G-ENERGY

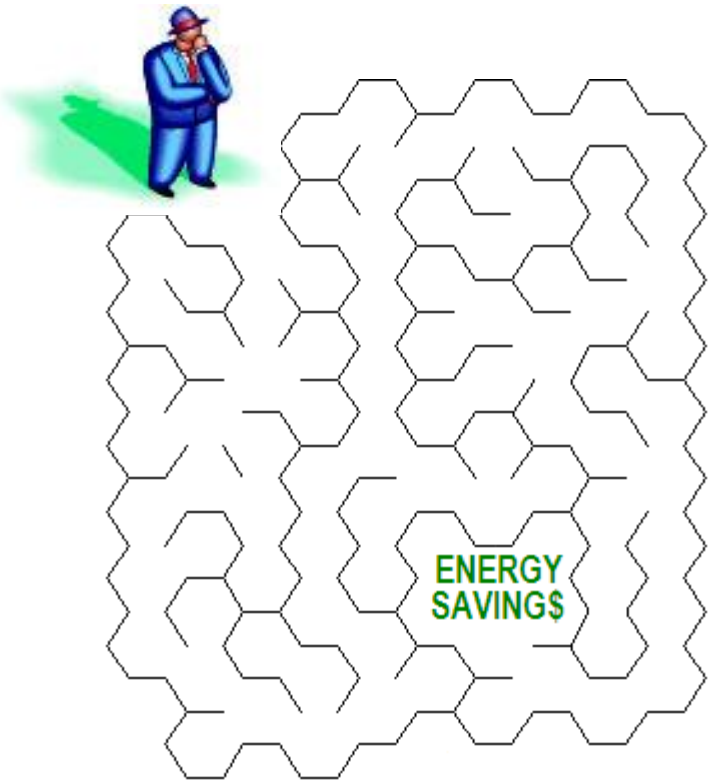
5-Minute Primer for Commercial Building Energy Audits

ENERGY STAR PARTNER

Why Energy Audits?

Because an energy audit is the first step to saving energy at your facility.

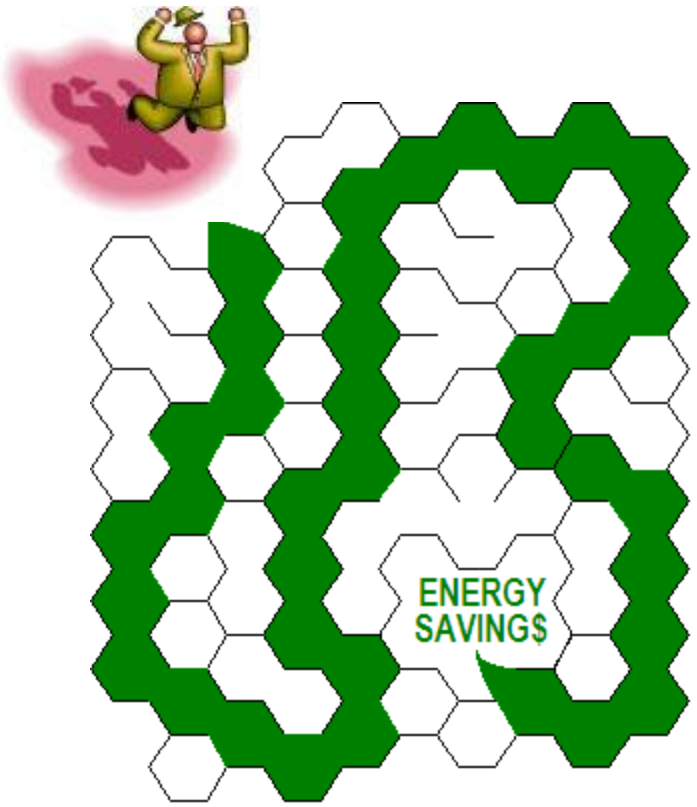
Putting together an energy project can be like finding your way through a maze… there are many directions you can take, many energy saving technologies to consider (and not all are cost-effective).



Why Energy Audits?

An energy audit provides focus and direction… it is the roadmap to energy savings.

An energy audit evaluates energy use and prioritizes savings measures according to cost-effectiveness to help you develop the best energy project for your facility.



Energy Audit Types

ASHRAE Terminology

Level 1 Energy Audit

Analysis of utility bills, brief survey and walk-through of facility.

Recommendations may include limited cost, savings & payback data… it's primarily a qualitative analysis.

Sufficient for developing an energy project of basic energy saving measures from no cost to moderate cost.

Typical Cost for Level 1 Energy Audit

$500 minimum up to $3500 depending on building size

Energy Audit Types

ASHRAE Terminology

Level 2 Energy Audit

More detailed analysis of utility bills, more in-depth inspection of the facility and breakdown of energy use at the facility, including identifying specific energy end uses.

Recommendations include implementation cost, savings and payback… it's a qualitative ***and*** quantitative analysis.

Sufficient for most energy projects including lighting, controls, basic HVAC and building envelope measures, energy efficient replacement of old equipment, etc.

Typical Cost for Level 2 Energy Audit

$2000 minimum up to $10,000 depending on building size

Energy Audit Types

ASHRAE Terminology

Level 3 Energy Audit

Thorough field inspection of facility, engineering analysis of energy use and potential improvements, PE audit certification.

Recommendations include cost, savings, payback, life-cycle cost analysis. Bid specification services usually provided, but usually at additional cost.

Necessary for large-scale energy projects… major HVAC upgrades, re-design and re-engineering of HVAC systems, energy management systems, building structural changes, etc.

Typical Cost for Level 3 Energy Audit

$10,000 minimum and up (requires detailed quote)

Energy Audit Basics

(Included components in *all* G-ENERGY Energy Audits)

Evaluation of Current Energy Use

Utility bill analysis (12 months)

Energy Use Index (EUI) (btu/sq.ft./year)

Energy Cost Index (ECI) ($/sq.ft./year)

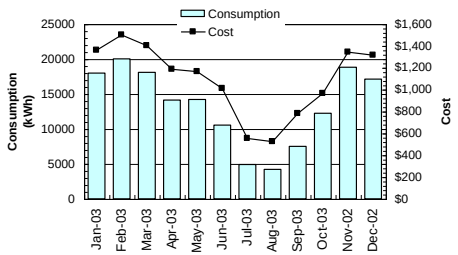
Energy use comparison to similar facilities

Energy Star® Benchmark (if building is eligible)

Bedford Falls Elementary
515 1st Avenue, Bedford Falls MI 49000

Building Area:
28,600
square feet

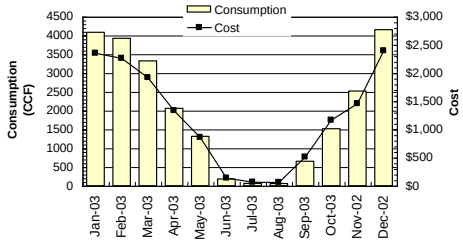
Electricity Consumption Profile



Month	kWh	Cost
Jan-03	17,976	$1,360
Feb-03	20,010	$1,500
Mar-03	18,093	$1,401
Apr-03	14,116	$1,185
May-03	14,199	$1,164
Jun-03	10,538	$1,010
Jul-03	4,912	$553
Aug-03	4,208	$523
Sep-03	7,500	$780
Oct-03	12,229	$964
Nov-02	18,812	$1,342
Dec-02	17,131	$1,314
Totals:	**159,724**	**$13,096**

Cost/sq.ft.: $0.46 per sq.ft./yr.
Elec EUI: 19,061 BTU/sq.ft.
Avg. Cost: $0.082 /kWh

Natural Gas Consumption Profile



Month	CCF	Cost
Jan-03	4,083	$2,350
Feb-03	3,923	$2,258
Mar-03	3,324	$1,916
Apr-03	2,060	$1,332
May-03	1,316	$856
Jun-03	181	$134
Jul-03	63	$63
Aug-03	57	$57
Sep-03	652	$508
Oct-03	1,516	$1,162
Nov-02	2,521	$1,456
Dec-02	4,151	$2,391
Totals:	**23,847**	**$14,483**

Cost/sq.ft.: $0.51 per sq.ft./yr.
Gas EUI: 85,883 BTU/sq.ft.
Avg. Cost: $0.607 / CCF

Annual Utility Cost = $27,579
Total Cost / sq.ft. = $0.96
Combined EUI = 104,943

Building Type: Elementary	Heating: (2) hw boilers (2000); elec (portables)	Interior Lighting: T8 fluorescent,
Age / Year Built: 1954	Cooling: Small DX (media center); DX (portables)	Exterior Lighting: High pressure sodium,
Windows: Doublepane	Distribution: Air handlers, radiant floor	Incandescent (above entries)
DHW: 50-gallon natural gas	Temp Control: Pneumatic stats on EMS	Other: Minor kitchen appl, refrigeration

Energy Audit Basics

(Included components in *all* G-ENERGY Energy Audits)

Summary of Energy Efficiency Measures

A list of applicable energy saving measures

Level 1 includes limited cost, savings, and payback data for basic measures; recommendations address specific building areas and systems.

Summary of Energy Conservation Opportunities

Energy Conservation Opportunity (ECO)	Applicable Building	ECO Additional Benefits
1) **T8 Fluorescent Lighting (with electronic ballasts)** Look into replacing some of the metal halide lighting in the high school with T8 fluorescent systems in the future as lighting levels diminish.	High School	Improve visual acuity; often can *increase* lighting levels; improve student performance
2) **Compact Fluorescent Lamps (CFLs)** Replace incandescent light bulbs in exterior fixtures above building entries with CFLs.	Elementary	Reduce maintenance… CFLs outlast 4-12 incandescent lamps (depending on lamp).
3) **Occupancy Sensors** Use occupancy sensors to control lighting. Rooms with irregular use, restrooms, storage areas and offices usually are the best possibilities.	Elementary Middle School High School	
4) **Water Heater Tank and Pipe Insulation** Add insulation jacket to water heater tank and all accessible DHW pipes in the room where the water heater is located.	Elementary	
5) **Timer for Water Heating Circulator Pump** Install timer on circulator pump to shut off water heating loop during unoccupied building hours.	Elementary Middle School High School	Reduce pump motor maintenance.
6) **Water Heating System Replacement** Replace middle school water heating system with a modular water heating system -- a small high efficiency (85%+) boiler coupled with properly sized storage tank & coil.	Middle School	Increase recovery capacity and maintain efficiency over life of system.
7) **Water Conservation** Retrofit toilet and urinal flush valves to save 20-50%. Replace showerheads with 1.5-gpm units to reduce water flow by 30-40% and reduce both water/sewer *and* water heating costs. Replace faucet aerators with 1.0-gpm moderators to save 50%. Replace pre-rinse sprayers in kitchen dishwashing areas with 1.6-gpm models to reduce water use by 40-75% and save on water heating, as well.	Elementary Middle School High School	Water heating system size can be reduced; shower quality often improved.
8) **Adjust Heating Temperature** Consider a review of current heating temperatures in comparison to recommended levels. Substantial energy savings can often be achieved (for *FREE*) by adjusting thermostats or energy management systems.	Elementary Middle School High School	
9) **Adjust Cooling Temperature** Consider a review of current cooling temperatures in comparison to recommended levels. Substantial energy savings can often be achieved (for *FREE*) by adjusting thermostats or energy management systems.	High School	

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Energy Audit Basics

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Summary of Energy Efficiency Measures

A list of applicable energy saving measures

Levels 2 and 3 include cost, savings, payback, and life cycle cost analysis; bid spec option (additional cost)

Level 3 includes energy audit certification by a Professional Engineer

Executive Summary of Savings Measures

Note: The savings measures listed below provide numbers of lamps, fixtures, appliances, etc. for the purpose of estimating cost and savings only. This is not a bid specification. Contractors interested in bidding on any of the measures below need to perform a walk-through inspection and develop their own materials and labor estimates for their proposal.

#	Description of Savings Measures	Implementation Cost	Annual Savings	Payback Years	Savings to Investment Ratio
1	**Compact Fluorescent Lamps** *Replace (14) 25-watt incandescent decorative bulbs in lobby chandelier with 3-watt decorative CFLs; replace 75-watt incandescent globe lamps in (5) lobby wall lanterns with 15-watt CFL globes; replace 75-watt incandescent light bulbs in (2) hanging lanterns in the main entry and (2) wall lanterns outside by main entry with 15-watt CFLs; replace 25-watt incandescent light bulbs in (5) elevator signs with 5-watt CFLs.*	$ 230	$ 845	0.3	3.36
2	**Faucet Flow Moderators** *Retrofit (56) kitchen faucets with 1.5-gpm moderators and (56) bathroom faucets with 1.0-gpm moderators.*	$ 340	$ 938	0.4	13.10
3	**Water Saving Showerheads** *Replace all (56) showerheads with 1.5-gpm models.*	$ 560	$ 615	0.9	9.93
4	**LED Exit Sign Conversions** *Replace incandescent lamps in (10) exit signs with 1-watt LED retrofit lamps.*	$ 300	$ 264	1.1	14.89
5	**Weatherstrip Doors and Windows** *Weatherstrip all windows and doors; repair/replace broken storm windows to assure double-glazing on all windows.*	$ 4,600	$ 3,307	1.4	7.77
6	**Pipe Insulation** *Insulate all accessible heating and DHW pipes in the boiler room.*	$ 1,700	$ 932	1.8	12.93
7	**Integrated Heating / DHW System** *Replace the boiler serving the basement apartments and (2) water heaters with a high efficiency integrated heating/DHW system. NOTE: This evaluation assumes the installation of (2) 175,000 btuh high efficiency boilers @ 87% AFUE with a properly sized hot water storage tank and electronic controller.*	$ 11,000	$ 2,467	4.5	6.58
8	**Front-Loading Washing Machines** *Replace all (3) top-loading washing machines with front-loading models. NOTE: Estimated delivered cost for coin-operated models, no labor included.*	$ 3,750	$ 467	8.0	1.55

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Energy Audit Basics

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Discussion of Energy Efficiency Measures

Description of each energy saving measure specific to its application on site, graphics/pictures/tables for better understanding of measures, environmental impact calculated for quantifiable measures.

Discussion of Energy Conservation Opportunities

The individual ECOs from the Summary of Energy Conservation Opportunities are discussed below. From experience, the energy savings for most ECOs will pay for the implementation cost in less than eight years… sometimes much less.

ECO # 1 : T8 Fluorescent Lighting (with electronic ballasts)

T8 fluorescent lamps powered by electronic ballasts use *30-50% less* energy than standard T12 fluorescent lamps. T8 fluorescents are a 1-inch diameter lamp compared to the 1½-inch diameter T12. They are available in common lengths but 4-foot T8s are most popular. Fixtures with 8-foot lamps can often be retrofitted with 4-foot lamps (installed end to end), which are more stable, less expensive and have a 33% longer service life than 8-foot lamps.

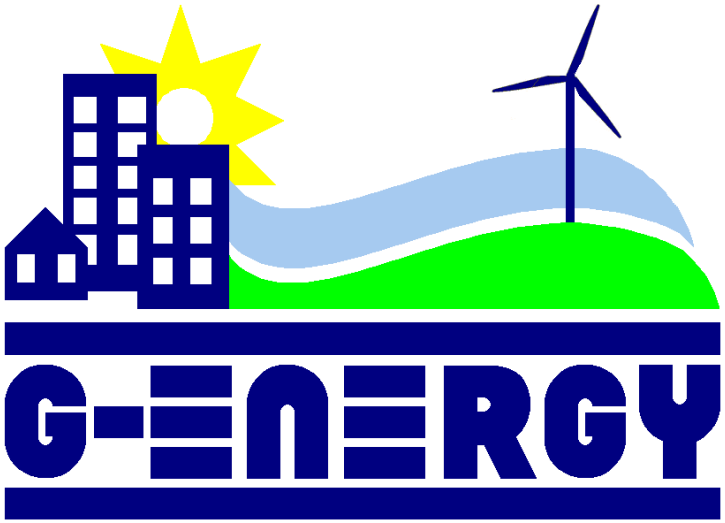
In most cases, older fixtures are replaced with new high efficiency fixtures pre-wired with T8 lamps and electronic ballasts. But when existing fixtures are in good condition, it is possible to replace just the ballast(s) and lamps.

Besides energy efficiency, T8 fluorescent lighting provides higher quality illumination. Color rendition is better and there is no detectable *flicker* (often exhibited by standard fluorescent fixtures). As a result, visual acuity is improved. Studies have actually confirmed increased student performance under T8 lighting.

At the High School, consider replacement of T12 fluorescent lighting with T8 fluorescent.

ECO # 2 : Compact Fluorescent Lamps (CFLs)

The compact fluorescent lamp (CFL) is an energy efficient alternative to incandescent lighting. CFLs provide equivalent lighting, consume 75-80% *less* energy and last 5 to 15 times *longer* than incandescent lamps. At one time, the application of a CFL was somewhat limited… mainly the replacement of a 60-watt light bulb on a non-dimming circuit. Now there are many types of CFLs available for a wider variety of purposes. Improvements in ballast technology have enabled CFL use outdoors in cold weather and with dimmers, too (but only as specified). They're also available in smaller sizes, and several shapes have been developed to provide more versatility.



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