ISO 50001 Energy Management System
Case Study

2021 Egypt

Abu Qir Fertilizers Company (AFC)

Abu Qir fertilizers company is one of the first certified fertilizers plants in energy management ISO 50001 in Egypt.

Abu Qir Fertilizers Company (AFC)

Organization Profile & Business Case

Abu Qir Fertilizers & Chemical Industries Company (AFC) is a pioneering company in the field of production and marketing of nitrogenous, specialized and liquid fertilizers in the Middle East and Africa and is one of the major Arab and international companies working in this field. It was established in 1975 for producing nitrogen fertilizers to cover the local demands and to export the excess production. The company is located at the coast of Abu Qir bay, about 20 kilometers east of Alexandria, Egypt.

The company produces and markets all types of solid, compound and liquid fertilizers in Egypt and abroad in which it represents more than 60% of the total market share of domestic fertilizers co. It comprises three plants producing more than 6000 tons daily from Urea periled, Ammonium nitrate granulated, Urea granulated, UAN solution, moreover Plastic bags factory, and Zero liquid discharge unit for industrial wastewater treatment.

The objective of Energy Management is to reduce energy requirements per unit of product to minimize production cost, reduce emissions, and Maximize company profit.

Energy management is now in the global spotlight, Energy efficiency is the most consensual option to meet energy saving … save energy means save money, environment and resources … investment in energy efficiency can be seen as an investment for the future.

Chemist. Saad Abou El Maaty
Chairman and Managing Director

Case Study Snapshot	
Industry	Chemicals
Product/Service	Nitrogen Fertilizers
Location	Alexandria - Egypt
Energy management system	ISO 50001
Energy performance improvement period, in years	4
Energy Performance Improvement (%) over improvement period	7.17 %
Total energy cost savings over improvement period	9,651,629.6 $ USD
Cost to implement EnMS	2,325,000 $USD
Total Energy Savings over improvement period	2,262,890 GJ
Total CO_2-e emission reduction over improvement period	67,408 Metric tons

The company keeps track of the most up-to-date technological methods, through the adoption and application of Energy management system ISO 50001, quality management system ISO 9001, Environmental Management System ISO 14001, Occupational Health & Safety Standards ISO 45001. The company has also adopted IFA's Protect & Sustain product stewardship and the gold medal as industry stewardship champion which has been the first to obtain these certificates and awards in Egypt.

Abu-Qir plant III was commissioned in October 1998, Krupp Uhde (TKIS) as Main contractor, produce 1200 ton per day liquid ammonia which revamped to 1236 ton per day in 2018 and 1750 ton per day urea granules (Stamicarbon technology) which design capacity 1925 ton per day, and under studying to revamp to increase capacity to 2370 ton per day with utilizing carbon dioxide which reduce emissions and decrease overall company carbon footprint.

Improving energy efficiency is an important way to reduce energy costs reduces waste and emissions, reduce total cost of production and Maximize profit.

Ammonia plant III was equipped with triple-bed radial-flow converter since plant commissioning in October 1998. Converter basket, internal heat exchangers and ammonia catalyst were approaching the end of their useful life; instead of proceeding with an in-kind replacement, Abu Qir fertilizers company decided to revamp their ammonia converter internals in Abu Qir III as energy optimization project; energy saving was the main goal of this revamp, Project was assigned to Casale and successfully completed in turnaround June 2018,An idea to optimize project economics was to use catalyst available in Abu-Qir warehouse since 1998, Abu-Qir available catalyst was tested by Casale and by JM catalyst Vendor: it was found in good conditions and suitable for converter revamping project. It was decided then to use it in second and third ammonia converter beds and to buy the extra amount as a new pre-reduced catalyst for the first bed, this increases catalyst life and decrease time for catalyst reduction.

Figure 1. Ammonia Converter Basket Revamp

Abu Qir resources were optimized by using ammonia converter catalyst stored from 1998 in company warehouse, converter catalyst volume has been increased of about 30%, with ammonia casale axial-radial flow pattern instead of radial flow, more efficient process configuration resulting in an increase the conversion per pass, at low synthesis loop pressure, leading to increase the productivity 3 % with a tangible decrease of plant overall energy consumption by 0.5 MMBTU/ton ammonia, and low operating costs.

Project was carried out and concluded successfully in all its aspects and was completed in less than 20 days with catalyst reduction time 3 days (more production and less natural gas consumption) achieving project target which is energy saving without impact on plant scheduled shut-down time. (*Nitrogen+Syngas,360, July-August,2019*).

Business Benefits

Abu Qir plant III energy management System implementation begins in the year 2016, with an external energy gap analysis, in order to identify as a diagnosis, which are the gaps that could be considered for an EnMS implementation based on ISO 50001:2011.

one of the most important objectives of energy management system in Abu Qir plant III is revamp ammonia converter internals as energy optimization

project; energy saving was the main goal of this project which is successfully completed achieving the target a tangible decrease of plant overall energy consumption by 0.5 MMBTU/ton ammonia, increase the productivity 5.8 %, decrease operating costs and increase the net profit.

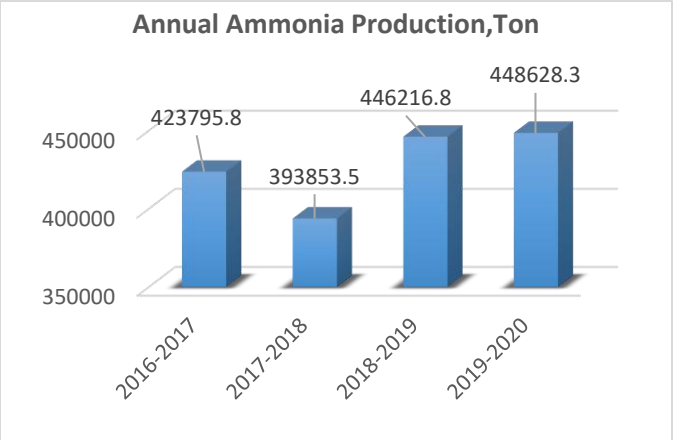

Figure 2. Annual Ammonia Production

The annual total ammonia production in (2019-2020) 448,630 ton compared with 423,800 ton in year (2016-2017) before achieved EnMs objective in turnaround (2018-2019).

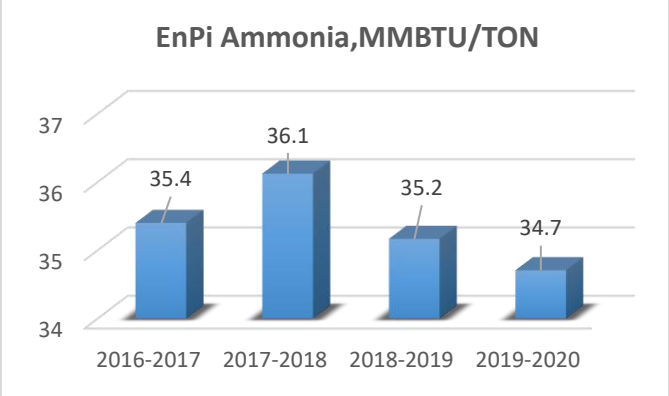

Figure 3. Ammonia plant Energy Performance (EnPi)

Improvement of Ammonia plant energy performance indicator (EnPi) from 35.4 MMBTU/Ton in year (2016-2017) to 34.7 MMBTU/Ton in (2019-2020) after achieving EnMs objective.

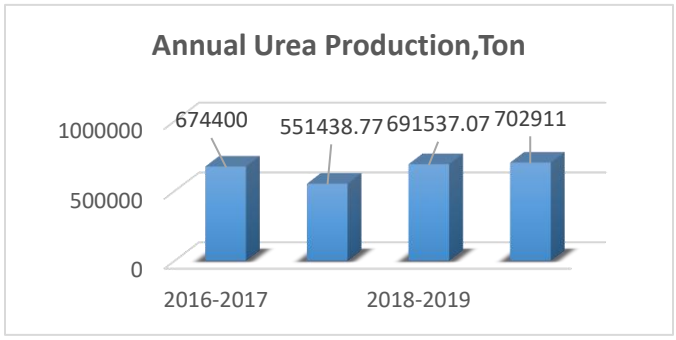

Figure 4. Annual Urea Production

The annual total urea production in (2019-2020) 703,000 ton compared with 674,400 ton in (2016-2017) before objective achieved in turnaround (2018-2019).

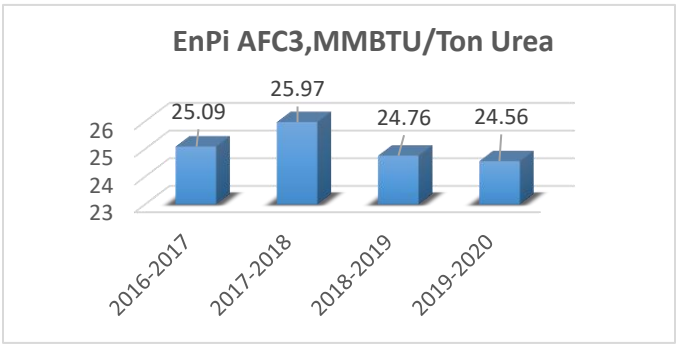

Figure 5. AFC III Energy Performance Indicator

Improvement of Abu Qir plant III Energy Performance Indicator (EnPi) from 25 MMBTU/Ton Urea in (2016-2017) before Energy Management System (EnMs) implementation to 24.5 MMBTU/Ton urea in (2019-2020).The time used in implementing the System, gap analysis, training people, elaboration of procedures, internal audits and certification was approximately 2500 hours and after the successful implementation of The Energy Management System according to the standard ISO 50001 in Abu Qir plant III, and after achievement the energy objectives, it was appeared an improvement of energy performance of 7.17,% over a period of 4 year, the total energy saving is 2,144,806 MMBtu, with a reduction of 67,408 Ton of Carbon dioxide emission, and the energy cost savings was around 9,651,629.6 $ USD, and this showed in increase net profit of Abu Qir plant III shared percentage in total company net profit (10 %).

Plan

Abu Qir Fertilizer Company decided to establish, document, implement, maintain and improve an Energy Management System in accordance with the requirements of the International Standard (ISO 50001) since 2016, and met the requirements of this international standard to achieve continual improvement based on Plan-Do-Check-Act framework.

Top management has committed to provide necessary resources in term of interesting, motivation and budget, for continual improvement energy projects and achievement objectives as aforementioned energy saving project with cost more than 2,500,000 $ USD, and also the top management appoints dedicated implementation team and facilitates them with sufficient training programs to ensure good competency.

The energy maps developed for the Abu Qir plant III illustrated in Figure (8) is utilized to follow up major energy flows and energy conversions to understand energy consumption and energy use within the process.

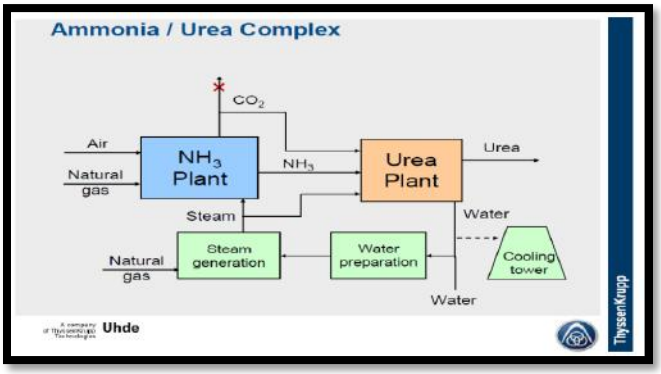

Figure 6. Abu Qir plant III Energy map

The focus of EMS is the continuous awareness of energy and always try to reduce the energy consumption. This will make it possible for the organization to continue improvements in a cycle with, policymaking, action planning, implementation, control of results and preparation of new policies based on the results.

- Energy use and Consumption data is collected from the plant metering system in both Ammonia plant, Urea plant and utilities within the production daily Reports.
- Monthly energy use and consumption is collected from the Daily Report Form and reported in the Monthly Production and consumptions Reports.
- Energy Sources Consumption is collected and Analyzed in our implementation forms by Energy team to identify what energy opportunities exist.

Improving Energy efficiency through the best practices technologies helps to save energy, reduce costs, optimize resources, reduce greenhouse gas emissions and increase profits. we invest to be fully integrated fertilizer complex.

Chemist. Saad Abou El Maaty
Chairman and Managing Director

Do, Check, Act

Plant energy performance is measured by monitoring and comparing the change in energy consumption from one month to the other considering production output, and energy use at a reference year (Base line) with the subsequent years to determine the improvement or deterioration that has taken place since the reference (Base Line) year to facilitate monitoring of performance especially in the significant energy uses identified in energy profiling.

Energy team ensure that the key characteristics of its operations that determine energy performance are monitored, measured and analyzed at planned intervals (monthly Base) and use the action plans and other outputs resulting from the planning process for implementation and operation.

The energy team determines relevant variables, Static factors that significantly impacts energy performance and determine the criteria for significant energy uses, moreover Energy objectives & targets and the criterion for prioritizing the energy objectives are Prioritized and documented in the forms.

The overall purpose of the energy management system is to improve energy performance and to continually improve this performance and help us to be confident

that performance targets are being met and if not to alert you of any problems at an early stage.
The energy maps were built based on overall energy balance model for energy transformation stages within the process. These energy balances constructed in Excel format

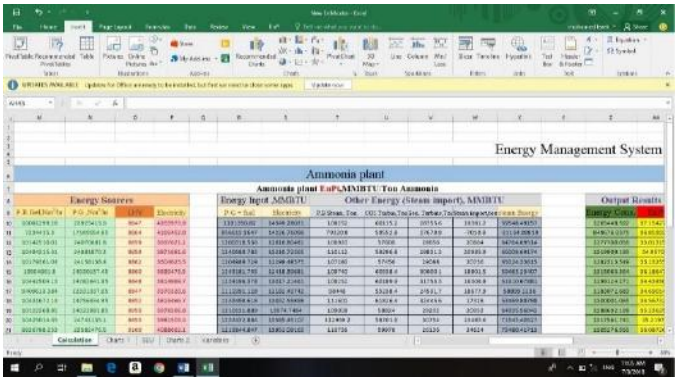

Figure 7. Abu Qir III Energy performance

Energy Performance Indicator (EnPi) is a quantitative value or measure of energy performance, so the organization should identify EnPi appropriate for monitoring and measuring its energy performance. The methodology for determine and updating the EnPi is: -

EnPi = (Feed + Fuel + Electricity + other energy) MMBTU / ton NH_3 production.

The concept of an EnPi can be used to compare organizational performance at different points in time. They should be selected to facilitate monitoring of performance especially in the significant energy uses identified in energy profiling.

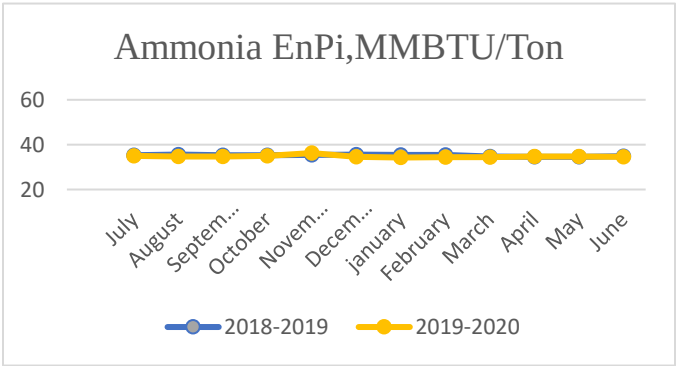

Figure 8. Energy performance indicator (EnPi)

Energy baseline was established considering a data period of fiscal year and Change in energy performance is measured against the energy baseline. The purpose of the energy baseline is to develop a starting point for measuring energy performance improvements.

Plant energy performance was measured by monitoring and comparing the change in energy consumption from one year to the other considering production output, and energy use at a reference year with the subsequent years to determine the improvement or deterioration that has taken place since the reference year.

A regression analysis was performed using the data from year (2018-2019), and a scatter diagram were generated as per to visualize the baseload of the present energy consumption and to obtain the linear equation of the compiled data. Also, the regression analysis was performed to develop a model that accurately describes the relationship between the X variables and Y variables, the correlation between the X and Y in order to calculate the energy base load as showing.

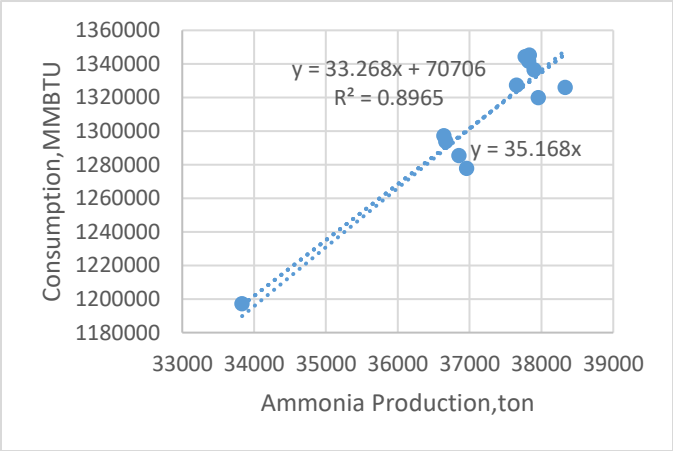

Figure 9. regression analysis

Abu Qir Fertilizers Plant III participated in the IFA Ammonia Plants Energy Efficiency and CO_2 Emissions Benchmarking. This benchmarking the energy efficiency performance and carbon dioxide emissions of the International Fertilizer Industry Association (IFA) member ammonia plants.
The nitrogenous fertilizer industry is a large energy consumer. Ammonia production is the most energy intensive step, accounting for 80-90% of the energy used in the fertilizer industry.

Transparency

Abu Qir Fertilizers Company ISO 5001 certificate is widely communicated, internally, through company internal communication network for employees and in entrance hall for visitors, and externally through the company website including all company certificates, awards, annual reports and sustainability reports were published.

http://abuqir.net/home

Abu Qir fertilizers Company is a member of several organizations such as International Fertilizers Association (IFA) and Arab Fertilizers Association (AFA) participating in technical and energy committees and work groups to introduce our energy management system achievement and best practices, and our success stories have been published in international conferences and magazines related to energy efficiency and sustainability. moreover, the company is holding Annual Water Treatment Technology conference in Alexandria, Egypt, as a main organizer.

http://wtt.abuqir.net/en/wttc

Figure 10. Energy Team (Iso 50001:2018 External Audit)

What We Would Have Done Differently

Implementation of energy management system became significant for energy efficiency improvement by the following future energy efficiency objectives and more opportunities for improvement which can we do for more productivity with low energy consumption and enhance our energy management system.

- Data analysis, Visualization and digitalization for energy management system improvement by revamping DCS system and utilizing simulation software and tools for equipment level (multi-levels) energy performance evaluation.
- Energy Dashboard for accurate online monitoring and analysis of energy consumption, production and dynamic energy performance indicator (EnPi) and cost saving that we achieved.
- Implement green technology such as green hydrogen and green ammonia in the future, hybrid with existing technology.
- Spreading energy management awareness sessions in a way that is sufficient to change energy efficiency culture, and motivate all employees for clear objectives and company long term strategic goals for business continuity and sustainability.

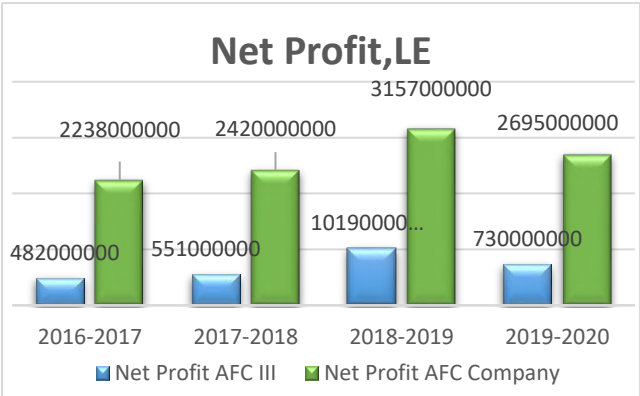

Figure 11. Net profit

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.

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together