Central States Water Environment Association

RESOURCE RECOVERY AND ENERGY (R_2E) COMMITTEE OF THE FUTURE

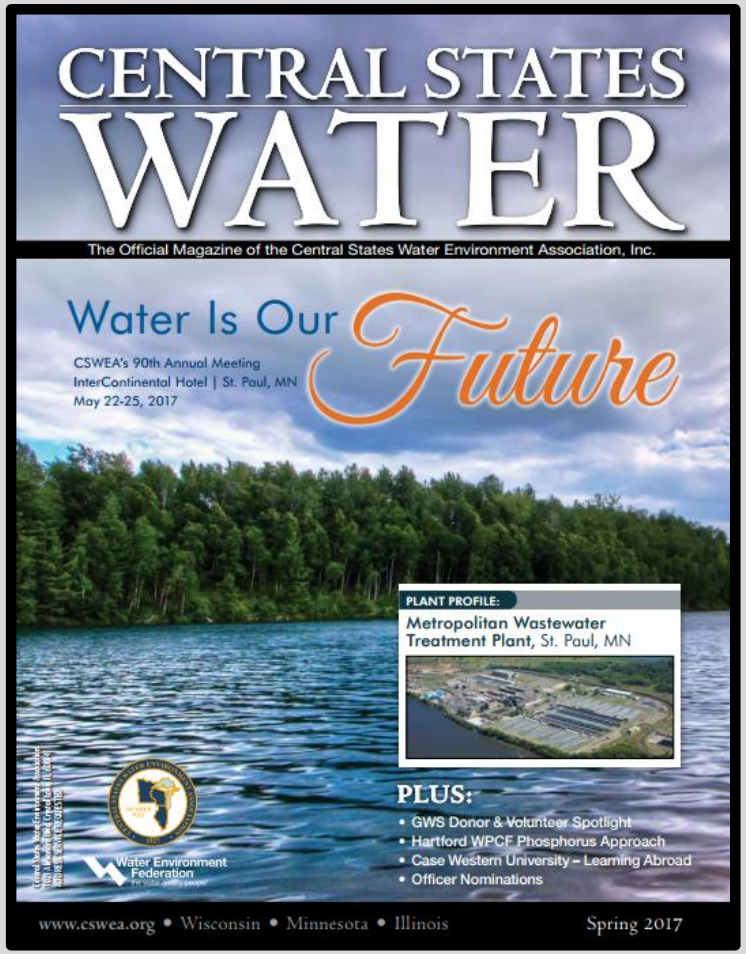
Overview

- R_2E Introduction
- Context: Sustainability & Resiliency
- Organizations and R_2E
- Technology & R_2E
- Funding for R_2E projects
- Case Studies
- Conclusions

Water Environment Federation
the water quality people®

CSWEA Vision Statement

"To provide a Water Environment Federation (WEF) organization (Illinois, Minnesota, Wisconsin) offering multiple opportunities for the exchange of water quality knowledge and experiences among its members and the public and to foster a greater awareness of water quality achievements and challenges"



R_2E Vision Statement

"To increase communication and provide tools and resources for all interested parties that are enhancing their nutrient recovery and energy related opportunities"

Resource Recovery and Energy (R_2E) – The Committee of the Future

- Resource for WWTF's
  - MN Learning Network
- Sustainable technology
- Planning for the future
- For operators, supervisors, and others
  - Large and Small Utilities
- Opportunities to get involved
- Conference on the Environment
  - Minnesota Utility Registration
  - Flexible presentation schedules

A Changing Wastewater Environment

- Treatment changes over the years
- Crumbling, aged infrastructure
- Lack of available funds for upgrades
- Other socio-environmental factors impacting wastewater treatment
- The impact of these factors on wastewater treatment

A Brief History of Wastewater Treatment in the US

1776 – 1870's

- Septic tanks, cess pools, and surface waters

1870's – 1930's

- Sewerage introduced, mostly untreated

1930's – 1970's

- "Treatment" consisted of settling ponds and lagoons

1970's – Present

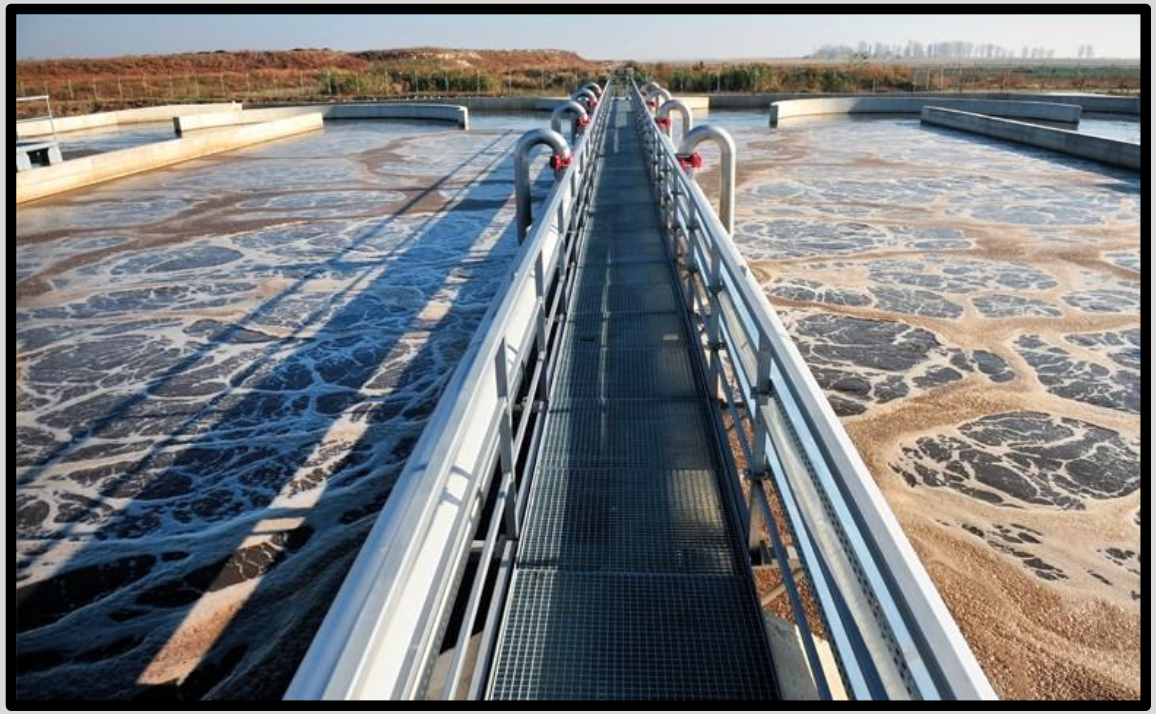
- Clean Water Act passed, Federal funding made available
- Many plants created/updated existing treatment facilities

Present day

- American Society of Civil Engineers (ASCE): Wastewater Infrastructure at a D+
- EPA: ~ 23K- 75K Sanitary Sewer Overflows (SSOs) annually
- No major federal funding for WWTF's since CWA
- Estimated costs to update these facilities within next 20 years is > $1 Trillion

Future Expected Challenges

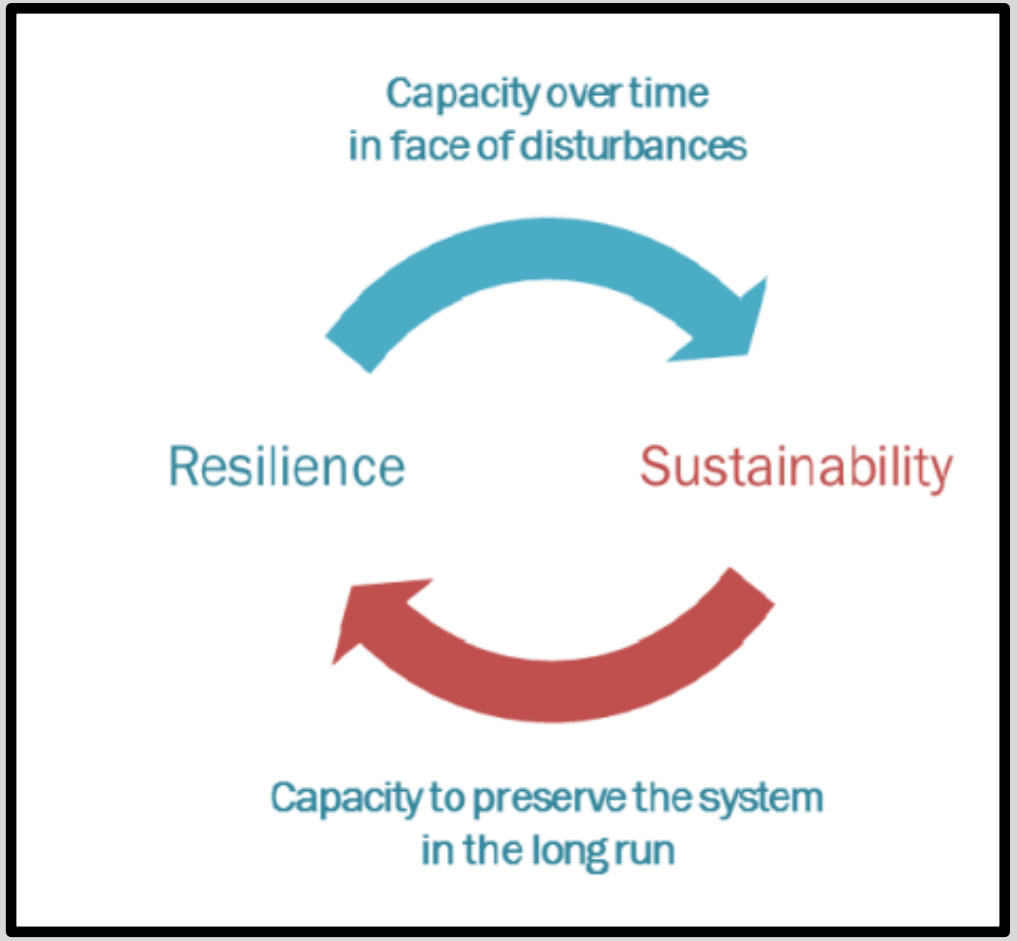
- Population
  - Rising in urban areas, falling in some rural areas
- Funding
- Utility Rates
- Regulations
- Environmental factors (for MN)
  - flooding, seasonal difference, changing precipitation



Sustainability, Resiliency, and the Future

How do we face these challenges?

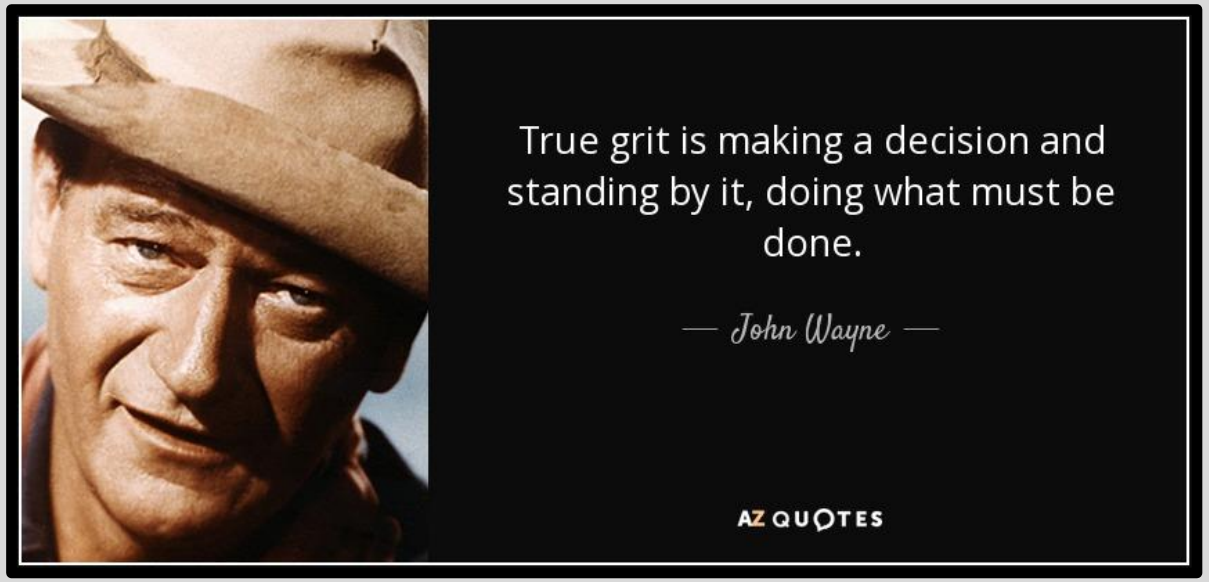
- Sustainability
  - Economy, Ecology, Community
  - “Utopian” vision not viable
- Resiliency
  - Ability to bounce back
  - Anticipating future setbacks
  - Collaborating with others
- Sustainability and Resiliency
  - Planning for challenges promotes sustainability



Sustainability through Resiliency

The how:

- Preparation and planning
- Collaboration and Consensus building
- Multiple stakeholders
- Innovation
- Learning networks
- Grit and hard work



R_2E, Sustainability, and Resiliency

- R_2E is a resource for the WW industry
- Collaborate with municipalities, engineering firms, regulatory agencies, communities
- Provide assistance and ideas for all interested WWTF's
- A learning network that builds trust among multiple stakeholders

Organizations

- **WEF**
  - ❖ Water Environment Federation
- **WERF**
  - ❖ Water Environment and Reuse Foundation
- **NACWA**
  - ❖ National Association of Clean Water Agencies
- **DOE**
  - ❖ Department of Energy

Water Environment Federation

WEF

- Est. 1928; over 33,000 members
- Connects professional, encourages innovation, provides education

- Resources
  - Resource Recovery Roadmaps
  - Biosolids & National Biosolids Partnership
  - Energy
  - Nutrients
  - Water Reuse

Water Environment Research Foundation

WERF

- Non-profit organization → WEF
- Research portfolio: >$200 Million
  - Applied research in water and the environment
  - Accelerating innovation and the adoption of technology
  - Transfer of knowledge
  - Setting industry research agendas

National Association of Clean Water Agencies

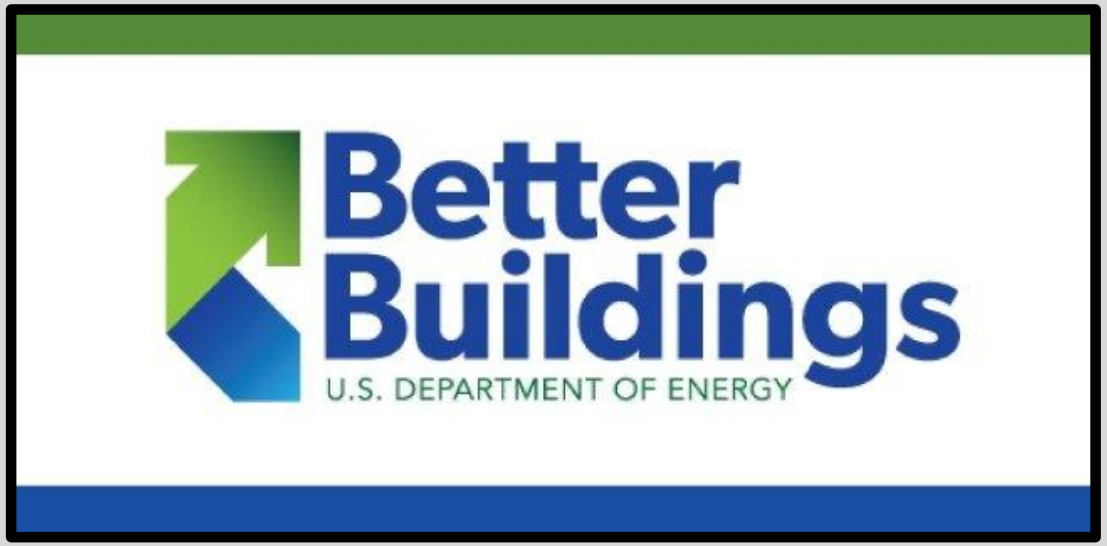
NACWA

- Created after CWA
- Advocated for EPA programs
- Local government oriented
  - WWTF's
  - Collection Systems
  - Stormwater Systems
- Water Resources Utility of the Future – Blueprint for Action
  - Also through AWWA

Department of Energy – Better Buildings

DOE

- Wastewater Treatment Plant → Water Resource Recovery Facility
- SWIFt – Sustainable Wastewater Infrastructure of the Future
  - Improve energy efficiency
  - Save money
  - Increase competitiveness
- 3 year initiative
  - Federal, state, regional, local
  - Catalyze adoption of sustainable design
  - 30% energy reduction goal
  - Encourage resource recovery



R_2E, Affiliated Organizations, and The Future

- Learning networks make us a stronger industry
- Collaboration within water quality community leads to innovation
- Multiple stakeholders improves resilience
- R_2E can help connect professionals

R2E Technology

- **Resource Recovery**
  - Biosolids
  - Phosphorus
- **Energy**
  - Solar
  - Wind
  - Biogas

Resource Recovery - Biosolids

- **Land application**
  - Beneficial to crops/agricultural community
  - Can utilize biogas from digesters
  - Simple, straightforward process
- **Waste to energy**
  - Incinerate biosolids for energy
  - Digesters not necessary
  - More complex than land application
  - Ash (potentially) used as fertilizer

Fuel Value/Nutrient Value of Biosolids

Fuel Value – Typical Sludge

- Wastewater sludge
  8,000 BTU / lb dry
- Wood
  8,700 BTU / lb dry
- Low grade Coal
  8,000 BTU / lb dry

Nutrient Value – Typical Sludge

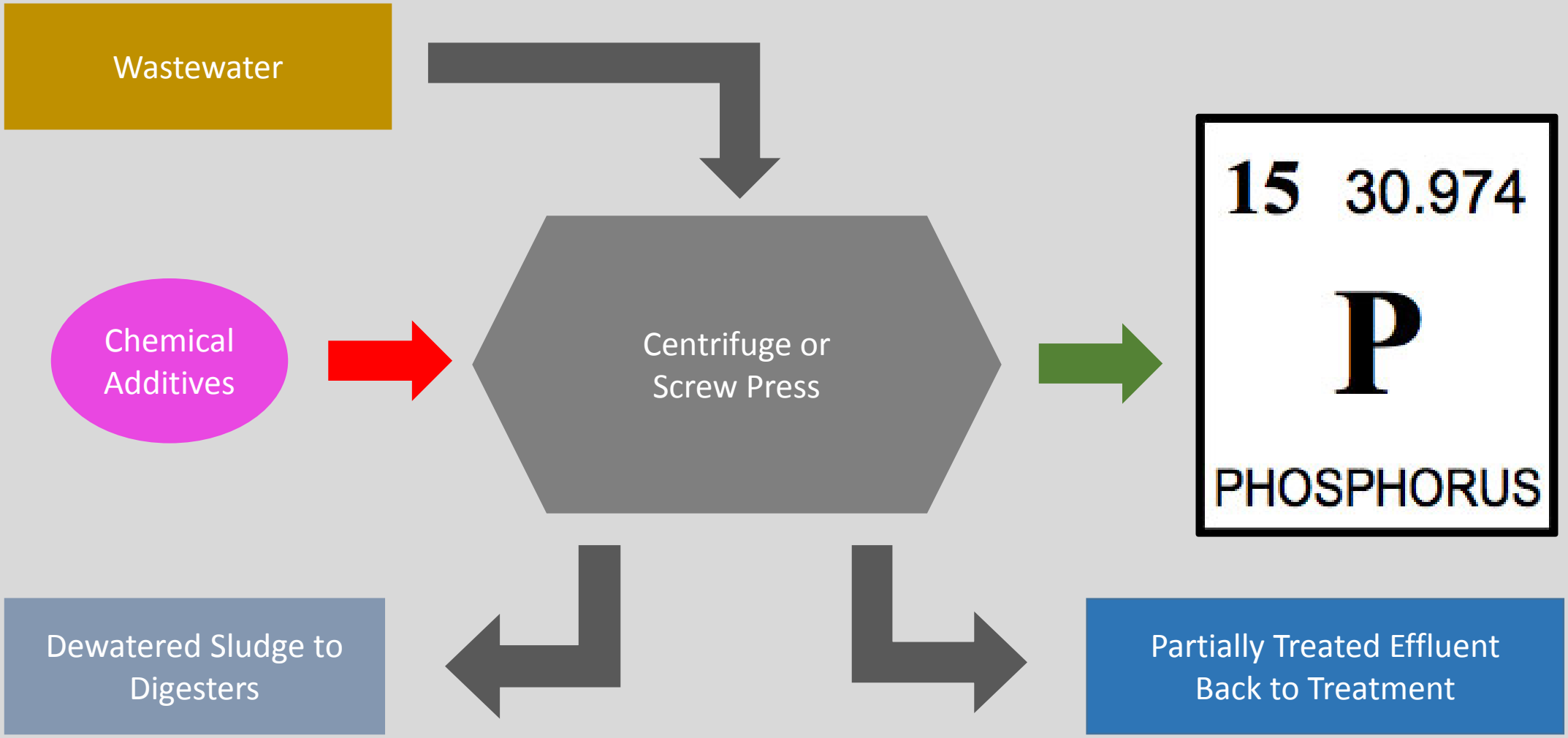
- Wastewater Sludge
  N = 3%
  P = 2%
  K = 0.3%
- Agricultural Fertilizer
  N = 5%
  P = 10%
  K = 0.3%

Phosphorus/Struvite Recovery

Recovery and Reuse

- Prevent struvite buildup
- Reduce amount of Phosphorus in effluent
- Treat wastewater
- Potential source of income

Phosphorus Removal & Struvite Recovery

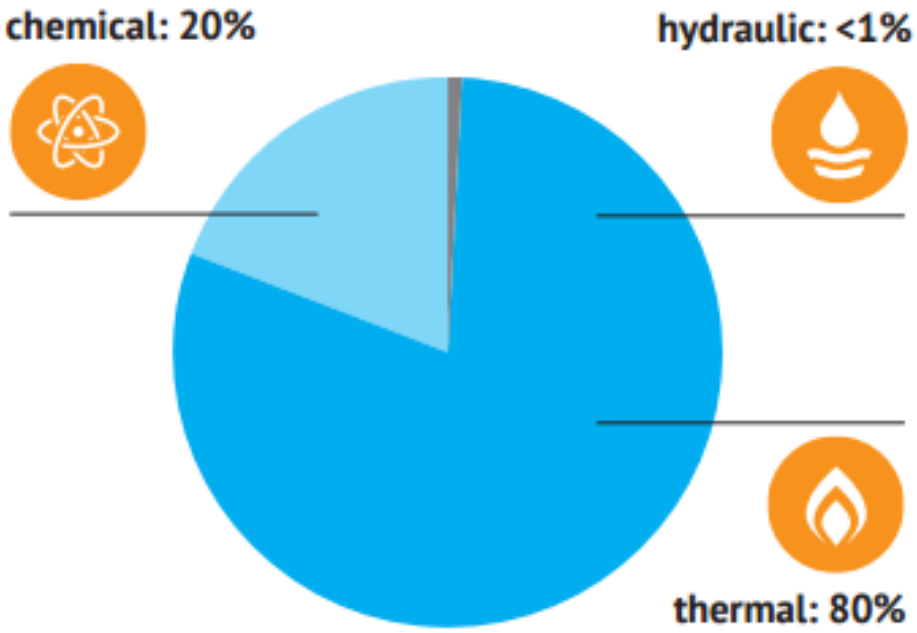


R_2E, Resource Recovery, and the Future

- Opportunities for stakeholder collaboration
  - Farmers, City, Citizens
- Valuable product used for energy or fertilizer
- Expand purpose of WWTF's
- R_2E can provide information, resources, and help network

Energy in Wastewater

Energy Embedded in Wastewater



Wastewater contains nearly five times the amount of energy needed for the wastewater treatment process – the majority in the untapped area of thermal energy.

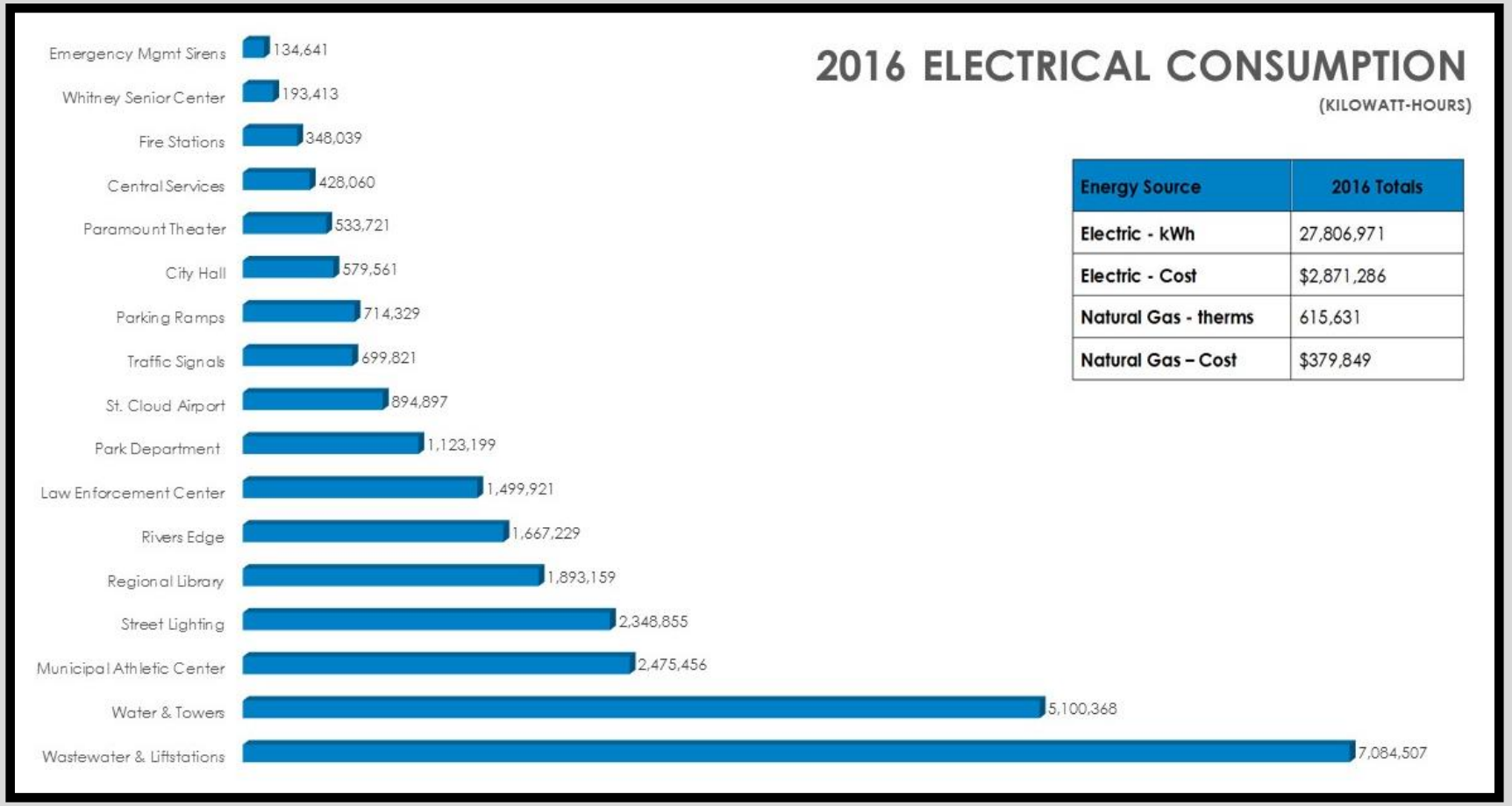
WERF Water Environment Research Foundation | Water Environment Federation the water quality people | NACWA A Clear Commitment to America's Waters

Energy – Bio-Gas Generators

- Already producing methane
  - Internal Combustion Engines
  - Compressed Natural Gas (CNG)
- High Strength Waste
- Heat Recovery

Energy - Solar

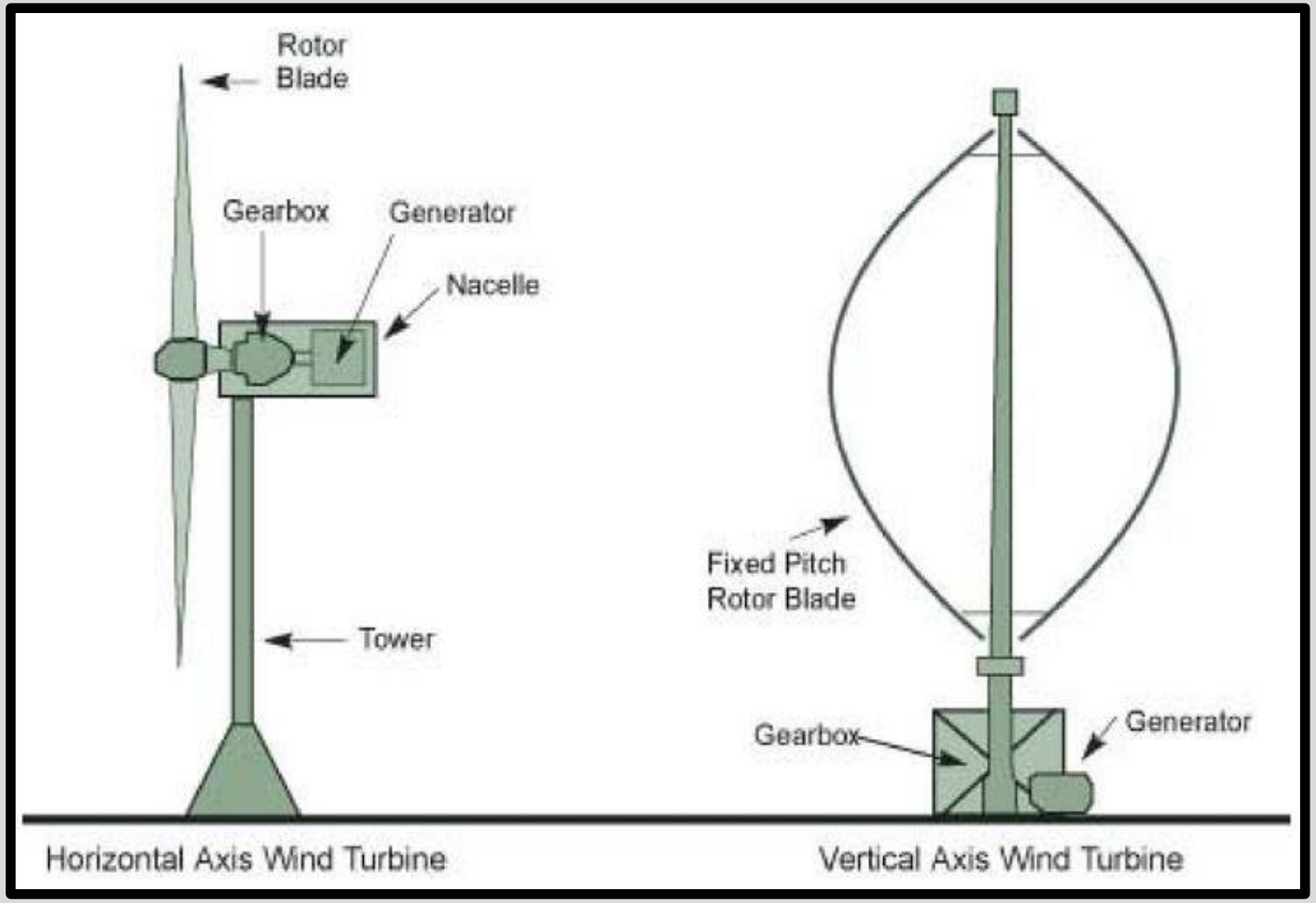
- Unique opportunities for WWTF's
- Massive energy consumers
- Space available for solar
- Advancements in solar:
  - "Perovskite" mineral
  - Nanotubes
  - Battery technology



Energy Source	2016 Totals
Electric - kWh	27,806,971
Electric - Cost	$2,871,286
Natural Gas - therms	615,631
Natural Gas – Cost	$379,849

Energy - Wind

- Types of Turbines
  - Horizontal
  - Vertical
  - Ducted
- Space for Wind Farms



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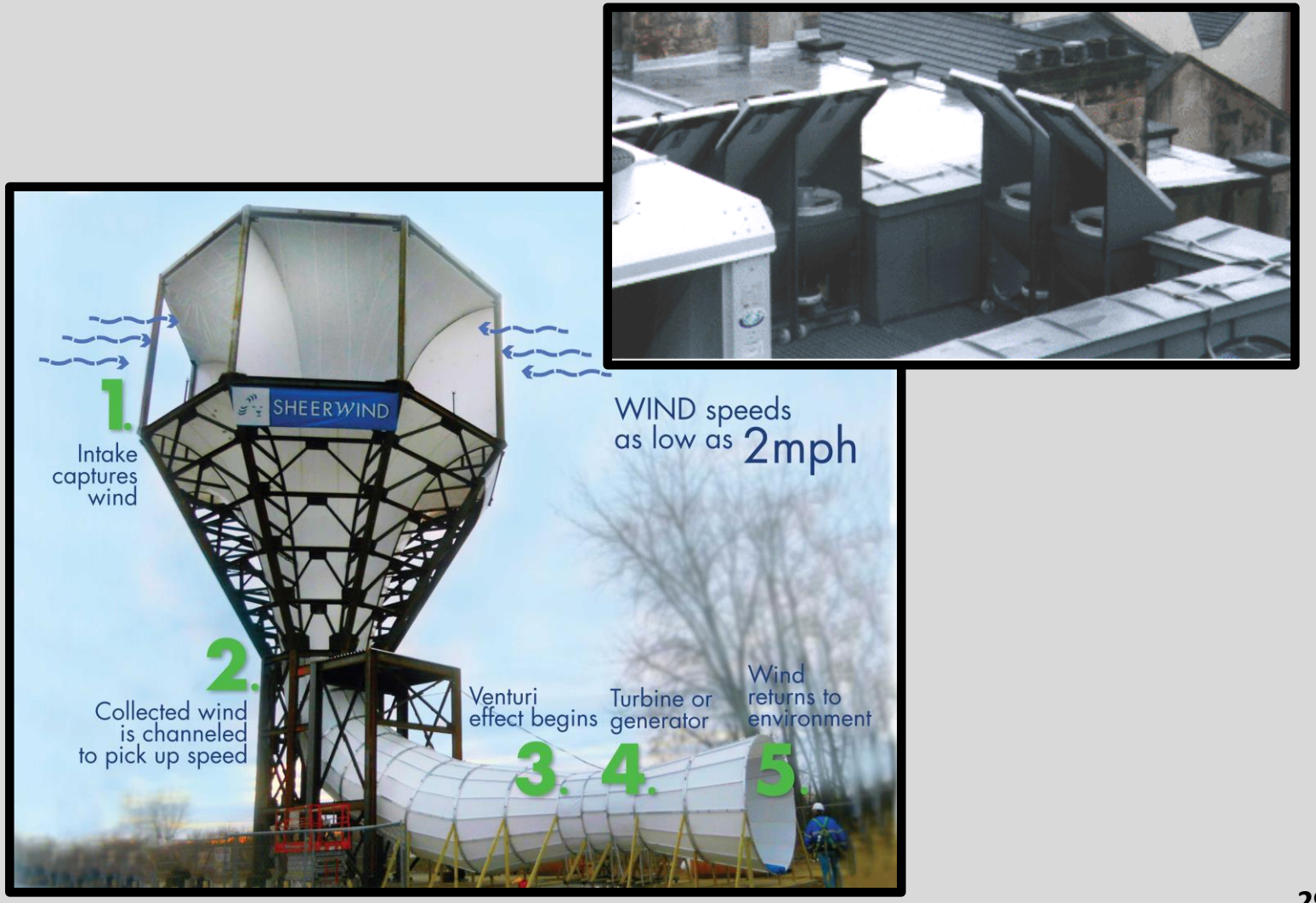


R_2E, Energy Production, and the Future

- Reduce reliance on power grid
  - "Behind the Meter"
- Offset other costs
- Promote sustainable development and reduce CO2
- Expand purpose of WWTF's
- R_2E can provide information about options to produce energy onsite

Funding

All of this sounds great, but how do we pay for it?

- Public Facilities Authority
- Point Source Implementation Grant
- Energy Savings Company
- Green Project Reserves

Public Facilities Authority

PFA

- Community financing/technical assistance for public infrastructure
- Protect public health and environment, promote economic growth
- 3 revolving loan funds provide Money for:
    - Drinking Water
    - Clean Water
    - Transportation

PFA – Point Source Implementation Grant

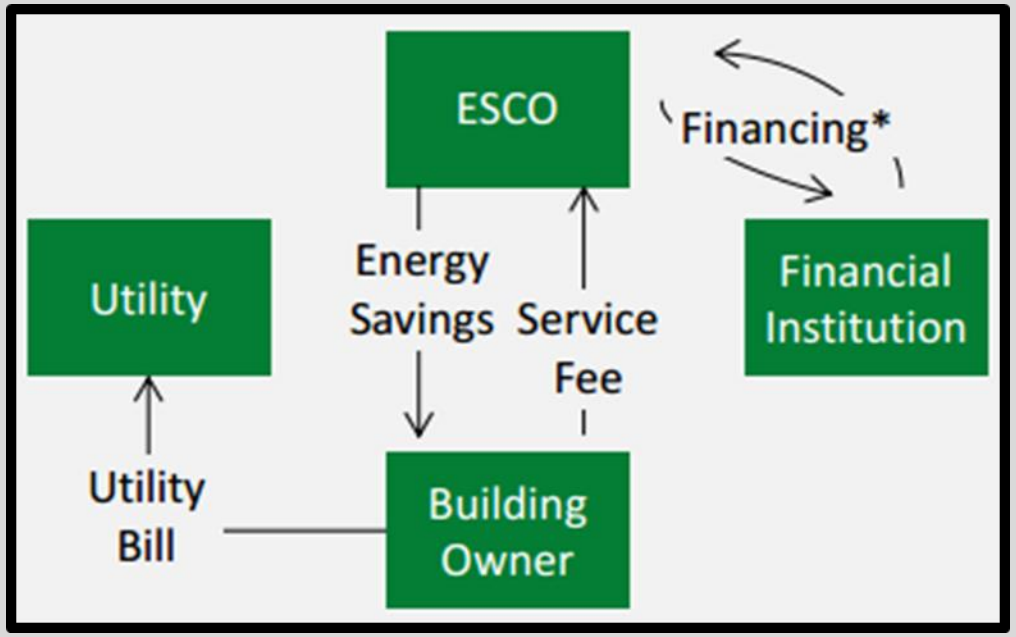
PSIG

- Designed for WWTF's
- Must be on "Project Priority List"
- Administered annually
  - Help meet TMDL plans
  - Reduce Phosphorus to <1mg/l
  - Reduce total nitrogen <10 mg/l
  - Meet/exceed MPCA requirements

ESCO Funding

Energy Savings Company (ESCO)

- Third party pays for project → energy savings reimburse ESCO
  - Guaranteed by ESCO
  - Varying payoff times
- Ideal for large municipal projects
  - Long-term property owner
  - Large consumer of energy



Green Project Reserves funding

- Administered by EPA/MPCA
- Low interest loans for municipalities
- Through Clean Water Revolving Fund
- For green infrastructure, water, or energy efficiency
- Up to $500,000; not as many requirements as other grants

R_2E, Funding, and the Future

- R_2E projects compliment WWT
- R_2E projects can open new doors
- R_2E can increase lifetime of WWTF's
- Matching funds
- R_2E committee is resource for funding and connecting professionals

Case Studies

- **MCES – Blue Lake**
  - Fertilizer
  - Waste to Energy
- **City of Rochester**
  - Waste to Energy
- **City of St. Cloud**
  - Biosolids
  - Energy
  - Phosphorus Recovery

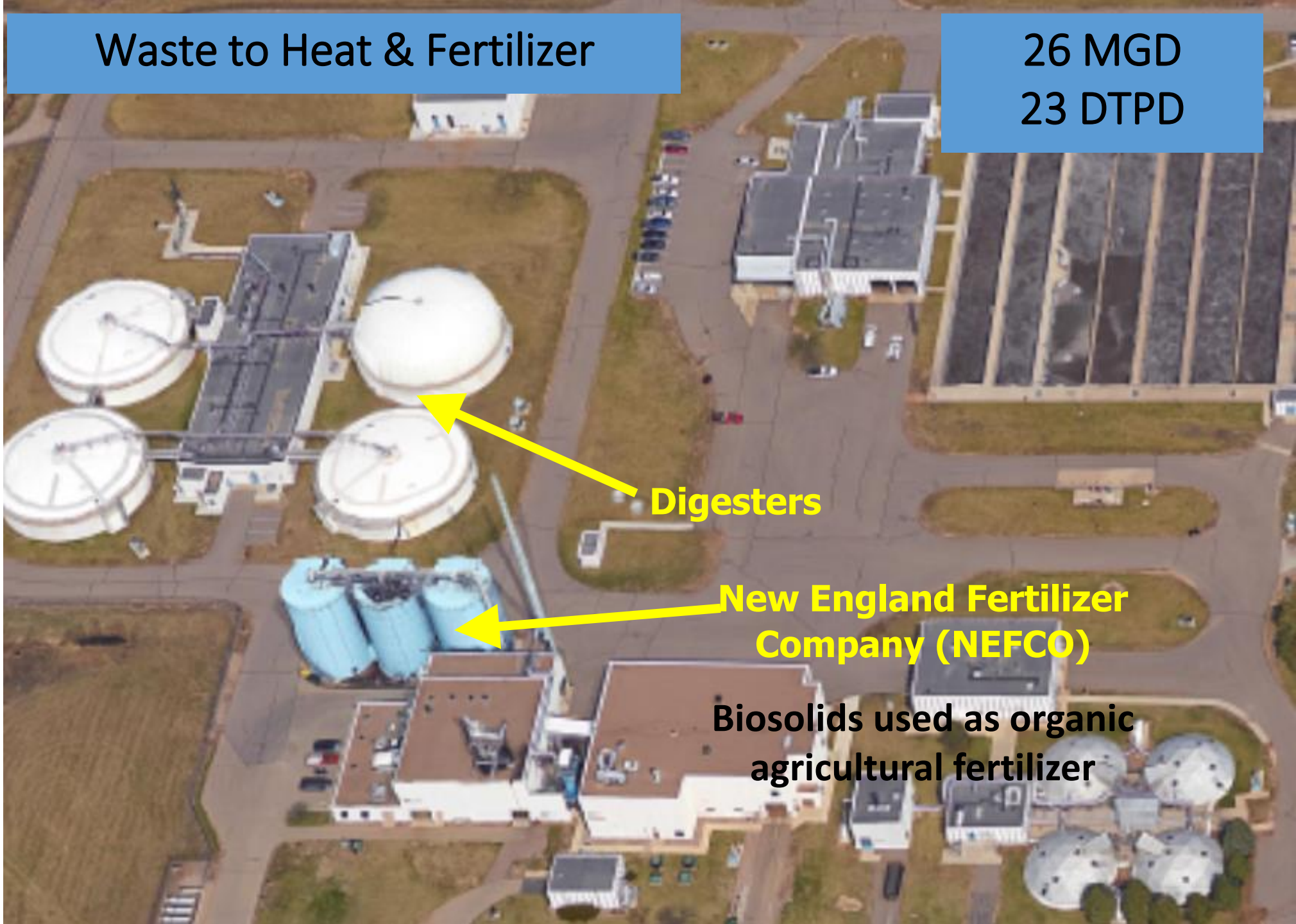
MCES Blue Lake WWTP

Anaerobic Digesters and NEFCO

Biogas:

$500,000/yr natural gas savings 4,600 tons CO_2 per year avoided
$150,000 energy rebate

Fertilizer:
23 dry tons per day of digested dewatered sludge is dried to 8000 tons per year of land-applied pellets



Rochester Water Reclamation Plant

Combined Heat and Power System

$230,000/yr electrical savings
$345,000/yr nat gas savings

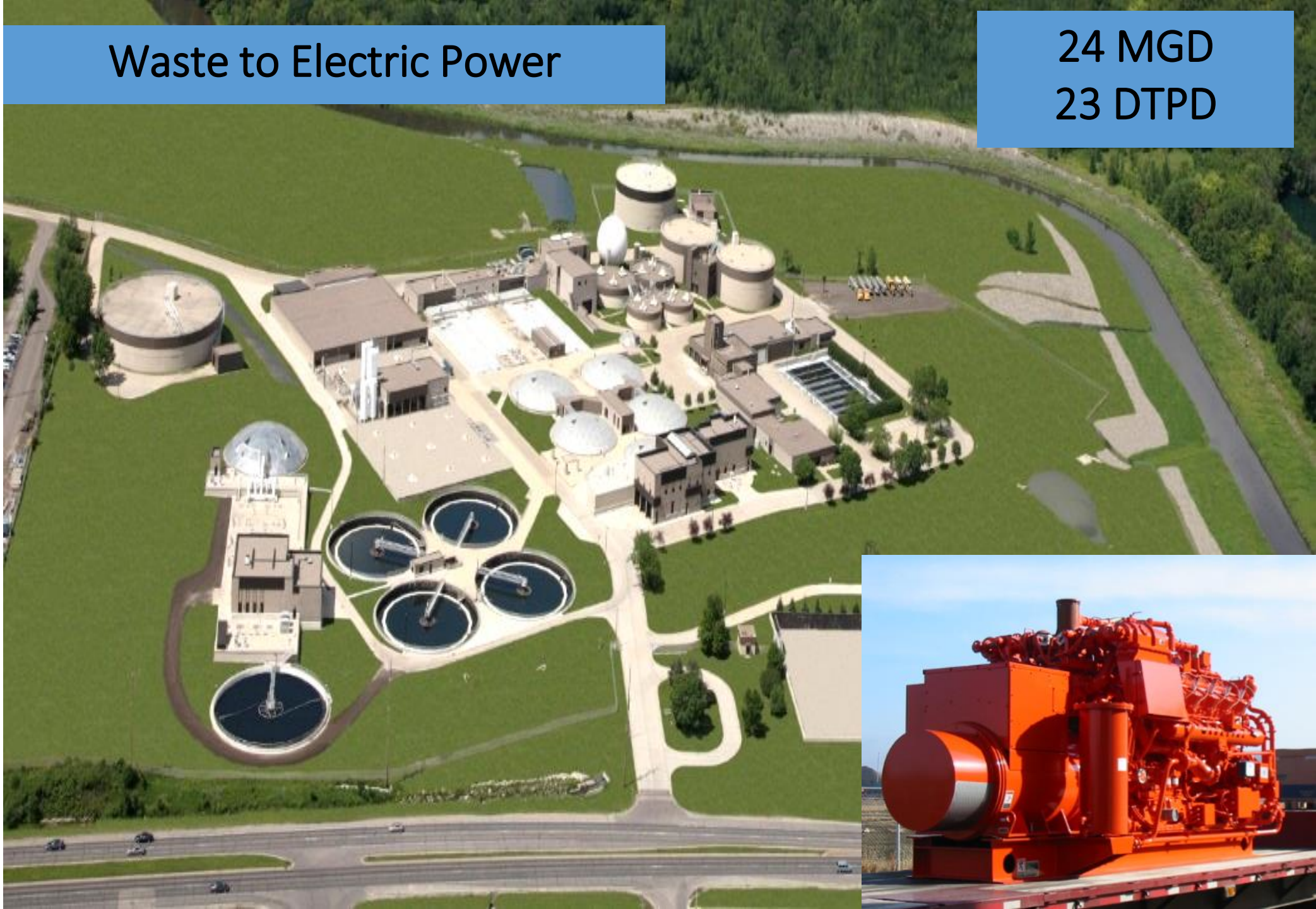
Total=$575,000

2,300 tons CO2 per year avoided

$240,000 energy rebate

Waste to Electric Power

24 MGD
23 DTPD



St. Cloud Resource Recovery Facility

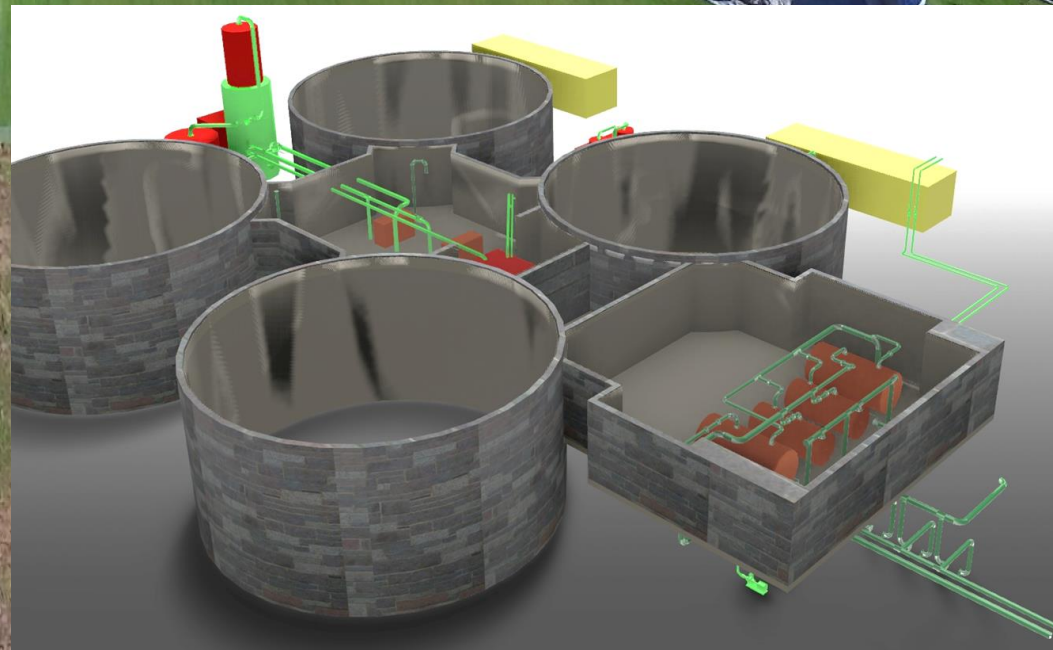
Biofuel Recovery Project

$400,000/yr energy savings

3,000 tons CO2 per year avoided

Waste to Combined Heat & Power

10 MGD



Sustainability Equivalencies

5,000,000 Kilowatt-Hours =

- **519** Homes' Electricity *(Use for one year)*
- **3,749,644** Pounds of Coal
- **8,421,560** Miles Driven *(By a passenger vehicle)*

R_2E, Case Studies, and the Future

- Communities with sustainable design
- Upgrades open new doors
- Facilities more resilient
- R_2E Committee has compiled these as a reference site for MN

Conclusions

- Many future challenges that R_2E is here to help with
- R_2E is a resource for WWTF's
- Several helpful affiliated organizations
- Technology of the future
- How to fund R_2E projects
- Minnesota examples
- Sustainable planning for the future will make the industry more resilient

Questions