ISO 50001 Energy Management System
Case Study

Argentina

YPF LUZ

Reliable and sustainable power generation that optimizes natural resources

Loma Campana Power Generation Complex

Loma Campana Case Snapshot	
Industry	Power Generation
Product/Service	Power
Location	Añelo, Neuquén, Argentina
Energy management system	ISO 50001
Energy performance improvement period, in years	1 year (2020)
Energy Performance Improvement (%) over improvement period	**14.88%**
Total energy cost savings over improvement period	**$ 99,897 USD** ($ 5,696 USD in power; $ 94,201 USD in chemical products)
Cost to implement EnMS	**$ 8,000 USD**
Total Energy Savings over improvement period	**722.09 (GJ)**
Total CO_2-e emission reduction over improvement period	**209.53 TnCO_2eq**

Organization Profile & Business Case

YPF Energía Eléctrica S.A. (YPF Luz) is a leading Argentine power generation company, dedicated to the electric power generation since 2013, from conventional (thermal) and renewable sources. Our mission is to be a profitable, efficient and sustainable power company, focused on optimizing natural resources and contributing to the energy development of Argentina. Our vision is to become one of the leading companies in the power generation sector, a leader in renewable energy, operating with world-class technology, efficiency and quality standards.

Today YPF Luz operates 10 thermal plants and 2 wind farms, with a total installed capacity of 2,360 MW. It is finalizing the construction of an additional wind farm of 123 MW of installed capacity, scheduled to begin operations in 2021.

Aligned with our mission and values, we have established a Quality, Environmental, Health and Safety (QEHS) Policy and an Operational Excellence Policy. These policies are implemented through the QEHS and Sustainability Committees, which set as an objective the implementation of the Energy Management System (EnMS) under ISO 50001 at all company facilities. At the moment, YPF Luz has certified ISO 50001 for six thermal power plants located in three sites:

- The Loma Campana Complex, in Neuquén Province, operates three power plants of 229 MW under a single Energy Management System.
- La Plata Cogeneración (LPC), in Buenos Aires Province, has an installed capacity of 218 MW and produces 400 tons of steam per hour. It is located within La Plata Industrial Complex (CILP), owned by YPF.
- The Tucumán Power Generation Complex (CGT), in Tucumán Province, consists of 3 combined cycles with a total installed capacity of 1,302 MW.

This case will review the implementation of the Energy Management System (EnMS) at the Loma Campana Complex in the year 2020, demonstrating the economic and management benefits of the ISO 50001 certification.

The Loma Campana Complex began operations in 2018 with the objective of optimizing the gas produced by YPF in Vaca Muerta, therefore focus on energy efficiency was an objective from the outset. In 2020, we committed to reduce energy consumption, waste, water consumption and carbon emissions.

With small adjustments and initiatives, the team achieved improvements that decrease the use of resources, energy and costs. We adjusted the cooling water concentration cycle, decreasing water and chemical consumption and lowering costs. We controlled the critical variables of the process by adding technology, contributing to process optimization. It is a case of energy, environmental and economic improvement, sustainable over time.

The complex is located in Añelo, province of Neuquén, and includes two thermal power plants with aeroderivative gas turbines: Loma Campana I, with an installed capacity of 105 MW, and Loma Campana II, with an installed capacity of 107 MW. The complex also includes Loma Campana Este, a thermal power plant located within the Loma Campana oil & gas production concession area, 18 km away from Loma Campana I and II, with an installed capacity of 17 MW. The complex includes a Green Lung of 100,000 poplar trees which are watered with 100% of the water effluents from the plant. The green Lung is part of the plant´s productive process.

Loma Campana Green Lung - 2020

"We seek to continually improve our processes with a focus on simplicity, efficiency and sustainability."

—Aníbal Lazarte, West Region Operations Manager

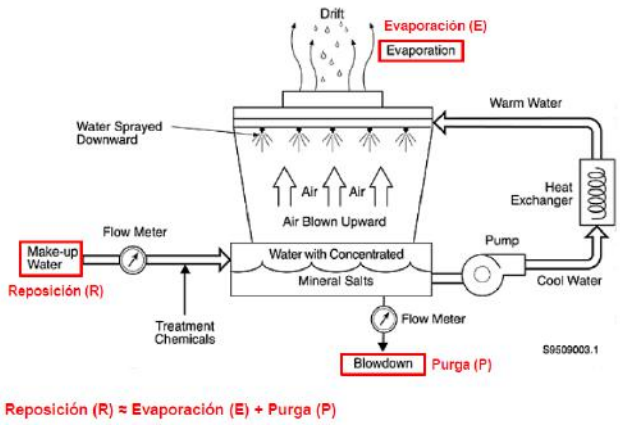
Business Benefits

At the Loma Campana Complex we had from the outset in 2018 the clear objective of implementing an EnMS to improve energy performance by increasing the reliability of the operation of our processes. The road was arduous and for this we leveraged on the following points:

- Staff Training.
- Maintenance strategies and plans.
- Control, analysis and improvement of processes.
- Service providers recognized for their expertise.
- The implementation of an Integrated Management System.

In our assets we managed to identify through an analysis of Pareto 80/20 the significant uses of energy and within these a process of great importance for energy performance: the cooling system of the turbines since an approximate heat of 35,751 kW is removed by evaporation and purging of water from different equipments that make up the process: Water-Air Intercooler; Mineral Oil Exchanger and Synthetic Oil Exchanger. We were convinced that if we could optimize this system, we would achieve a significant improvement in our energy performance and its associated costs.

Figure 1: Semi-Open Cooling Circuit



Semi-open Cooling Circuits: The cooling process is based on the evaporation of a certain amount of water (Figure 1). Evaporation causes an increase in concentration of salts and suspended solids and of these there are maximum operating limits according to the chemical treatment we use, not to exceed them we must purge water, which implies an energy cost. The further away we are from the ideal, the higher the energy cost. Therefore, the more variables we automate and control, the greater the benefits we can obtain.

YPF Luz generated an action plan in two stages:

1. Adjustment of concentration cycles through manual operation to reduce water consumption, which did not require an initial investment.
2. Invest in an online variable monitoring software: pH, conductivity, free chlorine, ORP and turbidity that allows the automatic dosing of chemicals, keeping the system in optimal operating conditions at all times. Automatic monitoring by sensors increases the reliability and control of the process since the operator monitors the system in real time 24x7 through alarms and notifications in a software without the need to take samples periodically.

Sensor System

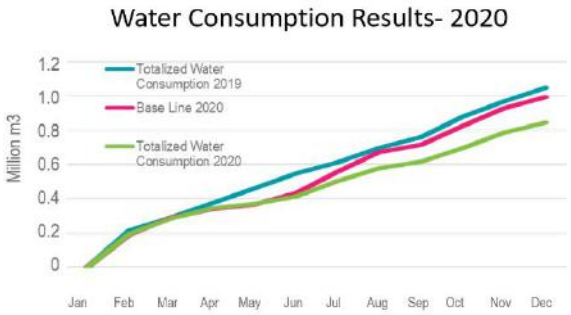
Tracking Software

The investment required in hardware was minimal since it had practically all the elements and sensors necessary to automate the process. The manpower to execute the tasks was all own personnel.

With the implementation of these measure, we managed to improve the Water Use Intensity Index from 0.86 m^3/MWh in 2019 to 0.73 m^3/MWh in 2020 as reflected in this table on water usage:

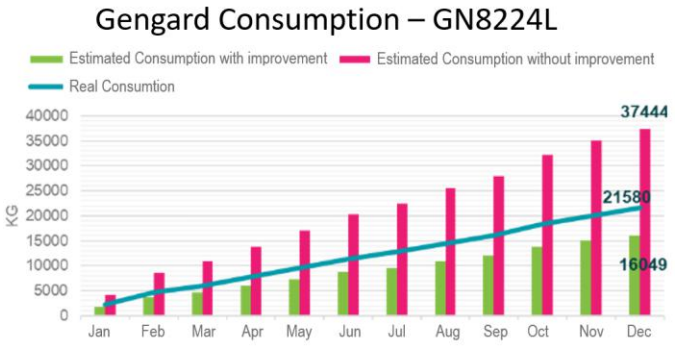
Product	2019	2020
Water Consumed - m^3	1,049,691.06	845,724.24
Energy Generated - MWh	1,225,202.08	1,159,639.03
Water Consumption - m^3/MWh	**0.86**	**0.73**

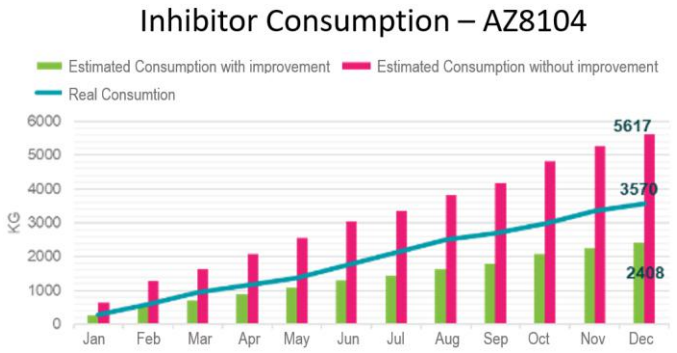
We optimized the use of water in electricity generation. This saving represents 147,795.72 m^3 per year. In the figure we can see the evolution of water consumption



where we notice in the green curve the decrease in consumption of the resource.

The savings associated with the operation (water and chemical costs) were 94,201 $USD as shown in the following graphs.





The saving of water consumption generated a saving of pumping energy of this fluid. During 2020 it was 200.58 MWh which results, following the following formula, in an energy saving of 14.88%:

$$\left[\frac{\text{Baseline Period Energy Consumption} - \text{Reporting Period Energy Consumption}}{\text{Baseline Period Energy Consumption}}\right] \times 100$$

$$\left(\frac{4854.06GJ - 4131.97GJ}{4854.06GJ}\right) x\ 100 = 14.88\%$$

The direct energy savings from implementing the EnMS represents about 5,696 $USD for the period.

The reductions in CO_2 emissions associated with the implementation of this system are summarized in Table 2, here the factors used are 0.788 kg of CO_2 eq/m3 of water and 0.464 kg of CO_2/kWh.

CO_2 not emitted from energy ($TnCO_2eq$)	93.07
CO_2 not emitted from water ($TnCO_2eq$)	116.46
TOTAL ($TnCO_2eq$)	**209.53**

Table 2: Emissions Reductions

The estimated internal and external staff time to develop, implement and maintain the EnMS is considered to be less than half a year of equivalent staff time responsible for the project.

"It is extremely important to manage energy throughout our production chain, from our suppliers to our customers"

—Anibal Gac, Head of Engines, Loma Campana Complex

Plan

Gradual Implementation

In early 2017, we established a plan to progressively implement ISO 14001, 9001, 50001, 45001 and 55001. The existence of an Integrated Management System according to international standards significantly helped in the implementation of an EnMS since many of the requirements were studied and completed such as: review by senior management, internal audits, control of documented information, staff training, etc.

Loma Campana Team during a visit by the CEO in 2020

Commitment

Commitment is a value of YPF Luz, and as such was a fundamental pillar in the implementation of the EnMS.

To achieve the necessary motivation among the staff; the Management organized meetings to inform and promote the benefits of implementing ISO 50001 and opened a communication channel to receive proposals for improving tasks and developing projects to achieve energy efficiencies within the company.

Energy Efficiency Committee

The first step was to create the Energy Efficiency Committee made up of professionals from different specialties and areas such as mechanical, electrical, chemical engineers and specialists in safety and environment. The resources and services necessary for the implementation of this stage were made available by senior management and no external resources were required. Good relations and constant communication between the different sectors of the Loma Campana Complex helped a rapid implementation of the EnMS.

"Energy efficiency is a fundamental pillar of our operation and maintenance management."

—Ignacio Apud, Head of Operations, Loma Campana

Training

Once the Committee was formed, the Human Resources and Safety and Environment Departments implemented training courses in energy efficiency and trained Internal Auditors on Energy Efficiency, to understand the nuances and particularities that are needed for the implementation of the EnMS.

The Internal Auditors then trained colleagues in their areas to optimize resources and improve management in each work sector: maintenance, operations, general services, safety and environment.

Analyze and measure energy

During the energy review, a list of all energy consuming devices was made, regardless of their source.

The measurement of energy consumption in some equipment was direct using their own devices, but in others, an intensive analysis with calculation and through a power logger (FLUKE) was necessary.

After these analyzes, the first guidelines for the development of improvement opportunities and their prioritization began to emerge. Energy Performance Indicators (EnPIs) complement quality indicators (KPIs) as parameters for decision-making.

Do, Check, Act

Identification of Energy Sources and Uses

One of the tasks that required the most time and resources was to identify the energy uses requested in the energy review.

Through a sector-by-sector plan, each of the teams identified and recorded energy uses, overcoming a series of challenges since many of the equipment did not have direct energy measurement capacity, so alternative models and calculation methods had to be used. Each of these methods were developed and documented in procedures.

Biweekly, meetings of the Energy Management Committee were carried out to update information and show progress in goals; the necessary field activities were carried out by our own operations and maintenance personnel.

It was in this energy review process that led us to understand the magnitude of energy use in our processes and where some opportunities for improvement were detected the most significant being the cooling process:

Opportunity for Improvement	

Updating reflectors	Replacement of allogeneic reflectors with LEDs
Optimize the Use of Air Conditioning in Offices	18°C degrees in winter, 24°C degrees in summer

Development of improvements to be implemented

Once the improvements were detected, an action plan was made where execution times and responsible personnel were defined in different stages.

The largest number of improvements was performed with own personnel while for the configuration of the automation system required the help of specialized personnel from a supplier.

The identified costs include hours of those involved in the project, built-in equipment and external service.

The baseline for 2020 was obtained using an estimation of the water consumption factor for 2019 considering an annual average ambient temperature correction factor.

Results

- We got a clear picture of the asset's largest sources of energy consumption.
- We reduced water consumption (and energy) per MWh generated.
- The team became aware of the importance of energy care at all levels of the company by implementing trainings and different means of communication such as signage in the plant and our internal communications network.
- ISO 50001 Certification led to a culture and processes focused on energy management.

Transparency

YPF Luz communicated the ISO 50001 certification through various internal and external media:

- Intranet
- Digital screens at all sites
- Corporate network that includes all employees of YPF Luz, YPF S.A and group companies.
- LinkedIn
- Internet
- Press releases

Communication from YPF CEO in internal Network

LinkedIn Publication

What We Would Have Done Differently

- We noticed that there are many opportunities for improvement to develop mini projects at the plant that could have been considered from the beginning of the construction of the asset, for example, the use LED lights in each space.
- Initially we had difficulties and used a lot of resources to determine the significant energy consumptions and we believe that we would have been more efficient if we contemplated measurements of our consumption in different processes of our plants or assets.
- Our next step is to focus on controlling our main process and maximizing efficiency by controlling our electric power generation process.