Project Goals

- Quantify the effectiveness and efficiency of equipment in facilities representative of the U.S. urban water supply’s delivery and treatment systems;
- Analyze the market potential to improve performance by using NEMA member products; and
- Evaluate the viability of applying energy savings performance contract practices to finance modernization upgrades. This report presents the results of the project team’s analysis and conclusions.
National Electrical Manufacturers Association

- NEMA has nearly 400 Members
  - Motors
  - Lighting Systems
  - Sensors and Controls
  - Security Imaging and Communications Products
  - Switches Boxes, Buses, Power Systems

- Strategic Initiatives - advance knowledge and understanding of technology advances, regulatory matters and industry data.

- Industry Technical Standards and Advocacy

- NEMA frequently partners with the Hydraulic Institute who represent the pump industry
Project Background

• US urban water systems rely heavily on energy – energy costs are second major expense

• Vast majority of energy consumption is for pumping to extract and move water (55-90%)

• Needed water-related infrastructure investment exceeds $1 trillion (AWWA)

• New and emerging technologies have advanced performance and reliability

• Slow uptake of advanced energy efficient technologies by water sector
Water Treatment Plant

Kenneth B Rollins WTP – Leesburg Virginia
US DOE W-E Climate Nexus

- Optimize freshwater efficiency of energy production, electricity generation, and end use systems
- Optimize the energy efficiency of water management, treatment, distribution, and end use systems
- Enhance the reliability and resilience of energy and water systems
- Increase safe and productive use of nontraditional water sources
- Promote responsible energy operations with respect to water quality, ecosystem, and seismic impacts
- Exploit productive synergies among water and energy systems
Approach

• Extensive investigation of available information and literature:
  – Status of energy efficiency efforts and best practices by urban water suppliers in the US
  – Available and needed funding
  – Barriers and challenges to system upgrades and optimization

• Surveys and interviews
  – NEMA Working Group Members
  – Water supply utilities (SurveyMonkey®)
  – Industry Organizations and Agencies

• Determined potential energy savings and assessed how ESCOs are or can be used by water utilities.
Findings

• Numerous studies and reports exist documenting the various applications and benefits of energy efficient technologies in water systems.

• Several entities (EPA, NYSERDA, EPRI, etc…) have defined effective energy-related BMPs for water managers.

• Although the survey was submitted to thousands of water utility representatives, few responded – few are interested in energy efficiency.

• There is significant energy efficiency potential in US water systems.

• ESCO’s are a viable business model to obtain advances.
Best Management Practices

1. Benchmarking and tracking monthly and annual energy use;
2. Identifying and prioritizing energy operations and issues that can increase efficiency;
3. Identifying energy efficiency objectives and targets;
4. Defining the performance indicator(s) to use to measure progress towards your energy targets;
5. Establishing energy management programs (i.e., action plans to meet your goals);
6. Monitoring and measuring the performance of your established target(s);
7. Documenting and communicating success; and
8. Reviewing your progress periodically and making adjustments as necessary.
## Energy Management Opportunities

<table>
<thead>
<tr>
<th>Energy Efficiency and Demand Response</th>
<th>Emerging Technologies and Processes</th>
<th>Energy Recovery and Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strategic Energy Management</td>
<td>• Odor Control</td>
<td>• Cogeneration Using Digester Biogas</td>
</tr>
<tr>
<td>• Data Monitoring and Process Control</td>
<td>• Membrane Bioreactors</td>
<td>• Use of Renewable Energy to Pump Water</td>
</tr>
<tr>
<td>• Water Conservation</td>
<td>• Deammonification Sidestream Process</td>
<td>• Recovery of Excess Line Pressure to Produce Electricity</td>
</tr>
<tr>
<td>• High-Efficiency Pumps and Motors</td>
<td>• Water Reuse</td>
<td></td>
</tr>
<tr>
<td>• Adjustable Speed Drives</td>
<td>• Residuals Processing</td>
<td></td>
</tr>
<tr>
<td>• Pipeline Optimization</td>
<td>• Microbial Fuel Cells</td>
<td></td>
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<tr>
<td>• Advanced Aeration</td>
<td>• LED UV Lamps</td>
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<td>• Demand Response</td>
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Source: EPRI/WRF 2010
Survey Major Participants
Survey Results

- Informal Responses
  - Information requested was detailed and answers had to be provided by several departments.
  - Data was not easily accessible or readily available within the time allotted.
  - Data is perceived to be sensitive and thus is not willingly shared.
  - Survey was too long, short response window, and timing was too close to the holidays.
Survey Results (cont.)

• Formal Responses
  – Most respondents can provide water production data in annual, monthly and daily intervals but less than half can provide hourly.
  – Peak monthly production can be 2x the annual average requiring most water utilities to maintain significant excess capacity in their systems.
  – Few respondents identified their energy utility and less than half new what they spent on electricity.
  – Median energy costs reported - $57/AF or $174/MG.
  – If a water utility has made energy efficiency improvements it is mostly to pumps and motors.
Challenges to Advancement

- Decision making processes
- Risk averse
- Competing priorities
- Minimal direct interaction between water utility representatives and manufacturers
- Lack of familiarity, experience, knowledge and understanding of new and emerging technologies
Water Utility Procurement

- Operating revenues are declining; investments must focus on short payback periods.
- Most elected decision-makers reluctant to raise rates limiting available funds for upgrade investments.
- Limited operating budget for competing projects.
- Available financial incentives can “tip the scale” and make energy efficiency a more attractive investment.
- Decision-makers and system operators do not always have the same priorities.
- Limits on the availability of debt-financed funding can discourage efficiency purchases if up front costs are large.
- Comprehensive Asset Management Programs may not be supported in all utilities.
Process Can Take Years

**PLAN**
- Identify needs and requirements
- Define approach and analyze potential solutions
- Define specifications

**SOURCE**
- Identify possible vendors
- Solicit bids
- Negotiate and select vendor
- Award contract

**INTEGRATE/MANAGE**
- Initiate project
- Prepare design
- Define success criteria
- **SELECT EQUIPMENT**
  - Install
  - Operate

**TIME**
Performance Contracting

- Value-based procurement process
- Dollars not spent on energy pay for facility improvements
- Shared risk and mutual accountability
- Tend to be more expensive than traditional “low-bid” solutions
- Utility and operational savings are guaranteed

Images Courtesy of Siemens
Estimated Savings Potential

Total estimated annual cost savings of $217 million across US (0.2-3.8%).

- We derived conservative estimates for potential savings using multiple data sources and studies.

- Savings depend on electricity rates paid, location, sources of supply and processes.

- Benchmarking and auditing can be used to prove actual savings.

Source: US EPA
Funding Opportunities

Tradition Sources

• Grants and Cost Share Funding
  – Drinking and Clean Water State Revolving Funds
  – WaterSMART

• Water Infrastructure Bonds

• Customer Rates

• Tax Revenues

• Incentive Programs

New and Emerging Sources

• Water Resources Reform and Development Act Program Low Interest Loans (2014)

• Green Infrastructure Bonds

• Expanded Energy Utility Efficiency Project Eligibility
  – Leak detection
Recommendations

• Support activities that expand the analytic capacity and capabilities of water utilities
  – Develop tools to facilitate site audits
  – Provide training to perform testing of pumps, motors and other equipment
  – Training and educate staff on the performance and integration requirements of new and emerging equipment

• Engage water sector more directly
  – Water Utility Focused Group
  – Partnerships on research or project implementation
  – Continue to support and fund technology demonstrations

• Identify and organize funding portfolios that leverage ESCOs, public and private dollars, and energy utility incentives.
To continue the dialogue, contact:

Lorraine White
Water-Energy Program Manager
916.631.4540  cell: 916.990-2410
lwhite@geiconsultants.com

GEI Consultants, Inc.
2868 Prospect Park, Ste. 400
Rancho Cordova, CA 95670
916.631.4500  fax: 916.631.4501
www.geiconsultants.com
EXTRA SLIDES

Important Concepts and Terms
Energy Intensity

**Illustrative Energy Intensity Calculation for a Pump**

\[ EI = \frac{E}{F} \]

**ENERGY INTENSITY OF WATER**

The amount of energy (electricity, natural gas or oil) required to produce a unit of water for a particular use. For the purposes of this study, energy intensity is expressed as kilowatt-hours per million gallons, or kWh/MG.

To determine energy intensity it is important to match system component to component function to associated energy demand.
Water Use Cycle

Two studies looked at different parts of the water system.

- Focus of Study 1: Source, Supply & Conveyance
- Focus of Study 2: Water Treatment, Water Distribution, Recycled Water Treatment, Recycled Water Distribution, Wastewater Treatment, Wastewater Collection

End Use: Agriculture, Residential, commercial, industrial

Vast majority of energy is needed for end uses

7.7% of CA Electricity Demand is 4,620 MW at Peak!

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<th>Water Use Cycle</th>
<th>Water-Energy Initiative Objectives</th>
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<tbody>
<tr>
<td>Supply &amp; Conveyance</td>
<td>Optimize energy use and reduce peak demand of wholesale water supply and conveyance systems</td>
</tr>
<tr>
<td>Treatment</td>
<td>Reduce energy intensity of water and wastewater treatment systems and processes</td>
</tr>
<tr>
<td>Distribution</td>
<td>Reduce energy intensity and peak demand of distribution systems</td>
</tr>
<tr>
<td>End Use</td>
<td>Develop technologies, tools and techniques that maximize savings of energy embedded in water</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Advance technologies that increase renewable energy production by water and wastewater systems</td>
</tr>
</tbody>
</table>
During summer months, energy used for groundwater pumping exceeds that used by the state’s 3 largest conveyance systems, combined.