

Recent WE&RF Energy Research and Action Opportunities

December 1, 2016

Deliver Balanced Research

- Manage peer-reviewed research to deliver timely, actionable results

Foster Innovation

- Serve as a research hub for the water quality community (utilities, policy makers, consultants, universities, and industry)

- Convene experts and support research to accelerate the adoption of new water technologies

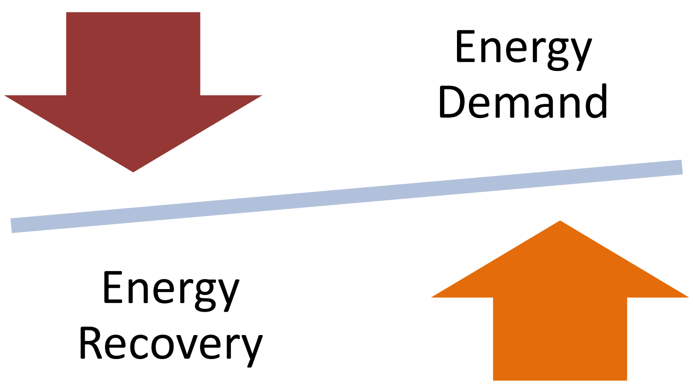
Create Collaboration

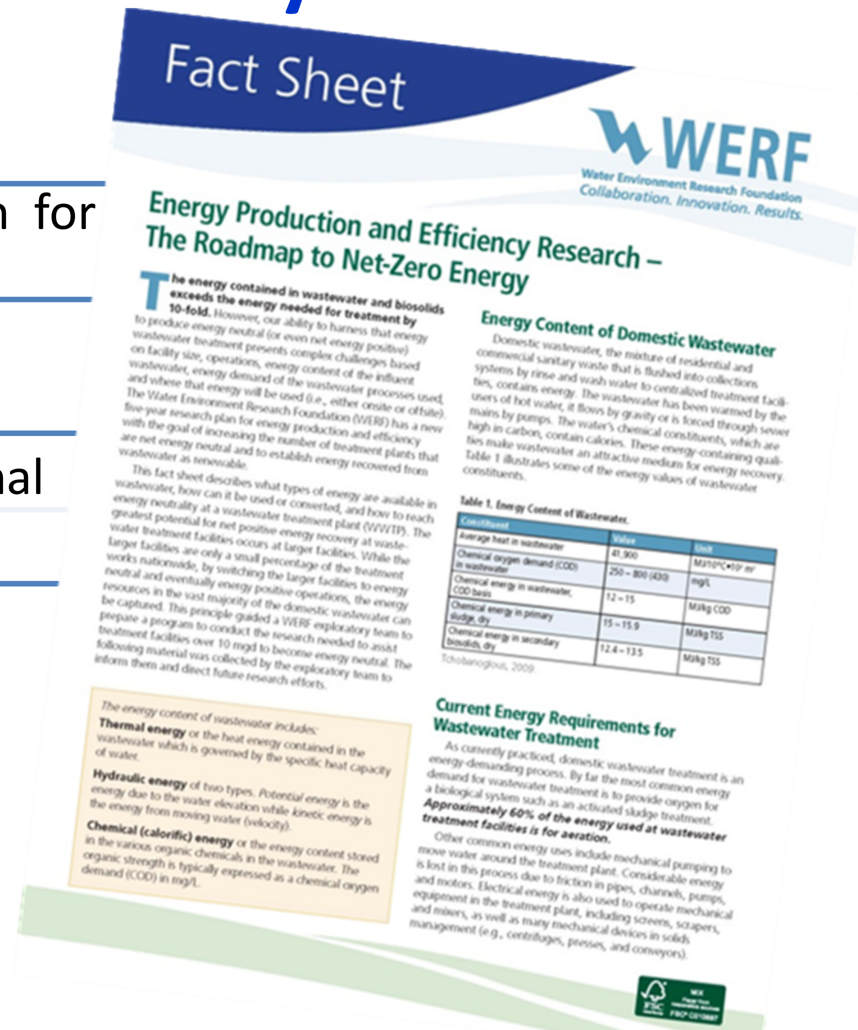
- 35-40 reports published annually that are housed in an online, searchable database

Disseminate Results

A Decade of Energy Research for the Water Industry

- Enhance Anaerobic Digestion for Energy Recovery
- Low Energy Alternatives to Activated Sludge
- Energy Recovery from Thermal and Biosolids




Fact Sheet

WERF
Water Environment Research Foundation
Collaboration. Innovation. Results.

Energy Production and Efficiency Research – The Roadmap to Net-Zero Energy

Energy Content of Domestic Wastewater

Current Energy Requirements for Wastewater Treatment

What is the Estimated Potential for Biogas Production Nationwide from Water Resource Recovery Facilities (WRRFs)?

- Nationwide volumetric biogas production potential from domestic WRRFs:
- From 5 mgd size upwards – 1027 facilities which can produce biogas
  - 113 billion cubic ft/year.
  - 67.8 trillion BTUs/year

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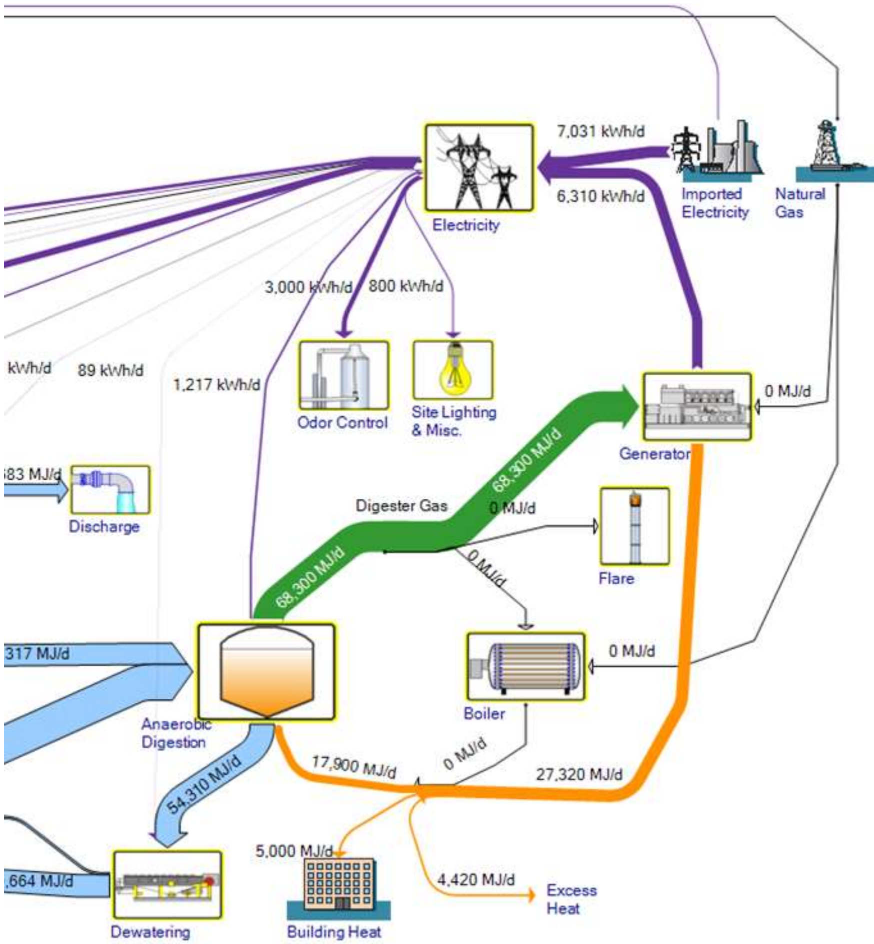
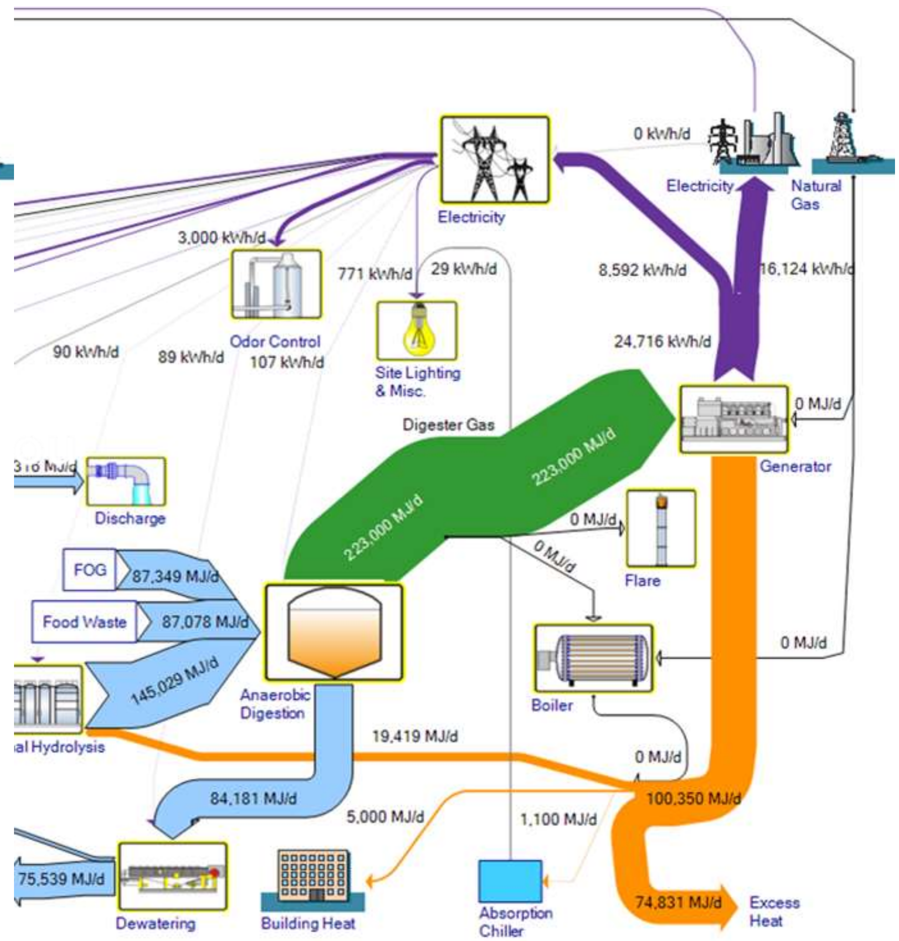
Energy Flow Diagram Comparison



Without Co-digestion



With Co-digestion

Food Waste – Co-Digestion Feedstock

- USEPA (2015) estimates that 35.2 MM tons of food waste are discarded annually with an energy content of 132 T BTUs
  - Source separated organic food waste
  - Food industry waste streams (such as yogurt factory waste)
  - Grease trap and restaurant / institutional wastes

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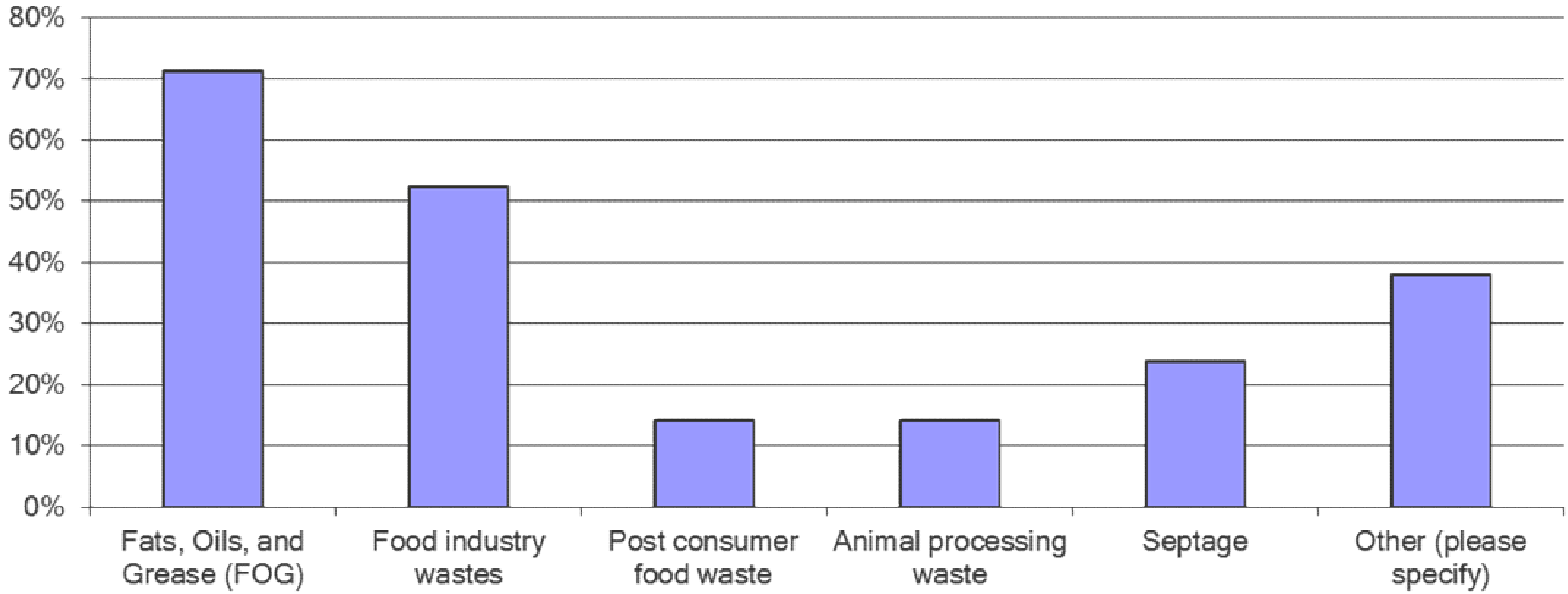
WE&RF Survey Results:

Co-Digested High Strength Organic Wastes (HSWs)



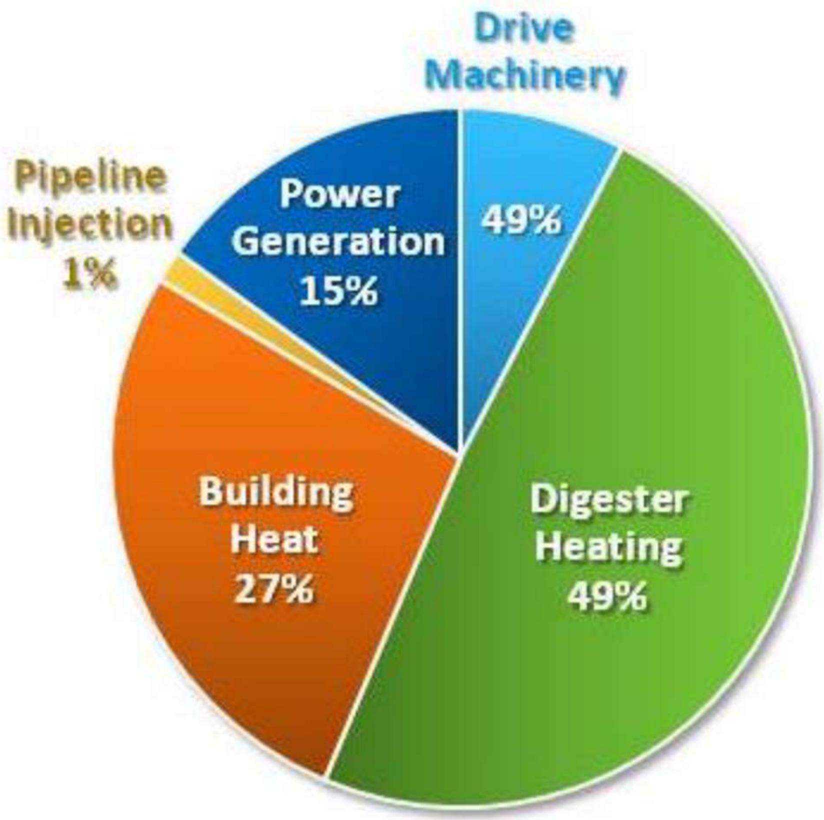
Glycerin,
Aircraft Deicing
Fluid

Average amount – 20 MG/year

WERF ENER8R13- Hazen & Sawyer

Beneficial Use of Biogas

- 85% of WRRFs with anaerobic digestion use their biogas in some manner (WEF, 2012)



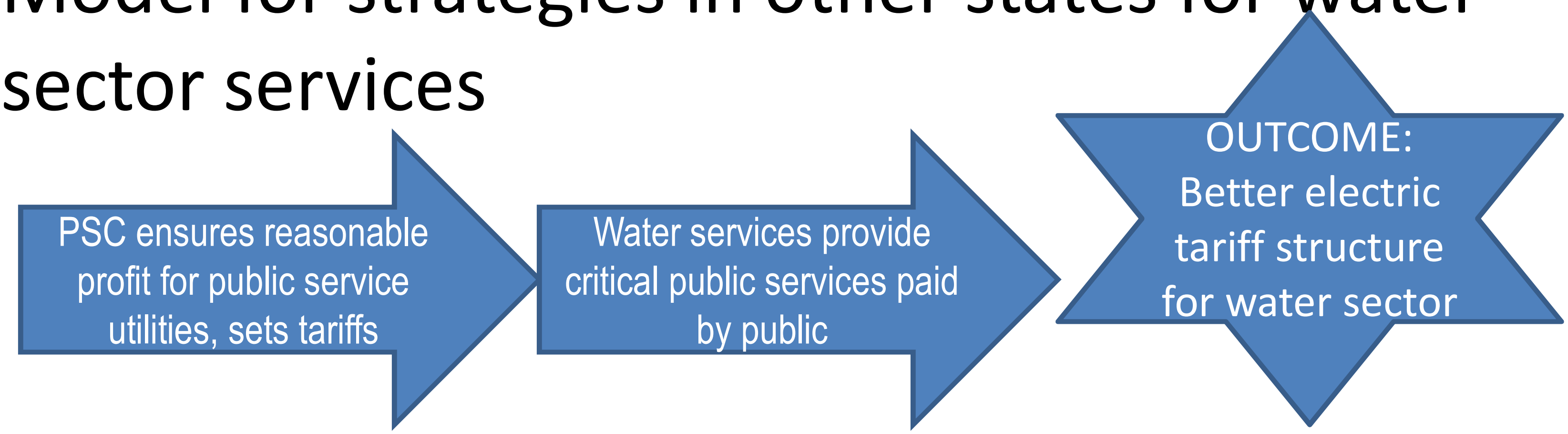
WEF 2013

Assessing the Benefits and Costs of Anaerobic Digester CHP Projects in NY State

- Findings: **Electrical Tariff Provisions Erode CHP Project Savings – result abandoned biogas CHP projects in feasibility study phase**
  - High demand charges, fixed charges and standby fees, minimum demand thresholds
- Tariffs set differently in each state by Public Utility Commissions and state regulations
- Public Utility Regulatory Policy Act of 1978 still applies in some states. States in MISO, PJM, ISO-NE, and the NY-ISO territories which provide wholesale markets that meet the statutory criteria qualify for relief from the mandatory "must purchase" obligation. WE&RF study by Brown and Caldwell (ENER7R13e)

Advance Strategies to Enable Energy Savings and Recovery at WRRFS

- Pursue a tariff structure specifically for water sector by petitioning the NY PSC.
  - The NYSUNY system procurement group did this successfully previously, setting a NYS precedent.
- Model for strategies in other states for water sector services



Barriers and Drivers Influencing Biogas Use for Renewable Energy

Convert to Electric Power	Upgrade to RNG for Sale or Use
• Barriers to sale to grid as distributed power • Must use onsite • Conversion loss to electric power • Electric provider agreements reduce any cost savings even from use onsite • RECs available in some states • Must remove contaminants (water H_2S, siloxanes)	• Access/market for biogas as RNG unknown but supported by AGA and RNG Coalition • Under Renewable Fuel Standard - Cellulosic RINs available when used as vehicle fuels as well as Advanced Biofuel RINs • RECs available in some states • Must remove contaminants (water H_2S, siloxanes)

Economically Better Choice

Renewable Fuel Standard (RFS) Program

- Created under Energy Policy Act of 2005 - established the first renewable fuel volume mandate in the US
- Energy Independence and Security Act of 2007 established new fuel categories and requirements
- Biogas qualifies in both D3 (cellulosic biofuel) and D5 (Advanced Biofuel) categories
- Must be used for transportation fuel

RIN Classification Codes

Category	Code	Description of Fuel
Cellulosic Biofuel	D3	Any process that converts cellulosic biomass to fuel: ethanol, renewable gasoline, biogas-derived CNG and LNG
Biomass- Derived Diesel	D4	Biodiesel, renewable diesel, jet fuel, heating oil
Advanced Biofuels	D5	Biodiesel, renewable diesel, sugarcane ethanol, heating oil, waste digester-derived CNG and LNG
Renewable Fuel	D6	Corn ethanol
Cellulosic Diesel	D7	Cellulosic diesel, jet fuel, heating oil

RIN Category	Code	Spot Price ($)	Previous	4 week avg.
Cellulosic	D3/D7	March 2016	- WEF Biofuels Task Force	
Current Year		1.8400	1.3300	1.4575
Previous YR		1.3400	0.6400	0.8150

EPA Finalizes Increase in Renewable Fuel Volumes

NEWS FLASH

	2014	2015	2016	2017	2018
Cellulosic biofuel (million gallons)	33	123	230	311	n/a
Biomass-based diesel (billion gallons)	1.63	1.73	1.9	2.0	2.1
Advanced biofuel (billion gallons)	2.67	2.88	3.61	4.28	n/a
Renewable fuel (billion gallons)	**16.28**	**16.93**	**18.11**	**19.28**	**n/a**

Is the RFS here to stay?

- WRRFs and the Renewable Natural Gas industry need assurances that the RFS will stay
- There have been several unsuccessful attempts to repeal the RFS. These are ongoing and may be successful under the new administration

"The oil industry has made a concerted, organized, and well financed attack on the RFS. A lot of focus has been on EPA…, but the oil industry has gone to court to limit the impact of the RFS …and to Capital Hill to curtail or restrict the RFS."
- Tom Vilsack, US Agriculture Secretary

- *Opportunity for Advocacy to retain the RFS and thwart any repeal efforts for the benefit of biogas to RNG projects at WRRFs.*

Energy Recovery from Thermal Oxidation of Wastewater Solids: State of Science Review

WERF Project ENER13T14

Robert P. Dominak
Friar Consulting
September 27, 2016

Co-Authors: W. Hoener, G. Queiroz, J. Welp

Study - Research Approach

- Evaluate potential energy recovery from the combustion of wastewater solids and FOG in MHIs and FBIs.

- Conduct a triple bottom line analysis comparing:

  a. The value of energy recovered from combustion of wastewater solids.

  b. The value of energy produced from burning coal at a power plant.

- Prepare a State of the Technology document covering:

  a. Existing and emerging technologies used to recover heat & energy.

  b. Three case studies of POTWs that recover heat & energy from the combustion of wastewater solids.

Today's Presentation
Case Studies

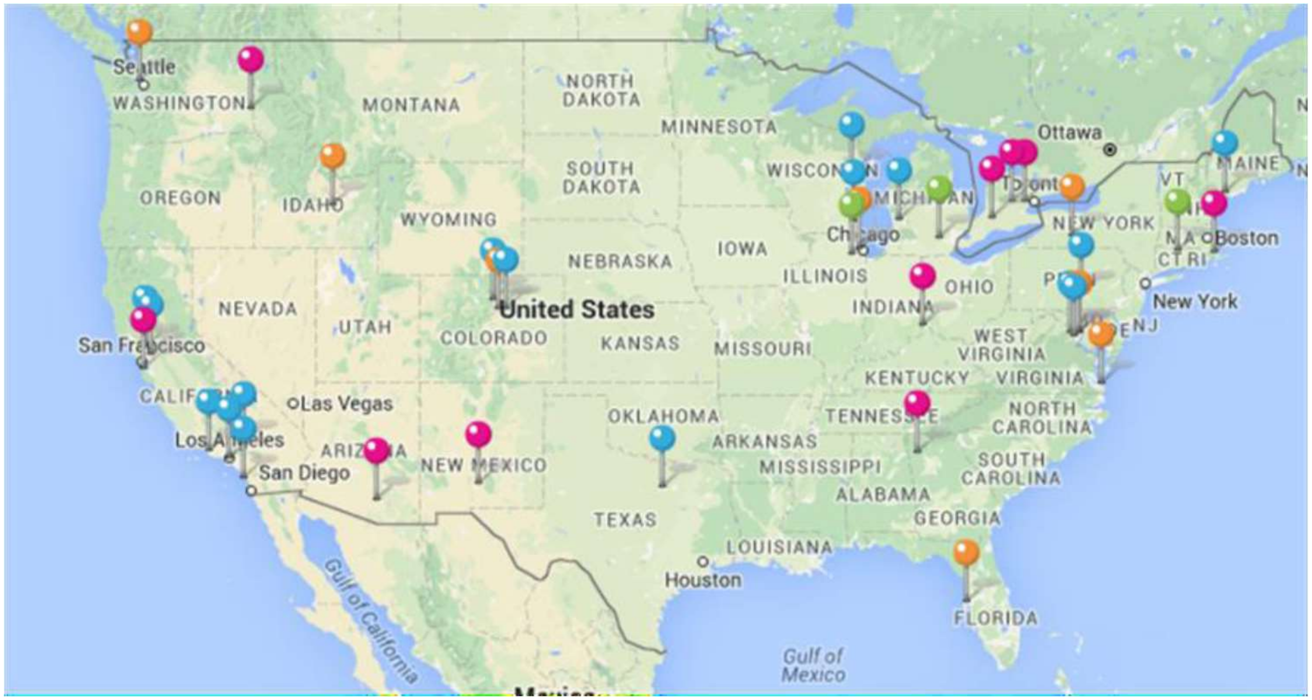
- **Metropolitan WWTP**
  St. Paul, MN

Köhlbrandhöft & Dradenau WWTPs
Hamburg, Germany

- **North WWTP**
  Menands, NY

Outcomes of Energy Research and Information Exchange

- US Department of Energy
  - LIFT Test Bed Network



DoE Better Plants Program

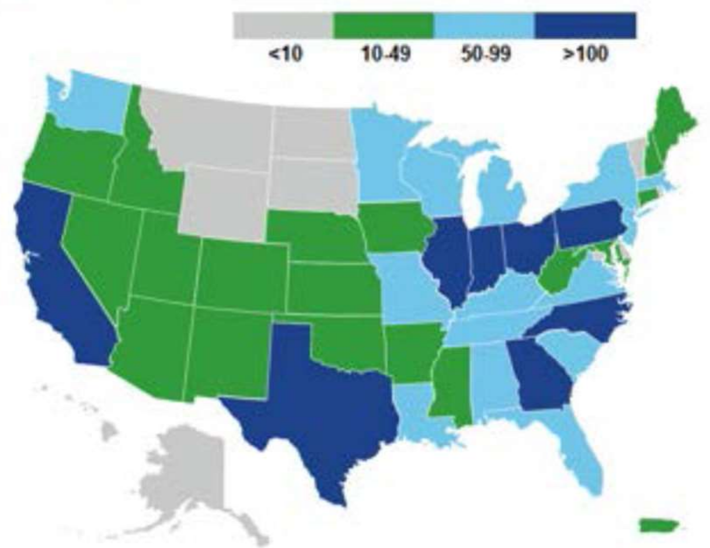
ENERGY SAVINGS AND PROGRAM FOOTPRINT CONTINUE TO GROW

https://betterbuildingssolutioncenter.energy.gov/better-plants/special-initiatives/water-and-wastewater

Better Plants Snapshot

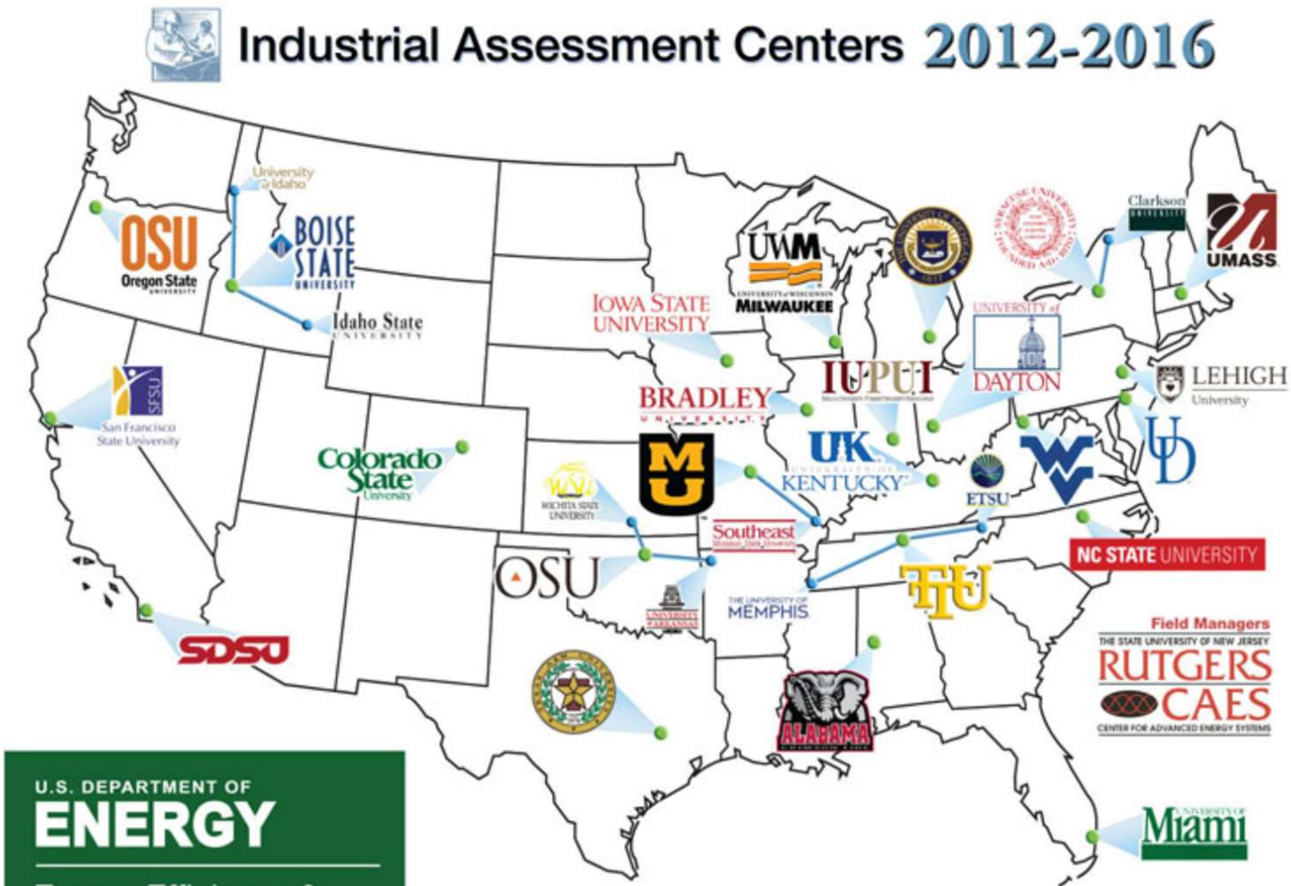
Partnership Size	**Total**
Number of Partner Companies	157
Approximate Number of Facilities	2,400
Percent of U.S. Manufacturing Energy Footprint	11.4%
Reported Savings through 2014	
Cumulative Energy Savings (TBtu)	457
Cumulative Cost Savings (Billions)	$2.4
Cumulative Avoided CO_2 Emissions (Million Metric Tons)	26.6
Average Annual Energy-Intensity Improvement Rate	2.1%

Regional Distribution of Better Plants Facilities



Industrial Assessment Centers

- Qualifying Better Plants Partners receive free energy audits from DOE's IACs
- IACs are university-based centers, led by professors and staffed by engineering students
- Typical audit uncovers savings equal to about 8% of plant-wide energy consumption



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Energy Efficiency & Renewable Energy

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Questions? Comments?

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