Diverting Food Waste for Bioenergy

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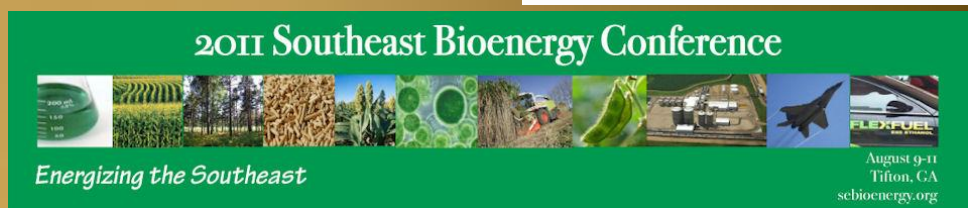
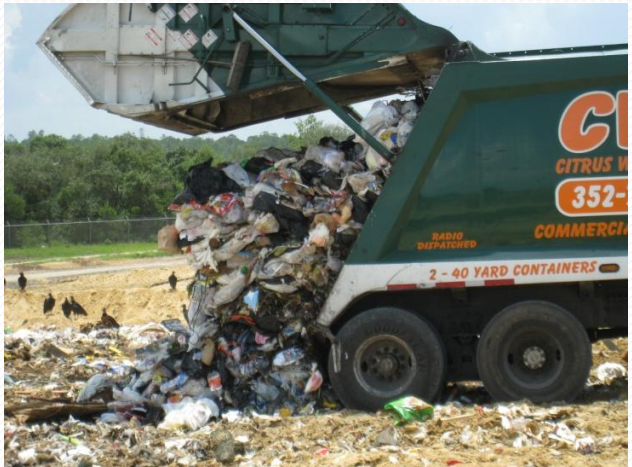


Food Waste: Think Globally…

- A third of all food produced globally is wasted (FAO 2011)
- 34.3 million tons annually in US or 14% of municipal solid waste (EPA 2009)
- 1.7 millions tons annually in Florida (FDEP 2009)

Food Waste: Think Globally…

- Food waste is predominantly sent to landfills
- Takes up valuable space in landfills
- Requires transportation to landfills
- Contributes to landfill methane emissions
  - Even with flaring and landfill-gas-to-energy, nearly half of all landfill methane is released to the atmosphere
- Food waste exacerbates landfill leachate problems



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… Act locally

- Food waste is generated throughout the community
  - Farms
  - Food processors
  - Grocery stores
  - Restaurants
  - Schools
  - Hotels
  - Prisons
  - Households

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Food waste by sector: schools

- A small school can generate 1.6 to 7.3 tons per year*
- Florida schools generate an estimated 36,000 tons per year (based on student numbers)

*Data from waste audits conducted in 2010

Food waste by sector: restaurants

- One restaurant can generate 7.8 to 18.5 tons per year*
- Florida restaurants generated an estimated 184,000 tons per year (based on employee numbers)

*Data from waste audits conducted in 2010

Florida 75% Recycling Goal

- Mandate within the Energy, Climate Change, and Economic Security Act of 2008
- 75% recycling rate by 2020
- Current recycling rate: 28%
- Creative options will need to be employed to reach goal
- Organics will need to be addressed in this goal

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One Solution: Anaerobic digestion

- Anaerobic digestion is the microbial decomposition of organic material to methane under anaerobic conditions
- Digesters harness natural microbial consortia, which occur in wetlands, lakebeds, and ruminant animals
- Two beneficial end products:
  - Biogas
  - Biofertilizer

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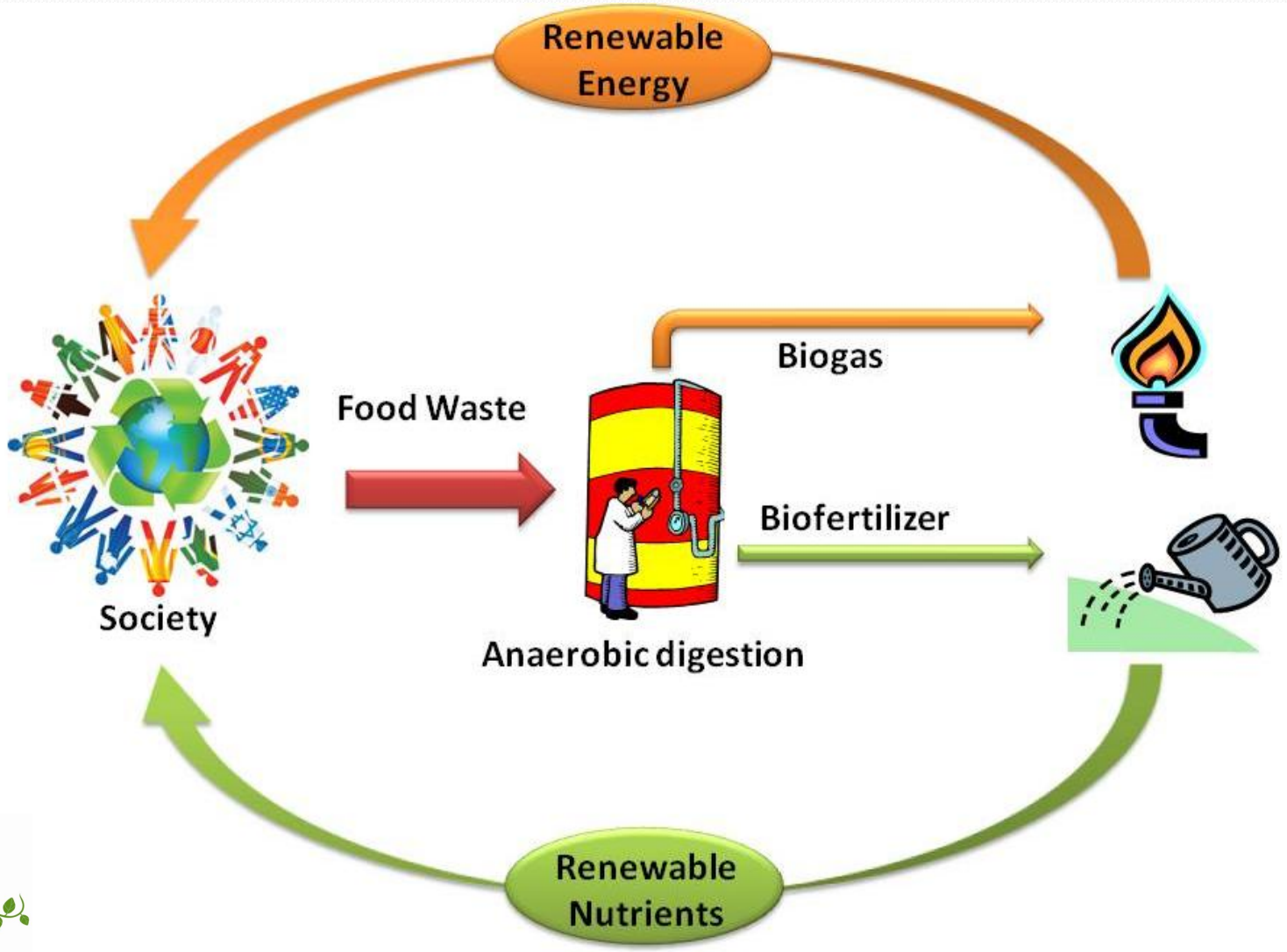
Closed-loop food waste diversion



Biogas: natural gas from waste

- Biogas composed of methane (65-80%) and carbon dioxide (20-35%)
- Readily combustible
- Clean burning
- Generated continuously from digester
- Biogas can be refined to biomethane (natural gas equivalent)

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Biogas: sustainable bioenergy

- Carbon neutral
  - Combats global warming
- Captures energy from waste
  - No need for energy crops
- Offsets fossil fuel use
  - Stretches energy reserves
- Requires little to no energy input

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Uses of biogas

- Cooking
- Heating (water/air/greenhouse)
- Electricity
- Lighting
- Vehicle fuel

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Biofertilizer: sustainable nutrients

- Nutrients converted to plant-available form
- Can be injected into existing fertigation systems
- Reduces use of synthetics
- Reduces cost of organic fertilizer
- Keeps nutrients within productive cycle
- Ideal for small organic farms and urban agriculture

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Food waste: an ideal feedstock

- High organic content
  - Greater methane production potential
- High moisture content (55-95%)
  - Facilitates high rate digestion
- Readily degradable
  - More than 50% solubilized in less than 8 hours

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Food waste digestion is scalable

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On-site vs. centralized digestion

On-site

- Small scale
- No hauling
- Gas used on-site
- Facility gets full benefits from digester

Centralized

- Municipal scale
- Requires hauling
- Gas used for pipeline or grid
- Economy of scale
- Fewer digesters to maintain

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Economic benefits

- Reduces waste hauling costs
  - Especially beneficial in urban areas
- Biogas used on-site to offset gas/energy needs
- Can be used to generate electricity sold to grid
- Biofertilizer can be sold to farmers or marketed for consumer use

Additional benefits

Schools

- Can facilitate hands-on education in science, engineering, sustainability, and bioenergy
- Biofertilizer can facilitate student gardening at the school

Restaurants

- Increased public relations due to “green” image
  - Can increase customer base and revenue

Local biogas potential: school

- Public elementary school in Gainesville (436 students)
- Generates an estimated 7.2 tons of food waste annually
- Methane potential of 19,000 to 28,000 ft^3 annually

Local biogas potential: restaurant

- Local restaurant in Gainesville (~300 customers daily)
- Generates an estimated 18.5 tons of food waste annually
- Methane potential of 47,000 to 71,000 ft^3 annually

Biogas in agriculture: tomato packer

- Tomato packer in South Florida generates 40,000-50,000 tons of culls annually
- Currently spread on fields for cattle feed
- Digesting tomatoes could generate 25 to 31 million ft^3 of methane annually

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Biogas in agriculture: small farm

- Small organic vegetable farm in Citra, FL with 2/3 acre under cultivation
- Generates 880 to 1200 lbs. of organic waste per week (in summer)
- Wastes include weeds, row clearings, culls, manures, and processing waste
- Can generate 560 to 780 ft^3 of methane per week

Florida's biogas potential

- Annual methane potential of:
  - Florida public schools = 85 to 128 million ft^3
  - Florida's restaurants = 472 to 707 million ft^3
  - Florida's total food waste = 4.8 to 7.2 billion ft^3

What's next…

- Determining the "low-hanging fruit" for food waste collection
- Optimizing pretreatment and digester configuration
- Spreading public awareness
- Pilot scale projects

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Thank you

http://biogas.ifas.ufl.edu/foodwaste

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