# ISO 50001 Energy Management System
## Case Study

Argentina

# YPF SA

YPF SA Petrochemical Site

## Organization Profile & Business Case

YPF's Complejo Industrial La Plata (CILP) is located in the city of Ensenada, Buenos Aires Province, Argentina. It has an extension of 340 hectares and it is one of the most important industrial complexes in South America as it has a processing capacity of about 189,000 barrels per day. It is dedicated to fuel, chemical products and lubricant productions, offering the market a complete variety of products. The complex is formed by the refinery site, which has refining, conversion and lubricants units, and the petrochemical site, with aromatics, olefins, polyisobutylene and maleic units. Since 2009, YPF have been developing actions to reduce greenhouse effect emissions by using energy in a rational way.

*Energy and climate sustainability aims and drives*

In 2014, the management of the complex moved forward to the implementing the Energy Management System (SGEn, in Spanish, Sistema de Gestión Energética) by defining, broadcasting and adhering to an energy efficiency commitment, which establishes the guidelines to work on energy intensity reduction according to ISO 50001. In November 2015, the Chemical Area obtained ISO 5001 certification issued by Bureau Veritas and in September 2018 the re-certification of the SGEn was also obtained. As for the results obtained, the management approved an implementation and certification program for 2019-2020 for the rest of the CILP.

As an organization, YPF's aim is to implement management sub-systems under ISO 50001 in all their facilities according to the sustainability reports.

| Case Study Snapshot | |
|---|---|
| **Industry** | YPF SA |
| **Product/Service** | Petrochemical |
| **Location** | Argentina |
| **Energy management system** | ISO 50001 |
| **Energy performance improvement period** | 4 years |
| **Energy Performance Improvement (%)** over improvement period | 6.2 % |
| **Total energy cost savings** over improvement period | 9.561.000 $USD |
| **Cost to implement EnMS** | 16.728 $USD |
| **Total Energy Savings** over improvement period | 1.717.549 (GJ) |
| **Total $CO_2$-e emission reduction** over improvement period | 98.378.280 |

## Business Benefits

The implementation of the Energy Management System (SGEn) with ISO 50001 has improved the energy performance from 2015 to 2018 in 6.2% regarding the baseline defined. The energy saving is of 788,943 GJ as the effective improvement between real consumption and expected consumption (baseline), and a total saving

of 1,717,549 GJ, including the improvement actions implemented during that period.
The saving reached during the period 2015-2018 is of about USD 9,561,000. The implementation of the standard brings about other non-financial benefits as:

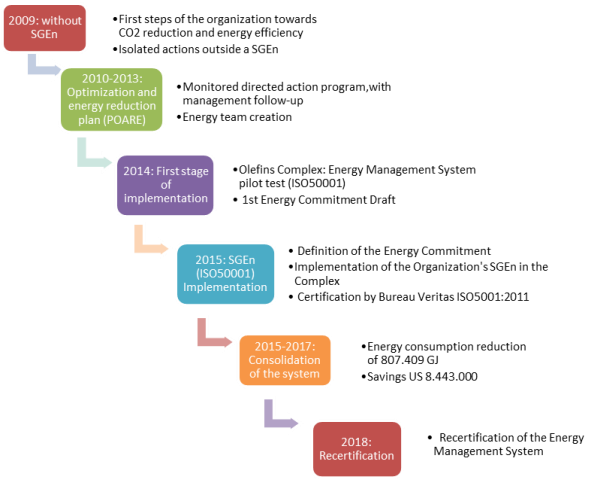
- ✓ Awareness of the staff about the importance of the energy rational use.
- ✓ Adherence of contractors to taking care of the energy and the environment.
- ✓ Proposals to improve work efficiency in all the organization levels and lines.

The SGEn implementation took a period of one year and a half, with full-time dedication of a technician and an own part-time person as well as the on-demand participation of all the areas involved. The implementation associated costs are connected to an external consultancy advice (three people) during the implementation time.

| Implementation costs | **Expenses (USD)** |
|---|---|
| Consultancy | 14873 |
| Training | 160 |
| Audit | 1695 |
| Other expenses (travelling expences, etc.) | 0 |

## Plan

ISO 50001 implementation started in 2014 at the Complejo Industrial La Plata, in the Chemical Branch, with a pilot test at the Olefins Plant that was later extended to the rest of the units. During 2015, it was implemented in the aromatics, polyisobutene, utilities and maleic operating units to supply these units, and the certification was obtained in November of that year. The certification process is as follows:




3.1 Implementation diagram

***"Implementing an energy management system is the only way to continuously improve energy"***

To develop the SGEn according to ISO 50001, an energy commitment was defined and an energy team responsible for the implementation and follow-up of the energy reduction program was created. The management released the energy commitment to the whole organization and appointed the energy team as the implementation leader. Thus, the participation of operations, maintenance, engineering and other cross-service staff was achieved. Follow-up KPIs for the program implementation were defined, and by means of monthly follow-up meetings with different company levels and a management team, the progress and the degree of compliance with the program were monitored.
Additionally, a high-level training course on the requirements of the standard was carried out, for all the organization levels, including the contractors.
The energy team together with Process made a survey and data collection in each of the operational units so as to determine the type of energy being consumed (vapor, power, fuel gas, natural gas, etc.), the equipment consuming those energies (furnaces, heat exchangers, reboilers, etc.), the measuring units and the different uses of those energies. Thus, the energy matrix for each was conformed. (See Figure 3.2).

At the same time, each operational unit was divided in sub-areas, depending on the commercial product produced, so as to obtain more detailed information. Example: Aromatics was divided in the areas of solvents, turpentine, benzene-toluene-xylene (BTX), etc.


Figure 3.2 Energy Matrix

The unit "fuel oil ton equivalent" (TnFOE) was defined as a uniform measurement unit for all the energy types. The "significance" criterion was established as the consumption representing the 80% of the total consumption. "Significant consumptions" for each area were established and analyzed, defining the pareto of each operational unit and sub-unit. (See Figure 3.3).

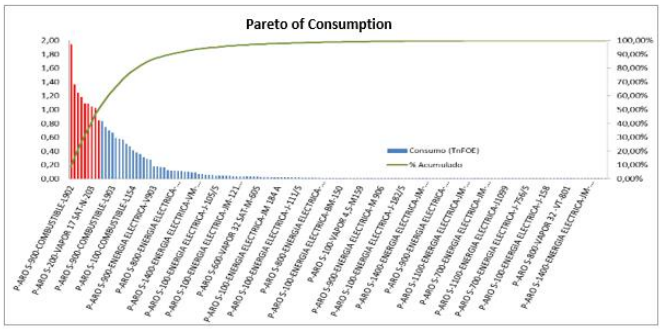



Figure 3.3: Aromatics Unit Pareto

A reference period of 2 years for the baseline was established, considering the significant consumptions previously defined. The baseline was established by mathematical regressions that relate each sub-unit consumption to the production reached during that period (2013-2014). In this way, knowing the production, the expected consumption for the unit is obtained.
Formula: Y = A*X^B,

where (Y= expected consumption (TnFOE); X= Production (Tn); A and B= rates adjusted to the regression).
The mathematical regressions were validated with the 2015 budget, determining their robustness and correspondence when determining the expected consumption to assess production. Figure 3.4 shows the mathematical regression for solvents sub-unit belonging to Aromatics.

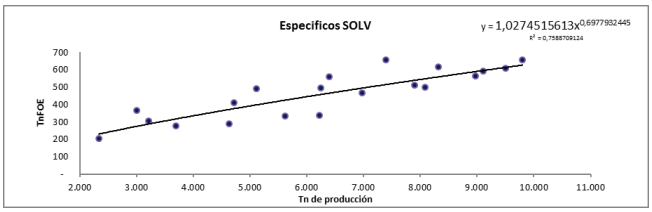



Figure 3.4: Solvents Sub-Unit Regression (Aromatics)

The baseline is used as a reference to measure the energy performance and to establish aims and objectives.
By means of work-journeys with the different operational and maintenance areas, the control operational variables for significant consumption and the established ranks for each variable that would allow the significant consumption to be within the expected consumption were determined. Screens were created in the control system (DCS Foxboro) to carry out the operational variable tracking, which have sound and light alarms that go out when an energy variable is out of its optimal operational range. Similarly, maintenance variables were loaded into SAP tracking plans so as to have a proper programming and execution of preventive plans. So as to establish the intervention priority in the pieces of equipment linked to significant consumptions, a failure notice type was created in SAP (corrective maintenance) linked to energy efficiency (SAP code D2-18), thus, prioritizing its intervention.
A list was made with the improvement opportunities related to significant consumptions. The journeys were multidisciplinary so as keep a wide view of the different improvement areas.
With the significant consumption information records, different level indicators were established.
The indicators were developed in such a way that the complete organization could follow the energy

performance, from level 1 at the management level, to level 5 at the console operator and supervisor on duty level, depending on their action, decision and responsibility levels. The indicator levels from 1-4 show the specific consumption (consumption in TnFOE per ton of production) in different levels, and level 5 corresponds to control operational variables of the previously mentioned console operators.

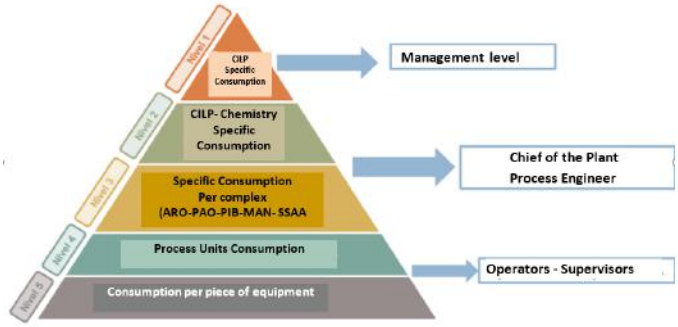



Figure 3.5: Indicators at different levels

## Do, Check, Act

The implementation of the operational controls was done by means of screens monitoring the significant consumptions in the control rooms. (See Figure 4.1). Operators should keep the consumptions defined as significant within the established ranges. Variable deviations should be managed by the operator through specific actions. Long-term deviations (above one hour) should be registered in the logbook, together with the variables, the causes and the actions taken (electronic record). A KPI was defined that allows for monitoring the time in the month in which each variable remains out of its control range. In case of recurrent deviation from this KPI, self-observations/self non-conformities are recorded in the SGEn that allow for the investigation and root-cause analysis and correction taking actions that would avoid future deviations.

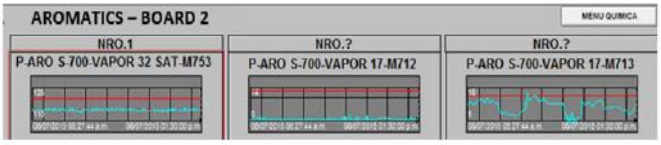



Figure 4.1: Operational Control Screen in the Aromatics Unit

Similarly, a KPI indicating the number of maintenance failure notices is followed, the notices are loaded in SAP versus the notices managed by that area.
An energy optimization, saving and reduction plan (POARE) was defined (see Figure 4.2) that considers improvement actions that remain selected, and the plan has an implementation budget every year, monthly tracking landmarks, the measuring mode for each landmark, the individuals responsible for each area, and the calculation methodology among other data.

Figure 4.2: Energy Optimization, Saving and Reduction Plan (POARE)

The action plan considers six strategic working lines:

- ✓ Saving and tracking objectives. They include all the quantifiable improvement actions in energy units, representing a saving in TnFOE for the current year (e.g. furnace and boiler improvement, surface condensers, stripping vapor reduction, measured loss reduction, etc.).
- ✓ Optimization objectives and energy performance improvements. They are equipment optimization actions that improve the energy performance, but they cannot be always quantified (e.g. intervention and use of soot blowers, furnace and boiler intervention, etc.).
- ✓ Good practices. Actions intended to improve people's behavior (optimization in the use of heating/refrigeration; on/off lighting; electronic elements use, etc.).
- ✓ Mid-term actions. Analysis and optimization studies to be applied in the mid-term (optimization studies of fractioning columns, furnace technological improvements, heat exchangers optimization, etc.).
- ✓ Education and training. Activities directed to improve the knowledge of the staff, technical and management training connected with energy

efficiency, furnace optimization course, energy management inductions, etc.).

- ✓ ISO 50001. Actions directed to comply and enhance the scope of the system (e.g. auditor training; handling and management of non-conformities, indicators development, etc.).

The saving reached by means of the action plans implemented between 2015 and 2018 is US 9,561,000. A summary of the figures is shown in Table 4.1:

| *POARE* | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|
| *Objetive (TnFOE)* | 1.404 | 21.345 | 4.646 | 3.346 | 30.741 |
| *Saving reached (TnFOE)* | 2.479 | 29.142 | 3.603 | 6.466 | 41690 |
| *Degree of compliance* | >100% | >100% | 78 % | >100% | >100% |
| *Price Usd/TnFOE* | 203 | 241 | 254 | 173 | ------- |
| *Saving (KUSD)* | 505 | 7.023 | 915 | 1.118 | 9.561 |

Table 4.1: Summary of the POARE Results

To ensure the energy performance, improvement plans and indicators to the different levels are monthly shared, where deviations, causes and the actions are taken are discussed. The results of the indicators and the action plans are monitored with the management every three months. The result of the management review is managed by the energy team.

CILP's energy performance is daily optimized through the energy system optimization software (Visual Mesa, license KBC/Sosteica) which contains an energy system online simulation, costs and degree of freedom to take optimization actions. The software runs continuously on a server. Every day, the process engineer of Utilities informs the measures to be taken to optimize the energy system. Operations analyses and makes the recommendations of the daily actions, and the figures for the savings reached are registered. (See Figure 4.3)

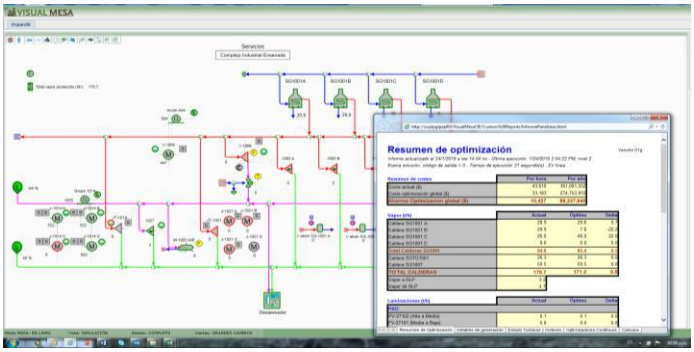
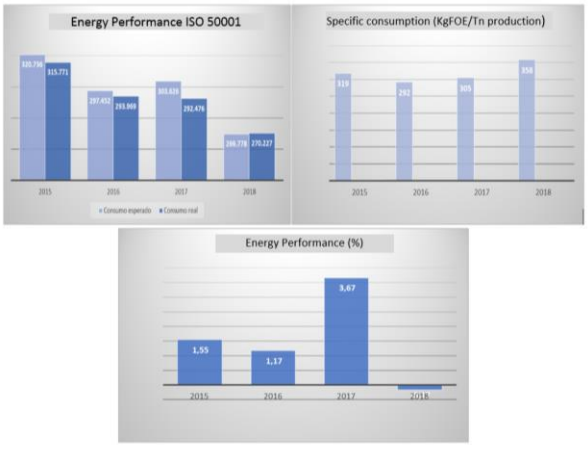



Figure 4.3: Optimization Screen from Visual Mesa and Optimization Report

Field energy audits are annually carried out so as to know the operational condition of the vapor traps, vapor loss, insulations, fin-fun-cooler operation, exchange trains, condensers, etc. The information from the audits provides the feedback for the action plans previously mentioned.

The energy performance of the informed period corresponds to the following data:

| --- | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| Consumption /TnFOE | 315771 | 293969 | 292476 | 270227 |
| Current specific (KgFOE/Tn) | 319 | 292 | 305 | 358 |
| Specific expected (KgFOE/tn) | 324 | 295 | 316 | 358 |
| Energy performance (%) | 1,5 | 1,2 | 3,7 | -0,2 |




Internal and external audits have validated our energy performance. The internal processes results of the internal audit were used in the continuous improvement, treating the findings and subsequent follow-up of the management team during the management review that was carried out every three

months. External audits have validated the system performance.
For energy, equipment and service procurement processes, an annex to the particular condition contract document was created that considers the energy uses and consumption declaration by the supplier. This information is assessed by the technical staff of the energy area who makes the recommendations according to the impact on the baseline.
For the new facilities or management of change, the energy team assessment step was added. The team will report the impact and will indicate the recommendations to improve the energy performance as well as assessment and compliance with the applicable legal requirements and other standard requirements.

## Transparency

The standard certification has been formally informed by mail to our main customers by the certifier organization Bureau Veritas.
Consequently, in our desire to contribute with the SGEn, we have delivered technical presentations within YPF Headquarters to our main customers, exposing the results obtained and the necessary steps for implementation and certification, as well as the benefits granted by the Secretary of Energy to the companies investing in a SGEn.
We have participated in the 5th Latin American and Caribbean Refining Congress organized by IAPG (Sheraton Mendoza, September 2018), and the Latin American Technology and Refining Conference (Hilton, Buenos Aires, September 2017), exposing our experience and results in the energy management system implementation and certification.

***"Integration and coordination between involved areas and employee awareness and motivation were our keys to success in our ISO50001 EnMS"***
***-Cecilia San Sebastián, Energetic Management Group Coordinator-***

## Lessons Learned

Applying the standard makes monitoring and uses and consumption controls simpler. From 433 consumptions identified in the energy matrixes, only 66 were significant consumptions, which were monitored through a total of 114 operational variables. The system is reduced to 15% monitoring of the whole number of consumptions identified.
Interdisciplinary working journeys allow for the identification of 87 improvement opportunities, which were the first lines of the improvement plans of these last years.
Establishing an energy management culture at all levels in the organization requires great contribution and support on the part of the management.
Broadcasting of concrete actions related to energy saving require higher awareness on the part of the staff.
Objective definition should have responsible people in the different levels so as to add their contribution and involvement.
Progressing towards having an energy management system in all the sites of the company builds consistency between the results obtained and the aims of the company.

## Citation and visuals

CILP is currently certified in UKAS9001:2015, UKAS 14001:2015, which were the bases for the items that are similar to ISO:50001:2011.
ISO 50002; ISO 50003, ISO 50004 and ISO 50006 were used as references.