ISO 50001 Energy Management System – Case Study

2024 Saudi Arabia

Manifa Producing Department (MPD) EnMP Implementation

The world's 5th largest oil field and the world's largest offshore crude oil project built in a single phase with several manmade islands that are fully integrated with energy power generation to articulate harmony of academia, technology, engineering, and architects.

Case Study Snapshot	
Industry	Manifa Producing Department
Product/Service	Crude, Gas, Condensate & Power
Location	Saudi Arabia, Eastern Region
Energy performance improvement percentage (over the improvement period)	35 % improvement over 3 years
Total energy cost savings (over the improvement period)	USD 9,685,120.00
Cost to implement Energy Management System (EnMS)	USD 1,233,156.00
Total energy savings (over the improvement period)	121,064 MWh
Total CO_2-e emission reduction (over the improvement period)	Please Refer to Saudi Aramco sustainability report. (Confidential)

Organization Profile / Business Case

Manifa is the world's 5th largest oil field and the world's largest offshore crude oil project built in a single phase. Several man-made islands, fully integrated with power generation, showcase the harmony of academia, technology, engineering, and architecture. The adoption of IR4.0 and the interconnection of all infrastructure, including production, processing, operation, stabilization, and power generation, interlink to elevate performance and deliver energy to the world. Manifa produces its own power through a combined cycle cogeneration (Co-Gen) plant backed up by the Saudi Electric Company's (SEC) grid. MPD Cogen plant is designed to produce 420 MW with the newest technologies.

The field has been granted a great number of first-ever worldwide custom-fit technologies that mitigate complex and sophisticated development and have reached various world records. The world's fifth-largest oilfield development has the most unconventional strategy of introducing man-made islands to preserve the environment with zero routine gas flaring and self-sufficiency in generating electricity. Manifa's success and the team's meticulous steps taken in protecting the environment can be recognized by the fact that a prestigious organization like National Geographic made a movie about the Manifa project. The Manifa Story and Manifa book provide further details, with each grain of sand and every drop of water revealing a unique narrative. The team did not stop at this level, where they deployed several initiatives recently in Manifa to enhance further energy savings in line with its green strategy and implement an effective energy management program with reference to ISO 50001 requirements.

"MPD accomplishments through implementing ISO 50001 has tremendously enhanced the Energy savings and establishing the path toward decarbonization evolvement"
—Saif Alomari, Energy Engineer

Business Benefits

Manifa Producing Department (MPD) has provided and implemented creative, innovative solutions and initiatives that balance social, economic, and environmental concerns in a professional manner, using modern technologies and concepts. Here are some of MPD Energy initiatives after the implementation of ISO 50001:

1) **Manifa Decarbonization initiatives: Implementing ISO 50001 EnMS has played vital role** to minimize the carbon footprint and reach the net-zero especially due to the newest technologies supported with the definitions of ISO 50001 EnMS. As a result, MPD implemented several initiatives that will contribute positively in reducing the department Green House Gases (GHG) emission by the following:

   a) MPD implemented a zero-flaring initiative at MPD offshore oil platforms. This initiative led to recover around 4,300 barrels and minimized the impact on the environment.

   b) In order to reduce the impact of released emissions and to conserve the sour gas, the idea of The Flare Gas Recovery System was introduced. The system consists of Compressors with a capacity of 3 MMSCFD. The gas is compressed and routed to a separator prior to sending the gas to the Suction of the Atmospheric Compressors. Currently, the system recovers 0.03-0.06 MMSCFD. Manifa team didn't stop at this stage but went even further by evaluating the possibility to recover additional gas. And an opportunity was realized by the Team to utilize Nitrogen which is generated here in the facility as purge gas for the flare stack instead of Fuel Gas. The additional recovered gas by utilizing Nitrogen instead of Fuel Gas is 0.1 MMSCFD which is equivalent to around 130,000 $/year. The recovered volume during 2022 is 660.98MMSCF, and 450.91MMSCF during 2023 and this enhanced the Energy intensity of the facility after the fuel gas saving.

   c) MPD completed the development of steam system optimization model. This will help MPD to proactively monitor energy efficiency performance and evaluate potential savings in energy consumption through real-time operational modifications. The study shows a potential benefit exists through boilers load management, and excess steam reduction to improve systems thermal efficiency by 2.1 % and reduced the emissions significantly.

   d) MPD is operating the entire offshore water injection platform (7 Platforms) by utilizing solar panels.

   e) As part of MPD green strategy, the department planted mangroves and native trees to offset the emissions from MPD's facilities.

2) **Manifa Autonomous Control via Advanced Process Control:**

To enable real-time monitoring, control and communication between machines, products and humans, Advanced Process Control (APC) has been deployed. MPD deployed such machine learning solution into their facilities with greater focus by the deployment of to optimize power consumption of the well driven pumps (ESP) by automatic

adjustment of downhole and well head parameters. Followed by an APC deployment at the crude processing facility which improved the crude stabilization process through crude recovery and reduction in steam consumption. APC will enhance stability, improve product quality, and reduce operator intervention and by this power demand is reduced by 5.2 MW.

3) **AI Based Power Real Time Monitoring, Optimization & Generation Control**

To maintain real time monitoring of cogeneration units performance and enable intelligent communication and decision making between power generation units, major equipment and the national grid, MPD deployed advanced power optimization and monitoring solutions, Power Monitoring System and I-PowerCenter. The two (2) autonomous systems aggregate more than 5,000 data points from Manifa Cogen that ranges from several performance indicators to detailed machine data. These solutions are capable to predict asset condition, take proactive measures, and to provides real-time advisory recommendations to improve system efficiency, plant's energy intensity KPI, as well as increases asset availability, and optimize Operation & Maintenance costs. In addition, make data-driven decisions to isolate the facility, loads and generators shedding.

Plan

Energy Management System is considered as one of the major elements under Operational Excellence Program. Manifa has planned and developed the implementation of the EnMS by making whole structure within a framework that includes the scope and boundaries of the Energy program, objectives and targets on yearly basis, establish and revise MPD Energy policy annually, Distribute the roles and responsibilities for the Energy team members and ensure top decision makers are part of the team with clear vision for the expectations of reaching the planned target, plan and implement energy actions by analyzing and establishing Energy KPIs, monitor the effectiveness of the EnMS and take the preventive and corrective actions accordingly.

MPD is committed to comply with all Kingdom and Corporate standards and requirements, as well as applicable needs and expectations of concerned parties both internally and externally related to energy efficiency & conservation. MPD Energy Coordinator will check and review the requirements on annual basis for the necessary requirements.

Moreover, Energy Team is utilizing the Plant Information (PI) system to closely gather and track the energy data. The PI system has been utilized to establish several online dashboards.

MPD has the Energy Intensity KPI (EI KPI) as the main drive for the EnMS. The yearly targets have been reviewed and approved by MPD Management. MPD has established a new KPI which is Energy Performance Indicator for the Significant Energy Users.

MPD Energy Management Team has developed an action plan in order to implement the EnMS objectives on timely manner. Addition energy savings ideas, initiatives' & technologies are included in the action plan. Following are the main sources for ideas, initiatives and technologies:

- Idea Management System (IMS)
- Emails.
- MPD knowledge sharing meetings
- Brainstorming sessions
- Energy Optimization Assessment
- Best Practices

MPD Energy Management Team has developed methodology to benchmark its energy performance and EnMS (step & sub-steps) for continuous improvement with the intent to identify improvement gaps either to maintain or to drive each of concerned organization to be among the best in class.

Department Manager and division Heads conduct Quarterly meeting to review the relevancy of the energy policy, objectives & targets, energy management plan& energy efficiency event and the status of achievement against the agreed KPIs, effectiveness of organization' internal energy management assessment/audit program, list of shared lesson learned, effectiveness of methodology of gathering, tracking and managing energy saving initiatives, performance of energy team to meet the department energy management plan and recognize achievements.

"ISO 50001 provides MPD a roadmap to establish, maintain and implement effective EnMS"
—Ali A. Asiri, Manifa Operations Efficiency Supervisor

Energy Intensity KPI Targets Form BP 2023 (Q 1,2,3,4) - 2024 - 2025 - 2026

Department Name: Manifa Producing Dept
Admin Area: NAOO

1. ETED/ECU to fill the yellow highlighted cells for 2020-2022 actual production and energy data from annual reports
2. ETED/ECU to fill the yellow highlighted cells for target production data from Pet.Eng. if available
3. Dept. Energy Coordinator to fill the yellow highlighted cells for products, energy data and initiative sections

PRODUCTS			2020-2022 Actual Data				2023-2026 Targ							
			2020 YE Actual	2021 YE Actual	2022 Q2 Actual	3-Yrs Avg.	2023 Q1		2023 Q2		2023 Q3		2023 Q4	
Stream Description	Unit of Measurement	Heating Value BTU/SCF, MMBtu/BBL	MBDoe	MBDoe	MBDoe	MBDoe	Flow Qty.	MBDoe	Flow Qty.	MBDoe	Flow Qty.	MBDoe	Flow Qty.	MBDoe
CRUDE (AH) (Manifa)	MBD	5,730	667.33	749.21	812.71	743.28	950.00	938.53	950.00	938.53	950.00	938.53	950.00	938.53
Condensate (Manifa)	MBD	5,418	33.90	40.35	43.52	39.26	50.00	46.71	50.00	46.71	50.00	46.71	50.00	46.71
Sour Gas (Manifa)	MMSCFD	1,080	10.94	11.94	12.92	11.93	70.00	13.03	70.00	13.03	70.00	13.03	70.00	13.03
						0.00		0.00		0.00		0.00		0.00
						0.00		0.00		0.00		0.00		0.00
						0.00		0.00		0.00		0.00		0.00
Total Product (MBDoe)			712.80	801.50	869.20	794.50		998.30		998.30		998.30		998.30
Delta Change in Production								25.7%		25.7%		25.7%		25.7%
ENERGY			2020 YE Actual	2021 YE Actual	2022 Q2 Actual	3-Yrs Avg.	2023 Q1		2023 Q2		2023 Q3		2023 Q4	
Stream Description	Unit of Measurement	Heating Value	MMBtu/h	MMBtu/h	MMBtu/h	MMBtu/h	Flow Qty.	MMBtu/h	Flow Qty.	MMBtu/h	Flow Qty.	MMBtu/h	Flow Qty.	MMBtu/h
Power Generation (Manifa)	MW	3.412	936.32	1,138.37	1,202.94	1092.54	340.00		348.00		350.00		347.00	
Power Consumption (Manifa)	MW	3.412					156.00		153.00		155.00		152.00	
Power Import (Manifa)	MW	3.412	46.73	44.47	50.30	47.17	6.75	55.23	6.75	55.23	6.75	55.23	6.75	55.23
Power Export (Manifa)	MW	3.412	1,663.50	1,932.12	1,977.50	1677.71	190.00	1798.50	193.00	1792.55	195.00	1794.19	192.00	1780.77
Sales Gas from MGS - Power Generation	MMSCFD	946	2,487.92	3,074.98	3,191.61	2918.16	81.65	3218.37	82.00	3232.17	81.70	3220.34	81.65	3218.37
Sales Gas from MGS - Process	MMSCFD	946	50.69	62.85	122.20	78.65	4.65	183.29	5.00	197.08	5.00	197.08	4.65	183.29
Total Energy Consumption	MMBtu/h		922.00	1190.10	1386.70	1166.30		1658.39		1691.93		1678.46		1676.12
Energy Savings due to Initiatives	MMBtu/h							-3.84		3.38		4.66		3.23
Net Energy Consumption	MMBtu/h		922.00	1190.10	1386.70	1166.30		1662.23		1688.80		1673.80		1666.90
Energy Intensity (EI) MMBtu/BOE	MMBtu/BOE		31.0	35.6	38.3	35.2		39.96		40.60		40.24		40.07

Figure 1. MPD EI KPI calculation by measuring the total product (oil, gas, gas condensate) and the power (Generation, Export, Import)

Do, Check, and Act

MPD has based-line the EnMS program on 2014 and establish the plan toward energy excellence. The program has significantly improved after MPD got certified with ISO 50001 and implemented the key factors of ISO 50001 to bring the organization energy sector to stable and developed entity.

MPD Energy Team has developed an Energy Action Plan where a champion/team has been assigned for each activity, description, ETC and the savings as applicable. The Action Plan is maintained by MPD Energy Management Coordinator. The Energy optimization activities include the following: operational control, design, and procurement. The following sections will describe how energy efficiency measures are incorporated in each of the three areas:

a. Operational Control

MPD shall identify the top energy consumers in Manifa central process facilities. Energy data for these top energy consumers shall be gathered and tracked by utilizing available resources such as PI system and daily reports. Moreover, means to enhance data gathering and tracking will be looked at and implemented as applicable. Then, corrective actions as applicable shall be addressed.

b. Design Control

MPD shall incorporate energy efficiency in any project managed by the department during the design phase.

c. Procurement Control

MPD shall incorporate energy efficiency as one of the criteria used for evaluation of the products and services.

MPD is monitoring and analyzing the EnMS effectiveness by monitoring the Performance Indicators of the Significant Energy Users (SEUs). In addition, monitor & analyze the Energy Intensity (KPI). Any abnormality in the SEU Performance or the KPIs, Root Cause Analysis (RCA) will be conducted. With the variance of Oil production due to the demand, energy consumption varies with the start-up and shutdown of additional SEU.

Normalization of the Energy consumption method is considered by setting an expected SEUs to be online in certain Oil production rates depending on the demand and see the actual operating SEUs during the year and calculate the variance rate and take corrective action plan into consideration.

Energy team conducts quarterly meeting with the department manager and division heads to discuss the organization's energy policy, goals, and targets, energy management plan, energy efficiency event, and the status of achievement in relation to the agreed-upon KPIs. They also discuss the efficacy of the organization's internal energy management assessment and audit program, exchange lessons learned, and evaluate the efficiency of the methodology used to gather, track, and manage energy-saving initiatives.

As a result, each individual contributed toward safe and clean energy savings with the reference to ISO 50001 implementation, the department manager recognizes these efforts to motivate and support the employee to keep the performance up to top.

MPD is utilizing the yearly Operational Excellence internal assessment to conduct the internal assessment. MPD Energy Management Team will conduct an internal assessment/audit to the EnMS at least once a year. The internal audit will be carried out by the MPD Energy Management Team. The audit results will be added to the Energy Action Plan for easier tracking and closure update. The audit results will be shared with MPD Management during the Energy Management Review Meetings.

In order to ensure that MPD employees working for energy related activities are competent on the basis of appropriate skills, training or experiencing, MPD recommended a training requirement for its employees.

MPD team is equipped with different energy certifications such as certified energy manager, certified energy auditor and ISO50001:2018 Lead Auditor. MPD planning for more energy workshops, conferences and courses.

To ensure high integrity and reliability of Energy Significant users in Manifa, several dashboards are used to monitor, manage, and generate data to ensure high energy intensity is maintained.

Below table provides measurement KPIs for EnMS:

Performance Measures	Formula	Source	Frequency
*Energy Intensity KPI	Total energy consumption (MBtu)/ Total production in barrels of oil equivalent (BOE)	Energy Coordinator	Quarterly
*Energy Use Intensity (EUI) KPI	EUI = E/A, where: E = Net energy consumption “kWh” annual A = Gross Floor Area in “m^2”	EMSC	Quarterly
*Energy Performance Indicators (EnPIs) for identified Significant Energy Users (SEUs)	Energy Performance Indicators (EnPIs) for specific SEUs	Energy Coordinator	Annually

To enhance the optimum operation of the Cogeneration plant and ensure maximizing the power & steam generation with least power consumption, below is one implemented dashboard that fully monitor the reliability of the assets.

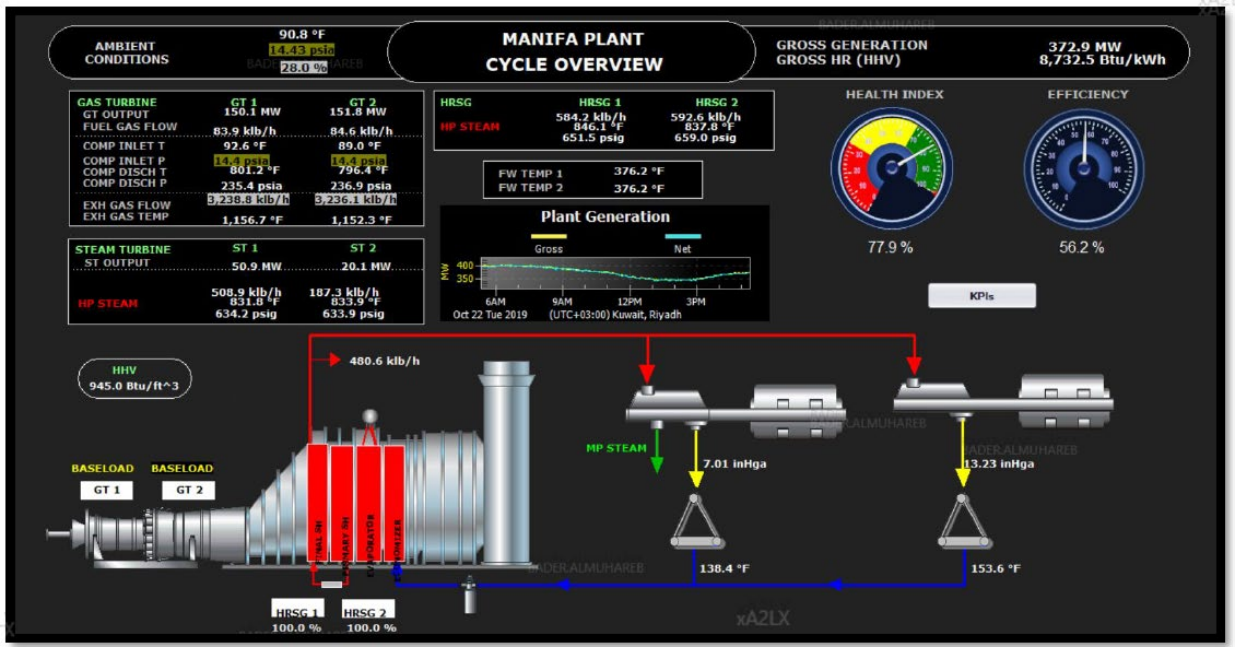

Figure 2. COGEN Monitoring Dashboard

Transparency

Upon receiving the ISO 50001 Certification, announcement was shared with the upper management. In addition, it was published in the official SA newsletter and this has been revealed and announced in Saudi Minister of Energy.

What We Can Do Differently

For the steps, tools:

1. Establish the communication with the Energy services companies and be part of implementing the program.
2. Focus more on digitalization, new technologies and renewable energy
3. Add development plan for the Energy team for using the energy simulators/software like BMS, energy modeling, demand response management …etc. In addition, focus on data analysis skill.

For plan for ISO 50001, MPD will maintain the certification and ensure annual audit.