>
<td>FY 07/08</td>
<td>700</td>
</tr>
<tr>
<td>FY 08/09</td>
<td>1,600</td>
</tr>
<tr>
<td>FY 09/10</td>
<td>2,300</td>
</tr>
<tr>
<td>FY 10/11</td>
<td>3,300</td>
</tr>
<tr>
<td>FY 11/12</td>
<td>3,900</td>
</tr>
<tr>
<td>FY 12/13</td>
<td>4,500</td>
</tr>
</tbody>
</table>
Tracking Energy Efficiency Savings

Cumulative Savings Since 2006 = $21.6 Million
Utility Rebate Incentives

- Southern California Edison has been a great partner in our energy efficiency efforts
3. Minimize Energy Costs

- Buy power through Direct Access
- Buy fixed price blocks of power
- Seek out utility rebates
- Pay attention to the bills
- Pay attention to the rules
Direct Access

• Choose your own power provider
  – SCE still provides delivery services

• Customized power purchases
  – 5 MW at $47.40 from Jul 2013 through Dec 2016
  – 2 MW at $50.02 from Jul 2014 through Dec 2016
  – 5 MW at $51.43 from Jul 2014 through Jun 2015
  – 4 MW bought in day ahead market (average $47)

• Savings over $1 million per year compared to utility rates

• Direct Access largely closed to new customers
Components of LACSD Electricity Charges

- SCE T & D
- Direct Access Surcharges
- Direct Access Power
Utility Bill Review

- 192 Edison Accounts
- Optimize Account Rate Schedules
- Identify Discrepancies and Rectify
- Track regulatory issues impacting rates
- Savings to date $2,400,000
Billing Errors and Rate Optimization Examples

- Changed 16 accounts to Rate Schedule PA-2 (medium sized pumping)
  - Savings $52k per year
- Found a mistake in demand charges on two bills (higher than historical levels)
  - Saved $60k
- Bills received for equipment that has been removed or has not been installed
Los Coyotes WRP Billing Discrepancy

June 2009 SCE Bill

Details of your new charges
Your rate: TOU-8 (Direct Access)
Billing period: Jun 3 '09 to Jul 2 '09 (29 days)

<table>
<thead>
<tr>
<th>Delivery charges</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilities rel demand</td>
<td>5,478 kW x $12.43000</td>
<td>$68,091.54</td>
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<tr>
<td>Energy-Summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On peak</td>
<td>245,104 kWh x $0.00663</td>
<td>$1,625.04</td>
</tr>
<tr>
<td>Mid peak</td>
<td>364,525 kWh x $0.00663</td>
<td>$2,416.80</td>
</tr>
<tr>
<td>Off peak</td>
<td>730,906 kWh x $0.00663</td>
<td>$4,845.91</td>
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<tr>
<td>Customer charge</td>
<td></td>
<td>$312.17</td>
</tr>
<tr>
<td>Power factor adj</td>
<td>1,421 kVar x $0.18000</td>
<td>$255.78</td>
</tr>
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**Direct Access cost responsibility surcharge**
- DA CRS DWR bond     1,340,535 kWh x $0.00491 $6,582.03
- PCIA               1,340,535 kWh x -$0.00007 $-93.84
- DA CRS UC          1,340,535 kWh x $0.01839 $24,652.44
- CTC               1,340,535 kWh x $0.00377 $5,053.82

**Other charges or credits**
- Revenue cycle services credit  -$15.46
- Generation Municipal Surcharge  $1,205.99

Subtotal of SCE charges $114,932.22
Your new charges $114,932.22
Los Coyotes WRP Billing Discrepancy

Corrected June 2009 Bill

Details of your new charges
Your rate: TOU-8 (Direct Access)
Billing period: Jun 3 '09 to Jul 2 '09 (29 days)

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<tr>
<td>Facilities rel demand</td>
<td>2,650 kW x $12.43000</td>
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<td></td>
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<td>On peak</td>
<td>245,104 kWh x $0.00663</td>
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Direct Access cost responsibility surcharge *

| DA CRS DWR bond                                        | 1,339,699 kWh x $0.00491 | $6,577.92 |
| PCIA                                                  | 1,339,699 kWh x -$0.00007 | -$93.78   |
| DA CRS UC                                             | 1,339,699 kWh x $0.01839 | $24,637.06 |
| CTC                                                   | 1,339,699 kWh x $0.00377 | $5,050.67 |

Other charges or credits

Revenue cycle services credit                           | -$15.46   |
Generation Municipal Surcharge                          | $1,205.48 |

Subtotal of SCE charges                                  | $79,751.55 |
Your new charges                                         | $79,751.55 |

Savings! $35,000
Electricity Rate Setting

- The California regulatory market is complex
- Utilities represent themselves well, ratepayer groups represent ratepayers well
- Industry and DA customers have limited representation
Electricity Rate Setting, cont’d

- The Districts participate in the Direct Access Customer Coalition (DACC)
- DACC and others representing competitive electric markets save LACSD at least 1cent/kWh or $1.4 million/yr
- The Districts saved $540,000 by tracking regulatory issues and learning of a ruling that applied to our facilities, but only if we took action
4. Demonstrate New Technologies that Reduce Air Emissions

  - NOx from landfill gas boilers was 80% lower than conventional natural gas power plants

  - 3-4 ppm NOx

- First operating fuel cell on digester gas in US (2005)
  - 0.05 ppm NOx

- First biogas-fired Solar Mercury 50 turbine (2010)
  - NOx 50-70% lower than previous BACT
Antelope Valley Green Energy Program

- Early demonstration program of clean digester gas-to-energy technologies
- 250 kW microturbine
- 250 kW fuel cell
NOx Emissions at Districts Facilities

- PH Engines
- PH Solar Centaur Turbine
- JWPCP Solar Mars Turbine
- CGTE Solar Mercury 50 Turbine
- PERG Steam Boiler
- CLF Capstone Microturbines
- Lancaster I-R Microturbine
- Palmdale Fuel Cell

Measured NOx, NOx Limit, NOx Target

Fuel Cell Measured NOx = 0.05 ppm
Thank You

- Mark McDannel
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