Monitoring Consumption: A First Step in Developing an Online Energy Management Solution

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Honeywell Process Solutions

CO₂ Summit: Technology and Opportunity
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Agenda

- Who is Honeywell and Honeywell Process Solutions
- What is an Energy Dashboard
- General Implementation Methodology
- Potential Benefits
Honeywell Corporate Overview

- Founded in 1886
- 128,000 employees in more than 100 countries
- A $36.6 billion (2008) Fortune 100 company
- One of 30 companies in the Dow Jones Industrial Average
- Global leader in advanced technology products, services and solutions

Financially Strong and Global: Working together providing advanced technology, products and services to a multitude of industries
A global leader in product and solutions that improve efficiency and profitability, support regulatory compliance, and maintain safe, comfortable environments in homes, buildings, and industry. More than 100 million homes and buildings as well as in 24 of 25 top oil refining companies rely on ACS products and services.

Focused on Sensing, Control, Communications
Honeywell Process Solutions

<table>
<thead>
<tr>
<th>Products</th>
<th>Projects</th>
<th>Aftermarket Services</th>
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<tbody>
<tr>
<td>Field Instruments</td>
<td>Integrated Systems Application</td>
<td>Maintenance</td>
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<tr>
<td>Sensors, wireless</td>
<td>Project Services</td>
<td>Software Upgrades</td>
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<td>Collaborative Production Management</td>
<td>Refining</td>
<td>Parts Management</td>
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<td>Process Control &amp; Safety Systems</td>
<td>Oil &amp; Gas</td>
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<td>Advanced Control &amp; Optimization</td>
<td>Power Generation</td>
<td>Lifecycle Management</td>
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<td>Process Simulation</td>
<td>Life Sciences</td>
<td>Safety &amp; Security</td>
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<td>Equipment Health &amp; Monitoring</td>
<td>Chemicals</td>
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<tr>
<td>Advanced Applications</td>
<td>Petrochemicals</td>
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**Products, Solutions, and Services to improve business performance that increase safety, reliability, and efficiency while optimizing productivity and reducing cost**
Opportunities for Energy Savings

- Energy and emissions management is critical in the current economic and regulatory environment
- Energy Management solutions can identify opportunities leading to improvements in energy efficiency and associated greenhouse gas emissions

Operational improvement

Online Monitoring
- Energy Dashboard
- Wireless Solutions

Online Control (Drive to energy efficient state)
- Dedicated Furnace Firing Controls
- APC & Optimization
- Automated Procedures

MES Applications
- Planning & Scheduling
- Control Room to Business

Operate Efficiently

Process Design Improvement

Heat integration & Recovery
- Pinch Analysis
- CHP- Cogeneration

Adv. Process Technology
- High Flux Exchangers
- High Efficiency Distillation
- Power Recovery Turbines
- Advanced Catalysts
- Process Design

Managing Emissions
- Ecofining
- Rapid Thermal Pyrolysis
- Callidus/Maxon Burners

Capture Energy Savings

Sustain & Improve Benefits

Sustaining Benefits
- Remote Performance Monitoring
- Continuous Improvement
- Technology Refresh

Improve Business Performance

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Operating Efficiently is Not Always Easy

- There are lots of variables to check
  - What should I be monitoring?
- Frequent operating changes make it hard to identify optimum conditions
  - Operator may be more focused on safety, production and quality
- Lack of coordination; Multiple disciplines required
- Complex interactions
  - Interactions make it hard to push up against multiple constraints simultaneously
- System wide approach
- Operator cannot always keep up
  - So he backs off to conservative position that may cost more energy or reduces throughput

Need tools to monitor and implement optimum operating conditions
# Energy Dashboard Solution

<table>
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<tr>
<th>Goals</th>
<th>Report on overall energy use</th>
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<tbody>
<tr>
<td></td>
<td>See all the inefficiencies</td>
</tr>
<tr>
<td>Approach</td>
<td>Establish actual use, “best practices” use, and predictive models</td>
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<tr>
<td></td>
<td>Monitor actual energy use against targets</td>
</tr>
<tr>
<td>Users</td>
<td>Engineers, operators, managers</td>
</tr>
<tr>
<td>Implementation</td>
<td>1. Identify units, metrics, approach (study)</td>
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<tr>
<td></td>
<td>2. Build models and calculations (offline)</td>
</tr>
<tr>
<td></td>
<td>3. Monitor and report (online)</td>
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<tr>
<td>Benefits</td>
<td>Reduced energy use</td>
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## Opportunities

<table>
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<tr>
<th>Area of Savings</th>
<th>Actions</th>
<th>Energy Improvement</th>
<th>Profit Increase</th>
<th>CO₂ Reduction</th>
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<tbody>
<tr>
<td>Improved operation and control</td>
<td>• Improve online monitoring, control and optimization through multivariable, predictive control and optimization applications</td>
<td>2 to 4%</td>
<td>$3 to 5M/year</td>
<td>24,000 to 48,000 metric tons/year</td>
</tr>
<tr>
<td>Improved heat recovery</td>
<td>• Increase heat recovery within and across process units.</td>
<td>4 to 9%</td>
<td>$4M to 8M/year</td>
<td>48,000 to 108,000 metric tons/year</td>
</tr>
<tr>
<td>Advanced Process Technology</td>
<td>• Employ new process technology, design, equipment and catalyst technology</td>
<td>3 to 7%</td>
<td>$5M to 10M/year</td>
<td>36,000 to 84,000 metric tons/year</td>
</tr>
<tr>
<td>Utilities Optimization</td>
<td>• Optimization and controls for onsite steam and power production/supply and demand optimization</td>
<td>2 to 3%</td>
<td>$3M to 6M/year</td>
<td>24,000 to 36,000 metric tons/year</td>
</tr>
</tbody>
</table>
| H₂ and Fuel Gas Management         | • Optimize H₂ recovery  
• Maximize LPG recovery          | 1 to 2 %           | $8 to 10M/year  | 32,000 to 44,000 metric tons/year |

**Total**                             | 12 to 25%                                                             | $23M to 39M/year  | 164,000 to 320,000 tons/yr |

Basis: for a 100,000 BPSD refinery; natural gas cost @ $6/MMbtu
First step in improving energy efficiency is to measure energy and emissions and then reduce.
**Goal: Energy Stewardship**

What might a suitable energy and emissions report look like?

### Analysis
- **Target energy use** is based on models and planned rates and conditions.
- **Analysis** is done per meaningful units or individual equipment.
- **Predicted energy use** is adjusted for actual rates and conditions.
- **Actual energy use** is calculated from fuel & electricity consumption, net duties, etc.
- **Actual/predicted comparison** shows inefficiencies. Economic Impact of deviations can be provided.
- **Can report CO2 emissions as part of energy summary for desired period**.
- **Should have a user-selectable time period**: day; week; month; YTD.

Many calculations are required to generate an energy monitoring solution.
What Calculations Do I Need to Do?

- Reference model with hierarchical structure
- Calculate actual energy use per unit/equipment
  - Calculate lbs Steam/lb production; mBTU fuel/lb production and MW Power /lb production.
  - Breakdown according to major units or items of equipment
- Also calculate Key Energy Indicators (KEIs) to provide guidance
  - KEIs are operational targets that help identify when and where energy is being wasted.
  - First step in providing remedial action
  - Example of KEIs would include targets for Excess Air; Stack Temp; Reflux Ratio; etc
What Calculations Do I Need to Do?

- Use models to calculate actual and predicted energy
  - Actual energy consumption is calculated using process data and/or thermo data from simulation
  - Predicted energy may come from statistical models created by fitting historical data
  - Use standard modeling tools, correlations, models

- Run simplified models online
  - Use simplified models that represent energy models for unit or major item of equipment
  - Model predicts energy consumption as a function of feed, feed composition; severity, etc.
  - Can also show planned energy based upon outputs from planning application

Energy target models are required for process operations and planning groups to measure against actual performance and to identify deviations.
Monitor - Tree Map Overview

Size of each rectangle corresponds to “nominal” energy use, recalculated to the same basis (MBTU/hr)

Calculated metrics like total economic impact (in $) of deviating from the target are used to characterize targets

Color indicates how well or poorly is the given energy target met

Tree Map visualizes relative energy use in the context of plant hierarchy. Rectangles correspond to individual targets, and are further grouped by equipment and plant.

The unit overview tree map shows the relative size and impact of energy & emissions in each unit of the plant (plant; area; unit; equipment; type)
Monitor – Unit Overview

Schematic provides Energy Overview

Snippets from Ops Monitoring to show Key energy Indicators.

Pull Down Tag to trend in window

**Plant overview energy schematic shows overall plant energy usage:**
*Gauges indicate the usage of each type of energy*
Monitor / Track Energy Use Performance Against Targets

- Compare actual to predicted use per unit/equipment
  - Set an adjustable threshold that identifies violations & alerts the user
  - Track over time - trending

- Calculate
  - Economic impact – using marginal energy costs [$/MBTU]
  - Environmental impact – using emission factors as defined by EPA in US.

- Deviation Analysis
  - Reasons are assigned to all deviations and the impact, time and duration is clearly visible for easy analysis
  - Use information from KEIs to provide guidelines
  - e.g. fuel consumption deviation caused by high excess air or high overflash
Visibility Leads to Improvement

- Use KPIs to connect plant data to business objectives

- For each unit roll up key indicators:
  - Actual/Predicted;
  - Total Deviations
  - CO2 Emissions;
  - Purchased/Sold Energy

- Use “Top 10” reports to help identify inefficiencies, in process data and unit energy utilization

- Reports help rank common reasons for inefficiencies
What if I Am Missing Some Measurements?

- Add measurements that help close material balance or provide improved granularity
  - Account for stream losses
  - Measure power to unit or major piece of equipment
- Wireless is a low cost way for non-critical measurements
  - Faster installation
  - Lower costs
  - Use handheld devices
  - Readily connect to DCS
- Mesh networks provide improved reliability

Close material balance with wireless transmitters
Turn Data in Actionable Knowledge

Overall I'm okay but the Alky Unit is high on steam

Top 10 report shows heat exchanger fouling - Maintenance is working on it

Energy goes up 5% when rate increases 10% and my planner uses this model

Reflux rates need to be watched

Allows the user to measure, monitor, track and adjust energy consumption & emissions
Energy Dashboard - Summary

• Honeywell’s Energy Dashboard improves energy efficiency in process plants by helping plant operators, engineers, and managers:
  – Calculate actual energy use
  – Estimate the energy needed when operating efficiently
  – Highlight performance issues
  – Track actual and target energy & energy metrics
  – Prepare regular statements of energy use & emissions

• The Energy Dashboard gathers information from various instruments and systems to report energy and emissions consumption:
  – Break down consumption by unit or major item of equipment
  – Capture and analyze data allowing users to understand key energy indicators (KEI) and how they affect overall energy consumption
  – Enable users to establish specific goals for improving energy use and emissions reduction objectives
Thank You