Energy Treasure Hunt

Dates
Energy Treasure Hunt Exchange
Overview
What is an Energy Treasure Hunt?

- An Energy Treasure Hunt is a 3 - 5 day event that focuses on identifying day-to-day operational energy efficiency improvements.

- The process involves observing the facility during idle / partially idle time periods (frequently Sunday) to identify energy waste.

Operational Energy Efficiency Improvements

- Turning off equipment when not in use
- Changing set points
- Automating shutdowns
- Reducing load on the equipment
- Recover wasted energy

Areas of Energy Efficiency Improvement
The Basic Mission

Assemble with 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 will pursue
Energy Treasure Hunt – Guidelines
Basic Daily Format – Energy Treasure Hunt

• Sunday – 10AM – 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

• 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

*Sunday is typically a non-production day for many facilities. The Energy Treasure Hunt agenda is adjusted appropriately for plant hosting the event*
Weekend Demand / Fixed Usage

Report Date: 2/26/2013 1:22:13 PM Time Period: 02/01/2013 - 02/14/2013 Total days: 14

Graph - Basic Usage Report

Weekend Demand
Determine Focus Areas / Teams

(Target 3 teams of 5 participants)

Examples of team focus areas. Select focus areas based on your facility.
How do we approach a Treasure Hunt?

- Observe operations & identify opportunities
- Analyze scope of opportunities and interview personnel
- Implement opportunities where possible
- Evaluate impacts and quantify opportunities
- Ensure future facilitator is trained
**Energy Kaizen Preparation (4-6 weeks prior to event)**

- **Meet Host:**
  1. Confirm purpose & benefit
  2. Choose plant location
  3. Confirm plant contacts
  4. Confirm focus areas
  5. Confirm team leaders & participants
  6. Provide event agenda

- **Preparation:**
  1. Update detail sheets & plant energy data
  2. Develop agenda & presentation material
  3. Summarize returned data from requests

- **Gather Data:**
  1. Annual utility cost & consumption
  2. Plant load profile
  3. Site maps
  4. Process equipment specifications
  5. List of energy projects open & complete
  6. Plant operating schedules
  7. Building equipment specification & maps
  8. Utility rebates

**Pre-Kaizen Webinar (1 week prior)**

- **Pre-KA Event:**
  1. Facilitate pre-EK webinar - present purpose, agenda, teams, expectations
  2. Familiarize team leaders with EK process & detail sheets

- **Attend webinar training with team leaders**
- **Facilitate safety requirements**
- **Establish logistics, schedule, & PPE for visitors**

**Energy Kaizen Event (3 days on site)**

- **Energy Kaizen Event:**
  1. Facilitate EK introductions
  2. Review agenda
  3. Present training material
  4. Facilitate detail sheet training
  5. Provide event structure & methodology
  6. Assemble closing summary presentation
  7. Facilitate closing meeting
  8. Support Q&A

- **Team leaders bring laptop and coordinate access to plant resources**
- **Identify energy reduction projects**
- **Evaluate project viability and quantify with detail sheets**
- **Facilitate energy measurements**
- **Summarize focus area opportunities**
- **Provide closing summary presentation content**
- **Present opportunities to management at closing summary**

**Post Kaizen Follow up**

- **Summarize overall EK results - send plant all documentation**
- **Provide technical support where requested**

- **Develop action plan and prioritization for opportunities**
- **Select opportunities to be implement and track**
- **Ensure focus area satisfaction with organization expectations**

- **Support host with action plan & opportunity prioritization**
- **Execute action plan where responsible**
- **Apply skills & training from EK to continuous improvement**
Host / Facilitator Responsibilities

**Host Responsibilities**
- Confirm participants / team leaders
- Determine team focus areas
- Identify who will be trained
- Provide data to facilitator
- Get buy-in from management
- Arrange event logistics
- Assemble closeout presentation

**Facilitator Responsibilities**
- Prepare detail sheets with host supplied data
- Conduct training with host / focus area leaders
- Present opening presentation, process, and agenda to participants during Energy Kaizen event
- Help teams use detail sheets to quantify opportunities
- Assist with closeout presentation with input from focus teams
1) Team leaders bring laptop and coordinate access to plant resources
2) Identify energy reduction opportunities
3) Evaluate project viability and quantify with detail sheets
4) Facilitate energy measurements
5) Summarize focus area opportunities
6) Provide closing summary presentation content
7) Present opportunities to management at closing summary
Selecting Team Leaders

Qualities / Attributes

- Strong leadership skills
- Strong experience or technical background in focus area
- Capable of running the laptop / excel calculators
- Knows where to get information, and who makes decisions in their area of focus

Consider These Roles

- Process owners / decision makers / managers
- Engineers, supervisors, area leads
- Subject matter experts, tenure and experience in operations
Core Team Makeup

The team must be able to validate ideas, understand existing process, and evaluate technical issues

Target 3 participants from the categories below for each team

- Maintenance – shift mechanic / electrician
- Production – operators, supervisors, leads
- Engineering – area engineer, process engineer
- Plant Subject Matter Expert / Owner – HVAC, Compressed Air, Electrical, etc.
Observing 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!
Fixed vs. Variable Energy Usage

1) Control operating times
2) Automate shutdowns
3) Control temperature set points
4) Just in time operations
Typical Treasure Hunt opportunities – Lighting

- Turn off excess lighting where possible. During a treasure hunt, experiment by turning off lights and then measuring the available lumens.

- At infrequently occupied areas, Implement shut down procedures or install occupancy sensors.

- Identify unnecessary lighting. Robots do not need light to work.

- Retrofit lighting with more efficient technology.

- LED can save more on maintenance than energy in some applications.
Typical Treasure Hunt opportunities – Steam

- General steam leaks
- Broken Steam Traps
- Condensate leaks
- Boiler Tune up
- Poor or missing insulation
- Building heat with poor control
Typical Treasure Hunt Opportunities – Compressed Air

- Operate at the lowest practical pressure set point
- 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
- No loss condensate drains
Typical Treasure Hunt opportunities - Exhaust

Exhaust systems frequently operate regardless of production requirements. Implement shut down procedures or automate shut down based on production processes.

- Fume hoods
- Scrubbers
- Dust collectors
- Extraction systems
- Chip collectors
Typical Treasure Hunt opportunities – Process Heating

- Combustion tuning

- Combustion efficiency – burner upgrades, recuperators

- Poor furnace insulation

- Furnace shut downs / non-production management
  - Temperature set points
  - Recirculation fans / blowers
  - Minimize ramp up time
  - Excessive soak time
Typical Treasure Hunt opportunities – 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
Typical Treasure Hunt opportunities – 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

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

- Optimize throughput
  - parts washers
  - cooling tables / fans
  - die heaters
  - Extrusion machines
Documentation using Opportunity Sheet

- An opportunity detail sheet is a tool that helps organize and document information about identified opportunities.
- Each opportunity should have an individual “opportunity sheet”

Information captured
- Description
- Implementation costs
- Energy Saved
- Cost Savings
- Payback Metrics

<table>
<thead>
<tr>
<th>Information Captured</th>
<th>Description</th>
<th>Implementation Costs</th>
<th>Energy Saved</th>
<th>Cost Savings</th>
<th>Payback Metrics</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Information Sheet Details</th>
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**Table:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Implementation Cost</th>
<th>Energy Saved</th>
<th>Cost Savings</th>
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<tr>
<td></td>
<td>0.10 Electricity</td>
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<td></td>
<td>6.50 Gas</td>
<td>$ -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Compressed Air</td>
<td>$ -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Other Fuel</td>
<td>$ -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Steam</td>
<td>$ -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>20.00 Water</td>
<td>$ -</td>
<td>-</td>
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<tr>
<td></td>
<td>- WWT</td>
<td>$ -</td>
<td>-</td>
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<tr>
<td></td>
<td>Other Savings</td>
<td>$ -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total:</td>
<td>$ -</td>
<td>-</td>
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</tbody>
</table>

**Simple Payback Period (yrs):**
Important instructions for opportunity sheets

• Each team leader will be given a flash drive with a copy of a blank master opportunity sheet that is “read only”

• For each opportunity open up the master opportunity sheet and “save as” the title of the opportunity.
  • There will be a separate opportunity sheet for each opportunity your team identifies.

• User inputs on the opportunity sheet are marked by green cells—do not modify non-user input cells, this can break the macros embedded in the spreadsheet or modify important formulas

• You may append new blank worksheets or “tabs” in a detail sheet if you wish to do off sheet calculations or document further information
Useful Resources
Useful Resources

The following resources are made available to help participants with each step of the treasure hunt process:

- **Energy Calculators**
  - To find “Energy Saved” for opportunity sheet

- **Handouts**
  - To help identify opportunity

- **Diagnostic Equipment**
  - To help collect accurate data

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Observe operations & identify opportunities

Ensure future facilitator is trained

Analyze scope of opportunities and interview personnel

Evaluate impacts and quantify opportunities
Energy Calculators

• To quantify the energy savings associated with an identified opportunity

• The results from the calculator are used to populate the opportunity sheets.

Two types of Energy Efficiency Calculators are available

I. Treasure Hunt Calculators
   • To estimate the savings associated with typical operational opportunities, e.g. Scheduling the equipment, reducing the load on the equipment etc.

II. Opportunity Specific Calculators
   • Available for some common opportunities that can't be easily quantified using the treasure hunt calculator e.g. Insulation, lighting replacement etc.

Participants can use their own method or tool to quantify savings, however, the result of the calculation and description still needs to be captured in the standard opportunity sheet provided.
Each energy source (and water) has its individual Treasure Hunt Calculator.

All the treasure hunt calculators have three common steps:
- **Step 1:** Determining operational time each year
- **Step 2:** Determine the rate of energy use
- **Step 3:** Determining consumption.

The calculators provide different ways to calculate “rate of energy use” depending on the energy source.

The calculators are designed for ease of use.

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**Step 2 - Determine Electricity Consumption**

**Identify the method to be used:**
- **Electricity consumption** can be determined by several different methods. The calculator sheets provide three options to determine consumption. The methods are listed starting with the most accurate and end with the least accurate.

  a. **Power Meter Method**
  - The best way to measure electrical consumption is with a power meter. Manufacturer's data on lights can be entered as if the measurements were done with a power meter.

  b. **Multimeter Reading**
  - Multimeter measurements are the second most accurate means of measuring electrical consumption and are accurate for DC and for AC. (When combined with the plant's uncorrected power factor).

  c. **Name Plate Data**
  - Motor nameplate data can provide a reasonable estimation of the energy that motors are consuming but are not as accurate as a power meter. Nameplate data does not tell the user how heavily loaded the motor is.

  d. **Ongoing/Other Method**
  - Choose this option if you are using a different method to find the electricity use.

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**Treasure Hunt Calculators**

**Energy Treasure Hunt Calculator - Electricity**

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**Choose Method of Measurement**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Meter Method</td>
<td>The best way to measure electrical consumption is with a power meter.</td>
</tr>
<tr>
<td>Multimeter Reading</td>
<td>Multimeter measurements are the second most accurate means of measuring</td>
</tr>
<tr>
<td></td>
<td>electrical consumption and are accurate for DC and for AC. (When combined</td>
</tr>
<tr>
<td></td>
<td>with the plant's uncorrected power factor).</td>
</tr>
<tr>
<td>Name Plate Data</td>
<td>Motor nameplate data can provide a reasonable estimation of the energy that</td>
</tr>
<tr>
<td></td>
<td>motors are consuming but are not as accurate as a power meter. Nameplate</td>
</tr>
<tr>
<td></td>
<td>data does not tell the user how heavily loaded the motor is.</td>
</tr>
<tr>
<td>Ongoing/Other Method</td>
<td>Choose this option if you are using a different method to find the electricity use.</td>
</tr>
</tbody>
</table>
The following calculators are available as part of the toolkit and DOE is continuously working to improve the portfolio of calculators available.
Data Gathering Tools

• DOE provides energy diagnostic equipment and teaches the participants how to use them

• Helps participants evaluate equipment performance and quantify energy performance improvement more accurately
Handouts

- System specific handout sheets are provided by DOE to help participants identify and quantify energy savings opportunities.

- Three sets of handouts for each system type is available;
  - System Checklist
  - Data Collection Sheet
  - System Cheat Sheet

- The handouts are not meant to be all encompassing

- Participants should only use the handouts as a tool to get started and not solely rely on it
Checklist (things to look for sheet) help identify common opportunities

- The handout provide a list of best practices
- Typical system schematic is provided wherever applicable
- A list of “things to check” is provided by system area

Checklist are available for
- Compressed air system
- Steam system
- Process heating system
- Chilled water system
- Pump and Fan system
- Lighting and
- Process Equipment

<table>
<thead>
<tr>
<th>System</th>
<th>Things to Check</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller</td>
<td>• Opportunities with chiller sequencing&lt;br&gt;• Opportunities with set points&lt;br&gt;• Opportunities to bypass chiller with cooling tower/ Opportunities with free cooling</td>
<td>• Load management to optimize chiller efficiency.&lt;br&gt;• Stage chillers to optimize part-load efficiency&lt;br&gt;• Turn off chilled water on weekends.&lt;br&gt;• Can the chilled water set point be increased?&lt;br&gt;• Can the Condenser water set point be decreased?&lt;br&gt;• Economizer to produce chilled water when outside air is cool enough</td>
</tr>
<tr>
<td>Cooling Tower</td>
<td>• Opportunities with Tower operation&lt;br&gt;• Opportunities with Tower Make-up Water</td>
<td>• Use cooling towers in place of chillers when possible&lt;br&gt;• Install Controls to Stage Cooling Tower Fans On/Off&lt;br&gt;• Install VFDs on Cooling Tower Fans&lt;br&gt;• Make-Up = Evaporation + Blowdown + Drift&lt;br&gt;• Decrease blow down of cooling towers</td>
</tr>
</tbody>
</table>
Data Collection Sheet help collect the right data to quantify common opportunities

<table>
<thead>
<tr>
<th>Measure</th>
<th>Data to Collect</th>
<th>Data</th>
<th>How to Collect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common System Data</strong></td>
<td>How many Compressors?</td>
<td></td>
<td>Interview the operators</td>
</tr>
<tr>
<td></td>
<td>How many compressors are running?</td>
<td></td>
<td>Interview the operators</td>
</tr>
<tr>
<td></td>
<td>Are the compressors running fully loaded?</td>
<td></td>
<td>Interview the operators/ from panel</td>
</tr>
<tr>
<td></td>
<td>Compressor(s) total connected BHP or kW</td>
<td></td>
<td>From panel</td>
</tr>
<tr>
<td></td>
<td>Current System Pressure</td>
<td></td>
<td>From Pressure Gauge in Header line</td>
</tr>
<tr>
<td></td>
<td>Highest System Pressure</td>
<td></td>
<td>Interview the operators</td>
</tr>
<tr>
<td></td>
<td>Highest Pressure Required at point of use</td>
<td></td>
<td>Interview manager/ personnel who use compressed air</td>
</tr>
<tr>
<td></td>
<td>Nominal Compressed air Output (CFM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Air Leaks</strong></td>
<td>How many leaks</td>
<td></td>
<td>Approximation based on the ones found</td>
</tr>
<tr>
<td></td>
<td>Diameter for the Leak</td>
<td></td>
<td>Ultrasonic Leak Detector / visual determination</td>
</tr>
<tr>
<td></td>
<td>Main header pressure</td>
<td></td>
<td>From nearby pressure gauge</td>
</tr>
<tr>
<td></td>
<td>Hours of operation of the leak</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reduce System Pressure</strong></td>
<td>Current System Pressure</td>
<td></td>
<td>From Pressure Gauge in Header line</td>
</tr>
<tr>
<td></td>
<td>Proposed system pressure</td>
<td></td>
<td>Determined from existing and needed pressure at end use</td>
</tr>
<tr>
<td></td>
<td>Hours when pressure could be reduced</td>
<td></td>
<td>Determined based on proposed operations</td>
</tr>
</tbody>
</table>
Cheat Sheets provide common “Rule of Thumb” for a system

- Provide typical system performance information
- Help participants estimate savings associated with commonly identified opportunities

Cheat Sheet help to quickly estimate savings associated with common opportunities

**Rule of Thumb**
- Lowering compressor Pressure settings by 2 PSIG will result in a 1% savings
- Lowering compressor inlet air temperature by 10°F will result in a 2% savings.
- 10% of the electric energy going into the compressors is lost as heat.

**Typical Losses**
- Positive displacement
- Suited for high pressure operations
- Typically used in smaller applications
- Typical Controls – On/Off
- Dynamic compression
- Better turn down characteristics
- Small – mid-sized applications <500 HP
- Typical Controls – Load/Unload, Modulating, VSD.
- Large applications >500 HP
- Butterfly Values, Inlet Guide Vanes

**Airleaks**

| Leakage rates* (cfm) for different supply pressures and approximately equivalent orifice sizes |
|-----------------------------------------------|-------------------------------------------------|-----------------|-----------------|-------|-------|
| Pressure (Psig)                              | 1/64                                            | 1/32            | 1/16            | 1/8   | 1/4   | 3/8   |
| 70                                            | 0.29                                            | 1.16            | 4.66            | 18.62 | 74.4  | 167.8 |
| 80                                            | 0.32                                            | 1.26            | 5.24            | 20.76 | 83.1  | 187.2 |
| 90                                            | 0.36                                            | 1.46            | 5.72            | 23.1  | 92    | 206.6 |
| 100                                           | 0.40                                            | 1.55            | 6.31            | 25.22 | 100.9 | 227   |
| 125                                           | 0.48                                            | 1.94            | 7.66            | 30.65 | 122.2 | 275.5 |

* For well-rounded orifices, values should be multiplied by 0.97 and by 0.61 for sharp ones

Cost savings = # of leaks × leakage rate (cfm) × kW/ cfm × # of hours × S/kWh
Summary

I. Walkthrough the facility and observe operations

II. Identify opportunities

III. Collect relevant data

IV. Quantify Savings

V. Create Opportunity Sheet

Leverage available Resources
Gather your teammates and head out!