

ISO 50001 Energy Management System Case Study

2021

Kingdom of Saudi Arabia

Haradh Gas Plant Department of Saudi Aramco

*Energy Efficiency as a strategic objective for
Haradh Gas Plant Department.*



HdGP is located at the southern tip of the Ghawar oil field, the largest conventional oil field in the world.

Organization Profile & Business Case

Organization Profile: Saudi Aramco's Haradh Gas Plant Department (HdGPD) is located 270 km southeast of Riyadh — the capital city of the Kingdom of Saudi Arabia — and 320 km to the southwest of Saudi Aramco headquarters in Dhahran. HdGP was built in a remote region of the Saudi Arabian desert, located at the southern tip of the Ghawar oil field, which is the largest conventional oil field in the world. The plant was commissioned in April 2003 to provide clean sales gas to the Master Gas System that provides clean fuel to power plants to produce electricity, and as a feedstock to the domestic petrochemical plants. Moreover, the hydrocarbon condensate is sent to the downstream facilities for blending and further fractionation, while the balance is exported to the international market. In addition, the liquid sulfur is shipped, by trucks, to the palletization towers to supply domestic and international industries.

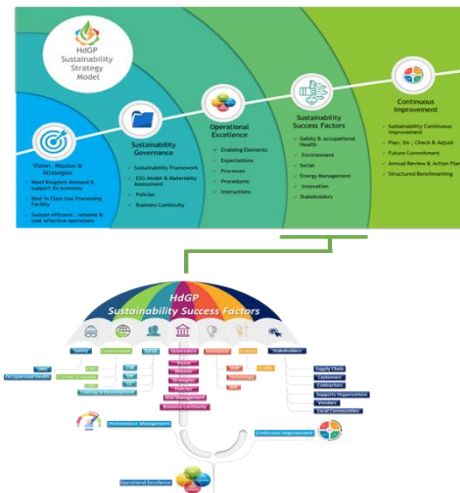
Case Study Snapshot	
Industry	Gas Processing
Product/Service	Multiple
Location	Haradh Village located 250 km southeast of capital city (Riyadh)
Energy management system	ISO 50001
Energy performance improvement period, in years	2 Years (2019-2020) 2019 Baseline and 2020 reporting period
Energy Performance Improvement (%) over improvement period	4.4%
Total energy cost savings over improvement period	\$845,459
Cost to implement EnMS	\$40,000
Total Energy Savings over improvement period	0.45 (GJ)
Total CO ₂ -e emission reduction over improvement period	49,000 Metric tons (49% reduction)

Motivation for Climate Change Action: Our motivation comes from Saudi Aramco's commitment to conserve natural resources, minimize the environmental footprint of our activities, and build a lower carbon economy while globally delivering the needed energy to support economic growth and social wellbeing. HdGP is aligned with Saudi Aramco in supporting the objectives set by the Paris Agreement, which aims to strengthen the global response to climate change threats in the context of sustainable development, and maintaining the global average temperature increase to below 2°C above preindustrial level.

Achieving Climate Change Targets Through EnMS: HdGPD aims to leverage its ISO 50001 and the Energy Management System (EnMS) to achieve such goals by building a lower carbon intensity operation while delivering the required energy demand to support economic growth. HdGPD is aligned with Saudi Aramco's strategy, which aims to grow its business sustainably by leveraging technology and innovation to lower its carbon footprint, and thus its climate impact. HdGP has one of

the lowest carbon footprints per unit of hydrocarbons produced in the industry, as low as 0.2 Kg of CO₂ per BOE.

EnMS Role in the Organization Business Strategy: The EnMS is not only an integral aspect of HdGP journey towards excellence, it is a corner stone of its Operational Excellence program implementation, corporate operational efficiency strategy, corporate energy transition strategy, and business sustainability model. In fact, the EnMS is the highest ranked program in the organization that drives the success of all other key operational efficiency programs. The EnMS is the organization's pathway to be a best in class gas processing facility, to meet the Kingdom's energy demand and support its economy, with an intent to maintain its position as a leader in Scope 1 and Scope 2 carbon intensity. HdGPD has developed its sustainability strategy model, based on a focused approach on EnMS, utilizing the existing departmental systems, subsystems, policies and initiatives. The energy management program has been identified as one of the most important success factors of the organization for achieving sustainable energy efficiency performance.



HdGPD Sustainability Strategy Model

Energy Management Actions Incentives Programs: The organization seeks to be a catalyst in driving energy management actions that support the ISO50001 and its EnMS. HdGP reinforced its commitment to being an energy efficient facility through integrated operational efficiency programs, to accelerate human engagement, as demonstrated in the following energy management action incentive programs:

- Patent and innovation Incentive Program: one patent related to energy conservation, granted by the U.S. Patent Office in 2019.
- Flare Minimization and GHG Management Programs
- Circular Economy Program
- Total Plant Reliability Maintenance Program
- Employees Engagement and Recognition Programs
- Capital Funding Program for Energy Conservation Project: budgeted generating 35% of plant power demand by rerouting plant heat sink to an ORC
- Energy Conservation Awareness and Tournament programs
- Energy Management Training and International Certification Program

“ISO50001 significantly helped HdGP to introduce a structured global energy management system, to drive higher performance, not only in energy efficiency, but in GHG management.”

—Fahad AlDossary, Plant Manager

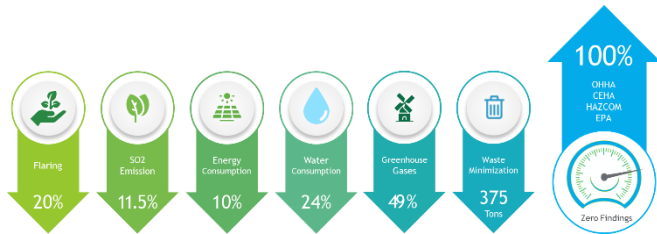
Business Benefits

Record Breaking Improvement in Energy Efficiency Performance: HdGPD has set a historical record in its energy intensity improvement, post the ISO 50001 implementation. HdGPD reduced its energy intensity by 4.4% for 2020 in a year-over-year basis. As a result of this improvement, HdGP reduced its GHG emissions by 49000 Tons CO₂e, which is another historical record in GHG management. Moreover, the organization realized an energy consumption drop of 0.45 GJ, which is equivalent to an annual energy cost saving of \$845,459.

Cost Estimate: HdGPD achieved an impressive financial return on its ISO 50001 certification investment cost in less than one-month post-implementation. The realized cost saving from the ISO 50001 implementation was \$845,459, while the staff and auditing costs were \$40,000.

Other Benefits: One of the most notable achievements in 2020 is a combination of the organization's tangible performance in many operational efficiency programs: energy consumption improvement, flare minimization, GHG emissions reduction, water conservation, waste minimization, sulfur dioxide emissions, and HdGPD's

overall environmental compliance, as shown in the following chart:



ISO50001 certification and implementation has brought more engagement to (318) employees, exposure to SEP 50001 standards and Georgia Tech virtual training, stakeholder's confidence in HdGPD capability to be part of the corporate energy transition and offered of benchmarking and prestigious awards to the organization. This had enabled HdGPD to be recognized as a 2021 environmental excellence award winner by GPA Midstream and 2019 Green World Award winner.

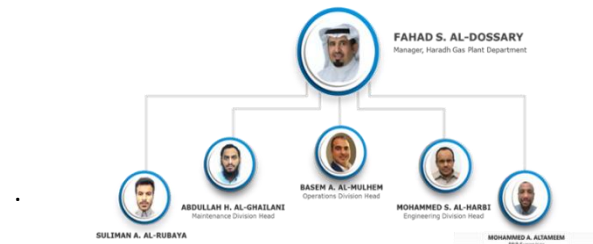
This section represents the benefits of ISO50001 for HdGP as a single site in Saudi Aramco. ISO50001 is a signatory for the HdGPD Energy Management System, and HdGPD is committed to sharing best practices and knowledge with peer organizations.

Plan

Organization Top Decision Makers Commitment: HdGPD energy policy was formalized and developed in accordance to ISO 50001 to act as a catalyst to engage the top management commitments to energy conservation. The goal is to surpass the established energy efficiency targets, and emphasize the need to regularly monitor and improve resource management, reduce carbon footprint, and minimize energy consumption.

Management Sponsors EnMS Implementation: The HdGP Energy Management Steering Committee (EMSC) is chaired by the department manager. The chairman endorses the annual energy policy, as well as the annual action plan. The engagement of top management ensures the allocation of needed resources and financial funding to successfully implement the EnMS. Management has been actively involved in sponsoring technology deployment, innovative solutions, best

practices, and capital projects, related to energy efficiency activities, as well as the contribution to the decision-making process for the department energy performance improvement.



To ensure attaining the department objectives, vision, mission, and strategies, EMSC take proactive actions with a positive attitude, to capture opportunities toward energy conservation and improvement through planning, executing, reviewing and adjusting the department's performance in its assigned responsibilities. HdGPD Energy strategies and action plans have been established to support the short- and long-term strategic objectives toward a greener environment, in alignment with Saudi Aramco's energy transition strategy. It has been developed to give a firm and clear blueprint for future goals and activities. The strategic intent helped HdGPD to emphasize and concentrate on managing GHG emissions through energy conservation. HdGPD develops, reviews and updates its energy matrix on an annual basis that includes identification for all energy aspects and impacts, all organization activities, products, significant energy users (SEUs) and the impact of each energy aspect, such as electricity and fuel gas. HdGP utilized the identified significant energy aspects and impacts to set energy objectives and targets, and translates these objectives and targets into action plans, with milestones that direct the organization towards achieving results and allocating the required resources and funding to implement the identified action plans.

Energy Consumption Assessment Methodology & Plan: HdGPD conducts an energy use and optimization assessment study in reference to Saudi Aramco corporate best practices. The study gathers all data related to plant overall energy consumption covering the following:

- Analysis of energy use and consumption based on actual measured data to identify current energy sources and evaluate past and present energy consumption
- Identification of Significant Energy Users (SEUs) and all factors affecting them
- Identification of opportunities for improving energy performance

After collecting all required data for energy consumption and generation, HdGP established an energy baseline that considers a 5-year data period. HdGP capitalizes on and utilizes the corporate best practice “Energy Intensity KPI Guideline” as the main reference for measuring and establishing energy Intensity KPI calculation, site specific targets and the baseline. The energy baseline is documented, approved and updated annually as part of the annual Energy Efficiency Plan. Moreover, HdGP established, implemented and maintains appropriate an energy plan for achieving its objectives and targets. The energy plan consists of the following: designation of responsibility, i.e., resources allocation; time frame to achieve the energy objectives and targets; a statement of the method by which improvement in energy performance shall be verified; and a statement of the method of verifying the results.

To encourage a better understanding of the relative energy consumption of processes, equipment, and systems, HdGPD established an energy balance detailing the energy consumption of the systems and equipment, energy consumption data sources, and all SEUs.



Electrical Power & Fuel Gas Energy Balance



“Certifying the organization with ISO 50001 has motivated our employees to take an active role towards achieving HdGP energy efficiency targets.”
 —Abdulaziz Khamas, Operation Shift Superintendent

Do, Check, Act

Success Story in ISO 50001 Implementation: the HdGP Energy Management Steering Committee (EMSC) is the overall sponsor of the entire EnMS and continues to be a

main driver for successful implementation, through full engagement of energy team members and providing all needed resources to establish, implement, maintain and improve the EnMS.

Highly Motivated & Empowered Energy Team: The EMSC appoints the energy team based on the needed qualifications and technical competencies. The team consists of multidisciplinary members including maintenance, operations and engineering.



HdGP Energy Team

The appointed team worked diligently to effectively implement the requirements of ISO 50001. The decision to certify the organization was committed through the annual energy action plan and was endorsed by the committee. HdGPD strives to play a key role in contributing to Saudi Vision 2030. This has propelled the organization to set challenging targets to build the competency of its workforce and positively contribute to the field of energy efficiency, by attending energy related workshops and conferences, presenting technical presentations and papers, filing patents, and achieving energy certifications.

Instilling Energy Efficiency Culture Through Training & Build Competency: HdGP top management efforts in sharing knowledge and raising awareness in the field of energy efficiency among the facility are evident. Management provides comprehensive training and advancement programs for its employees, encouraging energy innovation and professional development through a range of programs that reflect HdGP’s commitment to build employee competency. The facility incorporates challenging targets in its annual action plans, to ensure allocation of needed resources and secure management support. The efforts have been successful as HdGP managed to certify four engineers as Certified Energy Managers (CEM). Moreover, six HdGP team members have successfully obtained international certificates as Certified Maintenance and Reliability

Professionals and two as Certified Reliability Engineers. These certificates encapsulate the knowledge and skills in the field of maintenance and reliability related to significant energy users (SEUs). Furthermore, one of HdGPD Energy Team member successfully obtained an international certificate as a Certified ISO50001 Lead Auditor. Also, HdGPD worked jointly with the Association of Energy Engineers to recognize two as Operator Energy Efficiency Practitioners (OEEPs), by developing customized OEEP training materials covering wide range of energy management programs. Furthermore, towards employee competency, HdGPD sponsored the Superior Energy Performance (SEP) virtual training with Georgia Tech. The program was attended by six engineers. The objective of this course was to learn and apply the SEP strategies to implement the global energy management system, to achieve higher levels of improvement in energy performance.

Communication Plan: HdGPD established an effective and robust plan to communicate all energy related activities for department employees, stakeholders and customers, utilizing a plethora of avenues to motivate employees, increase awareness and promote engagement through the following: suggestion system, innovation program, posters, campaigns, energy treasure hunts, annual Earth Day celebrations, and energy tips.

Energy Optimization Activities Execution: The Energy optimization activities fall under three different areas – Operational Control, Design and Procurement.

Operational Control: HdGPD identifies and plans operation and maintenance activities related to its SEUs, which are consistent with its energy policy, objectives, targets, and energy plan. Such activities include: establishing and setting criteria for the effective operation and maintenance of SEUs; operating and maintaining facilities, processes, systems and equipment, in accordance with optimum operational criteria; and communicating the operational controls to personnel working for, or on behalf of, HdGPD.

Design: HdGPD considers energy performance improvement opportunities and operational control in the design of new, modified and renovated facilities,

equipment, systems and processes that can have a significant impact on HdGPD's energy performance.

Procurement: HdGPD established and implemented the criteria for assessing energy use, consumption and efficiency over the planned or expected operating lifetime, when procuring energy related products, equipment and services, which are expected to have a significant impact on HdGP's energy performance. HdGPD defines list of energy related materials to be reviewed for their energy efficiency and life cycle cost requirements. The list includes any electrical equipment (such as motor, HVAC, lights) or any other equipment that consumes or impact any energy system (power, fuel gas, and steam), to ensure effective Life Cycle Cost Evaluation and compliance to efficiency standards.

Energy Performance Improvement Measurement and Validation: Achieving performance improvement cannot be shown without implementing a robust energy monitoring program. HdGPD has developed an energy monitoring dashboard for energy performance and SEUs. The dashboard is being utilized to analyze the impact of the SEUs on the energy intensity KPI of the department. It also helps in creating action items to optimize the energy use of each equipment item. This dashboard improved the monitoring process of the energy consumption of the department, which lead to energy efficiency and sustainability.

HdGP had developed and used the energy intensity as one measure to gauge the energy performance improvement and the success of its EnMS and several other EnPIs, to monitor and analyze the department's energy consumption. This KPI is intended for two key applications:

- Benchmarking: against historical trends, against other competitors, and against targets.
- Process improvement: to monitor, measure and track efficiency of plants.

The calculation formula to measure the EI KPI is as follows:

$KPI = E/P$, where:

E = Total energy consumption in 1,000 Btu (MBtu)

P = Total production in barrels of oil equivalent (BOE)

HdGPD frequently monitor and measure the progress of EnMP implementation and KPIs performance to ensure its effectiveness and proactively correct any deviations through different venues, including: daily, weekly, monthly and quarterly, chaired by different levels of top management. Also, HdGPD conducting a frequent EnMP assessment (audit) in line with the corporate “Energy Management Program Assessment Guidelines,” to gauge their conformance to the agreed on EnMP requirements, objectives and targets. The main objective of the assessment is to identify any improvement opportunities and to correct them as soon as reasonably practical or possible. HdGP has been able to perform beyond the energy intensity set target, with significant improvement of a record breaking, 4.4% reduction in the intensity on a year over year basis. This significant achievement was realized by implementing several innovative programs to optimize the power, fuel, flaring/GHG emissions and water consumption with maintaining customers energy demand.

Key Energy performance activities implemented during the period:

- Granted a U.S. Patent to reduce fuel gas purging consumption by 11%
- IR 4.0 Load Management Model to reduce the facility annual overall power consumption by 12%
- Innovation to reduce power consumption in the Condensate sphere by 15%
- International award-winning GHG Management Program
- Achieved 98% in sulfur recovery operational efficiency
- Deployed technology to reduce air compressor power consumption by 30%
- Industrial/Nonindustrial Buildings Energy Performance Enhancement

Transparency

HdGPD is immensely proud of its achievements in the field of energy conservation. Our energy policy,

ISO50001 certification and awards are visible in every building in our plant. We are also publishing our energy performance in the Annual Sustainability Report.



HdGP Awards & Recognition for Energy Management System

What We Would Have Done Differently

Role of ISO Auditor: We have learned that the role of our ISO auditor is not to criticize our system but to improve it. Understanding the importance of this essential role could have helped us to take the certification step much sooner than 2019. This would have generated more energy savings for the organization.

Frontline Employees Engagement: Effective implementation of EnMS does not rely on a dedicated team only, but rather fostering an energy efficiency culture through the organization. The information received from our frontliners were invaluable to the success of the EnMS implementation.

Incentivizing Through the Reward & Recognition Program: Incentives program is not just a tool to drive performance and engagement. It stimulates collaboration and propel innovation. A more enticing reward program is a motivational force to accelerate participation from the whole organization employees to sustain EnMS performance.

Enhancement of Energy Manager (EM) Charter: The Facility EM is critical in monitoring and reducing the site energy consumption. We have incorporated the EM into in the gated project review cycle to capture energy saving opportunities.

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.

