

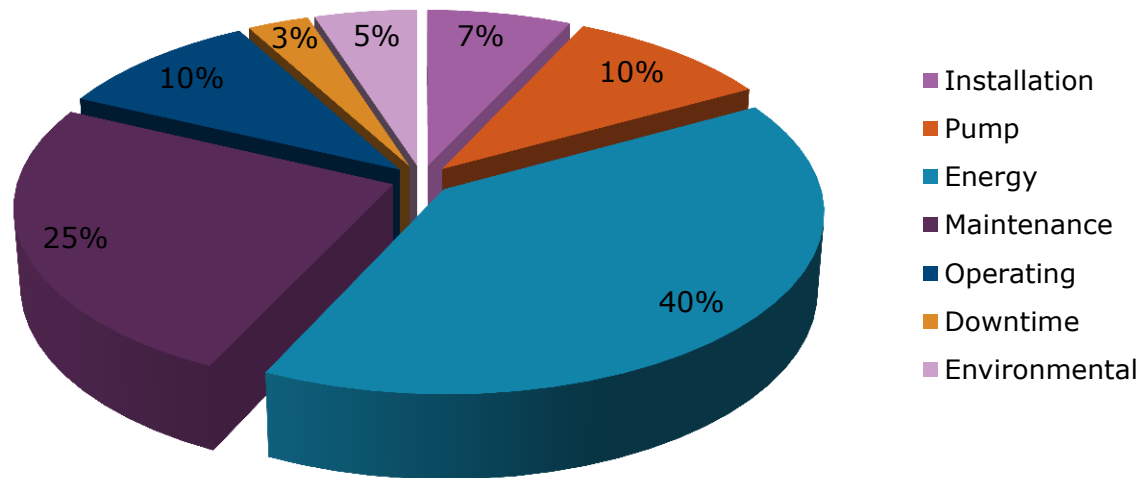
APS Pump & Blower Program.

Blaine Miller, CEM

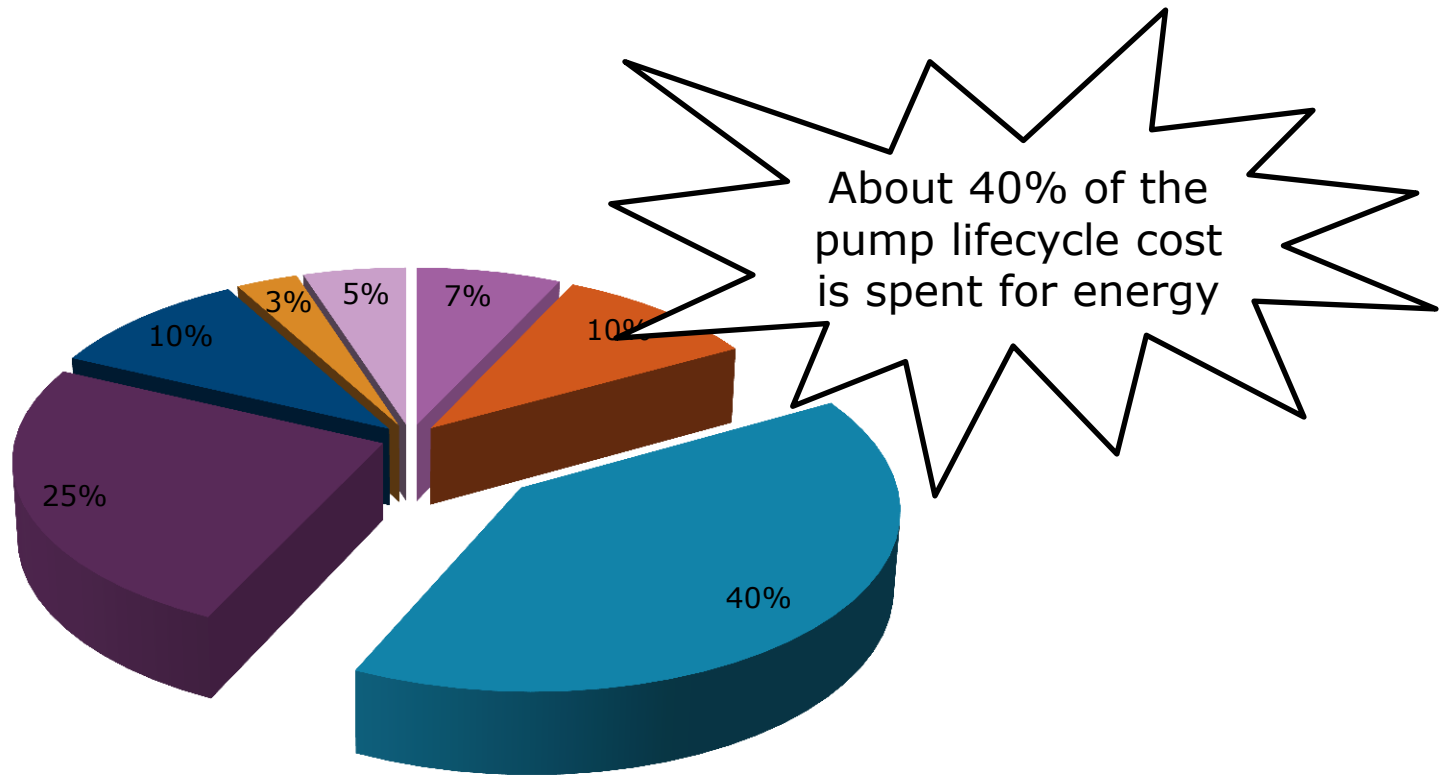
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Why Pumps for Energy Efficiency?




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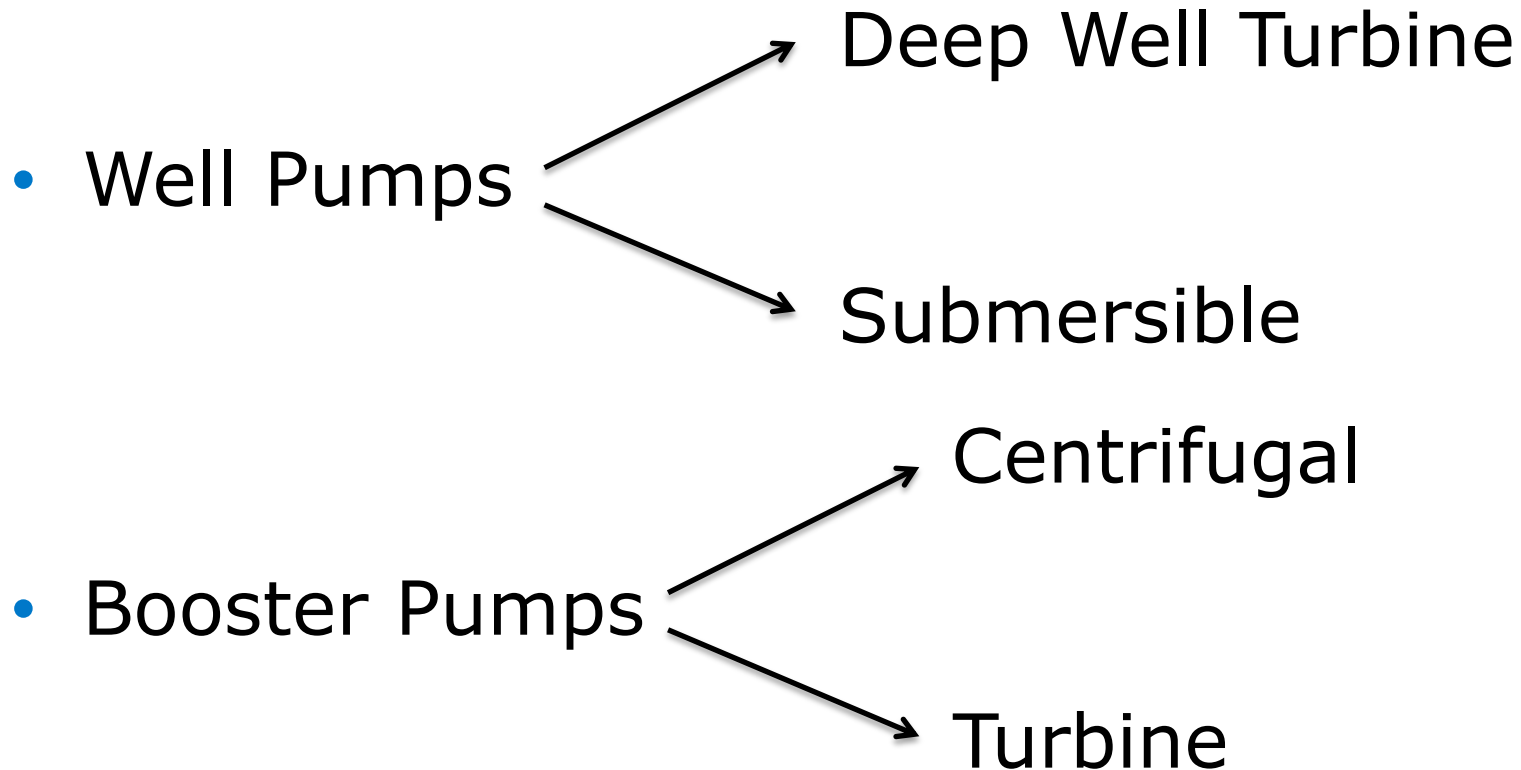
Pumps in Water & Wastewater

- Water Distribution Pumps
 - Booster Station :
700 – 1,200 kWh/MG
 - Well Pumps:
1,000 – 1,800 kWh/MG
- Waste Water Treatment Plants
 - System :
1,000 – 3,500 kWh/MG



Pumps in Water
& Wastewater
facilities account
for (1/7) of AZ
state energy
consumption.

Common Pump Types



Deep Well Turbine Pumps



- Most common in well pumping applications where water is to be pumped out of several hundred feet of depth.
- Driving mechanism is located over the surface and a column shaft connects the motor to the pump.
- Pumps often have several stages.

Submersible Well Pumps



- Commonly used in situations where water tables fluctuate considerably over the season and noise is a factor.
- Often used in conjunction with booster pumps so as to provide a positive suction head.
- Motor and pumping components located beneath the ground surface.
- Requires less maintenance.

Centrifugal Booster Pumps



- Commonly used as booster pumps in water/wastewater systems.
- Rotational energy of the impeller converted to pressure energy of water.
- Can be used for vertical as well as horizontal water pumping.
- High Efficiency over range of operating conditions.
- Also used in applications such as chilled water, power plants and industrial pumping.

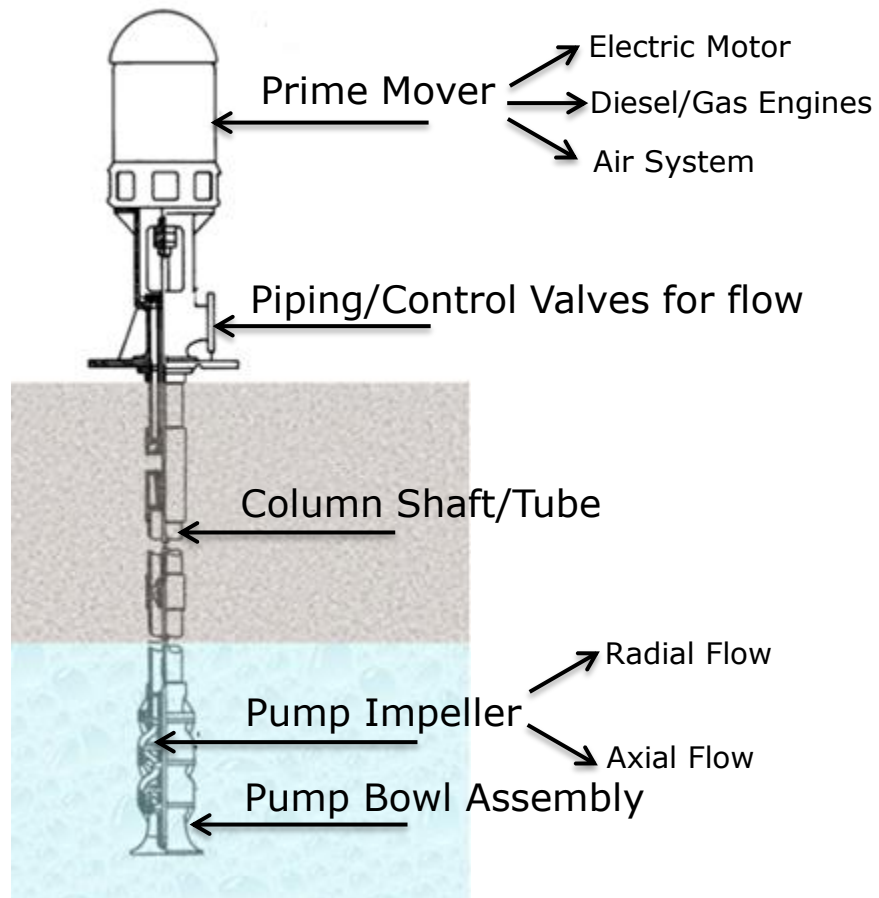
Turbine Booster Pumps



- Commonly used in booster stations with multiple pumps.
- Priming not needed.



Pump System Components

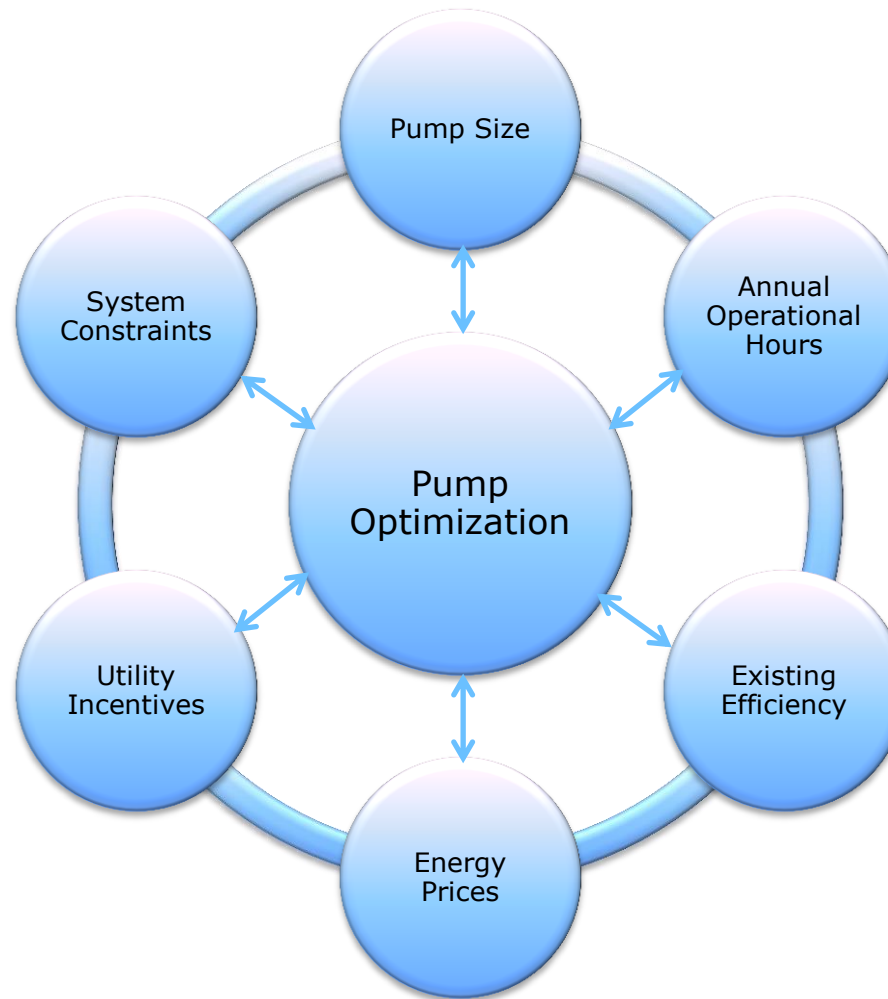


Pump Optimization EE Measures

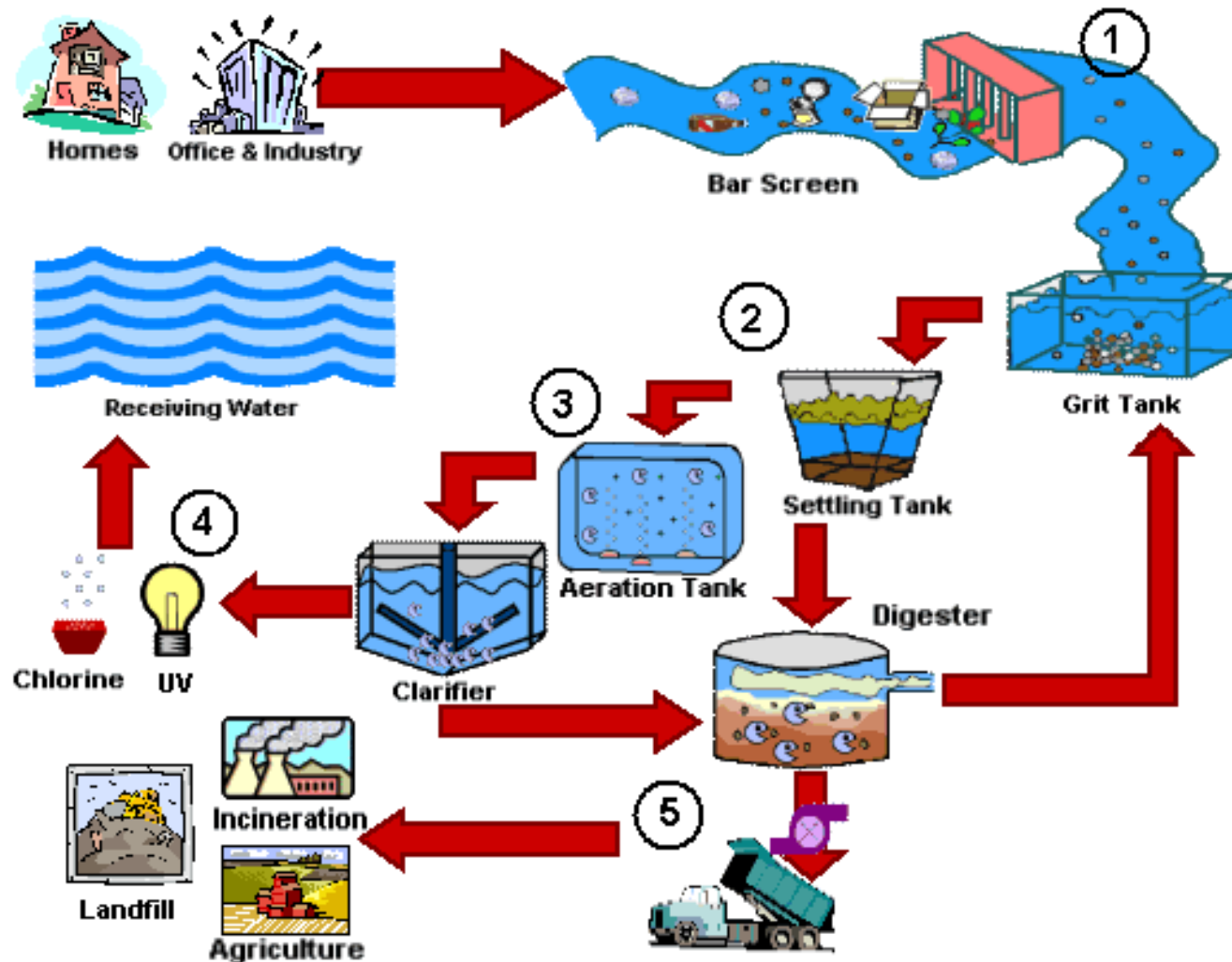
Wide variety of EE measures to optimize pump operation and its energy use. These include –

- Pump Efficiency (OPE) Improvement
 - Bowl Replacements
 - Impeller Replacements
- Column Tube/Shaft/Piping Replacements (reduce friction losses)
- Right Sizing Pumps
- Pump schedule changes (EE/DR)
- Pump Sequencing.
- System Improvements (match with design conditions).
- Prescriptive EE Measures–
 - Variable Speed Drives.
 - High Efficiency motors.

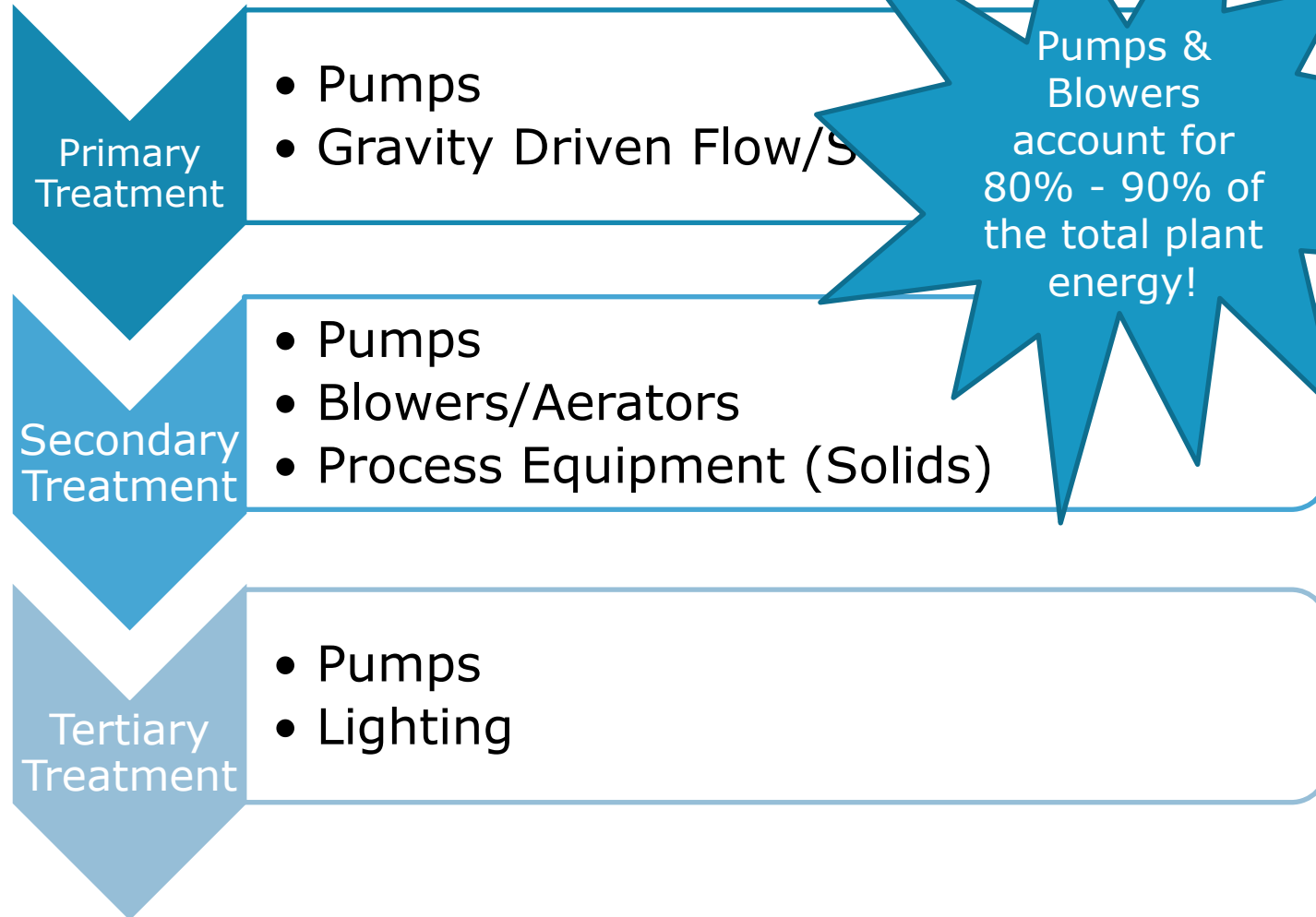
Pump Optimization Considerations



Typical Wastewater Processing



Major Energy Consuming Equipment



Pumps in WW Treatment Plants

Pump Systems		
Primary Pumps	Secondary Pumps	Tertiary Pumps
<ul style="list-style-type: none">- Influent Pump(s)- Booster Pump(s) <p>Pump Types:</p> <ul style="list-style-type: none">- Centrifugal.- Submersible. <p>Typical Discharge Pressure Levels = 15-30 psig.</p>	<ul style="list-style-type: none">- Booster Pump(s) <p>Pump Types:</p> <ul style="list-style-type: none">- Centrifugal.- Turbine. <p>Typical Discharge Pressure Levels = 10-20 psig.</p>	<ul style="list-style-type: none">- Booster Pump(s) <p>Pump Types:</p> <ul style="list-style-type: none">- Centrifugal.- Turbine. <p>Typical Discharge Pressure Levels = 0-20 psig.</p>

Blowers/Aerators

- Blowers/aerators are aeration devices that are used for introducing air into the treatment ponds/basins.
- The ingested air helps in growing bacteria that could assist in the biological digestion of the raw sewage .
- Responsible for 50-70% of total plant energy consumption.



WW System Benchmarking

- ENERGY STAR benchmarking.

Web link – <http://www.energystar.gov>

- Other Benchmarking Metrics.
 - Typical Range is 1,000 – 3,500 kWh/MGD
 - These metrics are a function of treatment processes. Typical ranges for
 - Primary = 1,000 – 1,200 kWh/MGD
 - Secondary = 1,200 – 1,800 kWh/MGD
 - Tertiary = 2,000 – 3,500 kWh/MGD

CASE STUDY

Carefree Water Company

Pump Upgrades | Carefree, AZ

Situation

Carefree Water Company is a domestic water service provider. Over the past few years, they had begun to experience an increased demand, accompanied by subsequent increased energy consumption. After hearing about the APS "Solutions for Business" pump testing program, they elected to get selected pumps tested for potential energy-efficiency improvements.

Solution

Carefree Water Company was evaluated for APS' energy-efficiency incentives, and their list of pumps was submitted to Lincus for pre-qualification of pumps to be tested. Test results indicated that five of their pumps qualified for the program, and were operating at an average of 55% Overall Plant Efficiency (OPE).

Some of the key energy-savings improvements recommended included:

- Installation of a new motor and pump on one of the wells
- Replacement of a motor on the second well
- Replacement of both the motor and bowl on one of the boosters
- Replacement of just the bowl on two additional boosters
- Replacement of just the motor on one additional booster



Onsite Measurement and Verification of motor replacements by Lincus Engineer.

Results

After reviewing their pump test results, Carefree Water Company decided to make improvements on several of their pumps. These upgrades saved them \$21,000 per year in electricity costs, and provided over \$20,000 in APS rebates. The overall simple payback for all installations was one year.

CASE STUDY

Liberty Water Company

Pump Upgrade and VFD Installations | Goodyear, AZ

Situation

Liberty Water Company offers water and wastewater utility services to businesses located in Avondale, Glendale, Goodyear, and Litchfield Park, Arizona. Over the past few years, Liberty Water began facing increased energy bills and wanted to identify which of its pumps needed improvements to help lower these costs. After hearing about APS' *Pump Testing Program*, Liberty Water signed up to get selected pumps tested through this beneficial program.

Solution

As part of APS' *Solutions for Business Pump Testing Initiative*, Liberty Water's pumps were evaluated and tested by Lincus' qualified engineering team to determine which APS energy-efficiency incentives could be utilized to both improve their equipment and lower costs. Pump test results indicated that five (5) pumps were only operating at an average of 55% Overall Plant Efficiency (OPE).

Some of the key energy-savings improvements that were recommended to be made to three of the five pumps included:

- Installation of new impellers for 2000 GPM @ 405' TDH on the first pump.
- Replacement of bowl assembly and installation of Variable Frequency Drive on the second pump.
- And a complete upgrade for the third pump



Aged turbine well pump prior to upgrade and variable speed drive installation.

Results

After reviewing the pump test results and recommendations, Liberty Water chose to proceed with making the suggested improvements, saving them approximately \$64,182 per year in electricity fees, and earned them \$44,278 in APS' energy-efficiency rebates. The overall simple payback for all installations took only four (4) months.

CASE STUDY

City of Yuma

Pump Upgrade and VFD Installations | Yuma, AZ

Situation

The city of Yuma is located in southwestern Arizona and delivers water to its customers through a series of well pumps and Central Arizona Project (CAP) station pumps. A large portion of the water is pumped through a series of 500 horsepower boosters. After hearing about APS' "Solutions for Business" Pump Testing Program and potential incentives, Yuma signed up to get their selected pumps tested to discover how they could operate more efficiently.

Solution

The city's Water Distribution Pumps were evaluated for APS' energy-efficiency incentives and qualified for free testing through the program. Test results indicated that sixteen pumps were operating at an average of 62.9% Overall Plant Efficiency (OPE).

Three of the key energy-savings improvements recommended were:

- Installation of a Variable Frequency Drive (VFD) on two of the 500 hp pumps
- Planned installation of VFDs on four of the 350 hp pumps
- Replacement of two 350 hp motors



Series of Large Booster Pumps

Results

Prior to the installation of the two VFDs, the pumping plant was producing four million gallons of water per day at 60 Hertz, with 282 feet of head and 92 PSI. After the installation, the plant now operates at 53 Hertz with 260 feet of head and 80 PSI.

After studying the results of their pump test, Yuma decided to make improvements on several of their pumps, along with the installation of VFDs on many of them. These upgrades saved them \$180,000 per year in electricity costs, and provided \$150,000 in APS rebates. The overall simple payback for all installations took six months.

CASE STUDY

City of Somerton

Pump Upgrade and VFD Installations | Somerton, AZ

Situation

The City of Somerton is located in Southwest Arizona and has a population of 13,000. The city owns and operates two local water treatment facilities that are fed by four different wells (that use both greens and media pressure filters.) These wells employ booster pumps that move the water into two, 2.2 million-gallon storage tanks, from where the post-chlorinated water is then piped to the 3,100 households located within the community. Pressure is currently maintained by another booster system to ensure fire safety.

Solution

Through APS' "Solutions for Business" pump testing initiative, Somerton submitted a number of their pumps for testing, and discovered that five were operating at an average of 45% Overall Plant Efficiency (OPE).

Two of the key energy-savings improvements that were recommended to Somerton were:

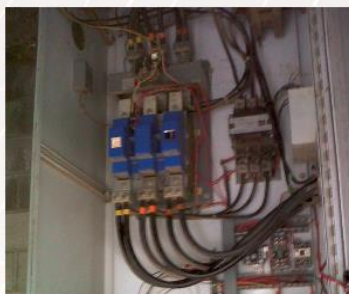
- Replacement of the bowls on two well pumps
- Replacement of bowl assembly and motor rebuilds for two booster pumps



Inefficient Turbine Well Pump

Results

The City of Somerton decided to improve the performance on several of their pumps by installing Variable Frequency Drives (VFDs), which provided them with a electricity cost savings of nearly \$25,000 per year, and provided over \$26,500 in APS rebates. The overall simple payback for these installations took less than 2.7 years.



3-Phase, 460 Volt Electrical Panel opened for Energy usage Measurement and Verification

APS Solutions for Business

- Pump Test & Repair Program
 - Tests for the Overall Plant Efficiency of individual pumps & blowers
 - APS covers half the cost of testing
- Technical Assistance
 - Cash incentives to help cover the cost of studies, could possibly include pump system studies or WWTP audits.
- Prescriptive Incentive Application
 - High-efficiency motor replacement
 - Installation of VFD \$50.00/HP(some restrictions apply)
- Custom Incentive Application
 - All other energy efficiency measures not covered by the prescriptive application
 - \$0.11/first year kWh saved up to 75% of incremental cost
 - Must pass a TRC test so submit a pre-application

APS Solutions for Business

- Additional equipment rebates offered in our program include:
 - Lighting
 - Cooling
 - Refrigeration
 - Whole Building
- Will look at any proven energy savings under our custom program

Program Requirements

- APS customer on qualifying rate
 - Qualifying rates include E-32, E221, all commercial retail rates
- $\geq 40\%$ load factor $\sim 3,000+$ operating hours per year, per pump
- ≥ 15 hp



Individual Pump Testing

- 50% off Testing for APS customers for Qualifying Pumps and Blowers
- Tests determine Overall Plant Efficiency (OPE) – standard measurement of pump efficiency
 - Measures head, flow and energy demand
 - Result shows the hydraulic energy out as a percentage of electric energy input
- Regular testing allows owners to
 - Track the performance of their pumps,
 - Identify problems before they become critical
 - Plan for repairs
 - Identify candidates for improvement

Next Steps

- Submit a request form
 - Gather information on pumping and blower system
 - Photographs of piping system are helpful
 - Existence of test ports
- Pumps approved for testing
- Test Contractor contacts to schedule tests
- Test performed
- Review Results
- Get quote for repairs
- Submit a pre-application for incentives
 - Notification required prior to repair work being performed

Q & A

