Global Energy Management System Implementation: Case Study

United Arab Emirates

Abu Dhabi National Oil Company (ADNOC)

ADNOC saved US $150 million in energy costs through its corporate EnMS since 2014

ADNOC recently opened its new energy-efficient headquarters, registered for LEED GOLD (skyscraper at left)

Business Case for Energy Management

Profile: The Abu Dhabi National Oil Company (ADNOC) is a state-owned oil and gas company established in 1971 to manage, produce and preserve Abu Dhabi's hydrocarbon resources.

ADNOC operates across the entire hydrocarbon value chain through a network of fully-integrated businesses, with interests ranging from exploration, production, storage, refining and distribution, to the development of a wide-range of petrochemical products. ADNOC operates through a group of companies comprised of 18 subsidiaries and joint ventures.

ADNOC produces 12% of the world's oil and gas and is ranked as the 12th largest oil producer in the world. It is the principle catalyst of growth in Abu Dhabi, and has had a positive and lasting impact on the quality of millions of lives.

"We will focus on four strategic areas: investing in our people, enhancing the company's performance, increasing profitability, and optimizing efficiencies."

\- Dr. Sultan Ahmed Al Jaber, ADNOC Group CEO

Case Study Snapshot	
Industry	Oil and Gas
Product/Service	Oil, gas, refined and petrochemicals products, Sulphur and marine transportation
Location	Abu Dhabi, United Arab Emirates
Energy Management System	ISO 50001
Energy Performance Improvement Period	3 years
Energy Performance Improvement (%) over improvement period	6%
Total energy cost savings over improvement period	US $150 million
Cost to implement EnMS	US $ 55 million
Payback period on EnMS implementation (years)	< 5 months
Total Energy Savings over improvement period	60 million gigajoules
Total CO_2-e emission reduction over improvement period	3.1 million metric tons

"Our group-wide ISO 50001-cerified EnMS will ensure that energy efficiency is built into the very fabric of our business and operations"

—Dr. Sultan Ahmed Al Jaber, ADNOC Group CEO

Drivers: In absence of regional and national targets for energy efficiency or emissions reduction, ADNOC signed a sustainability charter with its operating companies, in 2009, as a strategic initiative to integrate economic, environmental, and social considerations into its corporate decisions. In 2013, ADNOC launched 13 strategic initiatives to align its business with the Abu Dhabi Economic Vision 2030, with energy management as one component. From this, ADNOC initiated its corporate energy management system, known as ADNOC EnMS with the aim of support building an energy efficient economy in Abu Dhabi and the UAE

Energy reduction approach: Although ADNOC EnMS is relatively recent, the group companies haves been actively engaged in energy saving projects since the early 1990's. Vapor recovery and flaring reduction are among many initiatives to protect environment over the last three decades that led also to significant energy savings. Other energy projects were also driven by economic benefits or operational improvements. However, the implementation of ADNOC EnMS and ISO 50001 ensured that energy efficiency is built into the very fabric of our business and operations from resource-efficient production all the way to the transportation and use of our products. The group companies are now working together to achieve corporate objectives and targets.

Business Benefits Achieved

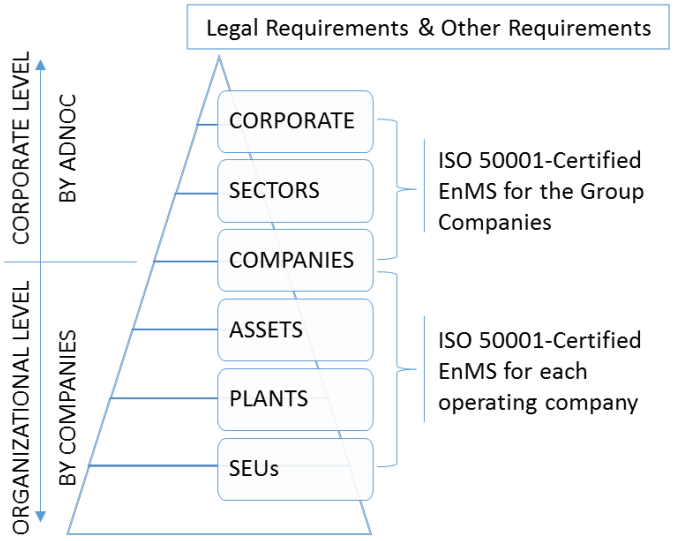
ADNOC has received many benefits from its EnMS. So far, its energy performance has improved 6% from the 2014 baseline. In terms of energy, this is equivalent to 57 billion cubic feet of natural gas or 60 million gigajoules. The result is a US $150 million cumulative cost savings and an emissions reduction of 3.1 million tons of carbon dioxide. ADNOC's mid-term target is to reach at least 10% improvement in its energy performance by 2020 to make a cumulative savings of about US $1 billion.

In addition, significant energy savings and emissions reductions are anticipated from several ongoing major energy projects and also implementation of the EnMS procedures for design and procurement optimization.

Moreover, ADNOC has achieved other non-financial benefits, such as creating more than 50 new jobs, and creating more business opportunities for our contractors and suppliers. The biggest benefit, however, has been an increased energy awareness among employees, their families, and the community at large. ISO 50001 enhanced our accountability, transparency, recognition and image to our stakeholders and customers and allows the establishment of a benchmarking process.

EnMS Development and Implementation

ADNOC developed its Corporate Enterprise EnMS to govern the petroleum industry in the Emirate of Abu Dhabi (ADNOC, 18 ADNOC Group companies and 3 independent operators).

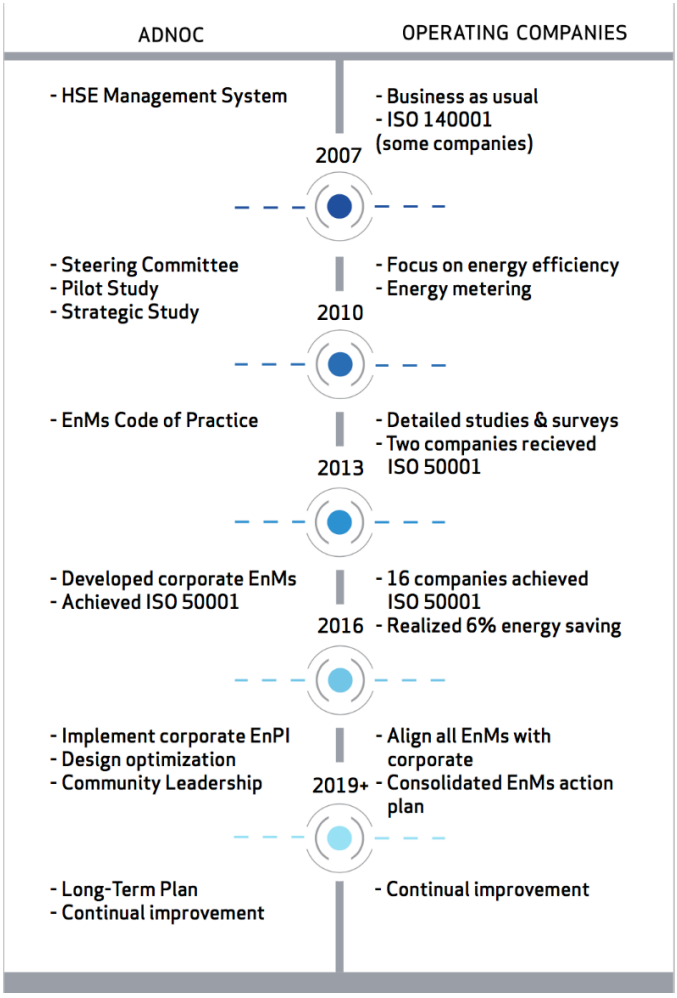


ADNOC EnMS Structure

"As large energy supplier and consumer, our EnMS enables us to deliver on our long-term gas plan in most efficient and cost effective manner"

— Omar Suwaina Al Suwaidi, Gas Management Director
Energy Management Sponsor

In 2010, ADNOC completed its first energy pilot study and Energy Management Strategic Study, which initiated the EnMS journey. The timeline diagram shows the response of the operating companies to ADNOC's energy actions.



ADNOC EnMS Timeline

Organizational: Following the Strategic study, a Corporate Energy Management Steering Committee was formed, comprised of senior managers from all group companies. Since then, the Steering Committee has been directing and overseeing the implementation of the energy initiatives. In response, the companies appointed their management representatives and energy teams and allocated resources to establish their independent EnMS. In 2013, ADNOC issued it code of practice for establishing integrated energy management system for ADNOC and its group companies and mandated that energy systems must be certified to ISO 50001. A member of the executive management team (the Gas Management Director) was appointed as a sponsor for the initiative, who in turn appointed a senior manager to act as a management representative and set the governance structure framework delegating system responsibilities to a number of senior managers across the group. Operating companies have been receiving ISO 50001 certificates from 2013 to date. The corporate ADNOC EnMS was implemented in 2014 and certified to ISO 50001 in January 2016.

Energy review and planning: As recommended by the Strategic Study, all operating companies initiated their independent detailed energy audits and studies. External experts were appointed to gather the necessary data, audit plants, analyze energy performance, and develop lists of prioritized energy opportunities based on their techno-economic feasibility. Each company determined suitable energy performance indicators and established its energy baseline, objectives, targets, and action plans for the short, mid, and long-term timeframes.

At the enterprise level, ADNOC compiled and analyzed the necessary data from the companies' audits and studies and identified the following:

- Energy flows and energy metering system that contribute to the overall performance of an individual company and its interfaces with others.
- Sectoral and enterprise energy use, efficiency, consumption, and performance metrics.
- Energy baseline (EnB) and performance indicators (EnPI) for each company and relevant sector.

A corporate EnPI was selected for each business sector and operating company. The selected EnPIs are typically the ratio of overall energy consumption of a company in gigajoules to its total production or function such as barrels of oil equivalent, tons of petrochemicals, dollars of turnover for services, miles of trips, total built area of buildings, or megawatt hours of generated power. The corporate EnPI and EnB for ADNOC and its group companies were set as an absolute value of total energy consumption in gigajoules for the entire group.

Upon analyzing energy performance and improvement potential, ADNOC set a mid-term target to improve its energy performance by 10% by 2020 from the baseline of 2014 and developed a corporate action plan to achieve this target.

Cost-benefit analysis: ADNOC and its group companies have invested significantly in the development and implementation of the EnMS as well as the implementation of other energy projects as follows:

EnMS development & implementation costs: the cost required for Internal staff time, hiring consultants and experts, additional monitoring and metering equipment, software, tools, third party costs, energy training and professional certification, internal communications and rewards programs.

Project Implementation Costs: expenses related to the implementation of low and medium-cost opportunities such as improved control systems, modifications of lighting and HVAC, and operational modifications.

Nevertheless, there are other capital-intensive projects at various development stages that will have a significant impact on the energy performance after 2020. The cost-benefit of these projects is not included in this analysis. The list covers major heat recovery, pressure recovery, process modifications and retirement of inefficient power generation and other projects.

ADNOC and its group companies have spent a total of US $55 million for all energy management related activities (US $28 million for development and implementation of the EnMS, and US $27 million for low cost projects). With a calculated savings of US $150 million in total, the investment payback period is less than 5 months.

Approach used to determine whether energy performance improved: Guided by ISO 50015, ADNOC developed its corporate guidelines for energy measurement and verification planning. It describes two basic approaches for determining energy performance improvement:

- *Organization-based approach*: This method measures the change in total energy consumption of an organization, or its constituent parts (assets and business units). It is applied monthly to monitor and report performance of an asset as part of a company or performance of a company within the entire group. ADNOC aggregates performance of all companies to define sectoral performance and corporate performance.
- *Action-based approach*: This aggregates energy savings from identified energy performance improvement actions (EPIAs). All operating companies apply this approach to assess benefits of one or more EPIAs through monitoring before and after the implementation. A similar approach is also used to determine possible energy performance improvement due to design changes of new projects.

In both approaches, the following steps are typically followed in accordance with system guidelines:

- Define the energy boundaries and period.
- Determine appropriate energy performance metrics and establish a baseline.
- Determine and gather data needed for analysis and normalization of energy performance.
- Normalize energy data, considering variations in relevant variables and static factors.
- Analyze energy data to determine energy use, consumption, and performance improvements.
- Record and report energy performance and improvements through the ADNOC EnMS Information Management System (EnMS-IMS).

Approach used to validate results: The verification and validation of energy performance improvements take place thoroughly at two distinct levels: organizational and corporate. Since every company has its independent ISO 50001-certified EnMS, it implements appropriate action plan, measurement & verification plan, audit plan, and tracking system suitable to its business nature and EnMS requirements. Internal audits are carried out by

certified lead auditors, while the key energy performance indicators are verified by the business management as part of the company's overall performance contract agreed with its shareholders. Third-party audits also are carried out for certification, certification maintenance, and recertification processes.

At the corporate level, organizational energy and EnMS performance are reported monthly through the web-based ADNOC EnMS-IMS. Then, ADNOC Energy Team monitors and analyzes companies' performance and identifies gaps between actual and planned.

In addition, ADNOC formed a pool of certified lead auditors from the entire group to audit ADNOC and its group companies under the corporate ADNOC EnMS. The ADNOC EnMS is also externally audited as part of the ADNOC EnMS certification process.

Moreover, corporate energy performance reports are issued quarterly for management review, and the Energy Management Steering Committee with the sponsor meet at least twice a year to oversee and direct implementation of ADNOC EnMS.

Steps taken to maintain operational control: Corporate guidelines and organizational procedures were developed to maintain operational controls and sustain energy performance improvements. The standard operating procedures for the significant energy users were updated to include criteria for energy efficient operation and maintenance. Employee awareness is maintained by conducting regular EnMS and energy efficiency training and refresher sessions and electronic campaigns. Moreover, energy management best practices are embedded into the key corporate business processes, including performance contracts, balanced score cards, asset integrity management, value assurance processes, design optimization, procurement, and learning and development frameworks.

Development and use of professional expertise, training, and communications: The development of people is a strategic focus area at ADNOC, and has consequently been set as a key corporate performance indicator. ADNOC maintains an annual training plan that includes sessions for EnMS and ISO 50001 awareness, technical training related to significant energy uses, certified training such as CEM, LEED AP and ISO 50001 auditing, and general energy awareness for employees and communities. Training needs are identified and employees are nominated for energy according to their roles and impact in the EnMS.

Currently, our ISO 50001-certified auditors carry out all internal audits, within their companies, and audit other operating companies under the corporate ADNOC EnMS. Our professionals also carry out routine energy reviews and design optimizations. They are also encouraged to deliver energy efficiency training related to their operations and monitor and coach young engineers.

Recently, ADNOC developed its corporate energy efficiency learning and development framework (EELDF) that sets the requirements and approaches to develop energy competency at all levels within the organization. The framework covers energy engineers, fresh graduates, and professional staff involved in the EnMS.

Tools & resources: ADNOC Group companies have been implementing ISO 9001, ISO 14001 and ISO 27001 for many years, and have infrastructure that supported implementation of ISO 50001. However, ISO 50001 was the first international standard to be adopted at a corporate level through a governing code of practice for establishing energy management systems. ADNOC also developed set of EnMS guidelines guided by ISO 50002, ISO 50004, ISO 50006, ISO 50015 and ISO 17741.

ADNOC adopted Enerit ISO 50001 software as the corporate EnMS Information Management System (EnMS-IMS) for consolidation, analysis, monitoring and reporting energy and EnMS performance data and activities for ADNOC Group companies.

On the other side, our joint venture partners bring numerous best practices and the most up-to-date tools and resources from their global operations to support their partnerships and share with all group companies.

"Through our world-class ISO 50001 certified EnMS, we'll lead by example to promote an energy efficient economy in our country,"

— Mr. Abdulla Al Minhali, Manager, Gas Support Unit, ADNOC-EnMS Management Representative

Lessons Learned

The formation of a group-wide steering committee for energy management was successful in driving the energy initiative, resolving interface issues, and streamlining efforts toward corporate targets.

Developing and sharing in-house expertise at corporate level to carry out energy reviews, audits, training and design optimization improves efficiency, cost effectiveness, and consistency of implementation.

Issues such as energy data transfer, security, and confidentiality and communication infrastructure for the corporate ADNOC EnMS-IMS require special attention due to the involvement of multiple organizations and stakeholders.

The availability, accuracy, and connectivity of sufficient meters to gather energy data from existing assets specially scattered and remote facilities and also for interfaces between different group companies, is a major challenge that must be addressed early in EnMS planning in order to maintain a reliable monitoring and verification system.

Introducing energy knowledge into educational curricula helps ADNOC to ensure the availability of a competent taskforce for future jobs, to meet its corporate social responsibility, and to promote energy awareness in the UAE at large.

ADNOC introduced a new category in its enterprise HSE Awards for energy management to recognize efforts made by companies, employees and contractors. This award helps to promote energy awareness and increase the involvement and accountability of individuals.

Keys to Successful EnMS Implementation

- Visible leadership commitment to ISO 50001.
- Clear definition of roles & responsibilities.
- Usage of existing team and group structures.
- Maximum involvement of employees at all levels.
- Make energy performance an important KPI.
- Reliable metering and monitoring systems.
- Availability of financial and human resources.
- Rewards & recognition of energy achievements.

Abu Dhabi Refinery triumphed to Quartile 1 in Energy Intensity Index (EII) of Solomon Benchmarking for 2014.

Through the Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit www.cleanenergyministerial.org/energymanagement.

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