

Global Energy Management System Implementation: Case Study

Korea

3M Korea

Naju plant improves Energy Performance 7.14% with SEP and ISO50001

3M Company has a long history of caring for the environment. 3M Korea also has made our effort to contribute to 3M strategic objectives. In 2015, 3M Korea Naju plant, one of 3M international subsidiary, had worked with KEA (Korea Energy Agency), to implement energy management system. Naju plant obtained certification of the ISO50001, global EnMS standard and is the first company in Korea achieved Superior Energy performance (SEP) from KEA. Naju plant's EnMS implementation enable 7.14 percent improvement in energy performance in 2 years.



Naju Plant of 3M Korea

3M Naju plant in Naju city, Jeollanamdo Korea has implemented energy management system that earned the plant both ISO50001 and SEP in 2015.

Business Benefits Achieved

3M Korea Naju plant EnMS saves 41,136 GJ and achieved a 7.14% energy performance improvement, saving over \$400,000 during 2014~2015. Naju plant, one of 3M subsidiary companies, successfully implemented an energy management system(EnMS) that meets all requirements of ISO50001 and Korea Superior Energy Performance (K-SEP).

Energy savings achieved in our plant were verified by KEA, one of Korea governmental companies. 3M Korea has already been working to save energy and improve energy performance in the past years.

“EnMS make us more focus on improving energy performance with systematical approach”

— Jonggu Kim
Naju Plant manager

| Case Study Snapshot | |
|------------------------------------|---|
| Industry | Chemicals |
| Location | Naju, Korea |
| Energy Management System | ISO 50001 & SEP |
| Product/Service | Industrial tape, material |
| Energy Performance Improvement (%) | 7.14% for 2 years - 3.17% in 2014 - 3.97% in 2015 |
| Annual energy cost savings | \$ 209,522 |
| Cost to implement | \$ 224,797 |
| Payback period | 13 month |

3M Naju plant's Profile

- People: 420 employees
- Facility: Established in 1990. Has 162,000 sq ft
- Products: manufacturing and industry product and home product, especially produces tape products, ranging from industrial tapes to common bundling and holding tapes.
- Energy profile: Electricity 62%, Natural gas 38%
- Energy management system(s): Certified under the Superior Energy Performance (SEP) program and the ISO 50001 Global Energy Management System Standard

Corporate goals

3M has global comprehensive Energy Management Program to guide 3M ongoing process of improving energy efficiency, reducing operating costs and reducing impacts on the environment. Our goal is to make energy/carbon efficiency a competitive advantage for 3M and to maintain a positive 3M image.

The Naju plant also work with 3M locations to help 3M control energy use, costs and the environmental impacts related to energy use. 3M Energy use and costs are tracked at over 250 locations in 39 countries world wide.



3M Earns Unprecedented 10th Consecutive ENERGY STAR® 'Sustained Excellence' Award

For an unprecedented and industry-leading 10th consecutive year, 3M has earned the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Partner of the Year "Sustained Excellence" Award for its comprehensive worldwide energy conservation efforts. No other industrial company has achieved this distinction as many times.

3M had 2015 Energy efficiency goals that that is improving energy efficiency 25% by 2015 from 2005 base year. To achieve corporate goals, the plant has a target that is a reduction in energy intensity of 3

percent per year as measured in British thermal units per pound (Btu/lb (joule/kg)); and the plant has an additional goal of 15% intensity-based performance improvement relative to the 2010 baseline.

Metrics :

BTUs

Finished and Semi-finished Goods

Keys to Success

Benefits of SEP & ISO50001 and Key to Naju's Success

SEP & ISO50001 certification is a great milestone which is a result of robust processes in the system.

There are many benefits like

- Sustainable energy efficiency improvement
- Develop energy cost saving opportunity
- Increase energy efficiency through actual statistical energy data
- Energy cost saving with energy efficiency improvement
- Co-work with KEA

Our key to Success

- Energy management is a long term planning. Our plant have tried to reduce energy cost and improve energy efficiency for years.
- Metering energy usage is a key to drive to success EnMS implementation. Metering data can be used while finding energy loss and proving energy saving.
- Management support is the most important source of EnMS implementation. Managing energy saving projects and performing projects actively can make management more receptive to funding

EnMS Development and Implementation

Our company management agreed to implement EnMS system. The Naju energy team proceeded development and implementation of EnMS at the plant.

| Energy team | Role & responsibility |
|---------------------------|---|
| Plant Manager | Ensure the EnMS is established, implemented, maintained, and continually improved |
| Plant engineering Manager | |
| Coordinator | Lead implementation |
| Electrical, Utility team | Energy data collection and Performing projects |
| Audit team | Lead audit |

EnMS implementation step

The first step to certify ISO50001 and the SEP was reviewing plant’s energy use. To develop baseline of Naju plant, the plant made energy flow drawings for electricity and gas. The plant also gathered related data. Our EnMS implementation strategy was to

- Energy usage & balance map
- Energy flow diagram
- List of metering units

Which was useful to understand energy flow. This kind of analysis was conducted which identified significant energy use, room for improvement in planning, operational controlling and training.

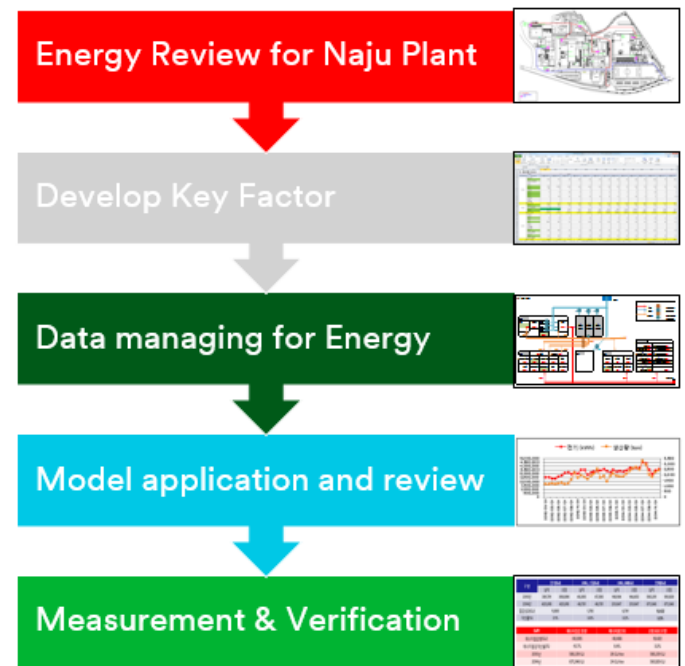
In order to adopt ISO 50001 framework, following actions were taken

- Energy Policy was made that was based on our 3M energy policy.
- Energy planning (energy review, energy baseline, energy performance indicators, targets and action plans)
- Implementation operations (competence, training, communication, documentation, operational control)

- Checking (measurement and analysis, legal and other requirements, internal audit, control of records)

ISO50001 requires all staff to be trained to certain competencies. Our energy team had been trained from a governmental company and then team members educated other employees. To assist with EnMS implementation, the plant hire a consulting company. A expert from hired company also educate our employees to reinforce their mind and culture.

SEP certification required a greater depth of energy-use analysis than required for the ISO50001 certification. The plant followed step like below.



Energy Review for Naju plant

- Energy usage & balance mapping
- Define production baseline of energy usage

Develop Key Factor

- Find key factor like total output amount, heating degree days, cooling degree days, other variables

Data managing for Energy

- Energy data collection & verification system set up
- Energy map improvement
- Baseline modeling and review

Model application and review

- Linear Regression analysis of modeling
- Measurement & Verification

Measurement & Verification

- Verify model application
- Applied to actual energy management system
- Corrective action set up

EnPI Tool

To assist plants in measuring and verifying plant-wide improvement, KEA(Korea energy agency) offered EnPI tool (Energy Performance Indicator) which is linear regression analysis method. By Using this tool, the plant measure actual energy performance improvements in compliance with the SEP measurements and verification protocol. But when using this tool, factors that affect energy use have to been reviewed and analyzed thoroughly. The company establish a normalized baseline of energy use, measure annual energy performance improvements and identify energy performance indicators.

Internal and Third-party Audit

In 2015, the Naju plant achieved third part certification to SEP and ISO50001. The third party certification for SEP and ISO50001 were performed separately. But audit steps are similar to each other.

- Pre-Audit : An auditor visited and reviewed progress of EnMS adoption. An auditor advised several points to get better grade.
- Phase 1 : A third part reviewed submitted documentation
- Phase 2 : Two-day on site visit to verify that the facility complied with the certification requirements.

Financial Support

3M Naju plant received financial support from 3M internally with Corporate Energy team's support. Staff at the plant also contributed by giving their time and commitment to the process.

Regarding SEP certification, KEA (Korea Energy Agency) had financially supported from consulting and implementing to audit. The Naju plant was the first pilot project to KEA.

Energy team



3M Korea Naju Energy Team

The Naju energy team have carried out from metering and performing projects to employee education

Work with passion

Team members enthusiastically investigated energy saving methods to make energy saving project ideas possible. Members also carried out their assignment to make project went smoothly.

Energy team meeting

Our team have a regular team meeting to discuss project status and problems. The plant also work with Lean Six Sigma team to get better ideas and calculate benefits using DEMAIC tool.

The results

3M Naju plant has already performed energy saving project and collected energy related data. So the plant could set up energy management system more easily.

- ISO50001, SEP certification in 2015



<SEP Certificate>



<ISO50001 Certificate>

- 7.14 percent energy performance improvement relative to previous year’s baseline for 2 years, as required by the SEP EnPI tool.
- Major energy project savings like ;
 - ✓ LED Lighting (Saving: \$140,000)
 - ✓ AHU & Compressor Optimization (Saving : \$153,000)
 - ✓ Heat Recovery & process improvement
 - ✓ (Saving : \$66,500)

Lessons Learned

Measuring and Verification

Measuring energy data is essential to improve energy performance. Using this data, engineers can find energy waste or loss of every equipment. The plant collects energy data manually which could cause human error. So the plant are going to install real –time energy monitoring system in 2016. The plant expecting

Opportunity

- Monitoring granularity of energy consumption in production
- Understanding waste in energy consumptions
- Optimizing energy targets in production

Key benefits

- Reduce unit cost
- Reduce waste in energy consumption
- Enhance energy consumptions in production

Verification and documentation of energy project savings are also important. A plant can crosscheck their improvements amount and project savings. This kind of savings could lead management’s support for further improvements.

Key factors for EnMS implementation

An EnMS can lead to significant cost savings. To successfully implement this;

1. Management willingness to commit resources
2. Energy team to lead EnMS with individual expert and responsibility
3. The development and performing of energy saving projects

Through the Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit www.cleanenergyministerial.org/energymanagement.

