Energy Audit at a Romanian Petrochemical Plant

Project Title : Energy Audit and Feasibility Study of Oltchim SA Petrochemical Plant
Leader: SC Oltchim SA, Ramnicu Valcea, Romania
Partner: Robert A. Watts, Consulting Engineering, Annapolis, MD USA
Location: Valcea, Romania
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EcoLinks Project Investment: Total EcoLinks Project Investment: $91,693: EcoLinks Grant Support: $50,000; Project Team Cost Share Contribution: $41,693.

Best Practice: Transferable Solution

This project is a Best Practice. Chemical industry plants can easily replicate the methods and applications tested and demonstrated at Oltchim in this project. Specific recommendations for saving energy and limiting greenhouse gas emissions are provided. A method for verifying projected energy savings, which can be used as an energy management tool in all types of industrial plants, is established. While the project generates specific analyses relevant to Oltchim, the transferability of the tools and techniques is high given that the analyses apply to equipment and energy consumption in general. Further, the energy audit methodologies for the process lines are transferable to other chemical plant utilizing similar technologies.

Project Summary

Romania has experienced a difficult transition from the socialist era. Growth in the industrialsector must be a priority for Romania in order to improve the overall economy through increasing company competition and promoting solid investment opportunities. It is further essential that new and existing industrial activities support a certain quality of life by meeting international standards for environmental performance. Improving energy efficiency allows companies to cut operating costs and reduce greenhouse gas emissions. With the support of an EcoLinks Challenge Grant, a consortium consisting of Oltchim, a US engineering firm, and a Romanian consulting firm developed (and tested at Oltchim) a workable methodology and appropriate technology for increasing energy efficiency.

Oltchim is one of the largest manufacturers of chemicals in Romania. It operates several plants and produces a variety of products including vinyl chloride, propene oxide and chlorinated substances. Chemicals production at Oltchim is energy intensive. The consumption of steam, electricity and natural gas make up 30% of the company's operating costs. This energy consumption, in addition to being costly, leads to high greenhouse gas emissions including nitrous oxide and carbon dioxide. Local air quality also suffers.

To improve energy efficiency, reduce greenhouse gas emissions, and lower operation costs this project emphasized two main activities: 1) evaluation of the company's energy use, and 2) articulation of energy efficiency measures. The project showed that an annual reduction of up to 9,000 tons of nitrous oxide and 326,000 tons of carbon dioxide could be achieved by introducing energy efficiency measures. Economic benefits of implementing the project recommendations would result in a savings of $1 million/year in the short-term. Implementing long-term measures would provide a savings of $1.9 million/year. The payback time for the identified energy efficiency measures varies from two months to five years. In this next section, a detailed outline of the project activities is provided. Project benefits, lessons learned, and contact information are provided in subsequent sections.

Project Activities

This project activities can be divided into two phases: 1) Project Planning and Training, and 2) Project Implementation. The purpose of these activities was ultimately to improve energy efficiency at Oltchim by identifying and recommending corrective measures for reducing greenhouse gas emissions, improving energy resource conservation and generating economic savings.

Phase I. Project Planning and Training

1. Initiated project

Action: The project began with several meetings to coordinate the different participants including Oltchim SA, Robert Watts Engineering Consulting, and

Petrodesign. Training materials for Oltchim were prepared and a training session was conducted with Oltchim.

Product(s): 1) Training materials and staff training sessions 2) Staff trained to perform energy audit activities.

Phase II. Project Implementation

1. Conducted energy audit regarding steam plant operations

Action: The first major step of project implementation was to conduct an energy audit. The steam plant, one of several plants at Oltchim, was specifically examined. The equipment was assessed and the steam, air, water, and fuel flows were calculated.

Product(s): 1) Data on energy consumption patterns related to equipment used and flows at the steam plant contributing to a database on Oltchim energy consumption and energy losses 2) The following major recommendations for improving the steam plant were developed:

- boilers should be converted from methane to methane/hydrogen mixture (hydrogen is manufactured on-site);
- condensate return pipes should be installed;
- combustion and exhaust air fans should be replaced;
- deaerating equipment should be installed;
- boilers' automatic control system should be upgraded; and
- heat exchangers should be repaired where necessary.

2. Conducted energy audit regarding process lines

Action: A process audit was conducted which involved measuring and recording energy consumption at the different divisions and plants at Oltchim including the chloralkali electrolysis plant, the chlorinated products plant, the vinyl chloride plant, the polyvinyl chloride plant and the propene oxide plant. The consumption of electricity, steam, water, and methane gas by each piece of operating equipment was calculated. The equipment with the highest energy consumption was identified. The total electricity consumption of each division and installation was then determined and the daily energy consumption for each division was calculated. To determine energy loss, the difference between energy delivered and energy consumed for each division was calculated.

Product(s): 1) Data on energy consumption patterns contributing to a database on Oltchim energy consumption and energy losses 2) Recommendations for equipment, electrical substations, and process lines were made. They include:

- adding heat recovery equipment;
- adding certain unit operations to improve entire processes;
- replacement of pumps, fans, compressors, and motors; and
- retiring some electrical substations or disconnecting them and leaving as spare ones.

3. Assessed emissions reductions

Action: The effects of excess energy use on the emission of nitrous oxides and carbon dioxide were calculated. An analysis of different fuel types used to generate energy was conducted to determine the most feasible, efficient, and least polluting sources.

Product(s): 1) A report titled, "The effect of power excess on nitrous oxide and carbon dioxide emissions" 2) New possibility for using less polluting energy source (i.e., fuel mixture comprising hydrogen).

4. Strengthened technological information

Action: A visit to Reichhold Chemical, a chemical plant in the United States was organized for Oltchim representatives from Bucharest, Romania. The purpose of the visit was to gain knowledge about the practices in the United States.

Product(s): Transferable technology for improving energy efficiency at Oltchim and other similar chemical plants throughout Eastern and Central Europe.

5. Reviewed legislation

Action: A review of the legislation regarding the generation of steam and electricity was conducted.

Product(s): Documentation of legislative overview.

6. Implemented and evaluated plan

Action: The findings generated through the energy audit and feasibility study are to be implemented over the next five years. Based on an evaluation of costs, payback, and expected life of needed equipment, short-term and long-term plans were generated. Those improvements that can be implemented with minimal cost shall be activated within one year. Other proposals generated from this project shall be implemented over a longer term as sufficient funding mechanisms are put into place and sufficient preparation is done.

Product(s): Short and long-term recommendations for decreasing energy losses.

7. Verified projected energy savings

A method for verifying projected energy savings was then developed. The method involved seven steps:

1) establish base line from which to measure annual savings;
2) determine new energy use;
3) compare these readings with the base line;
4) determine cost of plant modification;
5) review and evaluate results;
6) calculate emissions reductions; and

7) produce annual report that itemizes costs of plant modifications, annual savings from plan implementation, emissions reductions, and next steps for long-term plan implementation.

8. Finalized project

Action: General meeting of all project partners was convened.

Product(s): 1) Final draft of feasibility study.

Project Benefits

Several capacity building, environmental, and economic benefits can be asserted from applying the methodology and technologies developed and tested in this project. They are described below.

Capacity Building Benefits

The framework established through this project indicates several benefits that empower the appropriate setting for improving energy efficiency at Oltchim and other plants with similar needs. First, this project established a good working arrangement between Oltchim and an US firm that may be applied to future projects that also provide environmental and economic benefits. Second, the project outlines a training program through which Oltchim personnel acquired sufficient knowledge and skills to perform energy audits in their plants as well as for other similar companies. The training designed and implemented in this project improves the capacity for implementing energy efficiency measures.

Environmental Benefits

The overarching environmental benefit of this project is the reduction in energy use. The fuel that is used to generate electricity and steam is reduced which then limits the emission of CO_2 and NO_x. With the implementation of the project recommendations, an annual reduction of up to 9,000 tons of nitrous oxide and 326,000 tons of carbon dioxide would be achieved. This contributes to the global effort to reduce greenhouse gas emissions and to avoid wasteful use of non-renewable resources.

Economic Benefits

Several economic benefits are derived through the implementation of the recommendations outlined in this project. The implementation of the short-term measures established by this project would allow a savings of $1 million with varied pay back periods. The implementation of the long-term measures would provide a savings of $1.9 million. Table 1., Examples of identified energy saving measures - financial data, presents examples of energy saving measures, their costs, expected annual savings and a payback period.

Table 1: Examples of identified energy saving measures – financial data

Energy saving measure	Investment outlays ($)	Annual savings ($/year)	Simple Payback Time (years)
Single boiler conversion to CH_4/H_2 mixture[1]	100,000	173,000	0.6
Replacement of combustion and exhaust air fans [2]	84,000	120,000	0.7
Adding waste water heat recovery system to waste water discharge line [3]	280,000	372,000	0.8
Adding heat recovery furnace at dichloroethylene cracking furnace[4]	250,000	230,000	1.1
Pump replacement at chlorine removal plant	980	2,100	0.5

Lessons Learned

Some lessons were learned during this project. Aside from the obvious learning that took place during this project in terms of developing concrete recommendations for improving energy efficiency at Oltchim, the following points represent empirical findings based on project implementation experience. They are additional insights for those seeking to apply the methodology and tools to generate the benefits described in the project.

- Initial meetings in Romania and the site visit to a US chemical plant assisted with building cooperation amongst the project members.

- Having a record of basic energy requirements and excess energy use is essential for future planning regarding operations and equipment replacement.

Contact Information

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