Global Energy Management System Implementation: Case Study

Indonesia

PT. Indonesia Power

By implementing EnMS, 3,21% energy saving has been achieved every year

Suralaya Power Station, the biggest coal power plant complex in Indonesia

Business Case for Energy Management

As stipulated in Indonesia's Government Regulation no 70 Year 2009, every corporation whose annual energy consumption equals or more than 6 thousand TOE, is obliged to conserve energy through energy management. IP annual energy consumption is 8,014.29 thousand TOE, thus it is obliged to implement energy management system.

Environmentally, it is also required for every corporation in Indonesia to manage energy as part of natural resource that is annually monitored through PROPER (Program for Assessment of Company's Performance Rating in Environmental Management). PROPER is a prestigious annual award that is conducted by Ministry of Environment and Forestry. Considering its high importance, IP established PROPER as Key Performance Indicator (KPI) of Management and declared energy efficiency on its Policy.

Company Profile

PT. Indonesia Power (IP) is one of PT. PLN (Persero) subsidiary which focuses on power generating, Operation & Maintenance (O&M) services and related services. Currently own 8.155,06 MW of power plant, varied from coal fired, gas fired combined cycle, hydro power and geothermal power. Also operates 6.016,5 MW power plant as O&M Services Provider. Operation area span throughout Indonesia, from North Sumatera (PLTU Pangkalan Susu) to West Papua (PLTU Holtekam).

Case Study Snapshot	
Industry	Electric Power Generation
Product/Service	Electric power and related services
Location	Indonesia
Energy Management System	ISO 50001
Energy Performance Improvement Period	1 year
Energy Performance Improvement (%) over improvement period	3,21%
Total energy cost savings over improvement period	37,53 Million USD
Cost to implement EnMS	0,96 Million USD
Payback period on EnMS implementation (years)	0,0255
Total Energy Savings over improvement period	14.100.801,94 GJ
Total CO_2-e emission reduction over improvement period	1.332.525,78 MT

IP currently is the largest power producer in Java Bali System with 8.230 MW installed capacity, as well as O&M Services Provider with 6.016,5 MW managed capacity in 18 power plants.

With tough competitive atmosphere, IP struggle to maintain market share in Java-Bali Electricity System and O&M Services Market. One key factor to win the market is competitive electricity price, could be approached with fuel price reduction, fuel consumption reduction and O&M Cost reduction.

To be ahead in the competition, IP established several initiatives, one of them fuel consumption reduction through Energy Management System.

"Clean And No Leakage has been our drive in electric power generation business. In this tough competition, Energy Management System through 5E program enables us to be more competitive and ultimately secure our business sustainability"

—Eri Prabowo, Operation-1 Director

Business Benefit Achieved

PT. Indonesia Power (IP) is one of PT. PLN (Persero) which successfully implemented Energy Management System (EnMS) ISO 50001. As the largerst electric power producer in Indonesia IP must set a benchmark company for EnMS implementation.

EnMS implementation has been used as one approach by IP to achieve its Net Plant Heat Rate Key Performance Indicator. Another upcoming Key Performance Indicator is Performance Based Regulation (PBR) which will determine the energy saving and ultimately electric energy subsidies from the government of Indonesia.

IP's specific approach in implementing EnMS is by utilizing a method called 5E (Enhancing and Embedding Energy Efficiency Excellence). The emphasis of 5E approach beside improving power plant efficiency is nurturing the energy saving culture and energy saving program ownership throughout every level of IP employee.

By implementing EnMS through 5E, IP's has reduced its energy consumption by improving 3,21% power plant heat rate through execution energy saving ideas.

Financially, the improvement gained from EnMS has reduced IP's energy cost as much as 37,53 Million USD per year.

Implementation of EnMS has also risen employee awareness on energy and encouraged employee to innovate not only in the scope of Significant Energy Uses (SEU) but also in the larger production system. For example, innovation on condition based soot blowing has been successfully reduced flue gas temperature, increase main steam flow and increase production simultaneously.

EnMS Development and Implementation

Policy

The first significant energy efficiency initiatives in IP is launched in 2010 when company initiated the Efficiency Management framework in all IP's power plant. The efficiency management framework is a solid background for succesful EnMS implementation. To perfect the EnMS, IP then implement 5E to complement the well established Efficiency Management framework.

Realizing further energy saving could be achieved, in 2016 IP started to implement EnMS based on ISO 50001. By the time IP already have 10 certified energy auditor and 15 energy manager for all power plant sites.

Currently energy audit is conducted by internal energy auditor and external energy auditor as complement. EnMS is now become Management Policy as well as Sustainability Policy.

Following the policy, Energy Management Team (Figure 1) was then formulated; serial trainings and awareness are launched both in executive and working level.

Top Management appointed a Certified Energy Manager to manage energy and implementation of EnMS in IP's power plants. Energy Manager is supported by Operation, Maintenance and Engineering Manager. In each site Management Representative(s) is appointed. The Energy Management Team involves personnel cross-departmentally to ensure the expertise required is covered and well represented.

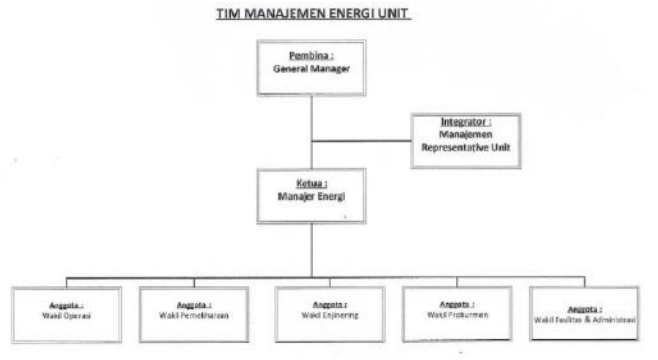

Figure 1 Energy Management Team

Plan

Prior to set energy objective, target and program, energy review was conducted to identify energy consumption & use, significant energy use, energy saving potential etc.

The energy review was also taking into account the energy audit done by internal energy auditors and Certified Energy Service Company.

The review covered also energy related regulation and standard applied to IP.

IP like any other electric power generation companies, is an energy intensive company with annual energy consumption of 8,014.29 thousands TOE per year. This energy is used for energy conversion and auxillary for power generation process and operation & maintenance process from varied source, from coal, gas, fuel oil and electric power (Figure 2). From energy review, it is understand that coal power plant used the most energy and thus coal consumption is SEU in coal power plant with 97.88% energy consumption (Figure 3).

Do

Energy action program is then created to mainly improve energy performance of energy conversion in the coal power plant, such as turbine and boiler.

Since turbine and boiler is a complex equipment and the performance change in one component will affect other component performance, the process in formulating efficiency improvement idea shall be done with systematic process. The formulation process started from data collection to real time monitoring in Energy Efficiency War Room. In this framework, data is validated from the collection process to ensure the idea generated from valid data thus would result as expected.

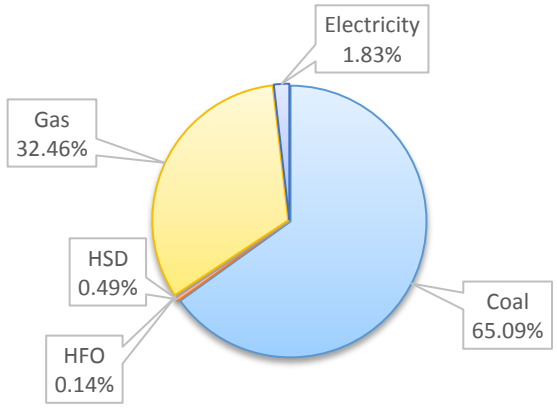

Figure 2 IP Energy Consumption

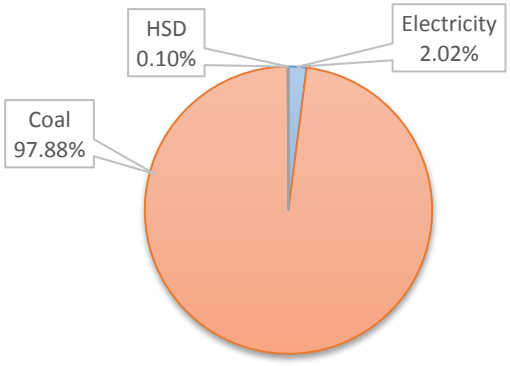

Figure 3 Energy Consumption in Coal Power Plant

Then energy saving idea generated from collaborative process through idea generation workshop. During this process idea is refined, prioritized and syndicated through Idea Charter. Then the result of idea execution

is monitored in real time in the Energy Efficiency War Room. The whole process resulted both in energy efficiency improvement and personnel awareness, since the process is done collaboratively. This one one advantage of our implementation method (Figure 4).

Check

To ensure all process described in Figure 4, IP established systematic business process that will ensure all issues regarding energy efficiency addressed and processed. This process is also integrating real time plant operation, plant performance evaluation to execution and evaluation (Figure 5). This business process covers issues in plant modification and operating procedures as well.

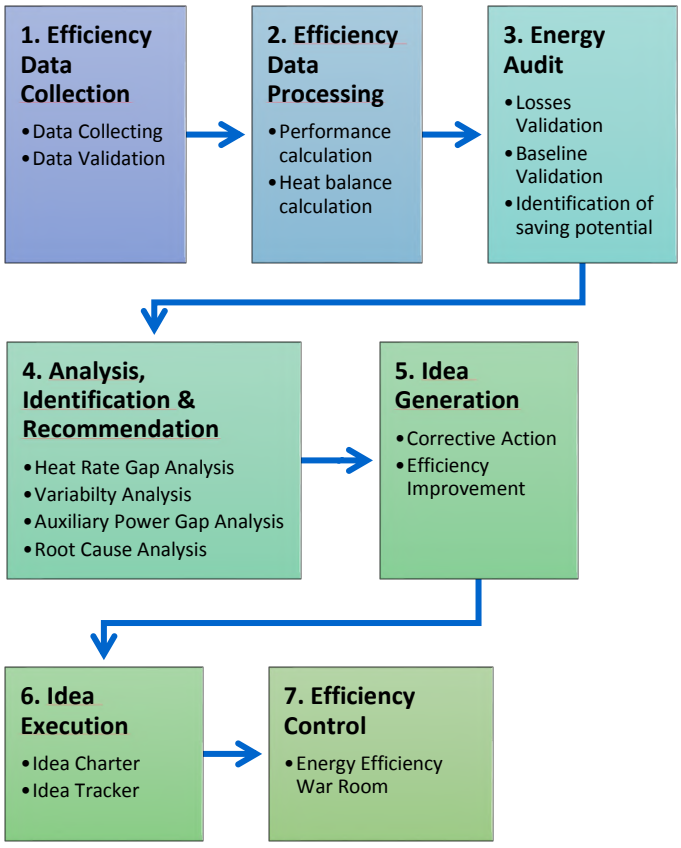

Figure 4 Scope and step of Energy Management System implementation

To ensure the achievement and acculturalization both of the program execution and Efficiency Management System, meetings are established periodically, i.e. daily meeting, weekly meeting and monthly meeting. Daily meeting is very necessary at the time of initial set-up, used for coordinating the daily activities of the internal team unit and the central team. If this efficiency program has been running well, the daily meeting is conditional to intensify ideas discussion that will or being implemented.

Participants of the daily meeting are internal Team, Head Office Team, internal expert and external expert. The weekly meeting discusses the data Monday to Sunday last week, as well as discussion of the progress of current and new corrective action and efficiency improvement. The participant of weekly meeting are operator, maintenance technician, engineering and laboratory technician.

Monthly meeting is a management meeting, where presented the progress of the program implementation, as well as the impact achieved. The participant of the monthly meeting are General Manager and Managers.

To fulfill competence of personnel, IP identifies training matrix which covers management and personnel driver to SEU. Both energy manager and energy auditor are Certified Energy Manager and Certified Energy Auditor issued by the National Profession Certificate Body.

Regular coaching to power plant personnel is conducted regularly to ensure thorough understanding and awareness.

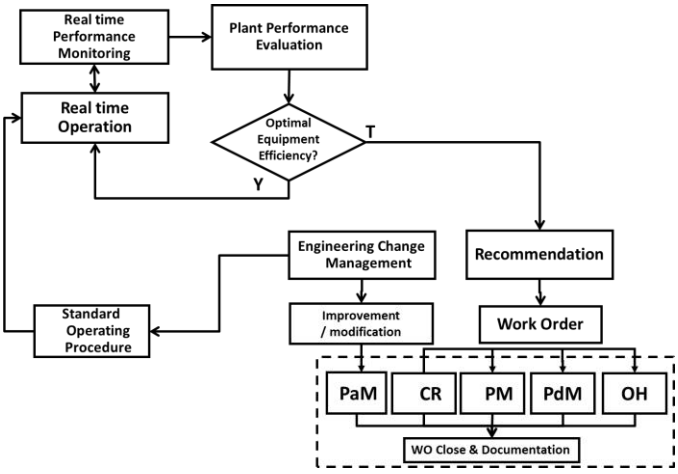

Figure 5 Efficiency Management workflow

Awareness of employee on energy is risen through serial coaching, broadcasts and training in parallel with Green Power Plant Program.

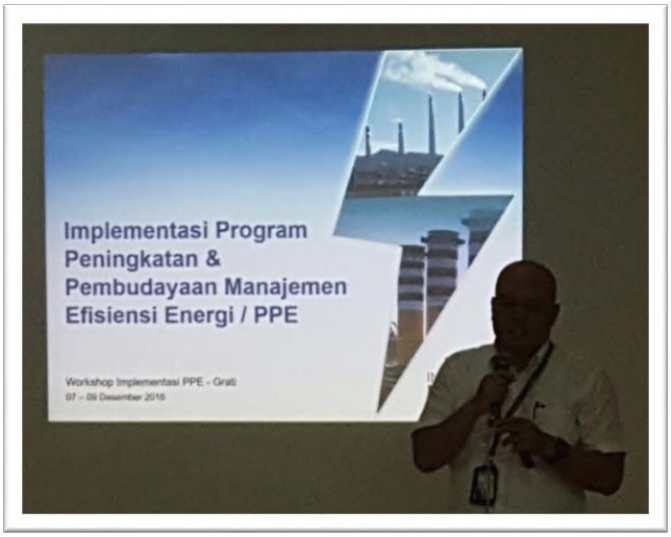

Figure 6 Energy Efficiency Coaching

Action

After executing all frameworks from data collection, data processing, analysis & identification, recommendation, execution and evaluation, two main results obtained, i.e. the waterfall diagram and program execution. From the waterfall diagram example from one of coal fired power plant as shown in Figure 7, the losses could be determined from the red sections, which indicated the performance gap from the baseline and actual.

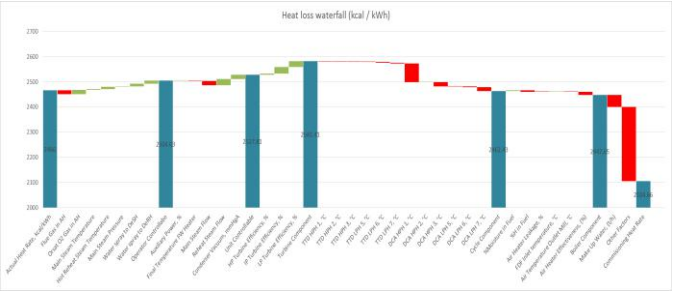

Figure 7 Example of waterfall diagram from coal fired power plant

The next task is to determine action to solve the losses. For this IP has developed several tools to help the efficiency engineer determine corrective action. The tools used e.g : tool for calculating performance using Microsoft Excel equipped with steam property calculation add-in, heat rate root cause diagram and corrective action identification guideline. To ensure correct implementation, IP's thermal efficiency specialist developed detailed Energy Efficiency Enhancement Guideline Book. The guideline now is used widely throughtout the company.

Recommended action then combined with heat rate conversion to have program and heat rate contribution tracking. The example of corrective action and efficiency improvement recommendation on coal-fired power plant in heat rate contribution (in kCal/kWh) shown in Table 1.

These corrective action and efficiency improvement recommendation periodically monitored in several meetings in the power plant. The monitoring process is one of the crucial process to ensure the success of the Efficiency Management System.

The total saving from idea execution in coal power plant approximately 37,53 Million USD per year (as per 2016) and contribute to 3,21% plant heat rate saving (Table 2).

Table 1 Example of corrective action and efficiency improvement recommendation on coal-fired power plant #1

Corrective action and efficiency improvement recommendation	**Saving (kCal/kWh)**
Operations on the main rated steam pressure 169 kg / cm2	3.817
Operation at rated steam pressure around 169 kg / cm2	8.025
Combustion optimization to reduce the temperature of flue gas output and minimize water spray to eliminate losses DERH (A / F ratio, mill outlet temp., CAD / HAD setting)	8.512
Combustion Optimization to lower the output temperature of flue gas and water spray to minimize losses DERH (A / F ratio, mill outlet temp., CAD / HAD setting)	11.177
Repair coal fineness through the better operation of classifiers / dampers	19.860
Changing the primary source of supply of steam towards BFPT originally from Aux. Steam Extraction Steam Header changed to # 4 on partial load (Unit 1)	42.39
To control the operation of the main steam pressure based design (16.7 MPa)	26.94
Control the operation of the main steam temperature based design (540 C)	15.84
Control operation based on the design of hot reheat temperature (540 C)	15.17
Optimizing the operation of tilting burner	13.42
Looking for the operation of air fuel ratio for optimal combustion in the boiler	13.42
Optimizing soot blowing operations to lower the flue gas temperature of 154oC to 150oC	3.95

Table 2 Total heat rate saving from idea execution

Power Plants	Ideas Executed	Saving (USD Mi/year)	Saving (kCal/kWh)	Heat Rate Saving
PLTU Suralaya	19	2.93	9.17	0.36%
PLTU Lontar	22	5.09	91.00	3.39%
PLTU Labuan	3	0.41	6.91	0.25%
PLTU Suralaya	6	4.67	75.75	2.61%
PLTU PalabuhanRatu	112	24.43	253.56	9.43%
Total	**162**	**37.53**	**436.39**	**3.21%**

Based on the energy saving benefit above and cost required to implement EnMS, IP has established very high cost and benefit ratio (3.163.52%) thus gives payback period in 0,032 year.

Implementation of EnMS has improved energy performance of IP since Year 2011 when it is start implemented. Although year to year comparison shows declining of thermal efficiency, but long term trend shows improvement.

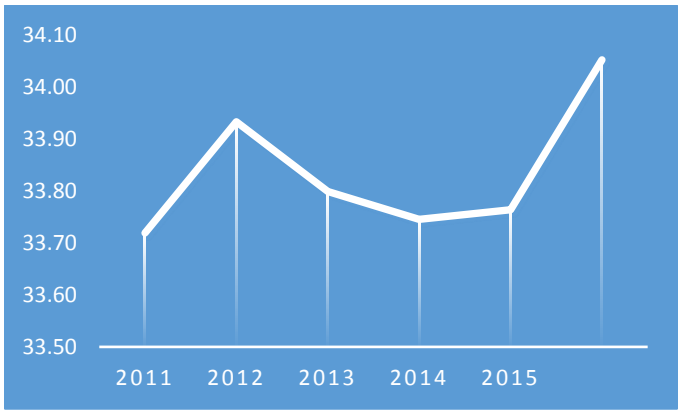

Figure 8 IP Energy Efficiency Performance (in thermal efficiency, %)

IP uses Thermal Efficiency (in %) or Heat Rate (in kCal/kWh) as energy performance indicator as it shows the power plant energy conversion performance and widely used in power generation industry.

> ***"Energy Management System has proven to be beneficial to company performance and would be a competitive edge for long term company sustainabilty"***
>
> —Mochamad Soleh, Certified Energy Auditor

Lessons Learned

- The large number of parties to be coordinated in the process of completion of the project requires good communication and coordination
- Implementation of EnMS has ensured alignment with Company policy and supports the achievement of the Company's Long Term Plan.
- To overcome the obstacles that arise during the process of defining the solution shall be taken from appropriate scientific references and tools.
- Detailed planning process in carrying out a EnMS implementation project is essential to ensure the project done well. In this case the preparation of schedules, resource management and coordination of the execution.

Keys to Success

- Leadership and commitment.
- Employee awareness on energy efficiency
- Intensive communication across department and function
- Well established Asset Management framework and other standard (ISO 14001, OHSAS 18001, ISO 55000, etc)