

Global Energy Management System Implementation: Case Study

Republic of Korea

LG Electronics Gasan R&D Campus

Through the energy management system, LG Electronics Gasan R&D Campus achieved 4.79% energy performance in 2016 compared with 2015 according to a quantitative evaluation.



LG Electronics Gasan R&D campus has continuously developed since its foundation in 2007, and now approximately 1,700 employees are working on area of 116,166 sq m.

Business Case for Energy Management

LG Electronics Inc. has established an **EESH (Energy / Environment / Safety / Health) policy*** and implemented an environmental management under a vision of protecting the clean earth and human health.

* EESH Policy: By practicing energy efficiency optimization, eco-friendly process operation and product development, workplace safety and health, as well as employee health promotion activities, LG Electronics will realize a global top company in EESH field. Additionally, as providing differentiated value to customer, the company will seek the global environment protection, sustainable social

development, and improvement in the quality of life for stakeholders.

“With a positive result of investment in the energy monitoring system, we were able to decide to continuously invest for energy saving activities.”

—Simon Jeon, Director of R&D center, Vice president

Case Study Snapshot

Industry	Electrical research
Product/Service	Research, development
Location	Seoul, Korea
Energy Management System	ISO 50001
Energy Performance Improvement Period	1 year
Energy Performance Improvement (%) over improvement period	4.79%
Total energy cost savings over improvement period	180 million won
Cost to implement EnMS	826 million won
Payback period (years) on EnMS implementation	4.51 years
Total Energy Savings over improvement period	14,386 (GJ)
Total CO₂-e emission reduction over improvement period	340.59 tons



Figure1. Green Management

Since 2009, under the vision of environmental management, LG Electronics has established four strategies to cope with climate change from 2009: improve productivity, product competitiveness, operational efficiency, and also social contributions. To achieve this, the company set its target for reducing greenhouse gas emissions to 150 thousand tons below 2008 level by 2020. It is 10 percent reduction from the baseline year.

As part of the achievement of the goal, LG Electronics introduced the energy management system (EnMS), and Gasan R&D campus finally received the first certification in October 2012.

LG Electronics R&D campus is made up three research laboratory buildings where research and development are mainly carried out: a research institute, experiment center, and annex building. There a research and development are in progress not only on the parts such as a motor and inverter but also electric appliances like a refrigerator, washing machine, vacuum cleaner, air conditioner and air purifier.

As experiments are constantly proceeding at Gasan R&D campus, the energy consumption in the laboratory is high. Therefore, the EnMS is operated to efficiently manage both the energy facilities related to the experimental equipment, and electricity and LNG used as energy sources. In accordance with the EESH policy, the campus invested in monitoring infrastructure in

order to manage and analyze the energy consumption from constructing the campus buildings.

A measuring instrument is installed on each side and floor of the each building, including the research and experimental equipment, in order to measure electricity, heating and cooling, and other power usage separately. As a result, it is possible to measure the energy usage of each part of the energy facilities as well as monitor it continuously.

Business Benefits Achieved

LG Electronics R&D campus aims to reduce greenhouse gas emissions by 3.0%, 463 tons of CO₂, compared to the baseline. To achieve this goal, the EnMS has been very helpful. Under a strong support of the campus management, each research team reports each laboratory's target power consumption and the actual performance against the goal. It made all employees have a clear role and responsibility and finally led them actively involved in the energy management activities.

Once all research teams share their performance relative to their goals, they get feedback on the analysis of the reasons for the increase or decrease. Then, the evaluations are conducted every month after reporting the results of monthly performance monitoring to the top management. Year-end rewards, based on the evaluations over each team, encourage the employees to lead reasonable energy management activities. Finally, it was possible to derive significant energy performance as follows;

- Baseline year : 2015
- Project year: 2016
- Energy Performance (Research) :
- 7.07 % (7,430 GJ)
- Energy Performance (Lab_experimental) :
- 6.26 % (4,718 GJ)
- Energy Performance (Lab_non-experimental) :
- 16.07 % (2,842 GJ)
- Energy Performance (Annex_experimental) :
- -1.87 % (-1,078 GJ)

- Energy Performance (Annex_non-experimental) :
- 1.07 % (473GJ)
- Energy saving cost : 180 million won

This achievement is considered reliable as a part of the evaluation of energy management system performance promoted by Korea Energy Corporation (KKEPCO).

The annual energy cost savings of 180 million won is a huge amount considering its properties of the R&D campus that mainly focuses on research and experiment. The value of cost reduction can be regarded as a value that cannot be compared with any other values. In particular, despite of having difficulties on quantitative analysis, it can be regarded as an excellent example of successful certification of the performance evaluation business for the first time in the domestic R&D field.

EnMS Development and Implementation

It is necessary to systematically manage, analyze and efficiently use energy due to internal and external factors; such as the EESH policy of LG Electronics head office, deepening of environmental regulations like energy greenhouse gas emission trading system, and the mid and long term goal to reduce 3% by 2020. In

Energy Review and Planning

Understand Current Situation

Since LG Electronics Gasan R&D campus is mostly composed of buildings for research and experimentation, the energy management team updates and manages the Fence Diagram, which can identify the energy flow at a glance, including the energy consumption used as an experimental power.

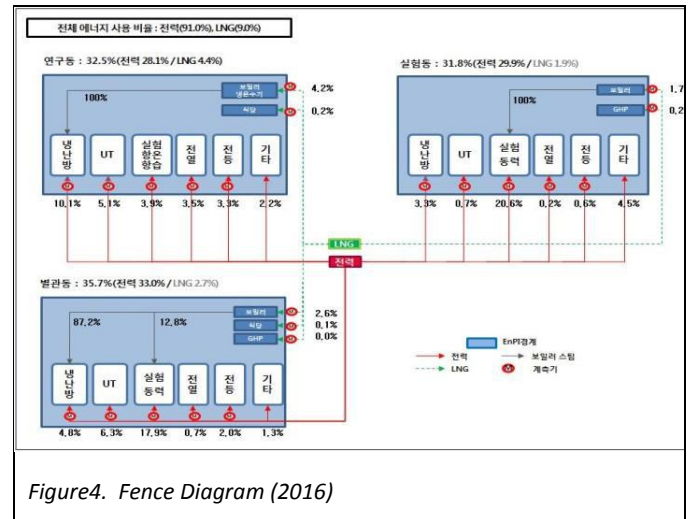


Figure4. Fence Diagram (2016)

LNG and electricity consumption per utility facility is measured by installing 89 meters. The energy consumption of experiment equipments is measured as electricity and heat by all chambers and also large energy consuming facilities. Through monitoring these data, the energy reduction performance is possible to confirm.

Conduct Significant Energy Use

Consider its current situation, the campus derived significant energy use that should be managed and analyzed mainly. The SEU is a key to lead energy reduction activities.

The campus selected SEU as an experimental power source that accounts for about 40% of the total energy consumption, the heating / cooling pump for the study building, the hot water boiler for the research facility, and the steam turbine laboratory facility. With the selection, the campus is looking for improvement opportunities.

“We have been able to achieve great energy saving. Thanks to all employees and their will to actively improve energy reduction”

—Simon Jeon, Director of R&D center, Vice president

Discover Improvement Opportunity

LG Electronics Gasan R&D campus has set priorities and created action plans for each improvement opportunity that it uncovered, and monitors its performance on a monthly basis.

High-rise automatic valve and inverter pump installation, air compressor inverter installation, high-efficiency boiler replacement, and replacement of the fuselage monitoring LED were determined, and the priorities were determined based on the estimated savings and return on investment.

Based on the data accumulated in the energy management system, the system recovers the report of the performance and the problem through the feedback process to determine the improvement plan. As a result, it established the appropriate management standard for the business site.

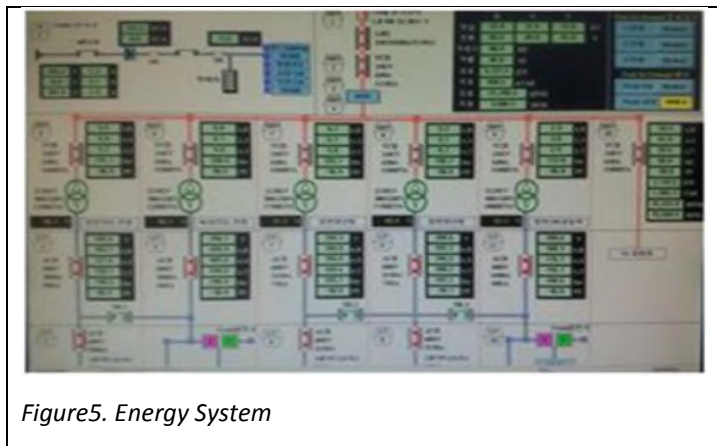


Figure5. Energy System

Confirmation of Energy Performance

Identifying Influential Factors

After LG Electronics Gasan R&D campus predicted and analyzed any factors affecting each energy usage, it identified the influential factors to consider at the campus.

Table. Identification of Impact Factors

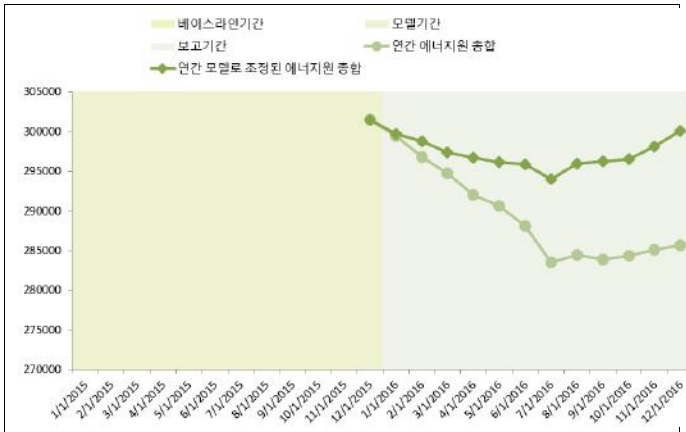
Energy Source	Independent Variable (P-Value)				F-Test	Adj. R ² (%)
	HDD (20)	CDD (20)	Chamber Running time (Lab)	Chamber Running time (Annex)		
Research building (GJ)	0.00	0.00			0.00	87.09
Lab building (GJ)			0.00		0.00	80.69
Lab_Non-experimental (GJ)	0.00	0.00			0.00	78.04
Annex_experimental (GJ)				0.00	0.00	88.53
Annex_non-experimental (GJ)	0.00	0.00			0.00	87.85

Derive Energy Performance

Using the derived influence factors, the energy performance of 2016, compared to 2015, the energy performance of 4.79% was confirmed.

Table. Derivation of Energy Performance

구분	년도	경계	Electricity (GJ)	Electricity +LNG (GJ)	Sum(GJ)
Baseline period	2015	Research building		102,285	301,500
		Experiment building	98,477		
		Annex building	100,738		
Project period	2016	Research building		97,671	285,686
		Experiment building	85,516		
		Annex building	102,499		
Performance (GJ)		Research building		7,430	14,386
		Experiment building	7,560		
		Annex building	-605		
Performance (%)		Research building		7.07	4.79
		Experiment building	22.33		
		Annex building	-0.8		



Analyze Cost-benefit

In the implementation of action plans, various activities such as activities that do not require investment and also activities that involve considerable investment have been uncovered. Based on economic efficiency, many projects have been carried out eventually.

Gasan Environment & Safety Team has obtained energy saving with less investment through energy conservation activities to improve energy loss. On the other side, the management of energy consumption target in the laboratory achieved energy savings too.

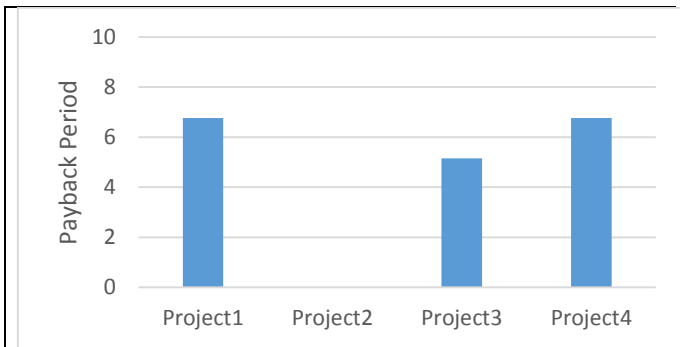


Figure6. Payback Period of Major Energy Saving Activities

Through the implementation of such energy efficiency improvement activities, the campus confirmed the energy cost reduction of approximately 180 million won during the achievement period of 2016. Excluding the expense of internal labor and the EnMS certification, the investment payback period of energy saving

activities is about 4.5 years. Furthermore, the campus will continue to improve energy efficiency through ongoing investment.

Communication, training, and Tool

To aim a company-wide participation in energy management, the campus sets a few strategies. It provides information and analysis results on energy consumption from each research team. Then, it holds regular discussion sessions to communicate about their energy management.

In addition, energy conservation campaign activities, public relations, and education also encourage an active participation in energy reduction. Each team's work is utilized as rewards at the end of the year.

To apply and acquire an advanced energy performance evaluation methodology using regression analysis, presented in ISO standard and M & V related literature, people in charge attended the performance evaluation training, conducted by Korea Energy Corporation.

M & V methodology and the energy management system EnPI Tool acquired from the training were successfully adjusted to the energy management system of LG Electronics Gasan R&D campus, and quantified results were derived.

Through an additional research and analysis about the methodology, the campus plans to suitably upgrade the M & V system for its business site. Also, it will build the foundation for efficient analysis and management by incorporating these parts into the system.

Lessons Learned

Developing Indicators to Confirm Performance after Implementation of Energy Management System

In some cases doing the energy related work, the managements are often hesitant to proceed because of uncertainty about the energy efficiency improvement activities.

As a solution to this problem, the EPA (EESH Performance Assessment) Index is developed and performed evaluations monthly. After developing the indicators, monthly performance could be monitored. It allows the managements to clearly decide whether to invest in particular energy saving activities.

Preparation Best Practices

When establishing the EnMS, the campus has set goals for energy management and reduction, and then invested heavily in measuring instruments to match them. So that it is possible to gather data on energy usage without any missing data, identify clear performance from energy saving activities, and finally improve problems or difficulties. It is important to make best practices through this process.

Furthermore, based on the best practices, the investing in infrastructures that can analyze more expanding range is possible. As well as improving any problems occurred in the existing systems is considered to be an efficient energy management and analysis method.

LG Electronics R&D campus is currently making investments in the EnMS in order to save energy with

this approach. In particular, improving the use of energy through an automatic installation of BEMS is under progress at the campus.

Keys to Success

- Energy saving activities that all the employees take a part
- Minimizing standby power in the building through the energy saving activities
- Management's intention to actively improve

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.

