

ISO 50001 Energy Management System Case Study

Argentina

YPF

Reductions achieved with the EnMS reached 33.7%, which is equivalent to US\$2.77 million in 7 years.



Organization Profile & Business Case

YPF S.A.: Organization Profile

As the leading Company in Energy and Hydrocarbons in Argentina, YPF headquarters are located in Puerto Madero. The Torre YPF Puerto Madero is a 160-meter-tall building with 37 office floors, 4 technical plants and 3 basements, with a total surface of around 72,000 m² that holds 2,800 employees a day.

The Tower has an Intelligent Management Central System that runs the HVAC system, electric power, lightning, access control and fire detection and extinguishing system. The thermo-mechanical system (which is the most significant) features a water cooling plant, composed of 4 chillers, 7 cooling towers and 37 air handling units. The total installed power in this building is of 8 MW.

With the purpose of promoting sustainable energy development in its three dimensions (economical, environmental and social) through a responsible and transparent business, based on innovation from new technologies and responsible practices, YPF committed itself to using the energy it produces and commercializes

Case Study Snapshot

Industry	Oil & Gas / Energy
Product/Service	Exploration and production of hydrocarbons and refining and commercialization of fuels / Energy generation
Location	Buenos Aires, Argentina
Energy management system	ISO 50001
Energy performance improvement period	7 years
Energy Performance Improvement (%) over improvement period	33.47%
Total energy cost savings over improvement period	2.77 Million \$USD
Cost to implement EnMS	296,820.51 \$USD
Total Energy Savings over improvement period	101,055.6 GJ
Total CO ₂ -e emission reduction over improvement period	15,017.76 Metric tons

in an efficient way in all of its businesses, not only to reduce emissions and contribute to mitigating climate change effects but also to preserve natural resources.

This commitment implies setting sustainability goals, plans and objectives that are transversal to the Company, which guarantee a periodical performance review and mechanisms for continuous improvement, on top of renewing the Company's pledge with the 10 Goals of the UN Global Compact.

Business Case: Torre YPF Puerto Madero

The Department of Patrimonial Management (DPM), which is responsible for running and managing the Tower, recorded in 2012 an annual consumption of 18,688 MWh; this is equivalent to the consumption of 2,270 average homes in Argentina. This encouraged the evaluation of the efficiency of energy consumption in the Torre YPF Puerto Madero and posed the challenge of reducing its consumption.

This challenge was not based on the expectation of economic savings, given that energy costs were low, but on the benefits associated with the reduction of the energy-environmental impact.

Business Benefits

Implementation of EnMS generated a 33.47% reduction of the Annual Energy Normalized Consumption (AECN), representing US\$ 2.77¹ million savings, 28,071 MWh not consumed, and 15,017 tons of CO2 not emitted.

Annual energy consumption (AEC)			
Year	Real [MWh]	Normalized [MWh]	%
2012	18688	18682	-
2015	13522	18554	26.94%
2018	12324	18577	33.47%

From the point of view of sustainability, energy saved is equivalent to 2.28² years of the building's actual energy consumption and the amount of CO2 not emitted during these 7 years represents the ability to catch 824 hectares of forests.

Economic savings allowed to feedback the management system making it possible to reinvest in new sustainability projects.

It's worth mentioning that, in the period 2012-2015, the reduction of energy consumption had already reached 26.94%, since actions taken during this period had a meaningful and direct impact in the improvement of energy performance.

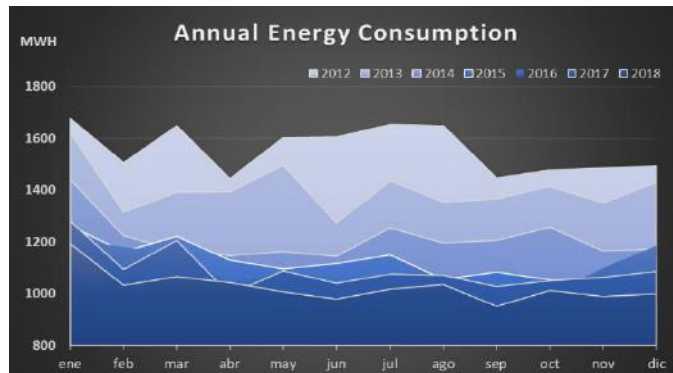


Figure 1 - Real Annual Energy Consumption

Since 2016, reaching new goals in consumption reduction represented a harder challenge, and only through the implementation of the ISO 50,001 standard did we manage to reach a reduction of 6.53% in the following period.

“Being part of an organization that is committed to sustainability generates motivation and satisfaction in its employees.”

—Jorge Martins, Management Representative ISO 50001

Implementation Costs

Concept	Costs summary
Personnel Training ³	USD -
Consultancy ³	USD -
Staff cost to develop, implement	USD 104,666.67
Internal/external staff cost to maintain	USD 45,333.33
Hardware	USD 20,000.00
Software	USD 122,000.00
Third-party auditing	USD 4,820.51
Total	USD 296,820.51

Plan

Organization Strategy

Between 2012 and 2015, the DPM identified specific cases where energy consumption did not have efficient management controls. For those cases, corrective actions were taken in order to obtain a controlled consumption in normal operating conditions.

Nonetheless, results showed that these isolated actions were not enough. In the year 2015, the Company signed an energy commitment and took the first step towards a

¹ Considering the fluctuation of energy costs & money exchange between 2012-2018. (58.37-129.71 USD/MWh and 4.34-39.60 ARP/USD).

² Actual Annual Consumption: 12324 MWh

³ These two concepts were provided and paid by the Argentinian Energy Secretary.

future focused on sustainability and the efficient use of energy.

In that same year, the senior management of the DPM promoted the gathering of a multidisciplinary team with members of the maintenance and security and environment areas, for the implementation of the EnMS in Torre YPF Puerto Madero. Regular meetings were held to plan the activities related to the implementation of the EnMS with the goal of obtaining the ISO 50,001 certification in 2017, integrating it in this way into the already certified environmental, security and occupational health management system (ISO 14,001 and OHSAS 18,001).

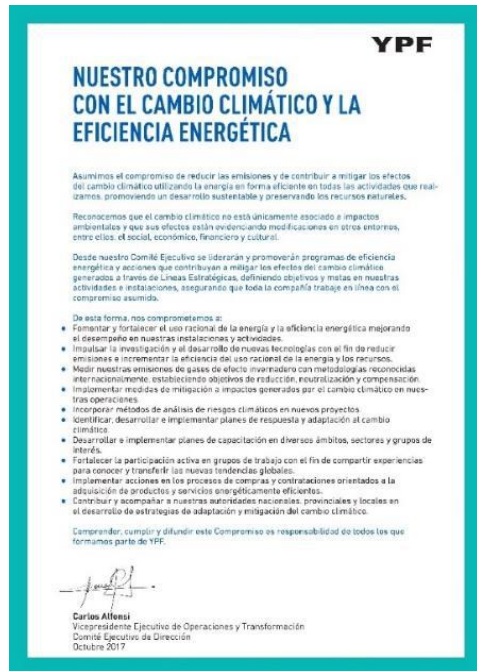


Figure 2 - Commitment to climate change and energy efficiency

Planning

The first step towards defining the action plan was to get to know in depth our energy scenario, as well as the associated activities and actors involved in the use and consumption of energy.

At the beginning of 2016, the first energy review was held. As a result, building energy distribution was obtained. Following, the current distribution is showed:

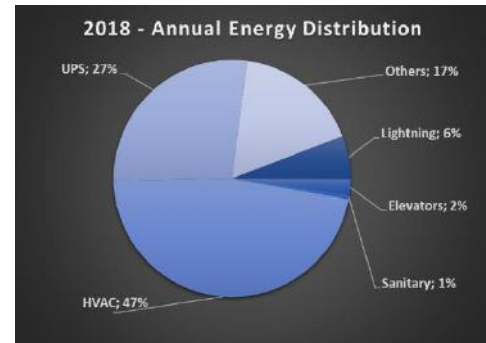


Figure 3 – 2018 Annual Energy Distribution

Furthermore, we were able to make visible the following:

- Main actors
- Energy usage
- Variables that impact on energy consumption (external temperature, humidity, amount of people in the building, seasonality, etc.)
- Inventory of all of the electrical equipment in the building

In this way, we were able to identify that the HVAC system was the main one in the distribution of energy and where more savings could be obtained if certain controls were applied.

Through that analysis, we determined the following:

- Baseline with energy distribution
- Criteria related to the most significant usage
 - More than 20% of energy distribution
 - Savings through an investment with a repay lower than 5 years.

Operational controls were designed based on the knowledge of significant consumption. Said controls were able to efficiently fulfill the energy demands of the building.

At the same time, trainings and specific communications were programmed for different actors according to their activities, distinguishing between: users, system operators, equipment maintenance managers, system implementers and buyers, among others.

Also, a program of objectives with specific goals was established according to the available resources, which included new savings projects, improvements in

measurement and monitoring of energy performance and improvements in operational control.

A methodology for evaluating new product or services purchases in terms of energy was designed. Furthermore, for new projects, an instance of energy and operational design evaluation was incorporated.

“ISO 50001 made us realize that operational control is more important than making great investments”

—Javier Diaz Saubidet, DPM Manager

Do, Check, Act

Implementation

From the annual objectives approved by the senior management, an action plan was drawn up to improve the efficiency of the equipment. This program included budgets, actions, deadlines and responsibilities. Some of the most relevant milestones were:

2011 – 2012

- Commissioning of the main facilities – First baseline

2013 – 2014

- Implementation of plans for consumption reduction

2015 – 2016

- The first Commitment to climate change and energy efficiency was developed and published
- Purchase and installation of energy analyzers – new baseline of the EnMS.
- Design of standardized performance indicators
- Participation in the Support Program of the Sub-secretary of Energy Saving and Efficiency
- Development and implementation of real-time monitoring software

2017 – 2018

- Commitment to climate change and energy efficiency of the Company was updated.
- Design of new monitoring tools

- Design and implementation of new operational control procedures (considering maximum power, temperature settings, time lapses and seasonality, extended lightning requests)
- ISO 50001:11 certification
- Acquisition of new technologies for monitoring and managing
- Dimming of lightning (2017)
- Automation of the cooling plant (2018)
- Technical-economic evaluation for possible saving and renewable energy projects, the following being applied:
 - Replacement of fluorescent lightning for LED
 - Photovoltaic panels of 25 kWp at the entrance of the building (2018)

As of certification of the EnMS, the senior management decided to incorporate a new professional to the multidisciplinary team who is specialized in EnMS.



Figure 4 - Photovoltaic panels at the entrance of TPM

Energy Performance Indicators (EnPI)

For the assessment of energy performance of the tower, 3 indicators were designed:

EnPI 1 – Energy consumed by the UPSs: Monthly comparison between the normalized uninterrupted energy (Regression: $R^2 = 88.23\%$) and real uninterrupted energy consumption

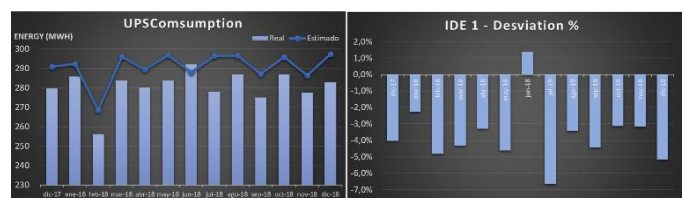


Figure 5 - Variables: Company occupancy, business days

EnPI 2 – Total energy consumed: Monthly comparison between the normalized total energy (Regression: $R^2_{\text{summer}}=83.22\%$; $R^2_{\text{winter}}=81.3\%$) and real total energy consumption

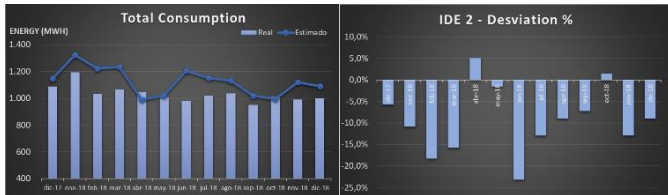


Figure 6 - Variables: DT18, accumulated cloudiness, business days

For both EnPIs, the normalized energy was obtained through a multivariable lineal regression in which the monthly consumptions of the baseline (2012) were taken together with the variables that had a dependency relationship ($R^2 > 80\%$). So, normalized energy is the energy with operation and installation conditions of the baseline, but with the values of the variables in the analysis period.

$$\text{Normalized Energy} = A_0 + A_1 \times X + A_2 \times Y + A_3 \times Z$$

A_0, A_1, A_2, A_3 = regression constants

X, Y, Z = period analyzed variables

Based on this standardization, energy efficiency and consumption reduction could be analyzed.

EnPI 3 – Interannual Energy Consumption: Comparison of interannual energy consumption considering business days and additional events (usage outside procedures)

In this EnPI, business days from the baseline are taken as a reference to compare year to year. So, if in the current month there were 20 business days and in the same month in 2015 there were 22, the corresponding energy of those 2 extra business days would have to be added.

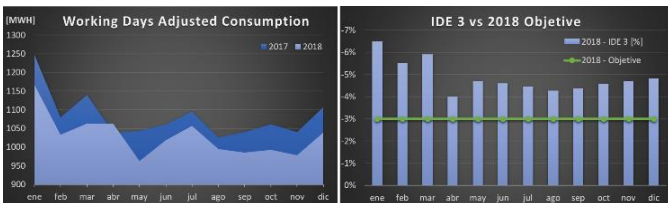


Figure 7 – Monitoring of interannual savings

Operational Control

Some of the considerations in terms of operational control are as follows:

Monitoring of the general consumption of the building in time slots and average and maximum power values

- Control of critical equipment
- Minimum and maximum temperature settings
- Time slots for lightning
- Procedure to request the extension of the lighting schedule
- HVAC plant: number of machines and operating hours
- Seasonality

Implementation of a monitoring software for energy analyzers is a key tool for monitoring and operational control.

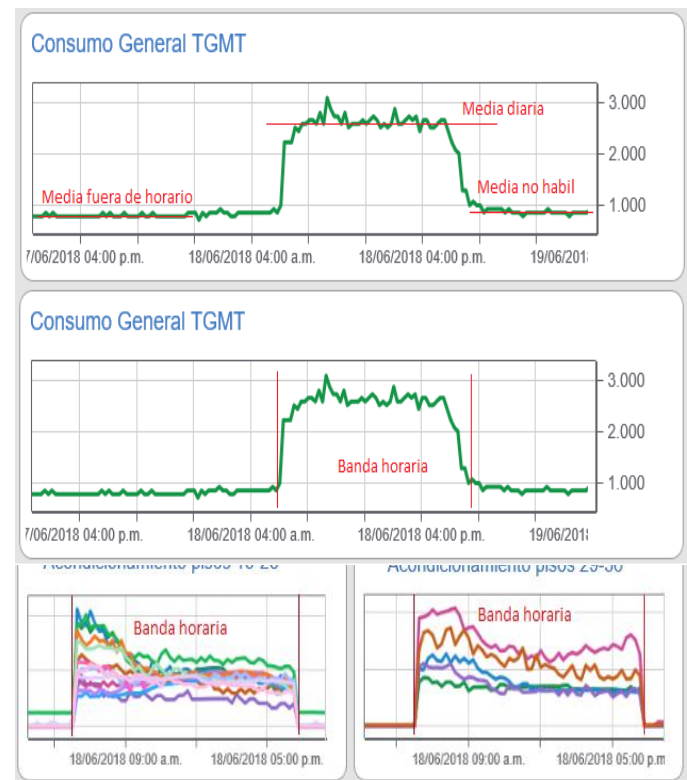


Figure 8 – Operational Control

This allows us to detect deviations from the procedure. In each case, an analysis of the cause is carried out and corrective actions are taken with the aim of feed backing the system.

The results of the execution of these controls can be seen in Figure 9, in which the years 2012 and 2018 are compared, and where the defined time slots, as well as the controlled maximum power and the stabilization of consumptions in non-working days hours are visible.

Monitoring & results

Every month, EnPIs are monitored and registered deviations are analyzed. Simultaneously, goal reaching is monitored, and operational controls are performed.

A monthly consumption report is prepared and presented to the senior management, where the monthly detected deviations are described together with their causes and the actions defined for its correction, the status of the objective for reduction and its projection.

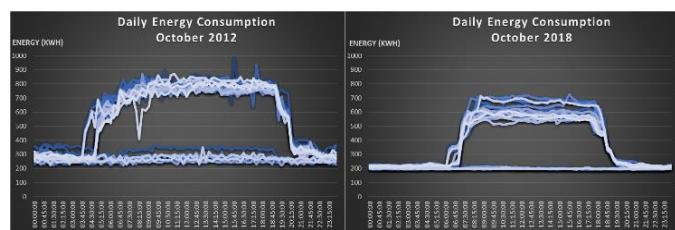


Figure 9 – Histogram of the energy consumed every 15 minutes

Every semester, an energy review is performed, in which improvement opportunities are detected, future consumptions are analyzed (including new sources of energy, equipment changes or new consumptions) and the need to modify the baseline and other items of the EnMS is evaluated.

Once a year, the Senior Management Review of our integrated management system takes place (ISO 50001:11; OHSAS 18001:07; ISO 14001:15), where achieved goals are analyzed, new targets are set, future projects are defined, and the assurance of continual

improvement of energy, environmental and security performance is verified.

Transparency

Every year, the Company generates a sustainability report, following the international standards of the Global Reporting Initiative (GRI), in order to communicate the environmental, social and financial performance. The information posted is veracious, contrastable, adequate and faithful. It includes energy performance and the Company commitment to sustainability.

These reports are published in the website of the Company: <https://sustentabilidad.ypf.com/>

Lessons Learned

The experience in Torre YPF Puerto Madero has been successful. Never the less, if we had to do it again, we would do some things in a different way:

- Join efforts of the technical maintenance team with the management system team from the beginning of the project, to obtain results in less time and in a systematic way.
- Establish an energy committee to create a space for exchange among the main actors of the EnMS, with members from technical maintenance, management system and operational areas.
- Direct human resources not only to great savings projects but also to small low-investment projects that, in sum, have an impact on energy performance
- Involve senior management since every project inception.

Today, we can apply these lessons learned to the EnMS implementation process in other corporate sites.

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.