Commercial & Institutional Steam Efficiency:

Checklist for Getting Management Approval

Note: These slides are best used for individual reading and reference, not for making presentations

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ALLIANCE TO SAVE ENERGY
Creating an Energy-Efficient World

Checklist Contents

PURPOSE: This document presents the elements for any discussion that promotes steam facility improvements. "Energy efficiency" actually provides *control over thermal resources*, which is the key to achieving reliability and saving money.

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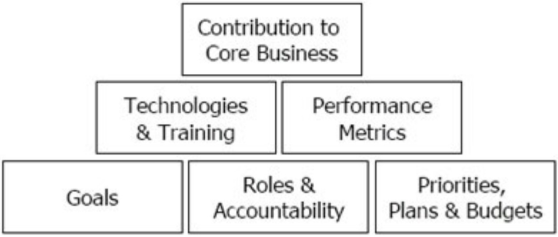
What *is* Steam Efficiency?

Energy Efficiency = Thermal Control = Process Reliability = Improved Business Performance



Contribution to Core Business

Technologies & Training

Performance Metrics

Goals

Roles & Accountability

Priorities, Plans & Budgets

"You can't manage what you don't measure"

Energy efficiency is woven into every-day facility activities.

Management Objections

THE NEXT TEN SLIDES:

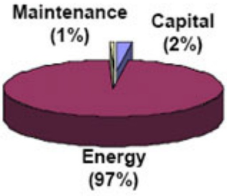
"*Energy efficiency is not our business.*"

Energy efficiency is widely misunderstood. That's why there are so many objections to it.

Use the next ten slides to demonstrate how energy efficiency contributes to overall organizational goals.

Management's Objections (1 of 10)

"We don't have the money for energy efficiency projects." (1 of 2)



Life-Cycle Boiler Costs

- That's because management is spending all its money on fuel. Do you have money to waste on fuel you don't need?
- They can pursue quick payback efficiency projects of 120, 90, 60 days or less (See Slide 9).
- After the payback period, they will have recouped the cost of the improvement project. The ongoing savings are NEW MONEY.

☑ Challenge management to start with low-risk improvements such as combustion improvements, changes in operating procedure, or other quick return, non-capital items.

Management's Objections (2 of 10)

"We don't have the money for energy efficiency projects." (2 of 2)

- The facility budget is probably set in stone, with no more money available.
- But look at other budget line items. What's the timing?
  - Insurance: two lump-sum payments, May and October
  - Legal & Audit: lump sum due in June
- Can they borrow against either of these accounts?
  - Pay for a 30- or 60-day payback project.
  - Energy savings pay back the "loaned" amount.
  - Savings after payback are **new cash flows**.

☑ Challenge management to borrow from within the budget, pay back within 2-3 months. Any improvement that pays for itself under six months is a no-brainer. Do it.

Management's Objections (3 of 10)

"We don't have the time."

- That's because they're too busy putting out fires and playing catch-up on overtime shifts.
- Select projects that can be hired out to a consultant or vendor (Energy Performance Contractor).
- Some states enjoy the availability of low- or no-cost troubleshooting assistance from state energy offices or university-based services. Many institutional plant managers can use this searchable, online database: **National Inventory of Manufacturing Assistance Programs** at **www.oit.doe.gov/bestpractices/nimap**.

☑ Take advantage of no- and low-cost assistance. Near-term projects can be handled by a contractor. Over the long term, energy management procedures will (1) shift labor from reactive to proactive duties, and (2) reduce the frequency of fire drills, giving staff more time to monitor and control.

Near term = less than 12 months
Longer term = over 12 months

Management's Objections (4 of 10)

"Programs take priority over maintenance." (1 of 2)

- Use energy efficiency:
  - Steam/water leaks = cash leaks from the budget
  - Recapture thermal resources lost to leaks, radiant heat losses, dumped condensate, etc.
  - Stop sending steam to abandoned lines and buildings
  - Dollars saved on energy = dollars available to core programs

- More communities demand environmentally-conscious facilities. Use energy efficiency to:
    - Cut emissions output
    - Reduce supply bottlenecks on local utilities infrastructure (electric, gas, and water)

☑ Demonstrate energy efficiency's potential to add cash back to the budget and win community support.

Management's Objections (5 of 10)

"Energy projects interrupt our operations."

Opportunities*	Pct. of Steam Load Avoided	Payback (Years)
• Water management (3 out of 24 plants)	0.14%	0.07
• Steam pressure reduction (not all plants) (13/24)	1.81%	0.19
• Changes to plant operating procedures (14/24)	1.07%	0.27
• Combustion improvements (19/24)	1.36%	0.29
• Steam & condensate piping improvements (7/24)	0.45%	0.57
• Insulation improvements	0.10%	0.96
• Heat recovery projects (26/24)	1.63%	1.41
• Steam & fuel metering and monitoring (6/24)	0.28%	1.96
• Miscellaneous non-capital projects (3/24)	0.11%	2.44
• Boiler plant capital improvements (17/24)	2.42%	7.02

* From summary of 24 institutional boiler plant audits conducted by Enbridge Gas Distribution, Toronto, Canada, 1997-2002.

☑ The first 10-12 percent of steam savings come from well-proven, everyday techniques. Nothing exotic here-- interruption risk is minimal.

Management's Objections (6 of 10)

"I'm held accountable for reliability, not efficiency."

Measuring, monitoring, and verification duties (MMV):

"You can't manage what you don't measure."

- MMV activities detect most abnormal conditions before they become big problems.
- Give the operator greater confidence in the plant's performance.
- Reduce the need to maintain expensive stand-by capacity. Produce steam that's needed, not what *may* be needed.

☑ Energy efficiency = control = reliability = meet steam requirements with greater ability and precision.

Management's Objections (7 of 10)

"I'd rather achieve efficiency by securing fuel at the lowest price."

- Low fuel prices may bring on complacency– there's less incentive to improve the consumption side of the expenditure equation (See Slide 16).
- Non-energy benefits are lost. Without a focus on consumption improvement, opportunities are lost to address related issues such as plant safety, costs of core program disruption, and improved emissions and community impacts.
- Exposure to energy market volatility is increased. With less incentive to reduce consumption, the manager is in a more vulnerable position if fuel prices spike upward.

☑ Energy expense is a function of price AND volume purchased. Also, energy-efficient practices make non-energy savings available.

Management's Objections (8 of 10)

"We're already as efficient as we can be."

- Sure, they may be 100% in using the best 20-year-old technologies and practices. Are they aware of energy management innovations since then? Is energy use per heating degree-day rising over time?
- Emissions compliance and workplace safety regulations keep evolving. Energy management training supports these agendas. Plants that don't keep up with these compliance duties face a greater chance of fines, or worse– the threat of life or property casualties.
- Give the plant manager a few BestPractices Steam **case studies**. If he/she appreciates software, give him/her a copy of the **Steam System Assessment Tool** (Everything is on the *Steam CD*, free from the DOE Clearinghouse: 877-337-3463).

☑ Efficiency gains are not a one-time exercise. Merge efficiency goals with operational maintenance to stay competitive.

Management's Objections (9 of 10)

"Do nothing costs nothing."

Price of "doing nothing" can be very high. It includes:

- Revenues lost to downtime.
  Why? Energy efficiency = process control = reliability = greater output
- Unrealized revenues from extra capacity.
  Why? Energy efficiency = control = reduced leaks and losses = greater application of thermal resources = additional output = more revenue
- Higher fuel and utility expenses.
  Need to buy fuel to feed those leaks and thermal losses.
- Higher idle resource costs.
  Downtime? With idle machines, plants still incur labor, overhead, and interest costs.
- Greater exposure to safety and emissions penalties.
  Improved training and maintenance not only reduces energy use, it reduces compliance risks. Also, safer plants can reduce hazard insurance costs.

☑ "Doing nothing" about energy efficiency actually directs your money into a wide range of things you don't want to pay for.

Management's Objections (10 of 10)

"We need to cut the fat."

Be careful what you cut… it may be muscle!

Energy Efficiency = Thermal Control = Process Reliability = Improved Business Performance

Think twice about cutting anything that gives you the ability to:

- Reduce expenses
- Generate revenue
- Control risk

☑ Management needs to know how the central plant contributes to business goals.

Expense Savings

THE NEXT SEVEN SLIDES:

Most people equate "energy efficiency" with fuel bill savings.
It's more than that.

Energy management activities can impact many line items on a plant's operating budget, including:

- Labor costs
- Environmental and safety compliance costs
- Insurance costs

The next seven slides illustrate energy and non-energy savings.

Expense Savings (1 of 7)

Reduced Fuel Bills

- Classic energy efficiency: reduce leaks and losses, so the plant uses less fuel to deliver the same steam load.

Price x Quantity Purchased = Expenditure

☑ Energy efficiency = less fuel per unit of steam delivered

Expense Savings (2 of 7)

Reduce the Average Price of Fuel Purchased

- Energy efficiency = control = predictable consumption
- Predictable consumption = ability to purchase a greater proportion of fuel via fixed-price contracts
- Energy efficiency = reliability: Reduce downtime and the need to fire up reserve capacity (which may require using less-efficient boiler assets)

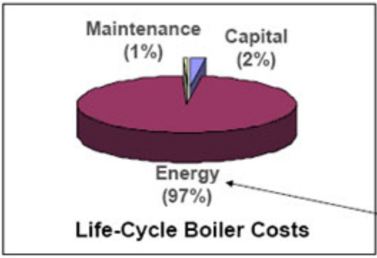
Price x Quantity Purchased = Expenditure

☑ Energy efficiency: predictable consumption volumes and usage patterns gives the facility manager leverage in locking in lower priced, fixed-contract fuel volumes.

Prove it with the plant's energy flow data.

Expense Savings (3 of 7)

Catch Utility Bill Errors



Life-Cycle Boiler Costs

- Utilities can and do make mistakes
- Use energy flow management data to balance consumption indicated on utility bills
- **GUESS WHERE THE LARGEST POTENTIAL ACCOUNTING MISTAKES ARE…**

☑ Energy management efforts (data) provide efficiency and also verify fuel procurement and consumption.

Expense Savings (4 of 7)

Reduce Budget Impact of Deferred Maintenance

Budget impact of reduced or delayed maintenance:

- **Hotels:** lower availability and turnover of rooms; may need to turn customers away… **REDUCES REVENUE**
- **Hospitals:** lower capacity for patients, reduced range & duration of functions, limits expansion… **REDUCES REVENUE**
- **Campuses:** lost lecture & dorm capacities; may need to find/rent alternative space… **CREATES UNEXPECTED EXPENSE**
- **Offices & Apartments:** Lost comfort and reduced indoor air quality = higher turnover of tenants. Attract new tenants only at lower rents… **REDUCES REVENUE**

☑ Energy efficiency improves control over thermal resources. Control allows central plants means less disruption of programs and services.

Expense Savings (5 of 7)

Lower Hazard Insurance Premiums

- Energy efficiency = closer monitoring of operations = better detection and correction of anomalies = operator's log book includes far fewer incidents. This may be leveraged with the insurance carrier for a lower premium and/or deductibles.

- The safer plant also faces fewer workman's comp claims and related settlement costs.

☑ Energy efficiency can also pay-off in lower insurance costs.

Expense Savings (6 of 7)
Avoided Emissions & Safety Penalties

- Energy efficiency = closer monitoring of operations = better detection and correction of anomalies = fewer opportunities for life and property casualties.
- Emissions output declines proportionately with fossil fuel consumption. A plant with a reduced emissions profile enjoys an extra margin of compliance certainty.
- A lower emissions profile from current plant assets reduces the need for emissions abatement hardware.
- The safer plant also endures fewer OSHA fines.

☑ Energy efficiency hedges against emissions penalties and huge-dollar risks associated with accident settlements.

Expense Savings (7 of 7)
Lower Idle-Resource Costs

- Many central plant assets are secured by debt financing. Interest costs associated with debt accrue every second of every day, regardless of plant output.
- Downtime for equipment failure does not stop interest costs from accruing.
    - Direct labor costs may still be incurred as staff wait for repairs to be made.

- Staff benefits and overhead costs also continue to accrue during work stoppages.
- Costs may apply as alternative space is secured for program or activities.

☑ Idle resources still cost money. Efficiency practices boost reliability, which is the key to avoiding downtime.

Revenue Creation

THE NEXT TWO SLIDES:

Get top management's attention by demonstrating energy efficiency's potential for *generating revenue*.

Revenue Creation (1 of 2)

Demonstrate the Revenue Equivalent of Energy Efficiency

INCOME STATEMENT	EXAMPLE	Pct.	
Revenue..................	$1,000,000	100%	
Operating Expenses....	900,000	90%	
Operating Profit..........	$100,000	10%	→ Operating Profit margin %

$$\text{OPERATING PROFIT} = \text{PROFIT MARGIN\%} \times \text{REVENUE} \Longrightarrow \$100{,}000 = 10\% \times \$1{,}000{,}000$$

$$\frac{\text{OPERATING PROFIT}}{\text{PROFIT MARGIN\%}} = \text{REVENUE} \Longrightarrow \frac{\$100{,}000}{10\%} = \$1{,}000{,}000$$

$$\frac{\$1\ \text{Saved}}{10\%} = \$10\ \text{NEW REVENUE} \Longrightarrow \frac{\$1\ \text{Saved}}{10\%} = \$10\ \text{NEW REVENUE}$$

☑ Top managers prioritize *revenue growth* over *expense savings*. Translate energy efficiency impacts into revenue equivalents.

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Revenue Creation (2 of 2)

Equate Energy Savings to Incremental Sales Volume

Example: Hotel with 200 rooms
Average rental rate: $100
Net annual energy savings = $20,000

PROFIT MARGIN	REVENUE EQUIVALENT 0F $20,000 SAVINGS	EQUIVALENT RENTAL UNITS	THIS RESULT SAME AS RENTING 200 ROOMS:
20%	$100,000	1,000	for 5 days
15%	$133,333	1,333	for 6.67 days
10%	$200,000	2,000	for 10 days
5%	$400,000	4,000	for 20 days

Note: the lower the profit margin, the greater the revenue equivalent of a dollar saved.

☑ If *sales units* are the measure of accountability, even steam managers can demonstrate their contribution.

Risk Control

THE NEXT SIX SLIDES:

Top management craves relief from the ever-increasing risks imposed on business today.

With energy efficiency comes energy *control*, and that control is what offsets risk.

Risk Control (1 of 6)

Defend Against Budget Variance (1 of 2)

- Plant managers usually “take the heat” for unexpectedly large utility bills.
- The plant manager’s defense is based on fuel **price and volume variance analysis**. (See Slide 28)
- **Measuring, monitoring, and verification** activities require the tracking of monthly fuel consumption and price experience.
- Plant managers who implement energy efficiency practices can demonstrate how:
    - consumption remains under control while energy prices vary with market activity.

- efficiency measures lower consumption, keeping energy **expenditures** below where they *would have been*.

☑ Managers of optimized plants have the means to defend against energy price impacts that are beyond their control.

Risk Control (1 of 6)

Defend Against Budget Variance (2 of 2)

Actual Bills	Consumption (therms)	Consump. per HDD	HDD*	Actual Price	Actual Expenditure
Nov-03 experience	20,700	559.5	37	$6.00	$124,200
Nov-02 experience	20,000	571.4	35	$5.00	$100,000

Variance Analysis	Consumption (therms)	Consump. per HDD	HDD*	Price	Expenditure
Nov-02 experience	20,000	571.4	35	$5.00	$100,000
Insert Nov-03 price	20,000	571.4	35	**$6.00**	$120,000
Insert Nov-03 HDD	21,143	571.4	**37**	**$6.00**	$126,857
Insert Nov-03 efficiency	20,700	**559.5**	**37**	**$6.00**	$124,200

**HDD = Heating Degree Days (see definition on slide 29)*

Risk Control (3 of 6)

Degree Day - Defined

- A ***degree day*** is a measure of the heating or cooling load on a facility created by outdoor temperature.
- When the average daily outdoor temperature is one degree below 65°F for one day, it is defined as one heating degree day (HDD).
- When the average daily outdoor temperature is one degree above 65°F, cooling degree days (CDD) are counted.

Example: 60°F (high)
+40°F (low)
100°F ÷ 2 = 50°F average daily temperature

65°F– 50°F = 15 heating degree days

☑ Use this calculation to account for monthly and yearly weather changes with respect to load. Only compare with your facility's energy bills, because other facilities often do not have the exact same billing cycle and load profile.

Risk Control (4 of 6)

Hedge Against Costs of Energy Market Deregulation

- Deregulated markets generally offer lower commodity prices for fuel, but plant managers face additional costs in search, negotiation, and verification of energy marketer services.
- Energy efficiency = utilization of energy flow data = leverage in securing supplier contracts.
- Plant managers who are better informed about their volume and timing of energy use have far greater leverage with fuel suppliers.
- Measurements of in-plant energy flows "after the meter" are the basis for balancing against fuel purchase invoices. Catch and challenge billing errors.

☑ Energy management activities generate information, which is valuable in the more complex world of energy deregulation.

Risk Control (5 of 6)

Hedge Against Evolving Emissions Criteria

- SO_2, NO_x, carbon, volatile organic compounds, and particulates are all the subject of scrutiny for current or future regulation.
- Emissions output is proportional to fossil fuel consumption. Reducing fuel consumption also reduces emissions output.
- Energy-efficient plants enjoy a larger margin of emissions compliance.
- Operator training covers energy use as well as safety and emissions management.
- Fuel savings due to efficiency are relatively easy to measure. Fines and costs related to emissions penalties are harder to measure, but are best avoided altogether.

☑ Energy management helps to avoid the risks associated with emissions regulation– both today and tomorrow.

Risk Control (6 of 6)

Hedge Against Safety Liabilities

- How many plant managers budget for OSHA violations?
- Safety comes with knowledge…. Knowledge comes with training…. Training is integral to energy optimization.
- Energy efficiency = monitoring, measuring, verification activities = control over operating parameters = fewer surprises = less catastrophic loss = lower legal and settlement costs.

☑ Energy management helps to avoid the risks associated with lapses in plant safety.

Relating Energy Efficiency to "Regular" Business Goals

THE NEXT THREE SLIDES:

Will energy efficiency *detract from* or *contribute to* core business goals?

Businesses are used to investing in order to grow.

The next three slides link energy efficiency to "regular" business investment goals.

Relating Energy Efficiency to "Regular" Business Goals (1 of 3)

Achieve a Cost Advantage

- Service prices are often dictated by the competitive marketplace, not by management. Tremendous effort goes into shaving pennies off cost as a way to maintain profit.
- Data generated from energy flow management duties helps to demonstrate energy efficiency's contribution to expense reduction. See Slides 15-22.

☑ Energy efficiency provides another margin of cost reduction in competitive service markets.

Relating Energy Efficiency to “Regular” Business Goals (2 of 3)

Generate Cash Flows Within the Business

- For some firms, the challenge is to make the best use of overhead in order to evolve their business in changing markets.
- Reducing *energy expenditures* increases **gross margins**, which represent funds available for overhead – including product development and marketing.
- Slides 15-22 illustrate ways that energy efficiency reduces expenses, thus releasing more cash to apply to overhead activities.

☑ Energy efficiency allows a greater proportion of available cash to flow into marketing and development activities.

Relating Energy Efficiency to “Regular” Business Goals (3 of 3)

Improve Return on Investment*

- Return on Investment, or “ROI,” is a key business performance indicator.

$$\text{ROI} = \text{Profit Margin} \times \text{Asset Turnover}$$

$$\text{ROI} = \frac{\underline{\text{Net Operating Income}}}{\text{Sales Revenue}} \times \frac{\underline{\text{Sales Revenue}}}{\text{Average Operating Assets}}$$

- Profit margin = “cost-price” efficiency

  - Asset turnover = revenue generating power
  - Both together = ROI = financial "productivity"
- Energy efficiency = reduced expenses = improved profit margin
- Energy efficiency = improved capacity utilization = increased production from existing assets = improved asset turnover

☑ Energy efficiency contributes to both components of ROI: profit margin and asset turnover.

*Facility level

Call to Action

THE NEXT FOUR SLIDES:

For facility managers who ask:

- *What can I do?*
- *Where do I start?*
- *Who can help me?*

Management's Objections (4 of 10)

"Programs take priority over maintenance." (1 of 2)

- Use energy efficiency:
  - Steam/water leaks = cash leaks from the budget
  - Recapture thermal resources lost to leaks, radiant heat losses, dumped condensate, etc.
  - Stop sending steam to abandoned lines and buildings
  - Dollars saved on energy = dollars available to core programs
- More communities demand environmentally-conscious facilities. Use energy efficiency to:
  - Cut emissions output
  - Reduce supply bottlenecks on local utilities infrastructure (electric, gas, and water)

☑ Demonstrate energy efficiency's potential to add cash back to the budget and win community support.

Call to Action (2 of 4)

Do this Month

Get a steam system energy audit

- Identify opportunities
  - Steam System Scoping Tool: your "discovery" checklist
- Prioritize: what to do first
  - Steam System Assessment Tool
    Evaluate costs and savings before you commit
- See how it's done
  - Steam Sourcebook, Tip Sheets, Case Studies
- Start tracking history: fuel bills vs. heating degree days

Call to Action (3 of 4)

Do by the End of the Year

- **Implement your best opportunity**

- In-house staff?
  or
- Engineering consultant?

- Use DOE BestPractices Tools
  - as do-it-yourself reference
  - way to check vendor claims
  - leverage on vendor prices

Call to Action (4 of 4)

Starting Next Year

Sustainable Energy Management

- Annual energy use targets
  - Steam/heating degree day ratios
  - Cost per 1,000 lbs. of steam

- Goals, accountability, rewards
  - Compare yourself to last year

- Your fuel bill data: good defense, good case for additional improvements

Additional References

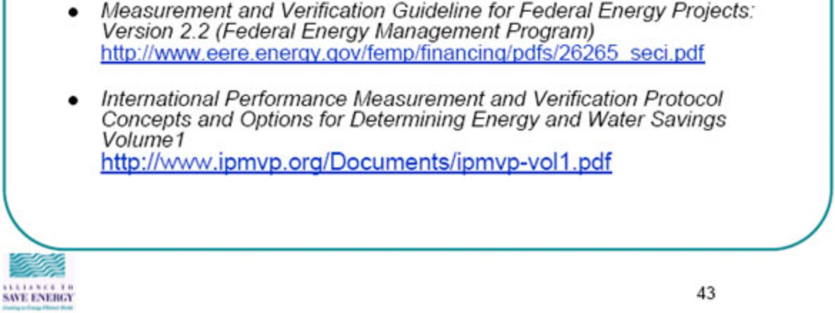
- *Steam Efficiency: Impacts from Boilers to the Boardroom* (C. Russell)
  www.ase.org/steamingahead/library/boilertoboard.pdf
- *Justifying Energy Efficiency Projects to Management* (C. Russell)
  www.ase.org/steamingahead/library/justifying.pdf
- *Cash Flow Impacts of Steam Efficiency* (C. Russell)
  www.ase.org/steamingahead/archives/2003_07-08.htm
- *The Dirty Dozen of Energy Efficiency Waste* (Fred Schoeneborn)
  http://www.ase.org/steamingahead/archives/2003_07-08_links/dirtydozen.pdf
- *Enbridge Gas Distribution's Steam Saver Program Results* (Bob Griffin)
  (66 steam plant audits, summary report)
  www.ase.org/steamingahead/archives/misc_links/enbridge03.pdf

(Continued on next slide)

Additional References

Other monitoring and verification references that may be useful for commercial facilities:

- *ASHRAE Guideline 14: Measurement of Energy and Demand Savings*
  http://resourcecenter.ashrae.org/store/ashrae/



- *Measurement and Verification Guideline for Federal Energy Projects: Version 2.2 (Federal Energy Management Program)* http://www.eere.energy.gov/femp/financing/pdfs/26265_seci.pdf

- *International Performance Measurement and Verification Protocol Concepts and Options for Determining Energy and Water Savings Volume1* http://www.ipmvp.org/Documents/ipmvp-vol1.pdf

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