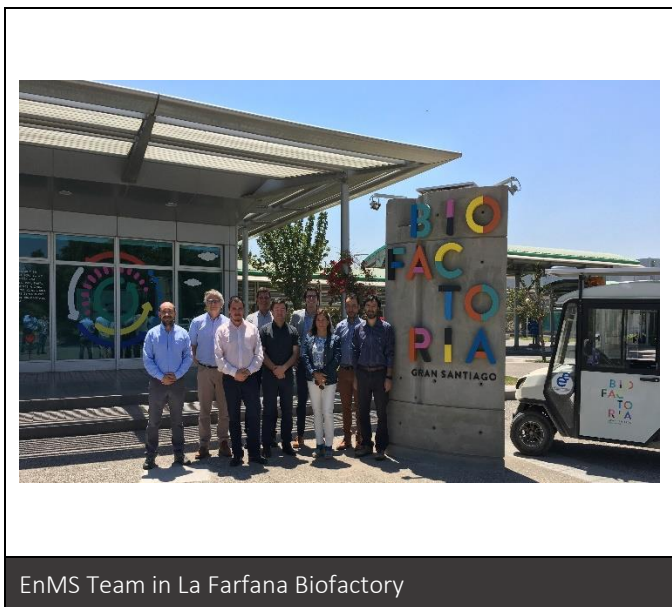


# Global Energy Management System Implementation: Case Study

Chile

## Aguas Andinas' Biofactory

*Transforming waste into resources*



EnMS Team in La Farfana Biofactory

### Business Case for Energy Management

Aguas Andinas is the largest sanitary services company in Chile and it's been in operation since 2000. Our business is to make the city works and give wellness to the people. Our vision leads us to be a sustainable referent in Chile, ensuring water for next generations. We manage all the urban water cycle from the source, through treatment, distribution and recollection to give back this resource to the environment. In this process, we provide services for approximately 7 million people.

Aguas Andinas always had had an operational efficiency goal, as part of that, energy management is a major concern. The 50% of all electric energy consumed is for the operation of two largest wastewater treatment plants, that we are transforming to Biofactories: Mapocho-Trebal and La Farfana, which give 100% wastewater treatment to 6 million people in Santiago, Chile.

*“Energy efficiency is an integral part of our Biofactory transformation plan and with it we are going to enhance to our goals: zero emission, zero waste, environment friendly and long term sustainable”*

—Narciso Berberana, Aguas Andinas CEO

### Case Study Snapshot

Industry	Sanitary services
Product/Service	Wastewater treatment and water production
Location	Santiago, Chile
Energy Management System	ISO 50001
Energy Performance Improvement Period	5
Energy Performance Improvement (%) over improvement period	10%
Total energy cost savings over improvement period	USD 1,000,000
Cost to implement EnMS	USD 338,000
Payback period (years) on EnMS implementation	1.7
Total Energy Savings over improvement period	43,200 [GJ]
Total CO <sub>2</sub> -e emission reduction over improvement period	5,000 [Metric tons]

That's why this two sites where the first to implement an energy management system, based on ISO 50001. Even when we have had energy improvements and energy

actions as far back as 2008 in La Farfana, we established our first energy baseline using 2012 data. In both sites, energy audits have been completed, and good practices have been shared to other installations as a part of the EnMS. In addition, both sites have the opportunity to generate their own energy using biogas as fuel, a byproduct of our operation. Each site has its own resolution: while La Farfana has a process to methanize biogas, which allows its use as Natural Gas for approximately two thousand households; Mapocho-Trebal has a conventional cogeneration engine which produce, nowadays, 80% of the site's electric energy requirement.

### Business Benefits Achieved

Both sites have implemented energy efficiency measures that led to a 10% reduction in energy consumption, using 2012 baseline. This represent more than 43 thousands GJ and 5 thousand tons of CO<sub>2</sub>e reduction. In addition, this is the equivalent to more than US\$ 1 million on direct savings on electric energy consumption. Those savings are larger if cogeneration and methanization process are considered, all of them aligned with our major goal: energetic-sufficiency and 100% renewable source.

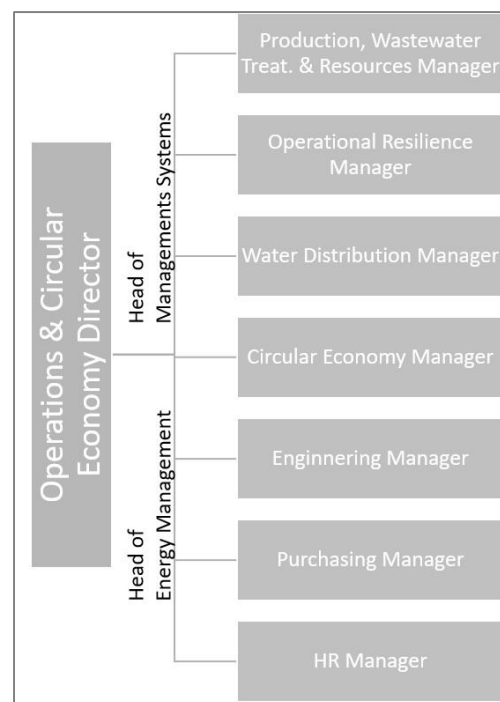
On the other hand, we can see benefits of the global efficiency goal in our employees. They work together to improve energy efficiency including it in many kinds of projects. Moreover, the complete awareness on energy issues, locally and globally, make a more committed work in every aspect on the site. Moreover, a new organizational area was created: Energy Management, which gives at least four new jobs and a new knowledge area available for all.

### EnMS Development and Implementation

Aguas Andinas has a long history with management systems, starting with the certification of the ISO 9001, ISO 14001 and OSHAS 18000 management systems certification on 2007. We are moving for better levels of efficiency and customer services so that's the reason why we submit voluntarily to all this management systems certification. The first site to implement the EnMS was

Mapocho-Trebal Biofactory. We began in 2013 with our first energy audit and then the implementation, properly. In 2014 and then, in 2017 we obtained the Gold Energy Efficiency Seal granted by the Ministry of Energy and the Chilean Energy Efficiency Agency, and in 2015 we became part of the first companies to achieve the ISO 50001 certification in the country. In 2016 we began the implementation on the second site, La Farfana Biofactory. In this case, the experience acquired in the last two years let us implement the ISO 50001 rapidly, due all the work done since 2008.

**Organizational.** The top manager with the responsibility to watch over the EnMS is the Operations & Circular Economy Director and below him every manager in areas related to energy.



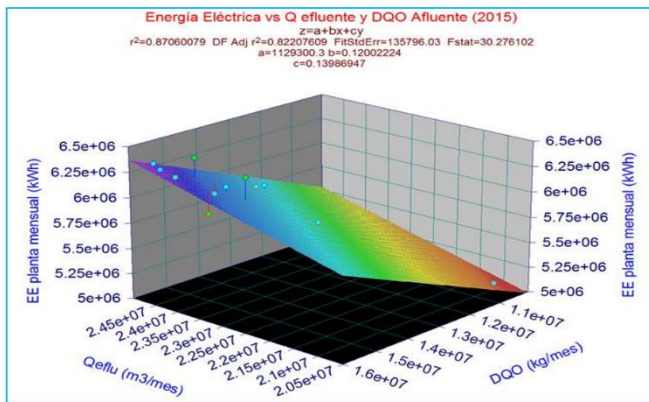
*Energy Management Committee.*

When we began to see the benefits, we started to think broadly and we wanted to pursue the challenge of being an energy efficient company, so we identified roles, organizational requirements and directory support to all the projects and activities which would come. We created a flat structure where all managers have the responsibility to create a fully committed organization on

every aspect of it: engineering, design, purchase department, process, maintenance and human resources. They are the Energy Management Committee at company level.

**Energy review and planning.** In each site with the EnMS implemented, a full Energy Planning study is carried on. The understanding of energy consumption is profound and includes highly detailed data, thanks to our automatized wastewater treatment plant that uses different types of sensors installed throughout the facility (oxygen, suspended solid, temperature) and statistical tools, like linear regression and multivariable analysis to determine how these factors affect energy consumption. For every process, a set of independent variables for measuring energy were identified: organic load (COD: chemical oxygen demand) and inlet water flow for the biological process, dry solid load on sludge treatment and degree days for the analysis of our offices building.

$$EE_{GLOBAL} = 0,120 * Q_{efluente} + 0,140 * DQO_{afluente} + 1129300$$



La Farfana Biofactory Mathematical Energy Model

**Financing.** Financing the project is an annual exercise linked to the energy planning stage, where we can set objectives and propose new projects or activities to achieve these new goals. For every project, we calculate financing ratios, like payback and total savings costs in order to prioritize the best opportunity for our business.

**Duration.** The first Energy Planning, with external help, took 6 months to complete. Now, linked to the annual exercise review, no more than 1 month is needed.

*“With the main issue that is energy in water cycle, an EnMS let us think in an energetic-sufficiency and 100% renewable source”*

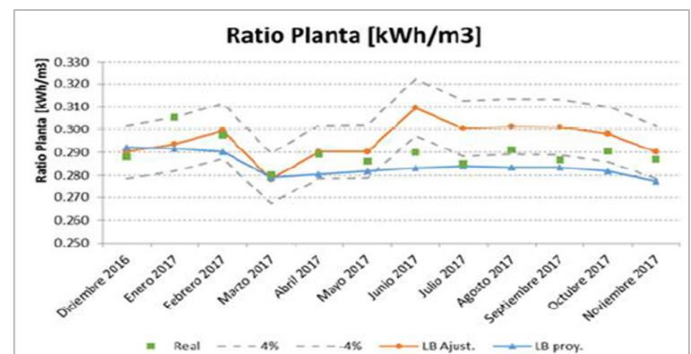
—Manuel Baurier, Operations & Circular Economy Director.

**Cost-benefit analysis.** Total cost of EnMS development, were related to:

- Internal costs: an induction for specific knowledge transfer was carried.
- Consultants: external consultants were important because of their previous experience.
- Third party audit: which is a main activity linked to the certification process.

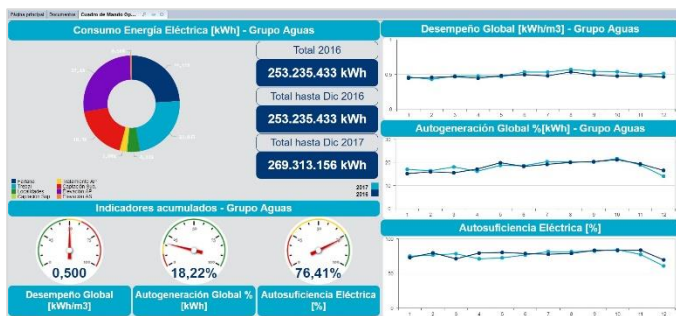
All of these costs sum up approximately US\$ 338 thousand. As the EnMS reports around US\$ 1 million of economic benefits, the EnMS has a payback of 1.7 years.

**Approach used to determine whether energy performance improved.** While determining the energy management gaps, one of the conclusions was the need of specific training for our employees. Now, four employees have been trained in the use of the International Performance Measurement and Verification Protocol (IPMVP). This protocol gave us control and independence on the results and tools to the determination of energy performance indicators finding an independent variable, through statistical analysis and mathematical models. To estimate the saving, we compared the baseline and the demonstrative period of savings, both normalized for an independent variable.

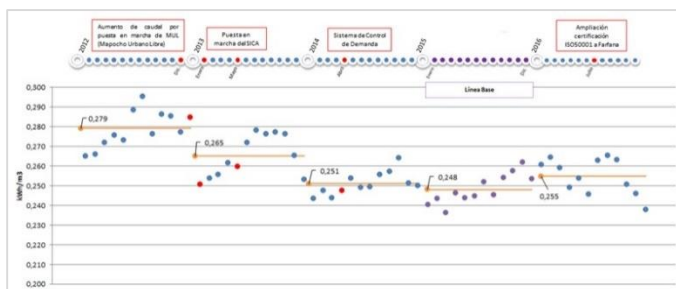


Baseline data and savings determination.

**Approach used to validate results.** Each site had its own key performance indicators which are presented every month in operational meetings, and every three months in the Energy Management meeting. In this last one, the Sponsor of the EnMS can see the results, trends and deviations, request for treatment and actions plans. Our Energy Dashboard allows us to follow our energy performance on line.



*Aguas Andinas' Energy Dashboard*



*La Farfana Biofactory – Evolution of Energy Intensity Indicator*

The efficacy of our EnMS is seen in the evolution of the Energy Intensity Indicator, which for this industry is [kWh/m3]. In La Farfana Biofactory case, this indicator drops more than 10% in four years, improving operation to use the installation at its design point or with technology improvements like SICA (Spanish acronym for Intelligent Aeration Control System).

**Steps taken to maintain operational control and sustain energy performance improvement.** The main control document it's the Energy Management System Manual which summarize our procedures to ensure that every site make calculations and analysis in the same way which include, "Baseline and Performance Indicator Procedure"; "Engineering Design Procedure" and "Purchasing Procedure", among others. Every process in

both sites has a written manual, which is updated with the new techniques or new operations rules. Maintenance team does the same process, within its scope.

The training programs it's an ongoing program all year long. Every year small seminars are made in every site, and we encouraged them to attend seminars of energy related issues and new technologies. Moreover, training is conducted to new employees that enters the company.

**Development and use of professional expertise, training, and communications.** Employee's development and improvement are major concerns for the company. Every year, employee's training requirements are defined and completed, knowledge that is later provided through proper training. Employee engagement is made with constant communication of the energy performance of the company; showing goals and continuous improvement through indicators. The company has an energy mailbox to collect all the ideas from employees, too.

We have a diverse external consultant network, which are continuously working with us in terms of audits, engineering, implementing projects or just consulting on specific topics. In this way we also have a satisfactory relationship with government organizations. Also, nowadays, we are looking for startups in an open innovation process getting universities and entrepreneurs as partners for our energy challenge in our AguasLab facilities.

**Tools & resources.** As we focused on special and technical requirements of the ISO 50001 standard and using other MS as backbone and support, we have required the assistance and experience from others utilities and consultants, especially to identify our baseline or key performance indicators. In addition, we received resources from the Chilean Energy Efficiency Agency for the implementation and certification of our EnMS on the first site.

Our facilities use SCADA systems to collect and manage huge amounts of data, which is later processed and



analyzed by employees specially trained. In addition, new sensor technology had been installed to improve energy efficiency through the analysis of the EnMS. To sum up, our employees have developed strong statistical skills, which is complemented with the use of software and advanced MS Excel.



Mapocho-Trebal Biofactory's SCADA View

***“Through the EnMS we could improve largely our energy consumption and our CO<sub>2</sub>e emissions... those are really our goals”***

—Maximiliano Mardoff, Head of Energy Management

## Lessons Learned

In the implementation of an EnMS, we identified that people are very important for a successful process, so we focus in encouraging good team work including all the areas of the first site and full communication on the company's performance in energy management. A barrier identified was the lack of technical knowledge, so we corrected this issue by providing specific training and learning from the experience of our external consultants. In the second site, more people came to work directly into the EnMS and we gained a lot of knowledge from their personal contribution. The key to our success in the technical knowledge issues was statistics, statistics and statistics.

Other issue was the correct definition of goals. On our first site we were very optimistic and had lots of enthusiasm, but operative reality is different. Now we understand this is a very delicate issue, so while keeping our main objectives, we updated our goals and procedures to define it and make more correct approach.

Taking this EnMS success, we are now expanding its coverage to certificate 4 more sites: two water distribution plants, one office building and a wastewater treatment plant.

## Keys to Success

- Top managers totally committed.
- Engage employees through full participation and communication.
- Develop technical skills for core team.
- SMART and clear goals.
- Continuous tracing of energy performance indicators and get some preventive alerts.



La Farfana Biofactory – Santiago, Chile.

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](http://www.cleanenergyministerial.org/energymanagement).