

ENERGY AUDITS: HOW EFFICIENT IS YOUR FACILITY?



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Doug Litwiller co-founded Energy Solutions-OTB, LLC, in 2010. Energy Solutions-OTB provides “outside the box” energy-related consulting services to commercial and industrial customers. These services include energy audits, feasibility studies for energy efficiency improvements and renewable energy projects, energy sales tax exemption studies, and project management.

Prior to founding Energy Solutions-OTB, Doug was project engineer in the Strategic Sales and Accounts group with Alliant Energy for about 13 years.

Doug is a mechanical engineering graduate of Iowa State University and is a registered Professional Engineer in the State of Iowa. Doug is also a Certified Energy Manager.

Agenda

1. First Things First - The “Ten-Step” Energy Management Process
2. Understanding Rate Structures and Bills
3. Identify Energy Savings Opportunities
4. Evaluate the Economics of the Opportunities
5. Wrap-Up

Ten-Step Plan

1. Get commitment from “Management”!
2. Appoint an Energy Executive/Champion.
3. Draft a written Energy Management Plan
4. Recruit Energy Management Team Members
6. Benchmark, Monitor, and Report Energy Use
7. Raise the level of energy awareness of the staff – get employees engaged!
8. Complete energy audits and assessments.
9. Take action – implement the justified recommendations.
10. Conduct an annual evaluation of the program.
11. Document and publicize the results.

- Mission Statement
- Management Support
- Plan Objectives
- Utility Strategy
- Energy Team
- Utility Consumption Tracking
- Submetering
- Capital Improvement Program
- Employee Training

ENERGY MANAGEMENT PLAN

Company Name
Company Location

Date Originally Prepared: **October 14, 2009**

PLAN REVIEW HISTORY

Review Date:	Reviewed and Approved By:
Review Date:	Reviewed and Approved By:
Review Date:	Reviewed and Approved By:

1. MISSION STATEMENT:

1.1. In an attempt to reduce overall operating costs at the Company Name facility, located in Company Location, and to be better stewards of the world's natural resources, an energy management plan has been developed and implemented directing the undertaking economic measures to increase our organization's energy efficiency without significantly negatively impacting the normal operations of our facilities.

2. MANAGEMENT SUPPORT:

2.1. The President and CEO of Company Name, Company CEO, is ultimately responsible for the administration of and the success of the Energy Management Plan.

3. PLAN OBJECTIVES:

3.1. General:

- 3.1.1. Promote energy efficiency throughout the facility via cost effective programs and initiatives.
- 3.1.2. Promote and encourage energy awareness and training of all employees.
- 3.1.3. Monitor, trend, and review and facility energy usage and develop corrective actions if energy use falls outside the bounds of preset limits.
- 3.1.4. Develop KPI's and assign accountabilities.
- 3.1.5. Develop, implement, and meet energy usage/cost reduction targets.
- 3.1.6. Maintain a close working relationship with the local utility companies.

3.2. Utilities Included in the Plan:

- 3.2.1. Natural Gas

1. Understand the three basic elements that impact an electrical energy bill:
 - Peak Demand (KW), Energy Consumption (KWH), Power Factor
2. Understand the components of the electrical “tariff”:
 - General characteristics/applicability
 - Peak demand (KW) and energy (KWH) charges
 - Power factor adjustments
 - Various energy cost adjustments
3. Understanding the tariff allows you to understand the impact of:
 - “When” (time-of-day) you use power (if you are on a “time of day” rate)
 - Operating lots of equipment simultaneously (peak demand)
 - The potential costs associated with having a low facility “power factor”

STATEMENT OF ELECTRIC SERVICE SUPPLIED

BILL DATE: 2/1/2011

BILLING DEMAND

13,311.35	Actual Metered Demand		
<u>13,017.60</u>	On-Peak Demand	13,017.60	KW On-Peak Billing Demand
293.76	Excess Off Peak KW X 50% =	<u>146.88</u>	KW Off-Peak Billing Demand
		<u>13,164.48</u>	KW Total Billing Demand *

* But not less than 75% of the highest billing demand similarly determined during the previous 3 months ended in August. 12,724.56 KW

METER DATA:

RATE CODE: 807-8

	Meter 1	Meter 2	Meter 3	
1/31/2011	19,877	10,160	18,327	Present Read
12/31/2010	<u>19,270</u>	<u>9,592</u>	<u>18,030</u>	Previous Read
	607	568	297	POWER FACTOR 99.9%
Multiplier	<u>4.800</u>	<u>4.800</u>	<u>4.800</u>	
	2,913,600	2,726,400	1,425,600	7,065,600 TOTAL

If billing demand is > than 6581, 10% demand price discount on growth

DEMAND CHARGES:

	Winter	Winter
	21	21
200.00 KILOWATTS @	\$12.68	\$ 2,536.00
800.00 KILOWATTS @	\$11.98	\$ 9,584.00
5581.00 KILOWATTS @	\$11.35	\$ 63,344.35
3419.00 KILOWATTS @	\$10.22	\$ 34,942.18
0.00 KILOWATTS @	\$11.18	\$ -
3164.48 KILOWATTS @	\$10.06	\$ 31,834.67
0.00 KILOWATTS @	\$9.48	\$ -
<u>13,164.48</u>		<u>\$ 142,241.20</u>

4.42% Primary Service Discount \$ (6,287.06)

\$ 135,954.14

9.00 % Power Factor Above 90% x Net Demand Charge \$ (12,235.87)

\$ 123,718.27

Total Demand Charge

Total Demand Charges \$ 123,718.27

ENERGY CHARGES:

				Growth kWhs	10% Discount
Winter On-Peak KWH	2,563,369	KWH @	0.01919	\$ 49,191.05	1,220,604 \$ (1,915.13)
Winter Off-Peak KWH	4,502,231	KWH @	0.01030	\$ 46,372.98	2,115,094 \$ (1,438.26)

ENERGY COST ADJUSTMENT = TOTAL KWHS X \$0.0207 per KWH \$ 146,257.92

Total Energy Charges \$ 362,186.83

EXCESS FACILITIES CHARGE

\$ 187.47

CITY FRANCHISE FEE

\$ 3,841.17

Net Bill Exclusive of Sales Tax \$ 366,215.47

98.00% TAX EXEMPT SALES TAX, 6.0% OP 7,324.31

\$ 439.46

Previous Balance \$ -

Total Net Bill \$ 366,654.93

WHAT THE
REVIEWER
SEES

REVENUE MONTH 01/2011
STATEMENT OF ELECTRIC SERVICE SUPPLIED

FROM: 12/31/2010
TO: 1/31/2011
BILL DATE: 2/1/2011

Blah
Blah
Blah
Blah
Blah
Blah
Blah
Blah
Blah
Blah

Bill Total

Total Net Bill

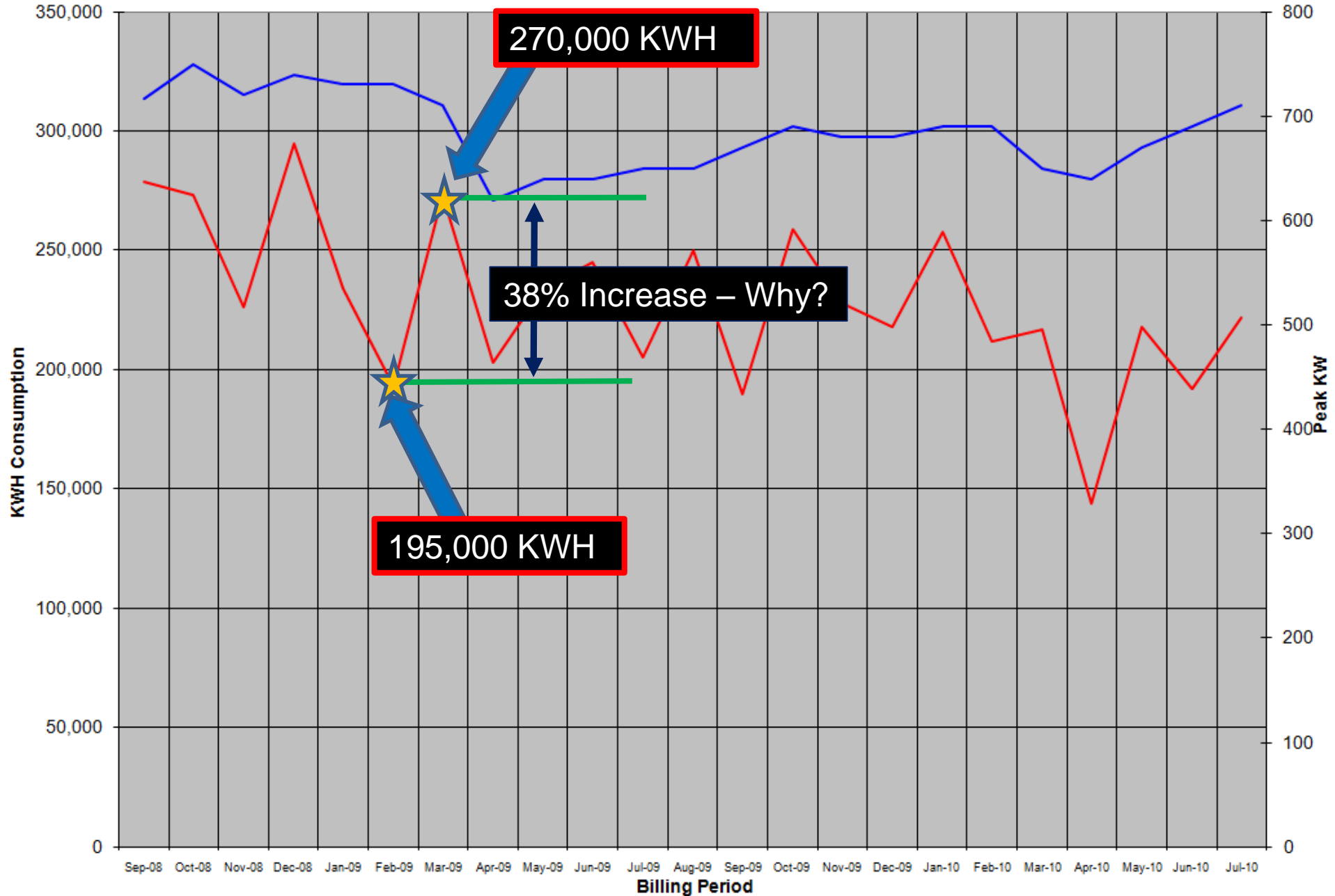
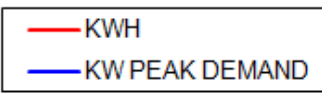
\$ 366,654.93

Energy Bill Dissection

1. Review and dissect the monthly energy bills.
2. Review monthly with members of your energy team.
3. Check for trends.
4. Compare the current month to the previous month.
5. Compare the current month to last year.
6. Explain major increases or decreases in energy usage.
7. Check for the impact of weather conditions.
8. Calculate “energy usage per widget” produced.

Changes in energy (KWH) consumption

Customer XYZ -- Main Elect



Energy Efficiency Improvements

1. Lighting
2. Fans, Pumps, and Motors
3. Compressed Air Systems
4. Building Envelope
5. HVAC Systems
6. Other Systems
7. Energy Awareness Training
8. Energy Audits and Assessments
9. Economics

Lighting

1. Leaving lights on when not needed is a very common “major” energy efficiency violation!
2. Economics of lighting replacement/retrofit projects is highly dependent on hours of operation!
4. Lighting projects have typically represented “low hanging fruit”!
5. Leaving outside lights on during the day is “frowned upon”!
Make sure your timers/photocells are operating properly.
6. Step #1: Conduct a complete and thorough lighting audit and analysis of the facility.

Fans & Pumps

1. The greatest percentage of electrical energy consumed in any given plant is consumed by motors driving equipment.
2. The greatest potential for energy savings involves “attacking” fan and pumping systems – specifically “centrifugal” pumps and fans.
3. Fan and pumping systems are often “oversized”.
4. Often, fans/pumps are operating at a “design” capacity only a small percentage of the time.
5. Replace “mechanical” flow control devices with an adjustable speed drive system – can result in significant energy savings!

7. Areas of opportunity:

<p>Oversized systems with flows controlled by dampers or valves – even constant flow systems</p>	<p>Systems with varying flow rates, controlled by dampers or valves</p>
<p>Systems with flows controlled by recirculation the fluid back to the source</p>	<p>High hours of operation</p>
<p>Systems with multiple pumps, operating in parallel, with all pumps operating all the time</p>	<p>Systems with a high level of valve or damper maintenance</p>
<p>Large motors</p>	<p>Systems that have changed over the years</p>
<p>Noisy valves, pumps, piping, dampers</p>	<p>Pumps replaced with pumps that were “on hand”</p>

Compressed Air Systems

1. Compressed air is often the “forgotten” utility – 20% of the energy consumed by an “average” compressed air system is used to feed leaks!
2. Systems should be operated at the lowest possible pressure – for every 10 PSI increase in pressure, the energy consumption increases by 5%.
3. Identify and fix compressed air leaks – use an ultrasonic leak detector – don’t just rely on your ears!
4. Make sure that compressed air is the “best” alternative for the application.
5. Consider hiring an independent compressed air system auditor to perform a complete system audit. Components of an audit should include:

1. Dock Doors:

- Make sure the dock door seals are in good condition.
- Install dock leveler seals.

2. Side Wall/Ceiling Dampers:

- Make sure the dampers seal tightly in the winter.
- Consider sealing them during the heating season.

3. Windows and Doors:

- Make sure doors and windows are properly weatherstripped.
- Confirm windows and doors operate properly and close tightly
- Fix broken windows.

4. Insulation:

- Add side wall and roof insulation where appropriate.
- When it is time to replace your roof, don't forget to evaluate the potential of upgrading the insulation at that time.

HVAC Systems

1. Replacing HVAC systems primarily to reduce energy costs is rarely cost-effective.
2. Shut systems off (or turn them down) when not needed.
3. Install VFD's and controls to move only that amount of air that is necessary!
4. Make sure the HVAC system "economizer" controls operate properly.
5. Install modern DDC (direct digital control) systems.
6. Confirm systems are maintained properly (e.g. filters are clean, dampers operate properly).
7. Optimize chilled water pumping and cooling tower systems.
8. Consider implementing a "retro- or re- commissioning" program.

1. Boiler Systems:

- Hot water boilers can be more efficient than steam boilers.
- Install boiler flue gas “economizers”.
- Make sure steam traps are operating properly.
- Confirm “hot” equipment and piping is insulated.
- Implement boiler blowdown heat recovery systems.
- Minimize steam pressure.

2. Industrial Heating Systems:

- Consider installing heat recovery systems.
- Minimize “idle” time.

Energy Awareness Training

1. Can result in significant “no-cost” or “low-cost” sustainable energy savings!
2. Get the employees involved and engaged!
3. Challenge the “this is the way we’ve always done it” syndrome.
4. Ask “why” and “what if” questions.
5. Document savings and report back to the employees!
6. Incorporate a customized energy awareness training program for all employees!

Energy Audits – Primary Purpose

1. Before proceeding, make a commitment to implement the recommendations that have favorable economics!
2. Identify and inventory how and where energy is used (development of an equipment database would be helpful).
3. Review operating and maintenance practices.
4. Estimate/measure how much energy is being used (baseline).
5. Identify ways to reduce energy consumption.
6. Estimate potential energy savings.
7. Estimate cost of implementation.

Energy Audits

1. Self-Assessment
2. Level I Audit
3. Level II Audit
4. Level III Audit

Self-Assessment Program

1. Conducted by in-house staff.
2. Staff is trained on what to look for and why.
3. Completed on a regularly basis.
4. Scheduled during AND after normal working hours.
5. Staff uses a customized assessment tool.
6. Results are documented in writing and publicized.
7. Action items are prepared and assigned to a particular individual with a completion date.

Level I Audit

1. Sometimes called a “walk-through” audit.
2. Conducted by a trained auditor.
3. Auditor tours the facility – typically no longer than one day onsite.
4. Auditor generates a report highlighting low-cost and no-cost energy usage reduction measures.
5. Identifies potential opportunities that warrant further study and analysis.
6. Relatively low cost.

Level II Audit

1. Sometimes called a “an energy survey and analysis” or a “general” audit.
2. Includes the Level I work.
3. Includes more detailed energy analyses and calculations.
4. Includes a financial analysis of proposed energy efficiency measures.
5. More expensive than the Level I audit (you get what you pay for).

Level III Audit

1. Sometimes called an “investment grade” audit.
2. Includes information from the Level II audit.
3. Will include a lot of detail, analyses, and “number-crunching”.
4. May involve energy “modeling” of various systems or possibly the entire building.
5. May also involve actual energy metering and data collection.
6. May include multiple auditors multiple days.
7. Most expensive!

Project Economics - General Comments

1. The most common “yardstick” is the “simple payback”.
2. Every “\$” you save by implementing an energy efficiency improvement project goes directly to the “bottom line”!
3. Ask “management” to determine how many “widgets” you would have to sell to bring that same amount of “profit” to the bottom line!
4. Consider employing a “yardstick” that is more sophisticated than the “simple payback” method.
5. There is almost always a cost associated with doing “nothing”!

Wrap Up

1. Energy audits are only a component of a comprehensive, written, energy management plan.
2. An energy audit has never saved one KWH of electricity or one therm of natural gas!

Other Resources

Other Energy-Related Resources (Page 1)

NAME OF SOURCE	URL	COMMENTS
Pump Systems Matter	http://www.pumpsystemsmatter.org/	Pumps
Hydraulic Institute	http://www.pumps.org/	Pumps
U.S. Council for Energy-Efficient Manufacturing	http://www.superiorenergyperformance.net/	Industrial energy efficiency
U.S. Council for Energy-Efficient Manufacturing	http://www.energyquickstart.org/	Comprehensive listing of energy efficiency and conservation resources that are available from public and non-profit sources
U.S. Dept of Energy – “Best Practices”	http://www1.eere.energy.gov/industry/bestpractices/	It’s mission is to improve the energy intensity of the U.S. industrial sector through a coordinated program of research and development, validation, and dissemination of energy-efficient technologies and practices.
Consortium for Energy Efficiency	http://www.cee1.org/	General energy efficiency (residential, commercial, industrial)
Compressed Air Best Practices	http://www.airbestpractices.com/	Great info on compressed air systems – subscribe to their magazine!

Other Energy-Related Resources (Page 2)

NAME OF SOURCE	URL	COMMENTS
U.S. Dept of Energy – “Save Energy Now”	http://www1.eere.energy.gov/industry/saveenergynow/	<i>Save Energy Now</i> is a national initiative that aims to drive a reduction of 25% or more in industrial energy intensity in 10 years.
Motor Decisions Matter	http://www.motorsmatter.org/index.asp	<i>Motor Decisions MatterSM</i> is a national public-awareness campaign sponsored by a consortium of electric utilities, industry trade associations, and others.
U.S. EPA – Energy Star	http://www.energystar.gov/	<i>ENERGY STAR</i> is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices.
Compressed Air Challenge	http://www.compressedairchallenge.org/	The Compressed Air Challenge is a voluntary collaboration of industrial users; manufacturers, distributors and their associations; consultants; state research and development agencies; energy efficiency organizations; and utilities. This group has one purpose in mind - helping you enjoy the benefits of improved performance of your compressed air system.
Federal Grants – Grants.gov	http://www.grants.gov/search/search.do?mode=VIEW&opId=47763	Information on federal grants for the funding of energy efficiency improvement projects
U.S. Dept of Energy – Industrial Assessment Centers	http://iac.rutgers.edu/	An industrial assessment is, quite simply, an in-depth assessment of a plant site; its facilities, services and manufacturing operations. Offered free of charge.

Other Energy-Related Resources (Page 3)

NAME OF SOURCE	URL	COMMENTS
Maryland "Save Energy Now"	http://www.energy.state.md.us/SEN/	<i>Maryland Save Energy Now</i> supports the State's industrial sector by offering local access to low cost facility energy assessments, energy efficiency training, financial incentives, and tools and resources
Energy Center of Wisconsin	http://www.ecw.org/	The Energy Center is an independent nonprofit that seeks solutions to energy challenges
"Flex Your Power" funded by the California Public Utilities Commission	http://www.fypower.org/	Flex Your Power is California's statewide energy efficiency marketing and outreach campaign
U.S. Dept of Energy – "Quick Plant Energy Profiler"	http://www1.eere.energy.gov/industry/bestpractices/software_quickpep.html	The Quick Energy Profiler, or Quick PEP, is a free <u>online</u> software tool to help U.S. industrial plant managers improve energy management at industrial facilities
Iowa State University Center for Industrial Research and Service – "Energy-Related Best Practices: A Sourcebook for the Chemical Industry"	http://www.ciras.iastate.edu/publications/EnergyBP-ChemicalIndustry/	Energy efficiency improvement guide for the chemical industry
Iowa State University Center for Industrial Research and Service – "Energy-Related Best Practices: A Sourcebook for the Food Industry"	http://www.ciras.iastate.edu/publications/EnergyBP-FoodIndustry/	Energy efficiency improvement guide for the food industry

Other Energy-Related Resources (Page 4)

NAME OF SOURCE	URL	COMMENTS
Natural Resources Canada	http://oee.nrcan.gc.ca/publications/commercial/m144-10-2003e.cfm	Saving energy dollars in hotels, motels and restaurants
EPA – Energy Star “K-12 Schools”	http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12	Energy efficiency improvement opportunities for K-12 school districts
Iowa Energy Center	http://www.energy.iastate.edu/Efficiency/index.htm	Information on energy efficiency, renewable energy, etc.
Lighting Research Center	http://www.lrc.rpi.edu/	The Lighting Research Center is the world's leading university-based research and education organization devoted to lighting - from technologies to applications and energy use, from design to health and vision
Washington State University “Extension Energy Program”	http://energyexperts.org/	Information on a wide range of energy efficiency topics
Alliance to Save Energy	http://ase.org/	The Alliance to Save Energy set out to improve the efficiency of America’s energy resources to ensure that we never use more energy that we need to.
Northwest Energy Efficiency Alliance	http://www.nwalliance.org/	Mobilize the Northwest to become increasingly energy efficient for a sustainable future.

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