

# Charting a Course to Energy Independence

**Providence, RI  
August 9-12, 2009**

**Adopting a Green mindset with your  
facilities automation and power  
distribution systems**





# What is “Green”

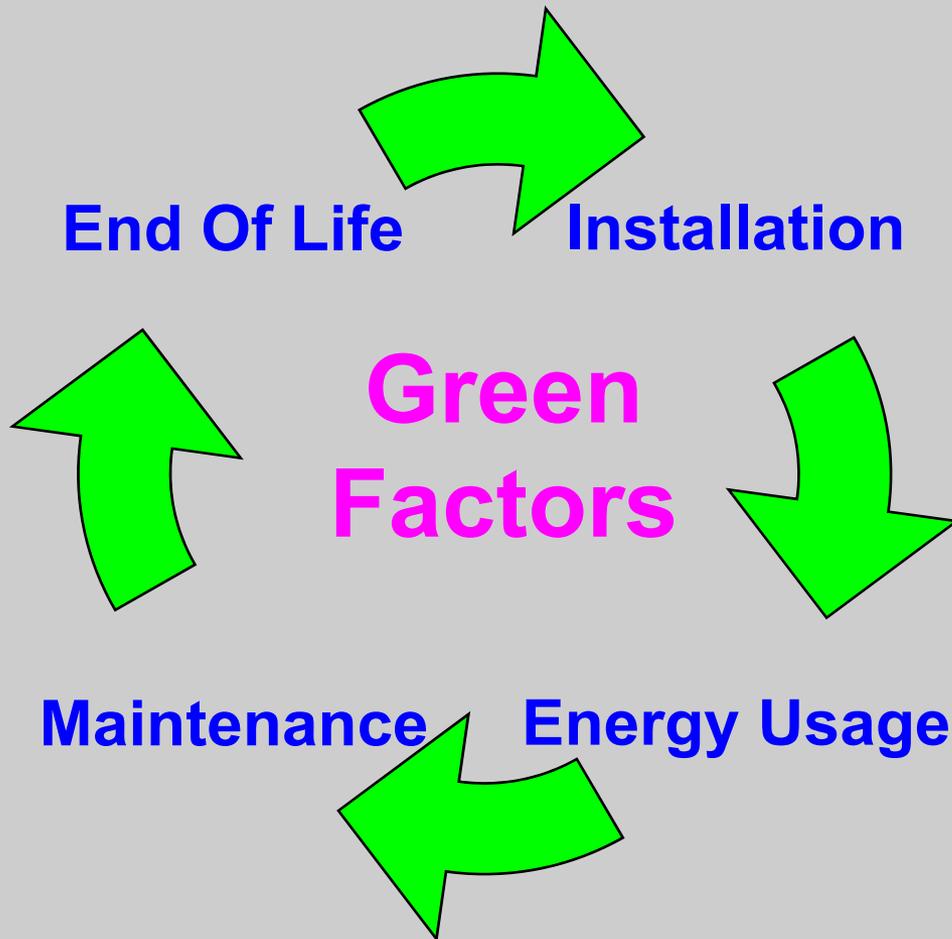
- Widely used term.
  - ☐ Subject to multiple interpretations
- Broad Working Definition:
  - ☐ “Beneficial to the environment”
  - ☐ “Favoring or supporting environmentalism”
- What it means to us:
  - ☐ Thinking about the environment in engineering and retrofitting our facilities



Definitions 12 a and b from <http://www.thefreedictionary.com/Green> taken on July 8, 2009



# How do we “Think Green”



- Equipment decay  
Time > Useful life
  - ☐ Products of decay can be hazardous
- Four interlinked areas
  - ☐ All areas considered simultaneously



# Green Factors for Installation

- Material Minimization
- Labor Minimization
  - ☒ Direct cost reduction
  - ☒ Green house gas reduction
    - Via decrease of equipment usage
      - ⊗ Drills
      - ⊗ Vehicles





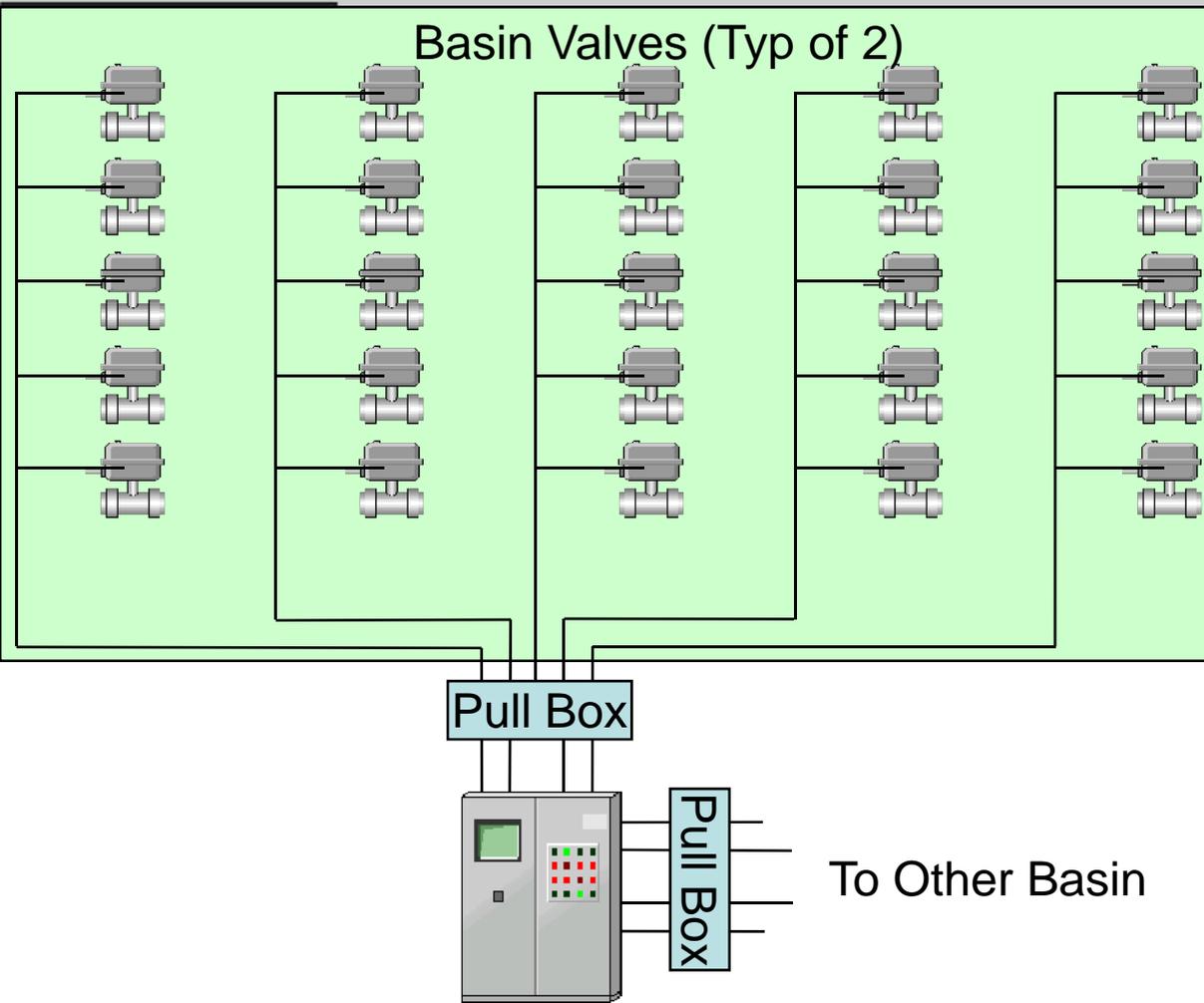
# Green via device level networks

- East Coast WWTP
  - ☐ Biological processing
    - Two basins
    - Diffused air
      - ⊕ Via floating diffuser grids.
        - » 25 per basins
        - » Each supplied by an automatic valve
        - » Nit/Denit control
      - ⊕ Several centrifugal blowers
      - ⊕ Built ~ 1994
      - ⊕ Facility built with traditional wiring





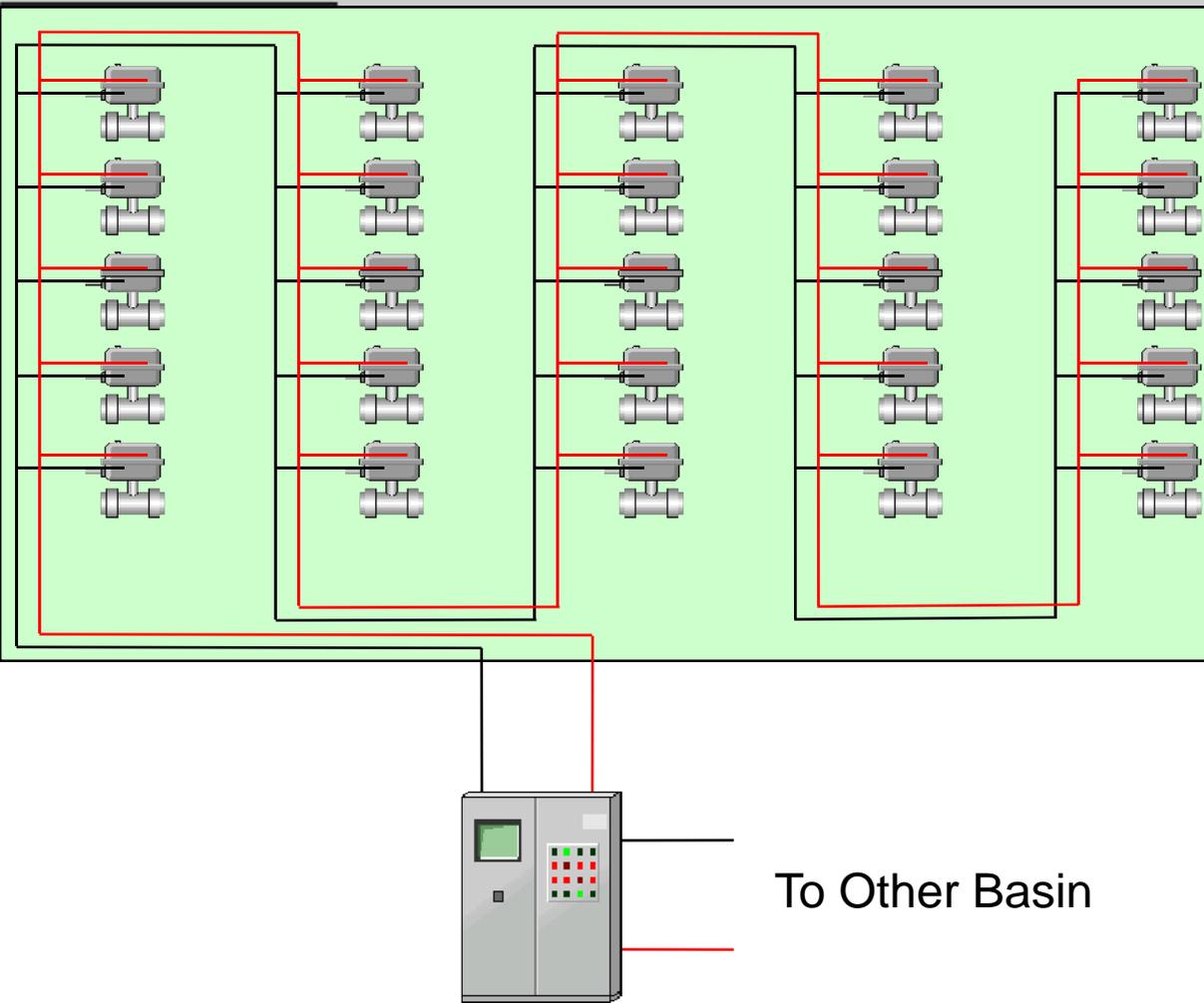
# CASE STUDY (Traditional Wiring)



- 6 Wires per valve
  - ☒ Open power
  - ☒ Close power
  - ☒ Open Over torque
  - ☒ Close Over torque
  - ☒ Heater Hot
  - ☒ Neutral
- Result
  - ☒ 4- 4" Conduits
    - 75 wires per conduit
  - ☒ 300 Wires Total



# CASE STUDY (Network Wiring)

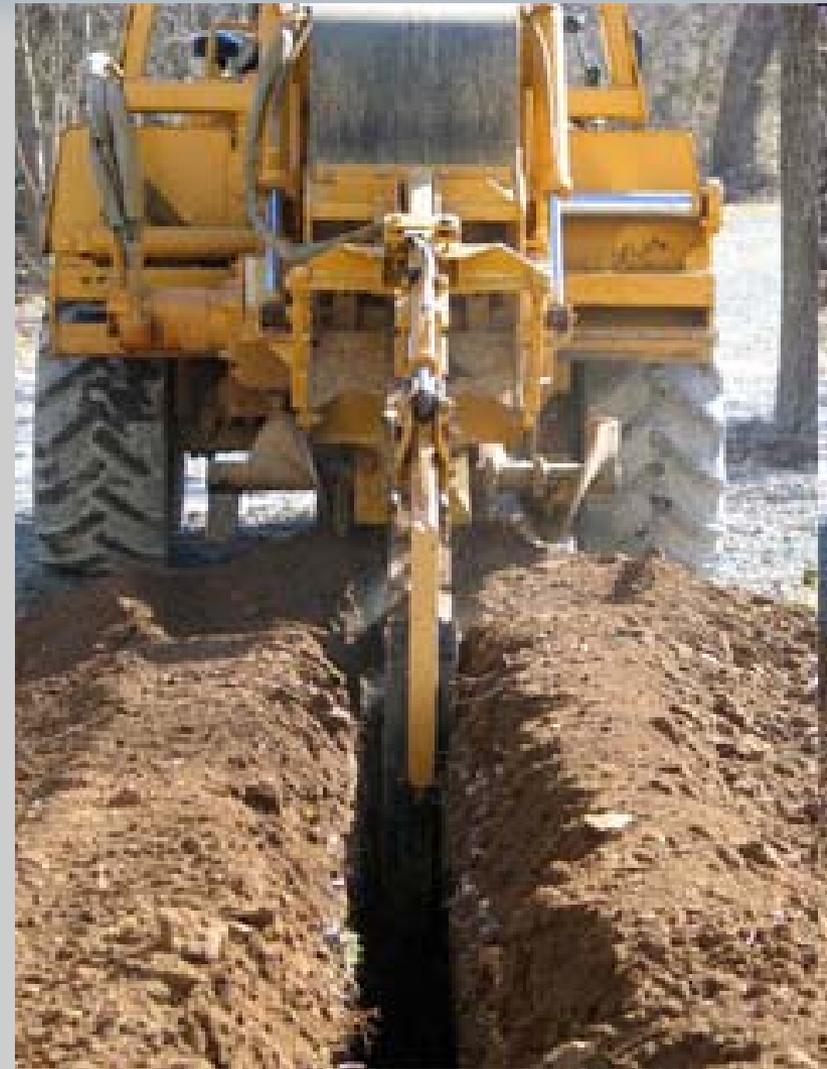


- Valve Wiring
  - ☐ 1 Network Cable
  - ☐ Hot
  - ☐ Neutral
  - ☐ Ground
- Result
  - ☐ 4- 3/4" Conduits
    - 2 with a single network cable
    - 2 with 120VAC wiring



# Green benefits of device networks

- **Smaller Conduit**
  - ☒ **Less Zinc for galvanization**
    - Hazardous Substance
  - ☒ **Less Wiring**
    - Less Landfill space
    - Less Toxic chemical from plastic
    - Costs less to retrofit
    - Lower trenching costs
      - ⊕ Carbon reduction from reduction in use of trenching machine
    - Lower disposal costs
      - ⊕ When system is taken out of service





# Other green benefits

- Smaller components
- “Combined Devices”
  - ☐ Compact NEMA vs..  
Traditional NEMA Starters
    - Less panel space = Smaller Enclosure
- Metalclad vs. Metal Enclosed switchgear
  - ☐ ME = less metal
    - Less metal that is forged.





# Green Factors for Energy Usage

## Interesting Water Facts

- Energy Reduction
- Harmonic Mitigation
- Surge Protection

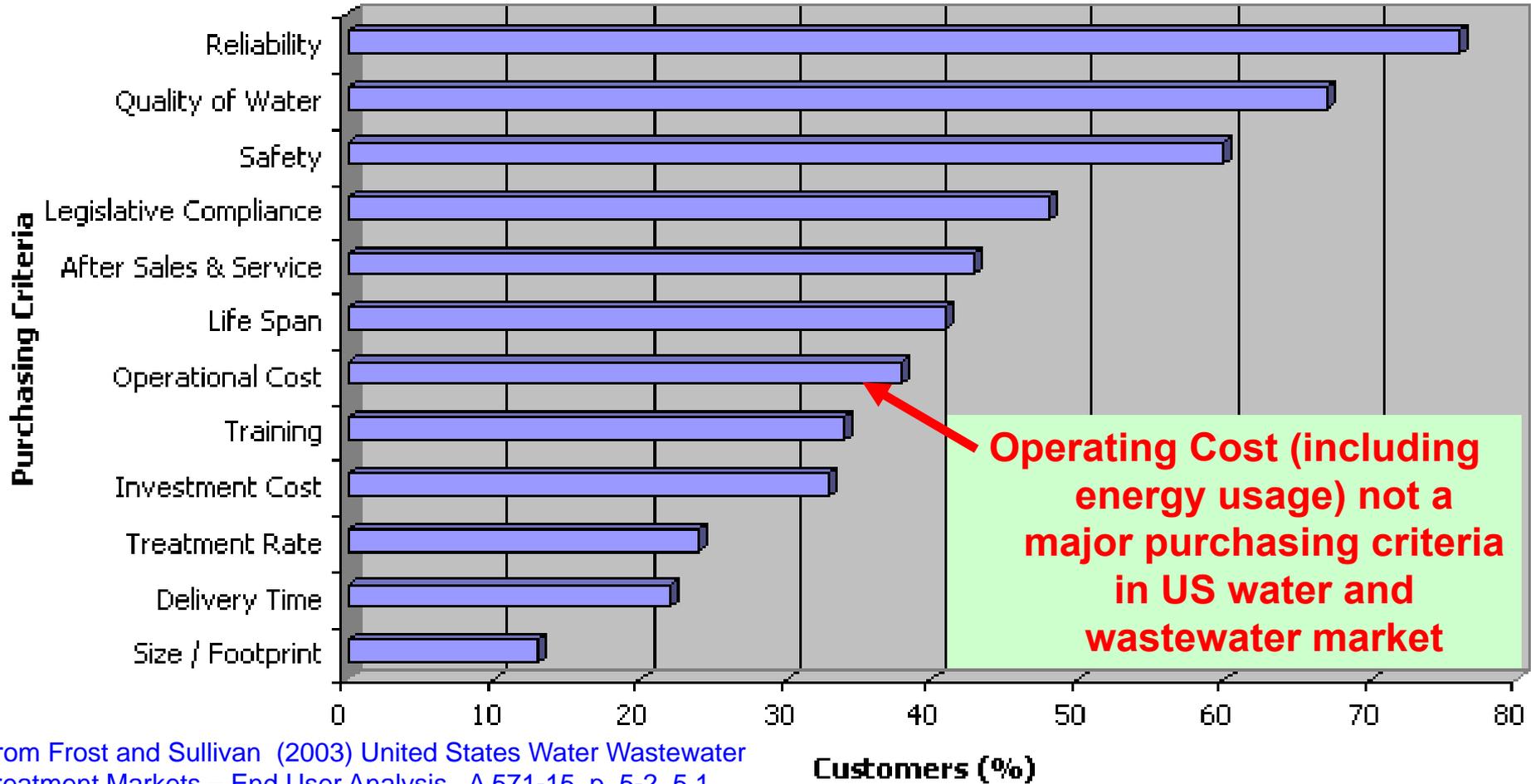
- 1. The US uses nearly 80 percent of its water for irrigation and thermoelectric power.**
- 2. If all water fixtures in the US were replaced with water conserving fixtures, then savings would be 3.4-8.4 billion gallons a day.**
- 3. 1/3 of a municipals energy bill represents water and wastewater treatment**
- 4. \$4 billion spent annually on power for water and wastewater treatment. A 10% reduction would save 5 billion kilowatts and save municipalities \$400 million**

Facts 1-3 are from GenGreenLife (<http://blog.gengreenlife.com/?p=771>)

Fact 4 from EPA Energy Star in water and wastewater web site fact sheet ([http://www.energystar.gov/index.cfm?c=government.wastewater\\_focus](http://www.energystar.gov/index.cfm?c=government.wastewater_focus))



# Current Water and Wastewater viewpoint on energy usage



From Frost and Sullivan (2003) United States Water Wastewater Treatment Markets – End User Analysis. A 571-15, p. 5-2, 5.1



# Viewpoint is changing

- New Focus due to post-Katrina volatility in the energy market
- Feb 4 2009 Jeannette Brown (Vice President of Water Environment Federation) testimony to US house subcommittee on Energy usage in water and wastewater
- Entry of Energy Star program into water wastewater market
  - ☐ Energy Star most famous for its consumer appliance initiative





# Energy Reduction

## Simple Affinity Law Power Usage

### Given:

Pump original speed (N2) = 100 RPM

Pump HP (H2) at N2 = 100 HP

Pump desired speed (N1) = 80 RPM

1 HP = 745.7 Watts

**Affinity Law states  $(H1/H2)=(N1/N2)^3$**

### Therefore:

$$(H1/100) = (80/100)^3 \quad H1 = 51.2 \text{ HP}$$

$$H1_{\text{wattage}} = 51.2 * 745.7 = 38.2 \text{ Kw}$$

$$H1_{\text{wattage}} = 100 * 745.7 = 74.6 \text{ Kw}$$

### Thus:

**80% speed  $\approx$  50 % power**

- Power Reduction in Pumping

- ☐ Given: VFD's Save energy

- Affinity Laws is reason

- ☐ VFD's more efficient than mechanical means

**Affinity Laws can be applied to traditional pumps, blowers, compressors, and HVAC fans**



# Energy Reduction

## Lighting Facts

- **Change Lighting:**

- ☐ Energy usage impact

- Direct energy usage
- Decreases air conditioning load
- Increase heating load

- ☉ Bulb efficiency < Furnace efficiency

- » Thus lower bill

- ☐ LED and Fluorescent last longer

- Fewer replacements
  - ☉ Less Labor time
  - ☉ Fewer Bulbs

- ☐ Net result is lower operating cost

- Energy + Maintenance + Bulb Cost

1. **Lighting is one of the largest consumers of power in office buildings**
2. **90% of Incandescent energy is heat**
3. **78% of Fluorescent energy is Heat**
4. **Track lighting that used LED lights can reduce power by as much as 87.5% compared to a Xenon bulb.**
5. **Compact Fluorescent can be put into any incandescent fixture**



# Energy Reduction

- Lighting Controls

- ☒ Occupancy Sensors

- Turn off lights when not occupied
      - ⊗ Not good in cube farms

- ☒ Intelligent

- Schedule based
      - ⊗ Cube farm answer
    - Light intensity
      - ⊗ Modifies artificial light to accommodate natural light





# Energy Reduction

- Power Monitoring
  - ☐ Single point (utility tie in) robs ability to analyze power use
  - ☐ Hawthorne Studies can lead to 4% power savings
  - ☐ Multiple points can find and lead to correction of real energy wasters.



Ten classrooms are monitored for power consumption. One classroom used 15% less energy. By interviewing the teacher, and passing on the lessons used, power can be saved in other nine rooms.



# Harmonic Mitigation and Surge Protection

## Terms

- Harmonics

- ☐ Increase current
  - Wastes energy
- ☐ Produce more heat
- ☐ Stress insulation
- ☐ Shorten equipment life

- Surge

- ☐ Damages equipment
  - Thus replacement needs rise
- ☐ Interferes with effective operation

1. **Harmonics:** long term distortions in the waveform that results in increased current. Usually a harmonic will have a base frequency. When this frequency is a multiple of the power frequency maximum damage can occur. Harmonics can be generated by VFD's, computers, UPS, entertainment equipment, etc.
2. **Surge:** short term distortion in the waveform. Duration is usually less than one cycle, and may not repeat. Most famous is lightning.

**Equipment Replacement ≠ Green**



# Green Factors for Maintenance

- Reduce Hazardous Substance Usage
- Fluid Usage
  - ☒ On new equipment
    - Eliminate if possible
      - ⊕ Our HVLcc does not need oil in its switch.
        - » Cost, and contamination eliminated
  - ☒ On old equipment
    - Find a more environmental friendly fluid
      - ⊕ Switchgear, transformers, etc.





# Maintenance

- Eliminate Environmentally dangerous parts
  - ☐ Wherever possible, use PLC's that do not require a battery for memory backup
    - Especially in pump station applications
      - ⊕ Battery failure can lead to CSO/SSO events
    - Heat can cause premature failure, and increase replacement costs
    - Lithium batteries present special fire and overheat challenges
    - Lithium batteries require special disposal steps, and possible hazardous disposal requirements



# Green Factors for End of Life (EOL)

- EOL is reached when equipment is no longer needed
  - ☐ Determine what to do with EOL equipment
  - ☐ Choose equipment that will be environmentally friendly at EOL
  - ☐ Minimize equipment that will have a EOL (See installation slides)



# What to do with EOL Equipment



- Abandon “Abandon in Place” (AIP)
  - ☒ AIP leaves pipes, wires, zinc plated conduit, etc
    - Gradual breakdown leads to contamination
    - Pollutants leach into ground water
    - Ground not prepared for breakdown
  - ☒ Mandate that contractors recycle, not landfill waste.
  - ☒ Recycle products EOL via maintenance.



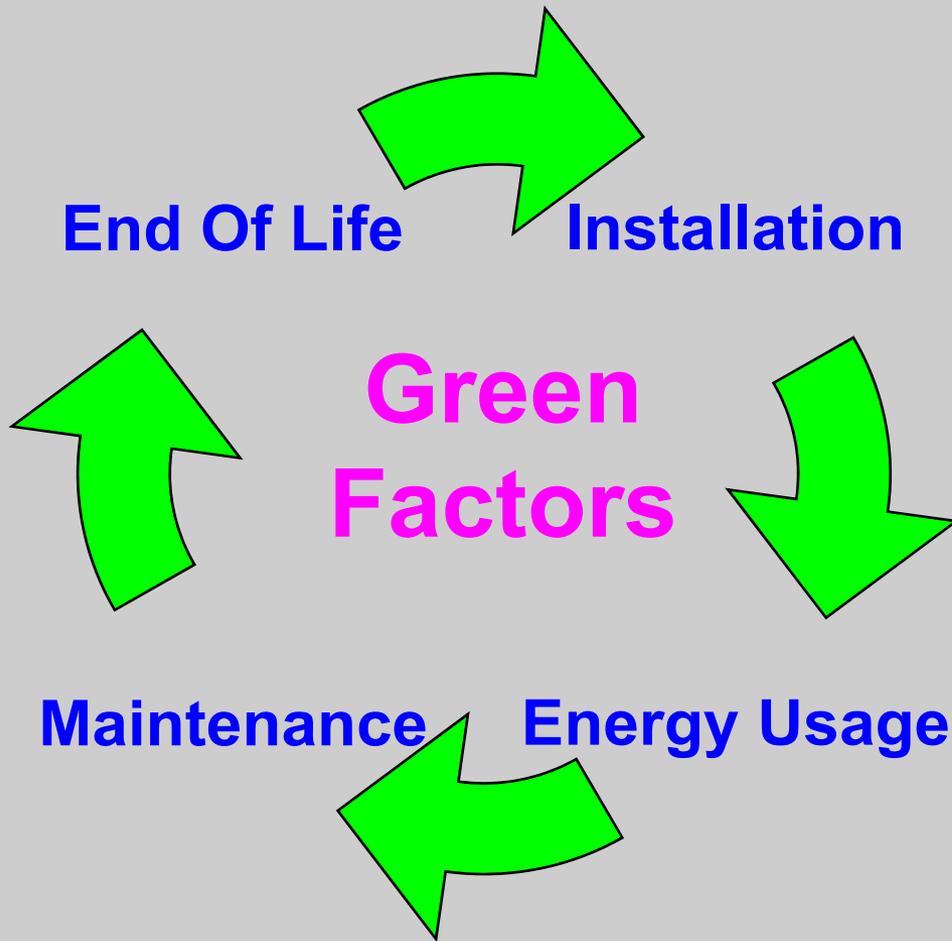
# Choose Environmentally Friendly products

- RoHS (Reduction of Hazardous Substances)
  - ☐ Law that requires electrical manufacturers to minimize toxic chemicals
    - Solder, circuit boards, plastic housings, semiconductors
    - Intent is to reduce hazardous substance load in landfills.
  - ☐ European law
    - Adopted in some of US
  - ☐ Global suppliers must comply due to European market
    - Thus, you can require it for your facility.





# How do achieve “Green”



- Look at four areas
  - ☐ During operations
  - ☐ During design
- Consider each areas unique considerations
  - ☐ RoHS
  - ☐ Device Networks
- Implement continuously