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Green Building with Onsite Wastewater Treatment Systems:

A Comparison of O&M Energy Use and Carbon Generation

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Key Take-Aways

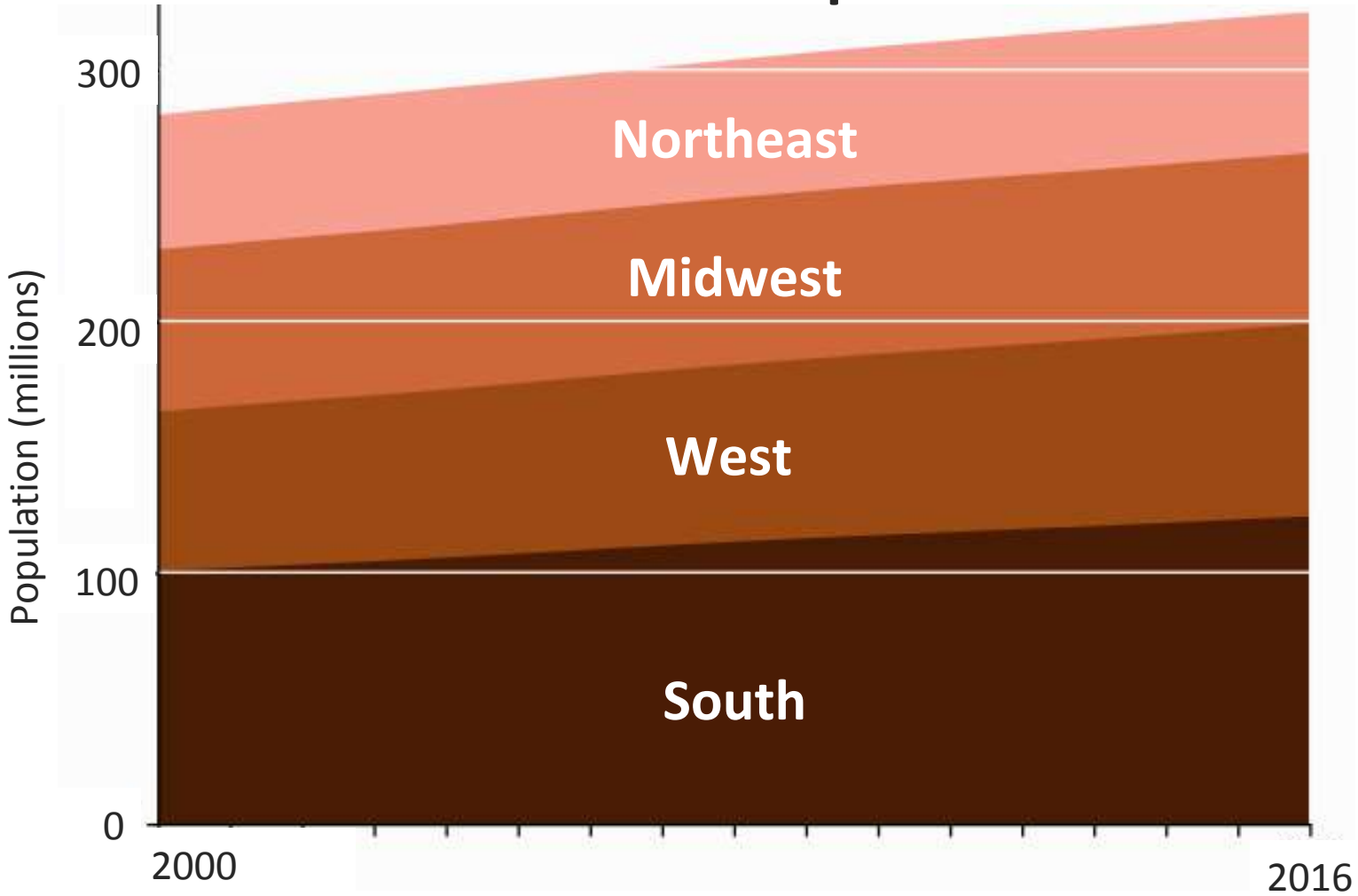
- Onsite vs. centralized treatment
  - Reduced carbon emissions
  - Reduced energy use
  - Reduced cost
- Onsite is a viable and sustainable alternative to a centralized WWTP

Introduction

Population and Wastewater Infrastructure

- Geographic migration shifts housing demand
- Increased potable water demand amplifies domestic wastewater production
- Wastewater infrastructure needs change with population growth and shifts

US Census Bureau Population Data



2000 Regional Population Data

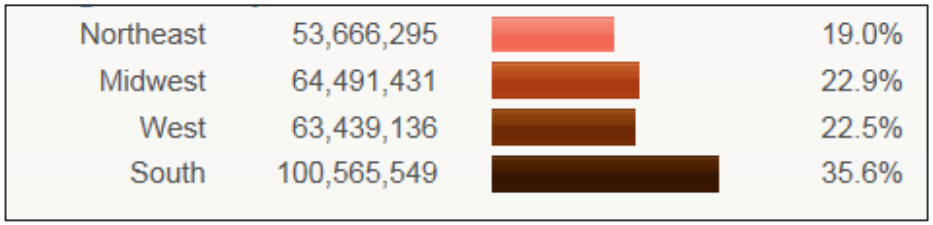
Northeast	53,666,295	19.0%
Midwest	64,491,431	22.9%
West	63,439,136	22.5%
South	100,565,549	35.6%

2016 Regional Population Data

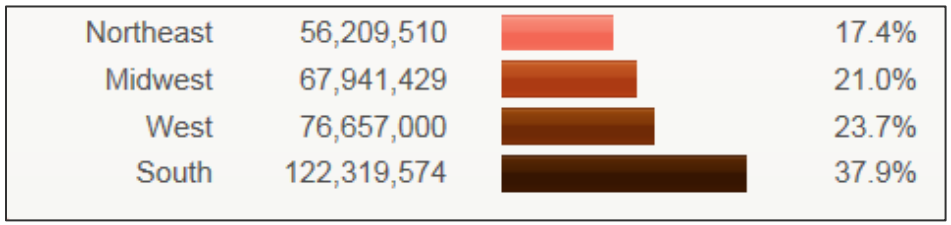
Northeast	56,209,510	17.4%
Midwest	67,941,429	21.0%
West	76,657,000	23.7%
South	122,319,574	37.9%

US Census Bureau Population Data

2000 Regional Population Data



2016 Regional Population Data



- West added 13.2 million people
  - 2,200 people per day
- South added 21.7 million people
  - 3,700 people per day

Population migration and growth create significant demand for new wastewater infrastructure

Centralized vs Onsite Wastewater Management

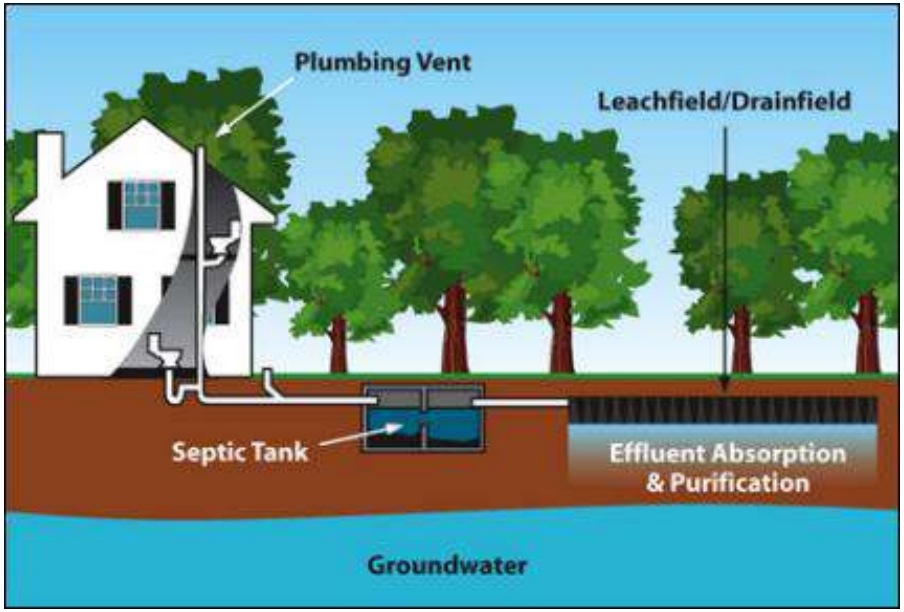
Centralized WWTPs:

- Treat 75% of wastewater nationally
- Energy-intensive conveyance and treatment processes
- Require chemical additions and pump stations
- Provide a high degree of treatment
- Often discharge to a surface water body

Centralized vs Onsite Wastewater Management

Onsite Wastewater Treatment:

- Soil-based treatment system
- Often passive
  - Relatively low O&M requirements
  - Low capital cost
- Natural physical, chemical, and biological processes



Wastewater Treatment Options

Centralized WWTP

- Frequently pumped
- Energy-intensive treatment processes
- Chemical additions common
- Typically surface water discharge

Onsite

- Typically gravity-fed
- Soil-based treatment system
- Typically no energy or chemicals
- Recharges groundwater

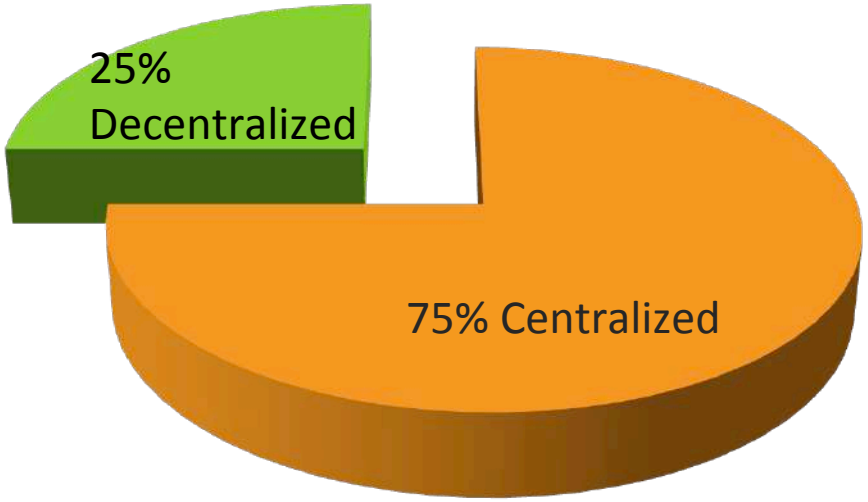
Common Goal

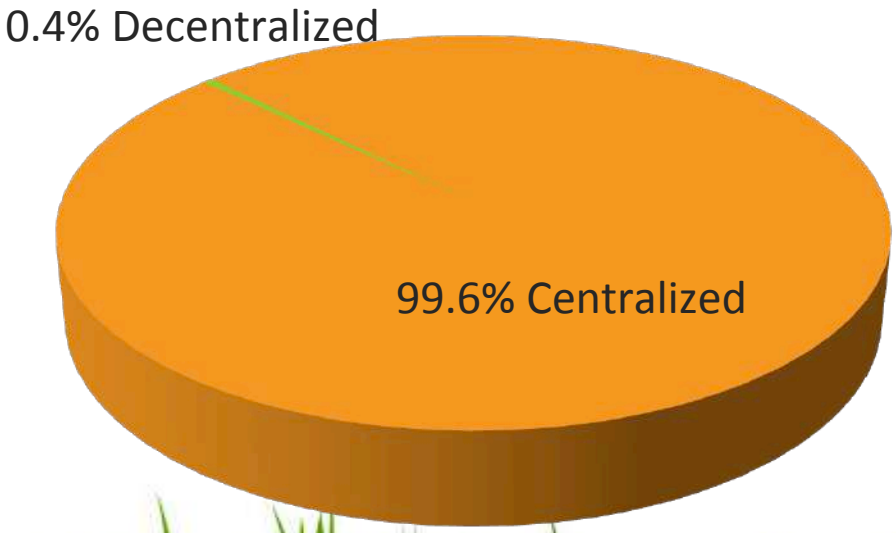
Both centralized WWTPs and onsite wastewater treatment systems aim to meet the goal of the Clean Water Act of 1972:

Regulate the release of contaminants into the water system.

The Flow of Sewage and Funding

- Over 25% of existing homes in the U.S. currently utilize decentralized wastewater treatment
- 0.4% of Clean Water State Revolving Funds for decentralized wastewater treatment systems





The Flow of Sewage and Funding

- In 2014, NOWRA began lobbying Congress for additional support of onsite wastewater
- NOWRA's goal is to bring onsite funding more in line with the balance of onsite and centralized wastewater treatment nationally

Study intended as a tool for quantifying the economic and environmental advantages of passive onsite wastewater treatment systems

Study Overview

GOALS

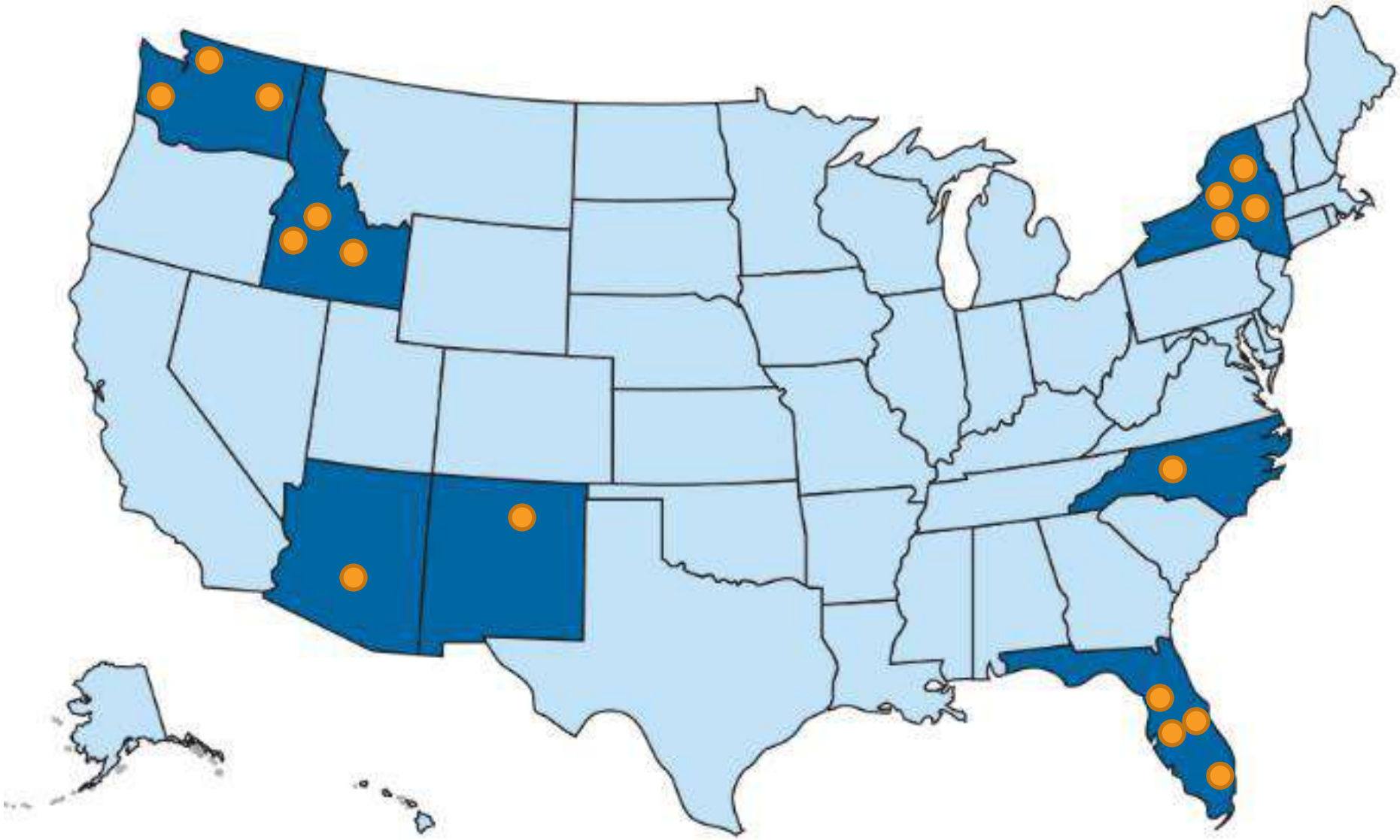
- Quantify O&M
  - Treatment cost
  - Embodied carbon (EC)
  - Embodied energy (EE)
- Types of systems examined
  - Small centralized WWTPs (<2 mgd)
  - Medium centralized WWTPs (2 - 22 mgd)
  - Gravity onsite wastewater treatment systems
  - Pump onsite wastewater treatment systems
    - Pump-to-gravity
    - Low-pressure pipe

What is embodied carbon and embodied energy and how is it obtained?

The total primary energy consumed and carbon released over a life cycle

Unit conversion factors for energy sources and chemicals obtained through LCA tools

Location of 17 Centralized WWTPs



Gravity Onsite Wastewater Treatment

- 3-bedroom daily household flow rate of 640 liters per day (WERF 2007)
- Non-electric system
- Septic tank pump-outs every four years

- Water quality:
  - Sewage and septic tank effluent BOD and TSS concentrations based on University of Arkansas study (Gross, 2004)
  - Soil-based treatment system achieves 90% BOD and TSS removal (Siegrist, 2014)

Pumped Onsite Wastewater Treatment

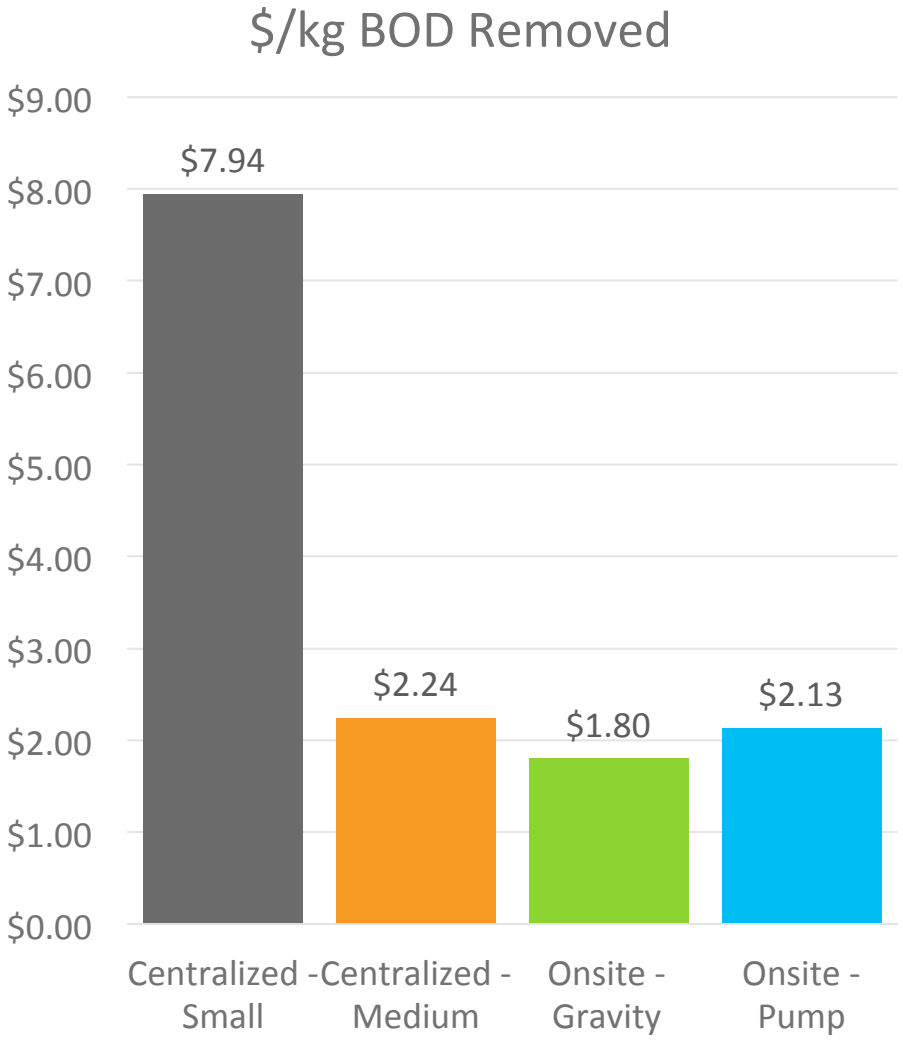
- 3-bedroom daily household flow rate of 640 liters per day (WERF, 2007)
- Septic tank pump outs every four years
- Pump replaced every 11 years
- U.S. average electricity cost of $0.13/kWh

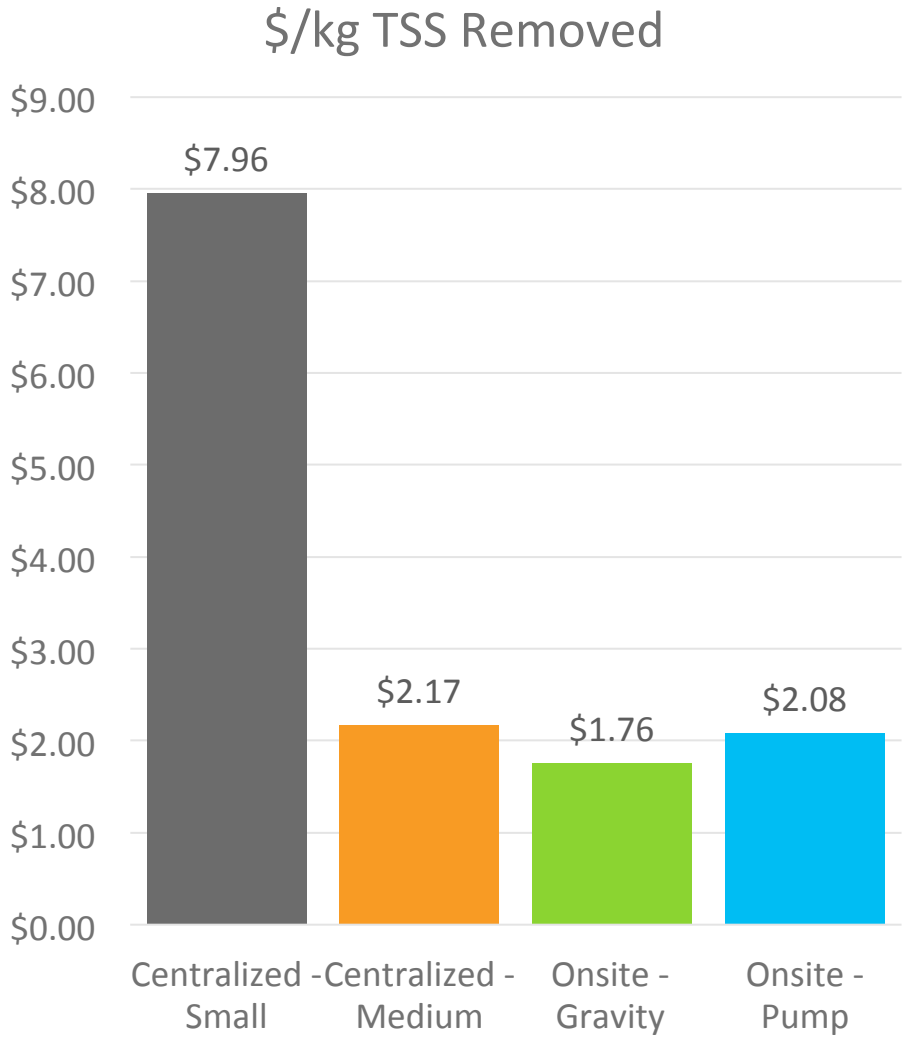
- Water quality:
  - Same sewage, septic tank effluent, and soil treatment assumptions as gravity system
- Pump run-time data based on 12 homes monitored during a 2014 North Carolina Department of Health and Human Services (DHHS) field demonstration program

Results

Treatment Cost

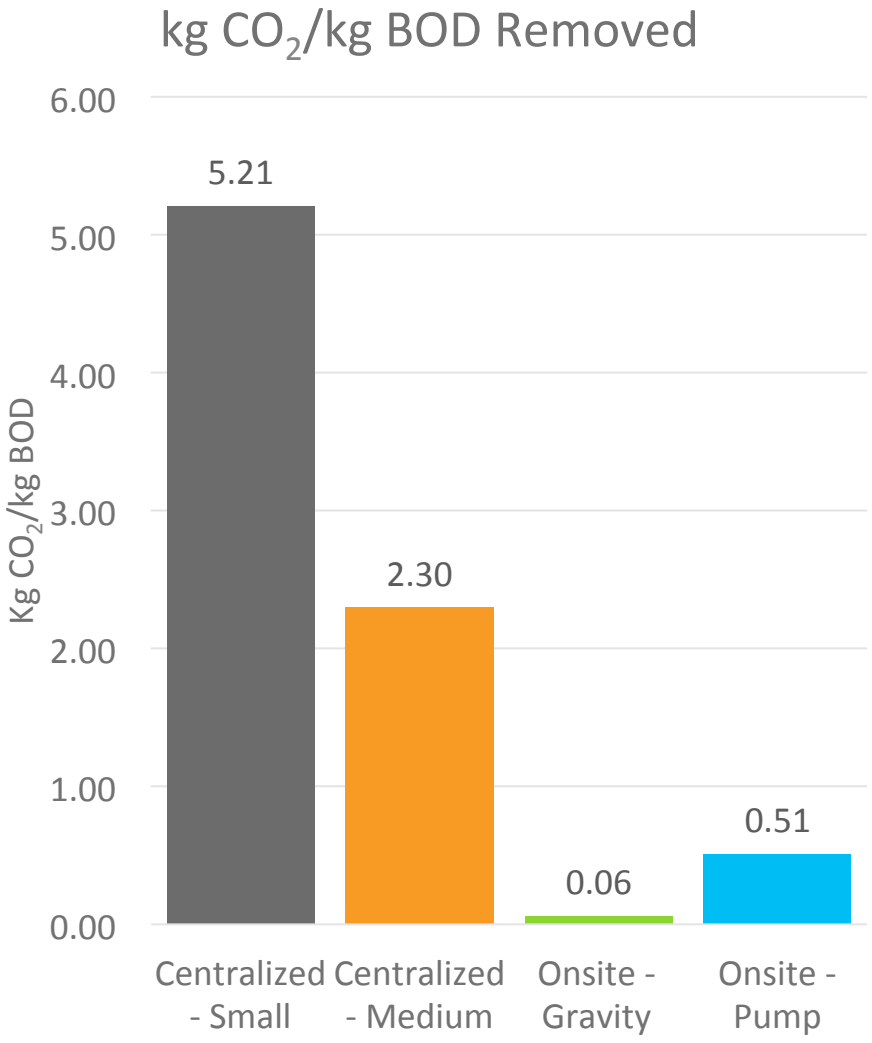
Average Treatment Cost

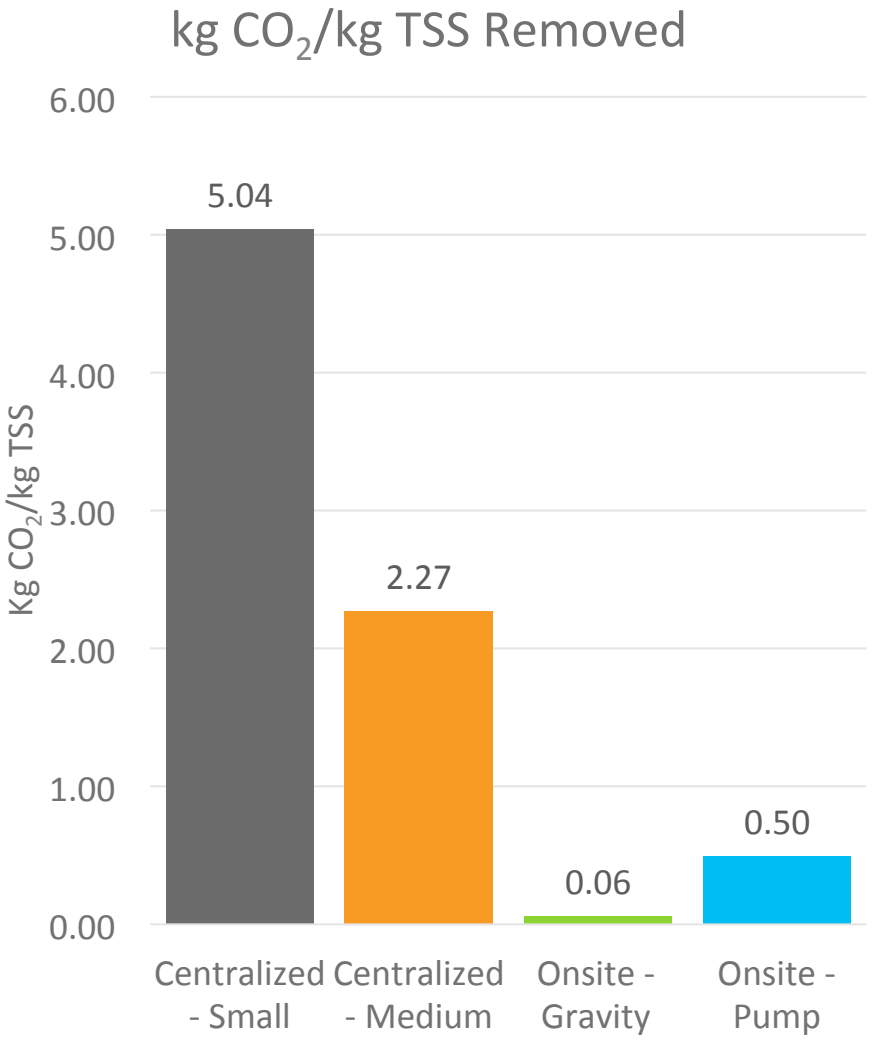




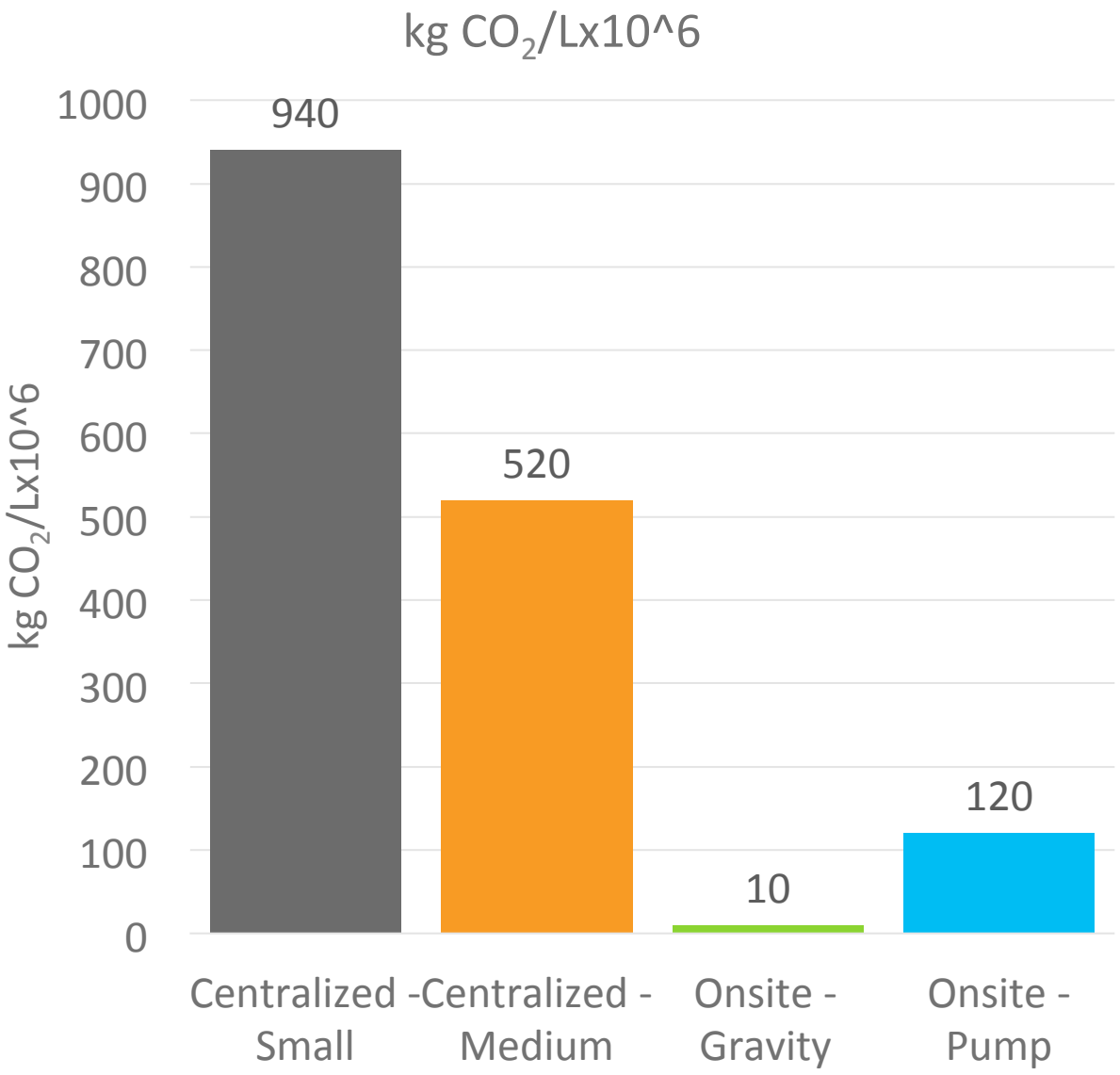
Embodied Carbon Footprint

Average Embodied Carbon Footprint



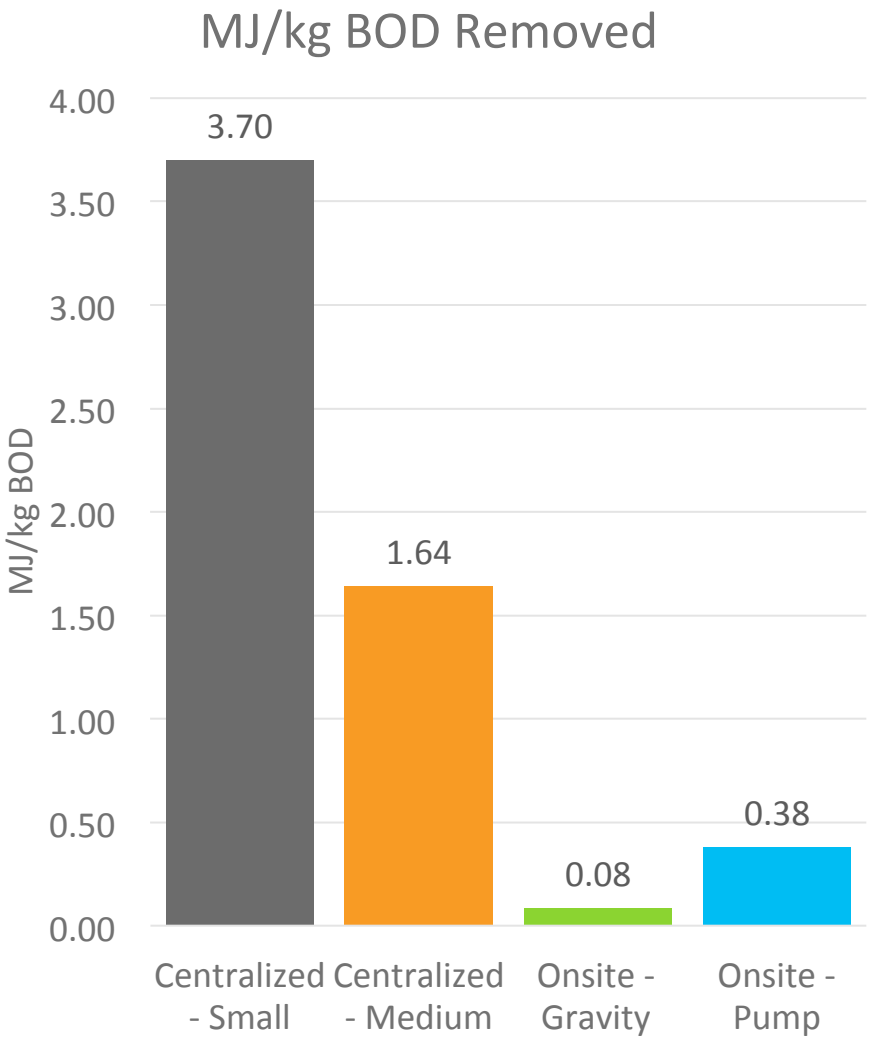


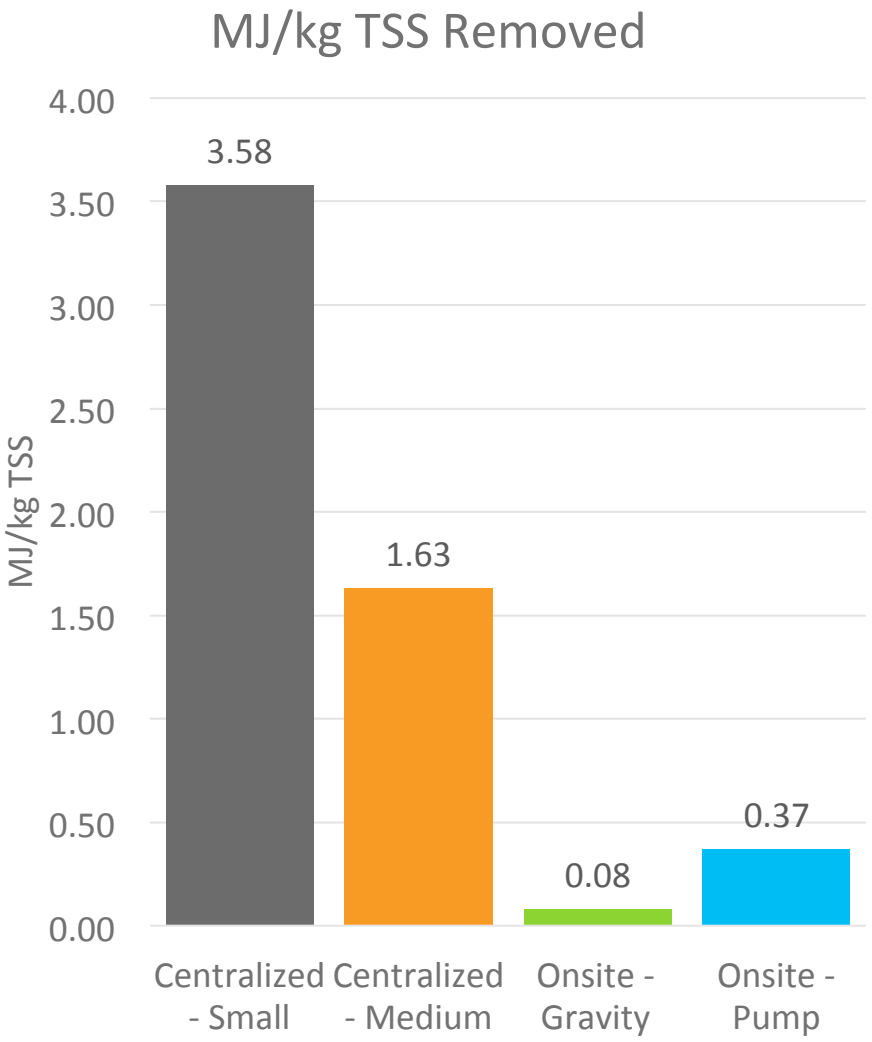
Average Embodied Carbon Footprint



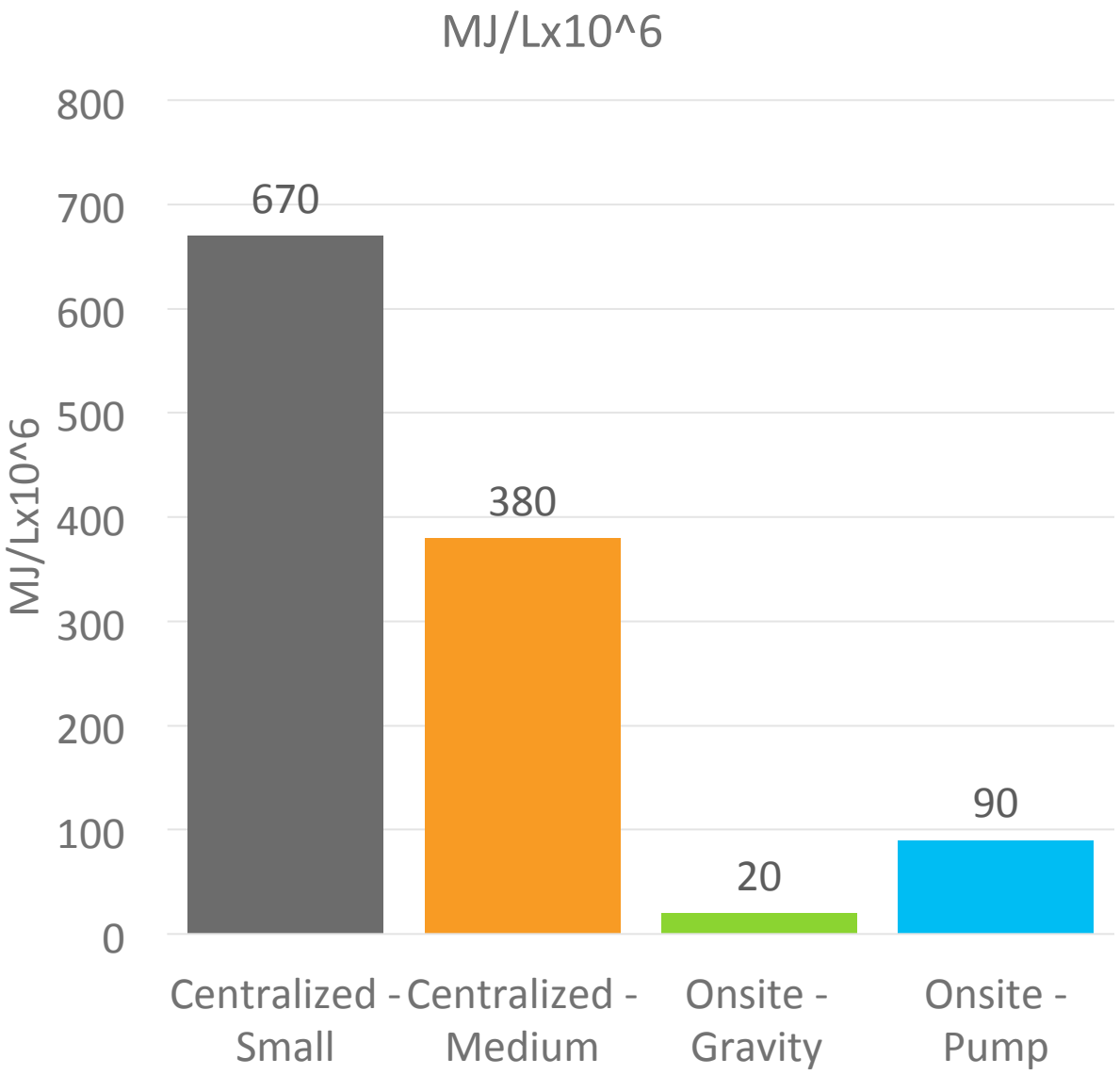
Embodied Energy Footprint

Average Embodied Energy Footprint





Average Embodied Energy Footprint



Total Annual Savings

Cost savings using onsite gravity and pump systems compared to centralized WWTPs

Total Annual Savings in North Carolina

- Over 321,000 onsite gravity and pump systems are installed in North Carolina (DHHS, 2017)
- Assuming 60% gravity and 40% pump
- Operating onsite systems in lieu of centralized systems reduces the cost of wastewater treatment

Based on study data, annual savings compared to centralized treatment: $218 million

Total Annual Savings in North Carolina

- Over 321,000 onsite gravity and pump systems are installed in North Carolina (DHHS, 2017)
- Assuming 60% gravity and 40% pump
- Operating onsite systems in lieu of centralized systems reduces carbon emissions

Annual CO_2 emission reduction:

Equivalent to removing over 37,000 cars

from road for one year

Total Annual Savings in North Carolina

- Over 321,000 onsite gravity and pump systems are installed in North Carolina (DHHS, 2017)
- Assuming 60% gravity and 40% pump
- Operating onsite systems in lieu of centralized systems reduces energy usage

Annual energy savings:

Equivalent to removing over 2,400 homes from electrical grid for one year

Conclusions

Benefits of Onsite Wastewater Management

- Passive onsite wastewater treatment is highly effective
  - Save money
  - Reduce carbon emissions
  - Reduce energy consumption
- Provides distinct advantages as part of the country's wastewater infrastructure solution
- Federal funding for the onsite industry should be adjusted to reflect national usage statistics

Key Take-Aways

- Onsite vs. centralized treatment
  - Reduced carbon emissions
  - Reduced energy use
  - Reduced cost
- Onsite is a viable and sustainable alternative to a centralized WWTP

Thank you!

Questions?

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