



The Latest Data on Biosolids Management in the U. S.

Results of the 2nd Comprehensive National Biosolids Survey • 2018 Data

Ned Beecher, Lead Author, NBDP & NEBRA

Juliana Beecher, Lead Author, NBDP & NEBRA

Janine Burke-Wells, NEBRA • Maile Lono-Batura, WEF

Nora Goldstein, *BioCycle* • Greg Kester, CASA • Bill Toffey, MABA

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Credits shown at
biosolidsdata.org.*

***California Bioresources Alliance Annual Symposium
November 10, 2022***

Thanks to these partners for funding support!



NACWA



Thanks to these partners for funding support!



Screenshot

Thanks to these partners for funding support!



Screenshot

The National Biosolids Data Project



- The original survey collected 2004 data.
- This 2nd Survey collected 2018 data.

<https://www.biosolidsdata.org>

- Lit. review & methods funded by USEPA Region 4
- 2018 was before much impact of PFAS on biosolids management.
- 2018 was representative of biosolids management in the decade of the 2010s.
- Comprehensive Biosolids Update
 - Regulation
 - Quality
 - End Use and Disposal Data



Project Team

NBDP Survey Topics

- How much & where biosolids were used or disposed in 2018
- Quality: Class A, B; nutrient levels, meeting Part 503 Table 3
- Biosolids management details
- Energy – limited data, but useful insights
- Economic Data – limited data, but useful insights never compiled before
- Issues & pressures on biosolids management programs; trends
- Septage & other outside wastes (limited data)



*Harvesting corn fertilized
with biosolids, Virginia*

Metadata & Quality of NBDP STATE-BY-STATE Survey Data



- Careful compilation of data for each state, DC, & larger territories
- Standard, consistent method & review process for each state report
- Corroboration using a) EPA ECHO data where available & b) calculated estimates based on wastewater flows and population
- Almost all state reports were reviewed by state biosolids coordinator or other state expert
- Confidence in states' data quality:
 - 32 "High" or "Moderately High"
 - 17 "Moderate"
 - 4 "Low"

a National Biosolids Data Project presentation • June 24, 2022

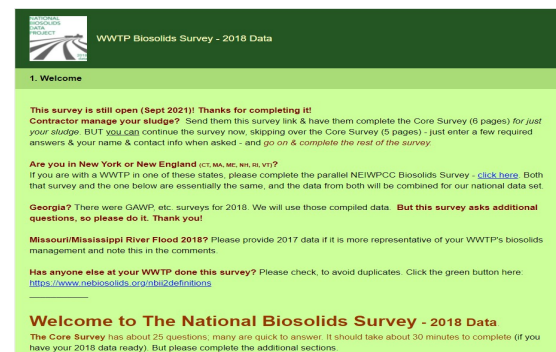
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Metadata & Quality of NBDP WRRF SURVEY Responses & Data



- 452 valid WRRF survey responses
- From 43 states & DC
- Representing ~12,000 mgd, or 34% of U. S. average total wastewater flow
- Total solids reported: 2,114,000 dry metric tons, which extrapolates to 6.1 million dmt, compared to the more robust state data of 5.823 dmt
- Good representation of:
 - Geography
 - WRRF size
 - Types of end use & disposal



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NBDP WRRF survey responses are...



- ...more from the largest WRRFs;
- ...more from New England especially, as well as from Missouri (plain states) & the Northwest; and
- ...less from smaller facilities (<10 mgd); and
- ...less from the southeast & south central states.

But, overall, good representation.

THANKS to all those who did the survey!

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*thermal
hydrolysis & AD
tour, Blue Plains,
Washington, DC*



Results



*biosolids
composting,
Topeka, KS*

*biosolids
demonstration
corn row, MI*



How much biosolids?

Total wastewater solids *used or disposed* in the U. S., 2018:

5,823,000 dry metric tons (dmt)

from state-by-state data compilation (5.823 million dmt)



Compare this to **6,132,000 dmt in 2004** (NEBRA et al., 2007, which does not include 382,000 dmt identified as "stored" in the 2004 data).

- **The 2018 total is 309,000 dmt lower due to:**

- The 2018 data were compiled with greater precision, assisted by increased consulting with state experts and use of EPA ECHO data for corroboration. There may have been more double-counting in 2004 data; this was avoided more in 2018. There were improvements in methods for estimating solids use & disposal for some states (e.g. MO). And, for 2018, NBDP did not extrapolate extra tonnage for small facilities with no data; it was assumed that most of those solids were stored and that capturing >75% of each state's flow accounted for nearly all solids used & disposed. For 2004, some states' data were rounded up.
- In 2018, there is more anaerobic digestion (which reduces tonnage) and less alkaline stabilization (which increases tonnage); for example DC Water produced and recycled 49,000 less dmt in 2018 than in 2004.

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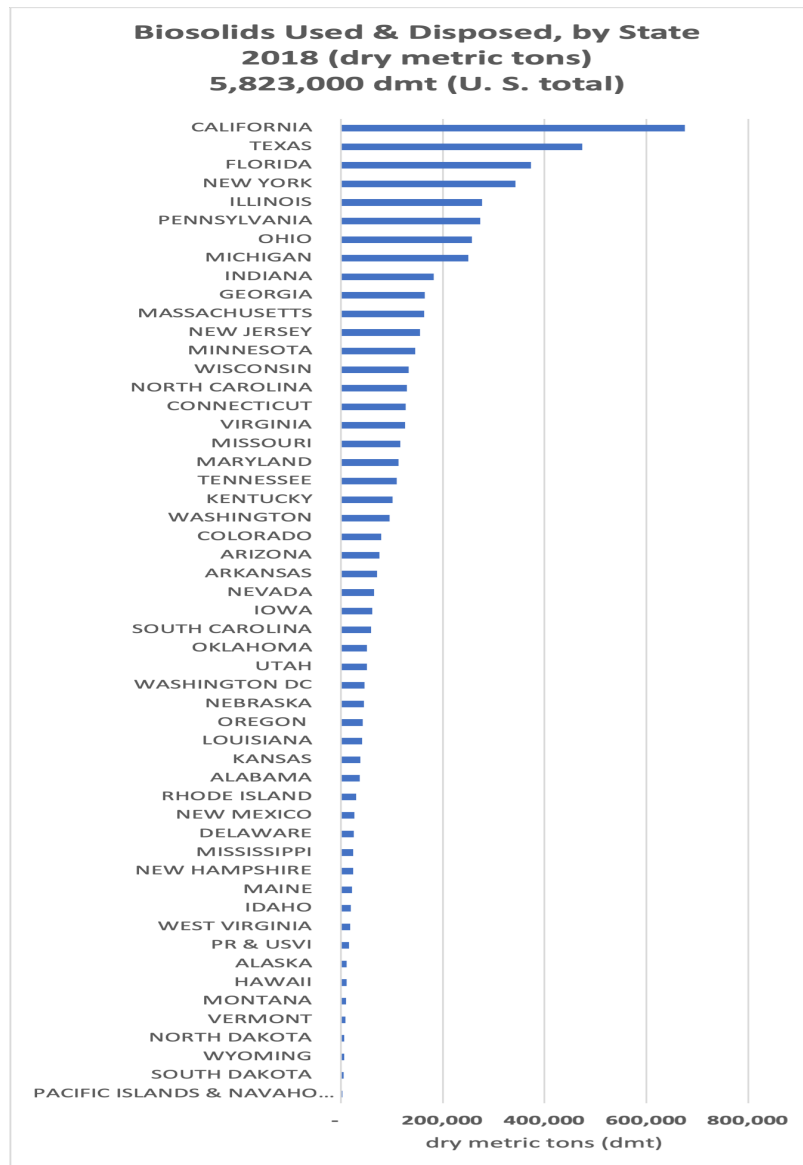
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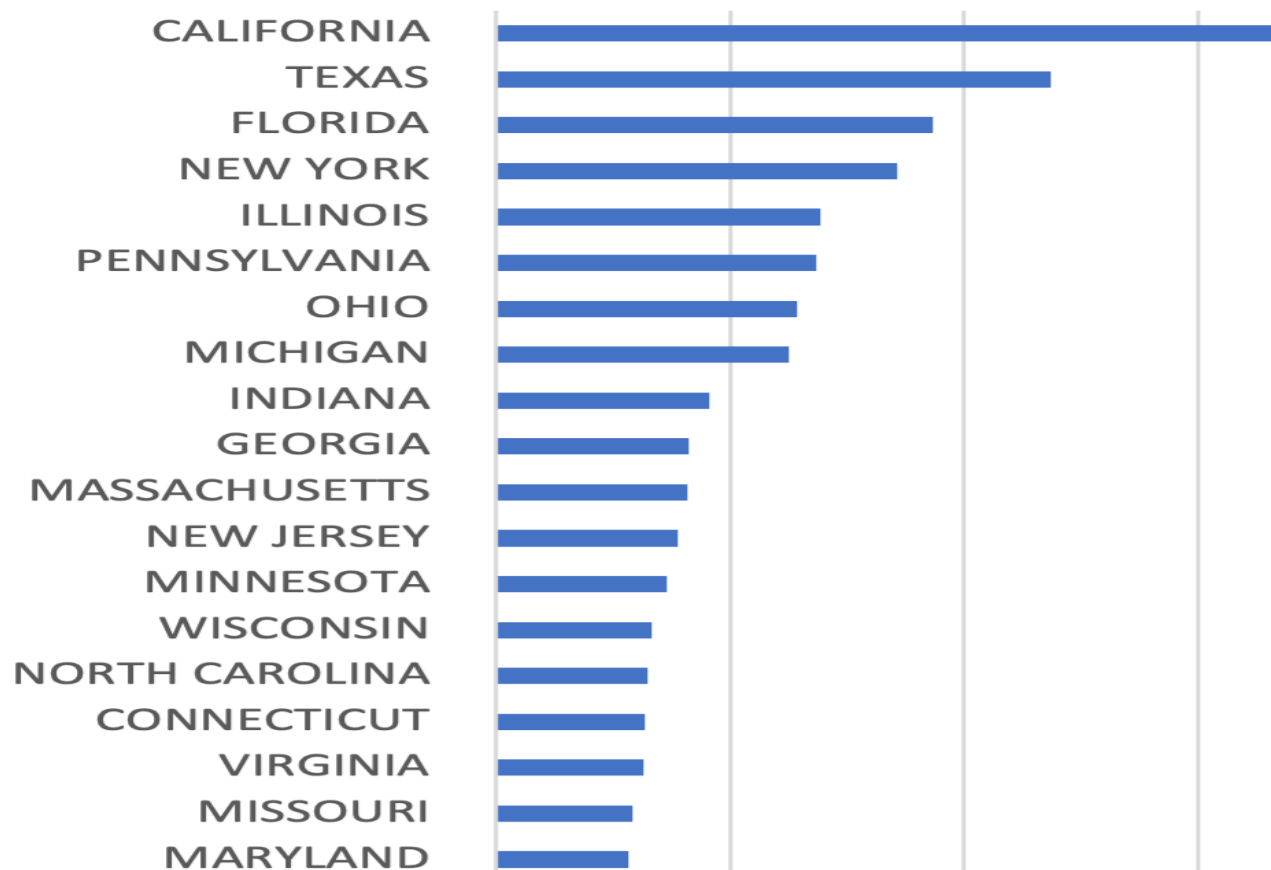
State-by-state (by mass, high – low)

biosolids use & disposal, 2018
(dry metric tons, dmt)

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Biosolids Used & Disposed, by State
2018 (dry metric tons)
5,823,000 dmt (U. S. total)



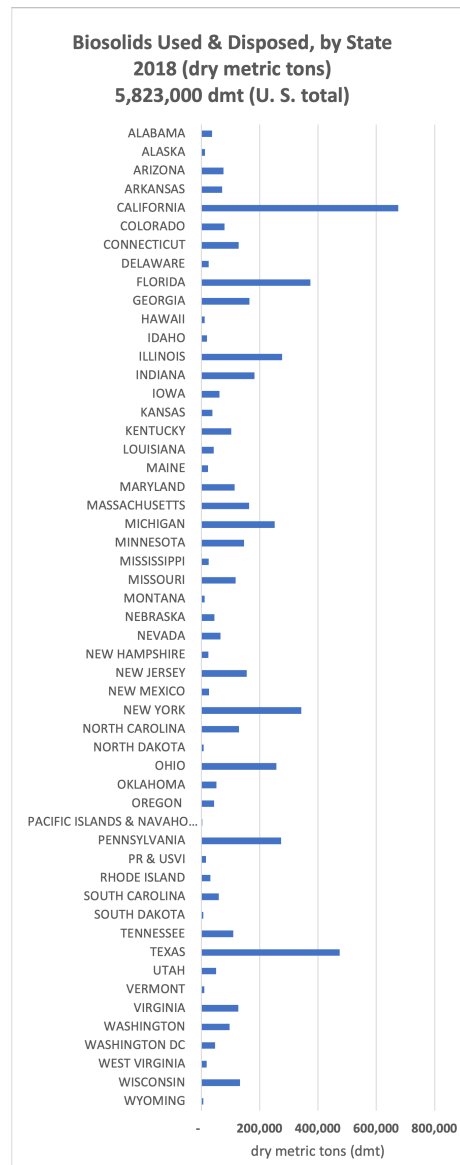
State-by-state (alphabetically)

biosolids use & disposal, 2018
(dry metric tons, dmt)

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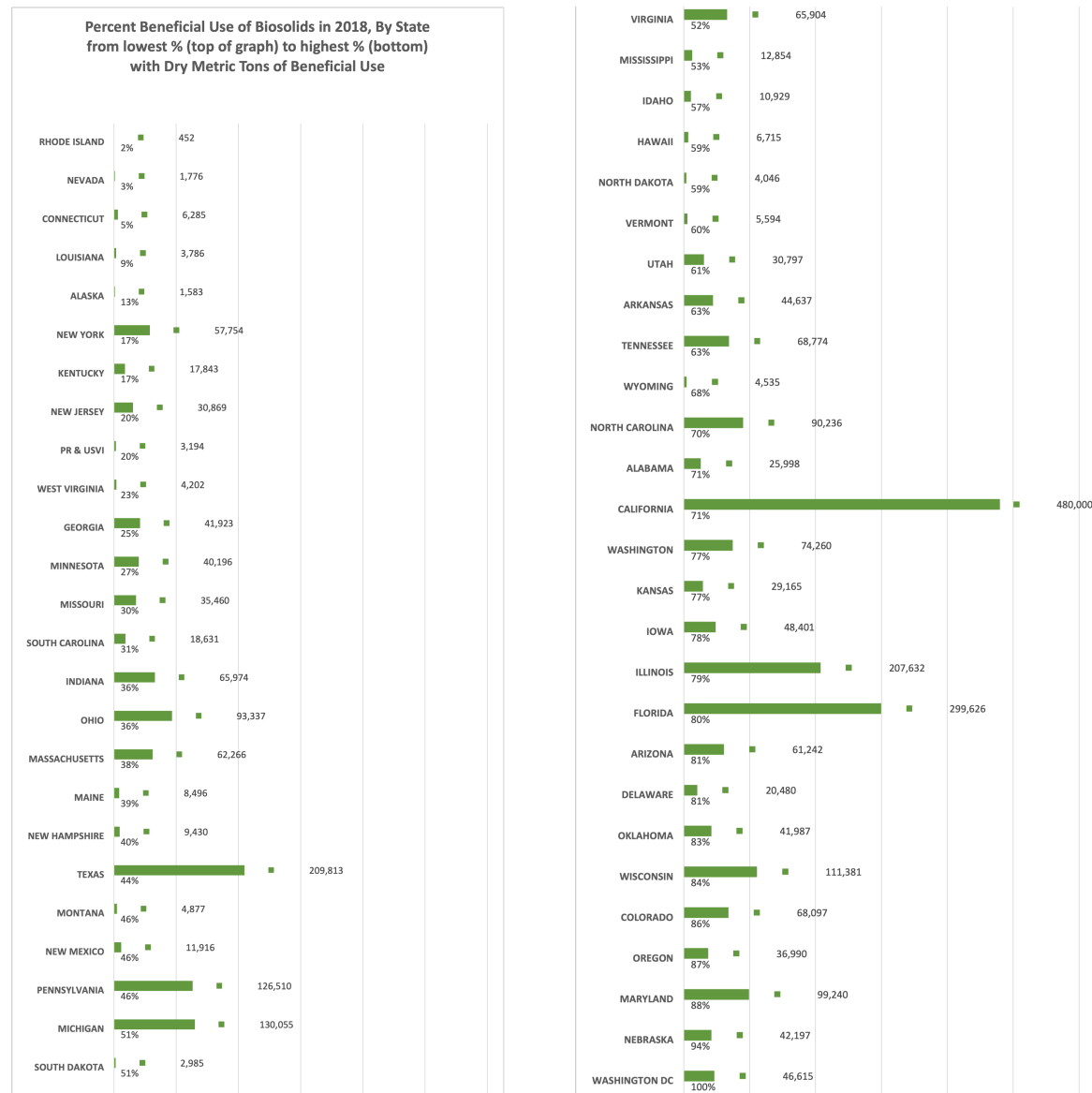
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State-by-state biosolids beneficial use, 2018 (percent (%) and dry metric tons, dmt)

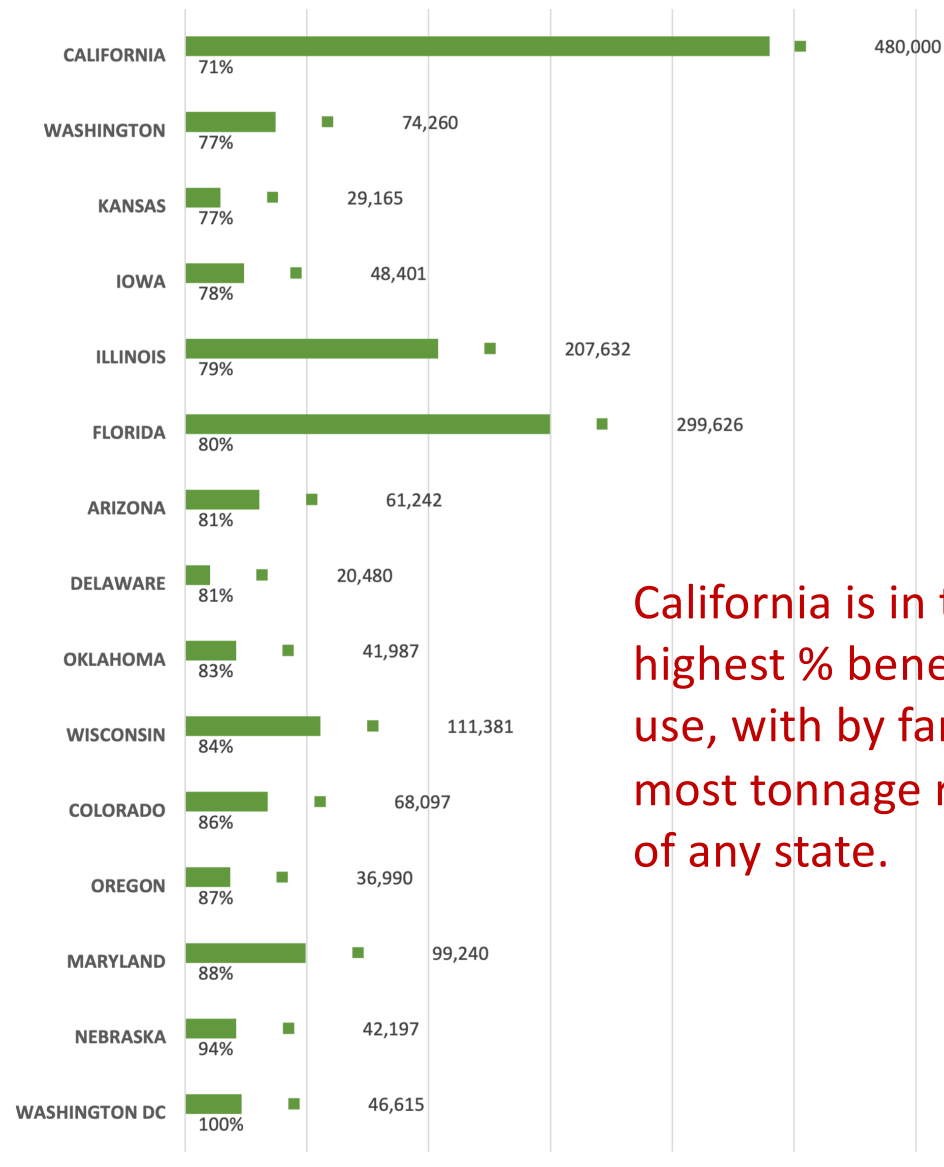
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State-by-state

biosolids
beneficial use,
2018
(percent (%) and
dry metric tons,
dmt)

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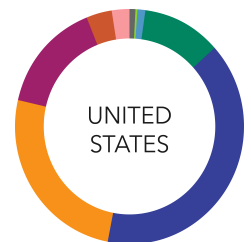
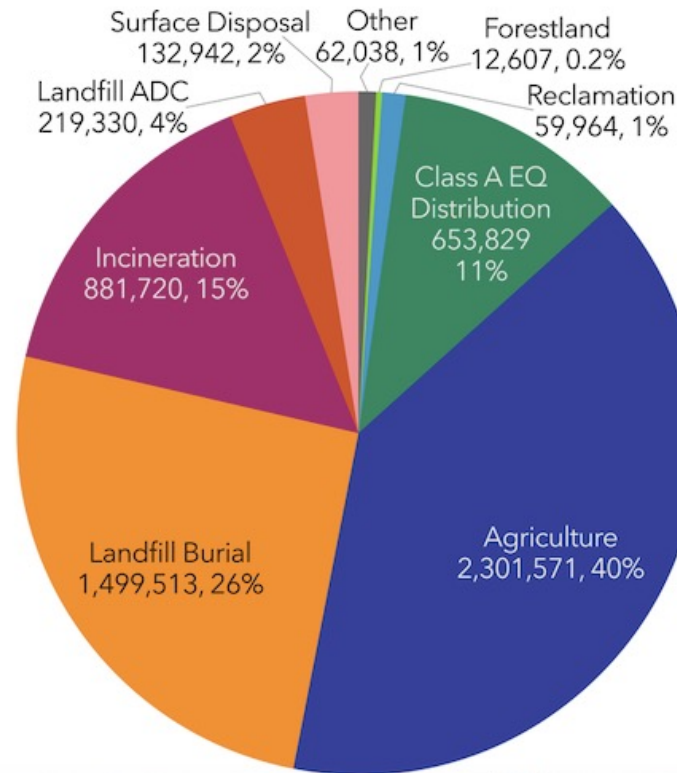
California is in top 15
highest % beneficial
use, with by far the
most tonnage recycled
of any state.

How much biosolids?

Use & disposal

Biosolids Use & Disposal	%	dry metric tons
% Beneficial Use	53%	3,027,971
% Disposal	47%	2,733,505
% Agricultural	40%	2,301,571
% Forestland	0.2%	12,607
% Reclamation	1%	59,964
% Class A EQ Distribution	11%	653,829
% Landfill Burial	26%	1,499,513
% Landfill ADC	4%	219,330
% Surface Disposal	2%	132,942
% Incineration	15%	881,720
% Other	1%	62,038
Total (dry metric tons)		5,823,000

United States
Biosolids Use & Disposal 2018
(dry metric tons, %)
Total: 5,823,000

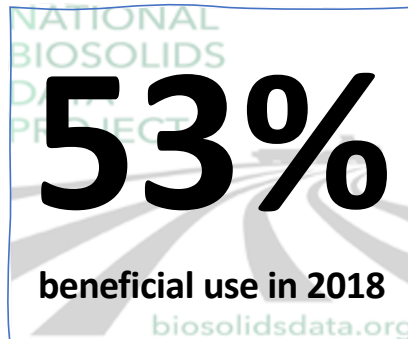


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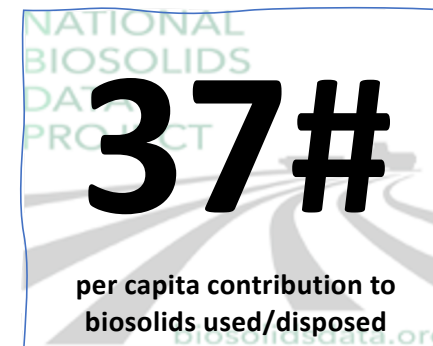
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U. S. Biosolids Use & Disposal, 2018



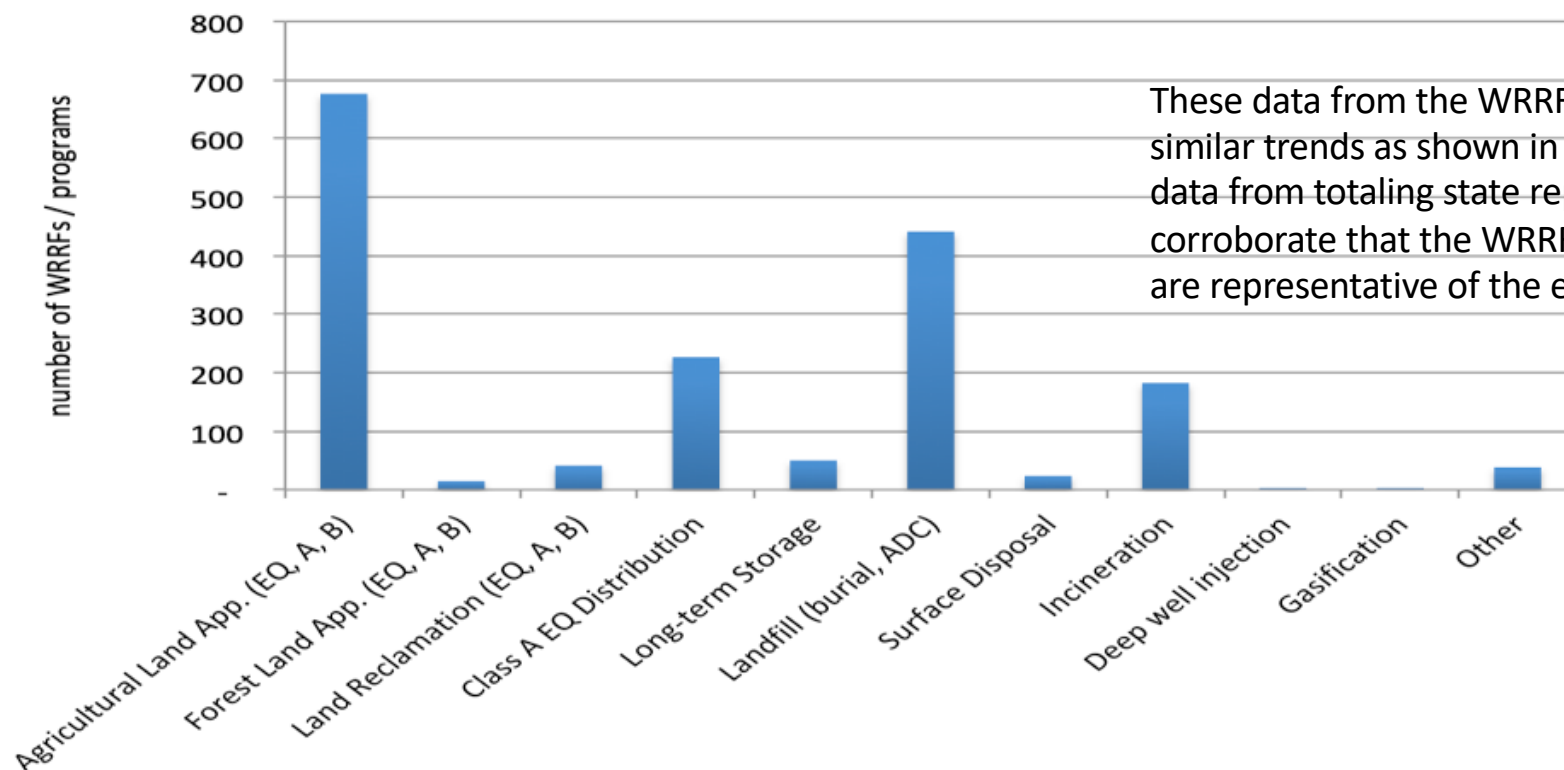
- 53% of biosolids were beneficially used in 2018

- ~37 pounds = the average per capita contribution to biosolids used or disposed in the U.S.



BIOSOLIDS END USE OR DISPOSAL

Relative numbers of WRRFs, in 2018, extrapolated from WRRF survey
(n = 452)



These data from the WRRF survey show similar trends as shown in the nationwide data from totaling state reports, helping corroborate that the WRRF survey data are representative of the entire U. S..

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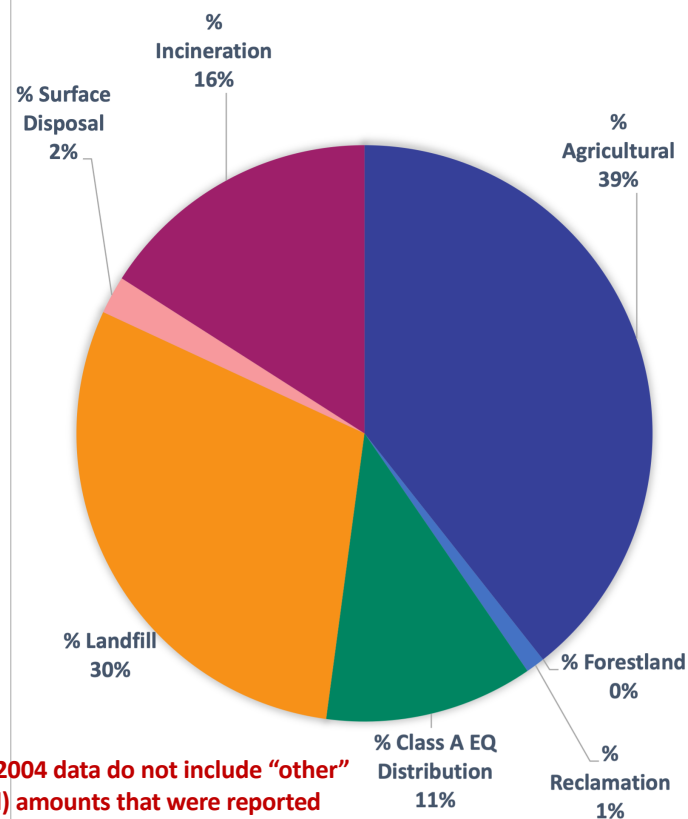
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Comparing 2004 to 2018 Use & Disposal (%)

NATIONAL
BIOSOLIDS
DATA
PROJECT

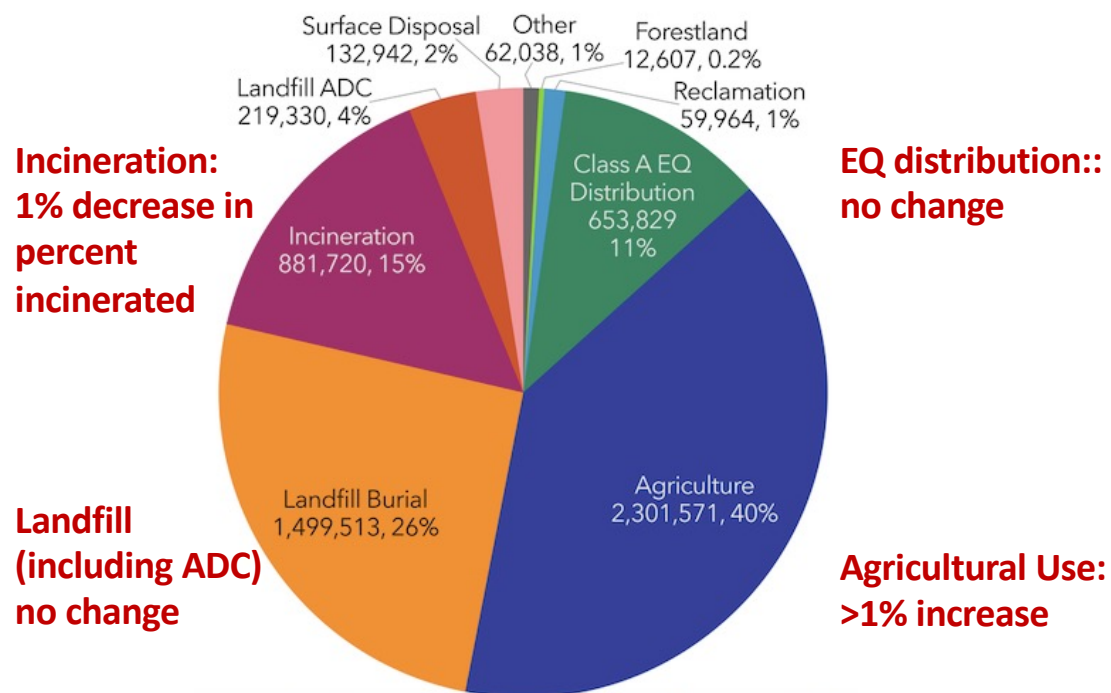


UNITED STATES
BIOSOLIDS USE & DISPOSAL 2004



These 2004 data do not include "other" (stored) amounts that were reported then but not used or disposed that year.

United States
Biosolids Use & Disposal 2018
(dry metric tons, %)
Total: 5,823,000



Incineration:
1% decrease in
percent
incinerated

EQ distribution::
no change

**Landfill
(including ADC)**
no change

Agricultural Use:
>1% increase

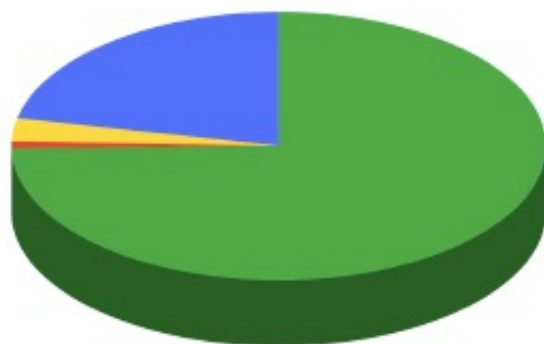
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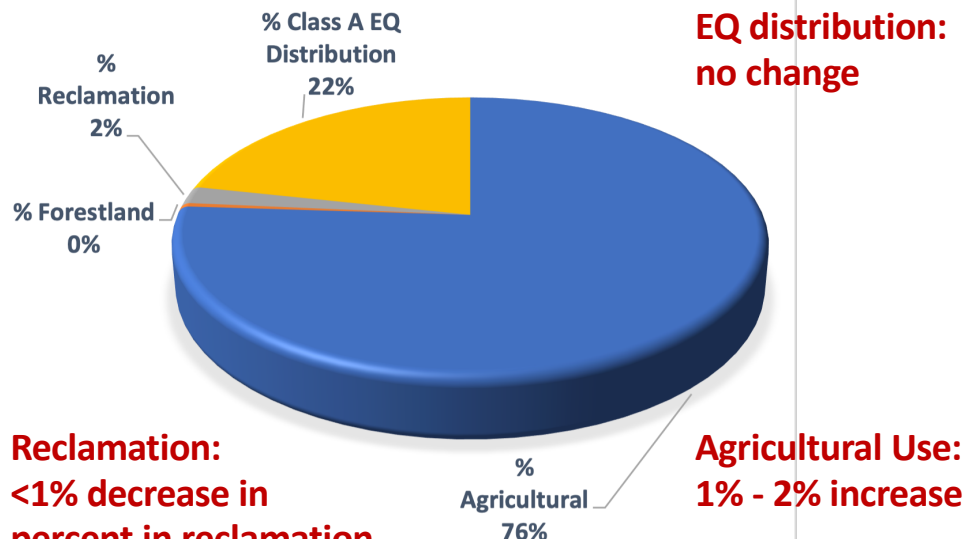
Comparing 2004 to 2018 Uses: Small increase in percent (%) agricultural use

Beneficial Use Practices
2004 U.S. Totals



■ 74% Agriculture ■ 1% Forestland ■ 3% Reclamation ■ 22% Class A EQ Distribution

BENEFICIAL USE PRACTICES
2018 U. S. TOTALS



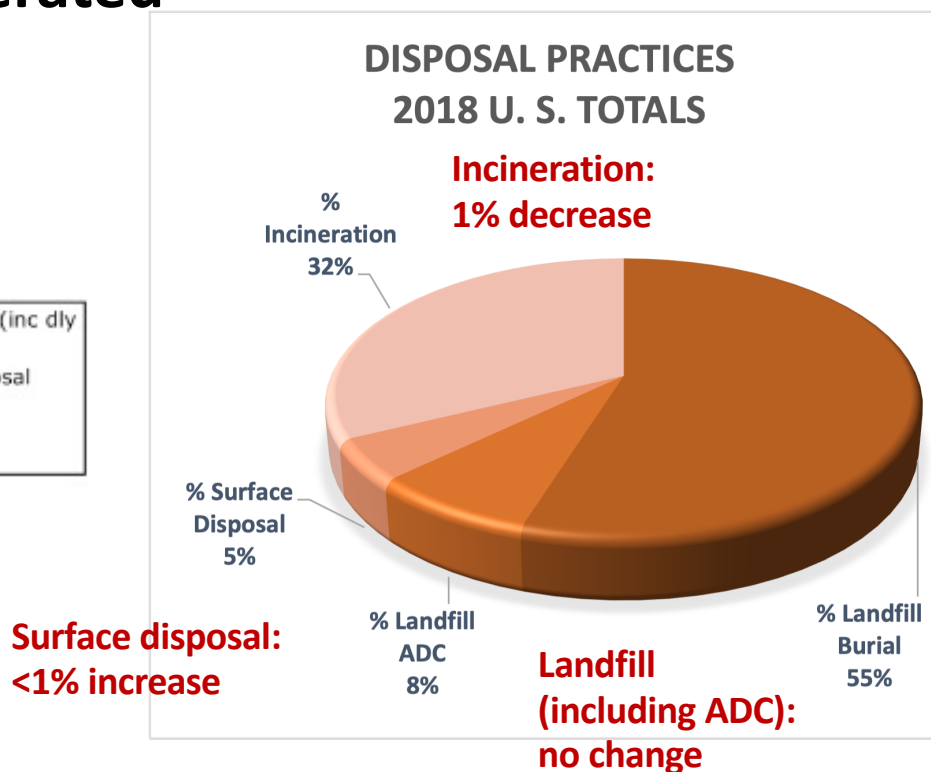
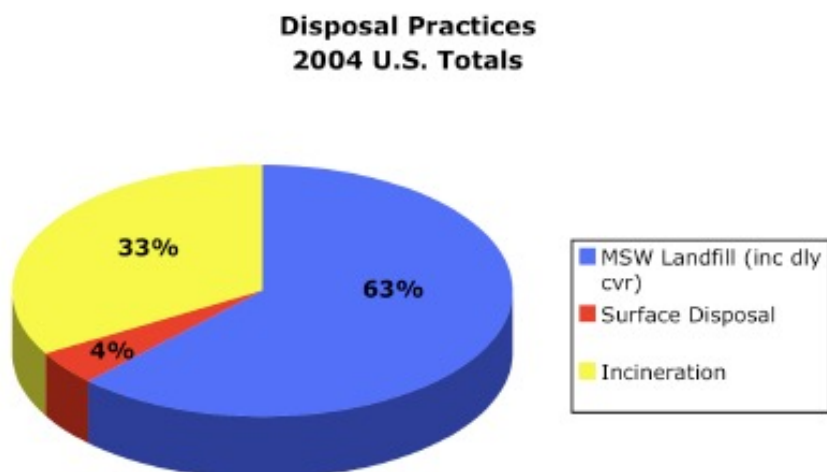
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How much biosolids?

Comparing 2004 to 2018 Disposal: Small decrease in % incinerated



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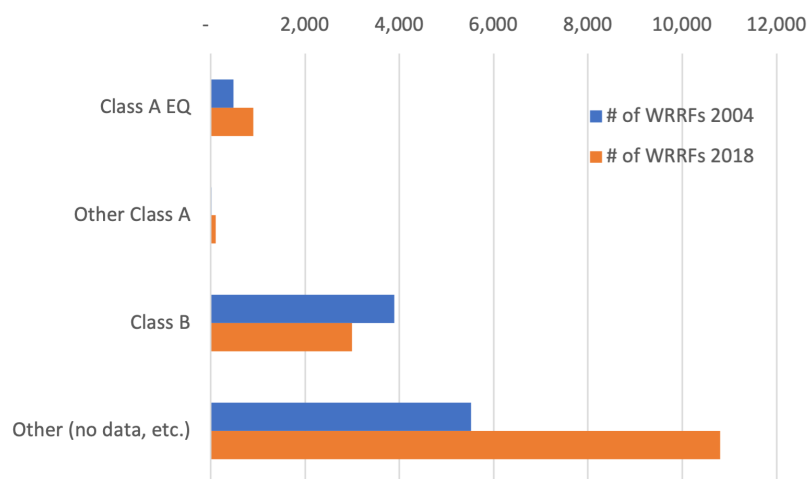
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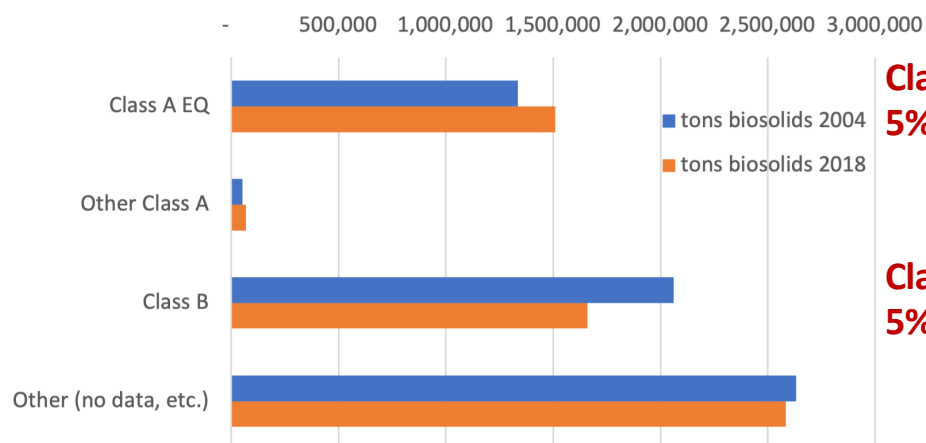
Biosolids Treatment Level (Quality): 2004 vs. 2018



Proportional Numbers of WRRFs
Producing Biosolids of Each Class,
2004 vs. 2018



Tons Biosolids Used or Disposed,
by Class, 2004 vs. 2018



Class A & EQ:
5% increase

Class B:
5% decrease

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Biosolids Quality (data from WRRF survey)

- In 2018, did all of your biosolids meet Part 503 Table 3 (high quality) standards? (n = 416)
 - 330 Yes
 - 13 No
 - 73 Don't know or Not applicable (often, there is no treatment when the solids are being sent to landfill or incineration)
- Average % solids of biosolids (n=80): 22%



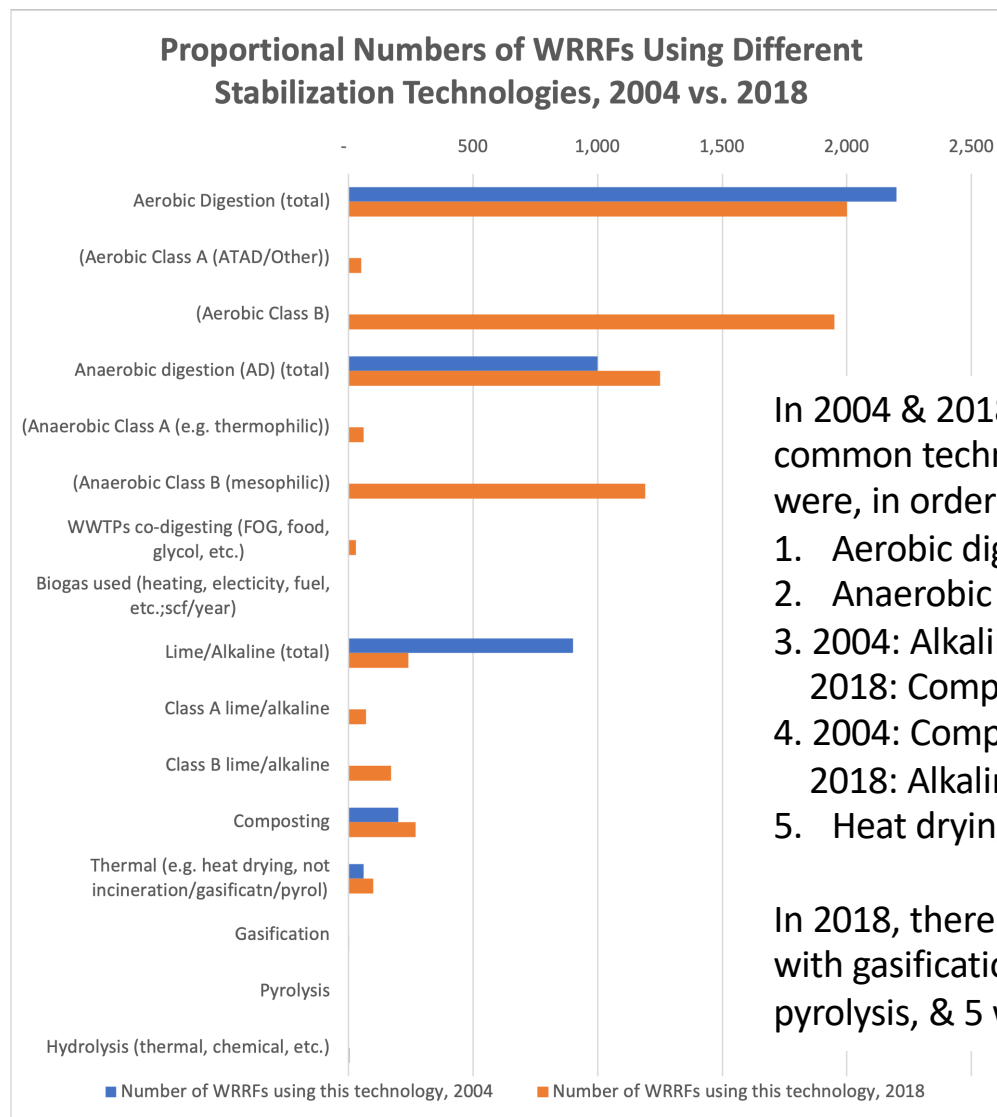
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Treatment Technologies in Use in the U. S. –

Stabilization

Proportional numbers of WRRFs Using Different Stabilization Technologies, 2004 vs. 2018

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In 2004 & 2018, the most common technologies used were, in order:

1. Aerobic digestion
2. Anaerobic digestion
3. 2004: Alkaline stabilization
2018: Composting
4. 2004: Composting
2018: Alkaline stabilization
5. Heat drying

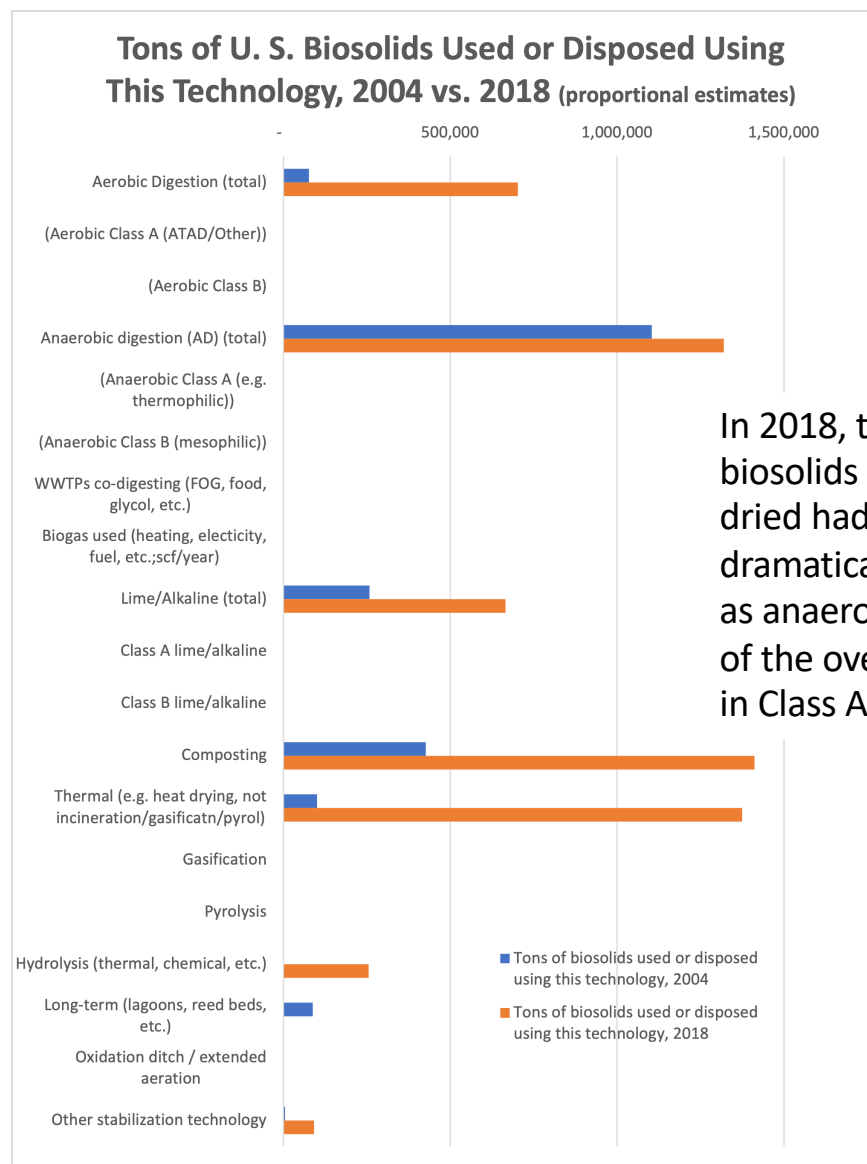
In 2018, there were 3 WRRFs with gasification, 0 with pyrolysis, & 5 with hydrolysis

Treatment Technologies in Use in the U. S.

Stabilization

Tons of Biosolids Used or Disposed Using This Technology, 2004 vs. 2018 (proportional estimates)

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In 2018, the tonnages of biosolids composted or heat dried had increased dramatically to similar levels as anaerobic digestion – part of the overall ~5% increase in Class A EQ biosolids.

Summary: Trends from 2004 to 2018

- More Class A & EQ biosolids being produced in 2018
- Same % of landfilled solids, despite more pressures & incentives to divert from landfills
- Less incineration (fewer SSIs & less tonnage)
- Decrease in state full-time employees (FTEs)
- In all years: Less than 1% of U.S. cropland would be needed for land application of all biosolids.

A local hardware store in western Maine enthusiastically advertises Milorganite every year.





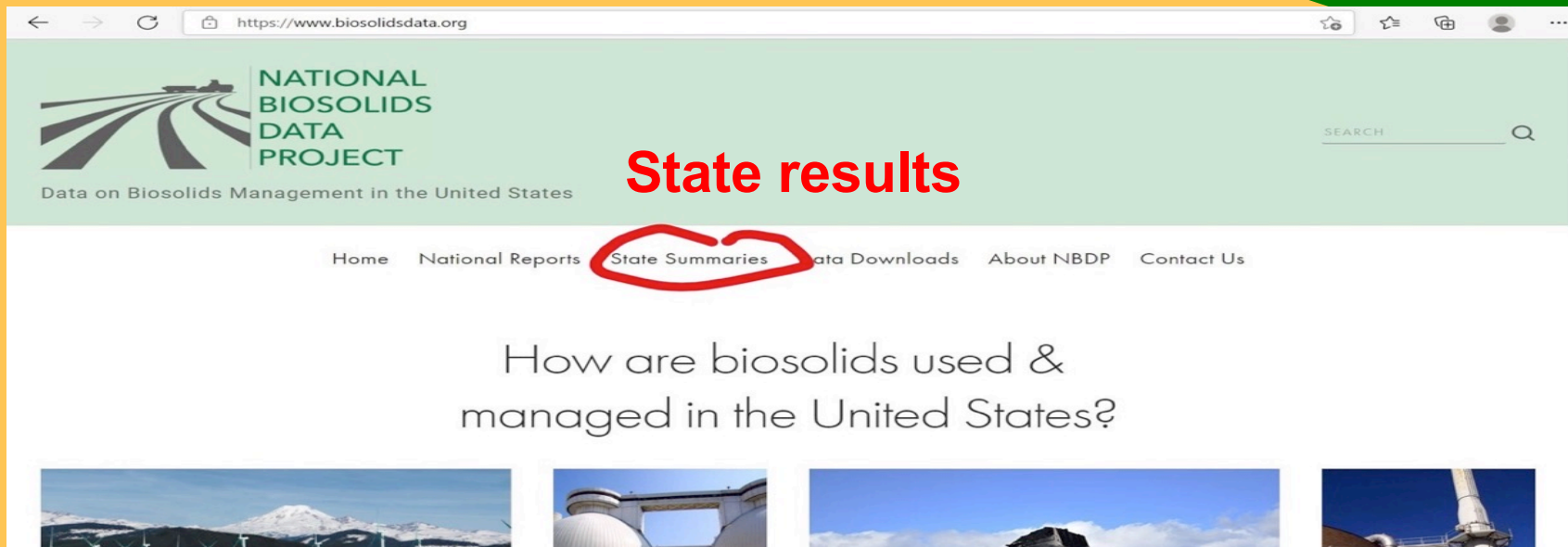
Navigating
<https://www.biosolidsdata.org>

*Liquid land
application by
injection,
Kentucky*



RESULTS

Results at www.biosolidsdata.org

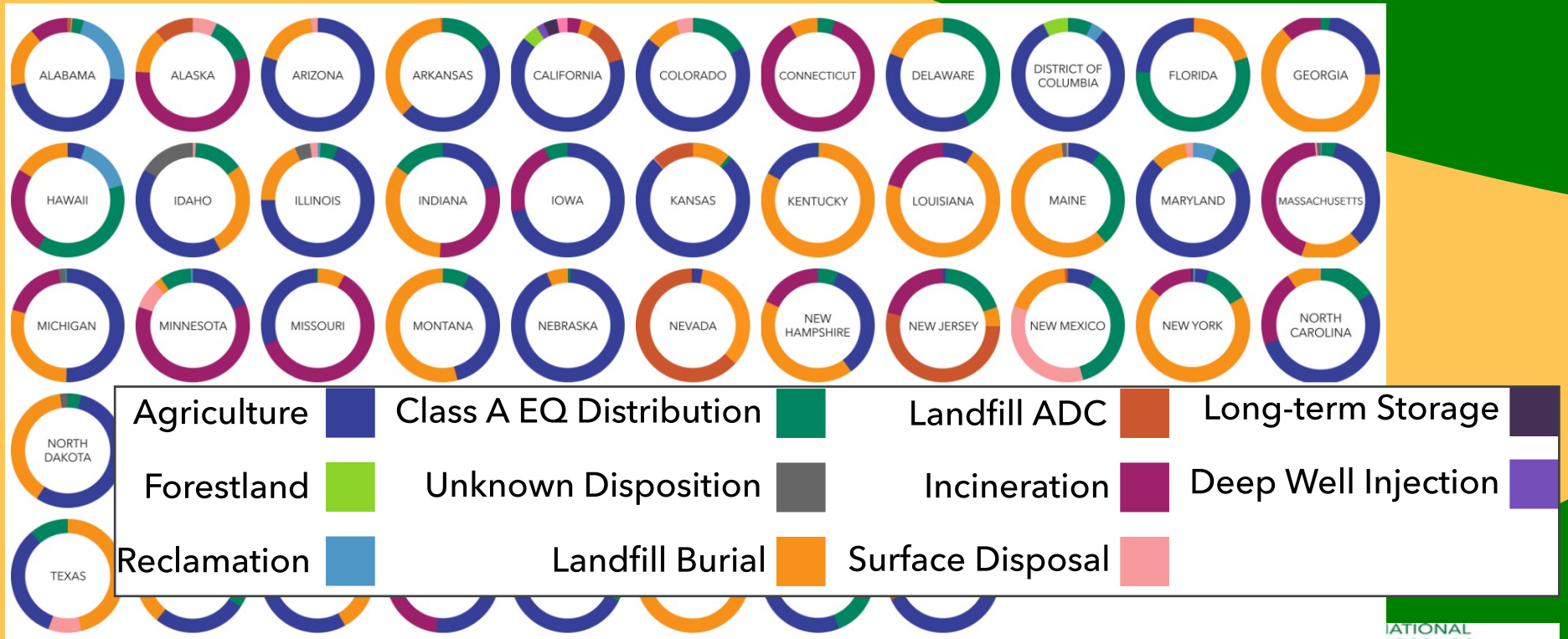


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Navigating state data

Project Website: www.biosolidsdata.org – State Data



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Navigating state data

Left column: state totals

Iowa Biosolids

Right column: state narrative summary

State Data

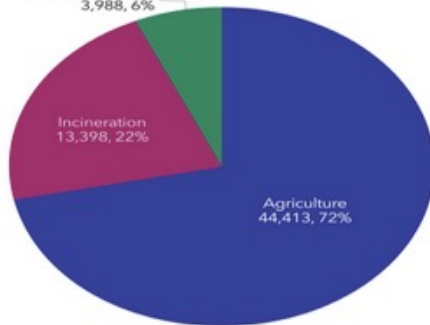
Confidence in data for this state:

HIGH

2018 data unless noted.

Iowa Biosolids Use & Disposal 2018
(dry metric tons, %)
Total: 61,800

Class A EQ Distribution
3,988, 6%



Iowa Septage Management 2018
(% estimated)
Total: 40,000,000 gallons



Middle column: dashboard of key state statistics

State Statistics Dashboard

Demographics & Wastewater

Avg population served per WRRF	2,138
Avg wastewater flow statewide (MGD)	807
WRRFs treating >75% WW flow	79
% of population served by on-site (septic) syste...	35
Biosolids used or disposed / person in 2018 (lbs)	58

Biosolids Application

% of state area in cropland	76.28%
% cropland to which biosolids were applied	< 0.27%
application rate if all state biosolids were applied to cropland (dt/acre)	< 0.262
% cropland needed if all biosolids were applied at typical rate of ~3dt/acre	< 1.8%

State Summary

- Iowa has abundant agriculture, and biosolids recycling to soils is prevalent, routine, economical, and encouraged. Landfill disposal of sewage sludge is discouraged and landfill disposal Class A or Class B biosolids is prohibited.
- Nutrient management is a growing concern statewide; effluent standards and non-point nutrient sources are a focus – and biosolids might be.
- Des Moines – the state's largest WRRF – is a national leader in advanced anaerobic digestion and renewable natural gas (RNG) production, putting to use the abundant food processing and other liquid wastes available for co-digestion.
- IA DNR provides robust data on biosolids treatment technologies; see the state's data spreadsheet.

STATE NARRATIVE SUMMARY REPORT (PDF)



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DASHBOARD

Iowa State Biosolids Statistics

Data Quality & Methods	2018	explanations & sources
<p>Quality & Confidence in this state's data:</p> <p>Data sources & methods:</p> <p>State biosolids included in 2018 EPA ECHO data</p>	<p>HIGH</p> <p>State biosolids coordinator, who was very thorough in completing this survey, tracks land application closely & compiles data from annual reports from WRRFs, which are now submitted electronically.</p> <p>103% % in ECHO vs. the total presented here</p>	<p>ranking by survey team based on information provided in survey (options: High, Moderate, Low, None)</p> <p>https://www.epa.gov/echo/echo-data-reports</p>
<p>Demographics & Wastewater</p> <p>State population:</p> <p>Total land area in state (acres):</p> <p>Population density (persons/square mile):</p> <p>Total number of WRRFs reported in state survey:</p> <p>total number of WRRFs permitted/reported elsewhere:</p> <p>number of WRRFs in EPA ECHO reports for 2018:</p> <p>Average population served per WRRF:</p> <p>Average wastewater flow statewide (MGD, NBDP):</p> <p>avg.wastewater flow statewide (MGD, Seiple):</p> <p>Number of WRRFs that treat >75% of state flow:</p> <p>% of population served by on-site (septic) systems:</p> <p>Biosolids used or disposed / person in 2018 (lbs):</p>	<p>3,156,145</p> <p>35,748,480</p> <p>56.5</p> <p>871</p> <p>763</p> <p>81</p> <p>2,718</p> <p>507</p> <p>371</p> <p>70</p> <p>25%</p> <p>39</p>	<p>U. S. Census estimate for July 1, 2018</p> <p>https://www.census.gov/data/tables/2018/decennial/cen2018-001.html</p> <p>calculated</p> <p>survey response by state expert</p> <p>Seiple et al., 2020; state experts, etc.</p> <p>https://www.epa.gov/echo/echo-data-reports</p> <p>calculated</p> <p>survey response by state expert</p> <p>Seiple et al., 2020</p> <p>https://doi.org/10.1016/j.jenvman.2020.110852</p> <p>Seiple et al., 2020</p> <p>https://doi.org/10.1016/j.jenvman.2020.110853</p> <p>survey response by state expert</p> <p>calculated</p>
<p>Biosolids Application</p> <p>Agricultural land cropland (acres):</p> <p>% of state area in cropland:</p> <p>Number of farms with that cropland:</p> <p>% cropland to which biosolids were applied:</p> <p>Application rate if all state biosolids were applied to cropland (dry metric tons/ac.):</p> <p>% cropland needed if all state biosolids were applied at typical rate (~3 dt/ac):</p>	<p>26,545,960</p> <p>74%</p> <p>77,943</p> <p>0.07%</p> <p>0.2%</p> <p>0.1%</p>	<p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p> <p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p> <p>calculated</p> <p>calculated</p>
<p>Nutrient Sources - Comparison</p> <p>Nitrogen (N) in all this state's biosolids (metric tonnes, 2018):</p> <p>N in this state's animal manures (metric tonnes):</p> <p>N in this state's purchased fertilizer (metric tonnes, 2011):</p> <p>If all state's biosolids applied, what % of state's applied N would come from biosolids?</p> <p>Phosphorus (P) in this state's biosolids (metric tonnes, 2018):</p> <p>P in this state's animal manures (metric tonnes):</p> <p>P in this state's purchased fertilizer (metric tonnes, 2011):</p>	<p>2,966</p> <p>398,551</p> <p>1,214,110</p> <p>0.2%</p> <p>1,236</p> <p>144,981</p> <p>200,085</p>	<p>calculated assuming avg. 4.8% biosolids N</p> <p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p> <p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p> <p>calculated assuming avg. 2% biosolids P</p> <p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p> <p>https://www.dnr.iowa.gov/record/93886034-6032-1726-4769-6666666666</p> <p>calculated</p>

STATE BIOSOLIDS SURVEY

Iowa

Infrastructure & Wastewater

	2004 Data	2018 Data	
Total Number of WWTPs:	78 (survey), 730 CWNs	871	
WWTP & Biosolids Infrastructure Totals			
Number of Separate Preparers (in- or out-of-state, receiving solids from your state):	no data	1	*****
Total number of your state's WWTPs sending to those Separate Preparers:	0	1	*****
Number of operating sludge incinerators in your state (total):	2	1	*****
Fluidized bed:	1	0	*****
Multiple hearth:	1	1	*****
Number of Part 258 landfills in your state accepting sewage sludge:	data not requested for 2004	0	*****
Number of WWTPs in your state with industrial pre-treatment programs:	data not requested for 2004	20	*****
Number of WWTPs in your state with sludge lagoons:	data not requested for 2004		*****
Wastewater Flow Totals			
Total statewide average daily wastewater flow (MGD):	data not requested for 2004	90.7	*****
Total statewide WWTP design capacity for wastewater flow (MGD):	data not requested for 2004	98.7	*****
Total statewide average daily dry weather flow (MGD):	data not requested for 2004	348	*****
Other Totals			
Number of documented odor & nuisance complaints received by state in 2018 related to biosolids transportation and use or disposal outside of the gates of the WWTP:	data not requested for 2004	0	*****
Number of WWTPs involved in those complaints:	data not requested for 2004	0	*****
Percent of population served by on-site systems (e.g. septic systems):	no data	25%	*****

The 871 WWTPs are all municipal WWTPs. • Davenport City is the 1 separate preparer, composting Davenport biosolids. • Iowa has 871 municipal WWTPs that have NPDES discharge permits. Our major POTWs are 107 facilities (in 2020) based on the design average wet weather flow equal to or greater than 1 MGD. The design AWW flow for the 107 facilities ranges from 1 mgd to 134 mgd. • Major POTW facilities have biosolids annual reporting requirements to EPA and state. Minor facilities keep their biosolids report at their site. • Design flow definitions are in the Iowa Wastewater Facilities Design Standards Chapter 14. • The average dry weather flow in this survey is based on the average of the facility's design average dry weather flow, which is 3,248 MGD. The average statewide wastewater design capacity is based on the average of the facility's design average wet weather flow, (the same number that designates a "major" facility), and is 6,236 mgd. The statewide average daily wastewater flow is the average of the ADW and AWW, in design. We did not run the LWR flow data for the actual average daily wastewater flow. All the flow numbers reported here are based on the wastewater treatment plant design flow in the construction permits that are approved by Iowa DNR. • Two dozen or more wastewater facilities are lagoon facilities that do not desludge every year. The survey data reported here are based on those POTWs that sent annual reports for biosolids land application.

Biosolids Use and Disposal

UNITS:		Dry U.S. tons		Dry metric tons	
BIOSOLIDS USED OR DISPOSED, 2018 (adjusted total): 61,800					
Summary					
	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	NOTE: Quantity of sewage sludge or biosolids used or disposed means the quantity that goes out the gate of the WWTPs. Use the units (the form of measurement) you chose above. The beneficial use numbers include some composted biosolids. The disposal numbers include incinerated biosolids. There is no town wastewater sludge going to landfill. State law prohibits Class A and Class B biosolids going to landfill. Solid Waste Rule 121 on land application of waste, discourages sewage sludge going to landfill.
Beneficial Use (applied to soils, not including ADC)	78	50,200	81	48,401	
Disposal & Alternative Dispositions	2	16,600	1	13,398	
Other	0	0	0	0	
TOTAL	78	66,800	82	61,799	
Beneficial Use					
	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	The Class A EQ material is composted biosolids sold to the market. This program is a separate preparer in Davenport, IA: the city's Composting Facility.
Agricultural (EQ, Class A, & Class B)	85	48,200	89	44,413	
Forestland (EQ, Class A, & Class B)	0	0	0	0	
Reclamation (EQ, Class A, & Class B)	0	0	0	0	
Class A EQ Distribution (bagged or bulk, public distribution, or unsure where it went)	11	2,000	1	3,986	
Beneficial Use Subtotal	78	50,200	81	48,401	
Long-term storage	0	0	0	0	
Number of acres to which biosolids were applied:	data not provided		18,689		
Disposal & Alternative Dispositions					
	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	Number of Entries (WWTPs & Sep. Preparers) Going To...	Quantity of Biosolids	
Landfill (total)	0	0	1	3,065	

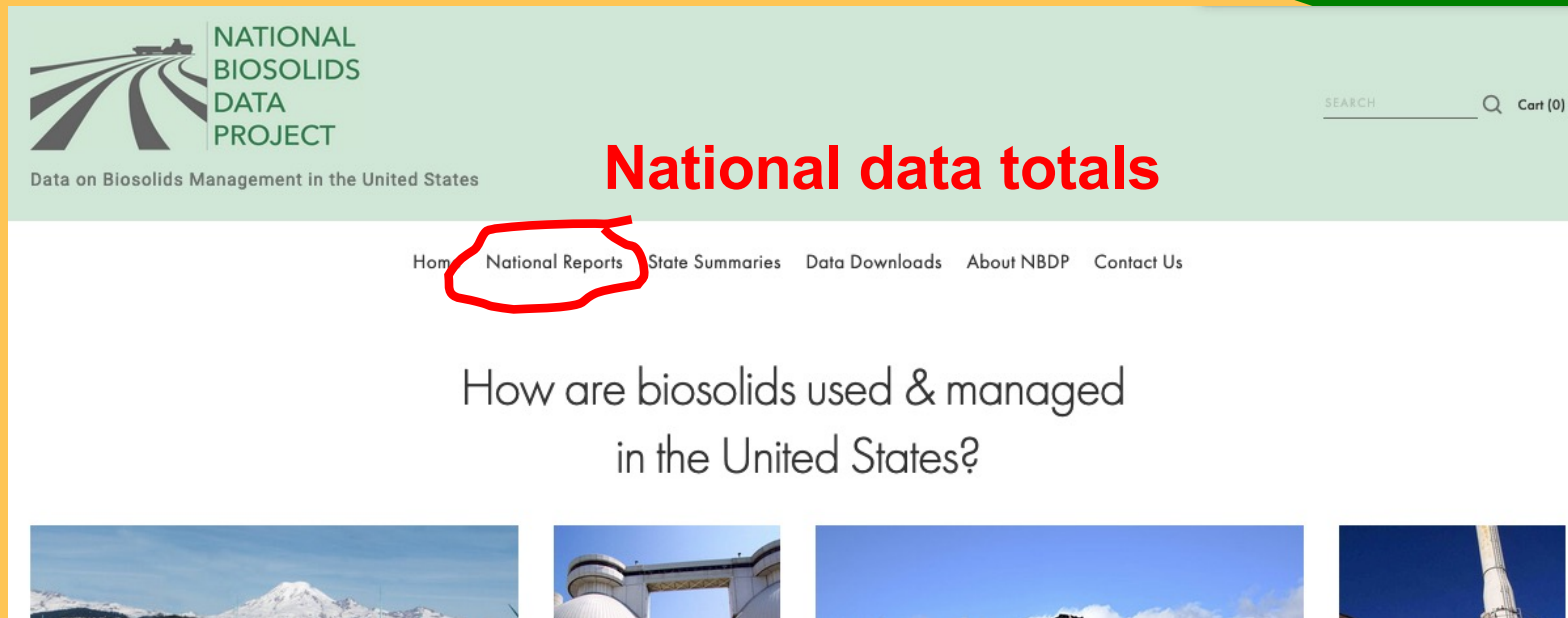
NOTE: Quantity of sewage sludge or biosolids used or disposed means the quantity that goes out the gate of the WWTPs. Use the units (the form of measurement) you chose above.

The beneficial use numbers include some composted biosolids. The disposal numbers include incinerated biosolids. There is no Iowa wastewater sludge going to landfill. State law prohibits Class A and Class B biosolids going to landfill. Solid Waste Rule 121 on land application of waste, discourages sewage sludge going to landfill.

The Class A EQ material is composted biosolids sold to the market. This program is a separate preparer in Davenport, IA; the city's Composting Facility.

RESULTS

Results at www.biosolidsdata.org



NATIONAL BIOSOLIDS DATA PROJECT

Data on Biosolids Management in the United States

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How are biosolids used & managed in the United States?

Four small images showing biosolids management facilities: a snow-capped mountain, a large industrial building, a blue sky with clouds, and a tall industrial chimney.

a National Biosolids Data Project presentation • June 24, 2022
A full set of slides (.ppt) is available for a fee at <https://www.biosolidsdata.org/data-downloads>.
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Questions?

<https://www.biosolidsdata.org>



Ned Beecher

ned.beecher@gmail.com

or

Janine Burke-Wells

janine@nebiosolids.org

603-323-7654



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