

**PEPS CASE STUDY**  
**The Pemex- Conae Collaboration in**  
**Energy Efficiency Actions and Programs<sup>1</sup>**

**Summary**

Mexico's National Commission for Energy Conservation (Conae) has supported energy efficiency actions in the National Oil Company (Pemex) for more than ten years. The strategy used has evolved from the analysis of isolated systems to the development of an Internet-based diagnostics and consultation system capable of reaching a great number of users, and finally to the implementation of a permanent energy efficiency campaign in Pemex with significant environmental and economic results. This collaboration process has helped Conae to develop new analysis tools and managerial strategies that have also been used in other programs implemented by Conae. In 2001 Pemex achieved savings of 10.6 million barrels of oil or nearly 200 million dollars. 3.2 million tons of CO<sub>2</sub> emissions were avoided as a result of these savings.

- **Background.**- Since its inception in 1989, Conae has had a governmental mandate to provide technical assistance on energy efficiency to the public sector. On the other hand, the exploration, exploitation and commercialization of oil and gas are reserved to the state-owned Pemex. Pemex is , the largest public sector company in Mexico and one of the world's ten biggest. Since it is a large energy consuming entity (in 1999 Pemex used roughly 108 million barrels oil-equivalent for all its different operations), it presents large energy-saving potentials. However, these potentials are scattered through a large number of productive units related with oil refining, gas processing, and crude oil and gas transportation. Also, large energy-saving opportunities have been detected in Pemex's electrical systems. To exploit these potentials, Pemex implemented a broad array of measures in a large number of productive units that collectively have a great impact. To implement these actions, it has been necessary to develop and apply new administrative schemes and technological tools within well-organized strategies and programs.

**Program Objectives**

- For Conae: to provide technical assistance to the largest public sector enterprise in Mexico (Pemex) for identifying and taking advantage of energy efficiency opportunities.
- For Pemex: to take advantage of these opportunities in order to operate more efficiently, to expand the supply of energy, save money, and reduce the negative effects of its activities on the environment.

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<sup>1</sup> "This case study was prepared by CONAE with support from the U.S. Agency for International Development."

## Description

- **Strategy.**- To take advantage of energy-efficiency potentials it was important to develop a large number of measures, both technical and operational<sup>2</sup>, in different Pemex units that would together have big benefits. The strategy has evolved in three stages. During the first (1995-1997), a number of isolated projects were consolidated in a collaborative scheme centered in a committee with clear objectives and a well-designed action plan. In a second stage, taking advantage of the experience acquired during the first, Conae designed a set of tools operated over the Internet and complemented with a series of training courses. These actions improved the applicability and effectiveness of the energy-efficiency and environmental protection initiatives that Pemex was developing. They were subsequently consolidated in a permanent energy-efficiency campaign for the entire company. Also during the second stage Conae implemented a “bottom-up” approach, providing greater responsibility to facilities operators, for the application of energy-efficiency actions in Pemex installations. In the third stage Pemex and Conae established a benchmarking and monitoring system of energy-efficiency indexes that could be used in either a plant, a system or a piece of equipment. In addition, Conae designed a tool to calculate a global energy index, which is defined as total energy consumption (either electricity, gas, diesel or other type of fuel) divided by the total production achieved in every Pemex productive complex. The global energy index along with a training program provided by USAID to perform environmental-energy audits, strengthened the permanent Pemex campaign.
- Below is a more detailed description of the evolution of the campaign in its three stages.

### **A) First stage: *The Pemex-Conae Committee and energy studies (1995-1997)***

During the first stage the Pemex- Conae Committee was established by experts from both institutions. The Committee had the objective of identifying and exploiting energy-saving opportunities by applying low-cost investments. During that stage, Conae performed several studies and determined that 70% of the energy consumption from Pemex productive units came from direct-fired heaters, steam generators and turbines, each of which presented large energy-saving potentials. Based on these studies, Conae’s specialists presented to the Committee different energy-efficiency measures together with their cost-benefit analysis to be incorporated into the activities, plan and budget of the PEMEX subsidiaries. From 1995 to 1997, fifty Pemex installations were analyzed. The Committee found fuel and electricity savings prospects equivalent to 40 million dollars per year (Figure 1). Also, significant water savings and opportunities to avoid greenhouse gas emissions were discovered.

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<sup>2</sup> Technical actions require investment, while operational ones do not.

Figure 1. Energy savings prospects identified in Pemex during the first phase.

Product or System	Savings Potential	Savings (Millions of US dollars)
Cooling towers	81,000 MWh/per year	\$1.6 per year
Direct Fire Heaters	10 MMKcal/h	\$140.4 per year
Lighting	5,100 MWh/year	\$2.4 per year
Heat recovery	170 MMKcal/h	\$7.2 per year
Steam generation and distribution	40 MMm <sup>3</sup> /year	\$2.4 per year

Source : Conae. Direction of Thermal Processes.

### **B) Second stage: The “bottom-up” approach and technical assistance through the Internet (1998-2000)**

The first stage allowed Conae to identify large energy-efficiency potentials. However, the opportunities were scattered throughout a large number of productive units. Therefore, in 1998, Conae’s experts designed methods to identify energy-saving potentials and made them available for Pemex users through Conae’s Webpage<sup>3</sup>. These Internet-operated diagnostic tools could be applied by Pemex personnel across the country and would reduce the transaction costs<sup>4</sup> and increase the quality of the measurements to be applied.

Also, Conae designed a “bottom-up” administrative approach for the application of the Pemex strategy. Energy-efficiency actions would be applied directly by the same Pemex personnel operating the installations and would be integrated into their daily operation, thus becoming systemic and permanent.

At the same time, in 1998, Pemex put into operation The Integral Security and Environmental Management System (SIASPA). SIASPA is a program designed by Pemex to be applied in its installations covering all aspects of industrial security, health and environmental protection. Many SIASPA elements<sup>5</sup> directly integrated energy-saving topics and others used them as an information source<sup>6</sup>. Pemex and Conae officials noted that SIASPA could be complemented with the new Conae diagnostic tools and Conae’s training courses could conveniently complement the Pemex institutional training program.

<sup>3</sup> The methodologies to be used in the Pemex-Conae Program consisted in the thermal use of gases and residuals for maritime and land installations; efficient use of energy in direct fire heaters and of process; optimization and rational use of cooling water; steam generation and distribution, energy assessment of lighting systems and co-generation.

<sup>4</sup> “ Cost of the identification process and quantification of one energy saving opportunity ... this cost is minimized with probed analysis tools by whom are used”. Odón de Buen, *Presentación Barreras al Desarrollo de Proyectos de Ahorro de Energía*. Diciembre de 2000.

<sup>5</sup> SIASPA was formed by 18 elements related to: human factor, methods and installations.

<sup>6</sup> Basically, some SIASPA elements such as Planning and Budget and Benchmarking reflected the information from energy saving measures in terms of financial resources saved and environmental pollution avoided and water savings.

In order to initiate these activities, Conae and Pemex agreed to launch a campaign for the entire institution. In August 1999, the “SIASPA Campaign for Energy Conservation and Environmental Protection” started with the goal of reducing by 5% the energy consumption indexes, which reflected a total production to total fuel consumption ratio, of 244 productive installations compared to the July 1998 – August 1999 period<sup>7</sup>.

To coordinate the SIASPA campaign, the Pemex-Conae Energy-Saving Network was instituted, substituting for the Pemex-Conae Committee. As of the SIASPA campaign’s close in July 2000, approximately 60% of the installations had achieved the 5% reduction goal, obtaining savings equivalent to \$1.9 million US dollars<sup>8</sup>. Also, Pemex recognized that the campaign reinforced the “energy-savings culture” among its workers.

From 1997 to 2000, along with hydrocarbon savings, significant reductions of electricity and water consumption were also achieved -- more than 27,000 MWh and 12 million m<sup>3</sup> per year, respectively. In that same period Pemex reported a reduction of more than 24,000 tons per year of CO<sub>2</sub> emissions and 110 tons of NO<sub>x</sub>. Furthermore, from 1998 to 2000, the utility cut 12 million cubic meters from its natural gas consumption.

### **C) Third Stage (2000-) Energy Performance Indices**

By 2000, the energy-efficiency programs in Pemex had achieved significant results and Pemex personnel had internalized an “energy-efficiency and environmental protection culture”<sup>9</sup>. Moreover, Pemex had obtained valuable information on energy consumption patterns, not to mention additional conservation opportunities. Beginning in 2001, as a continuation of the SIASPA campaign, Pemex established the “Institutional Program for Energy Efficient Use” to optimize its processes. This program included the *2001 Permanent Campaign for Energy Efficient Use and Savings* and had “the goal of reducing the Energy Consumption Index (total production to total fuel consumption ratio) between 1.5% and 5% per business line.”<sup>10</sup> Energy indexes were also used to compare energy efficiency for different plants and are calculated, as mentioned before, dividing total fuel consumption by total production<sup>11</sup> in every Pemex’s plant installation or productive complex.

As part of that campaign, an *Energy Indicators Control and Follow-up System* was established per processing plant, per system and per piece of equipment in all the Pemex petrochemical centers and gas processing complexes<sup>12</sup>. The System aims to contribute to

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<sup>7</sup> [www.pemex.gob.mx/p-seguridad.html](http://www.pemex.gob.mx/p-seguridad.html)

<sup>8</sup> Pemex. *Seguridad, Salud y Medio Ambiente - Informe 2000*. p.23

<sup>9</sup> Pemex. Boletines de Prensa, Noviembre de 2001 in [www.pemex.gob.mx/bol2522001.html](http://www.pemex.gob.mx/bol2522001.html)

<sup>10</sup> Pemex. *Seguridad, Salud y Medio Ambiente Informe 2001*. p.24.

<sup>11</sup> Conae, Dirección de Procesos Térmicos. Manual Corporativo pg.14-15.

<sup>12</sup> To carry out this system, the following steps were established: (1) to compile the annual consumption of global energy (2) to compile annual data on the production, (3) to perform a energy diagnostics to the energy consumer equipment, (4) to carry out a diagram of energy distribution, (5) to elaborate curves of efficiency standards, (6) to apply energy audits to the plants, (7) to perform energy diagnostics to systems and

the reduction goal by “laying the foundations and criteria for the design and implementation of energy-savings programs, identifying training requirements (associated with the programs) and quantifying, on a monthly basis, the savings obtained for their internal and external dissemination”<sup>13</sup>.

To establish the System, Conae developed a method to calculate the global energy index that, along with the training provided by the United States Agency for International Development (USAID)<sup>14</sup> for performing energy and environmental audits, enabled Pemex to identify and quantify not only facility energy consumption, but also the raw materials and final products generated by each complex. The energy consumption of the individual equipment and systems installed in these processing plants could also now be monitored<sup>15</sup>. The system was tested in 2001 in the “Independencia” and “Pajaritos” petrochemical centers, revealing savings potentials of nearly 650 million ft<sup>3</sup> of natural gas<sup>16</sup>. From the pilot project performed in “Pajaritos,” authorities learned that the major consumer of natural gas in that plant was the steam generation system. Accordingly, they developed a steam management plan to avoid leakage, reduce demand and extend the use of auto-generated energy.

Pemex and Conae specialists detected that the Control and Follow-up System of the “Pajaritos” complex “did not permit immediate determination of energy savings because it did not consider production levels and only refers to periods -- comparing a month last year with the month of the current year evaluated<sup>17</sup>. Pemex and Conae’s specialists perfected the system so it now considers the same production conditions for each indicator evaluated. Therefore, it provides the most accurate picture possible of the energy-efficiency measures applied.

This new approach allows estimation of savings potentials of all the equipment and systems in their current operating conditions and also permits estimates of the potential for the improving these systems through investment projects. The analysis was complemented by the establishment of minimum energy benchmarks and energy distribution diagrams, allowing a rapid examination of the efficiency of the energy-consuming equipment.

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equipment, (8) to define and establish energy indexes in systems and equipment and (9) to establish a periodically follow up of the energy performance.

<sup>13</sup> Gutiérrez David y Eduardo Valdivieso, ponencia “Establecimiento del Sistema para el Control y Seguimiento de los Indicadores Energéticos por Planta Sistema y Equipo en los Complejos Petroquímicos y Procesadores de Gas” Conae, Septiembre de 2001.

<sup>14</sup> During 2001, with the support of USAID, the training program to 320 specialists of the four subsidiaries was concluded. The program consisted in energy and environmental diagnosis and 58 more specialists were qualified on energy-efficiency project assessment. These personnel should perform the diagnosis in the main working centers and identify and assess the assorted projects to ensure the efficient use of energy in the enterprise. Pemex. *Seguridad, Salud y Medio Ambiente Informe 2001*. p. 25

<sup>15</sup> Red de Ahorro de Energía Pemex-Conae. Presentación Campaña Permanente de Uso Eficiente y Ahorro de Energía, periodo 2001.

<sup>16</sup> Conae, Dirección de Procesos Térmicos, documentos internos.

<sup>17</sup> Comité Institucional de Ahorro de Energía y Protección Ambiental, Red de Ahorro de Energía Pemex-Conae “Informe de Avance del Proyecto Piloto de Eficiencia Energética en el C.P.Q. Pajaritos” 7 de Septiembre de 2001.

Currently, this analysis system, along with other practices, is part of the basic strategy of Conae's Energy Efficiency Program for Industries. It has also been successfully applied in the Federal Electricity Commission (CFE) and in industrial and mining companies. Additionally, the approach is being adapted for Conae's Program for small and medium-sized enterprises<sup>18</sup>. Hence, the strategies and methodologies created for the oil industry are now being transferred to other sectors.

### **Results**

- Estimated savings in 2001 of 10.6 barrels of oil, equivalent to roughly US\$200 million
- Reductions of 3.2 million tons of CO<sub>2</sub> in 2001
- An energy-efficiency and environmental protection culture among Pemex personnel
- Systemic and permanent energy-efficiency actions in all Pemex installations
- Experience and tools that are replicable in other countries and sectors

### **Conclusions**

The energy-efficiency actions that Conae has developed in Pemex have triggered successful results. These actions have evolved, so far, in three stages starting from the analysis of isolated systems to the development of tools operated by the Internet to a broad and permanent energy-efficiency campaign in the entire company, yielding significant economic and environmental results. During that process, different analysis tools and managerial schemes were tested, such as a decentralized, bottom-up approach, which incorporates energy-efficiency actions in a permanent and systematic manner across a large number of productive units. The collaboration process with Conae has enabled Pemex to design, enrich and achieve the objectives of its different energy-efficiency and environmental protection programs and initiatives.

### **For More Information**

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### **Case Study Documentation**

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<sup>18</sup> The program aims to establish energy performance indicators in small and medium-sized enterprises to modify, in its case, their processes and technologies. Conae. Dirección del Sector Energético: Resumen de actividades de la Gestión. Pg.36.

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