

Global Energy Management System Implementation: Case Study

Chile



CMPC achieved a 22% energy performance improvement on its Pulp certified plants



“In CMPC sustainability is essential and energy efficiency has played a key role in this driver since the implementation of EnMS”

—Hernán Rodríguez, CMPC CEO



Figure 1. CMPC obtained the Gold Energy Efficiency Seal by the Chilean Ministry of Energy, along with the prize for best implemented energy efficiency project.

Business Case for Energy Management

Organizational Profile: CMPC is a leading Pulp & Paper company, established in 1920, that produces solid wood products, pulp, paper and packaging products and tissue over 8 countries in Latin America, which has sustainability as one of its main drivers.

Drivers: The pulp and paper industry requires large amounts of thermal and electrical energy, therefore energy represents an important production costs. CMPC has taken energy performance improvement as one of its main operational challenges and has taken charge by developing a series of concrete actions. The company generates clean energy for its own consumption, and since the end of 2015, it has an energy management unit whose objective is to define and implement the Company's energy strategy. CMPC currently poses a corporate objective which is to become more efficient and competitive in the markets it participates, while securing long term sustainable activities and processes. To this end, there is a corporate objective to implement EnMS, based on ISO 50.001, in all productive processes of each Business Unit of CMPC.

Case Study Snapshot	
Industry	Pulp & Paper
Product/Service	Pulp
Location	Bio Bio, Chile
Energy Management System	ISO 50001
Energy Performance Improvement Period	4
Energy Performance Improvement (%) over improvement period	22%
Total energy cost savings over improvement period	US \$40.2 million
Cost to implement EnMS	US \$12.6 million
Payback period (years) on EnMS implementation	1.3 years
Total Energy Savings over improvement period	18 million GJ
Total CO ₂ -e emission reduction over improvement period	198 thousand Metric tons

Energy Management Program: The process of implementation of EnMS started in 2013, under a scenario of high energy prices, with the support of the Chilean Energy Efficiency Agency. The EnMS based on the ISO 50.001 was implemented over 3 Chilean Plants of CMPC Pulp, Santa Fe, Laja and Pacifico. In October 2014, the multisite EnMS obtained its certification under the ISO 50.001 and during 2017 the system achieved its recertification.

Energy Reduction Approach: After defining the baselines of the EnMS of CMPC Pulp, a goal of improving the energy performance of its operations was established. The goal consisted in reducing by 20% the consumption of external energy inputs per unit of pulp produced by 2020, originating the Energy Efficiency Plan 20/20. This Plan has passed through different stages; initially started with an external energy audit focused on identifying opportunities in reducing the use of steam, close circuit energy use, biomass energy content improvements, and equipment efficiency improvement. All identified projects were studied and supported by an internal innovation programme called i-Cel which linked these opportunities with operational, resource and productivity efficiencies.

The excellent results obtained in the Pulp Division led to the definition of the previously mentioned corporate objective. Towards achieving this objective, currently CMPC is implementing EnMS in 24 plants plus 4 certified sites in 6 countries in Latin America. This process is being executed with a strategy of capturing experiences, lessons learned and best practices from the previous and ongoing implementation processes.

	Stage 1 ISO 50.001 Gap Evaluation & Work Plan	Stage 2 EnMS Design	Stage 3 EnMS Implementation	ISO 50.001 Certification
Cellulosa		Mulchén Nacimiento Bucalemu Los Ángeles Coronel Plywood		Planta Laja Planta Pacífico Planta Santa Fe [2014]
Tissue	Caleiras (Bra) Mogi (Bra) Altamira (Mex) Santa Anita (Peru) Cañete (Peru)	Zárate (Arg)	Talagante Puente Alto	Pando (Uru) [2016]
Papeles	Cartulinas (2) Papeles Cordillera Envases Impresos (3) Sorepa Chimolsa Edipac	Forsac- Chillán		

Figure 2. CMPC Corporate EnMS Implementation

Through this project, the main challenges which the corporate energy management unit has had to overcome are the diversity of processes and cultures within the business units and countries, which have led to an adaptation of the corporate guidelines to each local reality. Management commitment and leadership on the one side and the development and training of

each local energy team on the other side have been crucial in overcoming these challenges.

Business Benefits Achieved

The Energy Efficiency Plan 20/20 has been highly successful as the 2020 goal was exceeded during 2017, achieving a reduction of 22% of use of external energy inputs. This reduction was achieved with an average yearly reduction 4.5 million GJ, totalling 18 million GJ between 2014-2017, leading to an emission reduction of 198 thousand tons of CO₂-e. Moreover, the valuation of the energy savings obtained from the reduction of external energy inputs is 40.2 million USD. These improvements were obtained by the implementation of energy efficiency projects, operational best practices and improved process stability. Savings of the EnMS, considering all the energy efficiency projects and operational improvements, with total investments of 12.6 million USD, had a payback of 1.3 years.

In November 2017, CMPC Pulp received the Gold Energy Efficiency Seal from the Chilean Ministry of Energy and the Chilean Energy Efficiency Agency for its 3 certified Mills. Moreover, among all companies receiving the Gold Seal, a project from Pacifico Plant received the prize for best energy efficiency project and a project from Santa Fe Plant was also among the three finalists. These distinctions are a proof of the good work executed through our EnMS at CMPC Pulp and they have given the organization renewed motivation in order to set new ambitious goals which will lead the path to a continuous improvement of our energy performance.

EnMS Development and Implementation

In the year 2013, energy inputs represented a relevant direct cost of CMPC Pulp products. Hence, management was focused in improving our energy performance. This focus led to the decision of implementing the ISO 50.001 considering the benefits from referential international cases:

- Costs reductions due to changes in processes management followed by projects.

- Sustainable Development: emission reductions and implementation of innovative technologies which set the foundations of long term competitiveness.
- Public Image Improvement: showing third parties in an objective way the Company energy performance improvement efforts.
- Projection of internal and governmental policies.

After continuous collaboration with the Chilean Energy Efficiency Agency, an agreement of technical collaboration was reached in order to assist the implementation of a Corporate EnMS of CMPC Pulp, with a target to achieve its certification during 2014. This agency provided with the consulting company which assisted the implementation process. The implementation started in June 2013 and finished with the certification of the system in October 2014. This process established the execution of systematized energy analyses of our processes under an organizational structure and methodology with a focus towards energy efficiency.

As a direct tool of our EnMS, data acquisition through process variables monitoring has been essential towards maintaining a clear understanding of the energy performance indicators. Moreover, internal and external energy audits have been an ongoing tool in order to identify improvement opportunities, implementing operational controls, better utilization of the existing assets and investment projects.

CMPC Pulp executive management has been part of the leading energy committee of the EnMS from the beginning of the process, ensuring the availability of resources and alignment of the entire organization in order to establish a focus on energy management.

The committee established the structure of the energy team on each plant, led by its Chief with dedicated support of its technical department, which also is responsible for the other management systems (i.e. 9001, 14001 and 18001). Moreover, the initial structure defined that each plant team will have active members from the process, energy and technical departments. These local structures were complemented with the interaction of a corporate EnMS administrator which coordinates the activities with transversal areas such as

communications, supply, legal and human resources departments. The established structure has proven its efficiency by permitting each plant energy team to focus on their energy performance improvement, while ensuring the alignment and resource commitment of the whole organization.

Energy review and planning: Among the main processes of pulp production are: Wood Preparation, Cooking, Evaporation, Bleaching, Formation, Drying and Packaging. In regards to the energy use of our plants, the operations privilege the use of clean fuels derived from wood for steam generation and subsequent electricity generation. The main primary energy sources used are black liquor and internal biomass (both obtained as process by-products). The additional energy inputs required are obtained from external sources at market prices which are composed of external biomass, fuel oil 6, natural gas and liquefied petroleum gas. Hence, our yearly energy review is focused on the revision of the utilization of the previously mentioned energy sources in each of the sub-processes and the evolution of its performance, through their respective EnPI. The last is followed by a review of the current objectives, goals and action plans, together with the identification of potential changes and opportunities on each sub-process.

The baselines of each plant were defined with the data of a representative productive year, which initially was 2013 for the 3 plants. Each year, changes on relevant processes are identified, which have led to the actualization of the baseline for two plants. Each relevant project developed must be analysed in terms of its effects on energy performance in order to determine if the baseline must be actualized.

The data obtained from the yearly energy review is analysed in order to determine significant energy uses considering five main categories: saving potential, percentage of total energy use, relative cost compared to other energy sources, performance versus baseline, company image impact. Each category is given a score and the total accumulated score allows a prioritisation of the energy uses. At least the two highest ranking energy uses must be considered as significant, for which

new objectives, goals and action plans must be defined, focusing on the improvement of their energy performance.

The three plants have the same main EnPIs, which are reported to the Management Committee biannually. Each plant has the flexibility to establish sub-processes indicators for the main areas which have a significant use of energy, which are reported, analysed and managed internally within each plant's energy team. The main energy performance indicators follow: net primary energy consumption, electricity generated, electricity consumed, thermal energy consumed and external energy consumed per unit of final product.

The EnMS established channels to communicate innovative ideas and projects. Hence, each collaborator is promoted to propose their ideas which are initially screened by pre-evaluating their feasibility in techno-economic terms. Moreover, during the first year of functioning of the EnMS there was an external energy audit which was focused on identifying opportunities in reduction of the use of steam, change into close circuit energy use, biomass energy content improvements, motors and lighting efficiency improvement. These two channels, together with inputs from the energy teams form the portfolio of projects which are then studied and supported by the development department. Initially there was an innovation program called i-Cel which linked these opportunities with operational, resource and productivity efficiencies.

After the execution of the feasibility analysis, these projects are presented to the directors committee of the company in order to prioritize the best projects and secure their funding.

Since 2014, over 30 projects have been implemented under the Energy Efficiency Plan 20/20, with a total investment of over US \$ 12 million. One of the most notable projects executed has been a heat recovery project in the cooking process, part closing the cycle of thermal energy requirement, saving over 191 thousand GJ of thermal energy which then is used to generate over 62.3 thousand GJ of electricity and covered other thermal needs. Its implementation cost was US \$450 thousand with a payback of 5 months.

Cost-benefit analysis: the Chilean Energy Efficiency Agency subsidised the consultancy which supported the internal team from the implementation until the certification of the EnMS. There were costs related to the trainings of internal auditors, awareness and introduction courses and communicational campaigns, which have yearly plans with ongoing activities in order to maintain awareness and motivation.

In regards terms of executed projects, the implemented projects have had a focus on improving the use of fuels, energy efficient lighting and motors, variable frequency drives, closing thermal energy cycles, insulation improvements and actualization of energy data acquisition meters. The total expenditure for all energy management related activities is US \$12.6 million. When comparing to the savings obtained, calculated in US \$40.2 million, the payback period is 1.3 years over the average yearly savings.

Approach used to determine whether energy performance improved: results are verified by the control and analysis of the company's main EnPIs defined above. The change and long term evolution analysis of the indicators is performed in monthly meetings of the energy committee and on a weekly basis by each plant energy team. These revisions have a focus on the EnPI 20/20, which indicates the advance towards the 2020 goal. The following graph shows the improvement of overall external energy consumption per unit of product, the EnPI 20/20:

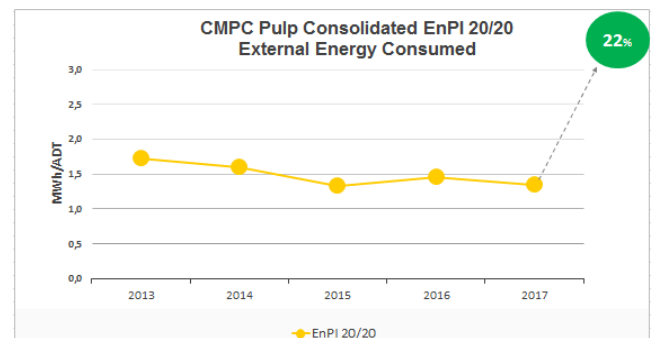


Figure 3. CMPC Pulp External Energy Performance

Data is obtained from monitoring and control systems such as DCS, SCADA and PI. Hence, it is possible to observe the behaviour of the main variables affecting energy use, which can be a focus of each revision.

The baselines have a yearly basis and initially they were based on the operational year of 2013 for all plants. Due to operational changes, the baselines of Laja and Pacifico were actualized. Each project involving areas with significant energy use must be analysed in order to ensure that the baselines are not affected.

Approach used to validate results: there have been over 30 executed projects in relation to the EnMS. The validation of the results achieved are analysed by establishing baselines of the sub-processes affected by each project, thus minimizing potential effects due to changes in other areas. These baselines are done for representative periods, ideally a year of stable production. After the commissioning of the project, considering a stabilization period of at least 6 months, data is analysed in order to calculate the real thermal and electrical energy efficiency gains. Real invoices and energy prices are considered to determine investment and savings. The following graph shows the data analysed for Pacifico’s gold seal awarded project:

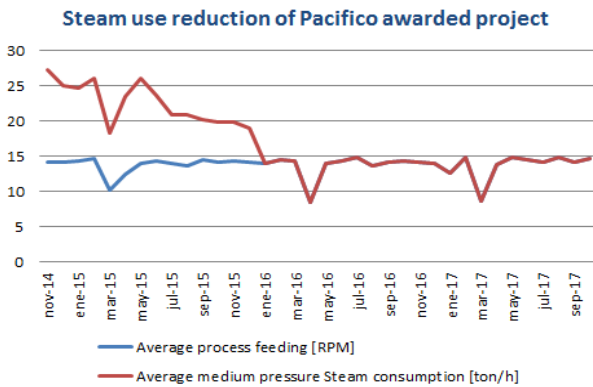


Figure 4. Pacifico’s project results validation

Preparations of internal and external audits of the EnMS are determined by each year action plan defined by the Management Committee. Internal audits are executed by internal certified auditing teams on a cross-plant basis, thus ensuring the objectiveness of the process. External audits are carried out by third parties for maintenance and recertification of the EnMS.

Steps taken to maintain operational control and sustain energy performance improvement: as energy has been an essential component of the functioning of pulp production processes, operational and maintenance procedures and tutorial have been

developed for each sub-process. In these documents, the main variables affecting the energy performance are identified, including their optimal operational, thus defining the operational range of each sub-process. When process changes are executed, the project unit actualizes these documents and together with human resources, provides trainings to all people involved. The EnMS coordinator ensures that best practices are actualized and implemented among all operations.

Development and use of professional expertise, training, and communications: In our EnMS people are considered as a vital element of its performance and long term value generation capability. Constantly, training necessities and knowledge requirements are reviewed, thus ensuring up to date tools and motivated energy team members. There is a special focus on people who have an impact on each plant significant energy uses. In this context, the focus is to have the following annual programmes on training in ISO 50.001 interpretation and awareness courses for all functionaries, internal and leading auditor courses for energy team members. Moreover, certified courses like CEM and CMVP are also taught to leading energy team members. Furthermore, communicational programmes establish a continuous use of material such as videos, intranet columns, posters, leaflets and stickers in order to disseminate awareness campaigns. These campaigns have been the importance and daily effects each worker has in our energy performance and to show the achievements met through the EnMS.



Figure 5. CMPC ISO 50.001 energy teams training

Tools & resources: From its conception, the documental management and responsibility was based on our technical units, which are also responsible for managing other pre-existing systems (ISO 9001, 14001 and OSHAS

“Our EnMS has allowed us to align our goals of efficiency, productivity and sustainability by providing real data on the effects of changes in processes and consequently promoting continuous improvements in our facilities on a daily basis.”

—Roland Haemmerli, CMPC Pulp COO

18001), thus ensuring integrated informational databases and eliminating procedural duplicity of tasks. Currently, our organization is implementing Lean Manufacturing and in order to integrate and enhance the tools of our EnMS, there will be an integral view of our energy performance in the new system scoreboards and reporting mechanisms. As mentioned before, there has been direct support and collaboration from the Chilean Energy Efficiency agency in the implementation phase but also in ensuring that our teams are trained at the best standards. External use of energy consulting firms has been important to have an objective overview of potential improvements of our EnMS and also to execute trainings and energy audits.

Lessons Learned

A key lesson we had from the first operational year of the EnMS to acknowledge the importance of a horizontal structure which has enough resources and weight in the organization, thus ensuring an efficient coordination among the areas involved. The company's management must show and transmit their commitment with the project from the initial point, establishing a clear energy policy and ambitious goals which together can provide a navigational chart which aligns efforts among the organization. There has to be

an active interaction from the beginning of the process with the human resources department to define competencies, capacity building and awareness.

Moreover, an initial inclusion of transversal departments such as engineering, maintenance and acquisition is important in order to have a global and practical perspective of procedures, minimum energy performance criteria and other relevant documentation related to significant energy uses. Our initial approach led to a definition of the documentation by a reduced team, which caused an initial disconnection to the rest of the organization. This issue was overcome by extensive internal awareness campaigns and transversal training courses about ISO 50001 and our EnMS.

It is essential to ensure the availability of data, ideally through online meters, in order to ensure that financial, operational and behavioral efforts are causing the desired effects. This is clear in the example of energy projects, especially when projects can be replicated in other sites, as it is mandatory to have the right tools to verify real results before reaching any conclusions.

Keys to Success

- Long term commitment of management, with active leadership and adequate resources.
- Clear definition of roles and responsibilities, including transversal collaboration.
- Integration of tasks with existing systems structures.
- EnPI link to leadership own objectives and goals.
- Establishment of an energy management culture among the whole organization.

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.

