The New Net-Zero: Dialing-up Sustainability Trends in Solid Streams

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Agenda

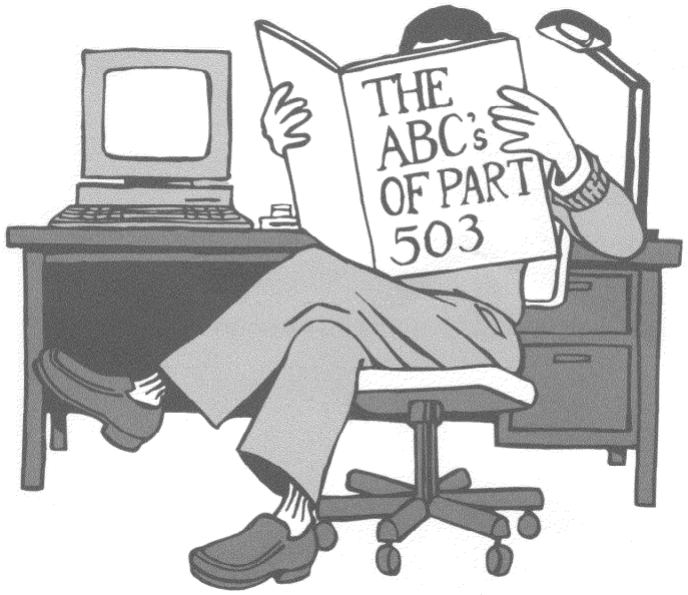
1. Problem Statement
2. Business as Usual
3. Drivers for reducing GHG emission
4. Tools for Change
5. Incentives to support GHG reduction

What can the water industry do to reduce greenhouse gas emissions?

Playing by the rules

The Part 503 rule establishes requirements for the final use or disposal of sewage sludge [biosolids] when biosolids are:

- applied to land to condition the soil or fertilize crops or other vegetation grown in the soil,
- placed on a surface disposal site for final disposal, or
- fired in a biosolids incinerator.



Business as Usual

Current Performance in the US

National Biosolids Data Project survey (2012)

- 7.18 million dry tons of biosolids produced in the US
- 55% of the were applied to soils
- 45% were disposed of in municipal solid waste landfills, surface disposal units, and / or incineration facilities.

Landfilling accounts for roughly 15% of methane emissions in the United States (US EPA, 2020).

If fully realized, new biogas systems could produce 41 billion kWh/year of electricity from 654 billion cubic feet of biogas per year.

Business as Usual

Where do our biosolids go in New England?

State	EQ Biosolids	Land Application	Incineration	Landfill	Dry US Tons per Year
CT	1	99	--	--	118,000
MA	36	3	36	25	201,700
ME	63	11	--	26	29,900
NH	45	21	16	18	28,300
RI	22	--	76	2	26,900
VT	15	14	2	69	8,400

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climate change: THE TIPPING POINT

The 'last hope' for limiting global warming to 1.5°C. That is what November's UN Climate Change Conference (COP26) is being called. With one UN chief describing the recent IPCC Report as a 'code red for humanity', all eyes are now on Glasgow to see if world leaders can unite in the face of climate change.

Drivers for Reducing Greenhouse Gas Emissions

1. United Nations Climate Change Conference of Parties
2. State Legislation and Plans
3. Corporate Pledges
4. Regional Greenhouse Gas Initiative (RGGI)
5. Renewable Portfolio Standards by State

Overarching goal: Secure global net zero by mid-century and keep 1.5 degrees Celsius temperature increase within reach

Tools for Change

How can we extract energy?

Bioconversion

- Anaerobic Digestion
- Combined Heat and Power

Thermal Conversion

- Thermal Oxidation (incineration)
- Pyrolysis
- Gasification

Technology	Input(s)	Output(s)	Technologies
Anaerobic Digestion	Thickened solids (3-6% solids), heated	Biogas Biosolids	Conventional AD Temperature Phased AD
Hydrothermal Processing	Thickened sludge (15 to 20%)	Biocrude oil Methane gas Inert solids	Fixed reactor
Thermal Hydroylsis	Dewatered solids (16-18% solids)	Biogas Heat + Steam	Pulper with batch reactors and flash tank
Supercritical Water Oxidation	Dewatered solids (10-20% solids)	Heat + Steam Mineral acids	Vessel or tubular reactors
Incineration	Dewatered solids (25-35% solids) Excess oxygen	Heat + Steam Ash	Multiple Hearth Incinerators Fluidized Bed Incinerators
Pyrolysis	Solids (80 to 90%), dried Oxygen at 25% of stoichiometric req.	Biochar Syngas Biocrude oil (tar)	Rotating Drum Reactor
Gasification	Solids (80 to 90%), dried Oxygen at 25% of stoichiometric req.	Heat (runs dryer) Biochar	Fixed bed Fluidized bed
Combined Heat and Power	Biogas	Heat + Steam	Internal Combustion Engines, Combustion Gas Turbines, Microturbines, Fuel Cells, Stirling Engines
Renewable Natural Gas	Biogas	Methane gas (pipeline quality)	Water Wash, PSA, Membrane, Compressor

Tools for Change

Potential energy from various fuel sources

1 cu. ft. of Biogas
700 Btu

6%

1 lb. of Biosolids (d)
8,000 Btu

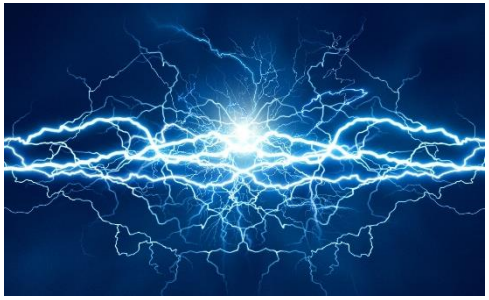
64%

1 cu. ft. of NG
1,000 Btu

8%

1 lb. of Coal
12,500 Btu

100%



1 kWh of electricity
3,400 Btu

27%

Tools for Change

What could it cost?

Technology	Unit Capital Cost ($)	Unit
Anaerobic Digestion	3,500	$ per dry ton / year
Thermal Hydroylsis	4,500	$ per dry ton / year
Incineration	5,000	$ per dry ton / year
Pyrolysis	7,000	$ per dry ton / year

How can we use the extracted energy?

- Heating (most common) – satisfying parasitic loads such as heat for drying
- Energy generation – CHP
- Convert to natural gas and sell to grid (natural gas pipeline quality) – RNG, RIN Credits

Technology	Unit Capital Cost ($)	Unit
Combined Heat and Power	10,000	$ / kWh
Renewable Natural Gas	13,000	$ / kWh

Resources: How do we close the gap?

- Regional Greenhouse Gas Initiative
- US EPA – Renewable Energy Credit
- US EPA – Renewable Fuel Standard
- By State - https://www.dsireusa.org/
  - MA – Clean Energy Center
  - CT – DEEP Climate Resilience Grant Program
  - VT – Renewable Energy Credits
  - Renewable Energy Incentives such as Feed-in Tariff (FIT) and Net Metering
  - Renewable Portfolio Standards - https://www.eia.gov/energyexplained/renewable-sources/portfolio-standards.php

Conclusion

- Sustainable treatment methods exist for New England biosolids to harness potential energy
- Various technologies exist for thermal conversion and bioconversion of biosolids
- Incentive programs exist to fund projects to reduce greenhouse gas emissions

We cannot afford to wait any longer to act on striving for net-zero carbon emissions in the water industry!

climate change:
THE TIPPING POINT

What will the water industry do to reduce greenhouse gas emissions?

Q&A