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Leverage Energy Assessments and ASHRAE Audits to Identify Energy-Saving Projects

Mike Kostrzewa, P.E., SmartWatt Energy

June 26/27, 2018

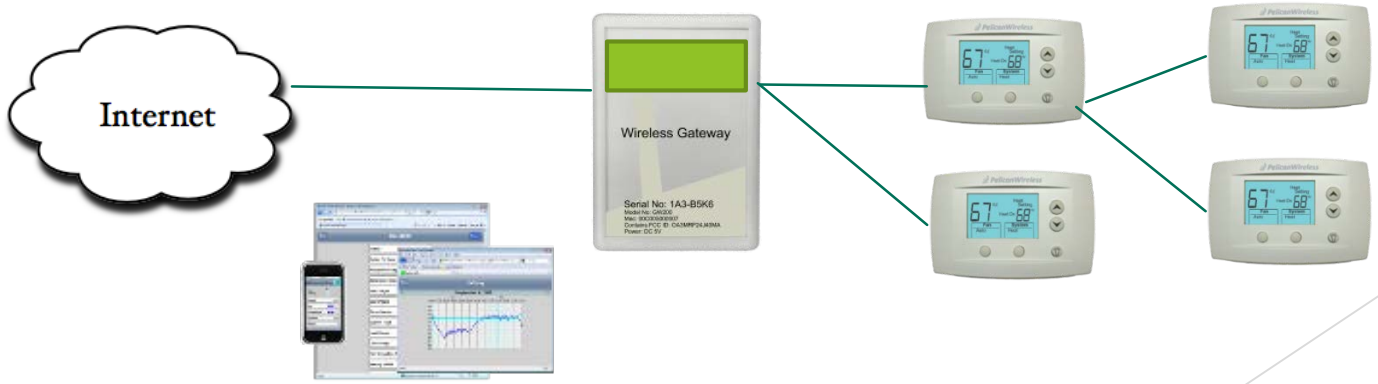
Free technology

Smart Networked Thermostats

- Free equipment and installation
- Centralized management of heating and cooling equipment
- Monitor & control from a centralized web portal
- Typical 10% heating and cooling energy savings
- Must participate in limited number of Community Energy Events

Participation requirements

- Must participate in 15 community energy events or 75% of all events, which ever is less
- At least 75% of devices have to play to get credit for event
- Events are two hours and held 1pm-7pm (typically 3pm-5pm)
- South: 1 June – September 30
- No events the day before or on holidays: two event max per week
- Facility can't have a Energy Management System
- Prefer five or more thermostats



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SolarGenerations

SolarGenerations incentives

	Expected Performance-Based Buydown	Performance-Based Incentive
	Up to 25 kW size	25 kw – 500 kW size
Public, Low Income, Non-profit	$490 per kilowatt	$0.0527 per kWh
Residential, Commercial, Industrial	$245 per kilowatt	$0.0264 per kWh

SolarGenerations offering

- Continuously open
- Eligible for system size up to 500 kW
- Incentives are paid up front for small systems (EPBB) and over time for larger systems (PBI)

Mike Kostrzewa, P.E.

- Currently Senior Energy Engineer, SmartWatt Energy in Las Vegas (2017)
- Assistant Director, U.S. Department of Energy's Industrial Assessment Center at Colorado State University, (1996–2016)
- Director, Colorado Industrial Energy Challenge (2008–2010)
- Energy expert in fan, pump and compressed air systems in support of the U.S. Department of Energy's Save Energy Now Program (2007-2009)

Agenda

- Describe what energy assessments and ASHRAE audits are – and aren't
- Review the definitions of different audit levels and what to expect from each one
- Review examples and perform sample in-class audit
- Discuss tips for potential energy-saving opportunities
- Review available incentives
- Understand the benefits of energy audits and discuss possible roadblocks from the auditor's perspective

Key points

- How efficiency projects reduce operating and maintenance costs for your business
- The value of free PowerShift energy assessments that identify potential projects within your facility
- ASHRAE Level 2 audits and their value in analyzing energy consumption
- How ASHRAE Level 3 audits offer detailed analysis for capital-intensive projects and their expected results
- Commercial incentives available for your business

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Energy assessments

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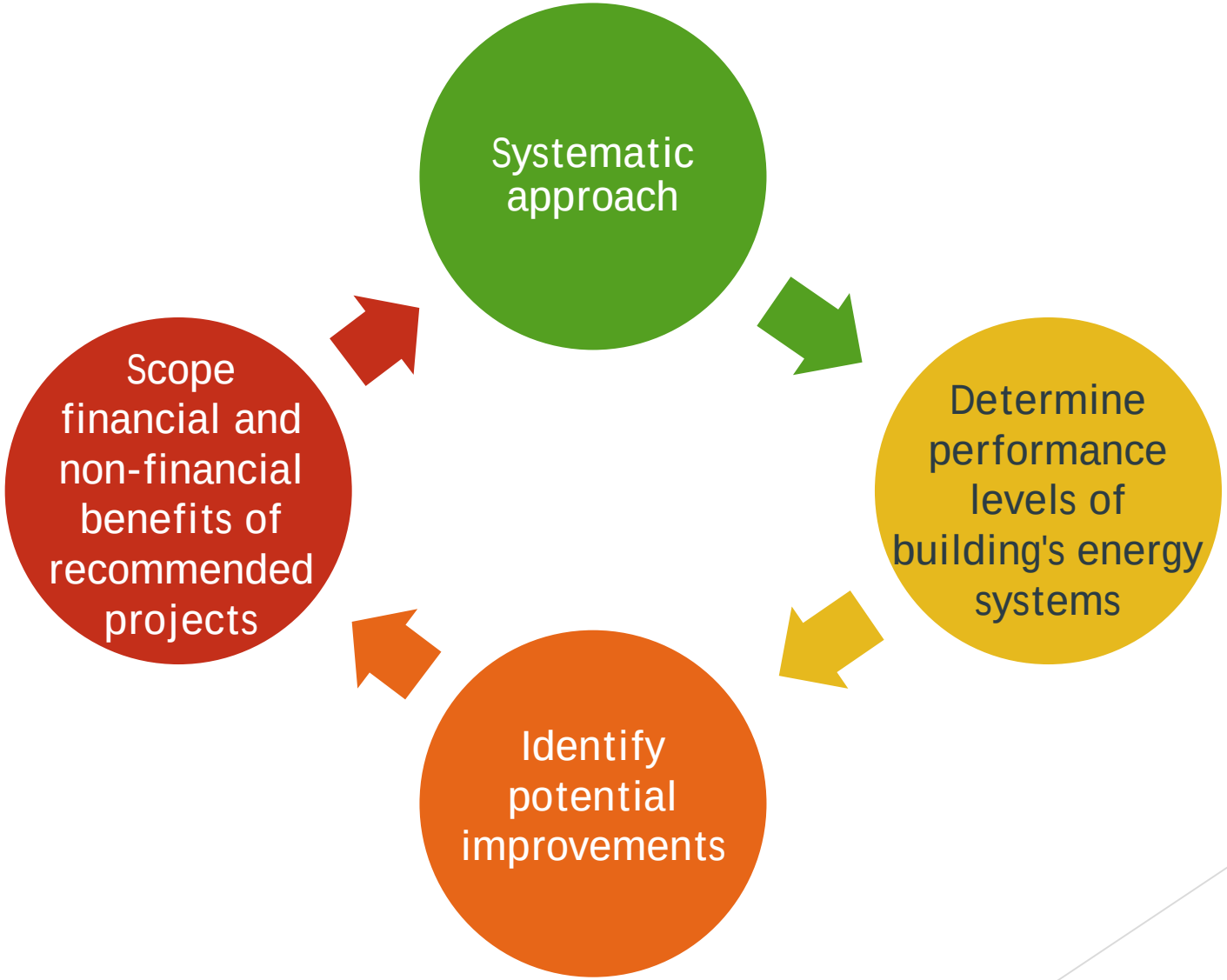
What is an energy assessment?



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Customer benefits

- Increase profits and offer quick payback on investments
- Reduce energy expenses, increase building value and improve occupant comfort levels
- Reduce operation and maintenance costs, and improve operational efficiency
- Modernize building and mechanical systems
- Enhance image as forward-thinking, sustainable organization and educate staff on energy efficiency efforts

Before the energy assessment

Helps the auditor understand the customer's needs and priorities

- What is facility used for?
- How do users interact with the space?
- Are there system issues? If so, what problems are they causing for users?
- Are there any unique business challenges that the organization faces?
- What is the appetite for change at that facility and within the business?

Free facility energy assessment

A starting point for customers interested in optimizing their building's energy usage

- A PowerShift **Energy Advisor** conducts an on-site walkthrough
  - Discusses Commercial Energy Services incentives
  - Interviews operations and maintenance staff regarding energy use
- **Customers** receive a report of findings:
  - Energy efficiency projects that align with Commercial Energy Services incentives
  - Demand response opportunities
  - Immediate and recognizable energy-saving improvements

Preliminary energy use analysis: beyond the facility assessment

Analysis of the historic building utility consumption and billing

Review 1-2 years of monthly bills and 15-minute demand data

Results in Energy Cost Index: $/floor area /year

Results in Utility Utilization Index: kBtu/floor area/year

- Compare with similar buildings to assess if further engineering investigation and analysis are warranted
  - U.S. EPA Energy Star Score (1-100) and Portfolio Manager
  - SmartWatt Blog: The Benefits of Energy Benchmarking
  - SmartWatt Blog: Energy Benchmarking - A How To Guide

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One reason for considering an energy assessment

Electric Historical Usage Data

Usage History	No. Days	kWh	Avg kWh Per Day
This Month	29	2,617,630	90,263.1
Last Month	29	2,588,321	89,252.4
Last Year	30	2,741,766	91,392.2

Avg Cost Per Day This Month: $5,352.76

Avg kWh Per Day By Month

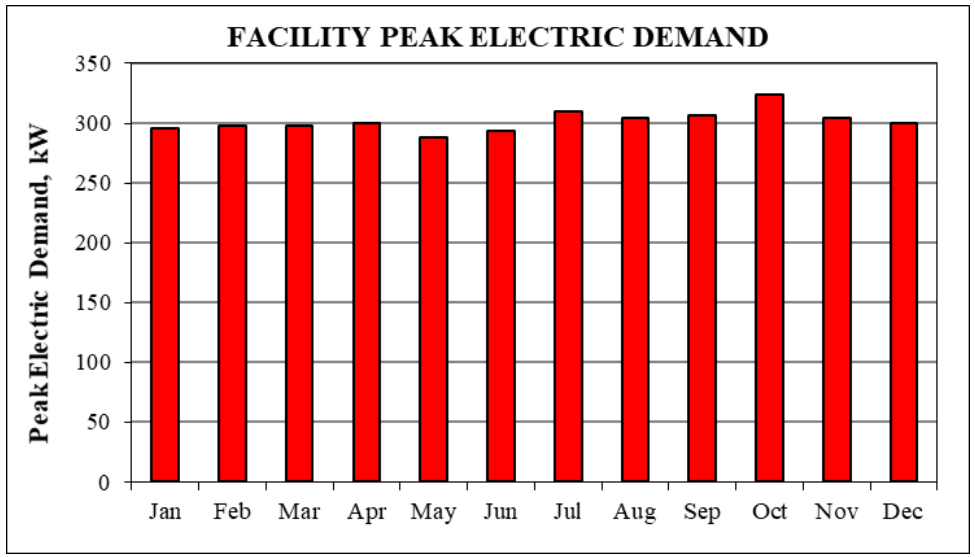
Electric: Lgs - 3 - Pri

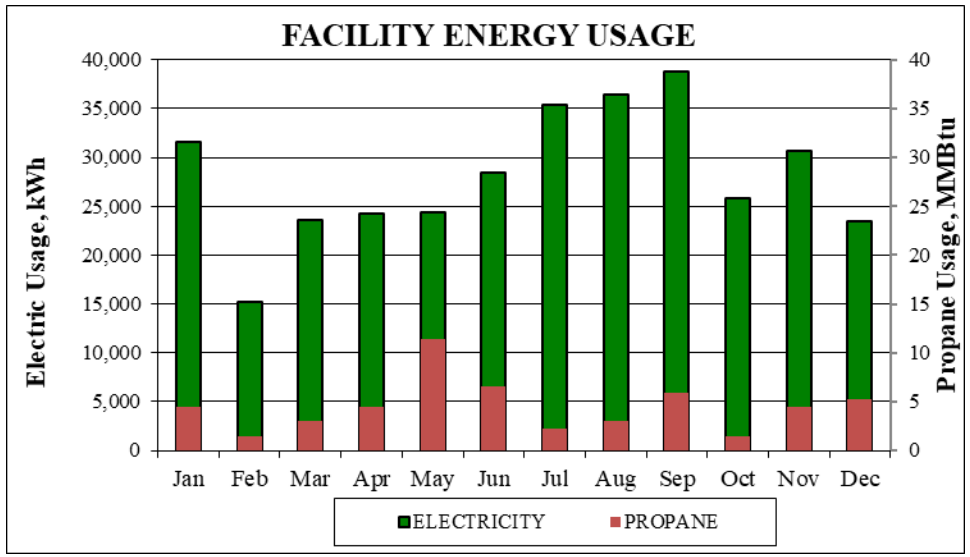
Meter Number	Service Type	Service Period From	Service Period To	Bill Days	Meter Readings Previous	Meter Readings Current	Meter Mult.	Usage
	Win On	Mar 22, 2017	Apr 20, 2017	29	362,317.058	364,934.688	1,000	2,617,630
	kW	Mar 22, 2017	Apr 20, 2017	29	4,188.000	4,436.000	1	4,436
	FAC kW	Mar 22, 2017	Apr 20, 2017	29	5,423.000	5,423.000	1	5,423

Electric Consumption (Prior Rate)	809,825.000	kWh	x	0.04511	36,531.21
Electric Consumption (New Rate)	1,807,805.000	kWh	x	0.04649	84,044.85
Demand Charge	4,436.000	kW	x	0.60000	2,661.60
Temp. Green Power Financing	2,617,630.000	kWh	x	0.00056	1,465.87
Renewable Energy Program	2,617,630.000	kWh	x	0.00101	2,643.81
Energy Efficiency Charge	2,617,630.000	kWh	x	0.00064	1,675.28
Universal Energy Charge	2,617,630.000	kWh	x	0.00039	1,020.88
Facility Charge	5,423.000	kW	x	3.20000	17,353.60
Additional Meter Charge	1	MTR	x	172.38000	172.38
Basic Service Charge					317.20
Local Government Fee				5%	7,334.67
Local Government Fee				5%	8.62

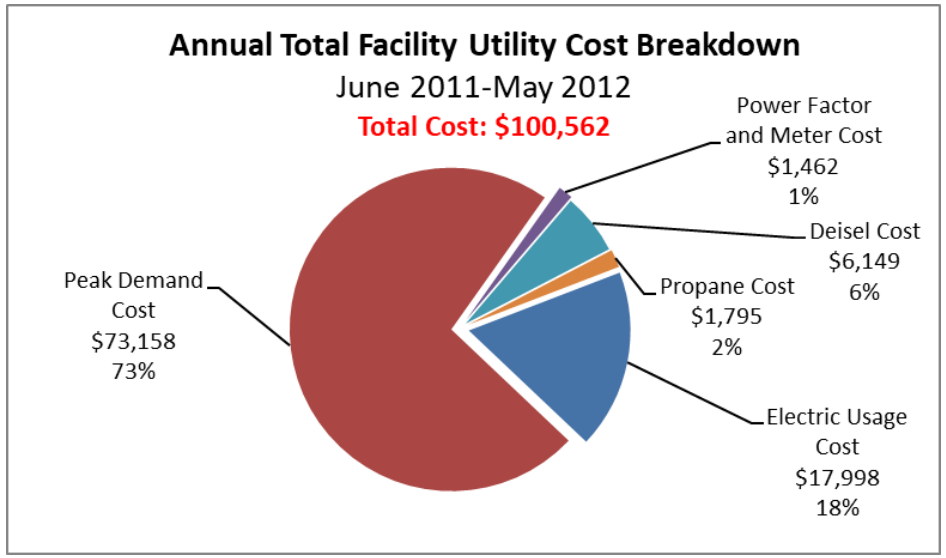
Total Electric Service Amount **$155,229.97**

Energy bill analysis, example 1





Energy bill analysis, example 1



OVERALL UTILITY BILL SUMMARY

Electric Usage	337,800	kWh or	1,152.9	MMBtu	Electric Usage Cost		$17,998
Peak Electric Demand	3,622.00 301.8	kW-mo or avg. kW/mo.			Peak Electric Demand Cost		$73,158
					Power Factor & Electric Meter Cost		$1,462
Diesel Usage	1,863	gals or	260.9	MMBtu	DieselCost		$6,149
Propane Usage	2,390	lbs or	53.5	MMBtu	Propane Cost		$1,795
TOTALS			**1,467.3**	**MMBtu**			**$100,562**

FACILITY ENERGY USAGE & COST PER SQUARE FOOT

Facility Size:	9,600	sq. ft.			
Electric Usage:	120,094	Btu/sq. ft./yr	Electric Cost:	$9.65	/sq. ft./yr
Propane Usage:	5,573	Btu/sq. ft./yr	Propane Cost:	$0.19	/sq. ft./yr
Total Energy Usage:	**125,667**	**Btu/sq. ft./yr**	**Total Energy Cost:**	**$9.84**	**/sq. ft./yr**

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ASHRAE audits

What is an ASHRAE Level 2 energy survey & analysis?

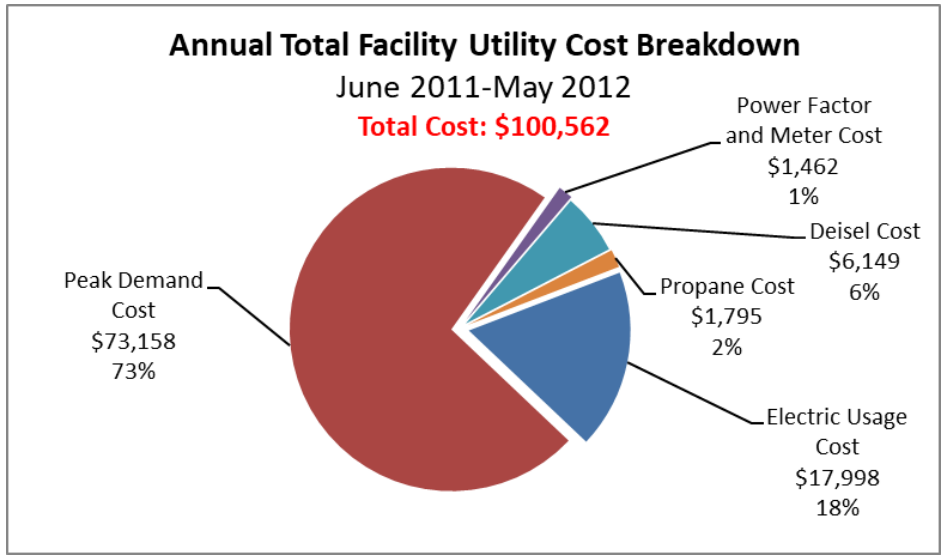
Interviews with facility staff, review of utility bills and other operating data, walk-through of the facility

- Detailed building survey, including energy consumption and peak demand analysis
- Savings and cost analyses of all practical energy efficiency measures
- List of potential capital-intensive improvements
- Informs on how to evaluate recommendations and proceed with projects

Qualifications for ASHRAE Level 2 energy surveys

- Facility or campus receiving electric distribution services from NV Energy
- Has at least one meter on one of these rate schedules:
  - GS, OGS-TOU, LGS-1, OLGS-1, LGS-2, LGS-3, and LGS-X (for Southern NV)
  - GS-1, GS-2, GS-2-TOU, OGS-1-TOU, OGS2-2-TOU, GS-3, GS-4, IS-1, IS-2 (for Northern NV)
- Audit conducted by an authorized NV Energy Commercial Energy Services contractor
- Audit and associated energy project must be completed between January 1, 2018 and November 15, 2018
- One audit per facility
- Audits can be requested every three years (new for 2018)

Energy bill analysis, example 1



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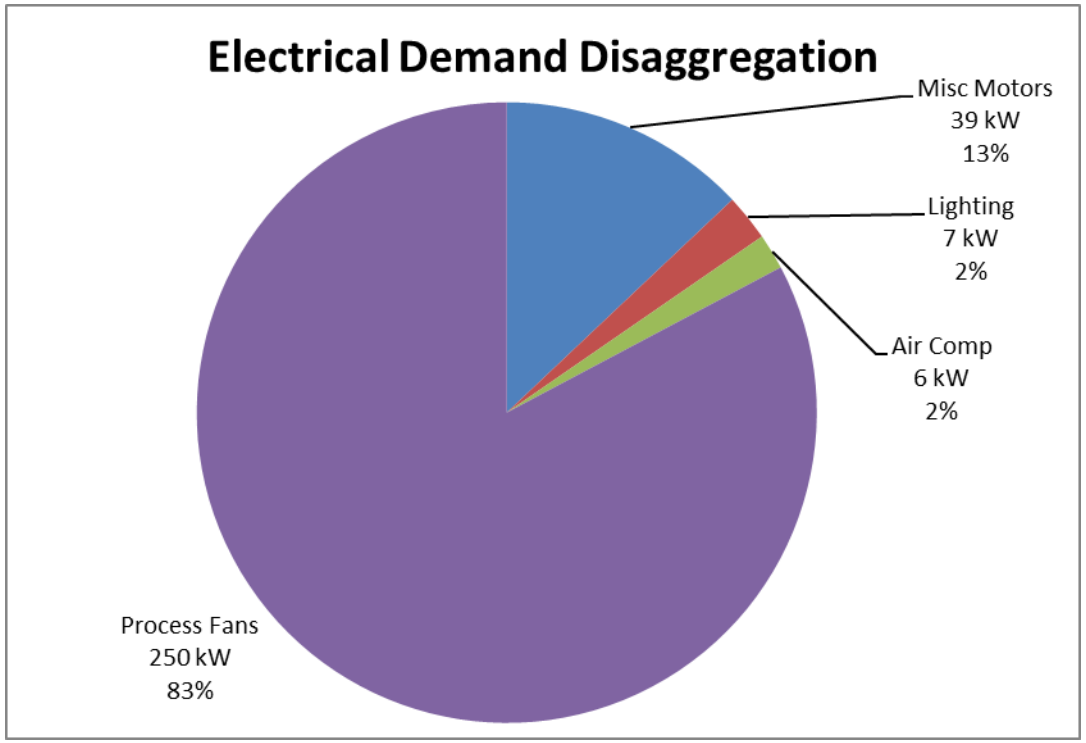
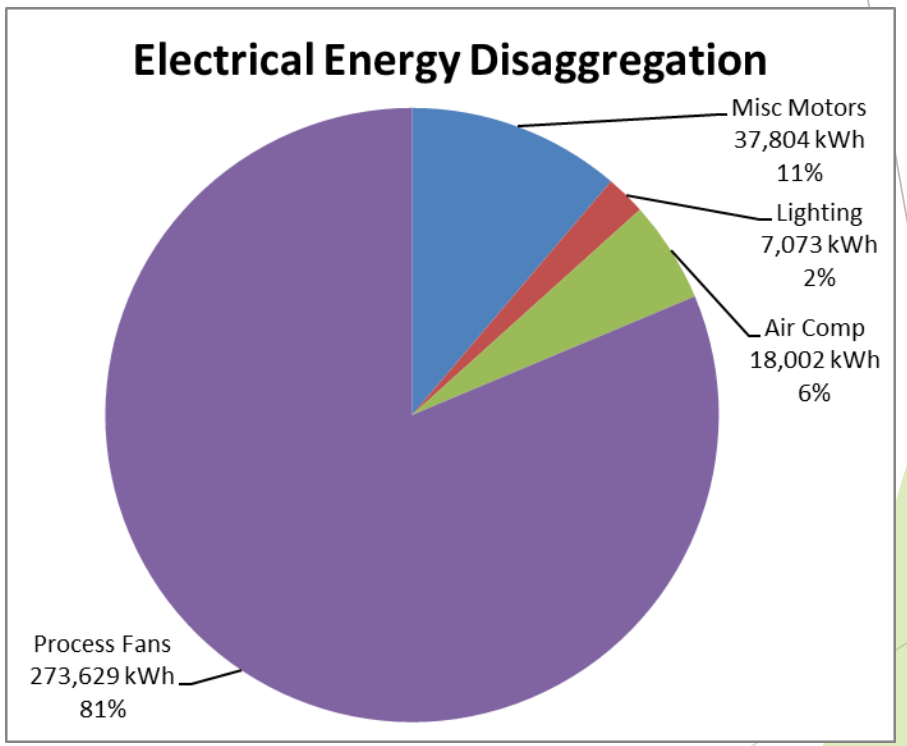
ASHRAE Level 2, example 1

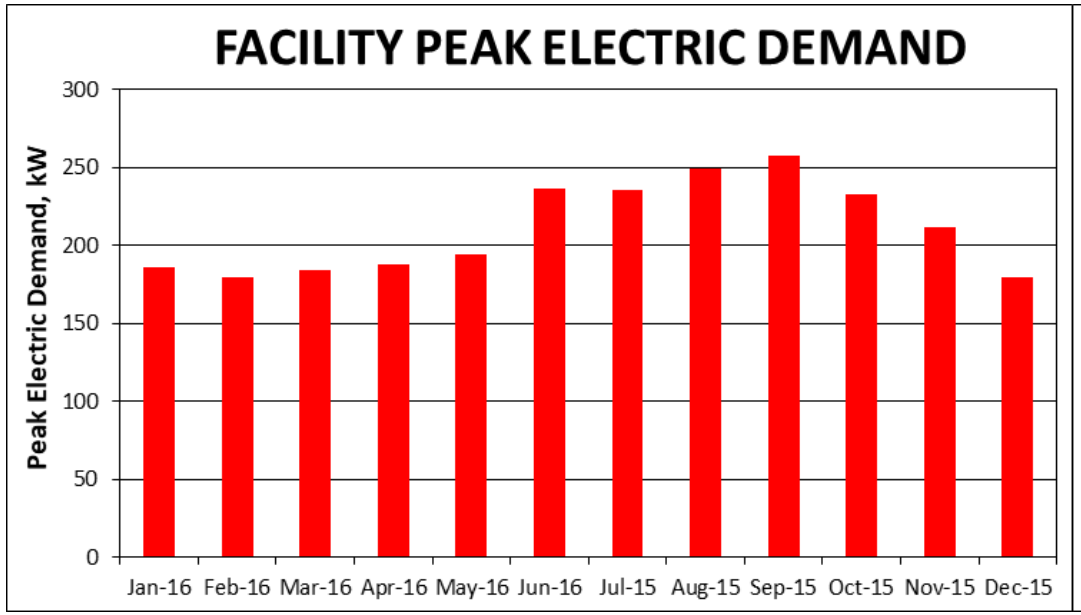


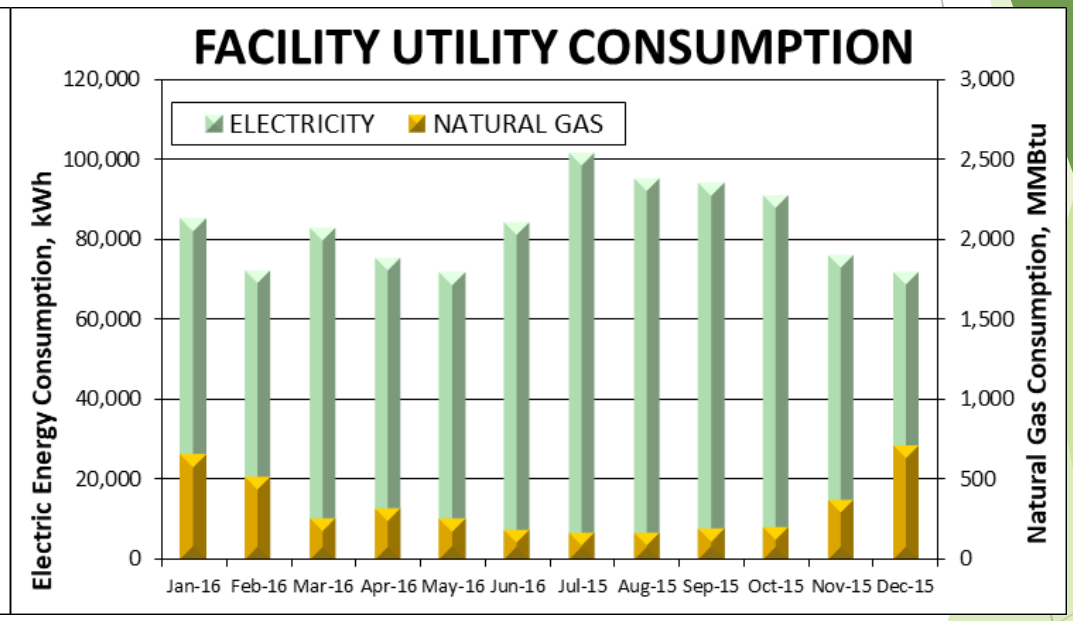


ASHRAE Level 2, example 1: Results

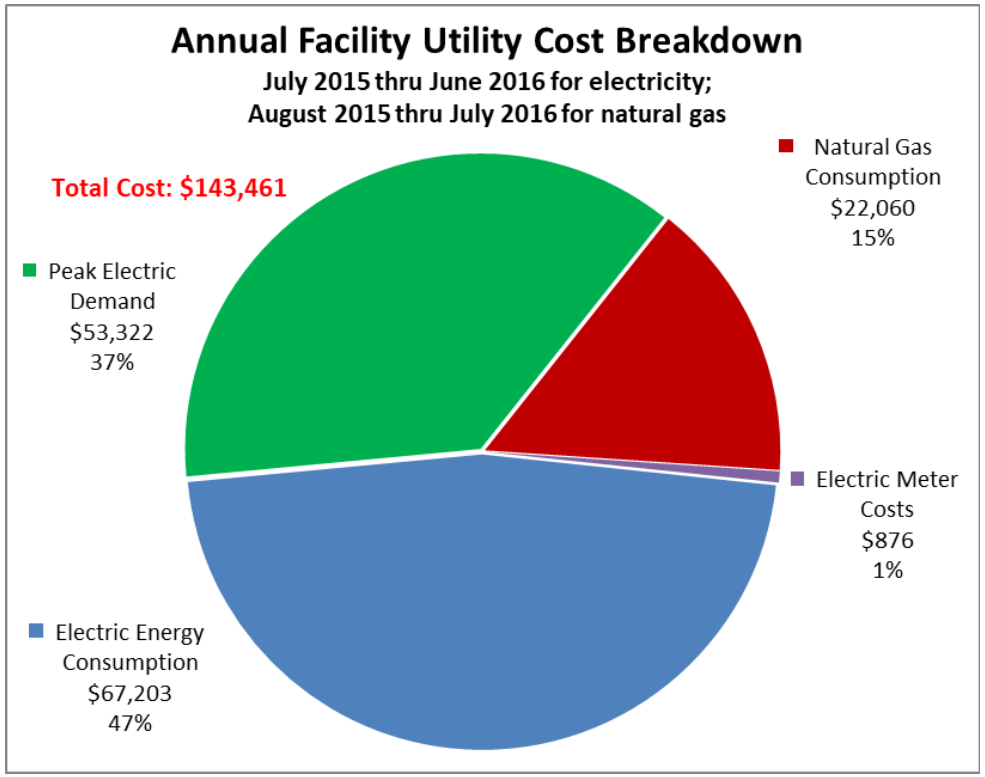
AR No.	Assessment Recommendation	Recommendation Summary	Resource Savings *per year*	Cost Savings	Implement Cost	Simple Payback
PRODUCTION-RELATED RECOMMENDATIONS						
1	Replace the Existing Motors with Premium Efficiency Motors	Premium efficiency motors could be purchased immediately to replace existing standard efficiency motors.	3,000 kWh electricity 15 kW-mo. demand	$510/yr	$3,090	6.1 yrs
BUILDING-RELATED RECOMMENDATIONS						
2	Apply for A Sales Tax Exemption on Energy Bills	Plant personnel should apply for tax-exempt status with the Colorado Department of Revenue in an effort to reduce the taxes currently paid on purchases of electricity	None - only cost savings	$2,610/yr	$500	0.2 yrs
3	Replace 400W Metal Halide Fixtures with Four-Lamp T-5 High Bay Fluorescent Fixtures	The existing 400W metal halide lamps in the plant could be replaced with lower wattage high bay fluorescent fixtures.	8,200 kWh electricity 42 kW-mo. demand	$1,420/yr	$3,310	2.3 yrs
TOTALS				**$4,540/yr**	**$6,900**	**1.5 yrs**
	Replace Existing Shredder with a Smaller Horizontal Tub Shredder	The existing 200 hp vertical shredder operasting at 35% of full load could be replaced with a 75 hp tub shredder	25,800 kWh electricity 149 kW-mo. demand	$4,780/yr	$140,000	
	Replace Conventional Blowoff Nozzles with Air Amplifying or Star Tip Nozzles	Air amplifying or star tip nozzles could reduce the amount of compressed air used for blowoff resulting in reduced energy consumption	500 kWh electricity 149 kW-mo. demand	$30/yr	$120	

ASHRAE Level 2, example 2





ASHRAE Level 2, example 2



Utility Type	Usage	Cost	
Electric Energy Consumption	1,003,200 kWh 3,423.9 MMBtu	$67,203	55.4% of total electric costs
Peak Electric Demand	2,533 kW 211.1 kW/mo. (avg.)	$53,322	43.9% of total electric costs
Electric Meter Costs	N/A	$876	0.7% of total electric costs
Natural Gas Consumption	4,042.1 MMBtu	$22,060	15.4% of total costs
TOTALS	**7,466.0 MMBtu**	**$143,461**	

Facility Size:	52,300	sq. ft.	
Electric Usage:	65,467	Btu/sq. ft./yr	Electric Cost: $2.32 /sq. ft./yr
Gas Usage:	77,287	Btu/sq. ft./yr	Gas Cost: $0.42 /sq. ft./yr
Total Energy Usage:	**142,754**	**Btu/sq. ft./yr**	**Total Energy Cost: $2.74 /sq. ft./yr**

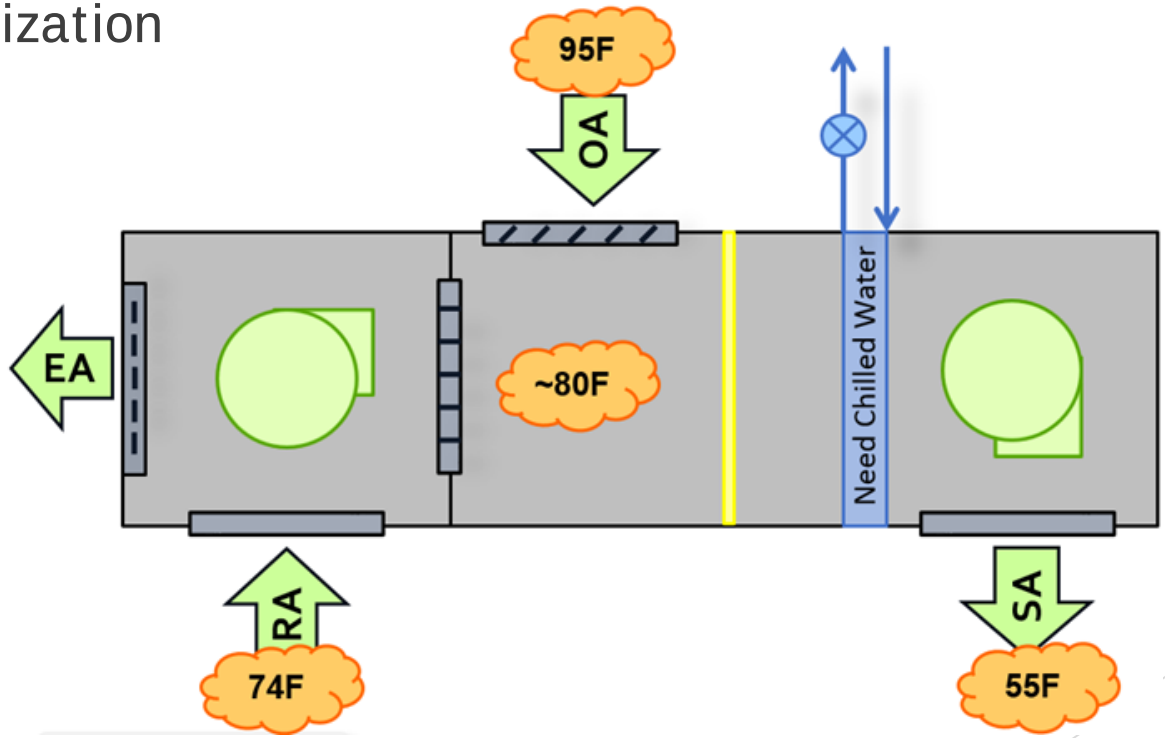
ASHRAE Level 2, example 2: Results

AR No.	Assessment Recommendation	Recommendation Summary	Resource Savings *per year*	Cost Savings	Implement Cost	Simple Payback
1	Install Indirect Evaporative Cooling Systems on Larger RTUs	Evaporative mister systems can be installed on larger RTUs to increase cooling capacity and reduce power requirements on the compressors	19,200 kWh electricity 172 kW-mo. demand	$4,910/yr	$31,560	6.4 yrs
2	Replace Existing Lamps with New Energy Efficient Options	Existing lamps and fixtures can be replaced with LED retrofits	26,200 kWh electricity 64 kW-mo. demand	$4,020/yr	$13,690	3.4 yrs
3	Install a Rooftop Photovoltaic System	A 25 kW photovoltaic electric array could be installed on the roof to supply electricity during the day	37,700 kWh electricity 14 kW-mo. demand	$2,820/yr	$14,180	5.0 yrs
4	Replace Standard V-Belts and Drives	Standard V-belt drives on the 5 hp and 7.5 hp RTU evaporator blower motors could be replaced with synchronous belts and sprocket drives	15,600 kWh electricity 21 kW-mo. demand	$1,500/yr	$1,860	1.2 yrs
TOTALS				**$13,250/yr**	**$61,290**	**4.6 yrs**

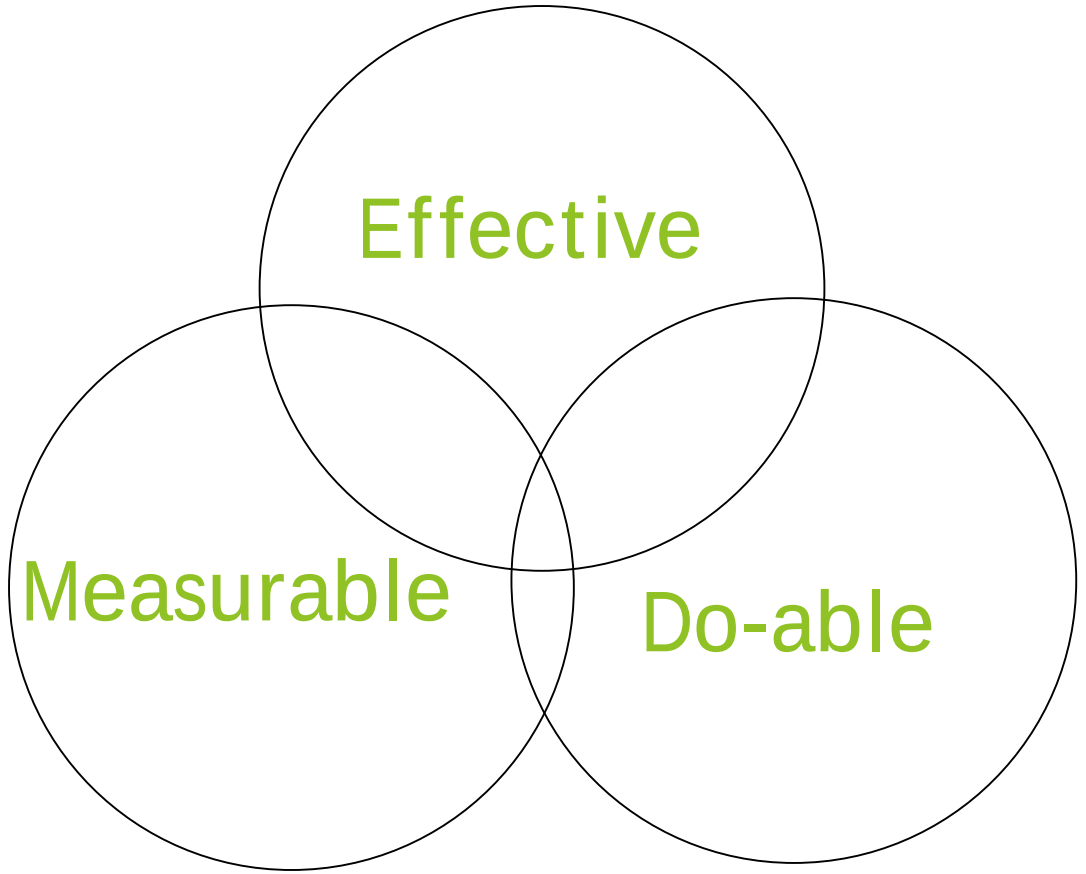
ASHRAE Level 2, example 2: Results

Summary of potential opportunities

- Controls upgrades/optimization
- HVAC (all)
- Repair/upgrade
- Part load operation
- Systems approach
- Building envelope
- Lighting
- Upgrade/control



Opportunity screening approach



Energy efficiency strategies

Turn off equipment when not needed – energy conservation (ala Jimmy Carter)

Use the most efficient equipment – energy efficiency (ala GHW Bush)

Turn off or reschedule equipment when needed – demand control

Look for oversizing & redundancy

Consider part load efficiencies

Energy efficiency strategies

Be ready when maintenance opportunities strike!

Consider new and emerging technologies

Seek assistance from your energy professionals in-house staff, utilities, consultants, vendors, government

Treat your workplace like your home

ASHRAE Level 3 detailed analysis of capital-intensive modifications

- Takes a close look at the benefits, costs and performance expectations for investment-grade projects recommended during the Level 2 audit
- Requires more detailed field data gathering and a more rigorous analysis
  - Existing utility data
  - Targeted sub-metering of major energy consuming systems
  - Monitoring of system operating characteristics
- Provides a realistic baseline to compare energy and operating savings of the proposed measures pre- and post-energy project implementation

ASHRAE Level 3 detailed analysis of capital-intensive modifications

- Modeling software used to predict/demonstrate how a building should respond to recommended energy system changes, modifications and retrofits
- Data collection may take place over several weeks or months. Data is used to calibrate the computer model and make modifications as needed to develop recommendations, and a 3-D computer model provides highly accurate expected project results
- This level of detail provides the confidence required for major capital investments

Another option: Targeted audits

- A targeted audit is an investigation with a limited scope, typically a single energy-using system, central plant or area of the building
  - Lighting-only audits
  - Cooling tower replacements
  - Air compressor improvements
  - Boiler control assessments
  - Tenant improvement projects
- Lighting-only audits CANNOT serve as a basis for a Level 2 or 3 incentivized audit

Another option: Targeted audits

- Because the audit is limited to a portion of the building, whole-building approaches such as end-use allocation and comparisons with historical utility bills cannot be used to provide a check on analytical methods
- Whole-building simulation is typically not a cost-effective approach except for large systems
- Targeted audits rely on measurements, data logging and trend data to provide a check on the energy use estimates in the base case

Summary of the processes for each audit level

Process	Level 1	Level 2	Level 3
Conduct PEA	•	•	•
Conduct walk-through survey	•	•	•
Identify low-cost/no-cost recommendations	•	•	•
Identify capital improvements	•	•	•
Review mechanical and electrical (M&E) design and condition and O&M practices		•	•
Measure key parameters		•	•
Analyze capital measures (savings and costs, including interactions)		•	•
Meet with owner/operators to review recommendations		•	•
Conduct additional testing/monitoring			•
Perform detailed system modeling			•
Provide schematic layouts for recommendations			•

Summary of the report for each audit level

Report	Level		
	1	2	3
Estimate savings from utility rate change	•	•	•
Compare EUI to EUIs of similar sites	•	•	•
Summarize utility data	•	•	•
Estimate savings if EUI were to meet target	•	•	•
Estimate low-cost/no-cost savings		•	•
Calculate detailed end-use breakdown		•	•
Estimate capital project costs and savings		•	•
Complete building description and equipment inventory		•	•
Document general description of considered measures		•	•
Recommend measurement and verification (M&V) method		•	•
Perform financial analysis of recommended EEMs		•	•
Write detailed description of recommended measures			•
Compile detailed EEM cost estimates			•

ASHRAE Level 2 and 3 Contractor Network

Minimum standards for incentivized ASHRAE audit contractors:

- At least 10 years of experience preparing ASHRAE Level 2 or higher audits
- Properly licensed and insured in the State of Nevada, able to perform all services associated with the audit
- Registered Professional Engineer on staff charged with final review and approval of the ASHRAE Level audit
- Must complete one energy audit the first year and two audits each year thereafter

ASHRAE Level 2 and 3 Contractor Network

- Mr. Dennis Landsberg, P.E., L&S Energy Services
  dlandsberg@ls-energy.com
- Ms. Jane Guyer, P.E., ETC Group
  jguyer@etcgrp.com
- Mr. Mark Hauenstein, P.E., Technical Designs
  markh@technical-designs.com
- Mr. Satyen Moray, P.E., Energy and Resource Solutions, Inc.
  smoray@ers-inc.com
- Mr. Mike Kostrzewa, P.E., SmartWatt Energy
  mkostrzewa@smartwattinc.com

ASHRAE Level 2 and 3 energy survey and analysis: Incentives

- NV Energy covers 50% of the audit up to $15,000
- When an energy efficiency project is pursued as a result of the audit there is an increased cost limit of 75% for the recommended retrofit project cost (subject to the tier limits and cost caps) - the amount of incentive paid cannot exceed 75% of the cost of the measure

ASHRAE Level 2 and 3 energy survey and analysis: Incentives

- If recommendations are pursued beyond 2018, the 75% cost cap will be considered
- Caveat: the paid incentive amount will vary from the calculated incentive when a facility or NV Energy customer receives total incentive payments that exceed the tiers stated below:
  - NVE will pay 100% of the calculated value of eligible incentives up to $100,000 per calendar year
  - 50% of the eligible value of incentives from $100,001 to $500,000
  - 20% of the eligible value of incentives from $500,001 to $1,000,000
  - 10% of the eligible value of incentives above $1,000,001

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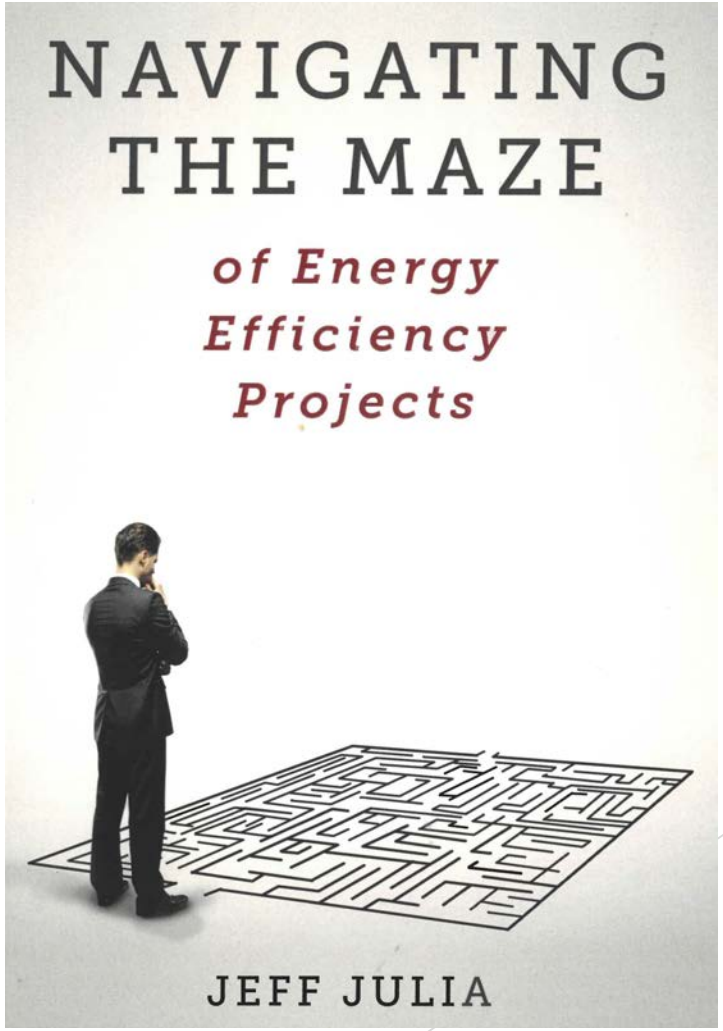
Navigating the maze

Navigating the Maze of Energy Efficiency Projects

Spoiler alert: Six steps of a successful energy efficiency project

1. Alignment with your needs
2. Qualifications of the provider
3. Dependability, functionality and necessity of equipment
4. Savings and benefits
5. Incentives and tax credits
6. Payment terms and options



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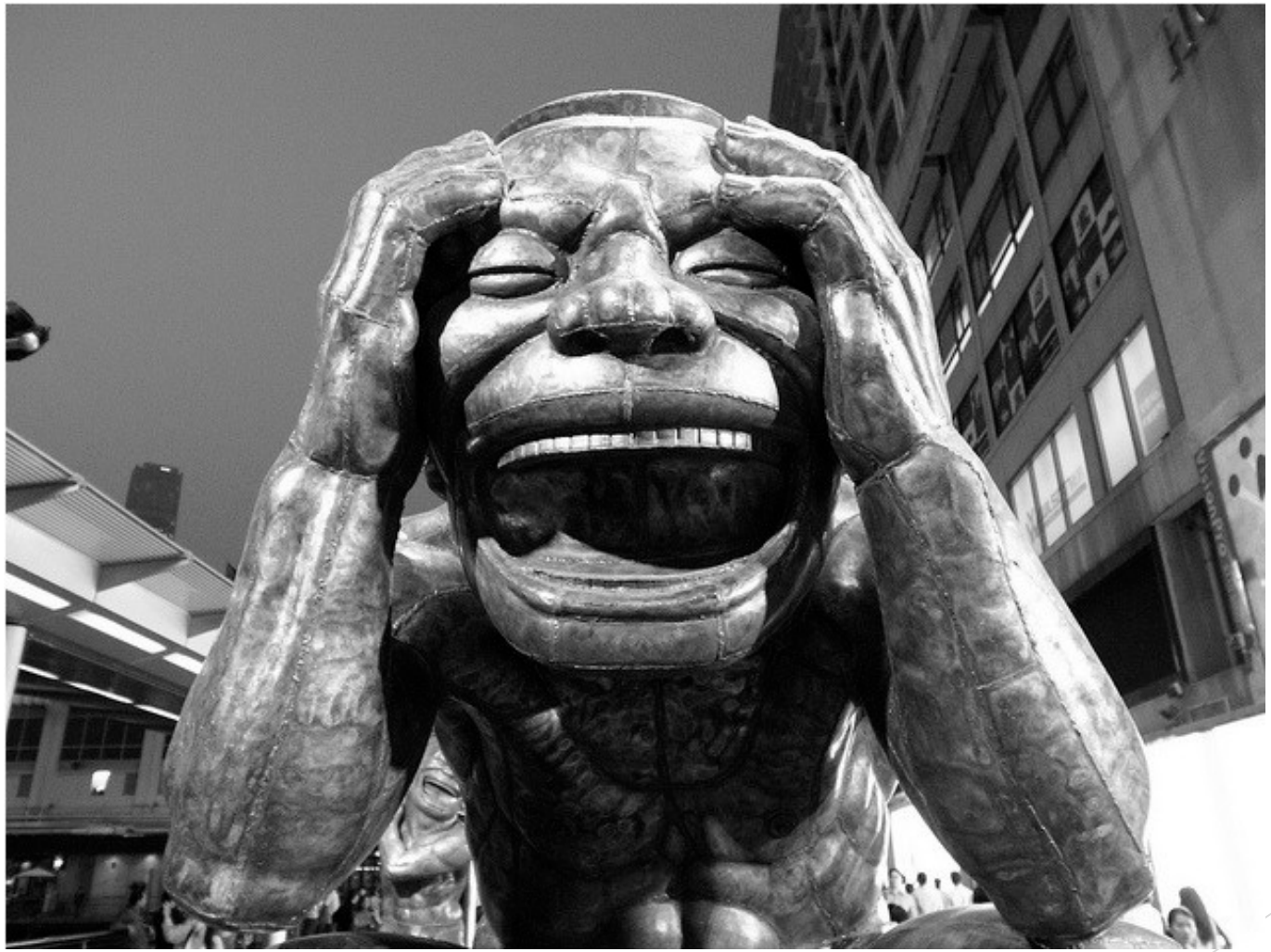
Frustrations of an energy engineer



Potential obstacles

- Financials – initial cost, payback, ROI
- Financing
- Competition with other projects, locations
- Resistance to change – and no knowing the price of doing nothing
- Customer time to carry project forward

Potential obstacles

- Having to convince your boss – and your boss' boss
- Difficulty understanding/trusting the audit recommendation
- Audits = failure detection
- Level of effort required to implement
- No clear action plan to follow after the audit

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Questions?