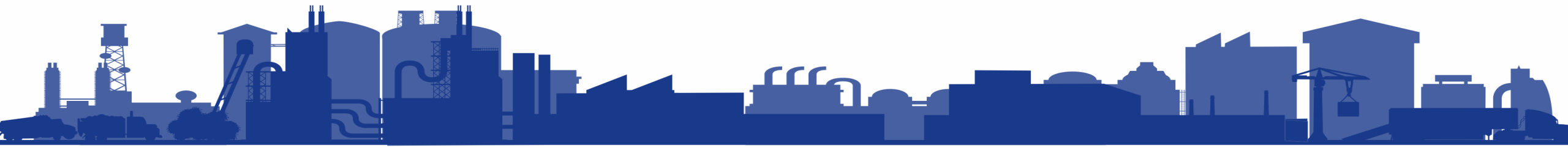
Better Plants
U.S. DEPARTMENT OF ENERGY

WATER VIRTUAL IN-PLANT (VINPLT) TRAINING

Session 7

U.S. DEPARTMENT OF ENERGY

Session 7: Persistence Strategies



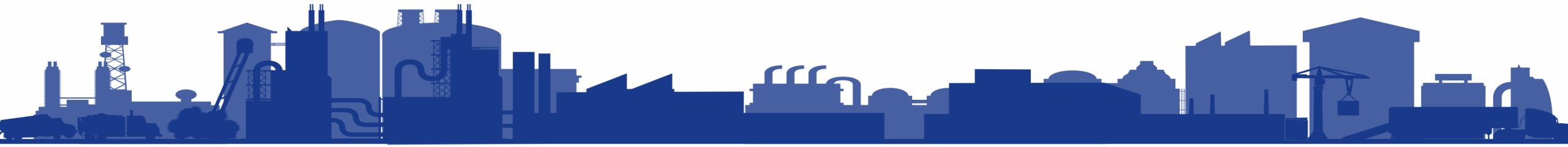
Thank You!

Sponsor:

Today's Agenda

- Homework Recap
- Session 8 Participant Presentations
- Engaging Employees
- Energy Calculations Review
- Break
- Persistence Strategies
- Kahoot!
- Q&A

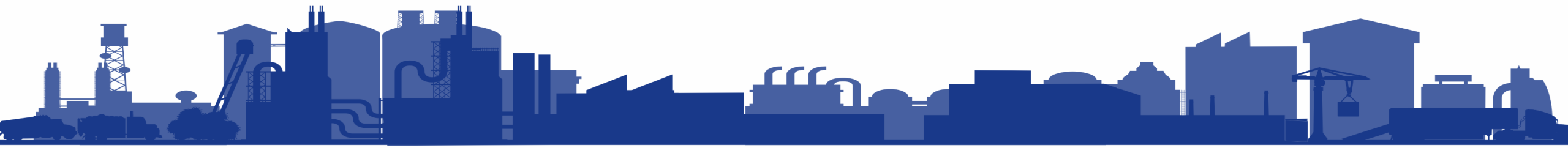
HOMEWORK RECAP



Homework Recap

- POLL

SESSION 8: CLOSEOUT



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Drinking Water Systems VINPLT: Close-out Presentation

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Savings Opportunities in

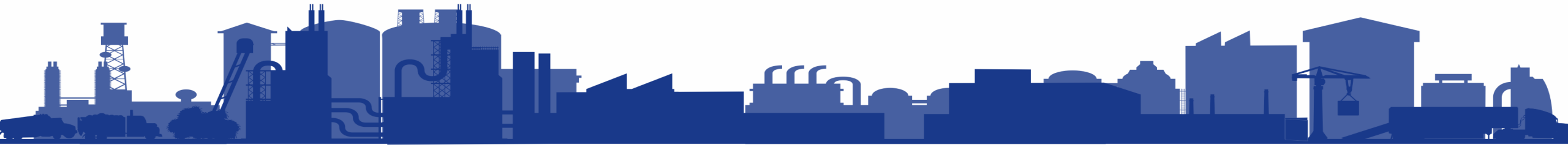
- Water Treatment
- Source Selection
- Leaping
- Looping
- Leaking
- Losing
- Loading
- Pumping
- Hydraulic Model

Tips Learned from this Training

Next Steps or Action Items after the VINPLT

- What are your next steps to implement opportunities?
- What are you planning to do after the VINPLT?
- Lessons learned?

ENGAGING EMPLOYEES



The solution to creating an effective, successful workplace is engaged people. Engaged people are more involved with their work and compelled to do their best; they will work smarter, serve better, and innovate more.

— Dennis D. Truax, Ph.D., P.E., DEE, D.WRE, F.NSPE, F.ASCE

When people are financially invested, they want a return.

When people are emotionally invested, they want to contribute.

Simon Sinek,
leadership guru and
promoter of "The Golden Circle"

An Engaged Workforce…

UNDERSTANDS the goals and objectives for energy management.

KNOWS their jobs impact energy performance.

Feels **EMPOWERED** to take steps.

Is **AWARE** of the process for collecting and vetting their energy ideas.

Is **RECOGNIZED** for their contributions.

SEM Alumni Employee Engagement Strategies

CITY OF Vernon

LESSONS LEARNED

- Staff bought in completely and quickly
- Questioning assumptions was crucial
- Surprised by how many energy saving ideas were generated
- Even with a small team, many projects were completed
- It didn't take a lot of time or money to get most projects implemented
- Energy saving projects were interesting and fun to work on

SEM Alumni Employee Engagement Strategies

Keep your team informed about successes (and failures)

Communication is critical to maintaining momentum. Failures are okay and expected. Take small steps with a new measure so you can back out before an issue grows.

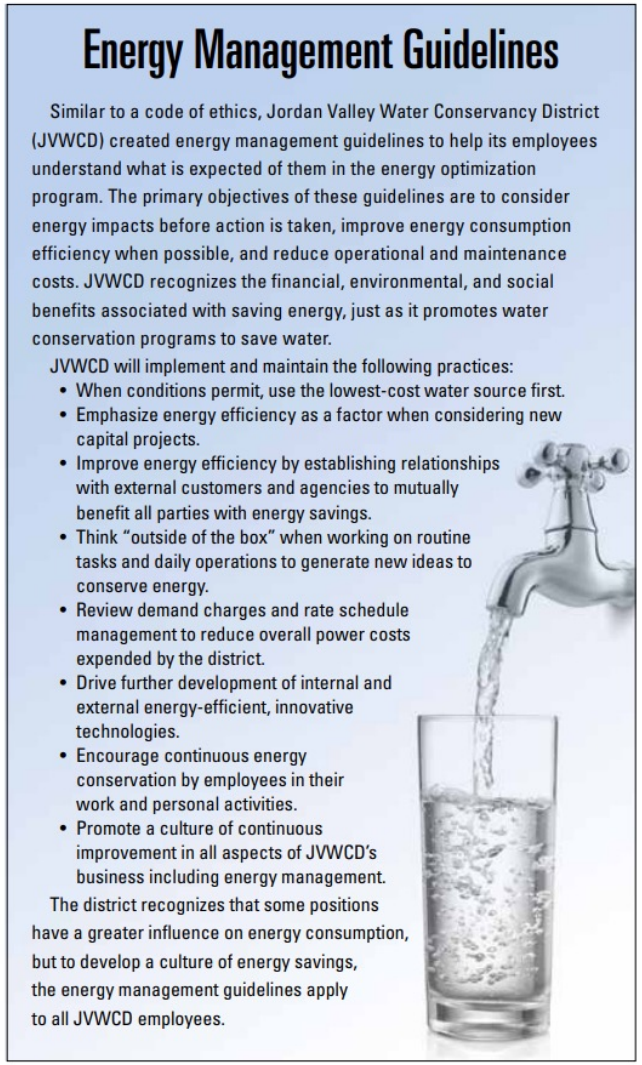
Team effort with operations, engineering, and management

All team members, including upper management, need to be involved and supportive. Ask for ideas from the entire staff.

SEM Alumni Employee Engagement Strategies

Jordan Valley Water Conservancy District

- 150 employees total
- 15-person energy team
- Each department
- Energy guidelines



Energy Management Guidelines

Similar to a code of ethics, Jordan Valley Water Conservancy District (JVWCD) created energy management guidelines to help its employees understand what is expected of them in the energy optimization program. The primary objectives of these guidelines are to consider energy impacts before action is taken, improve energy consumption efficiency when possible, and reduce operational and maintenance costs. JVWCD recognizes the financial, environmental, and social benefits associated with saving energy, just as it promotes water conservation programs to save water.

JVWCD will implement and maintain the following practices:

- When conditions permit, use the lowest-cost water source first.
- Emphasize energy efficiency as a factor when considering new capital projects.
- Improve energy efficiency by establishing relationships with external customers and agencies to mutually benefit all parties with energy savings.
- Think "outside of the box" when working on routine tasks and daily operations to generate new ideas to conserve energy.
- Review demand charges and rate schedule management to reduce overall power costs expended by the district.
- Drive further development of internal and external energy-efficient, innovative technologies.
- Encourage continuous energy conservation by employees in their work and personal activities.
- Promote a culture of continuous improvement in all aspects of JVWCD's business including energy management.

The district recognizes that some positions have a greater influence on energy consumption, but to develop a culture of energy savings, the energy management guidelines apply to all JVWCD employees.

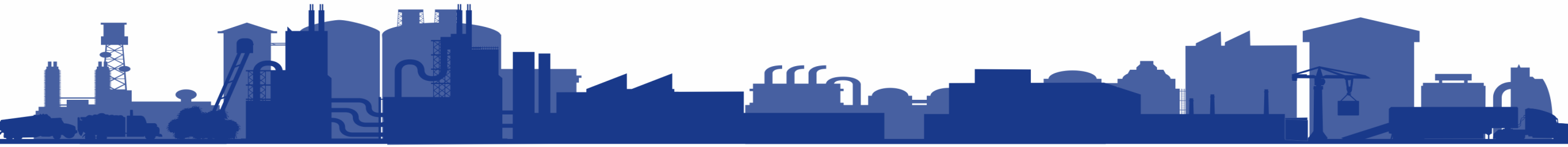
SEM Alumni Employee Engagement Strategies

- Not just operators
- Portion of energy savings went toward employees' "uniform" budget
- Ideas spilled over into other departments

Key takeaways: Culture change within the water department played a critical role in helping the public works staff embrace energy management. Recommended operational changes also improved operating pressures, which resulted in fewer customer complaints.

Past Experience with Employee Engagement

ENERGY CALCULATIONS REVIEW



Pressure Reduction

Booster station pumped 30 MG in June to maintain 85 PSIG line pressure.

Energy Calc:

$$\frac{3.14\ \text{kWh}}{\text{MG*Feet}} \times \text{MG} \times \text{Feet} = \text{energy consumption in a perfect world}$$

$$\frac{3.14\ \text{kWh}}{\text{MG*Feet}} * 30\ \text{MG} * 85\ \text{psi} * \frac{2.31\ \text{Feet}}{\text{psi}} = 18{,}500\ \text{kWh in a perfect June}$$

Pressure Reduction

Booster station pumped 30 MG in June to maintain 85 PSIG line pressure.

18,500 kWh in a perfect June

Wire-to-Water efficiency is the total efficiency stack, from the grid through the pump system to the material moved.

97% VFD x 94% motor x 85% pump = 77.5%

$$\frac{\textbf{18,500 kWh}}{\textbf{0.775}} = \textbf{24,000 kWh in June}$$

What is the energy intensity?

24,000 kWh/30 MG = 800 kWh/MG

Pressure Reduction

Booster station pumped 30 MG in June to maintain **80** PSIG line pressure.

$$\frac{\text{5 psi reduction}}{\text{85 psi}} * \text{24,000 kWh in June} = \text{1400 kWh savings}$$

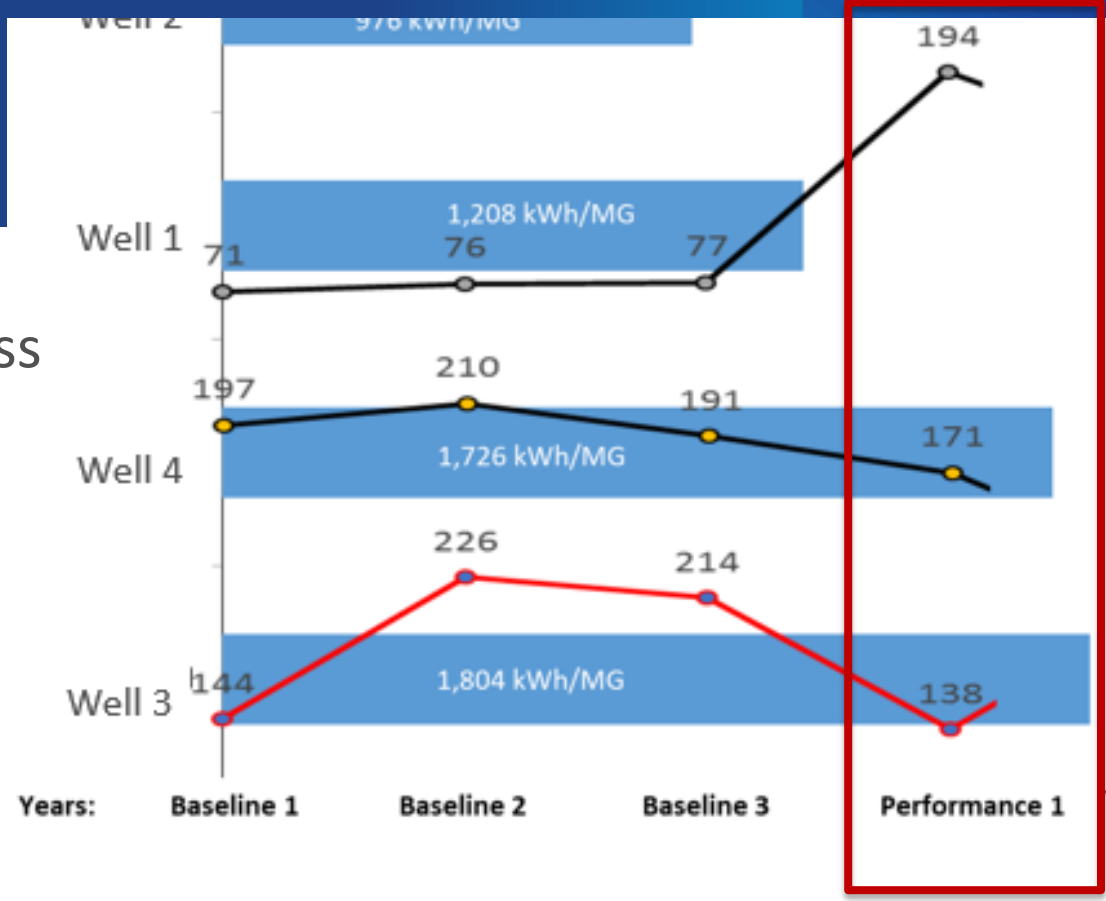
Leak repair

Energy intensity is 2,700 kWh/MG

Leak repair saves 60 MG/year

$$\frac{2{,}700\ \text{kWh}}{\cancel{\text{MG}}} * \frac{60\ \cancel{\text{MG}}}{\text{year}} = \frac{162{,}000\ \text{kWh}}{\text{year}}$$

Source Selection



Energy savings from using Well 1 more and Well 3 less

- Reduced Well 3 by 76 MG
- Assume Well 1 produced extra 76 MG

$$\frac{1800\ \text{kWh}}{\text{MG}} - \frac{1200\ \text{kWh}}{\text{MG}} = \frac{600\ \text{kWh savings}}{\text{MG}}$$

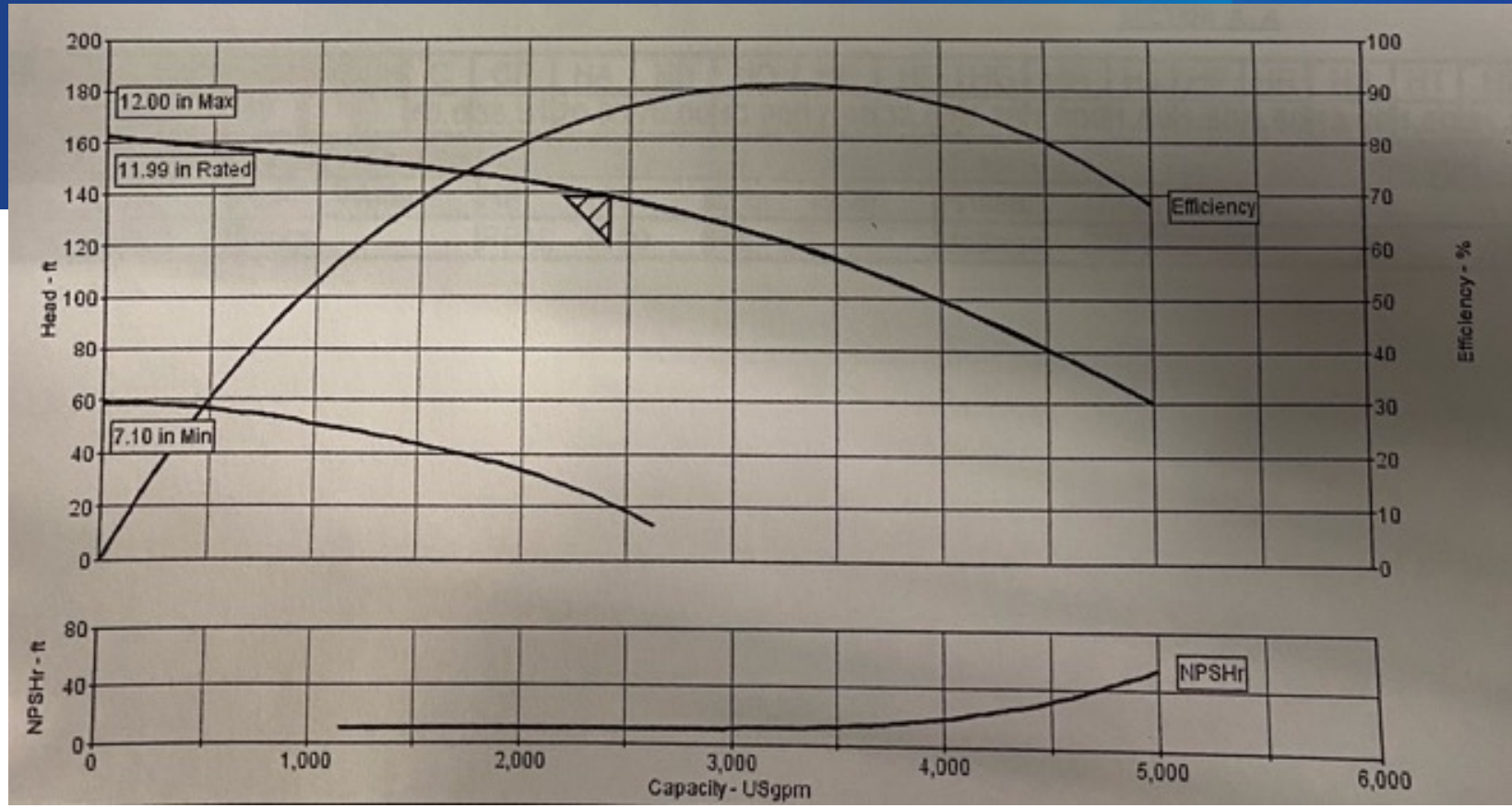
$$\frac{600\ \text{kWh savings}}{\cancel{\text{MG}}} * \frac{76\ \cancel{\text{MG}}}{} = 45{,}600\ \text{kWh savings}$$

$$\frac{45{,}600\ \cancel{\text{kWh}}}{\text{year}} * \frac{\$0.10}{\cancel{\text{kWh}}} = \$4{,}560 \text{ in energy (kWh) savings}$$

Increase efficiency

$$BHP = \frac{Q * H}{3960 * \eta}$$

$$BHP = \frac{2300*140}{3960*0.85} = 96 \text{ hp}$$



96 hp * 0.75 kW/hp / 0.93 / 0.97 * 5,000 hrs/year = 400,000 kWh/yr

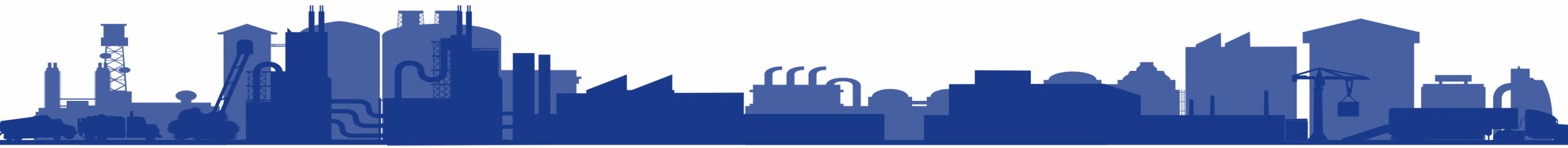
400,000 kWh/yr * 5% = 20,000 kWh/year

20,000 kWh/year * $0.10/kWh = $2,000/year

BREAK

Until 5 after

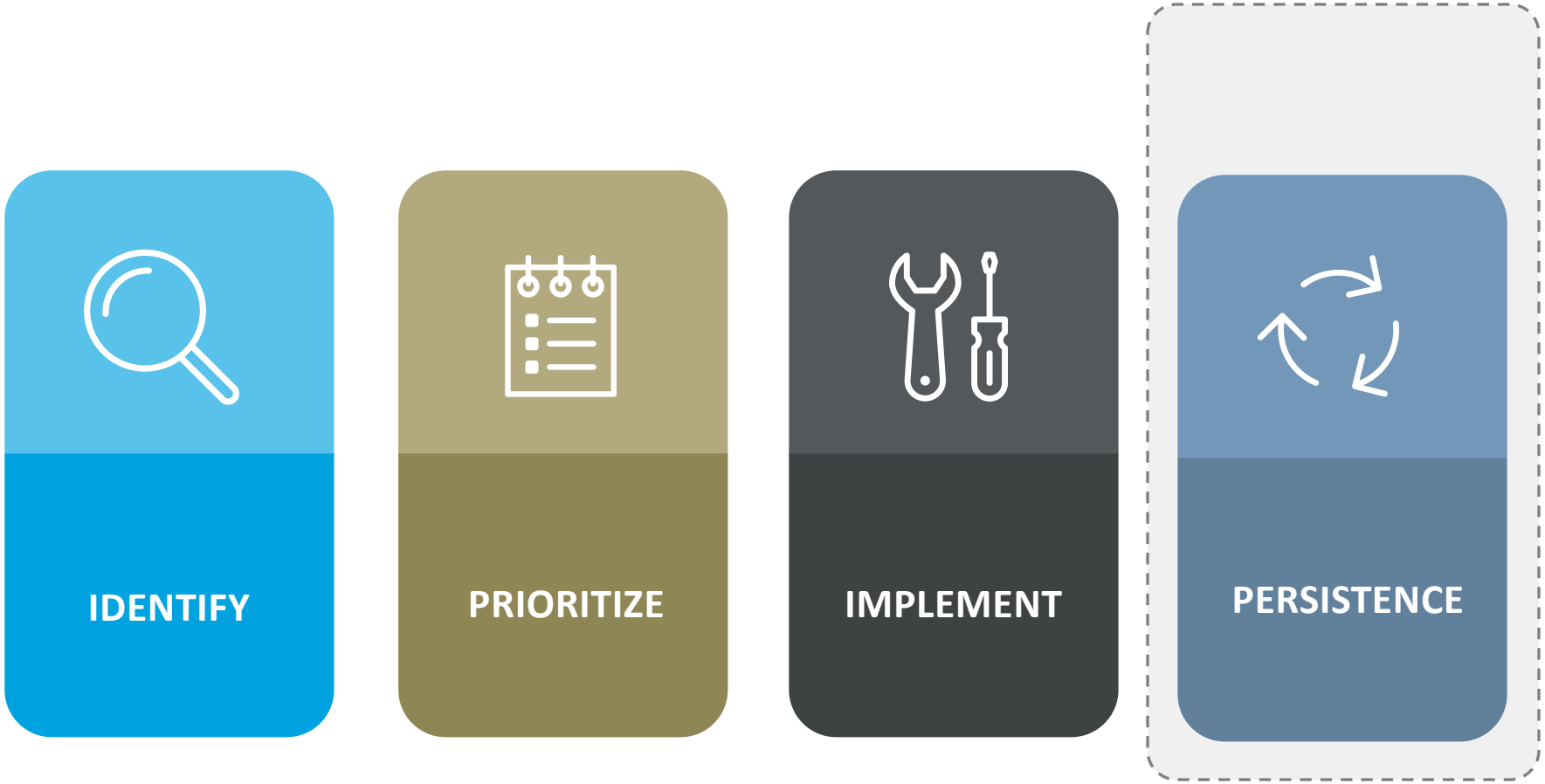
PERSISTENCE STRATEGIES



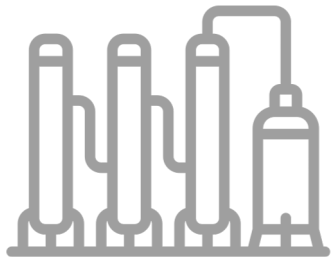
It's not just what you know, but how you practice what you know that determines how well the learning serves you later.

Peter C. Brown
Make It Stick

Energy Project Lifecycle

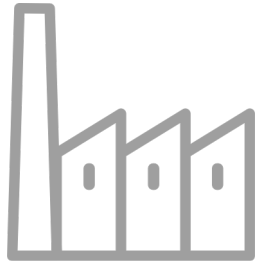


What could happen? Or has already happened?



New Equipment

New Operator



Change in Requirements

Persistence Strategies

- Backsliding Risk level – low, medium, high
- Frequency of monitoring implemented project – weekly, monthly, quarterly, semi-annually, annually
- Implemented projects:
  - Use lowest energy intensity source most
  - Backwash based on turbidity or pressure instead of hours
  - Reduce compressed air pressure
  - Eliminate looping (redundant pumping of same water) - modify PRV settings to keep water in desired zone
  - Optimize HVAC setpoints – unoccupied spaces

3 POWER/ENERGY ESTIMATES BASED ON MOTOR HP

MOTOR HP	POWER (kW)	ANNUAL ENERGY (kWh)
0.5	0.3	2,800
1	0.6	5,500
5	3.1	27,500
10	6.3	55,000
20	12.6	110,100
50	31.4	275,200
75	47.1	412,700
100	62.8	550,300
150	94.2	825,500
200	125.6	1,100,600
250	157.1	1,375,800
300	188.5	1,650,900
500	314.1	2,751,600

Assumes
80% motor load,
95% motor efficiency,
24/7 operation.

aquafficiency

Water System Energy **FACTS AND FIGURES**

PROBLEM	DESCRIPTION	SOLUTION
Looping	Redundant pumping of the same water. Can occur when water descends through a PRV into a lower zone and then is boosted back into the original zone.	Use hydraulic model to identify. Modify PRV settings to keep water in desired zone. Determine if pumps are appropriately sized.
Leaping	Boosting water to a higher zone than necessary and using PRVs to supply a lower zone.	Install pipeline or other facility to bypass higher zone; supply target zone directly.
Losing Head	Breaking pressure prematurely, e.g., at a spring or wholesale delivery point, when pressure could be used beneficially.	Configure system to maintain and/or reroute pressure.
Loading	Intermittent pump operation—spikes for short durations. Can occur when a facility is oversized for the current demand or when equalization storage is not used efficiently.	Implement controls to pump more consistently, install jockey pump, and/or use storage rather than pumps to meet peak demand.
Leaking	Water loss through aged pipes, loose equipment, and unmetered use. Water loss is also energy loss and revenue loss.	Invest in leak-detection equipment. Start leak-detection program and fix leaks. Use model to identify hotspots. Reduce pressure in system to minimize leaks.

1 PUMPING ENERGY CALCULATIONS

BASIC EQUATION

$$\frac{GPM \times Feet}{3960} \times \frac{1}{Pump\ Eff} \times \frac{1}{Motor\ Eff} \times 0.746 = kW\ from\ utility$$

Water HP — Brake HP (or Shaft HP) — Motor HP

Input HP x 0.746 = motor input kW*

Include transmission loss between motor and machine if not direct coupled:

Gear box - 92-98% depending on type

V-belt - 89-95% depending on proper tension

"cogged" or "synchronous" belt - 98%

Estimating energy from nameplate data

BHP = Motor Nameplate HP x 90% (for mixers) x "% of Full Load Power"

BHP = Motor Nameplate HP x 80% (for pumps) x "% of Full Load Power"

BHP = Motor Nameplate HP x Operating Amps / Full Load Amps (FLA)

$$\frac{Brake\ Horsepower\ (BHP) \times 0.746}{Motor\ Efficiency} \times hours = kWh$$

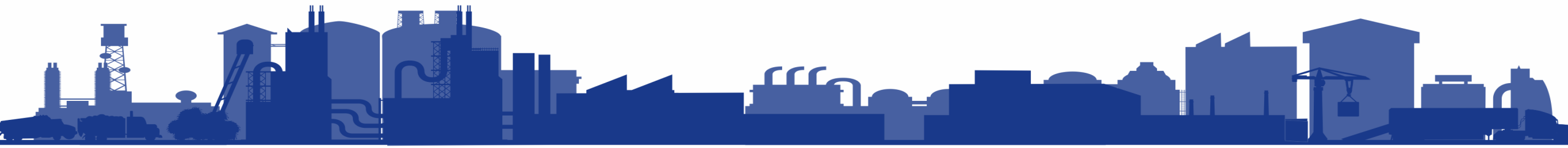
It takes 3.14 kWh to lift 1 million gallons 1 foot at 100% efficiency

Saving energy in pumping

- **Reduce the head** static and/or friction
- **Reduce the flow** pump only what is needed
- **Improve equipment efficiency** new equipment or better operating point

On your smart phone
Go to: https://kahoot.it/
Game PIN:

KAHOOT!



Takeaways

- Engage employees around energy savings
- Implement persistence strategies whenever you implement energy saving projects
- Use rough energy calculations to estimate savings
- Prepare to share next week

Closing

Questions
Comments
Discussion

SEE YOU TUESDAY!

aquafficiency®

Saving energy, one gallon at a time

EVALUATION