DEVELOPING A ROADMAP FOR GREENING WATER INFRASTRUCTURE

On July 22, 2009, the MAG Regional Council accepted stimulus funding from the American Recovery and Reinvestment Act of 2009 from the Arizona Department of Environmental Quality (ADEQ) for water quality management planning. The ADEQ received the stimulus funds from the Environmental Protection Agency (EPA) Region IX. The scope for the project included conducting a workshop on greening infrastructure for water and wastewater treatment plants focusing on Arizona issues and preparing a roadmap for greening water infrastructure.

MAG Greening Water and Wastewater Infrastructure Workshop

On January 12, 2010, MAG conducted the Greening Water and Wastewater Infrastructure Workshop. The workshop highlighted strategies for integrating green technologies into water and wastewater treatment and funding opportunities that are available. With approximately 80 percent of municipal water and wastewater processing and distribution costs being for electricity, many of the presentations focused on the water/energy nexus and methods for eliminating energy waste (Source: www.epa.gov/waterinfrastructure/basicinfo.htm). In addition, there was discussion on opportunities for capturing energy from water and wastewater infrastructure using solar, methane, biofuel, hydrotubines, and other technologies. Approximately 150 people attended the workshop, representing public and private utilities, consulting firms, academia, state and federal agencies, and others.

The workshop provided water and wastewater professionals with valuable resources and contacts. In addition, agencies such as EPA and the U.S. Department of Energy were provided the opportunity to become more acquainted with some of the challenges and also progress in Arizona. Workshop participants found the event to be very informative and beneficial for incorporating green infrastructure for water and wastewater treatment plants into short-term and long-term planning. Many attendees stated that the information learned will be shared with others and that they will be evaluating opportunities for making water and wastewater treatment plants more environmentally friendly. This workshop served as an important step to a more sustainable future. To encourage continued dialogue, the workshop participants were provided with the names and email addresses of those in attendance and a link to the workshop presentations that are posted to the MAG website at http://www.mag.maricopa.gov/detail.cms?item=11400.

Roadmap for Greening Water and Wastewater Infrastructure

A roadmap for greening water and wastewater infrastructure may assist utilities with assessing options for reducing energy consumption and chemical use, conserving water, and saving critical financial resources. Jurisdictions are currently facing decreased revenues due to the economy and need to push capital improvement projects further into the future. A roadmap could provide utilities with opportunities to reduce energy waste and lower costs. In addition, utilities would be doing something good for the environment by reducing their carbon footprint and exploring the use of alternative energy sources.

Following the workshop, a menu of ideas was developed for making water and wastewater treatment plants more sustainable. To assist utilities with implementing the ideas, links to resources and contacts were also provided. In addition, potential next steps for greening water and wastewater infrastructure in the region have been included. As we continue to move forward, it is important that we recognize and utilize sustainable approaches available in water and wastewater treatment.

MAG Greening Water and Wastewater Infrastructure Workshop

First Steps Today, Standard Operating Procedure Tomorrow

January 12, 2010 AGENDA

8:00 a.m. - 8:30 a.m.	**Registration**
8:30 a.m. - 8:35 a.m.	**Welcome:** Councilwoman Peggy Neely, *City of Phoenix,* Chair, *Maricopa Association of Governments*
8:35 a.m. - 9:00 a.m.	**Sustainability and the Water/Energy Nexus:** Benjamin H. Grumbles, Director, *Arizona Department of Environmental Quality*
9:00 a.m. - 10:15 a.m.	**Session 1: Doing the Audit** Moderator: Lindy Bauer, *Maricopa Association of Governments* 1. The How and What of Audits for Sustainable Infrastructure: Donald King, P.E., *Tetra Tech* 2. Benchmarking: Metrics for Success: Cheryl McGovern, *U.S. Environmental Protection Agency, Region IX* 3. Lessons from the Small Fry: Robert Casavant, Ph.D., *Arizona State Parks*
10:15 a.m. - 10:30 a.m.	**Morning Break**
10:30 a.m. - 12:10 p.m.	**Session 2: How to Fund the Fixes** Moderator: David McNeil, *City of Tempe* 1. Energy Audits and Financial Assistance: Melanie Ford, *Arizona Water Infrastructure Finance Authority* 2. Grants and Other Funding Opportunities: Cheryl McGovern, *U.S. Environmental Protection Agency, Region IX* 3. Power Purchase Agreements and Other Innovative Approaches: Guy Carpenter, P.E., *HDR* 4. U.S. Department of Energy Assistance Opportunities: Patti Case, P.E., *U.S. DOE, Intermountain Clean Energy Center*
12:10 p.m. - 1:10 p.m.	**Lunch and Keynote Speaker** Cashing In on Energy Management Initiatives for Sustainable Infrastructure: Shonnie Cline, *Water Research Foundation*
1:10 p.m. - 2:30 p.m.	**Session 3: Stepping Toward Sustainability** Moderator: Greg Ramon, *City of Phoenix* 1. Cogeneration, Demand Management Program, and Chemical Reduction: Ronny Lopez, *City of Mesa* 2. Innovations in Nitrate Treatment and Water Reclamation: Rick Scott and Larry Brotman, *City of Glendale* 3. Conserving Water with a Rebate Threshold Rate Structure: Graham Symmonds, P.E., *Global Water* 4. Water Smart Grids: Demand and Leak Control Using Intelligent Monitoring Systems: Eric Williams, Ph.D., *Arizona State University*
2:30 p.m. - 2:45 p.m.	**Afternoon Break**
2:45 p.m. - 4:20 p.m.	**Session 4: Opportunities for New Energy: Ready-to-Use Technologies** Moderator: Cathy Arthur, *Maricopa Association of Governments* 1. Hydroturbines: It's All Downhill from Here: Maureen Hymel, *City of Phoenix* 2. Not Hazy: Energy from FOG: Karri Ving, *San Francisco Public Utilities Commission* 3. Pima County Opportunities and Initiatives: Ed Curley and Eric Wiedulwilt, P.E., *Pima County Regional Wastewater Reclamation Department* 4. Improved Therapy for Wastewater Treatment Plant Digester Gas: David Mahaffay, P.E., *Black & Veatch*
4:20 p.m. - 4:40 p.m.	**Closing: Greening Water and Wastewater Infrastructure - The Path Forward:** Cheryl McGovern, *U.S. Environmental Protection Agency, Region IX*

Operation Certification Professional Development Hours (PDHs) are available for this workshop. You will earn 7.5 hours if you attend the full day. Please retain this agenda as your documentation.

Contact Julie Hoffman at (602) 254-6300 for more information.

MARICOPA ASSOCIATION of GOVERNMENTS

RECOVERY.GOV

ADEQ Arizona Department of Environmental Quality

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

A special thanks to the League of Arizona Cities and Towns for promoting the workshop.

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complex world | CLEAR SOLUTIONS™

"The How and What of Audits for Sustainable Infrastructure"

The Hawaii Experience

Donald H. King, P.E.

January 12, 2010

ALOHA! An Audit? OH MY!

AUDIT...

"ffi‹‡ffPtPt"

AUDIT!?

Yes, audit ***A team-oriented approach with win/win results!***

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THE HAWAII STORY

- Why Conduct an Audit?
- What Information is Required?
- The Hawaii Audit Team
- Audit Steps and Best Practices
- Energy Balance - Four Plants
- Energy Conservation Opportunities
- Preliminary ECO Findings
- Conclusions

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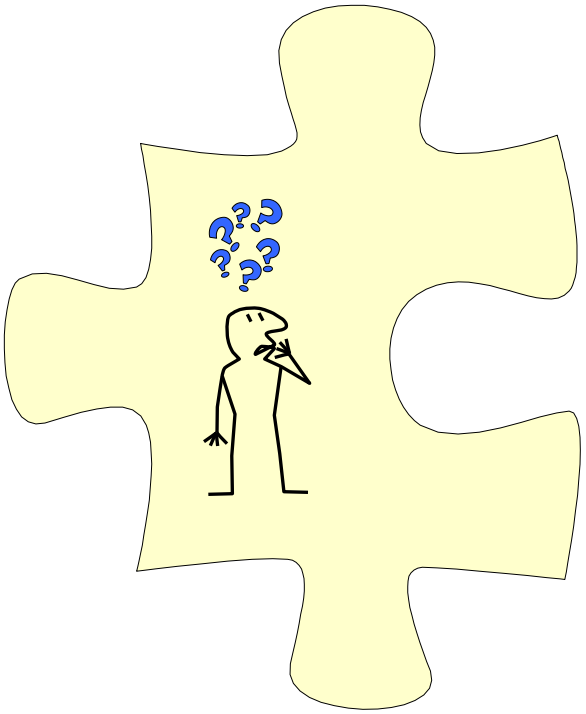
Why Complete an Energy Audit?

- Potential cost savings
- Identify improvements
- Identify fund alternatives (grants, incentives)
- Understand your energy use and costs
- Policy mandates
- It’s under your control



PLANT

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Benefits of Energy Audit?

- Improved understanding of plant processes & energy use
- Bridge communication between energy use and utility accounting
- Gain understanding of utility bills
- Recognize your successes
- Goal development
- Reduced operating costs
- Preparation for a renewable future

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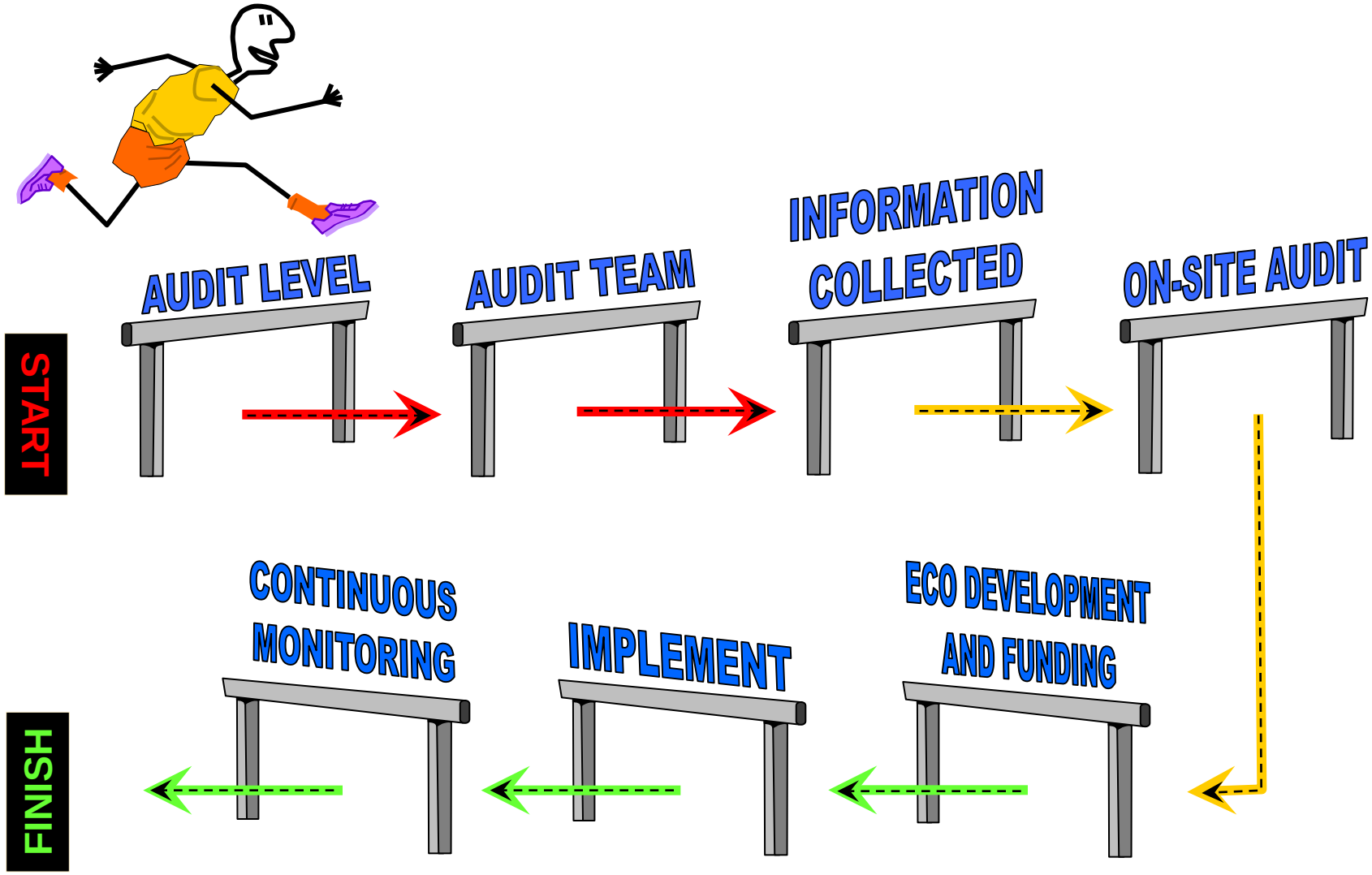
Energy Audit - Road Map



Hawaii - *Four Plants, Four Stories*

- Kailua WWTP, Oahu
  - 13 MGD / Fixed Film
  - Influent & Effluent Pumping
  - Comprehensive Odor Control
  - UV disinfection

- Waimea, Kauai
  - 0.25 MGD / Aeration Basins
  - Influent & Effluent Pumping
  - New Treatment Plant Under Construction

- Kihei, Maui
  - 3.5 MGD / Aeration Basins
  - Reclaim Water & Effluent Pumping
  - UV disinfection

- Hilo, Hawaii
  - 2.5 MGD/ Fixed Film
  - NO Influent & Effluent Pumping
  - Anaerobic Digestion

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Comparing “Treatment Plant Unique DNA”

ACTION	HILO	KAILUA	KIHEI	WAIMEA
Influent Pumping		X		X
Screening/Grit Removal	X	X	X	X
Primary Sedimentation	X	X		
Fixed Film (Biotower)	X	X		
Aeration Basins			X	X
SecondarySedimentation	X	X	X	X
Solids Contact	X	X		
Advanced Water Treatment			X	
Chlorine Disinfection	X			X
Ultraviolet		X	X	
Effluent Pumping		X	X	X
Common Outfall Pumping		X		
Comprehensive Odor Control		X		
Thickening	X	X		
Aerobic Digestion			X	X
Anaerobic Digestion	X	X		
Digester Gas Utilization-Heating	X	X		
Digester Gas-Cogeneration				
Dewatering-Centrifuge	X	X	X	
Dewatering-Solar Drying				X
Landfill	X	X		X
Composting			X	
Water Reuse			X	
FOG Program			X	

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Energy Audit - The Hawaii Team!

AUDITORS

Expertise in:
- Infrastructure
- Energy
- Sustainable Solutions

PLANT MANAGEMENT

"Long-Range Vision"

KEY PLANT STAFF

Managers, Accounting, & Plant Operators
- Understanding of Plant Processes
- Regulatory Requirements
- Health & Safety

UTILITY PROVIDERS

Kauai and Maui
Account Representative

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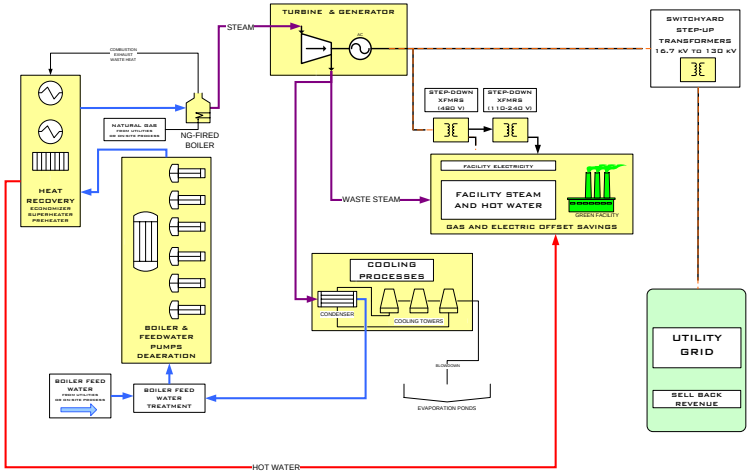
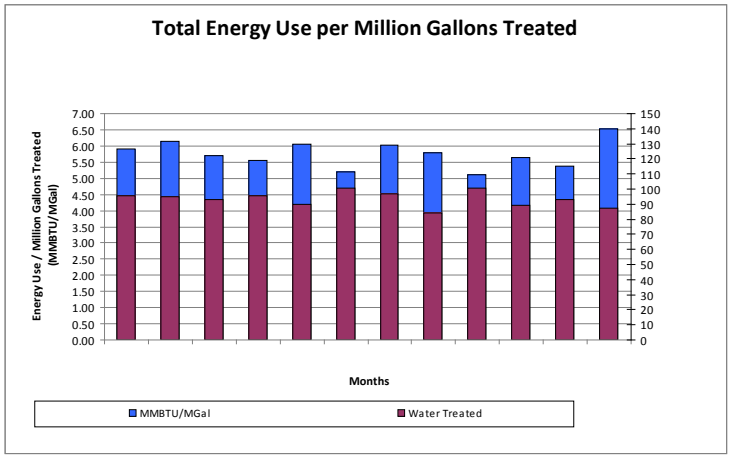
Energy Audit – Pre Audit Information Gathering

- Process Flow Diagram
- Site Plan
- Electrical One-Line Diagram
- Detailed Equipment List
- All Utility Bills
- Utility Contract Schedules





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Energy Audit – Onsite Audit Activities

- Introduction of participants
- Review collected materials
- Virtual operations review by plant staff
- Conduct site walk
  - Observe and Record Current Conditions
  - Taking Meter Readings
  - Inspect and verify equipment information
  - Photographic documentation

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Energy Audit – Onsite Information Gathering

- Equipment load verification “Demand Impact”
- Equipment operation “Consumption over Time”
- Regulatory permits or operational prohibitions
- Plant metrics
- Metering and monitoring

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Energy Audit – Onsite Audit Activities

- Interview operators
  - Gain better understanding of unique plant dynamics
  - Operational schedule
  - Control philosophy

- Review historical and seasonal events
- Conduct exit meeting & thank all participants

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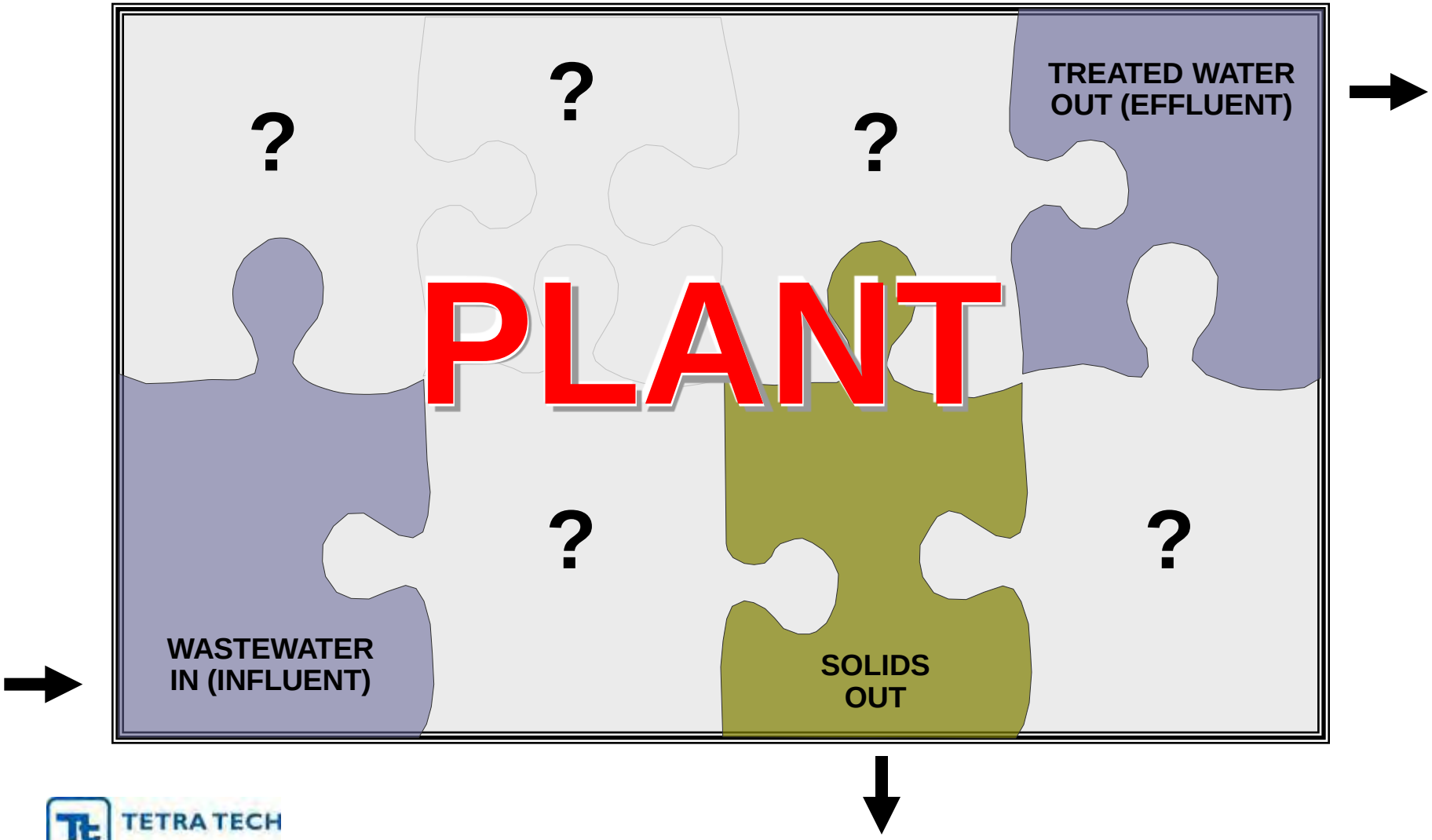
Energy Audit – What Energy Balance?



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Energy Audit – Energy Balance Part 1

- Draw boundary (BOX) around plant
- Determine all materials and energy entering and exiting the BOX
  - Influent flow into and through plant
  - Energy and fuel into plant
  - Potable water into plant
  - Effluent flow out of plant
  - Solids out of plant
  - Self-generated energy out of plant

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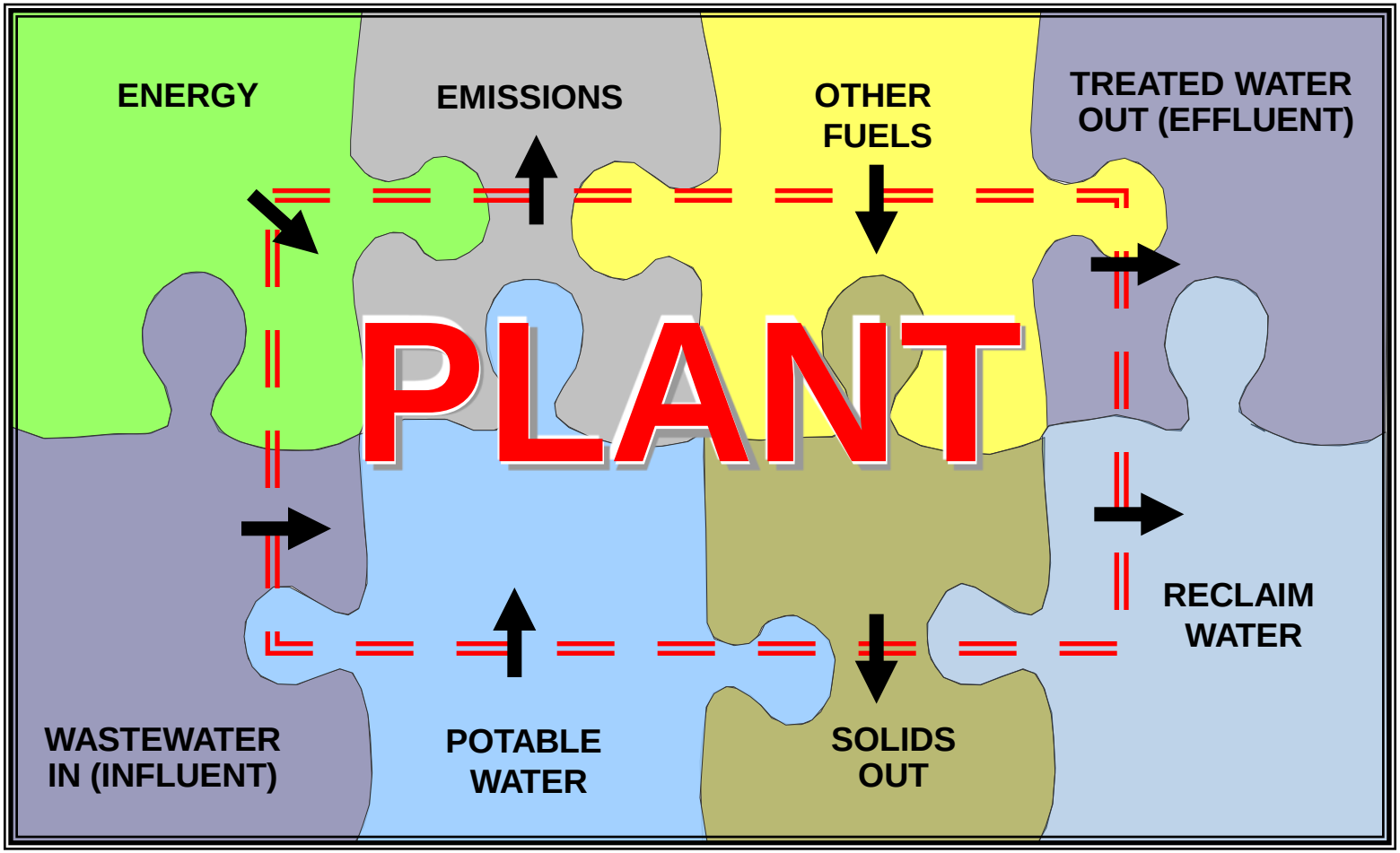
Energy Audit – Your Energy Balance!



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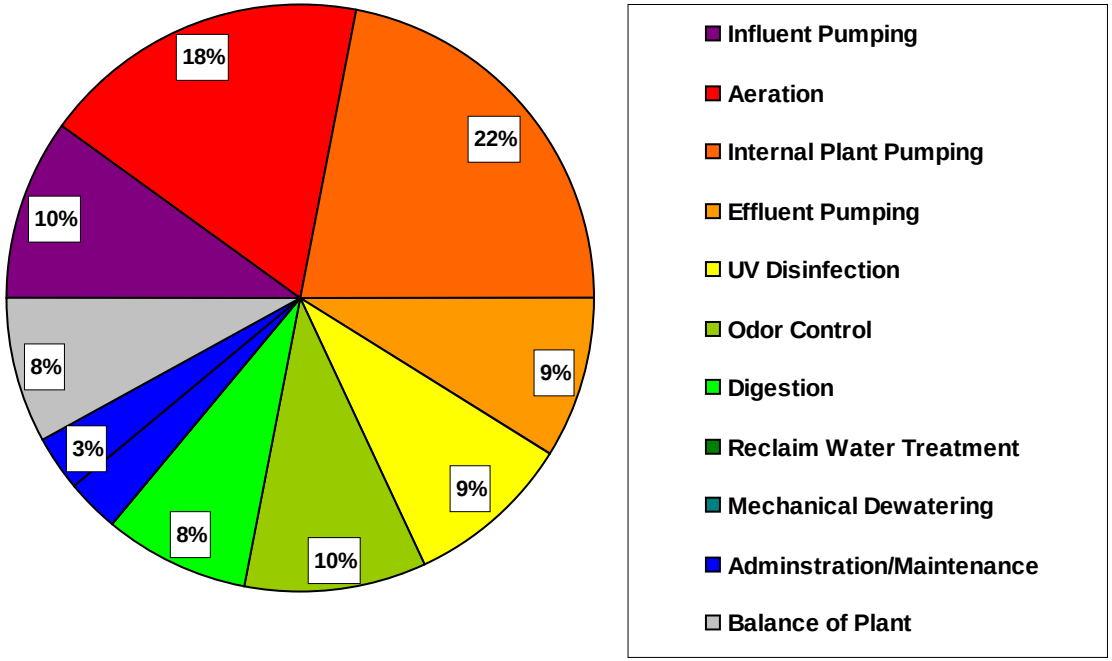
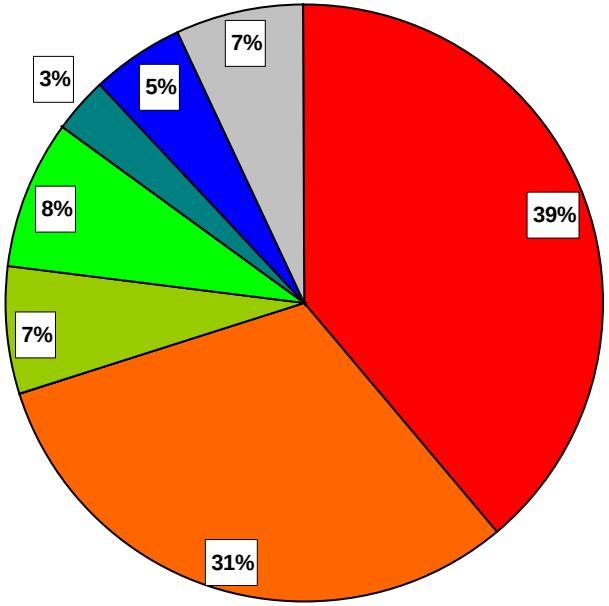
Energy Audit – Energy Balance Part 2

- Develop baseline metrics (e.g. $MMBTU_{eq}$ per MG)
- Analyze energy use for each process type (chart)

Kailua, Oahu



Hilo, Hawaii



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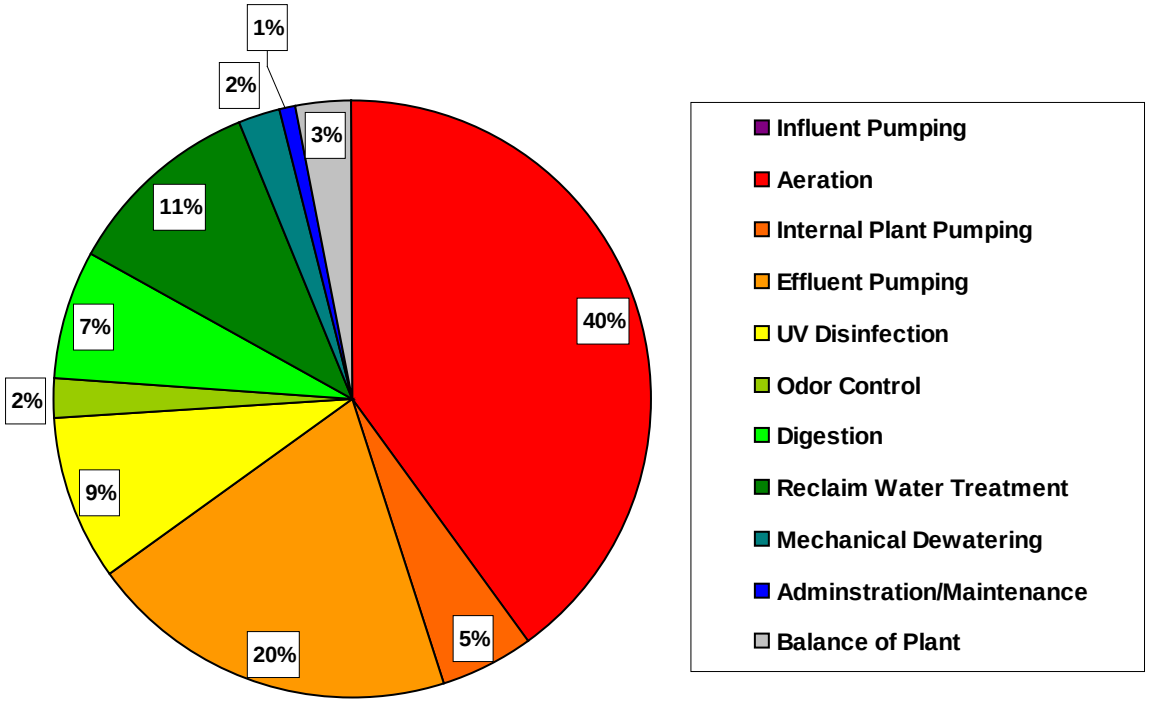
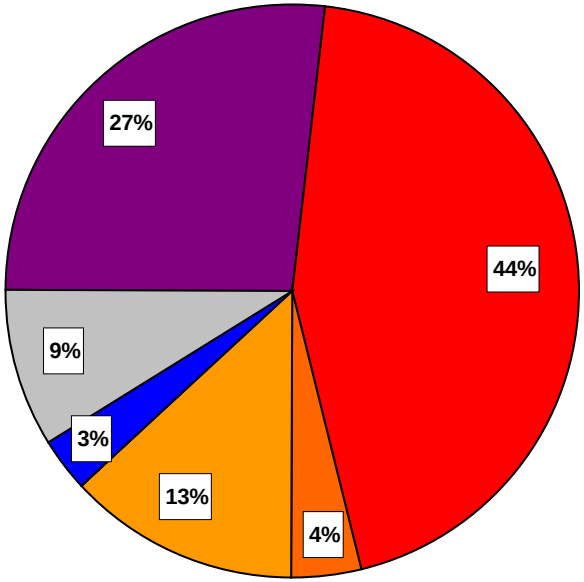
Energy Audit – Energy Balance Part 2

- Analyze energy use for each process type (chart)

Kihei, Maui



Waimea, Kauai



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Energy Analysis – ECO Development Process

- What's an ECO?
- ECO = Energy Conservation Opportunity
- Definition:

  "The systematic means, technologies or applications for improvement of specific processes that meets certain cost effectiveness"

- Commonly referred to alternatives:

  FIM = Facility Improvement Measures

  ECM = Energy Conservation Measures

  EEO = Energy Efficiency Opportunity

  AR = Assessment Recommendation

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Energy Analysis – ECO Development Process

Further evaluate findings from the Audit Phase through...

WHAT is happening Inside the BOX!

- Ask the investigative questions!
  - Who? What? Where? When? Why? How?
- Typically start with the larger energy use areas first “80/20 rule”
- Select potential list of ECO’s

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Energy Analysis – ECO Development Process

Examples of “Investigative” ECO questions:

- “Why are blowers operating 24/7?”
- “Why are UV and chlorine disinfection required prior to discharge?”
- “Why are four primary tanks in service when influent flow only requires two?”
- “How often does sludge dewatering occur?”
- “How efficient is a constant pressure pumping system with variable demands?”
- “If odor control is needed only 30 hours per week, why is the odor control system in operation 24/7?”

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Energy Analysis – ECO Screening Process

- List all ECO's
- Estimate of energy savings
- Estimate of capital improvement requirements
- Review ECO viability (non-energy factors)
- Select ECO's for further development

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Preliminary ECO's!

Waimea

- Effluent Pumping VFD modifications
- Aeration Blower System Modifications

Estimated Savings: 8-13%

Kihei

- Reclaim Water Storage and Pumping Improvement
- Aeration Blower Upgrade (Recently Installed)
- UV Replacement Project
- Plant Air Upgrade

Estimated Savings: 28-38%

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Preliminary ECO's!

Kailua, Oahu

- Replace existing UV with high-efficiency system
- Improve Plant Electrical Grid
- Install New Digester Gas Boilers
- Install biogas cogeneration (500 kW)

Estimated Savings: 15-33%

Hilo, Hawaii

- No. 2 & No. 3 Water System Modifications
- Modify Operation Schedule of Dewatering Odor Control System
- Modify # of primary clarifiers units on line
- Complete Collection System Repairs (I&I Reduction)

Estimated Savings: 13-22%

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Do the “Cents” Really Make Sense?

- Economic viability?
- Consistent with health & safety?
- Consistent with regulatory requirements?
- Consistent with plant reliability requirements?
- Consistent with long-term strategic planning?
- Is funding available?

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Energy Audit – Do's and Don'ts

- Three key's to effective auditing:
  "Information, *information*, & information!"
- Enlist team concept with plant personnel actively engaged in auditing
- Look beyond the numbers
- Understand local requirements and prohibitions
- Confirm assumptions
- Evaluate "aggressively" but "keep it real"
- Make the auditing process a learning experience for *all participants*

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Conclusions!

Good Information + Right Audit Team
=
Enhanced Energy Utilization
Operational Process Understanding
$$$ Savings

Save a couple of "cents" along the audit journey!

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Contact Information:

Donald H. King, P.E.
Tetra Tech
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don.king@tetratech.com

Benchmarking Wastewater Facilities in Portfolio Manager

Metrics for Success

U.S. Environmental Protection Agency

January 12, 2010

Cheryl McGovern

EPA

Learn more at **energystar.gov**

Metrics for Success

- **Introduction**
- **Goals and Metrics**
- **ENERGY STAR Portfolio Manager**
  - **Creating Views**
  - **Tracking, Reporting, Sharing**

What is ENERGY STAR?

- Mission: reduce greenhouse gas emissions through energy efficiency using metrics
- ENERGY STAR establishes specifications and labeling for Products; Home Improvements; Buildings and Plants; and New Homes; 12 Sectors through testing and measuring – wastewater beta testing since 2008
- Energy saving guidelines, technology information, target setting, recommendations, and contractors

ENERGY STAR Impact

- Americans, with the help of ENERGY STAR, saved enough energy in 2007 alone to avoid greenhouse gas emissions equivalent to those from 29 million cars — all while saving $17 billion on their utility bills.

- Over 80,000 buildings have been rated using Portfolio Manager: schools, hospitals, offices, etc. - Score of 75 is considered energy efficient

- Over 6,000 buildings have earned the ENERGY STAR

Why Metrics Matter

- How well are you doing?
- How do you know how well you are doing?
- How can you demonstrate to others how well you are doing?

What gets measured gets managed;
…and…
What gets managed gets *DONE*.

Where Do You Start? Goals

Low hanging fruit?

Projects with rebates?

Low cost projects?

What the GM wants?

What customer wants?

Analyze Your Data

Activity	Operation or Location	Type of Energy Used	Current Use and Costs
Heating, Ventilation, and Air Conditioning (HVAC)	Operations Building (Heating)	Natural Gas	• 150 MMBTU/year • $1,500/year
	Operations Building (Cooling, Ventilation)	Electricity	• 10,000 kWh/year • $1,000/year
Lighting	Operations Building	Electricity	• 24,000 kWh/year (4 kWh/ft², 6,000 ft²) • $2,400/year
Vehicle Use	Service Trucks	Diesel Fuel	• 1,000 gallons/year • $2,500/year
Equipment			
Pump #1	Treatment Building	Electricity	• 400,000 kWh/year • $40,000/year
Pump #2	Treatment Building	Electricity	• 480,000 kWh/year • $48,000/year
Pump #3	Treatment Building	Electricity	• 280,000 kWh/year • $28,000/year
Pump #4	Treatment Building	Electricity	• 160,000 kWh/year • $16,000/year

ESTABLISH YOUR BASELINE

Priority Ranking Steps

1. Decide on criteria (who decides?)
2. Decide on ranking system and values
3. Complete the ranking
4. Review the numerical rank order and "reality test"
5. Select as many top-ranked items as you are able to handle

Objectives and Targets

- ***Objectives***: goals that are consistent with the organization's policy
- ***Targets***: performance measures related to and supporting a specific objective.
  - Targets should be **quantitative, realistic, measurable**

What are you going to do, by how much, by when?

Example: Objectives and Targets

- Reduce overall energy cost by 10% by January 2011
- Increase energy purchased or generated from renewable sources of energy by 10% by 2013
- Reduce GHG emissions 20% by 2015

OBJECTIVE	TARGET	PERF. INDICATOR
Reduce Energy use	Reduce overall energy use by 10% by Jan 2009	kWh

Set A Target With ENERGY STAR

If rating is below 69, you can use PM to set a percent energy reduction target

PORTFOLIO MANAGER

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio > ABC Elementary > **Set Energy Performance Target**

Set Energy Performance Target

Portfolio Manager provides the ability to establish an energy performance target by either defining a target rating or a target reduction (%). The energy use and costs displayed reflect required levels to meet either the target rating or percent reduction goal for this facility.

To establish a performance target, a Baseline Period must first be set.

Select "RECALCULATE" to refresh this screen after making any changes to target rating or percent reduction. Select "SAVE" to store the entered targets in Portfolio Manager.

Baseline Period (12 Months Ending): 12/31/2006 Modify Baseline Period

Target (1-100 Rating)	Baseline Rating (1-100)	Baseline Energy Use (kBtu/year)	Target Energy Use (kBtu/year)	Energy Cost Savings ($/year)	Target Reduction (%)
69	47	2,333,817	1,914,136	$12,325	18 %

CANCEL | RECALCULATE | SAVE

What is ES Portfolio Manager

<u>An assessment tool</u>: measures your facility's energy efficiency now and over time; benchmarks it compared to similar facilities across the country with a score from 1-100

Dashboard for WWTPs – feedback, education

www.energystar.gov/benchmark

Mirror that reflects your facility in a new light

Portfolio Manager

- ENERGY STAR Portfolio Manager - interactive online energy management tool, free, 24/7, any computer
- Sets baseline of energy use/GHG emissions
- Reports current energy consumption/GHG emissions
- Creates reports and provides a vehicle to share information among facilities and within cities
- Offers simple target setting that is measurable

Background

- Regression analysis – energy use per unit of water treated based on modeling work by Water Research Foundation in 2004
- Normalized for external factors
- Wastewater – results against model shows statistical significance at 90% confidence level – some issues
- Energy generated onsite may or may not be part of calculation but needs to be added to reflect true energy efficiency
- 70 different values available to track over time

Benefits of Portfolio Manager

- Establish baseline, current energy use and costs, track over time while completing efficiency and clean energy projects
- Compare your facility against similar facilities in a national database and get a score from 1-100 (100 most efficient, 50 being average) on energy efficiency, easy message to send rate payers, board members, etc. Watch score improve
- Get GHG emissions varied by geographic region based on the type of power used, in international metric. Watch emissions go down

More Benefits

- U.S. drinking water and wastewater systems spend about $4 billion/ yr on energy to pump, treat, deliver, collect and clean water – with much of this cost borne by ratepayers and municipalities.

- Nationwide, **drinking water and wastewater systems use 75 billion kilowatt hours/ yr – as much as the pulp and paper, and petroleum industries combined (enough electricity to power 6.75 million homes/yr).**

- Reducing energy and water at wastewater facilities can make a significant difference for the environment and for the pocket book

What Can WWTPs Do Now?

- One hour phone call will establish your baseline, benchmark, and account
- Get an energy audit from the local power company or through USDOE's Industrial Assessment Centers, EPA
- Use EPA's 2008 Guidebook "Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities

➢ http://www.epa.gov/infrastructure/bettermanagement_energy.html

- Apply for SRF, DOE. PPA, State Public Purpose funds for energy efficiency and clean energy projects
- Create an Energy Team, Regional Partnerships

How to Get Benchmark

- Complete the Benchmarking Process
  - Login To Your Account (2 screens)
  - Enter Your Facility Information (8 screens)

1. Zip Code
2. Energy use for all fuel types – monthly for 16 months
3. Average Daily Influent Flow
4. Average Influent BOD and Effluent BOD – averaged over 12 months (mg/l)
5. Plant Design Capacity – treatment design – mgd
6. Fixed Film Trickle Filtration Process (y/n)
7. Nutrient Removal (y/n)

Setting up Your Home Page

- Viewing Your Data – CREATE A VIEW

File Edit View Favorites Tools Help

PORTFOLIO MANAGER

ENERGY STAR

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio > space1

Facility Summary: **space1**

How do I use this page?

Building ID: 1613627
Level of Access: Building Administrator

Electric Distribution Utility: Pacific Gas & Electric Co
Regional Power Grid: WECC California
Select my Power Generation Plant to calculate my electric emissions rate
Electric Emissions Rate ($kgCO_2e/MBtu$): 95.2 (what is this?)

Generate a Statement of Energy Performance for uses other than applying for the ENERGY STAR.

General Information Edit

Address: 75 Hawthorne Street
San Francisco, CA 94105

Year Built: 1990

Property Type: Water Utility/Wastewater Plant

Baseline Rating: 100 | **Current Rating: 100**

Eligibility for the ENERGY STAR

Not Eligible: Water Management Facilities are not eligible to apply for the Energy Star

Facility Performance Set Baseline Period | Set Energy Performance Target

Select View: Performance: Environmental Create View | Edit View

12 Months Ending	Current Rating (1-100)	Current Source Energy Intensity (kBtu/Sq. Ft.)	Change from Baseline: Adjusted Energy Use (%)	Change from Baseline: GHG Emissions ($MtCO_2e$)
December 2007 (Current)	100	N/A	N/A	0.00
Select Date		N/A		
Change				

REFRESH VIEW

Space Use

Space Name	Space Type	Average Influent Flow	Alerts

General Facility Administration
Track Energy Performance Improvements
Delete this Facility from Portfolio Manager
Contact us

Pick Seven Metrics to Track

File Edit View Favorites Tools Help

ENERGY STAR PORTFOLIO MANAGER

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio > **Create New View**

Create New View

How do I use this page?

Number of Facilities to display on each page:

○ 25 ◉ 50 ○ 100 ○ All (note: larger Portfolios will take longer to load)

To create/edit a custom View of your Facilities in Portfolio Manager, select **up to 7** columns from the list below. Use "Preferred Column Order" to set the order in which they will display in the View.

View Name: main **Set this View as My Portfolio Default:** ☐

Preferred Column Order	Facility Data
ENERGY STAR Rating	
1	**Baseline Rating (1-100)**
2	**Current Rating (1-100)**
	Target Rating (1-100) (N/A for Campuses)
Period Ending Dates	
	Baseline Energy Period Ending Date
3	**Current Energy Period Ending Date**
	Water Use Period Ending
Site Energy	
	Baseline Site Electric Use (kWh)

Preferred Column Order	Facility Data
Water	
	Indoor Water Cost (US Dollars ($))
	Indoor Water Use (kGal)
	Indoor Water Use per Sq. Ft. (kGal)
	Outdoor Water Cost (US Dollars ($))
	Outdoor Water Use (kGal)
	Total Indoor and Outdoor Water Cost (US Dollars ($))
	Total Indoor and Outdoor Water Use (kGal)
	Wastewater/Sewer Cost (US Dollars ($))
	Wastewater/Sewer Use (kGal)
	Water Use Alerts (N/A for Campuses)

You Can Create/Track Different Metric Views

File Edit View Favorites Tools Help

	Baseline Site Electric Use (kWh)
	Baseline Site Energy Intensity (kBtu/Sq. Ft.)
	Baseline Site Natural Gas Use (therms)
	Baseline Total Site Energy Use (kBtu)
	Current Site Electric Use (kWh)
	Current Site Energy Intensity (kBtu/Sq. Ft.)
	Current Site Natural Gas Use (therms)
	Current Total Site Energy Use (kBtu)
	National Average Site EUI (kBtu/Sq. Ft.) (N/A for Campuses)
	Target Site Energy Intensity (kBtu/Sq. Ft.) (N/A for Campuses)
Source Energy	
	% Difference from National Average Source EUI (N/A for Campuses)
	Baseline Source Energy Intensity (kBtu/Sq. Ft.)
	Baseline Weather Normalized Source Energy Intensity (kBtu/Sq. Ft.) (N/A for Campuses)
	Current Source Energy Intensity (kBtu/Sq. Ft.)
	Current Weather Normalized Source Energy Intensity (kBtu/Sq. Ft.) (N/A for Campuses)
	National Average Source EUI (kBtu/Sq. Ft.) (N/A for Campuses)
Financial Indicators	
4	**Annual Energy Cost (US Dollars ($))**

	Water Use Alerts (N/A for Campuses)
Performance: GHG Emissions	
	Baseline Direct GHG Emissions (MtCO2e)
	Baseline Indirect GHG Emissions (MtCO2e)
	Baseline Total GHG Emissions (MtCO2e)
	Change from Baseline: GHG Emissions (MtCO2e)
	Current Direct GHG Emissions (MtCO2e)
	Current Indirect GHG Emissions (MtCO2e)
5	**Current Total GHG Emissions (MtCO2e)**
Building Characteristics	
	Number of Students (N/A for Campuses)
	Number of Workers on Main Shift (N/A for Campuses)
	Total Floor Space (Sq. Ft.)
Energy and Environmental Reduction	
	Change from Baseline: Adjusted Energy Use (kBtu)
	Change from Baseline: Adjusted Energy Use (%)
	Change from Baseline: Adjusted Energy Use Intensity (kBtu/Sq. Ft.)
	Change from Baseline: Energy Use (kBtu) (N/A for Campuses)
	Change from Baseline: Energy Use Intensity (kBtu/Sq. Ft.) (N/A for Campuses)
Water Utilities and Wastewater Treatment Facilities	
	% Difference from National Average Source EUI (N/A for Campuses)

Name Each View

File Edit View Favorites Tools Help

	(N/A for Campuses)
	National Average Source EUI (kBtu/Sq. Ft.) (N/A for Campuses)
Financial Indicators	
4	**Annual Energy Cost (US Dollars ($))**
	Cumulative Investment in Facility Upgrades (US Dollars ($)) (N/A for Campuses)
	Cumulative Investment per Sq. Ft. (US Dollars ($)) (N/A for Campuses)
	Total Energy Cost per Sq. Ft. (US Dollars ($))
Organizational Descriptors	
	Building Owner (N/A for Campuses)
	Building Profile Status (N/A for Campuses)
	Building Type
	City
	County
	Last Modified
	Service and Product Provider (N/A for Campuses)
	Shared By (N/A for Campuses)
	State
	ZIP Code

	(N/A for Campuses)
	Change from Baseline: Energy Use Intensity (kBtu/Sq. Ft.) (N/A for Campuses)
Water Utilities and Wastewater Treatment Facilities	
	% Difference from National Average Source EUI (N/A for Campuses)
	Average Flow (MGD) (N/A for Campuses)
	Baseline Site Energy per Flow (kBtu/MGD) (N/A for Campuses)
7	**Baseline Source Energy per Flow (kBtu/MGD)**
	Baseline Weather Normalized Source Energy per Flow (kBtu/MGD) (N/A for Campuses)
	Current Site Energy per Flow (kBtu/MGD) (N/A for Campuses)
	Current Source Energy per Flow (kBtu/MGD) (N/A for Campuses)
6	**Current Weather Normalized Source Energy per Flow (kBtu/MGD)**
	Effluent BOD5 (mg/l) (N/A for Campuses)
	Influent BOD5 (mg/l) (N/A for Campuses)
	National Average Site EUI (kBtu/MGD) (N/A for Campuses)
	National Average Source EUI (kBtu/MGD) (N/A for Campuses)
ENERGY STAR Application Information	
	Eligibility for the ENERGY STAR (N/A for Campuses)
	ENERGY STAR Application Status (N/A for Campuses)
	Energy Use Alerts

That's It!

File Edit View Favorites Tools Help

	(N/A for Campuses)
	Total Energy Cost per Sq. Ft. (US Dollars ($))
Organizational Descriptors	
	Building Owner (N/A for Campuses)
	Building Profile Status (N/A for Campuses)
	Building Type
	City
	County
	Last Modified
	Service and Product Provider (N/A for Campuses)
	Shared By (N/A for Campuses)
	State
	ZIP Code

	Baseline Site Energy per Flow (kBtu/MGD) (N/A for Campuses)
7	**Baseline Source Energy per Flow (kBtu/MGD)**
	Baseline Weather Normalized Source Energy per Flow (kBtu/MGD) (N/A for Campuses)
	Current Site Energy per Flow (kBtu/MGD) (N/A for Campuses)
	Current Source Energy per Flow (kBtu/MGD) (N/A for Campuses)
6	**Current Weather Normalized Source Energy per Flow (kBtu/MGD)**
	Effluent BOD5 (mg/l) (N/A for Campuses)
	Influent BOD5 (mg/l) (N/A for Campuses)
	National Average Site EUI (kBtu/MGD) (N/A for Campuses)
	National Average Source EUI (kBtu/MGD) (N/A for Campuses)
ENERGY STAR Application Information	
	Eligibility for the ENERGY STAR (N/A for Campuses)
	ENERGY STAR Application Status (N/A for Campuses)
	Energy Use Alerts (N/A for Campuses)
	Full Year
	Space Use Alerts (N/A for Campuses)

CANCEL SAVE

Reports

- Three Ways To Get Reports
  1. From My Portfolio – Request Energy Performance Report
  2. From the Facility Summary Screen

     Generate a Statement of Energy Performance
  3. From My Portfolio – Download View Data into Excel

     - Create different views of different data

     you want to capture in Excel and download

Request Energy Performance Report

Portfolio Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=epreport.showEPRCriteria Go Links

business day.

* REQUIRED

Energy Performance Report Criteria

* **Please select the type of report:**
- Summary for year ending: Month Year
- Comparative for year ending: Month Year to year ending: Month Year
- Partner of the Year comparative for year ending: Month Year

* **Please select the facilities:**
- All facilities in my portfolio
- Group: Shared Facilities
- I'll choose specific facilities from my portfolio

Select a facility location (optional):

State: All States

Or

Zip Code:

* **Please select at least one report column:**
- Site Energy Intensity (kBtu/Sq.Ft.)
- Weather Normalized Source Energy Intensity (kBtu/Sq.Ft.)
- Site Electric Use (kWh)
- Site Natural Gas Use (Therms)

CANCEL CONTINUE

Done Internet

Start Cheryl McGovern... E:\Climate Chang... C:\Documents an... 3 Microsoft Offi... 1.28.09Benchma... Print Screen of g... Portfolio Mana... 4:32 PM

Generate a Statement of Energy Performance

Portfolio Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=sep.showSummaryReportDateSelect Go Links

The document can be read using Adobe Acrobat reader. If you do not have the free reader, you can download it from the Adobe Web site.

Use this statement as appropriate to document your facility's energy performance for important activities such as:

- LEED for Existing Buildings (LEED-EB) applications
- Mortgage, sale, and/or lease transactions
- Energy service company performance contracts
- Tenant/owner/customer communications

PLEASE NOTE: NOT FOR USE WHEN APPLYING FOR THE ENERGY STAR. Learn more about applying for the ENERGY STAR.

* **REQUIRED**

Indicate the Period Ending Date for which to Generate this Statement

*Period Ending Date: Select Period Ending

Optional Contact Information:

Select the Organization that owns this facility: Select Contact

Select the Primary Point of Contact for this statement: Select Contact

Select the Certifying Professional for this statement: Select Contact

Add/Edit Contacts and Organizations

Report Options:

* Select one or more of the following options:

- [x] Statement of Energy Performance (for uses other than applying for the ENERGY STAR)
- [x] Data Checklist
- [x] Facility Summary

CANCEL GENERATE REPORT

Done Internet

Start Cheryl McGov... E:\Climate Ch... C:\Document... 3 Microsoft ... 1.28.09Bench... Print Screen o... ESPM Report ... Portfolio Ma... 4:38 PM

Download Data To Excel

- Select Option to Download From P M

Current Energy Period Ending Date	Current Total Site Energy Use (kBtu)
	N/A
3/31/2009	3,758,294.71
4/30/2009	20,547,828.29
4/30/2009	19,827,873.49
4/30/2009	7,611,142.20
11/30/2008	6,355,266.26
12/31/2008	79,743,751.88
12/31/2008	N/A
	N/A
4/30/2009	N/A
12/31/2008	N/A
	N/A
4/30/2009	404,858,507.04
4/30/2009	N/A
10/31/2008	51,689,705.03
	N/A
2/28/2009	114,547,268.16
3/31/2009	70,255,476.59
	N/A
2/28/2009	21,489,194.83
3/31/2009	25,376,604.67

The Master Accounts feature allows master users to track progress of their constituents, such as local governments, state agencies, and school districts

(1)

Sharing Facilities

PORTFOLIO MANAGER

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio

Group Averages

Baseline Rating: 100 Facilities Included: 1	Current Rating: 100 Facilities Included: 2

Group Adjusted Percent Energy Reduction: 0%
Facilities Included: 1

Averages are weighted by Total Floor Space.
More about Baselines
More about Adjusted Percent Energy Reduction

(1)

Add a Property

Work with Facilities
Import Facility Data Using Templates
Update Multiple Meters
Share Facilities
Request Energy Performance Report

Apply for Recognition
Apply for the ENERGY STAR
ENERGY STAR Leaders

GROUP: East Campus Cluster | Create Group | Edit Group | View All

VIEW: General | Create View | Edit View | View All

Download in Excel

Search Facility Name: Search

Results 1 - 3 of 3

All # A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Facility Name	Current Rating (1-100)	Current Site Electric Use (kWh (thousand Watt-hours))	Current Site Energy Intensity (kBtu/Sq. Ft.)	National Average Site EUI (kBtu/Sq. Ft.)	CO2 Reduced (pounds)	Number of Occupants	Total Floor Space (Sq. Ft.)
Best Building	100	86,000.0	2.1	62.7	0.00	0	141,000
Charles Building	100	106,050.0	3.6	71.8	0.00	0	100,000
Sample Facility	N/A	189,100.0	38.0	77.0	0.00	0	17,000

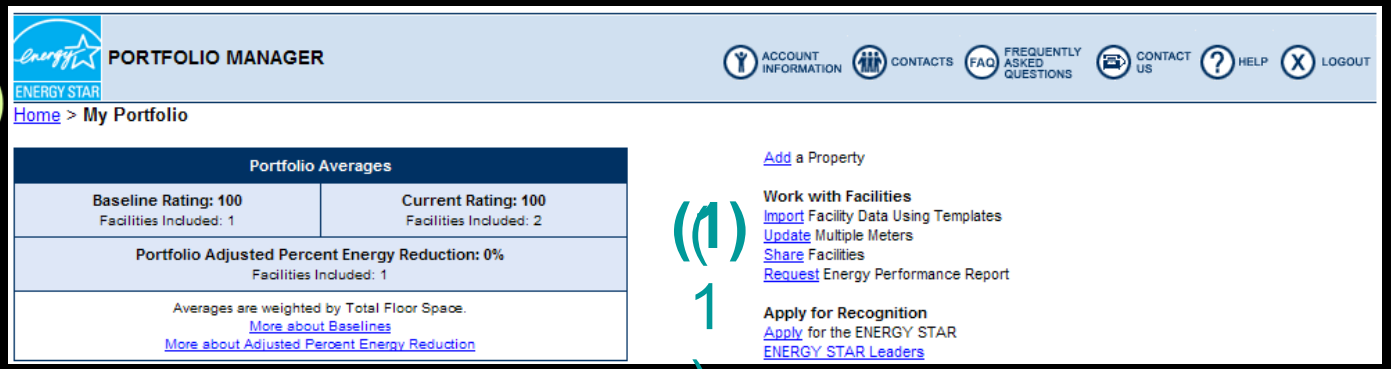
Download in Excel

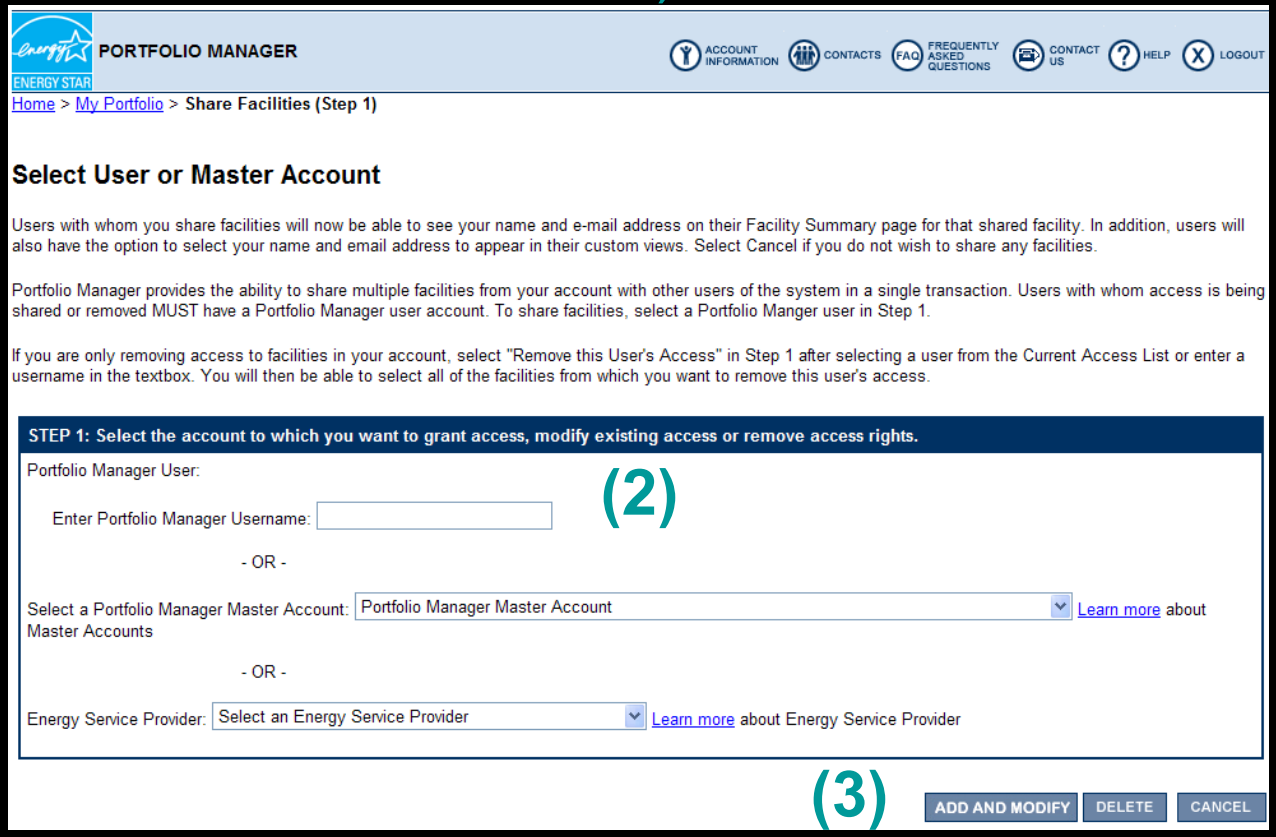
Search Facility Name: Search

Results 1 - 3 of 3

All # A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Sharing Facilities (Continued)





(1) In My Portfolio, click on "Share Facilities"

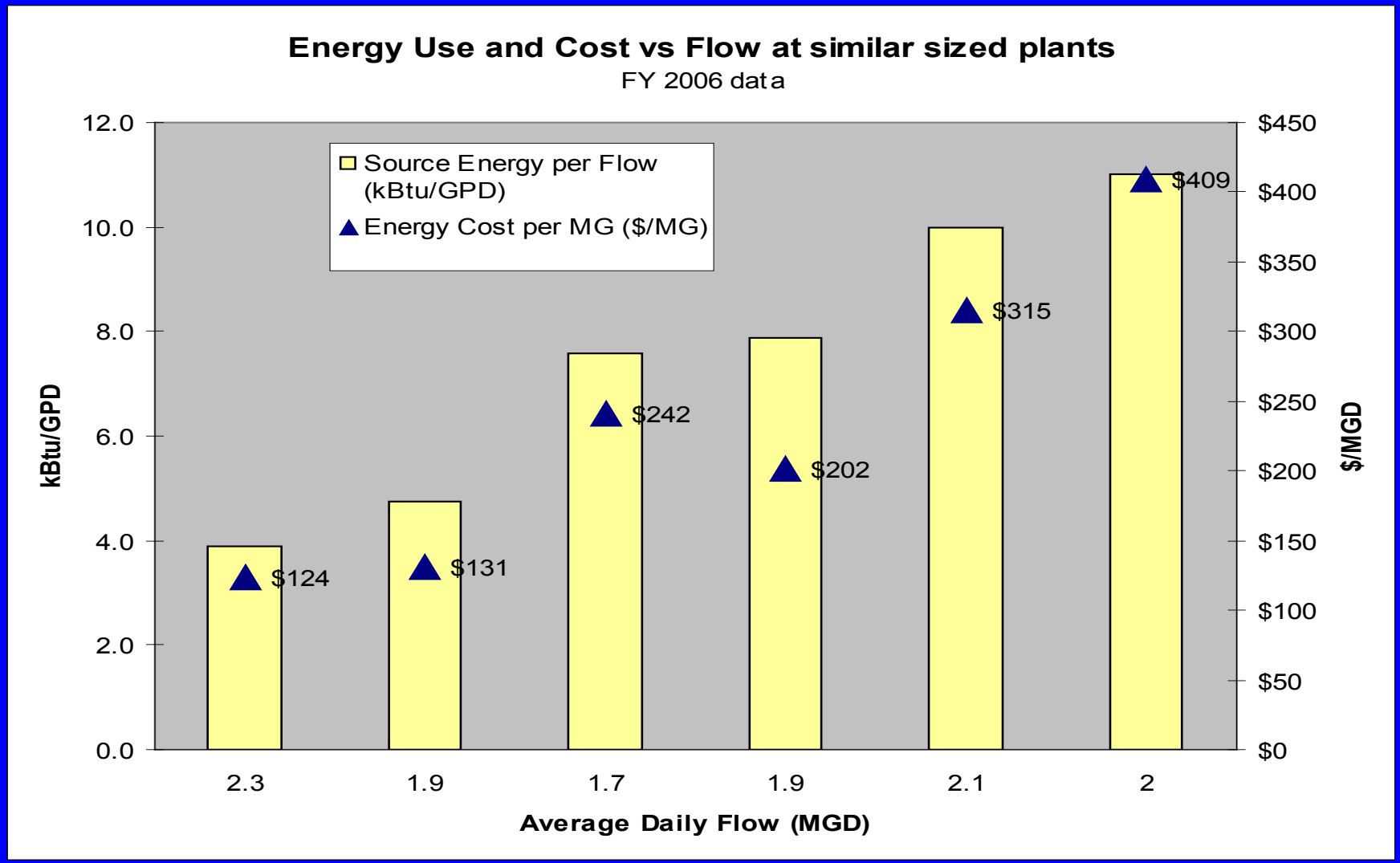
(2) Type in Portfolio Manager User Name

or

(2) Select a Portfolio Manager Master Account from the drop down menu

(3) Click "Add and Modify"

Energy Use at 6 Similar Plants



Identify and Move Toward Best Practices

The metric isn't the destination,
Just the mile marker...

A hint that potential Improvements exists.

Still need to figure out where to go

- **Apply expertise**
- **Investigate systems**
- **Devise and implement changes**
- **Assess performance**

Contact Information

www.energystar.gov

buildings@energystar.gov

<u>contacts:</u>

Cheryl McGovern, EPA Region 9

mcgovern.cheryl@epa.gov

(415) 972-3415

www.epa.gov/region09/waterinfrastructure

Bob Jannarone

The Cadmus Group, Inc.
(EPA contractor)

703-247-6117

Sustainable rural partnerships evolve with need, good research, collaboration, creativity, adaptability.…and <u>active listening</u>

“Lessons from the Small Fry”

Robert R. Casavant

Maricopa Association of Governments
Greening Water & Wastewater Infrastructure Workshop
Phoenix, AZ
Jan. 12, 2010

Preliminary Analysis:

A Water / Energy Best Practices Guide for AZ's Rural Water & Wastewater Systems

http://www.waterenergy.nau.edu/

An AZ Water Institute funded project (07-08)

Research Team:

S. Mead, C. Schlinger, W. Auberle, M. Roberts

NORTHERN ARIZONA UNIVERSITY

B. Billy, M. Budhu, R. Casavant

THE UNIVERSITY OF ARIZONA

Project Purpose

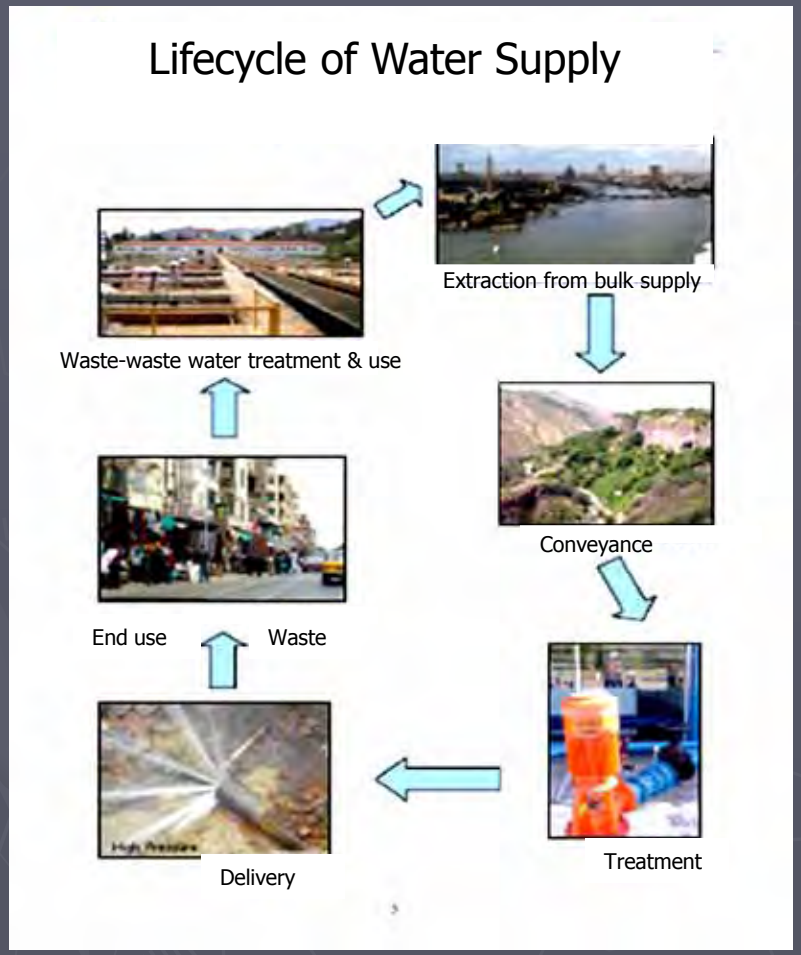
- Conduct preliminary research into "best water practices" of innovative small and/or rural communities in the United States, Europe, and elsewhere….
- to identify, evaluate and prioritize technologies and strategies that can be used by the rural Arizona providers to conserve water, reduce energy usage and related expenditures, and minimize greenhouse gas (GHG) emissions.

(Letter of Intent RFP to AWI)

Gen. Conclusions, Observations

- Rural WWS's, large & small, old & current -- can be optimized to enhance operational efficiency, reduce O&M costs, increase ROI leverage purchase power, & attract investment
  - On-site visits
    - Promote open discussion, collaborative data collection, review & analysis
    - "pilot checklist" developed and recommended - can lead to new insights, questions, and strategy for researchers and on-site managers
    - Continuation of detailed state-wide rural systems inventory is recommended
  - Interdisciplinary - "neighborhood watch" approach
    - Cost-effective sharing and opportunity to enhance material management, process, reduce infrastructure & O&M costs, & develop energy-efficiency
    - Invest in "low-hanging fruit" -- opens/maintains communication, builds advocacy, partnerships, experience to complete future and long-term investment for savings
    - Comparative "systems" analysis leads to continuous improvement
  - Rural partnerships
    - Provide for a "neighborhood watch"--faster transitions, less loss
    - Able to leverage & develop much needed political, financial and technical"capital" (intra- & interstate)-- the "school" effect ("we" vs. "me")
    - Smart growth, sustainability

Site Assessment



- Extraction Bulk Source
- Conveyance
- Treatment
- Delivery
- End Use
- Wastewater Treatment
- Compile, Analyze, Contrast Available Data

http://www.watergy.org/resources/publications/watergy.pdf

NAU-UA WWS study --Project Methodology

- Identify Study Sites
  - Rural Arizona towns (<50,000 pop.)
  - Relative proximity to universities
  - End-user, technical and geographic diversity
- Site Assessment
  - Visit each site to meet with personnel
  - Data accessibility for water/wastewater facilities
- Site Selection
  - Inventory of major processes – NAU questionnaire
  - Operational table matrix
- Analysis
  - Energy Usage (kwh)/1000 gals processed
  - Comparative Analysis

A Water/Energy Best Practices Guide for Rural Arizona's Water and Wastewater Systems

http://www.waterenergy.nau.edu/

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5. Develop Water Audits and Implement Leak Detection 14
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7. Create Financial Incentives for Water Customers 16
8. Adopt Water Efficient Ordinances and Codes 18
9. Create Water Education Programs 19

NAU-UA WWS study

System Design and Engineering **20**
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NAU-UA WWS study

Appendix 3 – Case Study Summaries

The following case studies were completed at Northern Arizona University and the University of Arizona as part of this project. Each consists of an evaluation of existing water and energy use at a rural Arizona water or wastewater facility, together with recommendations for best practices, presented herein, that may be of value at the respective facilities.

- Benson, AZ: Energy, Water, and Wastewater
- Grand Canyon National Park, AZ: Energy and Wastewater
- Kartchner Caverns State Park, AZ: Energy, Water and Wastewater
- Patagonia, AZ: Energy, Water and Wastewater
- Patagonia Lake, AZ: Energy, Water and Wastewater
- Payson, AZ: Energy and Wastewater
- Slide Rock State Park, AZ: Energy and Water

● ASP technical contribution

City of Benson, AZ

- Water Distribution Network
  - Brad Hamilton, City Engineer & Public Works Director
  - Al Carruthers, Water Supervisor
- Wastewater Treatment Plant
  - Larry Napier, Public Works Wastewater Supervisor
- Sulphur Springs Valley Electric Cooperative, Inc.
  - Dave Bane, Key Account Manager Sulphur Springs Valley Electric Cooperative, Inc.

Wastewater Treatment Questions

1. Name and location (address) of plant: _____
2. Operators (Please include contact information) _____
3. When was the plant built? _____
4. Have there been any modifications to the plant since its original design? (Yes/No) _____
   a. If so, what? _____
   b. Which components have been replaced / repaired? _____
   c. When? _____
5. Are operation & maintenance manuals available for reference? (Yes/No) _____
6. Are mechanical / electrical / civil plans & specifications available for reference? (Yes/No) _____

Plant Characteristics

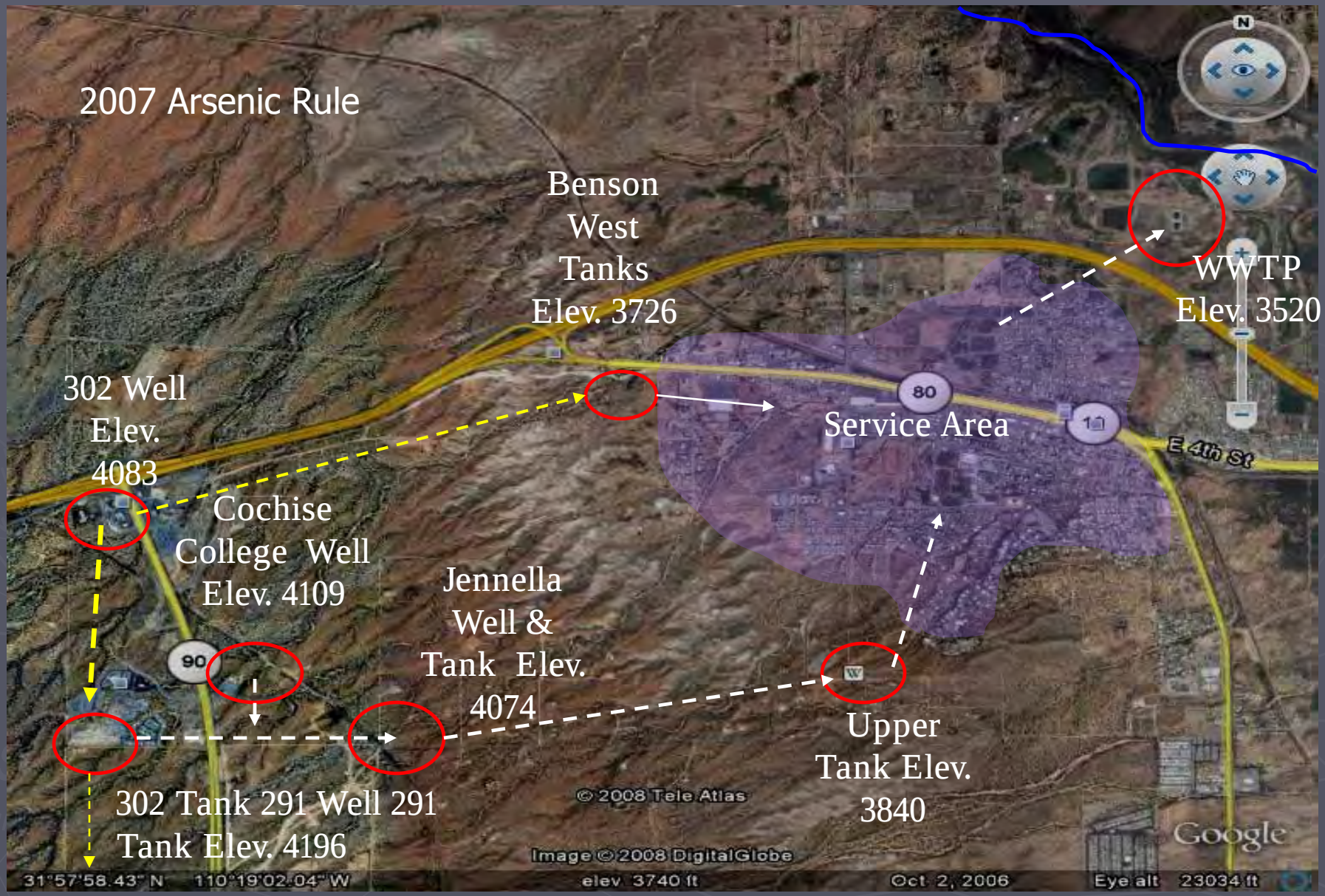
1. What is the design flow rate? (million gallons per day - MGD) _____
2. What is the average flow rate? (MGD) _____
3. What percentage of influent is residential? _____ Institutional? _____ Commercial? _____ Industrial? _____
4. What is the retention time? _____ What is the retention capacity? _____

Treatment Processes

1. Please describe the sequence of treatment used at this facility: _____
2. What are the horizontal and vertical distances that water is moved within the treatment facility? (horizontal) _____ (vertical distance, up/down) _____

Example page from site survey questionnaire

Benson Water Distribution Network



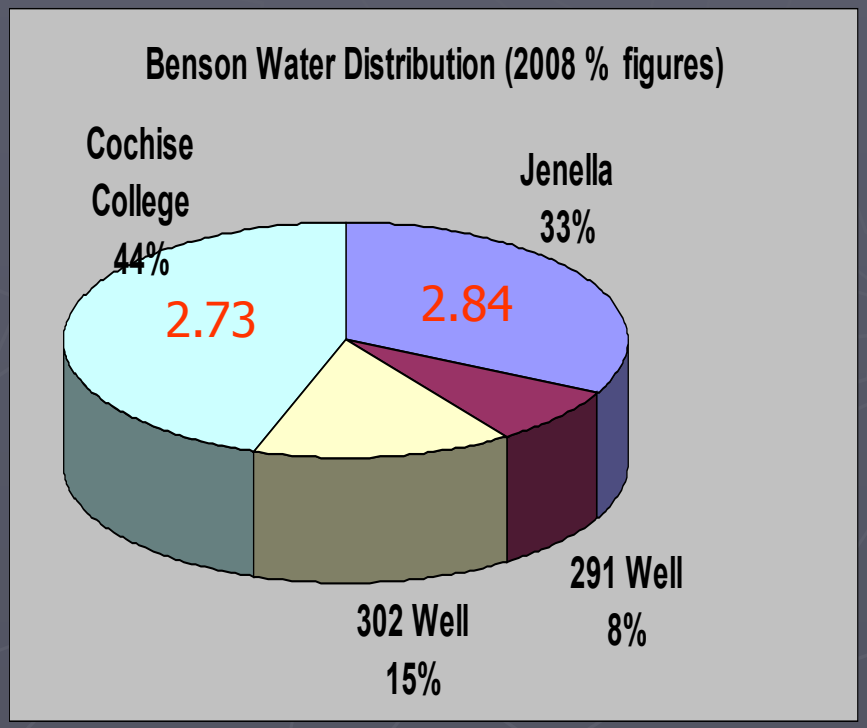
Benson Wastewater Plant

Facility Size ~ 250,000 sq ft

- Major Energy Consumption Processes
  - Oxidation Ditches – 3 rotors
  - Blowers/Agitators
- Plant Efficiencies
  - Gravity-Fed System
  - Completely Automated
  - Recently built in 2003
  - Expandable
- Plant Inefficiencies
  - Concrete piping

Benson Water Distribution Audit

- Total gallons pumped (2007) – 274.6 MG
- Energy consumed – 856,659 kwh
- Kwh/1000 gallons pumped – 3.12
- Jennella & Cochise Pumping Efficiencies in 2008
- Possible Water Loss – 2.7 MG (10%)
- Non-Chlorination



Benson Wastewater Audit

- 135.4 MG processed (2007)
- Energy consumed – 984,516 kwh
- Kwh/1000 gals – 7.27
- Annual Billing Cost – $124,200
- Cost($)/1000 gals processed – $0.92

NAU-UA
"case study" briefs

AN INVESTIGATION OF ENERGY USE AND WASTEWATER TREATMENT AT PATAGONIA,

By Brian Billy, Robert Casavant and Maurizio Budhu

Background

The City of Patagonia, AZ is situated in Santa Cruz County and located approximately 60 miles SE of Tucson, AZ at an elevation of 4,055 ft. The community has a population of 825 (2006 census). The town is located within the Sonoita Creek watershed and is outside Active Management Areas, which are designated by the Arizona Department of Water Resources. In 2003 a multi-agency grant was approved for upgrading the existing wastewater treatment plant (WWTP) and to rehabilitate portions of the sewer collection system. The plant upgrade has improved the quality of effluent discharged to Sonoita Creek by decreasing overall nitrogen levels. The sewage line rehabilitation has decreased the amount of wastewater leaking into the regional aquifer, resulting in improved health and environmental conditions. The electricity provider for the city is the Sulphur Springs Valley Cooperative (referred to herein as Sulfur Springs).

WATER

Supply, Pumping & Storage

The City of Patagonia relies solely upon groundwater to serve its residents. Two wells operated alternately and equipped with submersible pumps, are located within the center of town and supply water directly into the distribution system and to an upper storage reservoir. The static water levels at the wells vary from 15 to 30 feet below the land surface, depending on demand and time of year. The two recently overhauled 30-hp submersible pumps are controlled by telemetered signals from reservoir water level sensors. The pumps operate daily for up to six hours, at a rate of 325 gallons per minute (gpm), which yield nearly 110,000 gallons per day (gpd). The upper storage reservoir consists of two 200,000 gallon underground tanks. When the pumps are on, in addition to pressurizing and supply water to the distribution system, they pump water to the reservoir. There is metering at the well head. The water is pumped upgrade at slope of 6.5% for 0.75 miles (see Fig. 1).

Figure 1: Water System, Patagonia, AZ

Treatment

Currently there is no well head chlorination due to malfunctioning chlorinators. As a result the water supplied to the system when the pumps are running is untreated. The city is in the process of identifying replacements or repairs for the well head chlorination system. Presently, staff manually add chlorine tablets to the storage tanks every few days. Residual chlorine levels are monitored to maintain compliance with Safe Drinking Water Act standards.

Distribution

Treated water is conveyed either from the storage tanks via gravity or by direct well pumping to the service area, which has 114 connections. The pressure in the uppermost portion of town is 65 psi and rises to 95 psi in the lower portion. Pressure reducing valves are used to regulate the pressure. Water from storage is conveyed to the service area utilizing the same pipe (8 inch main) that is used to transport it to the reservoir. The main distribution pipeline bisects the city's business district, with laterals extending to various parts of the service area. The pipes range in size from 2 in. to 8 in. and are made primarily of ductile iron, Transite, and PVC. Leak detection is done by regular meter monitoring of flow at the well head and at points of individual use. Currently, there is no booster pumps to outlying or high elevation areas. One key issue that has been identified is malfunctioning check valves at the wells. The existing valves occasionally stick in the open position when the pumps turn off. This allows water to pass back through the check valves and back into the wells. Not only does water get lost from the distribution system back to storage, but there is potentially a condition of suction in the distribution system.

WASTEWATER TREATMENT

The treatment plant is located in the southwest part of the city at an elevation of 4027 ft on 2.5 acres adjacent to Sonoita Creek, within the 100-yr flood plain. The sewer system of Patagonia was constructed in 1965 under the town's "Sewer Improvement District One" project. The sewage collection system consists of 19,000 linear feet (lf) of 6, 8, and 10 inch gravity sanitary sewer pipes. Subsequent improvements to the system include rehabilitation of approximately 5,500 feet of the sewer lines and installation of an oxidation ditch for extended aeration wastewater treatment.

Conveyance and Treatment

The wastewater flows a horizontal distance of 3 miles at downward grade of 0.32% from the service area in a gravity-driven collection system. The overall system has a total design capacity of 110,000 gallons per day (gpd); however, on average the plant generates 60,000 gpd of effluent with 99-100% BOD removal. The influent is screened to remove large items and then passed through a grit chamber to remove the large colloidal particles. The wastewater is then lifted a vertical distance of approximately 10 ft and a horizontal distance of nearly 50 ft utilizing two 3 in. 10 hp grinder pumps that operate alternately. On average, the pumps operate 20 times daily for 15 minutes at 200 gpm. The plant utilizes activated sludge with an anoxic denitrifying chamber to ensure maximum nitrogen removal. The first process consists of a pre-anoxic basin where

Figure 3: Sludge Cake Belt Press at Patagonia WWTP

CENS Labs 1/10/09 11:24 AM — Deleted: THE NEXUS BETWEEN ...AZ
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CENS Labs 1/10/09 11:25 AM — Deleted: according to the
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CENS Labs 1/10/09 11:28 AM — Deleted: DISTRIBUTION
CENS Labs 1/10/09 11:28 AM — Deleted: with alternating . . transporting . . up. . the . . recently . . 3D . . have built-in . . and telemetry that responds to water levels within the reservoir. . extract water once per day for durations of. . or. . a. . and supplying water. . from the wells and . . extracted water. . cedar as extracted point and at point of usage
Computer Sup..., 1/22/09 1:27 PM — Deleted: right
CENS Labs 1/10/09 12:04 PM — Deleted: Distribution
CENS Labs 1/10/09 11:36 AM — Deleted: Conveyance
CENS Labs 1/10/09 11:36 AM — Deleted: When the pumps are not pressuring the system, the w. . of . . ar. . of some . . The w. . use that extend. . materials. . pipe. . The . . of leaks within the system are identified. . are so. . that are loosing water . . are . . currently as place often get losing up on. . due to the pressure head on the system, which . . instead the some water is being pumped multiple times
CENS Labs 1/10/09 11:36 AM — Deleted: Treatment: Chlorination is performed solely at the reservoir and by adding chlorine tablets by hand at the reservoir are every few days. Residual chlorine levels are sampled regularly to maintain compliance with drinking water standards. Currently there is no chlorination being conducted at the well sites due to malfunctioning chlorinators. The chlorination system has not functioned properly for several years and as a result, the water supplied to the system when the pumps are running is not currently treated. The city is in the process of repairing it or replacing it entirely.
CENS Labs 1/10/09 11:53 AM — Deleted: PLANT
CENS Labs 1/10/09 11:53 AM — Deleted: 3 . . of power lines . . ensured . . s . . cost a. . improvements . . installment
CENS Labs 1/10/09 11:55 AM — Deleted: is moved. . and introduced into the. . via gravity. . processes . . to the plant . . 4 . . 1D alternating . . work. . is needed to move the waste a vertical distance of approximately 10 ft and a horizontal distance of 50 ft. . The . . per day

AN INVESTIGATION OF ENERGY USE, WATER, AND WASTEWATER TREATMENT AT KARTCHNER CAVERNS STATE PARK, ARIZONA

By Brian Billy and Maurizio Budhu

WATER

WASTEWATER TREATMENT

- 2-pg summaries

- consistent metrics

- quick-look capability for comparison and analysis

- applied training for future resource managers, planners

- basis for new research (algorithm) = measuring effective system performance despite sig. diversity in infrastructure, age, demographics, population size

AN INVESTIGATION OF ENERGY USE, POTABLE WATER AND WASTEWATER TREATMENT AT BENSON, ARIZONA

By Brian Billy and Muniram Budhu

Background

The City of Benson is located in southeastern Arizona, approximately 45 miles south of Tucson, AZ, along Interstate 10 (I-10). It is located within Cochise County and has a population of 4,934 (2006 census). The area is experiencing a growth rate of 4.7% based on figures from 2000 to 2005. The city is located within the Upper San Pedro Watershed at an elevation of 3,580 ft above sea level. The city utilizes groundwater as its sole water source. In early 2007, wells that produced water containing elevated levels of arsenic were taken off line, and the water system was modified so that all water was supplied by low-arsenic wells located in the upper southwest region of the city. Compliance with the EPA's present arsenic rule is an issue of concern for Benson. The water uses in the area are: municipal, agricultural, livestock, industrial, and riparian. This study deals only with the municipal use. The electricity provider for the City of Benson is the Sulphur Springs Valley Electric Cooperative (referred to as Sulfur Springs).

WATER

Supply & Pumping

The City of Benson pumped approximately 842 acre-ft (af) of water in 2007. The average per capita water usage is 150 gallons/person, with 1794 connections. The four wells that currently supply the city are Jennella, Cochise College, 302, and 291. Static water depths have been measured at 463 ft, 450 ft, 580 ft, and 571 ft respectively; the water table has not demonstrated a significant amount of drawdown with the current pumping regime. Figure 1 shows the relative location of the wells and tanks. The Cochise College and Jennella Wells work in tandem and currently provide 80% of the total water supply to the City of Benson. The 302 and 291 wells supply the Benson west tanks and the growing population along State Route 90.

Figure 2: Jannella Well

Figure 1: Wells and Tank locations in Benson, AZ

Treatment

Raw water is not treated. In the event of bacterial exceedance, the system is spot chlorinated and flushed. The water quality is monitored daily and monthly compilations of lab results are submitted to the Arizona Department of Environmental Quality.

Transmission, Storage & Distribution

Groundwater is pumped to the surface and conveyed to multiple storage tanks within the city. Two booster pumps are needed to supply the SKP development area and convey water from the 302 well to the 302 tank. The total system production is approximately 274 million gallons annually and total storage capacity is 2.45 million gallons. The topography allows for the distribution system to convey the water via gravity through 4-in., 6-in., and 8-in. pipes. Distribution occurs over an area with elevation difference of 616 ft. Pressure reducing valves are utilized to maintain a pressure of 40-80 psi within the service regions. The ability to utilize gravity for conveyance from storage is one of the major efficiencies within the Benson system.

WASTEWATER TREATMENT

The wastewater treatment plant (WWTP) is located in the northern part of town (see Fig. 1) along I-10,, north of the main business district,at elevation 3,515 feet. The service area includes the main business district and residential areas west of the San Pedro River. The original treatment plant (pond system) was moved to its current location in 1960 and was completely rebuilt in 2002 to its current operation. The flows are metered at both the influent and effluent pump stations. The effluent is used to irrigate the city golf course at no cost.

Collection / Conveyance

The city's wastewater is conveyed to the plant via gravity and received at an average rate of approximately 420,000 gallons per day (gpd). During the peak season the flow rate increases to nearly 520,000 gpd. The system works efficiently and there have been no significant maintenance issues. The installed collection piping is a combination of concrete, vitreous clay, and PVC types.

Treatment

Town of Benson (pg. 1)

solid waste facility for disposal.

SYSTEM METRICS

Monthly water pumping data were provided by the City of Benson. The wastewater processing energy expenditures were provided by Sulphur Springs. The wastewater processing figures were provided on a monthly time step by plant personnel and are estimates derived from 2008 billing records. The records for gas usage were not considered since they were not readily available and are only used for back up generators that are periodically tested. Since the water distribution operations were modified in 2007 to accommodate new arsenic standards, the tables to the right reflect the operations of a system within its transition period.

Benson Potable Water System (2007)	
Number of Gallons Pumped	274,563,200
Service Population	5,000
Gallons Pumped per Day	752,228
Gallons Used per Person per Day	150
Annual kWh Usage	856,659
kWh/kgal	3.12

Benson Wastewater Treatment Plant	
Gallons of Wastewater Processed	135,360,000
Service Population	5,000
Average Gallons Processed per Day	370,850
Gallons Processed per Person per Day	74
Annual kWh Usage	984,516
kWh/kgal	7.27

Table 1: Water Distribution and Wastewater Treatment Plant Metrics

RECOMMENDATIONS/SUGGESTIONS

Presented below are best practice recommendations and suggestions developed as part of our qualitative evaluation.

NO OR MINIMAL COST

- Balance revenue and expenses.
- Understand how energy and water are utilized in the system.
- Review system plans, specifications, and records before considering upgrades/improvements.
- Evaluate costs for different available water sources.
- Secure operations and maintenance guides and training for city staff when new systems/components are installed.
- Further investigate blending of high- and low-arsenic ground water supplies.

LOW TO MODERATE COST

- Evaluate pumps, blowers, and motors for upgrade to either high-efficiency or VFD, as appropriate.
- Investigate available technologies for arsenic and other heavy metal reduction for future consideration.
- Consider high-efficiency ballasts and bulbs in the UV disinfection process, and elsewhere within the facility.
- Adequately ventilate or sunshield all electrical and mechanical equipment in warm weather.
- Utilize off-peak power usage strategies.
- Develop water audits and implement leak detection programs.
- Implement water budgets and rate structures.
- Create financial (or other) incentives for water customers to conserve.
- Adopt water-efficient codes and ordinances.
- Create water conservation education programs.

MODERATE TO HIGH COST

- Identify and eliminate areas where there are inefficiencies in potable water booster pumping and pressure management.
- Replace old meters and install automated units.
- Optimize treatment processes to reduce water and energy consumption.
- Reduce friction/energy losses in pumps, fans, pipes, valves, and production wells.
- Utilize renewable energy, as appropriate.

CONTACT INFORMATION

- Benson water system, contact Brad Hamilton, City Engineer: (520) 586-2245.
- Benson WWTP, contact Larry Napier: (520) 586-2245.
- Sulphur Springs Valley Electric Cooperative, contact Dave Bane,: (520) 515-3472.
- Project Sponsor: Arizona Water Institute.
- Partnering Universities: Northern Arizona University, University of Arizona.
- Lead case study author, Brian Billy: bbilly@email.arizona.edu.

Town of Benson (pg. 2)

City of Payson example - NAU

AN INVESTIGATION ENERGY USE AND WASTEWATER TREATMENT AT PAYSON, ARIZONA

By Matthew Roberts, Charlie Schlinger and Steve Mead

Background

All too often, little thought is put toward estimating how much energy is consumed after water goes down the drain, but wastewater treatment systems may use considerably more energy than potable water systems. With increasing concern about global climate change due to the use of fossil fuels and their rising costs, the Arizona Water Institute (AWI) sponsored this case study to identify potential applications for increasing the efficiency and decreasing the overall energy use of water and wastewater systems in rural Arizona. The purpose of the case study analyses of rural water systems is to determine the unique challenges that these smaller systems face and provide some guidance in overcoming this complexity. The Northern Gila County Sanitary District operates The American Gulch Water Reclamation Facility in Payson, Arizona, serving over 15,000 people. This facility was designed for 2 million gallons per day (MGD) and can expect an average flow of 1.3 MGD when the weather is dry. During periods of wet weather, short duration inflows at a rate of up to 5 MGD can be expected due to storm water infiltration.

WASTEWATER TREATMENT

The first step in the system is a continuously actuated conveyor-belt-type bar screen that removes large debris. The next step in the treatment process is uncommon in most wastewater treatment plants (WWTP): phosphorous removal. The influent flow has about 4 ppm phosphorous and the effluent has around 0.2 ppm, amounting to 99.5% removal efficiency. This is done by the five-stage Bardenpho process that uses volatile fatty acids (VFA) to encourage the uptake of phosphorous (P) by the microorganisms (bugs) in the nitrification basin.

Diversion of wastewater to the VFA basins was a supplement to the original design, utilizing a screw pump to lift the wastewater to where the VFA are mixed with return activated sludge at the entry to a fermentation basin. In the fermentation basin, P is released by the microorganisms, only to be taken up in greater amounts in the nitrification basin. Following fermentation, mixed liquor is returned from the nitrification basin and the water flows into the first anoxic basin where nitrates are converted to nitrogen gas. In the nitrification basin, two 100-hp blowers aerate the water through fine-bubble diffusers, digesting nutrients and converting ammonia to nitrates. Two reclaimed water sprayers from a hydro-pneumatic system are used to knock down foam atop the nitrification basin where most of the P is removed from the wastewater. A secondary anoxic basin allows further conversion of nitrates to nitrogen gas and, after re-aeration by a single 40-hp blower through fine-bubble diffusers to prevent the secondary release of P, the water flows to secondary clarifiers where excess biosolids are removed.

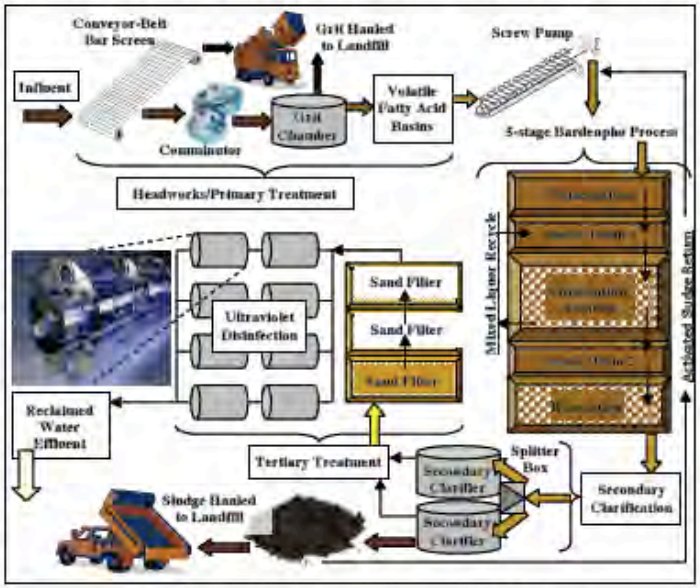


Figure 1: Schematic of the Wastewater Treatment Facility in Payson, AZ

Wastewater from the secondary clarifiers passes through a series of dual-media sand filters. The backwash water from cleaning these filters is returned to the headworks. The final step in the process is disinfection via low intensity UV lamps that sit directly in the flow of water. There are 30 bulbs in each of the 8 banks of lights; the bulbs are replaced every 2 years. The residence time in this system was estimated at 2.5 days.

The sludge removed from the secondary clarifiers is used in the manufacturing of fertilizer and some is recirculated to keep the bugs alive. The bio-solids enrichment and recycling (BER) process consisted of a dual belt-press to dewater the sludge before it is baked in a propane rotating dryer. By adding phosphoric acid and anhydrous ammonia to the sludge makes about 1500 lbs of pelletized fertilizer each day. This fertilizer was sold to local farmers, schools and golf courses at a loss of $900 per ton. This BER system was not large enough to support the amount of biosolids so hauling to the landfill has resumed, at a cost of $47/ton for solids taken to the landfill.

ere provided by
se data provide
ity. Occasional
l an estimate of
rics in Table 1

Electricity Use	Natural Gas Use	Annual Electricity Use	Annual Natural Gas Use
4.48-5.84 kWh/kgal	2.64-5.33 kWh/kgal	2.55 million kWh $215,300	72,800 Therms 2.13 million kWh $172,200

Table 1: Wastewater Metrics in Payson, AZ

NS
ns and suggestions as a result of additional qualitative analyses.

NO OR MINIMAL COST

nly enough to expose more bar screen, letting excess water drip off before deposition in a ndfill.
n freezing is not a threat. This could reduce the need for grinders as the bar screen is more en. The grinders then could be used only during times when the bar screen is in motion and

vement planning.

system.
fore considering upgrades/improvements.
scoping, design and specification of future projects.
upgrading over the expected life of the system.
chilled water or air.
ng for staff when new systems/components are installed.

LOW TO MODERATE COST

either high-efficiency or VFD.
eaks, and operate the facility at night.
activities warmer and possibly more reactive, to dry bio-solids in the fertilizer manufacturing

e facility, especially in the UV disinfection process.

echanical equipment in warm weather.

mers to conserve instead of expanding plant capacity.

conserve water and reduce wastewater production, instead of increasing plant capacity.

MODERATE TO HIGH COST

the amount of flow. This facility currently operates 3 of 4 light banks continuously.
tment facility.
utilizing: photovoltaic cells; drying beds, or a greenhouse with proper ventilation.
ergy consumption.
valves, and production wells.
out the wastewater system.

bout the study, supporting data, and background information: Matt Roberts (msr43@nau.edu), Charlie Schlinger (charles.schlinger@nau.edu) or Steve Mead (stephen.mead@nau.edu) at Northern Arizona University.
For further information on the American Gulch Water Reclamation Facility, please contact Dave Millien by email: ops@npgcable.com, or telephone: (928) 474-5257.
Project Sponsor: Arizona Water Institute (http://www.azwaterinstitute.org/).

System/process illustration

Kartchner State Park - example

- Water Distribution Network
  - Don Fletcher, Kartchner SP Building Maintenance
- Wastewater Plant
  - Rob Van Zandt, ASP
- Sulphur Springs Valley Electric Cooperative, Inc.
  - Dave Bane, Account Manager, Sulphur Springs Valley Electric Cooperative, Inc.

Kartchner Water Distribution e.g. site info collection

- Manual operated System (tank level dependent) – sensors turned off – too costly
- Well #2 Pump manually operated
- Gravity fed
- Metered at well only
- Chlorine injection at well

Kartchner Wastewater Plant

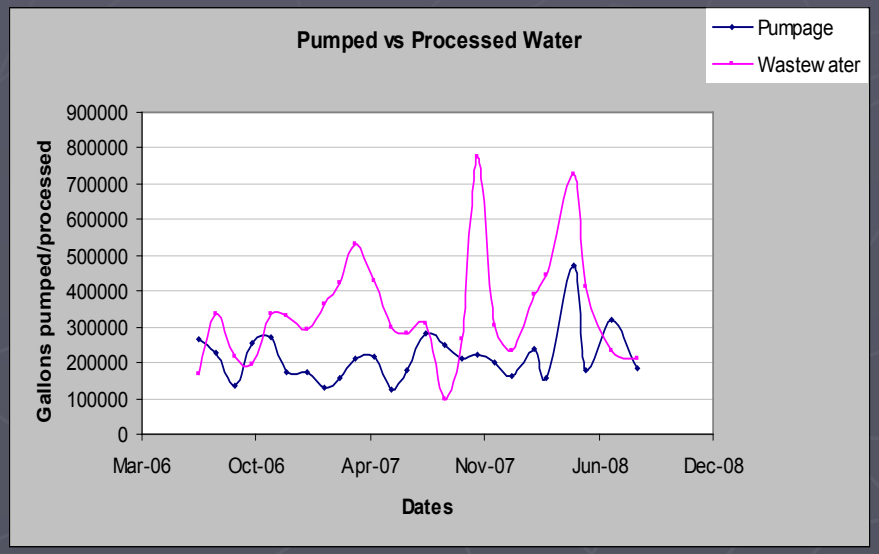
- Major Energy Consumers
  - 2 Blowers/train 24/7 altern
  - Grinder Pumps
  - Effluent Pumps
- Gravity Fed 3 ft/sec – topography
- Seasonal demand
- Metering – water & energy
- Single Utility Bill (estimate 65% - inventory being performed)
- Minimal sludge disposal

Kartchner Billing Records

	Kwh
4-Jan-07	91,200
2-Feb-07	102,000
5-Mar-07	109,680
4-Apr-07	91,920
2-May-07	75,120
5-Jun-07	78,240
5-Jul-07	76,080
3-Aug-07	68,160
6-Sep-07	81,360
3-Oct-07	60,720
5-Nov-07	86,160
5-Dec-07	87,600

Water distribution Energy Usage

Wastewater Energy Usage



Kartchner Water & Wastewater Systems Comp.

- Water distribution
  - 2.3 MG pumped (2007)
- Energy Consumed (0.65% of total)
  - 6633 kwh
- Kwh/1000 gals – 2.83
- Cost($)/1000 gals - $0.44

- Wastewater
  - 4.3 MG processed (2007)
- Energy Consumed (65% of total)
  - 663,000 kwh
- Kwh/1000 gals – 154
- Cost($)/1000 gals - $16

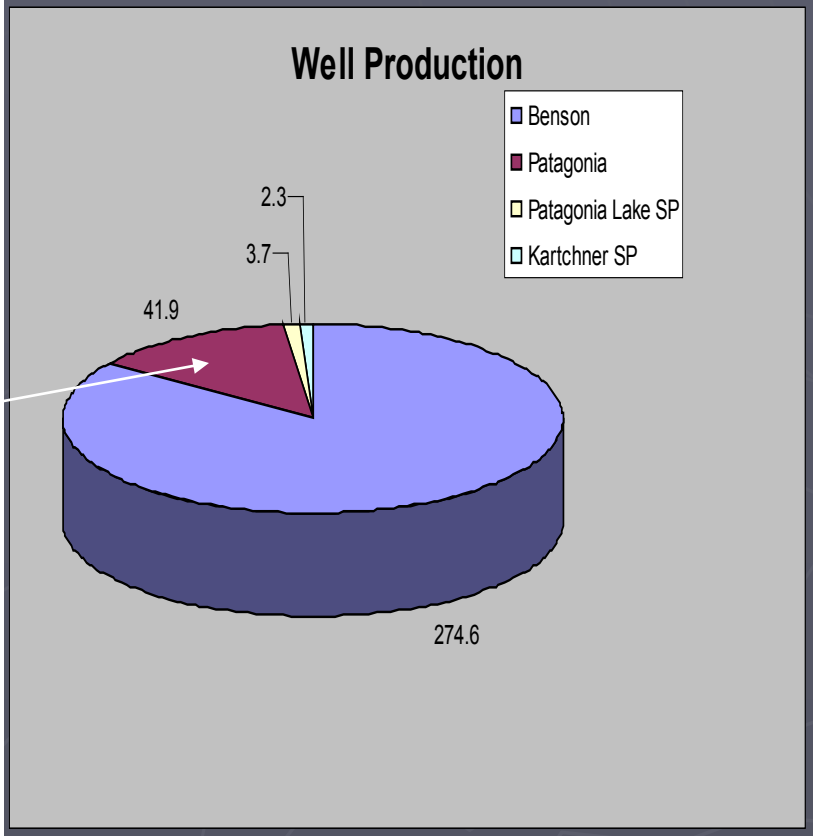
Example of preliminary findings

- Kwh/1000 gals processed = an equalizing metric
- Cities more efficient than parks
  - More funding & tax revenues?
  - On-site engineer/certified operators
  - Modernized systems, profit driven, less waste
- Little or no intra-system metering at State Parks
- Energy & water record keeping, monitoring, and knowledge transfer variable among many rural sites
- Macro billing data available, but little/no data for micro processes, on-park intra-system analysis and optimization
- Quantification of system losses is often minimal or inaccurate
- Best practice guides and flow metrics (audit templates) desired

Independent audits and data = raise candid questions, uncover data errors, separate people from the process, promote consistency & objectiveness, present WWS in terms of mass balance and energy consumption, incite best practices for energy cost savings and investment = profitability, efficiency

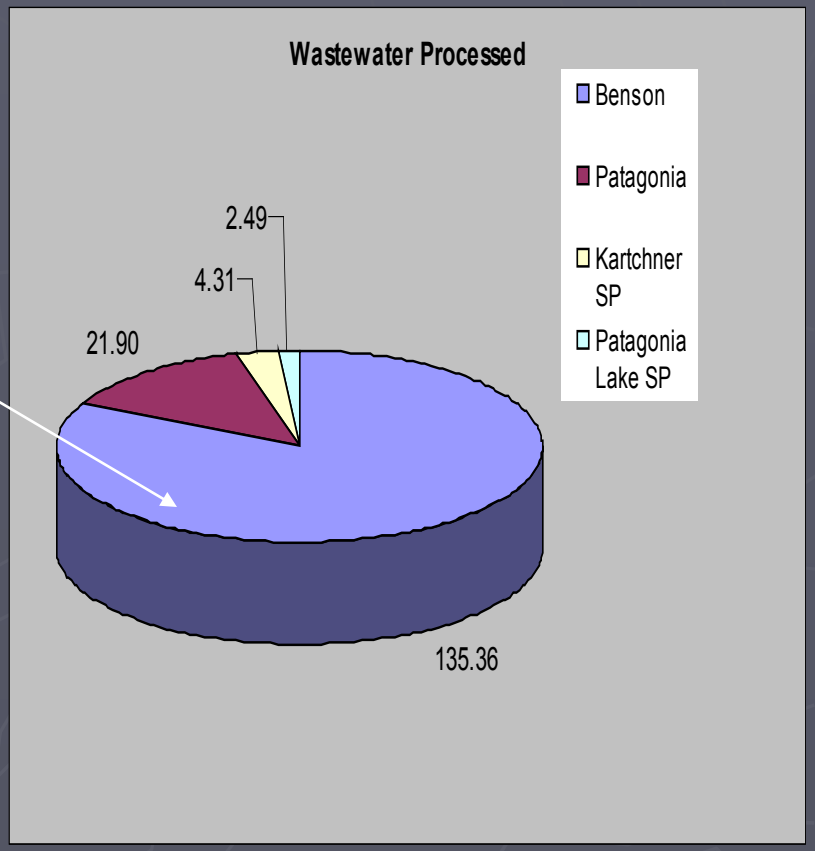
Water Distribution Analysis

	City Population Number of Park Visitors	Number of Gallons Pumped (MG)	Energy Consumption (kwh)	Kw h per 1000 gals pumped	Cost ($)/1000 gals processed
City of Benson	5000	275	857,000	3.1	Being calculated
City of Patagonia	822	41	56,000	1.4	$0.20
Kartchner State Park	225,000	2.3	6633	2.8	$0.44
Patagonia State Park	230,000	3.7	8125	2.2	$0.47



Wastewater Analysis

	Number of Gals processed (MG)	Energy Consumed (kwh) for processing	Kwh/1000 gals processed
Benson WWTP	136	985,000	7.3
Patagonia WWTP	22	296,000	13.5
Kartchner WWTP	4.3	663,000	154
Patagonia SP WWTP	2.5	29,000	11.7



Additionally, overall education and training for operators is essential so that they can understand utility policies, management and operations, be aware of energy supplies and uses and costs and understand the basis for successful application of best practices for water and energy conservation (Cantwell, 2008).

Renewable Energy

Because water and wastewater systems have regular and continuous power demands, there are excellent opportunities for using renewable energy sources. Renewable energy sources such as photovoltaic panels and wind turbines can be used to help meet day-to-day energy needs. Given the significant recent and ongoing investment in renewable

energy, technologies are becoming more efficient and cost effective. In Arizona, where there are ample sun and significant wind resources, renewable systems can be effective at reducing expensive peak power demand placed on conventional providers.

Other renewable sources include sludge digesters that produce methane. The methane is captured and used to power a gas engine generator or a micro-turbine system. These systems utilize the methane gas produced in anaerobic treatment processes, reducing the GHG emissions of the wastewater treatment plant. To date, these kinds of systems have been limited to plants that exceed a threshold of 5-10 million gallons per day (Mgd).

31. Wind Energy

Wind has long been used to help pump, distribute and treat water. In the early 20th century, the development of the steel windmill and reciprocating pump provided water to farms, ranches, and railroads in the rapidly developing American west. This technology is still used to pump water worldwide. According to a report from the National Renewable Energy Laboratory (NREL), there are over one million windmills in the United States, Argentina, and Australia alone (Argaw, 2001). However, wind-powered mechanical pumps have limitations. Because of their reciprocating pump design, these pumps need to be installed directly over a well head. This poses problems because groundwater is often tapped in low-lying valleys, and these locations are not usually optimal for available wind energy.

Given the above location constraints on windmill / reciprocating pump installations, an electric wind turbine offers greater versatility. These turbines are designed to generate electricity (AC or DC) that can be used to operate a variety of electrical devices. Wind power can be used effectively to power pump motors, fans, lights, controls, and

"Local & consistent energy needs of WWS are well-suited to renewable energy augmentation"

- wind
- solar
- biofuels
- small-scale hydroelectric

Appendix 2 – Funding Sources, Renewable Energy Specialists, and Other Resources

Funding Sources

WIFA – Water Infrastructure and Financing Authority (Arizona)

http://www.azwifa.gov/

Clean Water State and Safe Drinking Acts (State Revolving Fund Program)

http://www.epa.gov/safewater/

DOLA, CDPHE, CWRPDA
National Water Program Strategy (Response to Climate Change)
Direct and Leveraged Loans
Disadvantaged Community Loans

Colorado Water Resources and Power Development Authority

http://www.cwrpda.com/Programs.htm

Small Hydro Loan Program (Colorado only)
Water Resources and Power Development Authority
Engineering up to $150K per year, $15,000 per local government
Up to $2 million per borrower, 2% for 20 years
SRF – Planning and Design Grants have been a success

Energy Efficiency and Conservation Block Grant Program (EECBG)

http://www.usmayors.org/climateprotection/documents/eecbghandout.pdf

Acknowledgments

This project was financially supported by the Arizona Water Institute (AWI) and Grand Canyon National Park. We would like to acknowledge Bill Reed of ADEQ; Chuck Graf of ADEQ and AWI; Vern Camp of the Arizona Small Utilities Association; Tom Mossinger of Carollo Engineers; Guy Carpenter of HDR Engineers; and, Barbara Lockwood of Arizona Public Service (APS).

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AWWA. 1999. Water Audits and Loss Control Programs, American Water Works Association, Manual of Supply Practices, Manual M36, American Water Works Association, Denver, CO. *A new (3rd) edition of this manual is due out in 2009.* http://www.awwa.org/index.cfm

Future Research

- System Constraints / Optimization
  - Historical context – town & park politics - system inheritance
  - Data reliability and repeatability
  - Quick-look assessment software capabilities
  - Topographic considerations
  - State/Federal regulations
  - Monetary funding mechanisms
  - Consistency in system audits
  - Develop Mass Balance Model
  - Land locked areas - Expansion
- Carbon Emissions Impact
- Application of green technologies
- Parallel Systems approach

Big & small fry --- think & act as a "cooperative"

Collaborative inventorying and management of diverse rural systems will help you learn what you have / what you need…so that you collectively plan, optimize, and sustain natural / human ecosystems for "smart growth"

"Neighborhood watch"

-- a tree trimming story

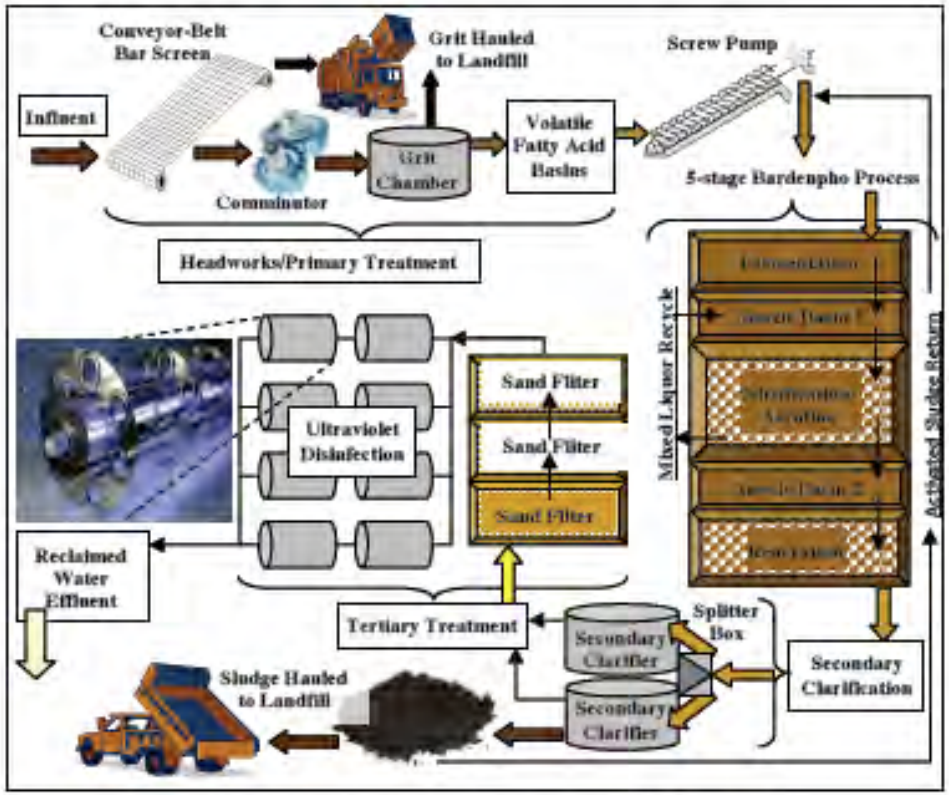


Figure 1: Schematic of the Wastewater Treatment Facility in Payson, AZ

Acknowledgements

Arizona Water Institute
AZ State Parks
National Park Service
City of Benson
City of Patagonia
City of Payson
MAG
AZ DEQ

“What gets measured, gets managed”.

(Peter Drucker)

Financial and Technical Assistance for Green Projects

Water Infrastructure Finance Authority of Arizona

WIFA

Water Infrastructure Finance Authority

Maintain and improve water quality in Arizona by providing financial assistance and technical assistance for basic water infrastructure.

Design, Improvement, Construction, Acquisition

of

Drinking Water, Wastewater, Water Reclamation and other water quality projects

Project Examples

Traditional Projects

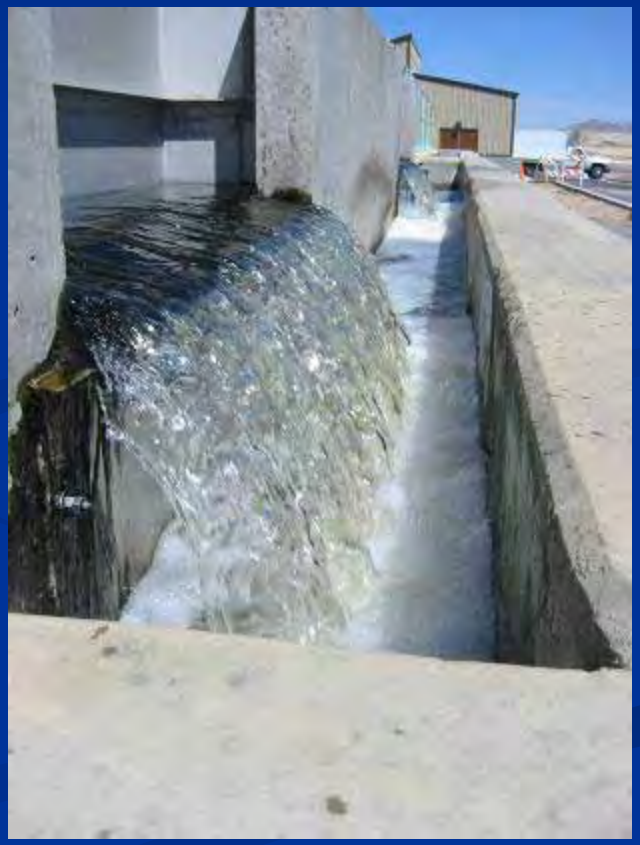
- Rehab/replacement of water distribution lines
- Arsenic treatment systems
- Wastewater treatment plant upgrades

Green Projects

- Energy audits
- Solar power for water and wastewater facilities
- Water reclamation

What makes WIFA a good funding option?

- Clean Water and Drinking Water Revolving Funds
- AAA credit rating = low-interest financial assistance
- No application fees or closing costs
- Grants and free Technical Assistance Programs



ARRA Financing

- Allocated $82 million of federal Recovery Act money

- Combined with our other funding sources - $183 million of projects on the ground
  - $24 million funded Green Projects

Project Environmental Benefits

Standard Environmental Benefits

- Protects/improves water quality
- Addresses watershed plan
- Corrects non-compliance
- Protects source water

"New" Green Projects

- Water efficiency
- Energy efficiency

20% of federal funding

Green Projects – Energy

Energy efficiency

- Clean/alternative energy
- Energy efficient retrofits and upgrades to pumps and treatment processes
- Energy audits

Need to demonstrate at least a 20% savings in energy

Green Projects - Water

Water efficiency, reuse and conservation

- Water reclamation, recycling, reuse
- Gray water recycling
- Leak detection
- Replacement or rehabilitation of distribution lines to correct water loss
- Water meters, automated meter reading systems
- Green stormwater infrastructure (e.g. green roofs, stormwater wetlands)

Eligible applicants

- Drinking Water
  - Public water systems owned by political subdivisions (cities, towns, districts and tribal entities) and private ACC-regulated systems
- Clean Water
  - Restricted to various types of political subdivisions, including tribal entities

Assistance Programs

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

FREE

ADEQ Capacity Development Program

Small drinking water systems (≤10,000 people) receive:

- System Evaluation
- Operations and Maintenance Package
- Energy Audit

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

FREE

Energy Audit

- Facility load
- Equipment condition
- Energy consumption
- O&M procedures
- Historical energy use
- Recommendations

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

For systems lacking technical staff

- Plan or design an infrastructure project
- Next cycle begins this spring
- Local match may be waived/reduced for green

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

Planning

- Rate Studies/Financial Audits
- Capital Improvement Plans
- Feasibility Studies

Pre-design/Design

- Engineering plans and specifications
- Environmental Assessments
- Preliminary Engineering Reports

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

Green grant projects

- Energy Audits
- Solar design
- Design projects to increase energy efficiency and reduce water loss
- Feasibility study of bioretention basins

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

Loans for Project Construction

- WIFA offers below market interest rates
  - 3.08% average for governmental
  - 4.97% average for non-governmental
- No application fees or closing costs

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

Two-step loan application process

1. Priority List application (online)
2. Project Finance Application based on "readiness to proceed:"
   - Debt authorized
   - Project designed
   - Plans approved
   - Bids solicited

DW Technical Assistance

Planning and Design Grants

Design and Construction Loans

Green Construction Loans

- Automatic meter reading systems
- SCADA systems
- Variable frequency drives
- Solar panel installation

Peoria Green Project

- Solar photovoltaic panels at Beardsley Water Reclamation Facility
- 26% of total power for operations building

Grand Opening and Solar Informational Fair

Saturday, March 13

Payson Green Projects

- Pipeline repair to reduce water loss
- Hydroelectric design

Water Infrastructure Finance Authority

Melanie Ford
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602-364-1321

Green Projects
Sara Konrad
skonrad@azwifa.gov
602-364-1319

WIFA website: www.azwifa.gov

ADEQ Capacity Development
(free DW Technical Assistance, including energy audits)
Kathy Stevens
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602-771-4653

Grants and Other Funding Opportunities

Greening Water and Wastewater Infrastructure Workshop

Cheryl McGovern

January 12, 2010

www.epa.gov/region09/waterinfrastructure

Mcgovern.cheryl@epa.gov

The Nicest that You'll See is at Your Own Front Door

- Energy Efficient Projects are Cost Effective by Definition

Do you know where your energy dollars are going?

Your energy audit will recommend projects that will pay for themselves – look at ROI

Money saved from reduced energy bills can pay for efficiency projects

Surprise! You may be paying for energy you don't need. Tracking energy turned up $30,000 + from energy company mistake!

Where is the Money?

- Biggest source of funding - Stimulus ARRA – has already been spent
- FY2010 Clean Water SRF draft allotment: $13,901,000 AZ
- FY2010 Drinking Water SRF: $27,259,000
- New SRF Money will include Green Project Reserve – so lets review

What is the Green Project Reserve?

- ARRA legislation:

"That, to the extent there are sufficient eligible project applications, not less than 20 percent of the funds appropriated herein for the Revolving Funds shall be for projects to address green infrastructure, water or energy efficiency improvements or other environmentally innovative activities"

- 4 categories of projects:
  - Water efficiency
  - Energy efficiency
  - Green (stormwater) infrastructure
  - Environmentally innovative

What is Eligible?

- Planning, design and building activities
- Portions of a project – or the entire project – may be green
- EPA has determined that some projects automatically apply – *categorical projects*
  - No business case required in most cases
- In other projects, the green components are not as clear – *require a business case*
- Only the “green” portion of the project can count towards the 20% reserve

1. Water Efficiency

- The use of improved technologies and practices to deliver equal or better services with less water
- Categorical projects are:
  - Installation of water meters (previously unmetered system)
  - Reclamation, recycling and reuse and existing rainwater, condensate, degraded water, stormwater and/or wastewater streams
  - Retrofit or replacement of water us equipment or appliances
  - Efficient landscape or irrigation equipment
  - Systems to recycle gray water
  - Collection system leak detection equipment

2. Energy Efficiency

- The use of improved technologies and practices to reduce the energy consumption of water quality projects
- Categorical projects are:
  - Energy efficient retrofits and upgrades to pumps and treatment processes (including aeration syster
  - Leak detection equipment for treatment works
  - Producing clean power for treatment works on site (solar, wind, hydroelectric, etc.)
  - Solids treatment (e.g., sludge dryers and incinerators, improved anaerobic digestion systems) and handling (e.g., fly ash, lime)
  - Variable frequency drives

- If energy savings are less than 20%, a compelling argument will be needed in the business case to get a green determination

3. Green Infrastructure

- No clear definition of “green infrastructure”. Here, generally means stormwater projects
- Includes a wide range of practices that:
  - Manage and treat stormwater
  - Maintain and restore natural hydrology by infiltrating, evapotranspiring and capturing and using stormwater
- Help maintain pre-development hydrology for discharge rates, frequencies, durations, temperatures etc.
- Can be large or small scale (e.g., wetland restoration to green roofs)
- EPA Green Infrastructure Website: http://cfpub.epa.gov/npdes/home.cfm?program_id=

3. Green Infrastructure, cont'd

- Categorical projects are:
  - Green streets
  - Water harvesting and reuse programs or projects
  - Wet weather management systems for parking areas (e.g., incremental cost of porous pavement, bioretention, green roofs, constructed wetlands)
  - Hydromodification to establish or restore riparian buffers, floodplains, wetlands and other natural features
  - Downspout disconnection to remove stormwater from combined sewers and storm sewers
  - Comprehensive retrofit programs designed to keep wet weather out of all types of sewer systems using green infrastructure technologies and approaches
  - Implementation of comprehensive street tree or urban forestry programs, including planter boxes
  - Green roofs (entire cost is eligible, including necessary structural changes to the building)

4. Environmentally Innovative Projects

- Projects that demonstrate new and/or innovative approaches to managing water resources in a more sustainable way. Includes:
  - § Projects that achieve pollution prevention or pollutant removal at the lowest life cycle cost
  - § Projects that foster adaptation of water protection programs and practices to climate change
- A business case will always be needed to explain the environmentally innovative approaches

4. Environmentally Innovative Projects, cont'd

- Eligible projects are:
  - Green infrastructure/low impact development
  - Wetland restoration and constructed wetlands
  - Decentralized wastewater treatment solutions to existing deficient/failing on-site systems
  - Water reuse projects that reduce energy or water use and treatment costs
  - Redevelopment practices that preserve or restore site hydrologic processes through sustainable landscaping and site design
  - Solid waste composting
  - Implement EPA Green Building practices (http://www.epa.gov/greenbuilding/)

4. Environmentally Innovative Projects, cont'd

- Categorical projects, continued
  - Projects that use water balance approaches (water budgets) at the project, local, or state level that preserve site, local or regional hydrology
  - Projects that facilitate adaptation of clean water programs and practices to climate change
  - Projects that incorporate differential uses of water, based on the level of treatment to reduce the costs of treating all water to potable water standards
  - Projects that identify and quantify the benefits of using integrated water resources management approaches

Example Projects: State of Arizona

- DW
  - 8 projects at $12.9 Million as of 11/2/09
    - Multiple meter installation projects
    - Multiple SCADA application projects
    - Sustainable energy generation
- CW
  - 6 projects at $10.7 Million as of 11/2/09
    - Storm water diversion and retention
    - Multiple Variable flow drive installations
    - Solar energy generation on site
    - Water reclamation and reuse infrastructure

Current EPA Solicitations

- Community Action for a Renewed Environment Program (CARE)
  - Closes March 9, 2010
  - Announcement http://www.epa.gov/air/grants_funding.html
  - Purpose: help communities understand and reduce risks due to toxic pollutants and environmental concerns from all sources
  - $2 million at $75,000 – 100,000 per grant

Current EPA Solicitations

- Source Reduction Assistance Grant Program
- Due February 4, 2010
- $130,000 for Region 9
- $10,000 - $130,000 per award
- Eligible Applicants – State, County, City, Districts, Tribes
- Priorities: Encourage GHG, toxics reductions
- Recycling, energy recovery, treatment projects not eligible

Current DOT Funding

- DOT Federal Transit Administration Urban Circulator Program
- $130 million
- Due Feb. 8, 2010
- Purpose: Support streetcars, buses to connect urban destinations and foster redevelopment of urban spaces into walking, mixed use, high density
- 6 awards anticipated
- http://www.fta.dot.gov/funding/grants_financing_7829.html

Current DOT Funding

- DOT's Federal Transit Administration Livability Bus Program
- $150 million
- Due Feb. 8, 2010
- Purpose: Capital projects to replace, rehabilitate, and purchase buses
- Selection Criteria: does it make a more environmentally sustainable transportation system, improve energy efficiency, reduce GHGs
- http://www.fta.dot.gov/funding/grants_financing_7829.html

Recent EPA Grant Opportunities

- **Local Climate and Energy Program**
- $10 million in Climate Showcase Communities grants to establish and implement climate change initiatives
- Proposals were due July 2009
- July 2010 Proposals Due $200,000 per Grant
- http://www.epa.gov/RDEE/energy-programs/state-and-local/showcase.html
- Environmental Education – closed 12/31/09

Other Government Incentives

- US Department of Treasury
  - Allows taxpayers eligible for federal business energy investment tax credit to receive a grant instead of the tax credit (could be used by partnering company)
  - Clean Renewable Energy Bonds (Muni Bonds)

    Certain entities, mostly public sector, may use CREBs to finance renewable energy projects. CREBs are issued, theoretically with a “0%” interest rate. The borrower pays back only the principal of the bond and bondholder receives federal tax credits in lieu of bond interest. Not for energy retrofits, all 2010 allocations are spoken for $2.2 billion.
  - Qualified Energy Conservation Bonds. Same as CREBs but can fund energy retrofits and private projects. Allocations go to cities and counties over 100,000 and they should still be available.

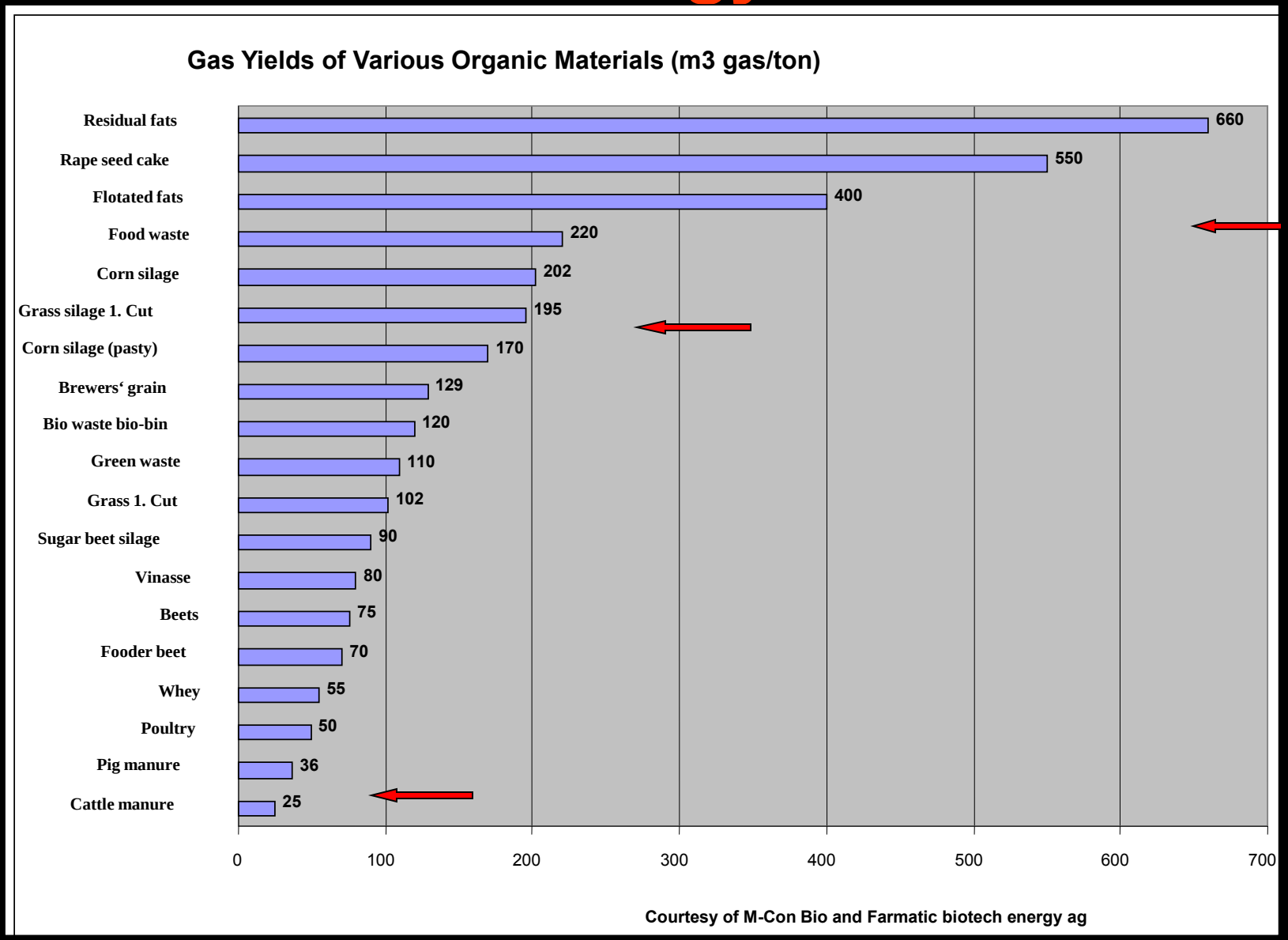
Grant Project Example
East Bay Municipal Utility District

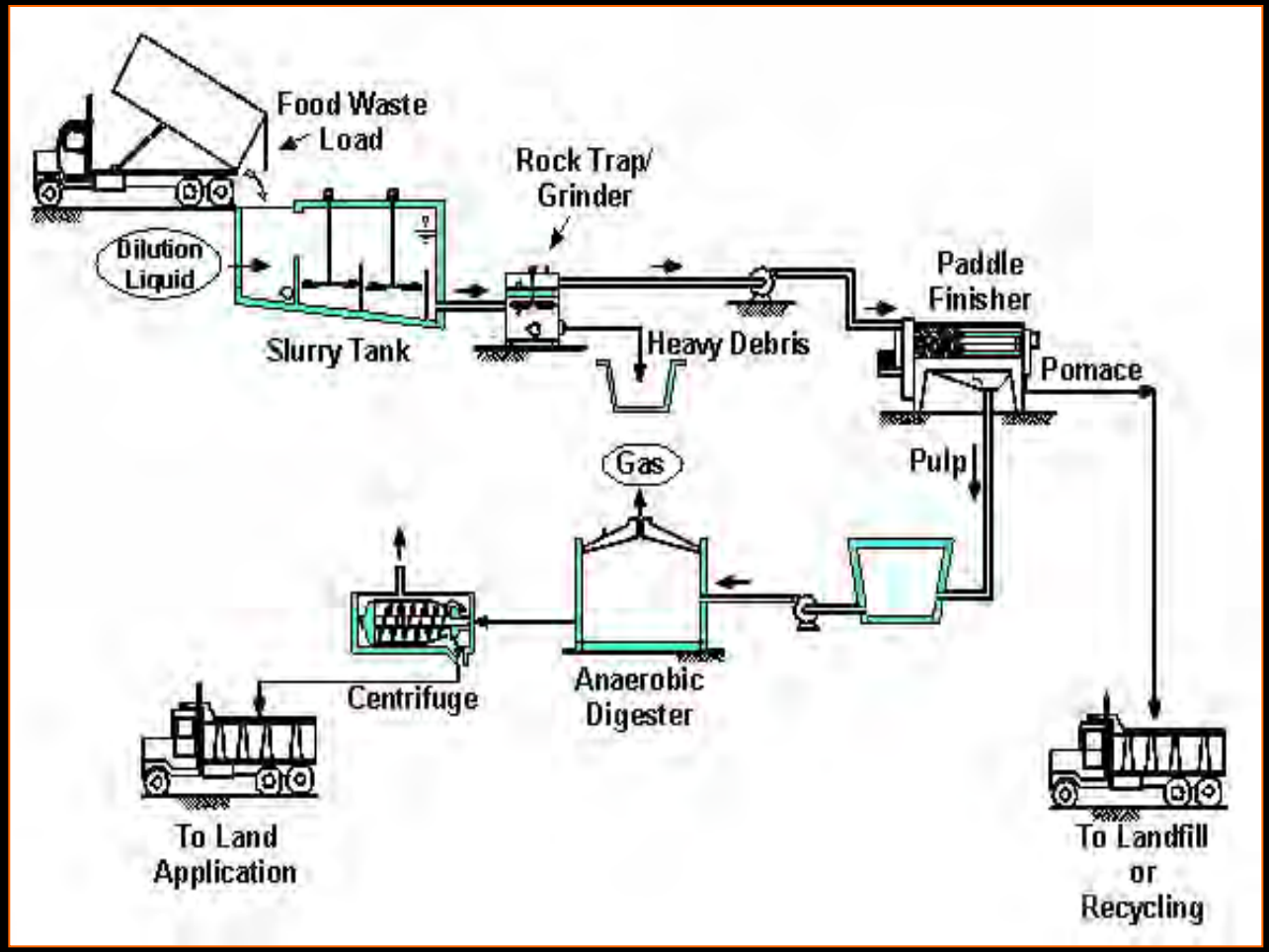
- Project funded through an EPA Region 9 grant
- Pilot study researching:
  - Volatile solids destruction rates
  - Temperature regimes
  - Solids residence times
  - Methane production
- GREAT RESULTS!!!!!

Source Reduction Assistance Grant
Anaerobic Digestion at Wastewater Treatment Facilities

- Ideal for urban areas
- Avoid permitting difficulties
- Excess Capacity
- Expertise on site
- Biogas utilization
- VOC Reduction
- Effluent disposal
- Potential to reduce 15% of landfill waste

Food Waste Has Valuable Energy!




Food Waste
Load
Rock Trap/
Grinder
Dilution
Liquid
Slurry Tank
Heavy Debris
Paddle
Finisher
Pomace
Pulp
Gas
Centrifuge
Anaerobic
Digester
To Land
Application
To Landfill
or
Recycling

Summary

- Food waste is a very valuable product
- We need finished compost to return to the soil to have a closed-loop, sustainable system
- However, the energy value in the food should first be utilized
- Europe has banned food waste from landfills

Potential Funding Opportunities Jobs for Main Street Act of 2010

- Recent legislation passed by Senate
- Proposes $75 billion in TARP (Troubled Asset Relief Program) savings fund infrastructure and job investments
  - $2 billion to help communities provide clean and safe water for citizens and the environment to assist more than 670 communities access the programs.
  - $100 million to the Bureau of Reclamation for reliable drinking water to rural areas and adequate water supply to drought impacted areas
  - $2 billion to DOE to promote rapid deployment of renewable energy and electric transmission projects

Clean

Reliable

Competitive

Integrated

Power Purchase Agreements & Other Innovative Approaches

January 12, 2010

MAG Greening Water & Wastewater Infrastructure Workshop

By Guy Carpenter (HDR) and Mark Reader (Stone & Youngberg)

HDR

ONE COMPANY | *Many Solutions*®

Why are we here?

The character of a society is the cumulative result of the countless small actions, day in and day out, of millions of people.

- Duane Elgin

HDR

Our Goals

- Help you brainstorm where opportunities might exist
- Leave you with a better understanding of how to fund & finance a project
- Make the connections between your concepts and a completed project
- Describe the mechanisms for funding, and the advantages & pitfalls

HDR

Your Goals

Higher

Where does your organization fall on this continuum?

Lower

- Restoration
- Design for sustainability
- Corporate social responsibility
- Integrated systems management
- Environmental cost accounting
- Resource productivity
- Reduce carbon footprint
- Stakeholder participation
- Material efficiency (recycling and reuse)
- Pollution prevention / waste minimization
- Impact reduction (EM&CP)
- Pollution control
- Compliance with regulations

Choosing the Right Shade of "Green"

HDR

What's Your Dream?

- Energy/Facility Audits
- In-pipe turbines
- Solar panels
  - Reservoirs
  - Floating on recharge basins
  - Landfills
- Wind and wave powered desalination
- Gas powered drivers for WTP pumping
- Solar thermal desalination with combined heat and power generation
- Small scale open-channel hydro power
- Fuel cell evaluations
- Cogeneration
- Biosolids to solid fuel (EnerTech process)
- Pumped storage for hydro power generation and for desalination
- Energy Service Companies
- FOG to biodiesel

HDR

Wind Powered Desal – Large Scale

- Perth, Australia:
  - 10-20% reduction in rainfall in past 30 years
  - Needed new water source
  - Seawater Reverse Osmosis
  - 38 MGD: $324M (2006)
  - 82 MW detached wind farm provides renewable energy source on grid

    Wind farm: 272 GWh/year

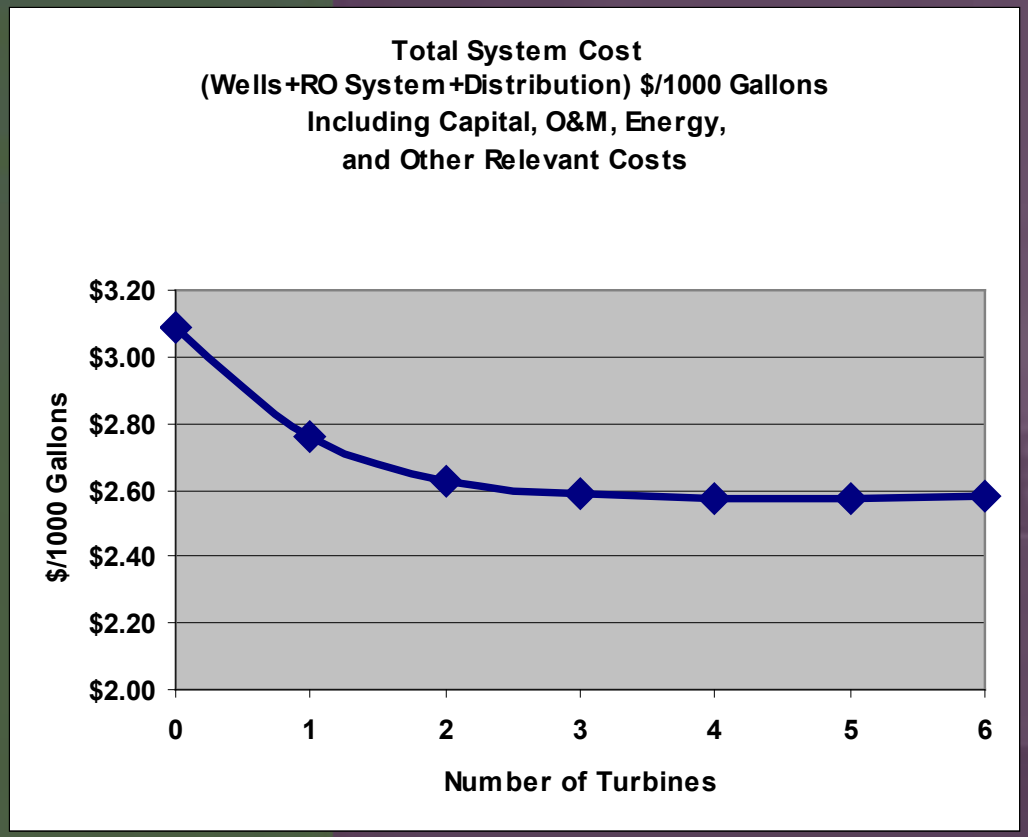
    SWRO demand: 185 GW/year
  - ERI isobaric energy recovery devices

Costs

- Capital
  - Desalination Plant $324 million
  - Connecting System (IWSS) $63 million
  - Total $387 million
- Operating and Maintenance
  - Desalination and transfer pumps+ membranes$ 19 million/year
- Unit Costs
  - Total Unit Cost $ 1.16/kL
  - Fence Unit Cost $ 1.00/kL (US $0.75/kL)

Source: D&WR Quarterly, November / December, 2006

Wind Powered Desal – Small Scale

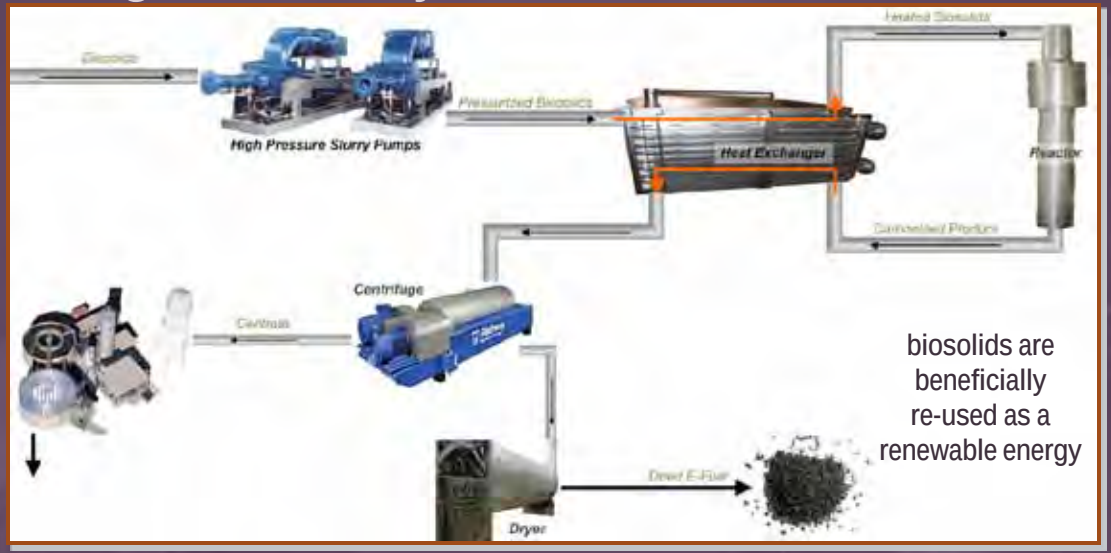


- 3 MGD; Seminole, TX
- 2000 ppm TDS feed water
- Santa Rosa formation, ~1200 feet deep
- Traditional energy use for water treatment with RO - $3.10/1000 gal
- Wind energy drives the cost down to $2.60/1000 gal

Source: Michael Hightower, Sandia National Labs

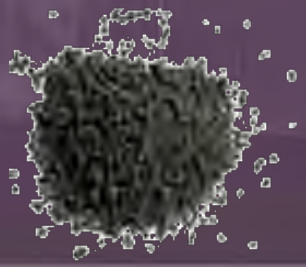
Managing Biosolids: SlurryCarb

A technology that applies heat and pressure to biosolids in order to improve their mechanical dewatering efficiency



biosolids are beneficially re-used as a renewable energy

The product E-Fuel is used as a replacement for fossil fuels such as coal



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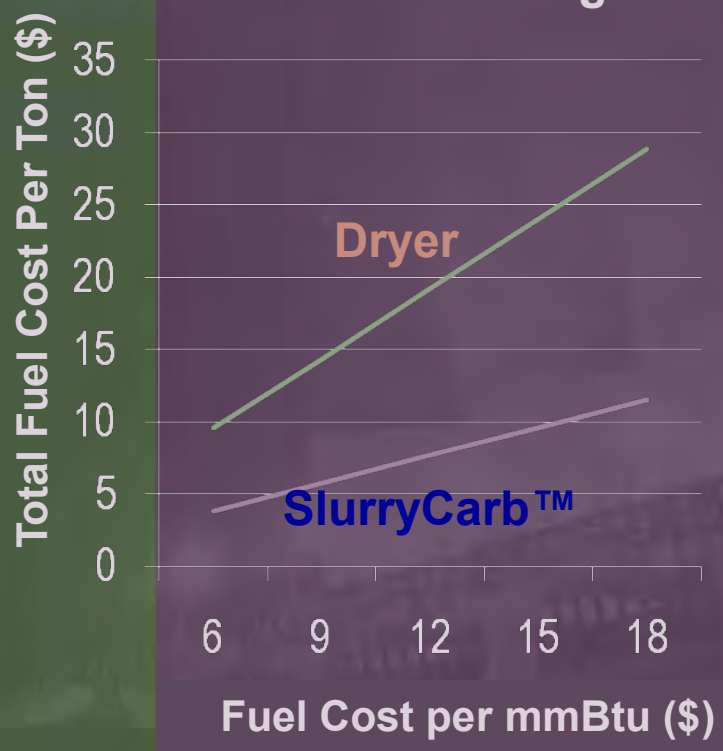
Managing Biosolids: SlurryCarb

Fuel Cost Savings



Assumes 80% H_20 biosolids

Energy Consumption

	H_2O Evaporated	Total Energy
Drying	80 tons	160,000,000 Btu
SlurryCarb	18 tons	64,000,000 Btu

Assumes 100 tons of biosolids at 80% H_20

- SlurryCarb™ process requires 60% less fuel per ton compared to a conventional dryer

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FOG to Biodiesel

Lee County Biodiesel Processing Facility Design and Permitting Services, Florida

- HDR is providing design and permitting services for a 120,000-gallon-per-year B100 biodiesel processing facility.
- Fuel sources come from available waste vegetable oils and other potential feedstocks.
- The renewable fuel produced will be blended with petroleum diesel fuel used by the county's vehicle fleet in an effort to reduce air emissions.

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The Proper Steps

- Conceptualize
  - Have you performed a holistic audit/evaluation?
  - What resources do you have?
  - Where are your needs?
  - Opportunities to connect resources to needs?

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The Right Steps

- Conceptualize
- Perform Feasibility Study
  - Where can I put it / do I have enough space?
  - What partners do I have / need?
  - What benefits are gained now? Later?
  - What's missing?
  - Understand and quantify the risks/rewards (SROI)
    - Quantify non-monetary elements
  - <u>Determine the economics (TBL) of the solution independent of the funding & financing</u>

HDR

The Right Steps

- Conceptualize
- Perform Feasibility Study
- Evaluate Funding & Finance Mechanisms
  - Inherent Cost Savings
    - Pay attention to effect on rate plans
    - Immediate savings may come from other part of solution
  - Federal & State Grants
  - Clean Renewable Energy Bonds (tax credit)
  - Qualified Energy Conservation Bonds (tax credit)
  - Low Cost Loans
  - Utility Credits
  - Power Purchase Agreements

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Power Purchase Agreement is Last…

- Power Purchase Agreement (PPA)
  - Power provider builds infrastructure and produces energy on host's site
  - Provider sells power to the host at a contract price for a term
  - Host may be able to purchase assets at end of term
- PPAs' finest hour may have come and gone
- Get's you "green", but may not be smartest long term move
- Mark Reader w/ Stone & Youngberg is here to tell you why…

HDR

Municipal Financing Options for Renewable Energy and Energy Efficiency Projects

MAG Greening Water and Wastewater Infrastructure Workshop

January 14, 2010

Presented by:
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S&Y STONE & YOUNGBERG

San Francisco Los Angeles San Diego New York Chicago Phoenix Richmond Annapolis Big Bear

Key Factors for Consideration

- What is the goal?
  - Superior economics?
  - Policy desire for green energy?
- Future rates under a “do nothing” scenario (Business as Usual)
  - Assumed growth rate will impact feasibility of solar facility
- How to best utilize available subsidies
  - Direct ownership versus 3rd party ownership
- Potential technological changes making solar generating system comparatively less advantageous
  - For example, “VHS vs Beta”

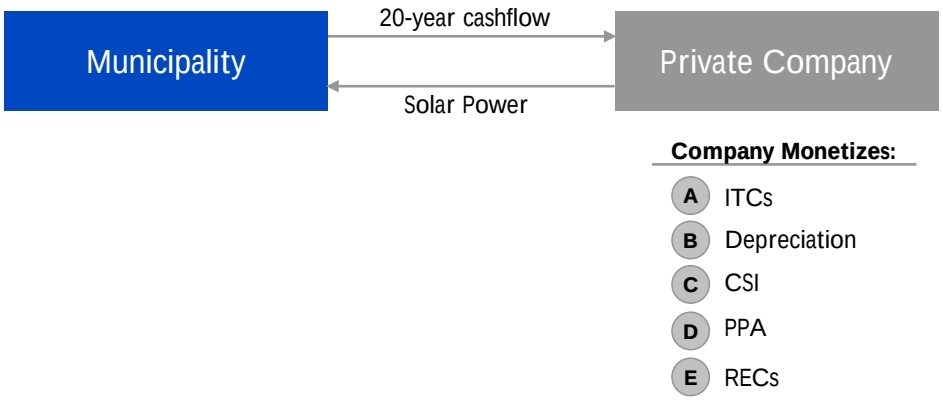
Federal Subsidies for Tax Paying Entities

- Federal Investment Tax Credits (ITCs)
  - Available to tax-paying entities who invest in renewable energy facilities
  - Authorized in American Recovery and Reinvestment Act of 2009 (“ARRA”)
  - ITCs equal 30% of the total eligible facility costs
- Depreciation
  - ARRA permits a 5-year depreciation using the Modified Accelerated Cost Recovery method (“MACR”) with a 50% bonus depreciation in the first year if the system is operational by end of 2009
  - Pursuant to the MACR formula, the majority of the facility (52%) is depreciated in the first 2 years
  - Only tax-paying entities are able to receive the tax savings resulting from the depreciation of an asset

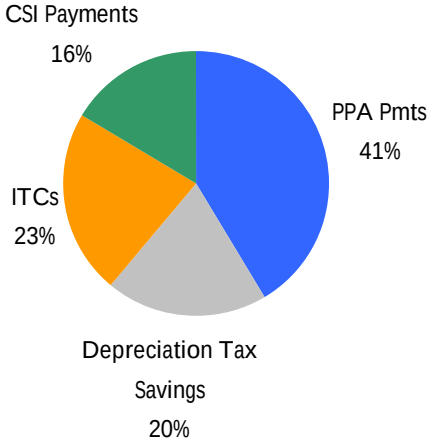
Private Ownership of Municipal Facilities

- Power Purchase Agreement (PPA)
  - Enables public entities to share in ability to monetize tax subsidies
  - Private entity owns facilities
  - Public agency purchases power for 20 years at a contractual rate
- Economic viability of PPA
  - Depends on rate of return investors in the PPA are seeking
  - After-tax rate of return has fluctuated from 7% to 14+% and is highly dependent on the tone of the overall financial markets
- Comparison of PPA to BAU
  - In today's market, may require upfront payment to "buy down" PPA price to make it competitive vs BAU

PPA Structure



Approximate Capital Source for
Private Party Financed Solar Projects



Public Ownership Funding Alternatives

- Traditional municipal bonds & WIFA programs
  - Bonds can be either conventional tax-exempt or Build America Bonds
  - Maximum advisable maturity typically 25 years based on useful life of asset
- Bank loan
  - Maximum maturity acceptable by banks is typically 15-20 years
- Repayment source for loans
  - Requires creditworthy repayment source (such as general fund, enterprise fund)
- California Energy Commission (CEC) loan program [Example: – AZ Program?]
  - Up to $3 million maximum loan with interest rate of 3%
  - Bond repayment term up to 15 years
  - Must demonstrate ability to repay loan from energy cost savings
- Tax credit bonds
  - Investor receives tax credit and possibly supplemental coupon
  - Bond maturity 14-17 years as determined by U.S. Treasury

Federal Subsidies for Municipalities

- Tax Credit Bonds
  - In theory, structured with principal payment only
  - Tax credit offered to investor in lieu of interest payment
    - Credit realized on a quarterly basis, recognized as income on federal return, carries over
    - Credit may be stripped (pursuant to pending federal regulations)
  - U.S. Treasury sets tax credit rate and maximum maturity date
  - Most tax credit bonds sold with a supplemental coupon

- New Clean Renewal Energy Bonds (New CREBs)
  - $2.4 billion split among three issuer groups
    - Governmental entities, Electric co-ops, Public power providers
  - Allocated by competitive process, awarded on October 27, 2009

- Qualified Energy Conservation Bonds (QECBs)
  - Issued by state and large local governments (population ³ 100,000)
  - $3.2 billion allocated nationally by formula

New Clean Renewable Energy Bonds

- What are New CREBs?
  - Tax credit to finance qualified renewable energy facilities
  - Tax credit capped at 70% of published tax credit rate
- Volume Cap Amount
  - $2.4 billion
- Issued by Qualified Issuers
  - Public power providers, cooperative electric companies, clean renewable energy bond lenders or not-for-profit electric utilities[(1)]
- Use of Proceeds
  - Capital expenditures incurred by "qualified owners" for one or more "qualified renewable energy facilities"
  - Qualified owners are governmental bodies, public power providers and cooperative electric companies

(1) Includes only not-for-profit electric utilities that have received a loan or loan guarantee under the Rural Electrification Act

New CREBs – Use of Proceeds

- "Qualified renewable energy facilities" include:
  - Wind energy facilities
  - Closed-loop biomass facilities
  - Open-loop biomass facilities
  - Geothermal energy facilities
  - Solar energy facilities
  - Small irrigation power facilities
  - Landfill gas facilities
  - Trash combustion facilities
  - Qualified hydropower facilities
  - Marine and hydrokinetic renewable energy facilities

New CREBs – Allocation Methodology

- $2.4 billion to be split in thirds
  - Qualified projects owned by governmental bodies, cooperative electric companies and public power providers
- Governmental and cooperative electric companies
  - Allocations based on a smallest to largest methodology
- Public power providers
  - Allocations based on pro-rata amount requested (ratio of individual project request to all project requests)

(1) Including the use of loans, grants, or other repayment mechanisms to implement such programs

New CREBs – Applications

- Deadline was August 4, 2009
- Applications must include:
  - Information regarding the qualified owner, the qualified issuer and the project (qualified renewable energy facility that will be funded)
  - A certification from an independent, licensed engineer
    - In general, engineer certifies that the project will (i) meet the requirements for a "qualified facility" under § 45(d)*, (ii) be technically viable, and (iii) produce electricity
    - Additional certifications are required for certain qualified hydropower facility projects
  - Other relevant information (prior allocations, plan of finance, etc)
- Form of application is available on the IRS website:
  - http://www.irs.gov/pub/irs-drop/n-09-33.pdf

*But without regard to § 45(d)(8) and (10) and to any placed-in-service date.

Case Study: City of Palo Alto CREBs

City of Palo Alto $1,500,000 Clean Renewable Energy Bonds

- Security:
  - Subordinate pledge of the City's Electric Net Revenues
- Use of proceeds:
  - $1.3 million towards a 250 kilowatt solar photovoltaic panel system
- Structure:
  - 15 year term, priced at a discount to par
  - CREBs tax credit rates ranged from 4.81% to 5.64%
  - Equal annual repayments of $100,000 in principal
  - Investor receives principal payments and tax credit (in lieu of interest) from the IRS
  - Tax credit is calculated as interest would be
    - CREB rate (%) x par amount
- Stone & Youngberg Role
  - As placement agent for the sale, Stone & Youngberg assisted the City in drafting the initial application to the IRS for the CREBs allocation, structuring the credit and securing a buyer for the bonds

Tax Credit Bonds (non-BAB), Generally

$10,000,000 TAX CREDIT BONDS (Non BABs)

Issuer's Theoretical Cashflow Comparison (Tax Credit versus Tax-Exempt)

	Tax Credit Scenario					Tax-Exempt Scenario		
Year	District Sinking Fund Deposit	Less: Principal Payment to Investor	Less: Interest Payments to Investor Est. @ 2.0%	Sinking Fund Interest Earnings Est. @ 3.0%	Sinking Fund Ending Balance	Principal	Interest Est. @ 5.0%	Estimated Annual Payment
1	$737,666		($200,000)		$537,666	$465,000	$500,000	$965,000
2	737,666		(200,000)	$16,130	1,091,462	485,000	476,750	961,750
3	737,666		(200,000)	32,744	1,661,871	510,000	452,500	962,500
4	737,666		(200,000)	49,856	2,249,393	535,000	427,000	962,000
5	737,666		(200,000)	67,482	2,854,541	565,000	400,250	965,250
6	737,666		(200,000)	85,636	3,477,843	590,000	372,000	962,000
7	737,666		(200,000)	104,335	4,119,844	620,000	342,500	962,500
8	737,666		(200,000)	123,595	4,781,105	650,000	311,500	961,500
9	737,666		(200,000)	143,433	5,462,204	685,000	279,000	964,000
10	737,666		(200,000)	163,866	6,163,736	720,000	244,750	964,750
11	737,666		(200,000)	184,912	6,886,314	755,000	208,750	963,750
12	737,666		(200,000)	206,589	7,630,569	795,000	171,000	966,000
13	737,666		(200,000)	228,917	8,397,152	830,000	131,250	961,250
14	737,666		(200,000)	251,915	9,186,732	875,000	89,750	964,750
15	737,666	($10,000,000)	(200,000)	275,602	0	920,000	46,000	966,000
	$11,064,987	($10,000,000)	($3,000,000)	$1,935,013		$10,000,000	$4,453,000	$14,453,000

Estimated Savings from Tax Credit Bond Scenario:

$14,453,000	Estimated Total Payments of Tax-Exempt Scenario
(11,064,987)	Estimated Total Payments of Tax Credit Scenario
$3,388,013	Estimated Future Value Savings
$2,343,281	Estimated Net Present Value Savings (@ 5.0% discount rate)

Qualified Energy Conservation Bonds

- What are QECBs?
  - Tax credit to finance "qualified conservation purposes"
  - Tax credit rate capped at 70% of published rate
  - Issued by state and local governments
- Allocation
  - $3.2 billion nationally
  - Allocations to states and large local governments (with a population ³ 100,000) based on population
- Use of Proceeds
  - 100% of available project proceeds(1) must be used for "qualified conservation purposes"

(1) Available project proceeds (APP) are proceeds from the sale of the issue less issuance costs (not to exceed 2%)

QECBs Use of Proceeds

- Capital Expenditures for:
  - Reducing energy consumption in public buildings by at least 20%
  - Implementing green community programs(1)
  - Rural development involving production of electricity from renewable energy resources
  - All Internal Revenue Code 45(d) "qualified facilities" without regard to placed-in-service dates, e.g. wind, solar, geothermal, biomass, landfill gas & hydro (does not include refined coal or Indian coal)
- Research facility expenditures and research grants for:
  - Cellulosic ethanol and nonfossil fuel development
  - Technologies to capture and sequester carbon dioxide produced through the use of fossil fuels
  - Increasing efficiency of existing technologies for producing non-fossil fuels
  - Automobile battery technologies and other technologies to reduce fossil fuel consumption in transportation
  - Technologies to reduce energy use in buildings

(1) Including the use of loans, grants, or other repayment mechanisms to implement such programs

QECBs Use of Proceeds, continued

- Mass commuting & related facilities to reduce energy consumption, including expenditures to reduce pollution from vehicle used for mass commuting
- Demonstration projects designed to promote the commercialization of:
  - Green building technology
  - Conversion of agricultural waste for use in the production of fuel or other purposes
  - Advanced battery manufacturing technologies
  - Technologies to reduce peak use of electricity
  - Technologies for the capture & sequestration of carbon dioxide emitted from combusting fossil fuels in order to produce electricity
- Public education campaigns to provide energy efficiency

QECBs - Allocations

- Allocations to States
  - Pro-rata based on population as of July 1, 2008
    - http://www.census.gov/popest/states/tables/NST-EST2008-01.xls
  - Arizona = $67.436 million
- Allocations to Large Local Governments (LLGs)
  - LLGs are any city or county that has a population ³ 100,000[1]
  - LLG allocations based on proportional population within State based on population as of July 1, 2007
    - http://www.census.gov/popest/estimates.html
    - Population used for county allocations must exclude the population of any net LLGs within the county

1. Indian Tribal Governments (ITGs) shall be treated as a LLG, except that (a) an ITG shall be treated as located w/in a State to the extent of so much of the population of such government resides within the State & (b) any bond issued by an ITG shall be treated as a QECB only if issued as part of an issue the APP of which are used for purposes for which such ITG could issue bonds to which §103(a) applies.

QECBs – Other Requirements

- Private Activity Bond Requirements
  - At least 70% of the allocation to any State or LLG must be designated for bonds that are not private activity bonds
  - Proceeds of private activity QECBs can only be used for capital expenditures
- Exception for green community programs
  - QECBs issued to provide funding mechanisms for capital expenditures to implement green community programs are not treated as private activity bonds

Summary of Energy Financing Alternatives

Structure	Ownership	Term *	Subsidies Available	Current Market
Power Purchase Agreement (PPA)	Private entity Public agency has option to purchase Who owns RECs?	20 – 25 years	ITCs Depreciation	May not be an economically viable alternative in current market
Traditional municipal bonds	Public agency owns solar asset Public agency owns RECs	Up to 25 years	Tax-exempt interest or BAB subsidy	25 year amortization provides annual cash flow flexibility
Tax credit bonds (QECBs and CREBs)	Public agency owns solar asset Public agency owns RECs	14-17 year max	Tax credit bonds	Provides lower cost financing Shorter maturity causes cash flow limitations Tax credit bond market "developing"

* Assumes 25-year useful life of asset for all scenarios

Concluding Considerations

- Economic benefits of renewable energy financings should be carefully evaluated
  - Many renewable energy pitches are based on high future energy cost growth rates
  - Changing market dynamics affect competitiveness of PPAs
- Available subsidies can influence preferred alternative
  - Hybrid municipal bond approaches using some combination of Tax Credit Bonds, BABs, or tax-exempt fixed rate bonds may be viable alternative
  - In today's market, self-ownership structures are often more cost effective than Power Purchase Agreements
- Stone & Youngberg provides unique expertise to deliver creative cost-effective renewable energy financing solutions

Summary of ARRA Bond Provisions

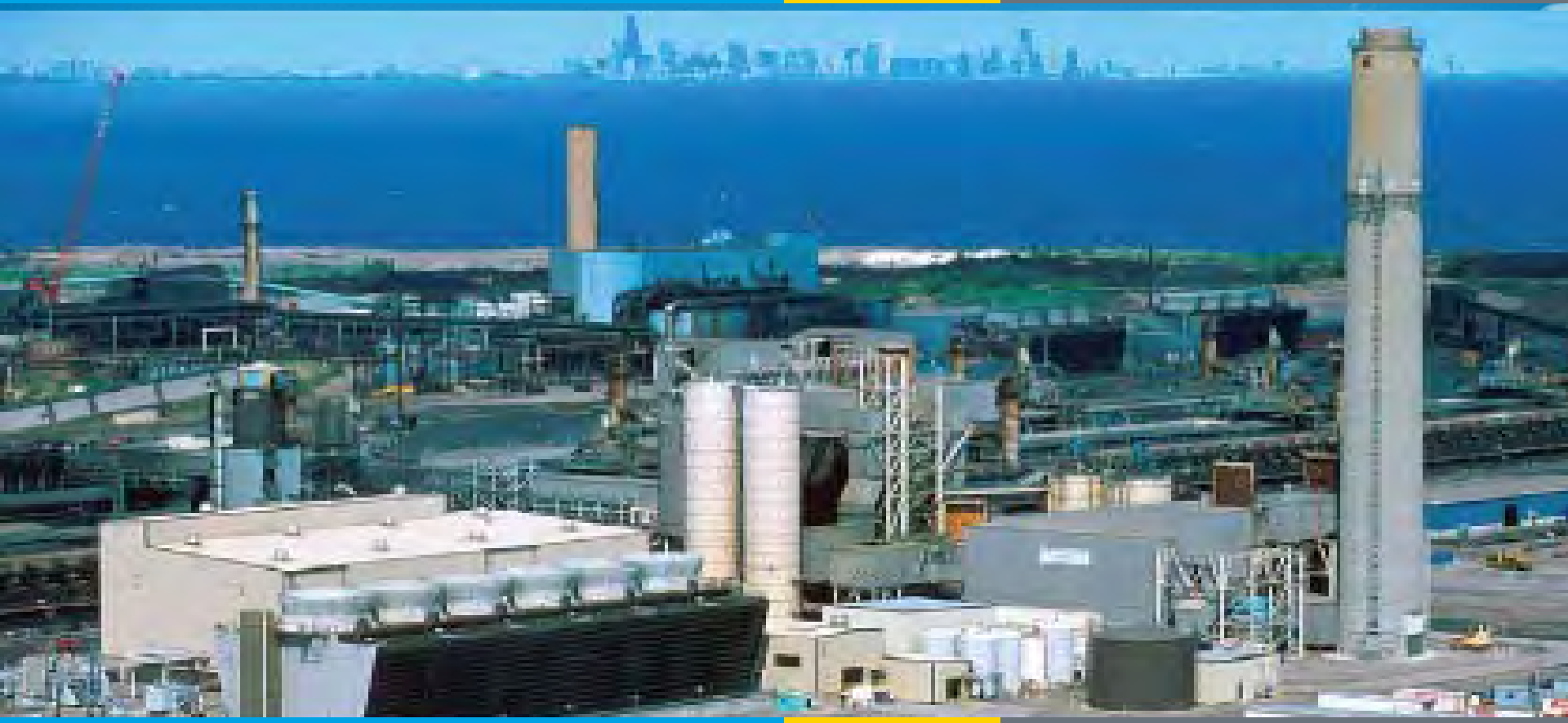
Name	National Allocation	Allocation Method	Use of Proceeds	Federal Income Tax Treatment*	Special Restrictions
Taxable Bonds					
Build America Bonds (BABs)	Unlimited for bonds issued by State and local governments, including school districts before January 1, 2011	Not applicable	Any purpose otherwise also eligible for tax-exemption (no private activity bonds)	Taxable, 35% interest subsidy paid to issuer by Treasury or as tax credit to investor	Refundings not eligible use of proceeds for issues where 35% interest subsidy is paid to issuer; refundings are eligible for issues where 35% tax credit is paid to investor
Recovery Zone Economic Development Bonds (RZEDBs)	$10 billion State and local governments, expires January 1, 2011 AZ = $408 million (est.)	Through States, then to counties & cities with populations [3] 100,000 in proportion to 2008 employment loss	Any purpose otherwise also eligible for tax-exemption, including job training & education (no private activity)	Taxable, 45% interest subsidy paid to issuer by Treasury	Formation of Recovery Zone (area determined by the issuer to be in general economic distress or meeting certain other criteria); Refundings not an eligible use of proceeds
Tax Exempt Bonds					
Recovery Zone Facility Bonds (RZFBs)	$15 billion State and local governments, expires January 1, 2011	Through States, then to counties & cities with populations [3] 100,000 in proportion to 2008 employment loss	Certain private activity purposes (excluding land, residential rental, gambling, liquor, golf, etc.)	Tax-Exempt	Formation of Recovery Zone (area determined by issuer to be in general economic distress or meeting certain other criteria); Refundings not an eligible use of proceeds
Tax Credit Bonds					
New Clean Renewable Energy Bonds (New CREBs)	$2.4 billion total, including 1/3 each to 1) public power providers, 2) governmental bodies & 3) electric cooperatives	IRS applications due by 8/4/09; 1/3 max each to 1) public power providers 2) governmental bodies & 3) electric coops	Wind, solar, geothermal, biomass, landfill gas & hydro energy facilities	Tax credit @ 70% of published Federal Tax Credit Rate	Refundings not an eligible use of proceeds
Qualified Energy Conservation Bonds (QECBs)	$3.2 billion to States and local governments AZ = $67.4 million	Pro-rata by population to States and then to local governments with populations [3] 100,000	Energy reduction in public buildings, green community lending programs, energy research, commuter facilities, education, etc.	Tax credit @ 70% of published Federal Tax Credit Rate	Not less than 70% of allocations must be used for non-private activity bonds; Refundings not an eligible use of proceeds

Tax credits may be stripped from the bonds and assigned to a separate owner. Tax credit bonds (except BABs) have a maximum maturity length (published daily on the Bureau of Public Debt website at https://www.treasurydirect.gov/govt/rates/irs/rates_qtcb.htm). The maturity length has ranged from 14 to 16 years in recent years.

Does not include additional Tax Credit Bond programs available to School Districts (Qualified Zone Academy Bonds and Qualified School Construction Bonds)

U.S. Department of Energy Assistance Opportunities:

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



MAG Greening Water and Wastewater Infrastructure Workshop, Phoenix AZ

Patti Case

US DOE Clean Energy Center, Intermountain Region

On Deck

- Goals
  - Resources for you/your operations
  - Provide information that we hope you will pass along to your "clients" - Commercial and Industrial End Users
- Path
  - Just a bit about DOE overall then "drill down"
  - Energy Efficiency and Renewable Energy
  - Industrial Technologies Program
  - Clean Energy Centers –Intermountain in particular
  - Other Technical Assistance

US Department of Energy

- A **Huge** entity with a broad mission
  - Science & Technology
  - Energy Sources
  - Energy Efficiency
  - Environment
  - Information/prices & trends
  - National Security
  - Safety and Health

Offices

- Civilian Radioactive Waste management
- Electricity Delivery and Energy Resources
- Energy Efficiency and Renewable Energy
- Environmental Management
- Fossil Energy
- Legacy Management
- Nuclear Energy
- Science

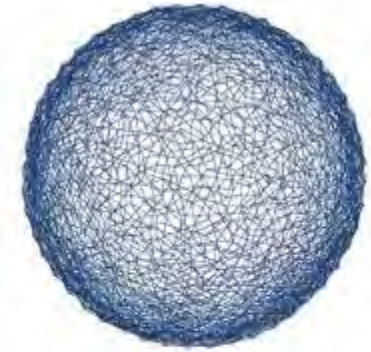
Program Areas

- Biomass
- Buildings
- Federal Energy Management
- Geothermal
- Hydrogen & Fuel Cells
- Industry
- Solar
- Vehicles
- Weatherization and Intergovernmental
- Wind & Hydro Power

Global Energy Issues in 2009

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Economic downturn
- Uncertain demand for products
- U.S./Worldwide Stimulus activities
- Energy price volatility
- International climate change negotiations
- New energy/climate legislation/policy

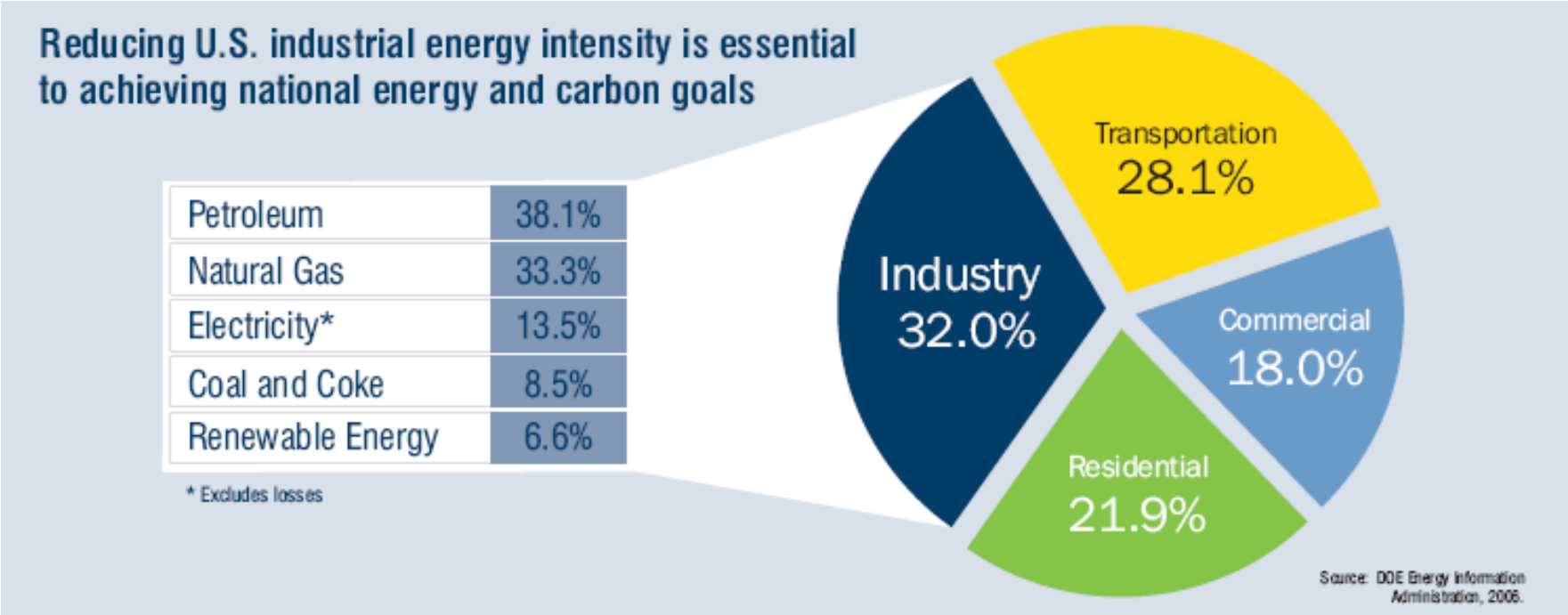


COP15
COPENHAGEN
UNITED NATIONS CLIMATE CHANGE CONFERENCE 2009

DOE - Industrial Technologies Program

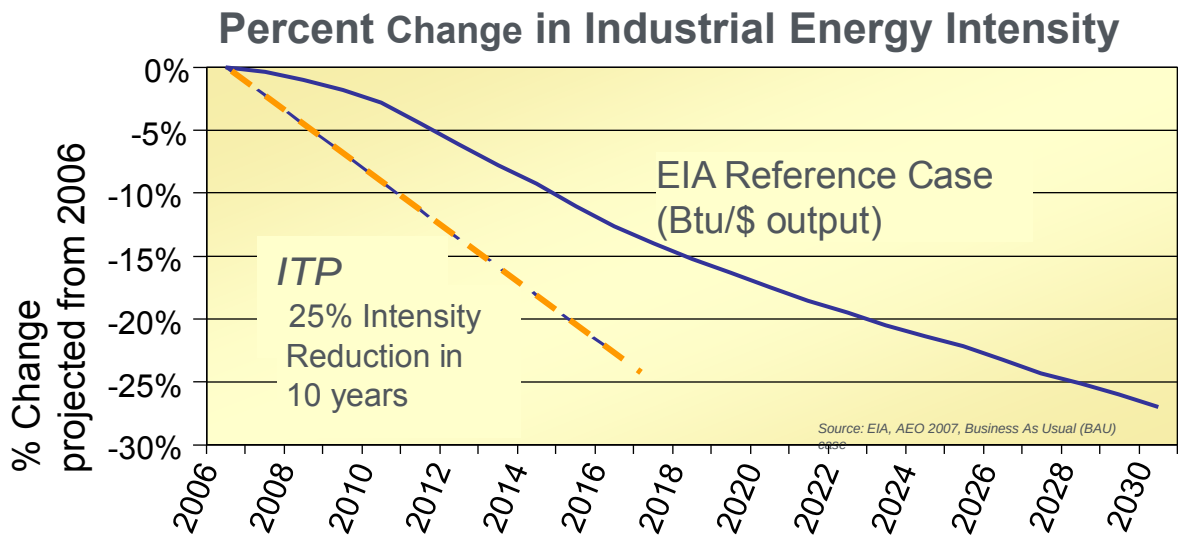
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Mission: Improve national energy security, climate, environment, and economic competitiveness by transforming the way U.S. industry uses energy.



ITP Strategic Objectives

- Reduce industrial energy intensity by 25% in 10 years
- Establish the U.S. as the Global Leader in Energy Management



Energy Efficiency R&D

Develop cross-cutting technologies that address the top energy savings opportunities across industry

Save ENERGY Now

Technology Delivery

Help plants save energy today by assessing opportunities and facilitating adoption of best energy management practices and efficient new technologies

DOE ITP FY'09 Budget: $100M

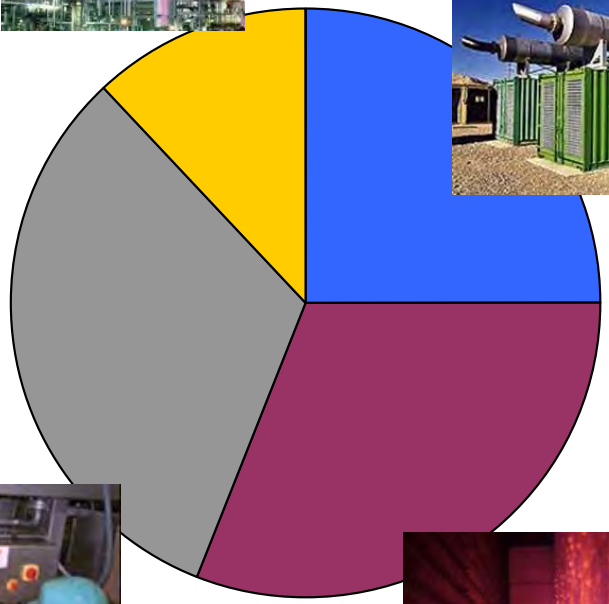
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

12% Industry-Specific

R&D addressing top priorities in America's most energy-intensive industries, incl. chemicals, steel, and forest products

25% Industrial Distributed Energy

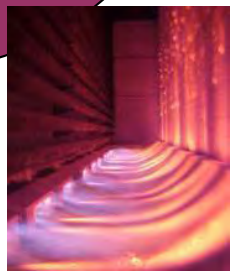
Activities to spur widespread commercial use of CHP and other distributed generation solutions



32% Industrial Technical Assistance

Helping plants save energy today using efficient energy management practices and efficient new technologies

31% Other Crosscut



R&D to develop technologies applicable to multiple industrial subsectors

DOE Project Funding

- **Recovery Act Funding Solicitation: CHP, District Energy, Waste Heat Recovery, and Ind. EE**
  - **< $200 Million Available**
  - **Received 367 Applications requesting $3.8 Billion Federal Funds for $9 .2 Billion total project investment (25 X more than available)**
  - **9 Projects Selected Include: CHP, Waste Heat, Landfill gas, Industrial Energy Efficiency**
- **DOE ITP CHP Demonstration Solicitation: Closed July 21,2009**

Top Initiative: Save Energy Now LEADER

- Voluntarily pledge to reduce energy intensity by 25% or more over 10 years
- Make continuous improvements in energy efficiency and carbon reduction as part of robust business strategy
- Gain enhanced access to enabling resources: tailored technical assistance, training, assessments, and more
- Receive high-level recognition for participation and achievements

A 25% reduction in industrial energy intensity is equal to the total energy consumed in the State of California in all sectors each year— 8.4 quads annually.

Reduces energy costs and carbon emissions today

Meets EPAct 2005 requirement for voluntary industry commitments to reduce energy intensity (Section 106)

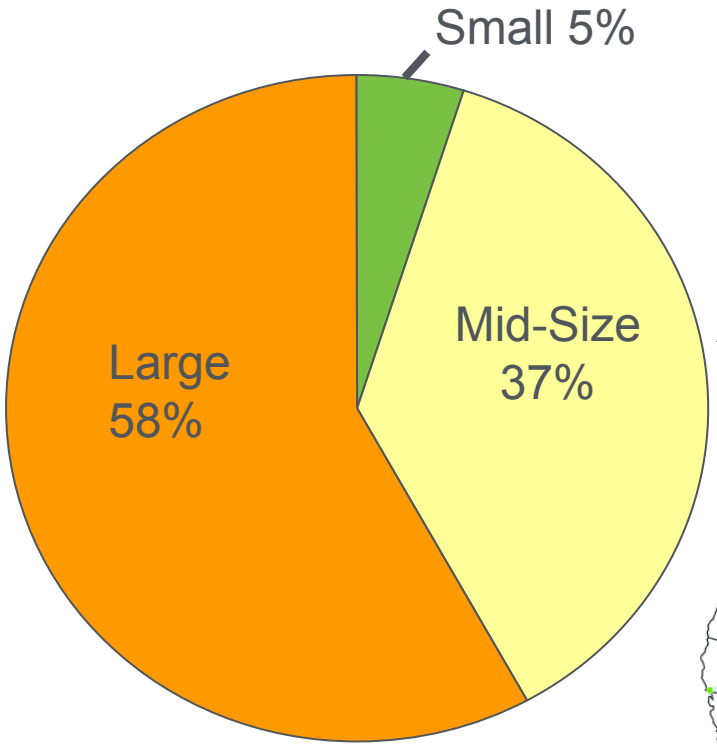
It's all about producing more with the energy used.

ITP Save Energy Now Assessments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

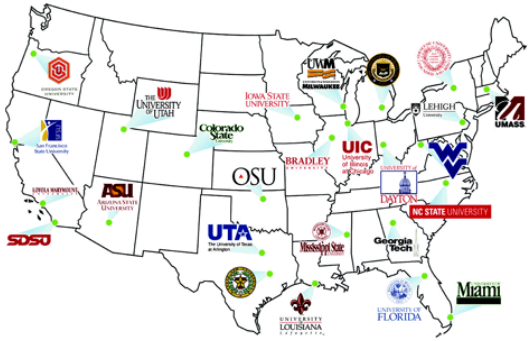
4,014 large plants use 58% of the energy

Energy Saving Assessments (System focused)



Industrial Assessment Centers (IAC)

Cross-Cutting Energy Assessments



Save ENERGY Now

Total Plants Assessed:	**2,098**
Identified Cost Savings:	**$1.2 billion**
Identified Energy Savings:	**134 trillion Btu (NG)**
Identified CO_2 Savings:	**10.5 million MT**

Combined Heat and Power

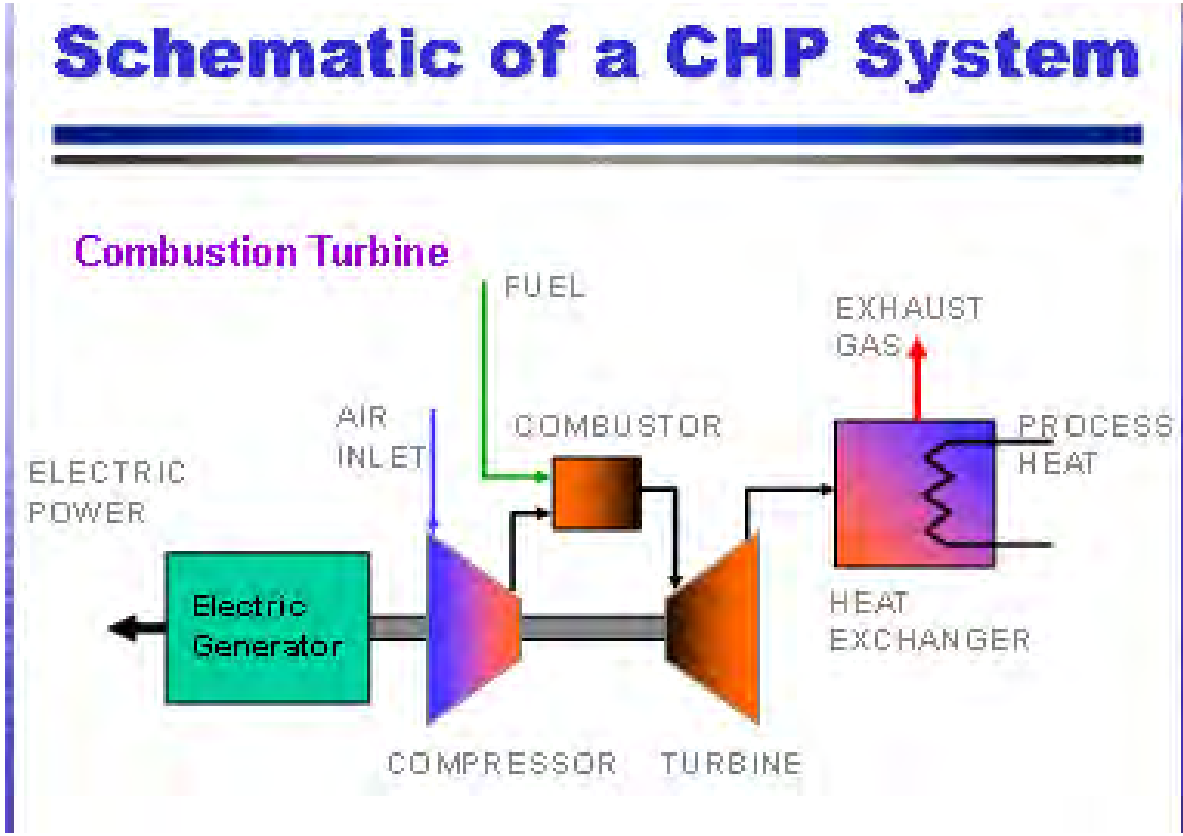
Generating electricity and heat from a single source, typically at or near the place where it is used.

Significantly more efficient than generating each of these separately.

The average power plant in the U.S. is 33% efficient, and the average overall efficiency of generating electricity and heat by conventional systems is around 51%.

CHP units are often more than 80% efficient.

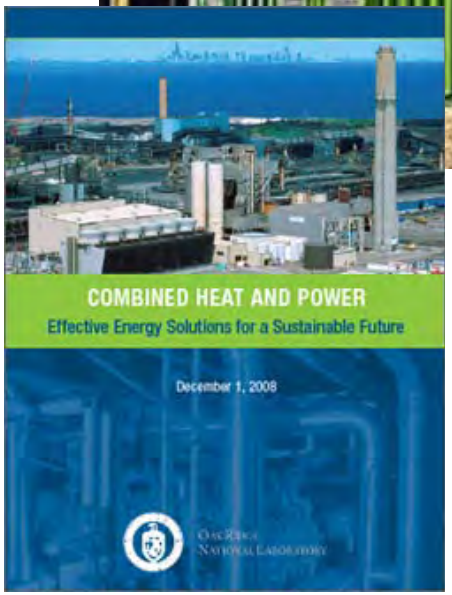
CHP is sometimes called "energy recycling" because the same energy is used twice - once for electrical energy and once for thermal energy



ITP's Combined Heat and Power (CHP) Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- CHP is recognized as the best means to *simultaneously*
  - Reduce GHG emissions
  - Promote use of secure domestic and renewable energy sources
  - Reduce exposure to energy price hikes and volatility
- ITP activities include
  - Facilitating deployment and addressing barriers
  - Serving as an independent, credible voice on applications and benefits
  - Conducting R&D to improve efficiency, lower costs, and extend applications



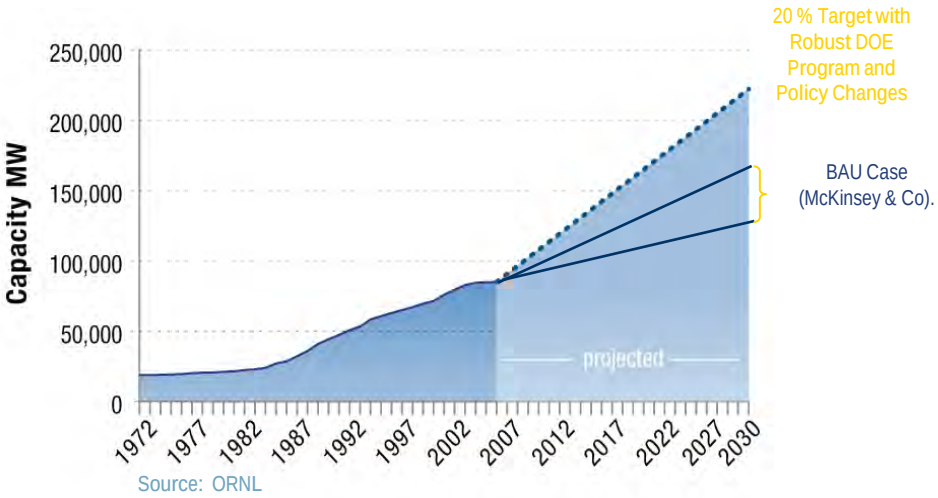
CHP offers a sizable near-term option for large energy efficiency improvements and CO_2 reduction

Source: EPA

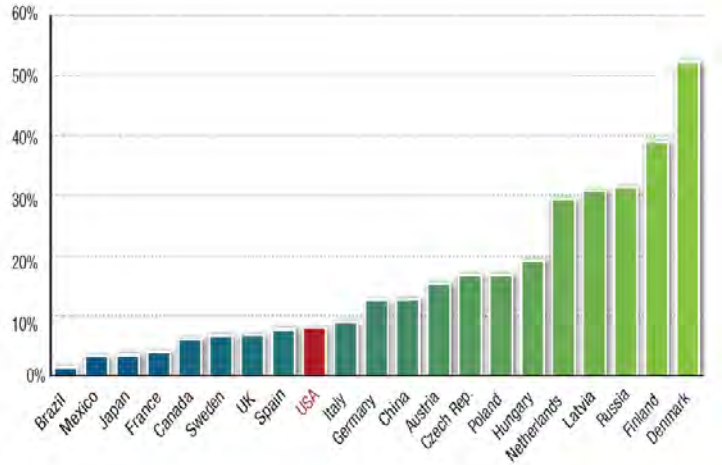
CHP - 20% of US Generating Capacity in 2030

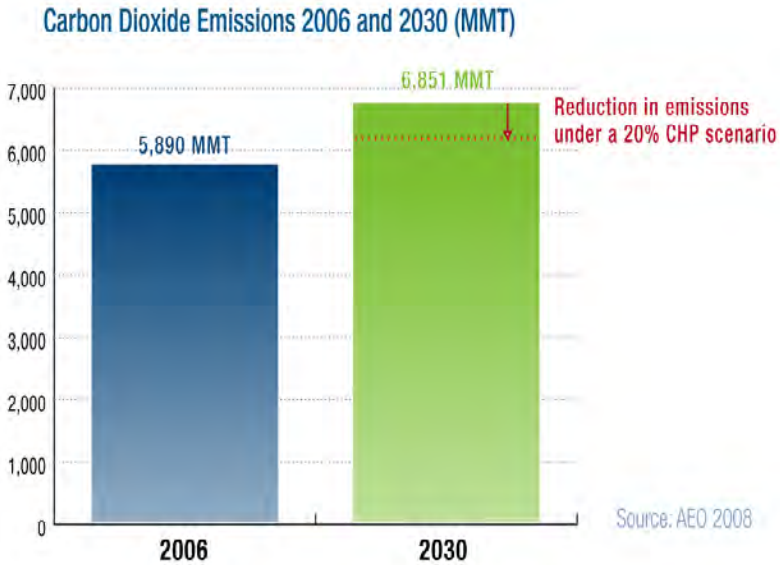
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

CHP	2006	2030 Target
Total Electricity Generating Capacity	85 GW (9% of current capacity)	240.9 GW (20% of projected capacity
Annual Energy Savings	1.9 Quads	5.3 Quads
Annual CO_2 Reduction	248 MMT	848 MMT
Number of Car Equivalents Taken Off Road	45 million	154 million



CHP in a Global Context – 20% Capacity Goal is Reachable





2030 Goal: Aggressive Growth in All Markets

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Large CHP >20 MW

Existing Industrial Market
- Improved performance
- Utilize new fuels and waste streams
- Overcome external barriers

Over 1,600 new systems

Mid CHP 1 MW to 20 MW

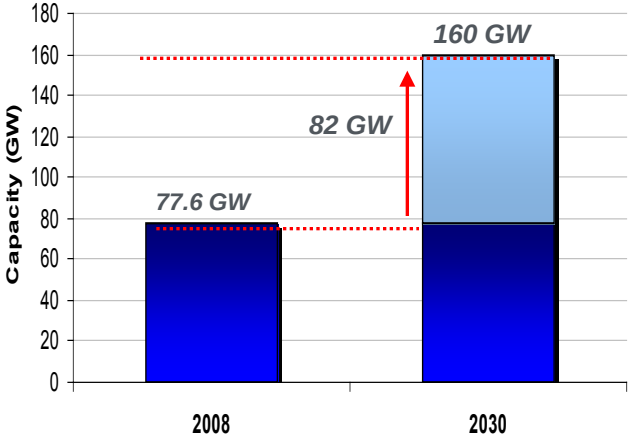
Fast-Growth Market
- Technology for new applications
- Packaged systems
- Demonstrations to make the business case

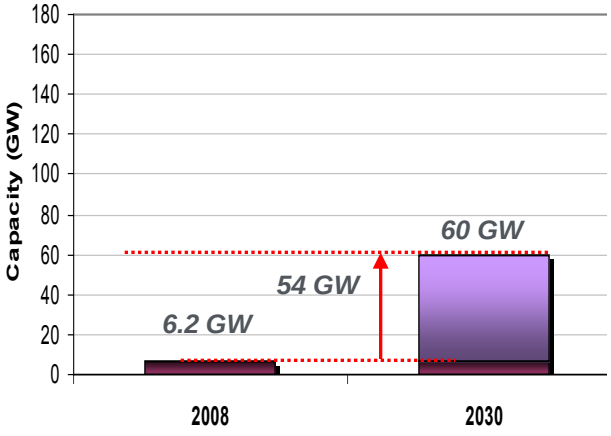
Over 10,000 new systems

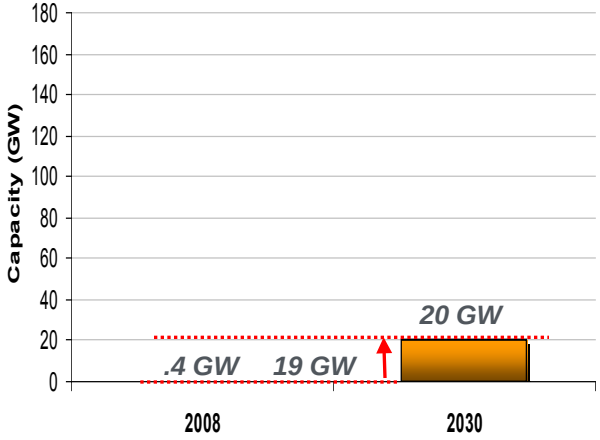
Small CHP <1 MW

Emerging Market
- New systems and technologies
- Smart Grid and 'green' consumers
- Build distribution network

Over 50,000 new systems







Market sectors include CHP, District Energy, and Waste Energy Recovery applications

Three Key Investment Areas

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Technology Research and Development

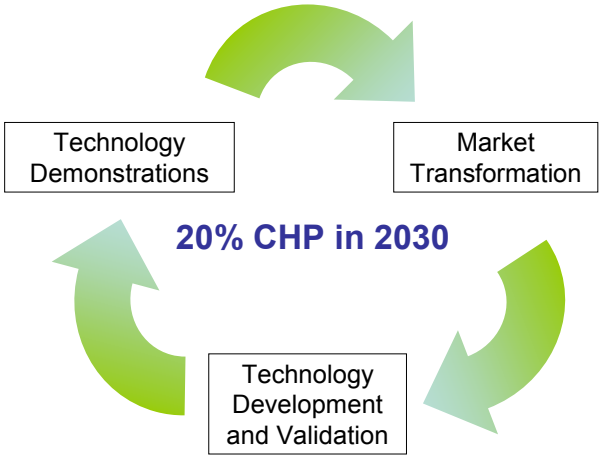
- *Alternative fuels and low-value waste heat*
- *Maximize utilization of waste streams in large industrial sector*
- *Small and mid-size systems for new markets*
- *Improve technical performance of CHP*
    - *Operating costs and installed costs*
    - *Efficiency*
    - *Reliability*
    - *Compliance with Emissions Regulations*

2. Technology Demonstrations

- *Innovative market applications*
- *Project development best practices*
- *Value to users, utilities and public*
- *Quantify CO2 reductions and energy savings*
- *Reduce technical risk*
- *Showcase systems*

3. Market Transformation

- *Targeted End-User Education and Outreach*
- *Coordination with Utilities on Technical and Regulatory Issues*
- *Regulatory/Policy Supportive Information and Analysis*
- *Accelerate the CHP Investment Decisions*
- *Demonstrate Role in GHG Reduction*



Accelerate the project develop/investment decision process and broaden range of users

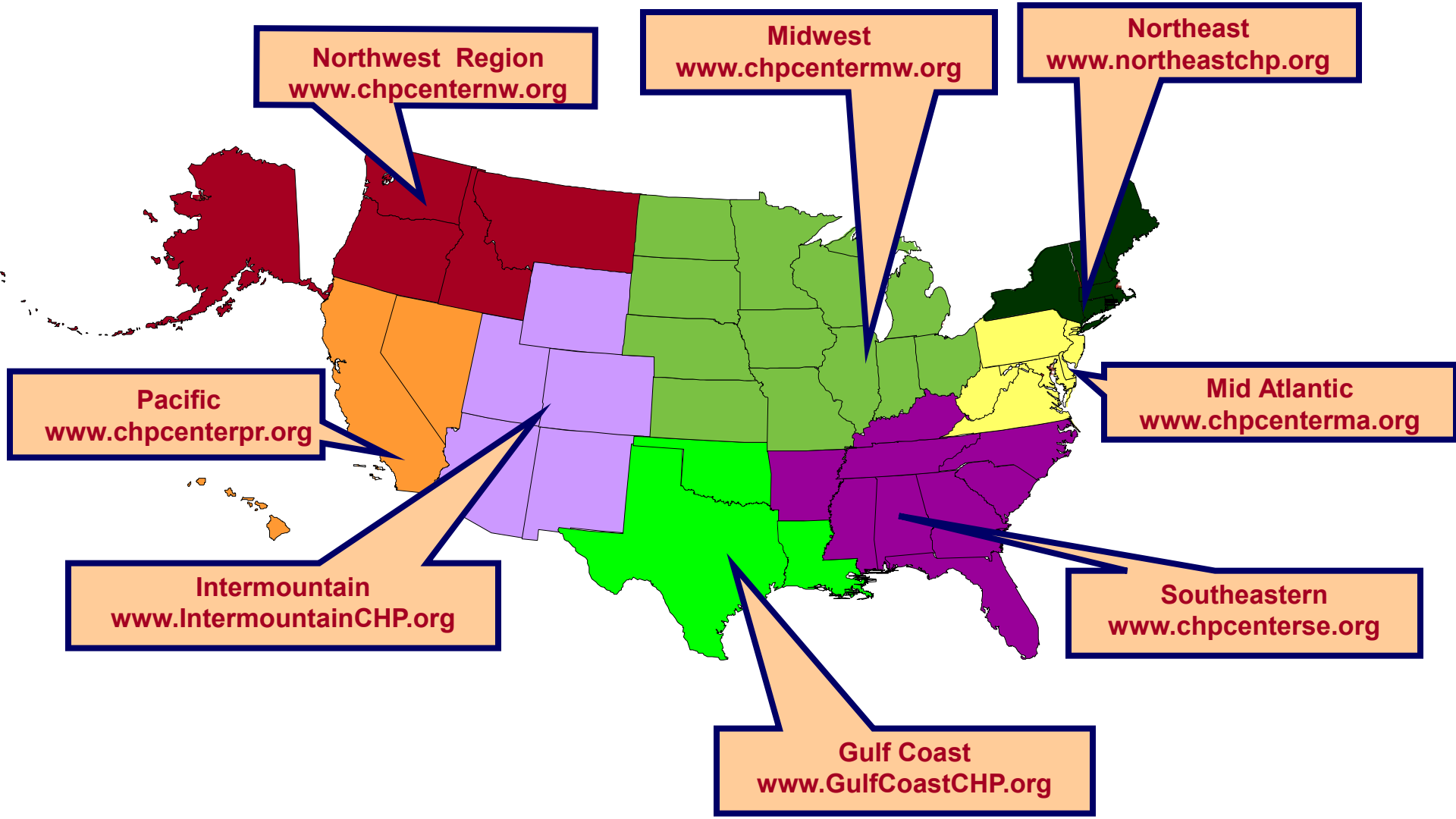
RACs lead DOE's CHP outreach efforts and establish DOE RAC brand through coordinated planning and execution of regional specific activities

US DOE's Regional Centers to Lead Deployment and Market Transformation by

- Educating regional players on benefits to remove barriers and reduce perceived risk
  - End-Users
  - Policy Makers
  - Regulators

US DOE Clean Energy Application Centers

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Intermountain RAC

- ETC Group, based in Salt Lake City,Utah
- Southwest Energy Efficiency Project (SWEEP) based in Boulder Colorado
- States of AZ, CO, NM, UT, and WY
- Technology Focus
  - Combined Heat and Power
  - Waste Heat Use/Recovery
  - District Energy

Activities

- Market assessment
- Education and outreach
- Coalition building
- Project support and facilitation
- Policy review and reform
- www.intermountain chp.org

Resources for WWT and Water Systems

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- CHP/Waste Heat projects
  - Technical Assistance to Identify and Quantify Savings
  - Project/proposal review
  - Case Studies
  - End User Workshops
  - Policy and Regulator Education
  - Utility Rate and Interconnection Issues
  - Permitting Issues
  - etc….

WWT Plant Digester Gas

- Wastewater treatment plants, with wastewater flows of at least 1 million gallons per day (MGD)
  - Municipal treatment plants*
    - At least 4,290 plants with 1 MGD or greater
    - Over 1,700 of these have anaerobic digesters, and over 1,500 are not currently utilizing digester gas
    - Paybacks in the 2-4 year range can be attained when investing in CHP and already possessing a digester
- CHP units range from $1,500-6,000/kW installed

Case Study
Ina Road WWT Plant

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Tucson, Arizona
- 25 million gallons/day (MGD)
- ELECTRICITY COST FROM CHP: $0.047/kWh
- ANNUAL SAVINGS: $1,260,000
- EQUIPMENT: 7 650-kW Waukesha engines with
- heat recovery, 950-ton absorption chiller
- FUEL: Digester gas, natural gas, and propane for backup
- CHP CAPACITY: 3,300 kW (1,100 kW from digester, 1,650 kW from natural gas)
- USE OF THERMAL ENERGY: HVAC, chilled
- water, domestic hot water, heating the digester
- CHP EFFICIENCY: 65%
- CHP IN OPERATION SINCE: 1977
- FUTURE PLANS: Expand CHP to 6-8 MW

Gas Fired Engines

Digester Gas

- 350,000 cubic feet/day (current)
- 1,000,000 cubic feet per day (future)
- 600 BTU per cubit foot
- 60% methane
- 40.1% Carbon Dioxide
- 0.23% Nitrogen
- 15 ppm Hydrogen Sulfide
- 0.025% Siloxanes (increasing)

- Seven 650-kW Waukesha engines

County and Municipal Target

WWT and Landfill Workshops (see www.intermountain chp.org)

- Denver – November, 2007
- Salt Lake City - August , 2005

Typical Agenda

- Market opportunities
- CHP Systems
- Fuel Cleaning and Conditioning
- Electrical Rates
- Case Studies
- Plant Operating Issues
- Energy Utilization Issues
- Tours

Upcoming Training Opportunity

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- CHP: Opportunities at Wastewater Treatment Facilities
- EPA CHP Partnership Webinar
- January 21, 2010 1:00 to 2:30 MST
  - Will address opportunities and challenges of implementing CHP at WWTFs.
  - EPA's CHP Partnership's efforts in WWTF and plans going forward
  - two case studies of successful CHP systems at WWTF
  - Register at: https://www2.gotomeeting.com/register/578096627
  - EPA CHP Partnership www.epa.gov/chp/

Industrial Assessment Centers

- Energy, waste, and productivity assessments to small and mid-sized manufacturers
- Assistance provided by upper-level engineering students

Industrial Assessment Centers

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Director: Dr. Douglas C. Hittle
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- Department of Mechanical Engineering
- Colorado State University
- Fort Collins, CO 80523-1374
- IAC Office Phone: (970) 491-7709

- http://www.engr.colostate.edu/IAC/

EERE Training Opportunity

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- 2010 Industrial Utility Webinar Series – Financial Mechanisms and Incentives
- Wednesday, March 10, 2010 12:00 PM - 2:00 PM EST
- This session will focus on various financial mechanisms and incentives which allow industrial energy consumers to implement energy efficiency projects. The Webinar topics may include the energy service company (ESCO) model, state incentives, public benefit funds, and utility rebates, along with other mechanisms and incentives. Utilities and industrial energy customers can share perspectives on which financial programs work best and why.
- http://www1.eere.energy.gov/industry/
- Events Section

Questions?

Intermountain Clean Energy Application Center

www.intermountainCHP.org

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Water Research Foundation

Water & Energy: Reaching for Sustainability

January 12th, 2010

WATER RESEARCH FOUNDATION™

ADVANCING THE SCIENCE OF WATER®

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About the Water Research Foundation

The Water Research Foundation (formerly known as AwwaRF) is the world's largest nonprofit organization dedicated to providing critical drinking water research.

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Clarifying Our Mission

- From *"Awwa Research Foundation (AwwaRF)"*
- *To the "Water Research Foundation (Foundation)"*

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New Name, Same Mission

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

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- **Drinking Water Research Program**
  - Centralized coordinated research program
  - Compliments local, regional, and legislative efforts through credible science
  - ~ 1000 Subscribers underwrite research (~900 water utilities)
  - > $500 million dollars worth of research
- **Collaboration**
  - Utility Community plans research
  - Project Advisory Committees & Foundation
  - ~ 1000 Volunteers provide input to projects and programs
- **Knowledge Base**
  - Reports & Projects (~850 published, ~300 ongoing)

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Basic Industry Knowledge

- *Hey two plus two is always four*
  And down is south and up is north
  Thirty-two degrees is freezing cold
  You play with fire you end up burned
  The early-bird gets the worm
  But the only thing you really need to know
  Is...

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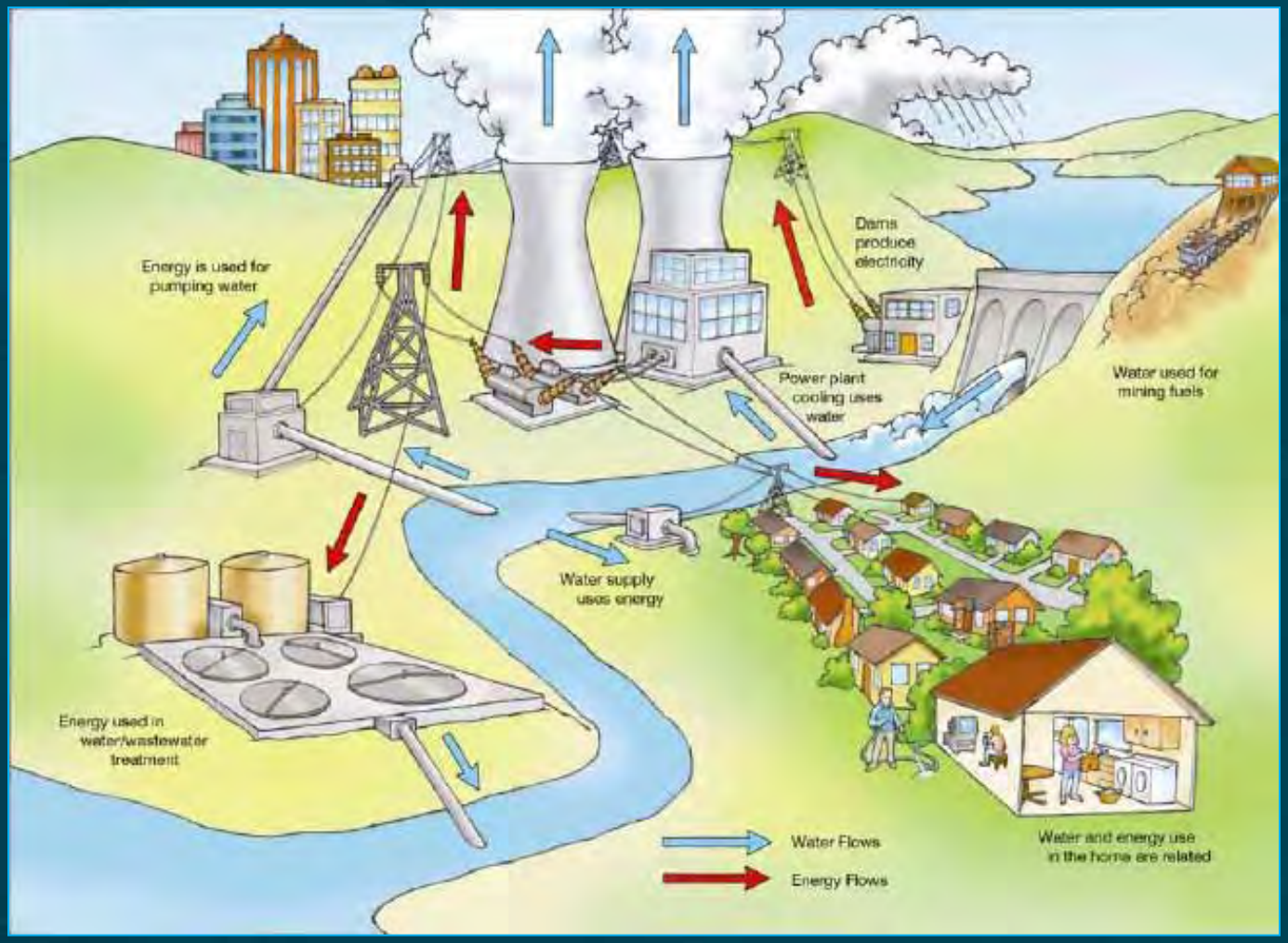
Water and Energy are Connected



•*Adopted from "Energy demands on Water Resources" U.S. DOE Report to Congress on the interdependency of energy and water.*

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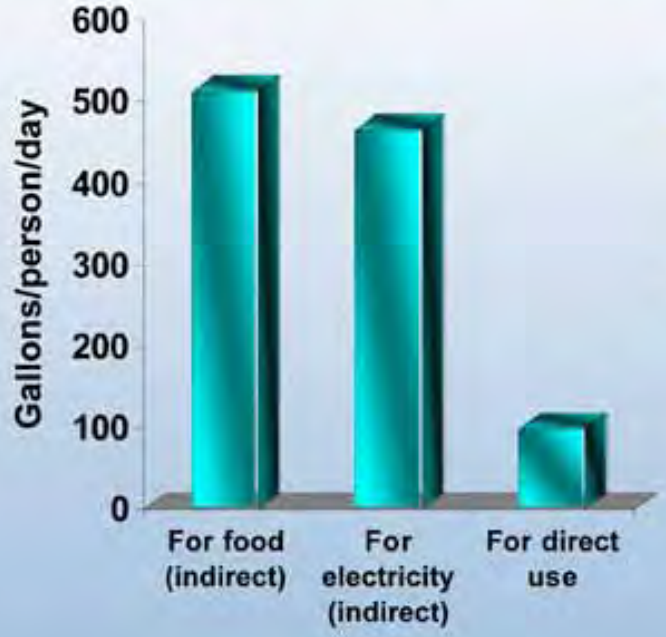
Energy Requires Water

Water used to produce household electricity exceeds direct household water use



GALLONS PER PERSON PER DAY

- 510 for food production
  - includes irrigation and livestock
- 465 to produce household electricity
  - Range: 30 to 600 depending on technology
- 100 direct household use
  - includes bathing, laundry, lawn watering, etc.

Source: derived from Gleick, P. (2002), *World's Water 2002-2003*.

EAO Energy Analysis Office
Understanding Energy Issues

NREL National Renewable Energy Laboratory

•http://www.nrel.gov/analysis/workshops/water_connect_workshop.html

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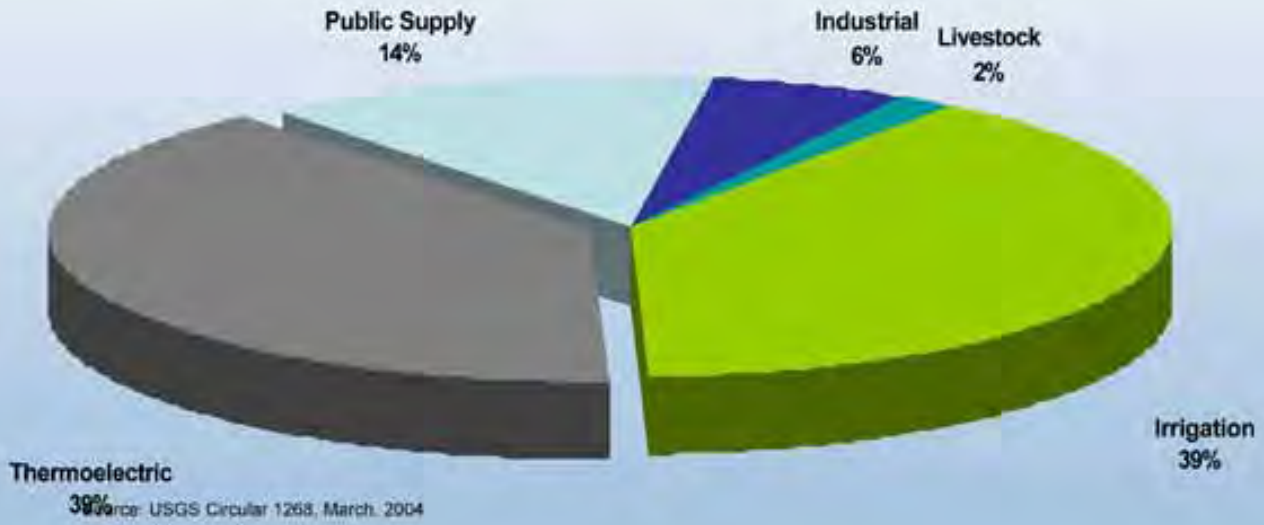
Energy Requires Water

Cumulative Water Use for Electricity Production Equals Water Use for Irrigation

Estimated Freshwater Withdrawals by Sector, 2000



EAO Energy Analysis Office
Understanding Energy Issues

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Fun Factoids

- 2.0 to 2.5 gallons of water = 1 gallon of petroleum
- 1,700 – 2,500 gallons of water = 1 gallon of ethanol
- 0.5 to 0.7 gallons of water = kilowatt
- 60 watt light bulb x 12 hrs/day x 365 days = 3,000 – 6,000 gallons of water

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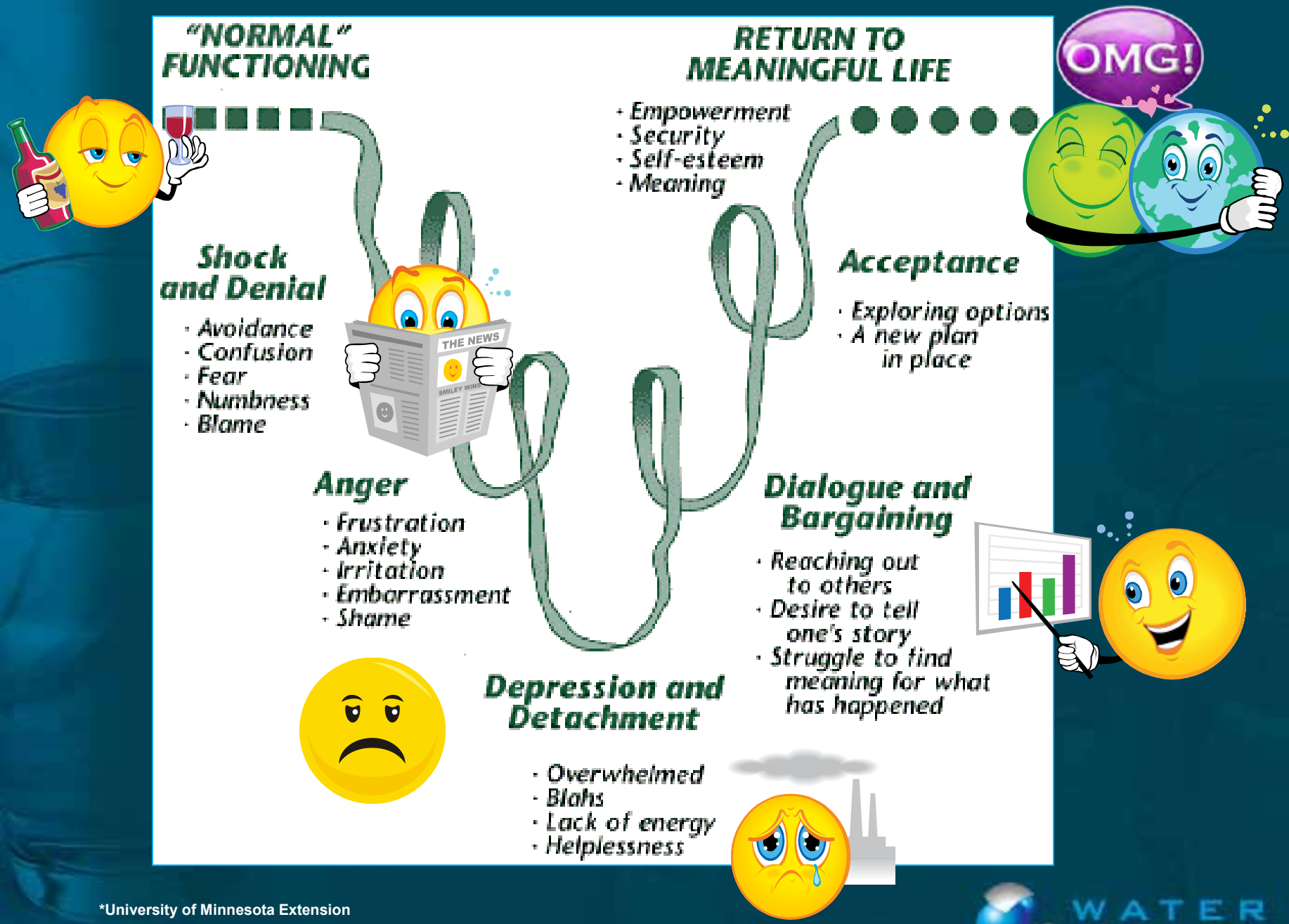

*University of Minnesota Extension

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Society Has to Come Along

- One thing to remember though - it's not like water is "destroyed" or "used up" in most of the uses above, especially cooling purposes. It's not like we're burning water like coal. Still, we obviously have a challenge on our hands keeping it clean and not contaminating what we've got!
  - Noree (Comment on water/energy nexus posting, July 2009)

•http://www.triplepundit.com/2009/05/the-energy-water-nexus/

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Good Intentions Gone Bad

- Energy Independence and Scarcity Act of 2007
  - Requires that 7.5 billion gallons of ethanol replace fossil fuels by 2012
  - Plants capable of producing 12 billion gallons/year planned
  - 48 billion gallons of water will be required just for production

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Water and Energy Integration Act (S. 531)

- **National Academy Energy-Water Study** – Requires a study to assess water use associated with developing fuels in the transportation sector, and the water consumed in different types of electricity-generation.
- **Power Plant Water and Energy Efficiency**– directs DOE to identify best available technologies and other strategies maximize water and energy efficiency in producing electricity.
- **Reclamation Water Conservation & Energy Savings Study** – directs the Bureau of Reclamation (BOR) to evaluate energy use in storing and delivering water from Reclamation projects, and identify ways to reduce such use through conservation, improved operations, and renewable energy integration.

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Water and Energy Integration Act (S. 531)

- **BOR Brackish Groundwater Desalination Facility**– Organic legislation to establish research priorities for this existing Facility, including renewable energy integration with desalination technologies.
- **EIA Energy Use for Water Assessment** – a requirement for Energy Information Administration to continually report on the energy consumed in water treatment and delivery activities.
- **Energy-Water Roadmap** – directs the Secretary of Energy to develop an Energy-Water Research and Development Roadmap to address water-related challenges to sustainable energy generation and production.
- As of March 2009 this bill was incorporated into S. 1462

•http://www.rivernetwork.org/blog/7/2009/03/09/energyh2o-bill-introduced-senate

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Energy and Water Research Integration Act (H.R. 3598)

Energy Water Architecture Council

- (1) make recommendations on the development of data collection and data communication standards and protocols to agencies and entities currently engaged in collecting the data for the energy required to provide water supplies and the water required to provide reliable energy supplies throughout the United States;
- (2) recommend ways to make improvements to Federal water use data to increase understanding of trends in energy generation and fuel production;

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Energy and Water Research Integration Act (H.R. 3598)

- (3) recommend best practices for utilizing information from existing monitoring networks to provide nationally uniform water and energy use and infrastructure data; and
- (4) conduct annual technical workshops, including at least one regional workshop annually, to facilitate information exchange among Federal, State, and private sector experts on technologies that encourage the conservation and efficient use of water and energy.

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Utility Energy Consumption

Water and Wastewater Systems = ~4% of total electrical demand in US

-EPRI 2002 "*Water and Sustainability(Vol 4): US Electricity Consumption for Water Supply and Treatment – The next Half Century*"

Drinking Water Utilities Spend as much as 35% of their annual operating costs on energy. 85% of this amount is used for pumping alone

- Foundation Report #3066 "*Water Consumption Forecasting to Improve Energy Efficiency of Pumping Operations*

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Utility Energy Consumption

Water and Wastewater Systems spend ~$4 Billion/year to collect, treat, and convey water. Energy consumption at utilities will grow by more than 20% in the next 15 years.

-Forbes: *http://www.forbescustom.com/EnergyPgs/WaterMgmentP1.html*

Range of power usage for 1 – 70 MGD plants = 338 – 4500 kWh/MG (Average 2240 kWh/MG)

-JAWWA 1998 Arora,LeChevallier "*Energy management opportunities*"

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The Big Picture

- Due to growing population we will need 393,000 megawatts of new energy by 2020 = 1300 – 1900 new power plants
- That is one plant per week for 25 years.
- 70 million new people over next 25 years will increase energy by 53% = enough water for energy to supply 53 million people.

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Reasons For Increased Energy Demand

- Increased regulation
- Increased use of impaired source waters (i.e. Desalination)
- Use of advanced treatment
- Increasing land development

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Advanced Treatment Energy Consumption

UV

Ozonation

Membrane Processes

Ultrafiltration

Reverse osmosis

Membrane Bioreactors

Energy Consumption

20 - 160 kWh / MG

500 – 7500 kWh / MG

-Foundation Project #3056 "*Evaluation of Dynamic Energy Consumption of Advanced Water and Wastewater Treatment Technologies*"

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Conventional Vs. Advanced Treatment

- Example

Conventional Treatment —*Increased Energy Consumption*→ **UV**

70 -100 kWh/MG

-Foundation Project #3056 "*Evaluation of Dynamic Energy Consumption of Advanced Water and Wastewater Treatment Technologies*"

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Energy Management

Best Practices for Energy Management (#2621)

Identified 19 Best Management Practices

Energy Procurement

- Market-Based Pricing
- Pricing Rate Structure
- Pricing Incentives

Energy Use

- Lessons from past design and operation
- Energy Audit
- Optimizing pump schedules

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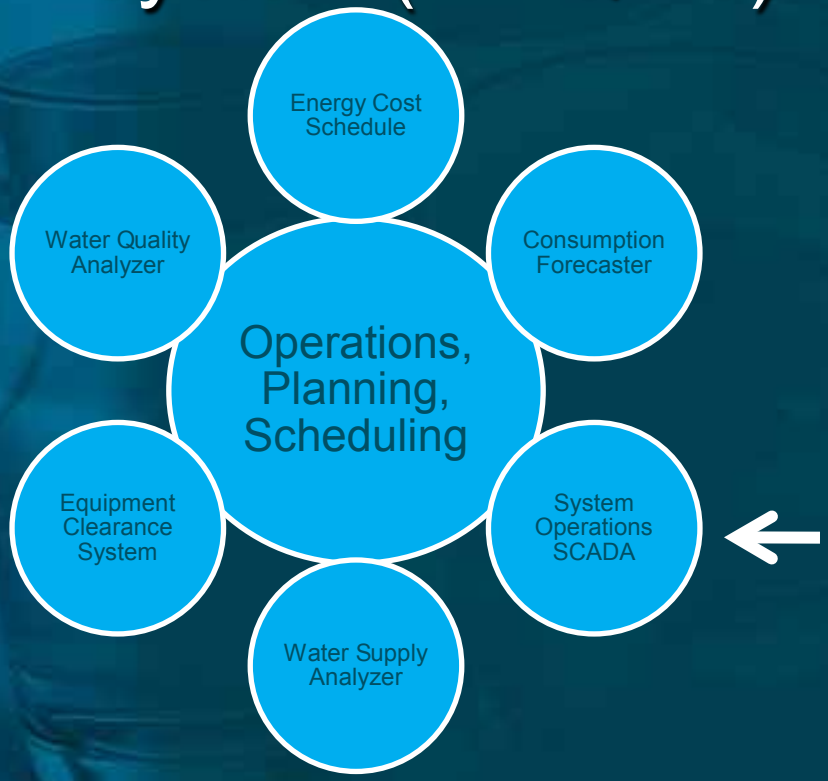
Energy Optimization Energy-cost Minimization

Energy and Water Quality Management System (EWQMS)



- Source Water Supply
- Wells
- Treatment Plants
- Pump Stations
- Reservoirs
- Distribution System Valves

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Water Consumption Forecasting to Improve Energy Efficiency of Pumping Operations

Subject Area:
Efficient and Customer-Responsive Organization

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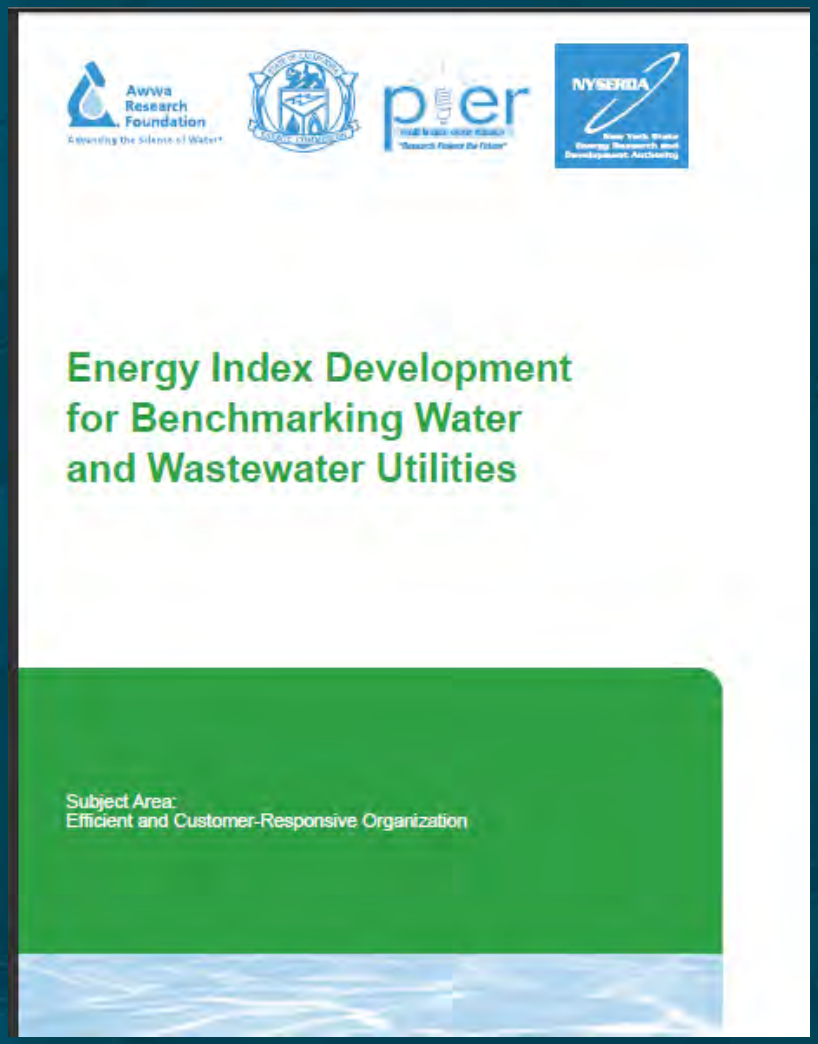
Ranking Your Performance



- **Project #3009**

Created metrics for comparing utility energy use among peers

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On-going Research

Decision Support System for Sustainable Energy Management #4090

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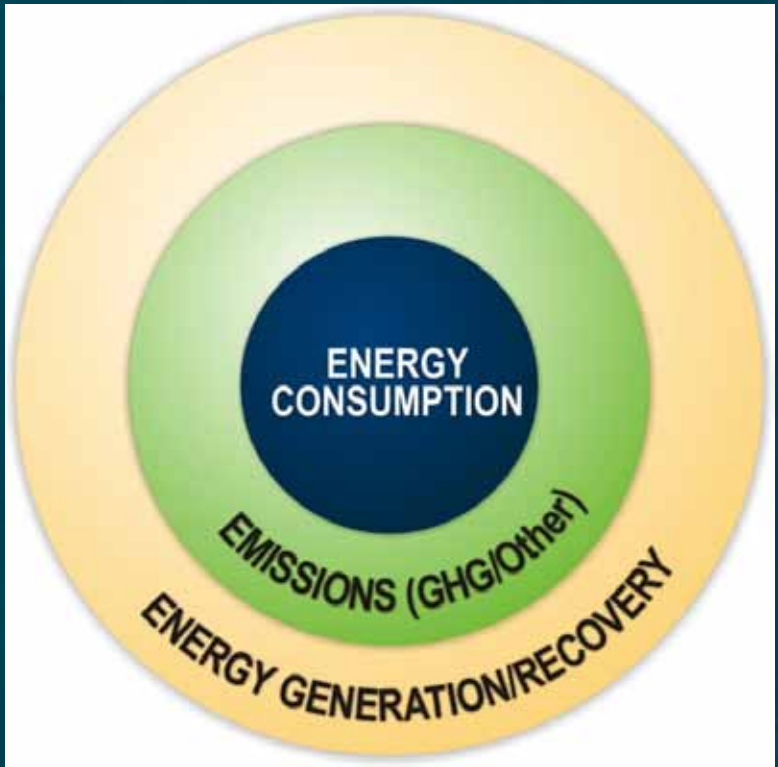
On-going Research

Energy Efficiency in the North American Water Supply Industry: A Compendium of Best Practices and Case Studies #4223



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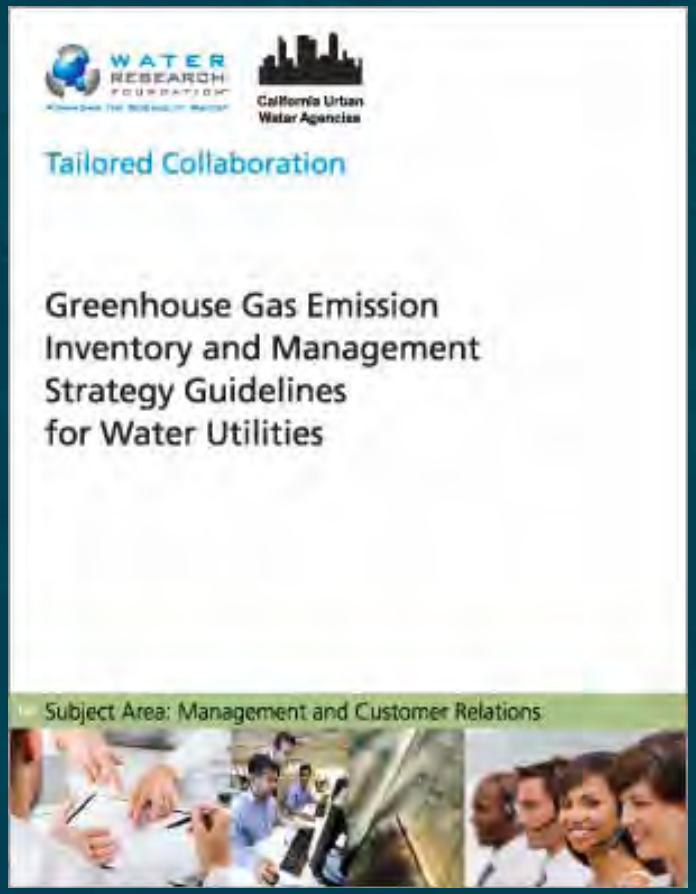
Greenhouse Gas Emissions

Greenhouse Gas Emission Inventory and Management Strategy Guidelines for Water Utilities (#4156)



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California Urban Water Agencies

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Greenhouse Gas Emissions

Toolbox for Water Utility Energy and Greenhouse Gas Emission Management: An International Review #4224

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Local Projects

Lowering Chemical and Energy Usage for Inland Desalination Concentrate Volume Reduction (4283)

- Tailored Collaboration with City of Phoenix
- Carollo Engineers

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Future Research

- Carbon footprinting if the capital improvement process
- Green certification program for water and wastewater utilities
- Carbon trading and the carbon market: opportunities for utilities
- Advancing process optimization: energy efficiency and control of GHG emissions
- Guidance for integrated water, energy, and environmental resource planning

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Partners

- Electric Power Research Institute
- Global Water Research Coalition
- California Energy Commission
- Water Environment Research Foundation
- New York State Energy Research and Development Authority

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Resources

- California Energy Commission http://www.energy.ca.gov/process/water/index.html
- National Renewable Energy Laboratory (NREL) http://www.nrel.gov/analysis/workshops/water_connect_workshop.html

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Thank You

Water Research Foundation

Shonnie Cline

scline@waterresearchfoudation.org

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City of Mesa - Steps Toward Sustainability

NW Plant Co-generation

NW Plant Co-generation

- Co-generation Unit installed in 2001
- Rated at 550 kW
- Original cost - $400,000
- Usage of co-gen limited by production, storage pressure regulation and operator time required
- In 8 years, only had 200 run hours
- Budget reductions, electric rate increases spur squeezing of available resources

NW Plant Co-generation

- Biogas produced at rate of 110 CFM with most being flared
- Started experimenting with extended run times in Feb 2009
- Developed run chart based on greatest return
- Chart is net saving after subtracting electrical use by gas compressor and dryer, generator maintenance costs and personnel

Optimum Co-Gen Run Time

Savings $/Hr at Peak Summer Rates, July & August				
Time of Day	Biogas Gen @ 250 kW	Biogas Gen @ 500 kW	Nat Gas Gen @ 250 kW	Nat Gas Gen @ 500 kW
Off Peak	1.39	13.57	-20.44	-30.09
Shoulder	11.44	33.66	-10.39	-9.99
Peak	28.66	68.11	6.84	24.46

Savings $/Hr at Winter Rates, Nov thru April				
Time of Day	Biogas Gen @ 250 kW	Biogas Gen @ 500 kW	Nat Gas Gen @ 250 kW	Nat Gas Gen @ 500 kW
Off Peak	1.06	10.86	-20.76	-32.79
Shoulder	10.26	29.26	-11.56	-14.39
Peak	16.24	41.21	-5.59	-2.44

Savings

- Net savings Feb through December were $39,201
- Maximum potential savings for year = $136,000
  - With available biogas
  - Generator available when needed
  - Coordinating run time with greatest savings

Demand Response Program

- Demand Response Program is a voluntary reduction of electricity by high use customers during periods of peak demand
- Program offered by SRP and managed by EnerNOC
- Facilities can be called upon to reduce power use within the next 10 to 30 minutes with events lasting up to 4 hours
- Greenfield plant looked at total plant shutdown but cost for plant diesel power generation were prohibitive

Demand Response Program

- Looked for specific large equipment and narrowed down to blowers and centrifuges, combined 840 HP
- Went through stages of testing with increased outage periods
- Once comfortable that plant could accommodate outage, enrolled in program
- Have had two events since signing on in June
- Are now looking at enrolling the NW plant in same program

Chemical Reduction

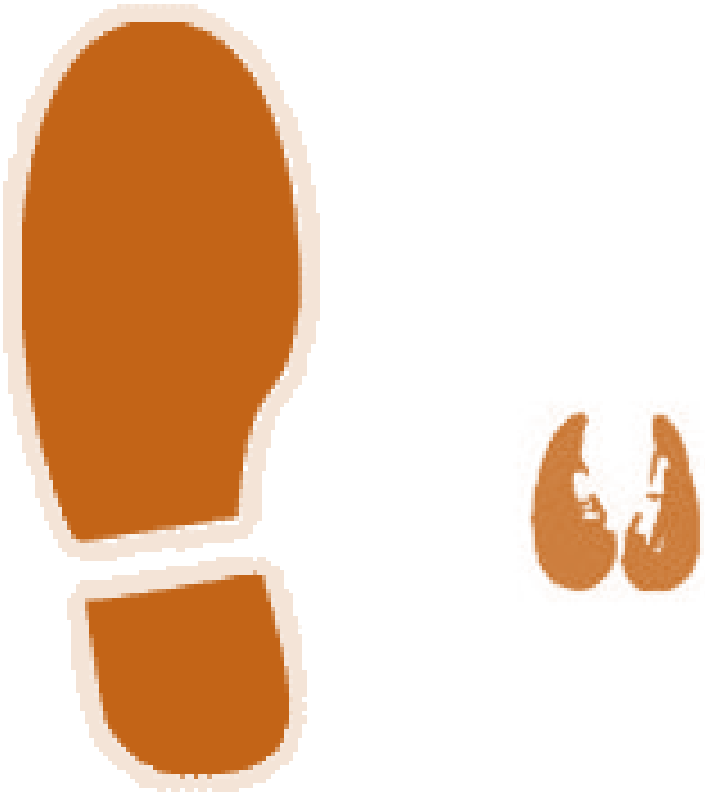
- Mesa has been working with OpenCEL, a private company doing research on cell lysing for more complete digestion.
- Expanded lysing experiment to create carbon source for nitrification/denitrification process and replace use of methanol.
- Carbon source needed due to influence of high ammonia side stream from dewatering process.
- Avg daily methanol usage was 224 gpd at avg cost of $2.27/gal
- Yearly cost of $186,000
- Currently, OpenCEL unit not operating and temporarily replaced with glycerine at cost of $0.20/gal

Weed Control

- 27 acres of recharge site getting overgrown with brush
- Use of plant personnel was cumbersome, needed 2 men plus back hoe for 2 weeks.
- Use of plant personnel cumbersome and bank areas difficult to reach
- Grazed goats for one year with herd varying from 10 to 40

Grazing Goats Giving Greening a Go

Footprint



Pilot Testing Biological Treatment of Nitrate-Contaminated Groundwater

MAG WATER AND WASTEWATER INFRASTRUCTURE WORKSHOP

January 12, 2010

CH2MHILL

GLENDALE AZ

ASU

Applied

Applied Process Technology, Inc.

WATER RESEARCH FOUNDATION

ADVANCING THE SCIENCE OF WATER

Water Research Foundation Partners

- City of Glendale
- Water Research Foundation
- CH2M HILL
- The Biodesign Institute at Arizona State University
- Applied Process Technology (Vendor)

Background

- Nitrate contaminated groundwater
  - *Second most common contaminant found above the MCL in a survey of private drinking water wells.*
  - *Treatment Techniques*
    - *Ion-exchange*
    - *Reverse Osmosis*
    - *Biological Treatment*

City of Glendale

When do you select biological treatment?

- Biological treatment is selected when it is the most *sustainable* choice based on environmental, societal, and financial considerations
- Triple Bottom Line

Greenhouse Gas Emissions
Residuals Disposal

Drinking Water Quality

Capital
O&M
Net Present Worth

City of Glendale

Background

- Advantages of Biological Treatment
  - *No brine*
  - *Targets wide range of contaminants*
  - *Sustainable*
- Challenges
  - *Not widely used in the United States*
  - *Typically requires substrate addition*
  - *May require proof of compliance for regulator approval*

Background

- Project Objectives
  - *To characterize the performance of biological nitrate removal technologies*
  - *To identify co-contaminant treatment*
  - *Evaluate ongoing ion-exchange pilot performance based on same criteria*
  - *Identify environmental issues for each technology*
  - *Develop cost comparison*
  - *Evaluate biological and ion-exchange systems based on criteria including the triple bottom line (TBL) of sustainability*

Background

- Biological Treatment Technologies
  - *Heterotrophic*
    - *well studied in Europe and in the U.S. in wastewater treatment*
    - *reliable*
  - *Autotrophic*
    - *less biomass*
    - *no residual substrate*
    - *easier to "dial-in" to fluctuating influent water quality*

Water Quality Implications of Biological Nitrate Reduction

- Water Quality Implications of Biological Treatment
  - *Treated water is anoxic*
  - *Even if carbon-based electron donor is removed or if the donor is inorganic (e.g. hydrogen), the treated water will contain some dissolved organic carbon from soluble microbial products*
  - *Heterotrophic plate counts are increased as a result of biofim detachment to varying degrees depending on the electron donor*
- An Aerobic Biologically Active Filtration Process Should Follow Biological Denitrification of Drinking Water.

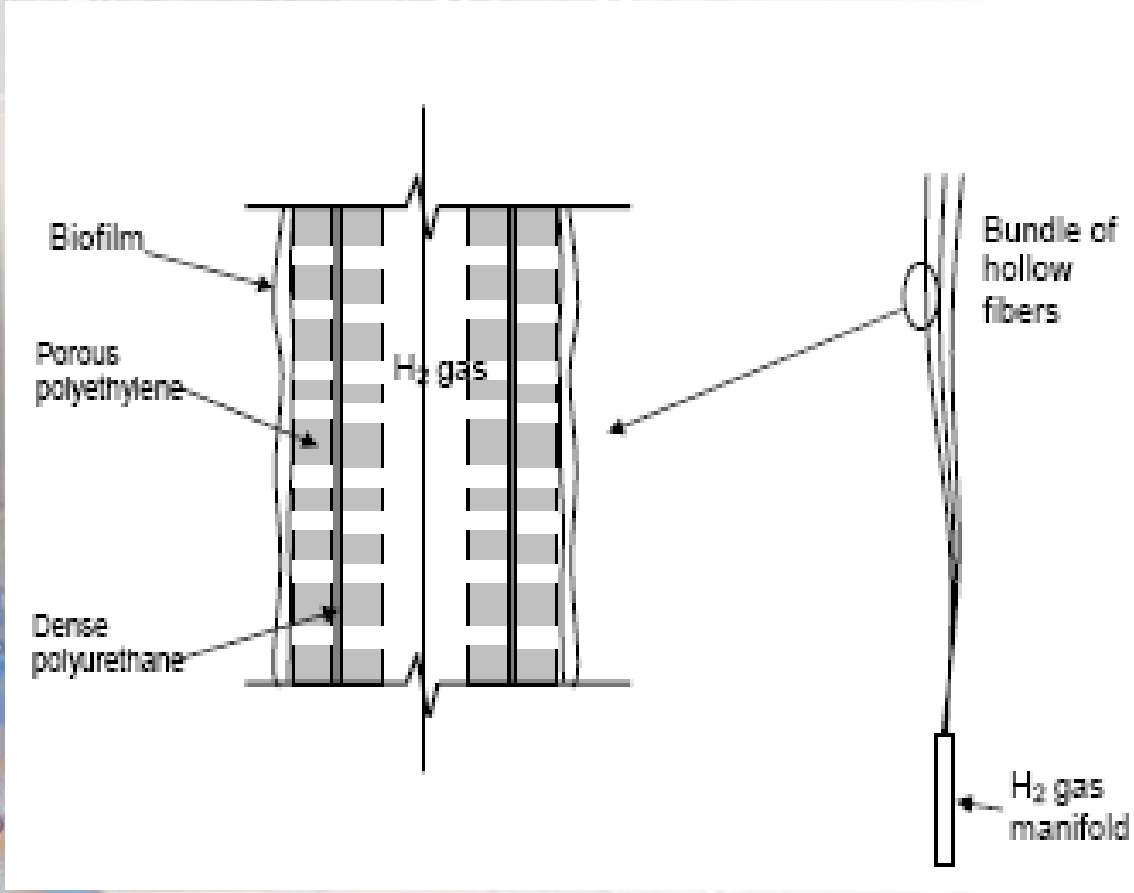
Current Regulatory Climate

- Many regulators are apprehensive about biological drinking water treatment despite the industry's long history with slow sand filtration, biological filtration and other biologically-based unit processes.
- Anoxic biological treatment is under more scrutiny than aerobic processes (less full-scale U.S. experience).
- Permits for biological groundwater treatment facilities in California are requiring post treatment that meets surface water turbidity standards and 4-log virus disinfection CT.

Pilot Processes

- Biological Nitrate Reduction
  - *Train 1 – Autotrophic Membrane Biofilm Reactor (MBfR)*
  - *Train 2 – Heterotrophic bioreactor – upflow bioreactor with plastic media*
  - *Train 3 – Heterotrophic bioreactor – upflow GAC bioreactor*
- Post Treatment
  - *Ozone Biological Activated Carbon*

Train 1 MBfR (Applied Process Technology, Inc.)



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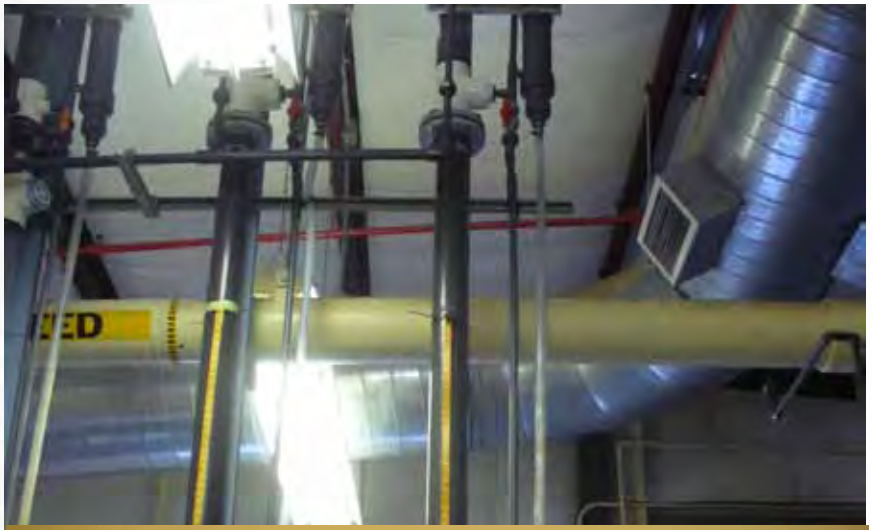
Train 2 – Upflow Bioreactor with Plastic Media

- Stages (#) - Two
- Media type – expanded polystyrene
- Media surface area – 660 m2/m3
- Media depth - 180 inches
- Operating Mode – Upflow with limited backwash
- Max flow – 1.5 gpm (6.0 g-N/m^{2}d)



Ozone Skid

- Average dose ~ 2 mg/L
- Flexibility to run with and without ozone

City of Glendale

Post Filtration (Biologically Active Carbon)

- Stages (#) - One
- Media type – 1.1 mm GAC (exhausted)
- Media surface area – 3000 m2/m3
- Media depth - 72 inches of Exhausted GAC over 12 inches of Sand
- Filter Loading Rate – 4.5 gpm/sf

Pilot Conclusions

- Identifying the optimum carbon and nutrient requirements is critical.
- Effective nitrate removal (typical effluent values less than 0.1 mg-N/L) in the effluent was achieved by Train 1 and Train 2 within seven and twenty days of determining the optimal carbon and phosphorus dosing, respectively.
- Effluent turbidity from Trains 1 and 2 were less than or equal to 1 NTU, with typical turbidity values of 0.2 NTU from Train 1 and 0.5 NTU from Train 2.
- The turbidity introduced through biological treatment was removed through post-treatment, which consisted of either ozonation or aeration, following by granular media filtration.

Pilot Conclusions

- Effluent turbidity from Trains 1 and 2 were less than or equal to 1 NTU, with typical turbidity values of 0.2 NTU from Train 1 and 0.5 NTU from Train 2.
- The turbidity introduced through biological treatment was removed through post-treatment, which consisted of either ozonation or aeration, following by granular media filtration.
- Higher than reported surface area removal rates for Trains 1 and 2 (2.2 g-N/m2-d and 6.0 g-N/m2-d, respectively) were demonstrated during this study.
- Effluent dissolved organic carbon (DOC) and phosphate concentrations were well-controlled at levels slightly higher than were detected in the raw water.
- Finished water met SWTR and IESWTR requirements.

Triple Bottom Line (TBL) Systems Analysis

- Establish full-scale treatment objectives
- Select most feasible nitrate treatment alternatives
  - *MBfR (Pilot Train 1) + Ozone + Biologically Active Carbon Filtration*
  - *Static Upflow Bed with Plastic Media (Pilot Train 2) + Ozone + Biologically Active Carbon Filtration*
  - *Fixed Bed Ion Exchange + Evaporation Ponds/Landfill*
- Based on pilot data and design criteria, create conceptual design for 10-mgd biological denitrification plant(s)
- Summarize 10-mgd Zone 4 fixed bed ion exchange treatment facility conceptual design
- Calculate capital, O&M and life cycle costs for treatment alternatives
- Conduct TBL evaluation of biological denitrification versus ion-exchange

Full-Scale Treatment Objectives

10 mgd groundwater nitrate treatment facility:

- Meet all applicable groundwater treatment regulations
- Meet City of Glendale goal of <6 mg/L NO_3-N (post blending)

Select Most Feasible Treatment Alternatives

- MBfR + Ozone + BAC
- Pilot Train 2 (Upflow Bioreactor with Plastic Media) + Ozone + BAC
- IX + Evap Ponds + Landfill

Full-Scale Treatment Objectives

10 mgd groundwater nitrate treatment facility:

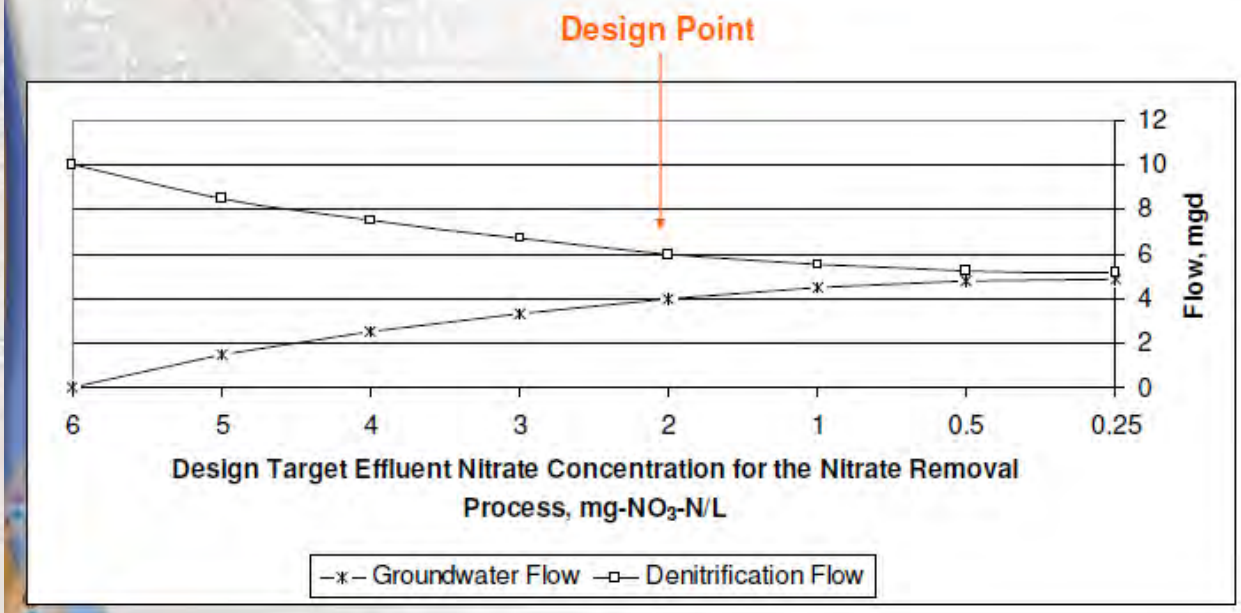
- Meet all applicable groundwater treatment regulations
- Meet City of Glendale goal of <6 mg/L NO_3-N (post blending)

Conceptual Design for Full-Scale Nitrate Treatment Plant Alternatives

- Nitrate-N = 12 mg/L
- Sulfate = 108 mg/L
- Dissolved Oxygen = 4.5 mg/L
- Nitrate Removal Process Effluent Conditions = <2 mg/L NO3-N

Conceptual Design for Full-Scale Nitrate Treatment Plant Alternatives

- Resulting blend ratio?
  - *6 MGD Nitrate Treatment Flow*
  - *4 MGD Raw Water Bypass Flow*



City of Glendale

TBL Decision Evaluation of Nitrate Treatment Alternatives

- Selected decision criteria representing important non-monetary benefits or attributes of an alternative that are independent, provide differentiation, and are measurable in some quantitative fashion.
- Weighted the decision criteria to prioritize the importance of the individual criterion to the decision process.
- Developed a quantitative measurement or scoring methodology to define the performance of each alternative with respect to each decision criterion.
- Scored the alternatives for each criterion. Calculated the non-monetary benefits offered by each alternative, based on the product of the weighting assigned to the criterion and the score.
- Calculated the benefit-to-cost ratio for each alternative.

Nitrate Treatment Alternatives Cost Summary

	10-mgd Alternative Costs		
	Capital	O&M	Life Cycle
IX + Evap Ponds + Landfill	$16,445,900	$3,175,100	$56,014,900
MBfR + Ozone + BAC	$23,844,400	$3,429,000	$66,593,500
Train 2 + Ozone + BAC	$19,652,000	$2,712,000	$53,449,900

TBL Decision Evaluation Conclusion

- The highest total benefit scores were associated with the two biological treatment options (Alternatives 1 and 2).
- Of these two alternatives, Alternative 2 had the lowest life-cycle cost, while Alternative 1 had the highest benefit score. Given the high benefit score and low life-cycle cost, Alternative 2 is the optimum alternative based on the highest benefit-to-cost ratio for the systems tested.
- Alternative 1 showed promising results. Based on pilot results, vendor is refining design to increase reliability and performance and reduce the cost.

When do you select biological treatment?

- Biological treatment is selected when it is the most *sustainable* choice based on environmental, societal, and financial considerations
- Triple Bottom Line

Greenhouse Gas Emissions
Residuals Disposal

Drinking Water Quality

Capital
O&M
Net Present Worth

City of Glendale

WRF Project #4131 Acknowledgements

CH2M HILL recognizes the City of Glendale and the utility staff for their significant financial and technical contributions for this work.

CH2M HILL and the City of Glendale acknowledge the ASU Biodesign Institute for their technical contributions to this project.

CH2M HILL gratefully acknowledges that the WRF is the joint owner of the technical information upon which this presentation is based. CH2M HILL thanks the Foundation for its, financial, technical, and administrative assistance in funding and managing the project through which this information was discovered.

City of Glendale

Glendale's Water Reclamation Program
Saving Valuable Resources

Green before Green was Cool

- Glendale's West Area Water Reclamation Facility was designed with the Green Movement in mind, even before it was called the Green Movement.
- Reclaimed materials were used in some of its construction features such as old windshield glass converted to floor tiles and reclaimed concrete converted to interior wall blocks.
- Renewable resources such as Bamboo Flooring instead of wood.
- Solar power and hot water were incorporated into the Administration Building design in order to save on operating cost and conserve fossil fuel.
- Of course, let's not forget the main function of the facility which is to reclaim the City's wastewater and help preserve the environment.

West Area Water Reclamation Facility

- **Glendale's largest 'Green' project with a multitude of features friendly to the environment**
- **Fully automated state of the art facility, constructed in 2000 to treat wastewater flows of 4.3 million gallons daily.**
- **Re-Rated in 2005 for increased capacity to treat 10 million gallons daily.**
- **And now currently rated at 11.5 million gallons daily with further expansions, as needed, to meet growth in the City.**

West Area Water Reclamation Facility ‘Green’ Features

Recycled materials such as automobile windshield glass made into floor tiles and natural materials such as renewable bamboo comprise the facility flooring materials.

West Area Water Reclamation Facility
‘Green’ Features

Plants, evaporative misters, and the water feature all directly contribute to the cooling of the courtyard and indirectly the administration complex itself.

West Area Water Reclamation Facility ‘Green’ Features

Skylights and glass block capture natural lighting to save electricity.

West Area Water Reclamation Facility

‘Green’ Features

Solar Hot Water Units

- **Solar Energy is converted to hot water for use in the buildings and for building heat.**
- **The system has approximately 4000 gallons of storage with an electrical back-up boiler.**

West Area Water Reclamation Facility ‘Green’ Features

- **Solar Electricity is produced to power for computers, outlets and lights for the administrative complex and meeting rooms.**

Photovoltaic Cells for Electricity

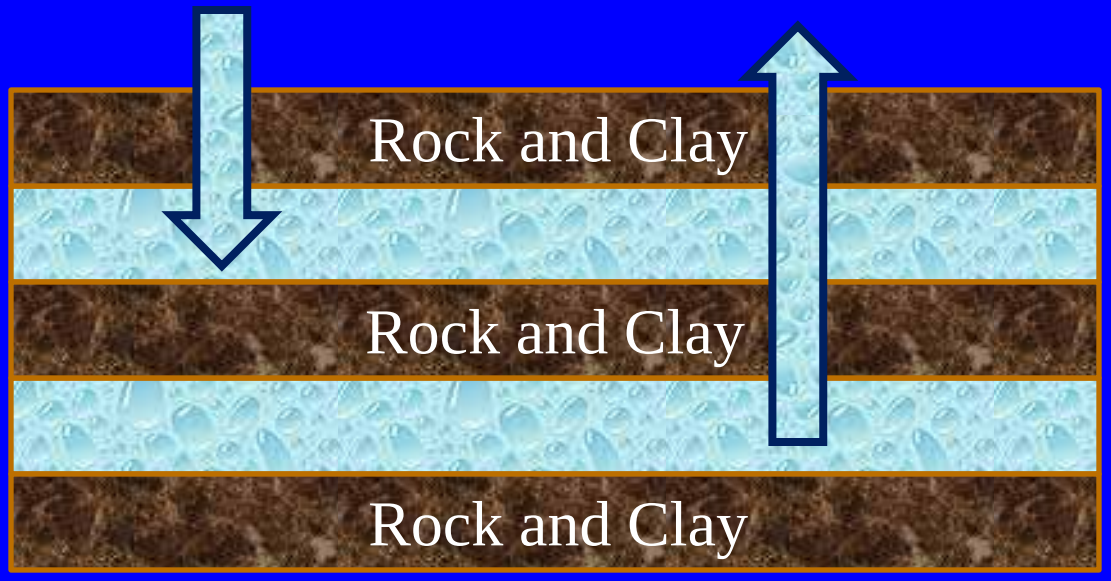
Water Reuse in Glendale

- The majority of water reuse in Glendale is through underground aquifer recharge.
- The recharge operation provides Glendale with ADWR Water Bank recharge credits which are used in exchange for domestic well water.
- The Treated Effluent and the Domestic Well Water never come into contact underground.

Aquifer Recharge

Recharge is shallow at or near the surface while Domestic Water is pumped from another level separated by impervious layers of clay, rock and soil.

Treated Effluent **Domestic Well Water**



Direct Reuse

- **Direct reuse is the use of treated effluent to fill lakes, provide irrigation, construction dust control water and in some cases for decorative water features.**

Future Changes and Challenges

- **More energy efficient systems and equipment as older equipment is replaced.**
- **New low pressure high output UV disinfection.**
- **Additional Variable Frequency Drives (FVDs)**
- **New recharge and filtration technology as capacity needs increase.**

Conserving Water with a Rebate Threshold Rate Structure

MAG Greening Water and Wastewater Infrastructure Workshop

Graham Symmonds, P.Eng.
Global Water

12 January 2010

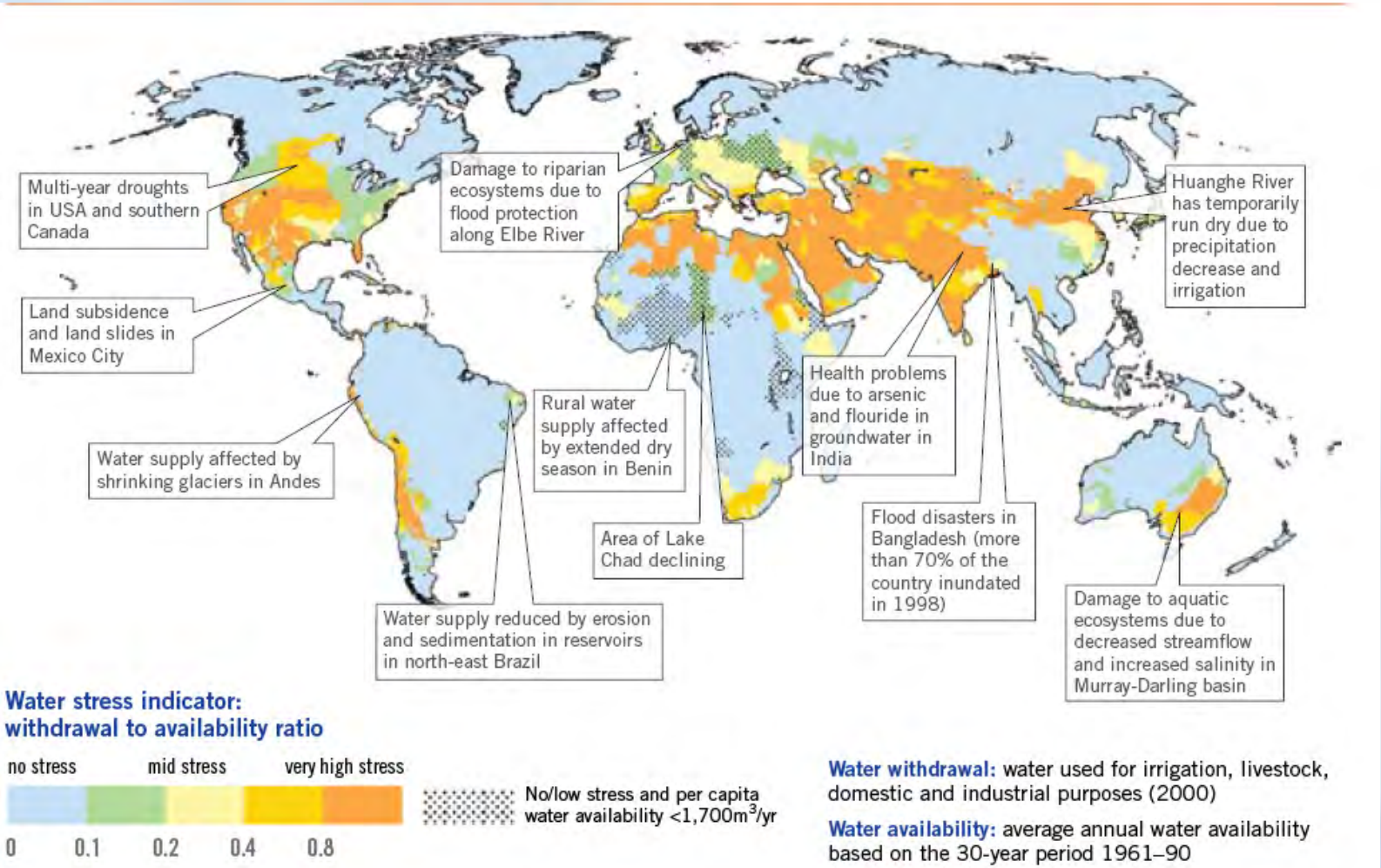
Conservation

- We must raise the awareness of the general public about water and scarcity.
- Increase the awareness of water use
- In general, water's intrinsic value is disproportionate to its monetary value.
- We must encourage and champion ways to get people to conserve.

- The role of rates in conservation is to get consumers to think about the *next* gallon and make an active choice in that regard.

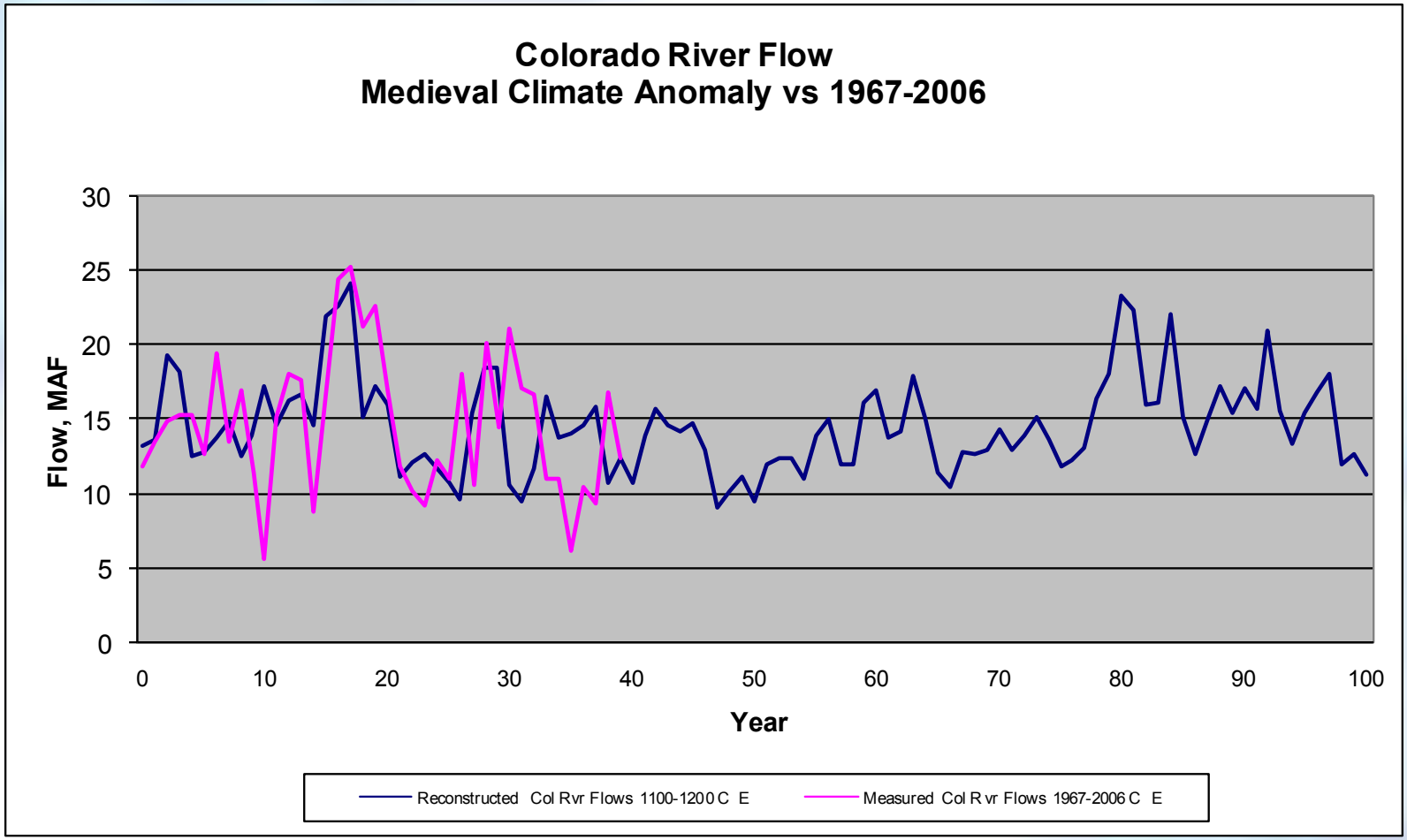
Should I Use it or Conserve it?

Water Stress Worldwide



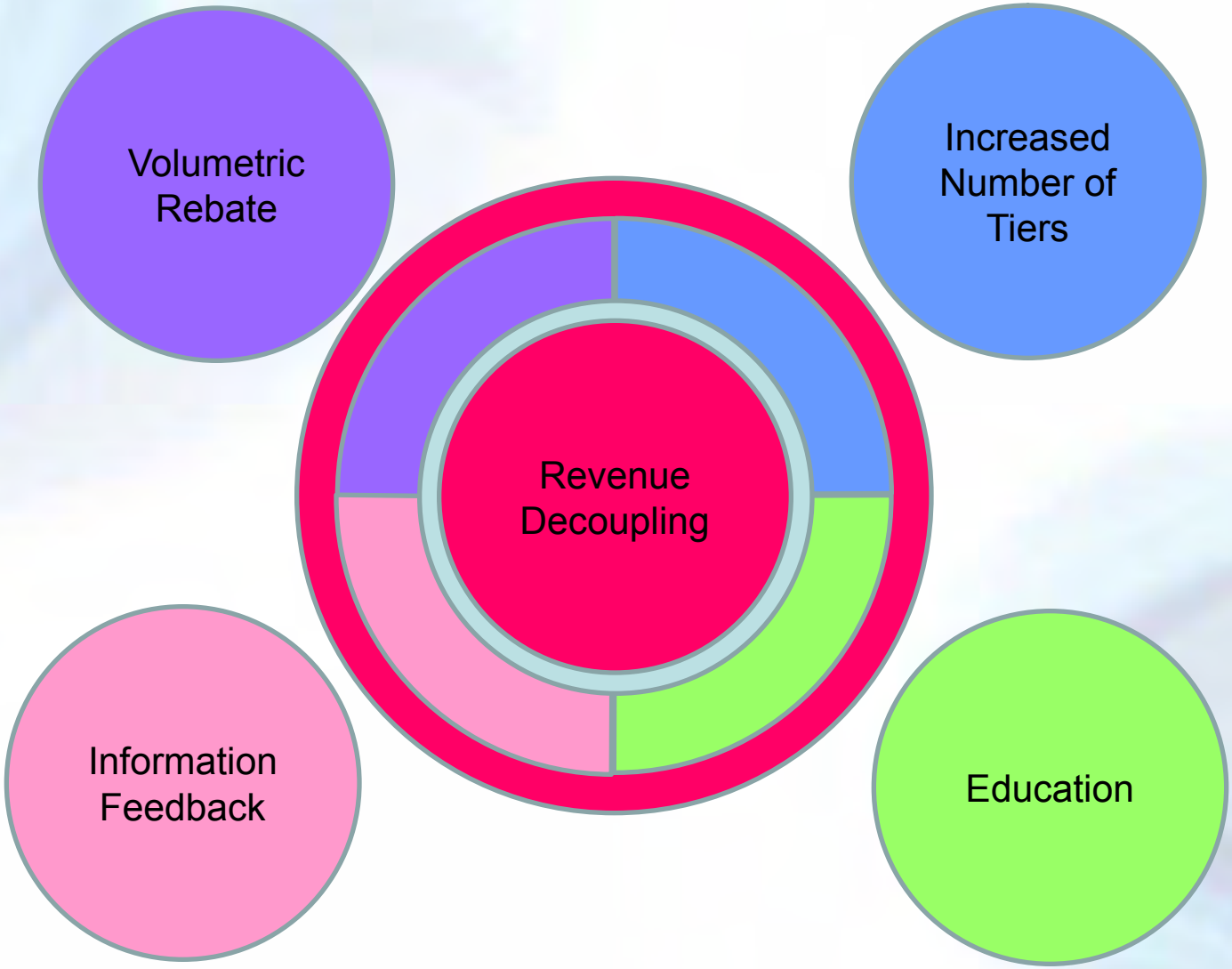
Source: B.C. Bates et al. "Climate Change and Water IPCC," Technical Paper VI of the Intergovernmental Panel on Climate Change.

Colorado River Water Scarcity
A Millennial Perspective

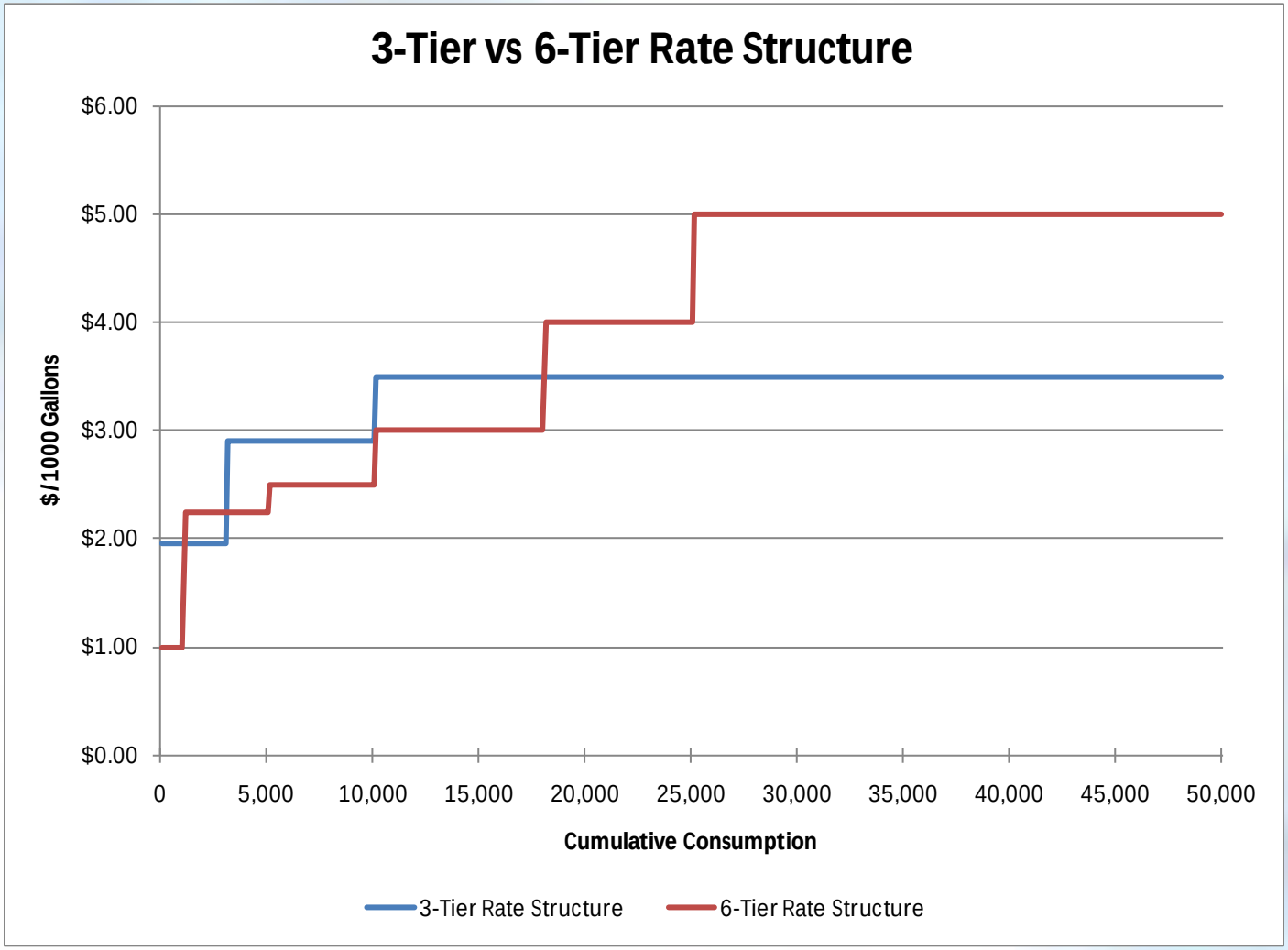


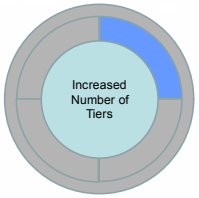
Source: Adapted from Meko, et al (2007)

Rebate Threshold Rate



6-Tier System





Volumetric Rebate

Provide incentives for active conservation

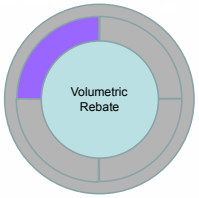
- Volumetric Rebate
  - Any time a customer achieves a consumption level below that of the Rebate Threshold, that customer is entitled to receive a reduction in volumetric charges (commodity charges).

Establish the Goal:

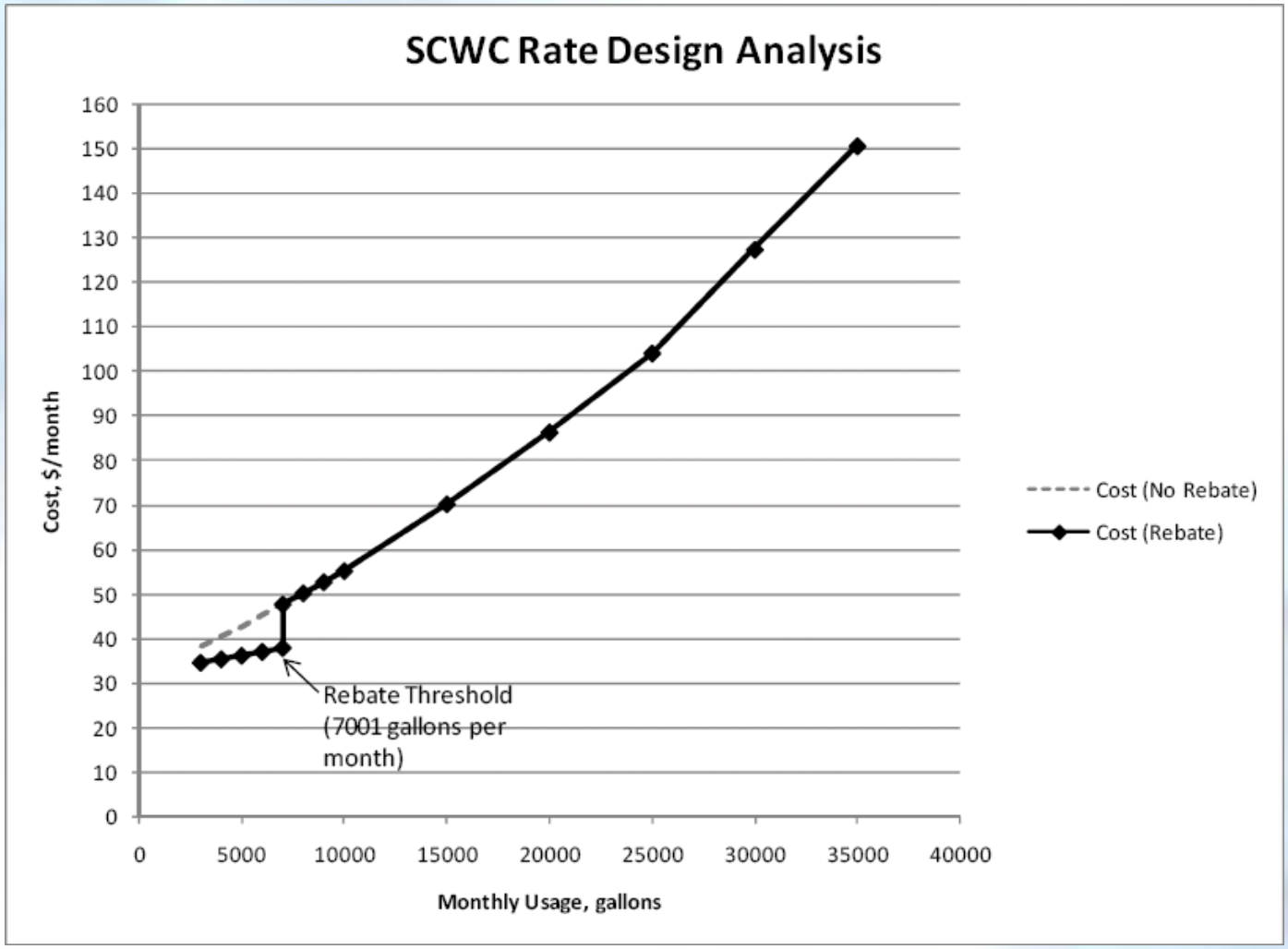
- 90% of Average Residential Consumption
- If this is met, the consumer is entitled to a rebate of 65% of the volumetric cost of the water.

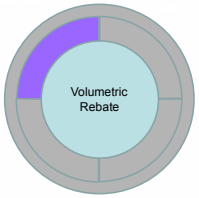
SCWC Res. Avg = 7700 gallons per month
Rebate Threshold = 7000 gallons per month

- A customer meeting the Rebate Threshold in Santa Cruz can save $9.75 per month – or $117.04 per year.



Volumetric Rebate

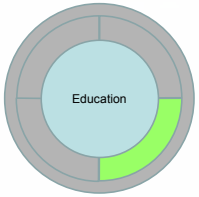




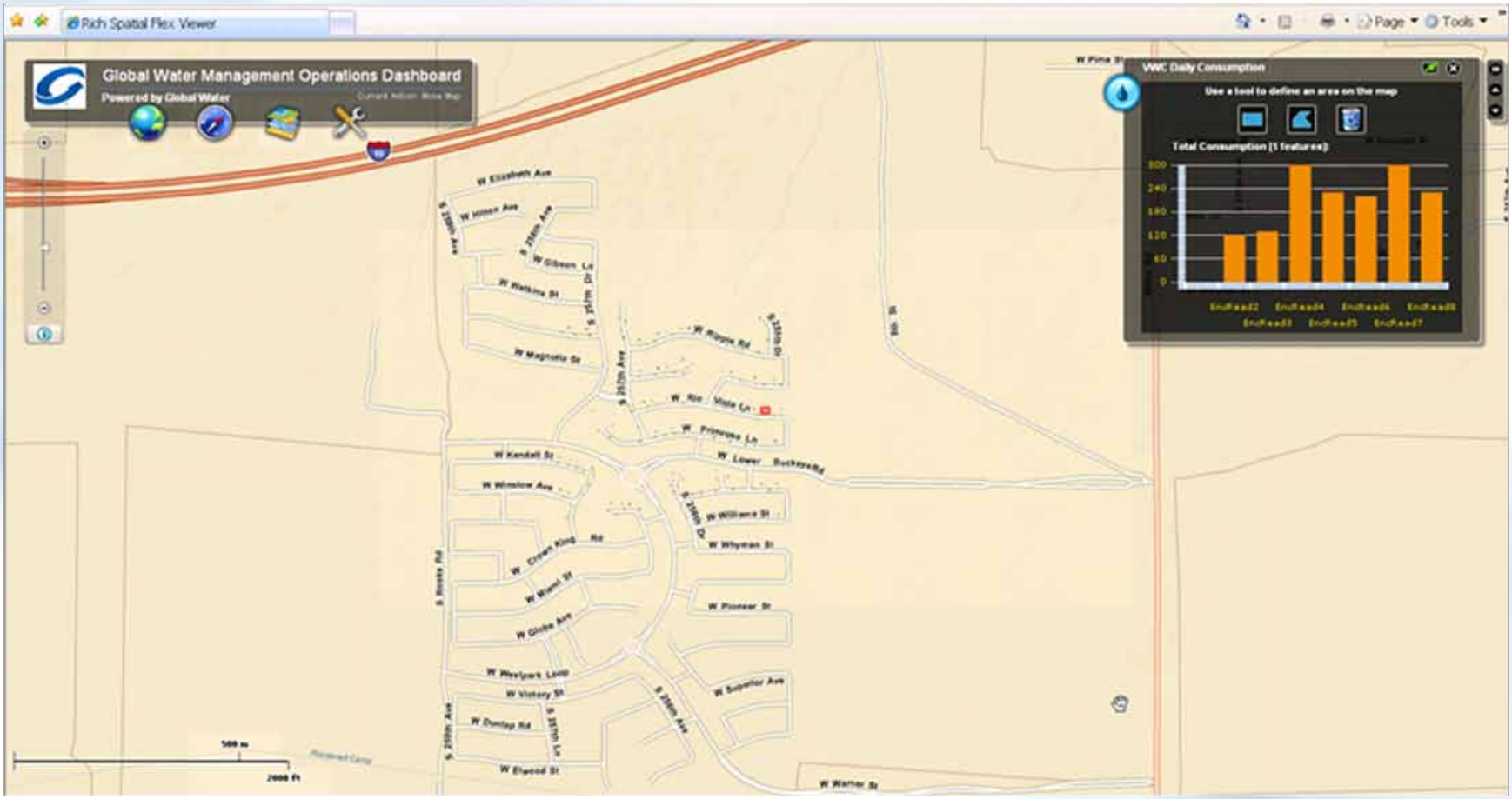
Source: Global Water

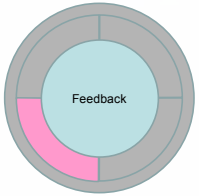
Education

- Increase the overall knowledge of water
- Increase the understanding of the costs of water
- Increase the awareness of how to conserve
- Increase the understanding of the effects of conservation
  - Reduced demand on sources
  - Reduced size of infrastructure
  - Reduced treatment demands
  - Hedge against future contaminant treatment requirements



Feedback – AMR/AMI





Decoupling

Revenue Decoupling

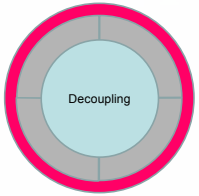
The monthly charge allows the utility to effect meaningful, measurable and repeatable resource conservation without the implosion of utility revenue.

To achieve conservation goals, we must break the cycle of selling more water. By allowing for the recovery of fixed costs with a bias toward the monthly minimum, we can achieve both goals.

0 %age of Fees from Volumetric Sales 100

Consumer has Low Incentive to Conserve

Utility has Low Incentive to Conserve



Conclusion

With the Rebate Threshold Rate Structure consumers can save over 10% of the costs of their water.

A Community like Maricopa can save up to 400,000,000 gallons per year.

Ira A. FULTON school of engineering

Smart Water Grid

January 12, 2010

Eric Williams
School of Sustainable Engineering and the Built Environment
& the School of Sustainability
Arizona State University

Michele Mutchek
School of Sustainable Engineering and the Built Environment
Arizona State University

Background

- Four-year project at ASU to analyze sustainable and resilient energy and water infrastructure for Phoenix, including energy/water nexus
- John Crittenden (PI) + 5 faculty + 6 graduate students
- Supported by National Science Foundation
- Not developing technology but trying to understand how to put technologies together to achieve benefits at reasonable cost.
- Started working on smart water grid ~ Oct 09 (caveat)

Smart Grid Comparison: electric versus water

Components of Smart Electrical Grid	Analogous Components of Smart Water Grid
Smart electrical meters	Smart water meters
Decentralized renewables: wind and solar	Decentralized water treatment/distribution/
Efficient home/business electrical management	Efficient home/business water management
Detection and improvement of power quality	Detection and improvement of water quality

Smart Water Grid Scales

- Treatment plants
- Distribution system
- Users:
  - Industry
  - Agriculture
  - Residential

What to address with smart water grid?

- Water demand – users usually use more water than needed to realize “service” delivered
- Water leaks – 10-20% of water lost in distribution, difficult to detect underground leaks
- Automate meter reading/data collection
- Checking water quality from treatment plant to tap

Technology element: smart water meter

- Smart water meters can:
  - Be networked
  - Record real time data
  - Do sophisticated information processing
- Challenges:
  - How to power: many meters not next to power line
  - Expense
- Potential solutions
  - battery/solar/low power mesh networks
  - Advanced processing to reduce number of meters

http://www.outpostcentral.com/english/ProductLiveWaterMeter.aspx

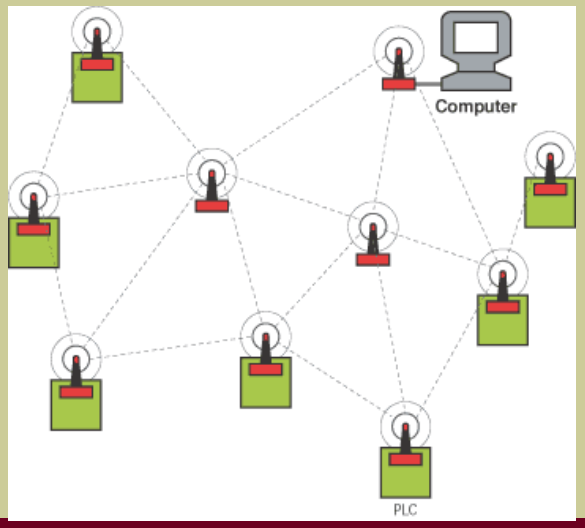
http://www.minsenmeter.com/product_SHOW.asp?product_id=137

Powering and networking water smart meters

- When not near electrical line, can use solar/motor, storing with lithium battery
- Low power network achievable with mesh-network concept: signal need only reach nearest nodes,

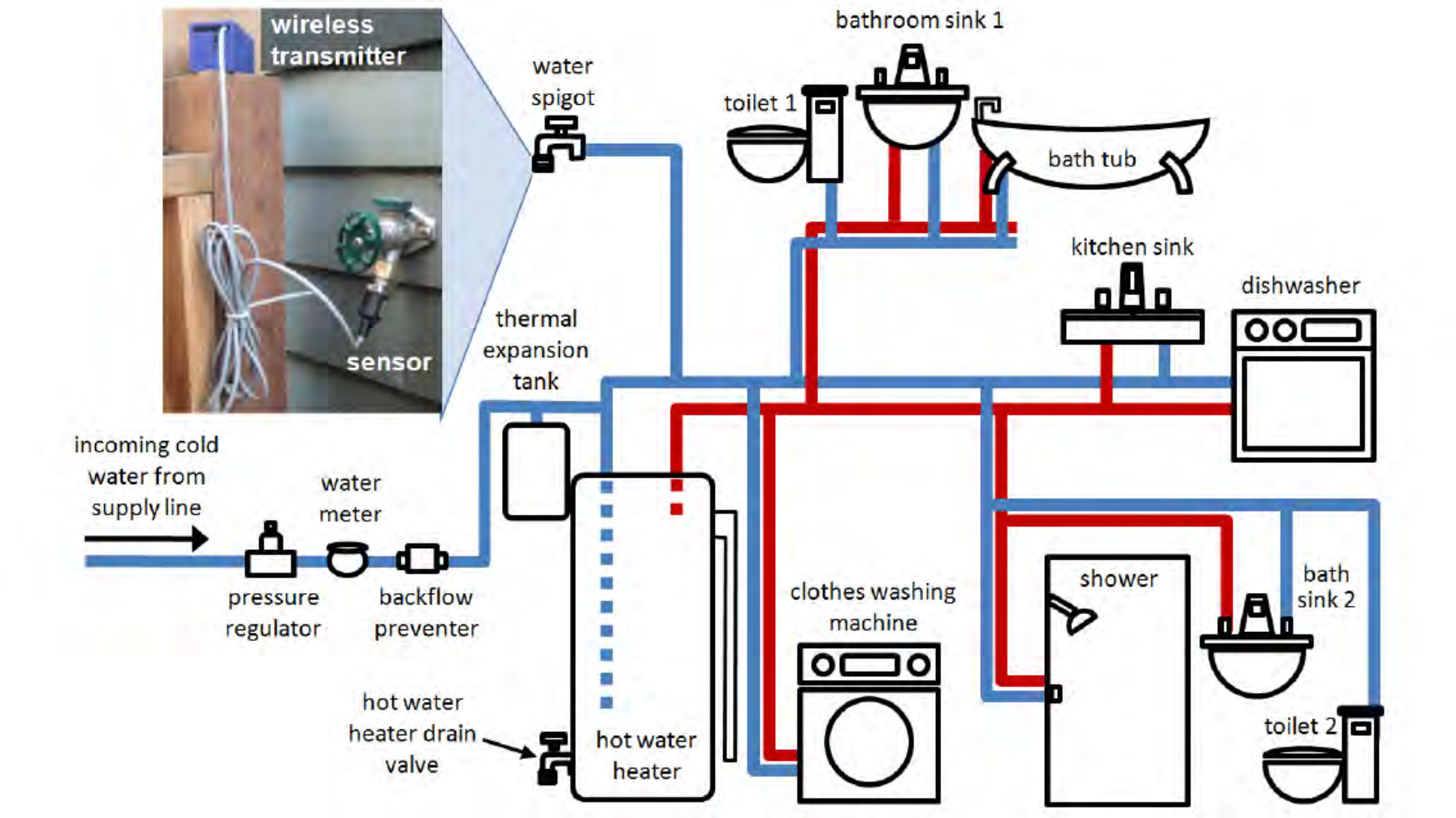
e.g. Zigbee protocol

Solar-powered smart water meter
Source: Hauber-Davidson and Idris (2006



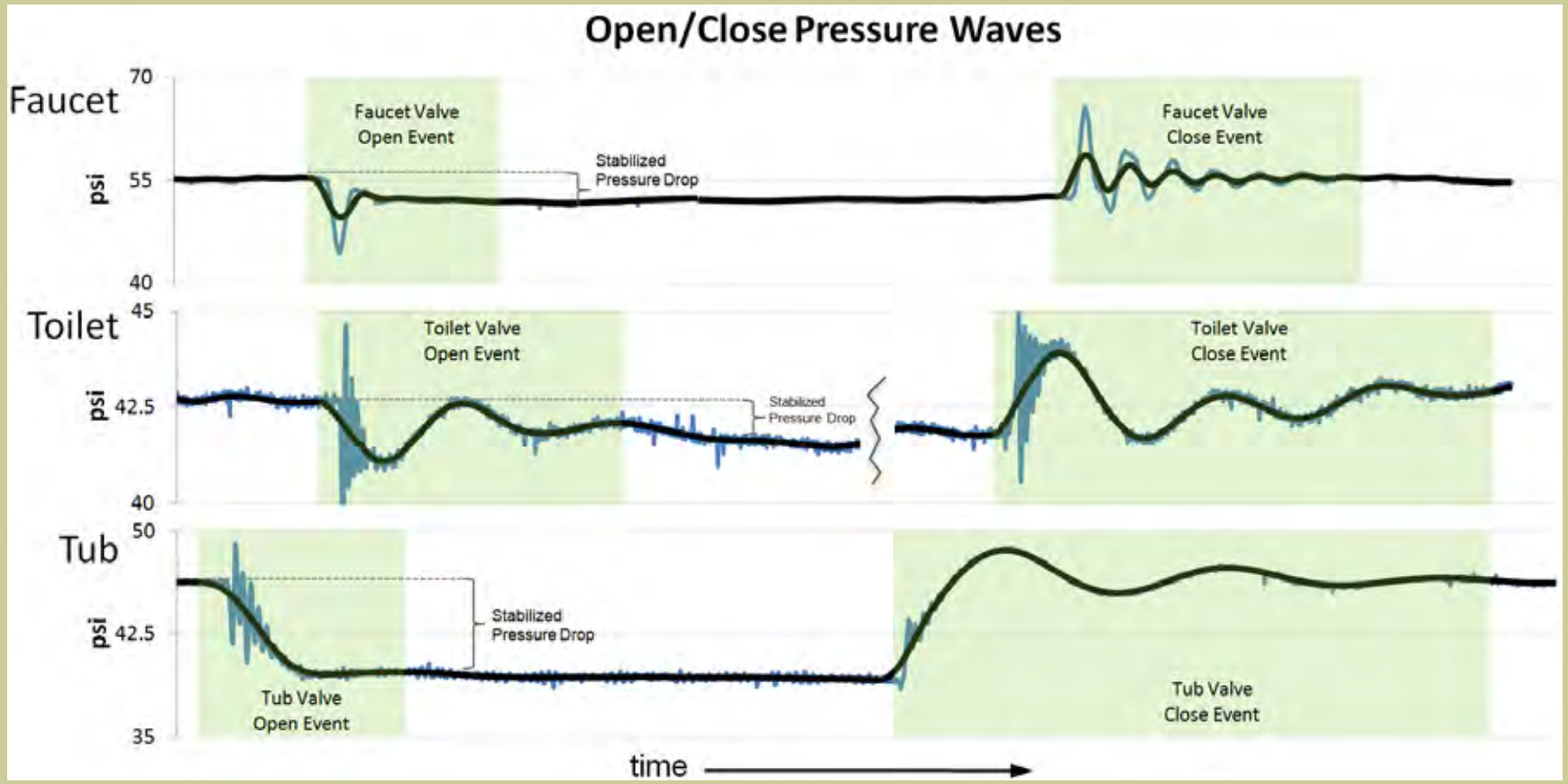
Topology of a mesh network

Advanced processing: Hydro Sense System



Source: Jon Froehlich et. al. U. Washington (2009)

Case Study: HydroSense Single-Point Sensing of Home Water Activity



Source: Jon Froehlich et. al. U. Washington (2009)

Application: advanced controllers reducing landscape water use

- Evapotranspiration (ET) Irrigation controllers use sensors, site information, and weather data to give landscapes the proper amount of water.
- Various systems commercially available
- Study in Las Vegas showed 26% average outdoor water savings (including desert climate/plants) without compromising plant health

Assessment: potential to reduce water use in Phoenix

Water implications	Annual Water Saved	Equivalent Amount of Water
ET controller in a single-family home, City of Phoenix, 2000	28,000 gallons	17% of total household water consumption
ET controller in all single-family homes, City of Phoenix, 2000	25,000 acre-feet	2% of municipal PAMA demand (1998)
ET controller at all turf facilities (golf courses)	25,000 acre-feet	1% of total PAMA demand (1998)

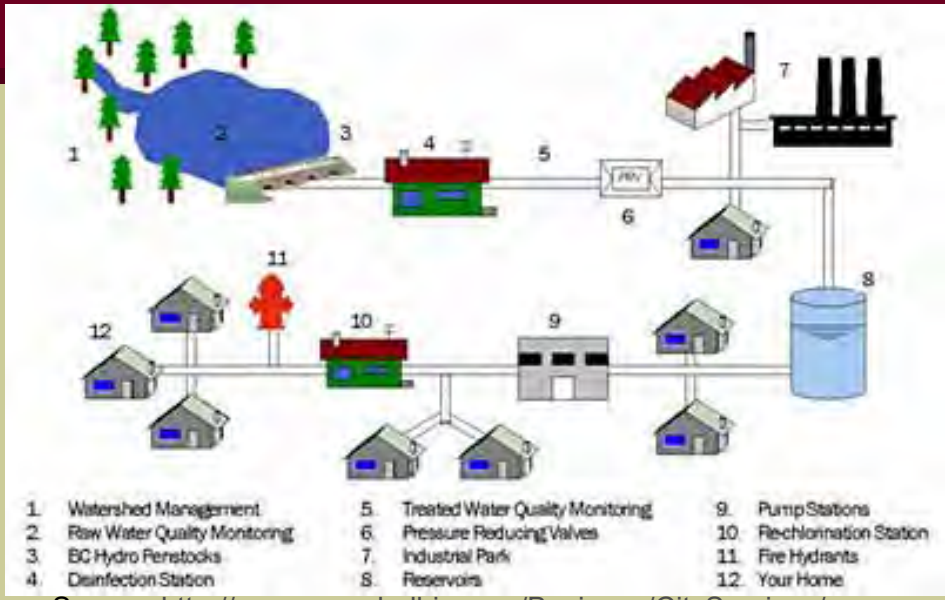
Price range of controllers (2004) is $99 to $485. In addition some have annual service costs

An average of $56/year can be saved on a Phoenix consumer water bill from installing an ET controller.

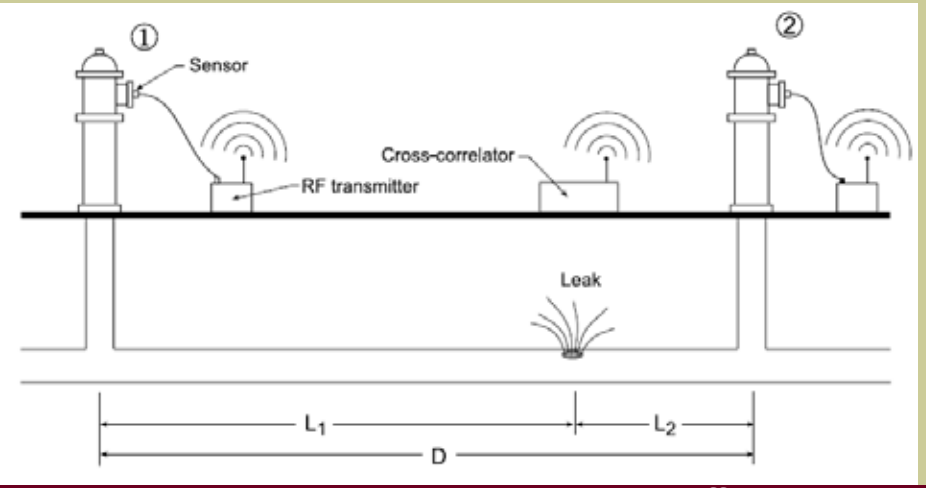
Source: Mutchek and Williams, in preparation (2010)

Application: identifying leaks

- Current system: monitored after treatment, then at end users (monthly or greater aggregates)
- ~10-20% losses in leaks
- The big question: do new technologies enable a different paradigm in detection?

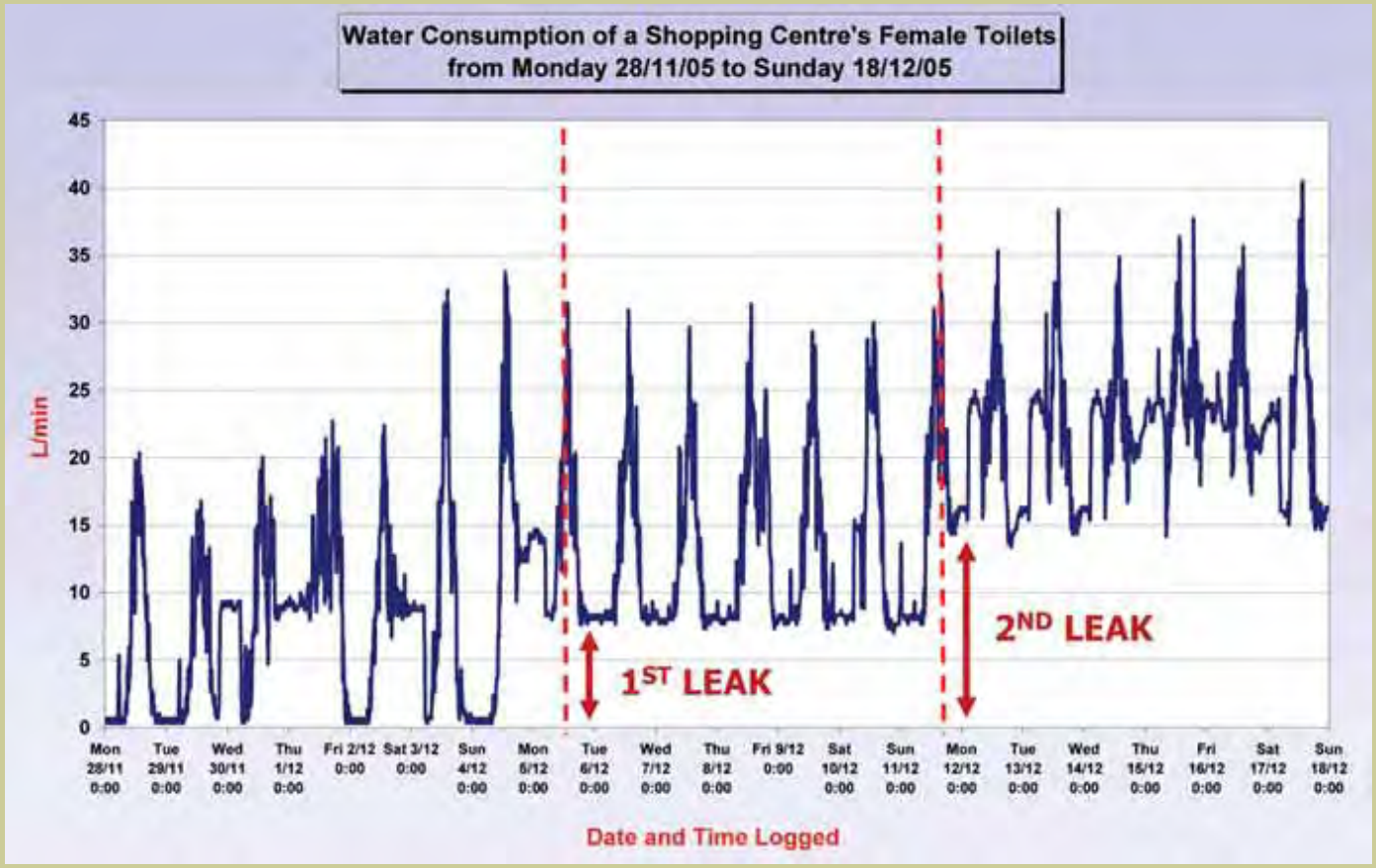


Source: http://www.campbellriver.ca/Business/CityServices/WaterSupplyandDistribution/Pages/SupplyandDistribution.aspx



Leak detection through sound timing differences
Source: Hunaidi (2000)

Application: Identifying leaks with Smart meters in shopping mall



Source: Hauber-Davidson, et. al. 2006

Future Direction

- Next steps:
  - Finish up evaluation of evapotranspiration (ET) Irrigation controllers
  - Develop clearer vision of water smart grids needs and solutions
  - Research on identified priorities
- Hope for feedback/input from experts here

Questions/ comments?

ericwilliams@asu.edu

michele.mutchek@gmail.com

Hydroturbines

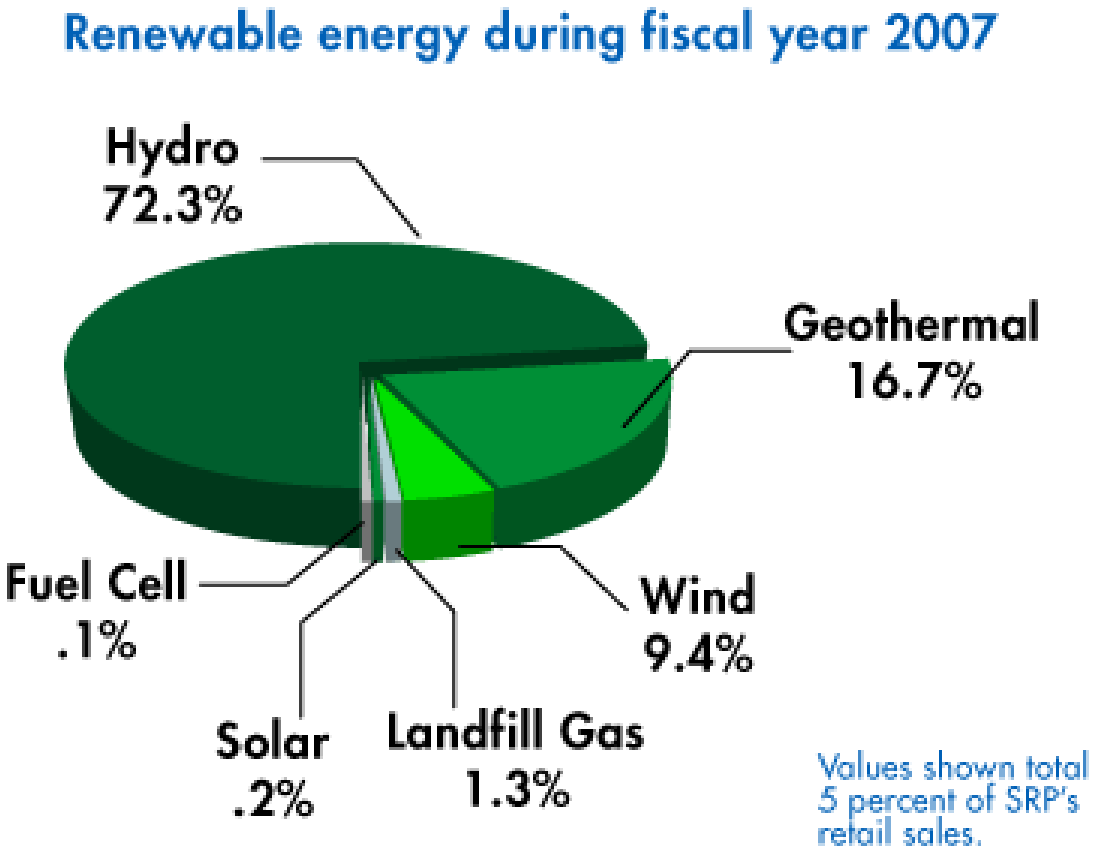
Its all downhill from here…

Maureen Hymel
City of Phoenix
Water Services Department

Historical use of water as energy

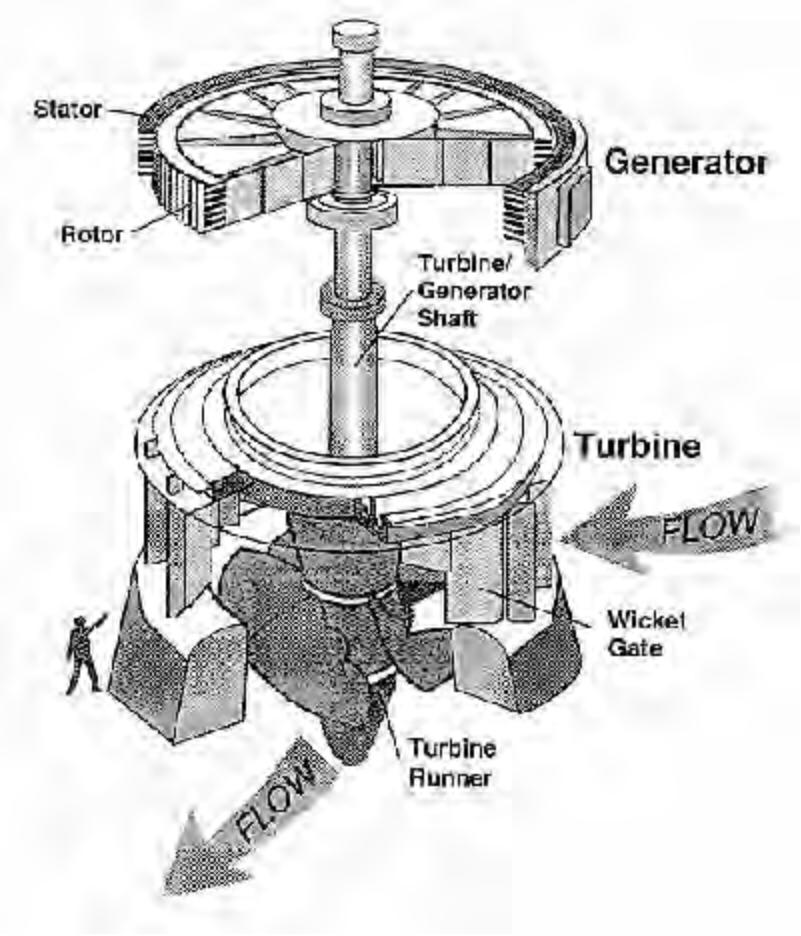
- 31 BC to 14 AD Water wheels used in Roman engineering (vertical)
- 31 AD Ancient China used water wheels (horizontal)
- 1500s Water wheels used for mining
- 1909 USBR built its first hydroelectric plant to help build Roosevelt Dam
- 1920 only 2% of energy was used to make electricity
- 1937 formation of SRP Agricultural Improvement & Power District

SRP Hydro Generation



Watts in a name?
A new frontier for old technology

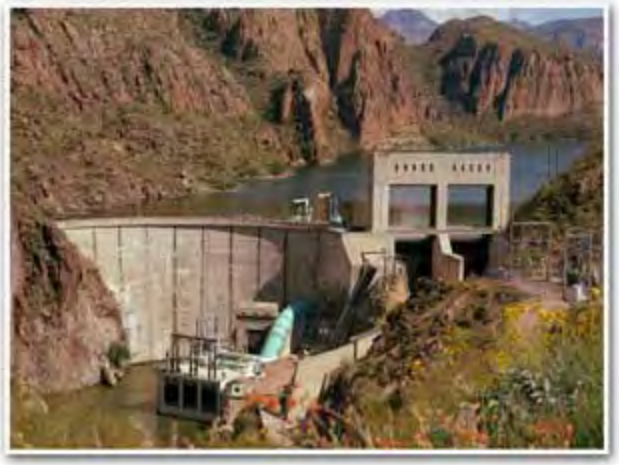
- Water wheel usually used for mechanical work
- Hydropower
- Hydrogeneration
- Hydroturbine
- Microturbine
- Hydroelectric Power



Courtesy of Doug Filer,
Army Corp of Engineers

Open channel vs closed pipe Vertical

- Elevation change (available head)
- Volume
- Velocity
- Load on generator



Elevation change or feet of Head

- 510’ Head Glen Canyon Dam (Lake Powell) 27,000,000 AF
- 249’ Head Theodore Roosevelt Dam 2,910,200 AF
- 72’ Head Parker Dam (Lake Havasu) 648,000 AK
- 29’ Head/1400 kw South Canal (SRP Canal)
- 14’ Head/ 750 kw Arizona Falls (SRP Canal)
- **Note: Some offshore installations work off tide water**

SRP Arizona Falls

- 14 ft elevation change/16” pipe
- 750 kilowatts
- 150 homes powered

City of Phoenix Water System

- Service area varies 940’ to 2020’
- Pressure Zones generally 100’ elevation intervals
- Water mains 2” to 108”
- Storage tanks and reservoirs provide 2’ to 43’ of operating head

COP Hydro-generation Studies

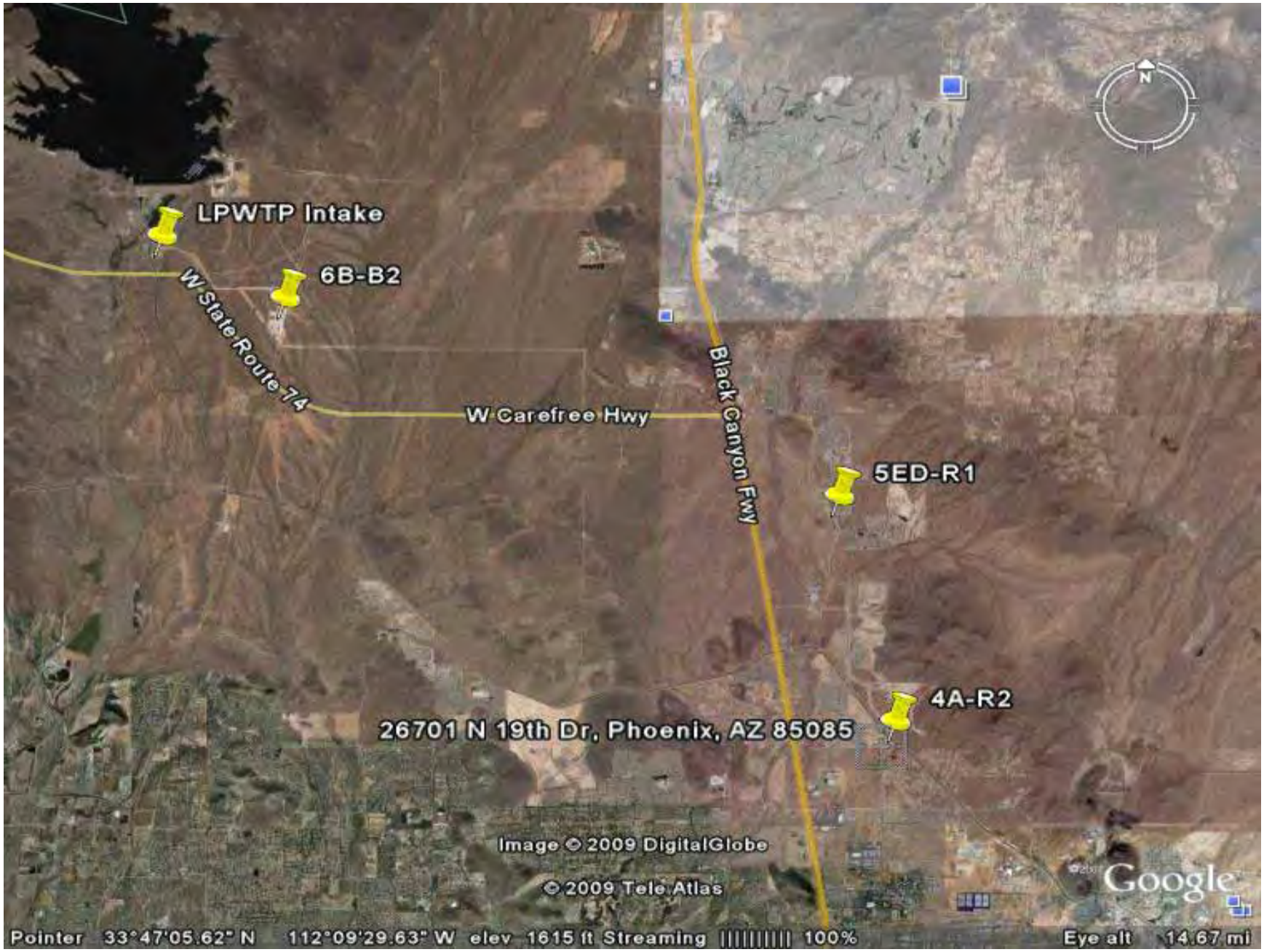
- 1987 Energy audit at four WT plants and considered hydro-generation on gravity mains
- 1991 In-line Hydro-generation Feasibility Study multiple pressure zones at 24 St WTP
- 2003 COP participated with SRP to re-construct Arizona Falls
- 2004 Hydro-generation potential for a new PRV station and a modified PRV at 24 St. WTP
- 2009 Lake Pleasant WTP Optimization- Investigate power production potential at PRV sites on the 54” transmission main

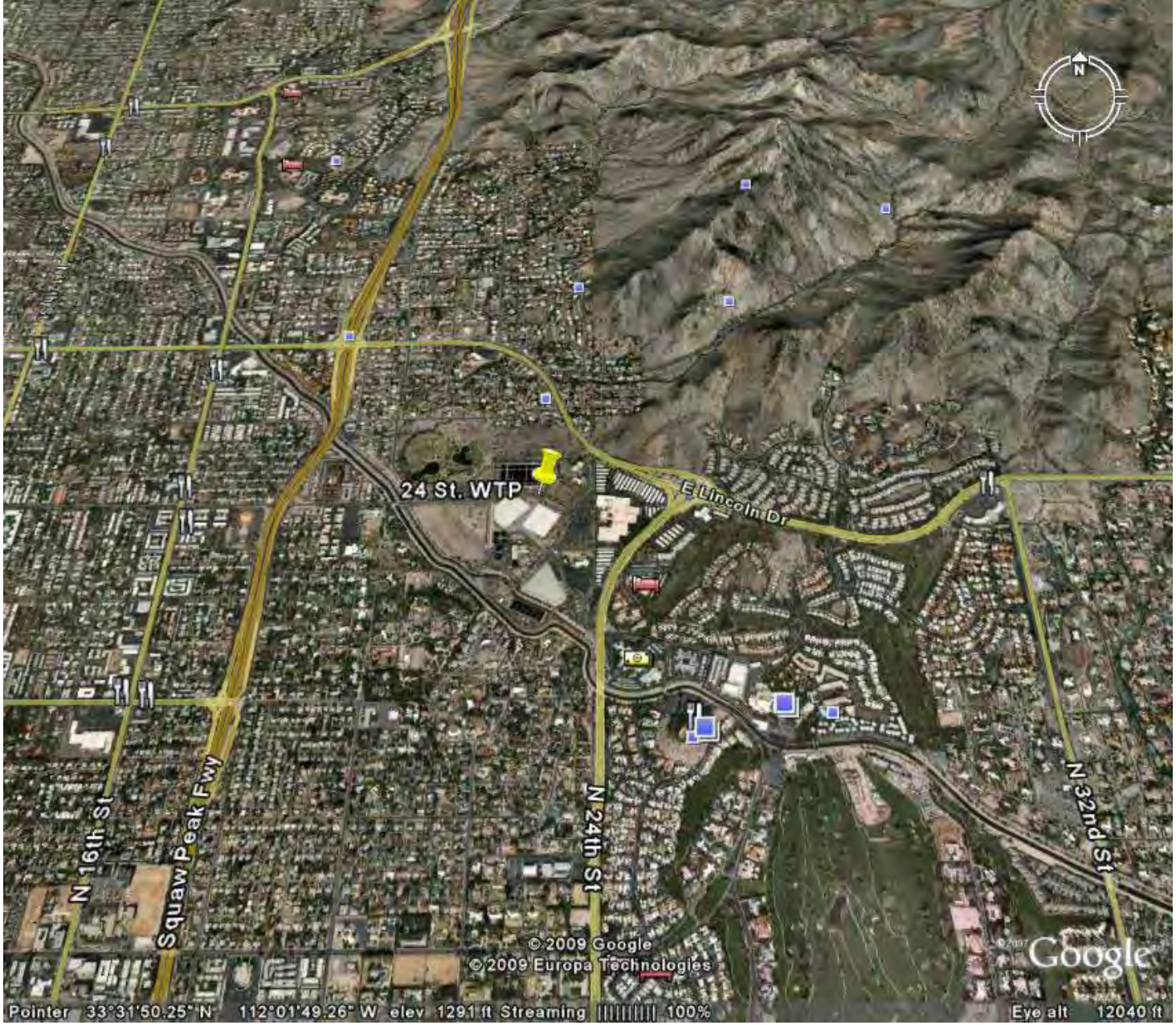
Use of Energy Dissipaters

- Pressure Reducing Valves
- Pressure Regulating Valves
- Pressure Control Valves
- Hydro-pneumatic Tanks

Hydro Generation Potential

- Potential PRV sites near I-17
  1. 5ED-R1 (54” main) and 100’ head
  2. 4A-R (54” main) and 100’ head
  3. 3D-R11 (20” main) and 100’ head
- ≈ 30 MGD (20,000 gpm) at each site
- 335 KW produced at each site


LPWTP Intake
6B-B2
W State Route 74
W Carefree Hwy
Black Canyon Fwy
5ED-R1
4A-R2
26701 N 19th Dr, Phoenix, AZ 85085
Image © 2009 DigitalGlobe
© 2009 Tele Atlas
Google
Pointer 33°47'05.62" N 112°09'29.63" W elev 1615 ft Streaming 100%
Eye alt 14.67 mi



Potential site near 24 St WTP

Pros for the sites

- Continuous operation at I-17 (possible at 24ST WTP)
- Consistent flow and head
- High head/ high flow
- Proximity to power utility connection to grid
- Green energy incentives
- Payback for installation
- Generate revenue
- PRV manufactures (Cla-val) options

CONS

- Hydroturbines are not traditionally used in water distribution systems
- All parts and lubricants that contact potable water are required to meet NSF 60/61 standard
- A special permit is required to generate electricity and send it to the grid
- Most installations will involve third party agreements to maintain equipment and negotiate send to grid
- No available facilities and infrastructure

Revenue Potential

- I-17 PRVs
  - 54” main, 100’ head, 340 to 420 kW potential
- 24 St WTP
  - 48” main, four pressure zones with 108’ to 371’ head
  - 400 to 1,000 kW power generation potential
- Sellback rate $.05 to $.095 per kWH
- Payback in 8 to 16 years

Considerations

- The most important variables that will determine the type of turbine and generator are:

1. Head height
2. Pipe diameter
3. Flow rate
4. Velocity

- Las Vegas Valley Water Authority
  - 48” with 930 kW power generation
  - 42” with 671 kW power generation
  - 36” with 522 kW power generation
- Greensboro, NC
  - 87’ head, 10 MGD, 81% efficiency, 87 kW
- San Diego

San Francisco Public Utilities Commission

SFGreasecycle

8" VCP
8178 BELVEDERE AV
061003004 -> 061003003
326'05"

28'05"

The cost of the sewer system

- Sewer Main

  780 miles = 4,118,400 feet

  4,738,370 LF * 200 $/LF = 8.2 billion

- Sewer Lateral

  2,200 miles = 11,616,000 feet

  11,616,000 LF * 115 $/LF = 1.3 billion

That is 9.5 billion for a new sewer system

And impacting it 5% = 475 million

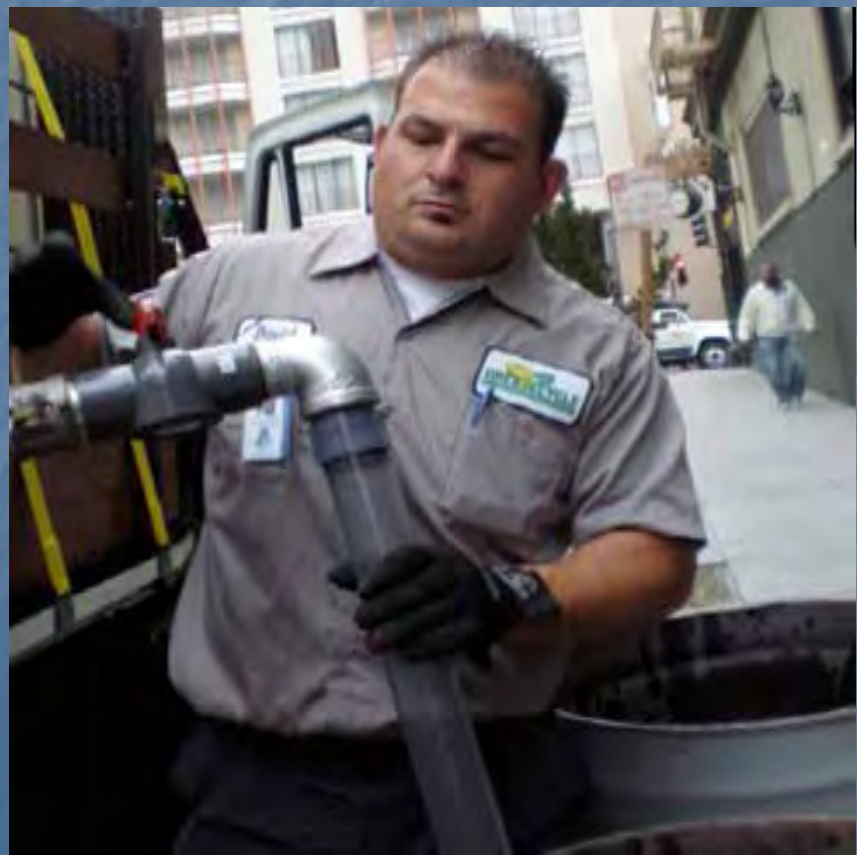
4% = 380 million

3% = 285 million

.5% = 47 million

Other reasons to protect the linear asset, the sewer system

- Public perception of bioenergy and alternative infrastructure is valuable
- Rising energy costs are expected
- Non-compliance with AB 32 will cost much more than that not according to a recent Air Quality Control Board study



THIS SIDE UP

THIS SIDE UP
DO NOT REUSE
Canola Oil

Corn Oil
Golden Chef
Soybean Oil

THIS SIDE UP
THIS SIDE UP
THIS SIDE UP

AVERAGE BIODIESEL EMISSIONS COMPARED TO CONVENTIONAL DIESEL, ACCORDING TO EPA

Emission Type	B100	B20
Regulated		
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
Nox	+10%	+2% to -2%
Non-Regulated		
Sulfates	-100%	-20%*
PAH (Polycyclic Aromatic Hydrocarbons)**	-80%	-13%
nPAH (nitrated PAH's)**	-90%	-50%***
Ozone potential of speciated HC	-50%	-10%

*** Estimated from B100 result**

**** Average reduction across all compounds measured**

***** 2-nitroflourine results were within test method variability**

38 GEARY
Ocean Beach
6269

SFFD

SUNSET SCAVENGER CO.
Biodiesel
STOP ENGINE

SFMTA
Powered by hybrid technology & fueled with biodiesel
Muni Light

San Francisco Task Forces

- SF Biodiesel Access Task Force
  - Established in February, 2006
  - 7 voting members (SF residents)
  - 11 non-voting members representing each SF City agency
- SF Biodiesel Access Task Force Marine Subcommittee
  - 5 voting members
- SF Peak Oil Preparedness Task Force
  - Established in May, 2007
  - 7 voting members

San Francisco Biodiesel Community

SF Biofuels Cooperative

PeoplesFuel

Red & White Fleets

Biofuel Recycling Cooperative

CytoCulture

Rainbow Grocery

Green Depot

BioSolar

Dog Patch Biofuels

SF Environment

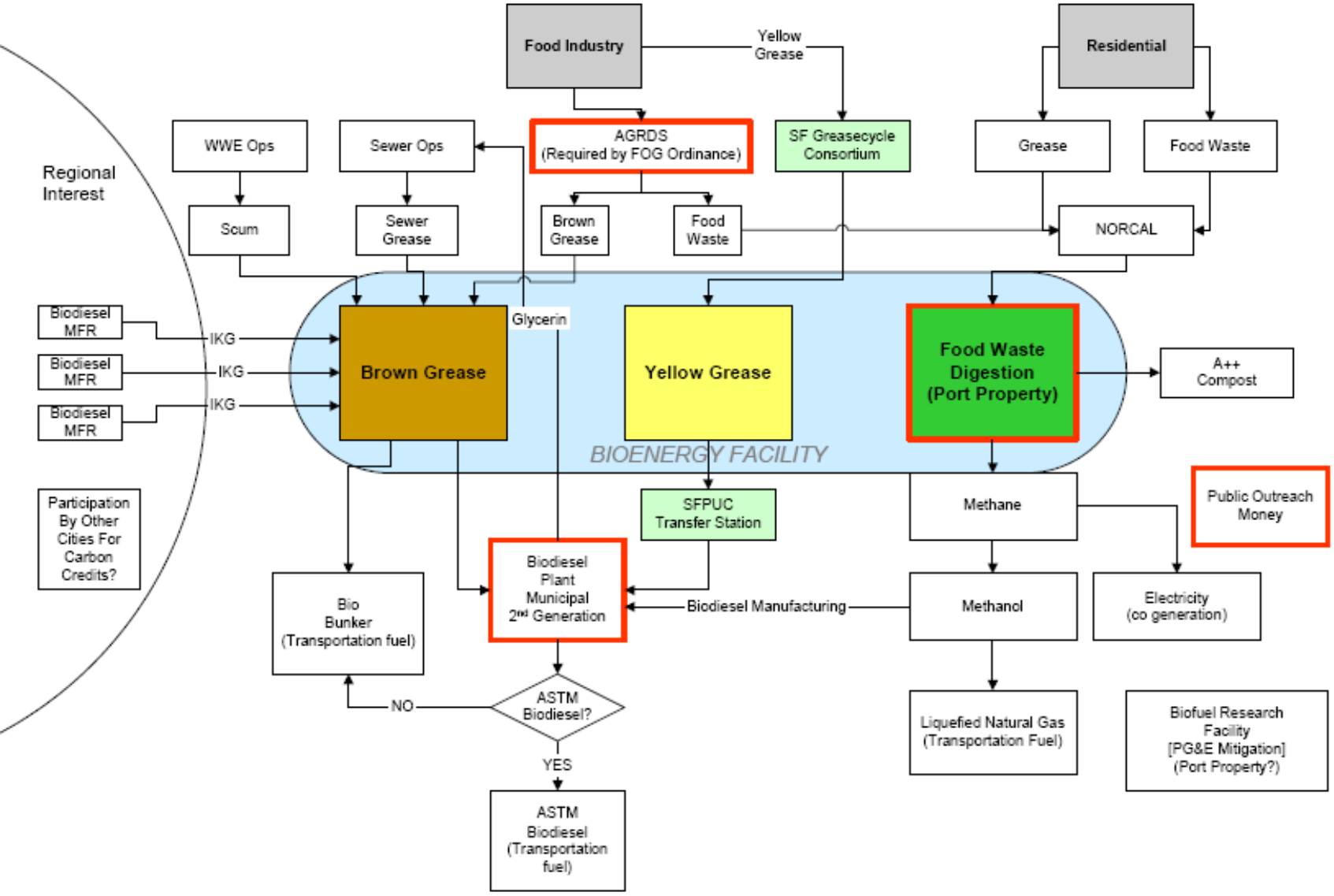
All debris box trucks operated by Norcal Waste Systems of San Mateo County run on alternative fuel (either liquefied natural gas or biodiesel).

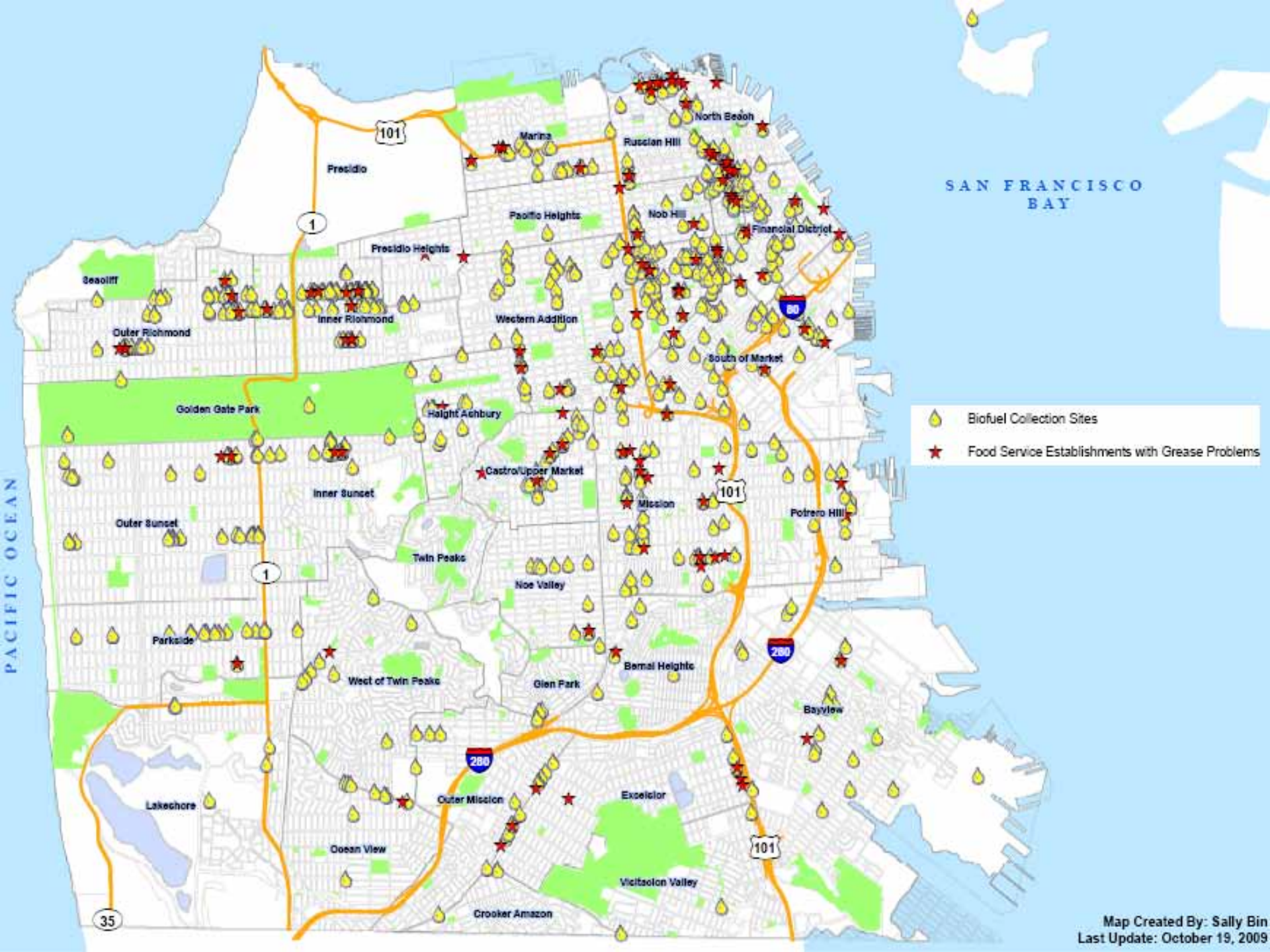
The biodiesel is B-20, a blended fuel including 20 percent biodiesel made from vegetable oil and 80 percent low-sulfur diesel.

Stricter environmental standards for diesel fuels, improved engine technologies, catalytic converters and using alternative fuels all combine to reduce truck emissions. Because we use alternative fuels, equip our trucks with superior catalytic converters, and maintain our fleet in good condition the overall emissions will measure well below legal limits.

CITY OF SAN FRANCISCO, PUBLIC UTILITIES COMMISSION
BIOENERGY FACILITY

May 19, 2008




SAN FRANCISCO BAY
PACIFIC OCEAN
Presidio
Marina
Russian Hill
North Beach
Pacific Heights
Nob Hill
Financial District
Presidio Heights
Seacliff
Inner Richmond
Western Addition
Outer Richmond
South of Market
Golden Gate Park
Haight Ashbury
Castro/Upper Market
Inner Sunset
Mission
Potrero Hill
Outer Sunset
Twin Peaks
Noe Valley
Parkside
Bernal Heights
West of Twin Peaks
Glen Park
Bayview
Lakeshore
Outer Mission
Excelsior
Ocean View
Visitacion Valley
Crocker Amazon
101
1
80
280
35
Biofuel Collection Sites
Food Service Establishments with Grease Problems
Map Created By: Sally Bin
Last Update: October 19, 2009

OLD
OIL
Nutrition Facts

Mazola
Mazola

Mazola

SF GREASECYCLE

SIGN UP | UPCOMING EVENTS | CONTACT US

Search

RECYCLE YOUR COOKING OIL FOR BIOFUEL. SAVE OUR SEWERS

- THE DISH ON GREASECYCLING
- UNCLOGGING OUR SEWERS
- FREE RESTAURANT & FSE PICK-UP
- FOR RESIDENTS
- KUDOS TO PARTICIPATING RESTAURANTS!
- FOG (FATS, OILS & GREASE) FACTS
- COMBATTING CLIMATE CHANGE

START SAVING TODAY! SIGN UP

Introducing SFGreasecycle

A new recycling program that turns a big mess into big benefits.

A big grease problem.

Home and restaurant used cooking oils are seriously clogging San Francisco's sewers and **costing us all a lot of money—over $3.5 million** each year to unclog the pipes. When poured down drains, cooking oil solidifies into thick layers inside drainpipes and sewer pipes, constricting water flow the way cholesterol affects blood flow in arteries.

Turned into big benefits.

But now the SFPUC is taking action. We're collecting waste vegetable oil from City restaurants for FREE and recycling them into biodiesel, an environmentally friendly alternative to petroleum diesel. San Francisco fleets will soon run on biofuel made from used cooking oils provided by

E collection services by clicking here. It only

DROP OFF YOUR USED COOKING OIL HERE.

Please make sure:

- your container has no leaks
- the lid is securely fastened
- your container is made of leak-proof material, such as a coffee tin
- to keep water, soap residue, food scraps and other debris separated from your used cooking oil

NO TRASH NO BASURA 不要置放垃圾

NO GLASS ENVASES DE VIDRIO NO

CLEAN IT BEFORE YOU DUMP IT

LÍMPIELO ANTES DE DESECHARLO 倒掉前請清潔！

HOW-TO HANDLE USED FRYER OIL

QUÉ HACER CON EL ACEITE DE LAS FREIDORAS 如何處理廢棄油

Filter oil from fryer

Filtre el aceite

從油鍋中濾出廢油

Don't contaminate with water

No agua

勿水

Keep out food particles

No partículas de comida

無食物殘渣

No trash

No basura

無垃圾

SF GREASECYCLE

SFGREASECYCLE SFPUC BIOFUEL PROGRAM

SFGREASECYCLE PROGRAMA DE BIOCOMBUSTIBLE DE SFPUC

SFPUC 生物燃料計劃

(415) 695-7300 sfgreasecycle.org

HOW-TO STORE USED VEGETABLE OIL

CÓMO ALMACENAR EL ACEITE VEGETAL USADO 如何儲存廢棄植物油

Make sure oil is not contaminated.

- No trap grease
- No food particles
- No rain water
- No motor oil
- No trash

Asegúrese que el aceite no esté contaminado y que no contenga:

- Nada de grasa colectada
- Partículas de comida
- Agua de la lluvia
- Aceite de motor
- Basura

確保廢油未受

- 無陷阱油脂
- 無食物殘渣
- 無雨水
- 無機油
- 無垃圾

Secure lid with ring.

Sujete la tapa con el anillo.

緊閉蓋子

Keep area clean free from oil drip

Mantenga el área limpia y sin gotas de aceite.

保持場地清潔，無滴漏

SF GREASECYCLE

SFGREASECYCLE SFPUC BIOFUEL PROGRAM

SFGREASECYCLE PROGRAMA DE BIOCOMBUSTIBLE DE SFPUC

SFPUC 生物燃料計劃

(415) 695-7300 sfgreasecycle.org

¡FACIL Y GRATIS!

Cualquier establecimiento de servicio de comida ahora puede inscribirse para que La Comisión Pública de Utilidades de San Francisco (SFPUC) recoja gratuitamente su aceite de cocinar usado mediante su Programa de Biocombustible.

Beneficiar: Recicla el Aceite para Cocinar para que la conviertan en Biocombustible. Salvemos a Nuestros Drenajes.

Ahora tiene una alternativa a vaciar el aceite para cocinar en el Drenaje! No tire su dinero a la basura. El SFPUC tiene un nuevo programa gratuito para recoger y convertir las grasas y aceites reciclados en biocombustible y así mantener libres de los drenajes de San Francisco. Las grasas y aceites pueden causar serios bloqueos en el drenaje lo cual puede interrumpir sus negocios y costarle al contribuyente dinero para costosos reparaciones de alcantarillas y otros daños para la tubería.

Tenemos una mejor idea. Un vez de pagar para que recojan sus desperdicios de aceite vegetal, nosotros vamos a recogerlo sólo gratis para convertirlo en biocombustible - un combustible que es más limpio al quemarse - y utilizar dicho biocombustible en los vehículos de la ciudad como los camiones Muni.

¿DE QUÉ MANERA SE BENEFICIARÁ USTED?

- Vehículos de recolección gratis de los usados aceites vegetales lo cual le ahorrará a usted el $$ que normalmente pagaría por deshacerse apropiadamente de los aceites.
- Menos problemas de drenaje que interrumpen sus negocios.
- Una calcomanía para su ventana mostrando que usted regularmente recicla el aceite vegetal usado para que se convierta en biocombustible.

¿DE QUÉ MANERA SERÁ BENEFICIADA LA CIUDAD?

- $3.5 millones ahorrados al año en mantenimiento de drenaje.
- Biocombustible limpio para mantener Muni y otros vehículos de la ciudad.
- Alimentar nuevos componentes de una ciudad autosuficiente.

Podemos fijar los tiempos de colección de aceite cuando le sea conveniente de acuerdo a sus necesidades de almacenamiento y asegurarle un servicio constante de alta calidad. En este momento no ofrecemos directamente servicios de remoción de grasa pero esperamos poder hacer en el futuro si crecer el programa. Mientras tanto, podemos referirle a compañías la cual podrían ofrecer este servicio.

La petición que mantenga el aceite libre de agua, desperdicios de comida u otros desperdicios sólidos.

INSCRÍBASE HOY PARA ESTE SERVICIO GRATUITO

Llame a la directora de Biocombustibles, Karl King (415) 695-7300 o envíe un correo electrónico a kingk@sfwater.org, lo fácil de hacer y por otra manera de ahorrar minutos valiosos al nuestro sistema.

(Las respuestas a preguntas comunes se encuentran al dorso)

SF GREASECYCLE

對於SFPUC生物燃料計劃經常提出的問題：
為餐館提供三藩市油脂循環
免費收集廢棄蔬菜煮食油造燃料
為我們的城市車輛提供柴油

你們收集哪一類的廢油？

[illegible]

你們能收取所有的烹飪油嗎？

[illegible]

收集服務要收取什麼費用？

[illegible]

你們不會要付費嗎，收集服務不收？

[illegible]

你們要否也提供收集服務？

[illegible]

你們要否收取部分動物油（脂肪）？

[illegible]

為什麼不能把水與油廢棄油倒？

[illegible]

你們要多久才來在我們的餐廳要保證清潔的服務？

[illegible]

START SAVING YOUR USED COOKING OIL NOW.

Drop it off at the SFGreasecycle Booth during the Chinatown Community Street Fair.

DROP-OFF DATES:
Saturday, February 7: 10am – 4:30pm
Sunday, February 8: 9am – 5pm

Kitchen Collection Easy How-to:

1. Cool down used cooking oil in the pan.
2. Pour used oil into a clean, non-breakable, leak-proof container with a tight lid. Consider reusing old ones, such as mayonnaise jars.
3. Please make sure there's no water, soapsuds, or food scraps in your used oil.

Look for the SFGREASECYCLE Booth on Grant Street and get a free strainer when you drop off your used cooking oil. Help us support the City's efforts. Instead of clogging drains and sewer pipes with your used cooking oil—a $3.5million problem for San Franciscans—recycle it for biofuel.

Thank you for your participation and Happy New Year!
For more information, visit sfgreasecycle.org.

SFPUC Water Wastewater Power

SF GREASECYCLE
RECYCLE YOUR COOKING OIL FOR BIODIESEL. SAVE OUR SEWERS

Soy Based Inks. 100% Recycled, 50% PCW, Process Chlorine-Free Paper.

EVERY DROP COUNTS

Put USED COOKING OIL in its place.

For drop-off info, visit SFGreasecycle.org

SF GREASECYCLE

在這個
年末節日期間，
給市政府送一件大禮：

您用過的烹調油。

在三藩市公用事業委員會的「三藩市油脂回收計劃」(SFGreasecycle) 之下，我們將把它轉變為生物柴油。

送交地點詳情
12月27日至30日

COSTCO WAREHOUSE
450 10th St (At Bryant)
時間：
星期六：10:00am-6pm
星期日：10am-6pm
星期一：中午12:00-下午6:00

[illegible]

關於油脂：
1. 冷卻煮過的食用油。
2. 將食用油倒入一個乾淨、不易破碎的容器，容器必須有蓋子。
3. 請確保食用油中沒有水、肥皂水、或食物殘渣。

廚業的垃圾會積少成多，特別是在烹調活動繁忙的節日期間。把用過的烹調油倒入下水道會造成堵塞，每年給市政府帶來三百五十萬美元的損失。請我們把它回收為消防車和公車可以使用的，燃燒清潔的生物燃料。

您可以在聖誕節和元旦之間把用過的烹調油交市內的 Costco 或任何一家 Whole Foods Market 分店。記得使用可以重複、不易破碎的容器。請訪問 SFGreasecycle.org 瞭解詳情。

SFPUC Water Wastewater Power

SF GREASECYCLE
回收你的烹調油 保護我們的下水道

THIS THANKSGIVING, GIVE THE CITY A GIFT:

YOUR USED COOKING OIL.

With the New SFGreasecycle Program, we're converting your used cooking oil into biodiesel to power the City's fleet.

COSTCO DROP-OFF DETAILS
November 23rd through 26th

HOURS:
Friday: 9:00am - 8:30pm
Saturday: 8:30am - 7:00 pm
Sunday: 10:00am - 8:00pm
Monday: 11:00am - 8:30pm

ADDRESS:
450 10th St (between Harrison & Bryant)

KITCHEN COLLECTION EASY HOW-TO'S

1. Cool down used cooking oil in the pan.
2. Pour used oil into a clean, leak-proof container with a tight lid. Consider reusing old ones, such as coffee cans.
3. Please make sure there's no water, soapsuds, or food scraps in your used oil.
4. Drop off your leak-proof container at Costco during hours of operation.

SFGreasecycle is a citywide effort by the S.F. Public Utilities Commission to divert Fats, Oils & Grease away from the sewers and recycle them into biofuel—cleaner-burning diesel fuel—to fire City fleets, such as fire trucks and Muni buses.

Even a little grease causes problems.
Most residents generate only a bit of used cooking oil during the year, but seem to use much more during the holiday season. The cumulative effect from so many homes contributes to clogged sewers.

Please don't pour ANY used oil down the drain. Instead, collect it in a container and bring it to Costco on 10th Street—right after Thanksgiving, from Friday through Monday—so we can recycle into clean-burning biodiesel.

With your help, we will save $3.5 million per year on sewer maintenance and keep our commitment to a sustainable city. Thank you for your participation. Visit SFGreasecycle.org for more details.

SF GREASECYCLE
RECYCLE YOUR COOKING OIL FOR BIODIESEL. SAVE OUR SEWERS

SFPUC SFGreasecycle Current and Future Job Opportunities

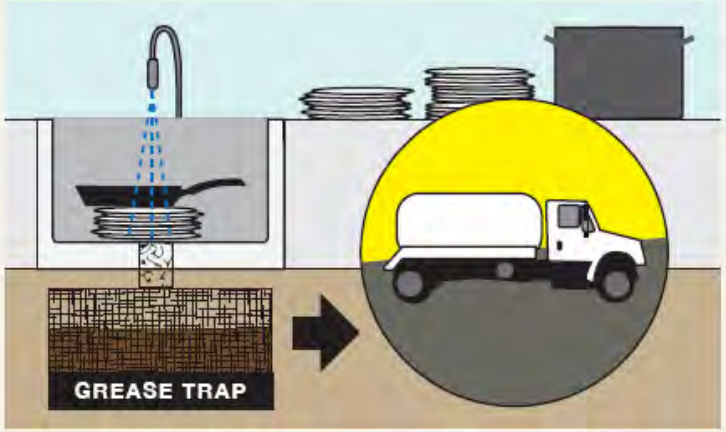
- Global Exchange 3-month internships (seasonal)
- SE Community Workforce Development 8-month positions (Currently 3)
- 9910 Public Service Trainees (1)
- 9920 Public Service Aids–Special Programs (2)
- 7375 Stationary Engineer Apprentices (1)
- 7515 General Laborers
- 7355 Licensed Truck Drivers (3)
- 7373 Stationary Engineer (1)

GREASE TRAP GUNK (AKA "BROWN GREASE") IS PROCESSED INTO CLEAN-BURNING BIOFUEL

Technology developments and enterprising water agencies are solving environmental and energy issues by using the scrapings at the bottom of the grease trap barrel. Here's how:

1. COLLECTION

Most, if not all, grease and food scrapings from dirty dishes and pots from commercial kitchens are captured in a grease trap. Instead of flowing straight from a restaurant's sink drain down into the sewer pipes, brown grease is collected (restaurants pay $ for this service) and hauled to a wastewater treatment plant (haulers then pay $ for disposal).



2. CONVERSION

At the plant, the patent-pending conversion process occurs, refining brown grease and creating three kinds of biofuel:

1. High-grade, road-worthy certified biodiesel for vehicles;
2. Lower grade boiler fuel for running sewage treatment plant equipment; and
3. Electricity converted from methane to run the treatment plant

3. DIVERSION

Unlike cooking oil from deep fryers, which can easily be processed and recycled, trap grease is so rancid that it is considered a pollutant. It has typically been sent to an incinerator or landfill. Today's technology enables this waste to be converted into alternative energy.

4. CONSERVATION & MARKET CREATION

Sewer maintenance, including repairs when brown grease clogs sewer pipes, costs municipalities millions of dollars annually. By being the raw material for biofuel, "brown grease" becomes a commodity. It assumes market value and less gets dumped down the drain, minimizing costs for sewer maintenance and repair.

In the end, every drop, every scrap is used to produce energy, leaving nothing wasted.

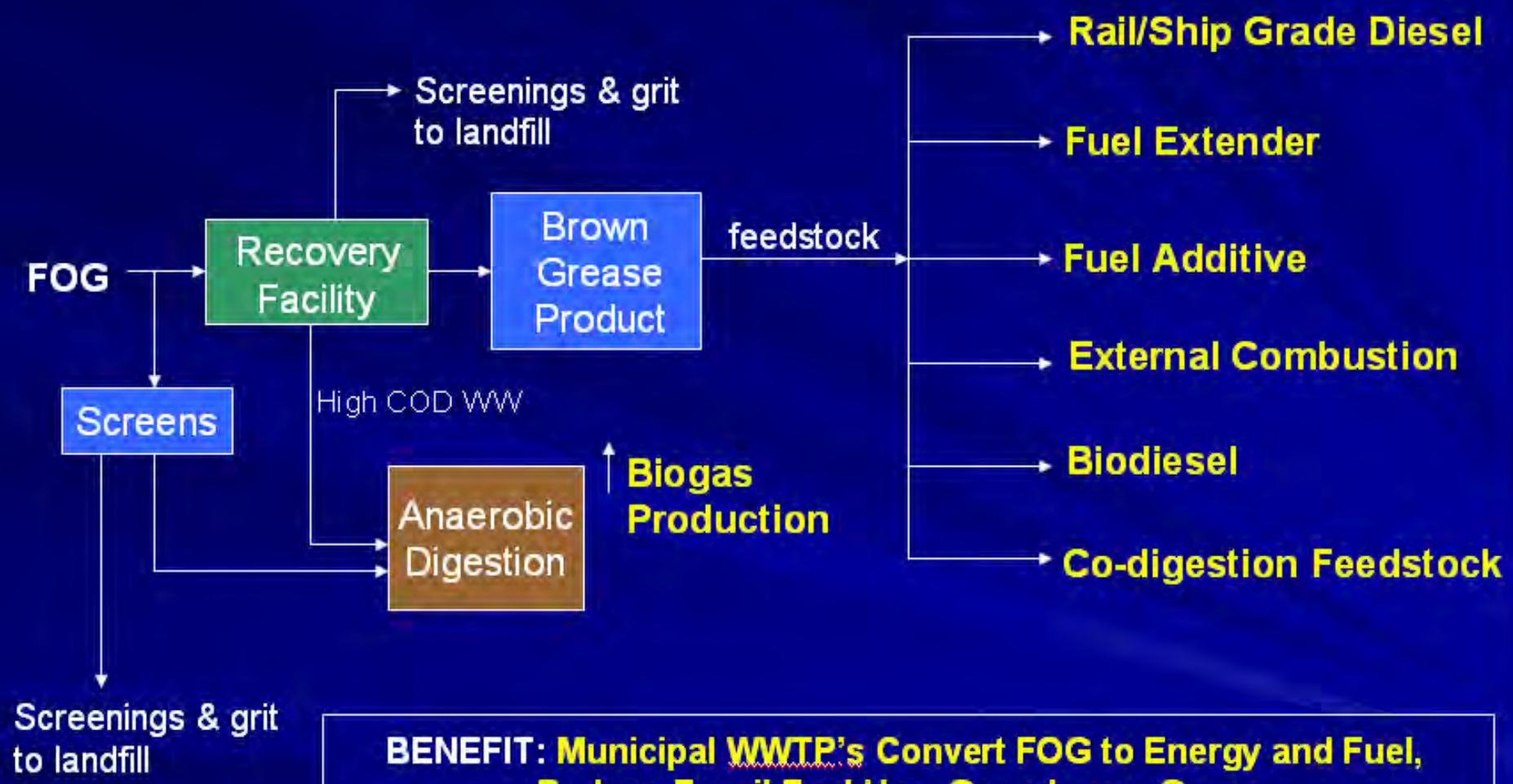
SF GREASECYCLE
RECYCLE YOUR COOKING OIL FOR BIOFUEL. SAVE OUR SEWERS

SFGREASECYCLE: SFPUC

(415) 695-7366 sfgreasecycle.org

SFPUC
WATER
WASTEWATER
POWER

FOG Recovery Facility



BENEFIT: Municipal WWTP's Convert FOG to Energy and Fuel, Reduce Fossil Fuel Use, Greenhouse Gases, and Waste Hauling Costs, and Extend Life of Landfills

SF GREASECYCLE

RECYCLE YOUR COOKING OIL FOR BIOFUEL. SAVE OUR SEWERS

Opportunities and Initiatives for Sustainability: Energy, Water and the Environment

Ed Curley, Strategic Planning Manager
Pima County Regional Wastewater Reclamation Department

MAG Greening Water and Wastewater Infrastructure Workshop

January 12, 2010

Framework for Integrated Sustainability Planning in Pima County

Pima County

Smart Growth Legislation
State requirements to plan for and address:
(1) Land Use, (2) Environmental Planning,
(3) Water Resources, (4) Energy, (5) Transportation, (6)
Cost of Development, (7) Open Space,
and (8) Growth Areas

- Sonoran Desert Conservation Plan
- Pima County Comprehensive Land Use Planning
- Conservation Lands System
- Pima County Sustainability Program

Community Planning

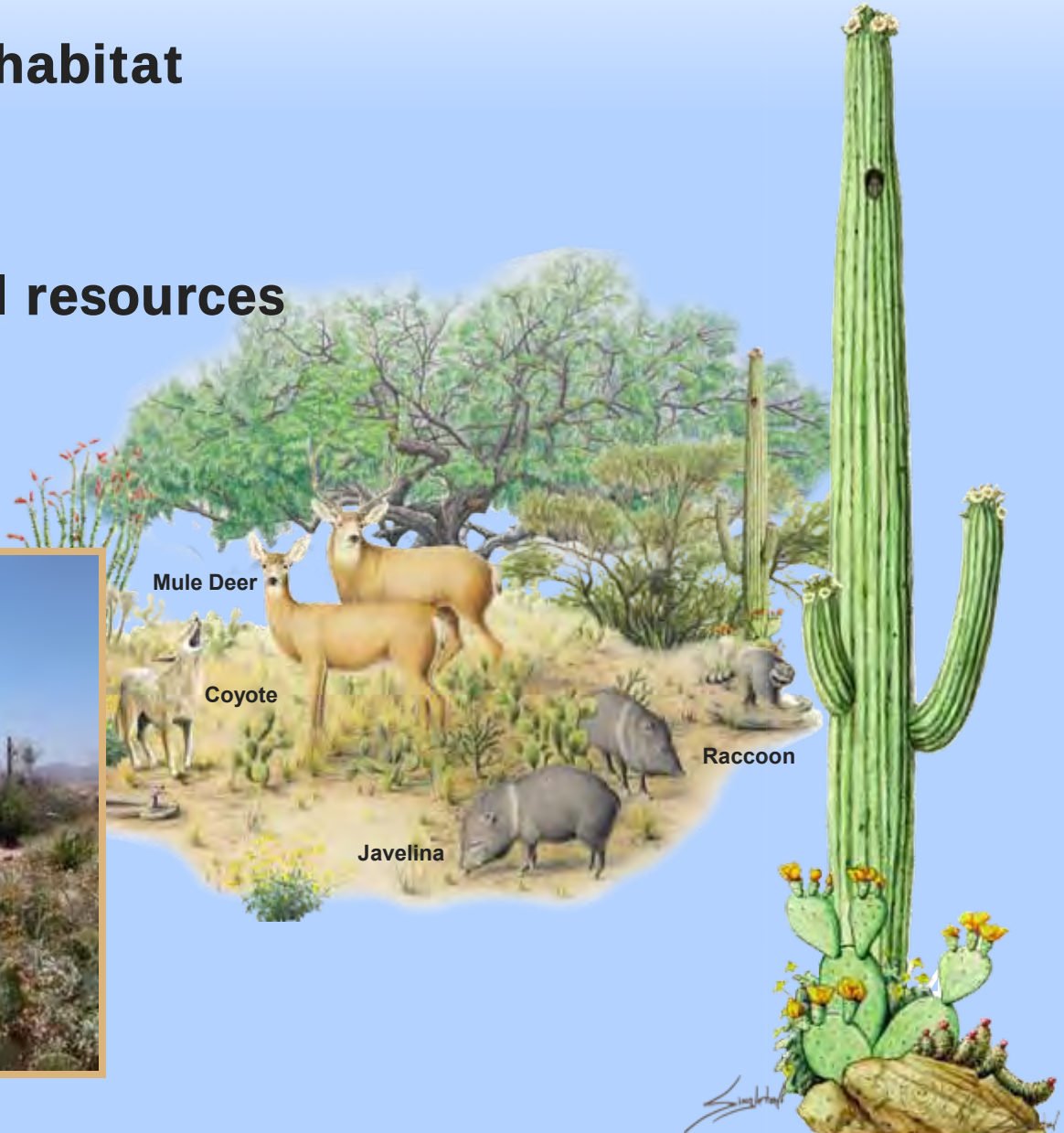
- Arid West Water Quality Research Project
- EPRI Retreat Project
- Water and Wastewater Infrastructure Supply and Planning Study

Sonoran Desert Conservation Plan – Goals

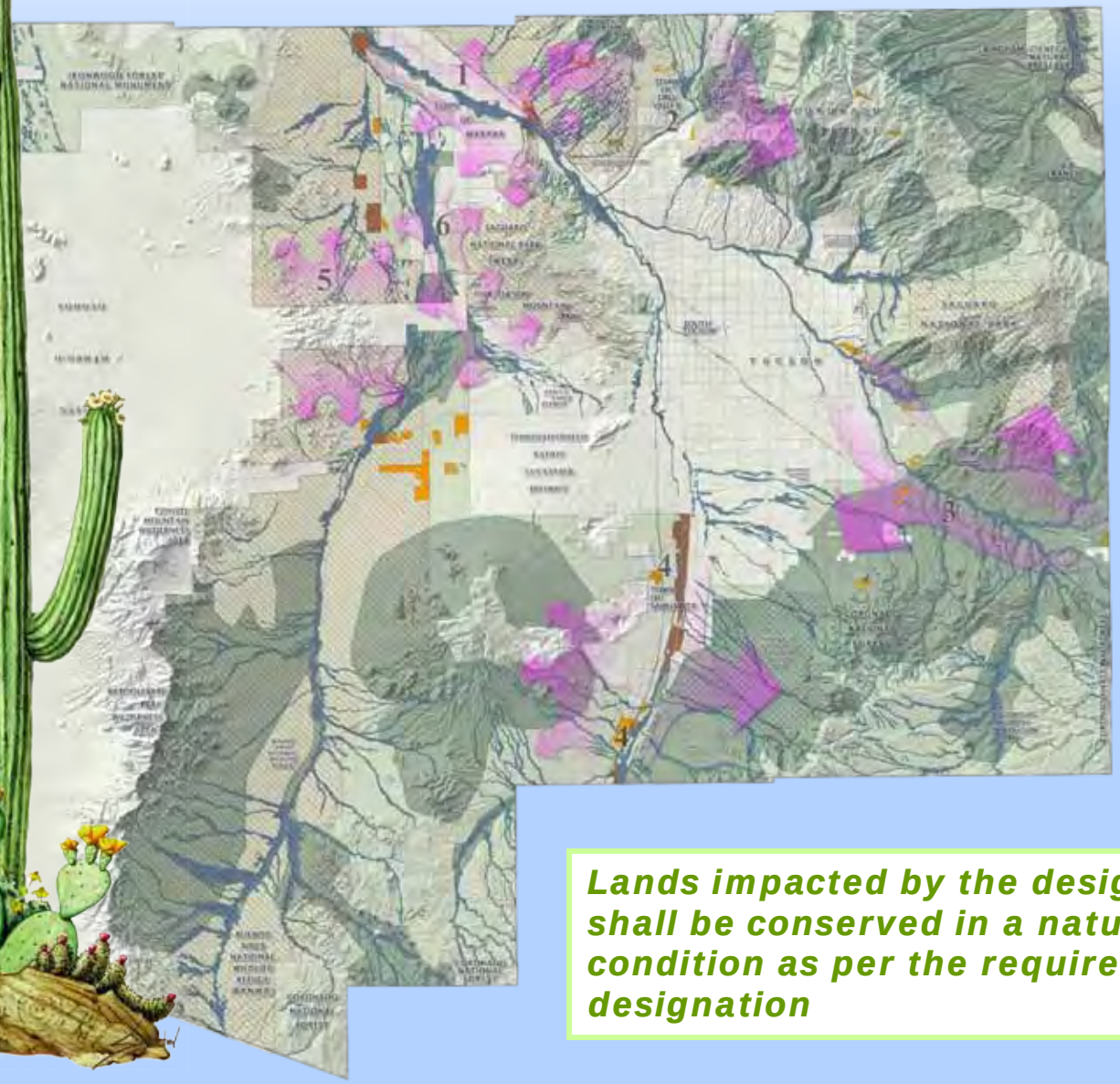
- Preserve and restore unique desert environment and wildlife
- Maintain wildlife habitat in the face of urban development

Sonoran Desert Conservation Plan – Elements

- § Critical and sensitive habitat
- § Biological corridors
- § Riparian preservation
- § Historical and cultural resources
- § Mountain parks
- § Ranch conservation



Conservation Lands System



Important Riparian Areas: 95 percent

Biological Core Management Areas: 80 percent

Multiple Use Management Areas: 66-⅔ percent

Special Species Management Areas: 80 percent (4 : 1 land conservation)

Scientific Research Areas

Agriculture In-holdings within the *Conservation Lands System*

Critical Landscape Connections

Lands impacted by the designations listed above shall be conserved in a natural or undisturbed condition as per the requirements of each designation

Pima County Sustainability Action Plan

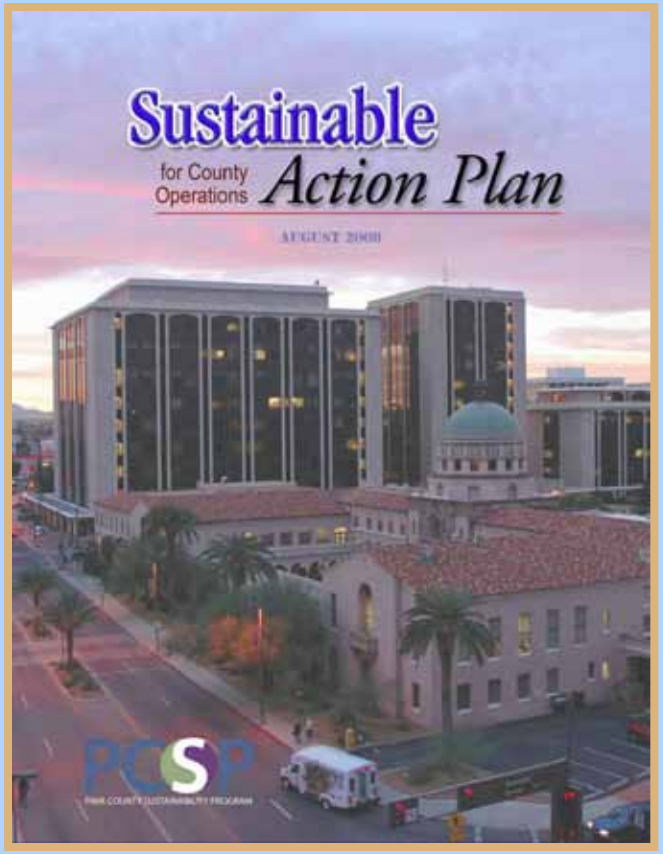
On May 1, 2007, the Board of Supervisors adopted a resolution for a series of initiatives to promote and advance sustainability in the areas of:

- Green Building
- Renewable Energy
- Alternative Fuels
- Waste Reduction
- Green Purchasing
- Water Conservation and Management
- Social Well-Being, Opportunity & Equity

Pima County Sustainability Action Plan

Goals

- Transition to renewable energy sources to meet 15% of the energy needs of County facilities by 2025
- Maximize methane use to help power County wastewater and landfill operations
- Maximize county water resource assets, including groundwater rights, surface rights and effluent for natural resource protection
- Reduce water use in County facilities by 15% by 2025



Arid West Water Quality Research Project (AWWQRP)

- **Project Purpose:**
  Improve scientific basis for regulation of water quality and protection of species, habitats and uses of effluent-dependent and ephemeral waters in the arid West
- **Funded by the U.S. Environmental Protection Agency**
- **Initiated in 1995**
- **Completed in 2007**

AWWQRP: Stakeholders Working Together

- **Pima County Wastewater Management Department**
- **U.S. Environmental Protection Agency**
- **Regulatory Working Group of Regional Agencies and Organizations** – *Identify regulatory issues that should be addressed by research and develop the Research Agenda*
- **Scientific Advisory Group** – *Review proposals received, rank and recommend worthy proposals based on scientific merit and review research products*

AWWQRP: Science and Policy

- **Established fact-based foundation to address arid west regulatory and environmental issues**
- **Brought together scientists, regulators, agencies, tribes, NGOs**
- **Created database of reports and research**
  - Updated constituent toxicity databases
  - Updated species lists for arid west waters
  - Updated constituent toxicity databases
  - Updated species lists for arid west waters
- **Provided opportunity to discuss critical water supply and quality issues in common forum**

www.pima.gov/wwm/wqrp

EPRI Retreat Project

Goal

Develop a vision of the ideal sustainable water infrastructure policies and practices

Objectives

Community-level water sustainability will:

- Integrate potable water/wastewater/ reclaimed water/stormwater across political, jurisdictional, economic boundaries
- Provide communities with cascading environmental, societal and economic sustainability benefits

Project Overview

- Recruit two diverse communities
- Recruit diverse group of advisory panelists
- Conduct pre-retreat teleconference to orient and engage
- Develop two community case studies
- Hold 2.5-day retreat to obtain input for a new paradigm for water infrastructure management
- Conduct follow up research
- Prepare final report

Retreat from June 1-3, 2009, in Hebron, Kentucky

Participants

Community Representatives

- Pima County Regional Wastewater Reclamation Department, Arizona
- Pima County Flood Control District, Arizona
- City of Tucson Water Department, Arizona

- City of Covington, Kentucky
- Sanitation District No. 1 of Northern Kentucky
- Northern Kentucky Area Planning Commission
- Northern Kentucky Water District
- Kentucky Dept. for Environmental Protection

Researchers & Experts

- USEPA – Office of Research and Development
- USEPA – Office of Wetlands, Oceans & Watersheds
- Tetra Tech
- CDM
- Allied Environmental
- CH2M Hill
- Inman and Strickler
- Blake Anderson Consulting
- East Kentucky Power Cooperative
- Electric Power Research Institute
- Carollo Engineers
- CollinsWoerman
- Water Environment Research Foundation (WERF)
- Coalition for Alternative Wastewater Treatment
- University of Alabama – Tuscaloosa
- AWWA Water Research Foundation
- Clean Water Action
- Electric Power Research Institute

ELECTRIC POWER RESEARCH INSTITUTE

Planning Sustainable Water Infrastructure

Recognize Desired Outcomes

- **Overarching Goals**
  - Environmental
  - Economic
  - Social
- **Specific**
  - Defined by each community

Adopt Sustainable Infrastructure Principles

- Value the resource
- Aspire to higher objectives that spawn better outcomes
- Smart, clean and green
- Integrate water mgmt. decisions with community planning and development
- Recognize true costs and maximize value/benefits
- Adapt and evolve
- Community shares responsibility and risks
- Locally driven and context sensitive at all scales
- Build intellectual infrastructure

Adapt and Integrate Technological Architecture

- Resource recovery and recycling
- Distributed resource management
- Multi-benefit infrastructure solutions
- Emerging technological approaches

Build the Institutional Capacity

- Integrated planning and smart growth
- Watershed scale planning and management
- Full life-cycle costing and market mechanisms
- Modified regulations
- Enhanced community engagement
- Build intellectual capital

Ongoing Sustainability Initiatives and Achievements

Regional Optimization Master Plan (ROMP)

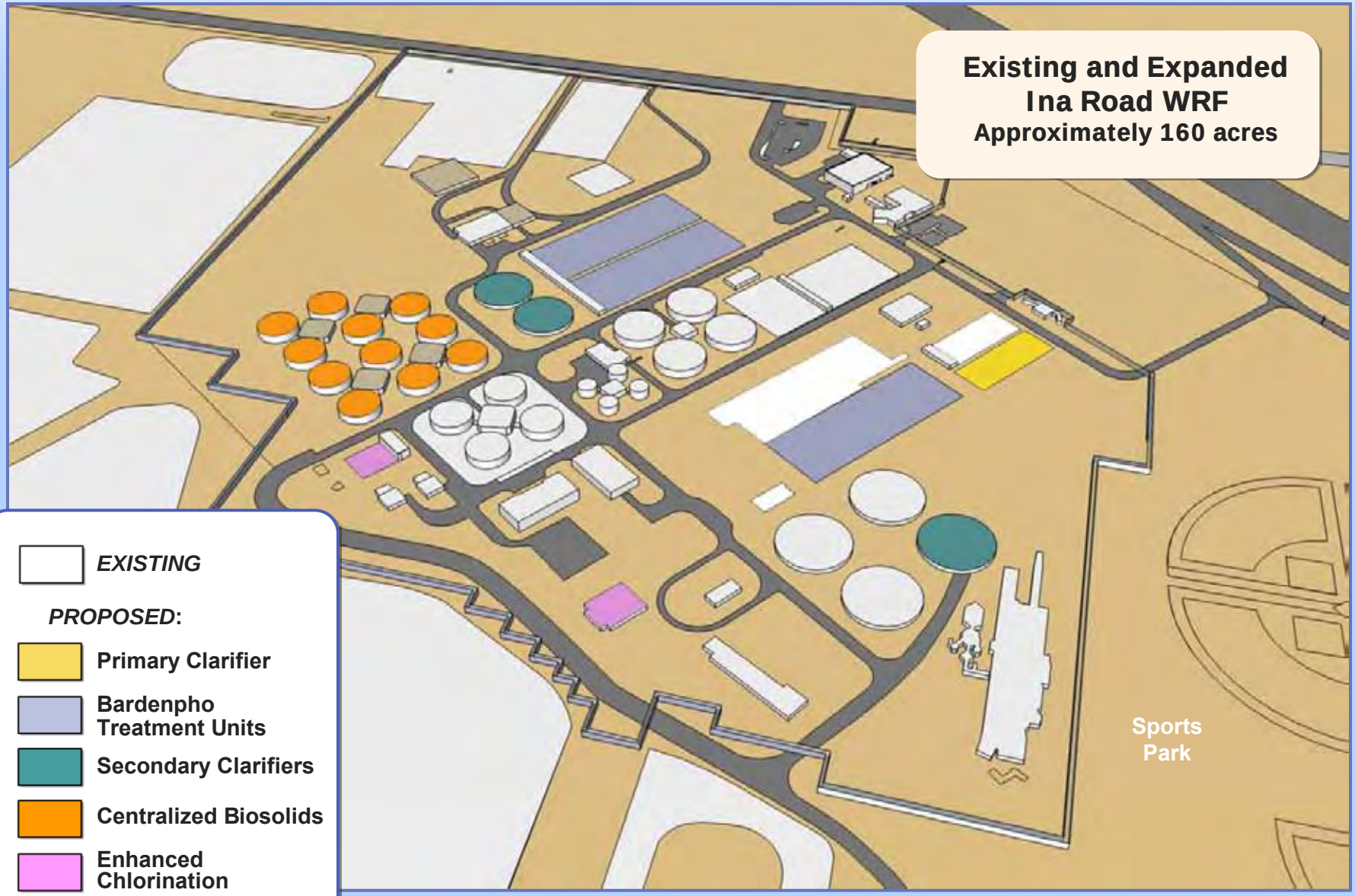
Program Goal

Develop the optimal treatment process and plan to comply with regulatory requirements to reduce total nitrogen concentrations in discharged effluent

ROMP Plan at a Glance

- Upgrade and Expand Ina Road WRF to 50 mgd
  - **Centralized solids handling and bio-gas power generation**
- Construct new 32 mgd Water Reclamation Campus (in vicinity of existing Roger Road WRF)
  - **Regional laboratory and staff facilities**
- Plant Interconnect – 36 mgd average, 81 mgd peak flow
  - **Major wash crossings and odor control structures**
- Good neighbor facilities
  - **Odor control, architecturally compatible to local area**
- Decommission existing 41 mgd Roger Road WRF

ROMP: Ina Road WRF Expansion and Upgrade



EXISTING

PROPOSED:

- Primary Clarifier
- Bardenpho Treatment Units
- Secondary Clarifiers
- Centralized Biosolids
- Enhanced Chlorination

ROMP: New Water Reclamation Campus

ROMP: New Water Reclamation Campus

Conceptual Plan of the Water Reclamation Campus includes landscaping and water harvesting features

- Showcase for cultural and biological resources
- Environmental and aesthetic enhancements: adjacent parks, natural areas and economic development centers
- Sustainability projects including LEED Silver Certification, solar project, and water harvesting at the Water Reclamation Campus; energy recovery at Ina Road WRF

ROMP: Solar Power at the Water Reclamation Campus

- 1 megawatt (MW) solar facility
- Will produce over 55M Kw/Hr during its 30-year expected life
- Upon completion 45% of the energy needs of the site will come from renewable sources
  - 15% will be from solar energy
  - 30% will be from methane gas

August 2009 – Groundbreaking for the Water Reclamation Campus Solar Energy Facility

ROMP: Power Generation and Energy Recovery Facility at the Ina Road WRF

Power Generation Facility

§ Facility will use renewable process biogas to:
- Produce 3 to 4 megawatts of electrical power
- Produce thermal energy for:
  - Process heating
  - Space heating and cooling
  - Domestic hot water
- Provide backup thermal energy
- Provide backup electrical energy

Other Sustainability Projects:
Santa Cruz Siphon – Solar Odor Control System

Other Sustainability Projects: Ecosystem Restoration

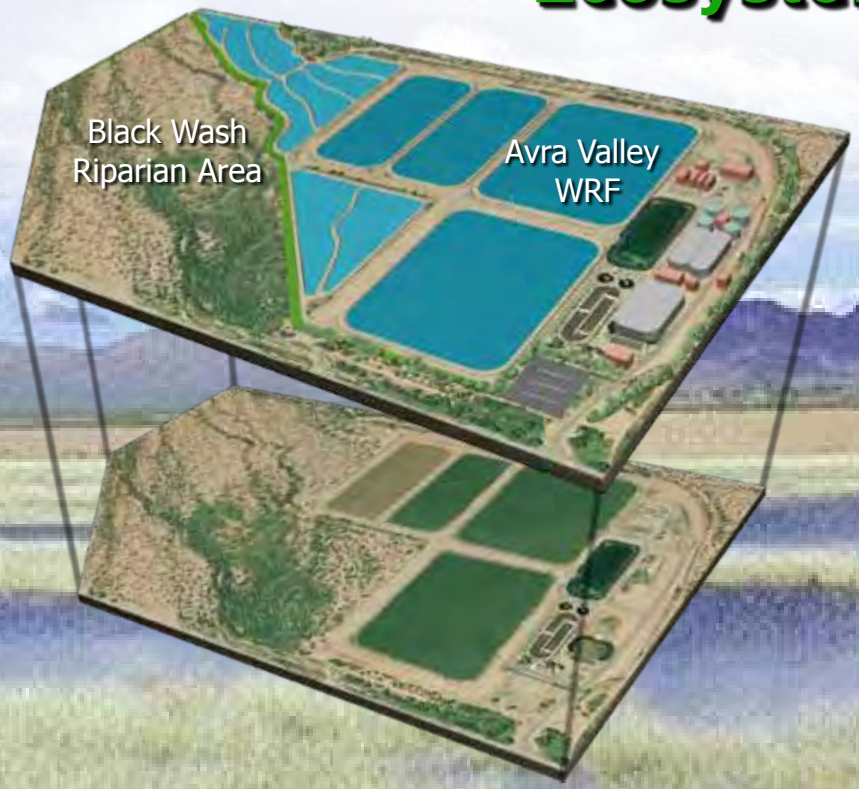
Kino Environmental Restoration Project

Army Corps of Engineers

Pima County RWRD & RFCD

City of Tucson

Other Sustainability Projects: Ecosystem Restoration



Avra/Black Wash Reclamation and Riparian Restoration Project

Bureau of Reclamation

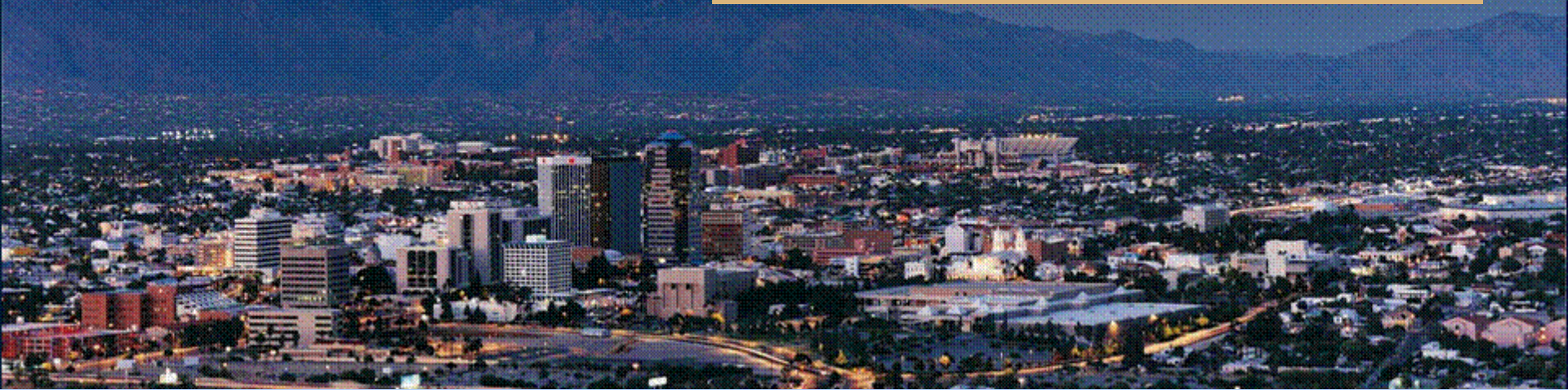
Pima County RWRD & RFCD

Gambel's Quail

Moving Forward with the Joint City/County Water and Wastewater Infrastructure, Supply and Planning Study

Program Goal:

Define and develop a sustainable water future and a livable region



Water

Infrastructure, Supply & Planning Study

A City of Tucson and Pima County Cooperative Project

Study Overview

Phase 1 Specific Objectives

City/County infrastructure, resources, sustainability and improved cooperation

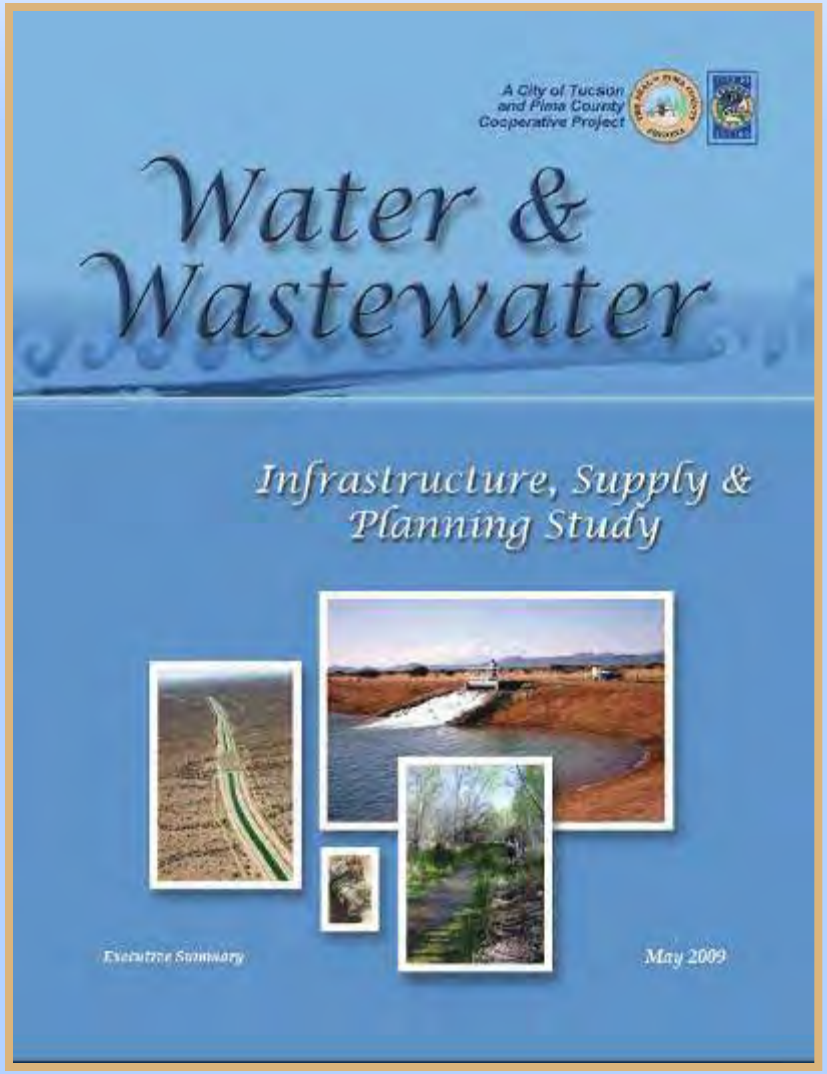
Phase 2 Specific Objectives

City/County common water and conservation goals

Phases 3-5 General Objective

Conjoin a regional dialogue on these issues to develop a sustainable water future

Water
Infrastructure, Supply & Planning Study
A City of Tucson and Pima County Cooperative Project



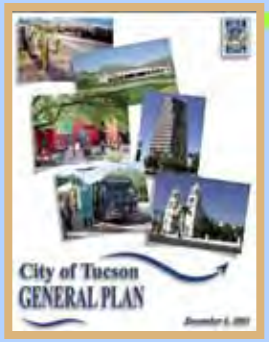
Phase 1 Reports

- Current State of Water, Wastewater, and Reclaimed Water
- Water Resource Assessment
- Critical Factors Associated with Water Sustainability
- City/County Collaborative Efforts Update
- Recommendations for Phase 2

Water Infrastructure, Supply & Planning Study
A City of Tucson and Pima County Cooperative Project

Phase 2 Topics

Integrated Planning



Water Supply

Respect for the Environment

Demand Management

Financial

Water
Infrastructure, Supply & Planning Study
A City of Tucson and Pima County Cooperative Project

Phase 2
Technical Papers

- Consolidated Drought Planning
- Reclaimed Water
- Water Conservation (2)
- Stormwater Harvesting
- Riparian Protection
- Environmental Restoration
- Location Of Growth, Urban Form And Cost Of Infrastructure
- Integrating Land Use And Water Resources Planning And Infrastructure
- Water / Wastewater Cost Of Growth
- Economic Efficiency And Water Management Decision Making
- Water Quality
- Additional Water Resources

Water
Infrastructure, Supply & Planning Study
A City of Tucson and Pima County Cooperative Project

Moving Forward

- **Phase 2 Report is complete**
  - Presented at a joint meeting of the Pima County Board of Supervisors' and the City of Tucson Mayor and Council on January 12, 2010
- **Moving into Phase 3: A regional dialogue to develop a sustainable water future for the entire region**

WORKING FOR A SUSTAINABLE WATER FUTURE

Summary: Pima County Sustainability

ISSUES *and* SOLUTIONS

Sonoran Desert Conservation Plan

Sustainability Action Plan

AWWQRP

EPRI

Regional Optimization Master Plan

Water and Wastewater Infrastructure Study

"Good
Deserts
are hard
to
find"

BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

Maricopa Association of Governments Greening Water and Wastewater Infrastructure Workshop

Green Energy Utilization of

91st Ave WWTP Digester Gas

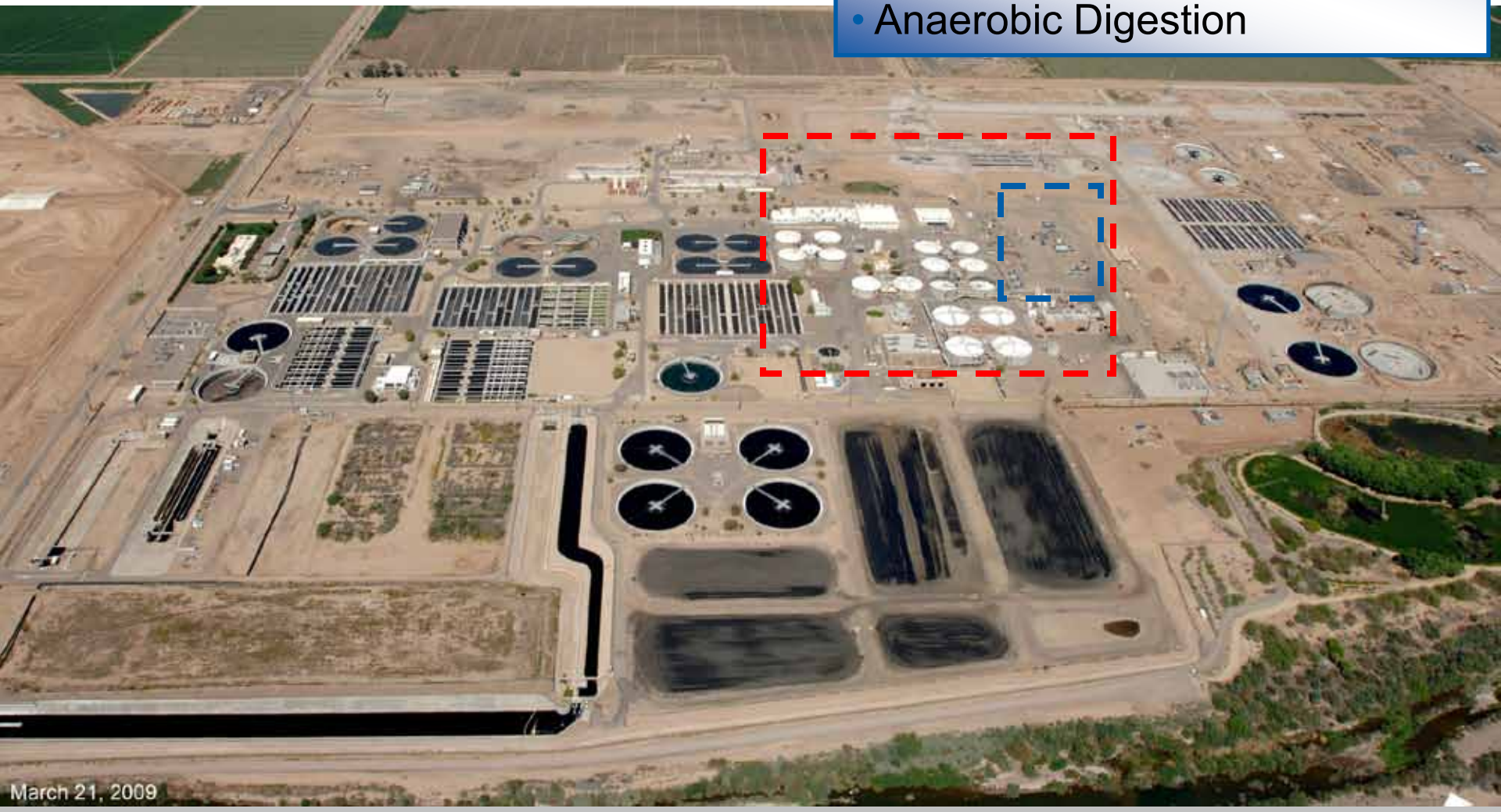
January 12, 2010

Previous SROG Studies

- 1995 Digester Gas Utilization Study
- 2004 Digester Gas Scrubbing System Evaluation
- 2008 Bio-solids Management Study

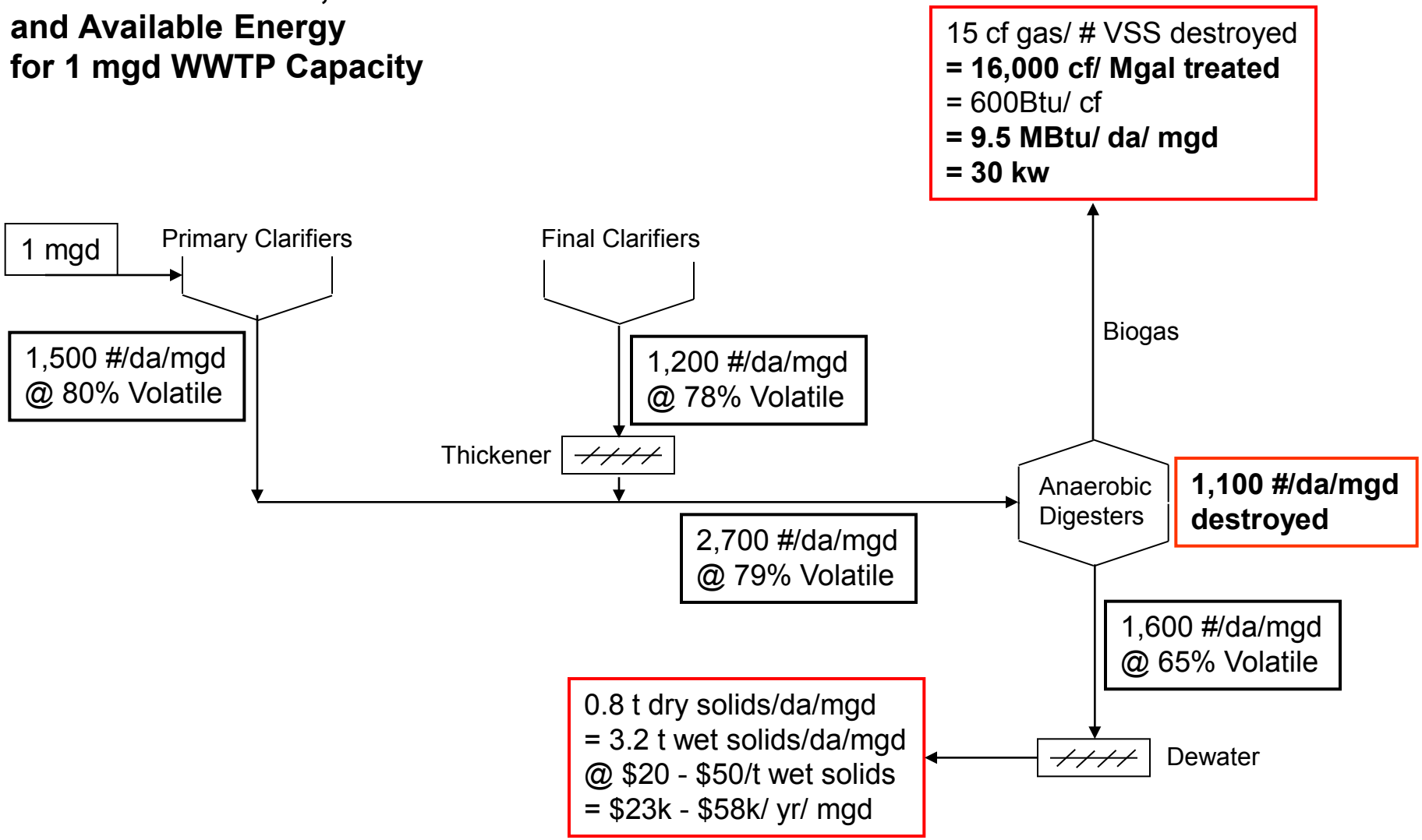
91st Ave WWTP

- 140 MGD 2009 Avg Daily Flow
- Primary Treatment
- Conventional Activated Sludge
- Anaerobic Digestion



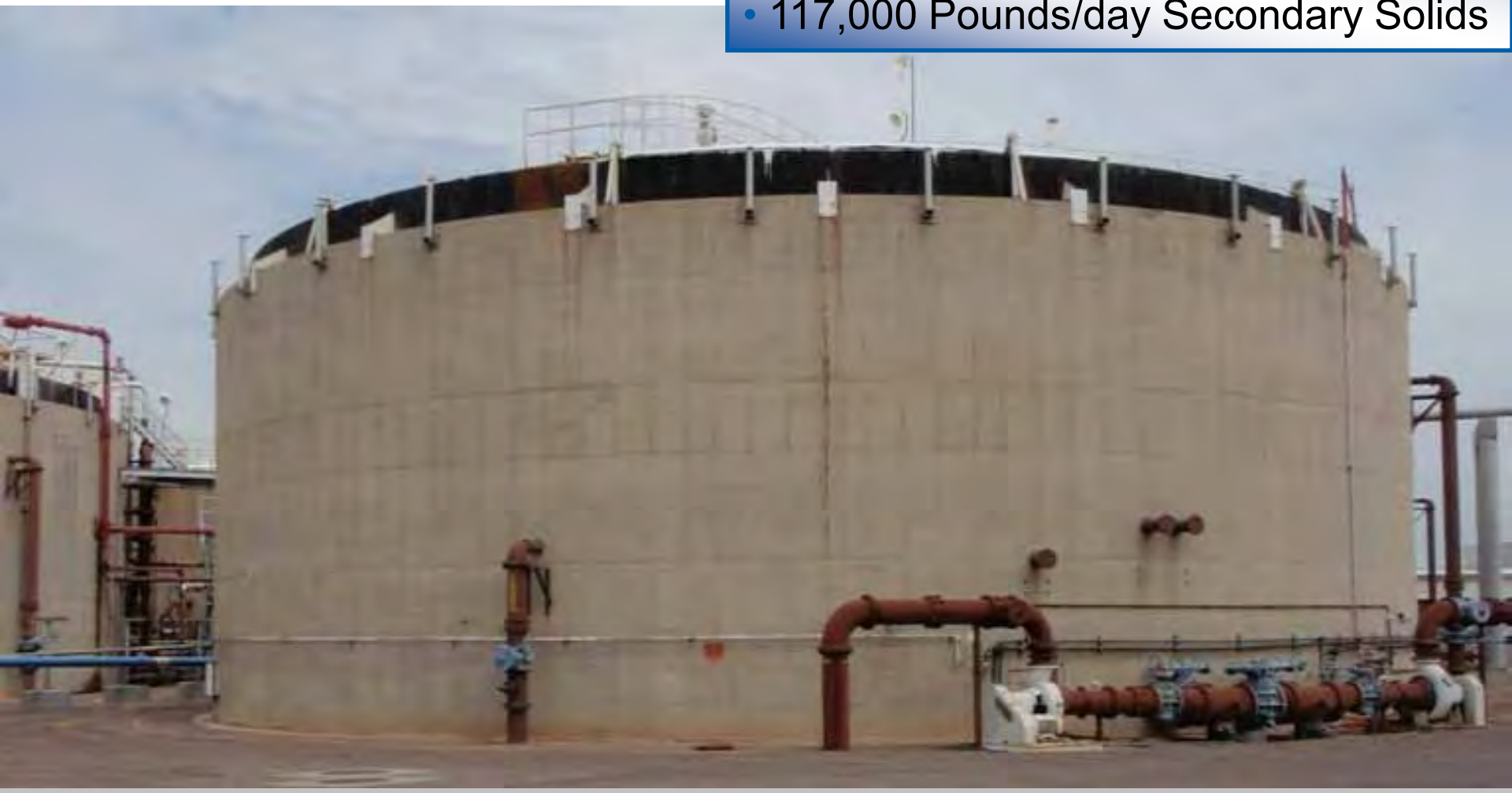
Typical WWTP Solids Schematic:

Unit Solids Balance, Gas Generation and Available Energy for 1 mgd WWTP Capacity

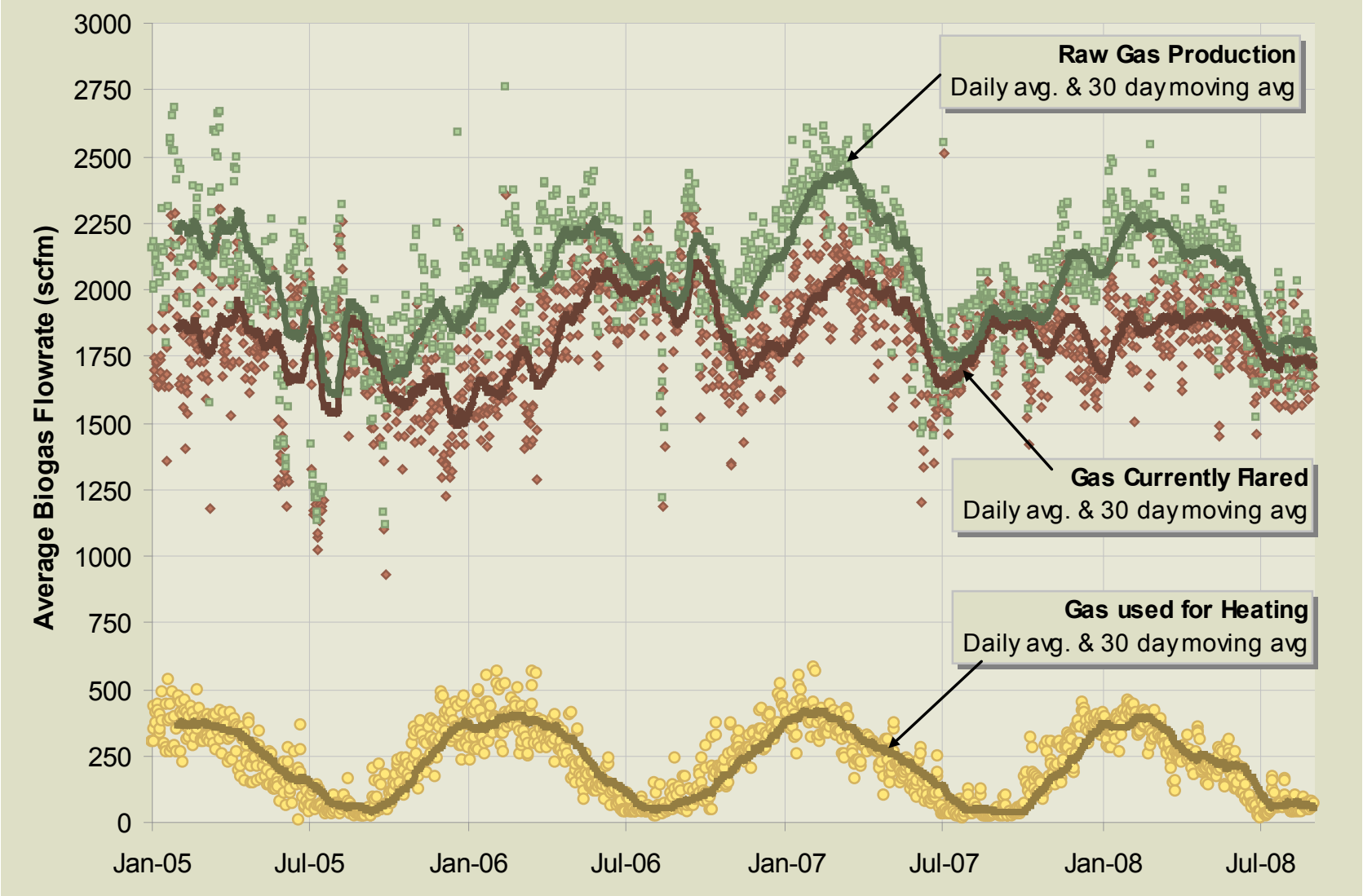


91st Ave Solids Treatment

- 16 Anaerobic Digesters
- 317,000 Pounds/day Primary Solids
- 117,000 Pounds/day Secondary Solids



91st Ave WWTP Digester Gas Production



91st Ave WWTP Digester Gas Production

- 2.97M Cu Ft/day Total Gas Production
- 0.47M Cu Ft/day Digester Heating
- 2.51M Cu Ft/day Flared
- 1500 MBtu/day

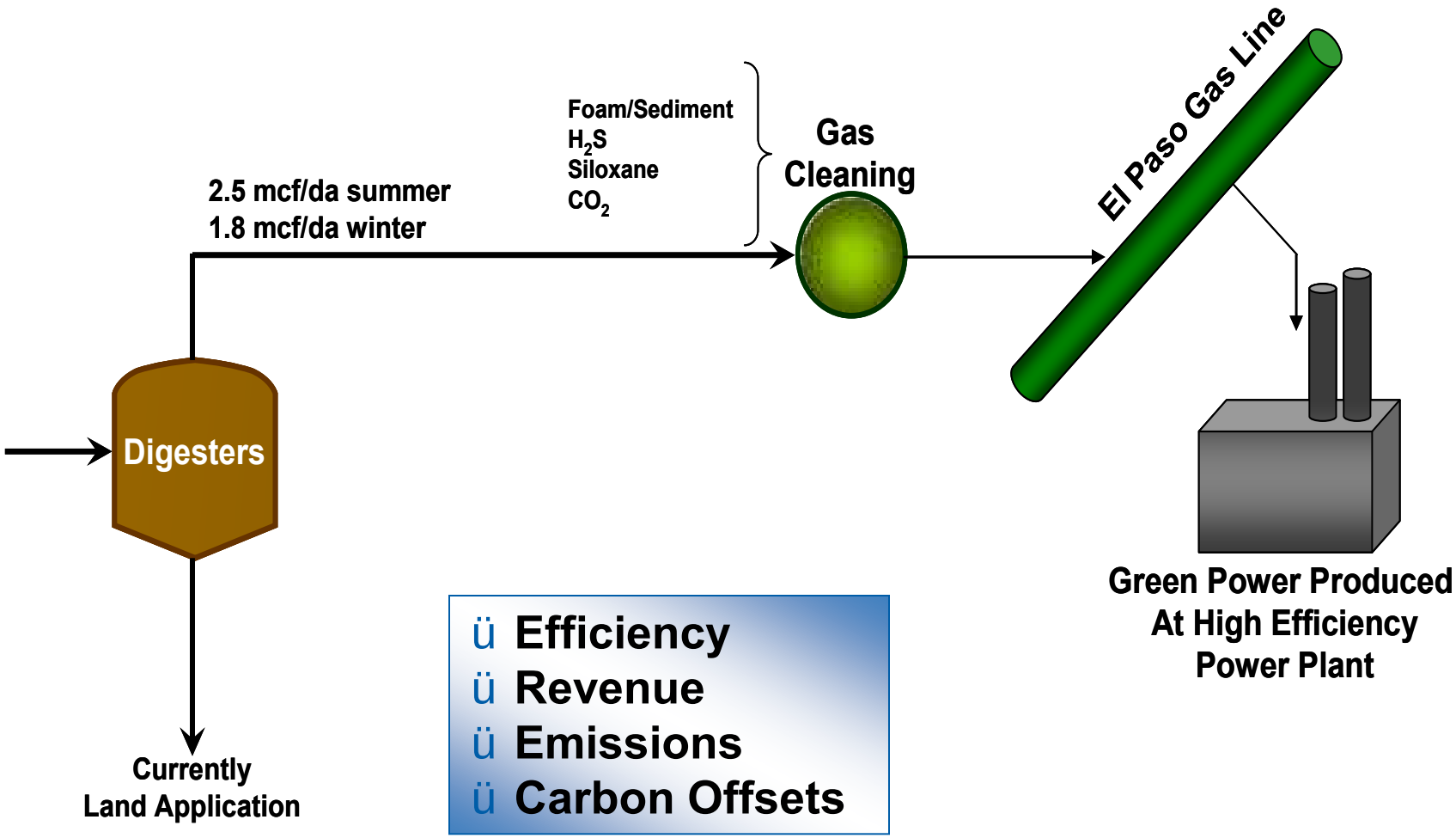
Gas Utilization Strategies

- On-Site Power Generation — Heat Rate = 13,000 btu/kwh
- LNG
- Bio-solids Drying
- Pipeline Quality NG with Power Generated at Combined Cycle Plant — Heat Rate = 7,000 btu/kwh

Considerations

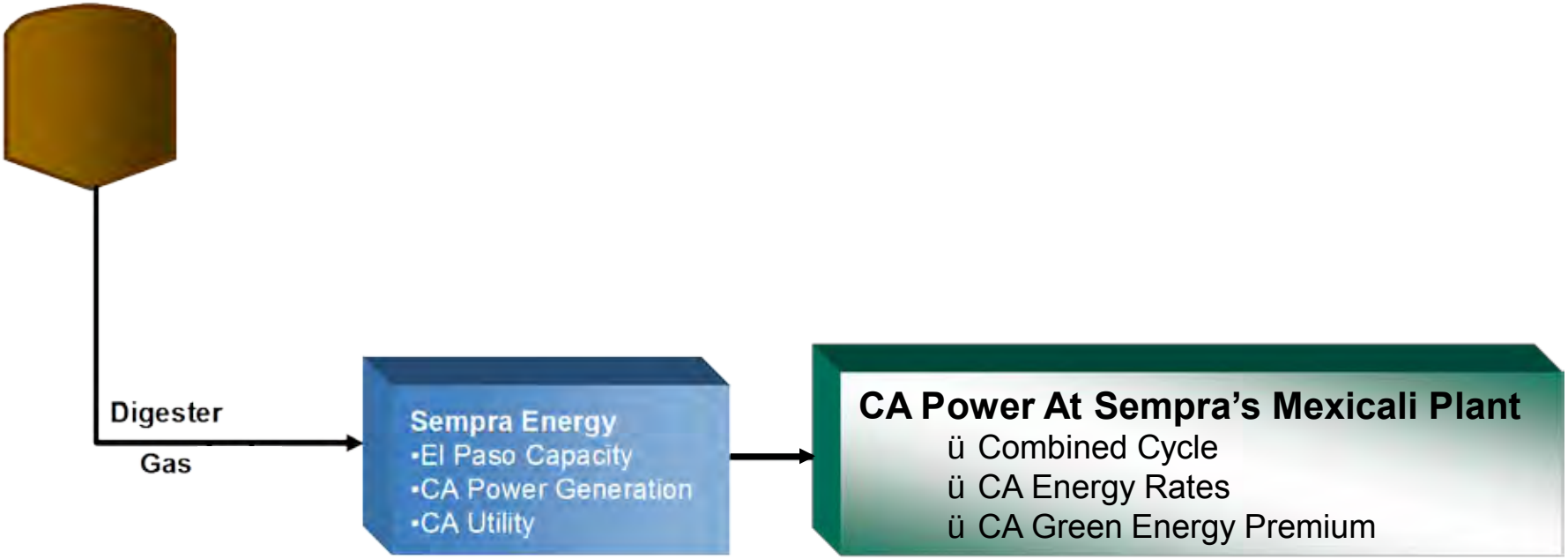
- Efficiency
- Revenue
- Emissions
- Carbon Offsets

Pipeline Quality Gas Cleaning Best Strategy

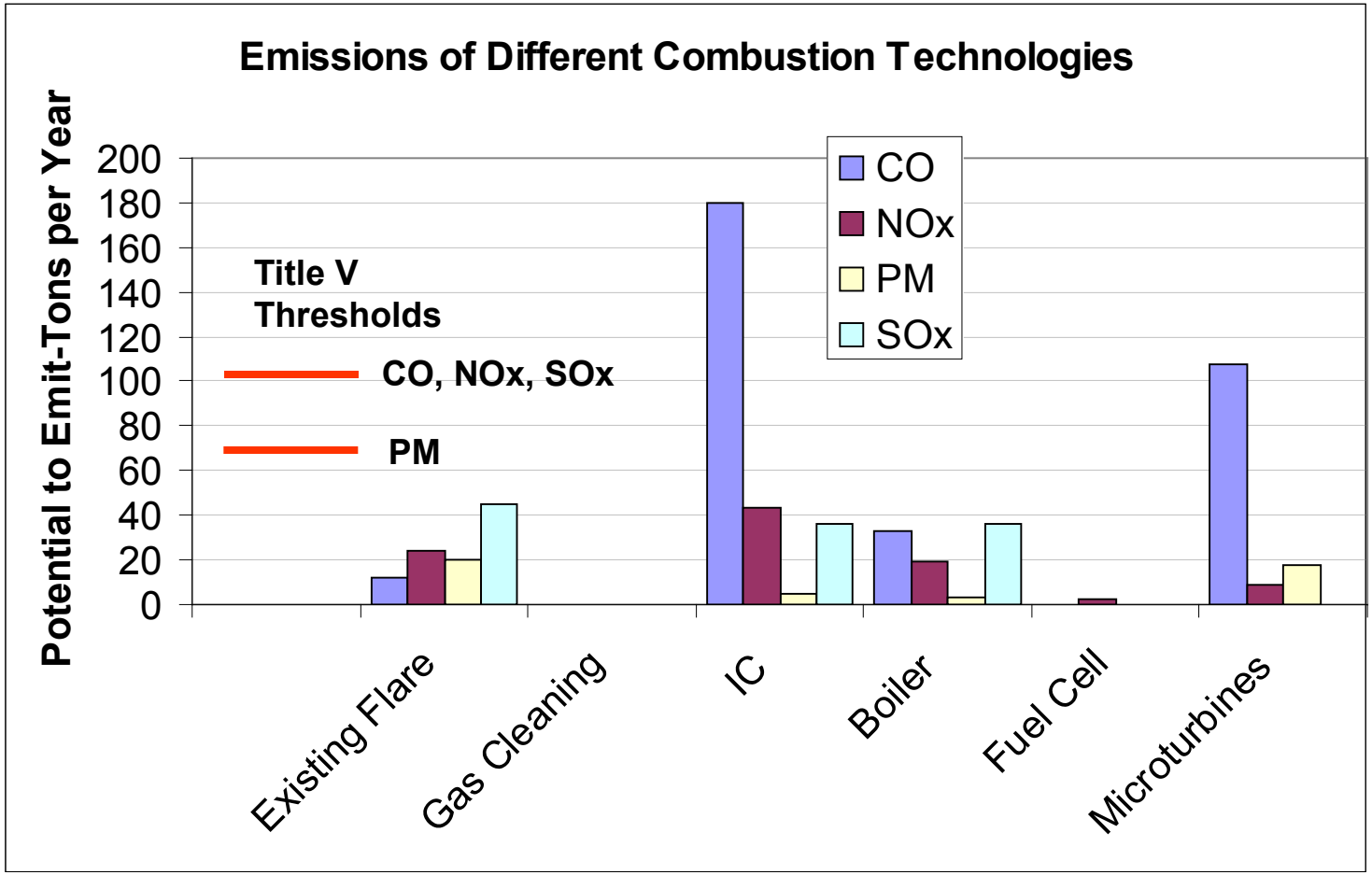


- ü Efficiency
- ü Revenue
- ü Emissions
- ü Carbon Offsets

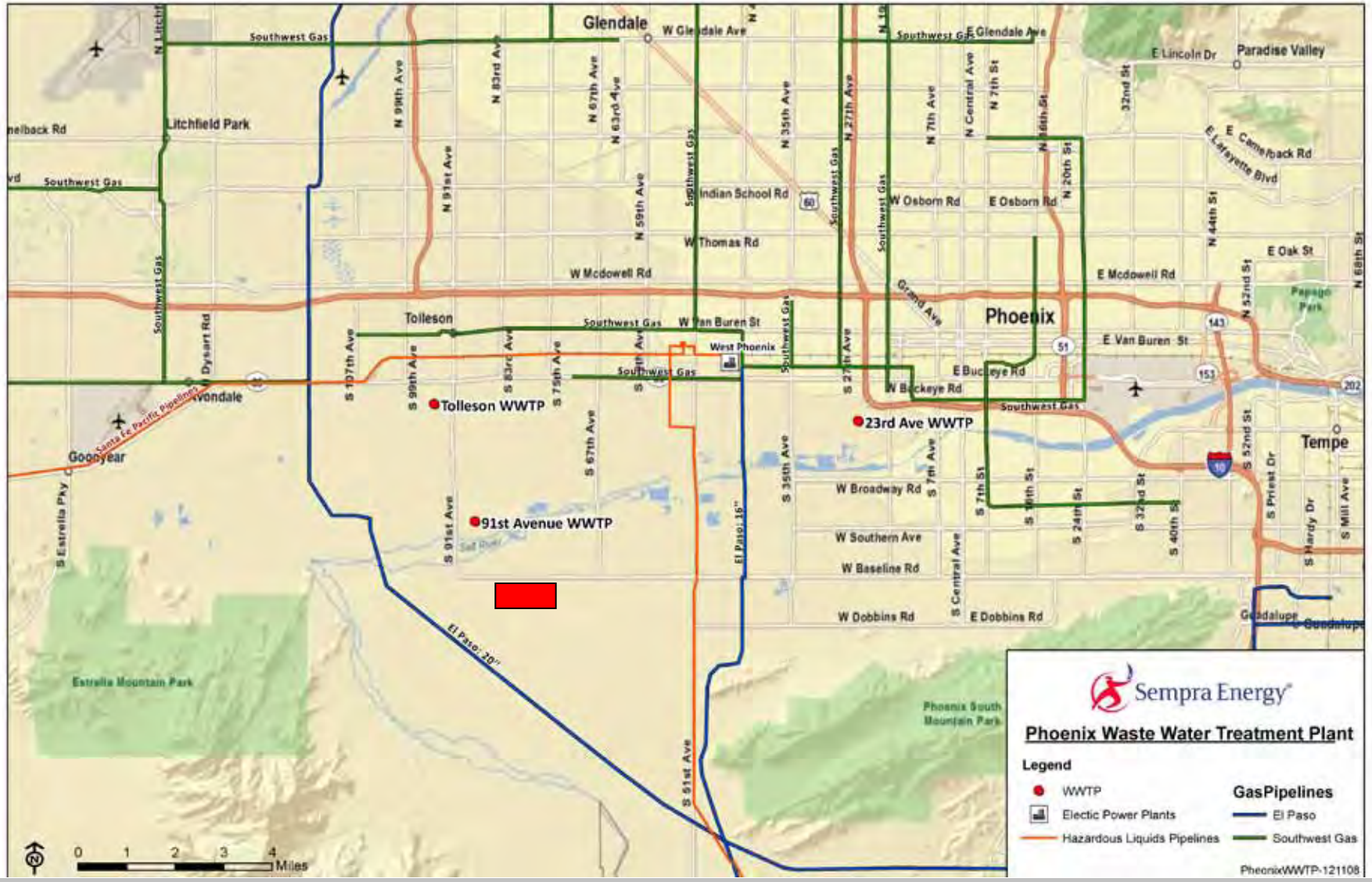
Sempra Energy Will Contract To Purchase Raw Gas and Generate Green Power



Emissions Favor Pipeline Quality Gas Cleaning



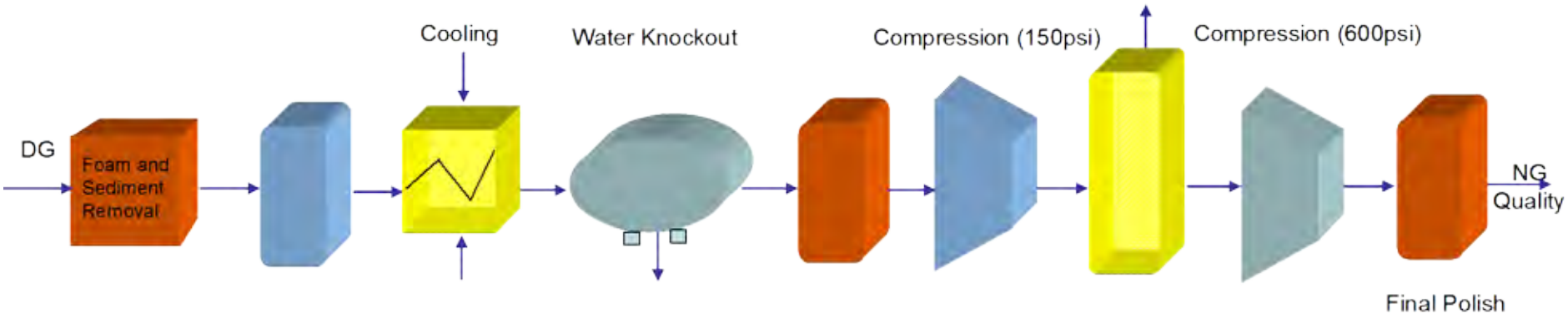
El Paso Pipeline Convenient To 91st Ave WWTP



Raw and Clean Digester Gas Compositions

Parameter	Unit	Digester Gas	Pipeline Gas
Heating Value	BTU/scf	600	990-1150
Water Content	ppm	70000	150
H_2S	**ppm**	**1000-2000**	**4**
Mercaptans	ppm	trace	5
Total Sulfur	ppm	1000-2000	12.6
CO_2	**vol %**	**31**	**3**
O_2	vol %	trace	0.2
Inerts	vol %		4
Hydrocarbons	gas dew pt.	>45F	45F
Wobbe		641	1279-1385
Pathogens		none	none
Siloxanes	**ppb**	**0 – 11000**	**70**
Ammonia	ppm	3	
Methane Content	vol %	60	
Pressure	psig	0.3	600

Gas Cleaning Schematic



H_2S Removal:

Chemical Scrubber

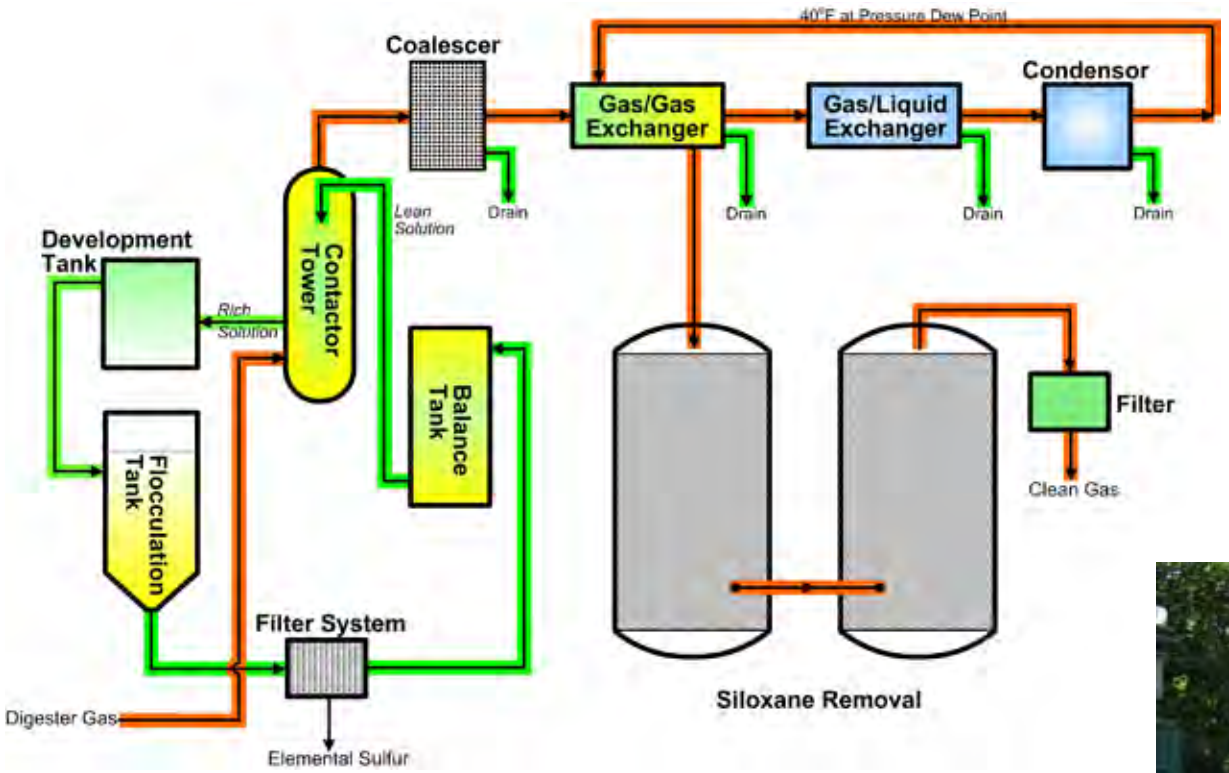
Siloxane Removal:

Adsorption Media

CO_2 Removal:

Pressure Swing Adsorption

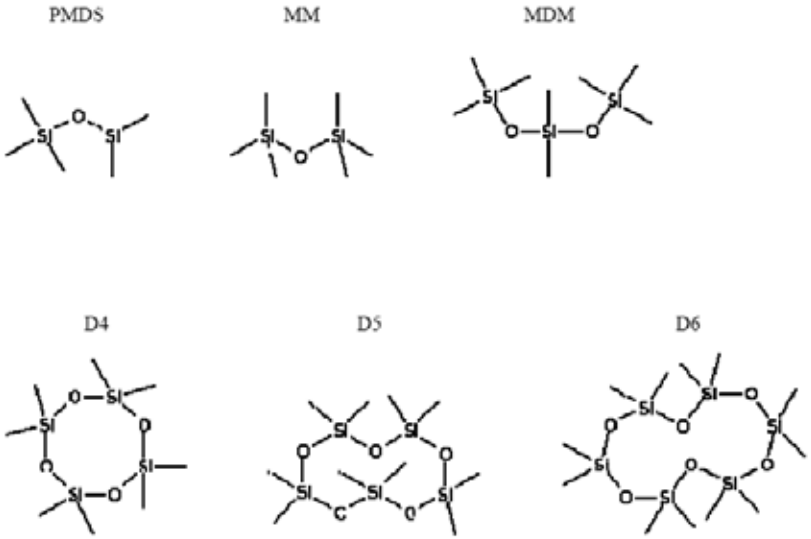
H_2S Removal



- Wet Scrubber
  - Proprietary Chemicals
  - Sulfur Cake Disposal

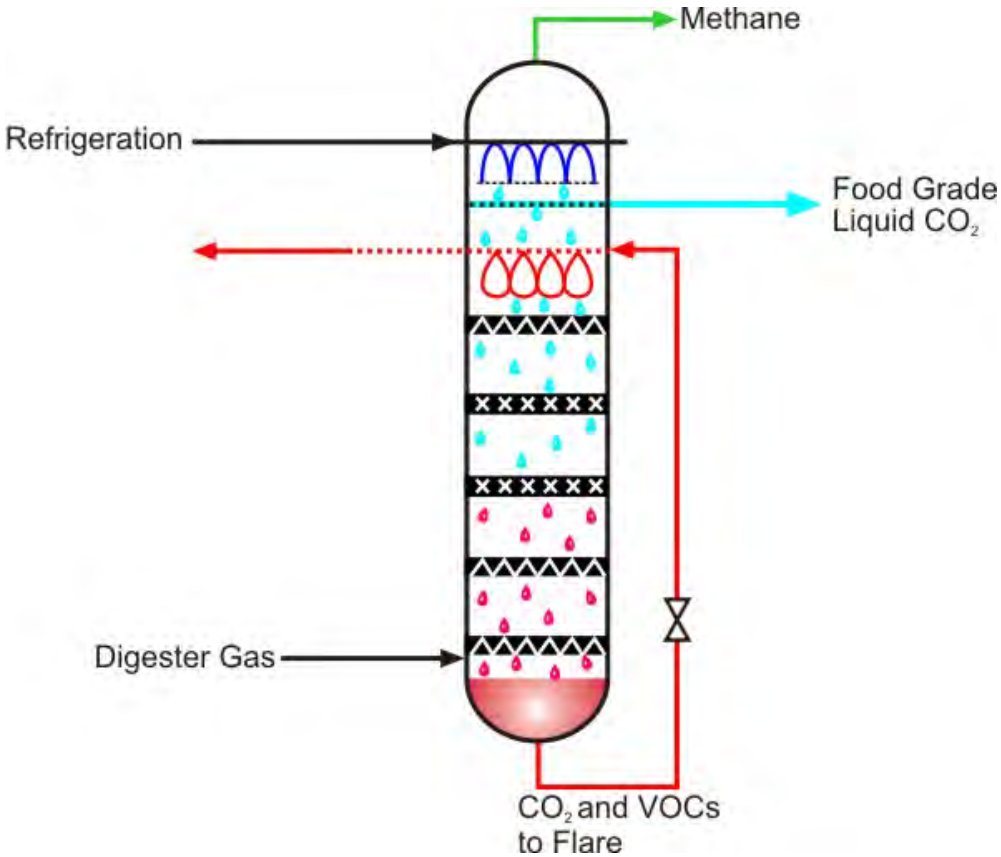
Siloxanes

- Family of man-made organic silicon compounds (**Si**licon, **ox**ygen, and meth**ane**)
- Relevant to WWTP and landfills only
  - From consumer products
  - Volatilizes under digestion conditions
  - Can deposit silicon dioxides when burnt



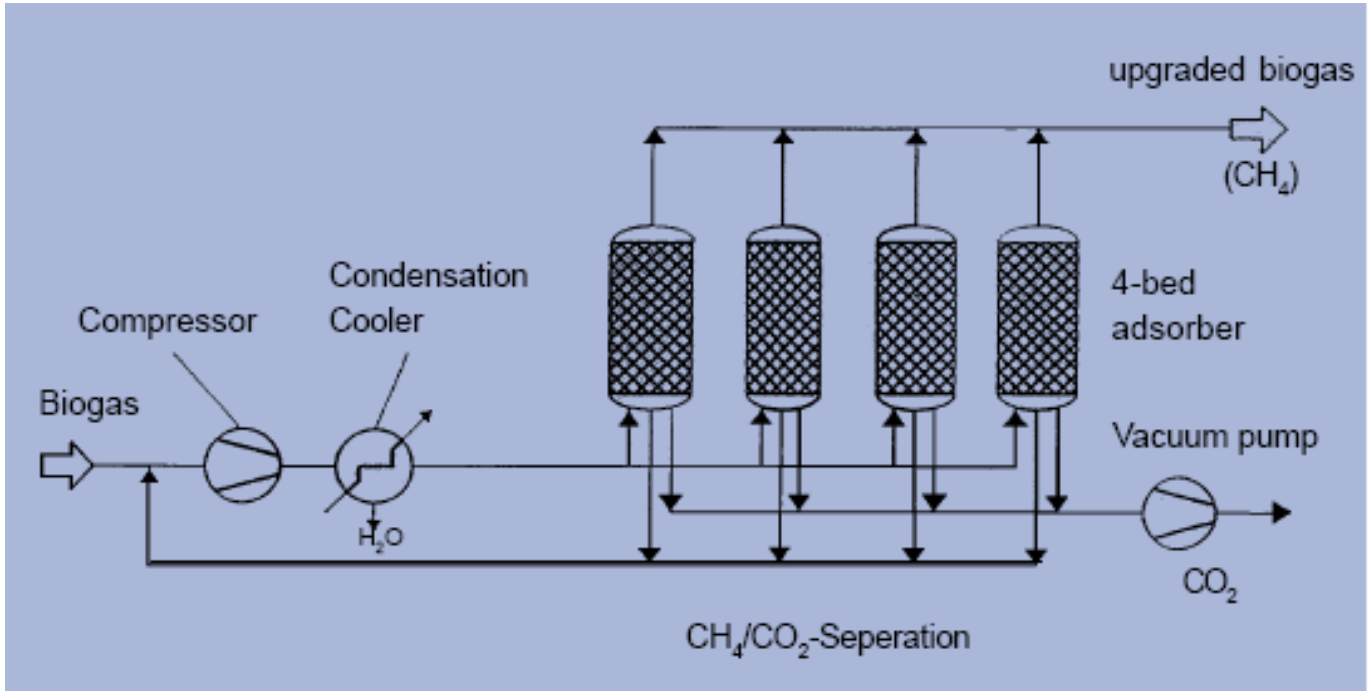
Siloxane Removal

- Adsorption
  - Activated Carbon
  - Proprietary Media



Siloxane vessels

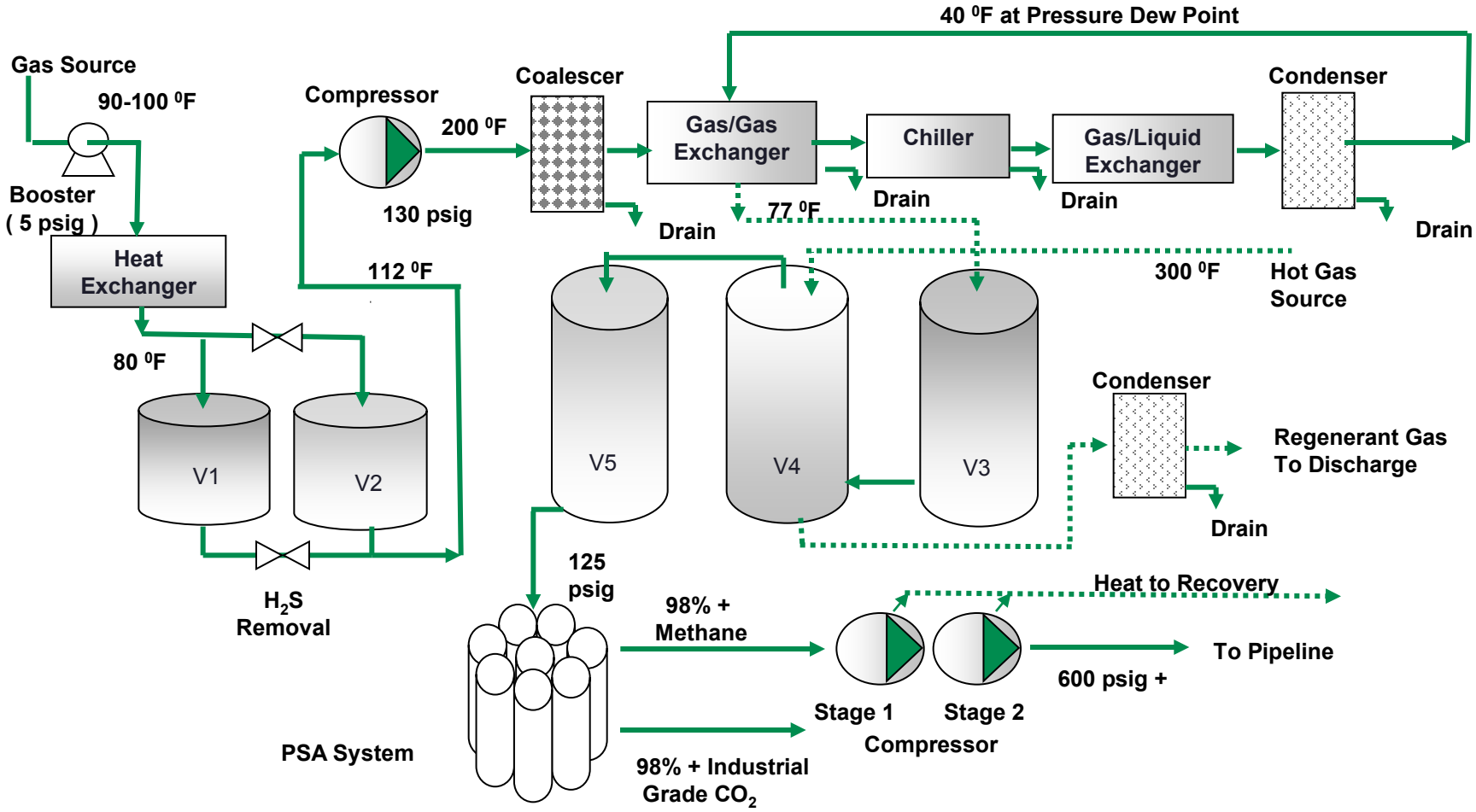
Pressure Swing Absorption (PSA)



IEA, 2003

- Zeolite or other solid sorbent in packed bed
- Impurities that can be captured depends on the solid
- Simpler than a solvent system

H_2S/Siloxane Gas Cleaning Schematic



Courtesy of AFT

Typical Cleaning System Installation

H_2S removal tanks

Gas conditioning skid

Siloxane removal tanks

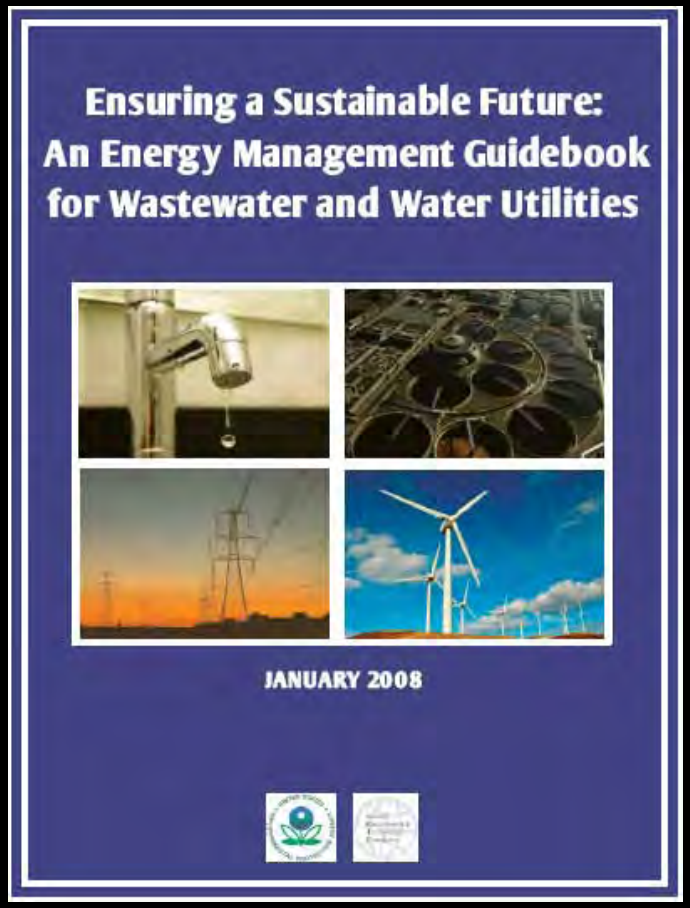
Greening Water and Wastewater Infrastructure

The Path Toward Continuous Energy Savings

Focus on Energy Management vs. Projects/Low Hanging Fruit

- Energy issues are here to stay – new opportunities will occur — it is an ongoing process!
- Individual projects are great, but something is needed to pull it all together (a system)
- Systematic management will ensure continuing focus on energy efficiency
- The Plan-Do-Check-Act approach has worked in many different sectors
- Enables consistent, organized, and integrated management of utility operations

Managing to Maximize Energy Efficiency



Designed to help utilities:

- Systematically assess current energy costs and practices
- Set measurable performance improvement goals
- Monitor and measure progress over time

Based on management system approach for energy conservation,

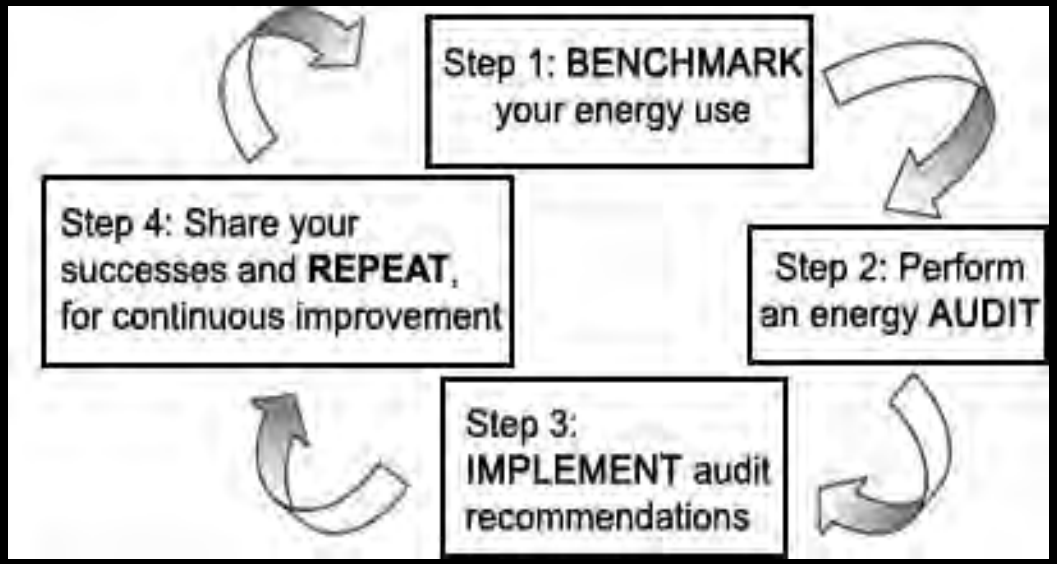
Based on the successful Plan-Do-Check-Act process (Environmental Management Systems (EMS)

http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf

The PLAN-DO-CHECK-ACT Framework

7 Steps

CONTINUOUS IMPROVEMENT



Plan

1: Get Ready

2: Assess Current Energy Baseline

3: Establish Energy Vision & Priorities

4: Identify Objectives and Targets

Do, Check & Act

5: Implement Energy Improvement Programs (and a Management System to Support Them)

6: Monitor & Measure Energy Improvement Management Programs

7: Maintain, Improve & Communicate

C E L E B R A T E ! ! !

1. Get Ready - Keys to Success

- Management Commitment and Support
- Active and Meaningful Engagement of Staff
- Ability to build on existing processes and projects
- Effective leader and team have authority to act
- Balancing the need for quick hits and longer term changes
- Communication of meaningful results

65% OF THE EFFORT GOES TO PLANNING!

GETTING READY

•**Secure Management Commitment, Involvement, Visibility**
Do managers need to know to provide support?
What are you asking of them?
Accountable Results, Staff Resources, Budget?
What are your managers priorities – what is most important?
Define Management Role: Ensure Accountability, Acknowledge and Reward Success, Advocate More Resources, Time Commitment, Empower Authority, Communication

•**Determine Your Scope, Boundary, Mission, Goals**
•How much can be accomplished with your resources?
•What is most important if you can't do it all now? Phases…..
Do you want to reduce your energy costs or support community sustainability activities?
What equipment and process do you have that use energy?
What has already been done to reduce energy-has it been documented?
Do you want to solve a known problem, assess for potential problems, reduce energy by __%
Are there time sensitive opportunities – What is the timeframe?

2. Assess Current Energy Baseline Status

- Benchmark
- Set Baseline time period
- Conduct an Energy Audit
- Review Legal and Other Requirements

3. Establish Energy Vision Priorities for Improvements

- Develop an Energy Policy
- Identify activities and operations that consume energy
- Prioritize activities, operations, potential for energy savings

Establish Energy Vision Priorities Keys to Success

- Align your energy policy with your utility goals
- Involve employees in the energy review process
- Remember the Keep It Super Simple Rule (KISS)
- Communicate status frequently and regularly
- Document recurrent processes and how decisions are made

High Energy Use Operations (from Guidebook, page 36)

High Energy Using Operations	Energy Saving Measures
Pumping	• Reduce load • Manage load • Water to wire efficiency • Pump selection • Motor and drive selection • Automated control
Aeration	• Fine bubble • Improved surface aerators • Premium motors • High efficiency motor drive • Blower Variable Frequency Drives (VFDs) • Automatic DO control
Dewatering	• Replace vacuum systems • Premium motors • VFDs for plant water pump
Lighting	• Motion sensors • T5 low and high bay fixtures • Pulse start metal halide • Indirect fluorescent • Super efficient T8s • Comprehensive control for large buildings
Heating, Ventilation, Air Conditioning (HVAC)	• Water source heat pumps • Prescriptive incentives for RTUs • Custom incentives for larger units • Low volume fume hood • Occupancy controls • Heat pump for generator oil sump

From a PG&E energy audit

TABLE ES-1 SUMMARY OF ENERGY EFFICIENCY OPPORTUNITIES SAVINGS AND COSTS

EEO No.	Description	Potential Energy Conserved	Demand Savings (kW)	Potential Savings ($/yr)	Implem. Cost ($)	Simple Payback (years)
	No-Cost Measures					
1.	Repair Domestic Aeration Blower Air Leaks	9,933* kWh/yr	1.1	848	0	0.0
	Low-Cost Measures					
2.	Install Premium Efficiency Motors When the Existing Motors Wear Out or Require Rewinding*	11,038 kWh/yr	1.0	1,209	1,866	1.5
	Investment Grade Measures					
3.	Install a Dissolved Oxygen (DO) Control System and Adjustable Speed Drives on the Domestic Aeration System Blowers	512,008 kWh/yr	58.4	54,566	126,000	2.3
4.	Install a Dissolved Oxygen (DO) Control System and Adjustable Speed Drives on the Industrial Aeration System Mechanical Aerators	269,460 kWh/yr	30.8	28,729	143,500	5.0
	Total Electrical Energy Savings	**802,439 kWh/yr**				
	Total Demand Savings		**91.3 kW**			
	Total Cost Savings			**$85,352**		
	Total Implementation Cost				**$271,366**	
	Simple Payback Period					**3.2 years**

* Two year incremental savings

4. Identify Energy Objectives and Targets

- Objective: Internal goal to achieve to improve energy performance, i.e. reduce facility energy use
- Target: Derived from objective, i.e., reduce energy 25% from 2006 levels by 2011
- Performance Indicator: Defines how it will be measured, i.e., $ or kWh/per unit of treated water
- Consider what you can track, monitor

5. Move to Action with Energy Improvement Management Programs

- What to do to reach the target
- Who will do it
- When to do it by
- What **R**esources or level of effort are needed

Good Project Management!

(Page 53)

6. Are We There Yet?

Monitor and Measure Energy Improvement Management Program Progress

7. Maintaining and Continuing Energy Improvements

- Guidebook
  - **Session 6:** Monitoring and Measuring Your EIMP
  - **Session 7:** Maintaining Your EIMP

What does it take to implement and maintain energy improvements?

- Roles and responsibilities
- Operating controls
- Managing and controlling documents and records
- Communication
- Monitoring and measuring
- Apply lessons learned

C E L E B R A T E ! ! !

IDEAS FOR GREENING WATER AND WASTEWATER INFRASTRUCTURE

INTRODUCTION

On July 22, 2009, the MAG Regional Council accepted stimulus funding from the American Recovery and Reinvestment Act of 2009 from the Arizona Department of Environmental Quality (ADEQ) for water quality management planning. The ADEQ received the stimulus funds from the Environmental Protection Agency Region IX. The scope for the project included conducting a workshop on greening infrastructure for water and wastewater treatment plants focusing on Arizona issues and preparing a roadmap for greening water infrastructure. On January 12, 2010, MAG conducted the Greening Water and Wastewater Infrastructure Workshop. The MAG Greening Water and Wastewater Infrastructure Planning Group assisted MAG in identifying topics and speakers that would provide the most benefit to water and wastewater utilities in the region. Approximately 150 people attended the workshop, representing public and private utilities, consulting firms, academia, state and federal agencies, and others. The workshop highlighted strategies for integrating green technologies into water and wastewater treatment and funding opportunities that are available. Presentations from the event have been posted to the MAG website at www.mag.maricopa.gov/detail.cms?item=11400.

IDEAS FOR GREENING WATER AND WASTEWATER INFRASTRUCTURE

Now that the workshop has been completed, the next step involves developing a roadmap for greening water and wastewater infrastructure. A roadmap may assist utilities in evaluating opportunities to reduce energy consumption and chemical use, conserve water, and save critical financial resources. On February 18, 2010, the MAG Greening Water and Wastewater Infrastructure Planning Group met to discuss a wide variety of ideas for making water and wastewater infrastructure more environmentally friendly, recognizing the importance of working toward a more sustainable future.

In general, the ideas from the Planning Group are designed to provide utilities with opportunities for reducing energy consumption and plant costs. Due to the economic downturn, jurisdictions are facing decreased revenues and having to push capital improvement projects further into the future. These ideas generated by the Planning Group could result in cost savings by identifying energy waste at current facilities. It is important to note that greening water and wastewater infrastructure today may pave the way for significant cost savings in the future. Not only will these ideas save financial resources, they will also improve our environment as we work toward a more sustainable State. The ideas from the Planning Group are discussed below.

Energy Audits

Energy audits for water and wastewater treatment plants assist utilities in determining energy consumption as well as discovering opportunities for improving efficiency and reducing operating costs. Funding alternatives for improvements may also be identified through the audit process. In addition, audits bring awareness to the issues a utility may be facing. At the end of the audit process, plant staff will have a better understanding of the energy used by the various processes in the facility and associated costs. The utility will be able to recognize successes and develop goals for the future. Furthermore, audits are a tool for

benchmarking against other facilities, as discussed in the next section. For all these reasons, audits are a useful exercise regardless of location and size of a plant.

Audits may be conducted at various levels of detail. Once the audit level has been determined, an audit team is assembled. The audit team works to collect as much information as possible prior to the site visit. Open discussion among the audit team, plant managers and staff is critical for a successful audit. The team then visits the site and assesses the energy usage. Audits typically break down energy usage by unit processes. The audit team is then able to review each process, determine opportunities for energy conservation, and estimate energy savings. A list of operation and maintenance and capital improvement recommendations is prepared. The utility reviews the list and selects the viable alternatives based on its needs, budget, and future growth. The audit team may also determine available funding opportunities. The plant then begins implementation and monitoring.

Utilities could also benefit by comparing their audit results with the results from other facilities. A comparative analysis may reveal additional possibilities for energy conservation, cost savings and partnerships. Several utilities working together could result in easier access to funding. In addition, rural communities may not be able to afford consultants to conduct the audits; therefore, audits performed at another facility by a contractor could guide treatment plant staff in conducting an in-house audit. The audit process serves as a valuable training and learning experience for plant staff. Staff will gain a greater understanding of how the plant runs and its impact on energy and resource use.

A first step in conducting audits of rural treatment facilities was completed in 2009. Faculty and students from the Northern Arizona University and University of Arizona assisted rural Arizona communities with assessing their water and wastewater treatment plants. The report prepared on the study, "A Water/Energy Best Practices Guide for Rural Arizona's Water and Wastewater Systems," could be used to assist utilities with beginning an audit. Funding may also be available for energy audits from the Water Infrastructure Finance Authority of Arizona (WIFA) and Arizona Department of Environmental Quality.

An alternative to a comprehensive energy audit that includes field visitation would be a desk audit. Desk audits are not as detailed; however, they still provide valuable information for a utility. They may also be a first step in efficiently performing a more comprehensive field audit. An idea mentioned by the Planning Group included conducting desk audits for many or all of the wastewater treatment plants in Arizona. The information could be inputted into the U.S. Environmental Protection Agency (EPA) ENERGY STAR Program and each facility would be provided a rating. These ratings could be publicized and propel utilities to continually evaluate potential green projects in order to better their rating. Agencies that could assist in promoting the effort include EPA, WIFA, Arizona Public Service (APS), and Salt River Project (SRP). In addition to assisting utilities with energy audits, APS and SRP also offer rebate programs.

Another suggestion by the Planning Group was to have the Arizona Department of Environmental Quality encourage and spearhead audits for smaller wastewater treatment plants in the State. The ADEQ could select a plant to audit which would serve as an example for small facilities (reality audit). The various steps of the process would be posted and provided to other interested utilities for guidance. This idea could prompt many other plants to initiate audits to become more sustainable, thus leveraging the power of the facility audit performed by ADEQ. Information sharing would also be encouraged so that utilities could gain from the experiences of others.

Resources:

- Water Infrastructure Finance Authority of Arizona Planning and Design Grant Program (targets smaller systems that lack technical staff to complete design and planning phases of projects)
  http://www.azwifa.gov/?pageid=pdgrant

  - Melanie Ford, WIFA
    mford@azwifa.gov
    (602) 364-1321

  - Sara Konrad, WIFA (Green Projects)
    skonrad@azwifa.gov
    (602) 364-1319

- ADEQ Capacity Development Program (free technical assistance for small drinking water systems serving 10,000 people or less)
  http://www.azdeq.gov/environ/water/dw/capdev.html

  - Kathy Stevens, ADEQ
    stevens.kathryn@azdeq.gov
    (602) 771-4653

- A Water/Energy Best Practices Guide for Rural Arizona's Water and Wastewater Systems
  http://www.waterenergy.nau.edu/

- EPA ENERGY STAR Program
  http://www.energystar.gov

  - Cheryl McGovern, EPA Region IX
    mcgovern.cheryl@epa.gov
    (415) 972-3415

- Salt River Project
  http://www.srpnet.com

- Arizona Public Service
  http://www.aps.com

Benchmarking

Benchmarking facilities relative to performance metrics provides the opportunity for utilities to track and evaluate their energy and water consumption. The EPA ENERGY STAR Portfolio Manager is a readily-available assessment tool to measure a facility's current energy efficiency and track progress over time. The Portfolio Manager provides benchmark metrics that allow comparison of operational efficiencies of wastewater treatment facilities with similar facilities across the country. The program may

be used to facilitate the dissemination of information since it creates reports and offers utilities the ability to share data. The Portfolio Manager also estimates a facility's greenhouse gas emissions using the international standard. There are 70 different values that could be tracked in the program. For wastewater treatment plants, EPA claims a 90 percent confidence level; however, beta testing is still being conducted.

Enrolling in the ENERGY STAR Portfolio Manager is easy, consisting of a one-hour phone call with an EPA specialist to establish the facility's account, baseline, and benchmark. The utility will then be able to determine its baseline energy use, target energy use, energy cost savings, and target reduction required. The Portfolio Manager rates the energy performance of the facility on a scale of 1 to 100 with 100 being the most efficient. A score of 75 or greater is considered energy efficient. If the facility has a score below 69, the Portfolio Manager could be used to set a percentage energy reduction target.

The ENERGY STAR Portfolio Manager is an interactive online energy management tool that is free, available 24 hours per day, and requires no special computers or software. It assists utilities in identifying ways to eliminate energy waste and lower operating costs of water and wastewater systems. Both drinking water systems and wastewater treatment plants are able to track energy use, energy costs, and associated carbon emissions using Portfolio Manager. However, only wastewater treatment plants may be compared with similar plants in a national database using the EPA energy performance rating system. The Planning Group members indicated that it would be beneficial to utilities if the comparison component of the Portfolio Manager would also become available for drinking water systems in the future.

The EPA recommends that in addition to using the Portfolio Manager, utilities should also perform energy audits. The Portfolio Manager provides only the energy consumption per year; however, an energy audit provides more detailed information. The Environmental Protection Agency has also published its 2008 Guidebook, "Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities" to assist utilities. The guidebook is based on a Plan-Do-Check-Act management system approach to reduce energy consumption and costs.

In addition to the efforts by EPA, the Water Research Foundation conducted a research project to benchmark water and wastewater utilities. The document was published in 2007 and is available to Water Research Foundation subscribers as "Energy Index Development for Benchmarking Water and Wastewater Utilities." The project established metrics for utilities to evaluate the effectiveness of new energy efficiency practices. The metrics also enable utilities to measure their performance relative to their peers, establish targets and budgets, and assess progress over time. The Water Research Foundation has a mission of advancing the science of water to improve the quality of life. As part of this mission, the Foundation coordinates an extensive research program.

Resources:

- EPA ENERGY STAR Portfolio Manager
  www.energystar.gov/benchmark

- EPA's 2008 Guidebook "Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities"
  www.epa.gov/waterinfrastructure/bettermanagement.html

- Cheryl McGovern, EPA Region IX
  mcgovern.cheryl@epa.gov
  (415) 972-3415

- Water Research Foundation, Energy Index Development for Benchmarking Water and Wastewater Utilities
  http://www.waterresearchfoundation.org/research/TopicsAndProjects/projectSnapshot.aspx?pn=3009

Energy Performance Contracts and Loans

The Arizona Department of Commerce Energy Office offers technical and program assistance to support energy efficiency programs including Energy Savings Performance Contracting. As part of this assistance, the State Procurement Office issued a request for qualifications from companies that provide energy savings performance contract services. A pre-qualified list of companies was created so that a governmental entity would not be required to conduct this step, therefore reducing the time necessary for securing a contract. The pre-qualified list of companies may be used by all governmental entities. State agencies are required to use the list; however, other entities are not required. They may use the established state contract or establish contracts on their own. Using the list does require an entity to follow all of the procedures in the State Procurement Office's initial solicitation. These services may greatly assist local governments with reducing energy consumption and saving money. While the pre-qualified companies may be able to provide some assistance in the area of water and wastewater treatment, they may not have the specific expertise some jurisdictions need. Since water and wastewater treatment are often some of the biggest energy users for municipalities, cities and towns would benefit from ensuring that their contract specifies access to water and wastewater experts.

Energy performance contracts are effective ways to green water and wastewater infrastructure. To finance projects, it was suggested that potentially the Water Infrastructure Finance Authority of Arizona could provide energy performance loans that would be paid back using the energy savings. Currently, WIFA is required to direct at least 20 percent of its drinking water and clean water federal funding toward green projects. Green projects are divided into two categories: energy efficiency and water efficiency. The project criteria set by WIFA is based on EPA's Clean Water and Drinking Water State Revolving Fund Green Project Reserve criteria. The projects may include planning, design, and/or construction activities. The whole project or just a component of the project may be identified as green. If WIFA were to offer energy performance loans to municipalities, this may increase the ability to make water and wastewater treatment processes more sustainable.

Resources

- Arizona Department of Commerce
  http://www.azcommerce.com/Energy/ESPC.htm

- Water Infrastructure Finance Authority of Arizona
  http://www.azwifa.gov

Technology Specifications

Additional efforts to green water and wastewater infrastructure may include incorporating energy-efficient specifications for areas such as lighting, motor pumps, and HVAC (heating, ventilating, and air conditioning) into standard practices. The specifications would likely vary by jurisdiction due to different plant sizes, processes and goals. The rebate programs at SRP and APS may provide assistance with incorporating energy-saving technologies. The Sustainable Cities Network, which was formed by the Arizona State University Global Institute of Sustainability, could also assist municipalities by sharing information on specifications that have already been developed.

Efficiency from Solar

Solar, especially photovoltaic solar, is one way for water and wastewater utilities to capture energy. The large footprint of many treatment facilities may allow for the installation of arrays of solar panels. While solar has been a great success in some areas, additional research and studies could be conducted to provide additional guidance on return on investment and pay back periods, particularly in light of changing rebate structures and regulations. Guidance would also be helpful for municipalities interested in reducing their carbon footprint at their treatment facilities by using solar.

The cities of Peoria and Glendale have implemented solar projects at their wastewater treatment facilities. Recently, the City of Peoria completed a solar project at the Beardsley Water Reclamation Facility that provides a portion of the power that is necessary for the facility's operations building. The City of Glendale uses solar energy at the West Area Water Reclamation Facility to provide all the hot water needs for the plant. In addition, the facility utilizes solar energy for the administration building. These solar projects have resulted in an approximately 40 percent cut in facility costs for the City of Glendale.

Hydroturbines

Hydroturbines harness the power of water to produce electricity. They are not traditionally used in water distribution systems; however, they are a clean and renewable source of energy. Hydroturbines are potentially usable in water distribution systems having significant elevation changes or multiple pressure zones. Hydroturbine technology has been in existence for a long time and continues to evolve. Additional guidance on generating electricity from hydroturbines would assist utilities in incorporating hydrogeneration into their processes. The City of Phoenix discussed hydroturbines at the MAG Greening Water and Wastewater Infrastructure Workshop. The link to the presentation is provided below.

Resource

- Hydroturbines: It's All Downhill From Here
  http://www.mag.maricopa.gov/detail.cms?item=11400

Arizona Corporation Commission

The Arizona Corporation Commission could work with utilities on sustainability initiatives. Areas of specific interest include the permitting process and third-party providers.

319H Nonpoint Source Grant Funds for Urban Sustainability Projects

The Arizona Department of Environmental Quality Nonpoint Source Program promotes and facilitates statewide efforts to manage the impact that nonpoint source pollution has on surface and groundwater. The majority of the work performed by the Program is funded by Clean Water Act Section 319(h) grant funding that is awarded to ADEQ by the U.S. Environmental Protection Agency. The Program focuses on land use activities that potentially have negative impacts on surface and groundwater quality including: agriculture, forestry, urban runoff, hydromodification, onsite/septic waste treatment systems, mining, and recreation.

The EPA estimates that approximately 30 percent of the known pollution to the nation's waters is due to stormwater runoff (Source: www.azdeq.gov/environ/water/permits/stormwater.html). One suggestion for the Planning Group was for ADEQ to potentially allocate a portion of the Section 319(h) grant funding for urban sustainability projects related to stormwater. The Environmental Protection Agency considers stormwater a point source once it reaches a municipal storm drain; therefore qualifying projects would need to address stormwater at sites prior to reaching the storm drain.

- Arizona Department of Environmental Quality Nonpoint Source Pollution Program
  http://www.azdeq.gov/environ/water/watershed/nonpoint.html

  - Krista Osterberg, ADEQ
    ko1@azdeq.gov
    (602) 771-4635

WIFA Reclaimed Water Rate Study

The Water Infrastructure Finance Authority provides three types of technical assistance for drinking water and wastewater facilities: project, operational, and policy. Project technical assistance involves assisting individual systems to conceive, plan, design, and develop infrastructure. For operational technical assistance, WIFA provides funding through the ADEQ Capacity Development Program to assist individual systems with improving day-to-day operations. The policy technical assistance includes developing and distributing guidance and performing related activities to benefit a wide range of drinking water and wastewater systems. Policy technical assistance provided by WIFA in the past has included guidance on arsenic treatment, how to hire an engineer, and funding of a water and wastewater residential rate study. This study was conducted by WIFA to provide unit rates and total monthly charges assessed by utilities for water consumed and wastewater generated. Since reclaimed water continues to be a valuable resource, WIFA could consider funding a reclaimed water rate study. Utilities would then have a base for comparison of rates and methodologies for establishing rates.

Sustainability in General Plans/Master Plans

In 1998, Arizona adopted the Growing Smarter Act which establishes roles of local and state government in the planning and management of new development. The Growing Smarter Plus Act of 2000 is an extension to the 1998 Growing Smarter Act. Together, these acts initiated requirements for extensive growth planning by municipal agencies. One of the components of the legislation requires municipalities

and counties to adopt general and comprehensive plans to serve as guides to future development. As municipalities prepare updates to their general plans, as required by the legislation, the Planning Group suggested that sustainability components could be incorporated into the discussions about water and wastewater treatment. There may also be the opportunity to include sustainability as the overriding goal of a general plan. Possibilities for including sustainability components into general plans may vary by jurisdiction.

Sustainability and 208 Water Quality Management Plans

The 208 Water Quality Management Plans are prepared by the designated Regional Water Quality Management Planning Agencies in accordance with Section 208 of the Clean Water Act. These plans include the desired wastewater treatment configuration for their regions. Currently, the SouthEastern Arizona Governments Organization (SEAGO) and Central Arizona Association of Governments (CAAG) are updating their 208 Plans. As part of the updates, the Arizona Department of Environmental Quality has indicated that sustainability/infrastructure greening issues must be addressed. As the Regional Water Quality Management Planning Agencies update their 208 Plans in the future, it may be beneficial for them to review the sustainability components included in the SEAGO and CAAG plans. While 208 Plans are prepared in accordance with Section 208 of the Clean Water Act, they are specific to each region. Therefore, differences among the plans are common. For example, processes and goals for rural areas may be different in comparison to urban regions.

Information Exchange

A forum for Arizona utilities to meet and discuss sustainable aspects of water and wastewater infrastructure could provide local governments the opportunity to share ideas and best practices. There have been efforts to initiate forums to discuss these ideas. For example, the Arizona State University Global Institute of Sustainability formed the Sustainable Cities Network as a place where professionals may discuss sustainability ideas, challenges, and best practices. In March 2010, the Network held the inaugural meeting of the new Water and Wastewater Workgroup. This group, which will include municipal and tribal representatives, will work to identify, discuss, and take action on sustainability challenges and move toward a more sustainable region. Potentially, the Sustainable Cities Network could also host a clearinghouse for green projects related to water and wastewater treatment systems.

There are many possible collaborative opportunities for making water and wastewater plants more environmentally friendly. Sustainability/energy partnerships could be formed with Arizona State University, for example. Local governments such as the City of Phoenix have already formed data exchange programs with the ASU School of Sustainability.

Resource

- Sustainable Cities Network
  http://sustainablecities.asu.edu

  - Anne Reichman, Sustainable Cities Network
    anne.reichman@asu.edu
    (480) 965-2168

Specialized Workshops

The MAG Greening Water and Wastewater Infrastructure Workshop included sessions that covered a variety of topics for making water and wastewater systems more sustainable. Additional workshops could be conducted to expand on the ideas discussed at the MAG workshop. Additional workshops could involve collaborations with the U.S. Department of Energy Intermountain Clean Energy Center and ASU Global Institute of Sustainability. In addition to workshops, it was suggested that a community college, such as Gateway Community College which already has similar programs, could offer a class for owners/operators of drinking water and wastewater treatment plants dedicated to sustainability opportunities.

Resources

- U.S. Department of Energy Clean Energy Center, Intermountain Region
  http://www.intermountainchp.org

- ASU Global Institute of Sustainability
  http://sustainability.asu.edu

Financial Resource Guide

A compendium resource that lists the funding opportunities for green projects such as audits and retrofits would aid utilities in improving the environment and lowering their costs. This resource could include descriptions of eligibility, grant ceilings or minimums, applicability, and cost shares. Utilities are very interested in making water and wastewater infrastructure more sustainable; however, the current economic climate has made funding these projects challenging.

At the January 12, 2010 MAG Greening Water and Wastewater Infrastructure Workshop, several speakers discussed funding opportunities for green projects. The presentations have been posted to the MAG website.

Resource

- MAG Greening Water and Wastewater Infrastructure Workshop Presentations
  http://www.mag.maricopa.gov/detail.cms?item=11400

Funding Agency Contacts

One of the challenges of working with large agencies is finding the appropriate contact within the agency. A list of contacts at agencies such as WIFA, ADEQ, EPA, and the U.S. Department of Energy (DOE) would be helpful for those with questions on available funding. There is also potential for local governments to partner with these agencies. Representatives from several funding agencies were in attendance and presented at the MAG Greening Water and Wastewater Infrastructure Workshop. Contact information is provided below.

Resources

- Water Infrastructure Finance Authority of Arizona
    - Melanie Ford
      mford@azwifa.gov
      (602) 364-1321
- ADEQ Capacity Development Program (free technical assistance for small drinking water systems serving 10,000 people or less)
    - Kathy Stevens
      stevens.kathryn@azdeq.gov
      (602) 771-4653
- U.S. Environmental Protection Agency Region IX
    - Cheryl McGovern
      mcgovern.cheryl@epa.gov
      (415) 972-3415
- U.S. Department of Energy Clean Energy Center, Intermountain Region
    - Patti Case
      plcase@etcgrp.com
      (801) 278-1927

THE NEXT STEPS TO GREENING WATER AND WASTEWATER INFRASTRUCTURE

Introduction

On January 12, 2010, the Maricopa Association of Governments conducted the Greening Water and Wastewater Infrastructure Workshop in Phoenix, Arizona. The workshop was highly successful with approximately 150 people in attendance, representing public and private utilities, consulting firms, academia, state and federal agencies, and others. To assist with the planning of the workshop, MAG had formed the Greening Water and Wastewater Infrastructure Planning Group. The Planning Group, comprised primarily of utility representatives from MAG member agencies, discussed topic ideas for the workshop and guided development of the workshop agenda. The agenda is posted on the MAG website at http://www.mag.maricopa.gov/pdf/cms.agendas/WQAC_2009-12-10_Greening-Water-Infrastructure_AGD-2_12777.pdf.

Following the workshop, the Planning Group met again to discuss ideas for next steps, including the development of a roadmap for incorporating green technologies into water and wastewater treatment plants. The Planning Group drew on both the information presented at the workshop as well as current and contemplated sustainability initiatives withing their jurisdictions. These ideas include water conservation, energy conservation and capture, and chemical use reduction measures. These measures focus on saving financial resources in both the short-term and long-term. This document summarizes the next steps suggested by the Planning Group. For further information, resources, and contacts, please refer to the companion MAG document, "Ideas for Greening Water and Wastewater Infrastructure."

Energy Audits

Energy audits (in conjunction with water use audits as applicable) were considered by the Planning Group as a first step in understanding the current "green" status of water and wastewater infrastructure and developing appropriate responses to enhance sustainability.

- Faculty and students from the Northern Arizona University and University of Arizona assisted several rural Arizona communities with assessing the status of their water and wastewater treatment plants. The report prepared on the study, "A Water/Energy Best Practices Guide for Rural Arizona's Water and Wastewater Systems," could be used as a first step by a utility in preparing to conduct an in-house audit or procuring outside audit services.

- Desk audits could be conducted for wastewater treatment plants throughout Arizona. The information could be inputted into the U.S. Environmental Protection Agency (EPA) ENERGY STAR Program and each facility would be provided a rating from 1 to 100, based on the ENERGY STAR formula. These ratings could be publicized and propel utilities to continually evaluate potential green projects in order to better their rating.

- The Arizona Department of Environmental Quality (ADEQ) could encourage and spearhead audits for smaller wastewater treatment plants in the State. The ADEQ could select a plant to audit which would serve as a model for conducting audits for other small facilities (a "reality" audit).

Benchmarking

The Planning Group considered benchmarking and associated metrics critical for gaging the effectiveness of implementing sustainability measures and for comparison with similar facilities in the State.

- The Water Research Foundation conducted a research project to benchmark water and wastewater utilities. The document was published in 2007 and is available to Water Research Foundation subscribers as "Energy Index Development for Benchmarking Water and Wastewater Utilities."

- The EPA ENERGY STAR Portfolio Manager is an assessment tool for facilities to measure current energy efficiency and track progress. There is also a component that compares operational efficiencies of wastewater treatment plants with similar facilities across the country. This is a free, online tool to assist utilities in eliminating energy waste and lowering operating costs for water and wastewater systems.

- The EPA published a 2008 Guidebook, "Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities" to assist utilities. The guidebook is based on a Plan-Do-Check-Act management system approach to reduce energy consumption and costs.

- At the January 12, 2010 MAG Greening Water and Wastewater Infrastructure Workshop, EPA offered assistance to utilities interested in benchmarking their facilities and/or applying the Plan-Do-Check-Act management system discussed in the EPA guidebook.

Energy Performance Contracts and Loans

- The Arizona Department of Commerce Energy Office offers technical and program assistance to support energy efficiency programs including Energy Savings Performance Contracting. As part of this assistance, the Energy Office created a pre-qualified list of companies to assist governmental entities. With water and wastewater treatment often being some of the biggest energy users for municipalities, cities and towns would benefit from ensuring that their energy performance contract specifies access to water and wastewater experts.

- Potentially, the Water Infrastructure Finance Authority of Arizona (WIFA) could provide energy performance loans that would be paid back using the energy saved by implementing sustainability measures at water and wastewater treatment plants. This type of program could promote faster adoption of energy saving or enhancement technologies by utilities. Currently, WIFA is required to direct at least 20 percent of its drinking water and clean water federal funding toward green projects.

Technology Specifications

- Energy-efficient specifications for areas such as lighting, motor pumps, and HVAC (heating, ventilating, and air conditioning) could be incorporated into standard practices for water and wastewater infrastructure procurement. The rebate programs at Salt River Project (SRP) and Arizona Public Service (APS) may provide assistance with incorporating energy-saving technologies.

- The Sustainable Cities Network, which was formed by the Arizona State University Global Institute of Sustainability, could also assist municipalities by compiling and sharing information on specifications that have already been developed.

Efficiency from Solar

- Cities are beginning to implement solar projects at their wastewater treatment facilities; however, additional research could be conducted to provide guidance on return on investment and pay back periods, particularly in light of changing rebate structures and regulations.

Hydroturbines

- Since hydroturbines are not traditionally used in water distribution systems, additional guidance on generating electricity from hydroturbines would assist utilities in incorporating hydrogeneration into their processes to capture energy that is currently wasted. Hydroturbines are a clean and renewable source of energy and have been implemented in the City of Phoenix water system.

Arizona Corporation Commission

- The Arizona Corporation Commission could play a role in assisting utilities in sustainability efforts. Areas of specific interest include the permitting process and third-party providers.

319H Nonpoint Source Grant Funds for Urban Sustainability Projects

- The Arizona Department of Environmental Quality could potentially allocate a portion of its Section 319(h) nonpoint source grant funding for urban sustainability projects related to stormwater.

WIFA Reclaimed Water Study

- Since reclaimed water continues to be a valuable resource, the Water Infrastructure Finance Authority of Arizona could consider funding a reclaimed water rate study. In the past, WIFA has funded water and wastewater residential rate studies to provide unit rates and the total monthly charges assessed by utilities for water consumed and wastewater generated. There is a need for a similar study for reclaimed water to compile both rates as well as methodologies for establishing rates.

Sustainability in General Plans/Master Plans

- As municipalities prepare updates to their general plans, sustainability components could potentially be incorporated into the discussions involving water and wastewater infrastructure. There may also be opportunities for including sustainability as the overriding goal of a general plan.

Sustainability and 208 Water Quality Management Plans

- As the Regional Water Quality Management Planning Agencies update their 208 Water Quality Management Plans, it may be beneficial for them to review the sustainability components being

included in the updates to the SouthEastern Arizona Governments Organization (SEAGO) and Central Arizona Association of Governments (CAAG) plans. The Arizona Department of Environmental Quality has indicated that sustainability/infrastructure greening issues must be addressed as part of these updates.

Information Exchange

The Planning Group considered information exchange to be a critical element in advancing sustainability in water and wastewater infrastructure.

- The Arizona State University Global Institute of Sustainability formed the Sustainable Cities Network as a forum where professionals may discuss sustainability ideas, challenges, and best practices. In March 2010, the Network held the inaugural meeting of the new Water and Wastewater Workgroup. Potentially, the Sustainable Cities Network could also host a clearinghouse for green projects related to water and wastewater infrastructure.

- There are many possible collaborative opportunities for making water and wastewater plants more environmentally friendly. Sustainability/energy partnerships could be formed with Arizona State University, for example. Local governments such as the City of Phoenix have already formed data exchange programs with the ASU School of Sustainability.

Specialized Workshops

- The success of the Greening Water and Wastewater Infrastructure Workshop conducted by MAG on January 12, 2010, in cooperation with ADEQ and EPA, spawned ideas for further workshops. These could involve collaborations with the U.S. Department of Energy Intermountain Clean Energy Center, EPA, the ASU Global Institute of Sustainability, and others.

- In addition to workshops, a community college such as Gateway Community College, which already has similar/related classes, could offer a class for owners/operators of drinking water and wastewater treatment plants dedicated to sustainability opportunities.

Financial Resource Guide

- A compendium resource that lists the funding opportunities for green projects such as audits and retrofits would aid utilities in improving the environment and lowering their costs. This resource could include descriptions of eligibility, grant ceilings or minimums, applicability, and cost shares.

Funding Agency Contacts

- A list of contacts at agencies such as WIFA, ADEQ, EPA, and the U.S. Department of Energy would be helpful for those with questions on available funding. Representatives from several funding agencies were in attendance and presented at the MAG Greening Water and Wastewater Infrastructure Workshop. Contact information is provided in the MAG document "Ideas for Greening Water and Wastewater Infrastructure."