Water Utilities can help Achieve Energy & Demand Response Goals

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But first, let's look at energy reliability

and costs

from their perspective…

The Energy⇔Water Nexus

- Energy is a large & essential input to water supply
  - Water & wastewater utilities consume ~ 50,000 GWh annually
  - 6.5% of CA energy used to move or treat water
  - Perhaps 20% of energy for all aspects of water
  - This compares to other large industries (pulp & paper, etc)
- Reliability and cost of energy a growing concern
- Energy use & reliance likely to increase in water sector in years ahead
  - Energy intensive treatment processes for reg compliance & new sources (UV, membranes)
  - Pumping further distances and greater depths

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Key Energy Industry Trends that are Affecting Water Utilities

- Transmission system constraints
- Temporal pricing of electricity
- Renewable Portfolio Standards (RPS)
- New self-generation options
- Natural gas price volatility
- Energy efficiency & demand response spending

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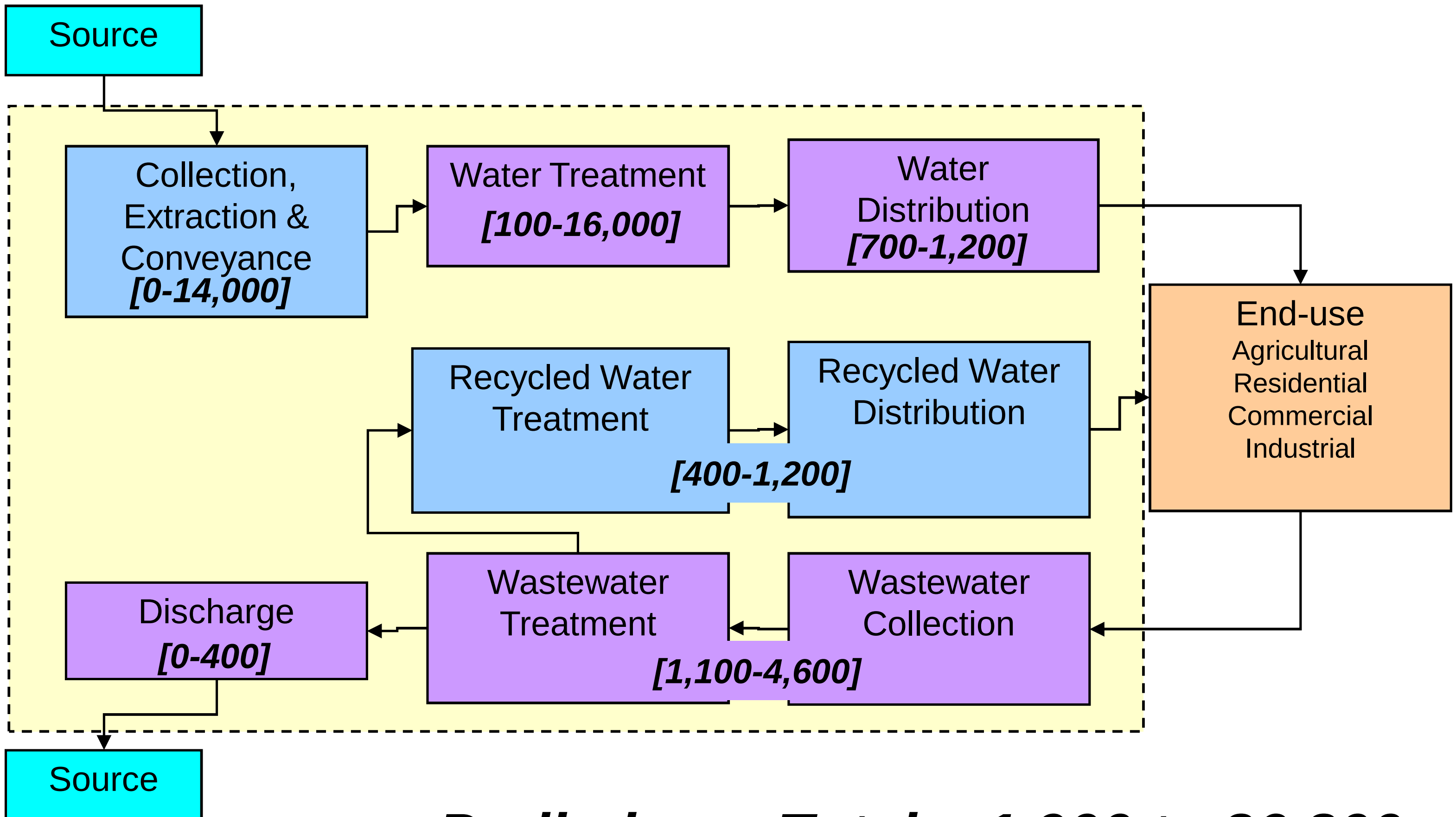
Water Use Cycle Energy Intensities (kWh/MG)



Preliminary Total = 1,900 to 36,200 kWh/MG [Source = CEC]

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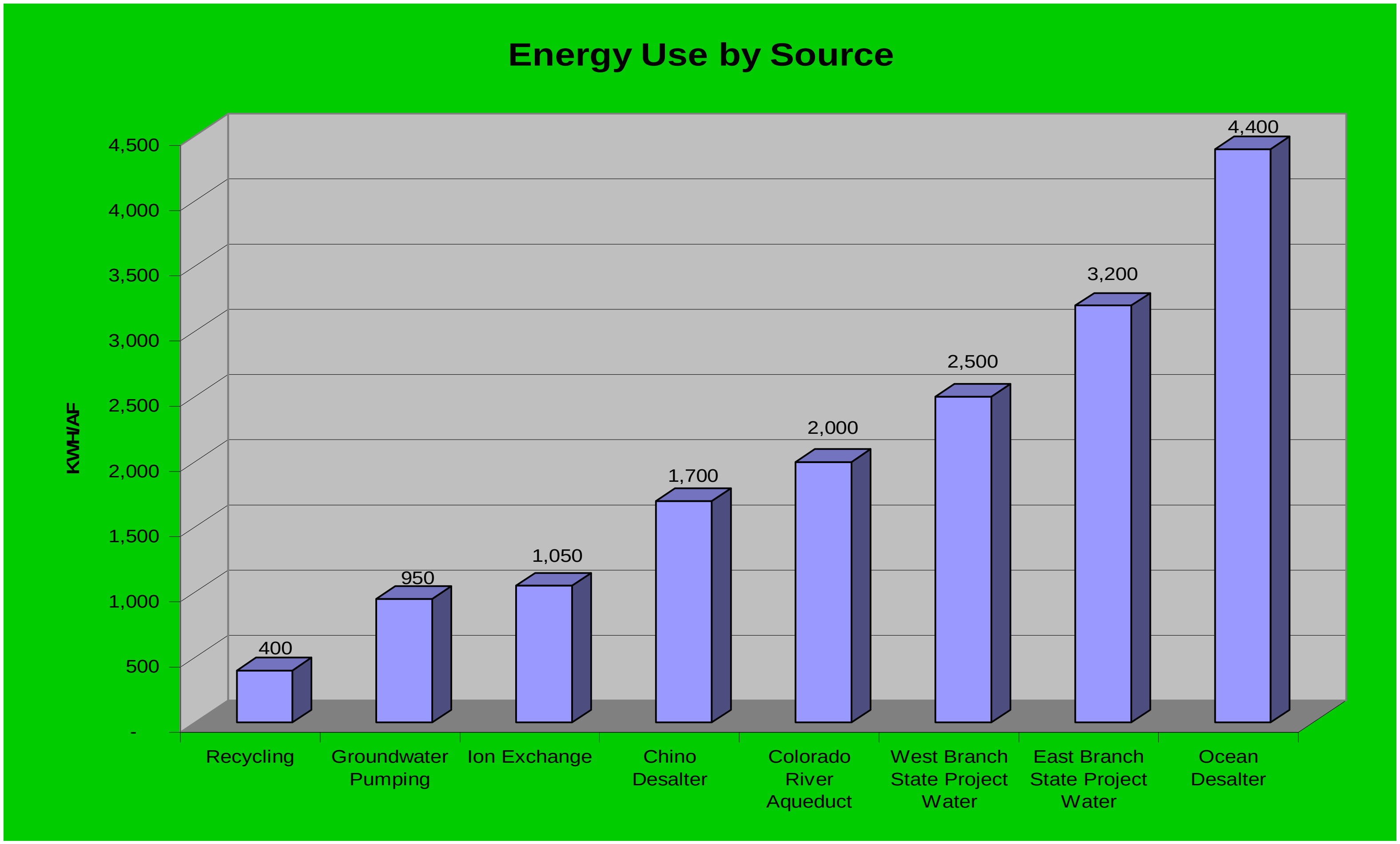
Example: Energy Intensity of Water Supplies (IEUA)



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Source: Inland Empire Water Department

New Regulations Driving Advanced Treatment Technology Selection

- Interim Enhanced Surface Water Treatment Rule (IESWTR) and Long-Term 2 ESWTR
  - Microfiltration/ultrafiltration (MF/UF) needed to achieve standards
  - NF/RO treatment results in 25-30% reject water with high TDS, hardness, etc.
- *Cryptosporidium* concerns
  - UV the most effective *Crypto* inactivation option
  - Virtually every U.S. utility doing new plant construction or upgrades considers UV integration
  - Relatively low cost and high impact of UV expected to result in very wide application in U.S. and beyond
  - Ozone as *Crypto* barrier may be selected over UV when other drivers important, but popularity of ozone waning since UV entered marketplace. Utilities with ozone at one facility frequently elect to add it at others

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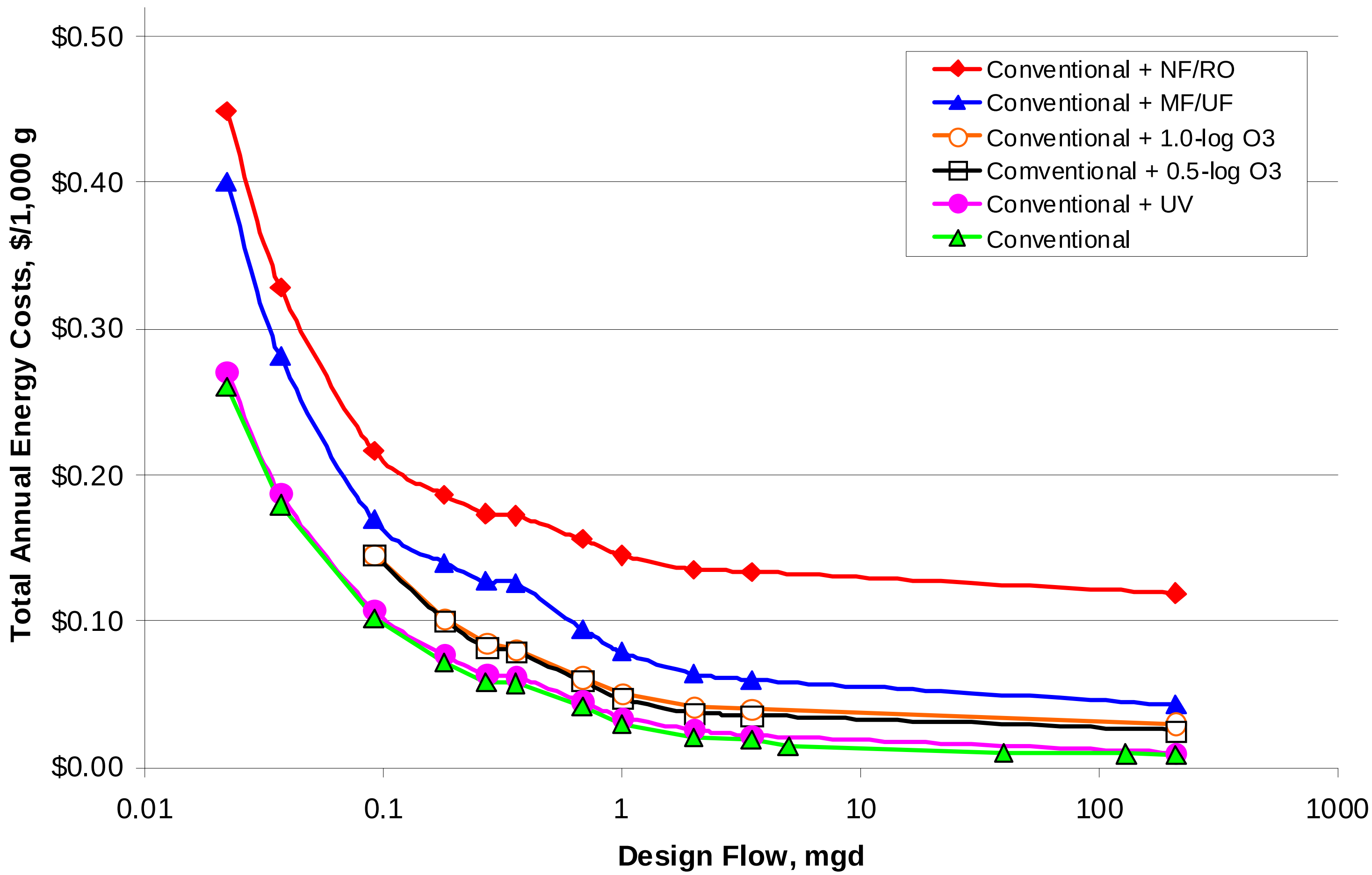
Energy Costs of Emerging Treatment Technologies



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Risks Posed by Energy Reliance in Water Sector

1. Financial cost: especially when energy use occurs in peak power demand (peak rate) periods
2. Reliability – health and safety: energy essential to ability to provide adequate and safe waters
   - Source to tap: pump, treat, distribute
   - Wastewater too (conveyance and treat)
   - How reliable is the grid?
3. Environmental: meeting CWA, air quality, ESA, and other applicable standards; stewardship

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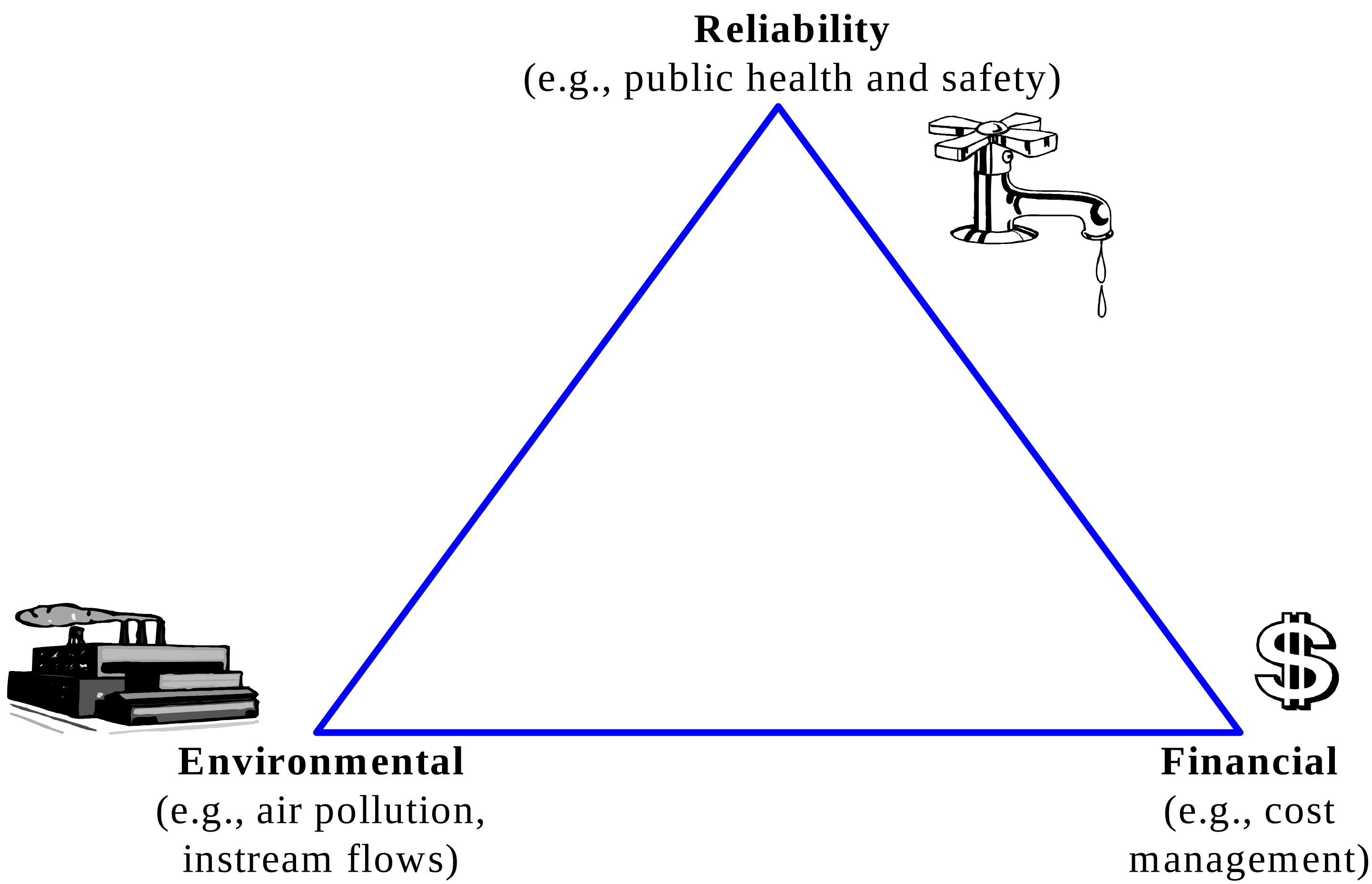
Three Dimensions of Energy Related Risks



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Strategies for Managing Energy Risks

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Demand Reduction Strategies

Options for reducing power demands	Benefits	Risks
Shift conveyance and distribution pumping to off-peak electric periods.	Significant electricity demand cost savings are possible.	Potential side effects on supply reliability and water quality.
Shift water treatment demands such as filter backwash to off-peak periods.	May provide significant savings in electric costs of treatment.	May have side effects on water quality reliability if backwash is overly deferred.
Optimize control strategies, upgrade pump motors, and employ variable speed drives or natural gas-driven pumps.	Reduces electric demand and consumption.	Cost of equipment, potential power quality issues, natural gas prices, and fuel storage.
Optimize the hydraulics of the water system to reduce pumping energy requirements.	Reduces pumping requirements, and thus energy needs and costs.	In and of itself does not increase reliability; may have water quality effects. Cost could also be an issue.
Develop additional water gravity-fed storage capabilities.	Independent of electric supply.	Capital cost, possible water quality implications.
Develop alternative treatment options.	May not reduce electric needs.	Cost and complexity of some systems.
Develop water conservation programs that reduce demand.	Reduces overall energy requirements.	May not reduce demand during critical peak periods.
Develop time-of-use (TOU) rates for water customers consistent with TOU cost of electricity supplies.	Brings water rates in alignment with true costs of supply, and reduces pumping during electric peak times.	Metering infrastructure and operating costs; may not break even in cost vs. demand reduction. TOU for water may not coincide with time of energy used in water delivered.

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Shift Pumping to Off-Peak

Benefits

- Pumping water during off peak can dramatically reduce electricity costs.
- Water pumped during off peak to elevation may have sufficient head to pressurize distribution systems.

Risks

- Pumping at off peak hours <u>may</u> require additional staff or automation investments.
- Failures in storage units can foil this strategy, for example if a basin is being drained for improvements.
- Fluctuations in water treatment plant production rates may affect hydraulic changes (increases) causing pathogen or other constituent breakthrough.
- Storage capacity may not exist, may not have the means to exist (lack of space) or may be too costly to implement.

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Add Water Storage

Benefits

- Allows water provider to shift pumping and treatment to off peak energy use periods.
- Allows water provider to exploit head differentials between storage basin or tower and system delivery end points.
- Use less energy overall than importing water (for groundwater recharge)

Risks

- Water stored in impoundment basins and towers is susceptible to intentional interference.
- Long-term storage may result in inappropriate cycle times causing taste and odor issues and/or chlorine residual decay.

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Water Conservation Programs

Benefits

- Reducing water demand, especially on peak, reduces the energy costs to supply water
- Common measures
  - **Low flow showerheads & Faucet aerators**

    Package direct energy savings =~ 600 kWh/yr
  - **Pricing policies (block pricing, etc.)**

Risks

- Education of single family units, one of the largest water consumers, can be costly on a per gallon basis.

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Supply Management Options

Options for increasing power supply reliability and/or reducing power costs	Benefits	Risks
Install or expand backup diesel power generation on-site.	Relatively inexpensive. Can be sized to operate critical treatment and pumping systems during emergencies.	Air quality issues limit the run-time of diesel engines. Blackouts could last longer. No option for economic dispatch.
Install natural gas fired backup generation on-site.	Cleaner burning options include natural gas reciprocating engines, microturbines, and combustion turbines. Can be used for "peak shaving" during times of high electric demand, taking advantage of electric DR incentives offered.	Higher capital cost than diesel engines. On-site staff may not be familiar with technology. Potential fuel price volatility.
Install renewable generation on-site.	Tax credits and other incentives available. No air pollution.	High capital cost. Wind or sun may not be available when needed (requires detailed analysis of system sizing and storage options).
Contract with electric provider for *guaranteed power,* where third party owns and operates backup systems for an annual fee, or electric utility provides a second feeder line to ensure power supply except during widespread blackouts.	Outsourcing provides expertise that is generally not a core competency at water utilities. Provides known annual cost for budgeting.	Added cost [the energy services company must make money, too]. Little or no internal capacity building.
Participate in electric utility DR programs (along with one or more of the options above), and consider all rate options available from local electric provider.	May offset the cost of some supply-side solutions, by securing payment or rate advantages from electric utility.	May require on-site operator for generation equipment, and active participation in electric utility program logistics.

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Install Backup Diesel Generators

Benefits

- Redundancy at critical electric nodes in the water system improves system reliability (diversified power sources)
- Relatively inexpensive
- Depending on air quality issues, generator(s) can be economically dispatched (reduce electric demand and consumption charges; hedge against price volatility; ancillary services markets)
- Easily scalable depending on power needs
- Mobility - can be sited where needed
- Ameliorate security concerns

Install Backup Diesel Generators

Risks

- Air quality issues limit run times and reduce options for economic dispatch (emergency generators that operate during utility power outages might be exempt from permitting restrictions)
- Capital, fuel, operations and maintenance (O&M), permitting, and testing costs
- Interconnection issues are still perceived by many as cost prohibitive. Most water agencies would prefer to serve their own load, rather than sell back to the grid.
- Possible on-site generation fees from electric utility (stand-by charges), even if the generator is connected to the grid
- Potential for cross-connection problems with generators utilizing single pass cooling system

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Install NG Backup Generators

Benefits

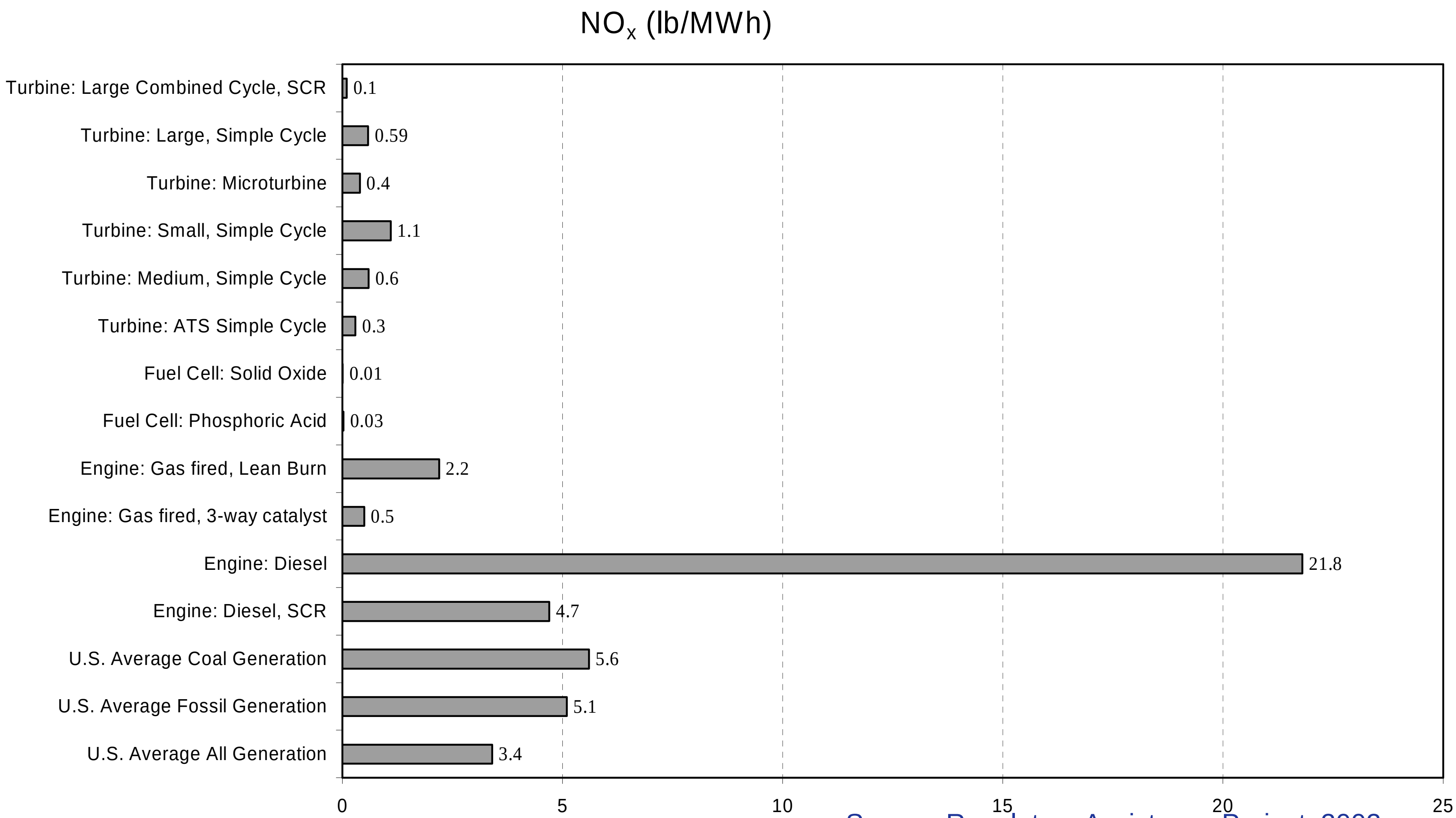
Same as diesel engines, plus:

- Cleaner than diesel (reciprocating engines, microturbines, and combustion turbines).
- Can be economically dispatched (reduce electric demand and consumption charges; hedge against price volatility; ancillary services markets).
- Enables participation in demand response programs without compromising water deliveries

Risks

- Higher capital cost than diesel generators
- Rising fuel, O&M, and testing costs are extending project payback times
- Potential fuel price variability
- Staff may be unfamiliar with technology
- Fuel storage issues less cut and dried than with diesel.

Air Quality Concerns



Source: Regulatory Assistance Project. 2002.

Install Renewable Generation

Benefits

- Tax credits and other incentives available
- Reduced or eliminated fuel costs
- Biogas can be used as fuel at wastewater treatment plants
- No emissions or air quality concerns for most renewables
- Easily scalable depending on power needs
- Solar power is coincident with electrical system peak
- Can be economically dispatched, provided the renewable resource is available and/or electric storage capabilities are built into the system
- Generation may qualify for renewable portfolio standard credits

Risks

- High capital cost
- Questions regarding how 'firm' the resource is (requires detailed analyses of system sizing and storage options, as well as potential weather dependency). Contingency planning required.

Rate Options & Demand Response

Benefits

- May offset the cost of some supply side solutions
- Many DR programs offer capacity payments plus performance payments
- DR audit provided by many program providers can be used to identify other energy efficiency opportunities
- Two-tier electric rate structures enable dollar savings through off-peak pumping and other demand shifting

Risks

- May require on-site operator or equipment controls
- May require active participation in electric utility program logistics
- May require detailed rate analyses (TOU vs. RTP, etc)
- Critical peak pricing and interruptible loads are seen by many as too logistically complex and too high a risk to plant operations.

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Characterizing & Managing Risk

Risk Management Strategies

Risk assessment	Risk management
1. **Identify risks**	4. **Select risk management option**
2. **Assess risk** (probabilities and consequences)	5. **Implement risk management approach** (monitor and refine)
3. **Evaluate risk management options** (reduce probability and/or consequence)	6. **Communicate risk management decision** (monitor and refine)

Risk assessment

Risk management

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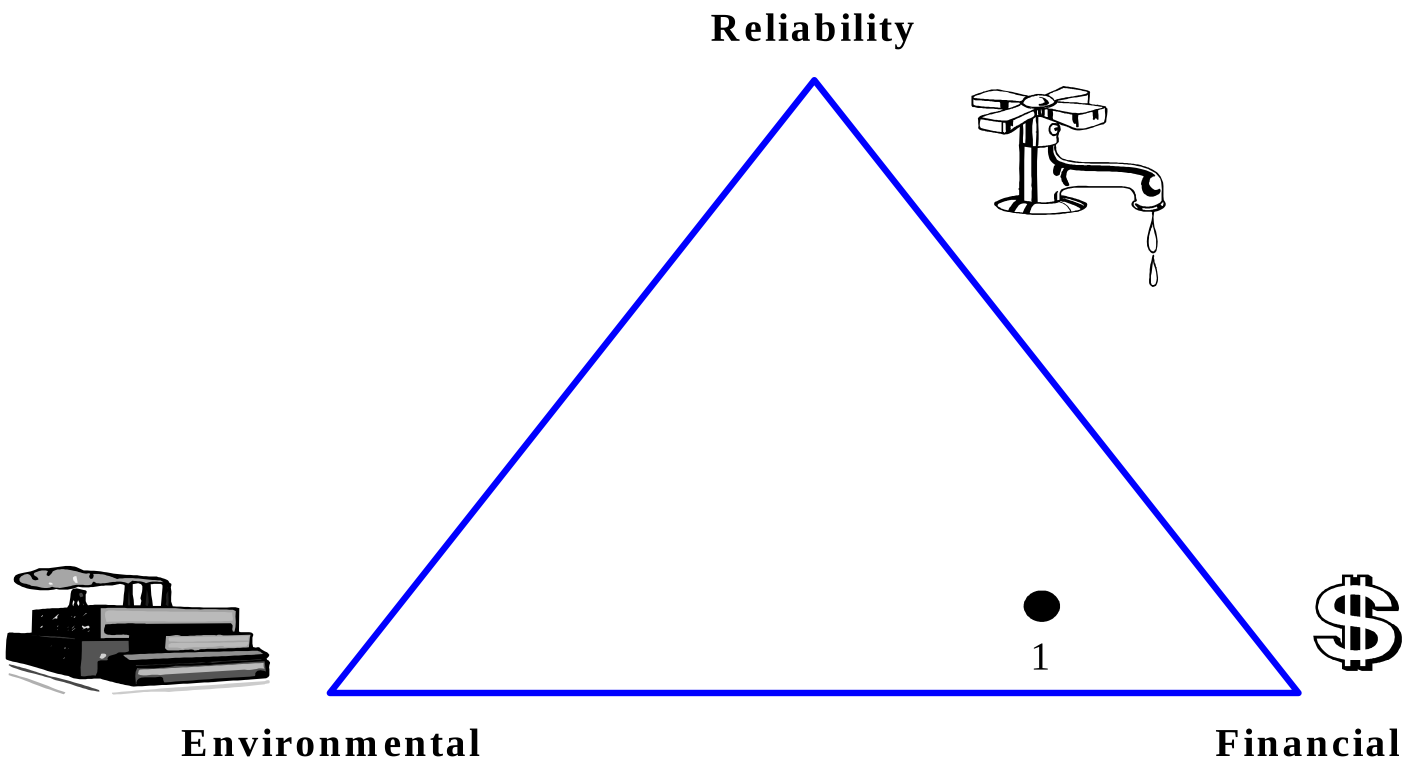
Given High Cost and Price Volatility of Energy Today. . .

. . . Many water utilities shave energy demands to save $s



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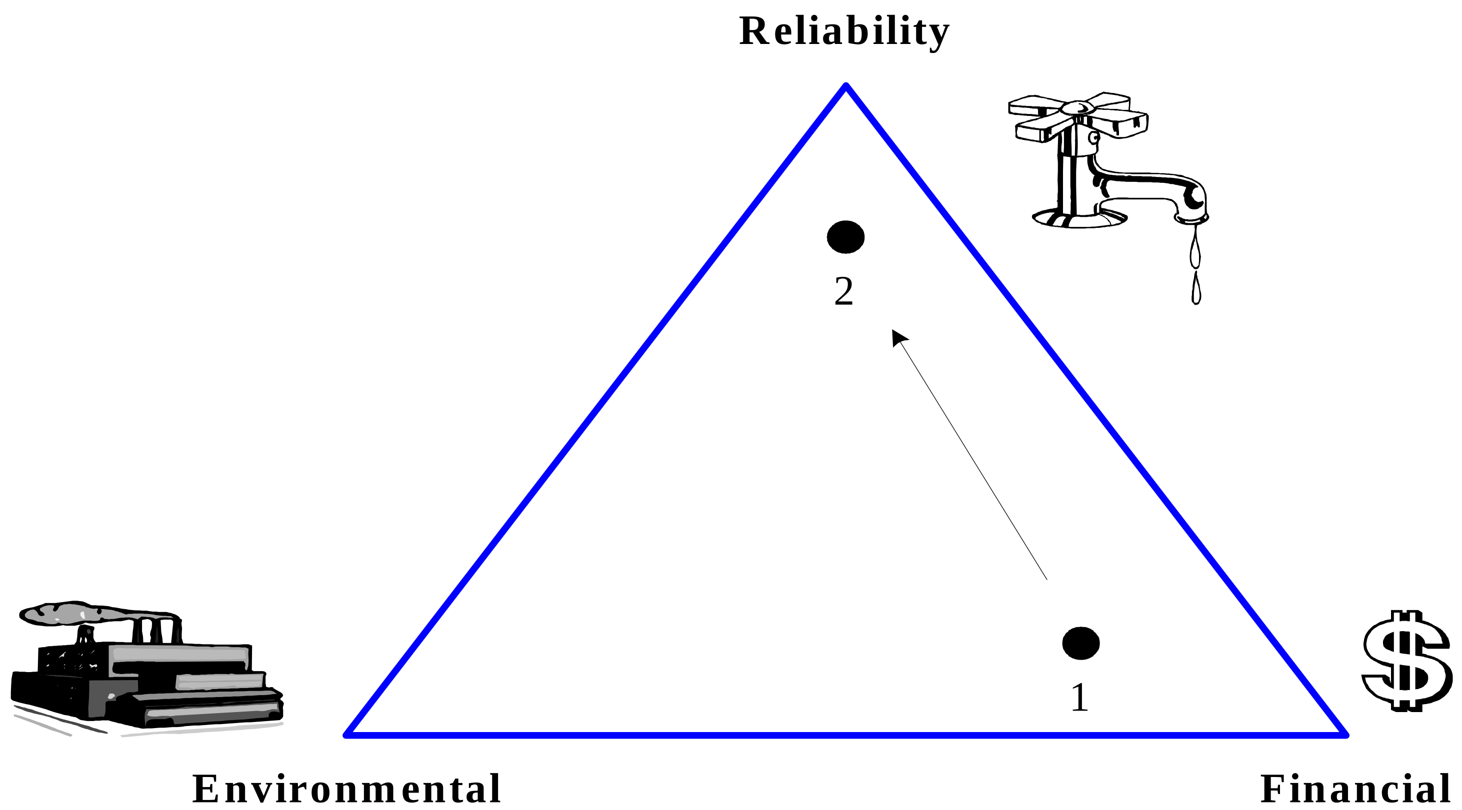
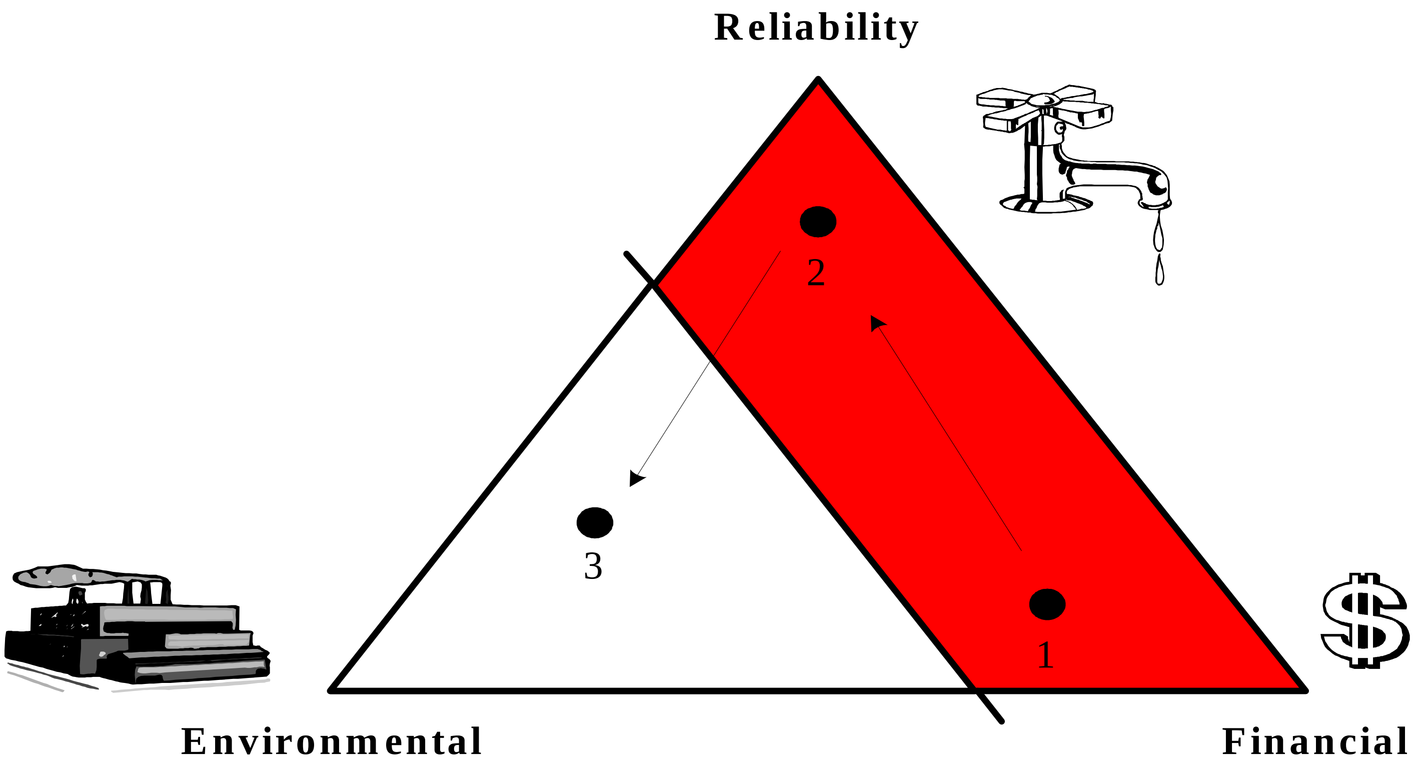
After Experiencing unexpected Blackouts . . .

. . . Many utilities invest in back-up power to increase reliability



Risk Balance is often Constrained by External Factors

E.g., air pollution rules limit reliability options
(e.g., preclude on-site diesel generators)



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Observations and Concerns

- Storage of treated water is a double-edged sword
  - Hedge against power loss and peak pricing, but..
    - Water quality risks (Stage 2 DBPs, T&O, etc)
- Who makes critical energy⇔water risk decisions? Based on what data, protocols, and timeframes?
  - Filter backwash (WQ) versus energy peak prices
  - Managing storage versus energy use and cost
  - Air quality violations versus outages

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Conclusions

- Water sector highly inter-dependent with energy
  - Very high energy use, reliance, & sensitivity
  - Trends suggest increased dependence
- Wide array of risks posed to water utilities
  - Financial – operating costs and potential savings
  - Reliability – core water utility objectives of delivering, protecting health, safety & welfare
  - Environmental – compliance and stewardship
- These risks pose different types of challenges and consequences for water utilities in different geographic areas

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Conclusions (cont.)

- Strike right balance between reliability, financial, environmental RISKS & the strategies to handle them
- In addition to managing energy demands, water agencies also have several “supply-side” options for how they generate power
- Forward looking water & Waste Water agencies are optimizing water/energy use and exploring alternative energy opportunities
  - Sewage & bio-solids as waste-to-energy
  - Move tomorrow’s water with energy from yesterday’s waste?

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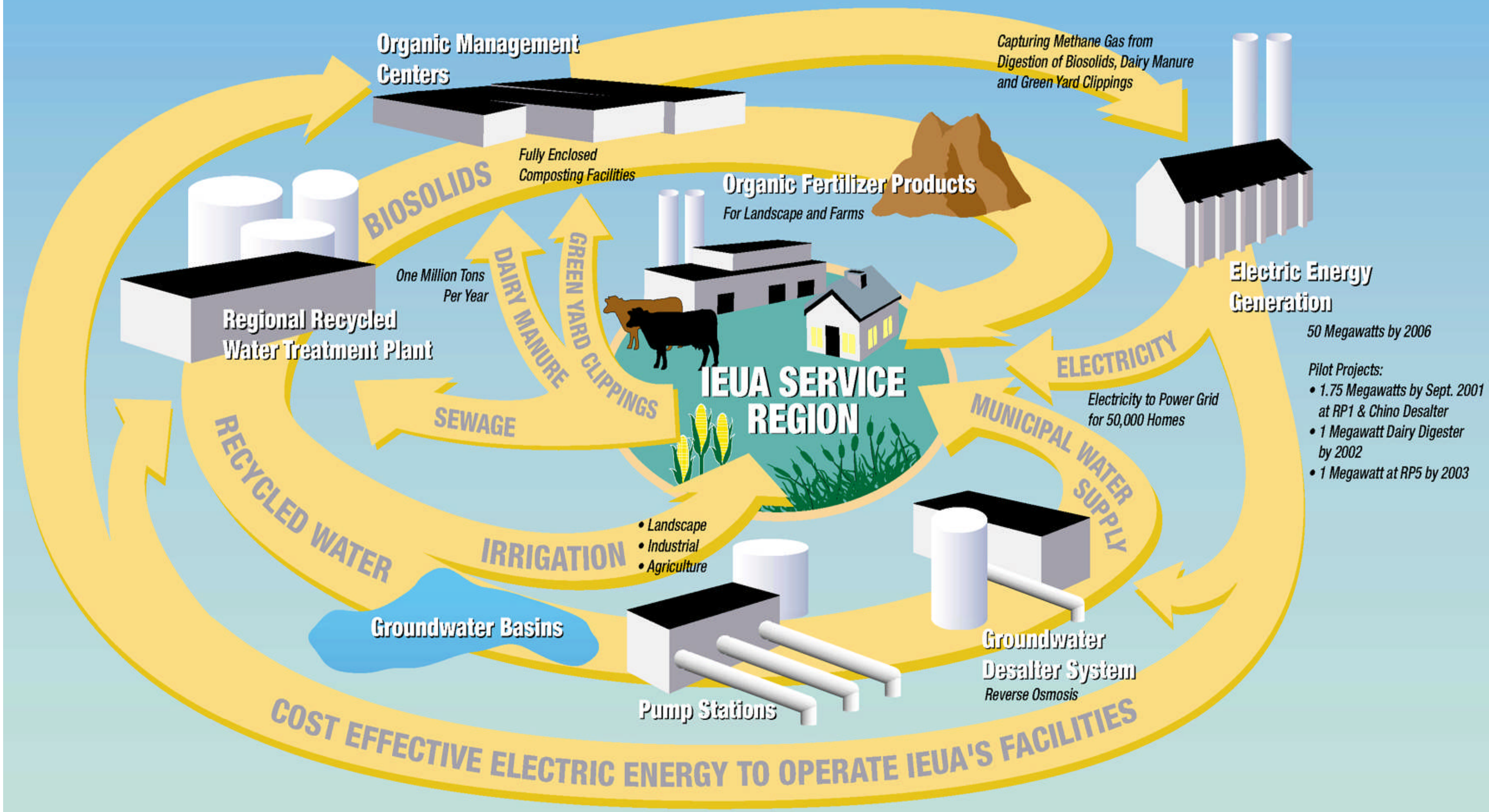
Chino Basin Recycling



Self Reliance

- New Local Water Supply to Drought Proof the Region
- New Local Energy Supplies
- Local Jobs and Economic Development

Environmental Benefits

- Reduce Air Pollution
- Comprehensive Recycling Program
  - Clean Renewable Energy
  - Safe Drinking Water
  - Protect the Santa Ana River

Cost Effective Products

- Lower Water and Sewer Bills
- Organic Fertilizer
- Inexpensive Electricity

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