ISO 50001 Energy Management System – Case Study

2024 Saudi Arabia

Tasnee Petrochemical Complex (TPC)

TPC is one of the largest petrochemical manufacturers in Saudi Arabia obtained ISO 50001 Energy Management. TPC achieved an energy improvement saving of 6.1% over 4 years.

ISO 50001 enabled TPC to demonstrate its commitment to energy efficiency at all the stages of its processes and provided an accurate representation of the energy footprint of its products.

Tasnee Petrochemical Complex (TPC)

Case Study Snapshot	
Industry	Petrochemicals
Product/Service	Polymers / Polyolefins Manufacturer
Location	Jubail Industrial City, Saudi Arabia
Energy performance improvement percentage	6.1 % improvement over 4 years
Total energy cost savings (over the improvement period)	USD 8,409,479
Cost to implement Energy Management System (EnMS)	USD 111,667
Total energy savings (over the improvement period)	1,120,257 MWh
Total CO_2-e emission reduction (over the improvement period)	158,503.04 Metric Tons

Organization Profile / Business Case

Tasnee Petrochemical Complex (TPC) is one of the largest petrochemical manufacturers located in the eastern province of Saudi Arabia which was commissioned in Y2004 with an annual capacity of 1.2 million tons of Polyolefins products. Since then, the complex followed a strategic growth in both brown & green filed projects and reached an annual production capacity of more than 4 million tons of various Polyolefins and chemicals products. TPC exports its products to various local & global markets with a recognized quality known for their strength, flexibility, heat resistance and reliability in many applications.

As a large manufacturing and industrial company, the scale and breadth of TPC activities interacting with the energy efficiency challenges that need to be managed. In Y2014, TPC established its energy efficiency program, not only to meet the governmental regulations but also to bring the operation efficiency and energy usage on par with the global trends. With this strategic approach, TPC conducted energy assessments, pinch analysis, and several audits consulting world-leading technical experts from KBC, DuPont, LUMMUS Technology, DSSA and ACTSYS.

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In accordance with the UN-SDGs, TPC established the sustainability management system in Y2017, acknowledging its role in controlling the environmental impact from all the operation units targeting to reduce the GHGs emissions and energy consumption.

Consequently, TPC committed to apply the best business practices to achieve a profitable and sustainable growth for all its stakeholders and society. TPC focused on addressing the major climate change challenges and has established its first decarbonization roadmap in Y2022 quantifying the scope-1 & scope-2 targeting to achieve the Net Zero by 2060. The energy efficiency efforts in TPC have been ongoing for years, but this "strategic" approach requires a "systematic" tool and global standard framework, therefore ISO 50001 Energy Management System (EnMS) was adopted.

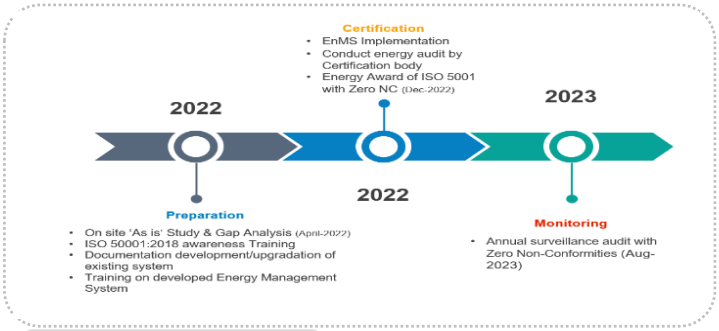

Fig.2: *TPC Energy Saving*

In Y2022, TPC obtained ISO 50001 which provided a structured methodology to achieve continuous improvement in energy performance. By adopting this standard, businesses identified energy-saving opportunities, implemented energy-efficient practices, and monitored the results over time which supported the climate change and decarbonization priorities.

ISO 50001 has effectively enabled TPC to strategically adopt proactive approach and culture in energy management and employee's engagement at all levels and set a systematic approach for identifying the energy indicators to reduce the overall cost. Moreover, energy management system enabled TPC to combine the best practices in project management, energy monitoring, and energy awareness along with an energy policy that governs our organization's approach towards energy use and performance. Therefore, ISO 50001 was the great engine and catalyst of enhancing our GHG program and promoting our sustainability indicators.

"There is no question that ISO 50001 has significantly improved our energy efficiency and energy culture for all employees"

— Khalid A. Al-Khater, Vice President Manufacturing

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Business Benefits

To implement the TPC EnMS, the total spent cost was approximately 111,667 $. This is including the certificate preparation, consultation, EnMS certification and trainings/awareness, in addition to the energy audits which were conducted by experts considering the large scale of the complex. **TPC has recognized the benefits upon implementing the EnMS as follows:**

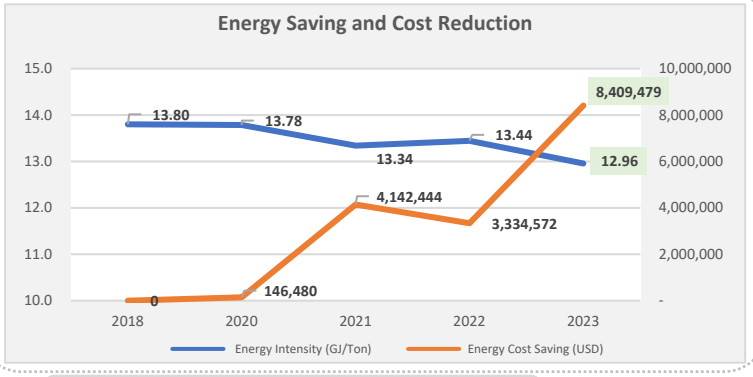

Fig.3: TPC Energy Saving and Cost Reduction

Energy Saving- Y2018 was selected as the baseline year with an energy intensity of 13.80 GJ/ton of product. Enhancing the plants availability, production throughput and implementing various energy initiatives, resulted to achieve improved energy intensity of 12.96 GJ/ton in Y2023 which was equivalent to total energy saving of 4,032,727 GJ (1,120,257 MWh). As described previously, energy improvement was ongoing for years, however EnMS provided a structured methodology to achieve continuous improvement in the energy performance. (Figure 3)

Cost Reduction- Implementation of EnMS and improving plants performance enabled TPC to improve the energy efficiency achieving cumulative cost reduction with 8,409,479 USD over the last 4 years. Please refer to fig. 3.

GHGs Reduction- Incorporating ISO 50001 with the existing management systems such as sustainability program has created synergies and maximized the benefits across various areas. Applying the EnMS improved practices reduced the environmental impact by reducing the greenhouse gas emissions and improving the ecological footprint. EnMS demonstrated a commitment to the environmental responsibility and sustainable practices, which can be appealing to customers, partners, and other stakeholders. On the other hand, GHGs intensity has been reduced from the baseline 0.898 tCOe/T in Y2018 to 0.863 tCOe/T in Y2023 equivalent to an absolute reduction by approx. 158,503.04 CO2e over the monitoring period.

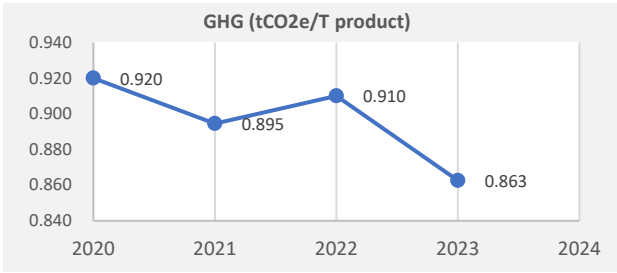

Fig.4: Greenhouse Gases Intensity Reduction

Clean Energy- ISO 50001 and ISO 14001 (Environmental Management) go hand in hand in fostering sustainability and reducing the environmental impacts. Combining these two standards enabled the organization to establish a comprehensive approach to environmental performance and promote clean energy. Therefore, TPC started the investment in renewable solar energy covering 20% of site offices and general facilities annual power demand aiming to play a pivotal role in creating a low carbon future. The project is in the initiation phase and expected to be completed by Y2025.

Other Benefits- ISO 50001 promoted the energy efficiency culture between all employees. Being certified to ISO 50001 allows the organization to demonstrate its commitment to energy efficiency at all stages of its processes. It also gives a recognized framework for developing an effective energy management system.

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Plan

Leadership and Commitment- TPC's management believes that the energy is vital for all business. As world energy consumption continues to rise & social demands for reductions in climate changing emissions are also growing, where reduced use of fossil fuels is a key aspect, TPC management recognized the need of structured framework for developing an effective energy management system which follows the "Plan-Do-Check-Act" process for continual improvement. The implementation of EnMS was a key step for TPC with a quarantined commitment from the management as it can be recognized in setting up the high-level organization KPIs which are cascaded to the frontline levels to reduce the energy use. Also, investing in people to become a CEM (Certified Energy Manager), emphasizing the energy knowledge share/awareness sessions and obtaining the financial support for energy projects funding approval.

Data Quality and Energy Review- Data quality & energy review are being checked regularly by dedicated team in the energy and sustainability section. This is to ensure that all inputs to energy monitoring are accurate. Findings such as measurements (transmitters) are immediately communicated with the concern discipline for required actions. Figure 5 illustrates the energy usage in one of the operating units inside the complex. Furthermore, the list of initiatives is being addressed with the energy reduction % with respect to the baseline. This practice is helping on prioritizing all the actions and supporting the project section. (Fig. 6)

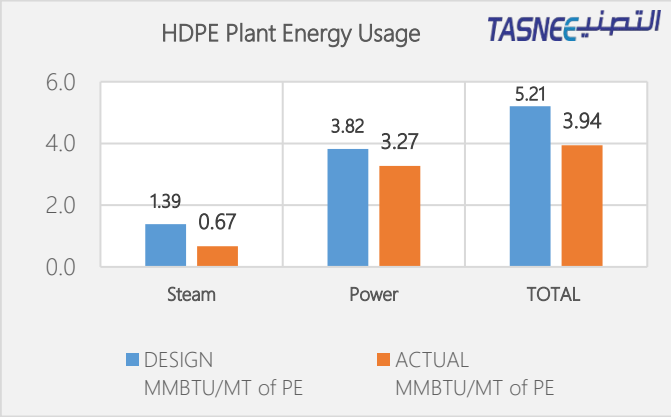

Fig.5: Energy Usage in HDPE Plant

Energy Baseline & Energy Performance Indicator (EnPI) – Energy consumption and carbon footprint emissions are expressed in absolute terms present challenges when used in comparison between companies from the same or different industries, or when analyzing historic performance of the same entity. For example, growth or decline of the business over the years will impact the absolute footprint and result in distorted performance analysis.

These parameters can be normalized through dividing the absolute values by an appropriate activity metric. The output is called an intensity metrics (or ratio) which provides an effective method to track and compare the energy efficiency and GHG emissions among processes, plants, and strategic entities, and is independent of growth or decline of the business. A declined intensity ratio is factor of a positive energy performance. Intensity ratios outline energy or GHG per unit of physical activity or unit of economic output. Example of intensity ratios include product emission intensity (tCO2 per unit of product).

Sr	Plant	Initiative Type	EE initiative	Progress	Target	Energy Annual Savings (MMBTU)	% Energy Saving	Responsible
1	HDPE	Power	Upgrade HDPE plant natural extruder VFD by installing smart controller which will be resulted of power saving.	Completed	2024	19,508.3	0.03%	GM Project
2	PDH	Combustion	Cleaning of WHB tubes internally and externally for better heat recovery. To recover flue gas heat flow form 186 to 178 Deg C	Completed	2023	353,727.0	0.61%	GM Maintenance
3	SAAC	Combustion	Interconnection between AA to BuOH Plant MP Steam.	Open	2024	308,700.0	0.54%	GM Project

Fig.6: Roadmap Energy Initiative List (selected part only)

TPC is applying the Saudi Energy Efficiency Center (SEEC) calculation to set the baseline in terms of MMBTU/T of product, as 2018 was selected as a baseline year Also, it follows the SEEC energy performance indicator (EnPI) considering a benchmarking analysis for same/similar technologies.

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"We fairly knew that ISO 50001 is the first step towards improving our energy efficiency, it enabled TPC to follow a systematic approach in achieving continual improvement of energy performance."

— Ahmed A. Al Zahrani, General Manager Technical Organization

Do, Check, and Act

Operation and Implementation – TPC followed the PDCA methodology in implementing and monitoring its energy management program supported by ISO50001 structured approached. To identify the energy use across the complex, figure # 7 illustrates the energy weightage % for all units of operation. A list of all initiatives and energy saving opportunities (fig. 5 as an example) is being monitoring on regular basis by a dedicated energy team to track the implementation. Units' wise performance with respect to the baseline and target is communicated on monthly wise with all management, operation & technical team. (Fig # 8 as an example)

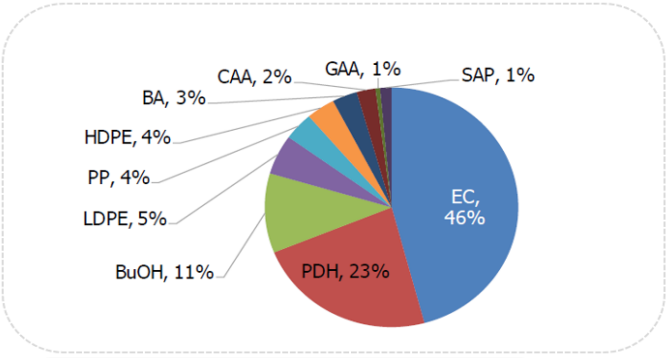

Fig.7: TPC Energy Use (weightage% by plants)

Moreover, TPC believes in the "sustainable energy conservation" in business where the requirement of **cyclic** maintenance for the purpose of energy conservation and consistent run is needed. Hence, TPC explored and implemented the latest technology for most effective solutions. This has already realized in PDH charge heater unit (as an example) using an advanced decoking tool resulted in a total annual saving of **50,992.4 MWh** & total annul GHGs reduction by **10,298 tCO2e**. (Fig. 9)

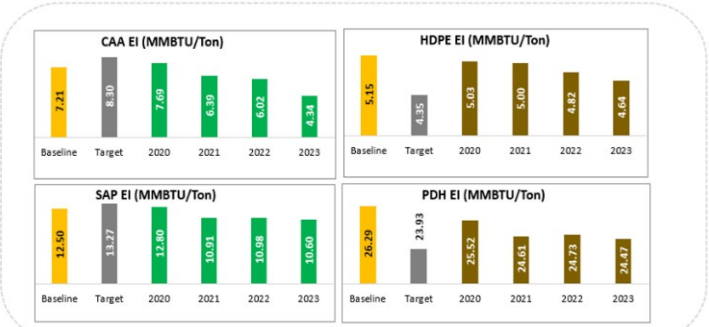

Fig.8: TPC Plant Wise Monitoring

Key High-Level Equations & Explanation – TPC applying the Saudi Energy Center (SEEC) calculation using Energy Intensity (Primary Energy MMBTU/ Production MT) for individual operation units and overall TPC energy performance. Energy saving % is calculated as below:

$$Energy\ savings\ (\%) = \frac{Baseline\ EI - Current\ EI}{Baseline\ EI} X\ 100$$

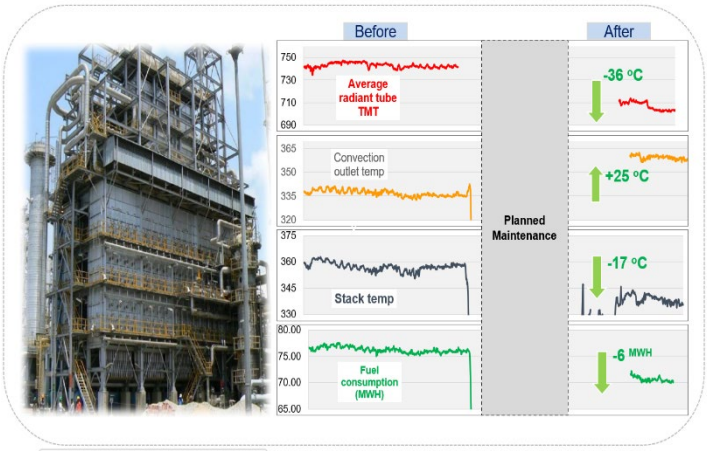

Fig.9: PDH RCH Post Cleaning Evaluation

The system conditions such as production rate, vessel pressure, shutdown events, instrument measurement accuracy/healthiness, feeds compositions, etc..are considered in the energy saving calculation's checks (before/after) to ensure normalization. Moreover, as described in the energy performance indicator; the parameters are to be normalized through dividing the absolute values of energy (MMBTU) by production (MT) to demonstrate the intensity metrics (or ratio). A declined intensity ratio is factor of a positive energy performance.

Assessing Energy Performance – A declining intensity ratio from the baseline year is a factor of a positive energy performance. The process of energy consumption validation is taking through 2 levels of validation steps every month. The production figures are based on the actual measured quantities of finishing products where it is posted in SAP system. Moreover, the data is being submitted to SEEC on annual basis as per the ongoing cycle of energy efficiency where it will follow a validation stage for all individual unit's performance and scorecard report will be submitted accordingly.

GHGs Implementation – The implementation of EnMS goes hand in hand in promoting sustainability and reducing environmental impacts. The EnMS helps TPC decarbonization roadmap to achieve its target. Energy efficiency initiatives related to GHGs are categorized in the initiative list with the expected annual reduction of CO2e. The reduction is communicated on regular basis to top managements & frontline teams. Reduction of GHGs is publicly announced in the annual sustainability report. Figure 10 is a selected example of GHGs related initiatives, the fuel saving in PDH WHB unit resulted in total GHGs reductio by **35,200** tCO2e/year.

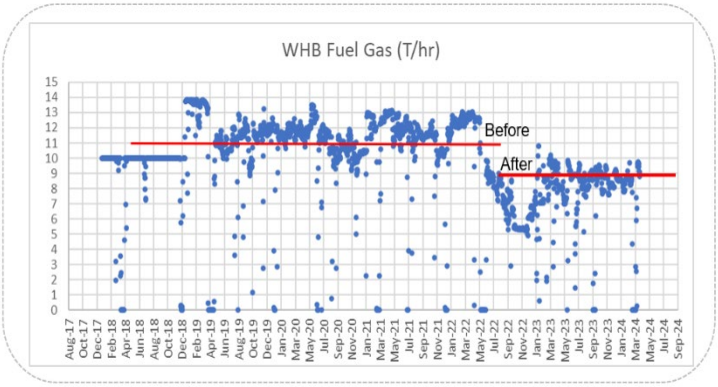

Fig.10: Example of GHG reduction initiative

Team Collaboration – Energy management involves planning, implementing, and monitoring the use of energy resources to optimize efficiency, sustainability, and cost-effectiveness. It requires coordination and communication among various stakeholders, if the team has a lack of collaboration, it can lead to deficient performance, wasted resources, missed opportunities, and low morale. Accordingly, TPC has launched the energy roadmap with clear targets for the generated initiatives supported by all stakeholders.

Continuous Improvement – TPC demonstrated an improvement in energy efficiency by 6.1% over the last 4 years. To promote the energy culture, regular awareness sessions are being conducted. Furthermore, the internal audit of EnMS implementation is conducted regularly and nonconformities are reported and communicated for correction and compliance. On the other hand, external EnMS audit will further assure the compliance to EnMS implementation. It is worth to highlight that TPC proudly achieved zero nonconformities for two consecutive years in the ISO 50001 annual surveillance audit.

Transparency

The accomplishment of ISO 50001 was announced in the annual sustainability report of Y2022. Defining energy management objectives is crucial for transparency and accountability. Hence, TPC defined the SMART (specific, measurable, achievable, relevant, and time-bound) goals which will accomplish with energy management initiatives and regularly reported to the Saudi Energy Efficiency Center (SEEC).

What We Can Do Differently

Lessons Learned – Due to the large industrial scale of TPC, the implementation of EnMS consists of massive data and documents. Hence, energy data handling, accessibility and reservation become a challenging process. This is including audits surveys, technical evaluation reports, performance reports, roadmap initiative list, etc. Accordingly, TPC has recently initiated the idea of digitization for the energy management system to develop the Energy Database which will reserve the data, improve the energy culture, and provide the accessibility to energy KPIs and targets by all levels at any time.

Looking Ahead – With the believe of "sustainable energy conservation" in business backed by the EnMS implementation, TPC will continue exploring the latest technologies for energy efficiency improvement and GHGs reduction considering the cost-effective solutions. Furthermore, TPC will enhance the EnMS data reservation and monitoring by the development of Energy Database.