



Awwa Research Foundation Water Utilities and Energy Management

**Consortium for Energy Efficiency
September 20, 2006
Dallas, Texas**

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Who Are We?

- **The Awwa Research Foundation (AwwaRF) is a member-supported, international, nonprofit organization that sponsors research to enable water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to consumers.**



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AwwaRF Subscribers

- 865 utilities
- 51 consultants
- 14 manufacturers



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Our Mission:

**Advancing the science
of water to improve the
quality of life.**



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We Achieve Our Mission By:

- **Sponsoring research**
- **Developing knowledge**
- **Promoting collaboration**



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Sponsoring Research:

AwwaRF sponsors an anticipatory and scientifically credible research program that is responsive to the needs of the water supply community.



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Developing Knowledge:

AwwaRF identifies the practical benefits of research findings and delivers this knowledge to stakeholders throughout the water supply community.



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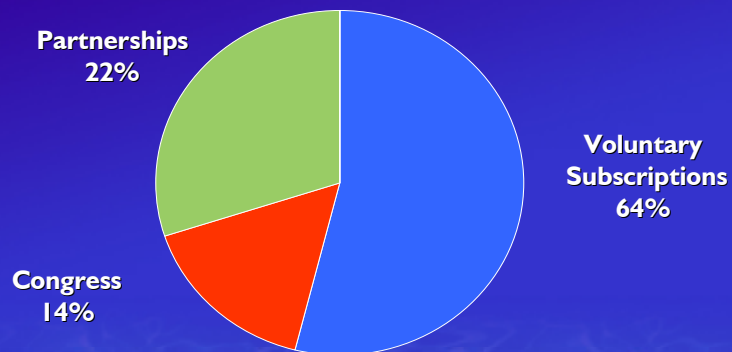
Promoting Collaboration:

AwwaRF cultivates partnerships with organizations around the world to leverage funding and share expertise.



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Sources of Funding



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Published Research

Quality Energy Efficiency Retrofits for Water Systems

- Prepared by HDR Engineering, Inc. & ENTEG, Inc.
- Funded by CEC, AwwaRF, EPRI's Community Environmental Center
- Published by EPRI 1997

The manual provides information that can help operations and engineering staff implement common energy-efficiency improvements



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Published Research

Quality Energy Efficiency Retrofits for Water Systems

Steps for a successful retrofit:

- Understand energy billing options
- Understand motor systems
- Conduct an energy audit to document consumption and recommend improvements



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Published Research

“Ozone Energy Optimization Project”

- Three-phase collaborative research effort with Electric Power Research Institute Community Environmental Center (EPRI-CEC)
- Project goals: develop, demonstrate and document an approach for achieving and maintaining optimized performance at existing ozone facilities



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Published Research

Ozone System Energy Optimization Handbook (DeMers et al., 1996)

Ozone Facility Optimization Research Results and Case Studies (Rakness and DeMers, 1998)

Advancing Ozone Optimization During Pre-Design, Design and Operation (Rakness and Hunter, 2000)



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Published Research

Energy and Water Quality Management Systems (EWQMS)

- *Energy and Water Quality Management System (Cirtocce, Jentgen, and Ward, 1997)*
- *A Total Energy and Water Quality Management System (Ladner et. al., 1999)*



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Published Research

Energy and Water Quality Management Systems (EWQMS)

- *Implementing a Prototype Energy and Water Quality Management System* (Jentgen et. al., 2003)
- *Optimizing Operations at JEA's Water System* (Jentgen et. al., 2005)



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Published Research

Best Practices for Energy Management (Jacobs, Kerestes, & Riddle, 2003)

- Initiated by the Western Regional Water Utilities Benchmarking Group
- TC project with 23 participating utilities



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Published Research Best Practices for Energy Management

- Participate in market based pricing
- Negotiate rate structure with electricity provider
- Utilize pricing incentives
- Aggregate electric meter demand values



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Published Research Best Practices for Energy Management

- Apply findings from past design and operations
- Conduct construction reviews
- Conduct energy audits
- Use double-precision laser alignment of the motor shaft with the pump



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Published Research Best Practices for Energy Management

- Forecast operations and load
- Evaluate alternative energy sources and market pricing
- Plan water distribution system pumping and storage



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Current Ongoing Research

2002 Partnership with California Energy Commission resulted in convening a workshop to develop a research roadmap

Co-funding six ongoing research projects worth \$4.7 M



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Current Research

(Project 3009)

Developing a Utility Energy Index to Assist in Benchmarking Energy Management for Water & Wastewater Utilities

Steve Carlson
CDH Consulting Inc.



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Current Research

(Project 3058)

Assessing Risks & Benefits of Drinking Water Utility Energy Management Practices

Bob Raucher
Stratus Consulting



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Current Research (Project 3058) **Assessing Risks & Benefits of Energy Management**

Demand-side energy management options

- **Shift pumping to off-peak**
- **Shift treatment to off-peak**
- **Optimize control & pumping strategy**
- **Optimize system hydraulics**
- **Implement water conservation programs**



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Current Research (Project 3058) **Assessing Risks & Benefits of Energy Management**

Supply-side energy management options

- **Install backup diesel generators**
- **Install natural gas based generation**
- **Install renewable generation**
- **Contract for guaranteed power**
- **Demand response and rate options**



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Current Research (Project 3058) **Assessing Risks & Benefits of Energy Management**

Energy-related Risks

- **Financial risk (bearing higher cost than necessary)**
- **Reliability risk (quality shortfalls or quantity disruptions)**
- **Environmental risks (air quality impacts from on-site generation or electricity purchased)**



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Current Research

(Project #3066)

Water Consumption Forecasting to Improve Energy Efficiency of Pumping Operations

**Larry Jentgen
EMA Inc.**



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Current Research (3066)

Water Consumption Forecasting

Objectives

- Identify, test, and evaluate available methods and tools for optimizing pumping schedules and energy use to support the implementation of EWQMS



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Current Research (3066)

Water Consumption Forecasting

Analyze & benchmark performance of existing STCF systems at

- JEA (ANN)
- LVVWD (multivariate regression)
- SDWD (ANN)
- CSU (similar day forecaster)



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Current Research (3066)

Water Consumption Forecasting

Define/Construct/Test/Analyze STCF
Prototypes (ANN, regression, heuristic)

- Toronto Water System
- Washington Suburban Sanitary Commission
- East Bay Municipal Utility District
- Seattle Public Utilities
- Greater Vancouver Regional District



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Current Research

(Project #3056)

Evaluation of Energy Consumption of Advanced Water & Wastewater Treatment Technologies

Yu-Jung Chang
HDR Engineering Inc.



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Current Research

(3056) Advanced Treatment Technologies

Objective: Quantify energy consumption of selected ATT unit operations, evaluate factors affecting energy consumption, identify energy optimization strategies



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Project #3056 Utility Partners

Utility	Location	Facility Type	Process Analyzed
Arizona American Water Company	Anthem, AZ	Drinking water (surface water) and wastewater	3 mgd MBR and 8 mgd UF
Cauley Creek Water Reclamation, LLC	Duluth, GA	Wastewater	5 mgd MBR
Central Lake County Joint Agency Water Authority	Rock Bluff, IL	Drinking water (surface water)	50 mgd ozone
Clark County Water Reclamation District	Laughlin, NV	Wastewater	15 mgd UV
Contra Costa Water District	Contra Costa, CA	Drinking water (surface water)	40 and 70 mgd ozone plants
City of Kamloops, BC	Kamloops, BC	Drinking water (surface water)	42 mgd UF



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Project #3056 Utility Partners

Utility	Location	Facility Type	Process Analyzed
City of Pooler, GA	Pooler, GA	Wastewater	2.5 mgd MBR
Sarasota County Environmental Services	Venice, FL	Drinking water (groundwater)	12 mgd EDR
City of Seward, NE	Seward, NE	Drinking water (groundwater)	1.15 mgd RO for nitrate removal
Southern Nevada Water Authority	Henderson, NV	Drinking water (surface water)	Two 600 mgd ozone plants
Water Replenishment District of So. CA	Torrance, CA	Drinking water (groundwater)	2.75 mgd brackish water RO
West Basin Municipal Water District	El Segundo, CA	Municipal and industrial water reuse	5.4 mgd MF, 4.6 mgd RO, and 12.5 mgd UV,



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3056 Preliminary Findings (GW/RO for nitrate)

- Pumping water to and from the plant accounted for nearly 80% of total energy consumption
- The majority of the remaining energy used was for the RO process for nitrate removal
- 1 kWh/1000 gallons as higher volumes of water were treated due to increasing efficiencies of the pumps (lower water production lowered pump efficiency and 3 k/Wh/1000 gallons



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3056 Preliminary Recommendations (GW/RO for nitrate)

- Cleaning the membranes would reduce the energy required for treatment and would extend the useful life of the membrane
- Increasing RO recovery rate to the design spec of 85% would reduce the volume of GW that is pumped to meet water demands
- Adding VFDs to the high service pumps to reduce power demand, provide greater mechanical reliability and better control in the distribution system



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Current Research

(Project 3010)

Zero Liquid Discharge and Volume Minimization for Inland Desalination

Rick Bond, Black & Veatch, Draft Report due September 2006

(Project 4038)

Desalination Facility Design and Operation for Maximum Energy Efficiency

(Project 3055)

Review of International Desalination Research



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Current Research on Water Loss

(Project #2811)

**Evaluating Water Loss and Planning
for Loss Reduction Strategies**

(Project #2928)

**Leakage Management Technologies
Project**

(Project #3188)

**Continuous System Leak Monitoring-
-From Start To Repair**



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Current Research on Sustainability

(Project #4008)

**Integrated Urban Water Management
Approaches**

(Project #3125)

**A Guide to Triple Bottom Line Reporting:
Societal, Economic, and Environmental
Sustainability**

(Project #2935)

**Water Efficiency Programs for Integrated
Water Management**



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What is Needed?

- Pilot renewable energy applications for water/wastewater treatment?
- Develop tool(s) to evaluate and support energy management decisions for drinking water utilities?
- Provide centralized easy utility access to available research, tools, and knowledge to support energy management evaluations and decisions?
- Benchmarking tool and peer reviews of best practices?



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Questions?

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