Global Energy Management System Implementation: Case Study

INDONESIA

PT PUPUK KALTIM

First ISO 50001:2011 Certified Fertilizer Manufacturer in Indonesia

PKT-3 plant of Pupuk Kaltim

Business Case for Energy Management

Company Profile

PT Pupuk Kaltim (Pupuk Kaltim) is a subsidiary of PT Pupuk Indonesia Holding Company and currently has a production capacity of 3.43 million tons of Urea per year, 2.74 million tons of ammonia per year and 350 thousand tons of NPK per year. Pupuk Kaltim also produces organic fertilizer with a capacity of 45 thousand tons per year. The company was officially established on December 7, 1977 and is located in Bontang, East Kalimantan, Indonesia. The vision of Pupuk Kaltim is to become a world-class company in the field of fertilizer, petrochemical, and other chemicals towards excellence performance and sustainable growth.

Energy Management Implementation Drivers

Pupuk Kaltim as the biggest fertilizer manufacturer in Indonesia always striving to improve the product quality and achieve the optimal plant performance while supporting the National Food Security and facing the challenges of global fertilizer market. In order to maintain the sustainability of business and reduce the energy consumption, Pupuk Kaltim delivers its commitment by initially developed an energy conservation policy since 2013. Since then, the company has implemented the energy management system to assure a continuous improvement of energy performance, including energy efficiency, energy use, and consumption.

Furthermore, energy management becomes a priority to be implemented at Pupuk Kaltim for several main reasons. First, the energy consumption cost at Pupuk Kaltim plant operation is up to 70% of total production cost. By implementing the energy management system (EnMS), a saving of energy yields a higher operational efficiency and more competitive price in the market. In other words, our customer will get a high-quality product with affordable price. In addition, the long-term corporate target that is reducing the energy consumption for all plants up to 3% by 2021 can highly be achieved.

Case Study Snapshot	
Industry	Petrochemical
Product/Service	Ammonia, urea, and utility
Location	PKT-3 Plant
Energy Management System	ISO 50001
Energy Performance Improvement Period	April 2016 – March 2017
Energy Performance Improvement (%) over improvement period	3.24%
Total energy cost savings over improvement period	$ 641,142 USD
Cost to implement EnMS	$ 357,580 USD
Payback period (years) on EnMS implementation	0.56 year
Total Energy Savings over improvement period	162,606.26 GJ
Total CO_2-e emission reduction over improvement period	8,608 Metric tons

Second, implementation of EnMS at Pupuk Kaltim is in accordance with the Indonesia's Government Regulation No. 70 Year 2009. The regulation is about the obligation for every corporation with the annual energy

consumption equals or more than 6,000 ton oil equivalent (TOE) shall conserve energy through energy management. The total energy consumption of Pupuk Kaltim per year is 2,650,000 TOE, thus the EnMS is mandatory to be implemented.

Third, the energy management is one of requirement for PROPER assessment (National Program for Assessment of Company's Performance Rating in Environmental Management). PROPER is the country most prestigious environment annual award, conducted by Indonesian Ministry of Environment and Forestry. In 2017, Pupuk Kaltim was one of the 19 companies in Indonesia that received the highest award in PROPER, the PROPER Gold. Considering its achievement, Pupuk Kaltim will consistently improve and innovate in all aspects including environment, energy efficiency, and community development and empowerment to retain PROPER Gold award in subsequent years.

Last but not least, Pupuk Kaltim established the EnMS in order to reduce greenhouse gas (GHG) emissions as stated in long-term (2017-2021) corporate plan. This action is also in line with one of the mitigation programs of Indonesia's Nationally Determined Contribution (NDC) with the outline is to achieve a low carbon future by managing a sustainable natural resource.

Energy Management Program

Pupuk Kaltim has participated and been a part of national energy management programs as follows:

1. National Energy Efficiency Award (PEEN) hold by Indonesian Ministry of Energy and Mineral Resources:
   - In 2013, the Second Winner for category of Energy Management in Large Industry
   - In 2017, the First Winner for category of Energy Management in Building (Special Submission)
2. Online reporting of energy management to Indonesian Ministry of Energy and Mineral Resources since 2016.
3. Pilot company on EnMS ISO 50001 and Pump System Optimization within the project of "Promoting Industrial Energy Efficiency through System Optimization and Energy Management Standards in Indonesia" held by UNIDO and Indonesian Ministry of Energy and Mineral Resources in 2016.

Long-term Corporate Plan for Sustainability

Natural gas (NG) is the most important raw material to produce nitrogen fertilizer (urea). Moreover, the NG is also used as an energy source for catalytic reactions, combustion, and electricity. Hence, the plant performances and energy consumptions shall be maintained properly. Pupuk Kaltim has established a comprehensive strategy to improve performance, reduce energy consumption and carbon emissions at certain level, and enhance management system, of which documented in a long-term corporate plan. The plan includes actions and target to be achieved in 5 years' period (2017-2021). For energy management system, Pupuk Kaltim is committed to implement the EnMS ISO 50001:2011 for all plants including Ammonia plant, Urea plant, Utility plant, buildings and office. Since Pupuk Kaltim has 5 Ammonia-Urea plants, i.e., PKT-1A, PKT-2, PKT-3, PKT-4, PKT-5 and considering the complexity of each plant process, the implementation of EnMS ISO 50001 and certification will be conducted for 1 plant per year (Figure 1).

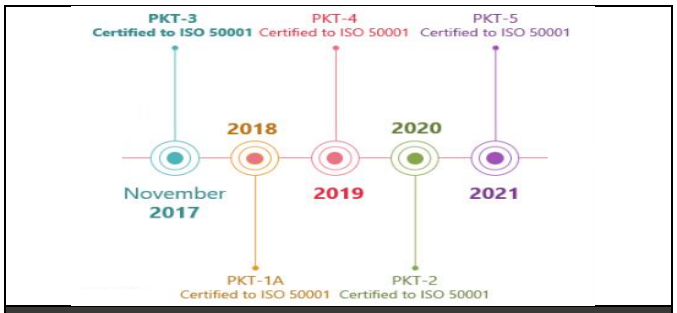

Figure 1. Long-term Corporate Plan for EnMS ISO 50001

As can be seen in Figure 1, by 2021, all Pupuk Kaltim plants would be certified to ISO 50001 and these targets are intended for the sustainability of the company.

Business Benefits Achieved

Pupuk Kaltim started to implement EnMS based on ISO 50001:2011 at PKT-3 plant in October 2016. PKT-3 plant was chosen as the first plant to be certified because the plant has the lowest complexity compared to other plants. Therefore, the established EnMS ISO 50001 at PKT-3 will be more easily applied to the next plant. At the beginning of its implementation, Pupuk Kaltim was assisted by energy management consultant (EnCoSS)

because they had a lot of experience in energy management projects. With the experience gained in the pilot company project for ISO 50001 hosted by United Nations Industrial Development Organization (UNIDO) and great efforts from the energy team, Pupuk Kaltim successfully received the ISO 50001:2011 certification 1 year later in November 2017. From this achievement, Pupuk Kaltim became the first fertilizer manufacturer in Indonesia that received the certification in EnMS based on ISO 50001:2011.

As stated earlier, Pupuk Kaltim sets the reducing energy target's 3% by 2021, which means 0.6% per year for each plant. By implementing EnMS ISO 50001, PKT-3 had reduced its energy consumption by 3.24% after 1-year baseline period. PKT-3 had surpassed the corporate target with a total annual energy savings of 162,606.26 GJ and a total energy cost savings of $ 641,142 USD. A corresponding reduction of 8,608 metric tons of CO_2-e was also realized over the same period.

By implementing EnMS ISO 50001 and having the certificate of ISO 50001, the awareness of employee on energy is increased and it encourages employee to innovate not only in the plant site but also in buildings and office. As a result, prestigious awards have been achieved such as the First Winner on The 2017 National Energy Efficiency Award (PEEN) held by Indonesian Ministry of Energy and Mineral Resources for category of Energy Management in Building (Special Submission) and the PROPER Gold award that was received at the end of 2017, where previously Pupuk Kaltim had received the PROPER Green 4 times in a row. These achievements further strengthen our relationships in the community and demonstrate our commitment to sustainability.

EnMS Development and Implementation

Enhancing energy efficiency is an important issue for Pupuk Kaltim where NG accounts for about 70% of total production costs. Therefore, Pupuk Kaltim focus on implementing an energy management system in order to improve productivity, lower operating costs and reduce environmental impacts.

Organizational

To engage all levels of employees in the organizational structure in managing the energy, Pupuk Kaltim established the energy policy. The energy policy is defined by the Board of Directors (BOD) as their commitments and communicated throughout entire organization. Furthermore, BOD provide essential resources to the implementation and the management system control including human resources, financial resources, and specialized skills. Recently, Pupuk Kaltim already has 6 certified energy managers and 7 certified energy auditors.

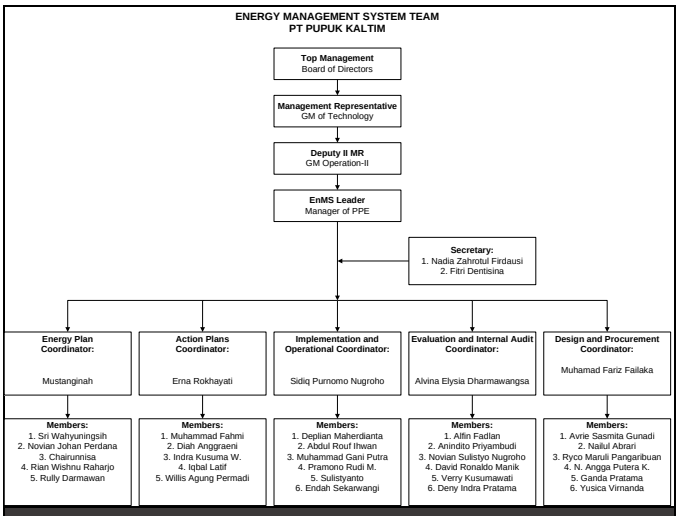

Figure 2. Pupuk Kaltim Organizational for EnMS Team

BOD also form EnMS team that consists of Management Representative (MR), Deputy II MR, Process and Energy Management Manager as an EnMS leader, and 5 energy team coordinators (including energy plan coordinator, action plans coordinator, implementation and operational coordinator, evaluation & internal audit coordinator, and design & procurement coordinator) to cover all EnMS ISO 50001 requirements (Figure 2). In addition, the members of each coordinator are associated with departments such as operation, maintenance, engineering, procurement, quality, and human resource departments. All their roles and responsibilities have been clearly defined in the EnMS team job description. The EnMS team worked collectively with MR and Deputy II MR for feedback-driven development process of all EnMS materials and processes in order to achieve consistency in practice.


Figure 3. EnMS Team with the TUV Nord Auditors

"The implementation of energy management system based on ISO 50001 has provided great value to our company and guarantee us to always lead the way in conserving energy and preserving the environment."

— Bagya Sugihartana, Production Director

Prior to ISO 50001 implementation, Pupuk Kaltim has solidified the systematic approach which is already ingrained by ISO 9001 certification since 1996 and ISO 14001 certification since 1997. In 2007, Pupuk Kaltim launched the Integrated Management System (IMS). The IMS is an integration of existing ISO systems that provide the necessary foundation and framework for successful implementation of EnMS ISO 50001. By having the IMS, the EnMS team made use of the preexisting procedures and documents from the integrated management manual for all systems including ISO 9001:2015 and ISO 14001:2015 standards to cope with the requirements in ISO 50001. Then, Pupuk Kaltim established the Energy Management Manual as a guidance for consistent implementation of the EnMS.

Pupuk Kaltim also encourages all employees in innovating and improving the energy efficiency through quality improvement activities such as group activity using 7 Basic Quality Tools and Six Sigma, Total Quality Management (TQM), and Employee Suggestion System (ESS). To get more ideas and suggestions, Pupuk Kaltim holds an annual internal competition, which is Pupuk Kaltim Innovation Award (PIA) and awards are given to ideas that considered to be practical and innovative.

Energy Review and Planning

The scope and boundary of the first ISO 50001 certification is the PKT-3 plant including Ammonia unit, Urea unit, and utility unit. As a strategy to achieve energy savings target and ensure a continuous energy performance improvement in each unit, the work instruction (WI) were established from the Energy Management Manual including energy planning WI, energy baseline WI, energy review WI, energy performance monitoring WI, and competency requirement and evaluation WI. These procedures include methodology how to conduct energy planning, energy baseline, energy review, build the energy management program, and identify training matrix for management and personnel driver to SEU.

Review, analysis, and planning

Pupuk Kaltim has 2 significant energy uses, i.e., natural gas (NG) and electricity. For ease energy planning, each unit will be divided into several sub-units based on the energy used on that unit. For example, Ammonia unit is divided into Ammonia Thermal sub-unit and Ammonia Power sub-unit. Then, the significant energy user (SEU) of each sub-unit will be identified (Figure-4).

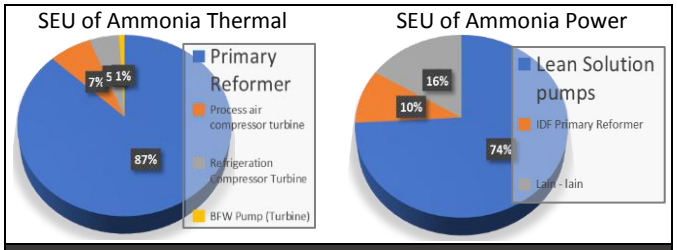

Figure 4. SEU of Ammonia Sub-units

The Energy Performance Indicators (EnPIs) has been defined to monitor the energy performance of each sub-unit with the basis of past and present energy consumption. Baseline is set for each EnPI using statistical linear regression approach that describe the correlation between energy consumption and the driver for the 12 months after the last turn around (TA), i.e., April 2015 – March 2016. This period is considered as the baseline because TA activities will restore and improve performance of the plant to the highest level. The coefficient of determination (R^2) indicates the degree of acceptance of the drivers or if it needs additional studies and analysis to determine other drivers.

The EnMS team conducts energy review in order to analyze the performance of the SEU of each sub-unit, of which the actual energy consumption is compared to the baseline energy consumption. This analysis is used to determine the EnPIs, the difference between actual and expected, and the Cumulative Summation of energy saving (CUSUM). Then, the energy conservation opportunity (ECO) of each sub-unit is identified from energy review as well as the result of energy audit. Moreover, these ECO lists become programs and documented in the Energy Management Programs Log. The proposed action plans are made for each program including methods, pay out time, responsibilities, completion date target, and contribution in energy

saving, carbon reduction, and financial saving. To ensure the achievement of the energy management programs, meetings are established periodically, i.e., daily meeting for programs that can be done in daily routine job, and weekly and monthly meetings for programs that need process modifications, equipment modifications, and investments. The utilization of EnMS team work steps proved to be essential during the internal and external audit processes because it provides consistency and effectiveness in implementing ISO 50001 standards.

Financing

In order to realize the energy management programs, the programs are classified into 4 investment classes (Table 1), i.e., no cost (NC), low cost (LC), medium cost (MC), and high cost (HC). Considering these investment classes and a complete feasibility study for each program, the BOD will approve the most feasible programs for the company after being screened from Budget, Finance, Internal Audit, and Procurement Department.

Duration

Duration of program's implementation is usually determined by the company capital budgeting and the size of the project. The implementation of LC programs usually takes time up to 2 years, and for MC and HC programs, maximum up to 5 years. Meanwhile, programs without investment will be done in less than one year.

Cost Benefit Analysis

During the implementation of EnMS at PKT-3 plant, Pupuk Kaltim had achieved $ 641,142 USD savings from investment of $ 357,580 USD including EnMS team training and certifications, technical assistance by EnCoSS for the ISO 50001 certification, ISO 50001 certification audit, and programs implementation. As a result, the payback period was less than 1 year (7 months).

Approach used to determine whether energy performance improved

The energy performance improvements are easily monitored and analyzed in real-time because the PKT-3 plant has an online monitoring software of key performance indicators for each SEU. The performance data (energy consumption in MMBTU) of SEU is captured and normalized before being compared with the energy baseline. Normalization of existing data is highly necessary to make an apple-to-apple comparison to the energy baseline, of which the 12 months period of baseline had been normalized to production rates. Regression analysis was conducted by using Microsoft Excel add-in tool (Regression) and features made by the EnMS team to expand the output with data displays including CUSUM chart, CUSUM Finance chart, and pie diagram of SEU rank. The EnMS team has also established the energy performance monitoring tool and executive dashboard, which are updated daily, to track energy performance of all plants and data integrity at each plant. Energy performance assessment is performed monthly to identify either saving or wastage of energy at each plant and reported to Management Representative.

Approach used to validate results

At PKT-3 plant, a negative slope of CUSUM graph (Figure 5) indicates actual consumption is lower than predicted value. An improvement in energy performance was the results of internal GTG upgrading and adjustments of operation parameters. The overall reduction trend is validated through energy audit internally by Evaluation and Internal Audit Division of the EnMS team. Furthermore, EnMS internal audit and annual external audit by certification body are conducted to measure overall improvement of the system and ensure the EnMS is performing as expected. The audit results will be reported to BOD at the Management Review Meeting as input prior to adjusting corporate key performance indicator targets for the following year.

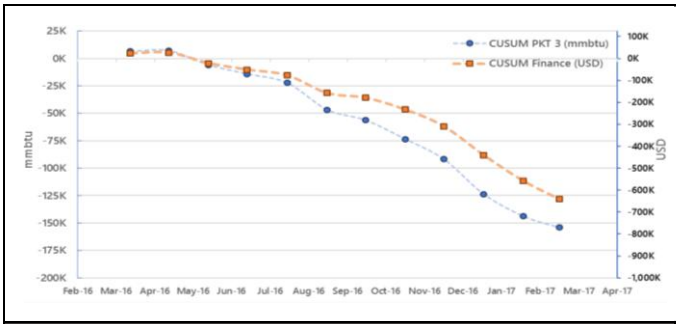

Figure 5. CUSUM and CUSUM Finance chart of PKT-3 Plant

Steps taken to maintain operational control and sustain energy performance improvement

Implementation and Operational Division of the EnMS team has a responsibility to ensure that the existing

Standard Operating Procedure (SOP) and Work Instruction (WI) for operational control, maintenance, and quality control have been reviewed periodically and adjusted to the ISO 50001 standard. Moreover, a WI of energy performance monitoring was established as a guideline to monitor the SEU's performance effectively and sustain energy performance improvement. Personnel related to SEUs were trained to ensure full understanding of the practices described in SOPs and WIs. The effectiveness of the training will be evaluated every 6 months and recorded in Competency Requirement and Evaluation Log. In addition, through Knowledge Sharing Program, the EnMS team also shared the achievements of maintaining EnMS to preserve continuous improvement in their minds.

Development and use of professional expertise, training, and communications

Pupuk Kaltim participated in pilot company project on EnMS ISO 50001 and Pump System Optimization by UNIDO and Indonesian Ministry of Energy and Mineral Resources in 2016. The project provided trainings by experts on EnMS and system optimization. The BOD also committed to develop and optimize internal human resources through training program and certification.

Employee engagement

Pupuk Kaltim has many communication media to raise awareness of employees to save energy and reduce environmental impact including monthly internal magazine "Media Pupuk Kaltim", poster and stickers, Knowledge Sharing Program, Knowledge Management Web Portal, and annual Pupuk Kaltim Innovation Award (PIA).

Professional expertise

Pupuk Kaltim utilized energy consultant, PT. Mitra Solusi Energi Berkelanjutan or EnCoSS to assist the EnMS team with the initial ISO 50001 system and internal audit. They provide national experts that enhance the experience of the EnMS team to implement EnMS ISO 50001.

"Through continuous improvement and implementation of energy management system based on ISO 50001, the corporate sustainability objectives involving Triple P (Profit, People, and Planet) can always be achieved."

— Sri Mukartiningsih, Management Representative

Tools & resources

The EnCOSS consultants introduced the tool prepared by UNIDO, which was a Microsoft Excel-based tool in order to help the EnMS team get more familiar with the implementation of EnMS. Based on this tool, the team developed the energy performance monitoring tool and executive dashboard for measurement, monitoring, and analysis. Pupuk Kaltim also has Knowledge Management Web Portal (km.pupukkaltim.com) where ideas and innovations from group activity using 7 Basic Quality Tools and Six Sigma, Total Quality Management (TQM), and Employee Suggestion System (ESS) are stored.

Lessons Learned

As the first ISO 50001:2011 certified fertilizer manufacture in Indonesia, the main concern during implementation of EnMS was to shape and integrate the existing management system to the requirements of the standard. Therefore, Pupuk Kaltim chose PKT-3 plant as the first plant to be certified because the plant has the lowest complexity compared to other plants. The experience of success in certification will be shared to other plants, ensuring that in 2021, all Pupuk Kaltim plants would be certified to ISO 50001.

Keys to Success

- The proactive commitment of the Board of Directors and great efforts from the Energy Team are the key role for successful implementation of EnMS ISO 50001. Without these actions, implementation of EnMS will be more time consuming and require more resources.