

PERTAMINA EP DONGGI MATINDOK FIELD

Pertamina EP Donggi Matindok Field became the **first company of PT Pertamina EP** group that achieved ISO 50001 certification in 2022. By energy management system implementation, we have succeeded getting a **better energy performance and energy saving culture**.



Case Study Snapshot	
Industry	Oil and Gas
Product/Service	Natural Gas
Location	Banggai, Central Sulawesi, Indonesia
Energy performance improvement percentage (over the improvement period)	11 % improvement over 2 years
Total energy cost savings (over the improvement period)	USD 6,590,973.83
Cost to implement Energy Management System (EnMS)	USD 108,541.67
Total energy savings (over the improvement period)	233,712.53 MWH (797,460.25 MMBTU)
Total CO ₂ -e emission reduction (over the improvement period)	571,518.76 Metric Tons of CO ₂

Organization Profile / Business Case

As natural gas production company operating since 2016, Pertamina EP Donggi Matindok Field located in Banggai, Central Sulawesi, has two central processing plants (CPP), namely Donggi CPP and Matindok CPP. Inside the CPP, processed gas not only sold to PT Donggi Senoro LNG as buyer, but rather used as **main fuel** for some equipment which often called as **own used fuel gas**. Electricity used for process and for the supporting activities are **generated by gas turbine generator (GTG) as private generator** for the plant. By this mechanism, Pertamina EP Donggi Matindok Field has **full authority for its energy consumption** and not dependent on third party energy supplier. GTG becomes one of significant energy use (SEU) equipment by 61.1% usage of total own used gas purposed in generating electricity.

From the commissioning year until 2021, Pertamina EP Donggi Matindok Field has been implementing energy management and efficiency effort conventionally, which originated from problems occur on production process that particularly related to energy use. Starting with **energy audit in 2021**, the company began to realize many activities and equipment inside CPP were consuming energy inefficiently. Therefore, many processes and equipment needed to be **improved on energy consumption aspects without giving disadvantage to production process**. By using own used fuel gas for plant operational, there are three units identified as **significant energy use (SEU)**, namely Gas Turbine Generator (GTG), Hot Oil Fire Heater (HOFH), and Incinerator/TOX. Energy became one of highest concerns for us because it is not only impacting on process reliability, but also affecting financial quality. We also have intention to not only looking for profit, but rather **providing benefits and positive impacts to our environment and society**.

Since 2022, Pertamina EP Donggi Matindok Field **built a team consists of all department** in the company to perform the implementation of energy management system. By the involvement from all department, energy management system not only resulted in programs but also manifested as company policy, requirement in procurement process, qualification standard of project and equipment, and evaluation of energy consumption. **In July 2022, we achieved our first ISO 50001 certification from TUV SUD**. In order to comply with Indonesian Government Regulation no. 33 year 2023 regarding Energy Conservation, Pertamina EP Donggi Matindok commits **to implement full cycle of energy management system based on ISO 50001**.

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We held monthly meeting for energy management team, campaign the implementation of energy efficiency activities, benchmark with other company about their energy management scheme, conduct continuous monitoring plan and supervision of energy consumption for the determined equipment, and also invest on some efficiency energy program and research about potential sustainable energy efficiency programs. By implementing energy management system, not only energy optimization was able to be achieved but also emission reduction which **reported as decarbonization program** to the company's holding; Pertamina EP Regional 4. This multiple positive impact has reduced environment impact based on LCA assessment, especially for **global warming potential** up to **9.91E-02 kgCO₂eq/MJ-year**. We also have reported **energy efficiency program in Corporate Performance Rating Program in Environmental Management Awards** runs by the Indonesian Ministry of Environment and Forestry and **have proven to support the Sustainable Development Goals** no. 7 about affordable and clean energy and no. 12 about responsible consumption and production with percentage of energy efficiency program achievements against SDGs **indicator 7.2.1 is 1.75%** and **indicator 7.3.1 is 1.06%**. Annually, as a company that has implemented energy management system, we are obligated to report our energy management system to an application called **Online Reporting for Energy Management** runs by the Indonesian Ministry of Energy and Mineral Resources.

Our persistence and tenacity in energy efficiency effort resulted not only positive impact to the process reliability and financial improvement, but also established an energy saving culture, reduced emission, and supported Sustainable Development Goals policy made by the government. Despite fluctuations occurred during progress, there has been **gradual cultural change** on both individual worker and team scale in carrying out energy-saving action. Apart from that, the equipment comes from latest procurement process also put **energy specification requirement** so the quality of the equipment used for the plant is expectedly has a **prime energy performance**.

“By implementing energy management systems, our focus can lead to providing benefits and positive impacts to our environment and society.”

—Ridwan Kiay Demak, Pertamina EP Donggi Matindok Field Manager



Business Benefits

Energy management system implementation of Pertamina EP Donggi Matindok Field gives many impacts for the company and relevant stakeholders. The company supports personnel certification and workshop regarding energy conservation, by hiring accredited third-party for energy audit and assistance. Total amount of **energy investment made is USD 108,541.67**. Not only investing on money, we invest time for personnels to develop, implement, and maintain energy management system **about one year and even more for each personnel**. This happened because of the company's regulation of employee roaster system and employee transfer cycle.

A. Internal Benefits – By the implementation of energy management system, Pertamina EP Donggi Matindok has a lot of positive impacts such as **improvement of energy performance, energy cost saving, emission reduction gained**, revenue increased, maintenance cost reduced and **also enhancing company's good name and image**.

Energy performance improvement is determined by energy saving from energy program efficiency. We used 2019 data as the baseline with Energy Performance Indicator using **linear regression with dual variable**. We use the data analysis level 2 on energy baseline which comparing real energy consumption and energy baseline for each CPP.

Table 1. Donggi Matindok Energy Monitoring

YEAR	REAL FUEL GAS CONSUMPTION (MMBTU)	PREDICTED FUEL GAS CONSUMPTION (MMBTU)	ENERGY SAVING (MMBTU)	CUSUM ENERGY SAVING (MMBTU)
2021	2,425,613.42	2,545,430.05	133,519.01	133,519.01
2022	2,242,842.57	2,545,455.93	326,386.41	459,905.42
2023	2,224,608.83	2,559,915.74	337,554.83	797,460.25

We have archived energy efficiency data from 2020 to 2023, even though energy management system itself was only officially implemented in 2021. Until 2023, we achieved **11%** of energy efficiency by implementing some energy efficiency program and achieved energy efficiency up to **797,460.25 MMBTU**. Primary energy optimization in own use fuel gas is proven by implementation of **Load Priority Selection (LOTION) in GTG**. Initially, there were 3 GTGs running and 1 GTG on standby mode, but inefficiency energy occurred as each GTG were only operate at 40% capacity.

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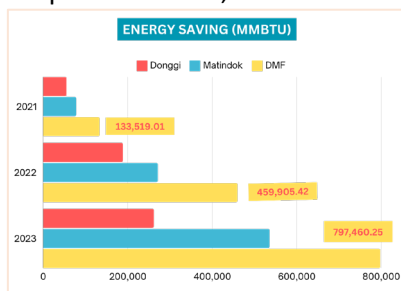
Then, we decided to operate only 2 GTGs and 2 GTGs on standby mode, with the risk of blackout in case of a malfunction in one of them. To minimize the risk of production process disrupted due to blackout, we implemented “LOTION” which is developed by the combination of AHP (analytical hierarchy process), pair wise comparison, scoring methods and also classifying load for GTG from 12 criteria to recognize critical and non-critical load units, resulting in blackout prevention and reliability improvement. By implementation of “LOTION”, the number of reduction fuel gas consumption of GTG is up to **190,531.10 MMBTU/year**. **Optimization of GTG’s heat rate** which represent the generated electricity on GTG’s fuel consumption also reduced from **0.0185 MMBTU/kWH to 0.0159 MMBTU/kWH**.

Table 2. Energy Efficiency Program 2020-2023

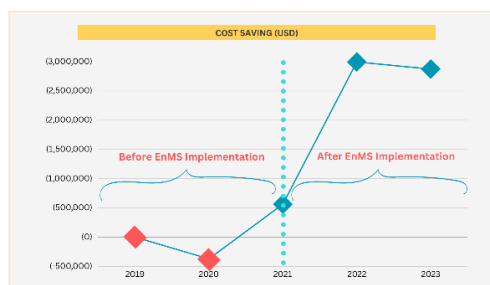
Efficiency Energy Program	Energy Saving (MMBTU)	Cost Saving (USD)
LOTION (Load Priority Selection)/Load Shedding	898,097.40	8,000,208.97
Hot Oil Fired Heater Operation Optimization by AFR Method	45,934.38	387,788.77
Flare Utilization	32,918.4	256,583
3 in 1 Transportation	3,904.04	1,713.47
Tube Luminescent Lamps Replacement	9.31	64.95

Energy cost saving is one of positive impacts from energy management system implementation. It is determined by the reduction of energy consumption from energy net saving on baseline and energy reduction from implementation of energy efficiency program. Detail amount of energy cost saving is shown at Table 2.

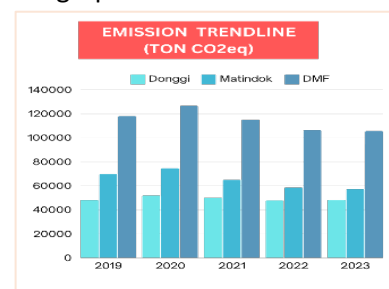
Emission Reduction is being one of main impacts in line with energy efficiency and even support the core implementation of ISO 50010 about Net Zero Carbon. By converting energy saving into emission factor based on API Compendium 2021, we do have data for emission reduction since 2019-2023 shown at graphic in Picture 3.



Picture 1. Cusum Energy Saving



Picture 2. Cost Saving



Picture 3. Emission Reduction

Enhancing company’s good name and image is non direct impact but has excellence impact to company’s pride. Since implementing energy management system, Pertamina EP Donggi Matindok succeeded to achieve some awards from external parties such as:

- Gold Category in National Program for Assessment Performance Rating in Environmental Management (**PROPER**) from the Indonesian Ministry of Environment and Forestry 2023 and **one of evaluated aspect is efficiency energy**.
- Winner Energy Sector of **Subroto Awards** in Special Innovation Category and Energy Management Category from the Indonesian Ministry of Energy and Mineral Resources (2023) by highlight achievement if from **Load Priority Selection (LOTION) as main program of ISO 50001 implementation**.
- Gold Category of Environmental and Social Innovation Awards (**ENSIA**) and Subroto Awards by program “THIOKAL (Processing of H₂S Flue Gas with Local Bacteria “Thiokal” for Energy Efficiency)” and **efficiency energy achievements up to 100,188 MMBTU/yr** and one of energy performance improvement innovation in plant.
- Gold Category of **International Convention on Quality Control Circles (ICQCC)** 2023 for the "LOTION (Load Priority Selection)/Load Shedding" program that **impacted to own use gas consumption reduction and cost saving**.

B. External Benefits – Pertamina EP Donggi Matindok Field succeeded to support the **Sustainable Development Goals** target made by government especially for goal **no. 7 about affordable and clean energy** by implementing fuel gas use as main energy source that have low impact to emission (determined by its heat value) and goal **no. 12 about responsible consumption and production** by always take action to monitor, manage, and evaluate energy use so energy consumption will be efficient. Energy efficiency program also succeeded to reduce environment impact from **LCA assessment** in 2021-2022, particularly in **global warming potential up to 9.91E-02 kgCO2eq/MJ**. Energy

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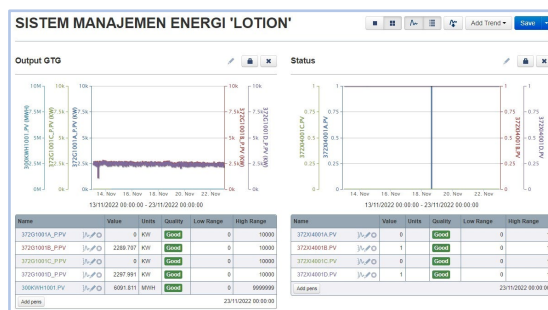
efficiency program is reported for decarbonization program also support zero emission effort of Pertamina Holding's concerns.

Society - Even though we don't use renewable energy resources for plant's operational needs because own used gas is considerably significantly efficient, we still undertake to educate energy conservation practices through the use of solar cells for village road lighting in Batui area and for Biodiversity Park learning center main electricity in Kokolomboi. Moreover, there are wind and wave power energy electricity for fish aggregating device used by fisherman community (Popoloti Group) in Batui. These social innovations are located on the targeted areas of our corporate social responsibility and become parts of our green energy implementation and awareness spreading.

Multiple Sites Benefits – PT Pertamina EP Donggi Matindok Field is the **initiator of Energy Management System implementation** in Pertamina EP Region 4 Zone 13 which consists of 2 entities. Technical sharing session from our company is becoming the first milestone of energy management system replication for the other entities exist, JOB Pertamina-Medco Tomori, which currently has been successfully implemented and achieved ISO 50001 certification in 2023. Furthermore, our energy management program, LOTION (Load Priority Selection), which currently used as new standard in generation system design because of its prominent impacts on increasing processing plant reliability and efficiency also successfully shared and replicated to other companies such as **JOB Pertamina-Medco Tomori, Pertamina EP Cepu Field, Pertamina EP Sukowati Field, PT Panca Amara Utama, and PT Candra Asri.**

Plan

Leadership and Commitment – Pertamina EP Donggi Matindok Field has energy management system team led by Ridwan Kiay Demak as Field Manager and consists of all department such as production operation, maintenance, engineer petroleum, financial, supply chain and warehouse management, planning and evaluation, and HSSE. This commitment not only shown by energy policy but also by company's standard operating procedure which considering energy performance. We also held monthly meeting for energy management team, budgeting plan for energy audit and technical assistance, and investment of operation cost for energy improvement program.

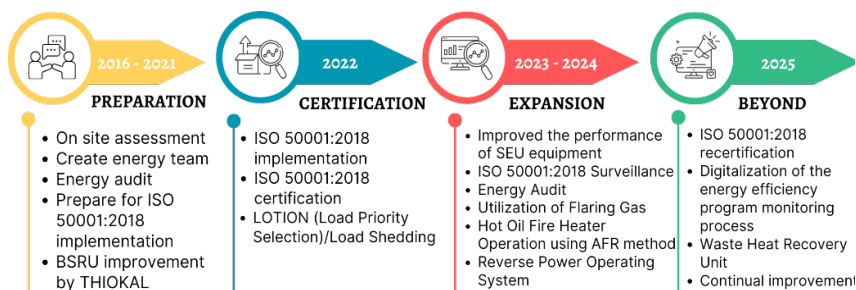


Picture 4. Real Time Energy Monitoring Dashboard

Energy Review – All of energy consumption record collected real time through Exaquantum system. Energy auditors carried out assessments of equipment included Significant Energy Used-category to ensure equipment performance thus optimization can be accomplished immediately if energy inefficiencies are found in the equipment.

Table 3. Baseline Requirement Fulfillment using Linear Regression

Requirement	2019	2020	2021	2022	2023
Mean bias error < 0.005%	Pass	Pass	Pass	Pass	Pass
T. stats > 2	Pass	Fail	Pass	Fail	Fail
R2 > 0.75	Pass	Fail	Fail	Fail	Fail
Cvrmse < 0.2	Pass	Pass	Pass	Pass	Pass
Total Pass	4	2	3	2	2



Picture 5. Energy Management System Roadmap

Energy Baseline and Energy Performance Indicator – By using data baseline in 2019, with Energy Performance Indicator by **linear regression with dual variable**. We use level 2 in energy baseline by comparing real energy consumption and energy baseline. Baseline year is chosen form linear regression criteria fulfillment ($R^2 > 0.75$). For significant energy used equipment, output parameter also set to determine energy performance indicator.

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Energy Planning – Energy planning is determined based on the results of **Energy Audit or Energy Review**. Energy audit report or energy review process has suggested each inefficient equipment to be improved. However, every suggestions has been analyzed through cost and benefits evaluation to acquire priority scale which stated in long-term and short-term roadmap. Therefore, roadmaps become an instrument that emerge sustainable mechanism to achieve **Energy Targets**.

Management Review and Internal Audit – These two activities are done by relevant certified personnel and are carried out to evaluate energy performance thus if discrepancy is found with the target, adjustments can be made immediately. This also anticipates the emergence of negligence in the calculations and implementation of the program.

Surveillance Audit dan Re-Certification – Apart from internal review, the company also uses accredited certificatory parties to review the implementation of the energy management system. This is an attempt to ensure that all efforts made can receive input for improvement and also as soon as possible can overcome problems that arise during the implementation of the energy management system.



Picture 6. ISO 50001 Certification

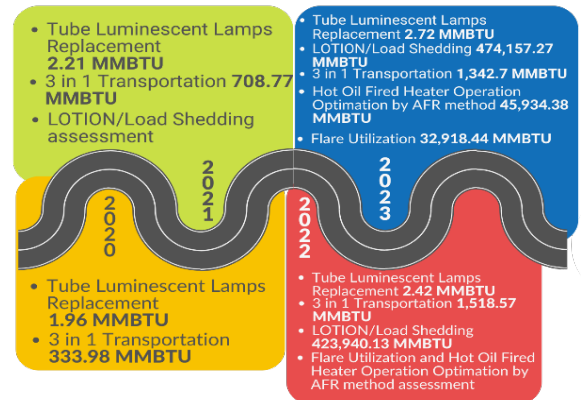


“Energy improvement is a friend for us. See, we always can do something better.”

– Reza Pahlepy, Production&Operation Asst. Manager, and Energy Manager Representative

Do, Check, and Act

The implementation of the energy management system is for **multiple sites, Central Processing Plant Donggi and Central Processing Plant Matindok**. The energy management data is monitored regularly and discussed through **monthly energy management meetings**. The results of the meeting will be a contemplative consideration for management in making decisions regarding ongoing project opportunities and evaluating implemented projects. Apart from that, there are several programs which are still in the study stage and will also be executed in the coming year. Not only looking at the achievement of efficiency targets, the success of the program is also seen from the achievement of the implementation period.



Picture 7. Energy Efficiency Program Achievement

DONGGI MATINDOK FIELD (Level 1)
 Energy [MWh/day] = 1427.24 + 5.99 x feed Gas DNG (MMSCFD) + 7.08 x Feed Gas MTD (MMSCFD)

CPP DONGGI (Level 2)
 Energy [MWh/day] = 565.17 + 6.07 x Feed Gas (MMSCFD)

CPP MATINDOK (Level 2)
 Energy [MWh/day] = 963.89 + 4.78 x Feed Gas (MMSCFD)

Picture 8. Baseline Equation Formula

To calculate monthly energy performance, the **actual energy consumption is compared to expected energy consumption** based on the **established baseline from production feed gas**.

The CUSUM graph is used to display the results of energy efficiency performance. Afterwards, evaluation and monitoring are conducted to find any opportunities for improvement if there is inefficiency of energy use according to ISO 50015 (Measurement and verification of energy performance of organizations). **If business activities or EnB change causes different input value range on energy performance, normalization is conducted by shifting data (modification of data) points or developing energy consumption and/or performance models.** This circumstances commonly caused by uncontrolled ambience condition. EnPi value normalization which takes relevant variables into account provides a more accurate indication of energy performance.

Transparency

- Online Energy Management Reporting (POME) by the Indonesian Ministry of Energy and Mineral Resources (<https://simebtke.esdm.go.id/sinergi/>)
- Corporate Performance Rating Program in Environmental Management (PROPER) and emission monitoring by the Indonesian Ministry of Environment and Forestry (KLHK) (<https://proper.menlhk.go.id/>) and (<https://ditppu.menlhk.go.id/simpel/>).
- External validation from the National Research and Innovation Agency (BRIN) of the LOTION/Load Shedding
- Copyright of the LOTION/Load Shedding program in Indonesia from HAKI no. 000401011
- Publication of a book entitled “ESG-Based Sustainable Environmental Management Towards a World Class Company” with International Standard Book Number (ISBN) 978-979-9336-62-0

What We Can Do Differently

After implementing the energy management system for 2 years, there are several lessons learned which can be used as considerations for future improvements, namely:

- **Gradual energy cultural change** out of production area such as energy consumption in office and dormitory area (TL Lamp Replacements) and optimization of vehicle use by scheming batches for passenger according to their destination (3 in 1 Transportation).
- Biological Sulphur Recovery Unit (BSRU) fuel efficiency is accomplished by bio-innovation research and development of **Local Bacteria-Thiobacillus sp. (THIOKAL) bred in Dieng, Central Java** to substitute factory-default bacteria sent from Netherland without any drawback in BSRU performance. This unit also becomes eco-friendly method and energy efficient compared to other methods of H₂S treatment such as wet sulfuric acid (WSA). Total energy efficiency achieved by Thiokal is up to **15,246.46 MMBTU/yr**.
- GTG efficiency through the **Load Priority Selection (LOTION)** program is a modeling design calculation based on combination modelling of **analytical hierarchy process (AHP), pair wise comparison, and scoring methods** and is **the world's first tool to classify equipment load priorities with less risk and subjective opinion**.
- **Reverse Power Operating System (REPOS)** as best model to electricity generating process innovation **which restored the supply from different types of generators** by synchronizing voltage (6600 volts/medium voltage and 400 volts/low voltage), capacity (4.6 MW/higher capacity and 1.2 MW/low capacity), and frequency (50 Hz and 60 Hz). In this case, a low capacity generator can supply a high capacity generator using a new system modification to optimize the operation of the power plant according to its capacity without disturbing the type and function of the generator. For example, when only 1 GTG running, electricity can be supported by Emergency Diesel Generator (during low load condition which cannot be supplied with only 1 GTG), **the initial installation has been modified to meet the electricity needs for turn around event (once in three years)**.

In the future, several efforts need to be made to ensure that the energy management system at Pertamina EP Donggi Matindok Field is implemented sustainably, including:

- Energy data management and computational system to **improve energy performance integration** and make the evaluation process and monitoring easier to ensure more specific energy performance evaluation process.
- Fuel energy efficiency program by utilizing stack gas using the **WHRU (waste heat recovery unit)** system in Gas Turbine Generator and TOX.
- **Addition of criteria for energy efficiency and carbon neutral purpose design and procurement** at the early stages of the company development project process.
- **Automation system for lights and air conditioning** using temperature sensors, PIR sensors and LDR sensors.



The Energy Management Leadership Awards is an international competition that recognizes leading organizations for sharing high-quality, replicable descriptions of their ISO 50001 implementation and certification experiences. The Clean Energy Ministerial (CEM) began offering these Awards in 2016. For more information, please visit www.cleanenergyministerial.org/EMAWards.