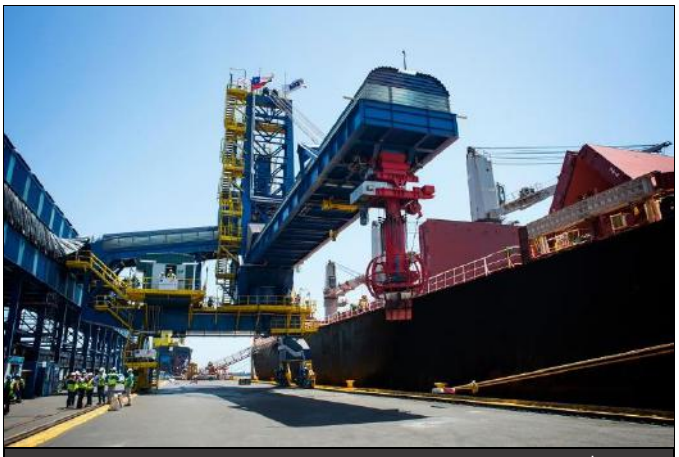
Global Energy Management System Implementation: Case Study

Chile

Puerto Ventanas S.A (PVSA)

The strategic vision of PVSA. is based on developing its business with excellence and sustainable management, with a strong focus on quality of service, care for the environment, safety and the development of its employees in generating value shared with the neighboring communities and society.



Puerto Ventanas Pier Area. In January 2018 operated a new ship-loader of high efficiency in Pier No. 3 (1500 Tph) – Partial View

Business Case for Energy Management

Profile: Puerto Ventanas SA is located in Quintero bay, Valparaíso region, Chile, is the main bulk port of the country and annually ships around 5.5 million of bulk cargo. Of them, 1.7 million tons of copper concentrate, which is received from the main mining operations in the central zone of Chile and it is stored in warehouses and then shipped to different parts of the world. The Port has 4 piers with the largest drafts of the central zone of the country, with the capacity to receive and attend vessels of up to 70,000 tons, with maximum drafts of 14.3 meters (46.91 feet). Our facilities also include an area for depositing bulk products, warehouses for general cargo and large storage yards for all types of cargo.

"Much more than being efficient in costs, we want to be efficient in the use of resources"

—Jorge Oyarce, General Manager

Case Study Snapshot	
Industry	Ports
Product/Service	Management Services in Loading, Discharging, Portage, Storage and Dispatch of Bulk, Liquid and Breakbulk Cargo.
Location	Bahía de Quintero, región de Valparaíso
Energy Management System	ISO 50001
Energy Performance Improvement Period	4
Energy Performance Improvement (%) over improvement period	5%
Total energy cost savings over improvement period	US $136,084
Cost to implement EnMS	US $21,000
Payback period (years) on EnMS implementation	< 1 year
Total Energy Savings over improvement period	4,810.7 gigajoules
Total CO_2-e emission reduction over improvement period	511 metric tons

Drivers: Puerto Ventanas S.A. focuses on providing services that contribute to the creation of value for our groups of interest, such as our customers, employees, communities surrounding our operation and society in general. PVSA wants to be leaders in the community where we are located, strengthening long-term relationships with our primary stakeholders. We seek to be a source of pride for our county of Puchuncaví and its inhabitants. In order to meet this objective Puerto Ventanas S.A. have developed four strategic focuses that are fundamental for the development of our company. Each one considers different types of initiatives, for example, as a signatory to the Quintero Bay-Puchuncaví Clean Production Agreement, Puerto Ventanas S.A. have complied 100% with the APL (Clean Production Agreement) commitments, which was audited by the Clean Production Council (CPL).

Energy management program: The Energy Management Program (EMP) established at the Port due to the implementation of ISO standard 50.001 has made it possible to identify guidelines with respect to the energy practices and policies that must be complied with and reinforced yearly, in order to comply with the objectives and targets proposed therein. This includes: Maintaining an energy efficiency management system that enables the continuous detection of savings opportunities. Objectively quantifying the energy performance through meters installed in the Pier unloading system. Keeping the Energy Efficiency Seal valid, obtained in September 2014 and November 2017.Ensuring that the acquisition of energy efficient technologies is preferred in projects of implementation, modification or renewal of equipment.

Energy reduction approach: The EMP seeks alternative savings opportunities and new perspectives related to the use and consumption of energy in the facilities of Puerto Ventanas.

Business Benefits Achieved

In the period 2013-2017, Puerto Ventanas mobilized a total of 33 million tons using electric power. The energy performance to date has allowed to generate energy savings of 1,336.3 MW/Hr and the consequent energy cost savings US $136,084.

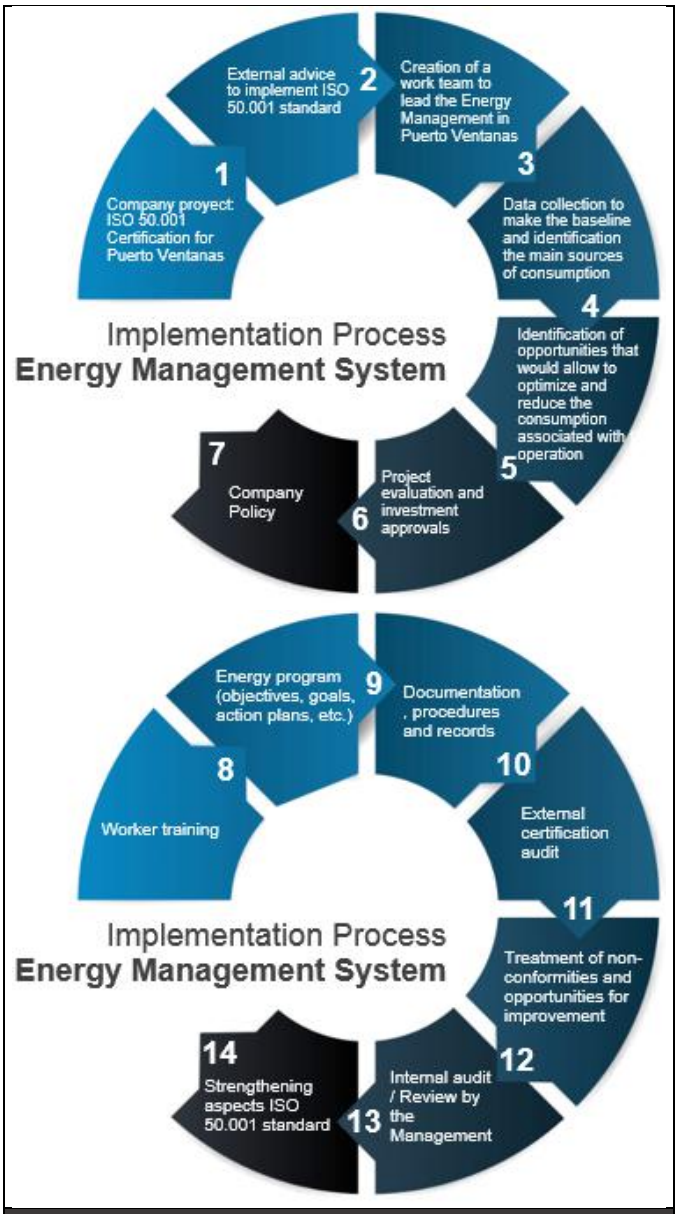
The reduction of 0.044-kilowatt hour per ton mobilized in the period 2014 - 2017 results in the reduction of greenhouse gases (GHG), representing an accumulated reduction of 511 Tons of equivalent CO2, associated with electrical consumption in port operations. The Master Plan for modernization, improvement of infrastructure and energy efficiency of the Port is a benchmark in the solid bulk port industry in Chile and has allowed the creation of alliances with public bodies such as the Ministry of the Environment, an entity with which we jointly develop the first Guide of Good Practices in the Storage, Transport and Handling of Solid Bulks in Industrial Installations. In the same way, it has allowed to generate alliances with the Ministry of Energy of Chile, through the implementation of the Energy Efficiency Plan, achieving that Puerto Ventanas S.A obtained during 2014 and 2017 the Gold Seal of Energy Efficiency granted by this Ministry.

On the other hand, Puerto Ventanas S.A was the first port in Chile to obtain the European EcoPorts certification, the main environmental initiative of the European port sector. The main objective of EcoPorts is to create awareness about the protection of the environment through cooperation and the exchange of knowledge between ports to improve environmental management.

EnMS Development and Implementation

The development of an energy management system was strengthened with the general management's directive to continue demonstrating that sustainability and the use of resources is a priority for the business and the relationship with the neighboring community. An energy management team was created and managed by an external company to incorporate the ISO 50001 standard into the company's processes. The implementation of energy efficiency initiatives generates multiple benefits in areas such as: Reduction of the expense of energy and the operating or production costs, decreases the

environmental impact, reduces the emissions of greenhouse effect gases and improves the security of the supply of energy.



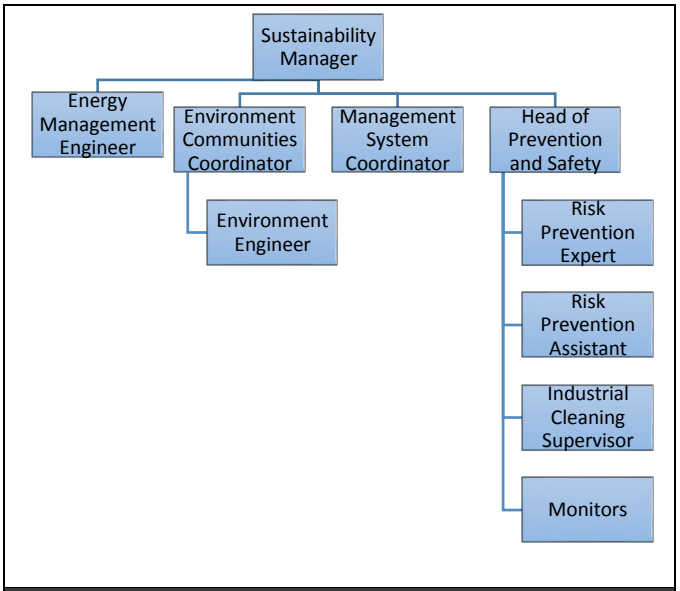
Implementation Process Energy Management System in PVSA

Organizational: Puerto Ventanas S.A. has implemented an integrated management system which it manages the aspects associated with the Environment, Quality, Energy Efficiency and Occupational Health and Safety. Puerto Ventanas Integrated Management System has been structured on the basis of the requirements contained in the ISO 14.001, ISO 9.001, ISO 50.001 and OHSAS 18.001 international standards. Since 2013, Puerto Ventanas S.A. has environmental management certification under standard ISO 14.001, which is periodically verified and certified by Lloyd's Register Quality Assurance (LRQA), while, in December of 2017 Puerto Ventanas was re-certified in ISO 50.001 standard until January 2021.

"Maintaining an EnMS is a team effort and it should be everyone's responsibility to keep it in force"

—Matías Navarro, Energy Management Engineer

The Sustainability Department is responsible for the Port's environmental management, for which it has a team of university-educated professionals with extensive experience to provide support to the areas regarding the environmental management of Puerto Ventanas.



Sustainability Management Structure – Puerto Ventanas S.A

Sustainability Manager is the officer named by the General Manager as the representative of Management with the specific responsibility of ensuring the implementation of the Integrated Management System.

The Environment Coordinator leads the environment area, with the primary responsibility of supporting the preparation of procedures and instructions required by each stage of the process, coordinating the required environmental monitoring of the company, updating the matrix of environmental aspects and impacts and regulatory obligations of the Port's operations. Integrated Management System Coordinating, has the primary function of ensuring that the requirements of the standards in which the Puerto Ventanas S.A. operations are certified are duly and satisfactorily implemented. Energy Management Engineer has the primary objective of ensuring the development of an energy efficiency plan and ensuring the due implementation of the Puerto Ventanas energy management system, pursuant to the requirements contained in ISO standard 50.001. The other part of the energy team is composed of electrical engineers from the maintenance area and is in charge of the implementation and technical evaluation of the projects.

Energy review and planning: The Energy Management Program (EMP) involve the entire organization, and focus on the following topics:

Leadership and Management Commitment, Legal Framework and Commitments Voluntarily acquired, Implementation and Management of the Energy Management Program, Training Courses, Procedures and Inspections and Operational control, Monitoring and Measurement. The purpose of this document is to comply with the commitments established in the Integrated Policy, through the implementation of specific actions that contribute to the reduction of electricity consumption. In addition, quantify objectively the energy performance through meters installed in the operational systems, ensure that in projects of implementation, modification or renewal of equipment, the acquisition of energy efficient technologies and maintain control operations applicable to saving electric consumption is privileged through energy indicators that relate the energy used to mobilize a ton of cargo **(kWh/Ton)**.

EnMS compliance strategy

There is a specific plan "P-004-EE Annex Energy Efficiency Plan" with strategic activities to ensure effective control of the progress during the period. Each month, follow-up meetings are held, coordinated by the head of the Energy Management System, and are aimed at evaluating the status of implementation and evaluation of the following aspects: **A.-** Modification of facilities that affect the Energy Management System. **B.-** Follow-up to improvement projects and savings in development. **C.-** Monitoring of energy efficiency indicators. **D.-** Determination and projection of energy consumption and performance. **E.-** Monitoring of non-conformities and open improvement opportunities detected in internal and external processes.

Cost-benefit analysis: The consumption avoided makes it possible to monetarily quantify the cost associated with each of the energy efficiency measures adopted at the Port during one year in normal conditions.

The costs avoided per year correspond to approximately one month of total PVSA energy. This is equivalent to 5% annual savings.

Energy Efficiency Measure	Consumption Avoided [MWh/year]	Cost Avoided [$US/year]
• Replacement led lamps–PVSA Terminals	304.26	33,975
• Pier operational controls	21.64	2,416
• Installation VFD Andina Feeders	40.28	4,498
• Installation of led road lamps – Access pier and TGL	7.02	783
• Replacement of efficiency idlers in belt C02-unloading	6.19	690
• Bypass Pier substation–Andina substation	0.64	71
• Change of transformer primary control room	11.52	1,286
TOTAL $USD	**391.55**	**43,719**

Consumptions and costs avoided by each Energy Efficiency Measure

Approach used to determine whether energy performance improved: ISO 50.001 standard has made it possible to identify guidelines with respect to the

energy practices and policies that must be complied with and reinforced yearly, in order to comply with the objectives and targets proposed therein.

The energy performances of each port area are separated and monitored periodically. These indicators are compared month by month according to the amount of cargo moved or the number of ships in operation. In case there were changes in the facilities, equipment or variations in dynamic or static factors, the measurements should be normalized. For this reason, it is necessary to have a measurement tool or an energy analyzer equipment before making an improvement or a new energy efficiency project. In this way it is possible to validate energy performance results after a measure or project was implemented. The information is collected in energy performance registers and matrices. In addition, projects and opportunities for improvement are stored in evaluation and monitoring matrices of projects "R2-D-001 EE Savings Opportunities_ prioritized".

The results are reported to the respective area heads.

Coordination meeting and review of EnMS results

Approach used to validate results: Lloyd's Register Quality Assurance (LRQA) conducts an external audit every 6 month to verify compliance by the Puerto Ventanas energy management system. In each audit process, LRQA prepares a report where it registers the findings or observations made in this process, which are managed through energy management system tools. PVSA has an internal auditing process that seeks to improve the management processes of EnMS to each of the areas involved. Also, in order to keep the identification of the legal and other requirements applicable to Puerto Ventanas S.A. operations updated, the spreadsheet containing the identification and compliance with the applicable Legal Requirements is reviewed once per year.

Steps taken to maintain operational control: The operational control is performed on obtaining the data that feed the energy review matrix, planning the maintenance actions related to the significant use of energy according to what is described in the PVSA maintenance manual. Likewise, trained personnel will be considered for the handling and operation of those equipment taking data with instruments that are calibrated or verified in accordance with the provisions of said manual. Area heads and maintenance staff are responsible for creating awareness and defining operational procedures for reducing energy consumption in conjunction with the energy management team.

Development and use of professional expertise, training, and communications: Energy Management Engineer leads the implementation of projects to improve the efficiency of the consumption of energy at Puerto Ventanas, such as: studies of the uses and consumption of energy at the port and participation in contractual reviews of electrical supply; management of technical information (plant equipment and systems, automatic control and power system), development of works at site and supervision (Technical Works Inspector), monitoring and following-up on energy efficiency indicators, providing feedback to the various port areas regarding the results of the consumption of energy and options for minimizing and using energy efficiently. The energy management team participates in training courses for Certified Measurement and Verification Professional (CMVP) and attends seminars annually given by the Chilean Energy Efficiency Agency.

Tools & resources: The information related to energy controls is processed through a system of supervision, control and data acquisition (SCADA). Puerto Ventanas

developed a Distributed Control System (DCS) that allows to centralize the information of the different processes that compose it. Includes energy management and measurement software. In addition to a virtual data storage for evaluation of temporary tendencies.

System of supervision, control and data acquisition (SCADA).

Lessons Learned

The creation of a committee in charge of a management system allows better coordination of tasks focused on improving energy performance. The ISO 50.001 standard must be reinforced by the management team to the different areas of work. The biggest challenges are related to the acquisition of energy data related to port processes. The measurement is fundamental to improve the energetic performances of the activities and processes within the facilities of the company. One of the ways to improve and solve the data insufficiency was to automate the processes, including online measurements of the energy consumptions of each area. The data is stored in virtual servers so that it can then be processed by engineers through software designed for data management. The commitment and the support of the head offices must be constant, and it is fundamental to the success of a management system.

Keys to Success

- Commitment of the General Management and the headquarters with ISO 50001.
- Definition of roles and responsibilities within the Energy Management System.
- Knowledge of the facilities, uses and energy consumption of the company
- Involvement of all employees of the company.
- Periodic evaluation of energy efficiency indicators
- Invest in measurement and monitoring systems.
- Recognition of energy achievements.

Recognition Gold Energy Efficiency Seal 2017 with Ministry of Energy

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.

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