

Saudi Arabian Glass Company (SAGCO)

The largest container glass manufacturer in the Middle East, SAGCO was one of first companies to achieve ISO 50001 in SAUDI ARABIA, the energy performance was improved by 6% during the E.N.M.s implementation period. And committed to a continual improvement with the integration of optimized energy applications in the forthcoming years to reach the 20% by 2030.



Case Study Snapshot

Industry	Glass
Product/Service	Glass containers manufacturing
Location	Jeddah , industrial area ,Western province of Saudi Arabia
Energy performance improvement percentage (over the improvement period)	6 % improvement over the years of EnMS implementation
Total energy cost savings (over the improvement period)	USD 910,000.00
Cost to implement Energy Management System (EnMS)	USD 78,260.00
Total energy savings (over the improvement period)	252778 MWh
Total CO₂-e emission reduction (over the improvement period)	110000 Metric Tons

Organization Profile / Business Case

As the largest glass producer in the Middle East, Saudi Arabia Glass Company has a total annual production capacity of approximately 360,000 metric tons, serving industrial and retail customers in local and international markets. A comprehensive range of food packaging products is sold under popular brands such as Coca-Cola, Pepsi and AB InBev, in addition to other types of food product brands such as Almarai, Al Shifa and others.

SAGCO operates in one integrated industrial complex that uses five furnaces in the Jeddah industrial area with a capacity of (1,000 metric tons/day packed) supported by a glass container decoration process, in addition to some logistical sites and warehouses spread locally and internationally.

Our Energy Management Motivation:

For more than 35 years, SAGCO has maintained domestic and international leadership in the glass container industry through competitive advantages that include a diverse, consistent, high-quality portfolio of glass container products and backed by an outstanding brand reputation and strong distribution networks.

However, there are many more risks facing our business in the medium and long term, which include increased competition and fluctuations in the prices of goods and raw materials.

We understood that raising the prices of finished products will not be a favorable strategy for SAGCO to follow.

It is also not possible to modify the raw materials and batch composition due to the precise requirements in the glass container industry. In such circumstances, we have chosen to impact our production costs by reducing energy consumption through implementing ISO 50001 - Energy Management System (“EnMS”).

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We were confident that the implementation of EnMS will not only provide us the opportunity to achieve the cost efficiency, but also an added value for our product quality and safety as we can integrate the ISO 50001 to impose stringent controls across all stages of our manufacturing processes along with various international quality management, health and safety management and food safety management standards. This strategy enabled us to remain focused on strengthening our supply chain, reinforcing our environmental base, and improving our productivity.

ISO 50001 certification Goals:

To achieve its strategic goals, SAGCO considers ISO 50001 certification a crucial factor, which includes reducing costs, improving operational efficiency, improving environmental and energy performance, and fully complying with government regulations.

Climate and sustainability strategy

We deeply understand our role in protecting the environment and caring for natural resources for current and future generations. Therefore, we strive to be responsible and apply precautionary measures as a way of managing our energy, as well as taking steps towards mitigating the effects of climate change and reducing greenhouse gas emissions (“GHG”).

The ISO 50001 provides a perfect approach to SAGCO, so that we can transform the way we manage our energy and integrated the EnMS into our business practices. We started our EnMs journey since 2017 when several governmental organizations and external consultants conducted visits to SAGCO and recommended the implementation of ISO 50001.

At that stage, the management realize the importance of the matter, and began raising awareness of the ISO

50001 standard and held several meetings to ascertain potential measures that could affect energy consumption and initiate the first steps to set up the EnMs. These efforts bore fruit in that period to launch the project of conversion of our Furnace 2 from Recuperative to Regenerative. At the same time, concerned departments started to be involved with monitoring energy consumption by manually collecting energy data and uploading it into classic database. Nevertheless, in order to refine our energy data before defining the energy baselines “as required by ISO 50006 guidelines”, Human errors in data entry were a real challenge that needed to be avoided.

This point has been successfully crossed through the digital transformation project which consist of the setup of Industry 4, a real-time process control system designed by (GE) General Electric, which initially focused on the glass melting production process, as the first stage of the project, in order to monitor furnaces behavior on one hand and collect energy data promptly in real time on the other hand. The development and full implementation of the

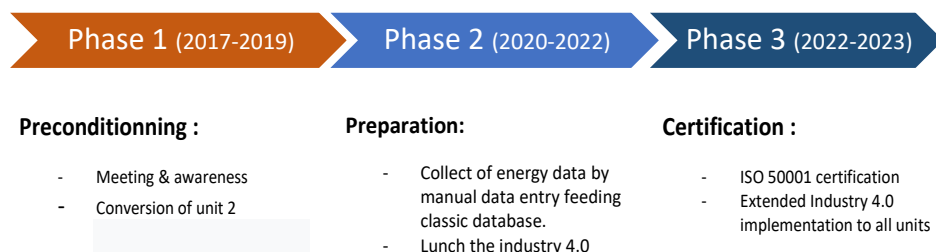


Figure 1. SAGCO journey on ENMS implementation

“Obtaining EnMs ISO 50001 considered a positive step supporting facility to improve energy utilization in which reduces costs, make optimal use of country’s wealth and authenticate the environment”.

—Rami Mohammed Aldobi, Plant manager

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documented ISO 50001-EnMS - Certification was postponed for two years (2020 to 2022) due to COVID-19. Thereafter, the project to fully implement the ISO 50001 Energy Management System was resumed by 2022 to finally obtain the EnMS Certification by 2023.

Business Benefits

To implement the ISO 50001-EnMS standard, we spent approximately US\$78,260, most of which was on the Energy Team working hours, technical assistance from external experts including training and consulting followed by certification costs. Considering our large and complex business, we realized that the cost of implementing the energy management system is negligible compared to all the positive impacts and benefits that could be gained from fully implementing ISO 50001-EnMS

Cost saving:

We achieved a US\$ 210,000 energy cost saving in the first year and continue to a total of almost US\$ 1 million (910,000) in five years of cumulative saving. Prior to determining the energy cost saving, we were measuring the energy performance by calculating the differences between actual energy consumption and the predicted energy consumption as given from the predetermined baseline.

The differences were displayed in the cumulative of sum (CUSUM) and clearly described our energy performance along with energy cost saving as displayed in the figure2.

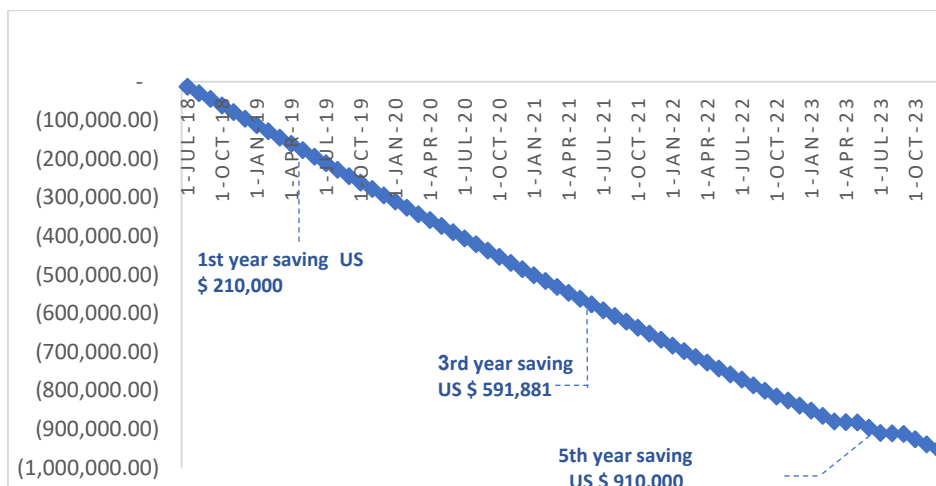


Fig2. Energy cost saving in five year cumulative.

Energy saving:

What was previously defined in terms of energy cost savings is also translated and evaluated on the basis of energy value, in fact, over the past five years, thanks to the conversion of furnace number two, the company has saved a huge amount of heavy fuel estimated at 33.7 million liters, which saved energy Equivalent to 910.5 Tera joules (252778 Mwh).

Clean & Renewable Energy application:

During recent years, the previously mentioned EnMS efforts have contributed to making the company more environmentally friendly. The furnace No 2 conversion project has contributed to reducing the rate of the amount of fuel burned / metric ton of glass melted by more than 40 %, which reduced the rate of emissions and thus reduced the rate of pollution in the surrounding community.

GHG emission reduction

Referring to the contribution of the previously mentioned projects during the past five years, such as the displacement of more than 35 million liters of fuel, thanks to changing the type of furnace No. 2. Saudi Arabian Glass Company achieved a saving of approximately 110,000 tons of dioxide equivalent. Carbon. During the EnMS setup journey.

Corporate social and governance benefits

ISO 5001 - EnMS has contributed to strengthening relations with government agencies, resulting that the Saudi Energy Efficiency Center (SEEC), chose to assist and cooperate fully with Saudi Arabian Glass Company to fully implement the ISO 50001- EnMS successfully. This cooperation and interest is continuing through the Energy Efficiency Center's keenness for Saudi Arabian Glass Company representatives to be present in awareness seminars and training campaigns related to energy efficiency at the national level (*please check QR code page5*).

The "Saudi Authority for Industrial Cities and Technology Zones," known as "Modon," contributed also to this issue by fully funding the campaign to evaluate the industrial digitization index IND4.0, conducted by the McKinsey consulting in SAGCO's plant.

It is worth noting that SAGCO became a key partner and initiator in the factories rehabilitation program to substitute fossil fuels with clean energy also. This is demonstrated by its summoning as a member of the development workshops for the government portal addressed to renewable energy projects, named "TANAFUSIYA" portal.

Plan

Leadership and commitment

As a leading manufacturer of food container glass for more than three decades, we are well aware that energy plays an essential role in our business, and, to be able to maintain the company's position in the long term. Therefore, our top management has demonstrated leadership and commitment with respect to continuous improvement in each stage of the implementation of EnMS. Our top management, also, is actively involved in regular energy meetings across the plant processes to discuss problems, solutions, and give suggestions related to both technical and financial aspects along with giving direct approval on financial support as required to speed up the entire progress.

"We believe that the implementation of ISO 50001 EnMS will help us enhance our corporate & social responsibility goals through reducing the cost of energy in our operations as well reducing the quantum of pollutants released into the atmosphere."

—Dr. Tariq Othman AlFadl, General Manager

Data quality and energy review

In order to review the Significant Energy Users running at SAGCO. We first tried to collect energy consumption data for 24 months from invoices for all types of energy used in the factory, and converting the data to energy amount (by kcal).

By sorting the results we found that 93% of the total energy consumed is contributed by fuel oil and electricity, mainly by fuel oil with 77% of the total amount of energy consumed.

In terms of scope of work and process, to determine the energy uses, a study was conducted with the aim of understanding the main energy types, SEU (Significant Energy Users) and the main energy application.

This study is a combination of instantaneous measurement and continuous examination of the energy used in all major equipment (oil, electricity, gas and diesel). Confirming the result reached in the previous study (in terms of source of energy type), we found that the melting of raw materials process, which mainly uses fuel oil, consumes more than 85% of the total energy.

The Sankey flow diagram (figure 3) demonstrate the flow of sources of energy through the energy users, then summarized by the scopes and processes.

Energy baseline

We develop energy and carbon footprint baselines based on statistical regression analysis which have the highest correlation ($R^2 > 90\%$) between energy consumption and emission against production parameters (Tab1). We set the input of the baseline formula as the quantity produced (melted or packed), the output of the formula is set as the

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quantity of energy estimated to be consumed from (electricity, HFO, LPG, diesel). As the Enms campaign start from 2018, we were defining 24 months from February 2015 to February 2017 as the base period of study due to the better quality of data and minimum data normalization.

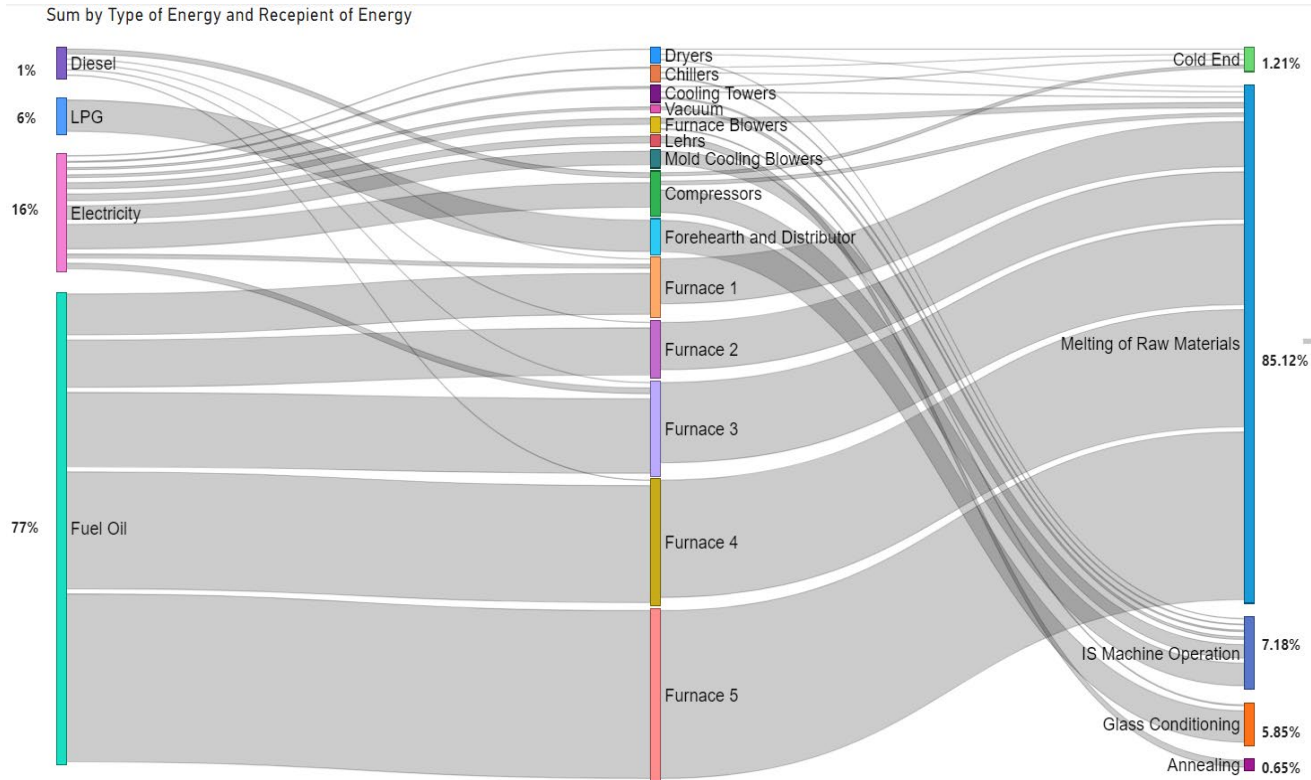


Figure 3. Sankey energy flow diagram from source of energy to process

“ISO 50001 is a real facilitator to improve system efficiency by ensuring an economical product and improving operational profit while considering environmental balance... Leading to sustainable business growth.”

—Issam Ali Abdelkefi, Energy manager

Support on strategy and energy target

After several meetings with relevant departments, we evaluated the energy saving potentials of the processes and equipment. By assessing each potential through a quantitative priority scoring matrix, taking into account the potential amount of energy saving, the level of difficulty, the time required to achieve, the

Unit	Source of energy	Baseline equation	Estimation quality (R ² >90%)
Unit1	energy	y = 0.1211 x + 39.211	92%
Unit2	energy	y = 0.2321 x + 157.02	90.7%
Unit3	energy	y = 0.194 x + 146.34	90.8%
Unit4	energy	y = 0.124 x + 489.33	97%
Unit5	energy	y = 0.1898 x + 208.84	96%
PLANT	CO2 carbon footprint	Y = 0.4818 X + 4001	96%
y = energy & emission, x = quantity of glass melted			
<i>Tab1 .Energy & emission baseline equations for fuel oil</i>			



“SEEC recommendation... Scan here... “

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investment rate return, and the impact on quality, where the potential with the highest evaluation value is transformed into an action program that is implemented to achieve energy saving. Moreover, this campaign takes into account our target of achieving energy efficiency of 3% per year as agreed with the management, **as SAGCO main target is to improve energy efficiency and reduce our carbon footprint by 20% from the baseline, by 2030.**

Do, Check, and Act

Based on the list of actions selected, we prepared the work program, then uploaded it into the ISOMS software, which is a program specialized on ISO workflow monitoring, we use specifically the action module.

Action control process:

The process consists on uploading the task with all details in ISOMS action log, and once the task deadline is reached, the program begins sending daily reminders to the person responsible for the action until close out. Weekly, a dashboard is sent to relevant departments showing the status of actions... Remaining pending actions are highlighted in monthly management meetings.

Employee skills improvement:

SAGCO continuously improves the awareness and skills of plant employees, with a particular focus on their understanding of the importance of energy efficiency. Since the implementation of Enms, efforts have begun and continued through regular awareness campaigns. Also, sharing awareness folders and presentations to all computers, enables the provision of information to all parties and fosters awareness of critical responsibility in energy control

SEET Team involvement:

To enhance this process, our top management has also formed a new organizational structure, called the SEET (SAGCO Energy Efficiency Team). The members of this team are experts from various specializations, headed by a certified energy manager, to lead energy across SAGCO's plant & processes, various departments and to directly report every progress and results to top management.

Brand Buzz: third party involvement:

The EnMS system has also been enhanced with BrandBuzz support, a specialized consulting firm that aids factories in building their Enms. The Brandbuzz team helped us quickly overcome the obstacles and accelerate the process of establishing the system. An external audit was carried out by brandbuzz to confirm the system's effectiveness, which allowed us to identify weaknesses prior to the certification audit of TUV Austria.



The screenshot displays the ISOMS 1.5.0 software interface. On the left is a dark blue sidebar menu with icons and labels for various modules: Dashboard, Master List, Doc Manager, Action Manager, Action Dashboard, Action Register, Sources, Priorities, OTP Manager, Training Manager, Risk Manager, Audit Manager, and MOC Manager. The main area shows a table of actions with columns for ID, SAGCO, and description. Several rows are highlighted in red, indicating pending or critical actions.

ID	SAGCO	Description
00010/2024	SAGCO	MOM 11 / 1. b : To initiate distinguishing between departmental audit and ISO system audit (once a year) in the calendar
00011/2024	SAGCO	MOM 11 / 1. c : Training and Awareness must be initiated one time per 2 months
00012/2024	SAGCO	MOM 11 / 2 : ENPI :We must take into account the booster consumption data to give a more accurate picture of consumption behavior
00013/2024	SAGCO	MOM 11 / 4 a : Service requesters must initiate the request through the software manwinwin to be registered and tracked
00014/2024	SAGCO	MOM 11 / 4. b : Action Procedure: The deviation will be taken into account if the current Enpi is 20% higher than the baseline
00015/2024	SAGCO	MOM 11 / 5 a :Involve Jihad and Ibrahim (Furnace incharge & safety incharge) to be active member of SEET team
00016/2024	SAGCO	Big fluctuation on the electrical consumption of the account number 30004725018 from 30-01-2024 to 27-02-2024
00017/2024	SAGCO	considerable fluctuation on electrical consumption on feeders related of the account number 30004725018 from 30-1-2024
0003/2024	SAGCO	Following the audit non conformity : this action will confirm the usage of the service communication log log book
0004/2024	SAGCO	Audit non conformity : Breakdown Maintenance: No formal request generated by user department. Reporting by phone or Whatsapp which is not auditable.
0005/2024	SAGCO	Preventive Maintenance System: System not optimized. (All equipment such as pumps and filters are not identified / numbered. Monthly PM for MCB's only have greasing as action point and no other observations or actions are recorded during this activity.
0006/2024	SAGCO	Unit 2 (Glass Service simulation study) to solve furnace pressure issue and optimize energy consumption.
0007/2024	SAGCO	objective is postponed : Unit 1, 3, 4 & 5 (Install O ₂ sensors in the waste gas for controlling the Air-to-Fuel ratio, minimizing the ingress of air and optimizing energy efficiency of the furnaces)

Figure 4. Snapshot from action module, on ISOMS “ISO management platform”

Assessing energy performance:

We also established **GE proficiency operation hub IND4.0** a Centralized Energy Monitoring System to enhance our energy management system on real-time basis, which in details includes all parameters related to melting area scope. With automated data reading and **real-time** actionable insights along the production, the system can collect energy consumption data and operation information then forming a classification of energy & carbon footprint consumption, sub-item and sub-area statistics. It includes online monitoring, analyzing and other functions.

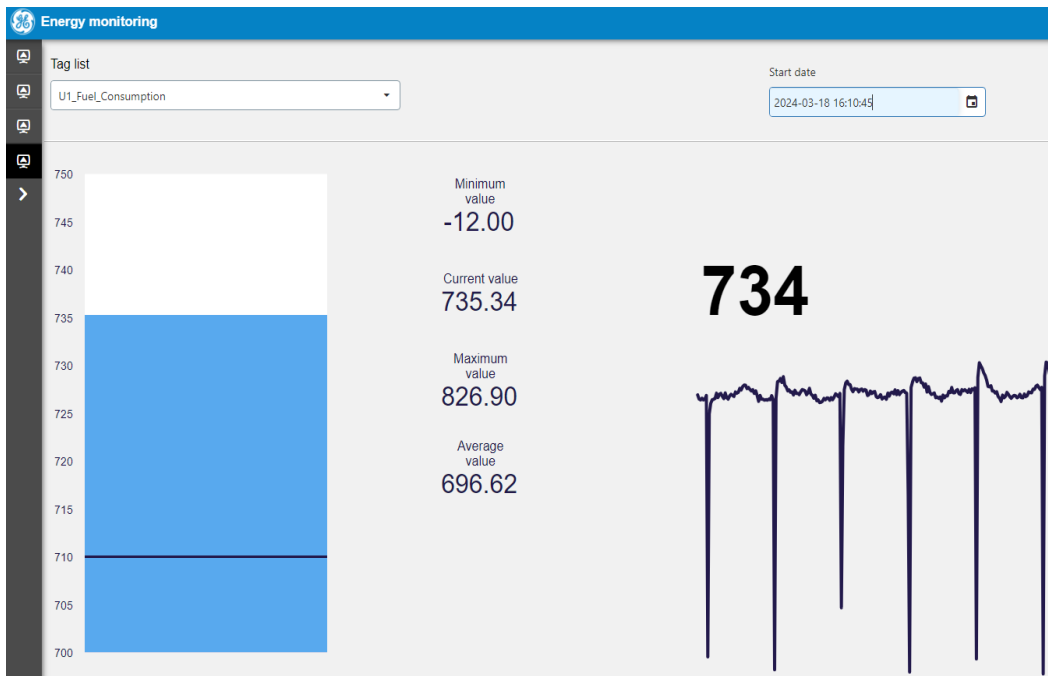


Figure 5. Snapshot from GE Real time centralized energy monitoring system

KPI definition:

Based on the energy review findings, management decided to base the KPI on the melting output as it was the most important area to focus on.

KPIs are defined as following:

Interest	Formula	Level of monitoring
Energy	$KPI_{energy} = \frac{Energy\ consumed\ (kcal)}{kg\ melted}$	Unit level
Carbon footprint	$KPI_{GHG} = \frac{ton\ CO2_E}{ton\ melted}$	Plant level

Although energy is monitored by unit, carbon footprint is evaluated at the plant level in general.

Real time Operations control:

Using real-time monitoring, through the GE IND4 dashboard, continuous control is performed to compare operating records with regressed values. We determined that over 20% deviation in one point of result, shall be addressed and recorded due to the probability of unusual events (eg. trial of new equipment or production for a special product) and other factors. Moreover, if a deviation occurred three times during a week, the 'red flag' will be sent to the impacted Process/Area responsible to lead the required action, then raise a non-conformity action on ISOMS, to be followed up, as described previously, in order to prevent recurrence of the problem.

Continual improvement and achievement:

During the preparation and certification period of ISO 50001 - EnMS, i.e. from July 2018 to July 2023. Total energy saved was estimated at 915 TJ, equivalent to 6% of total energy consumed during the same period.

With reference to the data analysis from 2016 to 2023, we found a 52 percent reduction in the KPI_{energy} on the level of unit 5. During the same comparison period, at the entire plant level, the GHG performance index KPI_{GHG}

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was decreased by 8 per cent. This was a very encouraging result given the large amount of energy and carbon footprint saved during the certification, during the 2023 energy management review meeting, top management stated their satisfaction with the achieved energy savings and have set an Energy and carbon footprint improvement target of 3% annually starting from January 2024 and then to reach the overall Energy & GHG emission improvement target of 20% by July 2030. The effectiveness of our ISO 50001 – EnMS is reviewed after bi-monthly scheduled internal audits (system and processes) in each production unit and department.

Considering the outcome of the energy review. The Procurement Department has put in place a strict policy to make sure that all requirements and information specified in the procurement procedure are fulfilled for the melting process, regardless of whether it's fuel or equipment.

“ISO 50001:2018 incorporates more business management terminology and concepts ensuring that systems and information are integrated into SAGCO’s overall business processes... Rather than being separate entities.”

—Nicolaas de Wet , Management Systems Consultant

Transparency

Our progress and results in achieving the ISO 50001 - EnMS are reported to and validated by our Government through the Saudi Center for Energy Efficiency (SEEC) (***please check QR code page5***) which continuously monitored all steps of the EnMS implementation project until obtaining certification. The Saudi Center for Energy Efficiency provides an online platform called **50001 Ready**. This platform allows companies to schedule and follow up on the work required in a smooth and accurate manner to establish the EnMS. However, on the other hand, the platform provides the center with the database required to evaluate transparently the status of the EnMS project in the participating company. And it is not limited to this. Just so, even after the certification, communication with the center continued by scheduling some checkpoints to verify progress in achieving the goals and confirm whether there was a format for improvement or not.

What we can do differently

Lesson learned

Within almost five years, since the start of The EnMS implementation campaign, there are several lessons that can be learned for our improvement of EnMS:

- The implementation of simple baseline regression must be changed to multiple variable regression, specifically on the glass melting process where Energy consumption are significantly affected, considering that the percentage of cullet (recycled glass) used in the raw material batches, are limited and can frequently change due to low availability of recycled glass in Saudi Arabia.
- With the start of EnMS implementation, Manual data entry using classic databases such as MS Access, has helped us to start monitoring. However, manual data entry significantly contributed to mistakes on energy consumption data as the information was not digitalized in real time and integrated with factory operational systems.

Forward looking

As we work toward extended EnMS implementation on the next phase, we plan to improve our SMART Industry Readiness Index framework, by consolidating the usage of some industry 4 revolution tools recently activated in the Plant processes, for example, the Power Bi solution, and the Google Forms solution. Along with the online and real-time monitoring solution through the GE product. We expect that our energy monitoring systems will be centrally integrated covering remaining manufacturing and logistics operations.



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.