

ISO 50001 Energy Management System Case Study

2020

United Arab Emirates (UAE)

Tabreed

Establishing PMT as part of commitment to enhanced Energy Efficiency



Tabreed Plant, Dubai, UAE

Organization Profile & Business Case

National Central Cooling Company PJSC (DFM: Tabreed), is the leading UAE-based district cooling developer. For over 20 years, Tabreed has remained the partner of choice in providing environmentally friendly district cooling solutions that support the region's energy sustainability strategy. Driven by this strategy and commitment from Top Management, Tabreed received ISO50001:2018 certification for the successful implementation of its Energy Management System (EnMS), becoming the first district cooling company in the region to have been certified under the revised (2018) version of the standard.

In order to implement sound EnMS, the core focus was Tabreed's initiative focusing on reducing their energy consumption across our chilled water plants. In March 2018 the "Performance Management Team (or PMT)" was established with an intent to enhance operational excellence and due focus on energy efficiency requirements across all its plants.

Case Study Snapshot

Industry	District Cooling
Product/Service	Chilled Water
Location	UAE
Energy management system	ISO 50001
Energy performance improvement period, in years	One
Energy Performance Improvement (%) over improvement period	1%
Total energy cost savings over improvement period	\$USD 1.1million
Cost to implement EnMS	\$USD269,343
Total Energy Savings over improvement period	35,138GJ
Total CO ₂ -e emission reduction over improvement period	0.006 million metric tons

Being awarded with an ISO 50001 certification is a clear manifestation of Tabreed's efforts of more than 20 years in optimizing energy efficiency.

—Bader Al Lamki, CEO

Business Benefits

As a recognition of Tabreed’s energy management efforts that were vividly reflected by PMT initiatives, ISO 50001 was attained in 2019 making Tabreed the first District Cooling company to do so under the revised version 2018. PMT was instrumental in transforming the way Tabreed operated their plants by seeking and deploying innovative approaches to enhance Operational Excellence. All collective efforts and initiatives yielded the following:

- Total electrical energy savings for 2019 were enough to power 117,500 homes in the UAE every year while preventing the release of several metric tons of carbon dioxide into the atmosphere. This is equivalent to eliminating the emissions from 268,000 vehicles annually.
- Enhanced the electrical performance of plants (KW/RT) by 1% of energy baseline (2019 vs. 2018).
- Enabled higher energy savings.

These results motivated Tabreed to look on studying and expanding the successful implementations in the upcoming years, which would result in enhanced operation strategies and substantial reduction in energy.

By implementing the EnMS, Tabreed focused on the following key initiatives that would benefit our business in the long run. These initiatives are described in the subsequent sections:

- Digital Transformation: collecting and historizing operational data from its geographically scattered plants.
- Artificial Intelligence: to improve online condition monitoring techniques using live data.
- Optimization Software: to enhance the plant electrical performance.

In 2019, these initiatives led Tabreed, in general, and PMT, in specific, to embark on certain energy efficiency endeavors including but not limited to:

- Designing and conducting specific training programs to bridge the gaps in areas related to energy

management and operational excellence (e.g. Introduction to Energy Management, PID Tuning and Optimized Cooling Towers Operation).

- Collaboration with customers: A custom-made recommendation plan was presented to each customer in order to enhance their air and chilled water systems, which would result in higher Delta T and lower electrical consumption for the customer and Tabreed.
- R&D Initiative: Building partnership with UAE-based Khalifa University (KU) to develop research initiatives called ‘Optimal Chiller Plant Control’. This tool would look at the multivariable effecting chiller efficiency and calculate in the background the optimal cooling tower number and speed required to reject the chiller’s heat load.

The cost to implement the EnMS included:

- Internal staff time to develop and implement EnMS: USD30,439.
- Prepare for external audit: USD4,348.
- Additional monitoring and metering equipment installed to meet EnMS requirements: USD220,000
- Third-party audit: USD5,299.
- Consultants to assist with EnMS: USD9,103

Internal/external staff time to develop, implement, and maintain EnMS was less than a half year of equivalent staff time.

Overall energy cost savings were \$USD 1.1million; approximately USD715,000 were savings from the EnMS/Operation Excellence and USD385,000 savings were from projects with capital investments. Percent of overall cost savings that was due to operational savings were between 50-75%.



Figure: Lower Inlet Temp. Effect on Chiller Performance

Plan

Tabreed operates in a competitive market, where constructing and operating district cooling plants is inherently risky. Consequently, as part of Management initiatives focusing on energy efficiency across chilled water plants, in March 2018 the “Performance Management Team (PMT)” was established with an intent to enhance the operational excellence in Tabreed plants. The decision was based on the individual trials and strategies that was carried out prior to that date, realizing the potential spectrum of energy savings with its environmental and financial impact.

One of the primary endeavors led by the PMT was “**Digital Transformation**”, which entailed collecting and historizing operational data from several Tabreed’s geographically scattered plants. Under this endeavor, Tabreed became **the first district cooling company** worldwide to utilize the “**PI**” software, which is a sophisticated plant historian and analysis package. The PI would collect process and equipment data from 20 plants with a 1-minute frequency. It allowed PMT to leverage on “Big Data” analysis in order to provide more process insights and recommend enhancements proactively.

An ideal example on how utilizing “artificial intelligence” enabled PMT to develop and continuously improve online condition monitoring techniques using live data would be “Chiller Management Solution”. This is a holistic strategy that aims to monitor chiller’s performance, analyze its current conditions, provide automated notifications to Tabreed’s Operation and Maintenance teams, set priorities for most efficient equipment to run and assist Maintenance to enhance the quality of their work. Since chillers are “Significant Energy Users (SEU)” in the district cooling process, consuming 70-80% of total plant electrical input, this initiative resulted in achieving significant energy reductions. Utilizing PI to identify issues hindering plants’ optimal performance that shall produce savings in the magnitude of 0.5-1% reduction of the total electrical performance (KW/RT) of the plants connected to PI.

The successful establishment of PMT, initiatives taken by them and the optimal results and savings obtained thereof enticed the Management to consider ISO50001 certification. In addition to resources allocated to establish the PMT and run its functions, the Management also provided resources for implementing sound EnMS. This included establishing an Energy Management Team (EnMT) to oversee EnMS implementation, providing essential training (CEM, Lead Auditor, etc.) to key PMT and EnMT members, and engaging accredited third-party auditors to assess EnMS implementation. In 2019, as an acknowledgement of successful implementation of its EnMS, Tabreed became the first district cooling company in the region to have been certified under the revised (2018) version of ISO50001.

The EnMS was implemented at multiple Tabreed plants. Detailed excel-based tool sheets were developed containing, beside other things, the data obtained from PI for energy consumption by plants and respective SEUs, data trend analysis, EnPIs, action plan for energy efficiency improvements, and monitoring and measurement plan as well as the maintenance criteria for SEUs. In 2020, these tool sheets will be linked with PMT’s Business Intelligence tool to ensure fail-safe automation of data acquisition.

The EnMS was integrated into the existing management systems to ensure that all Tabreed departments (incl. Finance, Supply Chain, and Projects) were aligned and onboard with Tabreed’s strategies and key objectives. For example, those contractors were prequalified who either were ISO50001 certified or had implemented energy management in their processes.

“Our commitment towards sustainability is evident through our robust EnMS, which is particularly important within the context of GCC’s growing demand for environmentally friendly cooling solutions.”

—Bader Al Lamki, CEO

Do, Check, Act

As part of the implementation process, firstly the Top Management endorsed the EnMS Policy and provided resources for establishing the PMT with an intent to enhance operational excellence and due focus on energy efficiency. Secondly, the EnMT was established to oversee the EnM implementation process and ensure ISO requirements were met to help achieve the certification. The EnMT included a representative from PMT and members from various Tabreed departments including HSEQ, HR, Admin, Supply Chain, Operations and Maintenance. Each EnMT member played a vital role in ensuring smooth implementation of EnMS from different perspectives. Although the EnM monitoring and implementation started with one plant, more plants were added as soon as the data was available via PI Tool.

Top management supported by determining and resolving external and internal issues, providing the resources for establishing teams and purchasing equipment, ensuring competency, such as through training, and attending strategic meetings, such as Management Review and Steering Committee.

Some of the key activities efficiently implemented were:

Low Delta T Syndrome: A custom made recommendation plan was presented to each customer in order to enhance their air and chilled water systems, which would result in higher Delta T and lower electrical consumption for both the customers and Tabreed. Target achieved: Results on the customers' side showed good improvements (of up to 30% reduction in customer's electricity bills) in cases where Tabreed PMT's recommendations were fully adopted.

Digital Transformation: This is described in the previous section.

Target achieved: The successful implementation resulted in significant energy reductions totaling at around 1% reduction in electrical consumption of plants connected to PI.

Optimization Software: The optimization software is divided into 2 main categories: Dynamic (online) and

Plant Optimum (offline) control. Dynamic control software evaluates all variables effecting the process, then using the "Advanced Process Control" and patented optimization techniques, it sends set points to plant's cooling equipment (chillers, chilled water pumps, condenser water pumps and cooling towers) which shall result in a holistic reduction of electrical energy consumed across the whole plant. The software is dynamic in nature since it acts directly in autonomous mode with any disturbance in the process ensuring that the plant is optimized under any condition. The Offline Control software is based on weather forecasts that impact the plant cooling production, which ultimately depicts the minimum number of cooling equipment and the optimal chilled water flow required across the network. Boundary limits are added in order to maintain comfort cooling to customers while optimizing the flow required. Both techniques ensure that the minimum electrical energy is required to deliver chilled water to the customer without deterring their cooling requirements.

Target achieved: Plant electrical performance enhancement in the range of 5-11%.

Optimal Chiller Plant Control: The proprietary solution consists of an offline smart tool capable of selecting optimal running conditions for the cooling equipment depending on actual measured samples, using accurate empirical heat exchange models and historical data collected. This tool looks at the multivariable effecting the chiller's efficiency and calculates in the background the optimal cooling tower number and speed required to reject the chiller's heat load. Ultimately it ensures that the total electrical power consumed through the condenser and chiller systems are aggregated at its lowest possible.

Target achieved: Initial results showed 2% of electrical energy savings in the plant where the tool is currently implemented.

Methodology for determining energy performance improvement: Based on Interaction protocol for

measurement and verification (IPMV), using combined options of B and C depending on sub meters validity.

Timeline for baseline reporting period: The baseline is set based on previous year data and during Management Review and Steering Committee meetings, as applicable. Whereas, the plants and SEU consumption data is organized on quarterly bases for trend analysis and subsequent reporting to auditors.

Regression analysis: was used to identify plant energy models considering variables of weather (especially wet bulb) and cooling production mainly. Tools used excel and R studio.

Detailed EnMS Action Plan: Tabreed has developed a detailed Action Plan to ensure that essential energy management initiatives are realized, implemented, monitored and checked for effectiveness. The action plan includes the following:

- Allocation of responsibility for energy management action plan tasks
- Statement of initiatives addressed by the action plan
- Summary of actions to meet the initiatives:
 - i. Measures that will be taken to monitor energy performance
 - ii. Necessary changes to competence, training and awareness
 - iii. Necessary changes to operational controls and communication
- Allocation of resources (human, technical and financial) for implementation of the action plan
- Methods to verify energy performance improvement achieved by execution of the action plan for an energy improvement opportunity
- Methods to verify the effectiveness for all the activities in the action plan
- Schedule for completion of planned actions
- Schedule for reviewing and updating the plan

The action plans are documented and updated at defined intervals fulfilling the requirements of ISO 50001:2018.

Third-party EnMS Audit: An external, accredited Consultant was engaged to perform the gap analysis. The Consultant worked closely with EnMT to update the existing and prepare additional documentation necessary for the third-party audit. Once Tabreed Management was comfortable that the EnMS documentation and implementation was effective, the third-party auditors were engaged. Both the Stage I and II audits were conducted with a gap of six months before confirming Tabreed’s ISO50001 certification.

Training and Awareness: Several training sessions, technical and EnMS based, have been provided to both the PMT and EnMT members respectively. These include Certified Energy Manager (CEM) and ISO50001:2018 Implementation and Lead Auditor courses. Tabreed employees are communicated regularly on energy management tips, initiatives, results and improvements in energy savings using tools such as ‘Performance Dashboards’ and ‘Electronic Display Screens’.

EnM Provisions in Tabreed’s Procurement Process: To ensure the energy performance of procedure equipment and services, Tabreed communicates with relevant parties (contractors, suppliers, etc.) as follows:

- During pre-qualification and bidding stages: through a simple compliance questionnaire inquiring about their ISO50001 certification and/or energy management initiatives
- During the provision of services or equipment: to ensure compliance and raise any non-conformities



Figure: Chiller Monitoring Screen

Transparency

Tabreed’s ISO50001:2018 certification received the following media coverage:

- Al Bayan; Arabic (11 Sep 2019)
- Al Khaleej; Arabic (11 Sep 2019)
- Gulf Today; English (11 Sep 2019)
- Al Watan Voice; Arabic, online (11 Sep 2019)
- Trade Arabia; English, online (10 Sep 2019)
- Utilities Middle East; English, online (10 Sep 2019)
- Zawya; English, online (10 Sep 2019)
- Gulf Industry Online; English (10 Sep 2019)
- Trade Arabia; English, online
- Gulfprojects.me; English, online (10 Sep 2019)
- Oil & Gas News (OGN); English, online

Furthermore, Tabreed is consistently collaborating with UAE’s Department of Energy (DOE) regarding the implementation of its EnMS and effectiveness of energy efficiency measures.

Lessons Learned

Tabreed Management is satisfied with our approach to establish and implement EnMS that resulted in adopting various energy efficiency measures. The continuous monitoring of EnMS will shed light on continual improvement. However, the following could be considered for enhanced results:

- Follow a more systematic approach starting from the conceptual design phase, execution and finish it with standardized measurements and verification (M&V) plans.
- Use standardized M&V plans according to IPMV for assessing all energy management strategies results.

- Thorough preliminary assessment, based on best practices using accurate empirical or regression energy models, can help in reducing financial and operations risks when selecting EnM initiatives.

“ISO50001 helped Tabreed in assessing the different EnMS by adopting a systematic approach, which guided the strategic decisions of deploying state of art optimization technologies in district cooling industries”.

— Jean-Francois Chartrain, COO

“EnM is a holistic approach that should include all aspects of your process from the equipment level performance, maintenance adequacy, human interference up to management believe in change.”

—Mohamad Tamer, Head of Tabreed PMT



Figure: Discussion on plant energy efficiency data (using PI Tool) at PMT’s Center of Operational Excellence (COE)

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.

