# U.S. EPA Local Climate & Energy Webcast
# Energy Efficiency in Water and Wastewater Facilities

**October 30, 2013**

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Project Manager, MassDEP
www.mass.gov/dep

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

# Water / Wastewater Treatment in MA

- 370 public facilities
- $150M / year

## Impacts

- 1 billion kWhs
- 1 million tons ($CO_2$)

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# A New Public / Private Partnership

Public

- (7) Water &  (7) Wastewater Facilities
- MA Dept. of Environmental Protection
- MA Executive Office of Energy / Environmental Affairs
- MA Dept of Energy Resources
- EPA New England
- MA Renewable Energy Trust
- University of MA – Northeast CHP Center

Private

- Every Major Investor-Owned Electric & Gas Utility

Non Profit

- Consortium for Energy Efficiency

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# Massachusetts' Energy Pilot

(2007 – 2010)


- Advance energy efficiency
- Advance clean energy
- A working model

**Goal: 20% reduction in costs & $CO_2$ emissions**

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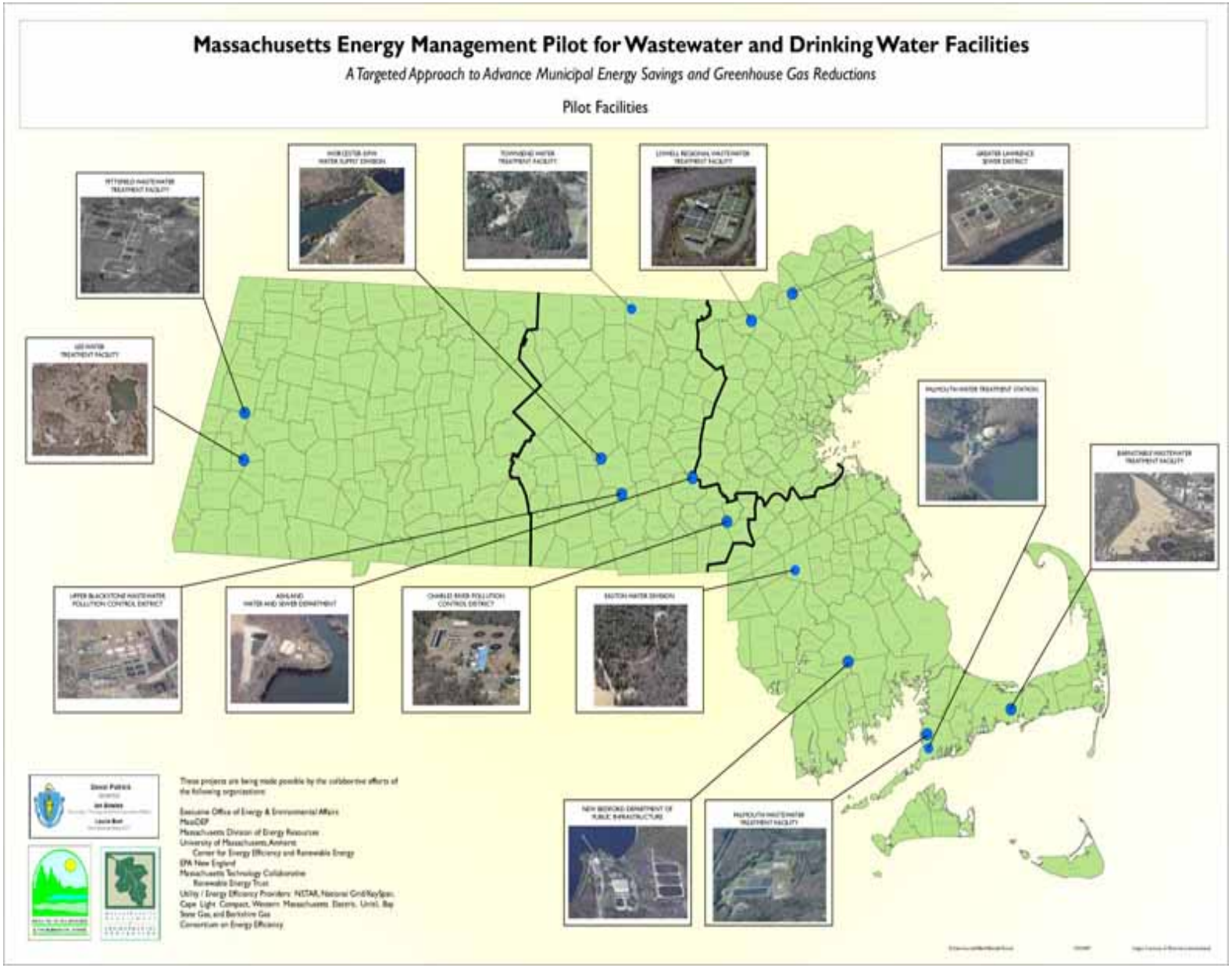


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# 14 Pilot Facilities

Efficiency: **Save $2M / Year**

Green Power: **Save $1.7M / Year**

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# ARRA – Green Infrastructure

Recovery & Reinvestment:

Clean Energy & the Environment

**Jump-start "Green" projects: 20% of SRF ARRA**

**Fully Implement Energy Pilot & Other "Green" projects**

| | |
|---|---|
| **(7) Wastewater Plants:** | **$42.6M** |
| **(7) Water Plants:** | **$ 8.2M** |
| | **$50.8M** |
| **(7) Others** | **$17.8M** |
| **Total** | **$68.6M** |

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CITY OF PITTSFIELD
WASTEWATER TREATMENT PLANT UPGRADES
FUNDED THROUGH MASSACHUSETTS DEP'S
CLEAN WATER STATE REVOLVING FUND (CWSRF) PROGRAM &
AMERICAN RECOVERY AND REINVESTMENT ACT (ARRA)
BAR RACK REPLACEMENT
$1,860,000
CONTRACTOR: R.H. WHITE
AUBURN, MA
AERATION UPGRADES
$2,371,863
CONTRACTOR: C.H. NICKERSON
TORRINGTON, CT
COMBINED HEAT & POWER
$1,919,000
CONTRACTOR: R H. WHITE
AUBURN, MA
PHOTOVOLTAIC INSTALLATION
$7,324,682
CONTRACTOR: NEXAMP
NORTH ANDOVER, MA
KLEINFELDER
S E A
ENGINEER: KLEINFELDER/S E A
ROCKY HILL, CT

# Results

- Save $5+M / year for ratepayers
- 34% annual reduction in energy costs and $CO_2$ emissions
- 10+ megawatts of “green” power
  - 5.2 MW (solar), 4.8 MW (wind)
  - .34 MW (CHP), .20 MW (hydro)
- Zero-net energy pathway

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# MA Energy Leaders

- Coalition of state, federal, community & energy efficiency providers (Mass Save®)
- Each meeting has a technical presentation, a presentation from a utility, a discussion on energy management planning, and a site visit.

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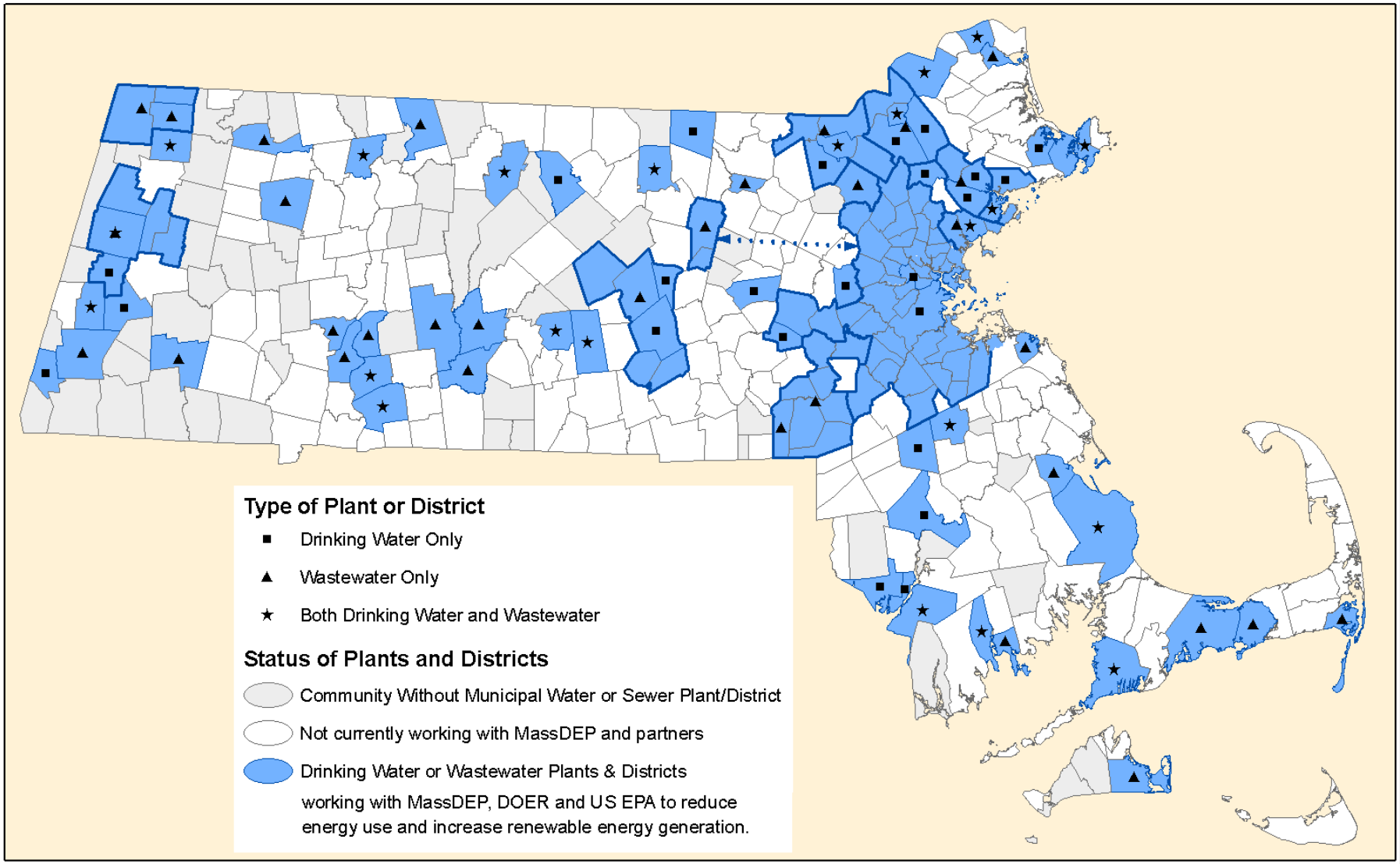
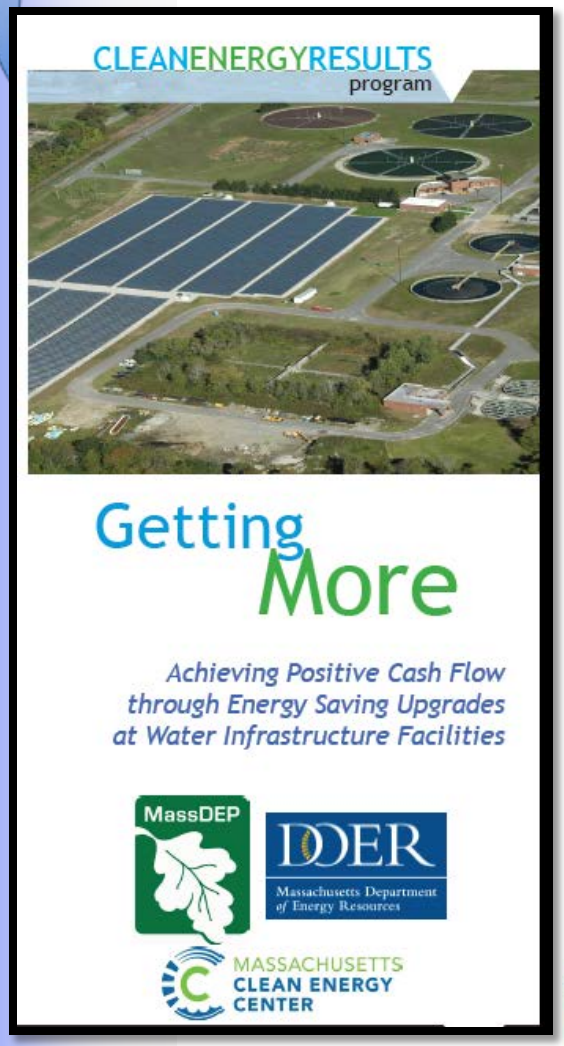
# Drinking Water and Wastewater Plants and Districts Working with MassDEP, DOER, and U.S. EPA to Address Energy Use




0 4 8 16 Miles

Map provided by DOER
7-22-11, jpfister

# Reducing Operating Costs & Reinvesting in your Facility




- *Quantify energy & cost savings*
- *Energy-savings can boost your bottom line & reduce your carbon footprint*
- *Pay for wasted energy or reinvest it in your facility (people / equipment / assets)*

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## Thank You!

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# GREATER LAWRENCE SANITARY DISTRICT
# ENERGY EFFICIENCY PROGRAM
# 2000-2013

## U.S. EPA Local Climate & Energy Webcast
## Energy Efficiency in Water and Wastewater Facilities
## October 30, 2013

Presented by:

Richard E. Weare, GLSD Capital Projects Manager

# GLSD WWTP SYSTEM

- MEMBER COMMUNITIES
  - Lawrence, Methuen, Andover, No. Andover, Dracut, MA & Salem, NH
- Wastewater Treatment Plant
  - Design Capacity - 52 MGD
  - “Wet Weather” Peak Flow Capacity - 135 MGD
  - Based on CSO LTCP increase wet weather pumping to 167 MGD
  - Peak Secondary Flow Capacity - 126 MGD
- Pumping Station
  - 2 - 800 h.p. Pumps and 2 – 1250 h.p. Pumps
- Sludge Drying Facility
  - 2 Process Trains rated at 19 dry tons/day each

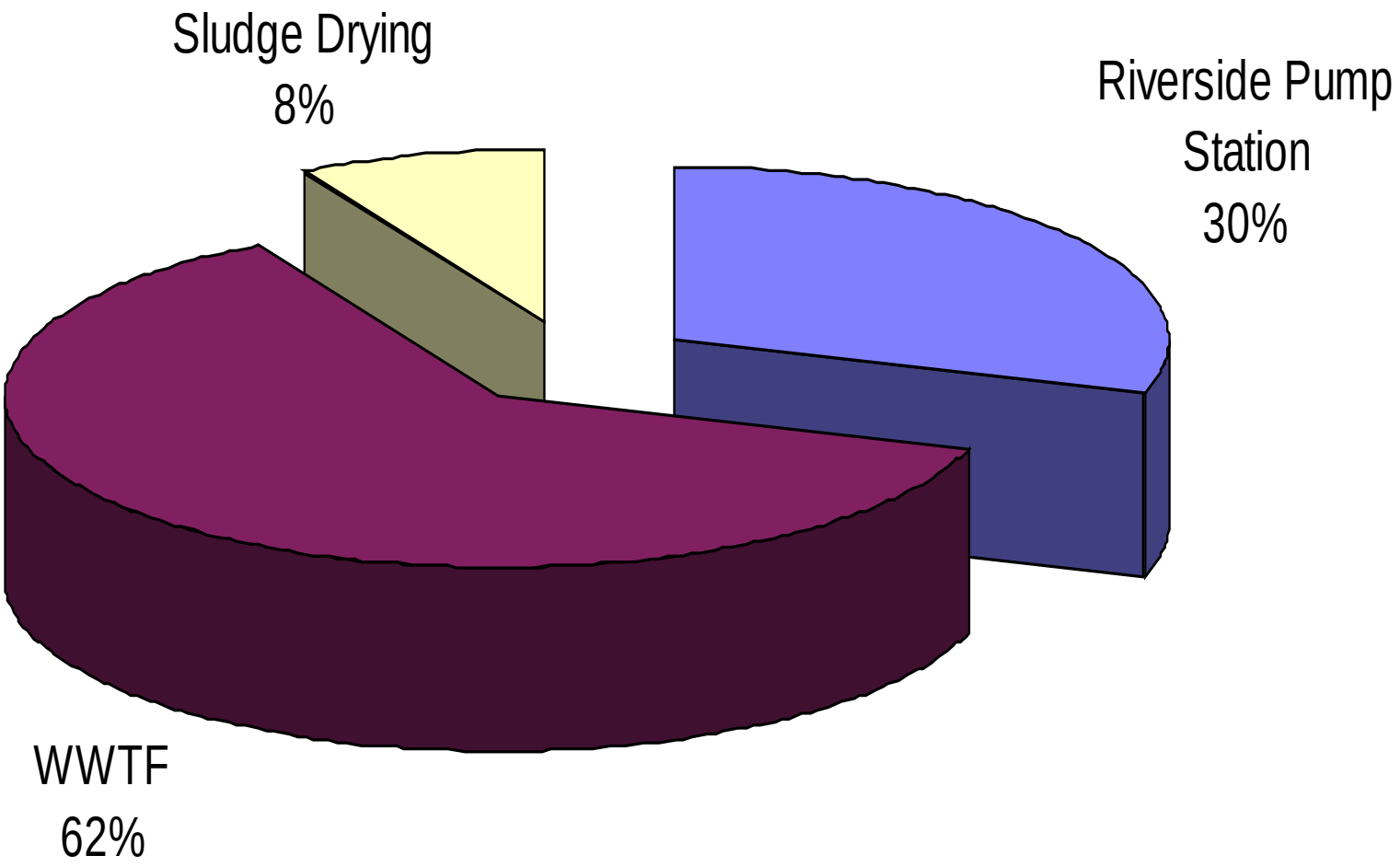
# GLSD ENERGY EFFICIENCY STUDY PLANS

- Energy Evaluation Audit – 1995
  - No Action on 1995 Evaluation
- Biosolids Improvement Study - 1998
- Lighting System Evaluation – 2001
- Secondary Treatment System Evaluation – 2004
  - Replace Mechanical Aeration with Fine Bubble Diffusers and Anaerobic Selector – Completed in 2006
- Renewable Energy Assessment - 2008
- Comprehensive Energy Evaluation Audit – 2009
  - Participated in the DEP Energy Management Pilot Program
  - Phase 1 Construction Completed in 2010 with ARRA Stimulus Funds
- Lighting System Evaluation – 2009
- Primary and Secondary Energy Evaluation - 2012

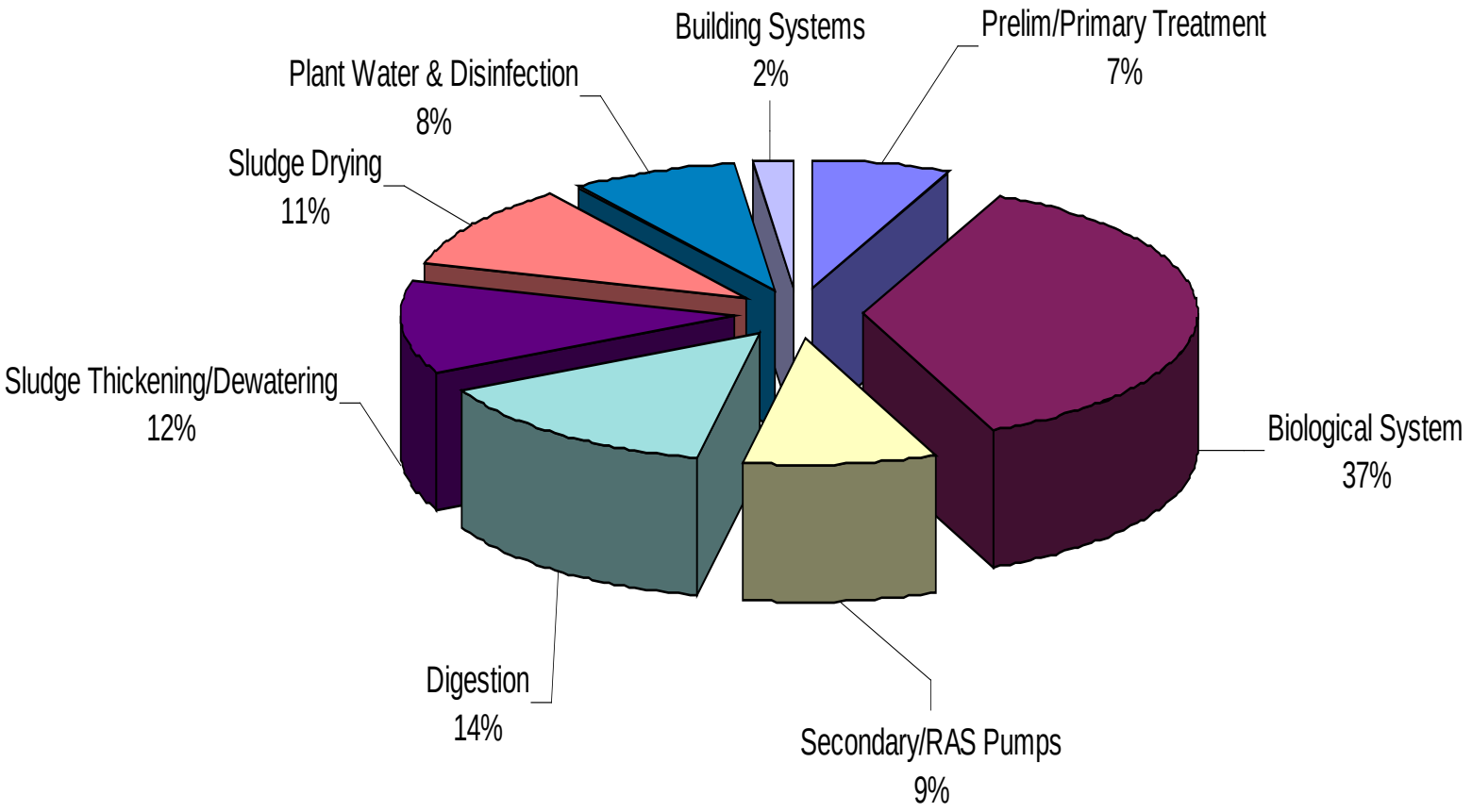
# SCOPE OF 2009 ENERGY AUDIT

- A Comprehensive Energy Evaluation Audit was performed which provided specific energy improvement recommendations
- Identified Energy Use and Cost Components
- Cost Effective Energy Savings Recommendations:
  - GLSD Operational Measures
    - 5 Low Cost Operational Measures Identified
  - GLSD Energy Conservation Measures
    - 18 Conservation Measures Identified
  - GLSD Energy Supply Measures
    - 2 Supply Measures Identified
- GLSD uses the EPA Plan-Do-Check-Act system for its Energy Program

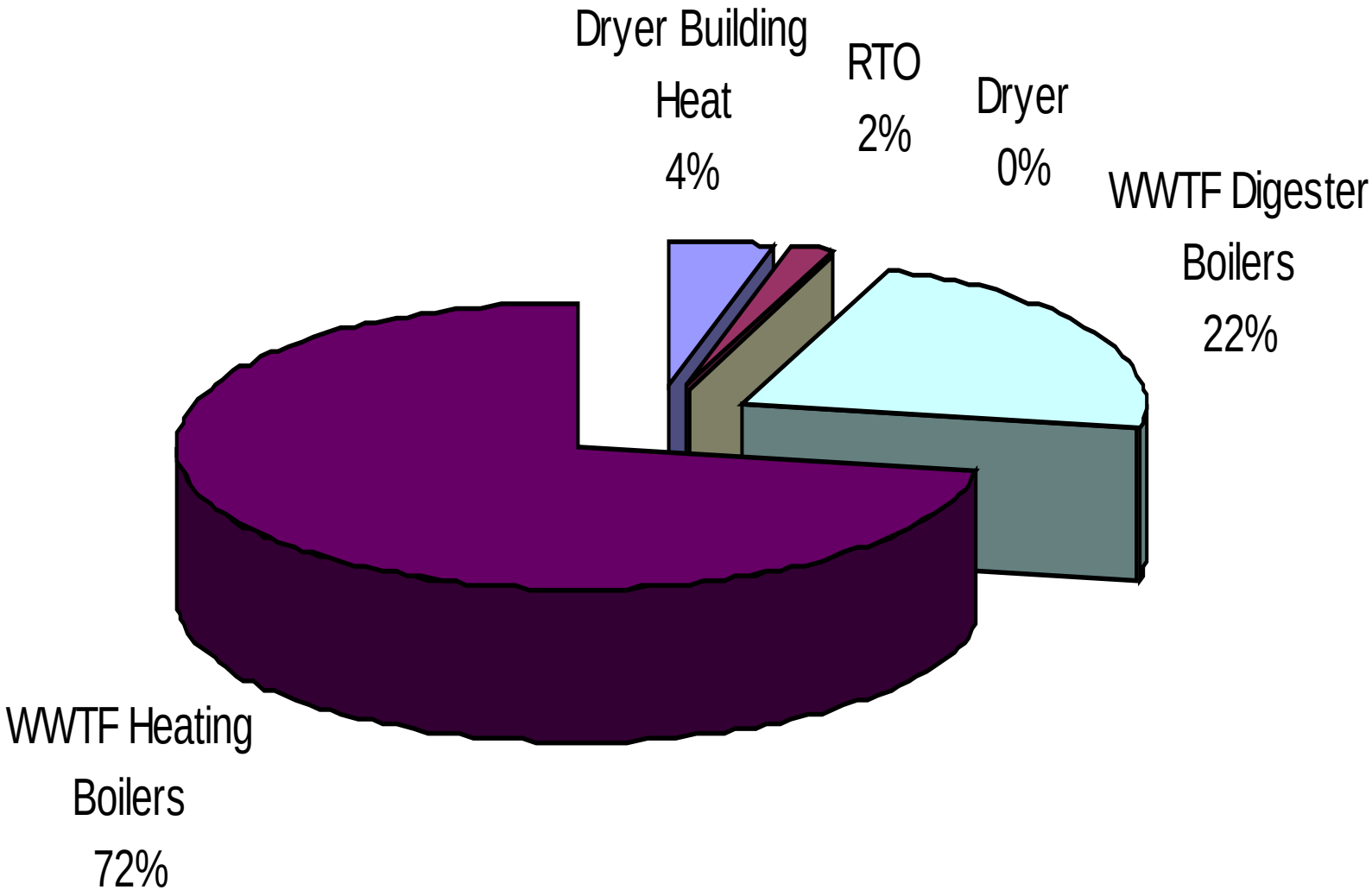
# Electric Energy Use



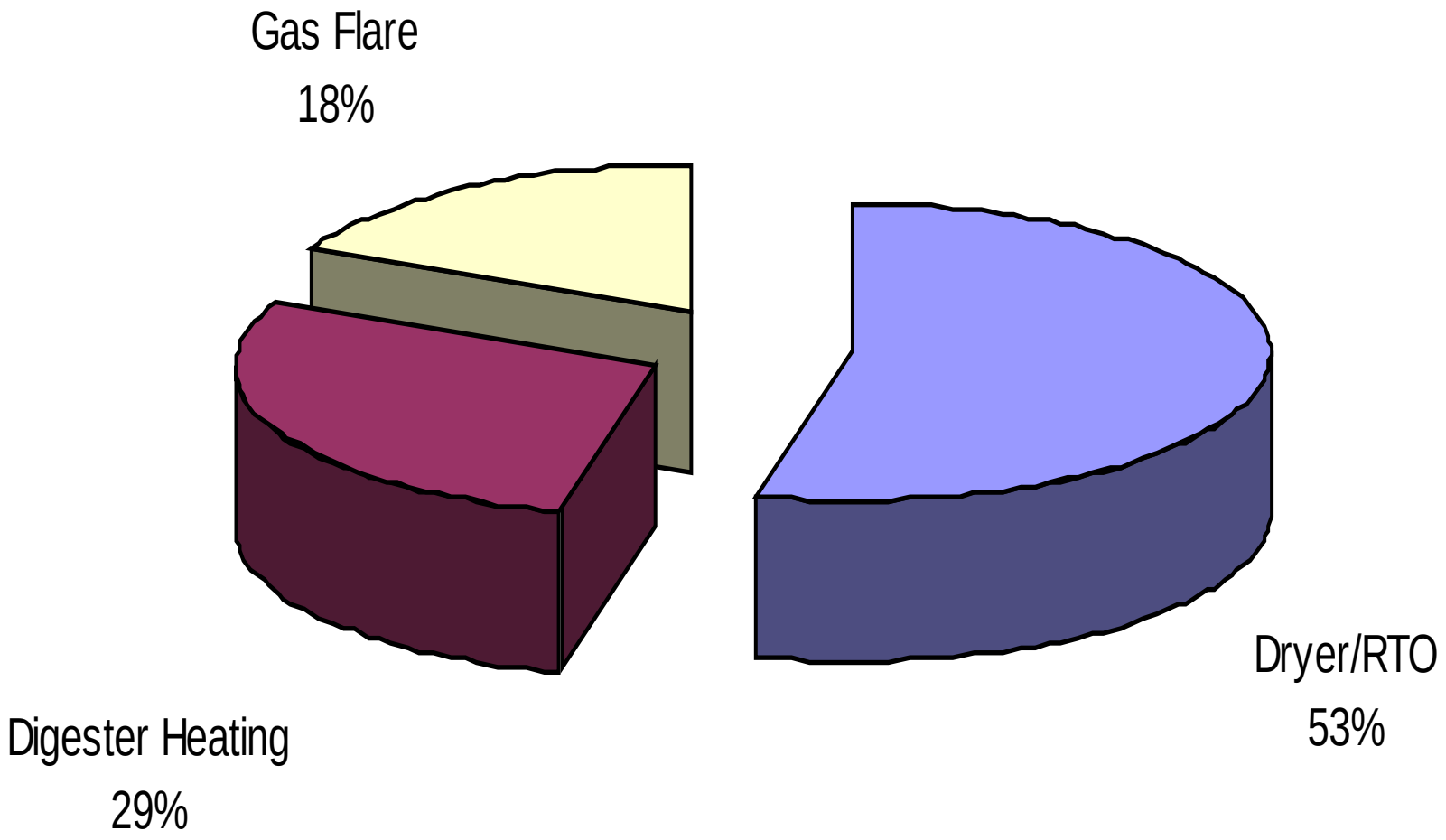
## GLSD WWTF Electric Energy Breakdown



# 2007 GLSD Natural Gas Use



# 2007 Digester Gas Use



# 2009 ENERGY AUDIT STUDY
# ESTIMATED SAVINGS

- **Electricity**
  - kWh Savings (1) : 4,537,062
  - kW Savings (2) : 550
  - Electric Cost Savings: $ 636,963
- **Natural Gas**
  - MMBtu Saved: 28,150
  - Natural Gas Savings (3): $ 349,624
- **Reduced Emissions**
  - Carbon Dioxide 2035 Tons
  - Methane 349 lbs.
  - Nitrous Oxides 73 lbs.

(1) Based on $0.1343/kWh;
(2) (2) Based on $4.74/kW
(3) Based on $12.42/MMBtu

# 2010 CONSTRUCTION PROJECT SCOPE

- Energy Efficiency Upgrade, Phase 1
  - 3 engineering firms/4 construction contracts:
    - Installed 23 VFD's to replace Eddy Current Clutches
    - Replaced 19 Motors with Premium Efficiency Motors
      - 25 h.p. to 125 h.p. units
    - WWTP Admin. Building EMS & HVAC Improvements
    - Pump Station HVAC Control System Improvements & installation of VFD and premium efficiency motor
    - Installed KW Meters to Track Energy Usage
    - Fine Bubble Aeration System Upgrade utilizing Motorized Air Valves
    - Upgraded Hot Water Condensate Pumps with VFD's
    - Replaced Plant Water Pumps and installed VFD's.

# 2010 CONSTRUCTION PROJECT SCOPE (continued):

- Energy Efficiency Upgrade, Phase 1
  - Installed New Energy Efficient Steam Boilers w/Dual Fuel Burners (Natural Gas & Digester Gas)
  - Lighting System Improvements
  - Installed 441 kW Photovoltaic Arrays.

# 2010 CONSTRUCTION PROJECT FUNDING

- Energy Efficiency Upgrade, Phase 1

  Four Construction Contracts prepared under a “fast-track” design schedule to allow projects to be “shovel ready” and eligible for DEP’s AARA funding grants.

  – ARRA Funding paid Construction Costs $4,922,384
  – Utility Incentives paid Design Fees $ 693,084
  – Net Cost to District $ 0
  – Simple Payback without funding 2.9 years

# CONSTRUCTION PROJECT FUNDING
# 2000 - 2013

| YEAR | PROJECT | CONSTRUCTION COST | UTILITY INCENTIVE | DEP FUNDING |
|---|---|---|---|---|
| 2000 | Biosolids Improvements, Contract 1 | $17,580,759 | NAF | $12,356,880 |
| 2000 | Biosolids Heat Drying Facility | $12,169,501 | NAF | $8,553,502 |
| 2003 | Lighting System Upgrade - 2003 | $139,213 | $39,100 | $0 |
| 2006 | Secondary Syst Upgrade - Fine Bubble Diffusers | $19,162,497 | $750,000 | 2% Loan |
| 2010 | Energy Project, Contract 1 - PEM & VFD's | $590,003 | $315,046 | DEP-ARRA |
| 2010 | Energy Project, Contract 2 - HVAC | $1,156,359 | $137,285 | DEP-ARRA |
| 2010 | Energy Project, Contract 3 - PW & VFD's | $531,400 | $381,083 | DEP-ARRA |
| 2010 | Energy Project, Contract 4 - Solar System | $1,976,172 | $0 | DEP-ARRA |
| 2010 | Lighting Upgrade, Phase 1 | $99,613 | $23,947 | $0 |
| 2013 | 72" Force Main Replacement | $11,265,786 | N/A | 2% Loan |
| 2013 | Primary Clarifier Baffles & Aeration Upgrade | $2,136,712 | $350,203 | 2% Loan |
| 2013 | Lighting System Upgrade, Phase 2 | $118,399 | $9,530 | $0 |
| | TOTALS | $66,926,414 | $2,001,194 | |
| | | | | DEP GRANT |
| | Energy Projects Identified in 2009 Energy Audit | | | DEP 2% LOAN |
| | | | NAF = Not Applied For | |

# CONSTRUCTION PROJECT SAVINGS
# 2000 - 2013

| YEAR | PROJECT | CONSTRUCTION COST | ANNUAL kWh/MMBTU SAVINGS | ANNUAL COST SAVINGS | PAYBACK (YRS) |
|---|---|---|---|---|---|
| 2000 | Biosolids Improvements, Contract 1 | $17,580,759 | - | ↓ | - |
| 2000 | Biosolids Heat Drying Facility | $12,169,501 | - | $1,000,000 | - |
| 2003 | Lighting System Upgrade | $139,213 | 382,848 | $41,728 | 1.77 |
| 2006 | Secondary Syst Upgrade - Fine Bubble Diffusers | $19,162,497 | 3,314,607 | $287,376 | 1.52* |
| 2010 | Energy Project, Contract 1 - PEM & VFD's | $590,003 | 464,280 | $65,309 | 0 |
| 2010 | Energy Project, Contract 2 - HVAC | $1,156,359 | 62,196/6067 ** | $83,600 | 0 |
| 2010 | Energy Project, Contract 3 - PW & VFD's | $531,400 | 474,105/5497** | $135,010 | 0 |
| 2010 | Energy Project, Contract 4 - Solar System | $1,976,172 | - | $59,000+ | 0 |
| 2010 | Lighting Upgrade, Phase 1 | $99,613 | 260,225 | $44,923 | 2.21 |
| 2013 | 72" Force Main Replacement (@165 mgd) | $11,265,786 | 1,402,800 | $188,396 | - |
| 2013 | Primary Clarifier Baffles & Aeration Upgrade | $2,136,712 | 1,298,501 | $169,022 | 4.9 |
| 2013 | Lighting System Upgrade, Phase 2 | $53,497 | 101,379 | $17,438 | 2.13 |
| | TOTALS | $66,926,414 | 7,760,941/11,564 | $2,091,802 | |
| | | | * Based on $1,170,000 Cost | Savings based on $0.1343/kWh | |
| | Energy Projects Identified in 2009 Energy Audit | | ** kWh/MMBTU | Now: $0.08355/kWh | |

# D/B PHOTOVOLTAIC SYSTEM

| | Capacity |
|---|---|
| • Area 1 & 2 | |
| – Ground Mount System (bid in 2010) | |
| – kW Capacity: | 441.0 |
| – Number of PV Modules: | 2100 |
| Total D/B Bid Cost: | $1,971,742 |
| Cost per Watt | $ 4.47 |

- In Comparison, ENR (8/19/2013)* indicates:
  - Installed PV Systems larger than 100 KW average $4.60 per watt
  - Utility-scale PV projects prices ranged from $2.30 to $6.80 per watt

* Data from Berkeley National Laboratory

# PHOTOVOLTAC SOLAR SYSTEM

- The Solar System will save GLSD approximately $59,000 per year in Electricity Costs based on $0.106 per kW

- Solar Renewable Energy Certificates are available to GLSD to sell on the Open Market [2012 REC sale equaled $32,280]

- GLSD Solar Array generates enough electricity to power the equivalent of approximately 80 Massachusetts homes

# FUTURE PROJECTS

- Pump Station – 2 New 800 h.p & 2 new 1250 h.p. Pumps & VFD's
  - Est. kWh Savings: 1,722,326
  - Est. Electric Cost Savings: $239,474
- Future CSO LTCP Projects and other project designs will always have energy savings initiates included
- EPA's Plan-Do-Check-Act system says always look to improve

# CLEAN ENERGY FOR OUR KIDS FUTURE