Biosolids, the Other Recyclable Food “Waste”
Markets, Trends, Drivers, & What the Future Holds

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Presentation Outline

- The full universe of organics in this region
- Biosolids management
  - National perspective
  - Markets & uses
  - In this region – trends & drivers
- What the future holds...

or
The full universe of organics

The following data are rough...

The following graphs show approximate data, mostly from the late 2000s, gleaned from state reports and other resources. Citations available on request. Take with a grain of salt.

Organics GENERATED in 10 NERC Region States

- 31% Other Organic
- 27% Biosolids
- 42% Food Waste

% of the 24,514,000 wet tons/year organics GENERATED
Wet Tons RECYCLED
in 10 NERC Region States

6,817,000 wet tons/year organics RECYCLED
Comparing RECYCLING RATES in 10 NERC Region States

6,817,000 wet tons/year organics RECYCLED
State by state...

% Recycled in Vermont

% Recycled in CT

% Recycled in MA

% Recycled in NH

% Recycled in ME

% Recycled in Rhode Island
Delaware biosolids data courtesy Brian Churchill, DNREC
17,649,000 wet tons/year organics NOT RECYCLED
Observations

• Other Organics (leaf & yard waste, etc.) have high recycling rates.... And have for many years.
• There is a reason food waste is a target now: it is a significant fraction of MSW (~20 – 40%), and its recycling rate is low everywhere.
• Biosolids are recycled successfully in many states, with high rates in ME, NH, & DE (>50% recycling). Southern New England relies on incineration for wastewater solids management. A large percentage is landfilled throughout the region.
What deserves recycling attention?

- **Food residuals**: ~10 million wet tons/year underutilized
  - Creates methane / GHG emissions in landfill
  - Wet & costly to burn
  - Recycling is a worthy goal!
  - Can create valuable energy & soil amendment products
  - → *Challenging to accumulate and make clean products*

- **Wastewater solids (sludge)**: ~4.3 million wet tons underutilized
  - Also creates methane / GHG emissions in landfill
  - Also wet & costly to burn
  - Recycling is a worthy goal!
  - Can create valuable energy & soil amendment products
  - → *Already accumulated, ready to go, quite consistent*
Why biosolids & industrial organics are ignored in recycling statistics…

➤ Regulatory program divisions (water vs. solid waste)

➤ Functional separation between sewers and MSW collection / landfills

➤ Negative impression of “sludge”, biosolids; concerns about contaminants, etc.
But, organic* matter is organic matter...

- Food waste
- Animal manures
- Wastewater solids
- Grass, green crop waste
- Leaves, stalks

* containing carbon (C)
Challenges shared by all organics:

- **Odors / stability** – wastewater solids, manures, & food residuals are putrescible and can stink

- **Wet, gunky stuff** - wastewater solids, some manures, & food waste are mostly water

- **Pathogens / Vectors** – wastewater solids (and some manures) have more and need more treatment (required for biosolids use)

- **Contaminants** – heavy metals, chemicals, and plastics/trash contamination is a challenge for all organic residuals recycling (biosolids contaminants are strictly regulated based on scientific risk assessment; such standards sometimes applied to other organics)

- **Nutrient-rich** – wastewater solids. Manures, & food waste, more than other organics, have considerable N and P – a good thing, except that end product use may be restricted by nutrient management restrictions

- **Regulatory challenges for final products & uses**

- **Public acceptance of final products & customer education on proper uses**
It’s time to tear down the fence…….
Co-processing organics provides many opportunities for efficiencies & better, customized, end products – recycled products!

The future is co-processing.
Biosolids Management: National Perspective

Biosolids and paper mill residuals create a new topsoil for a farm in central Massachusetts.
USA total wastewater solids: 7,180,000 dry U. S. tons/year (~35.9 million wet tons)

55% is used on soils

Biosolids Use and Disposal Practices
2004 U.S. Totals

- Beneficial Use: 49%
- Disposal: 45%
- Other: 6%
Percent Biosolids Beneficially Used by State, 2004
Markets are diverse – and diversifying

- Agriculture – Class B (and some A) in bulk, like manures
- Horticulture, landscaping, turf (sports fields, parks, golf courses, turf production, etc.) – Class A heat-dried & composts
- Topsoil blending – Class B and A, including for exacting sports field and golf green standards
- Reclamation of disturbed sites – using engineered topsoil blends of Class B (and some A)
- Energy – the current hot topic... Water Resource Recovery Facilities can be net-zero energy consumers!
Agriculture

- Bulk material markets: animal feed crops (corn, hay), grains (wheat, hops), soy, other commodity crops

- Prices:
  - Class B - $0 - $30 / wet ton
  - Class A – up to $60 / ton

- Trend: increasing demand; waiting lists in some areas

Moorhead, MN: Feed corn grown with liquid injected, Class B, anaerobically-digested biosolids, July 2012
In the drier west, biosolids improve the water-holding capacity of the soil.
Agriculture - Waco, TX

Pasture, 1 year after application of bulk Class B, anaerobically-digested biosolids, December, 2012
Agriculture

Central Valley, CA

Virginia
Forestry

Photos courtesy of King County, WA
http://dnr.metrokc.gov/WT
d/biosolids/

- Only in some areas
- Speeds up harvest cycle in actively managed stands
- Price:
  - Class B $0 - minimal

Photo courtesy of Philadelphia Water Dept.
Biosolids compost use on my home garden – raspberries, May 2014

Class A bulk material markets: potting mixes (e.g. Tagro), golf courses (e.g. Milorganite), parks, lawns, growing turfgrass (e.g. in RI), sports fields (hi-spec turf)

Prices:
- Class A bulk – up to $60 / ton
- Class A bagged/retail – up to $450 / ton

Trend: increasing demand for the quality, consistent products
Horticulture / Landscaping / Turf

Billerica, MA biosolids compost applied on a green, mid-1990s.

Merrimack, NH biosolids compost helps keep this central MA golf course green.

Biosolids compost supports the growth of wildflowers along a NH interstate highway, 1999.
Biosolids compost use, White House lawn
Washington, DC

before

after

Mid-1980s - photos courtesy of Eliot Epstein, Ph.D., and Orgro
Topsoil Blending

- Bulk biosolids given or sold to topsoil blenders
- Prices: vary, often $0
- A way to use less processed material
- Topsoils used for reclamation, landfill cover, highway embankments, construction sites
- Trend: steady use

Topsoil blending with paper mill residuals and biosolids, central MA, 2006
Reclamation of Disturbed Sites

Spectacle Island in Boston Harbor was reclaimed with biosolids compost and other recycled organics, 2004.

- Bulk material market
- Used to restore healthy soil ecosystem and either native vegetation or cropland
- Prices: vary, often $0
  - Uses a lot of biosolids
- Trend: increasing use, because of huge benefits – biosolids use is best practice for this kind of reclamation
Reclamation of Disturbed Sites

Pennsylvania mine before

Same Pennsylvania mine after
Bunker Hill, ID mine
Superfund site
before

Bunker Hill, ID mine 2 years after reclamation with a blend of biosolids, wood ash, and logging debris.
Energy - incineration with energy recovery

Does not utilize the nutrients & organic matter; requires net energy input.

Cement kiln, Wikipedia photo
A biosolids treatment process that results in biosolids to be used or discarded.

Trend: Huge interest & activity now, across the continent.
In this region...

Trends & drivers

- Interest in extracting energy via anaerobic digestion (AD)
- Continued demand for cost-efficient fertilizers from farmers, others
- Continued (but less) public concern about biosolids use
- Food waste / SSO diversion from landfills = more organic residuals to markets, need for processing / co-processing
- Improving technologies, treatment processes, and biosolids products
- Increased variety of biosolids uses to solve environmental and social challenges.
Maine

Lewiston Auburn Water Pollution Control Authority
new anaerobic digestion facility, 2013
New Hampshire

Class B land application continues / compost use / septage.... New biosolids regulations being developed.
Concord, Nashua, and some other towns sell Class A and B biosolids for bulk land application for feed corn and hay crops.

Wood ash is a standard part of the agricultural amendment markets.
Improving treatment processing and biosolids products: 2PAD arrives in Brattleboro & So. Burlington

Public concerns in 2013 around Stowe permit renewal led to state rule-making. Public concerns still drive end use or disposal and stymy recycling in some places.
Co-digesting biosolids & other organic residuals
Essex Junction, VT
Oct. 1 – Organics ban

- Infrastructure support
- How do biosolids fit in?
- Co-processing is envisioned by many, but some object to mixing SSO (food waste) with biosolids
- As elsewhere, adding lots of food waste to organic residuals markets has impacts
- Regulations & markets for new residuals products are uncertain

Deer Island Wastewater Treatment Plant
Boston: Lots of excess capacity; piloting food waste co-digestion
Co-composting of MSW & biosolids

Marlborough, MA:

Co-composting of biosolids & MSW has been happening for years.

More co-processing expected in the future.
Research: University of Massachusetts

Research on digestion, algae treatment, co-digestion with food waste, etc.
New EPA regulations create stricter air emissions requirements, lessening appeal of incineration of biosolids. A few municipal biosolids incinerators are closing, e.g. Fitchburg, MA.

Incineration with energy recovery for electricity at New Haven, Connecticut
Incineration is the norm in RI.

Providence, RI has begun to recycle biosolids – but out of state. RI uses biosolids from elsewhere, however:

Biosolids pellet use for turf farms (right 2 photos).

URI research on soil amendment uses (below).
Gloversville-Johnstown, NY: co-digestion of dairy waste (whey) and biosolids – lots of energy generated...

But western NY is seeing some public upset, which drives less recycling of biosolids.
Wilmington solids have been going to landfill, but they hope to return them to the soil soon, while generating more energy from them via AD.

In PA, public concerns about biosolids use continue, and costs of landfill disposal are low and hassle-free, leading to less incentive to recycle biosolids.

Elk gameland was created at a barren site using biosolids and other amendments to build topsoil.
What the future holds...

A growing focus on recovering resources from wastewater, including biosolids:
- Energy
- Nutrients (P especially)
- Organic matter (carbon)
- Water
- For sustainability...

Challenges continue:
- Public acceptance
- Trace chemical concerns
- Odors
- Final product quality
- Changes in organic residuals markets with increased organics diversion efforts

http://www.wef.org/uploadedFiles/Biosolids/PDFs/ENABLING%20THE%20FUTURE.pdf
Our Changing View of “Water Resource Recovery Facilities”

“There is growing awareness that wastewater treatment plants are not waste disposal facilities or polluters, but rather water resource recovery facilities that produce clean water, recover nutrients (such as phosphorus and nitrogen), and have the potential to reduce the nation’s dependence upon fossil fuel through the production and use of renewable energy.”
Co-Digestion Example: Des Moines, IA

Other U. S. co-digestion programs:

East Bay MUD, Oakland, CA (large facility)
Gloversville-Johnstown, NY (mid-size)
Essex Junction, VT (small)
Co-composting examples:

Co-composting, Unity, ME

Ipswich, MA indoor composting
C Findings: Lower GHG emissions when biosolids go through AD and are land applied

"Methane avoidance"

Using virgin lime **if recycled lime → total to -211**

- Landfill
- Incineration 1
- Incineration 2
- Class A Alkaline Land Ap
- Anaerobic dig. Land ap

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Best option: Remove P at WWTF

Struvite and other P minerals can be precipitated at wastewater treatment plants, usually by a treatment process applied to a digestate dewatering side-stream. This is a growing trend (Chicago has taken the lead).

Removing P at the WWTF makes the biosolids a more balanced fertilizer and allows use of the P in concentrated form on soils where it is needed.
Public interest remains high regarding chemicals in the environment. …

- What is their fate?
- Do they have any impact?
- They illustrate the connection of individuals’ activities with the environment

What does it mean for biosolids management?

- There are similar reactions / processes for all chemicals
- Persistent chemicals present highest level of concern; others will be decomposed in soils

Biosolids land application as a tool for managing these

- Assimilative capacities of soils
- Best management practices, such as limited application rates
The future looks bright for biosolids, as they are used to solve challenges and serve agriculture.

The following slides show examples of new, exemplary uses of biosolids in British Columbia to solve environmental challenges.
Landfill Closure / Methane Mitigation

Slide courtesy of Sylvis, Vancouver, BC
Landfill Leachate Treatment

Slide courtesy of Sylvis, Vancouver, BC
Carbon Sequestration Plantations

Slide courtesy of Sylvis, Vancouver, BC
Foreshore Restoration

Slide courtesy of Sylvis, Vancouver, BC
Acid Rock Drainage Mitigation

Slide courtesy of Sylvis, Vancouver, BC
Biosolids improve soils and solve problems. Their use is not disposal.
Resource: an excellent video from Ontario

http://www.endless-films.com/site/?portfolio=biosolids
Resource: Fun videos about King County biosolids, called “loop.”

Everyone has a story. Our friends share what they find inspirational about Loop.

http://www.loopforyoursoil.com/what-is-loop/galleries/
A nice fact sheet...

Land Application and Composting of Biosolids

What are biosolids?
Every day, wastewater treatment facilities across the country treat billions of gallons of wastewater generated by homes and businesses. The treatment process produces liquid effluent that is discharged to water bodies or reused as well as a byproduct of solid residues (sewage sludge) that must be managed in an environmentally responsible manner. Although the terms “biosolids” and “sewage sludge” are often used interchangeably, they are not the same. With further treatment, sewage sludge can yield biosolids, which is defined by the U.S. Environmental Protection Agency (EPA) as “nutrient-rich organic materials resulting from the treatment of domestic sewage in a treatment facility... that can be recycled and applied as fertilizer to improve

What are some of the benefits of biosolids land application?
The benefits of biosolids for both soil and vegetous and well recognized. Biosolids provide primary (nitrogen and phosphorous) and secondary nutrients (calcium, iron, magnesium and zinc). Also, the use increases crop yields and maintains nutrients in place and unlike chemical fertilizers, biosolids provide a sustained release of nutrients over the growing season as the material mineralized and made available for plant uptake. The addition of biosolids can also offer net greenhouse gas emissions by recycling carbon to the soil and fertilizing vegetation.

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