Benchmarking Toward Energy Efficiency

Robert Schoch

Director of Business Administration

Council Rock School District

2008 ENERGY STAR Partner of the Year

December 2008

Council Rock School District

Bucks County, Southeastern Pennsylvania

Profile

- Council Rock is the 9th largest with 12,500 students, 1400 professional and support staff
- District comprised of 72 square miles
- 15 Schools – 1.8 million square feet under roof
  - *2 High Schools - 350,000 so each (built 1968 & 2002)*
  - *3 Middle Schools – 85,000 so, 134,000sf, & 142,000sf (built 1954, 1963, 1975)*
  - *10 Elementary Schools – 31,000 so to 96,000 so (built 1951 to 2000)*
  - *Administration building – 35,000 so (built 1871, renovated 2004)*
- 2005 Energy Profile (Baseline)
  - *Budget - $3.74 million*
  - *Intensity – 102 kBTU/GSF*
  - *ENERGY STAR rating - 16*

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Benchmarking Defined

- Benchmarking is…

A disciplined approach for comparing the performance of processes, methods, procedures, products or services against "best-in-class" criteria.

Benchmarking is a positive process, providing objective performance measurements for goal setting and progress monitoring, which can lead to dramatic innovations. (Shafer & Coated, 1992)

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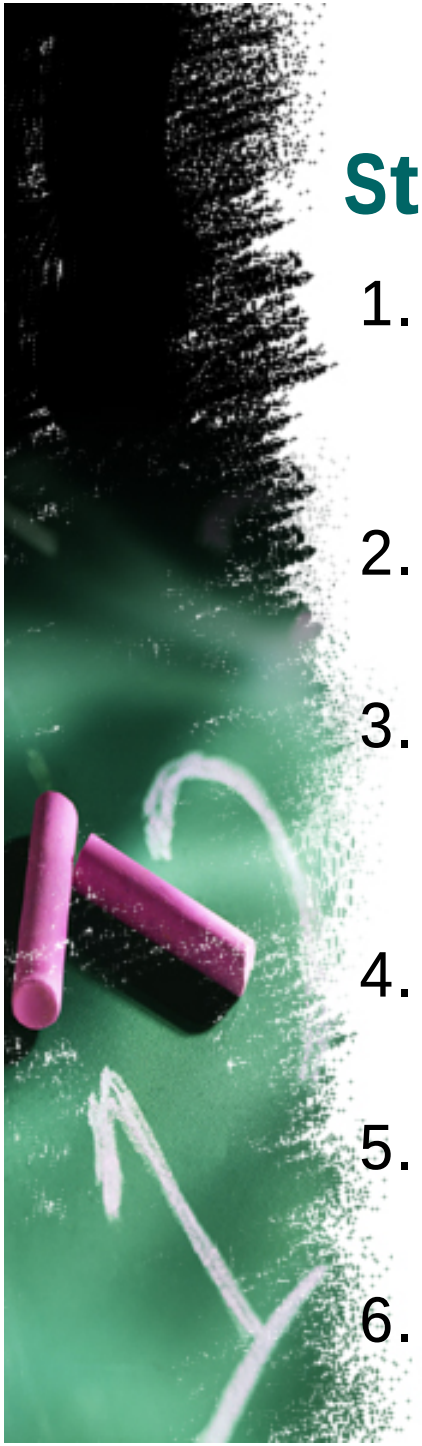
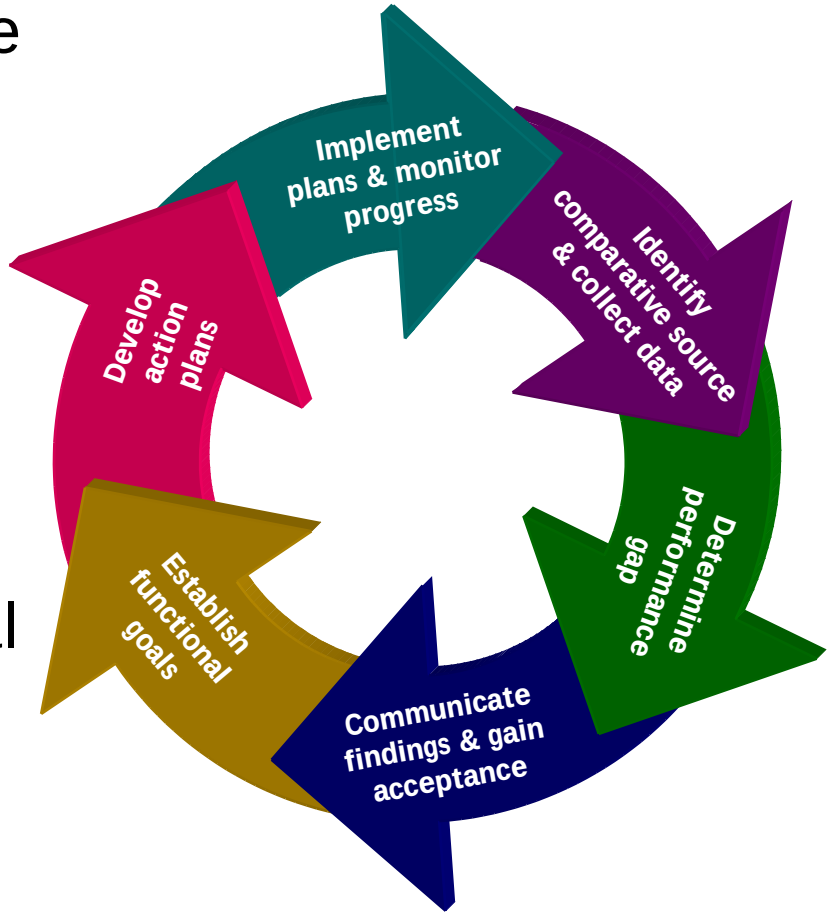


Steps of Benchmarking

1. Identify comparative source and collect data
2. Determine performance gap
3. Communicate findings & gain acceptance
4. Establish functional goals
5. Develop action plans
6. Implement plans & monitor progress



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Benchmarking Energy Management

Benchmarking Used to Guide Energy Management Program in

- Assessing Opportunity
- Developing Policy
- Selection of Overall Approach
- Implementation and Evaluation of Efforts
- Sustaining Progress

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STEP 1

GET YOUR GREEN ON!

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Assessing the Opportunity

Step 1 - Identify Comparative Source & Collect Data

PASBO – Provides benchmarking surveys of various facility data including energy cost – "Facilities Benchmarking Report"

Energy Star® – Provides benchmarking of energy consumption by building and by district through its on-line Portfolio Manager tool.

Consultant – Some energy consulting organizations maintain databases which can run benchmarking comparisons against similar institutions.

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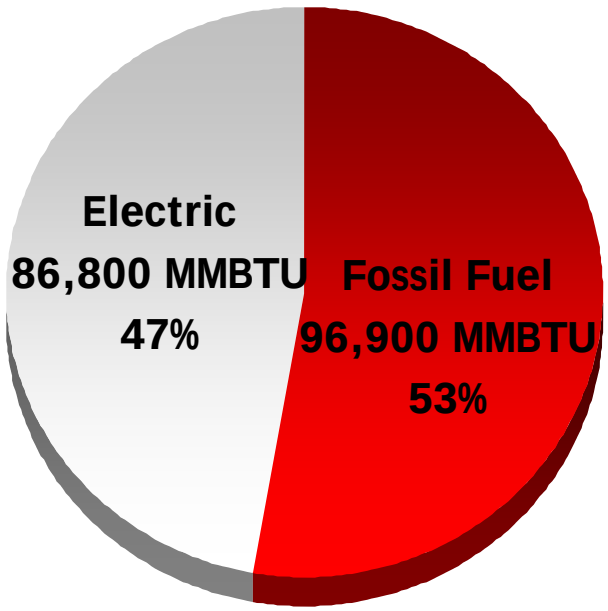
Assessing the Opportunity

Step 1 - Identify Comparative Source & Collect Data

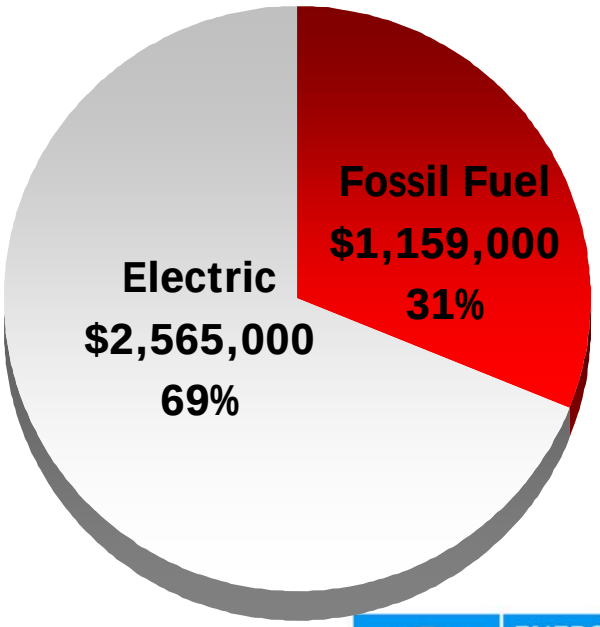
District Energy Cost and Consumption: Jan – Dec 2005

Total Consumption:	183,700 MMBTUs
Total Cost:	$3.7 Million
kBtu/GSF: 102.0	$/GSF: $2.07

Consumption (MMBTU)



Cost



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STEP 2

GET YOUR GREEN ON!

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Assessing the Opportunity

Step 2 - Determine Performance Gap:

Council Rock SD benchmarked at $1.80/sqft

Median - $1.44/sqft **Lowest - $0.97/sqft**

2003-2004 PASBO Facilities Benchmarking Report		STUDENT COUNT		
		All Districts		More Than 7,000
		2001-2002	2003-2004	
Highest 1/3	From	$2.04	$2.65	$1.88
	To	$1.28	$1.43	$1.52
Mid 1/3	From	$1.27	$1.42	$1.51
	Median	$1.15	$1.30	$1.44
	To	$1.06	$1.16	$1.27
Lowest 1/3	From	$1.05	$1.15	$1.26
	To	$0.60	$0.53	$0.97

CRSD

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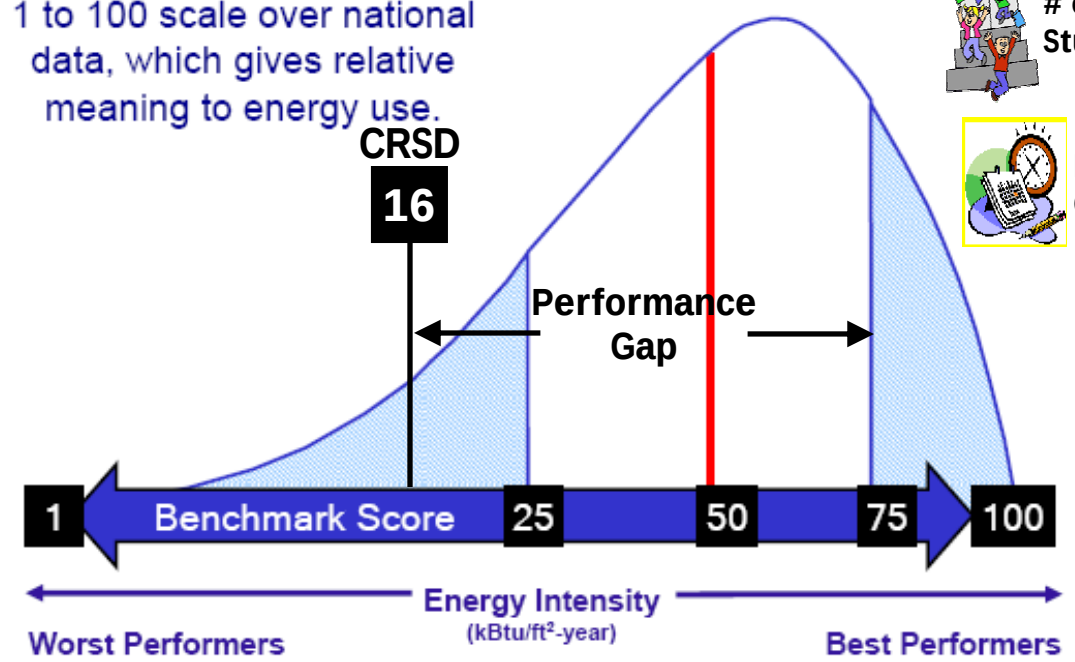
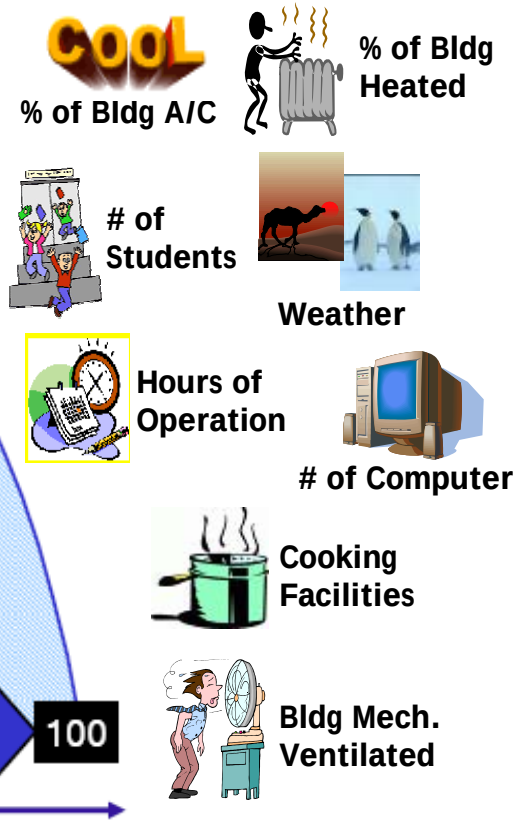
Assessing the Opportunity
Step 2 - Determine Performance Gap:

Energy Star® - Portfolio Manager Rating

The rating system overlays a 1 to 100 scale over national data, which gives relative meaning to energy use.





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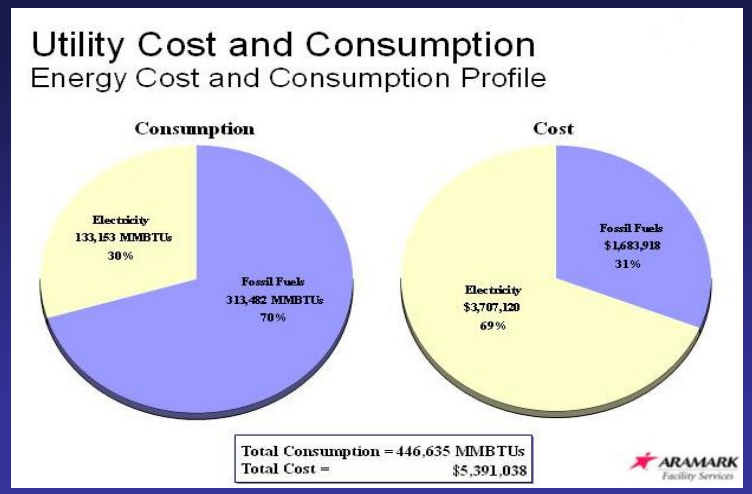
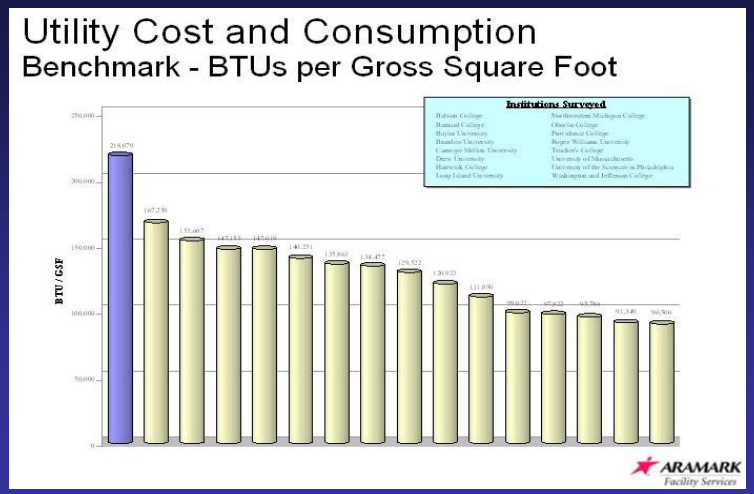
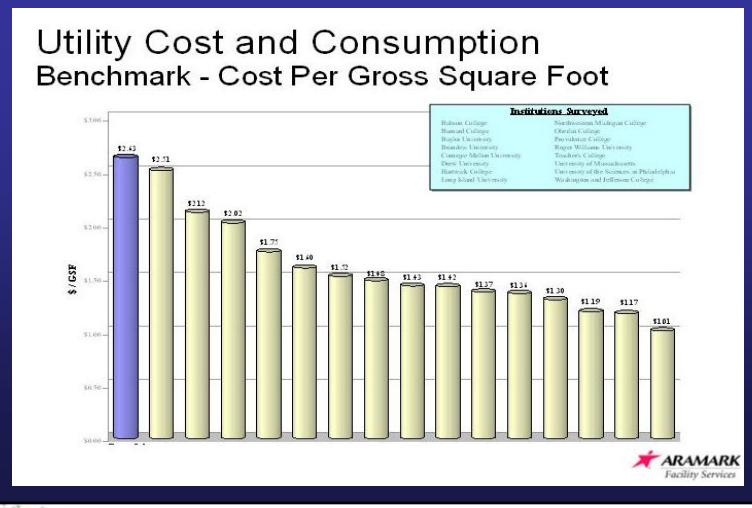
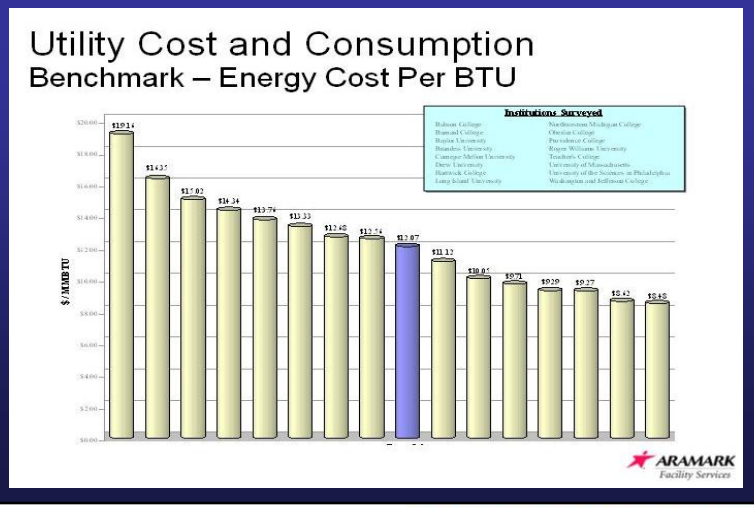
Assessing the Opportunity

Step 2 - Determine Performance Gap: Consultant









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Assessing the Opportunity

Step 2 - Determine Performance Gap

Potential Savings → $792,000

Source	Potential	CRSD Baseline	Gap
PASBO	$1.44/sqft	$1.88/sqft	$0.44/sqft
EnergyStar®	50	16	34
ARAMARK EDUCATION BenchMARK Performance Measurement	$1.65/sqft	$2.11/sqft	$0.46/sqft

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STEP 3

Communicate findings & gain acceptance

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Developing Policy & Selecting Overall Approach

Step 3 - Communicate Findings & Gain Acceptance

- District had energy performance contract in 1998 which did $2 million in work and led to belief that all easy savings had been implemented. Still paying more for that contract than current energy program.
- District administrators had negative experience with shared savings incentive program.
- Costs of delay-it took school board 5 months to decide
- "Change is not required. Survival is not mandatory." W.Edward Deming

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Developing Policy & Selecting Overall Approach

Step 3 - Communicate Findings & Gain Acceptance

Administration & School Board

- Performance gap-costs of delaying decision/implementation
- Policy elements compared to best practices in education
- Temperature settings-heat/cool, type of space, occupied/unoccupied
- Responsibility
- Shared savings incentive
- Management
- How to get quick results and sustain them
- How to decide on mix of program components-operating changes, maintenance procedures, and capital improvements

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STEP 4

GET YOUR GREEN ON!

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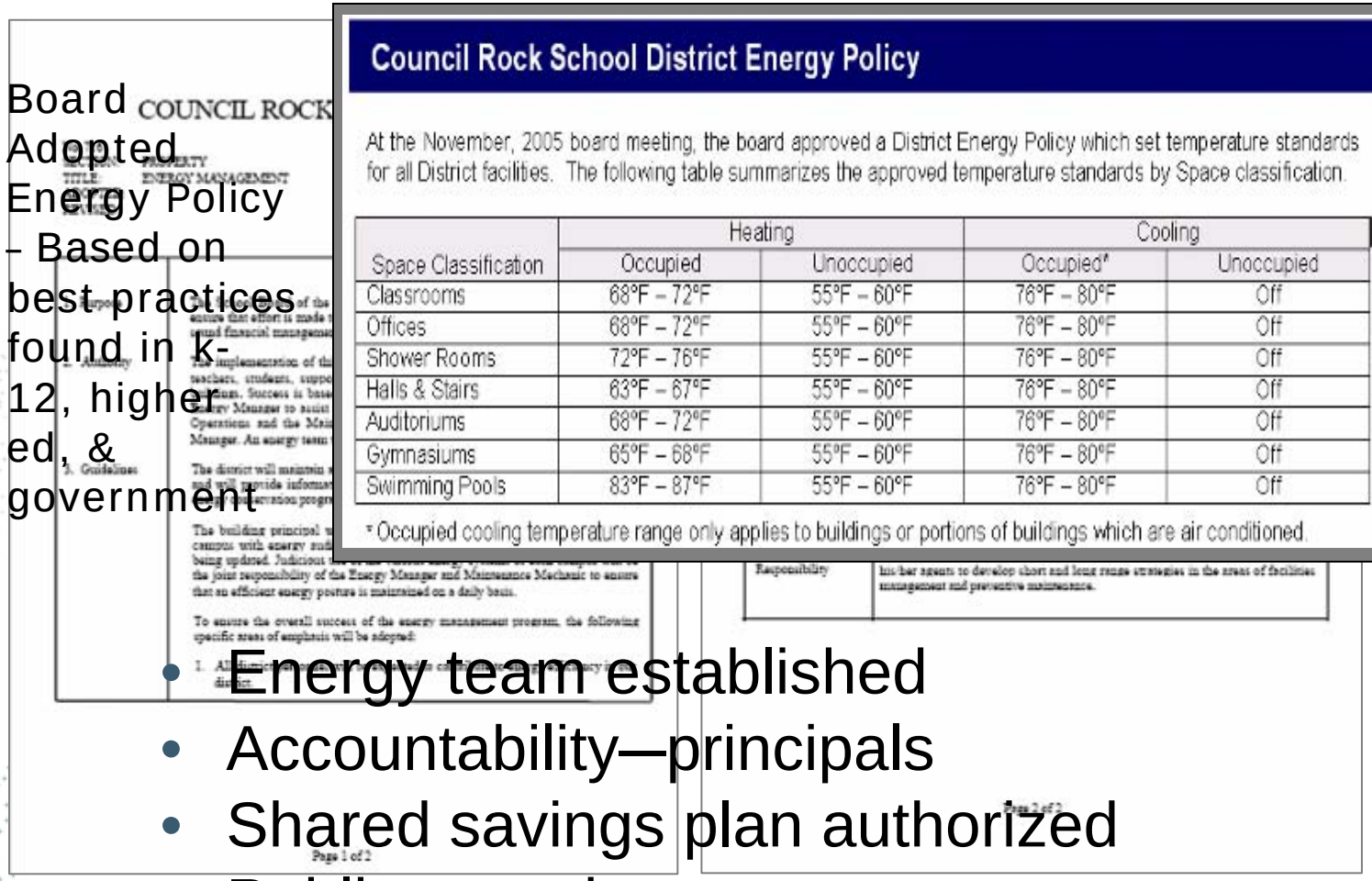
Developing Policy & Selecting Overall Approach
Step 4 - Establishing Functional Goals

- Board Adopted Energy Policy – Based on best practices found in K-12, higher ed, & government



Council Rock School District Energy Policy

At the November, 2005 board meeting, the board approved a District Energy Policy which set temperature standards for all District facilities. The following table summarizes the approved temperature standards by Space classification.

Space Classification	Heating		Cooling	
	Occupied	Unoccupied	Occupied*	Unoccupied
Classrooms	68°F – 72°F	55°F – 60°F	76°F – 80°F	Off
Offices	68°F – 72°F	55°F – 60°F	76°F – 80°F	Off
Shower Rooms	72°F – 76°F	55°F – 60°F	76°F – 80°F	Off
Halls & Stairs	63°F – 67°F	55°F – 60°F	76°F – 80°F	Off
Auditoriums	68°F – 72°F	55°F – 60°F	76°F – 80°F	Off
Gymnasiums	65°F – 68°F	55°F – 60°F	76°F – 80°F	Off
Swimming Pools	83°F – 87°F	55°F – 60°F	76°F – 80°F	Off

* Occupied cooling temperature range only applies to buildings or portions of buildings which are air conditioned.

- Energy team established
- Accountability—principals
- Shared savings plan authorized
- Public reporting

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ENERGY STAR Case Studies

Buildings & Plants Partner List Results: ENERGY STAR Leaders : ENERGY STAR - Microsoft Internet Explorer provided by Council Ro

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Address http://www.energystar.gov/index.cfm?fuseaction=partner_list.showPartnerResults&leaders_yn=Y&poy_yn=N&success_yn=N&partner_type_id=CIK&s_code=ALL

Management
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Expert Help
Commercial Building Design
Green Buildings

Getting Started for...
Commercial Real Estate
Corporate Real Estate
Government
Healthcare
Higher Education
Hospitality
Industrial
K-12
Retail
Small Business
Congregations
Service & Products Providers
Utilities & Energy Efficiency Program Sponsors

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Buildings & Plants Partner List Results

ENERGY STAR Leaders

Printable: Results 1 - 20 | All Results

Select another sector: K-12 Education

Select another location: All States Go

More information on Leaders and Awards

Results **1** - **20** of 43 Next | View All **All #** A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Name	Sector	Location	Leaders	Award Winner
Albert Lea Area Schools	K-12 Education	Minnesota	20 Percent (2008) View Story	
Austin Public Schools ISD 492	K-12 Education	Minnesota	Top Performer (2007) View Story	
Averill Park Central School District	K-12 Education	New York	20 Percent (2006) View Story	
Blue Mountain School District	K-12 Education	Pennsylvania	30 Percent (2008) View Story	
Buffalo-Hanover-Montrose School ISD 877	K-12 Education	Minnesota	10 Percent (2006) Top Performer (2007) View Story	
Burleson Indpendent School District	K-12 Education	Texas	Top Performer (2008) View Story	
Burnsville Eagan Savage ISD 191	K-12 Education	Minnesota	10 Percent (2006) Top Performer (2008) View Story	
Cambridge-Isanti Public Schools ISD 911	K-12 Education	Minnesota	10 Percent (2006) View Story	

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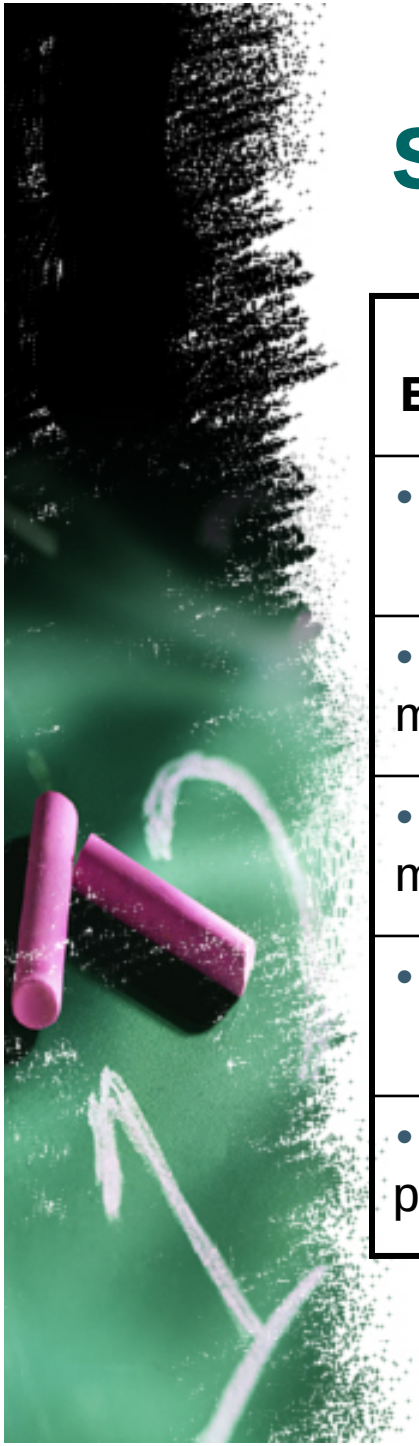

Selecting an Energy Program

Options for Energy Management	Program Cost	Energy Saving Potential
•Do nothing	None	None
•Use existing maintenance staff	None	Low
•Hire additional maintenance staff	Low	Medium
•Hire energy manager	Medium	Medium
•Contracted energy program	High	High

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Council Rock's Decision on Best Plan

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Council Rock's Decision on Best Plan

Customized Program Contract Provisions

- Guaranteed savings in excess of program cost — *Net Savings!*
- 20% performance bonus beyond guarantee with $100,000 maximum.
- 3 year full-time program then 2 year transition.
- District capital commitment of $500,000.
- District approval of Energy Manager candidate
- Extra services by mutual agreement

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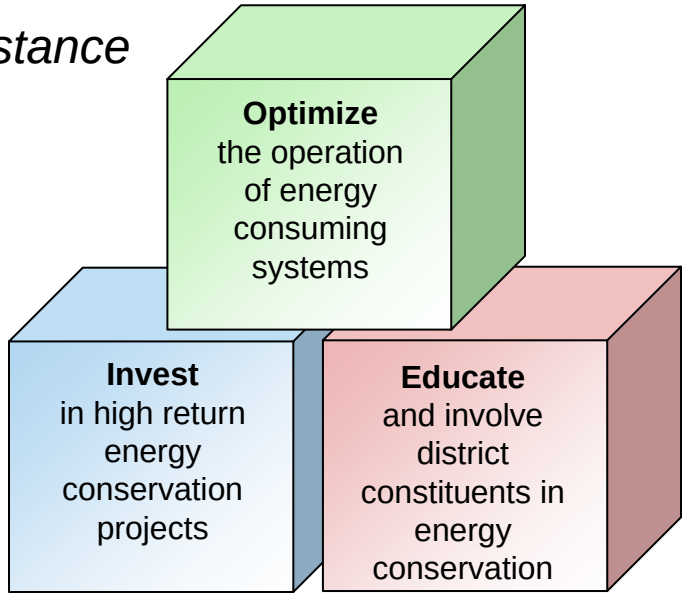
Contracted Program Services

- Energy Program conducted by ARAMARK Education using comprehensive approach model
  - *Full time Energy Manager to conduct program*
  - *Direction and hands-on assistance for field activities such as retro-commissioning*
  - *High impact investment opportunity identification*
  - *Educational involvement of staff and students*



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Developing Policy & Selecting Overall Approach
Step 6 – Implement Plans & Monitor Progress

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Implement Plans & Monitor Progress

- Once you've decided on which type of program it's time to put it to action
- ENERGY STAR provides evaluation tools to determine extent of implementation of program components
  - *Portfolio Manager-ratings for each building (1 to 100 normalized scale)*
  - *Case Studies(43 districts, some with ratings of 93 on 1 to 100 scale)*
  - *Energy Program Assessment Matrix (degree of implementation of research proven program elements)*

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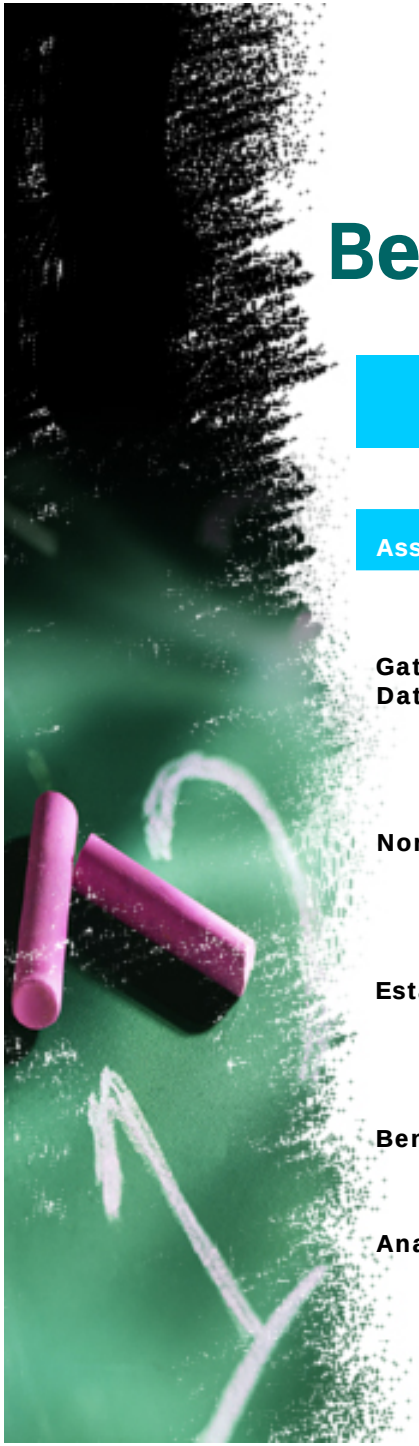

Benchmarking Implementation Levels

ENERGY STAR Energy Management Assessment Matrix

	Little or no evidence	Some elements	Fully Implemented
Assess Performance and Opportunities			
Gather and Track Data	Little metering/no tracking	Local or partial metering/tracking/reporting	All facilities report for central consideration/analysis
Normalize	Not addressed	Some unit measures or weather adjustments	All meaningful adjustments for organizational analysis
Establish baselines	No baselines	Various facility-established	Standardized organizational base year and metric established
Benchmark	Not addressed or only same site historical comparisons	Some internal comparisons among company sites	Regular internal & external comparisons & analyses
Analyze	Not addressed	Some attempt to identify and correct spikes	Profiles identifying trends, peaks, valleys & causes

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The Council Rock Program

District Commitment of $500,000 for Energy Saving Capital Improvements

- Goal is to make equipment more efficient when operating
- Directed at quick payback efforts < 2-3 yrs

Initial Site Review Team

- Needs identified—Included both energy efficient equipment upgrades and deferred maintenance
- Project cost and simple payback analysis

Energy Manager

- Stage projects according to payback and coordination with future steps and Facility Master Plan
- Adjust project list as more information is gathered
- Specification writing, project management and commissioning

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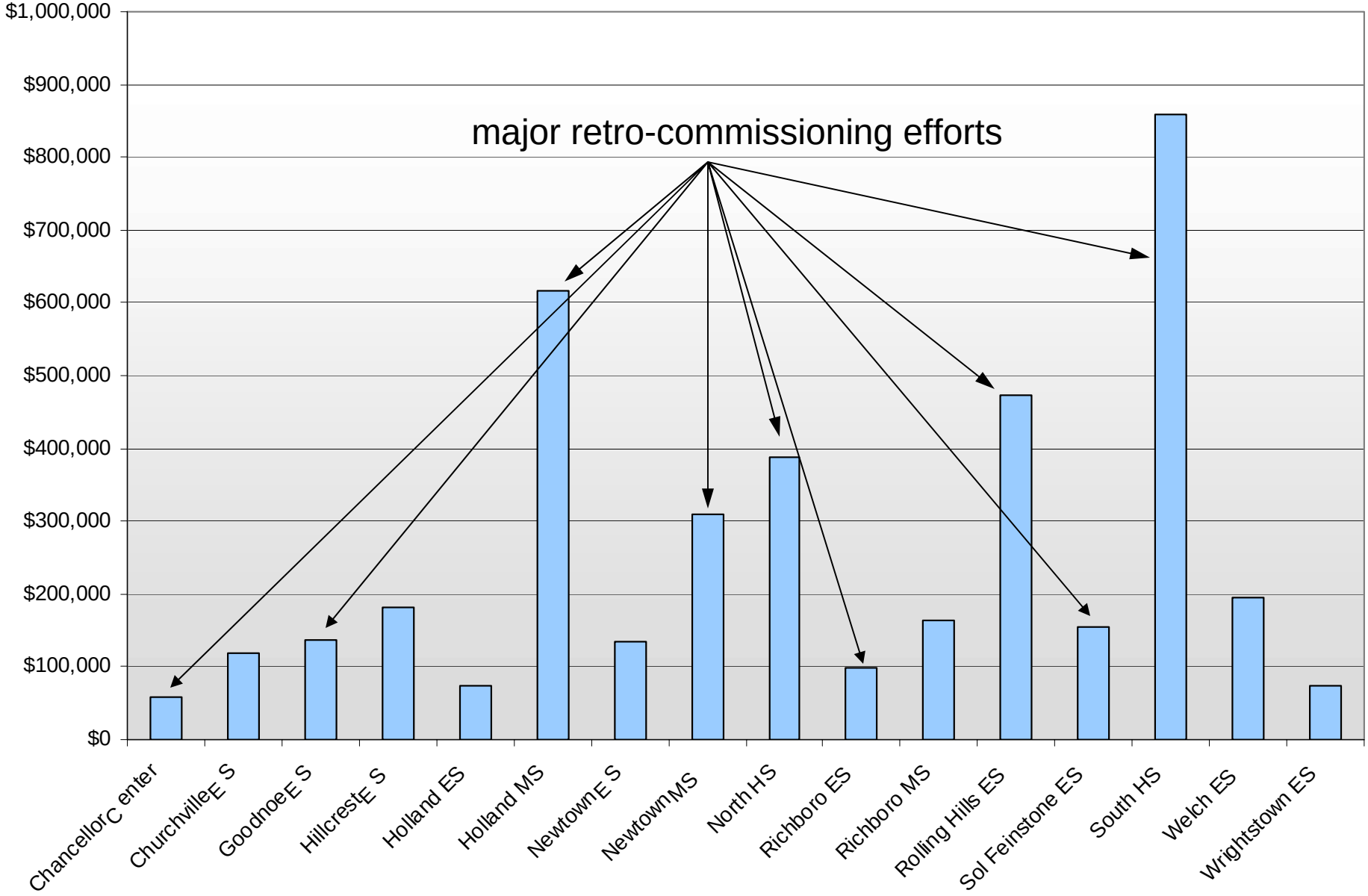
Focus on Financial Return, Refocus Often



Program Results

- Current Energy Profile
  - *Budget - $3 million*
  - *Intensity – 59 kBTU/GSF*
  - *ENERGY STAR rating - 54*
- Energy reduction
  - *41.6% District Reduction - not temperature adjusted*
  - *38.4% ENERGY STAR Reduction-temperature adjusted*
- Cost Avoidance-$4.3 million in 33 months
- Capital investment- approx. $150,000
  - *Interconnect building automation systems for centralized and remote access and control*
  - *Thermostats for modular classrooms*
- General maintenance budget expenses total of approximately <$100,000 in parts and limited control service contracts for retro-commissioning work
- Two buildings ENERGY STAR labeled

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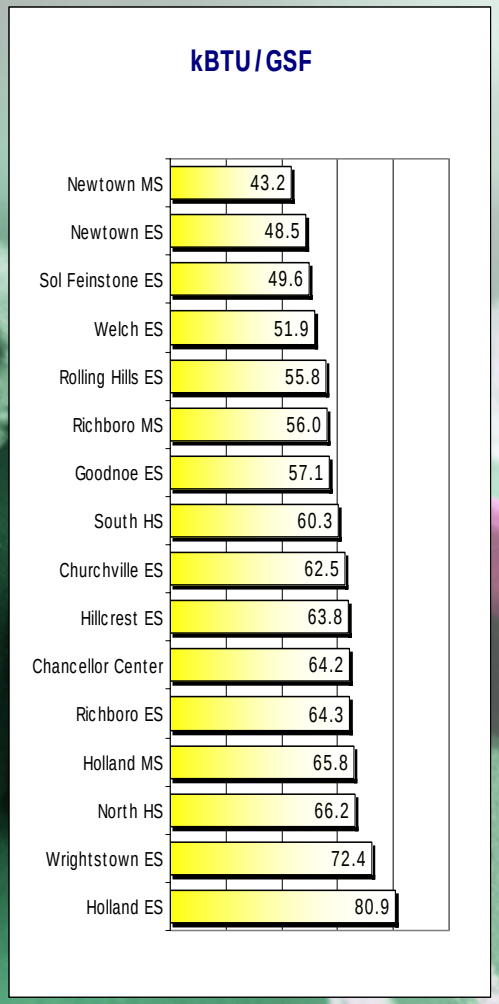
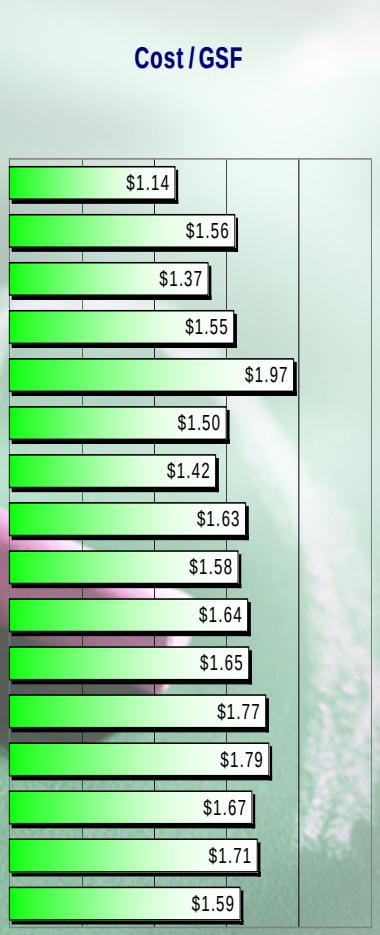
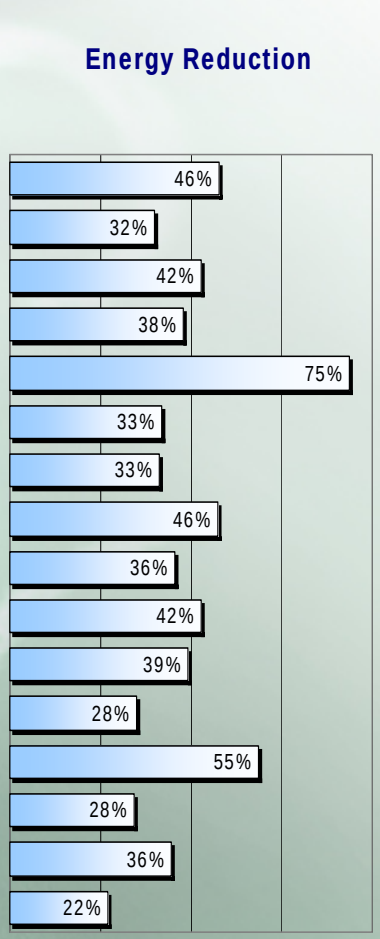
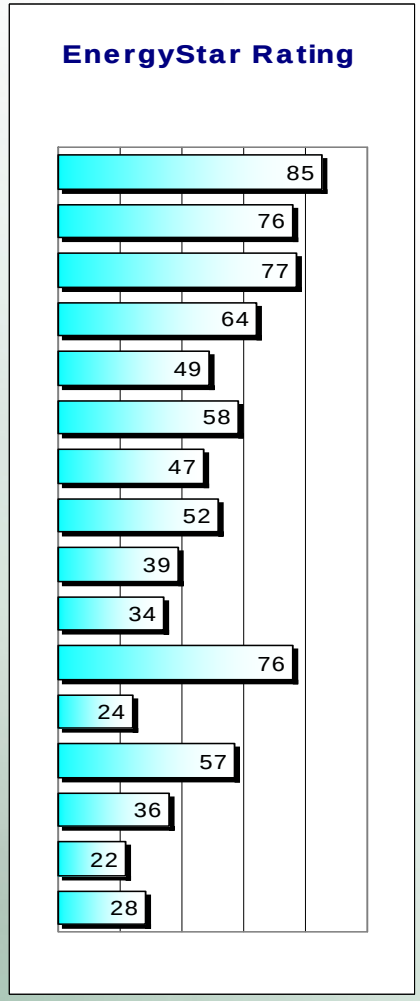
Council Rock School District-Monthly Report

School Performance Through April 2008

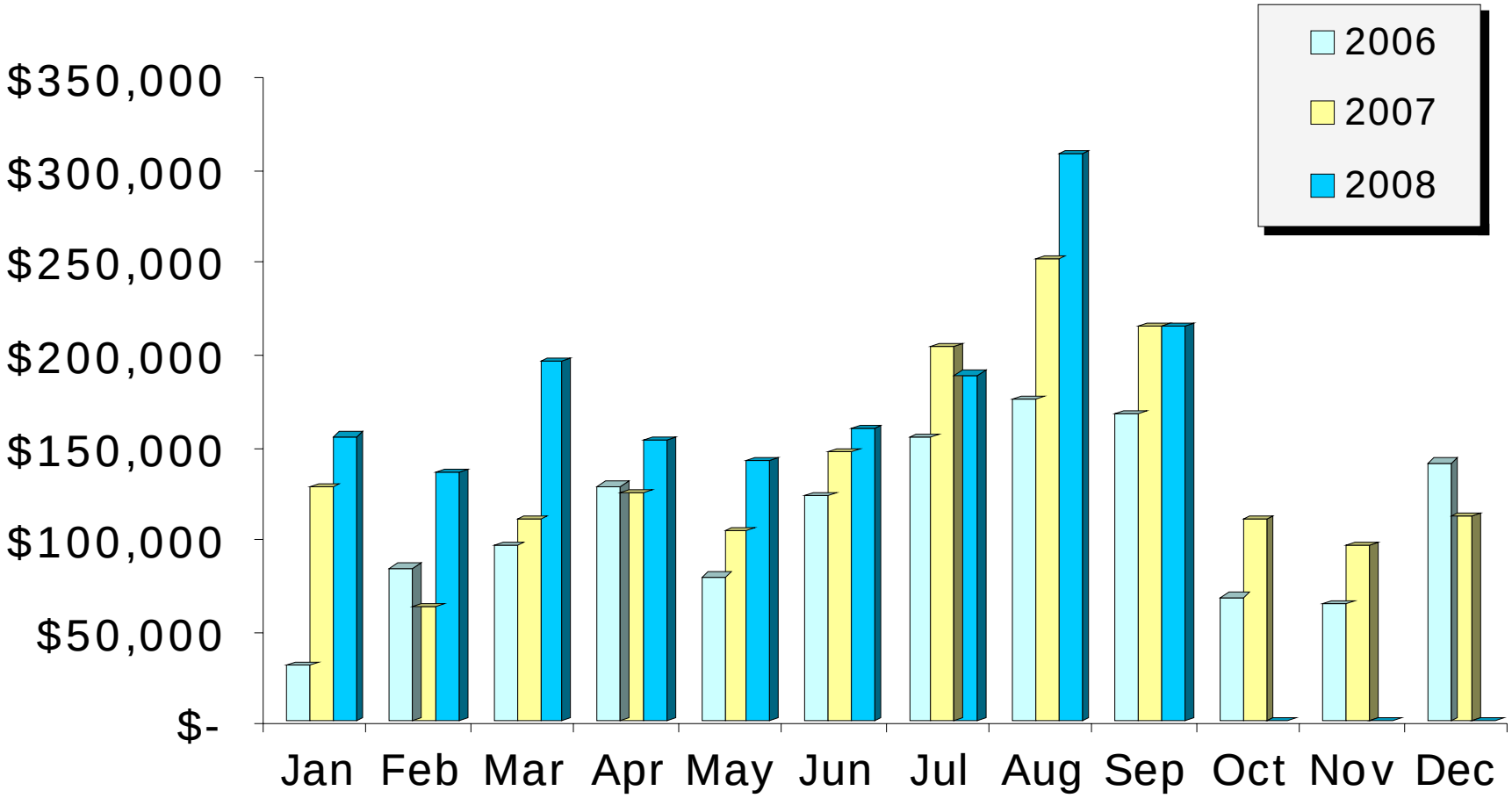






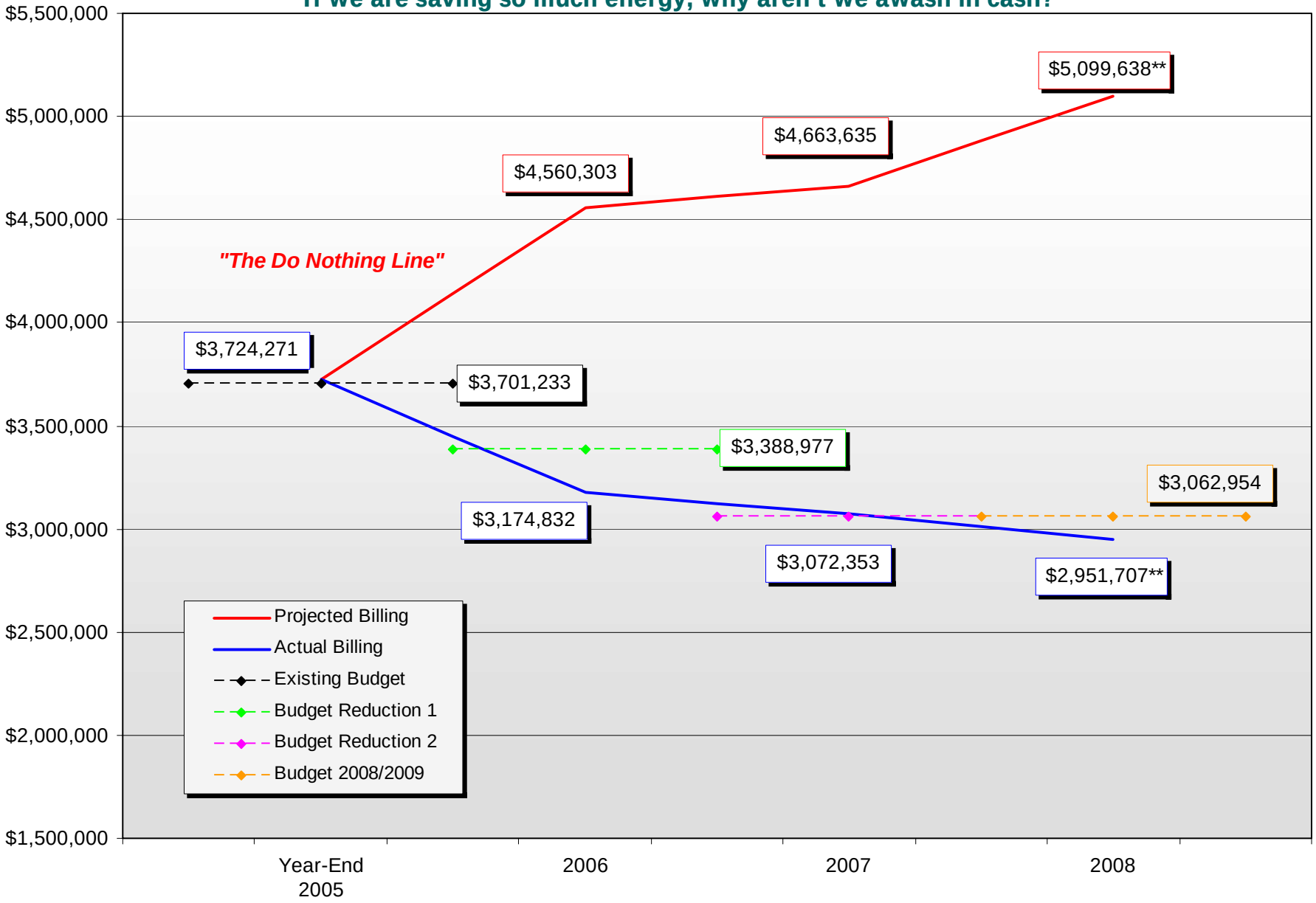


District Cost Savings

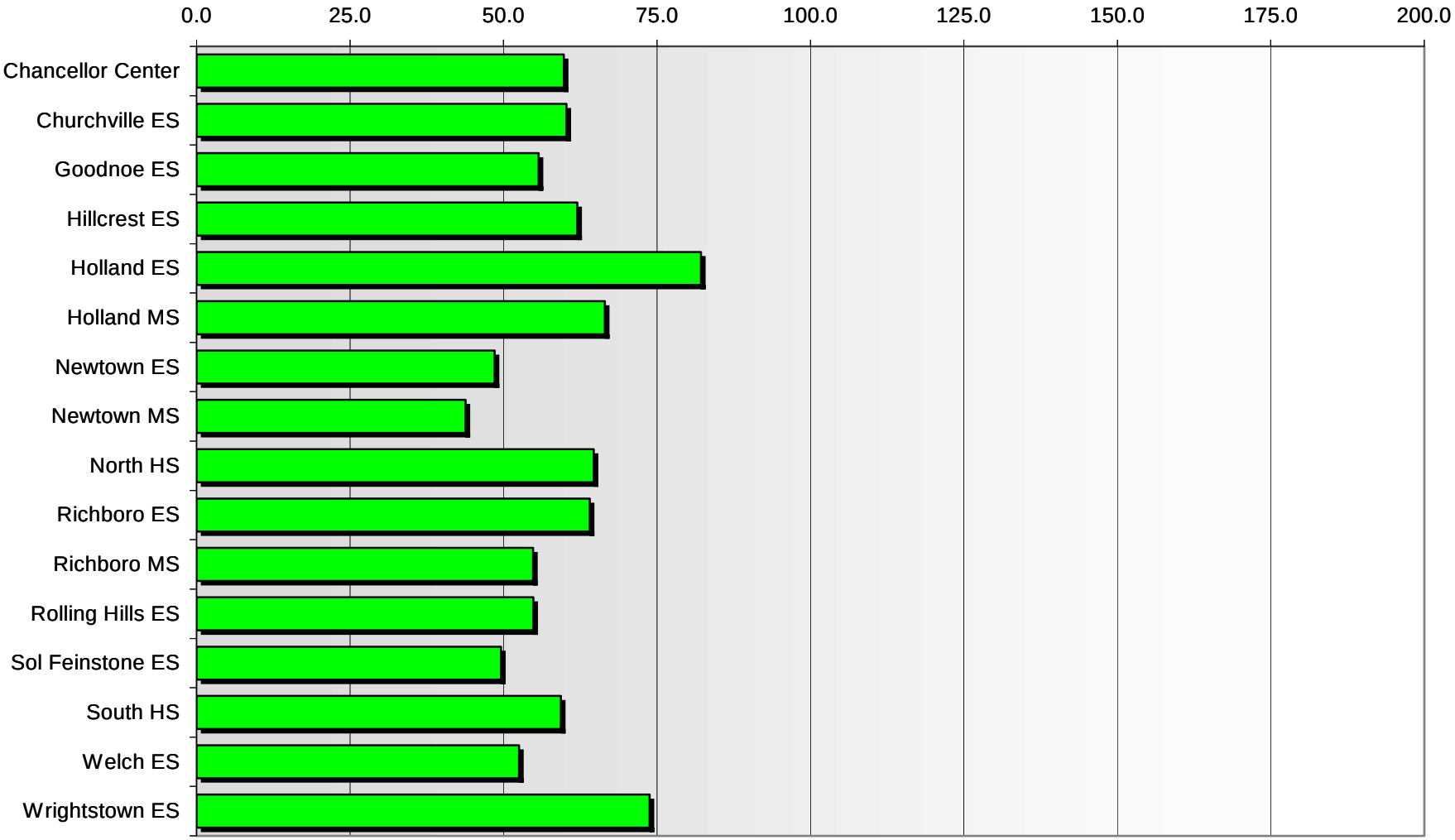


3-Year Financial Analysis

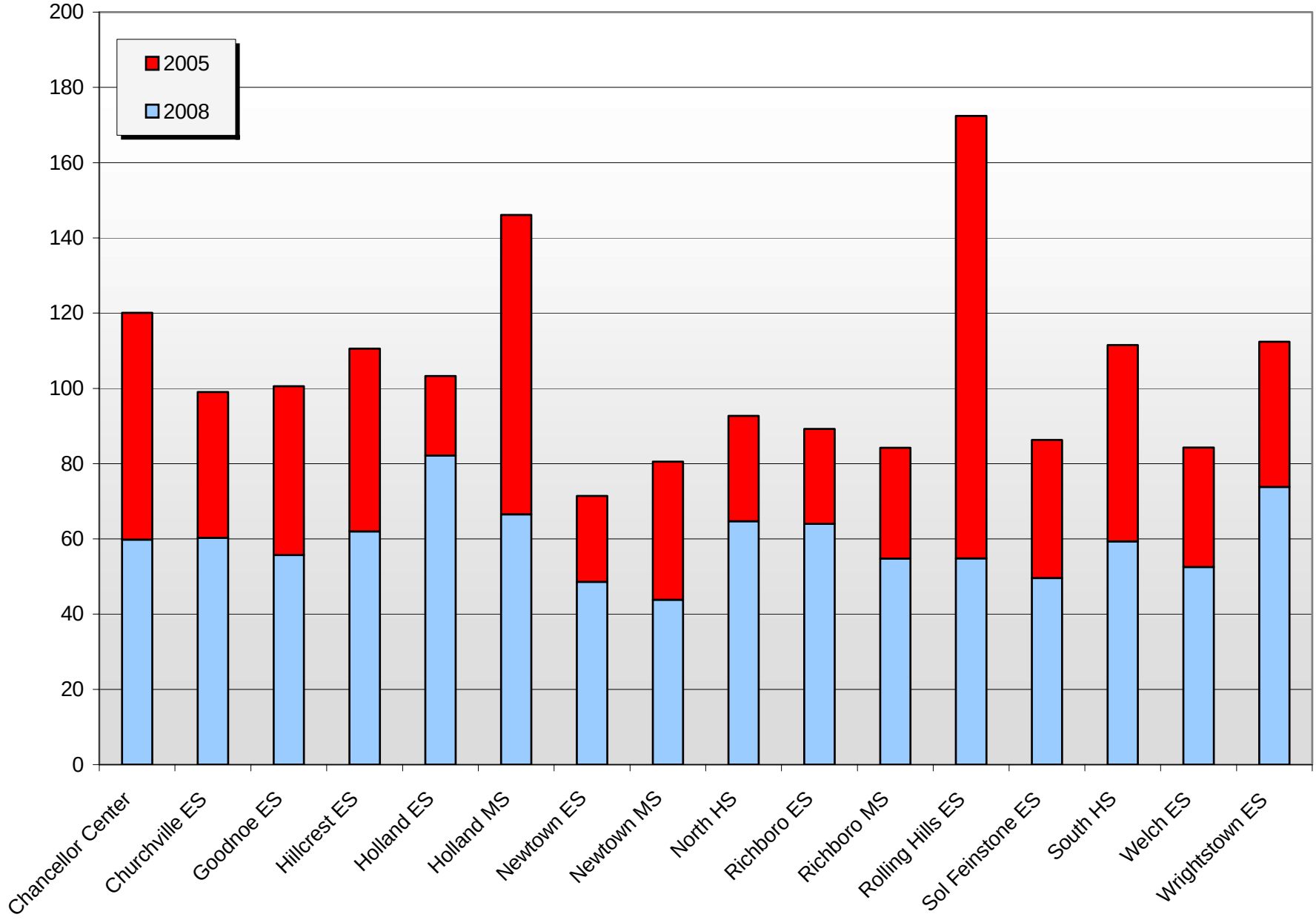
"If we are saving so much energy, why aren't we awash in cash?"



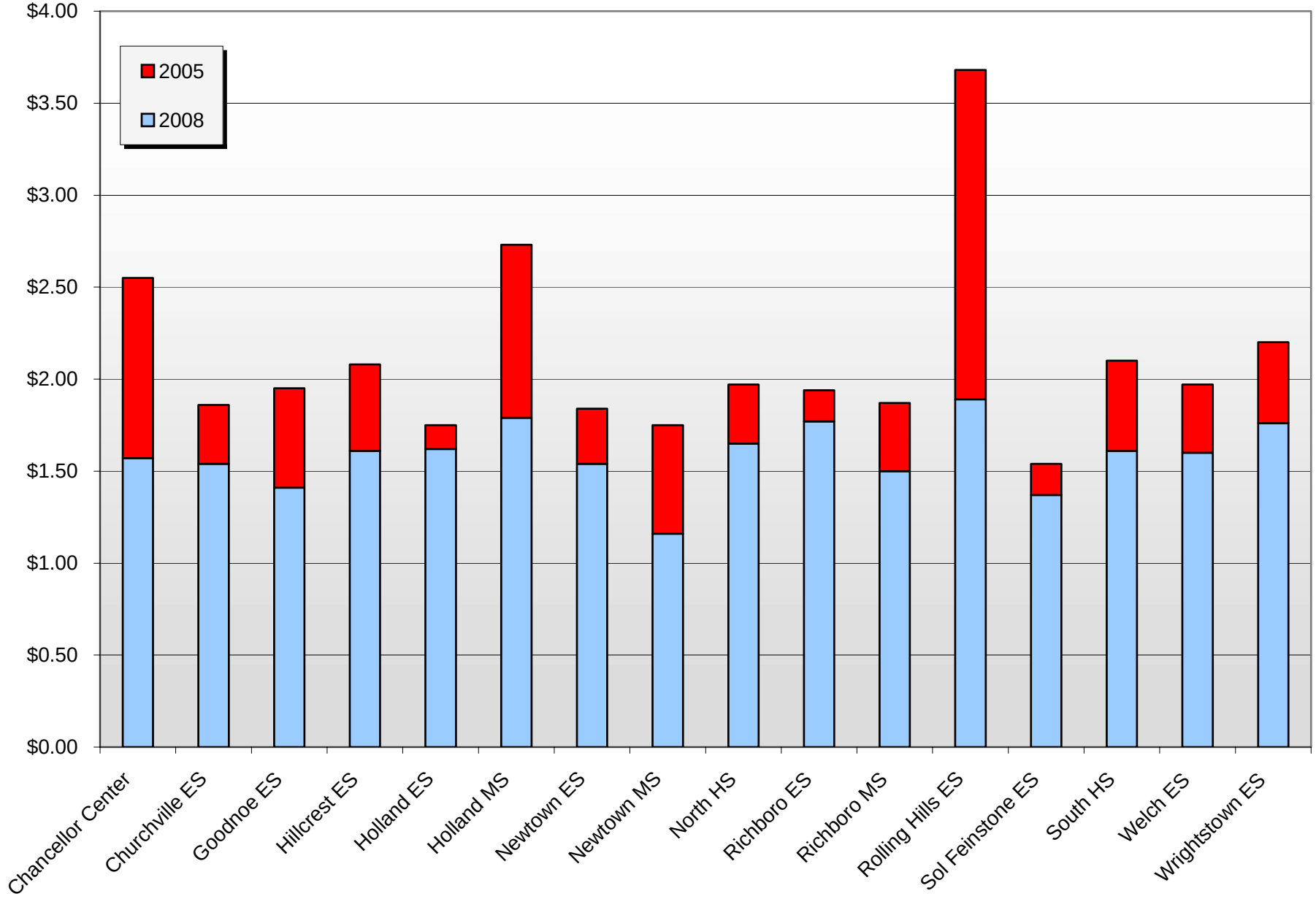
Energy Use per Square Foot



kBTU / GSF


2005
2008
200
180
160
140
120
100
80
60
40
20
0
Chancellor Center
Churchville ES
Goodnoe ES
Hillcrest ES
Holland ES
Holland MS
Newtown ES
Newtown MS
North HS
Richboro ES
Richboro MS
Rolling Hills ES
Sol Feinstone ES
South HS
Welch ES
Wrightstown ES

Cost / GSF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2005
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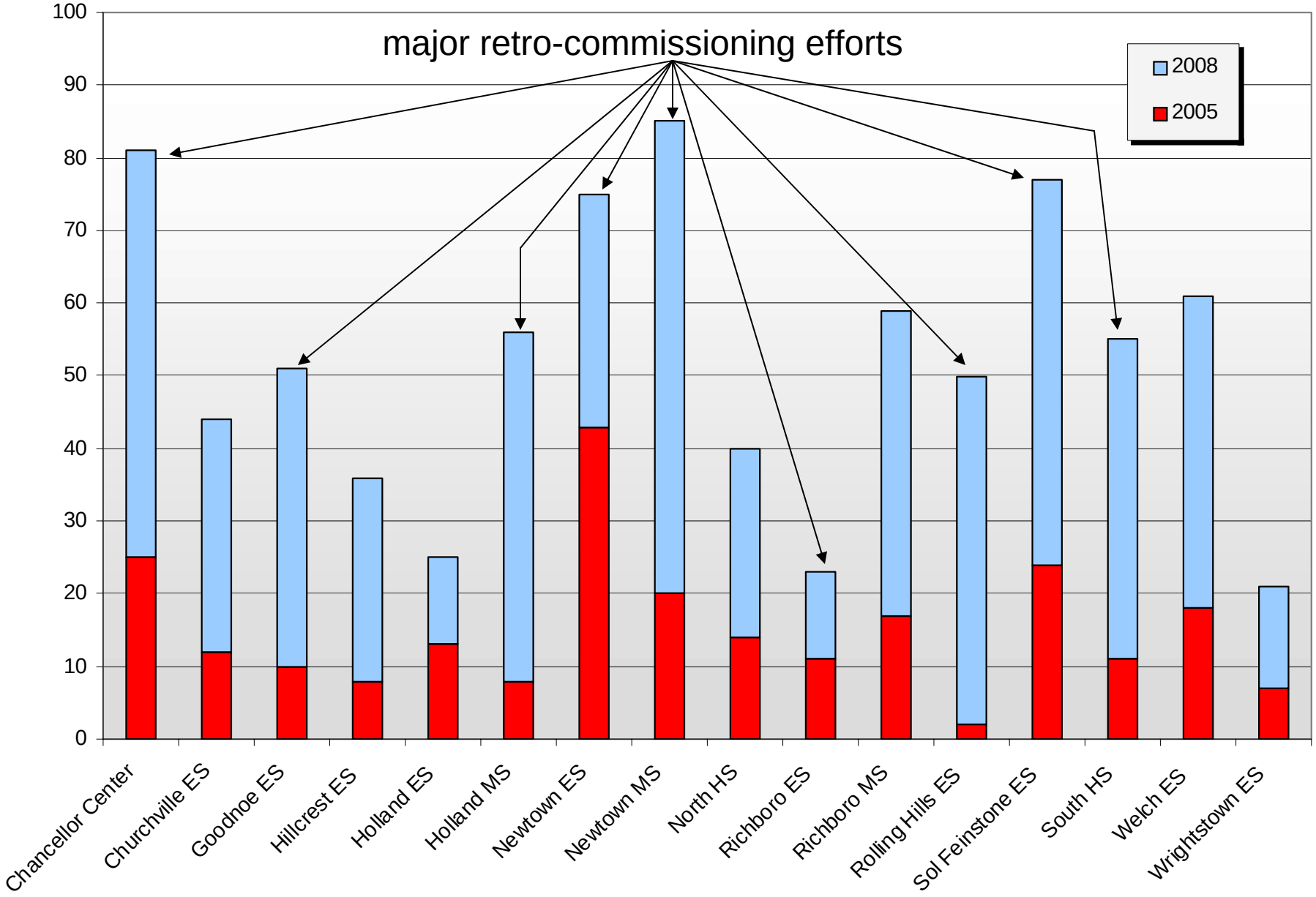
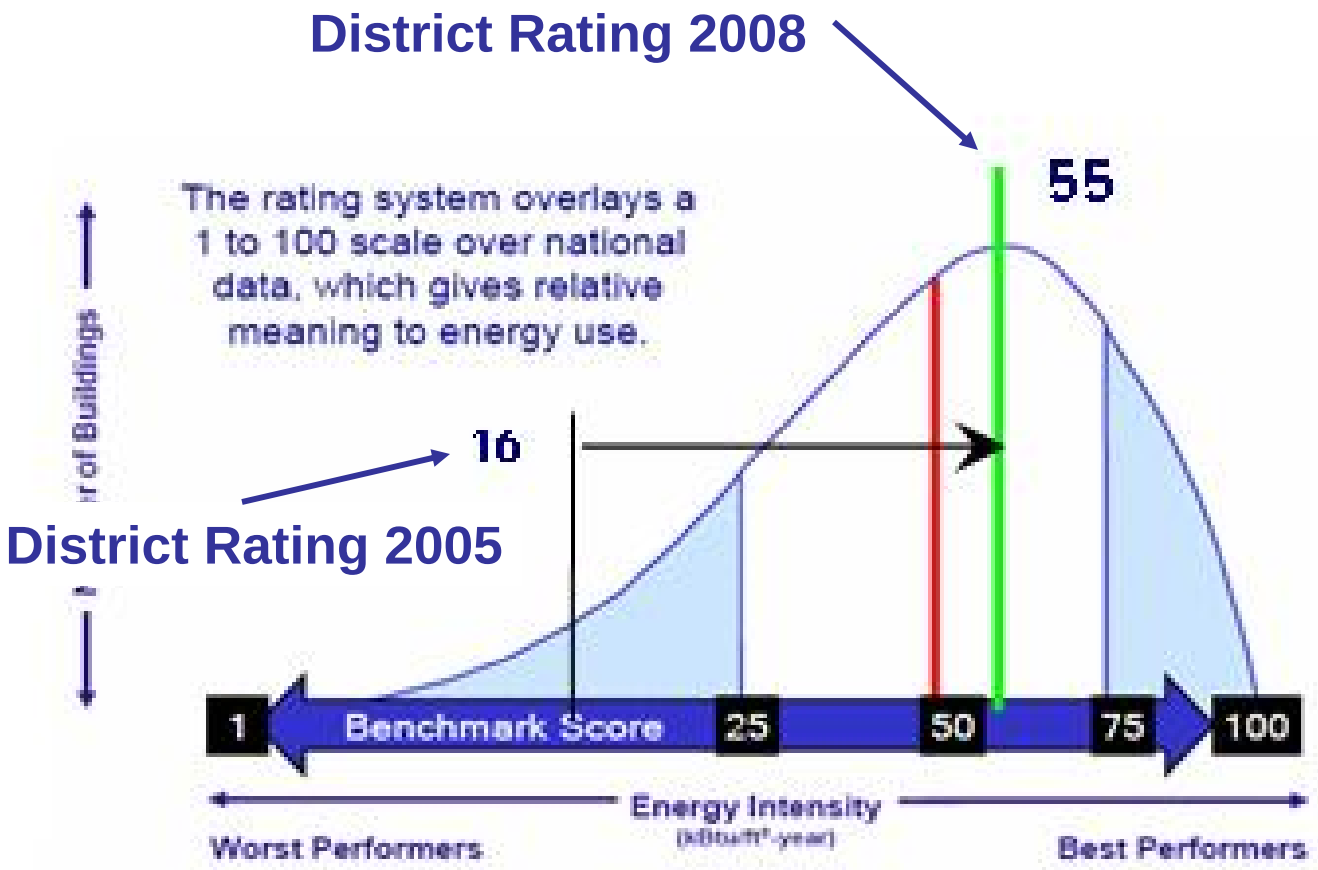
Churchville ES
Goodnoe ES
Hillcrest ES
Holland ES
Holland MS
Newtown ES
Newtown MS
North HS
Richboro ES
Richboro MS
Rolling Hills ES
Sol Feinstone ES
South HS
Welch ES
Wrightstown ES

ENERGY STAR Rating



ENERGY STAR Rating System

"Aren't we done yet? No, 42% energy reduction in 33 months yields average performance"



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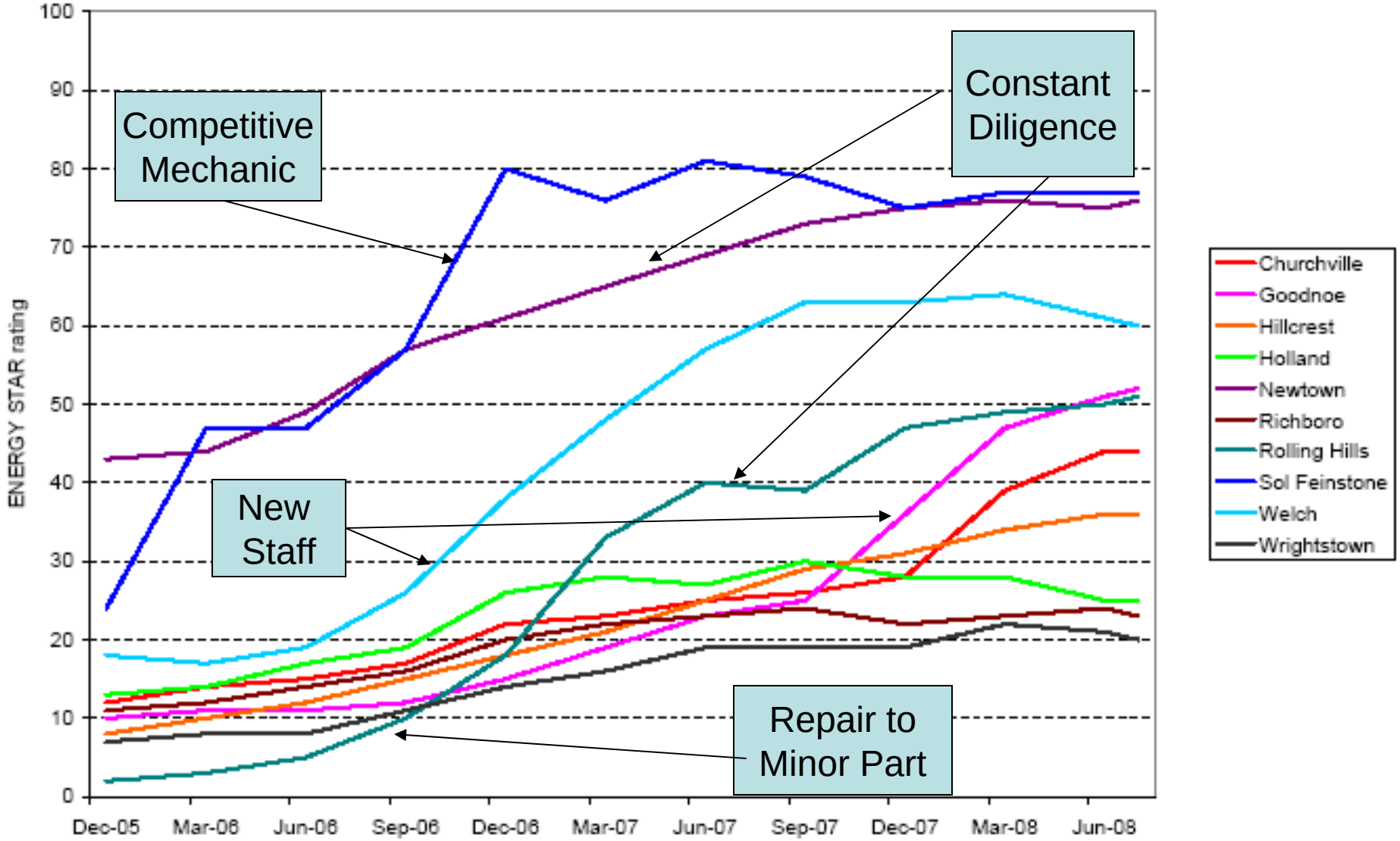
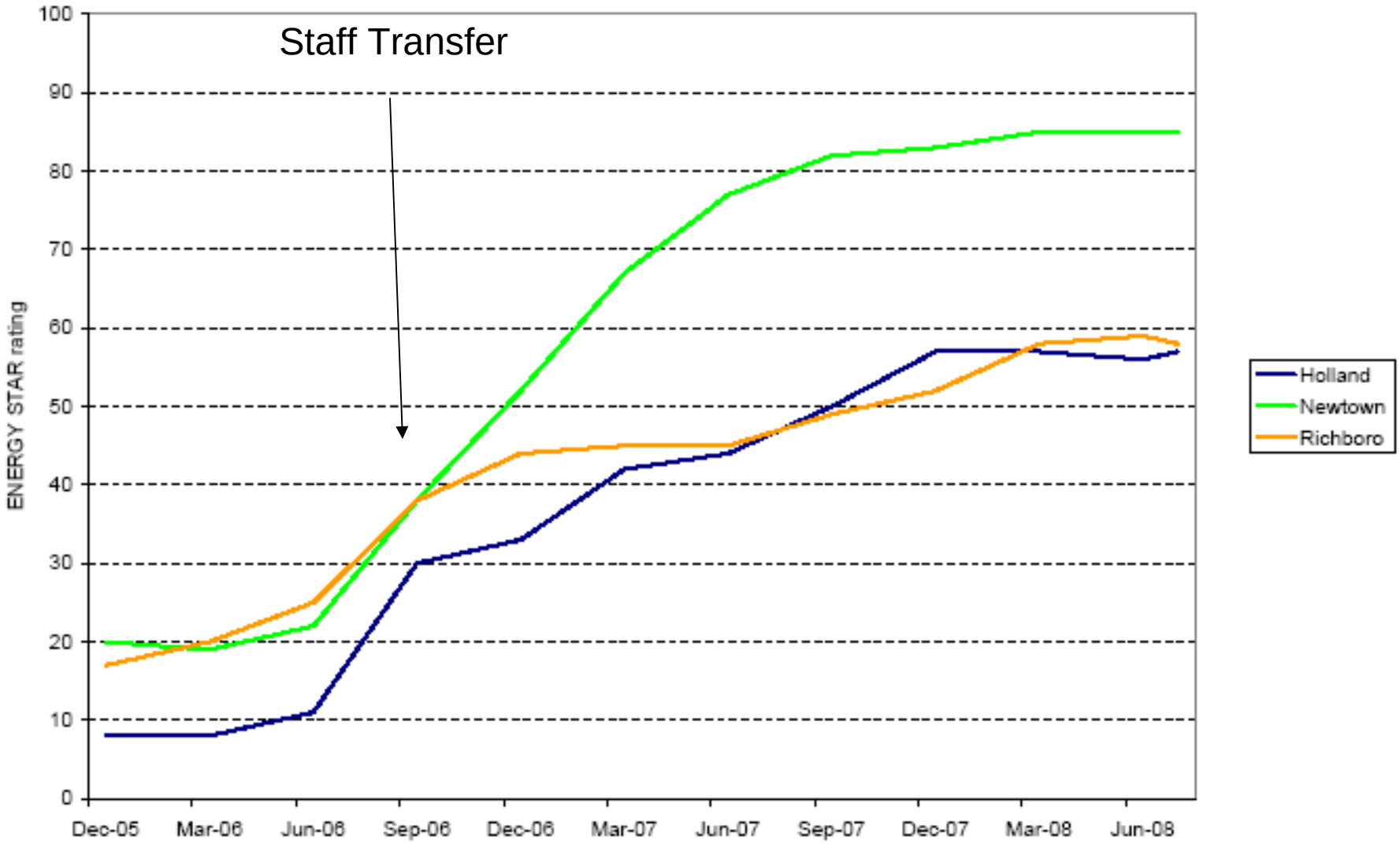
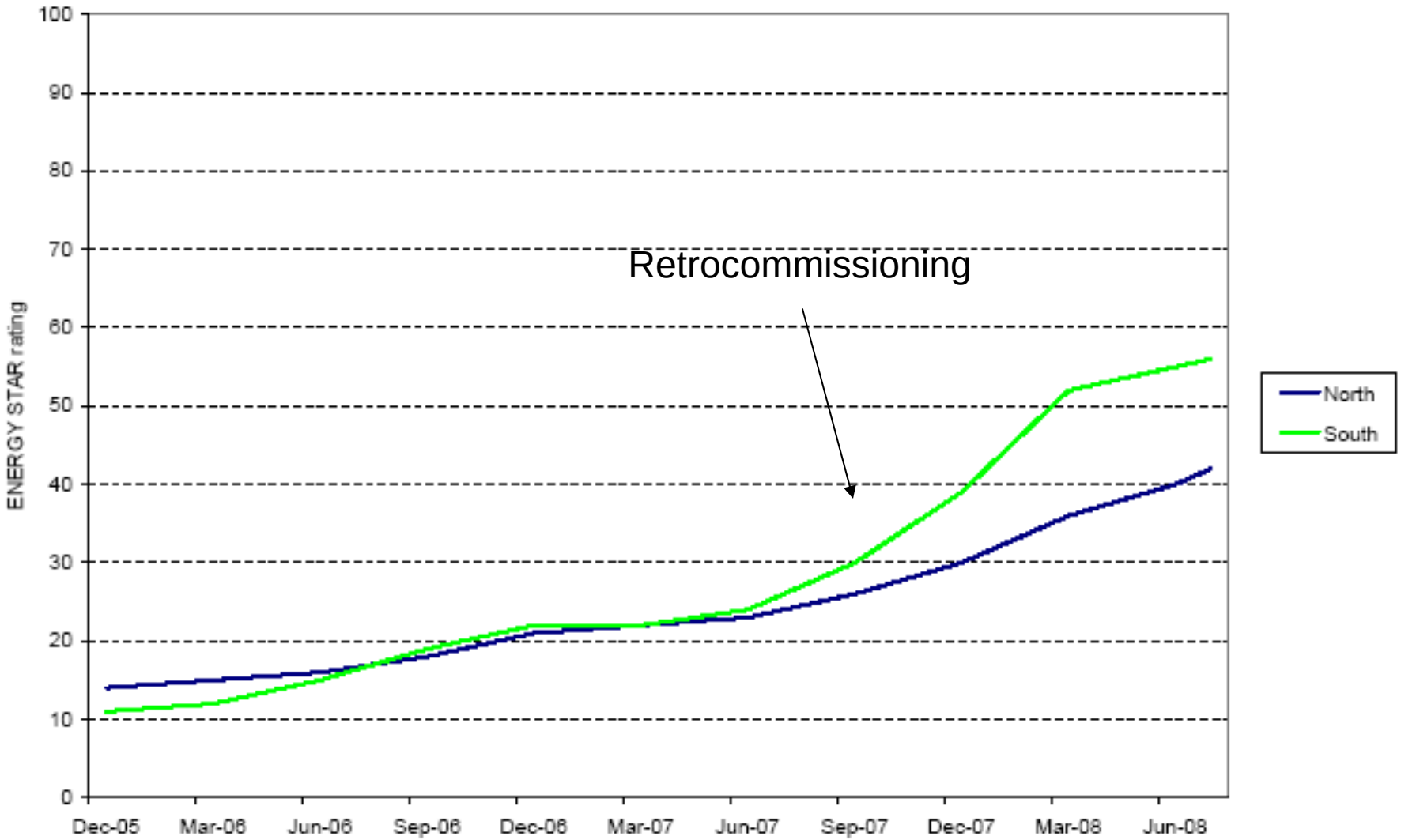
Elementary Schools' ENERGY STAR Ratings



Middle Schools' ENERGY STAR Ratings



High Schools' ENERGY STAR Ratings



Instructional Staff Role

- Greening CR committee:
  - *35 teachers and administrators*
  - *Discuss and initiate a yearly initiative such as enhanced recycling efforts and reduction of paper use*
- Supporting the program by participating and understanding the need for conservation
- Promoting the environmental impact of the program to the students
- Bringing sustainability and energy conservation into the instructional process
- Encouraging students to get involved at school and home by recycling, turning off lights, closing blinds, etc.

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Student Roles

- Support and promote conservation and environmental sustainability
- Promote the environmental impact of the program
- Encourage other students to conserve
- Logo contest-elementary
- Poster contest all ages-calendar
- Energy essay contest
- ENERGY STAR award presentations
- ENERGY STAR website video
- Why environmental benefits matter to the next generation-sustainability, global competitiveness, energy security.

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Public Reporting of Results

www.crsd.org

November 2007 Energy Program
for Council Rock School Dis

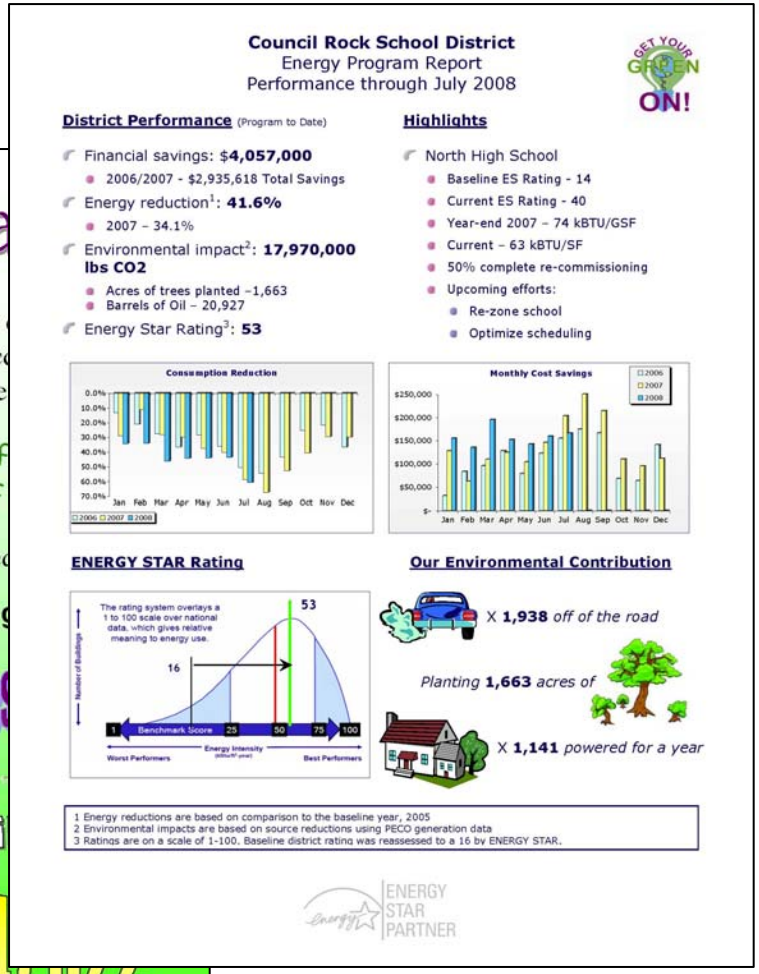
Where have we been? In a word, "busy." The Council Rock Energy Program
success throughout the year with significant effort on everyone's part. Co
energy consumption by 34 percent! Total reduction of carbon dioxide emissions
Savings for 2007 are on target to exceed $1.7 million.

Council Rock was recently recognized by the International Association of Schoo
excellent Energy Program. Council Rock was awarded the Pinnacle of Excellenc
conference in October. The award includes $5,000 from the sponsor, Virco, whi
the student scholarship established to recognize younger students for their inte
The scholarship fund will present four $250 scholarships to elementary school
students will be selected by the Energy Committee based on essay submittals
announced during Energy Awareness Week. Remember, from our last newslette
created from the winning of the Achievement Award from the Pennsylvania Ass
Officials in March.

Program Activities

Many of the program activities during the past months have been confined to
systems throughout the District. Teams from Johnson Controls and Siemens hav
upgrades and are providing assistance with use. The enhanced controls allow t
technical support personnel to see what is going on in each building and make
before. Many issues have been corrected throughout the District, and the work
correct outstanding problems. The new software also allows optimizing the ope
according to how they are actually used throughout each day. Significant savin
South High School as a result of over two months of effort and is still ongoing.
planned for North.

Principal Kevin King and maintenance mechanic Ted Qualli from Newtown Elem
at a meeting hosted by the Sierra Club and League of Women Voters in Octobe
Local Response" featured several presentations on local efforts and ideas on
"green" initiatives including the Council Rock Energy Conservation Program.
Informing the public and getting them involved is very much a part of this
program. This is the second time these people have presented on the subject.
Their efforts and the sacrifice of their personal time are very much appreciate
We can all make a difference at work and at home if we keep a positive
perspective.



Council Rock School District
Energy Program Report
Performance through July 2008

District Performance (Program to Date)

- Financial savings: **$4,057,000**
  - 2006/2007 - $2,935,618 Total Savings
- Energy reduction[1]: **41.6%**
  - 2007 – 34.1%
- Environmental impact[2]: **17,970,000 lbs CO2**
  - Acres of trees planted –1,663
  - Barrels of Oil – 20,927
- Energy Star Rating[3]: **53**

Highlights

- North High School
  - Baseline ES Rating - 14
  - Current ES Rating - 40
  - Year-end 2007 – 74 kBTU/GSF
  - Current – 63 kBTU/SF
  - 50% complete re-commissioning
  - Upcoming efforts:
    - Re-zone school
    - Optimize scheduling

1 Energy reductions are based on comparison to the baseline year, 2005
2 Environmental impacts are based on source reductions using PECO generation data
3 Ratings are on a scale of 1-100. Baseline district rating was reassessed to a 16 by ENERGY STAR.

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Our Environmental Contribution
(based on reduced carbon emissions)

X **1,900** *off of the road*

Planting **1,650** *acres of*

X **20,000** *never burned*

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Maintenance Organization

Staffing

- Council Rock employs 40 maintenance personnel
  - *1 maintenance personnel per building in the Elementary and Middle Schools*
  - *4 maintenance personnel in each of the High Schools*
  - *Maintenance Specialists*
    - HVAC
    - Electrical
    - Plumbing
    - Carpentry

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Technical Skills of Staff

Modern Buildings Require Modern Skills

- HVAC Specialist
  - *Understanding of commercial HVAC operations*
  - *Ability to troubleshoot mechanical and control system problems*
  - *High level of automatic temperature control software knowledge with ability to make limited programming changes*
  - *Knowledge and ability to balance equipment*
  - *Out of the box thinker*
  - *Excellent teamwork with Energy Manager*
- Building Mechanic
  - *Each has own primary skill and training is provided to round out the skills of each mechanic as needed*

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Operational Changes

Control modification examples

- Re-zone schedule groups
  - *Schedule all Administrative Offices together, not with the classrooms*
- Demand ventilation
  - *Operate Gymnasium outside air based on CO2 levels*
- Tighten start-up and shut-down times closer to actual occupancy and utilize optimization programming
- Vary control setpoints based on outside air temperature
  - *Heating water loop and boiler temperature*
  - *Chilled water loop temperature*

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Retro-commissioning Process

- Inspect and operate each piece of equipment:
  - *Confirm equipment shutdown response to schedules*
  - *Confirm sequence of operation (if available)*
  - *Confirm operation of all actuators and valves*
  - *Confirm water and air flow to balancing report where needed to resolve room problems*
  - *Test and calibrate system devices as required (temperature, flow, differential pressure, etc.)*
  - *Check mechanical condition and effectiveness of current preventative maintenance procedures*

  CORRECT ALL DEFICIENCIES IMMEDIATELY

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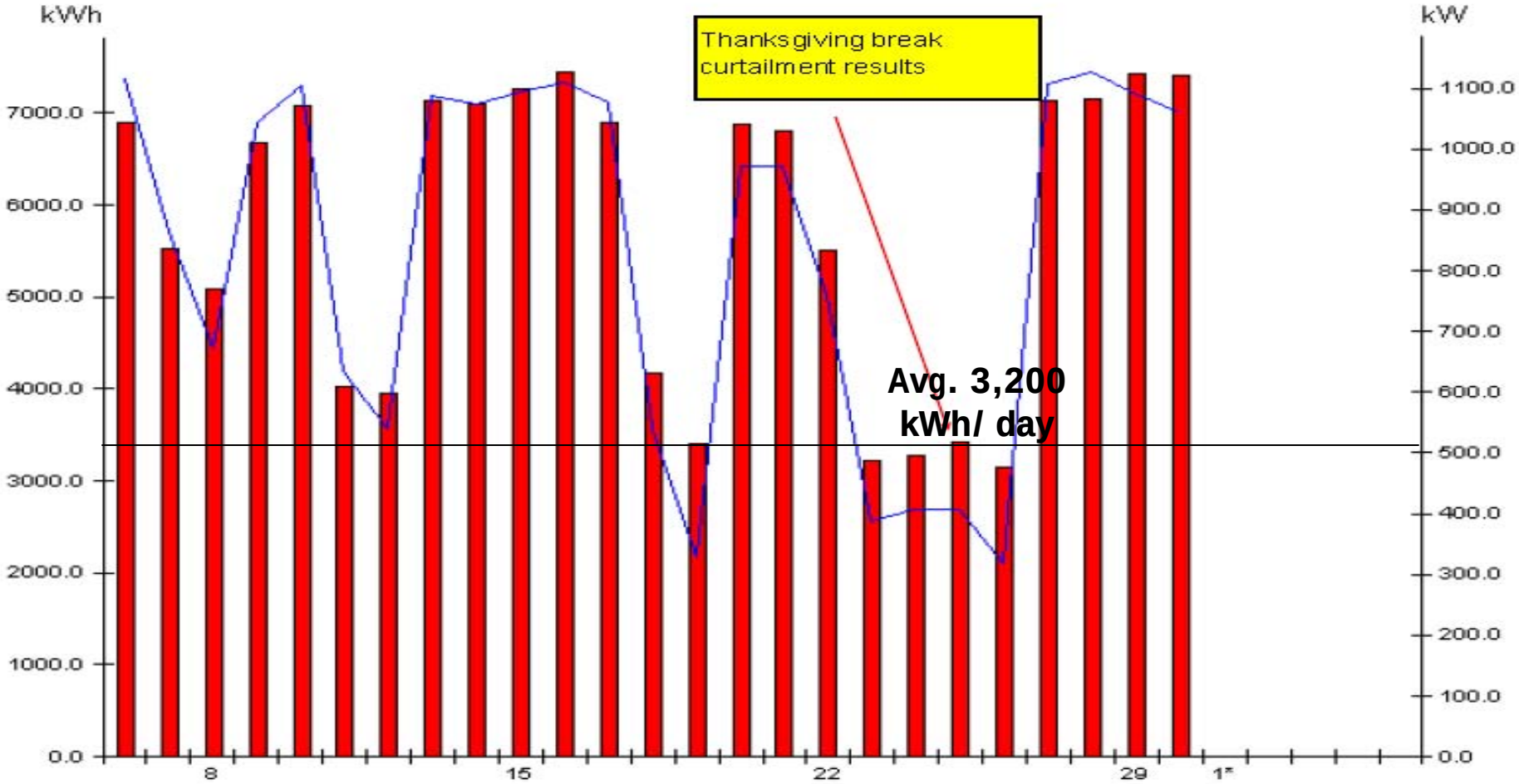
Verify Impact of Program Elements

Holiday Shutdown-Deep Setbacks

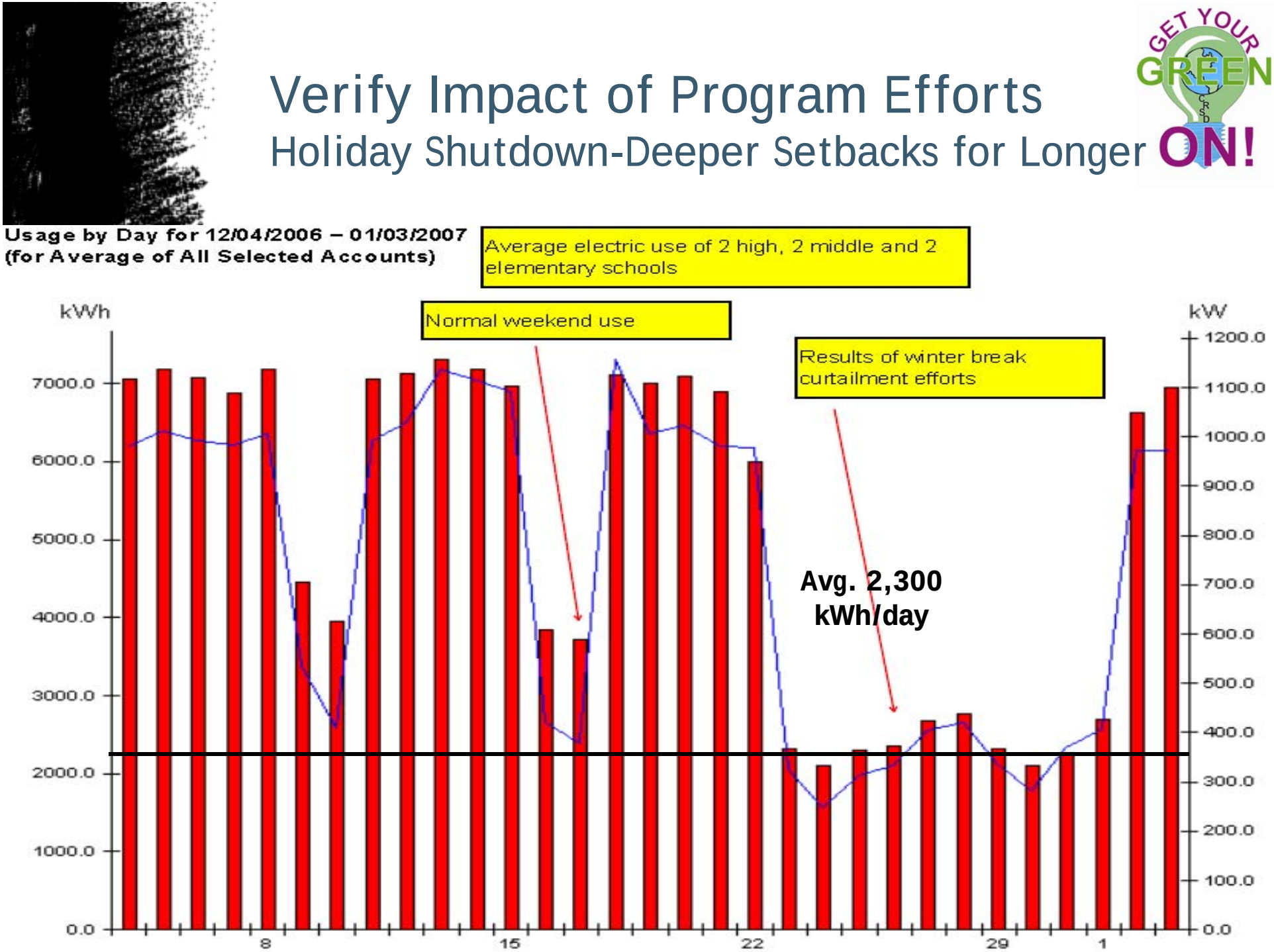
Usage by Day for 11/06/2006 - 11/30/2006
(for Average of All Selected Accounts)

Average electric use for 6 schools



Verify Impact of Program Efforts

Holiday Shutdown-Deeper Setbacks for Longer



Rolling Hills Elementary School

Importance of Benchmarking

	2005	2006	2007	2008
kBTU/SF	172.4	77.2	59.4	54.5
Cost/SF	$3.68	$2.18	$2.03	$1.89
Energy Reduction	-	55%	65%	76%
ENERGY STAR	2	18	47	50

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Newtown Middle School

Importance of Benchmarking

	2005	2006	2007	2008
kBTU/SF	80.5	58.3	47.8	44.1
Cost/SF	$1.75	$1.40	$1.23	$1.16
Energy Reduction	-	27.5%	40.5%	45.2%
ENERGY STAR	20	52	83	85

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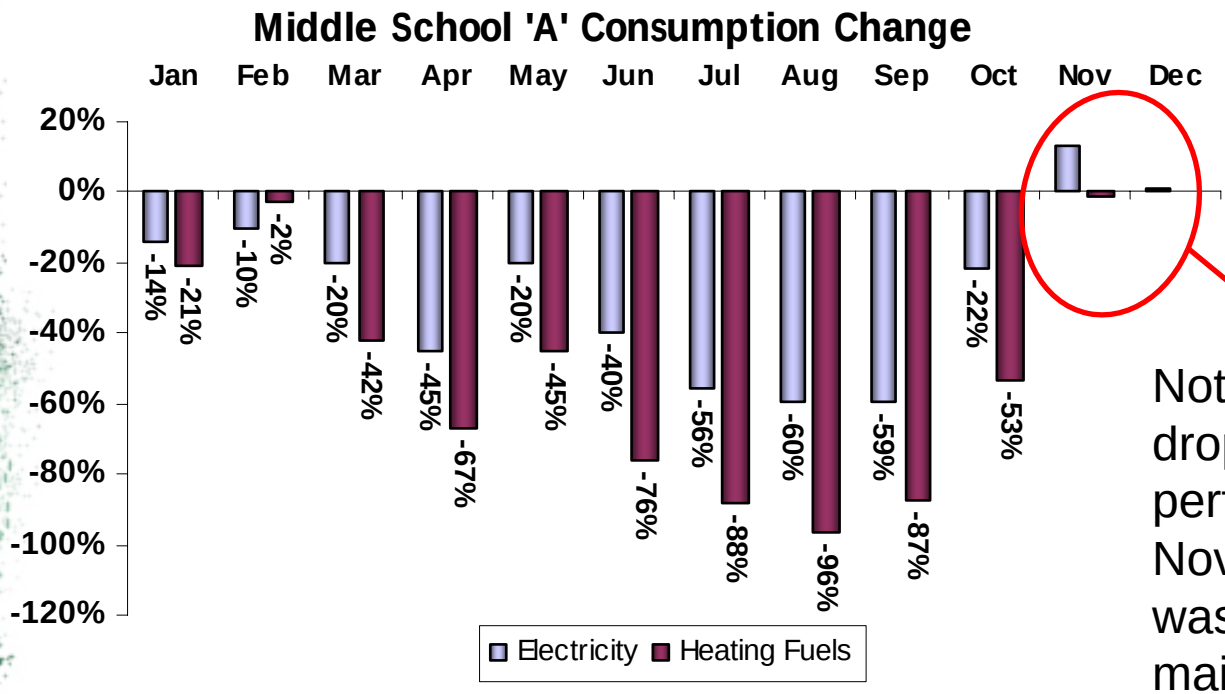
Verify Impact of Program Efforts
Monitor to Identify Problems Quickly



Note the rapid drop in performance in Nov. and Dec. This was due to maintenance and operational errors made in Oct.

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Findings from Process

- Examples from retro-commissioning, including the two High Schools (one built in 2002 and the second renovated in 2005), as well as other buildings of various ages:
  - *Terminal unit microprocessors not responding to main controls*
  - *Pneumatically controlled equipment not shutting down*
  - *Sequence of operations not correct*
  - *Start contacts jumpered from construction*
  - *Differential pressure sensors failed causing "runaway" pumps*
  - *Valve actuators failed or wired for improper direction of travel*
  - *Maintenance and operating procedures in need of improvement*
    - Damper actuators not operational, belts destroyed or missing, broken motor shafts and sheaves, plugged water-side strainers, dirty coils
    - Operating points and safety controls overridden

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Effort vs. Results

- During the summer of 2007, two HVAC specialists and the energy manager started to retro-commission our newest High School built in 2002 (350,000 so)
  - *In 8 weeks 50% of the building was inspected*
  - *All large spaces retro-commissioned. (Library, Gym, Auditorium, Administration Offices)*
  - *25% of the classrooms completed*
- August 2007 vs. August 2005; 64% reduction in energy (part of which was the result of some program changes on the summer)
- September 2007 vs. September 2005; 53% reduction in energy (same type of program use in 2005 & 2007)
- This reduction was achieved even with automatic temperature control service contracts in effect since acceptance of equipment

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Lessons Learned

- Benchmarking, external and internal, is important
- Every district is different in potential savings, building type and age, skills of staff, etc.. Buildings differ too.
- Savings are possible without capital investment
- Work first to get all components of temperature control systems working to maximum potential. Even new buildings need retro-commissioning.
- Indoor air quality improves with retrocommissioning
- Maintenance staff need extensive training with modern systems and building design
- Communication is key-focus on rapid results then sustainability
- Green is inspiring to students, staff, and the community (financial reasons inspire few)

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Next Steps

- Energy efficiency design standards for ten year facilities improvement plan
- LEED-EB (Leadership in Energy and Environmental Design-Existing Buildings)-Pilot Program with USGBC
- Use financial crisis to drive higher results through more cooperation

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Questions?

- Contact Information
  - *Tom Schneider, Operations Supervisor, Council Rock School District, 215-944-1015, tschneider@crsd.org*
  - *Mike McGarvey, Energy Manager, Aramark Education, mmcgarvey@crsd.org*
  - *Robert Schoch, Director of Business Administration, Council Rock School District, 215-944-1040, rschoch@crsd.org*
- Visit our website-www.crsd.org
  - *Quicklink-Go Green/Energy Management*
    - Green Team Mission Statement
    - District and School Energy Reports
    - Go Green websites for most schools
    - Newsletters
    - Related links

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