

ISO 50001 Energy Management System – Case Study

2022

United Arab Emirates (UAE)

ADNOC REFINING

ADNOC Refining has achieved 25 MUSD Energy saving equivalent to > 200 kT CO2 abatement.



Case Study Snapshot

Industry	Crude Oil / Condensate Refining, Storage & transfer of Petroleum Products
Product/Service	- Fuel and Petrochemical products like Ethane, LPG, Naphtha, Gasoline, Jet, Diesel, Propylene, Calcined Coke, Carbon black, base Oil, Sulfur etc. - Supply of Power & Water to Ruwais Facilities - Waste treatment and disposal for Ruwais Industrial waste
Location	Abu Dhabi, United Arab Emirates (UAE)
Energy performance improvement percentage (over the improvement period)	>2.8 % improvement over 2 years
Total energy cost savings (over the improvement period)	USD ~25 million
Cost to implement Energy Management System (EnMS)	Approx. 100,000 USD
Total energy savings (over the improvement period)	5 million GJ
Total CO₂-e emission reduction (over the improvement period)	>200,000 Metric Tons

Organization Profile / Business Case

Abu Dhabi Oil Refining Company (erstwhile TAKREER) (trading as 'ADNOC Refining') was set-up in 1999 for crude oil and condensate refining, and production/ supply of petroleum products. ADNOC Refining has 1 MM BPSD of processing capacity producing variety of fuels and petrochemical products. It also produces power (~650 MW) and has a water desalination plant (2600 m³/hr) to supply utilities to Ruwais Industrial area. Additionally, we operate waste treatment plants to treat and safely dispose hazardous waste from across the Ruwais industrial area.

ADNOC Refining continuously works to harness the nation's energy resources in a responsible and environmentally sustainable manner. Energy Management is an integral part of our business strategy. It helps in business strategy to minimize energy costs, reduce carbon emissions, and helps to create a sustainable future. By 2030 we target to improve our energy efficiency by more than 25%. As part of our plans to support the UAE's strategy for net zero emissions by 2050, we also target to reduce greenhouse gas emissions by 25% by 2030 and 50% or more beyond then.

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“ADNOC Refining has paved a robust foundation for energy efficiency by using the Energy Management System (EnMS). We hope to be a trendsetter for many organizations.”

—Mohammed Rasool Al Hashmi, Team Leader – Energy Management

Business Benefits

ADNOC Refining has been implementing the ISO 50001 standard since 2014. In 2016 we also achieved IMS certification – which was then merged with an integrated energy management system in 2020.

The impact of these standards has been significant across our company. For instance, since 2019 the Energy Management System has helped us to achieve a more than 2.5 % energy saving through the implementation of various initiatives. When looking at the period between 2020 and 2021, the total energy saved from EnMS initiatives was 5 million GJ, which saved us \$25 million and led to an annual CO₂ abatement of >200,000 tons.

Other benefits of EnMS also included higher throughput in our condensate units, improved fuel gas balance & loss accounting and precise energy forecasting for the business needs.

IMS certification across multiple sites has minimized third party costs for audits and certification. A common implementation approach at all sites also requires fewer resources and allows for synergy of optimization analyzing overall benefits rather instead of localized ones.

The EnMS mindset has also been instrumental in changing behavior across our workforce, instilling a mindset that ensures efficient energy use through improved processes and enhanced skills & knowledge of how to efficiently use and conserve energy. Additionally, we have shared our Energy Management ethos with our suppliers, vendors, and consultants in a bid to help them operate more sustainably too.

Looking ahead, we’re putting energy efficiency at the front of our minds when designing any new facility, ensuring that detailed energy workshops and energy review reports are conducted at every phase of the project. With several major projects due for completion in the near-future, ADNOC Refining will achieve a total of 20 million GJ per annum of energy saving by 2026. We’ve also implemented ADNOC’s landmark agreement with EWEC to power our sites with up to 100% of clean energy sources.

Plan

Our Energy Management team is a dedicated full time functional department, formed to focus and steer our company’s energy optimization efforts. It deals with various functions across the organization as shown below and operated with a dedicated budget.



We have also created an online energy management proposal system to generate ideas from across the company on how we can better conserve energy.

When planning and implementing the EnMS for recertification, we have built upon our existing experience within the ISO 50001 standard. We updated our organizational structure, procedures, and fine-tuned our monitoring in accordance with the ISO 50001:2018 standard. The new standard guided us to clearly establish the needs &

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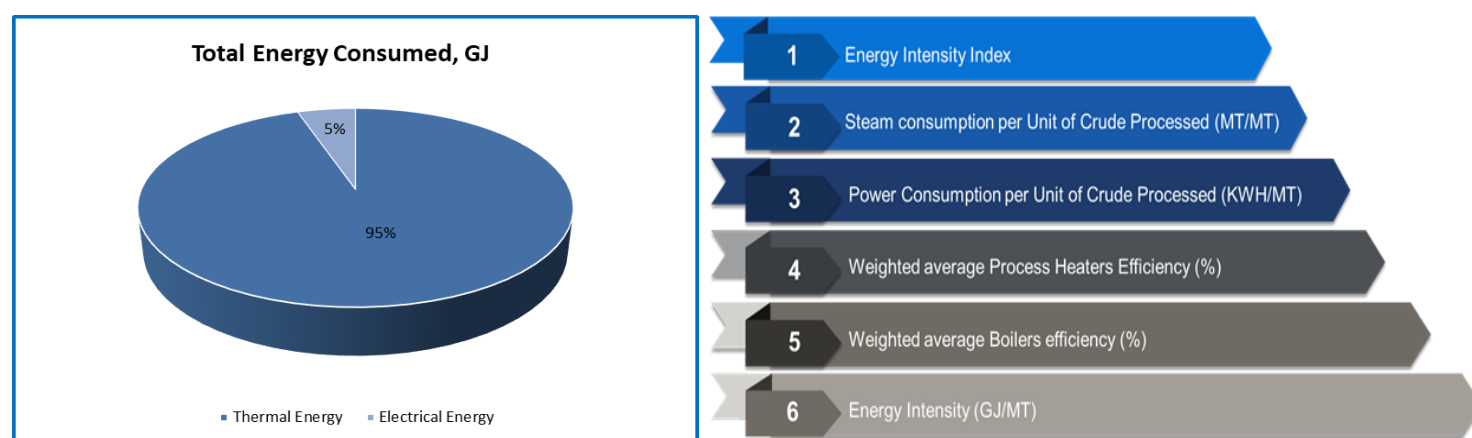
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expectations of internal (Operations & Maintenance) and external (Shareholders) customers, energy use risks and opportunities and the normalization of energy performance indicators based on static factors and relevant variables.

Energy consumption monitoring is carried out daily across all sites as part of the Energy Management System, giving us a real time picture of exactly how much energy we are using, and where. We obtained the data via the Plant Information (PI) system. The data for all sites was compiled and are reviewed against the business plan. Energy performance indicators are defined for each site and monitored against the baseline values. For each site, Significant Energy Uses (SEUs) are defined with criteria of any consumer having >1% energy consumption. This is illustrated below. Such a breakdown allowed us to focus our efforts on the highest consumers (thermal use).

While implementing EnMS, the first step was to collect relevant data. The data was categorized according by site, units, and equipment-based consumption. The energy source data was also divided between thermal and electrical, due to their differences in cost and efficiency.



We then held brainstorming sessions to identify ways in which we could target aspects of our operations to improve energy efficiency. Specific initiatives that arose from these meetings included the optimization of the crude condensate unit heater duty by minimizing the kerosene side stripper re-boiling requirements, optimizing energy use by maximizing steam turbine drives instead of using a motor, and by shifting steam production from low efficiency medium pressure boilers to high efficiency high pressure boilers.

ADNOC Refining's senior management team also supported the energy efficiency drive by creating unique programs called "Project Light" and "Variable Cost Efficiency" which challenged employees from across the company to devise innovative plans to drive down our energy consumption costs.

Additionally, we appointed external consultants to perform energy improvement and benchmarking studies according to industry recognized practices, e.g., Solomon benchmarking. For instance, between 2018 and 2020, studies were performed across our sites to find ways to enhance our energy management. These recommendations have now been incorporated as part of our five-year business plan.

ADNOC Refining's training and development division has supported our efforts by educating our employees on the importance of careful energy management and equipping them with the skills to enhance energy efficiency. Only those personnel who have undergone such training are entrusted to perform frontline operational roles.

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Our project & procurement teams also focus on energy efficiency when performing technical evaluation for any new product or project. As part of design of any new facility, a detailed energy report must be submitted with the relevant energy improvement ideas adequately evaluated.

“ISO 50001 is a tool to keep track of your progress on Energy Efficiency against organization’s objectives and EnMS helps to maintain focused approach without deviating from goals.”

—Aisha Al Mehrezi, Manager-Technical Assurance Department

Sr. No.	Title	Energy saving, million GJ per year	CO2 abatement, million MTPA	Total cost saving, MMUSD per year
1	Waste heat recovery project at GUP	20	> 1	100-200
2	Flue gas expander operation			
3	Heat Recovery (Steam generation) in Diesel pump around stream			
4	Heat Recovery (Steam generation) in diesel product stream			
5	Power generation turbine in Thermal desalination			
6	Heat recovery from stripper bottom stream by DM water heating			
7	Power generation turbine in RR II			
8	Generation of power in Steam Generation System			
9	Preheating cold feed with lean Sponge Oil			
10	Installation of Turbo Generator across MP/LP Let-Down			
11	Energy Gap identification & Improvement Feasibility study	To be identified and prioritized as per study outcome		

Energy Improvement roadmap

Do, Check, and Act

The time chosen here for baseline is Y-2019 and reporting period is considered as 2020-2021. Normalized Energy Intensity (GJ/MT of production) was used as an indicator for assessing energy performance improvements. Relevant variables affecting energy consumption includes the capacity utilization of each refinery unit, product yields, excess oxygen for heaters & boilers, heater stack temps, and reactor temperatures.

Internal and external audits are frequently performed to ensure that we do not deviate from the ISO 50001 standard and our objectives. A monthly energy review report is also published by all sites with recommendations for improvements, whenever there are deviations from the system or unnecessary energy losses.

As energy consumption varies according to the different complex processes involved in oil refining, we adopted an initiative-based saving calculation to come up with improved performance, i.e., for each initiative, the baseline period before implementation (typically the previous year’s data) is compared against a year’s data following implementation of the Energy Management System to determine improvements and energy savings.

The calculation to review results was as follows:

- Energy saving is calculated as Energy saved through all initiatives for a defined period (typically a year).

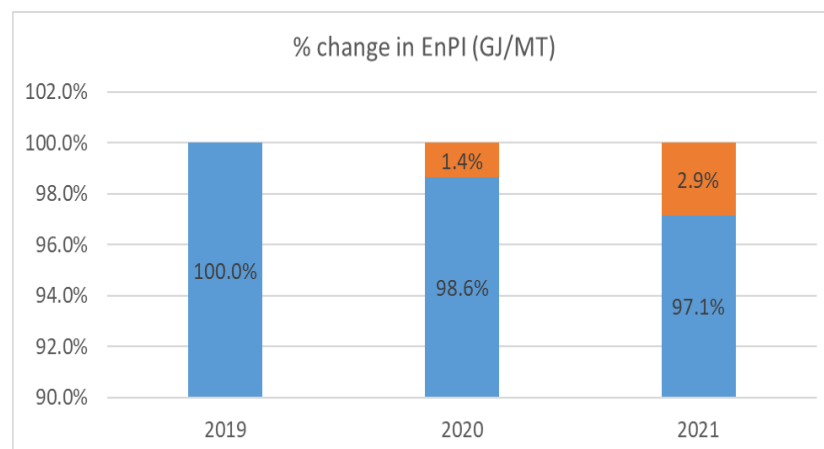
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- Energy saving % = (summation of all energy savings achieved in GJ / Total energy consumption in, GJ) *100
- Energy saving for an initiative = Energy Consumption during baseline period – Energy consumption during monitoring period
- Any period during which there was change in feed flow or product specifications, are normalized based on design data or using simulation tools.

Multiple EnPIs are established which provides the overall site wise specific energy consumption. The graph below shows the normalized Energy Intensity for the ADNOC Refining from 2019-2021.



ADNOC Refining uses in-house excel based tools for monitoring and normalization. However, to optimize efforts and increase output, standard templates have been developed. They are linked with PI system and lab data (Laboratory Information Management System LIMS) which can get automatically populated with change in dates.

The implementation of advanced process control also led to energy conservation benefits in addition to improved performance in major units like the Residue Fluid Catalytic Cracker and Crude Distillation Unit Block.

Operation planning and control is performed through daily work instructions, toolbox talks, energy monitoring parameters (calculated/derived) displayed in operator rooms, and monthly energy consumption reports.

Energy patrolling is also frequently carried out by our energy, operations, maintenance, and technical teams.

In terms of continual improvement, when seeking the EnMS recertification, ADNOC Refining prepared a team who had led our ISO 50001:2018 application. It reviewed the EnMS manual in line with the new requirements and held 27 awareness sessions with each site and division to inform them of the new requirements. In total, we reached over 1000 staff.

We also note the importance of involving all employees in our continual improvement plans. Hundreds of employees generated ideas that have led to successful implementation have been honored and celebrated across the company in the hope that others will take inspiration from their proactive approach to energy management.



Earth hour celebration

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Transparency

ADNOC Refining's commitment to the ISO 50001 standard is well-known to all our staff and partners. We inform all our vendors/suppliers/contractors about our commitment to comply with the EnMS ISO 50001 standards in every possible way, e.g., through tender scope of work and/or annexures, through tender clarification meetings, during contract kick-off meetings, during HSE inductions etc.

Our Communications and Corporate Social Responsibility Division also frequently announces our ISO 50001 undertaking in various internal forums.

What We Can Do Differently

Given the opportunity to do things differently, we would fast track training and awareness program through “train the trainer concept,” use of online sessions (emerged very effective during COVID situation) and use of IT tools for energy monitoring and reporting. Further, we aim to minimize the tendering & approval time between different phases of major capital expenditure projects.

One major energy enhancement project nearing completion is the Waste Heat Recovery Project at our General Utilities Plant in Ruwais. Once complete, it will improve energy efficiency of the plant by almost 30%, leading to an overall CO2 reduction of ~1 MMTA.

ADNOC Refining is committed to continually improving our performance within the ISO 50001 EnMS requirements. Against a backdrop of increasing energy costs and the need to decarbonize our assets, we are confident in achieving top quartile energy efficiency performance.



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.