Energy Treasure Hunt

2017 ESI Members Meeting

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Agenda

- What is an Energy Treasure Hunt?
- What value do they bring?
- What are the results?
- Who are the ideal participants?
- How are they performed?
- Typical opportunities identified?
- Calculations

Activity Overview

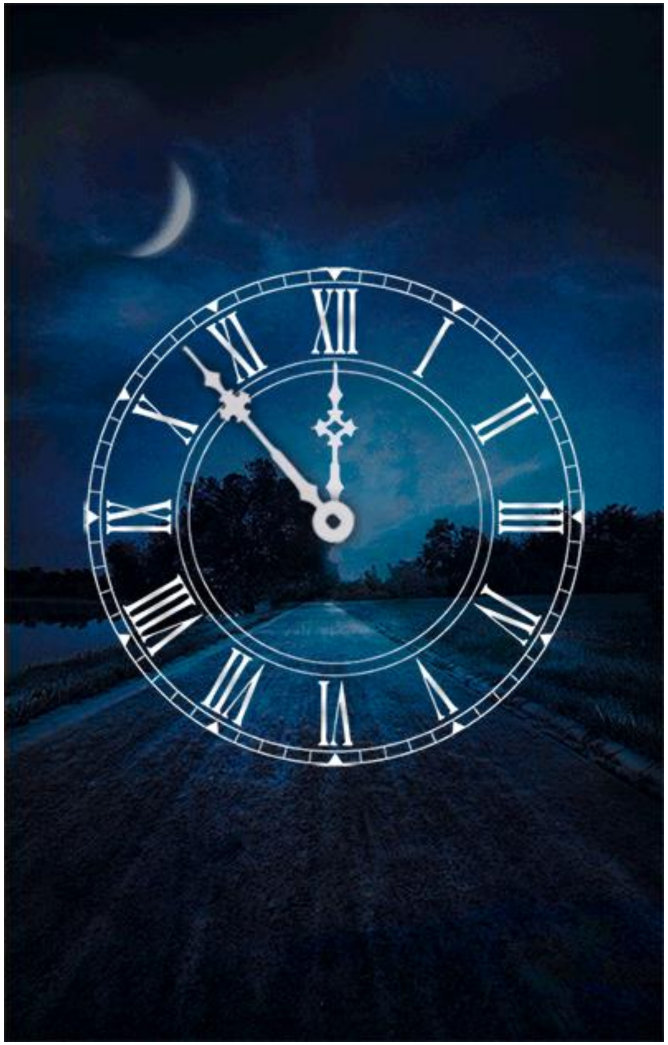
A three day activity focused on:

- Low cost and no cost actions to reduce energy consumption
- Learning ways to continuously improve and reduce energy consumption
- Cross-functional teams brainstorm ways to reduce energy use
- Teams identify, analyze, and evaluate energy savings opportunities by observing daily operations
- Opportunities for reduction are quantified using a standard methodology and calculation

TE Connectivity is in Good Company

Key Elements

- Observing the idle facility –start on Sunday or periods of reduced production
- Facility employees conduct the Energy Treasure Hunts and have ownership of the ideas/opportunities
- Outside experts/participants are there to facilitate the process, generate discussion, and help quantify opportunities
- Local personnel have the most expertise on optimizing facility production and operational changes



What are the benefits?

- Enhanced employee engagement and awareness
- Reduced cost and improved efficiency
- Quick and actionable ideas to reduce energy usage
- Opportunities are not capital intensive
- Opportunities can be replicated across similar processes and business units
- Historically, more than 50% of opportunities are implemented
- Movement toward corporate sustainability goals

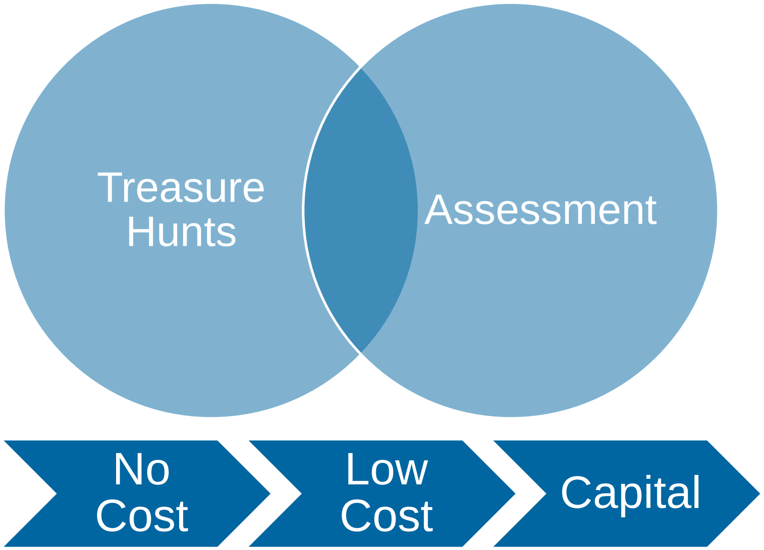
Energy Treasure Hunt vs Energy Assessment

Treasure Hunt

- Continuous process (repeat annually, quarterly, etc.)
- Internal resources
- Focus on operational opportunities

Assessment

- Standalone event (assess as needed)
- External resources
- Focus on system performance and technology

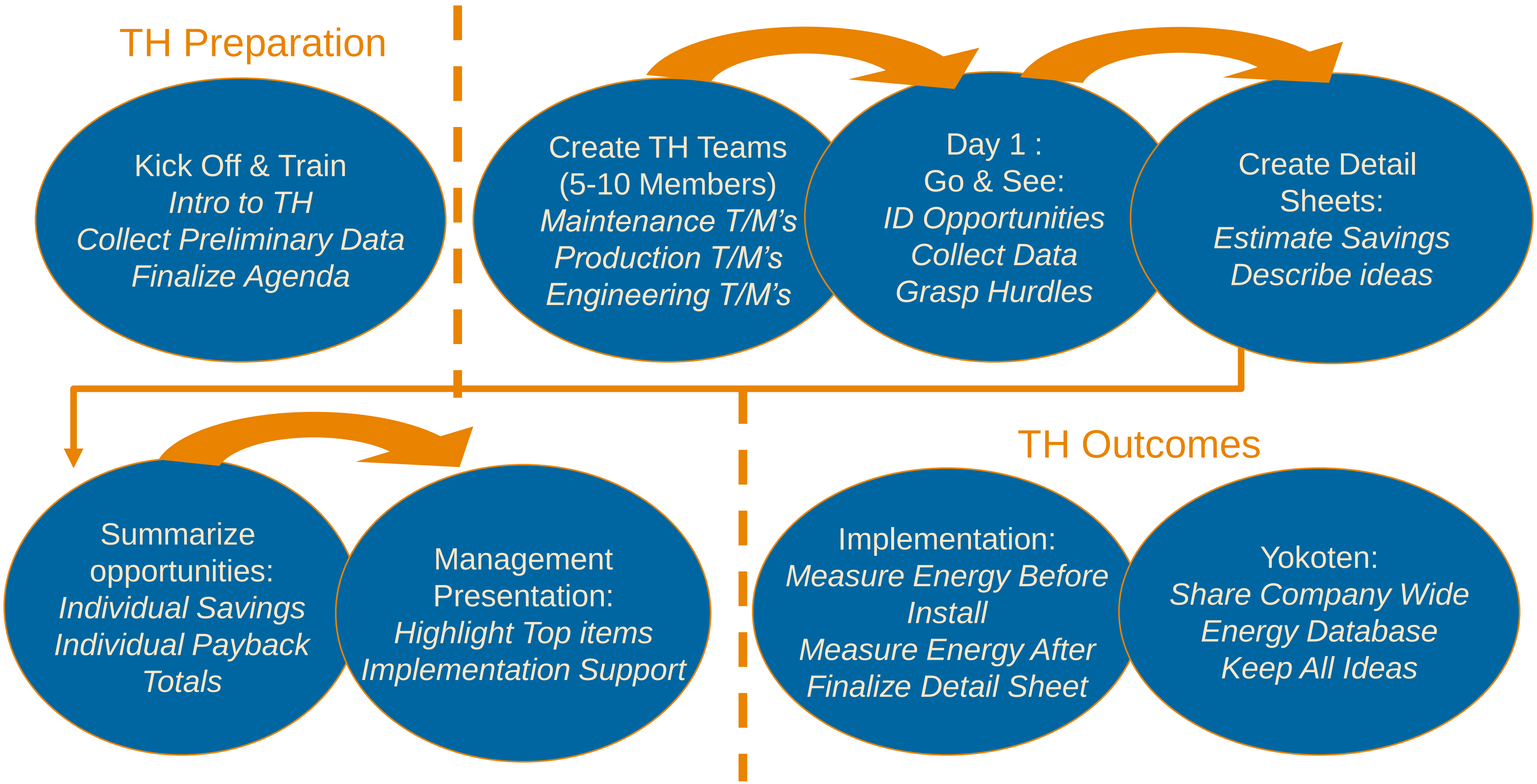


What are we looking for?

No cost, low cost, and high return.

No Cost / Low Cost Energy Actions Items	$0 to <$10K Usually an expense or operating cost
Low Cost and High Return Energy Actions Items	$5K to <$20K Capital less than 1 year simple pay back
Capital Investment Energy Actions Items	Capital greater than 1 year simple pay back
Productivity Actions Items	Added production capacity, scrap reduction, etc.

Energy Treasure Hunt Process Flow



Basic Daily Format

Sunday – 8AM – 4PM

- Introductions, background information
- Training on best practices identification
- Training on use of diagnostic equipment
- Observe idle facility, generate ideas
- Daily flip-chart notes – major opportunities

Sunday is typically a non-production day for many facilities. The Energy Treasure Hunt agenda is adjusted appropriately for the plant hosting the event.

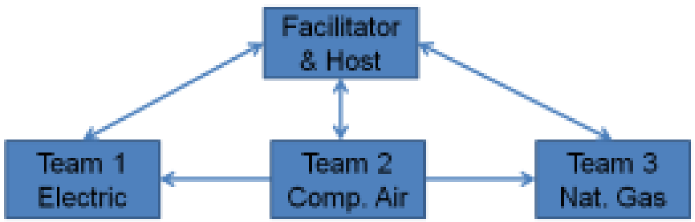
Monday – 7AM – 5PM

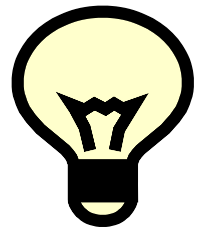
- Training on use of DOE software tools and calculation sheets
- Observe facility under operation
- Investigate ideas, gather information
- Identify and complete top 2 detail sheets
- Complete presentation slides for top 2 detail sheets

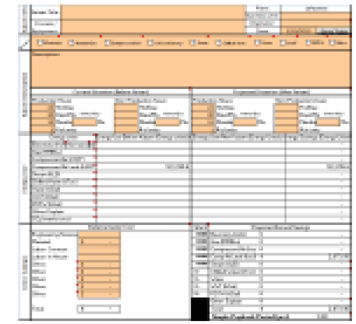
Tuesday – 7AM – 4PM

- Finalize / review all detail sheets
- Findings summary
- Dry run through presentation / format
- Present to management

The Basic Mission



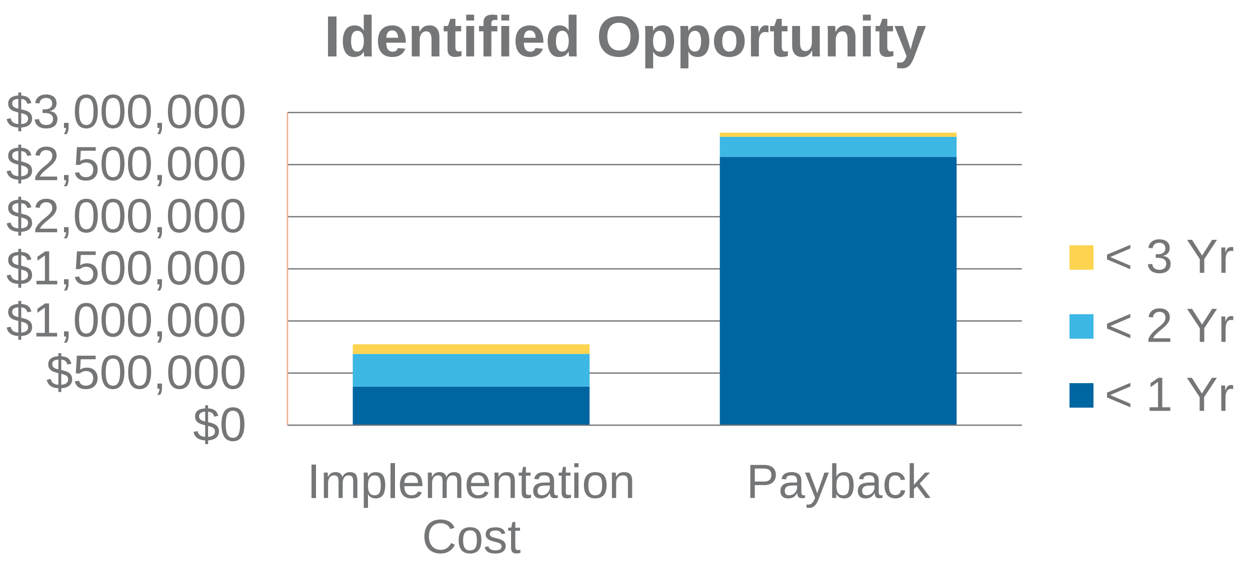




Assemble your teams → Facility walk through for each team to generate ideas → Assess idea feasibility, gather data, quantify

At the end of each day the teams brief each other on what they are pursuing.

Average Payback



Opportunities tend to be small, but economically competitive!!

Team Makeup

Core Team (combination of at least 3)	Internal Participants	External Participants
Maintenance (shift mechanic/electrician)	Administrative support	Consultants (compressed air, process heat, energy specialist)
Production (operators, supervisors, leads)	EH&S	Previous hosts
Engineering (area engineer, process engineer)	Buyers, planners	Similar facilities, future hosts, other stewards
Subject Matter Expert (HVAC, compressed air, electrical, etc.)	Anyone enthusiastic to participate	Suppliers, vendors

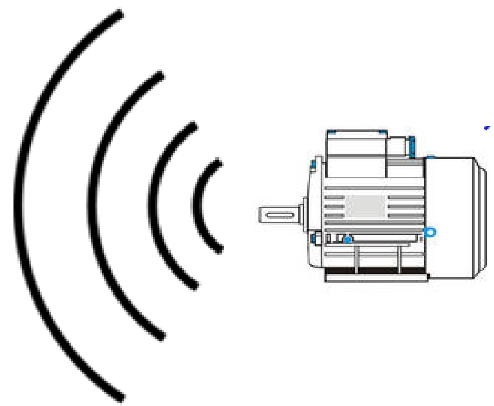
Observe the Idle Facility

Most important day for generating ideas

Rarely is production activity 24 hrs / 7 days a week

- Take note of maintenance downtime / shift changes / off shifts

Use your eyes and ears to find wasted energy!



Typical Treasure Hunt Opportunities

Lighting

If sufficient day lighting is available, turn off excess lighting where possible:

- During a treasure hunt, experiment by turning off lights and then measuring the available lumens.

Evaluate areas that are infrequently occupied during the day or non-production hours:

- Implement shut down procedures or install occupancy sensors and calculate the savings.

Identify unnecessary lighting:

- Robots do not need light to work
- Infrequently accessed areas with large lights (400KW – 1000KW) such as tops of ovens, warehouse shelves, and storage areas

Retrofit lighting with more efficient technology

LED technology can save more on maintenance than energy in some applications

Steam & Compressed Air

Steam

- General steam leaks
- Condensate leaks
- Boiler efficiency
- Building heat with poor control:
  - ➢ If areas are excessively warm experiment with reducing steam heat.

Compressed Air

- Operate at the lowest practical pressure setpoint
- Replace pneumatic energy with electrical energy where practical
- Evaluate high efficiency nozzles
- Eliminate inappropriate end use applications
- Optimize control strategy
- Perform a leak survey
- Install solenoid valves on open blowing

Process Heat

- Combustion tuning
- Combustion efficiency – burner upgrades, recuperators
- Poor furnace insulation
- Furnace shut downs/non-production management
  - Temperature setpoints
  - Recirculation fans/blowers
  - Minimize ramp up time
  - Excessive soak time

Cooling/HVAC

Cooling Towers

- Match tower capacity with process requirements
  - Less active cooling may be needed during night, colder seasons, and non production
- Check for throttled pumps / opportunities for VFD

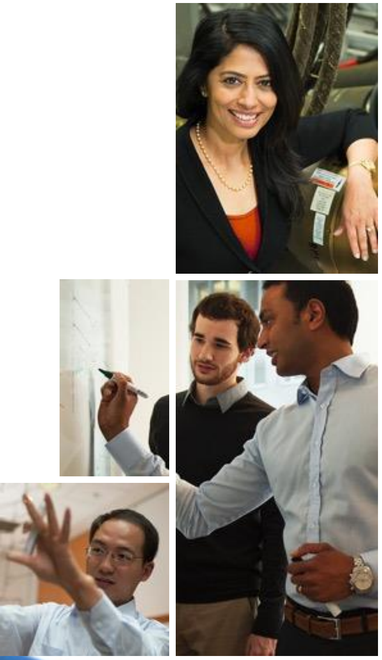
HVAC / Makeup Air / Comfort Cooling

- Use programmable thermostats to optimize cooling schedule:
  - Particularly in non-24/7 areas such as offices, warehouses, partial production areas
- Challenge temperature set points
- Less makeup air may be needed during non production, if possible, shut down a few units

Process Equipment

- Ensure auxiliary energy is minimized during non-production:
  - Shut down lubrication pumps, valve off compressed air, consoles, lighting panels
- Production cells should have a shut down procedure during idle time
- Optimize throughput:
  - parts washers,
  - cooling tables / fans
  - die heaters

- If the process is not a bottleneck in plant production, consider batch processing and avoid constant idle time waiting for product



TE Connectivity Treasure Hunt Opportunities

EVERY CONNECTION COUNTS

Thermalator Management (Molding)

- Molding houses 118 molding presses with approximately 40-45 down at any given time
- Each press uses two thermolators
- Estimations were made by turning half the thermolators off

Annual Savings: $56,461

Installation: $14,000

Payback period: 0.25 years

<u>BONUS FACT</u>: Based on data collection, a dual heater is more energy efficient than two single heaters on a press.

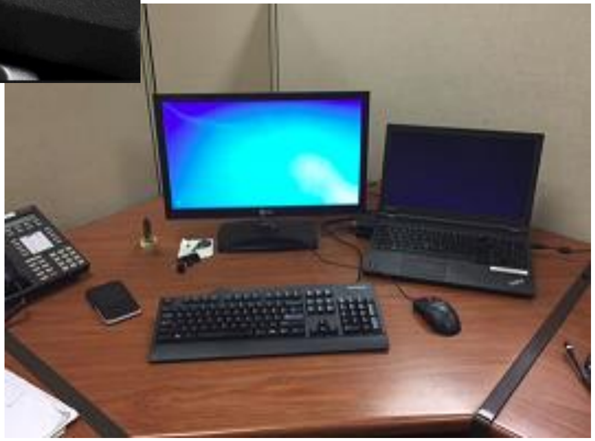
Sleep Mode Savings – Office Desktop/LapTops

By setting all office desktop and laptop monitors and displays to go into sleep mode after 10 minutes

Annual Savings: $5,539

Installation: $0

Payback period: 0.0 years



Partially De-lamp High Bay Fluorescent Lights

High bay fluorescent lights measure from 89 foot-candle to 95 foot-candle

- Recommendation: Remove 2 bulbs from each fixture

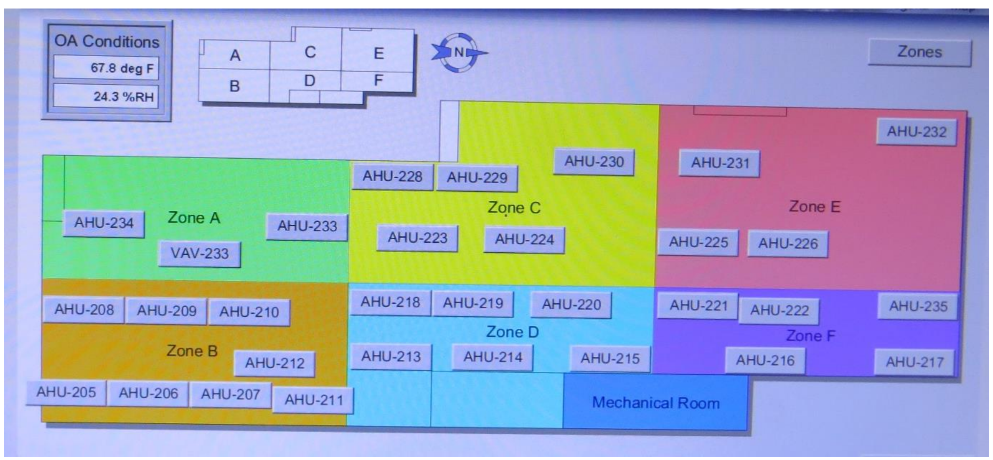
Current = $500\ HB\ * \frac{6\ lamps}{fixture}$ = 89 - 95 foot-candle

Projected = $500\ HB\ * \frac{4\ lamps}{fixture}$ = 75 - 80 foot-candle

Total Energy Savings: $19,290

Retro-Commissioning HVAC System

- Perform a recommissioning of the building's systems operations to improve overall performance of the computerized maintenance management system
- Focus on HVAC, process cooling water, process chilled water
- 41 points on a chiller, 42 points on an air handler



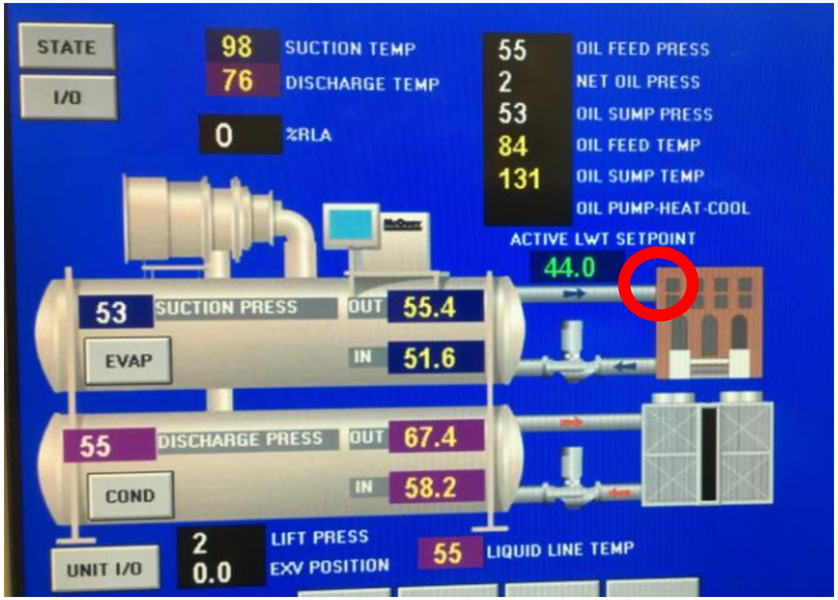
Total Energy Savings: $20,729

Implementation Cost: $25,232

Simple Payback Period: 1.2 years

Raise Chilled Water Temperature

- System is set for historic process chilled water demand;
- Only process remaining on system is the laser welders;
- Welders are tolerant of much higher water temperatures;
- Chilled water temp can vary with air conditioning demand. The lower the HVAC requirement, the higher the chilled water temp can be.



Total Energy Savings: $7,100

Implementation Cost: $0

Simple Payback Period: 0.0 years

Compressed air pressure reduction

Reduce compressed air system pressure from 95psi to 75psi.

Cost to implement may include pressure boosters and/or small modifications to some of the existing equipment.

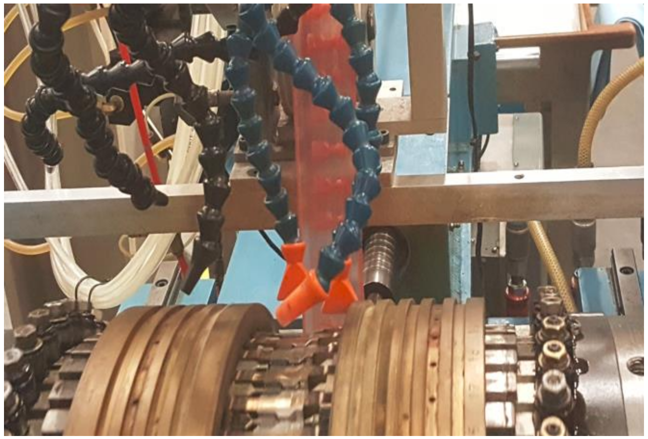
Total Energy Savings: $38,000/year

Implementation Cost: $28,000

Simple Payback Period: 0.63 years

Air knife blow off conversion

Before



Current usage: 278,865 kscf
Current Cost: $ 38,217

After

Future usage: 41,954 kscf
Future Cost: $ 5,622

Total Energy Savings: $32,595/year

Implementation Cost: $27,400

Simple Payback Period: 0.84 years

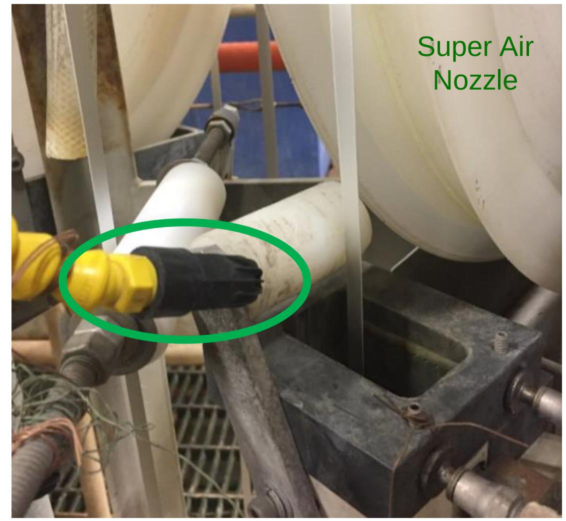
Additional Benefits:

- Noise reduction from 83 dBA to 69 dBA
- Standardized set-ups, less adjust time

Plating air reduction

Before

After



Current usage: 388,800 kWh
Current Cost: $27,216

Future usage: 58,579.2 kWh
Current Cost: $4,100.54

Total Energy Savings: $22,124.79/year

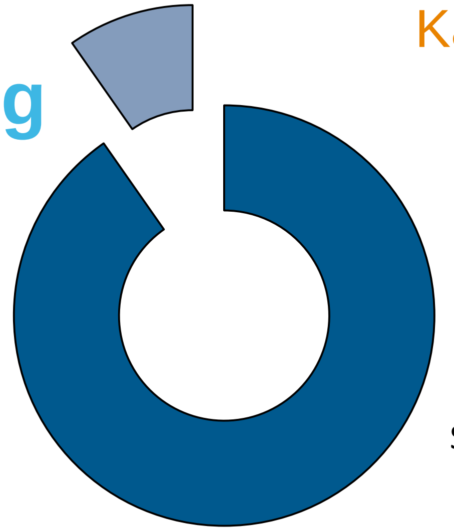
Implementation Cost: $583.30 + 2 labor hours

Simple Payback Period: 0.02 years

What does this mean?

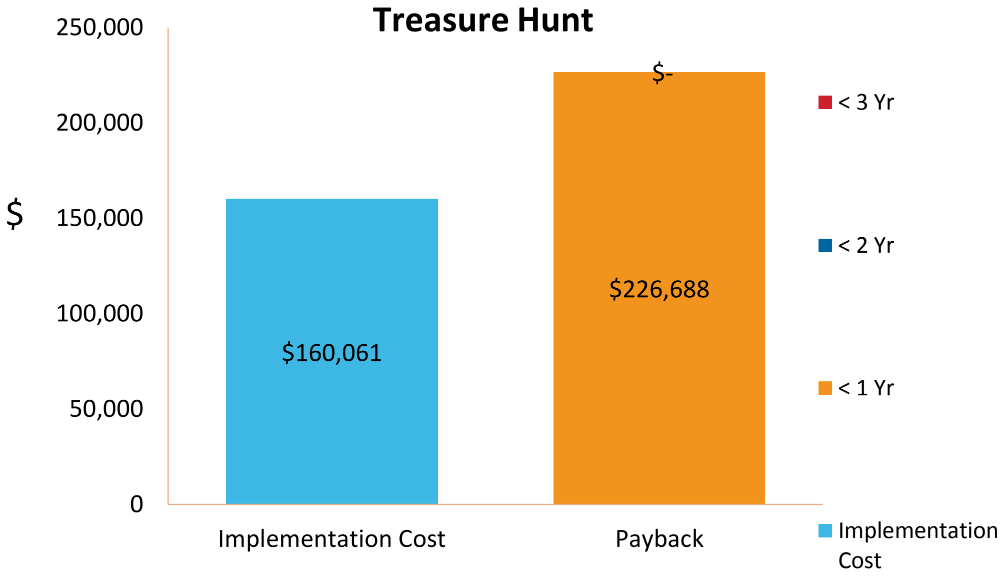
Electric Expenditures

10%
Spending



Current
$2,200,000
(Electricity)

Kaizen savings:
$236,696



Detail Sheets

Documentation and Calculations

- A “detail sheet” is the excel calculator we use to document and quantify an opportunity during an Energy Treasure Hunt
- To use the detail sheets you must quantify a “before” and “after” state for the equipment
  - ➢ Consider equipment operating profiles
  - ➢ Note nameplate energy consumption or take a measurement

Current Situation (Before Kaizen)					
Production Hours			Non-Production hours		
24	Hrs/Day			Hrs/Day	
30	Days/Mo.	Winter/Gas		Days/Mo.	Winter/Gas
12	Months	Mo.		Months	Mo.
1	# of units			# of units	

Projected Situation (After Kaizen)					
Production Hours			Non-Production hours		
24	Hrs/Day			Hrs/Day	
30	Days/Mo.	Winter/Gas		Days/Mo.	Winter/Gas
12	Months	Mo.		Months	Mo.
1	# of units			# of units	

- As a group we will create a “detail sheet” for <u>each</u> opportunity

Plant Cost Information Tab

Electric		CO₂	
Avg Electric Cost [$/kWh]	$ 0.054 /kWh	CO_2 Rate [lb/kWh]	1.000 lb/kWh
		NG CO_2 Emission Rate [lb/MMBtu]	114.2 lb/MMBtu

Misc		Water	
Gas Cost [$/MMBtu]	$ 2.89 /MMBtu	Water Cost [$/kGal]	
Compressed Air Cost [$/kcf]		CHW Cost [$/kTon]	
Steam Cost [$/klb]		WWT Cost [$/kGal]	
Altitude (Above MSL) [ft]	1 /ft	POTW Cost [$/kGal]	

Sub Resources			
Type	Compressed Air (kscf)	Steam (klb)	Chilled Water (kTon)
Electricty [kWh/unit]	2.73 kWh/kscf		0.25 kWh/kTon
Gas [MMBtu/unit]			
Water [kGal/unit]		1.000 kGal/klb	0.01 kGal/kTon
Other [$/unit]			

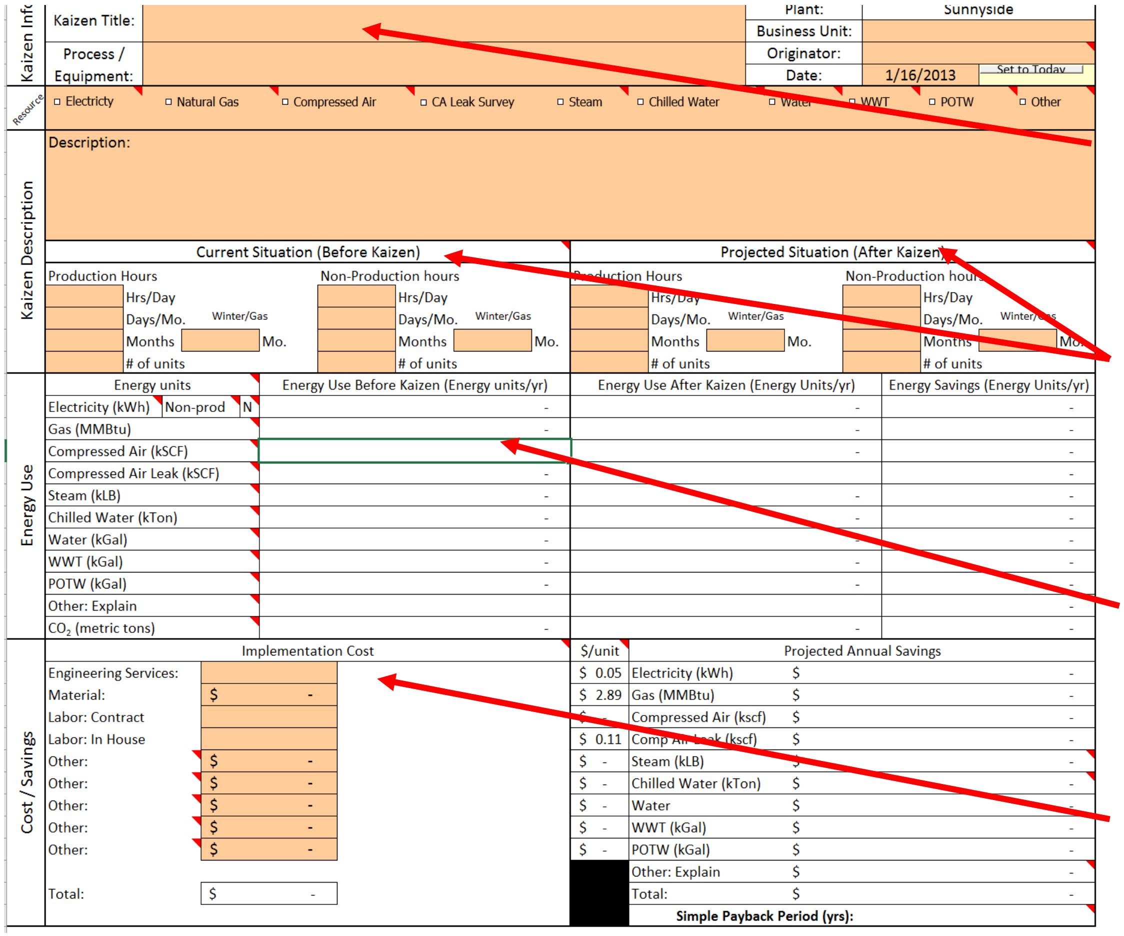
Use regional CO_2 rate, default value if CO_2 value is desired or zero (<u>optional</u>)

Use ONLY if these are purchased and not generated on site (seldom the case)

These are system capabilities If compressed air, chilled water and steam are generated on site (usually this is the case)

The “Detail Sheet”

Only *complete pertinent* ***orange*** *cells*



Kaizen Info			
Kaizen Title:		Plant:	Sunnyside
		Business Unit:	
Process / Equipment:		Originator:	
		Date:	1/16/2013 Set to Today

Resource: ▫ Electricty ▫ Natural Gas ▫ Compressed Air ▫ CA Leak Survey ▫ Steam ▫ Chilled Water ▫ Water ▫ WWT ▫ POTW ▫ Other

Kaizen Description

Description:

Current Situation (Before Kaizen)		Projected Situation (After Kaizen)	
Production Hours	Non-Production hours	Production Hours	Non-Production hours
Hrs/Day	Hrs/Day	Hrs/Day	Hrs/Day
Days/Mo. Winter/Gas	Days/Mo. Winter/Gas	Days/Mo. Winter/Gas	Days/Mo. Winter/Gas
Months Mo.	Months Mo.	Months Mo.	Months Mo.
# of units	# of units	# of units	# of units

Energy Use

Energy units	Energy Use Before Kaizen (Energy units/yr)	Energy Use After Kaizen (Energy Units/yr)	Energy Savings (Energy Units/yr)
Electricity (kWh) Non-prod N	-	-	-
Gas (MMBtu)	-	-	-
Compressed Air (kSCF)		-	-
Compressed Air Leak (kSCF)	-		-
Steam (kLB)	-	-	-
Chilled Water (kTon)	-	-	-
Water (kGal)	-	-	-
WWT (kGal)	-	-	-
POTW (kGal)	-	-	-
Other: Explain			-
CO_2 (metric tons)	-	-	-

Cost / Savings

Implementation Cost		$/unit	Projected Annual Savings	
Engineering Services:		$ 0.05	Electricity (kWh)	$ -
Material:	$ -	$ 2.89	Gas (MMBtu)	$ -
Labor: Contract		$ -	Compressed Air (kscf)	$ -
Labor: In House		$ 0.11	Comp Air Leak (kscf)	$ -
Other:	$ -	$ -	Steam (kLB)	$ -
Other:	$ -	$ -	Chilled Water (kTon)	$ -
Other:	$ -	$ -	Water	$ -
Other:	$ -	$ -	WWT (kGal)	$ -
Other:	$ -	$ -	POTW (kGal)	$ -
			Other: Explain	$ -
Total:	$ -		Total:	$ -
			Simple Payback Period (yrs):	

Title is important for summary

Before and after completed even if no change.

These will be completed by excel but do a “sanity check”

If there is a cost to complete estimate here

Example

Kaizen Info

Kaizen Title:	Injection Molding: Press and Auxillary shutdown	Plant:	Lickdale
		Business Unit:	Appliance
Process / Equipment:	Molding Press, Grinder, Dryer, Conveyor, Picker, Work Station	Dept. Manager	
		Date:	12/7/2016 Set to Today

Resource

☑ Electricty ☐ Natural Gas ☐ Compressed Air ☐ CA Leak Survey ☐ Steam ☐ Chilled Water ☐ Water ☐ WWT ☐ POTW ☐ Other

Kaizen Description

Description: Shutdown of Press and Auxillary when not in operation. Based on the calculation of each individual piece of Auxillary equipment and the press, using the amperage each pulls while running versus powered down. We can deduce that one press could provide $5537.04 a year reduction. Including the average press utilization, we could potentially create a savings of $33,222 across the course of a year.

Current Situation (Before Kaizen)				Projected Situation (After Kaizen)			
Production Hours		Non-Production hours		Production Hours		Non-Production hours	
24.0	Hrs/Day		Hrs/Day	24.0	Hrs/Day		Hrs/Day
28.5	Days/Mo. Winter/Gas		Days/Mo. Winter/Gas	21.0	Days/Mo. Winter/Gas		Days/Mo. Winter/Gas
12.0	Months Mo.		Months Mo.	12.0	Months Mo.		Months Mo.
6	# of units		# of units	6	# of units		# of units

Energy Use

Energy units	Energy Use Before Kaizen (Energy units/yr	Energy Use After Kaizen (Energy Units/yr)	nergy Savings (Energy Units/
Electricity (kWh Non-prod N	247,957.2		247,957.2
Gas (MMBtu)	-	-	-
Compressed Air (kSCF)	17,446.5	-	17,446.5
Compressed Air Leak (kSCF)	-		-
Steam (kLB)	-	-	-
Chilled Water (kTon)	-	-	-
Water (kGal)	-	-	-
WWT (kGal)	-	-	-
POTW (kGal)	-	-	-
Other: Explain			-
CO_2 (metric tons)	112.5	-	112.5

Cost / Savings

Implementation Cost	Total Units	Individual Unit
Engineering Service:		$0.00
Material:		$0.00
Labor: Contract		$0.00
Labor: In House		$0.00
Other:		$0.00
Other:		$0.00
Other:		$0.00
Est. Int Labor (Hrs.):	40.0	6.7
Total:	$0.00	$0.00

$/unit	Projected Annual Savings		
$0.07	Electricity (kWh)	$	16,613.13
$2.75	Gas (MMBtu)	$	-
$ -	Compressed Air (ksc	$	-
$ 0.15	Comp Air Leak (kscf)	$	-
$ -	Steam (kLB)	$	-
$ -	Chilled Water (kTon)	$	-
$3.29	Water	$	-
$ -	WWT (kGal)	$	-
$ -	POTW (kGal)	$	-
	Other: Explain	$	-
	Total:	$	16,613.13
	Simple Payback Period (yrs):	0.00	

Questions / Comments?