Climate and Organic Materials Management

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How are Waste and Climate Connected??

• What is the Life Cycle of a material?
• The simplified version:
  – Raw material extraction (bauxite mining, tree harvesting, oil pumped from underground, etc.)
  – Raw materials are processed into manufacturing inputs (trees made into paper, etc.)
  – Products are made from manufacturing inputs
  – Products are used
  – End-of-life products (and other discards) are managed as recyclables or waste
Emissions from Organics Management

• Landfills
  • Transportation (CO$_2$)
  • Decomposition in landfill (CH$_4$)
  • Possible avoided energy generation (CO$_2$)
  • Landfill carbon sequestration (C)

• Composting
  • Transportation (CO$_2$)
  • Composting process (currently zero)
  • Soil carbon sequestration (C)

Landfill Carbon Storage

Landfill carbon storage
• Some materials are not completely decomposed by anaerobic bacteria, so some of the carbon in these materials is stored in the landfill
• Counted as an anthropogenic sink since this carbon storage would not normally occur under natural conditions
• Included in factors for corrugated cardboard, magazines/third-class mail, newspaper, office paper, phonebooks, textbooks, lumber, fiberboard, food scraps, grass, leaves, branches
Landfill Carbon Storage (cont.)

Biogenic vs. Anthropogenic Emissions

- IPCC – and therefore EPA – does not count biogenic carbon as a greenhouse gas if it would otherwise have been released as part of the natural carbon cycle. Thus, carbon dioxide from organic materials in a landfill are not considered a greenhouse gas.

- However, if the gas is converted to methane in a landfill it would be counted as a greenhouse gas because it would not have occurred naturally.

- This is also true of organic materials burned for combustion.

Compost soil carbon storage

- Four potential processes
  - Accumulation of applied carbon (soil carbon restoration)
  - Greater standing crop of biomass due to nitrogen fertilization
  - Conversion to slowly degrading humic materials in composting process
  - High rates of compost application changing the equilibrium level of biomass (not analyzed)
New research

- Integration of decay rates, rather than lifetime methane yield
- Recognition that even the best landfill capture systems take time before they are at optimal performance
- In the near future – different types of composting??

Proposed change

- Decay rates and landfill capture systems
- Old method:
  - Total methane released over life of material X capture rate
- New method:
  - \((\text{Methane released in time } t_0 \times \text{ capture rate in time } t_0) + (\text{Methane released in time } t_1 \times \text{ capture rate in time } t_1) + \ldots\)
  - For 100 year timeframe
Reduction of Fertilizer Use with Compost

• Add an additional upstream factor to compost analysis.
  • How much fertilizer does compost replace?
  • How does transportation use change?
  • What are the emissions from producing fertilizer?
    • Majority of life-cycle data available focuses on Nitrogen-heavy fertilizers

Tools to measure the environmental and monetary cost of organics management

• Waste Reduction Model (WARM)
  – www.epa.gov/warm
  – Climate and energy benefits

• Food waste management cost calculator
  – www.epa.gov/foodscraps

• Jeffrey Morris’s work
  – See Biocycle October 2008
Food waste management cost calculator

- Estimates the cost competitiveness of alternatives to food waste disposal
  - source reduction
  - donation
  - composting
  - recycling of yellow grease

- Compares cost estimates for a disposal versus an alternative scenario.

WARM Emission factors

Food Scraps, Leaves, Grass, Branches, Yard Trimmings, Mixed Organics (Food Scraps 48%, Yard Trimmings 52%)
  - Source reduction (NEW!)
  - Composting
  - Combustion
  - Landfilling
  - 26 material types and 6 categories of mixed materials
Future versions of WARM

- Will have categories for different landfill conditions, most likely
  - Average
  - Wet
  - Dry
  - Bioreactor

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