Urban Biomass Conversion Technologies Deployment in California – An Update
Overview

• Resource base and policy drivers
• Conversion Technologies in a nutshell
• Sample Projects
• CalRecycle Projects & Resources
California landfilled waste stream

- 39 million tons MSW landfilled per year
- 70% carbon based
- About 25% suitable for Anaerobic Digestion
- Energy potential 15,000 GWh/year
- 8% of State electricity

Source: CalRecycle
Conversion Technology Drivers
(a partial list)

1- Lack of new landfill space close to population centers

2- **AB 32** - Global Warming Solutions Act of 2006
   Anaerobic Digestion measure

3- **Renewable Portfolio Standard** - 33% by 2020

4- **Low Carbon Fuel Standard**: Deliver automotive energy by 2020
   with 10% less greenhouse gases than 2010

5- **CalRecycle Strategic directives 6.1 & 9.2** – Organics diversion
   and Bioenergy & Biofuels R&D
<table>
<thead>
<tr>
<th>Feedstocks</th>
<th>Technologies</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSW *</td>
<td>Anaerobic Digestion</td>
<td>Electricity</td>
</tr>
<tr>
<td>Green waste</td>
<td>Fermentation</td>
<td>Biogas</td>
</tr>
<tr>
<td>Food waste</td>
<td>Gasification</td>
<td>Biodiesel</td>
</tr>
<tr>
<td>Paper</td>
<td>Pyrolysis</td>
<td>Ethanol</td>
</tr>
<tr>
<td>Wood waste</td>
<td>Hybrid</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Fats Oil Grease</td>
<td></td>
<td>Heat</td>
</tr>
<tr>
<td>MRF residuals **</td>
<td></td>
<td>Chemicals</td>
</tr>
</tbody>
</table>

* MSW: Municipal Solid Waste
** MRF: Material Recovery Facility

- Compost
- Liquid Fuels
- Syngas
Evaluation of Conversion Technologies for Municipal Waste Management

Jurisdiction Sponsored Evaluations (a partial list)

• City of Los Angeles
• County of Los Angeles
• City & County of Santa Barbara
• Salinas Valley Solid Waste Authority
• Cities of San Jose, Tulare, San Diego & Santa Cruz
Evaluation of Conversion Technologies for Municipal Waste Management

- **Jurisdiction Sponsored Evaluations** (partial list)
  - City of New York
  - Taunton, Massachusetts
  - Toronto, Ontario, Canada
  - San Lucie County, Florida
  - Delaware Solid Waste Management Authority
  - Connecticut Resources Recovery Authority
Anaerobic Digestion

Hydrolysis

Insoluble Organics → Soluble Organics

Extracellular Enzymes

Cellulose, Proteins, Lipids, Phosphorylated Organics

Acid Formation

Glucose, Amino Acids, Fatty Acids, PO$_4$-$^3$-$^-$

Acid Producers

Acetic, Propionic, Lactic + Cells

Methane Formation

Organic Acids → Methane CO$_2$

Methanogens

Cells, Stabilized Organics

Credit: Bob Gillette, Carollo Engineers
European Installed Anaerobic Digestion Capacity

Source: De Baere & Mattheeuws, Biocycle – Feb ‘10
Anaerobic Digestion of Food Waste in Waste Water Treatment plants

(A partial list)

• East Bay Municipal Utility District
• Sacramento Co. Regional WWTP – SMUD
• City of San Rafael – Central Marin Sanitation
• City of Riverside
• Humboldt Co. Waste Authority

Photo: J. Franco – City of San Jose WWTP
East Bay Municipal Utility District
Food waste digestion project

Photos by EBMUD
Planned California AD projects (partial list)

Inland Empire Utility Agency (IEUA), Chino
- Food Waste
- Phase 1: 200 tpd (up to 500 tpd)

Zero Waste Energy, San Jose
- Post MRF organics, 150,000 tpy
Planned California AD projects (partial list)

- Sacramento Transfer Station

  Throughput: Around 120 tpd (Two phases)
  Source separated black bin (46% organics)
  Partnership with SMUD & US DOE funding
  Developer: Real Energy (Napa)
  Technology Vendor: Ros Roca (Spain/Germany)
Proposed CR&R, Perris AD Project (150 tpd)

- Will digest various organic residuals
- In negotiations with City and County of Los Angeles
- ArrowBio technology developed in Israel (facilities in Australia & Israel)
Simplified conversion of biomass to liquid fuels (Gasification)

Biomass → Gasifier → Syngas → Catalyst → Liquid Fuels

Gasification Reactor

Synthesis Reactor

C. Monoxide, Hydrogen

Ethanol, Biodiesel, etc
Phoenix Energy LLC., Merced Gasifier

Feedstock: Waste wood pallets (4,000 tons/year)

Generating Capacity: 750 Kwh

Power purchase agreement with PG&E in place

Funding: CalRecycle’s Recycling Marked Development Zones (RMDZ) loan

Loan Info: www.calrecycle.ca.gov/RMDZ/Loans/

Photo: Jacques Franco, CalRecycle
Dixon Ridge Farms Walnut Shell Gasifier, Yolo Co.

Photos: Jacques Franco

Project Funding: CA Energy Commission & others
UC – West Biofuels Biomass to Power & Ethanol pilot project, Woodland, CA

• Dual Bed Gasifier design

• **Capacity**: 5 tons per day

• **Production Cost Goal:**
  Less than $60 per barrel of oil equivalent

• **Phase 1**: Wood chips

• **Phase 2**: Post Material Recovery Facility residuals

*Photo: Jacques Franco*
UC – West Biofuels  Biomass to Power & Ethanol project

Sample Phase II feedstock:  Post Material Recovery Facility Residuals
Dockside Green - Nexterra Waste Wood Gasifier, Victoria, BC - Canada

Photos: Jacques Franco
Research Projects and Resources

- UC Davis Biogas Energy Project
  aka Anaerobic Phased Solids Digester
- Yolo County Landfill. In-Situ AD compost Project
- Rotary Drum Reactor technology assessment project
- AD Programmatic Environmental Impact Review
UC Davis Biogas Energy Pilot Project

Photo: Ruihong Zhang, UC Davis
Yolo County Landfill
In-Situ AD Compost Pilot Project

Photo: Ramin Yazdani, Yolo Co.

5/10 - Landfill-Based Anaerobic Digester-Compost Pilot Project at Yolo County Landfill

CalRecycle
California Department of Resources Recycling and Recovery

Landfill-Based Anaerobic Digester-Compost Pilot Project at Yolo County Central Landfill
UCD Rotating Drum Reactor Project

Source: Ruihong Zhang, UC Davis

6/10 – Integration of Rotary Drum Reactor & AD technologies for the treatment of MSW
Recent CalRecycle Publications

Conversion Technologies Status Survey (4/09)

Current Anaerobic Digestion Technologies Used for MSW organics treatment (3/08)

www.calrecycle.ca.gov/Organics/Conversion/
Anaerobic Digestion Programmatic EIR

Preparation of an Environmental Impact Report to assess the environmental impact of siting new anaerobic digestion facilities in California.

Draft report due in the Fall

Contact: Ken Decio, 916-341-6313
Resources

CA Energy Commission AB 118 funding:
http://www.energy.ca.gov/altfuels/index.html

Jurisdictions Conversion Technologies Evaluation Reports:
www.calrecycle.ca.gov/Organics/Conversion/Events
Resources

• CalRecycle Conversion Technologies (CT) page: www.calrecycle.ca.gov/

• CT mailing list: www.calrecycle.ca.gov/Listservs/

• California Biomass Collaborative Forum biomass.ucdavis.edu/
Questions?

Jacques Franco: 916-341-6608

jacques.franco@calrecycle.ca.gov

www.calrecycle.ca.gov/Organics/Conversion

Mail List: www.calrecycle.ca.gov/Listservs/