

Intro to the Biogas Industry

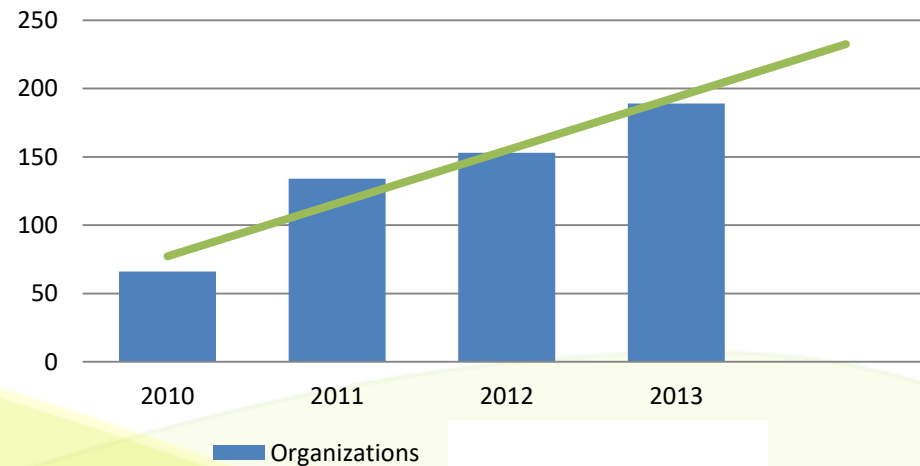
Trends and Opportunities

**Patrick Serfass, American Biogas Council
Sustainable Food & Beverage Packaging Value Chain Meeting
10 December 2014 | Washington, DC**

American Biogas Council: The Voice of the US Biogas Industry

- The **only** U.S. organization representing the biogas and anaerobic digestion industry
- **Over 220 Organizations** from the U.S., Germany, Italy, Canada, Sweden, Belgium and the UK
- **All Industry Sectors Represented:**
 - project developers/owners
 - anaerobic digestion designers
 - equipment and supply chain companies
 - waste managers
 - waste water companies
 - farms
 - composters
 - utilities
 - consultants and EPCs
 - financial firms

ABC Membership





Organic material is delivered to the digester system

This may include animal manure, food scraps, agricultural residues, or wastewater solids.

Digested material may be returned for livestock, agricultural and gardening uses.

Organic material is broken down in a digester

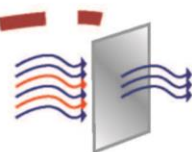
The digester uses a natural biological process under controlled conditions to break down organic material into products for beneficial use or disposal.

Some biogas can be used to heat the digester.



BIOGAS

DIGESTED MATERIAL



Raw biogas is processed

Typically, water, carbon dioxide and other trace compounds are removed, depending on the end use, leaving mostly methane.



Processed biogas is distributed and used

The gas may be used to produce heat, electricity, vehicle fuel or injected into natural gas pipelines.

SOLIDS

LIQUIDS



Digested material is processed and distributed

Solids and liquids from the digester may be used to produce marketable products, like fertilizer, compost, soil amendments or animal bedding.

organic material

Organic materials are the "input" or "feedstock" for a biogas system. Some organic materials will digest more readily than others. Restaurant fats, oils and grease; animal manures; wastewater solids; food scraps; and by-products from food and beverage production are some of the most commonly-digested materials. A single anaerobic digester may be built for a single material or a combination of them.

the digester

An anaerobic digester is one or more airtight tanks that can be equipped for mixing and warming organic material. Naturally occurring microorganisms thrive in the zero-oxygen environment and break down (digest) organic matter into usable products such as biogas and digested materials. The system will continuously produce biogas and digested material as long as the supply of organic material is continuous, and the process continues inside the system.

biogas processing

Biogas is mostly methane, the primary component of natural gas, and carbon dioxide, plus water vapor, and other trace compounds (e.g. siloxanes and hydrogen sulfide). Biogas can replace natural gas in almost any application, but first it must be processed to remove non-methane compounds. The level of processing varies depending on the final application.

biogas distribution

Processed biogas, often called "biomethane" or "renewable natural gas," can be used the same way you use fossil natural gas: to produce heat, electricity, or vehicle fuel, or to inject into natural gas pipelines. The decision to choose one use over another is largely driven by local markets.

digested material

In addition to biogas, digesters produce solid and liquid digested material, containing valuable nutrients (nitrogen, phosphorus and potassium) and organic carbon. Typically, raw digested material, or "digestate," is processed into a wide variety of products like fertilizer, compost, soil amendments, or animal bedding, depending on the initial feedstock and local markets. These "co-products" can be sold to agricultural, commercial and residential customers.

What goes INTO a biogas system? (organic materials)

Food Waste



Food Waste



Food Waste



Green Waste



Manure (animal/human)



What comes OUT of a biogas system? (gas, solid and liquid products)

Electricity (gas)



Heat (gas)



Fuels (gas)



Soil Products (liquid/solids)



U.S. Biogas Market—Current and Potential

2,000+
Operational
Biogas
Systems
Today

11,000+
Potential
New Biogas
Systems



● On Farm (Dairy and Swine)	● Wastewater	● At Landfills
239	1,241	636
8,000	2,440	450

U.S. Biogas Market – Potential Impact

13,000+
Biogas Systems



Emission reductions
equivalent to removing
1 - 11 million passenger
vehicles from the road



Enough energy to power
3.5 million American
homes

Trending:

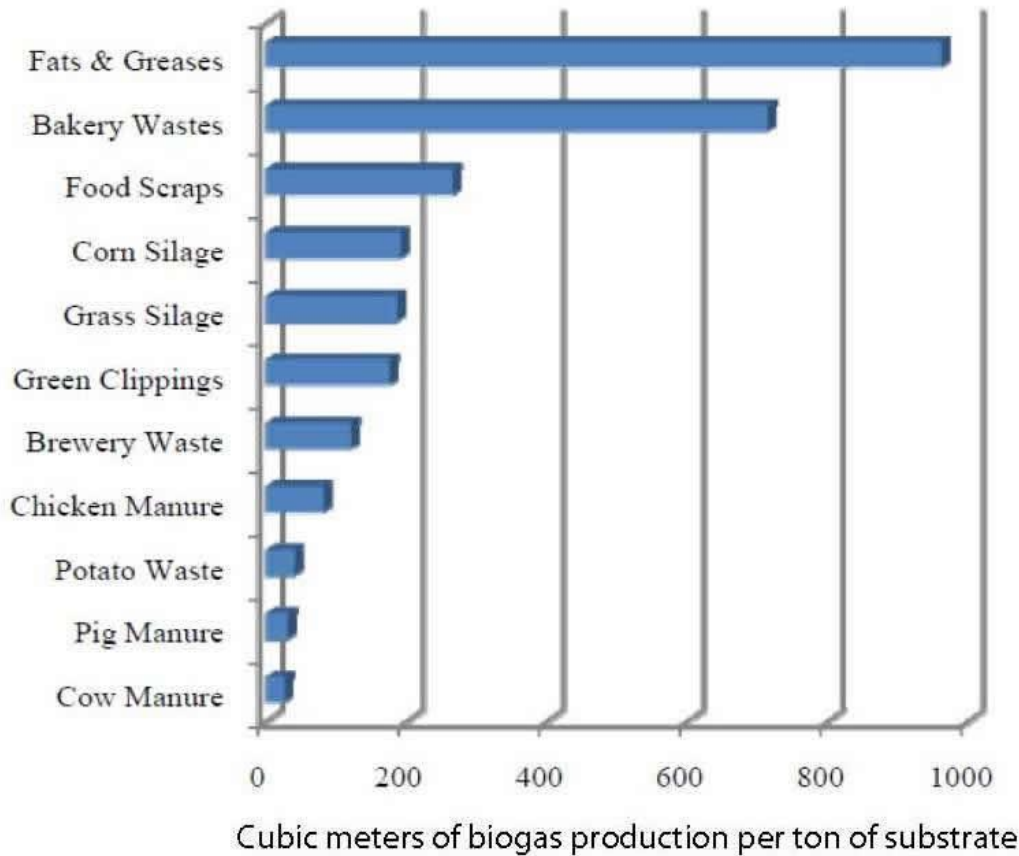
Adding Food Waste

Making Vehicle Fuel

and

Making Products from Digestate

What wastes are BEST for making biogas?



35x manure

25x manure

10x manure

A Focus on Commercial Organics



Sources: MIT and Tim Horton

- Restaurants (example), Grocery Stores, Convention Centers, Hotels
- Lots of organic waste generated

Mandates, Incentives — Food Waste Recycling

Municipalities: San Francisco, Seattle, Austin, Vancouver, New York City, most starting in 2009-10

2011: CT, Public Act 11-217 (updated in 2013)

2012: VT, Universal Recycling Law, Act 148—all organics, largest generators first, effective 7/1/2016

2013

- CT: Public Act 13-285 (update to 2011)—Commercial organics, **effective 1/1/14**
- NYC: Local Law 146-2013—Commercial organics, effective 7/1/2015

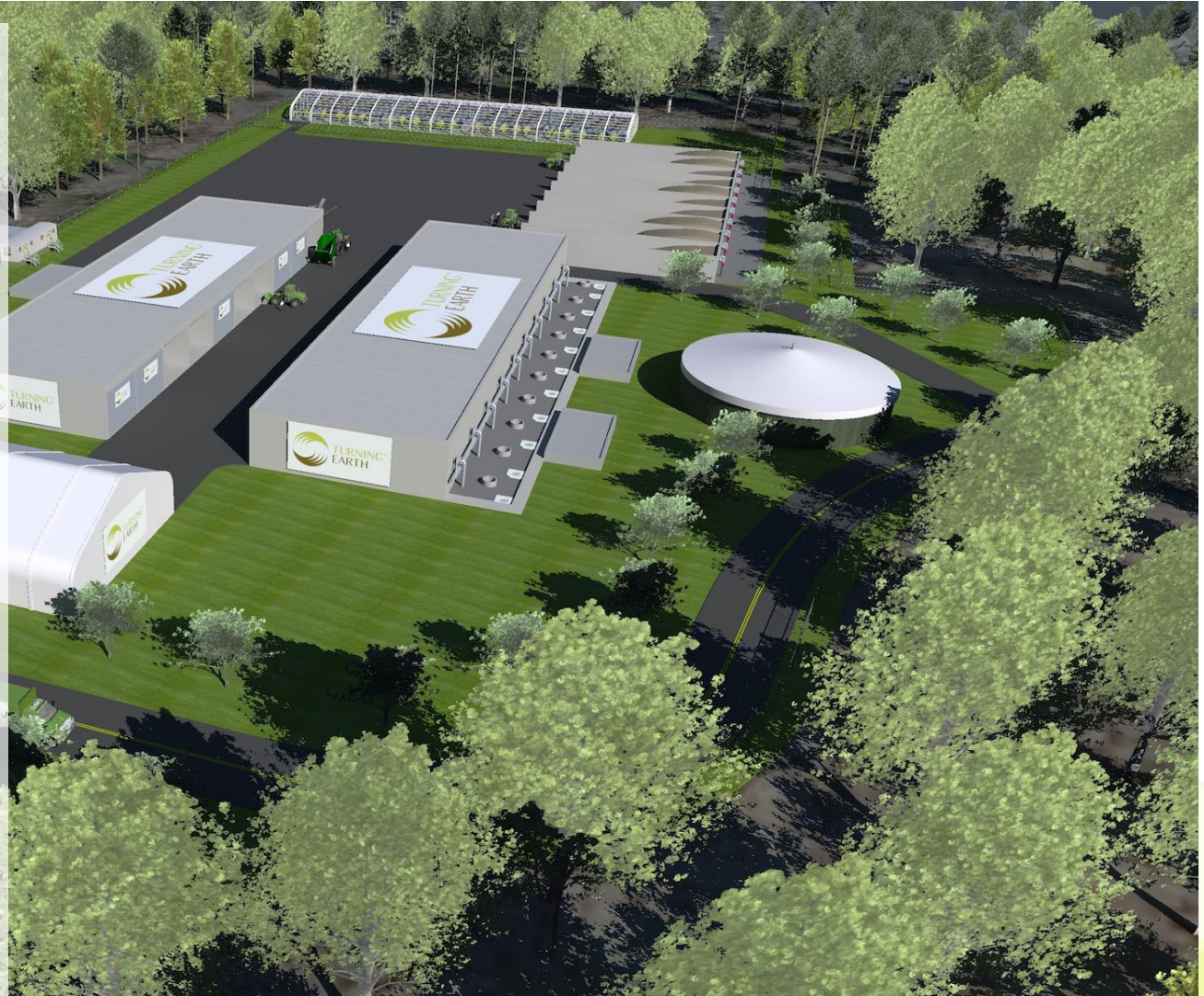
2014

- MA: 310 CMR 19.000 regulations—Commercial organics, effective 10/1/14
- RI: An Act Relating to Health and Safety—Commercial organics, effective 1/1/2016
- *CA AB 1826: Mandatory Commercial Food Waste Recycling (awaiting Gov's signature)*
- *MD: Composting and Anaerobic Digestion Facilities-Yard Waste and Food Residuals (pending)*

Food + Yard Waste (CT)

Central Connecticut Organics Recycling Facility

- +Near Hartford, CT
- +75,000 tons/year of municipal and commercial organics (Food, yard and woody waste)
- +16 municipalities contributing
- + 1.4 MW + CHP
- +Digested Material: high quality compost and engineered soil products
- +Construction: late 2014
- +Commissioning: late 2015



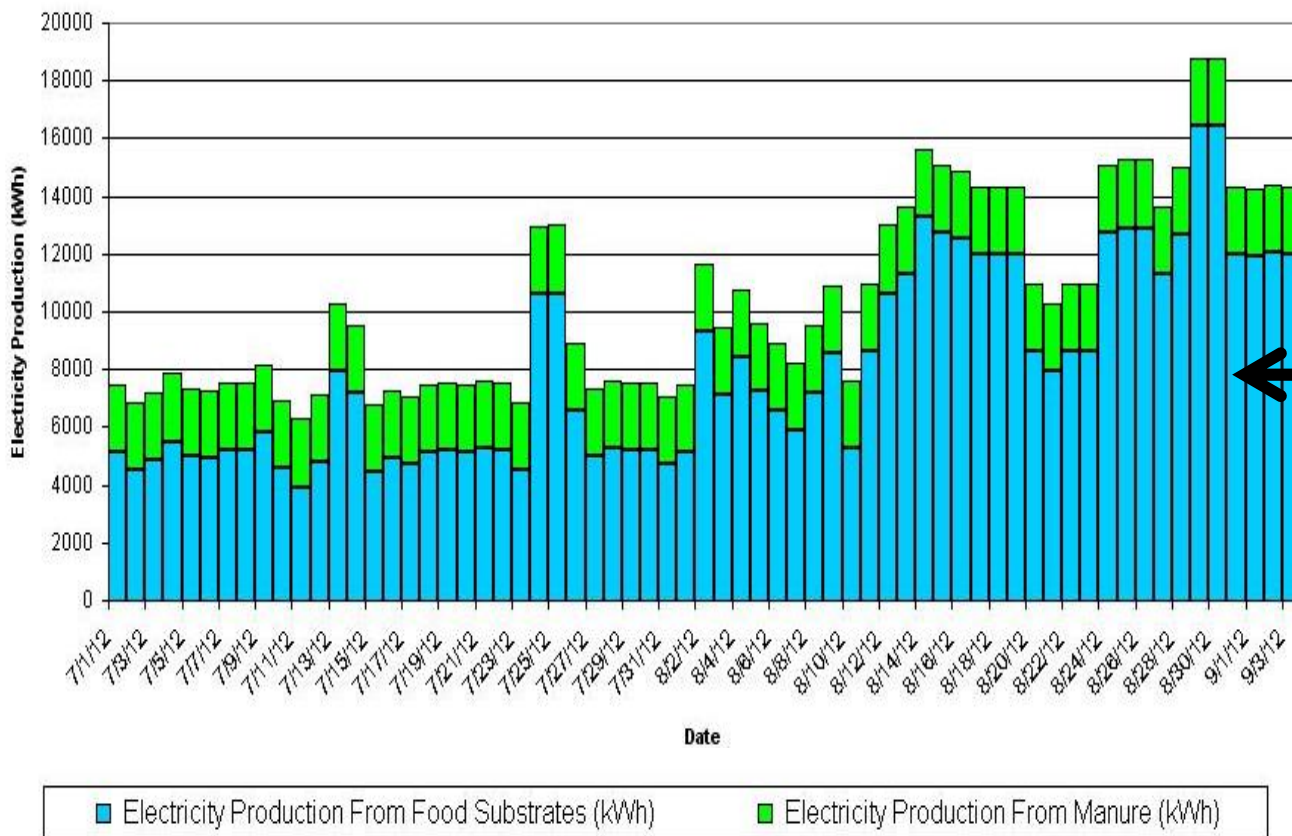
Food Waste + Biosolids (FL)

Harvest Energy Garden

- +130,000 tons per year of biosolids, fats, oils, grease, and food waste—mostly from Walt Disney Resorts and hotels
- +3.2 MW of installed power generation
- +2.2 MW of recoverable heat
- +Digested material: class AA granular fertilizer and phosphorous-rich Struvite sold as a fertilizer additive



Manure Digester + Food Waste



70% of the electricity from food waste



Thank You!

- **Learn More**
 - Sign up for the **FREE Biogas News**
 - www.AmericanBiogasCouncil.org
- **Become a Member**
 - Dues start @ \$75-\$1,250
 - Application online, or contact us

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Vehicles: Recent EPA changes to Renewable Fuels Standard (RFS2)

- Before:
 - Feedstocks: Biogas from manure, wastewater and landfills
 - Uses: CNG vehicles
 - RIN credit: D5 “advanced biofuel”
- After:
 - Feedstocks: Biogas from virtually ALL feedstocks (all the ones before + non-manure agricultural waste, food waste, yard waste, MSW, energy crops, crop residues)
 - Uses: CNG vehicles + LNG, electric vehicles (battery and fuel cell), DME (renewable diesel)
 - RIN credit: mostly D3 “advanced cellulosic biofuel” (more valuable) and some D5, depending on project.

Fuels



Food + Yard Waste (CA)

Zero Waste Energy

- +San Jose, CA
- +90,000 tons/year
- +1.6 MW electricity + CHP
- +Digested Material: high quality compost
- +Phase 2 completed
- +Phase 3: Turning residential food waste into biogas for vehicles



Food Waste (CA)

Sacramento, CA

+Awarded International Bioenergy Project of the Year (2013)

+40,000 tons/year of food waste

+700,000/year diesel gallon equivalents of renewable CNG

+fueling Atlas waste haulers and city vehicles



Biogas + Ethanol (KS)

Himark BioGas/Western Plains Energy

+Biogas and ethanol (50M gal/yr) production

+Biogas Inputs: cattle feedlot manure, ethanol plant waste, slaughter-house waste and municipal organics, rich in sand, dirt, rocks, plastic, and cellulose.

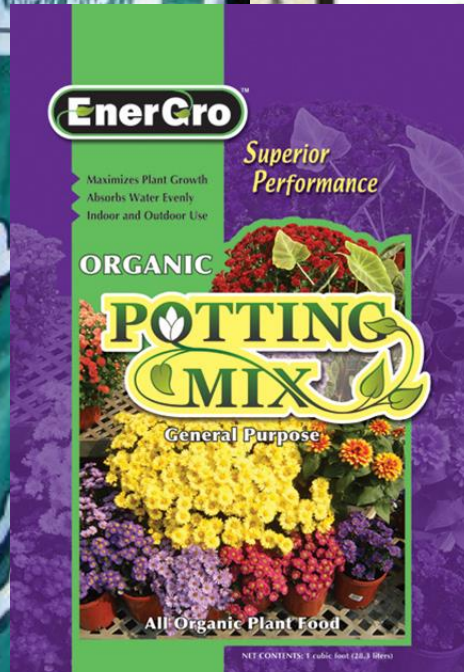
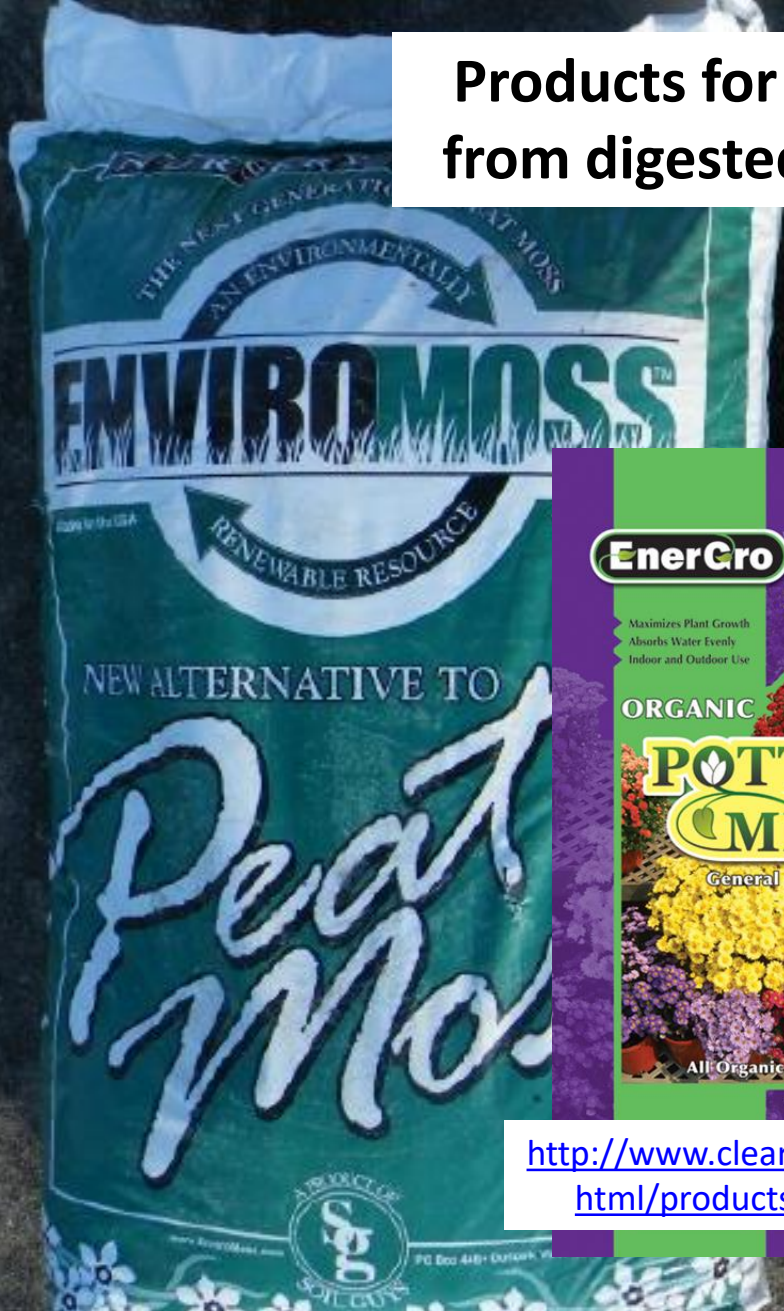
+Biogas offsets fossil natural gas in ethanol plant (13MW equiv.)

+Digested materials fertilize largest plot of sweet sorghum in US



HimarkBioGas.com

Products for sale made from digested materials



MAGIC DIRT™
GROW GREAT GARDENS...NATURALLY

ORGANIC GARDEN AND POTTING MIX
SUSTAINABLE ALTERNATIVE TO PEAT MOSS

Every cubic yard of Magic Dirt™ comes from creating more than 100 kWh of renewable energy and removing over 300 pounds of greenhouse gases from the environment.



Volume
1 Cubic Foot

MAGIC DIRT™
1 Cubic Foot
Made in the U.S.A.

<http://www.clearhorizonsllc.com/html/products/indexEP.htm>

<http://www.dailysunnews.com/news/2009/jun/19/local-dairy-going-green-with-enviromoss-product/>

<http://www.magic-dirt.com/>

A Legislative and Regulatory Push

Federal Activities

Farm Bill (elec.)

Biogas ITC (gas)

Tax Extenders (elec.)

Renewable Fuel Standard
(gas)

Clean Energy Standard
(elec.)

USDA, EPA, DOE, DOD

■ State Activities

□ Organic Waste Plans: Top
11 States

□ CA, WA, OR, WI, MN, NY, MA,
PA, NJ, MD, NC

