

The 2017 Ameren Illinois

Business Symposium

Do-It-Yourself Energy Audit

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Agenda

- » Basic Terminology
- » Background
- » Benchmarking
- » Audit Types/ASHRAE Standard
- » Building Audit – Systems & Tools
- » Retro-commissioning - Lite
- » Energy Efficiency Programs

Basic Terminology

HVAC - Heating, Ventilation & Air-Conditioning

EUI - Energy Use Index (kBtu/Ft²/Yr)

kBTU - One Thousand BTU (kWh and therms converted & combined)

kWh - Kilowatt hour (3.413 kBtu) = 1,000 Wh

Therm – Unit of Heat (100 kBtu)

ECM - Energy Conservation Measure

FIM - Facility Improvement Measure

VFD – Variable Frequency Drive

GPM – Gallon per Minute

CFM – Cubic Feet per Minute





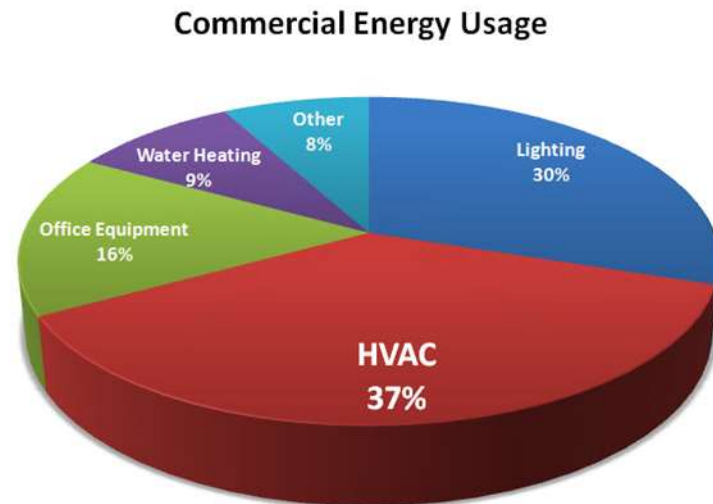
ENERGY SAVINGS MADE EASY

Background



Why Should I Perform an Energy Audit?

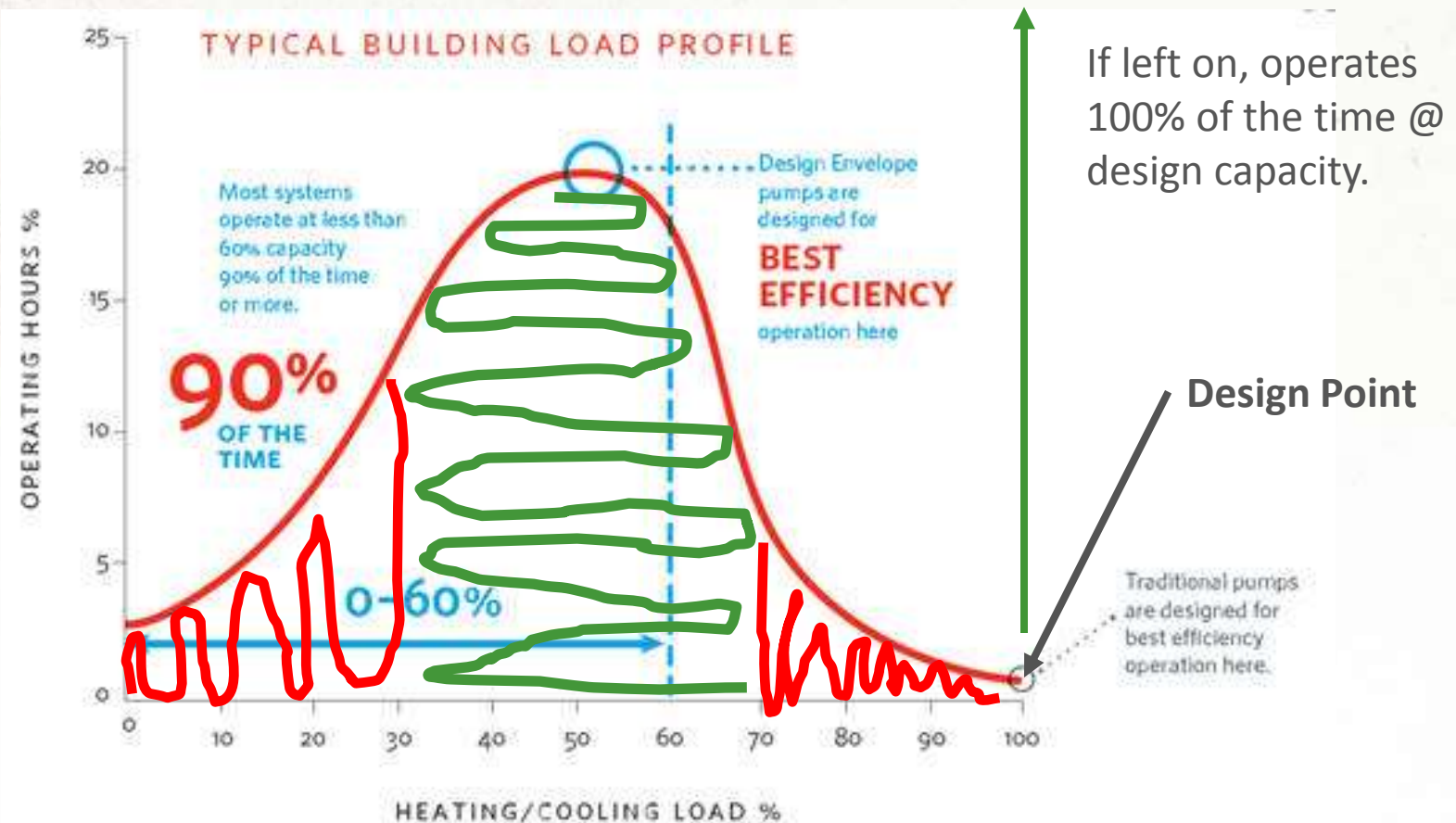
- » Determine ECMs & FIMs to save energy and improve the functionality of the building
- » Learn how your building compares to similar building types
- » Develop a long term Energy Plan and Goal for the facility
- » Determine where to invest to enhance your building performance
- » Learn how to manage your energy use



Background

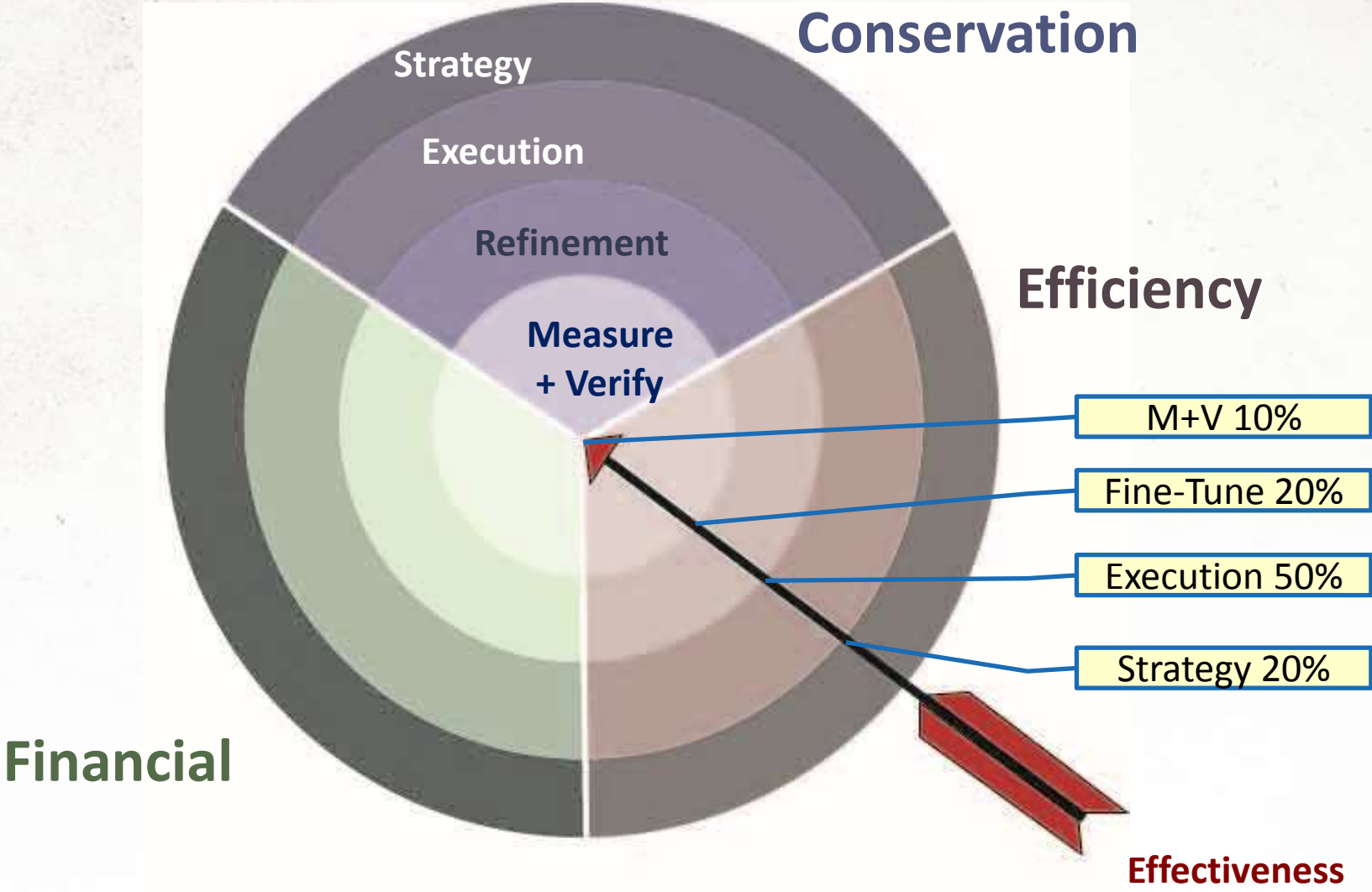
Why Should I Perform an Energy Audit?

- » Equipment CAPACITY is sized for operation 2-4% of the year!
- » Can you slow down, stop or turn off equipment?



Background

Targeting Energy Performance with a Strategy





ENERGY SAVINGS MADE EASY

Benchmarking

ENERGY STAR® PROGRAM

- » Began in 1992
- » 25,000 Certified Buildings & Plants
- » Tool for 21 different types of facilities
- » Provides a score of 0-100
- » Compares performance to peer facilities across the country
- » Normalizes for various metrics specific to the building/facility type
- » Score of 75 or higher achieves the ENERGY STAR recognition
- » *Benchmarking consistently shows an improvement of 2.4% year-year*



Benchmarking

Where do I start? What Information do I need?

- » Utility Bills
 - 2 Years Preferred
- » Building Floorplans (sq. ft.)
 - Architectural
 - Mechanical
- » Building Usage – Type
- » Equipment List
- » Building Background

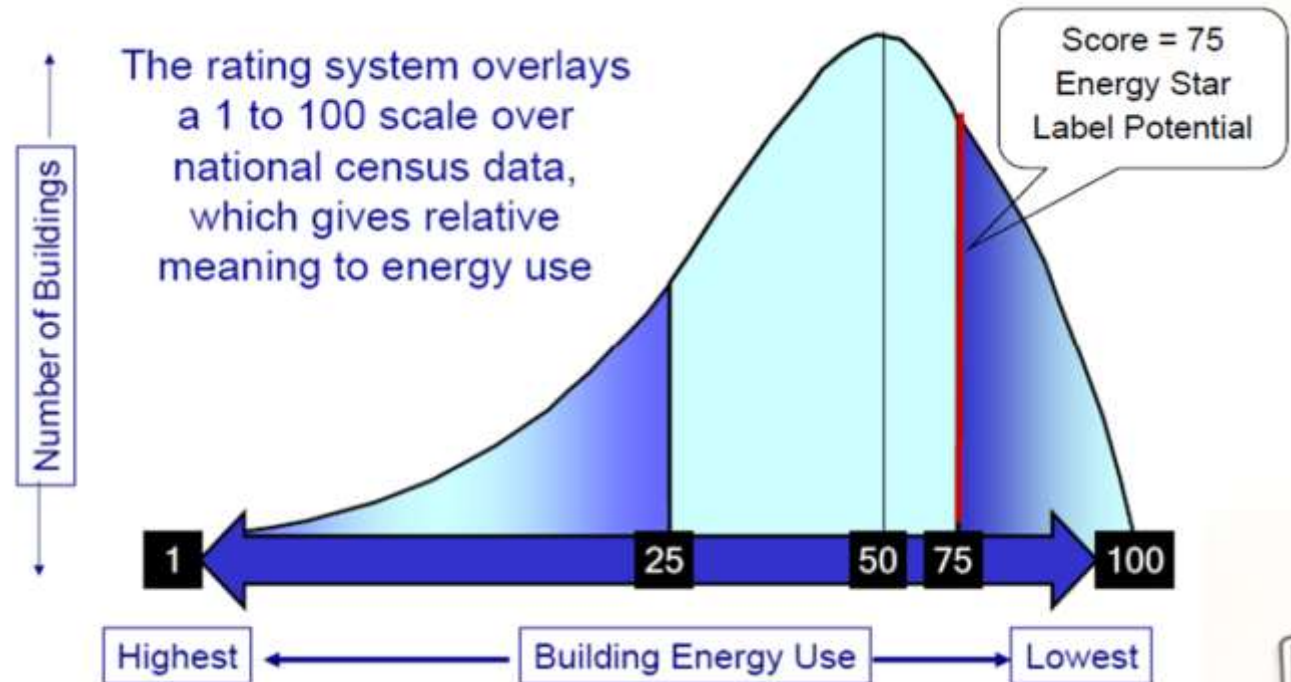


Benchmarking

A Peer/Peer & Self-Improvement Tool

Benchmarking is an objective method to compare building energy consumption using performance metrics rather than just dollars.

- kBTU/Ft²/Year
- Rating Scale of 0-100





Audit Types/ASHRAE Standards

ASHRAE Levels Defined

Level 1 Audit

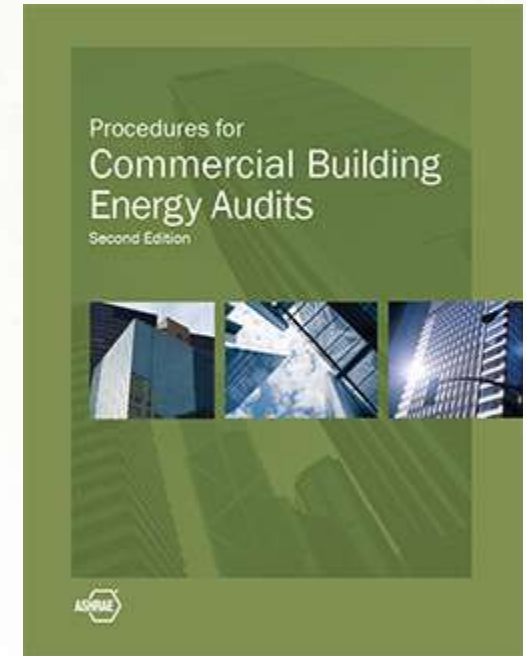
» Walk Through Analysis

- Brief on-site survey of the building
- Savings and cost analysis of low-cost/no-cost Energy Conservation Measures (ECMs)
- Identification of potential capital improvements meriting further consideration

Level 2 Audit

» Energy Survey and Analysis

- More detailed building survey
- Breakdown of energy use
- Savings and cost analysis of all ECMs
- Identification of ECMs requiring more thorough data collection and analysis (Level 3)



Level 3 Audit

- » Detailed Analysis of Capital-Intensive Modifications
 - Attention to capital-intensive projects identified during the Level 2 audit
 - More detailed field analysis
 - More rigorous engineering analysis
 - Cost and savings calculations with a high level of accuracy



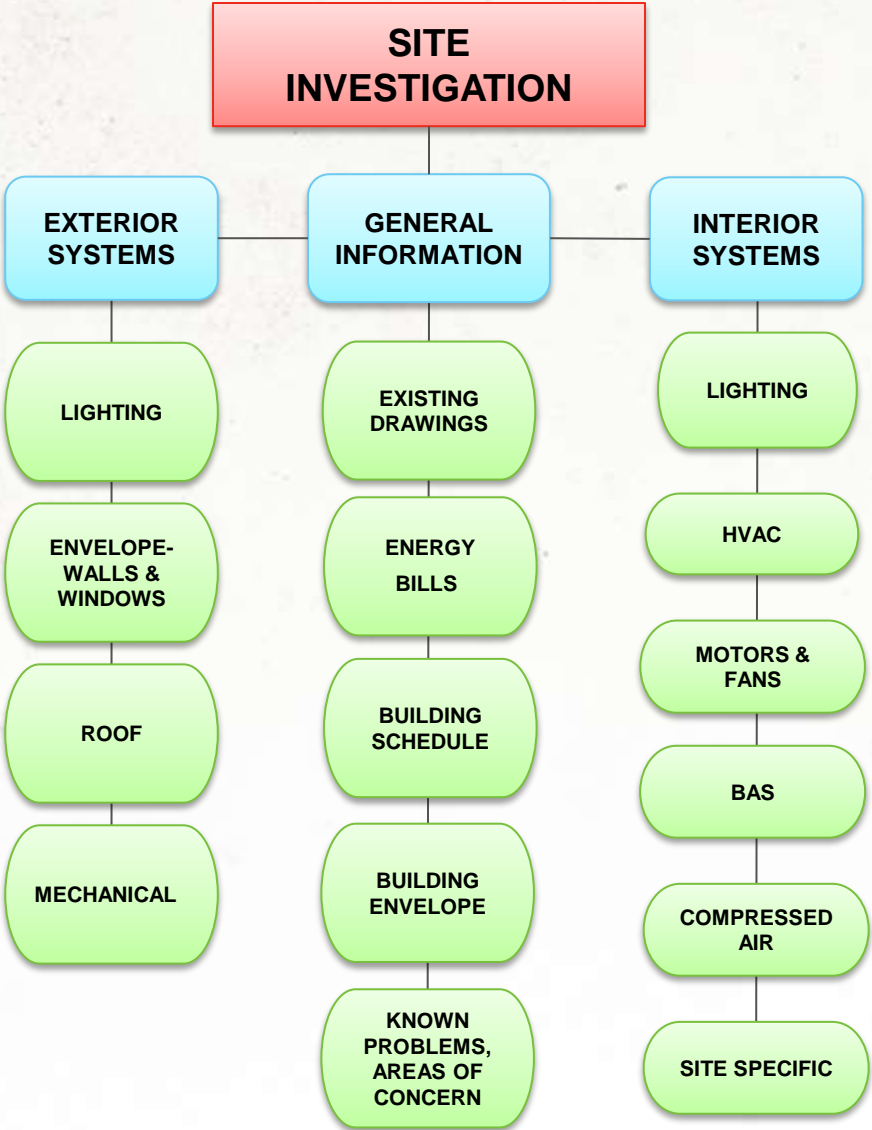
Shaping Tomorrow's
Built Environment Today



ENERGY SAVINGS MADE EASY

Building Audit

Building Audit



General Information

» Existing Drawings

- Mechanical, Electrical & Architectural
- Additions, Repairs, Upgrades

» Energy Bills

- 2 Years of existing Electrical, Gas, Fuel Oil Bills
- Benchmark Data: Use Portfolio Manager to compare, Spreadsheet

» Building Schedule

- Occupancy Schedule
- Unit Schedules

» Building Envelope

- Insulation Values for Walls, Windows and Roofs

» Known Problems, Areas of Concern

- Employee Survey
- Reoccurring Problems
- Comfort Issues (Drafts, Hot, Cold, etc.)

Exterior Systems

» Lighting

- Are the bulbs the most efficient type?
- Are lights on in unoccupied areas?
- Is there over lighting?
- Lighting Controls?

» Walls & Windows

- Are there cracks in the walls or windows?
- Do the windows need replaced?
- Could the walls use more insulation?

» Roof

- Does the roof need replaced?
- Are Shingles missing/turned up?
- Are there any known leaks? Had a thermal scan?

» Mechanical

- Are louvers stuck open/closed?
- Are units clean?
- Are Exhaust Fans in proper working order?

Interior Systems

» Lighting

- Are the bulbs the most efficient type?
- Are lights on in unoccupied areas?
- Is there over lighting? Controls?

» HVAC

- Types of heating and cooling systems? Efficiency?
- Are there any known leaks in the system?
- Is the equipment regularly maintained?

» Motors & Fans

- Are VFDs used?
- Is the equipment regularly maintained?
- Sized correctly?

» BAS

- DDC or Pneumatic Control?
- Are the units scheduled?
- Is the ventilation scheduled?
- Are energy savings strategies used on the operation of the equipment? (DCV, SAT reset, PRS reset, etc)

» Compressed Air

- Are there any leaks in the system?
- Scheduled?
- Storage, Any? Too small?

» Site Specific

- Wastewater Plant?
- Industrial Plant?
- Misc. Equipment?

Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

| GPM 1 | | GPM 2 | | PSI 1 | | PSI 2 | | kWh 1 | | kWh 2 | | SAVINGS |
|-------|------|-------|------|-------|------|-------|------|-------|--|-------|--|---------|
| 1 | 100% | 10 | 100% | 100 | 100% | 100 | 100% | 0% | | | | |

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

| GPM 1 | GPM 2 |
|-------|-------|
| 1 | 100% |
| .9 | 90% |
| .8 | 80% |
| .7 | 70% |
| .6 | 60% |
| .5 | 50% |
| .33 | 33% |
| .25 | 25% |

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

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| 1 | 100% |
| | 90% |
| | 80% |
| | 70% |
| | 60% |
| .5 | 50% |
| | 33% |
| | 25% |

How much energy can be saved if
You reduce the flow of your fan/pump
by 50% ?

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Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

| GPM 1 | | GPM 2 | | PSI 1 | | PSI 2 | |
|-------|------|-------|------|-------|--|-------|--|
| 1 | 100% | 10 | 100% | | | | |
| | 90% | | 81% | | | | |
| | 80% | | 64% | | | | |
| | 70% | | 49% | | | | |
| | 60% | | 36% | | | | |
| .5 | 50% | 2.5 | 25% | | | | |
| | 33% | | 11% | | | | |
| | 25% | | 6% | | | | |

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

Building Audit

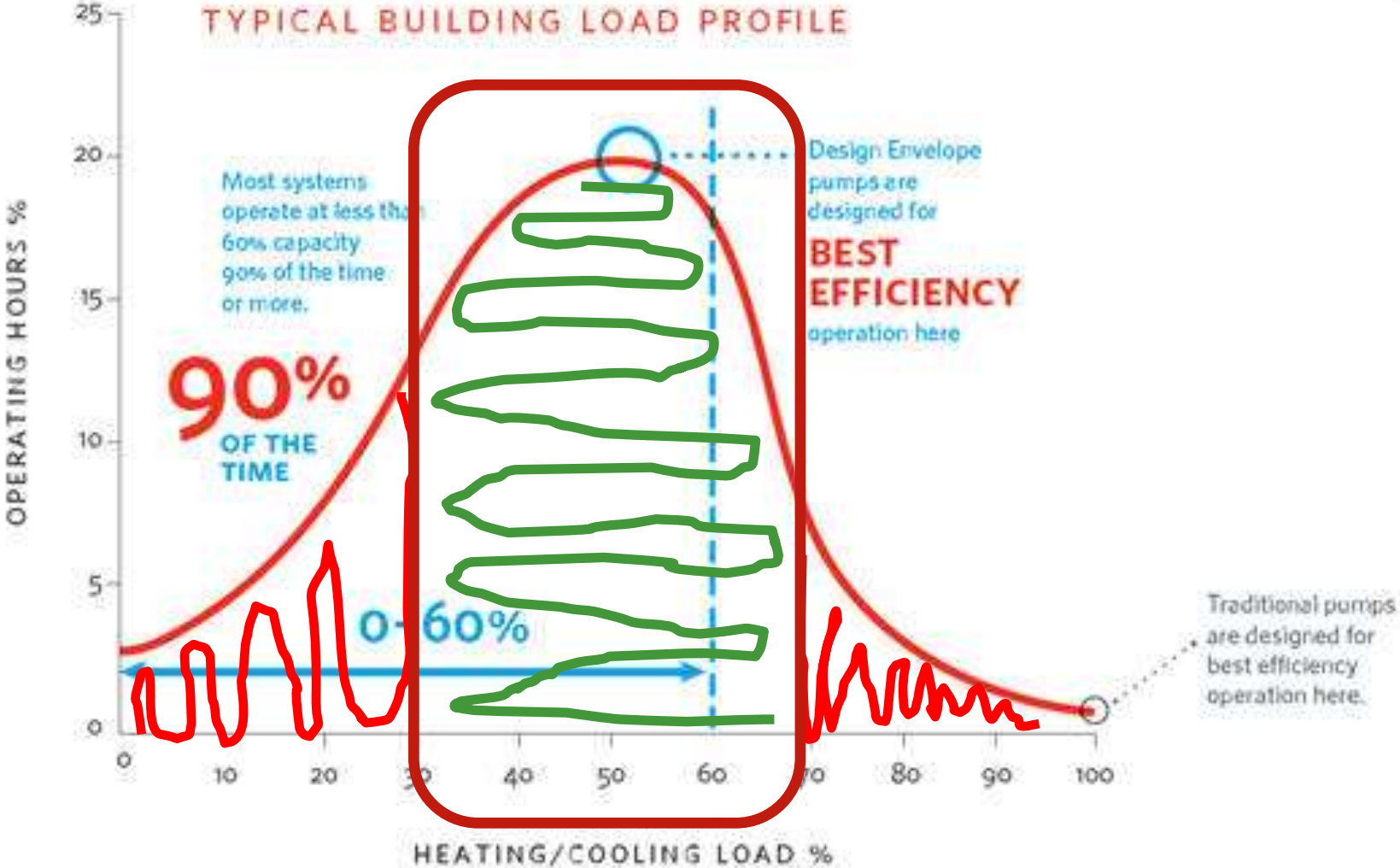
Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

| GPM 1 | | GPM 2 | | PSI 1 | | PSI 2 | | kWh 1 | | kWh 2 | | SAVINGS |
|-----------|------------|------------|------------|-----------|------------|------------|--|-------|--|-------|--|---------|
| 1 | 100% | 10 | 100% | 100 | 100% | 0% | | | | | | |
| | 90% | | 81% | | 73% | 27% | | | | | | |
| | 80% | | 64% | | 51% | 49% | | | | | | |
| | 70% | | 49% | | 34% | 66% | | | | | | |
| | 60% | | 36% | | 22% | 78% | | | | | | |
| .5 | 50% | 2.5 | 25% | 13 | 13% | 87% | | | | | | |
| | 33% | | 11% | | 4% | 96% | | | | | | |
| | 25% | | 6% | | 2% | 98% | | | | | | |

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

Affinity Laws



Building Audit

Affinity Laws

FLOW/SPEED ~ PRESSURE ~ POWER/ENERGY

| GPM 1 | | GPM 2 | | PSI 1 | | PSI 2 | | kWh 1 | | kWh 2 | | SAVINGS |
|------------|------------|------------|------------|-----------|------------|-------|--|-------|--|-------|--|------------|
| 1 | 100% | 10 | 100% | 100 | 100% | | | | | | | 0% |
| .7 | 70% | 4.9 | 49% | 34 | 34% | | | | | | | 66% |
| .6 | 60% | 3.6 | 36% | 22 | 22% | | | | | | | 78% |
| .5 | 50% | 2.5 | 25% | 13 | 13% | | | | | | | 87% |
| .33 | 33% | 1.1 | 11% | 4 | 4% | | | | | | | 96% |

$$\left(\frac{FLOW_1}{FLOW_2}\right) = \left(\frac{RPM_1}{RPM_2}\right) \sim \left(\frac{SP_1}{SP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^2 \sim \left(\frac{HP_1}{HP_2}\right) = \left(\frac{RPM_1}{RPM_2}\right)^3$$

Building Audit

(7) Basic Tools for +/- \$ 1,000



Thermal Imaging Camera

\$250



Volt-Amp Meter

\$75



\$150

Programmable Thermostat



Infrared Thermometer

\$100

Building Audit

(7) Basic Tools for +/- \$ 1,000



Pressure Differential Manometer Kit

\$150



Tachometer

\$100



Data Logger

\$125

Temp/RH/Light Data Logger

\$125



Vane Anemometer

\$150

Common or Quick Payback ECM's

- » HVAC Tune-Up
- » Replace Lighting and/or add lighting controls
- » Seal cracks in walls, windows & roofs
- » Thermostat Setback Schedules
- » Ventilation Setbacks / Demand Controlled Ventilation
- » Vending Machine Controls
- » VFDs on constant volume fans/pumps
- » Wall/Roof Insulation
- » Window Replacement





Retro-commissioning - Lite

Retrocommissioning - Lite

- » Retrocommissioning identifies areas for performance improvement in your facility's equipment, lighting and controls system.

- » Retrocommissioning will provide your building with an in depth analysis of the current systems and lighting using tools such as:
 - **Functional Testing of Equipment**
 - Determine if the current system needs improvements or replaced
 - **Thermal Imaging**
 - Scan the building for areas of heat loss to improve envelope
 - **Data Loggers**
 - Determine space and equipment Temperature and Relative Humidity
 - **Building Load Analysis**
 - Calculate the current load on the building and compare to the equipment
 - **Energy Model of the building**
 - Provide ECM's with energy savings for the building
 - **Review and Programming of the current BAS**
 - Determine the most Energy Efficient way to control the buildings systems



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Energy Efficiency Programs

Energy Efficiency Programs

» What are Energy Efficiency Programs?

- Energy Efficiency Programs provide a range of financial and other incentives to encourage investments in energy-efficient technologies and/or behavior change. These incentives range from simple cash rebates for the purchase of efficient products to bundled customized financial incentives and technical assistance.

» What are Prescriptive Rebates?

- Prescriptive rebates are fairly straightforward. The utility or agency offering the rebate gives specific guidelines about energy-saving upgrades, and the rebate amount you'll get for performing those upgrades.

» What are Custom Incentives?

- Custom Incentives are usually provided as \$/kWh saved and \$/therm saved. Custom incentives usually have to fall within a certain payback period and are sometimes capped at certain amounts.

Ameren Incentives

Prescriptive Rebates for

- » Lighting
- » Heating/AC
- » VFDs
- » Water Heaters
- » Steam Traps
- » and More!

Custom Projects (PY9)

- » \$0.06/kWh saved per year
- » \$0.90/Therm saved per year
- » Payback Period Before and After Incentive must be between 6 months and 1 year.
- » Custom incentives payments are capped at 50% of the customer's incremental cost to purchase efficiency measures, or the preapproval amount, whichever is less.

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Thank You!



Questions?

