Focusing on Energy Through Power Generation at wastewater Treatment Plants

Examining Data From 583 Resource Recovery Facilities Across Wisconsin

NASEO Energy Water Nexus Webinar

December 19, 2018

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Presentation Overview

- Why Address Energy Use Through Regulatory Reports?
- Training Initiative
- Best Practice Guide Forecasted Energy Use
- What Does The Collected Data Look Like
- Process Questions
- Facility Distribution
- What is The Data Telling Us
- Focus Assistance
- Summary – Actions – Q & A

Why Address Energy Use Through the Regulatory Process?

One of the primary purposes of the Compliance Maintenance Annual Report (CMAR) is to foster **communication**.

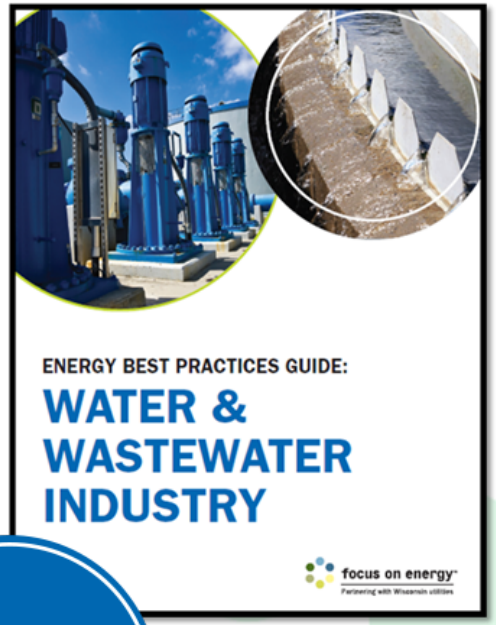
Communication of Wastewater Resource Recovery Facilities needs among **operators, governing bodies**, and the **DNR**.

This project allows the CMAR to become an educational tool that increases awareness of the importance and **value** of wastewater treatment **energy efficiency.**

Why Address Energy Use Through the CMAR?

The Clean Water Loan Fund requires an Energy Audit, first step of energy audit is to create an energy use baseline.

In 2017 Focus on Energy provided energy efficiency incentives to over 50 Wisconsin Wastewater Treatment Facilities.



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Collaborative Process to Develop Questions?

Design Phase (2015)

CMAR Energy External Workgroup with in-person meetings to develop the new questions and data table with the charge of keeping it short, simple and easy to complete.

Jack Saltes – DNR Madison
Joe Cantwell, Focus On Energy
Jeremy Cramer, Fond du Lac WWTP
Kevin Freber, Watertown WWTP
Sharon Thieszen, Sheboygan WWTP
Gary Hanson, Short Elliot Hendricksen
Steve Ohm, DNR-Rhinelander
David Argall, DNR-Madison
Megan Levy, OEI
Kevin Splain, OEI

WISCONSIN WASTEWATER OPERATORS' ASSOCIATION

focus on energy℠

Partnering with Wisconsin utilities

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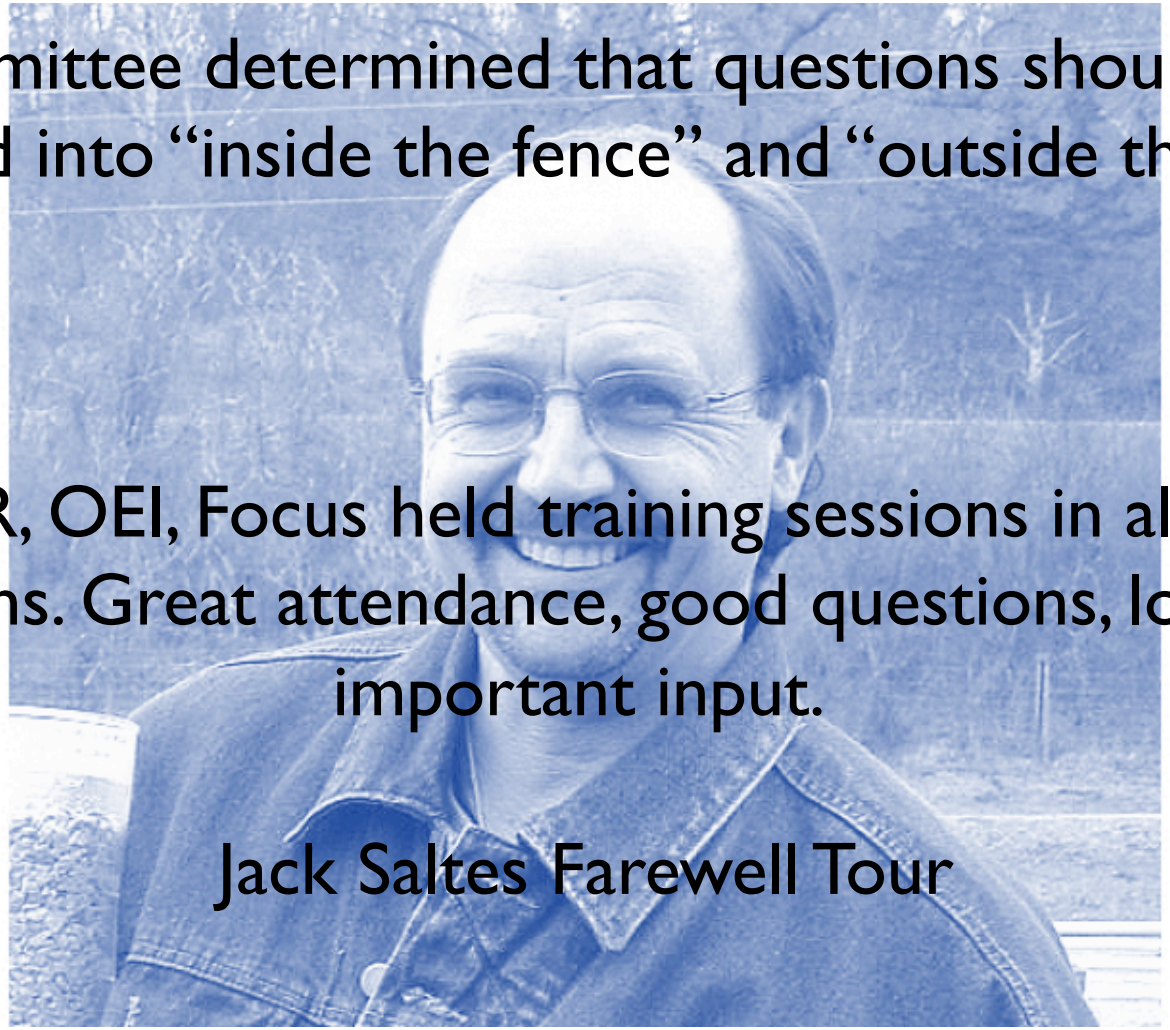
Initial Questions on Energy Use/ Training Initiative

Committee determined that questions should be separated into "inside the fence" and "outside the fence"



WDNR, OEI, Focus held training sessions in all DNR regions. Great attendance, good questions, lots of important input.

Jack Saltes Farewell Tour

Energy Best Practice Guide: Table 4

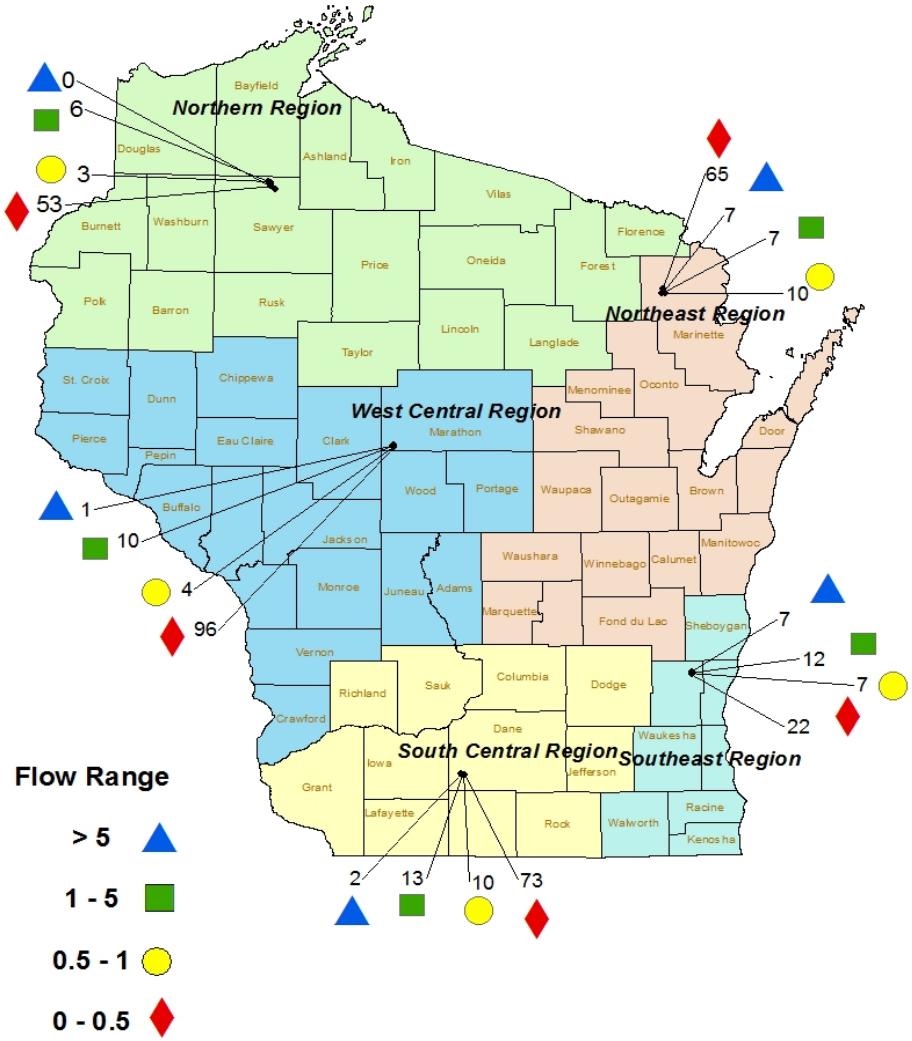
Table 4 Best Practice Benchmarks and Top Performance Quartiles for Wisconsin Wastewater Facilities

Facility Type	Flow Range (MGD)	Average Energy Use (kWh/MG)	Top Performance Quartile (kWh/MG)	Best Practice Benchmark (kWh/MG)	Average Potential Savings
Activated Sludge**	0 -1	5,440	< 3,280	3,060	44%
	1 - 5	2,503	< 1,510	1,650	34%
	> 5	2,288	< 1,350	1,760	23%
Aerated Lagoon	< 1	7,288	< 4,000	3,540	51%
Oxidation Ditch	< 1.2	6,895	< 4,000	4,320	37%

Facility Distribution Across the State

	DNR Region					
Size Range	Northeast	Northern	South Central	West Central	Southeast	Totals
0.0-0.05	17	19	28	23	2	**89**
0.05-0.125	21	15	17	32	6	**91**
0.125-0.25	21	11	13	23	5	**73**
0.25-0.5	6	8	15	18	9	**56**
0.5-1.0	10	3	10	4	7	**34**
1.0-5.0	7	6	13	10	12	**48**
>5	7	0	2	1	7	**17**
Total Surveyed	**89**	**62**	**98**	**111**	**48**	**408**
Total WPDES	**134**	**114**	**149**	**176**	**68**	**641**

Facility Distribution Across the State



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What the Data Looks Like and What it Tells Us-2016

Flow Range (MGD)	Number of Facilities	Median Flow (MGD)	Best Quad (kWh/MG)	Median (kWh/MG)	Lowest Quad (kWh/MG)
0 - 0.05	163	0.023	123.33	3,825.65	9,089.09
0.05 - 0.125	117	0.072	1,542.22	4,253.15	6,357.29
0.125 - 0.25	79	0.184	2,677.83	3,894.32	5,523.13
0.25 - 0.5	70	0.352	2,290.91	3,607.38	4,564.06
0.5 - 1	39	0.644	1,921.98	2,781.67	3,207.98
1 - 5	58	1.630	1,702.18	2,058.50	2,906.92
>5	19	10.986	1,351.18	1,965.30	2,487.36
0-100	545	0.118	1,575.52	3,237.91	5,663.82

What the Data Looks Like and What it Tells Us-2017

Flow Range (MGD)	Number of Facilities	Median Flow (MGD)	Best Quad (kWh/MG)	Median (kWh/MG)	Lowest Quad (kWh/MG)
0 - 0.05	186	0.022	11.83	3,855.82	8,941.33
0.05 - 0.125	125	0.074	1,279.16	4,607.23	6,525.83
0.125 - 0.25	81	0.187	2,516.79	3,690.82	5,563.75
0.25 - 0.5	73	0.340	2,403.38	3,271.55	4,228.38
0.5 - 1	41	0.652	2,175.83	2,609.37	3,502.66
1 - 5	58	1.694	1,660.88	2,172.53	2,884.26
>5	19	10.981	1,453.91	1,894.51	2,523.28
0-100	583	0.100	1,538.74	3,072.32	5,392.48

What the Data Looks Like and What it Tells Us

2016 kWh/BOD

Flow Range (MGD)	Number of Facilities	Median Electricity Consumed (kWh)	Best Quad (kWh/BOD)	Median (kWh/BOD)	Lowest Quad (kWh/BOD)
0 - 0.05	163	33,004	95.54	2,761.99	5,723.26
0.05 - 0.125	117	118,680	1,253.23	2,701.51	4,230.17
0.125 - 0.25	79	263,920	2,056.31	2,838.25	3,925.73
0.25 - 0.5	70	425,140	1,489.41	1,904.17	2,715.07
0.5 - 1	39	639,606	995.86	1,422.73	2,063.95
1 - 5	58	1,495,596	826.82	1,057.86	1,400.75
>5	19	6,524,275	675.56	1,101.78	1,278.79
0-100	545	168,200	987.59	2,062.65	3,859.35

What the Data Looks Like and What it Tells Us

2017 kWh/BOD

Flow Range (MGD)	Number of Facilities	Median Electricity Consumed (kWh)	Best Quad (kWh/BOD)	Median (kWh/BOD)	Lowest Quad (kWh/BOD)
0 - 0.05	186	29,420	8.40	2,370.80	5,463.86
0.05 - 0.125	125	112,600	1,365.37	2,958.71	4,349.39
0.125 - 0.25	81	224,830	2,010.55	2,737.36	3,628.20
0.25 - 0.5	73	415,680	1,508.91	1,863.72	2,571.02
0.5 - 1	41	736,825	992.27	1,697.89	2,178.98
1 - 5	58	1,527,130	810.50	1,096.39	1,537.67
>5	19	6,734,757	683.79	1,032.74	1,504.45
0-100	583	163,700	920.54	2,035.78	3,617.16

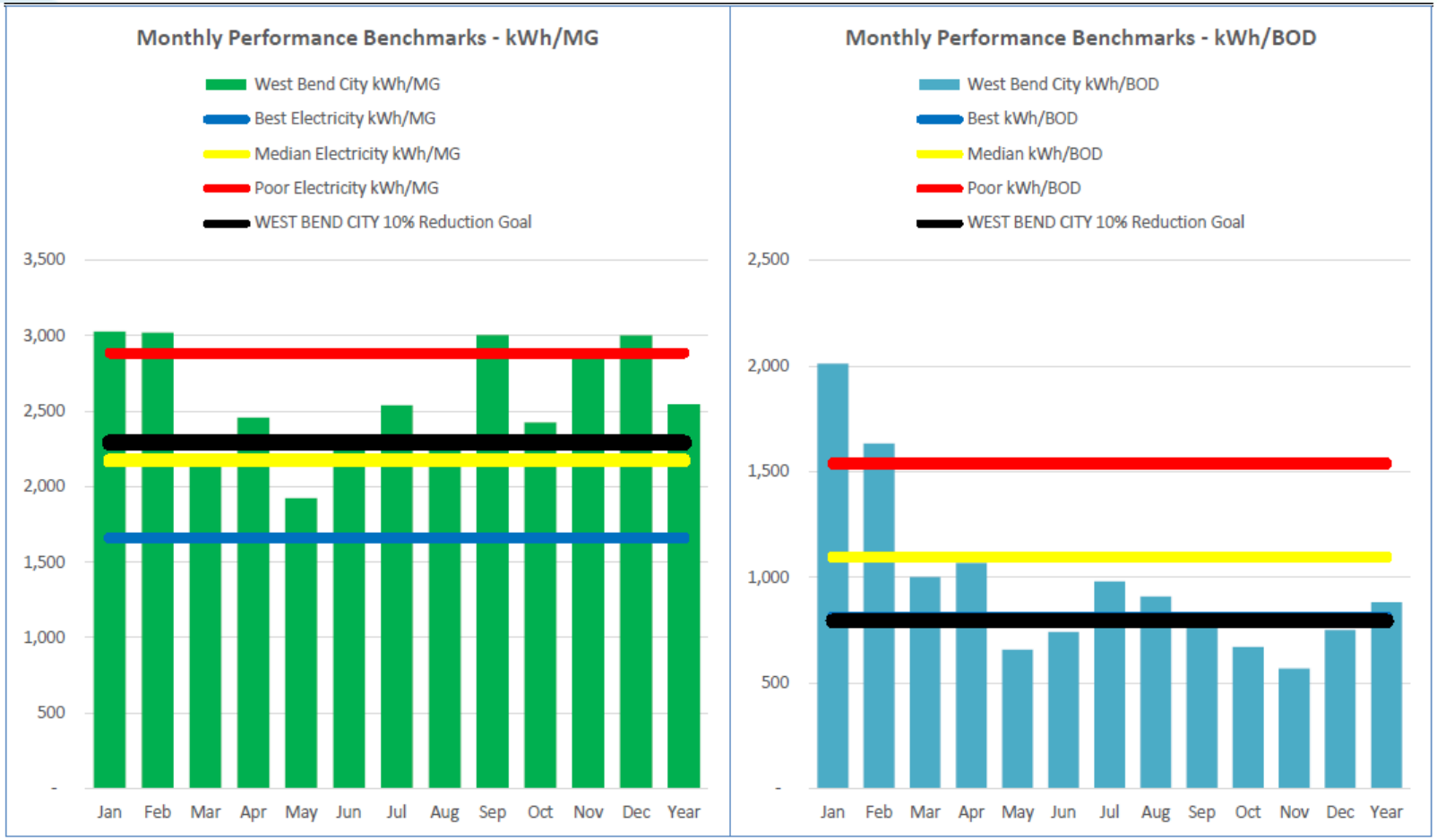
Process Questions

7.2 Energy Related Processes and Equipment

7.2.1 Indicate equipment and practices utilized at your treatment facility (Check all that apply):

- ☐ Aerobic Digestion
- ☐ Anaerobic Digestion
- ☐ Biological Phosphorus Removal
- ☐ Coarse Bubble Diffusers
- ☐ Dissolved O2 Monitoring and Aeration Control
- ☐ Effluent Pumping
- ☐ Fine Bubble Diffusers
- ☐ Mechanical Sludge Processing
- ☐ Nitrification
- ☐ SCADA System
- ☐ UV Disinfection
- ☐ Variable Speed Drives
- ☐ Other:

Facility Performance and Benchmarking Analysis



Water and/or wastewater utility managers index their facility's energy usage through a production or demand index, such as kWh/MGD or kWh per 1,000lb of Biological Oxygen Demand (BOD). This index is called a Key Performance Index (KPI) or Energy Performance Index (EPI). Establishing an energy baseline helps facility managers understand the relative efficiency or change in efficiency relative to the core purpose of the operation, i.e., water production or wastewater treatment. It is recommended utilities set a goal to save five to ten percent of its energy after it has implemented energy efficiency measures, a new annual average line is set as the targeted KPI level with monthly Monitoring & Verification (M&V).

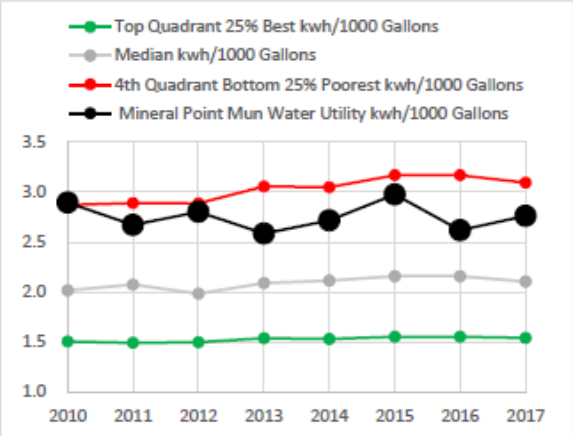
Water Utility Analysis

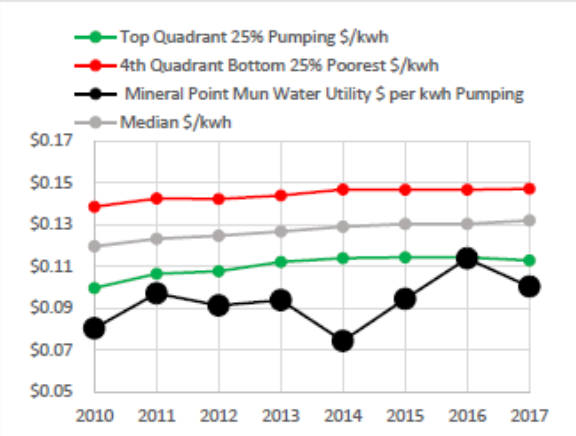
Quartile Statistical Benchmarks where 1 = Top Quadrant 25% Best, 2 = 2nd Quadrant Good, 3 = 3rd Quartile below Median & 4 = 4th Quadrant Bottom 25% Poorest

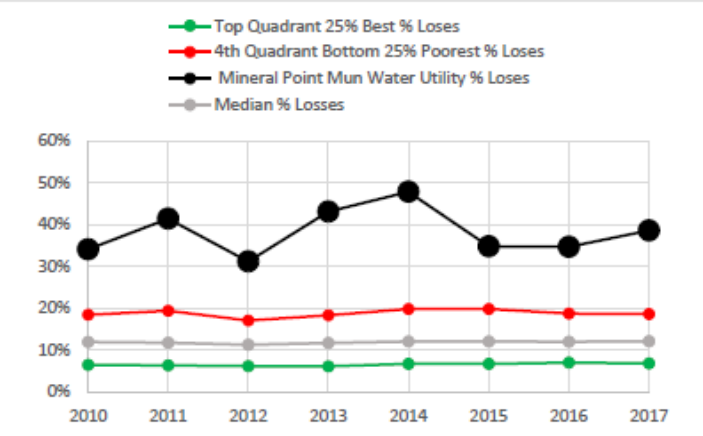
Utility ID	Utility	Performance Benchmark	2010	2011	2012	2013	2014	2015	2016	2017	2010-2017 Average
3740	Mineral Point Mun Water Utility	kwh/1000 Gal Quad	4	3	3	3	3	3	3	3	3
3740	Mineral Point Mun Water Utility	% Water Losses Quad	4	4	4	4	4	4	4	4	4
3740	Mineral Point Mun Water Utility	$ per kwh Pumping Quad	1	1	1	1	1	1	1	1	1
3740	Mineral Point Mun Water Utility	$ per 1000 Gallons Quad	2	3	3	2	2	2	3	2	2

Water utilities with benchmarks of 3 (Yellow) and 4 (Red) can request that MEETAP prepare a system analysis of wells, towers and pumps to estimate demand, energy and cost savings (capacity and average operating characteristics – on-peak, capacity factor, constant flow high pressure control vs variable flow constant pressure, etc.).

Utility ID	Utility	Performance Benchmark	2010	2011	2012	2013	2014	2015	2016	2017	2010-2017 Average
3740	Mineral Point Mun Water Utility	kwh/1000 Gallons	2.89	2.67	2.80	2.58	2.72	2.97	2.62	2.76	2.75
3740	Mineral Point Mun Water Utility	% Water Losses	34.07%	41.39%	31.15%	43.07%	47.78%	34.77%	34.66%	38.55%	38.18%
3740	Mineral Point Mun Water Utility	$ per kwh Pumping	$ 0.08	$ 0.10	$ 0.09	$ 0.09	$ 0.07	$ 0.09	$ 0.11	$ 0.10	$ 0.09
3740	Mineral Point Mun Water Utility	$ per 1000 Gallons	$ 0.23	$ 0.26	$ 0.26	$ 0.24	$ 0.20	$ 0.28	$ 0.30	$ 0.28	$ 0.26







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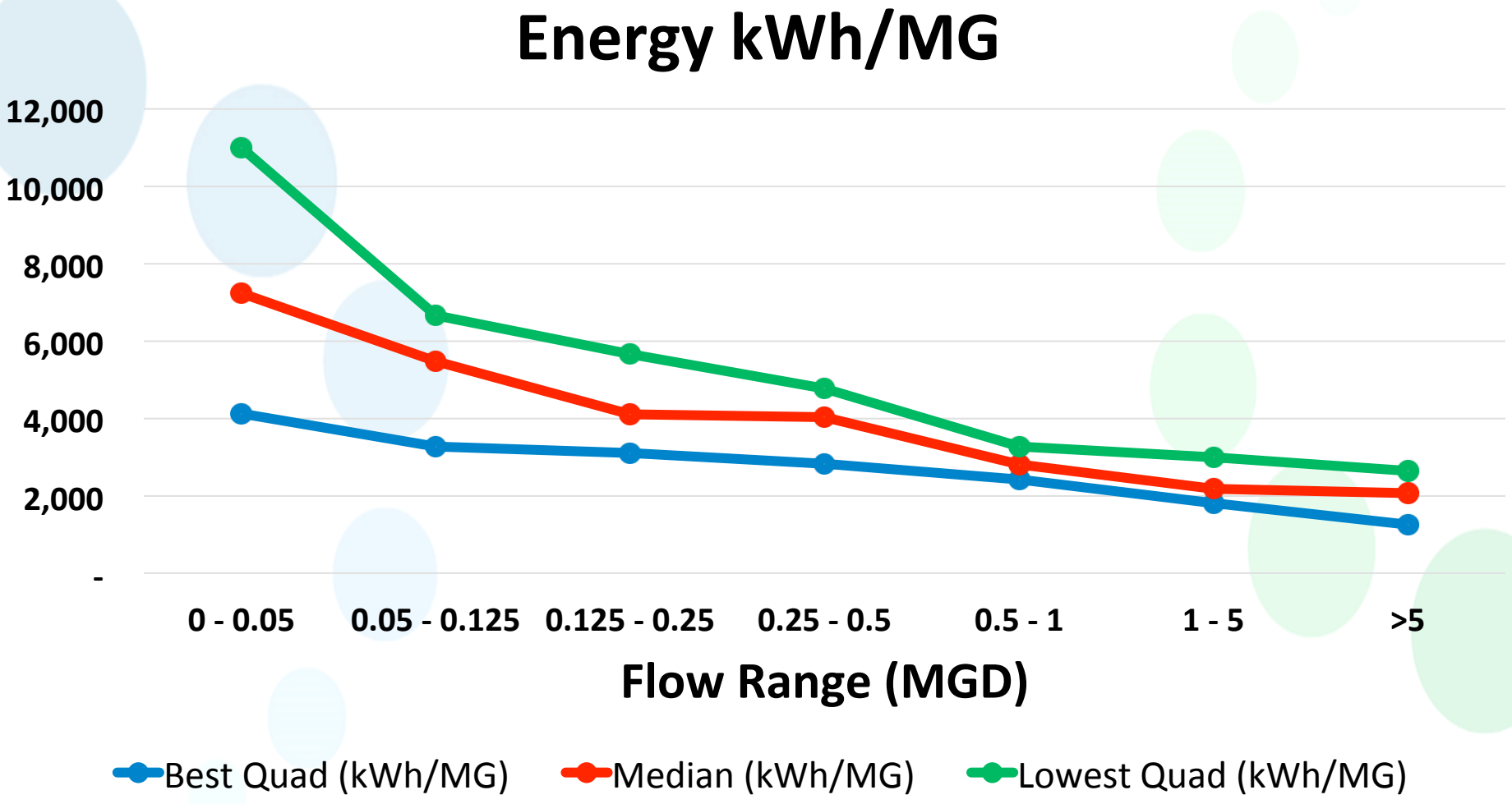
What the Data Looks Like and What it Tells Us



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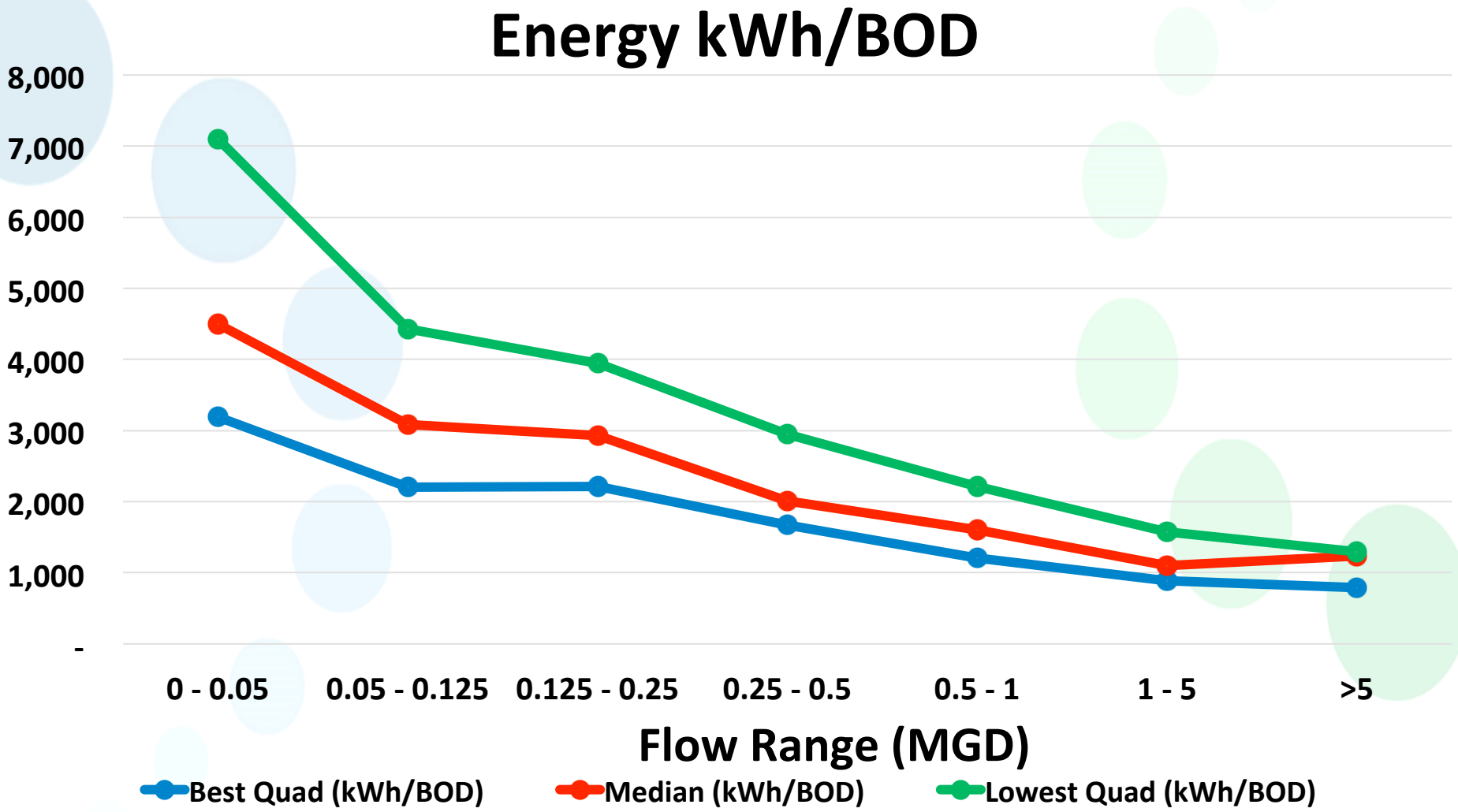

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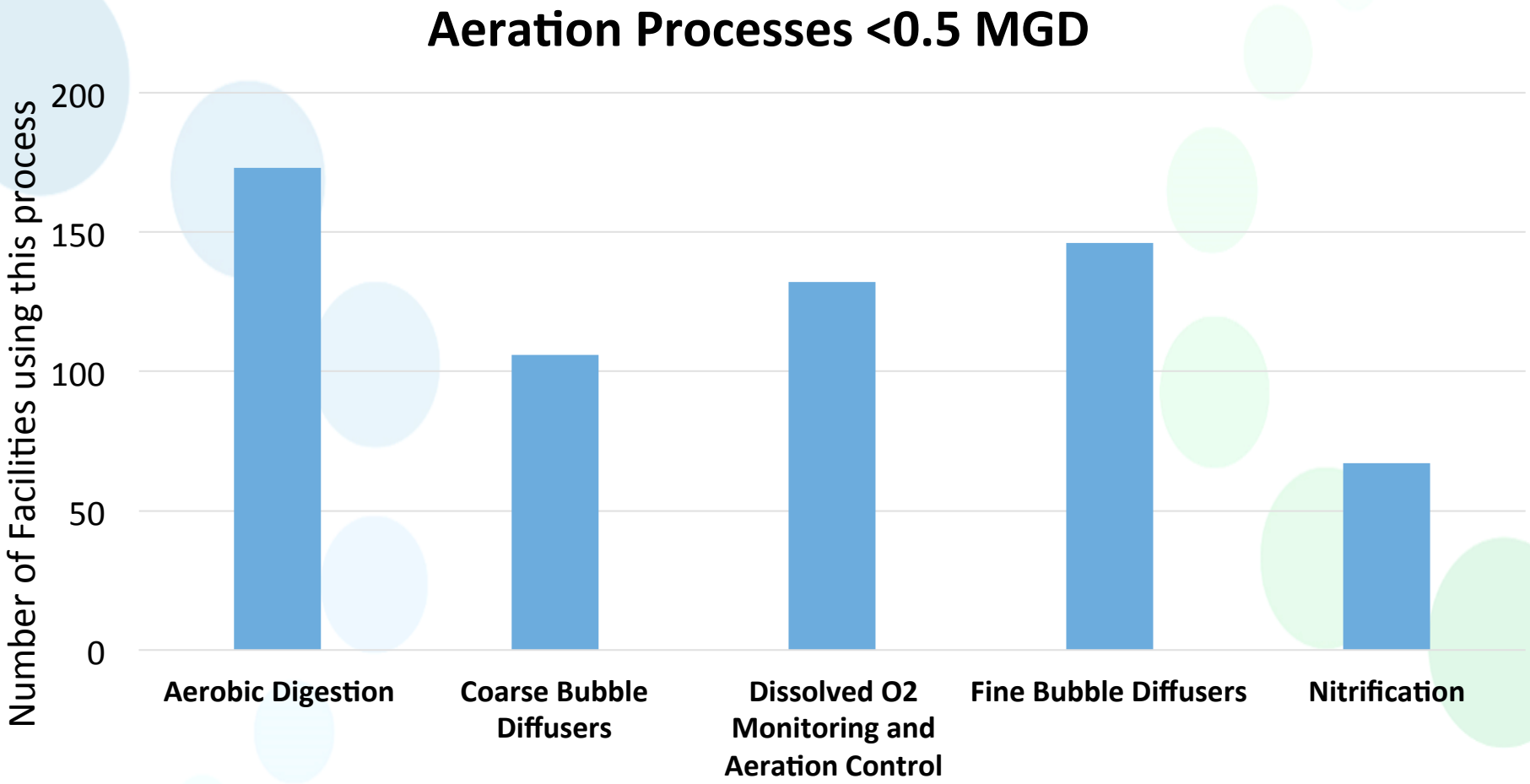
<0.5 MGD 309 Facilities Across the State



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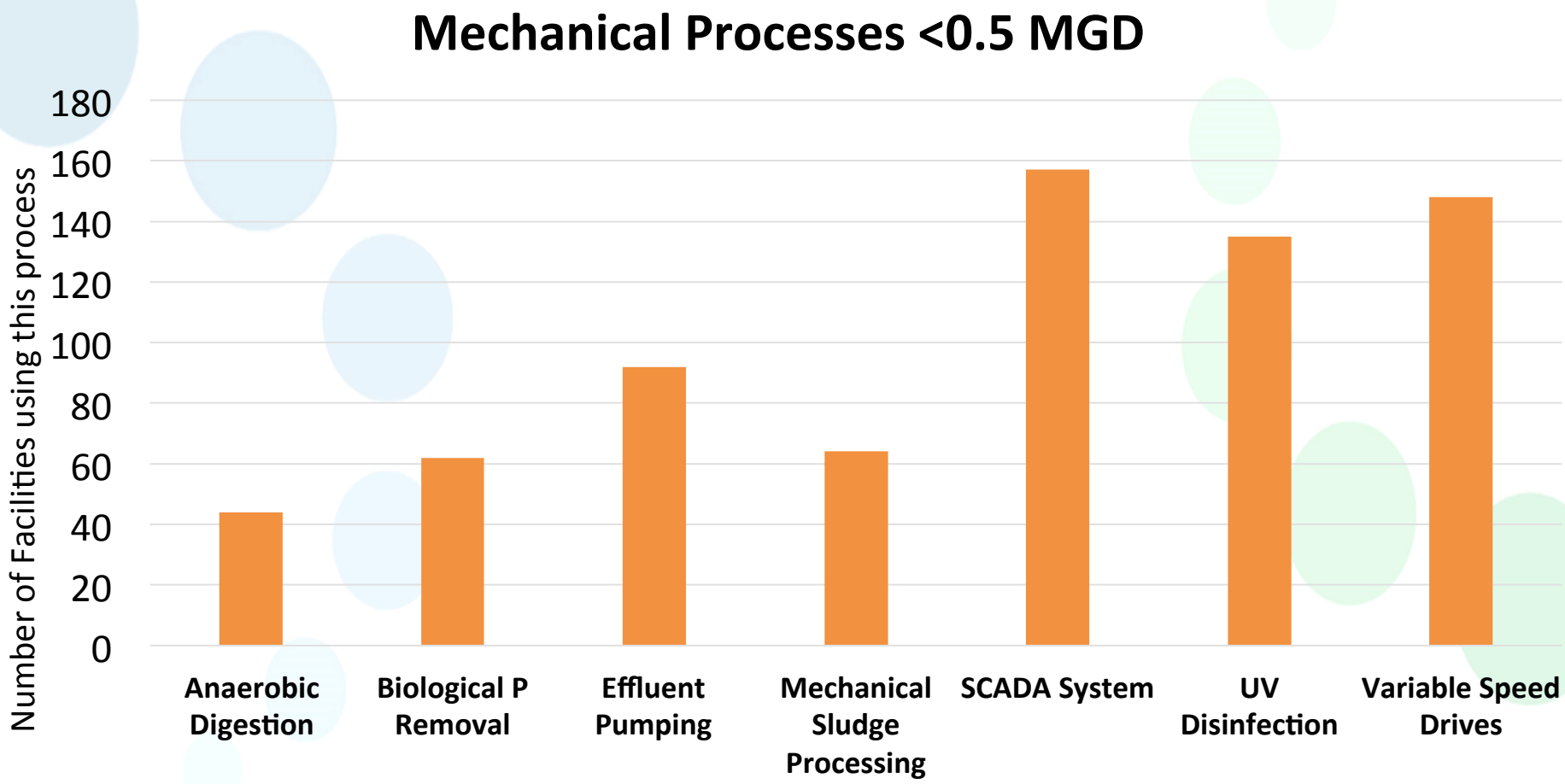
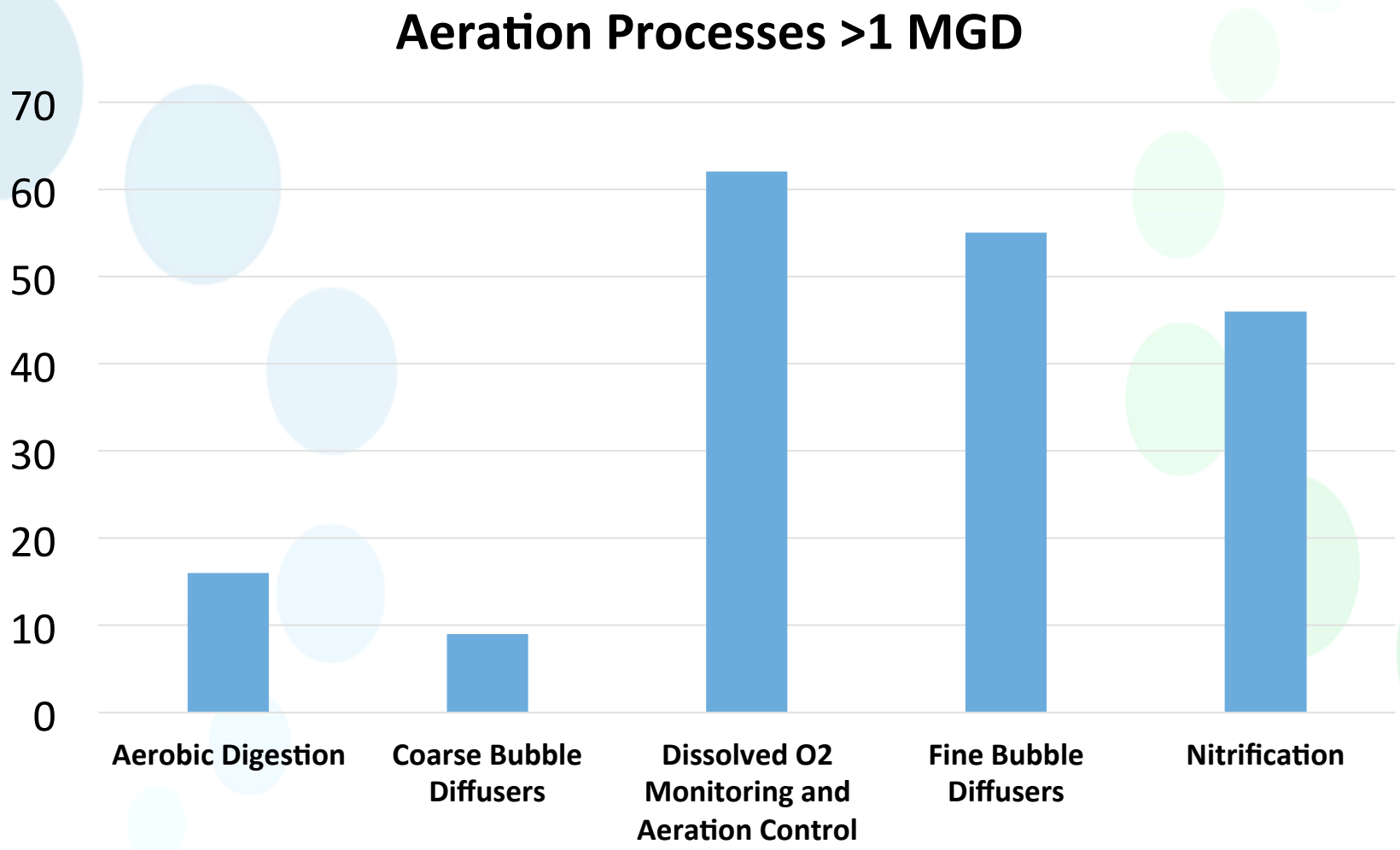
<0.5 MGD 309 Facilities Across the State



>1 MGD 65 Facilities



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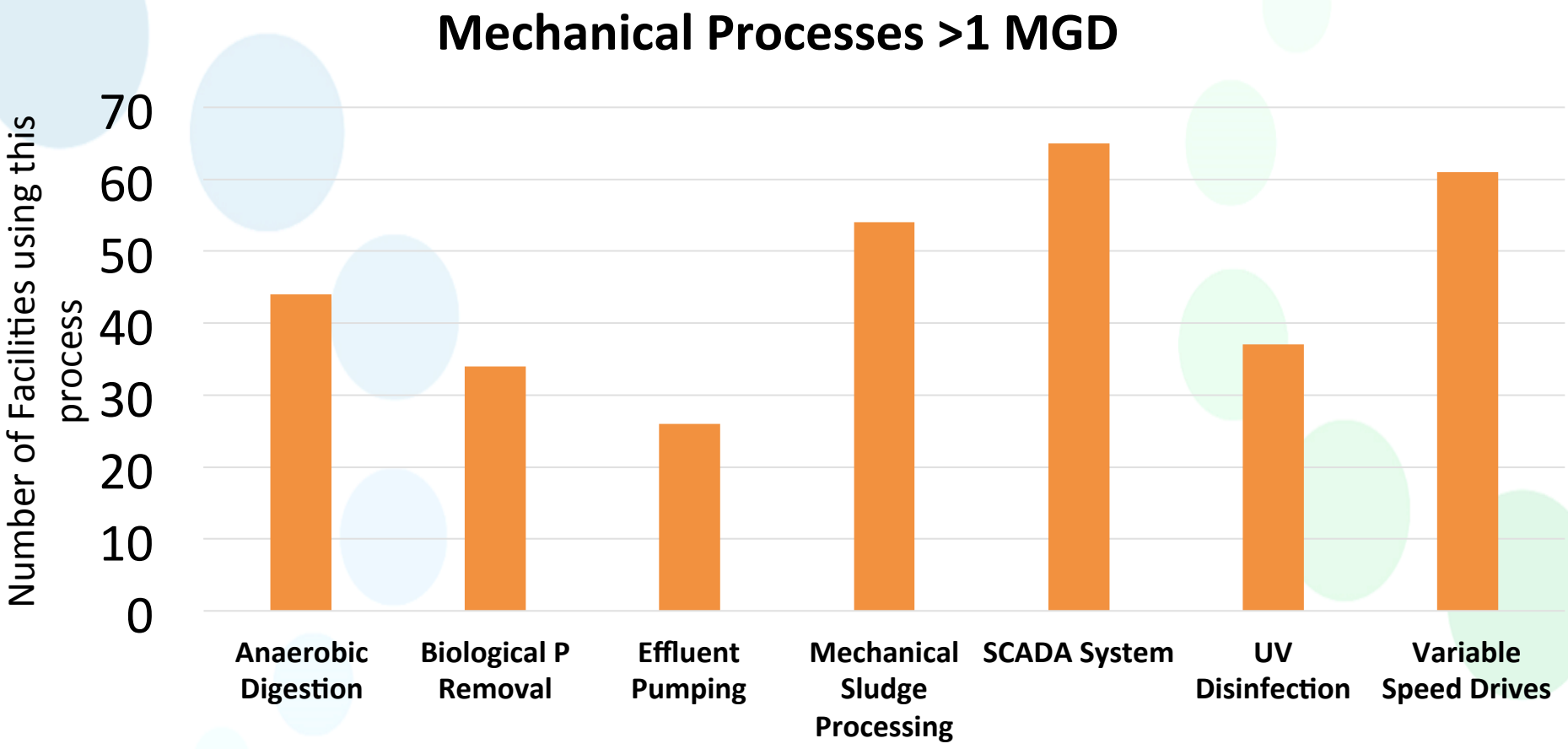
>1 MGD 65 Facilities



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What Can We DO About it?

Flow Range	Number of Facilities	Average Energy Use (kWh/MG)	Average Flow (MGD)	Present Ave Annual Energy Use (MWh/year)	Best Quad (kWh/MG)	Forecast of Yearly Energy Use if all at Best Quad (MWh/yr)	% Energy Reduction (Ave to Quad) Per Flow Range
0-0.05	89	8,309	0.03	7,507	4,124	3,781	50%
0.05-0.125	91	5,841	0.08	15,103	3,269	6,651	44%
0.125-0.25	73	4,569	0.18	22,164	3,111	7,072	32%
0.25-0.5	56	4,123	0.35	29,726	2,826	9,354	31%
0.50-1.0	34	3,168	0.69	27,042	2,421	6,378	24%
1-5	48	2,461	2.01	86,742	1,803	23,190	27%
> 5	17	1,978	23.17	284,409	1,253	104,240	37%

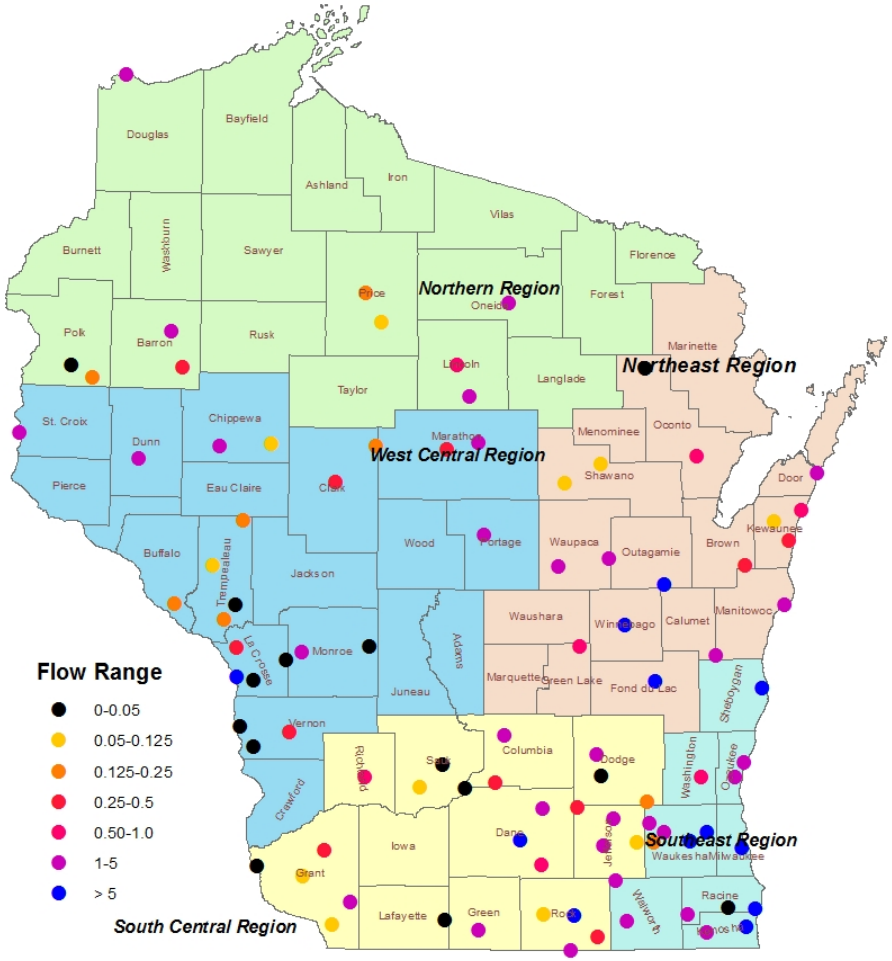
What Can We DO About it?

Flow Range	Number of Facilities	Present Ave Annual Energy Use (MWh/year)	Forecast of Yearly Energy Use if all at Best Quad	Forecast of Potential Energy Use Reduction to Best Quad Value (MWh/year)	Per Cent of Total
0-0.05	89	7,507	3,726	3,781	2.4%
0.05-0.125	91	15,103	8,453	6,651	4.1%
0.125-0.25	73	22,164	15,092	7,072	4.4%
0.25-0.5	56	29,726	20,372	9,354	5.8%
0.50-1.0	34	27,042	20,664	6,378	4.0%
1-5	48	86,742	63,551	23,190	14.4%
> 5	17	284,409	180,169	104,240	64.9%

Anaerobic Digesters Across the State

	Region					
Size Range (MGD)	Northeast	Northern	South Central	Southeast	WestCentral	Grand Total
0.05-0.125	3	1	5	0	2	11
0.125-0.25	0	2	1	1	4	8
0.25-0.5	2	1	4	0	4	11
0.50-1.0	3	1	2	1	0	7
0-0.05	1	1	5	1	6	14
1-5	5	4	9	7	6	31
> 5	3	0	2	7	1	13
Grand Total	**17**	**10**	**28**	**17**	**23**	**95**

Anaerobic Digesters Across the State



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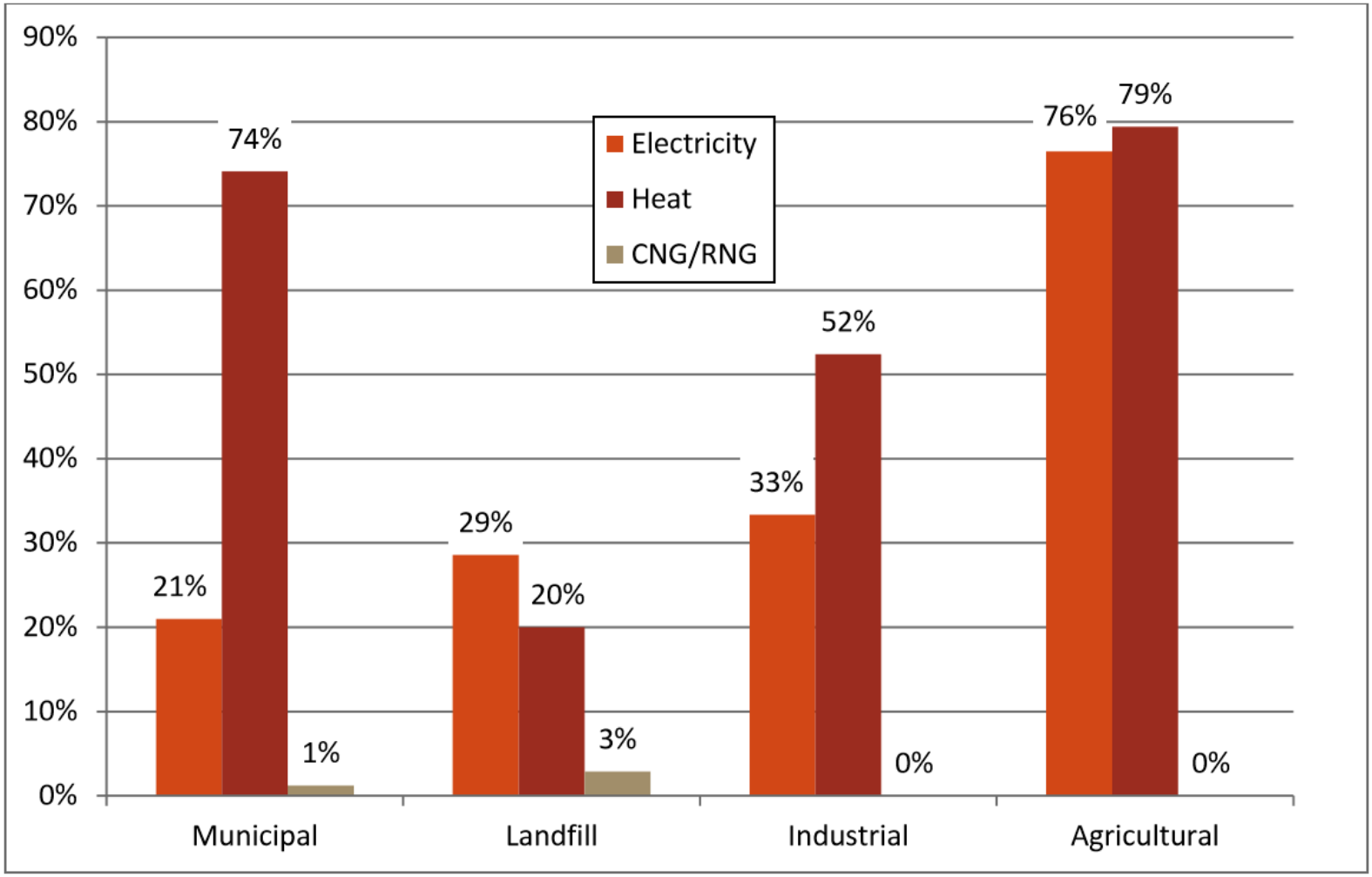
Biogas Across the State



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Biogas Across the State

Sector	Number of systems
Municipal wastewater with digester	81
Landfill with gas capture	35
Industrial wastewater with digester	21
Agricultural with digester	34

Top 25 Low Cost No Cost Measures to Implement

https://focusonenergy.com/business/WWbridge

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2017 Energy Advisor Territory Map

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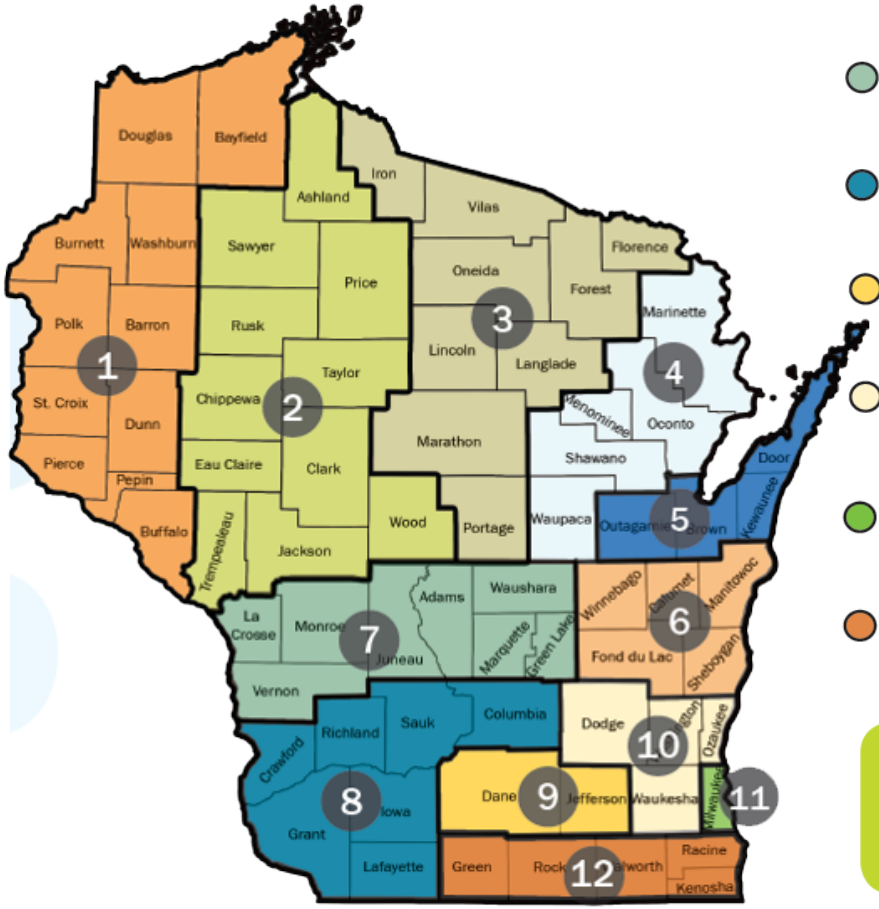

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Talk to an AgSG Rep today!
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Resources

- **Focus on Energy - 800.762.7077**
  - **https://focusonenergy.com/business/water-wastewater**
  - Energy Advisor Map, **focusonenergy.com/ea-map**
  - Ag, Schools, and Government Program
  - Large Energy User Program
- **Office of Energy Innovation**
- **Wisconsin Municipal Energy Efficiency Technical Assistance Program (MEETAP)**
- **Request Wastewater Treatment Facility Energy Tracking Tool:** Vanessa.Durant@Wisconsin.gov

Summary

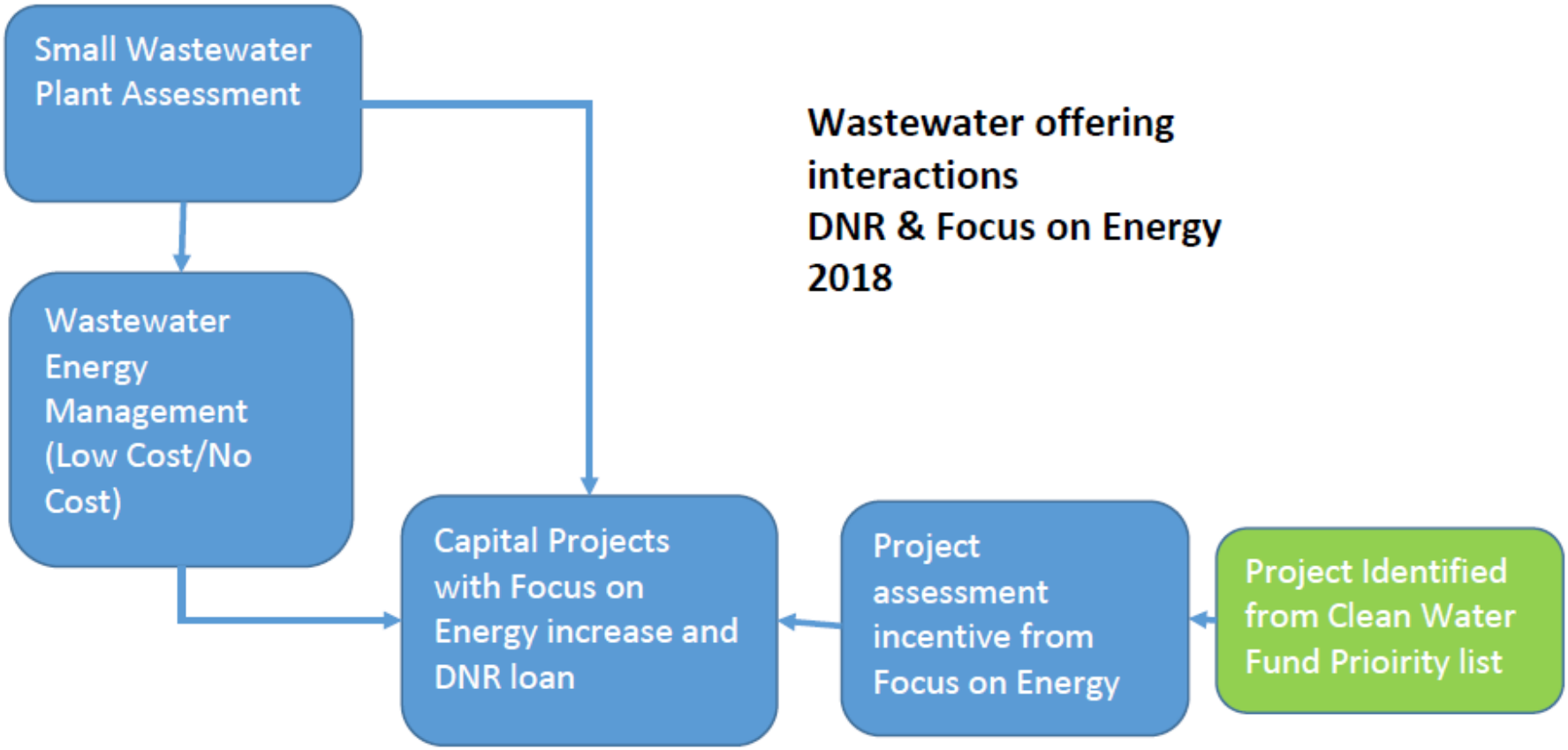
- Range of reported energy use: **690 to 26,926 kWh/MG**
- Average energy use:
  - 0.0 - 0.05 MGD: **8,309 kWh/MG**
  - 0.5 – 1.0 MGD: **3,168 kWh/MG**
  - > 5 MGD: **1,978 kWh/MG**
- Percent of Energy Reduction Available (From Average to 75 percentile Data): **24 to 50 %**
- Amount of forecasted energy savings available from wastewater facilities: **256 MWh/year**
- Forecasted value of energy savings at $0.10 /kWh
  256,000,000 kWh X 0.10 $/kWh = **$25,600,000 / year**

Take Away & Actions

- - Wastewater System energy use can be reduced
  - Focus on Energy assistance is available
  - If you have completed one energy project now look for the second, third, fourth- are you harvesting heat? Methane capture?
- **ACTIONS**
  - Continue data analysis
  - Reach out to facilities with high energy use
  - Develop and provide additional education and training materials and/or sessions
  - Encourage facilities to contact Focus on Energy for assistance

    Provide individual reports to WWTFs that show blind comparisons

Take Away & Actions



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Questions – Comments - Contact

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