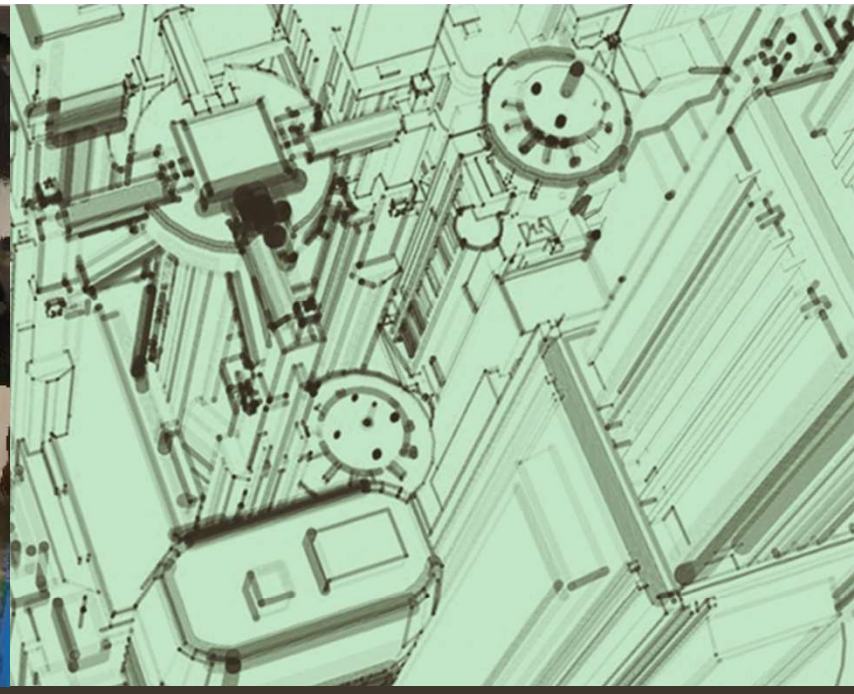




Perfecting Your Pumps – Pump System Optimization

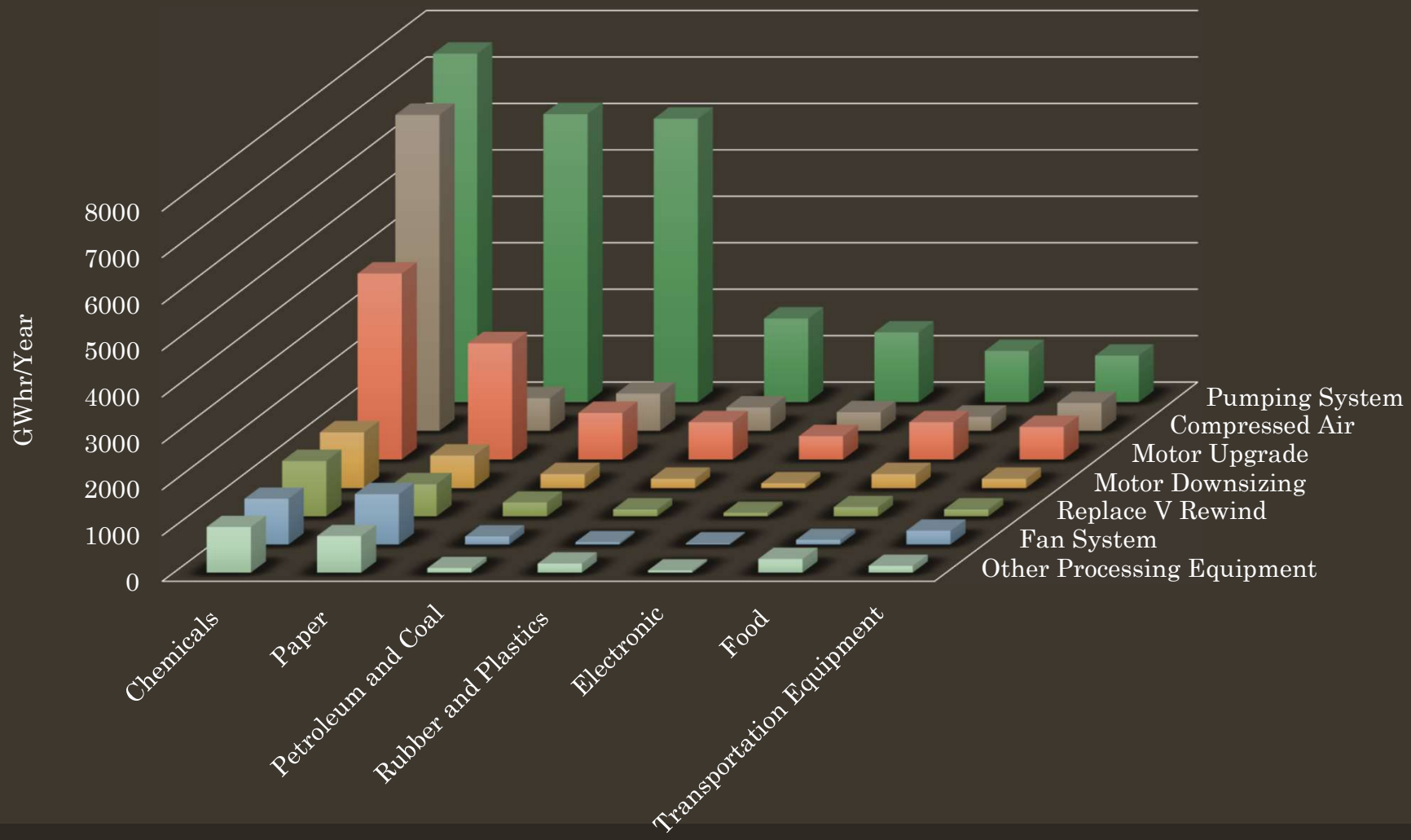
Jen Muir

JKMuir

Pump System Efficiency

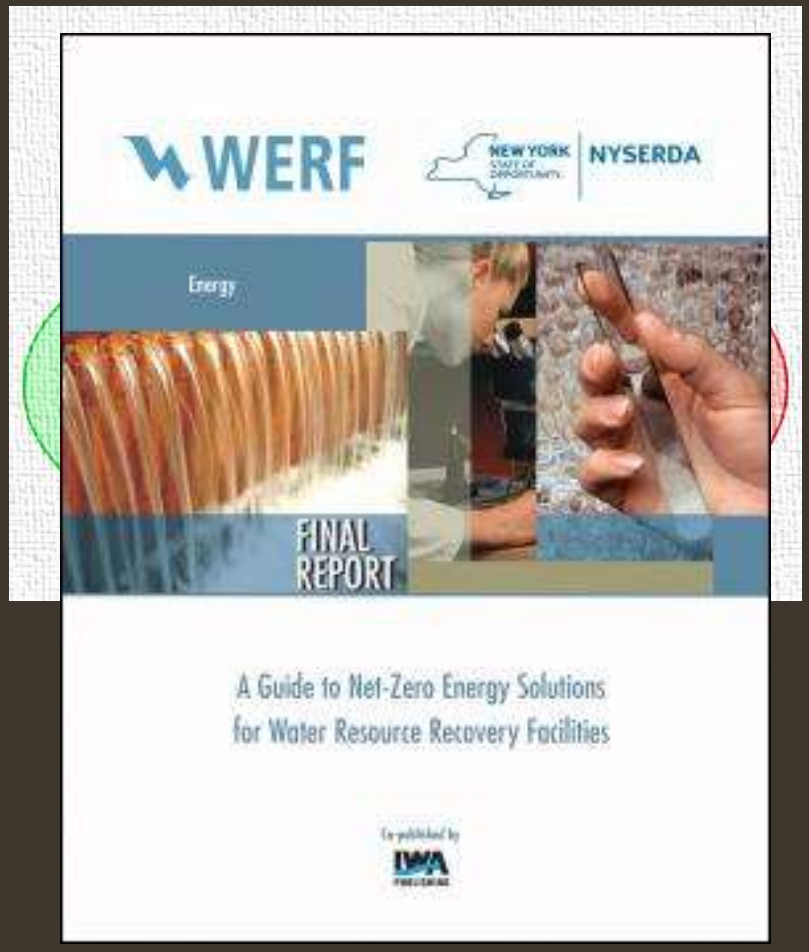
- What is Pump Efficiency?
- New DOE Energy Conservation Standards
- Energy Savings through Pump System Optimization
- Pump Testing & Monitoring Programs and Benefits
- Training and Certifications for Pump Systems Professionals

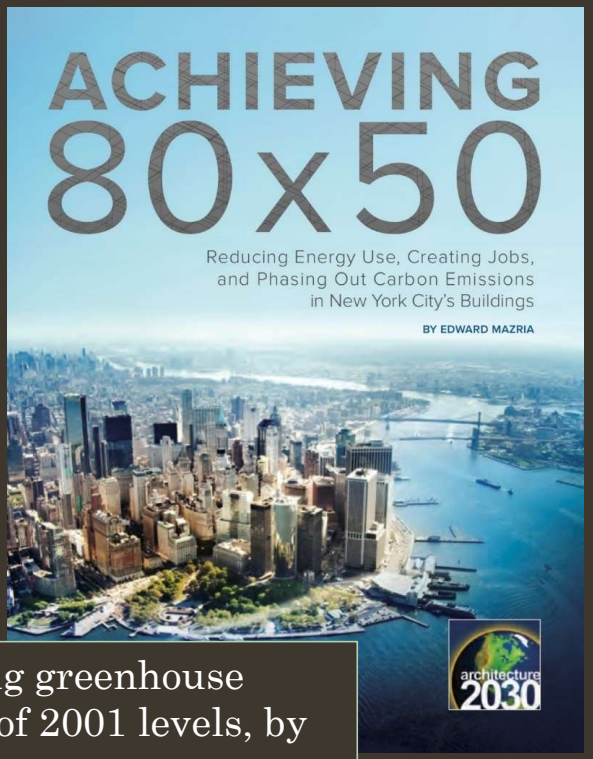
Pumping Energy



Benefits of Assessments

- Electrical motors account for 66% of North American Industrial Electricity usage & Pumping Systems = **25%**
- In wastewater plants, pumping system electrical usage = **20-30%** of total consumption
- In municipal water systems pumping = **46%**
- **Energy Costs = 75% of lifecycle costs**





Goal: Reducing greenhouse gases to ***80%*** of 2001 levels, by ***2050***

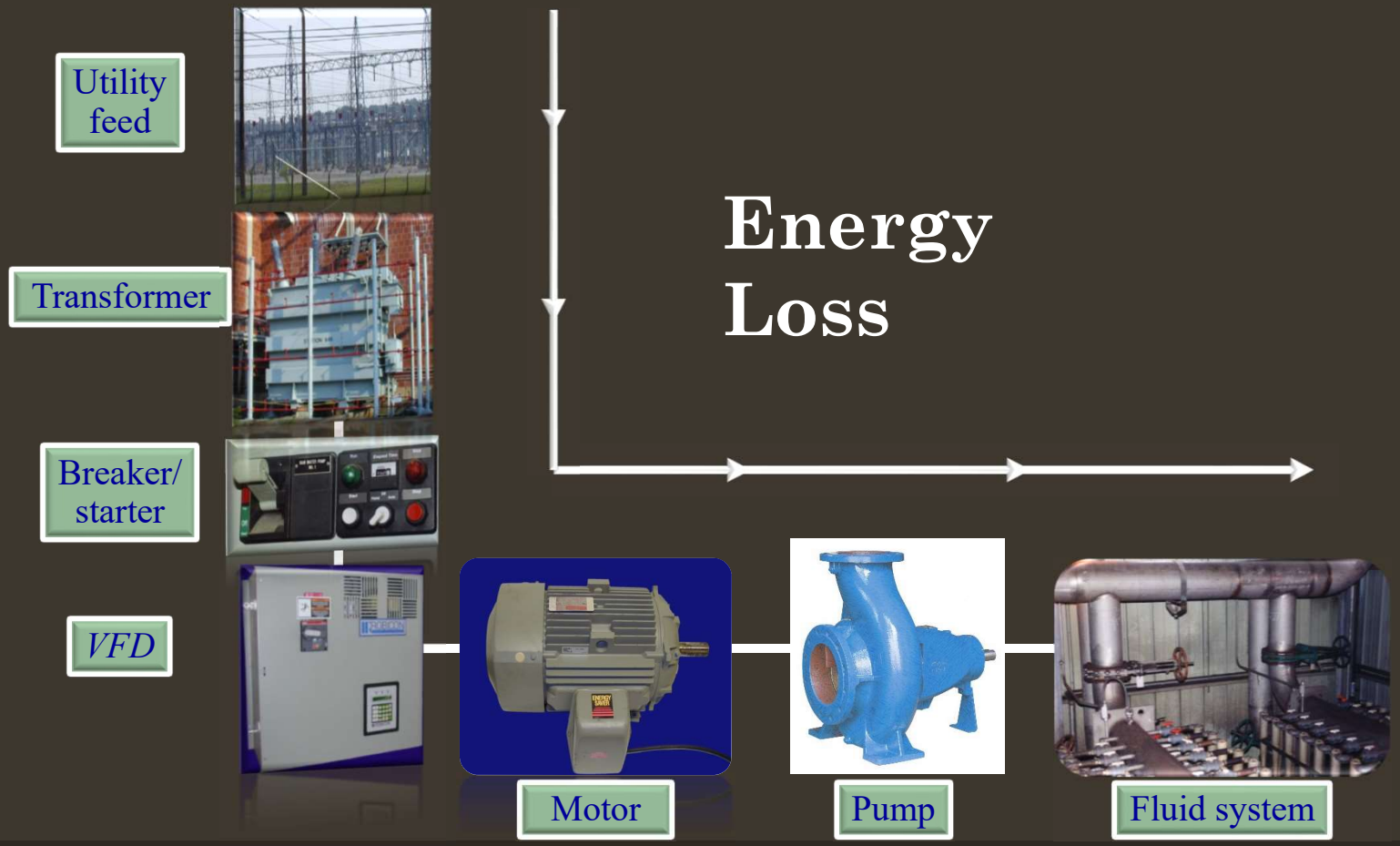
"Significant additional measures and breakthrough technologies."



"If we want to avoid extreme energy, we need extreme efficiency."

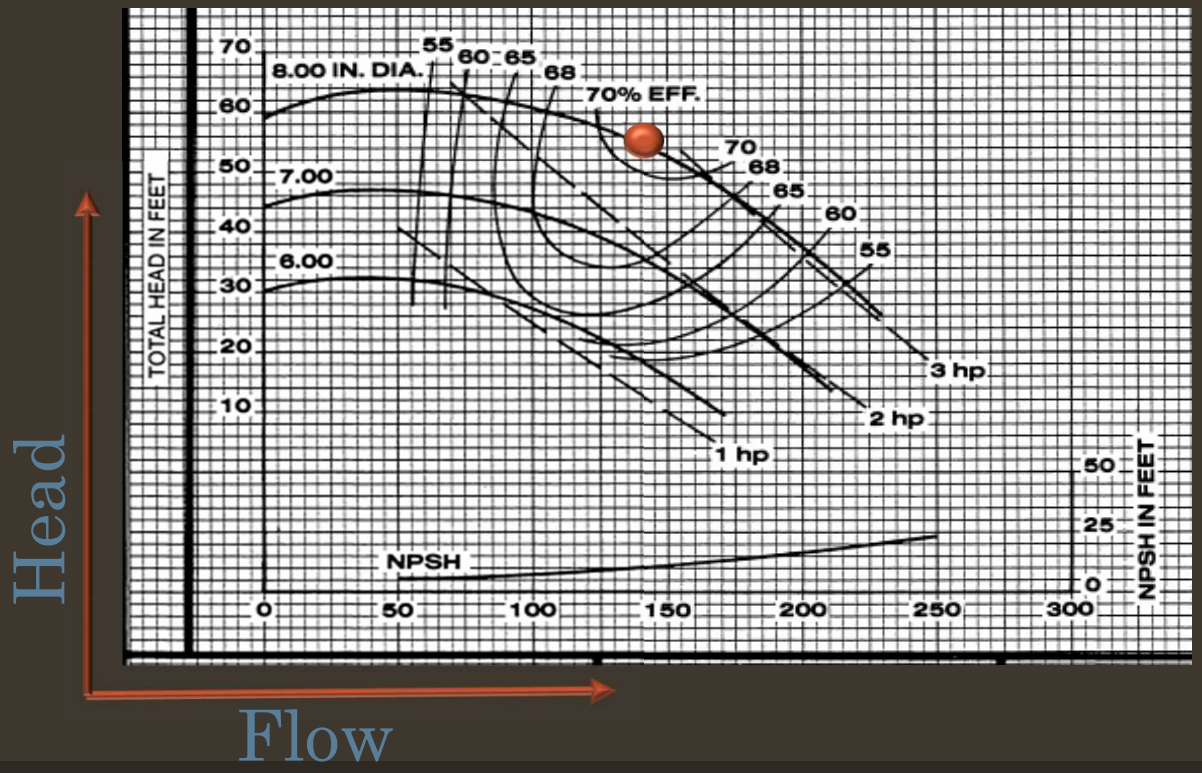
-*Daniel Gross, "Moneybox" column and senior editor at Newsweek*

Pump System Efficiency



What is Pump Efficiency

$$\text{Pump Efficiency} = \frac{\text{Flow} \times \text{Head} \times 0.746}{3960 \times \text{kW} \times \text{Motor Eff.} \times \text{Drive Eff.}}$$

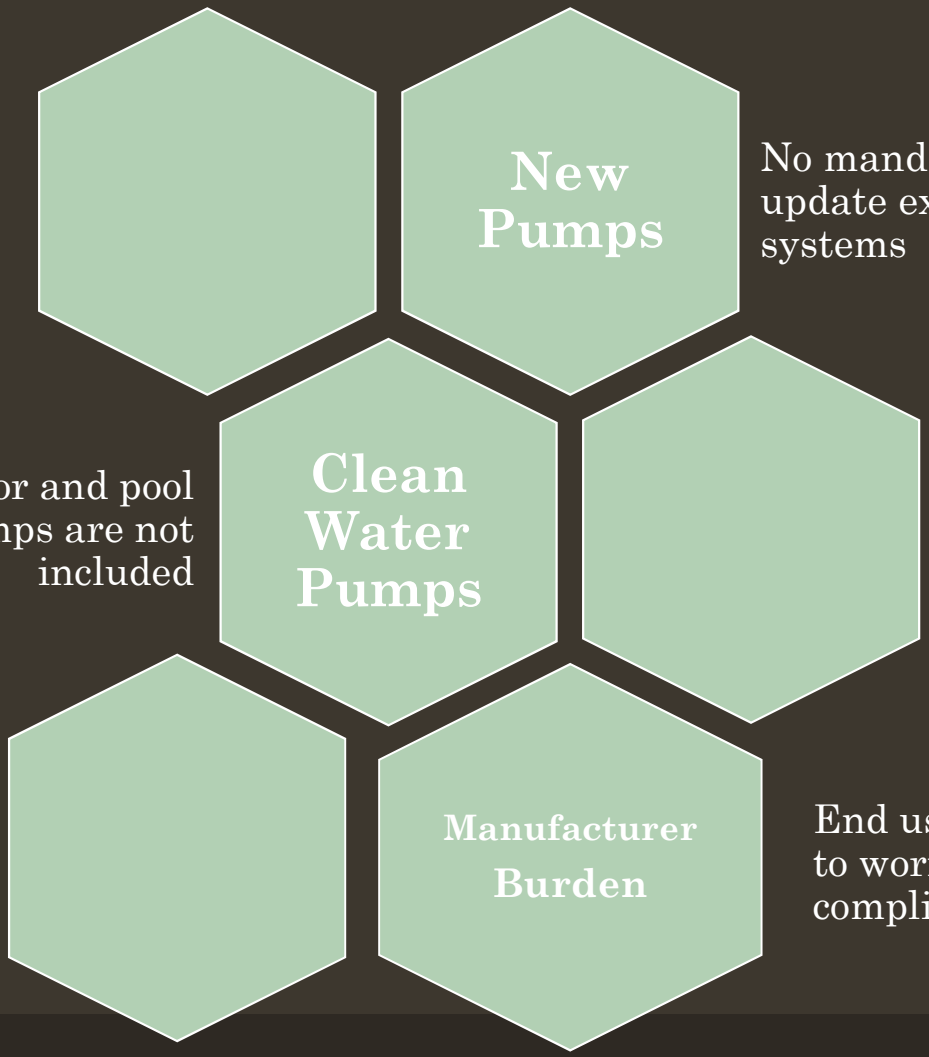


DOE Standards for Pump Efficiency – Final Rule

- Energy Conservation Standards for Pumps (10 CFR Parts 429 – 431)
- Finalized in Jan 2016
- Defines Pump System Efficiency Testing Procedure
- 1st Rule related to Pump System Efficiency
- Requires testing at key load points
- Measures efficiency at varying loads
- Compliance begins in 2020



DOE Standards for Pump Efficiency



No mandate to update existing systems

Circulator and pool pumps are not included

End users do not have to worry about compliance

DOE Standards for Pump Efficiency – Final Rule

- Pump Energy Index =

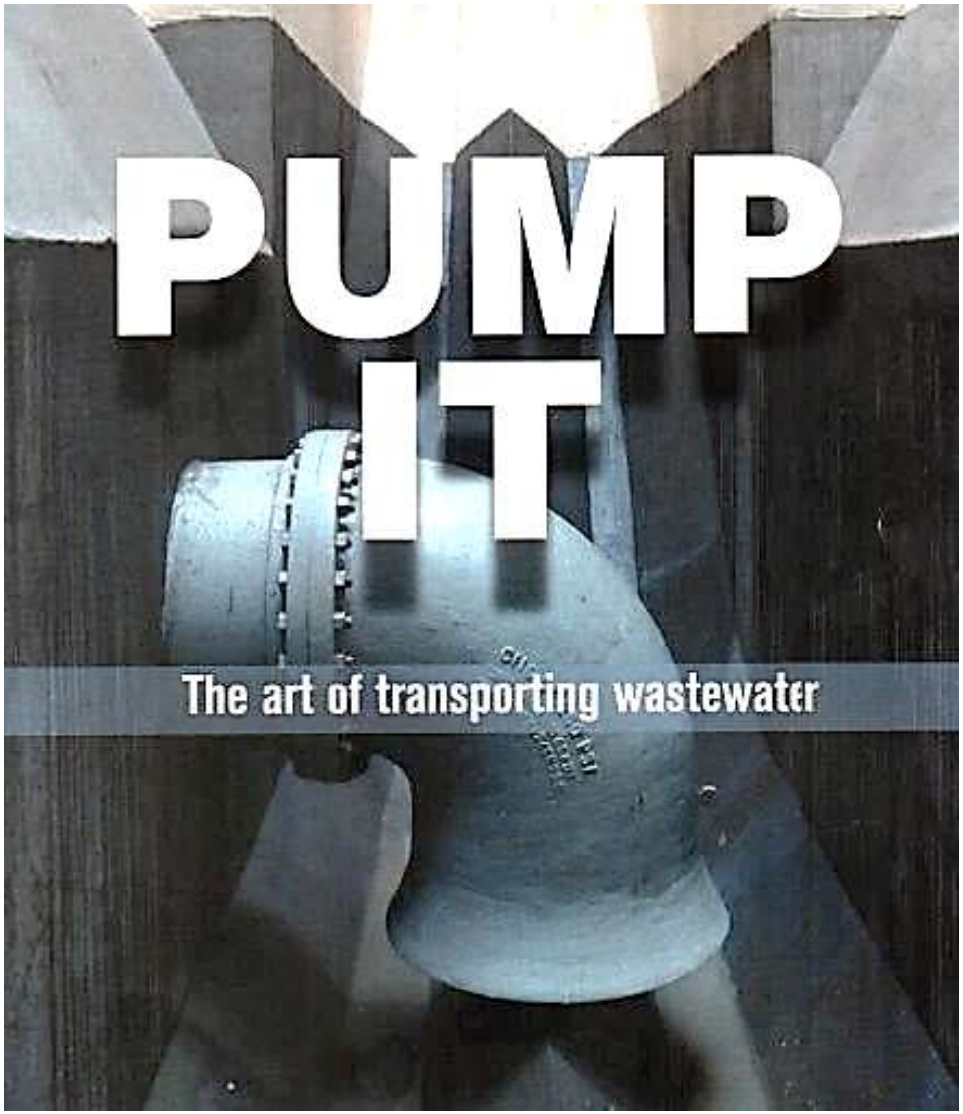
  Pump Efficiency Rating (PER)

  Minimally Compliant PER

- PER = Weighted Ave energy use over load profile
- Minimally compliant PER
  - Unique to pump model
  - Specific speed, flow at BEP, & C value
  - C value is used to define the attainable efficiency
- Inclusive of motor and controls
- PEI differentiates for nominal speed (1800/3600 rpm)

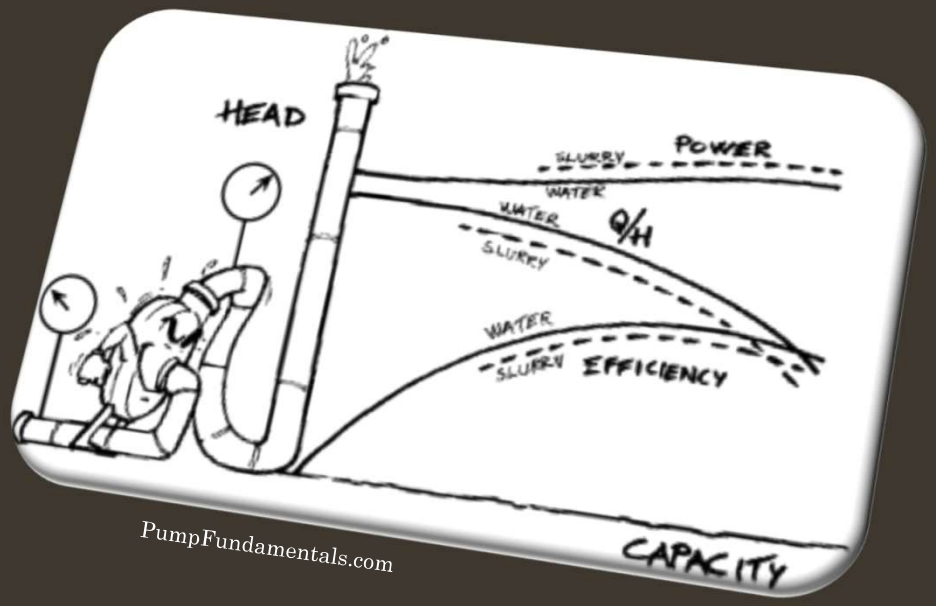
Size (HP)	Flow (gpm)	Head (ft)	Speed (rpm)
1-200	>25	<459	3600/1800

- PEI < 1.0
  - Pump is more efficient than standard requirements
- PEI > 1.0
  - Pump does not comply with DOE Standards


PUMP
IT
The art of transporting wastewater

What affects Pump Performance & Efficiency

- Hydraulics
  - Valves
  - Piping
  - Elevations/Water levels
- Wear
  - Bearings
  - Seals
  - Clearances
  - Surface roughness
  - Vibration/misalignment
- Impeller modifications
- Cavitation



What The DOE Rule Does NOT Do:

- Prevent oversizing
- Control where on the curve pump operates (BEP)
- Address pump throttling
- Correct for misapplication of pumps
- Reduce friction loss
- Improve system controls
- Control wear





How to Incentivize?

- Prescriptive?
- System Specific
- Manufacturer Specific
- How can we encourage adoption of new technology?
- How do we support retrofit of existing systems?



What About All The Pump Systems Already Installed?



Existing Systems

Efficiency testing includes:

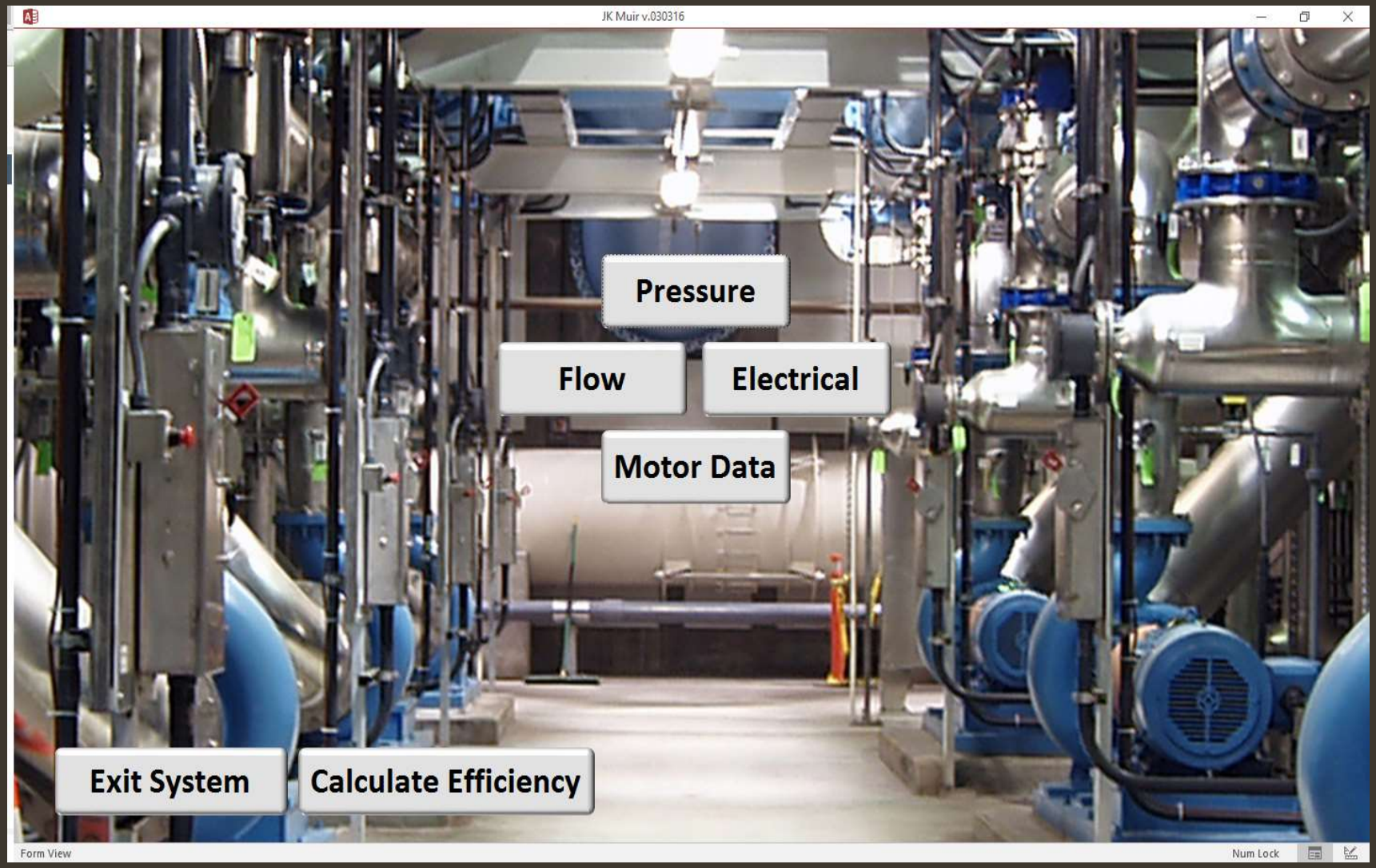
- **Flow** monitoring
- **Pressure** instrumentation to determine pump head
- **Power (kW)** measurements
- Data loggers to evaluate energy use changes over a period of time

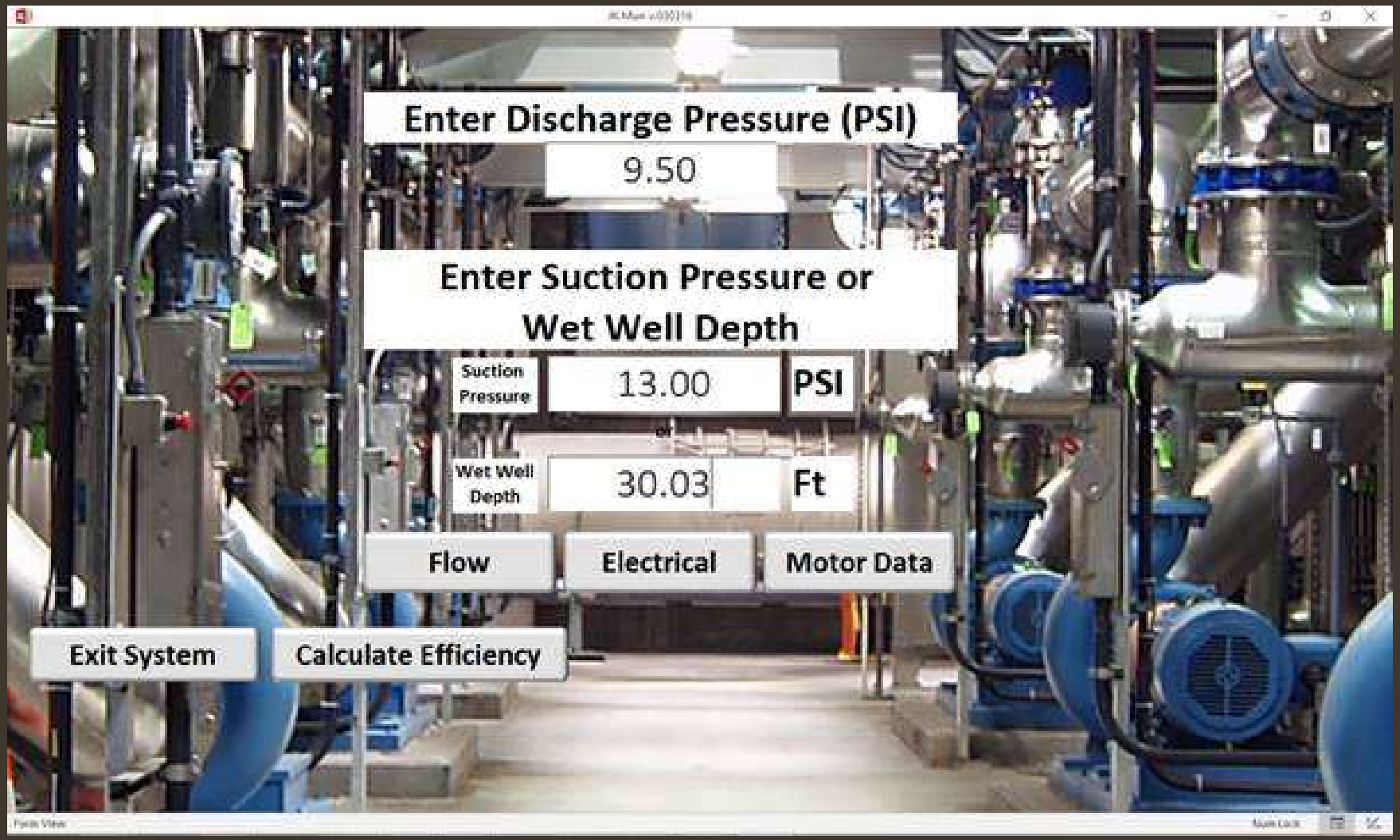


Compare to the original pump performance

⬇

Evaluate Efficiency Options


JK Muir v.030316
Pressure
Flow
Electrical
Motor Data
Exit System
Calculate Efficiency
Form View
Num Lock

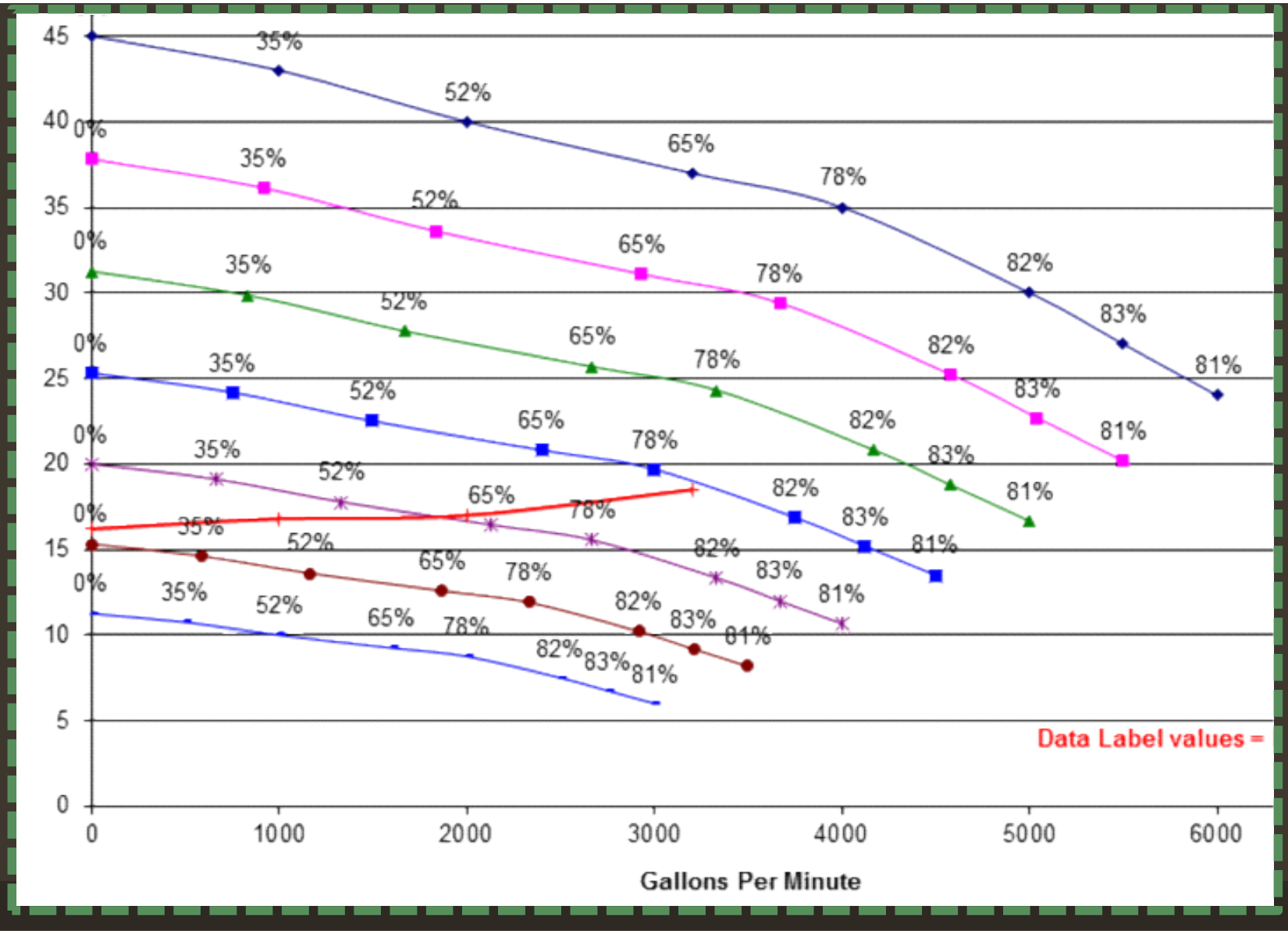

Enter Discharge Pressure (PSI)
9.50
Enter Suction Pressure or
Wet Well Depth
Suction Pressure
13.00
PSI
or
Wet Well Depth
30.03
Ft
Flow
Electrical
Motor Data
Exit System
Calculate Efficiency

How Can Pump Efficiency Be Restored?

- Pump Rebuilds/ Replacements
  - Maintain and restore
  - More efficient / new standards
  - Application of Interior Coatings
- VFD Installation
  - Head and Flow reduction
- Change Operating Point
  - BEP
- System Configuration
  - Piping Modifications
  - Setpoint Modifications






45
40
35
30
25
20
15
10
5
0
0
1000
2000
3000
4000
5000
6000
Gallons Per Minute
Data Label values =
0%
35%
52%
65%
78%
82%
83%
81%

Interior Coatings





Photos: WE&T March 2010

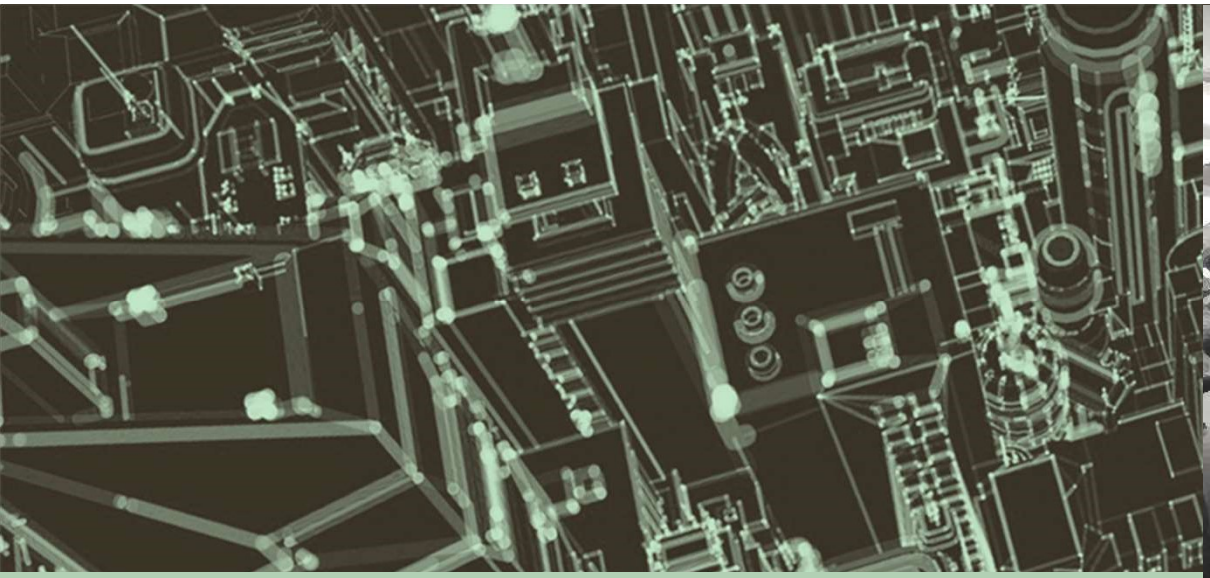
- ✓ 20-30% below specified efficiency
- ✓ Increased Efficiency
- ✓ Maintains Efficiency over time
- ✓ Pumping Systems Optimization Pilot Studies

What's Next

- DOE Rule on Dedicated Purpose Pool Pumps
- DOE Rule on Circulator Pumps
- Hydraulic Institute (HI)
  - Pump Efficiency Testing Standards
  - Certification for Pump Testing Professionals (PSA)
  - Masters Certification in Pump System Assessment
- Coatings/materials to improve performance
- Monitoring: real time feedback
  - Smart grid
  - Internet of things
  - Program v. one time replacement
- Utility support & customer/end user out reach



Hydraulic INSTITUTE
Creating Pump Standards Since 1917



Thank You

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