PT Pertamina Hulu Energi West Madura Offshore (PHE WMO)

Achieved 10.2% energy efficiency and USD 931,986 cost savings through ISO 50001:2018 implementation since 2020

Case Study Snapshot

<table>
<thead>
<tr>
<th>Industry</th>
<th>Oil and gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product/Service</td>
<td>Oil and gas</td>
</tr>
<tr>
<td>Location</td>
<td>Gresik, East Java - Indonesia</td>
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<tr>
<td>Energy performance improvement percentage (over the improvement period)</td>
<td>10.2% improvement over 1 years (2020)</td>
</tr>
<tr>
<td>Total energy cost savings (over the improvement period)</td>
<td>USD 931,986</td>
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<tr>
<td>Cost to implement Energy Management System (EnMS)</td>
<td>USD 48,045</td>
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<tr>
<td>Total energy savings (over the improvement period)</td>
<td>295,713 GJ</td>
</tr>
<tr>
<td>Total CO2-e emission reduction (over the improvement period)</td>
<td>48,095 TonsCO2eq</td>
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</table>

Organization Profile / Business Case

PHE WMO is an Indonesia’s national oil and gas company whose working area is in Zone 11 Region 4 PT Pertamina Hulu Energi (PT PHE). It operates in upstream oil and gas at West Madura Offshore (WMO) Block located between Madura Island and Bawean Island with Onshore Receiving Facility at Gresik, East Java. It produced 4,403 BOPD oil and 65.44 MMSCFD gas in average in 2021 and contributed 0.92% and 1.8% to Indonesia’s crude oil production and gas production respectively. It successfully maintains environmental performance during uncertainty due to natural decline of production and significant change in its holding company’s organization including SCM, finance, legal and HR division.

In oil and gas industry, PHE WMO is competing with other oil companies both national and multinational oil companies. To remain ahead in the competition, PHE WMO consistently implements best practice available to the extent it is reasonably practicable. One of them is implementation of Energy Management System based on ISO 50001:2018 since 2020. Milestone of implementation of EnMS in PHE WMO is provided in Figure 2.

Figure 1 PHE WMO Production Facilities

Figure 2 Milestone EnMS PHE WMO
PHE WMO consumes more than 1 million GJ of energy annually, therefore it implements ISO 50001:2018. Moreover, implementation of ISO 50001:2018 ensure company’s compliance to regulation and cost saving through energy efficiency.

Significant Energy Use is gas fuel that accounted for more than 90% of total energy consumption. Positive impacts of ISO 50001 implementation is maintaining energy intensity as much as 10% (2019) and 11% (2020) during which oil and gas production declined significantly. The achievement is obtained through targeted energy efficiency innovation such as energy efficiency in Turbine Compressor with Turbo-CTAR, X-Treme, El-Barkah innovations and in Turbine Generator with SAKERA dan SAJANE innovations. Those innovations have been registered in national patent and received multiple awards nationally in Indonesia.

In addition, PHE WMO vision is “towards world class oil and gas company” and implementation of Energy Management System ISO 50001 plays significant role in achieving the vision. PHE WMO is committed to produce quality product in a safe and environmentally responsible manner. Therefore, implementation of ISO 50001 is supported by existing implementation of other international management system standard such as ISO 9001, ISO 14001 and ISO 45001.

“Implementation of ISO 50001:2018 ensure company's compliance to regulation and cost saving through energy efficiency”
— Muhamad Arifin – PHE WMO General Manager

Business Benefits

Before ISO 50001 is implemented, PHE WMO understood that investment has to be made to save its energy beyond business-as-usual approach. The investment includes ISO 50001 system development; internal staff time to develop, implement the EnMS and prepare for external audit; personnel certification; ISO 50001 certification as well as investment for energy efficiency program. In 2020, PHE WMO invested total of USD 48,045 to run its EnMS ISO 50001 initiatives. Successful implemented ISO 50001 saved energy cost and other benefits that accounted more than total investment.

**Tangible Benefits:**

**Energy cost saving:** implementation of ISO 50001 saved energy cost as much as USD 931,986 based on improved energy performance by comparing baseline and actual energy performance provided in Cumulative of Sum (CUSUM) as shown in Figure 3. Baseline period was set in December 2019 – September 2020 and energy driver identified as gas production and oil production. Year 2020 is selected as baseline period since it represents normal period of production.

**Energy Consumption Reduction:** PHE WMO consumes significant amount of energy in its operational activities. Energy sources are natural gas (own use), biodiesel and imported electricity from power company. Energy consumption of PHE WMO from 2019 to 2021 is shown in Figure 4 below. Implementation of Energy Management System is proven to reduce energy consumption during 2019-2021 period with very substantial reduction of 476,911 GJ equivalent with 23% total energy reduction.
Renewable Energy Use: As part of initiatives to achieve energy efficiency, PHE WMO installed solar cell for outdoor lighting in offshore and onshore operation facilities. Application of solar cell is company’s commitment to achieve energy target as well as contribute to Government of Indonesia’s achievement of Sustainable Development Goal’s (SDG’s) Number 7 is Affordable and Clean Energy. PHE WMO produce 314 GJ annually from its solar cell program.

GHG Emission reduction: Implementation of ISO 50001 has significant contribution to company’s emission reduction. Based on emission calculator referring to Ministry of Environment No 12 Year 2012, PHE WMO has reduced its carbon emission as much as 48,095 TonCO2eq during 2019 to 2021 period which is equivalent with 26% reduction.

Intangible Benefits:
Indirect benefits of EnMS implementation for PHE WMO are:
- Successful implementation of EnMS has put PHE WMO as benchmark for other Pertamina’s Companies
- Sustainability report wherein energy performance improvement is part of good practice reported
- Motivates its employee to propose innovative energy efficiency program with estimated of 3,800 man-hours involved every year
- Winner of National Energy Efficiency Award 2021
- Gold PROPER Rating (the highest rating) of environmental performance rating from Ministry of Environment
- Gold Medal in Continuous Improvement Program with energy efficiency innovation namely X-Treme and PERHIJO
- Installation of solar cell & wind turbine with a capacity of 1.6 KW/day at the Marine Tourism Park
- Meet the Key Performance Indicators (KPI) in Sustainable Emission Reduction of 0.25% annually
- Emission reduction of 26% is direct contribution to the government’s target to reduce GHG with a target of 29% by 2030 in accordance with the Nationally Determined Contribution (NDC).

Plan

Top Management Commitment
PHE WMO is committed to implementing ISO 50001. This commitment is stated in the Health, Safety, Environmental Protection & Security (K3LL & Security) Policy. The contents of the policy indicate that PHE WMO “implements an Energy Management System and strives to optimally in efficient and responsible energy consumption”. In addition, PHE WMO also established Energy Management Policy in which energy efficiency target is set 5% reduction from 2020 to 2025 or the equivalent of 0.8% annually. PHE WMO also has a specific policy with emission reduction target of 29% by 2030. Top level management is also committed to providing resources in the form of budgets to improve personnel competence and energy efficiency programs or innovations with a total of USD 2,367,320 as can be seen in Figure 6.
**Energy Review, Baseline and EnPI**

PHE WMO has determined Significant Energy Used (SEU) from energy review. SEU in PHE WMO is gas fuel accounted for more than 90% of total energy. Gas Fuel is used as an energy source for Gas Turbine Compressor (GTC), Gas Turbine Generator (G TG) in PPP area and PHE5 area as well as reboiler in ORF.

PHE WMO has defined types of Energy Performance Indicators (EnPI) and Energy Baseline (EnB) for each level referring to ISO 50006:2014 as shown in Figure 7.

**Objective Target**

The energy saving target has been set at 5% or equivalent to 0.8% annually or equivalent to 52,337 GJ until 2025 which is stated in the energy efficiency management policy approved by top management. Top Management has also target to maintain ISO 50001 in 2023.

**Action Plan**

To achieve energy efficiency targets, PHE WMO identified energy saving opportunities through third party energy audits, internal auditors who are nationally certified, as well as any competent parties in their respective fields. These energy saving opportunities are evaluated and ranked to determine priority and timeline of implementation. Energy saving opportunities are also ranked based on several criteria, such as potential cost savings, required investment and investment payback period (simple payback) as shown in Figure 8. Based on the ranking evaluation with those criteria, PHE WMO defined strategic plan of energy management program for 4 years of implementation as shown in Figure 9.

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### Energy Performance Indicator (EnPI) Table

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<tr>
<th>Level</th>
<th>Reference</th>
<th>Cost (GJ)</th>
<th>Total Investment ($)</th>
<th>Total Saving ($)</th>
<th>Category</th>
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<tr>
<td>PHE WMO 2022</td>
<td>ISO 50006:2014 level 1 EnPI type 3</td>
<td>19416.41</td>
<td>0.00</td>
<td>High Cost</td>
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<tr>
<td>GTC-26S</td>
<td>ISO 50006:2014 level 1 EnPI type 3</td>
<td>45051.29</td>
<td>35417.24</td>
<td>High Cost</td>
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<tr>
<td>GTC-26R</td>
<td>ISO 50006:2014 level 1 EnPI type 3</td>
<td>5545.24</td>
<td>10333.28</td>
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<td>Water vapor handling from TGRS (Den Sel Bakti)</td>
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<td>15981.81</td>
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<td>Gas Fuel</td>
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<td>Electricity</td>
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### Ranking Criteria Table

<table>
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<tr>
<th>Criteria</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Annual Cost Savings</td>
<td>&lt; Rp 100 million, Rp 100 million - Rp 500 million, Rp 500 million - Rp 1 billion, &gt; 1 billion</td>
</tr>
<tr>
<td>Investment</td>
<td>&gt; Rp 1 billion, Rp 500 million - Rp 1 billion, Rp 100 million - Rp 500 million, &lt; Rp 100 million</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>&gt; 3 years, 13 months - 3 years, 6 - 12 months, &lt; 6 months</td>
</tr>
</tbody>
</table>

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### Figure 7 PHE WMO SEU and Baseline equation & EnPI

![Figure 7 PHE WMO SEU and Baseline equation & EnPI](image)

### Figure 8 Strategic plan of energy management program

![Figure 8 Strategic plan of energy management program](image)

### Figure 9 Evaluation and ranking criteria

![Figure 9 Evaluation and ranking criteria](image)
Do, Check, and Act

Implementation Action Plan

Energy management action plan is determined on yearly-basis based on strategic plan. In addition to energy efficiency program identified from energy audit, PHE WMO also harness improvement working culture from its employee to identify opportunity for energy saving. Pertamina’s “Continuous Improvement Program” (CIP) is a catalyst for the innovation and ideas for energy efficiency as part of continuous improvement.

“Energy is core of the life, let us activate body and soul to sustain energy transformation.”
— Sapto A. Sudarmanto – PHE WMO Field Operation Manager

Capacity Building
To implement EnMS ISO 50001, PHE WMO provided competent personnel including energy manager, national certified energy auditor, EnMS ISO 50001 internal audit. Currently PHE WMO has a nationally certified energy manager, four nationally certified energy auditors and 69 ISO 50001:2018 internal auditors. For technical competency, PHE WMO has conducted training for SEU personnel both operation and maintenance team.

Monitoring Measurement Plan
Energy team and operations team determined monitoring and measurement schedule to ensure improvement of energy performance of each SEU. PHE WMO developed applications developed BABLEFISH server, CCMSYS, and El-Barkah. BABLEFISH server is used for data collection for energy data, production data, and other relevant data and connected them to a local network and monitored in real time basis. Computerized Centered Maintenance Management System (CCMSYS) is a predictive maintenance application developed based on energy criteria. CCMYS contains database of equipment specifications and configurations, asset health information, a list of findings based on energy criteria, performance achievements and maintenance backlogs as well as a Pareto graph of SEU’s maintenance.

![Figure 10 Energy management action plan](image-url)
El-Barkah (Electronic Basis Redundancy Control via HMI) functions as an integrated control and monitoring function of SEU 3 Gas Turbine Compressor (GTC) units to facilitate real-time supervision from control Room. El-Barkah has reduced downtime by 99.1% from 3 GTC units. Tracking achievement of energy efficiency targets, PHE WMO measured operational data, analyzed, and compared with the baseline as shown in Figure 12. The baseline calculation based on variable (x1) oil production and (x2) gas production, and baseload. Energy baseline equation is 

\[ y = 0.94 \times x_1 + 0.99 \times x_2 + 13508 \]

EnPlus equation (2020)

\[ y = 0.94 \times x_1 + 0.99 \times x_2 + 13508 \]

<table>
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<tr>
<th>Month</th>
<th>Oil Production</th>
<th>Gas Production</th>
<th>Total Production</th>
<th>Fuel Consumption</th>
<th>Demand (kWh)</th>
<th>Load (kWh)</th>
<th>Total (kWh)</th>
<th>GJ</th>
<th>Energy Consumption Actual</th>
<th>Energy Efficiency</th>
<th>Energy Consumption Predicted</th>
<th>Efficiency Difference</th>
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<td>102123</td>
<td>10.2%</td>
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</tbody>
</table>

Verification and validation

Energy performance measurement and monitoring of SEU is carried out by operators who are competent and checked by energy auditors and approved by energy managers. The results of EnMS implementation as well as energy saving are reported to Pertamina Persero as parent company and to the Ministry of Energy and Mineral Resources, Government of Indonesia.

Figure 12 CCMSYS application & El-Barkah Operating Principle

Figure 11 Cumulative energy efficiency improvement

Figure 13 Baseline equation

The calculation results compared to baseline indicates that PHE WMO achieved energy efficiency of 10.2%. The achievement surpassed the target of 5% in 2025 or 0.08% annually. The efficiency results are reported to top management on a monthly basis as well as to internal and external interested parties on a monthly, quarterly and annual basis. Although energy intensity is not a measure to track its energy performance, PHE WMO still monitor its energy intensity as environmental performance benchmark within Pertamina Group and Indonesia’s Petroleum Association (IPA).
Internal audit and management review

Internal audit of EnMS ISO 50001 conducted annually and is chaired by nationally certified energy auditor. Internal audit activities and its audit report are reported to top management during management review. Top Management demonstrates its support to EnMS implementation by providing sufficient infrastructure and budget to improve EnMS and achieve EnMS target such as budget for personnel competence, innovation program as well as renewable energy. Top Management shows his appreciations to employees and contractors who are involved in EnMS program during management walkthrough, management review and employee performances review.

Transparency

PHE WMO obtained its certification of EnMS ISO 50001:2018 implementation in 2020. PHE WMO promoted and publicized its achievement to both internal and external parties.

Internal Organization

PHE WMO communicated internally using several publications means such as banners, stickers, broadcasts and direct communication in every morning meeting.

External Organization

1. Energy Contest
   - Continues Improvement Program organized by Pertamina where PHE WMO is consistently participating with energy related innovation proposal
   - The winner National Energy Award organized ministry of EMR for large scale industries in mining and energy sector
   - ASEAN Energy Award organized by ASEAN Center for Energy where PHE WMO participated representing Indonesia

2. Government Assessment
   - To Ministry of Environment and Forestry Government of Indonesia as in PROPER Rating/Assessment
   - To Ministry of Energy and Mineral Resources Government of Indonesia via Online Energy Management Reporting System annually since 2019
   - Sustainability report published annually and available for any stakeholders

3. PHE WMO’s Patent
   - Innovation SAJANE granted Copyright Patent No. EC00202036906. Winner of Gold Medal in CIP Forum PHE.

What We Can Do Differently

- Provide monitoring and measurement tools on equipment that the data result is more accurate
- Identification of long-term energy efficiency program to continually improve energy performance and ensure sustainability of PHE WMO’s energy management system
- Provide more competent personnel in each area to raise knowledge of energy management
- Innovative approach of EnMS communication
- Attractive reward mechanism for energy role model.