Lean & Energy

The Roadmap to Less Energy Use
Energy Consumption

Energy Consumed by Sectors

- Industry & Manufacturing: 32%
- Transportation: 28%
- Commercial: 18%
- Residential: 22%

Source: U.S. Energy Information Administration, Annual Energy Review 2005
Benefits of Coordinating Lean & Energy Management

- Reduce operating and maintenance costs
- Reduce vulnerability to energy and fuel price increases
- Meet customer expectations
- Enhance productivity and improve environmental quality
- Reduce greenhouse gas emissions
- Remain below air permitting emissions thresholds
- Increase overall profit
Understand The business Opportunities Related to Strategic Energy Management:
• Benefits
• Costs
• Risks

Select Energy Management Approach:
• Set goals
• Set metrics
• Decide scale
• Allocate Resources
• Integrate with Lean and Six Sigma

Understand Baseline and Identify Opportunities:
• Energy Assessment
• VSM
• Energy Treasure Hunts
• Six Sigma

Energy Efficiency:
• TPM
• Right size
• Standard Work
• Plant layout

Implement With Kaizen events

Lean and Energy Tool Kit Connections
Chapter 1 Chapter 2 Chapter 3 Chapter 4 & 5
The Five Principles of Lean *

1. Value – Work performed that the customer is willing to pay for

2. Value Stream – Value plus WASTE

3. Flow – Cellular Manufacturing, TAKT, Standardized Work, 1-pc flow

4. Pull – Strategically located buffer inventory that is controlled thru visual signals

5. Perfection – Zero waste

* Lean Thinking by James Womack and Dan Jones
# Energy Use Hidden in Lean Wastes

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Environmental Impact</th>
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<tbody>
<tr>
<td>Overproduction</td>
<td>Consume excess raw material; obsolescence; disposal of hazardous materials</td>
</tr>
<tr>
<td>Inventory</td>
<td>Excess packaging; deterioration; damage; HVAC space; lighting; handling equipment</td>
</tr>
<tr>
<td>Transportation &amp; Motion</td>
<td>Energy in transport; emissions; space HVAC; spills of hazardous materials</td>
</tr>
<tr>
<td>Defects</td>
<td>Energy and raw materials wasted; recycling of scrap; space needed and HVAC; Lighting</td>
</tr>
<tr>
<td>Over-processing</td>
<td>Raw materials and energy; emissions</td>
</tr>
<tr>
<td>Waiting</td>
<td>Spoilage; damage; Space and HVAC; lighting</td>
</tr>
</tbody>
</table>
Wood processing waste:

Excess material movement: Excess WIP inventory:

This wood was removed from an automated line, stacked, moved, stacked again, and placed back into the automated line.
Wood processing waste:

This operator is aligning wood re-entering the process.
Under utilized People:

Waiting for the machine to jam...

This happens so often, they installed a fan.
Wood processing waste:

Wood yield: This is wood that could become hi-grade dowel stock. Currently it is chipped and burned to heat the mill.
Value Stream Mapping

Current State Map - Picture using icons of the Value plus WASTE

Future State Map - Waste Free map with Flow, Pull and Perfection

Continuous Improvement Plan - Kaizens needed to implement Future State
Value Stream Mapping with Energy Component

**Current State Map** – Picture using icons of the Value plus WASTE
  - Energy Use Identification
    - SIPOC
    - Energy Treasure Hunt
      - Energy Related Improvements Identified

**Future State Map** – Waste Free map with improvements in Flow, Pull and Perfection identified
  - Kaizens identified

**Continuous Improvement Plan** – Kaizens needed to implement Future State
  - Continuous Improvement Plan
    - Lean Transformation Improvements
    - Energy Related Improvements
KAI ZEN-A Definition

- **KAI** - Take apart and make new. Rebuild
- **ZEN** - Think. Make good the actions of others. Help each other. Do good deeds
- **KAI ZEN** - Make it easier by taking it apart, studying it and making the improvement through the elimination of waste
- **CONTINUOUS IMPROVEMENT**
KAIZEN vs TRADITIONAL

TRADITIONAL METHOD

- Analyze
- Recommendations
- Decision
- Implementation
- Changes

- Analysis Team
- Management
- Implementation Team
- Employees

KAIZEN METHOD

- Analyze
- Trials
- Changes
- Implementation

- Kaizen Team

MONTHS

DAYS
Value Stream Map - CS
1. Use SIPOC as road map
Value Stream Map - FS
What is an Energy Kaizen Event?

- Short burst (3-5 days)
- Focuses on eliminating wastes
  - Operational
  - Energy
- Involves a multifunctional team
- Makes improvements during the event
- Stresses non-capital improvements
Energy Reduction Tools and Strategies

- Total Productive Maintenance (TPM)
  - Reduce Equipment Energy Waste
- Right size your equipment
- Plant layout to improve flow and reduce energy use
- Encourage energy efficiency with standard work, visuals and poka-yoke
Four Strategies

- Autonomous Maintenance
- Train employees
  - Identify energy waste
  - Improve equipment efficiency
    - Maintenance and operations
- Energy Kaizens
- Build on energy efficiency best practices
What is TPM?

- Maximize Overall Equipment Effectiveness (OEE)
  - Eliminate equipment related waste
- Production system lifecycle
- All departments
- Everyone participates
- Zero losses
Six (6) Big Losses

- Equipment Availability (EA)
- Equipment Efficiency (EE)
- Equipment Quality (EQ)

1. Breakdowns
2. Setup and Adjustment Losses
3. Idling and minor stoppages
4. Reduced speed
5. Defects and rework
6. Startup and yield loss
OEE = EA X EE X EQ
Replace Oversized and Inefficient Equipment

- Oversized building fan systems occur 60% of the time
- Most chillers are 50-200% oversized
- Right sizing motors with variable speed drives can save 50-85% on energy use
Three (3) ways to right size fan systems

- High efficiency motors vs standard efficiency
- Larger pulleys
- Use static pressure adjustment variable air volume (VAV) systems
Flow and Energy Use

- Redesigned heat transfers loops
- Big pipes small motors versus small pipes and big motors
- Layout pipes before the equipment
Encourage Energy Efficiency Thinking

- Energy reduction checklists
- Visual controls
  - Energy consumption dashboards
  - Signage
  - Color coding
- Poka-Yoke or mistake proofing devices
RESULTS

A Waste Free Value Stream!!!

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