The 7 Steps of an Energy Management Program

Energy Assessment Tools & Methods

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Indiana Partners for P2 Conference
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Kentucky Pollution Prevention Center

EPA WATER EFFICIENCY LEADER AWARD

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Mission

The Kentucky Pollution Prevention Center (KPPC) at the *University of Louisville* is Kentucky's primary resource for technical information and assistance to improve environmental performance.

The Center facilitates and promotes the proactive implementation of management systems and technologies to improve the competitiveness of businesses, industries and other organizations.

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SSE

P2 = Source Reduction

- **P2 means "Source Reduction" & other practices that reduce or eliminate the creation of pollutants through:**
  - ✓ **Increased efficiency in the use of raw materials, energy, water or other resources; or**
  - ✓ **Protection of natural resources by conservation.**

Resource Management

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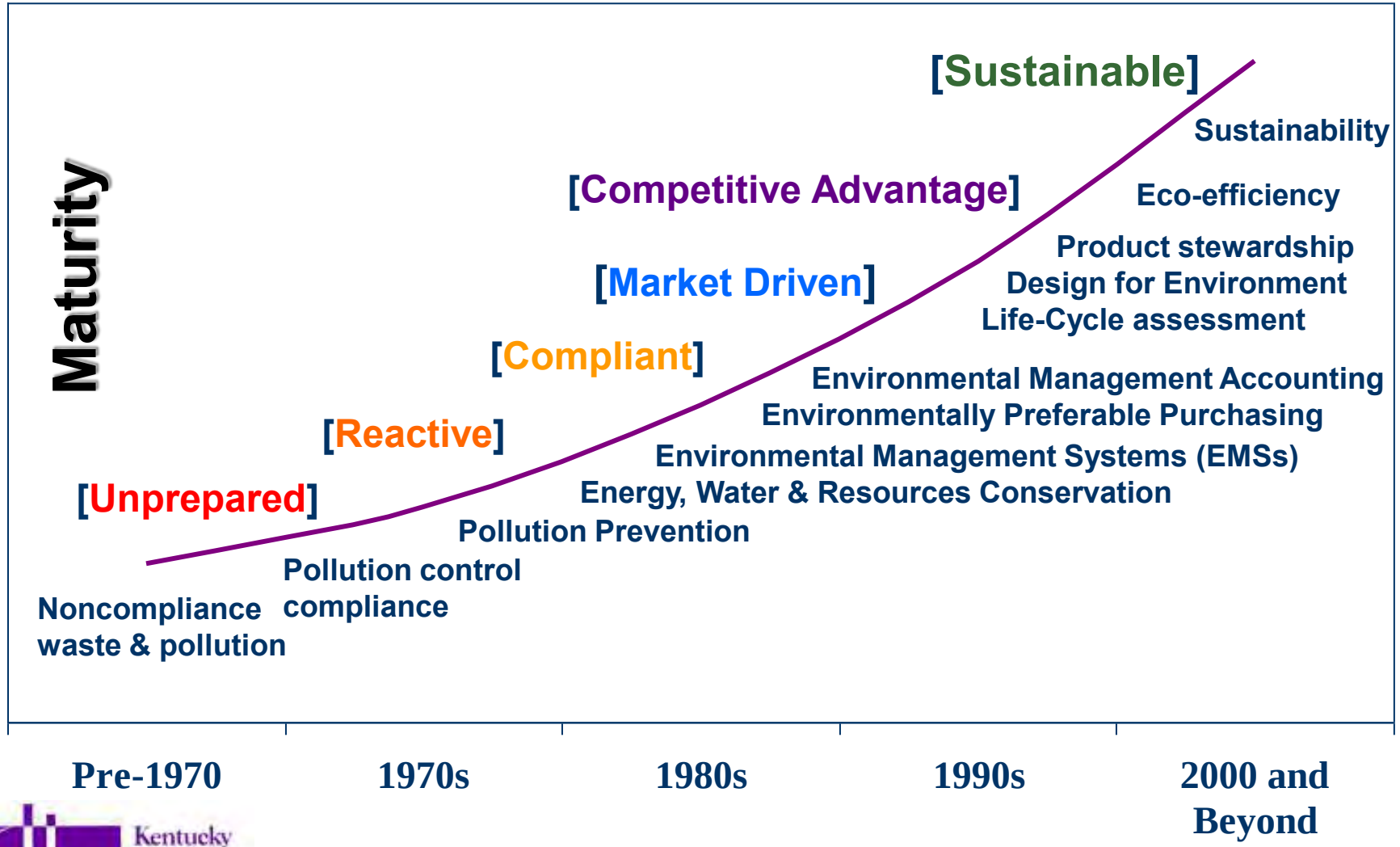
Evolution of Business



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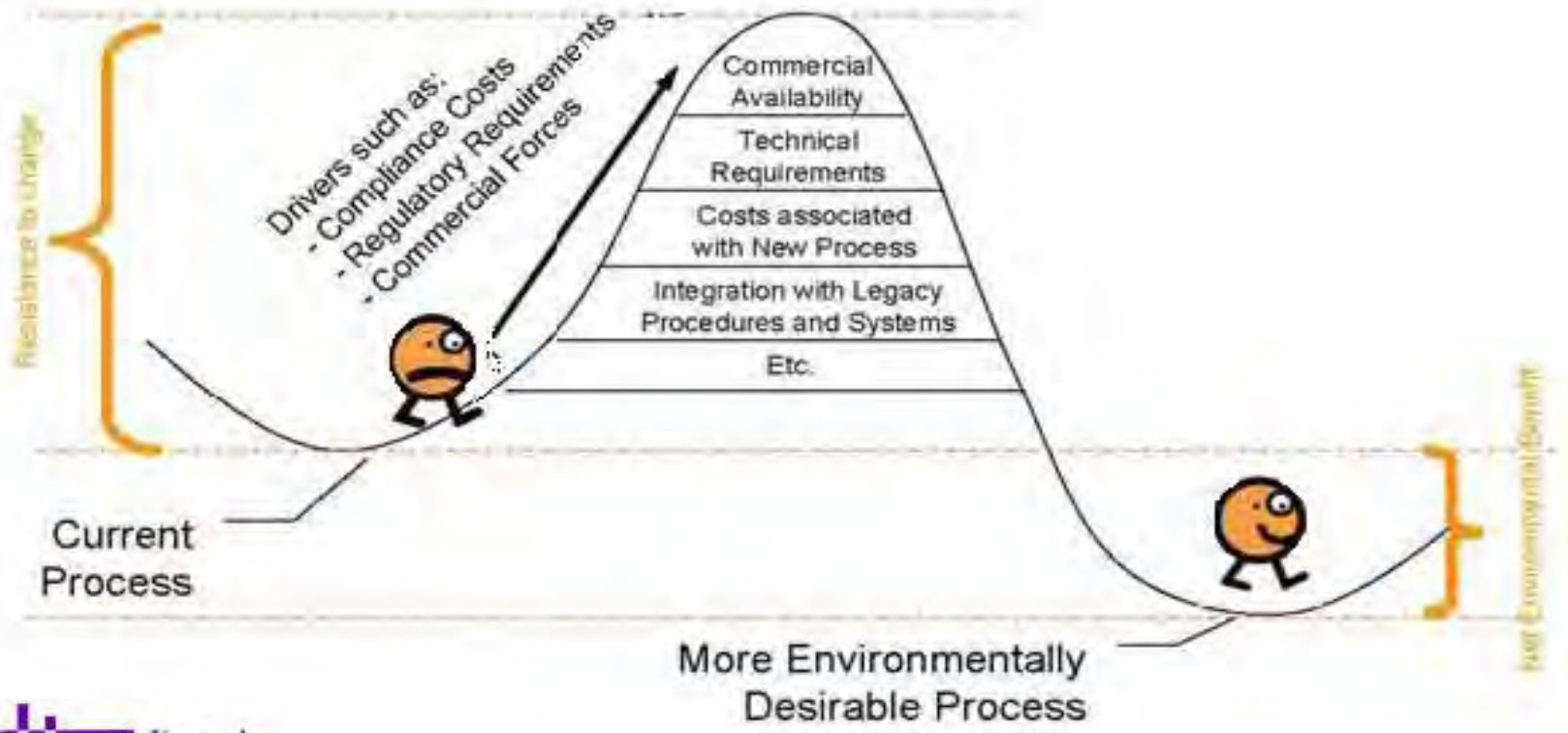
Implementing Change

- **Change requires some combination of:**
  - ✓ **Increased drivers**
  - ✓ **Decreased resistance**



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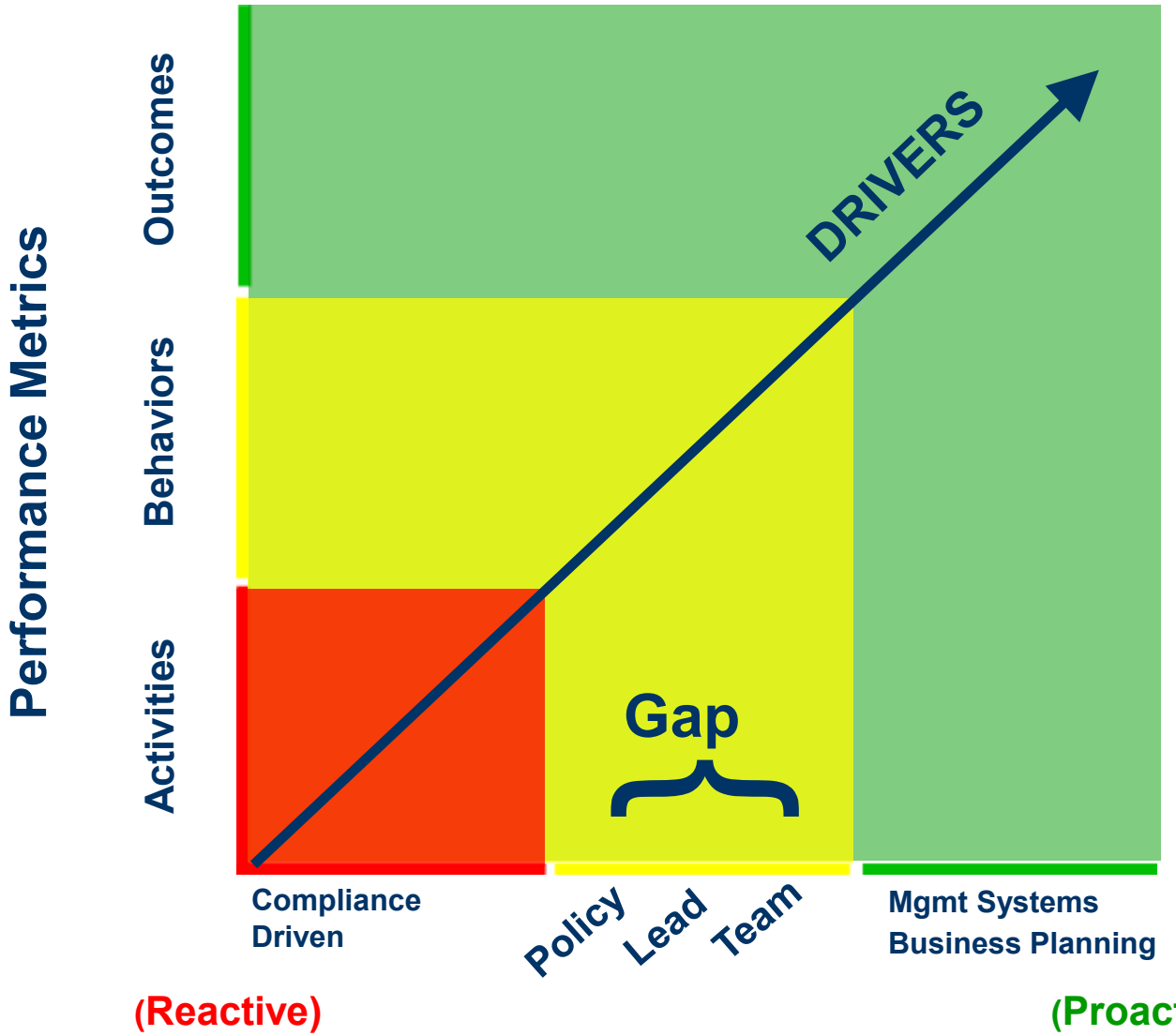
Organizational Capability



"Business Condition"

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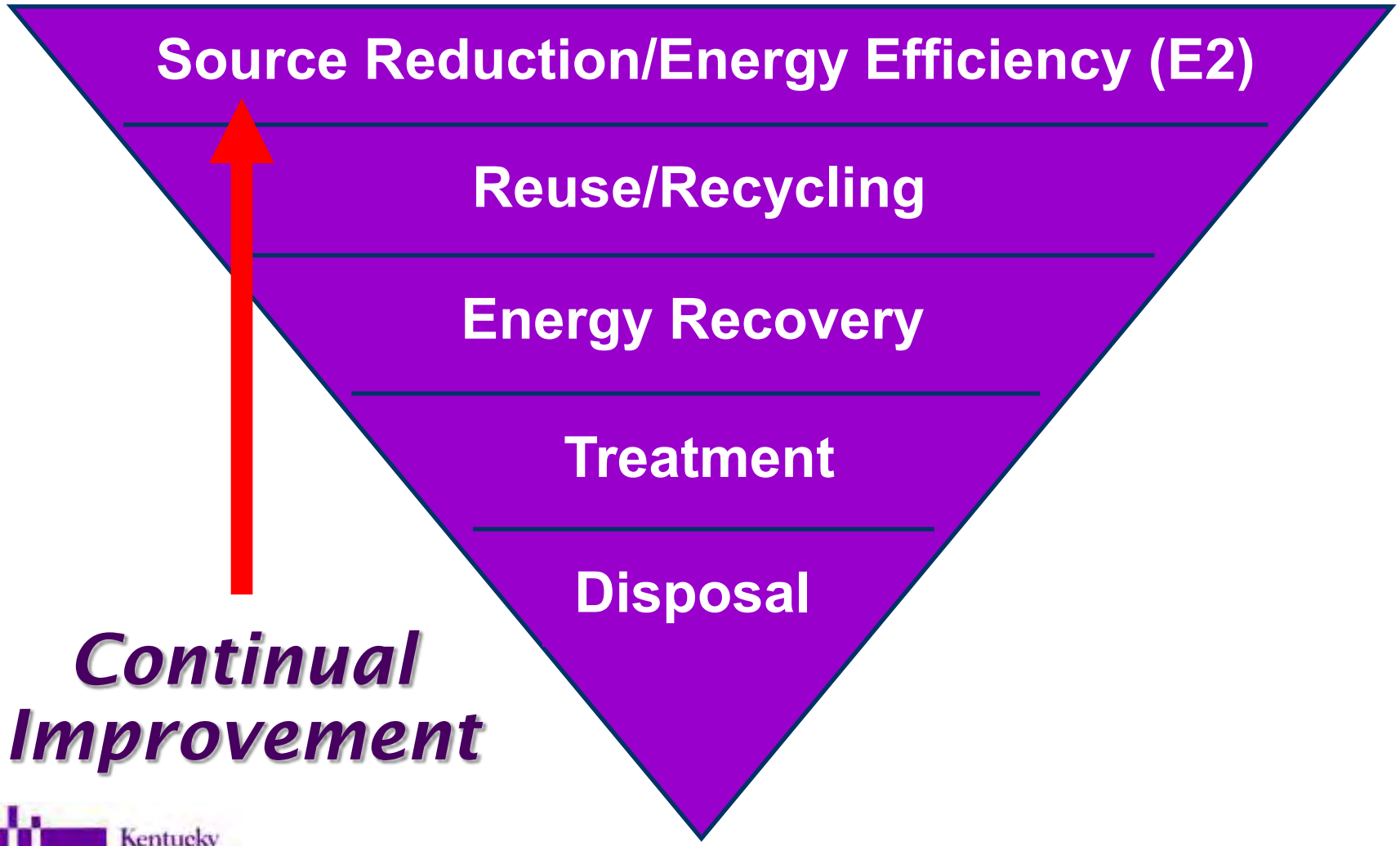
Move Up the Waste Management Hierarchy



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Winner 2007
USEPA Water Efficiency Leader Award
for
NGO Category

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7 Steps of an Energy Management Program (EMP)

1. Make Commitment to Continual Improvement
2. Assess Performance & Opportunities
3. Set Goals
4. Create Action Plan
5. Implement Action Plan
6. Evaluate Progress
7. Recognize Achievements

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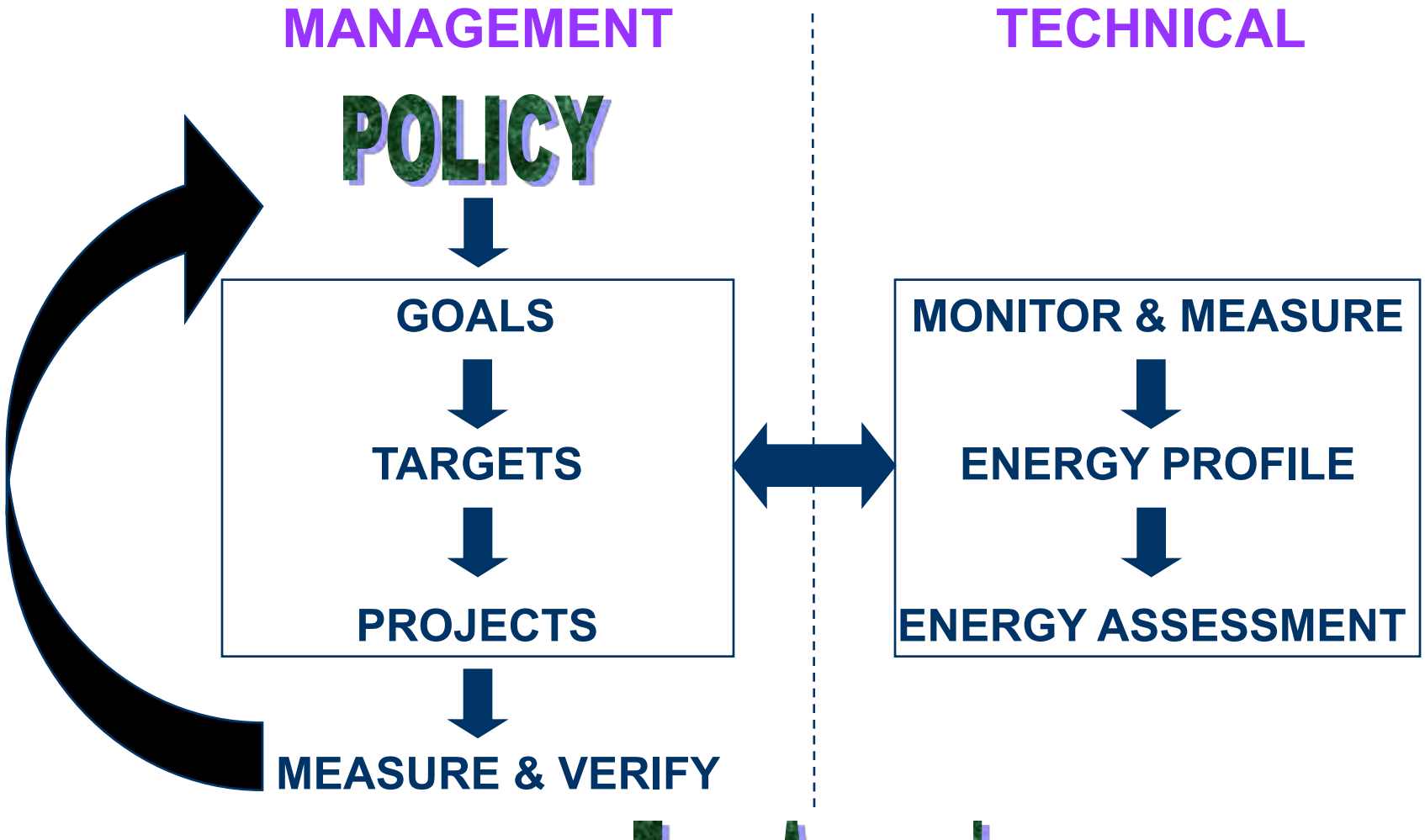
Make Commitment to Continual Improvement

- **Success based on commitment:**
  - ✓ Appoint an "energy manager"
  - ✓ Establish an energy team
  - ✓ Institute an energy "policy"
- **EMP will:**
  - ✓ Define energy usage goals
  - ✓ Involve all levels of the organization
  - ✓ Organize the energy management project(s)
  - ✓ Regularly assess energy performance
- **Organizations see financial returns from EMPs**

Energy Management Program



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Assess Performance & Opportunities

- Process of evaluating current & past energy use & costs for all major facilities & functions
- Analyze energy use to:
  - ✓ Identify energy opportunities
  - ✓ Improve energy performance
  - ✓ Gain financial & environmental benefits
- Key aspects of assessing performance include:
  - ✓ Data collection & management
  - ✓ Data analysis
  - ✓ Baselining & benchmarking
  - ✓ Technical E2 assessments

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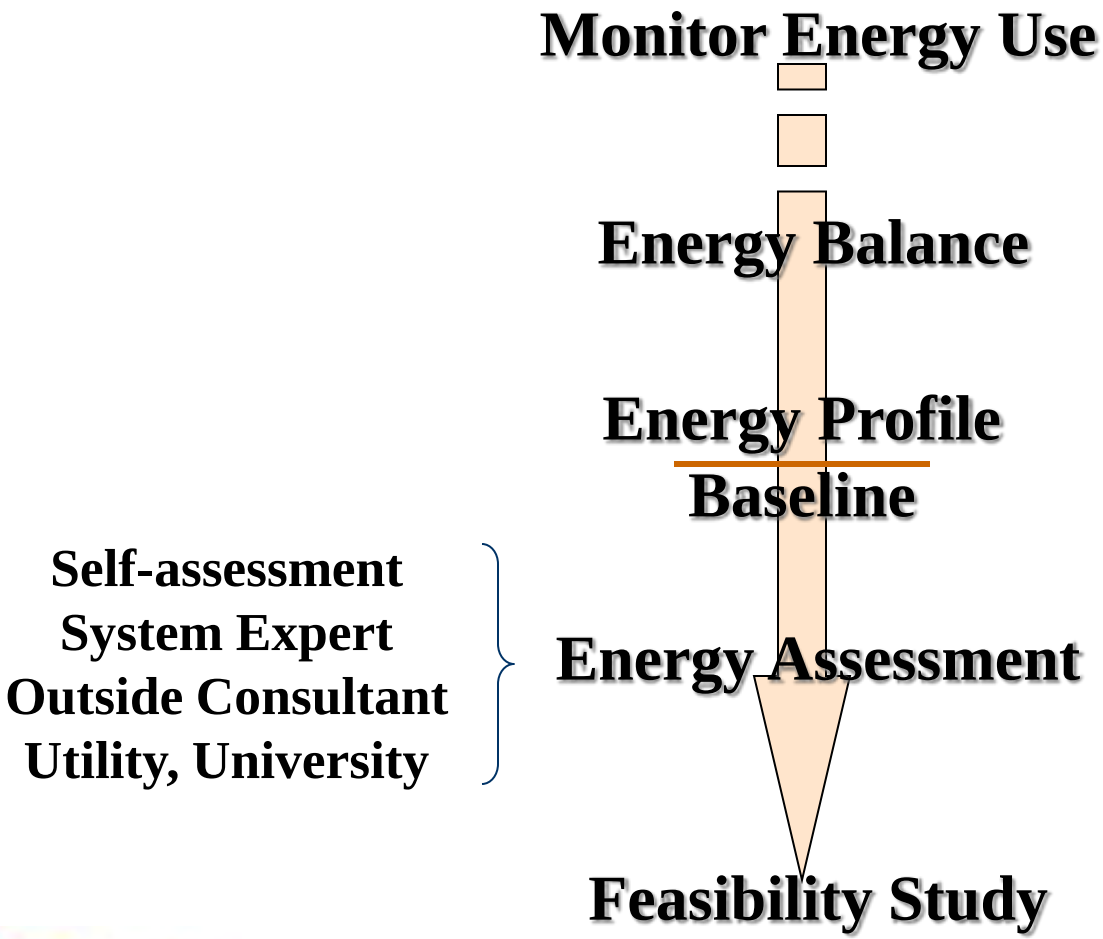
Don't Just Pay the Bill!

How Do I Find Energy Management Opportunities?



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Energy Bill Analysis

- **Essential component of any energy management program**
  - ✓ **Continuing account of monthly energy use & associated costs**
  - ✓ **Separate record for each type of energy used, i.e., gas, electric, oil, water, etc.**
  - ✓ **Utility data can be electronically monitored by internet-based tools**

"The Low Hanging Fruit"

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MBM Corporation

- Refrigerated warehouse
- Energy conscious company
  - ✓ Replaced HP sodium lights with T5 fluorescent
  - ✓ Asked KPPC to help identify more opportunities
- KPPC's E2 team examined the utility bills
  - ✓ Uncovered electric bill rate errors
  - ✓ Resulted in $21,000 credit

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Found Money

Daviess County High School

- State Department of Education requested KPPC help with electric billing audit
- School was being charged wrong rate
  - ✓ Switched demand rates
  - ✓ Annual savings of $6,000
- ***School has it's own transformer***
  - ✓ Eligible for rate discount it wasn't getting
  - ✓ Resulted in $20,000 credit

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Found Money

Kenton County School District: Successes Using No Cost Measures

Electric Rate Reviews

Meet with local electric supplier to ensure facilities are on the correct rate structure

2006 – 2007

- **River Ridge Elem – 5% reduction in electric costs saving $10,000**
- **Scott H.S. – 6% reduction in electric costs saving $25,000**
- **Summit View Campus – 11% reduction in electric costs saving $40,000**

Total Savings = $75,000

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Kenton County School District: Successes Using No Cost Measures

Natural Gas Suppliers

Solicit competitive bids from natural gas suppliers for high gas usage facilities

Estimated Annual Savings

- **Summit View Campus - $17,700**
- **Simon Kenton H.S. - $27,900**

Total Savings = $45,600

Kenton County School District: Successes Using No Cost Measures

Targeting Schools with DDC Systems

Limiting Setpoints, increasing heating offsets, controlling schedules

2006 – 2007

- **Ft. Wright Elem – 3.6% reduction in electric usage saving $4,600**
- **White's Tower Elem – 4.2% reduction in electric usage saving $3,700**
- **Taylor Mill Elem – 10.1% reduction in energy usage saving $16,600**
- **Piner Elem – 10.3% reduction in energy usage saving $6,100**
- **Dixie H.S. – 17.8% reduction in energy usage saving $32,700**
- **Simon Kenton H.S. – 19.2% reduction in energy usage saving $52,800**

Total Savings = $116,500

Found Money

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The Thoroughbred Center

- Training for thoroughbred horses
- 700 to 800 horses
- Several barns, 3 racetracks
- KPPC examined water bills
  - ✓Found sewer charges
  - ✓The center has no sewers
  - ✓Resulted in $ 14,000 credit

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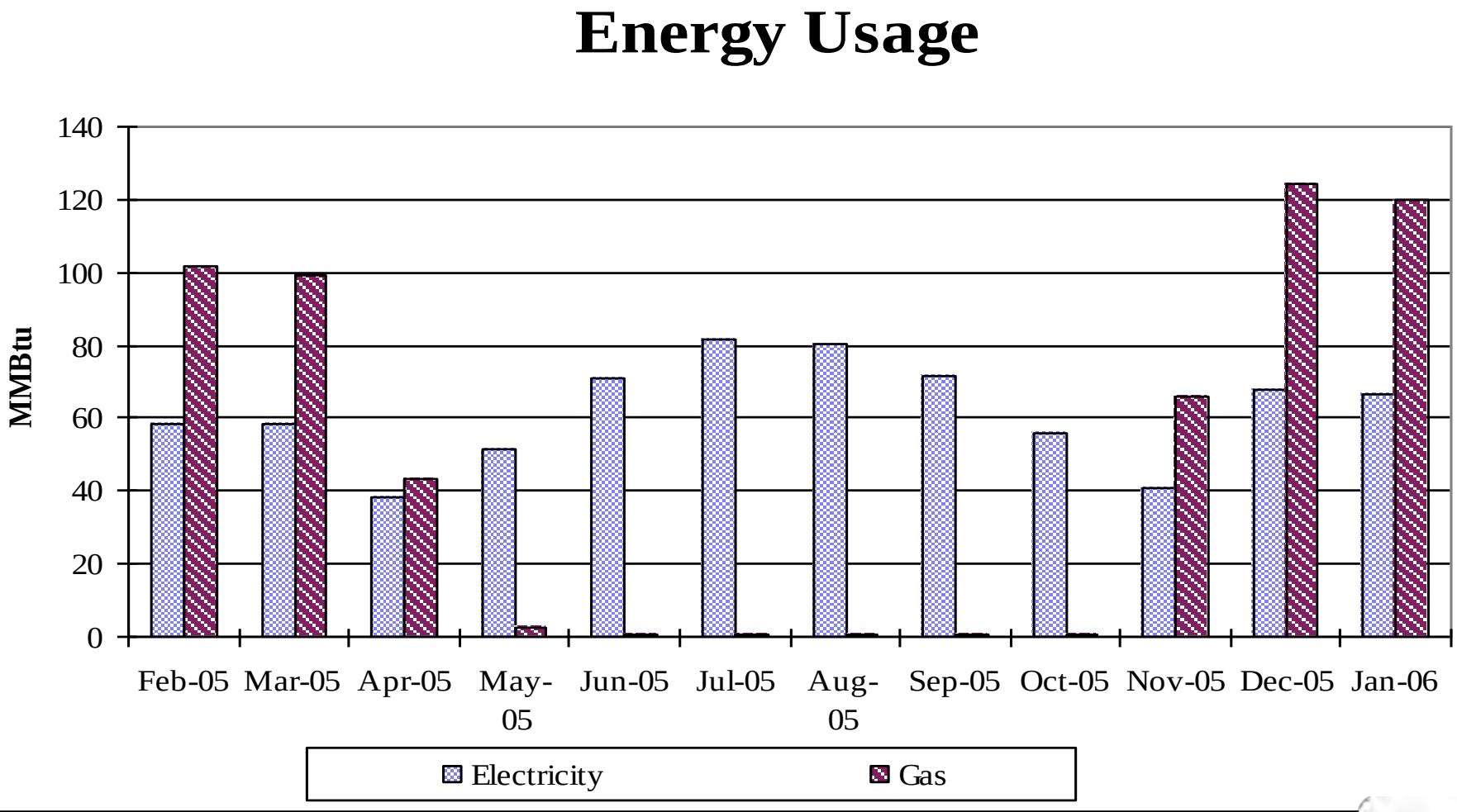
Found Money

Tracking Energy Use



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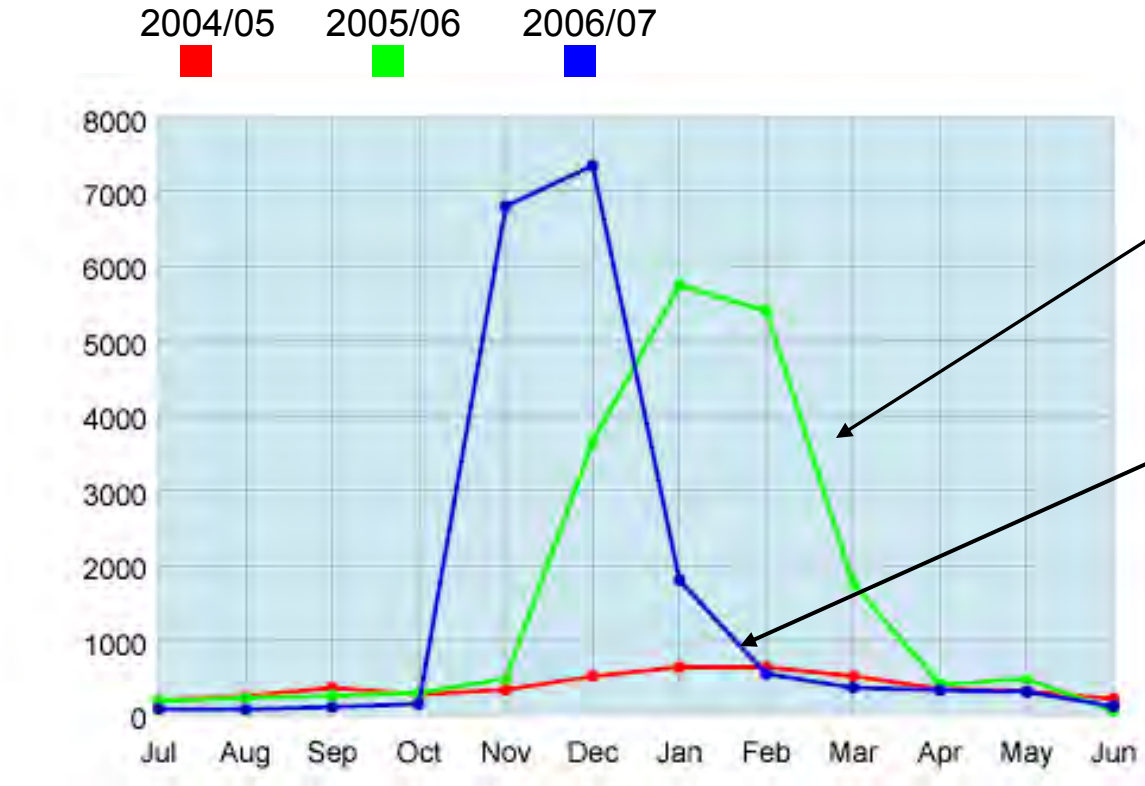
Monthly Energy Usage & Costs

- Trends & irregularities in energy usage & costs can be detected
- The relative merits of energy conservation & load management can be assessed
- Plotting the ratio of energy consumption to production may also be useful
  - ✓ For industry, appropriate measures of production can be gross sales, number of units produced, pounds of raw materials used, etc.
  - ✓ For commercial, the energy usage/cost can be benchmarked against building size

You Can't Manage What You Don't Monitor

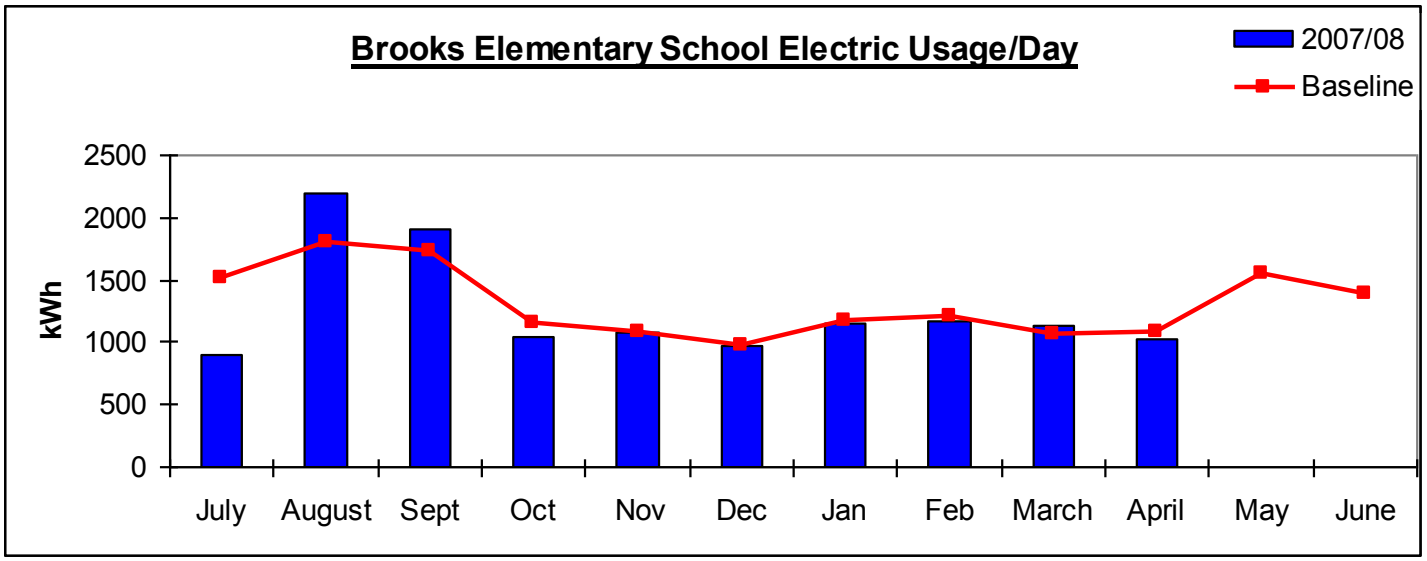


$23,500 more than the previous year.

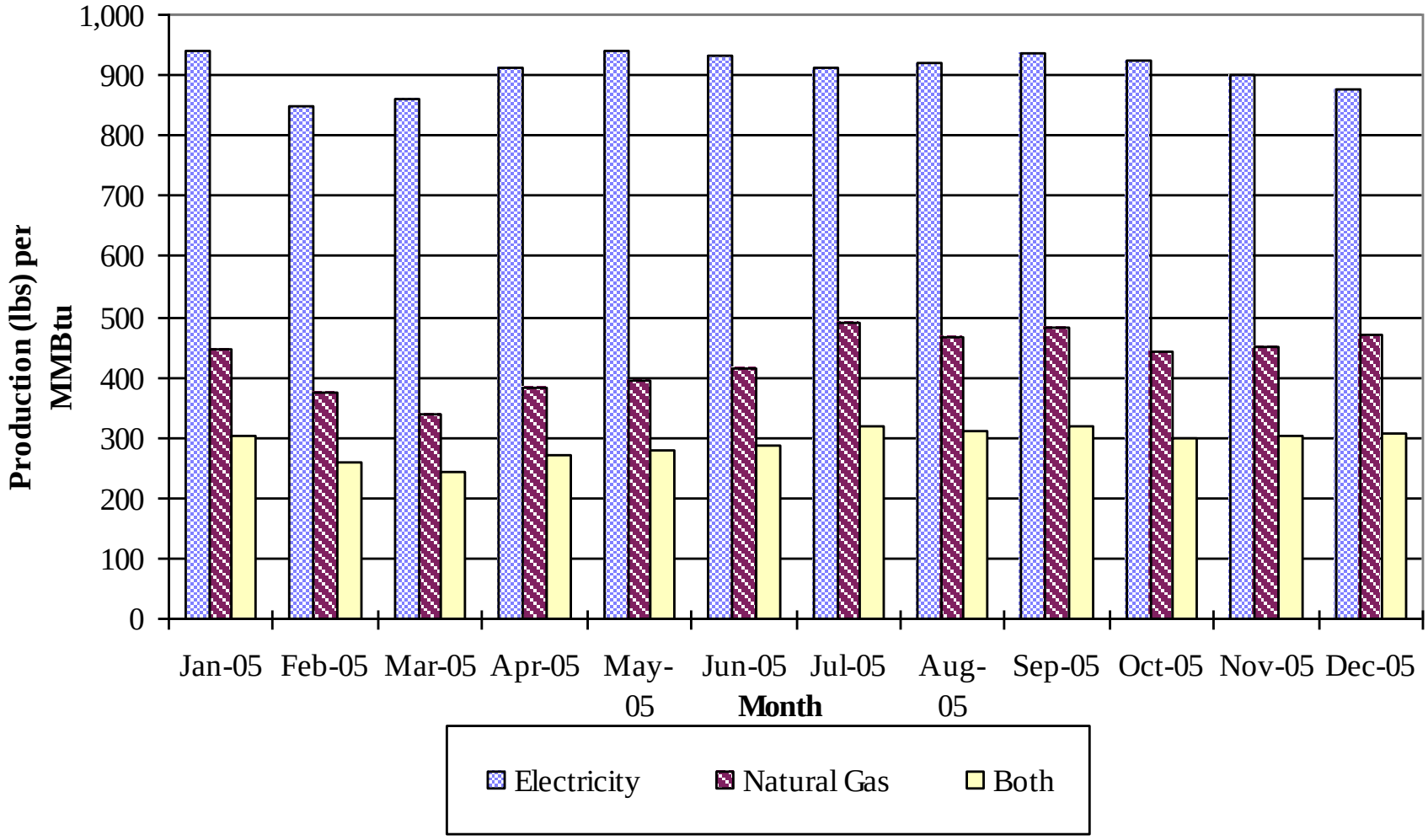
Equipment Checked and Reset. Gas Bill $5,000 less than previous month

Elementary School Natural Gas Usage

Brooks Electric Usage/Day (kWh/Day)				Weather Data			
Month	2007/08	% Change from Baseline	Baseline	2007/08		Baseline	
				CDD	HDD	CDD	HDD
July	904	-40%	1519	397	0	429	0
August	2200	23%	1793	629	0	389	5
Sept	1899	10%	1732	350	3	218	17
Oct	1035	-9%	1143	149	107	47	167
Nov	1076	-1%	1087	2	443	4	436
Dec	979	1%	973	0	712	0	910
Jan	1152	-2%	1171	2	935	0	853
Feb	1170	-3%	1209	0	776	0	703
March	1133	6%	1067	0	558	9	541
April	1030	-5%	1087	30	237	39	205
May			1546	0	0	164	68
June			1391	0	0	352	0
Average	1258	-4%	1310			1648	3902



Productivity Index for Energy Usage



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Completing an Energy Balance

- Collect energy usage (electric & gas) from utility bills
- Prepare equipment survey that contains the rating of all major energy consuming equipment
  - ✓ calculate annual energy usage for each type, annual operating hours & the efficiency
- Duty factors & load factors must be used to get the energy usage by the equipment
  - ✓ Duty factor is the fraction of the equipment operating hours when the equipment is running (cycling on)
  - ✓ Load factor is the ratio of average power consumption to the nominal rated input
- The total energy usage estimated by all equipment surveyed should equal the energy usage from the utility bills

Air Compressor Survey

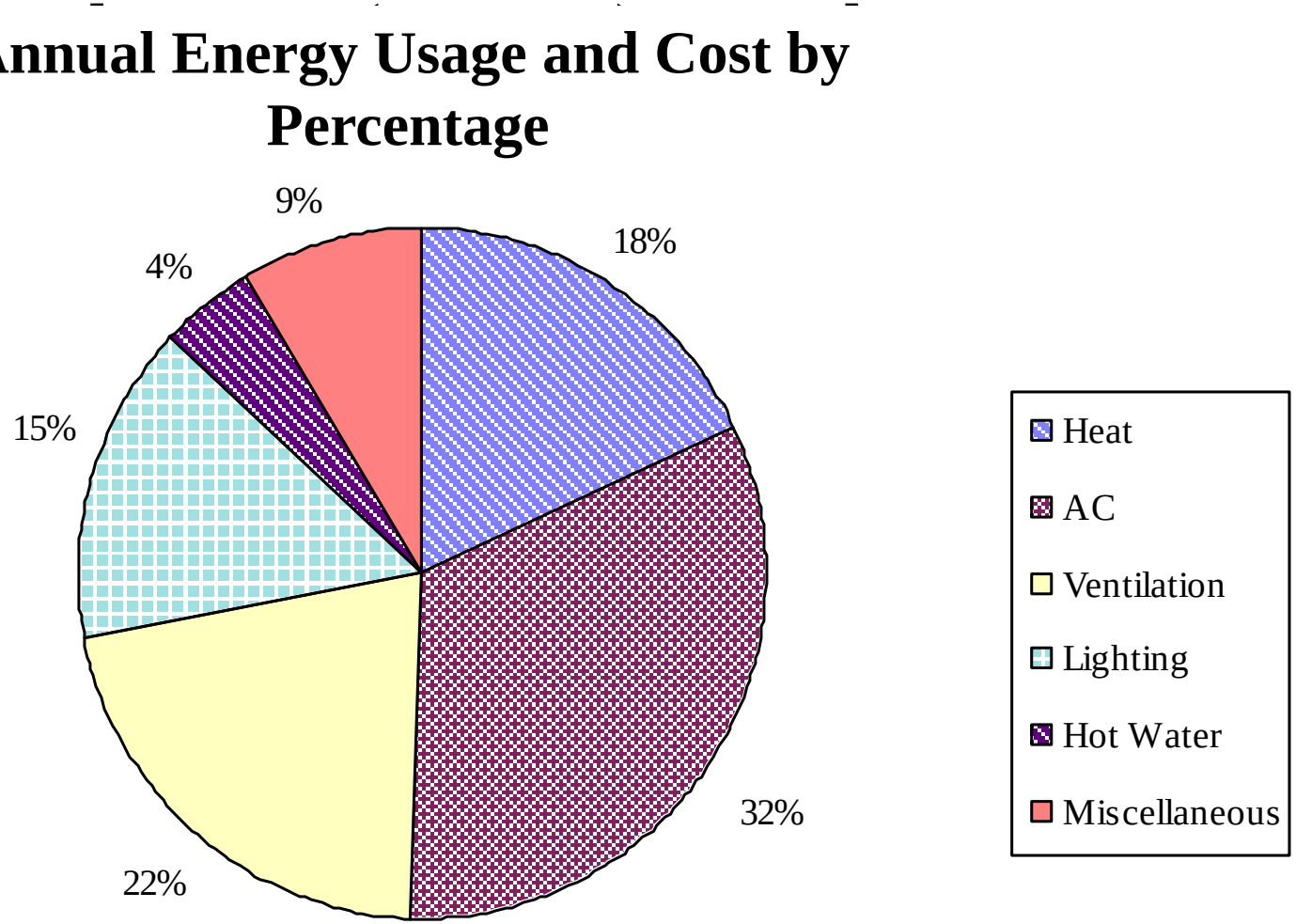
Equipment Description	Location	Motor Rating (HP)	Motor Rating (kW)	Annual Operating Hours	Duty Factor[1]	Load Factor[2]	Efficiency	Annual Energy Usage[3] (kWh/yr)
Quincy (120 psi)	Mechanical Room	350	261	8,760	0.5	0.4	0.96	476,325
Total			261					476,325

1) Duty Factor is the fraction of the equipment operating hours when equipment is running (Cycling On)

2) Load Factor is the ratio of average power consumption to the nominal rated input

3) Annual Energy Usage = kW x Annual Operating Hours x Duty Factor x Load Factor/ Efficiency

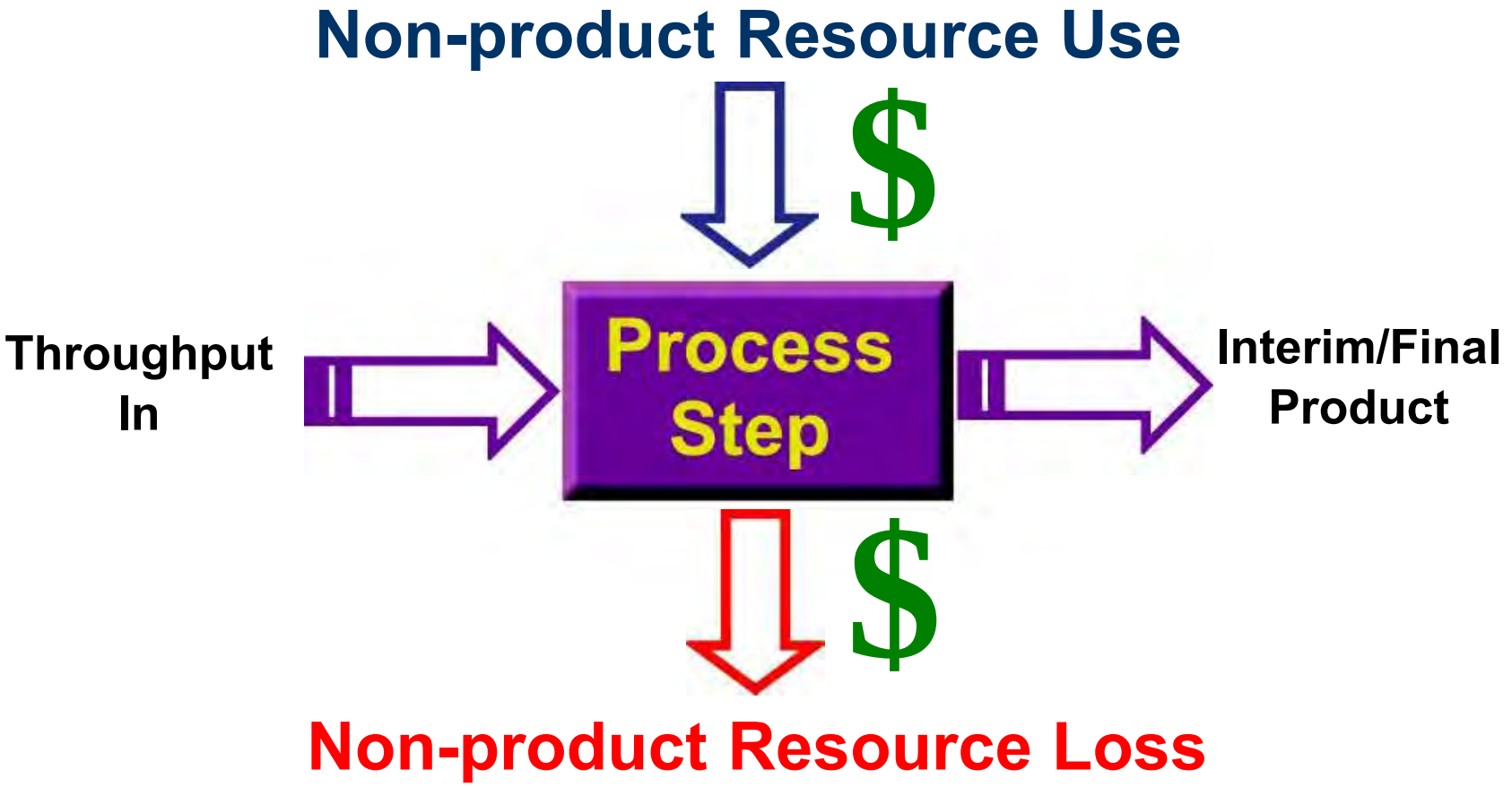
Energy Management Opportunities



Benefits of Energy Balance

- Determine which processes to concentrate efforts on for reducing & eliminating energy usage
- Establishes a baseline over which efficiency improvements can be tracked & benchmarked
- Effective tool to determine & compare economic feasibility of various energy efficient improvement strategies

Resource Accounting



Step 3: Set Goals

- **Performance goals**
  - ✓ Drivers for energy & water management activities
  - ✓ Promote continuous improvement
- **Setting clear & measurable goals**
  - ✓ Critical for understanding intended results
  - ✓ Developing effective strategies
  - ✓ Reaping financial gains
- **Well-stated goals**
  - ✓ Guide daily decision-making
  - ✓ Basis for tracking & measuring progress

Managing Energy Wisely

- Do not want to negatively affect occupant comfort or safety
- Focus on what's happening when the building is unoccupied
- During occupied times, make sure equipment is running efficiently

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Step 3: Set Goals

- Identify Low/No Cost Measures
  - HVAC Controls
    - Time Clocks, Programmable Thermostats, Exhaust Fans
  - Exit Signs
  - Incandescent to Compact Fluorescent Light Bulbs
  - Remove Bulbs from Vending Machines
- Identify Capital Improvement Measures
  - Performance Contract
    - Lighting, Upgrade Controls, Efficient HVAC Equipment

Step 4: Create Action Plan

- Roadmap to improve energy performance
- Successful organizations use action plan to:
  - ✓ Ensure a systematic process
  - ✓ Implement energy performance measures
- Action plan is regularly updated to reflect:
  - ✓ Recent achievements
  - ✓ Changes in performance
  - ✓ Shifting priorities

Action Plan for Step 1

		Planning Date	1/6/2008
Step	Task	Status	Start
1	**Make Commitment to Continuous Improvement**		
1.1	Create an Energy Program: Agree & Sign KEEPS Memorandum of Agreement (MOA)	COMPLETE	12-Jul-07
1.1.1	**Hire/Appoint an Energy Auditor/Manager**	COMPLETE	12-Jul-07
1.1.2	**Establish a Cross-Functional Energy Team**	COMPLETE	12-Jul-07
1.1.3	Schedule Energy Team's Monthly Meetings	COMPLETE	12-Jul-07
1.1.3.1	September 07 Energy Team Meeting	COMPLETE	12-Jul-07
1.1.3.2	October 07 Energy Team Meeting	COMPLETE	12-Jul-07
1.1.3.3	November 07 Energy Team Meeting	COMPLETE	12-Jul-07
1.1.3.4	December 07 Energy Team Meeting	COMPLETE	12-Jul-07
1.1.3.5	January 08 Energy Team Meeting	RED	12-Jul-07
1.2	**Institute an Energy Policy (Sustainable Energy Plan)**	COMPLETE	12-Jul-07
1.3	Develop Plan for Approved Training	AMBER	23-Jun-07
1.3.1	Approved Training #1: KPPC/KESC Workshop (Louisville)	AMBER	23-Jun-07
1.3.2	Approved Training #2: Basic Energy Management	GREEN	23-Jun-07
1.3.3	Approved Training #3: High Performance Sustainable Schools Conference	GREEN	23-Jun-07
1.4	**Become an ENERGY STAR Partner**	COMPLETE	1-Sep-07

Step 5: Implement Action Plan

5	Implement Action Plan			
5.1	Create communication plan for employees, customers & stakeholders	GREEN	1-Dec-07	31-Mar-08
5.2	Raise awareness with energy facts & figures (E2 Tips in Internal Communication)	GREEN	1-Dec-07	31-Mar-08
5.3	Build capacity through training & best practices	GREEN	1-Dec-07	15-May-08
5.4	Motivate with incentives & recognition	GREEN	1-Dec-07	31-May-08
5.5	Track and Monitor - update, review & identify necessary corrective actions	GREEN	1-Dec-07	15-Jun-08
5.6	Consider Purchasing ENERGY STAR labeled equipment	GREEN	1-Dec-07	15-Jun-08
5.7	Consider Designing new facilities to ENERGY STAR specifications	GREEN	1-Dec-07	15-Jun-08
5.8	Consider Implementing KY National Energy Education Development (NEED) program	GREEN	1-Dec-07	15-Jun-08
5.9	Consider Becoming a KY School Plant Management Association (KSPMA) member	GREEN	1-Dec-07	15-Jun-08

Steps 4 & 5: Create and Implement Action Plan

- Items to Address by Building or Maintenance Staff
- Raise Awareness
  - Initial Memo Sent District Wide
  - Shut-down Checklists Before Each Break
  - Website
  - Mascot Contest
  - Energy Star Change a Light Campaign
  - Regular Energy Walkthroughs
    - Meet with Principals and Custodians
  - Workshops
  - District Awards Program

Step 6: Evaluate Progress

- **Evaluating progress includes:**
  - ✓ Formal review of both energy use data & activities
  - ✓ Compares it to your performance goals
- **Review should include:**
  - ✓ Looking at effectiveness
  - ✓ What activities & projects were successful
  - ✓ Documenting "best practices"
  - ✓ Goals that were not met (determine root cause, decide corrective & preventative actions)
- **Formal review process results are used to:**
  - ✓ Create new action plans
  - ✓ Set new performance goals

Program Success

- **Financial**

  Electricity - $101,477/yr

  Natural Gas - $22,464/yr

  Rate Change - $12,000/yr

  Account Credits - $11,900/yr

  Avoided Costs - $11,000/yr

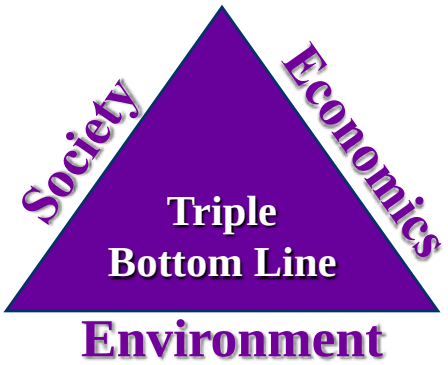
  TOTAL - Over $158,000/yr in Avoided Costs!

- **Improved Energy Conservation Behaviors and Attitudes**

Step 7: Recognize Achievements

- Proven step for sustaining momentum & support for your program & new initiatives
- Motivates staff & employees through increased job satisfaction
- Brings positive exposure to the energy management program
- Validates importance of the energy management program to internal & external stakeholders
- Provides positive exposure for the organization

Sustainable Performance



- **Triple Bottom Line**
  - ✓ **Social well-being**
  - ✓ **Strategic plan for economic goals**
  - ✓ **Environmental Management Guiding Principles**
    - **Pollution Prevention/Energy Efficiency**
    - **Compliance with all regulations**
    - **Continual improvement of performance**
    - **Conservation of natural & cultural resources**

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KPPC Contact Info

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