

Charting a Course to Energy Independence

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

**Lighting the Path
to Identification of
Energy and Productivity Improvements
in Industrial Buildings**





Federal Energy Management Program (FEMP)

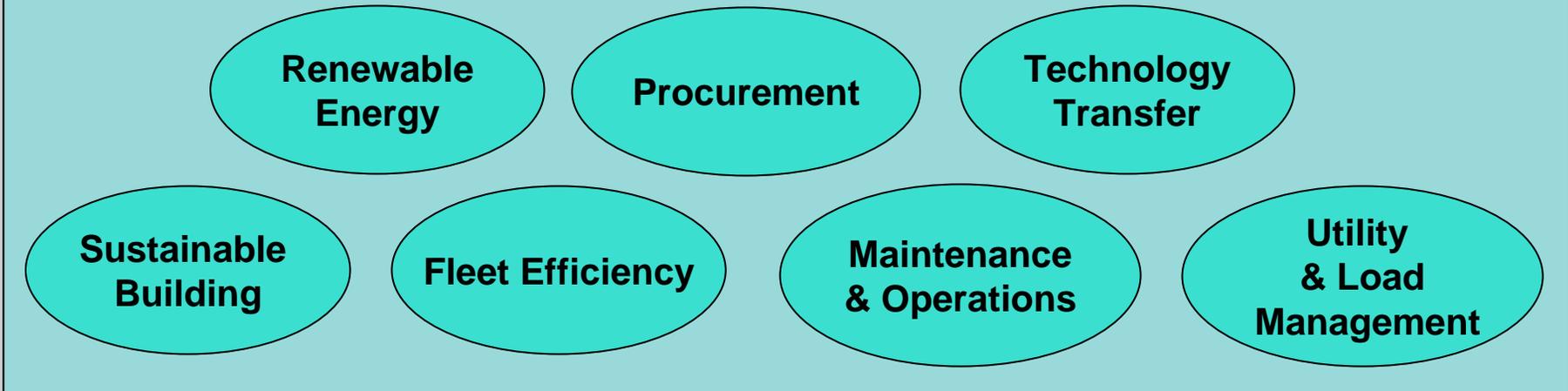
“facilitates the Federal Government’s implementation of sound, cost-effective energy management and investment practices to enhance the nation’s energy security and environmental stewardship.”

<http://www1.eere.energy.gov/femp/>

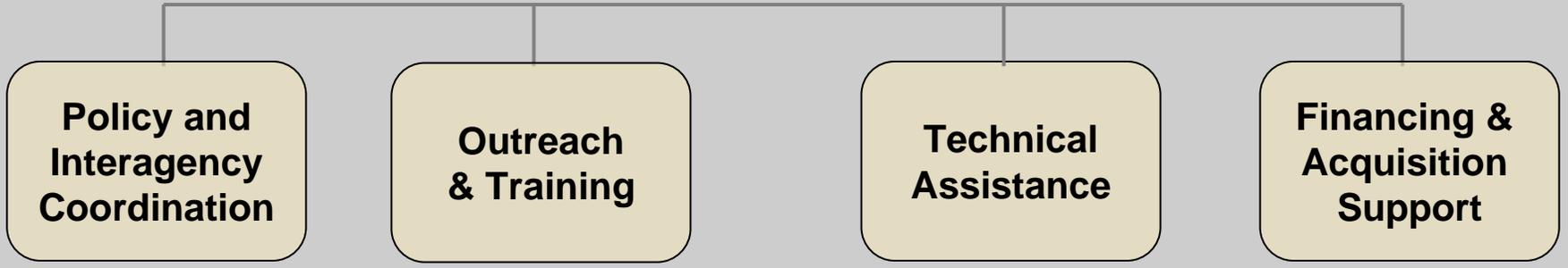


FEMP's Strategies for Market Transformation

FEMP's Service Areas



FEMP's Strategies for Market Transformation





Industrial Facilities Initiative (IFI)

- *Partnership between DOE's FEMP and Industrial Technologies Program (ITP) began in 2000*
- *Using the same Save Energy Now assessment methodology, federal facilities can receive an industrial energy assessment*
- *Serving federal industrial customers, providing technical expertise from:*
 - ☐ *Oak Ridge National Laboratory*
 - ☐ *Industrial Assessment Centers*
 - ☐ *ITP BestPractices Qualified Specialists*





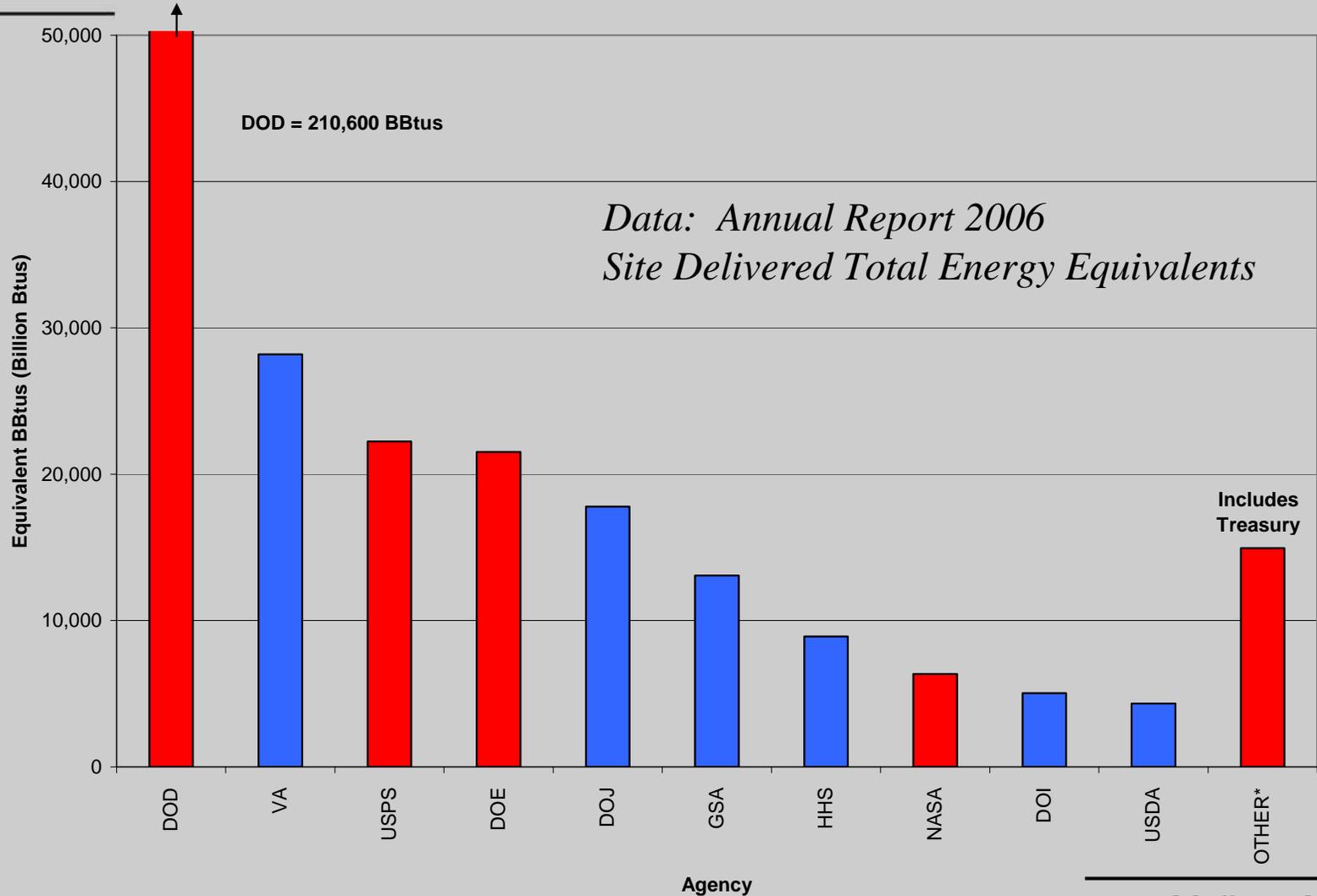
Simply... “Industrial”

- **Not creature comfort!**
- *Identified by the facility’s mission:*
 - ☐ *Production, manufacturing, refurbishment, destruction*
 - ☐ *Heat-treating*
 - ☐ *Welding*
 - ☐ *Painting*
 - ☐ *Cutting, Forming*
 - ☐ *Preparing product for its actual purpose*
 - ☐ *Mission-critical requirements (temperature/humidity)*
 - ☐ *Productivity and Waste Reduction*





Federal Energy Use by Agency



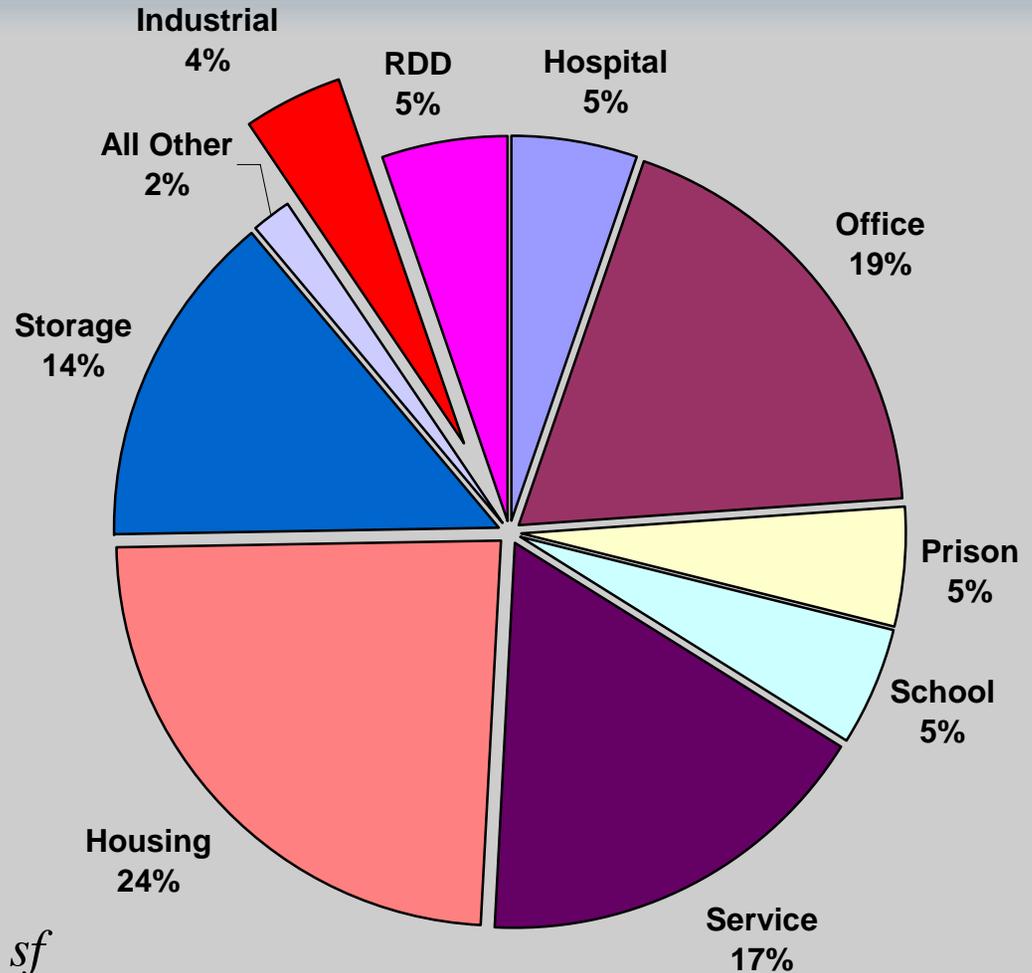


Industrial is 4% of Federal Footprint

Non-Industrial Bldg types may include industrial components:

- *Data Centers*
- *Laboratories*
- *Training Facilities*
- *Special Storage*
- *Special Mission Functions*

*Industrial = 114 Mgsf (>25ksf)
Of which 91 Mgsf are >100,000 sf*

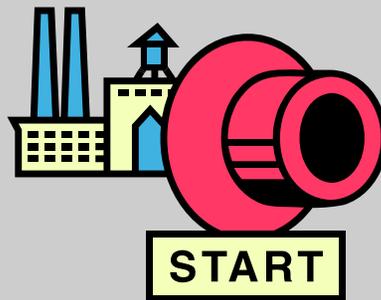


Data: General Service Administration, 2005



Now We See the Potential...

How do we start to identify Energy and Cost Saving Opportunities and Productivity Improvements?



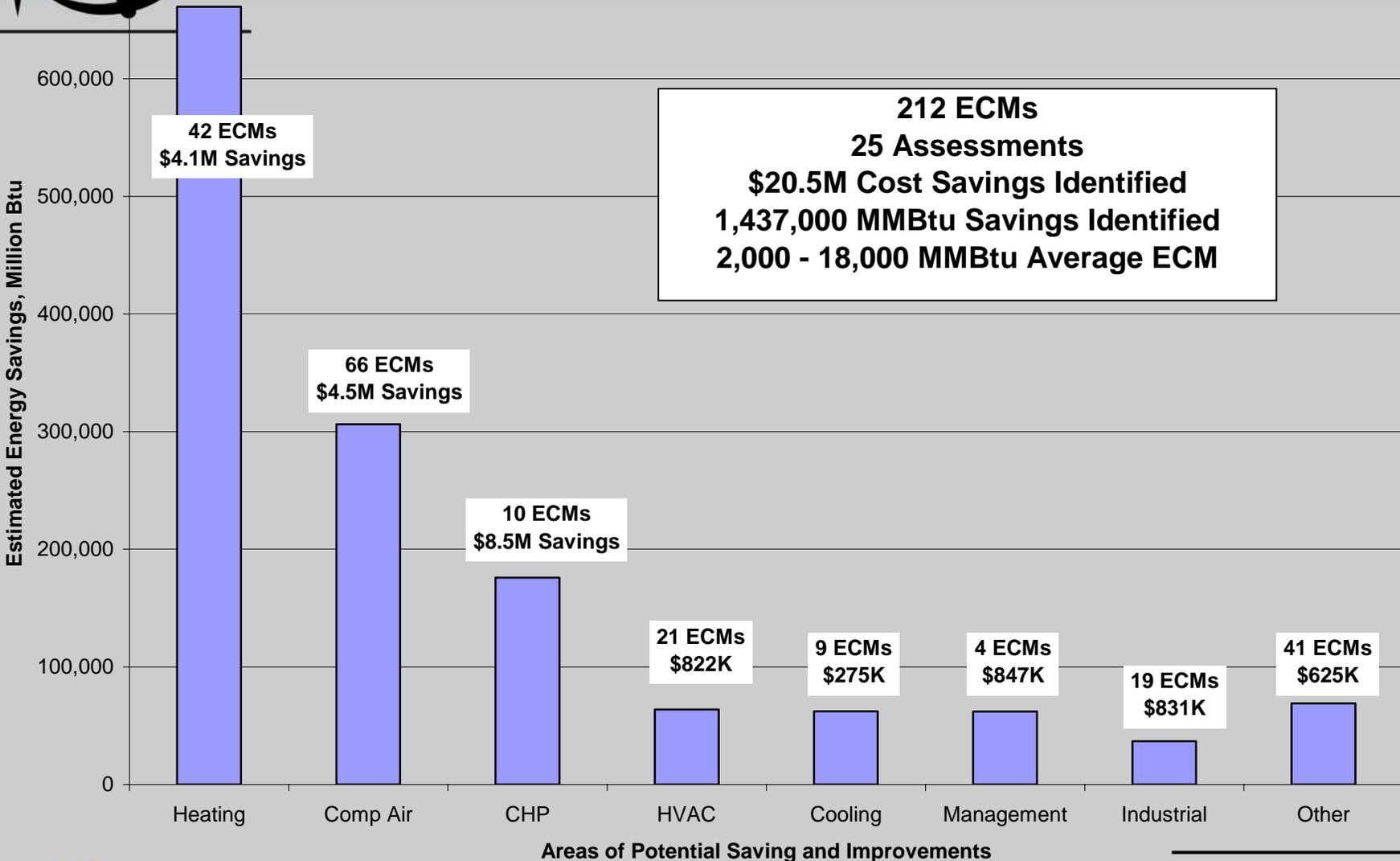
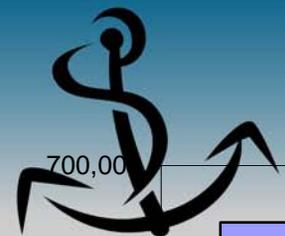


Industrial Energy Assessments

- *Entire industrial process assessments*
- *Targeted system assessments*
 - ☐ *Steam*
 - ☐ *Process Heating*
 - ☐ *Compressed Air*
 - ☐ *Pumps/Fans/Motors*
(direct drive equipment)
 - ☐ *Chilled Water*
 - ☐ *Service Water*
 - ☐ *Mission-specific Requirements*



Target Areas for Energy Savings





Heating (Steam) Improvements

- *Change in Steam Conditions*
 - ☐ *Steam Demand Reduction (End Use)*
 - ☐ *Temperature, Pressure*
- *Dedicated Boiler / Seasonal Shutdown*
- *Steam Leak and Trap Repair*
- *Boiler Combustion Control*
- *Boiler Blowdown*
- *Condensate Recovery/Return*
- *Heat Recovery*
- *Equipment Upgrades*





Compressed Air Improvements

- *Appropriate End Use and Conditions*
- *Leak Repairs*
 - ☐ *Remove Abandoned/Unused Distribution Lines*
- *Controls and Sequencing Compressors*
- *Optimize System Configuration*
 - ☐ *Right-size / Upgrade Compressors*
 - ☐ *Reduce Pressure to Meet Demand*
 - ☐ *Adequate Grade for Purpose*
 - *Dedicated/Satellite Compressors*
- *Heat Recovery*

*Compressed Air
is “not free air”.
\$100-\$950/scfm*



Idaho National Laboratory Compressed Air Assessments - 2007

- *Several ECMs/Scenarios identified*
 - ☐ *Optimize Existing Systems vs. State of the Art System Upgrade*
 - ☐ *Controls Upgrade*
 - ☐ *Demand Reduction*
 - ☐ *Heat Recovery Options*
- *Individual Savings*
 - ☐ *\$<1K-138K Cost Savings*
 - *2- 12 yr Simple Payback*
 - ☐ *Between 35 to 2,400 MMBtu Energy Savings*
 - *Nearly 9 Million gallons of Water Savings*
- *Implementation*
 - ☐ *Repairs identified during Site Visit*
 - ☐ *ESPC in Development*



Photo courtesy of INL's Ernest Fossum



DHS Coast Guard Yard-Baltimore Compressed Air Assessment - 2005

- *Savings*
 - ☐ *\$41K Cost Savings*
 - ☐ *1,800 MMBtu Energy Savings*
 - *22 million gallons of water*
- *Implemented In-House*
 - ☐ *Dedicated shop compressor*
 - ☐ *Leak repair (growing list)*
 - ☐ *Discharge pressure reduction*
 - ☐ *Appropriate use resolved*
 - ☐ *Recondition compressor for peak shaving & backup*
- *ESPC*
 - ☐ *New compressor with digital control sequencing*
 - ☐ *Leak repair wrap up*
 - ☐ *Also underground steam piping replaced and new cogeneration facility with landfill gas – 5MW*



Photo courtesy of US Coast Guard



DOD's Rock Island Arsenal Comprehensive Assessment – 2004

- *Twelve ECMs identified*
 - ☐ *Boiler Summer Shutdown*
 - ☐ *Steam System Improvements*
 - ☐ *Compressed Air Leaks*
 - ☐ *Compressed Air System Improvements*
 - ☐ *Paint Booth Upgrade*
 - ☐ *Process Improvements*
 - ☐ *Lighting Upgrades*
- *Savings*
 - ☐ *\$878K Cost Savings*
 - *Productivity (\$435K)*
 - ☐ *147,000 MMBtu Energy Savings*
 - *Electricity, Coal, Natural Gas (expense)*



Photo courtesy of Army's Rock Island Arsenal



Rock Island Arsenal Implementation – Ongoing...

- *Maintenance Projects \$5.2M*
 - ☐ *Steam Absorption to Centrifugal Chillers*
 - ☐ *Coal Steam Plant Summer Shutdown*
 - ☐ *NG Boilers for Summer Steam*
 - ☐ *Other Boiler Repairs and Upgrades*
 - ☐ *Additional Labor Savings (\$200K) realized*



Window Replacement in Progress

Photo courtesy of RIA's Jay Richter

- *Maintenance During Summer Shutdowns Since 2004 - \$17M*
 - ☐ *Firing Design, controls, monitoring*
- *ECIP*
 - ☐ *Paint Booth, Building Envelope, Lighting, Ventilation*
- *SEC Army Energy Award, FEMP Award, FEMP Energy Champion*



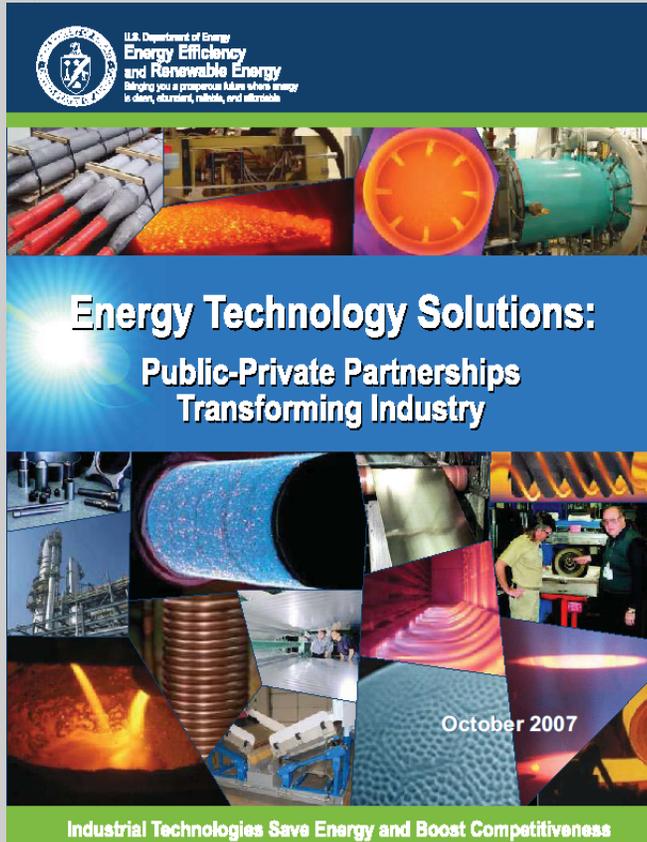
Other Areas to Investigate

While IFI works to identify ECMs specific to the industrial components, IFI can also look to more Advanced Components to provide these and other services to the industrial areas.





New and Emerging Technologies



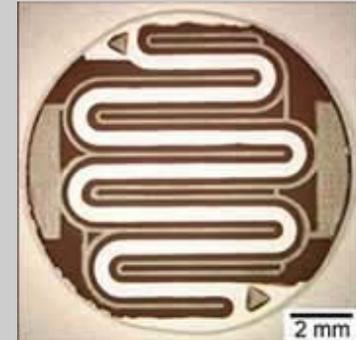
- *Many applications for specific industry and components*
 - ☐ *Process-specific*
 - *Aluminum*
 - *Metal Casting*
 - *Steel...*
 - ☐ *Cross cutting technology*
 - *Combustion*
 - *Sensors*
 - *Auxiliary Equipment...*

http://www1.eere.energy.gov/industry/bestpractices/pdfs/itp_successes.pdf



Wireless Sensor Technology

- *Reduced installation costs– no wires!*
 - ☐ *\$50-\$2,000 per foot wiring cost*
- *Increase Productivity*
 - ☐ *Real-time monitoring of performance*
 - ☐ *Identification of repair needs*
- *Reduction in Maintenance Costs*
 - ☐ *Easily replaced*
 - ☐ *Remote sensing for hazardous environments*
 - ☐ *Reduces need for manual inspections*
- *Energy Tracking*



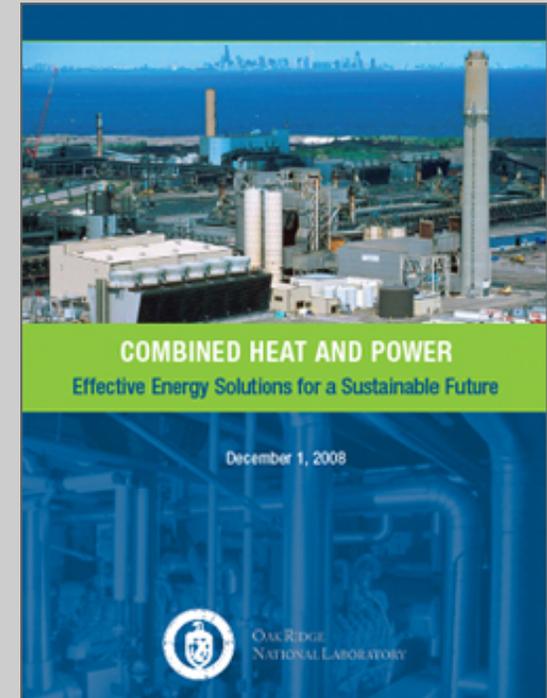
Exhaust Gas Sensor
Courtesy of ORNL

http://www1.eere.energy.gov/industry/sensors_automation/pdfs/transformational_wireless.pdf



Combined Heat and Power (CHP) – On-Site Generation

- *Grid Independency / Energy Security*
- *Utilize Waste Heat*
 - ☐ *Absorption Chillers*
 - ☐ *Heat Recovery for Steam/Hot Water*
 - ☐ *Heat Recovery for Process*
 - ☐ *Desiccant Dehumidification*
- *Excess Steam Generation*
- *Carbon Dioxide Reduction*
- *Minimizes Distribution Loss*
- *Alternative Fuels*
 - ☐ *Biomass, Landfill Gas*



http://www1.eere.energy.gov/industry/distributedenergy/pdfs/chp_report_12-08.pdf

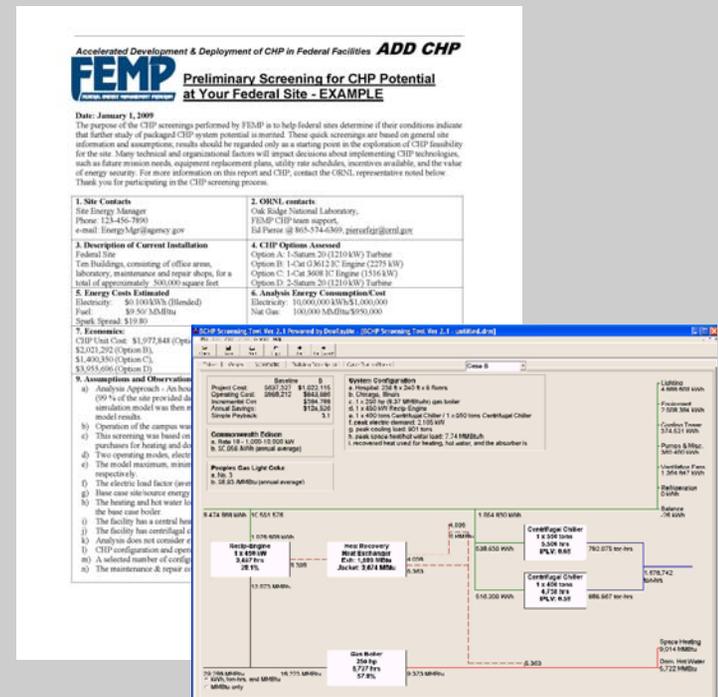
http://www1.eere.energy.gov/femp/der/derchp_chpbasics.html



CHP Screenings and Analysis

• CHP technologies and Operating Scenarios

- ☰ Gas Turbines
- ☰ Internal Combustion Engines
- ☰ Microturbines
- ☰ Fuel Cells
- ☰ Backpressure Steam Turbines
- ☰ Biomass Opportunities
 - Landfill Gas
 - Wood Waste



• Determine if CHP Scenarios Merit Additional Study

http://www1.eere.energy.gov/femp/der/derchp_chpscreening.html



Army's Fort Bragg CHP Fayetteville, NC

- *Partnership with Honeywell in 1997*
- *5 MW Taurus 60 gas turbine*
- *Utilization of waste heat from of turbine exhaust*
 - ☐ *exhaust-firing an absorption chiller*
 - ☐ *heat recovery steam generator*
- *\$1.8 million per year cost savings*

**25% reduction
in total energy cost**



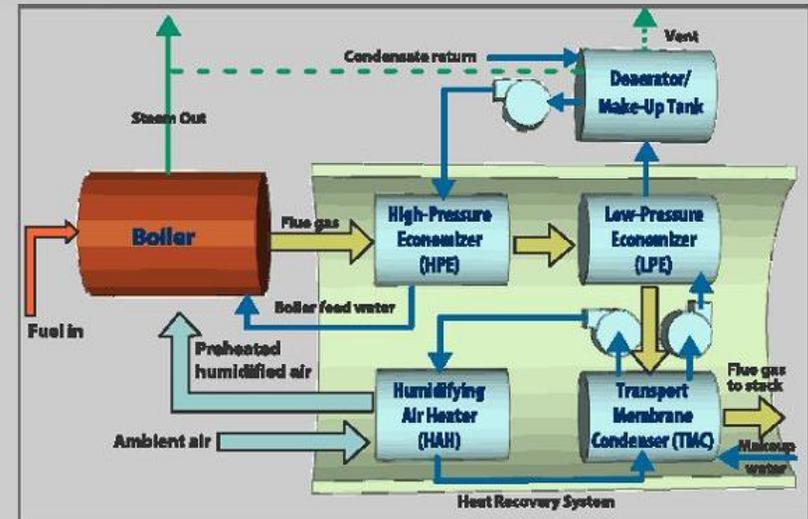
Photo courtesy of DOE's Patti Garland

*Fort Bragg can manage
electrical consumption
better and operate as an
'island' during
prolonged grid outages.*



Super Boiler Technology

- *What makes it 'Super'?*
 - ☐ *Less floor space*
 - ☐ *Advanced controls*
 - ☐ *Heat Recovery of Flue Gas*
 - ☐ *Staged and intercooled combustion system*
 - ☐ *Ultra-low emissions*



http://apps1.eere.energy.gov/industry/bestpractices/energymatters/articles.cfm/article_id=265

- *EERE: 25% increase in steam generation efficiency with first generation.*
 - ☐ *SuperBoiler is reported at 90-94% efficiency*
 - ☐ *Traditional Boilers are typically mid-80's efficiency*
 - ☐ <http://www1.eere.energy.gov/industry/combustion/pdfs/superboiler.pdf>



Super Boiler

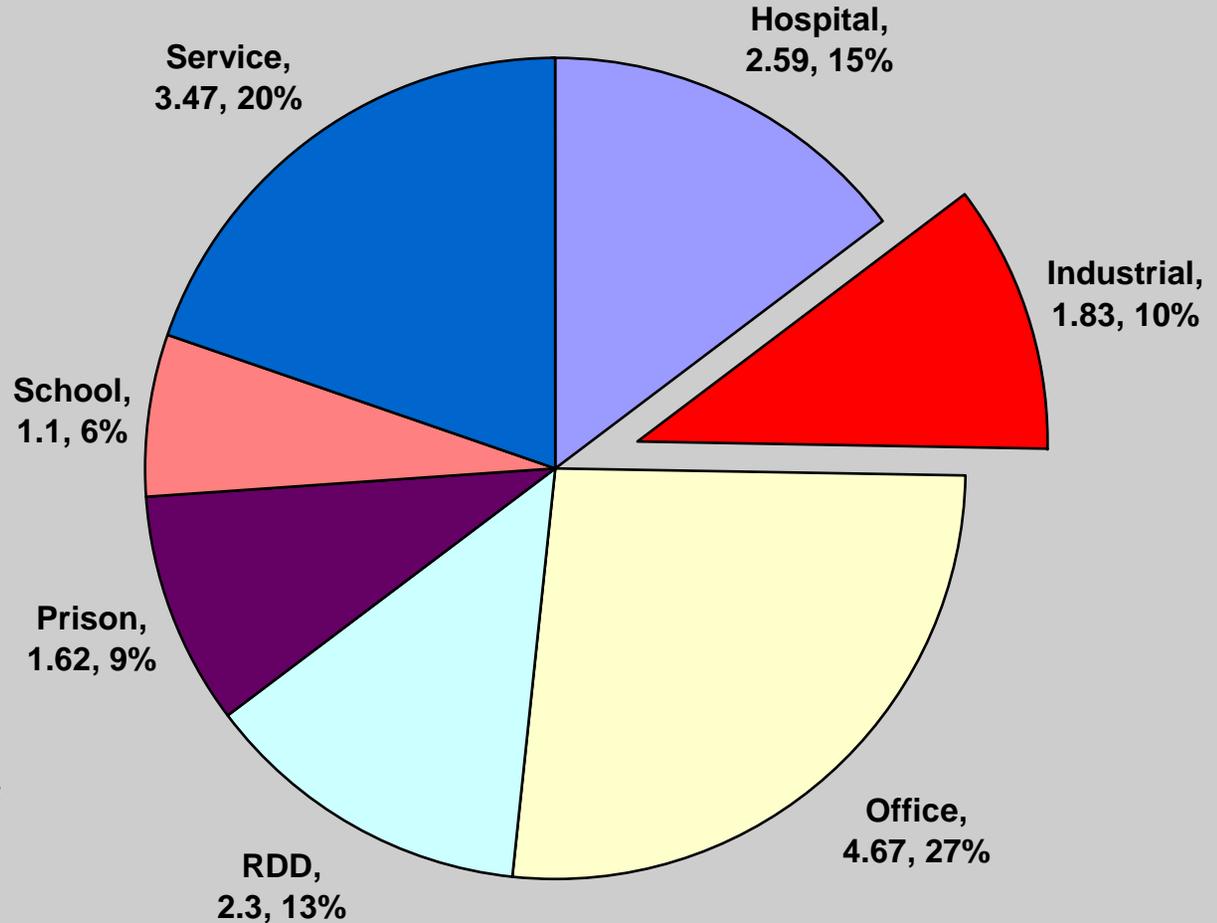
Potential Federal Savings of 18 TBtu/yr

Industrial Applications

Boiler Energy is based on 39% of Bldg Energy.

Estimated Industrial Savings at 25% for nearly 2 TBtu/yr or 10% of SB Potential.

Data: Super Boiler Potential at Federal Sites (Interim Report) - John Shonder

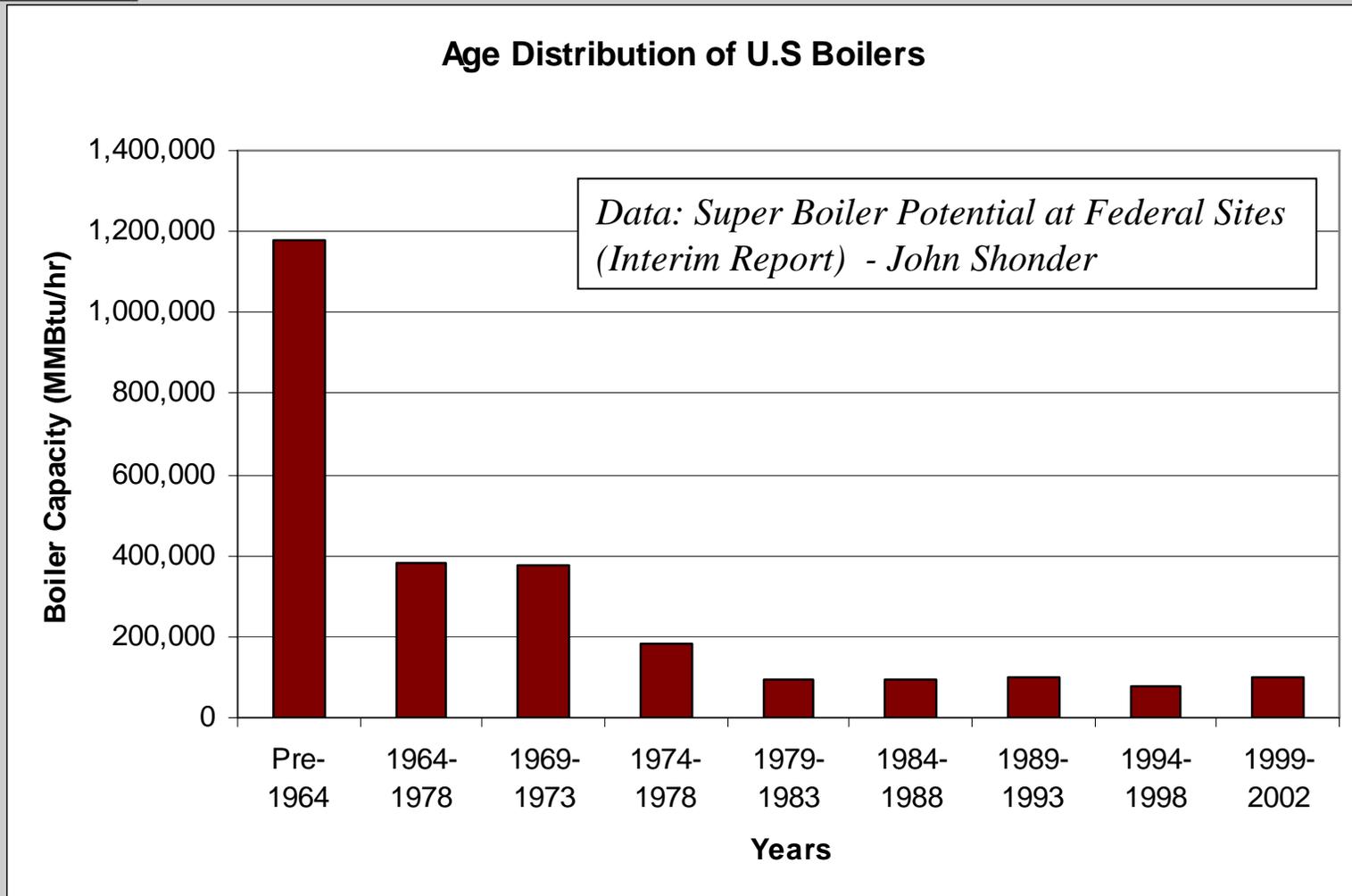


For all Bldgs > 25,000gsf



US Boiler Age Distribution

Short Term Savings of 11 TBtu/yr





ORNL's Super Boiler Demonstration

- *Final design/initial construction in progress*

- ☐ *Eliminate over a mile of steam line (above ground)*

- ☐ *Install new, localized boiler plant*

- *300 HP SuperBoiler preferred loading*
- *3-100 HP redundant conventional boilers*

- ☐ *Repair/replace traps, leaks, insulation*

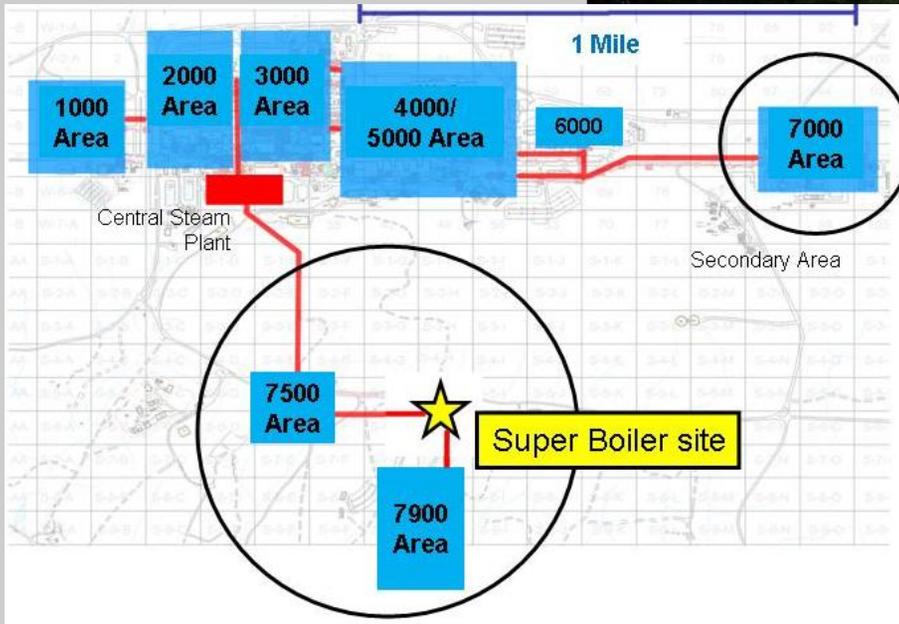
- ☐ *Retrofit a small, secondary area with new building heating*



<http://www.cbboilers.com/superboiler.htm>



ORNL Super Boiler Project Site



Drawing courtesy of Johnson Controls and ORNL

Photo courtesy of ORNL's Rob Crowell



ORNL's Super Boiler (continued)

- *Projected Results*

☐ <i>Implementation Price</i>	<i>\$7,008,300</i>
☐ <i>Energy Savings</i>	<i>65,900 MMBtu/yr</i>
☐ <i>Energy Cost Savings</i>	<i>\$ 627,500/yr (11.2 yr SPB)</i>
☐ <i>Completion Date</i>	<i>2010</i>

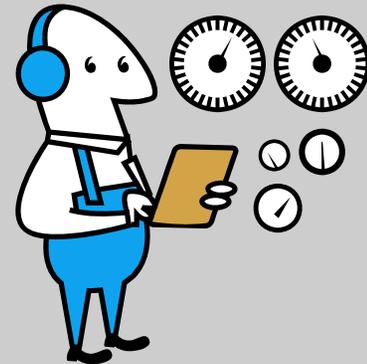
- *Project Evaluation*

- ☐ *Connect key performance parameters to an enhanced data collection system*
- ☐ *Monitoring, trending and logging*
- ☐ *Track and evaluate performance*
- ☐ *Report success of project*



How to get started with IFI...

- *Prioritize Buildings/Systems in Scope of Work*
- *Preliminary Data Collection*
 - ☐ *Annual Energy Consumption of Buildings/Systems*
 - ☐ *Preliminary Discussions with Personnel*
 - ☐ *Any Data, Drawings, previous Assessments*
- *Site Visit*
 - ☐ *Measurements and more Data Collection*
 - ☐ *Escorts and Craft Support*





What You Receive...

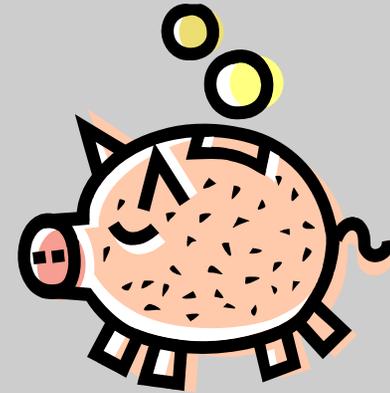
- *Comprehensive Energy Audit*
- *Training on Site*
 - ☐ *How-to Tips*
 - ☐ *BestPractices Tool Introductions*
- *Report of Recommendations*
 - ☐ *Energy and Cost Savings*
 - ☐ *Conceptual Implementation Costs*
- *Follow-up on Implementation*
 - ☐ *Identify FEMP services to help move toward implementation*





Now you have Projects in Mind...

- *Management/Staff Approval*
- *Funding Sources*
 - ☐ *Fix Energy Problems that Fix Maintenance Problems*
 - ☐ *Appropriations Requests*
 - ☐ *Alternative Financing*
 - ☐ *Demonstration Project*
- *Buy-In from Personnel*
 - ☐ *“I don’t want to stop production”*
 - ☐ *“It has always been this way”*





Technical Resources

- *Best Practices Publications*

 - ☰ *Handbooks, Sourcebooks*

 - ☰ *Tip Sheets, Fact Sheets*

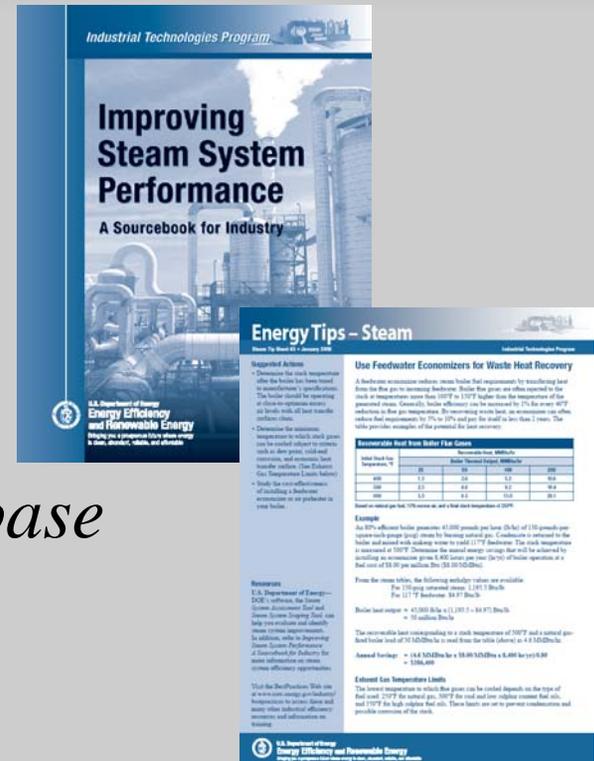
- *Industrial Recommendations Database*

- *Training*

 - ☰ *BP Software Tool Introduction Webinars*

 - ☰ *BP End User Training (One-day Instructor-led Course)*

<http://www1.eere.energy.gov/industry/bestpractices/resources.html>





Software Tools

- *Steam System Tool Suite*
 - ☐ *Steam System Scoping Tool*
 - ☐ *Steam System Assessment Tool*
 - ☐ *3E Plus ® Insulation Thickness Tool*
- *QuickPep*
- *AIRMaster+ (Compressed Air)*
- *Pumping System Assessment Tool*
- *Fan System Assessment Tool*
- *Process Heating Assessment & Survey Tool*
- *Industrial Facilities Tool Suite*
- *Chilled Water System Analysis Tool*
- *MotorMaster+*

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Industrial Technologies Program Tools Suite
Steam System Assessment Tool v. 3.0

Electricity Units: kWh

Energy Use System	Annual Electricity Consumption	Energy Consumption (kWh)	Energy Consumption (MMBtu)	Percentage of Total
Combined heat and power (cogeneration)	0.00		0	0.00%
Compressed air	13,088,820.00	13,088,820	44,946	9.47%
Industrial facilities: (Lighting, HVAC, and Facility Support)	6,500,000.00		22,179	4.68%
Fans and blowers	9,500,000.00	9,500,000	32,415	6.84%
MotorMaster+	5,566,666.67		1,089	2.34%
			6,773	16.21%
			9,964	31.66%
			0	0.00%
			7,246	20.53%
			2,796	2.70%
			6,601	5.62%
			8,659	

Pumping System Assessment Tool

Condition A | Condition B

Parameter	Condition A	Condition B
Pump rpm	1780	1780
Dive (feet above)	150	150
Units	gpm, ft, hp	gpm, ft, hp
Kinematic viscosity (cSt)	1.00	1.00
Specific gravity	1.000	1.000
# stages	2	2
Fixed specific speed	165	165
Line Reg	30 Hz	30 Hz
HP	102	102
Motor rpm	1780	1780
EF class	Standard efficiency	Standard efficiency
Voltage	480	480
Estimate FLA		
Full-load amps	172.8	172.8
Size margin, %	2	2
Operating fraction	1.000	1.000
Flow rate, gpm	2390	2390
Head loss	Head, ft: 217	Head, ft: 217
Load estim. method	Process	Process
Motor kW	112.0	112.0
Voltage	480	480

Summary for Condition A:

Parameter	Value
Pump efficiency	85.9 %
Motor rated power	150 hp
Motor shaft power	140.4 hp
Pump shaft power	140.4 hp
Motor efficiency	87.5 %
Motor power factor	88.8 %
Motor current	162.0 amps
Motor power	112.0 kW
Annual energy	981.7 MWh
Annual cost	49.1 \$1000
Annual savings potential, \$1,000	3.3
Optimization rating, %	93.3

<http://www1.eere.energy.gov/industry/bestpractices/software.html>

http://www1.eere.energy.gov/femp/information/access_tools.html



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Questions?

Industrial Facilities Initiative

http://www1.eere.energy.gov/femp/program/industrial_facilities.html