Global Energy Management System Implementation: Case Study

South Korea

LG Chem

LG Chem, Ltd. Ochang Plant: Acrylic Film for LCD Modules & Lithium-Ion Batteries Manufacture – improves Energy Performance 9.39% due to the implementation of EnMS in 2014.

In order to build business model, which contributes in national power saving movement, LG Ltd. has developed LG photovol taic power generation, which sizes about 43,410 m^2 with capability of 2,988kWp. Since July 2012 when the installation finished, it creates 12.9GWh accumulatively. (by 2015 Dec)

Photo: LGChem Ochang plant Solar power generation

Business Benefits Achieved

LG Chem, Ltd. Ochang plant, which produces Acrylic film for LCD modules and Lithium-Ion batteries, has success fully implemented Energy Management System (EnMS) in 2014.

Since the ISO 50001 based EnMS was implemented in 2014, the Ochang plant set a goal to reduce energy cost by 10% in each year. The Ochang plant pursues energy saving by conducting self-assessment to seek more cost-saving opportunities. As a result of a monthly report assessment of its energy use and GHG, the Ochang plant achieved energy cost reduction by 13% ($9.5million) in 2014 and by 11% ($7.0 million) in 2015.

The Ochang plant, is actively involved in a GHG related regulation, and continuously reduced emission by 272,536 tCO_2 in 2012, 253,285tCO_2 in 2013, and 238,275tCO_2 in 2015.

As a participant in Korea Superior Energy Performance (KSEP), the plant verified its energy performance

Case Study Snapshot

- **Industry :** Manufacturing Industry
- **Location :** Cheongju-si, Chungcheongbuk-do, South Korea
- **Energy Management System :** ISO 50001
- **Product/Service**
  Design of Acrylic Film for LCD Modules & Lithium-Ion Batteries
- **Energy sources :** Electricity , Natural gas and Steam
- **Energy Performance Improvement (%)**

***2014 (baseline 2013)**

$$\text{EnPI}(\%) \quad \frac{6{,}125{,}939\text{GJ} - 5{,}550{,}682\text{GJ}}{6{,}125{,}939\text{GJ}} = 9.39\%$$

- **Annual energy cost savings**
  More than $9,492,000 (2014)
- **Cost to Implement :**
  More than $3,440,000 (2014)
- **Payback period**
  2014 ROI 0.36 (About 4.32 Month)
- **Energy reduction goal**
  10% reduction in energy by annually

improvement in 2014 with 9.39% reduction rate of energy uses. As a result, the facility earned a “Superior Energy Management certificate”.

“Energy is primary element in future. LG Chem will grow as a Global No. 1 Green company with advanced energy technology. We need to put full effort to maximize energy efficiency with achievable practical goal and advanced energy technology”

—LG Chem CEO JinsooPark, Energy Portal

Company Profile

Korean leading Chemical Company

Since its foundation in 1947, LG Chem has been served as Korea's representative chemical company, contributing to the development of the national economy and the improvement of the life quality through continuous technological development, new product introduction, and quality innovation based on its stable growth.

We have established the production, sales, and R&D networks at home and abroad, expanding our business into the global market. We aim to become a world-class chemical company that provides innovative materials and solutions by sharpening our competitive edge in high-value added core businesses while expanding new business opportunities in IT & Electronic Materials and Energy Solutions.

LG Chem, Ltd is the biggest manufacturer of large-sized Polarizer in the world market and all different kinds of batteries including Lithium-Ion batteries which LG Chem developed for the first time in Korea in 1991.

Business Case for Energy Management

Our Vision

As a materials company, LG Chem strives to create sustainable value by respecting people and respecting the environment in all of our business activities. To this end, we have chosen to include strategies for sustainability, economic, environmental, and societal management in our vision entitled "Sustainable Chemistry for Humanity and the Environment."

▣LG Chem Ochang Plant (Products)

No 1 manufacturer of large-sized Polarizer in the world market

As one of the key materials that constitute the LCD (Liquid Crystal Display),this optical film transmits the light emitted from the LCD's backlight in a single direction while blocking the light coming from other directions. LG Chem boasts its competitiveness as the largest manufacturer of large-sized Polarizer in the world market.

Technologies with industry-leading competitiveness

In the Rechargeable battery, lithium-ions move between cathode and anode to produce electricity. The battery is used for a variety of devices such as smartphones and laptops. In 19 99, LG Chem succeeded in developing a lithium-ion battery for the first time in Korea. Since then, It has continued to increase its sales volume in the battery market based on its competitive technologies and innovative product development.

(Mobile battery)

(Advanced & ESS battery)

LG Chem strives to be “GREEN Company” with responding to domestic and international Energy and GHG related regulation and promoting improvement in energy efficiency which leads to a goal to reduce GHG emission while value added.

Especially in order to respond to the government’s carbon emission trading system to reduce 30% of national emission by 2020, LG Chem set a short and long term goal to reduce 23% of emission by 2020. To achieve that, the facility implemented an ISO 50001 based EnMS. With meeting all requirements of ISO 50001, the facility established full set of EnMS which includes energy goal setting, energy monitoring, training practitioners and competence of employees and management review processes. Also, LG Chem keeps promoting employee awareness about the importance of energy saving. Furthermore, in order to objectively analyze the result of the EnMS, the facility participated in KSEP which is a program that Korean Energy Agency conducts as a third party Measurement &Verification of EnMS.

By sharing and supporting experience in energy saving and compliance of energy related regulations, LG Chem cooperates with partners/initiatives to grow together to gain energy sustainability which contribute to the social responsibility that a chemical company has.

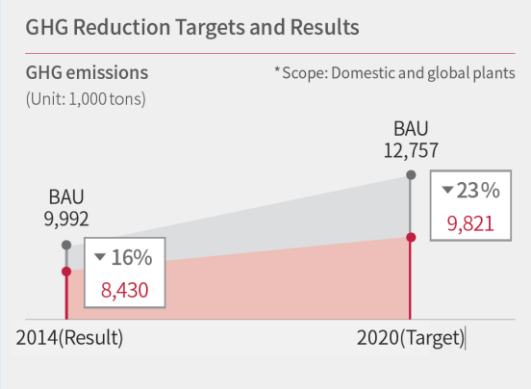
Since the LG Chem Ochang plant was established in 2004, the plant pursued energy saving project. By 2012, the plant mainly focused on operational improvement such as upgrading machines in order to improve efficiency which results in 5% saving ($2.6 billion) annually. From 2013, Ochang plant implemented Top Management which considered as a turning point of energy saving activities, the facility achieved 10% of reduction in energy use which is doubled the result.

Energy saving team was refined with Energy saving TFT implementation, and conducted energy audit and bench mark of leading facility‘s energy management system which result in 11% saving (7.9 billion).

In 2014, LG elaborated its energy management process by adopting EnMS, forming an energy committee to conduct energy reviews and report it to Top management, and implement IT system based Energy management (measurement and monitoring) which achieved 13% saving, (11.4 billion). Also LG gained national recognition in environment improvement.

▣ LG Chem Energy GHG reduction Targets

By 2020, reduce 23% of GHG emissions.

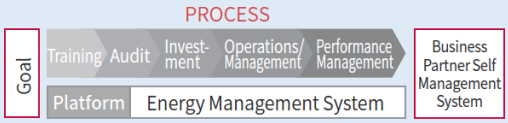


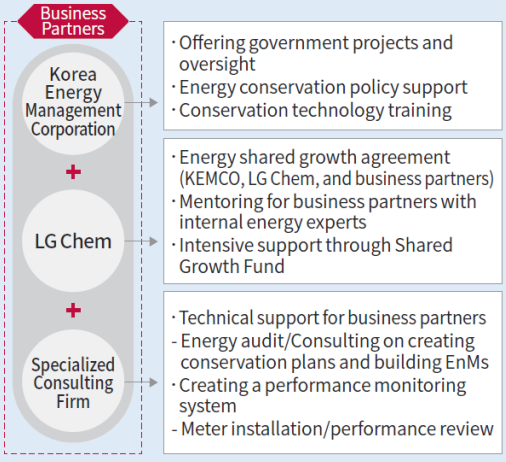
▣ Received CDP‘Climate change award’ 2years

In 2014 received CDP Supply Chain as top industry, the Only “The A List” industry in Korea..

LG Chem Ltd
Country: South Korea
Sector: Materials

Year	Program	Disclosure Score	Performance Band
2015	Climate Change 2015	98	A-
2015	Water 2015	Not Scored	Not Available
2015	CDP Supply Chain 2015	Not Available	Not Available
2014	CDP Supply Chain 2014	Not Available	Not Available
2014	Climate Change 2014	99	A
2013	CDP Supply Chain 2013	Not Available	Not Available
2013	Climate Change (Investor CDP)	95	B





Superior Energy Management system by Korea Superior Energy Performance (KSEP) project which is conducted by Korea Energy Agency (KEA) since it achieved 9.39% saving.

Keys to Success

- Ochang plant's EnMS was supported and encouraged by Top management, and all employees' awareness about Energy efficiency made this project successful.
- By Adopting ISO 50001 and KSEP, the facility is able to analyze with more reliable resources which leads to reduce energy loss and to find more energy saving opportunities.
- Successful adoption of ISO 50001 and KSEP, contributed to LG Chem's reputation/image as Green, environmental friendly company which makes us to increase its competitive ness globally.
- Energy saving affects the customer price, which leads LG produce more sophisticated products with lower cost, which makes the product more competitive globally.

"LG needs to be a global leading figure in Energy sector. Energy saving is our new product of LG chem."

—LG Chem CEO JinsooPark, Energy Committee

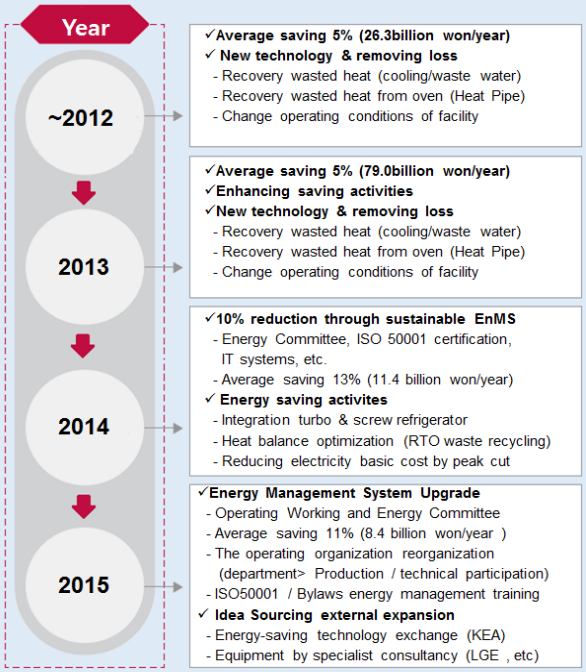
EnMS Development and Implementation

LG Chem Ochang Plant achieved reduction of energy use cost by 10% each year. In 2014 the plant achieved energy cost reduction by 13% ($9.5million) and by 11% ($7.0 million) in 2015. Since the plant participated in KSEP, it achieved 9.39% saving in 2014, and 8.29% in 2015 which made them to earn certificate as Superior Energy Management system.

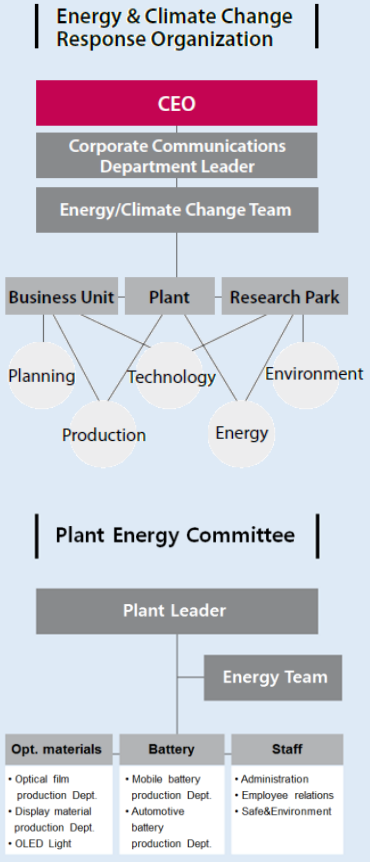
The plant has energy committee and energy (practitioner) team as energy management system's operating team. Energy committee is top level decision making committee which discuses, reviews and makes a decision on energy saving actives and issues. Monthly the committee shares practical figures on energy use /saving, status changes, energy related regulations, best practice in energy saving. Energy <practitioner> team is the group applying energy management system in real life. The team takes a role of establishing practical response to energy related regulation, seeking further energy saving opportunities,

▣ Ochang plant Energy Management History

History of energy reduction approach



▣ Energy committee Oraganization



and carrying on the projects. Suggested projects form energy teams are brought up in Energy committee for decision making. If energy committee decided to conduct the suggested projects, the project would be announced to all employees for awareness.

In order to conduct the enacted project in all plants, through video conference, plants in foreign countries such as China would be informed about this as well. Furthermore, energy management system's result will be reviewed in annual energy committee which is led by top management for promoting continual support from top management.

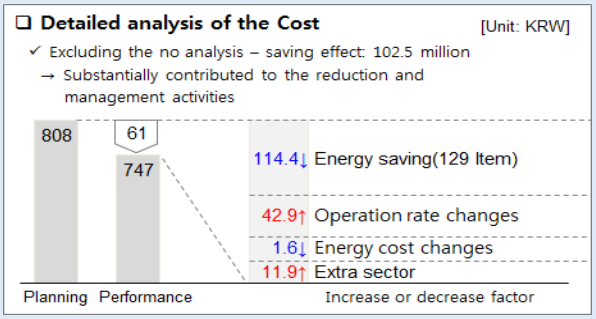
LG Chem Ochang plant conducts energy review and planning session from November to December annually. By Setting the previous year's energy use analysis as an

energy baseline, the plant establishes the coming year's energy use plan with prediction and analysis of each month's trends in regard to future production plan and energy cost change. Change in plan is managed and categorized with energy saving, operation rate changes, energy cost changes, and extra sector.

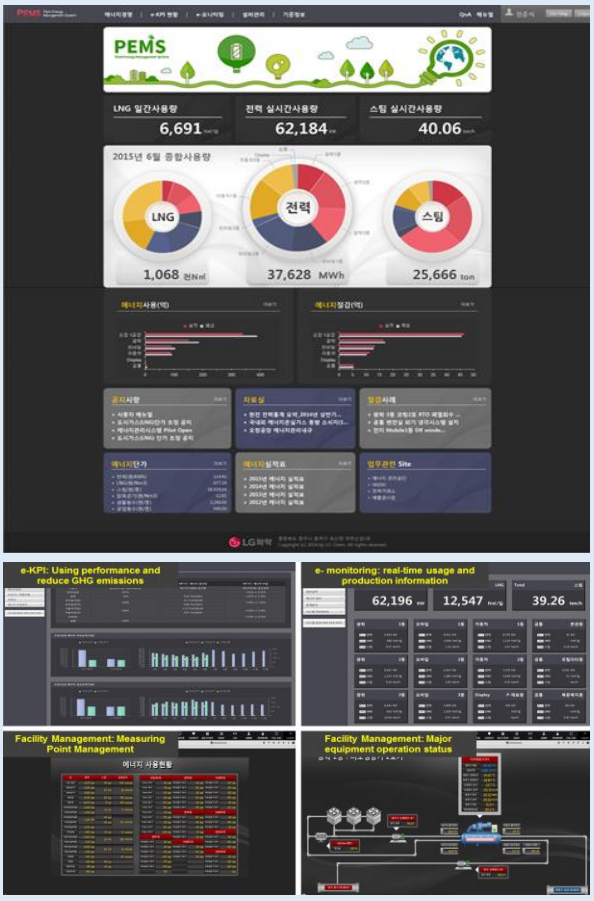
Based on a measurement by energy source, the plant creates an energy map and calculates significant energy in regards to energy use and its potential. In order to conduct more detailed and reliable energy review, energy meters which are able to monitor real-time energy use at all levels have been installed. Additionally, a web based energy management IT system with high accessibility was established for promoting more systematic energy management and continuous employees' interest in energy. Energy performance management, real-time energy use management, equipment with significant energy use operational status management are included in this Web system. Through this system, internal energy saving project such as management of Energy dependent variables and analysis of energy loss has been established. Furthermore, the plant conducts energy audit every 5 years, participates in Energy Saving through Partnership (ESP) led by Korea Energy Agency, and gets third party professional consulting.

Energy saving projects from various sources go through business review. If the Return on Investment (ROI) is under 2 years, we categorize and conduct energy saving projects under short term planning. Projects with 3 years or more of ROI go under the mid-long term planning.

Energy Performance analysis



Plant Energy Management System (PEMS)



Energy Storage System (ESS)

Main energy saving project is installation of energy efficient equipment, such as improvement in industrial air conditioning for clean room, waste heat recovery system, chiller improvement with water control. As battery manufacture, the plant installed Energy Storage System (ESS) for recognition as a green company and contributed to electricity peak reduction.

The LG Chem Ochang plant has successfully implemented ISO 50001 with background of implementation of ISO 9001, ISO 14001, OSHAS 18001, and ISO 27001. Energy management such as Energy management standard, and operational guidance of significant energy use equipment and all the related processes are standardized with continuous training and internal auditing,

In order to verify all energy saving results which came out from the adoption of energy management systems more concisely, the plant participated in KSEP, which is a program that help to verify energy saving by establishing statically useful linear regression model in regard to energy use from the past and its dependent variables. If the energy saving rate is over 3%, Korea Energy Agency will certify the facility with "Superior energy management system certificate". LG Chem Ochang plant has received "Superior Energy management system certificate" with energy saving 9.39% 2014 and 8.29% in 2015.

"By participating in KSEP, LG Chem's efforts and its best performance in energy saving has been recognized"

—LG Chem CEO JinsooPark,
Korea Superior Energy management performance ceremony

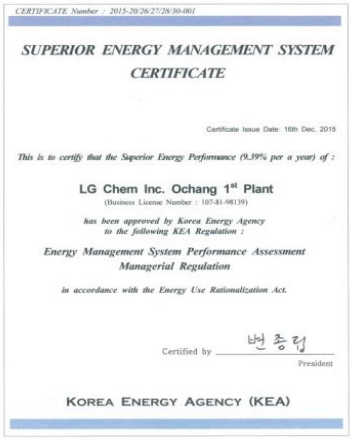
"With a good example of LG Chem, We will expand KSEP to various industries which strive to actively work on improvement of energy efficiency."

—Korea Energy Agency CEO Byun, Jong-Rip,
Korea Superior Energy management performance ceremony

Introduction of Energy team

As an elite engineering team in LG Chem, with objective "Utility production cease 0" the Ochang Plant energy team place a role in providing and managing energy resources. The team also responds to emission trading, as adopting

▣ Korea Superior Energy Performance Project



CERTIFICATE Number : 2015-20/26/27/28/30-001

SUPERIOR ENERGY MANAGEMENT SYSTEM CERTIFICATE

Certificate Issue Date: 16th Dec. 2015

This is to certify that the Superior Energy Performance (9.39% per a year) of :

LG Chem Inc. Ochang 1st Plant
(Business License Number : 107-81-98139)

has been approved by Korea Energy Agency to the following KEA Regulation :

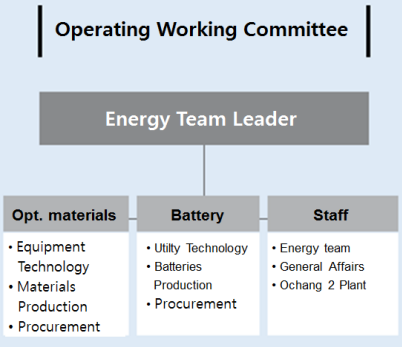
Energy Management System Performance Assessment Managerial Regulation

in accordance with the Energy Use Rationalization Act.

Certified by 변 종 립
President

KOREA ENERGY AGENCY (KEA)

▣ Ochang Plant Energy Team



ISO 50001 and KSEP, the team raises energy awareness among employees and conducts promotion.

Ochang energy team established energy management system, and cooperate with headquarter to operate standardized process with energy saving. Through conducting energy consulting, the team seeks for improvement in process and operates mentoring activities to save energy. Furthermore, the team leads factory energy committee and consultative group.

Lessons Learned

Adoption of Energy management System helps the Ochang plant to predict energy saving as well as improvement of energy efficiency more concisely, and prove its benefits.

Linear regression model for Energy performance assessment and new investment in equipment help to predict potential saving and help to appeal this project to top management for its reliability and visibility. It helps to Ochang plant strengthen competitiveness in energy resource.

Implementation of EnMS decreases the conflict between manufacture practitioners and energy team and creates a synergy effect. In early stage of implementation of EnMS,

Manufacture practitioners had negative ideas such as risk in quality and production, and energy team did not have any evidence to persuade their negative thoughts to positive.

However, after implementing the EnMS, the energy team provided training to raise awareness of energy saving and provide evidence that EnMS helps to reduce energy loss without any operational change.

As employee's perspective in EnMS has changed, the plant can decrease energy loss in every level, and it creates cooperation between production workers and facility engineers.

RESULTS

The Ochang plant received "Superior Energy Management system certificate" with 9.39% in 2014, 8.29% in 2015 of reduction rate in energy use. Adoption and use of ISO50001 & KSEP reduce 575,257 GJ ($9.5 million) in 2014, 469,082 GJ ($7.0 million) in 2015

By adoption of Factory Energy Management System (FEMS), lots of benefit has been come out. First, the facility can achieve national recognition on Energy efficiency. Second, this recognition raised our company's reputation as Green/ environmental friendly. Third, due to this, all of employees feel pride as a member of LG as well as the awareness of Energy efficiency has been raised among our employees. Last but and not least, by adopting the EnMS, we established a management system with the newest energy technology.

The Ochang plant will actively use EnMS as a planning strategy to continuously improve energy efficiency and potentially seek to way to expand EnMS to other partners' facilities in order to have win- win situation.