IMPROVING ENERGY EFFICIENCY PROFITABLY IN A MANUFACTURING COMPANY BY USING KNOWN TECHNOLOGIES CONSEQUENTLY UNDER FINANCIAL TOOLS

Matching reduction of energy demand by 50% specifically within 1½ decades[1]

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Abstract

Energy saving has become a very important responsibility for future decades. We are facing the problem of warming up the atmosphere which increases the greenhouse effect caused by CO_2 emissions as well as the limited availibilty resp. resources of fuel energy. The limitation of fuel is usually evidenced by soaring prices. The backing of energy savings could be done by focussing on economically successful projects. One of the challenges of the future will be the progress of industrialization and the motorizing of countries with large populations, which are now in the status of "developing countries", at least parts of them. From the point of view of highly industrialized nations there should be an improvement in energy efficiency by using more effectively the resources already available to them.
The saved money can be used for more competiveness in the manufactured products market or in rising profits. The process in achieving energy savings in considerable amounts of money can need a longer period on behalf of fitting the savings projects exactly into the manufacturing processes used in this facility. Using energy savings as a successfully project contains the meeting of the return of investment of these projects at the business standards given by the management. The experience showed that the acceptance of such projects will rise sharply when the business standards are matched and controlled by the internal revision department. The results of economically successful energy savings over a long time period show that the way of meeting business figures may be a pattern for future handling of the use of limited resources, like fuel. With going alongside this way money will be saved for raising profits or the corporation would be more competitive in the market for providing the manufactured products. Besides these advantages knowledge of a long lasting promoting process will be achieved and this achievement will also last against competitors.
On behalf of the fitting of the energy savings technology into the manufacturing processes of the facility and the reflection on the whole manufacturing plant, the process of reducing the energy demand needs some time for showing changes in the numbers of the energy supply.

Summary

The realization of energy savings resp. energy costs reduction within the manufacturing industry like durable goods is being effectively on the long run by matching standards of business figures like return

of investment. Energy saving projects like detail changes in the energy supply of the manufacturing process or an investment in the field of energy supply of the whole facility are in competitive research against the usual basic supply of energy. This research is crucial for economical success. Considering on concerning single projects of energy saving are necessary for meeting planned figures with the appearing figures when the project is put into operation. The successfully work of technical implementation of energy saving can reduce the energy demand per manufactured unit by 50% within approximately 15 years under the strict measure of given standards of return of investment. The savings include the better extraction of basic fuel energy by using combined processes to get higher yields of the provided kinds of energy. Without restriction of quantity or quality of manufactured products and without restrictions in comfort of working conditions this result was reached. Disturbing the manufacturing process or the production in any way was avoided. All projects were realized without any influences on the above mentioned issues. The key factor for sustainable energy savings resp high energy efficiency is the return of investment as acceptable payments of interest of the invested capital related to these especial projects.

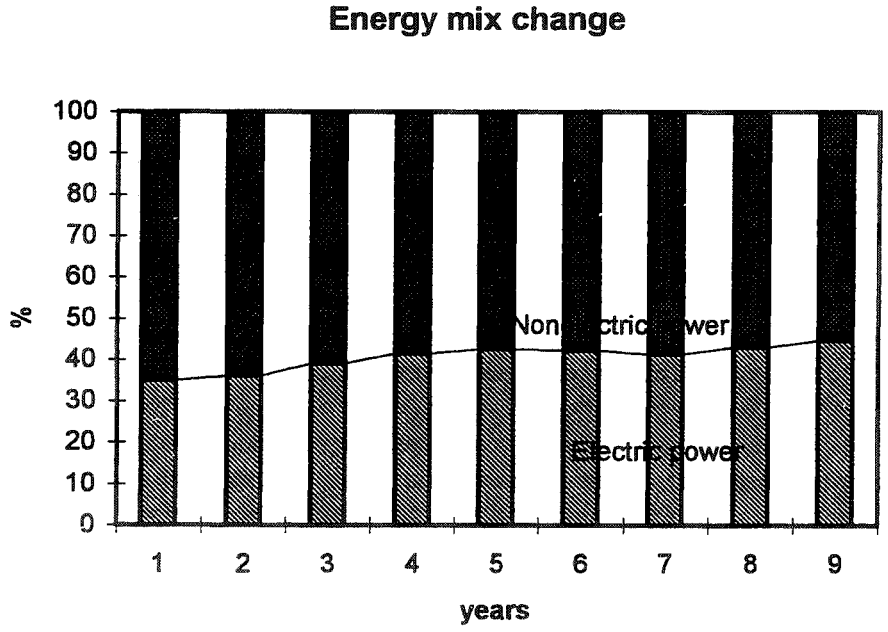

Fig. 1: Specific energy demand show the slightly increase of power in the energy mix
Impact of this change does mean an increase of energy costs, power is about triple the price of natural gas and oil.

Databases

Dates metered by instruments with their range of tolerance are the basis for energy savings and their control of realization. The metering of electricity is relatively simple, exact and inexpensive; the metering of e.g. steam or heating water is relatively lavish, "exact" only in a defined range and expensive in comparison metering power. These facts should be understood when working on this issue. Equipping an already existing facility with heating water metering for the sole purpose of tracking the distribution ways of energy and controlling set measurements will economically kill such a project. This alone can cost millions of dollars, without reaching any energy savings on the investment.

On the other side the accuracy of the data basis is very important for controlling and tracking the success. In a case like the described one the experience of the related project workforce is important. For reasons of hedging investments and revision control The figures for non electrical kinds of energy should be adjusted and controlled for the hedging of investments and revision control. This work is very intensive and is related to the experience of the workforce. Crosschecks are one of the normal ways of proof of the adjustments and use of energy figures. The purchase of all kinds of energy at the border of the facility from the utility companies are the decisive control of all steps which had been taken within of the manufacturing plant.
The metered dates of the different kinds of energy over a period of preceding years with the above mentioned control steps widens the basis of dates makes correct decisions. The trend of the figures showing the preceding years should be in relation with other figures of the facility. The more related datas are compared the more control one has for use in the calculations.
The influence on energy demand of the different issues like e.g. climate and changes in the technology in manufacturing processes changes, making manufacturing plant size and the occupation of shopfloor necessary. The specific manufacturing demand is the basis for the supply of different kinds of energy. Either transforming the energy within the plant should be done, or ready for use energy should be obtained. Observing the possibilities of the combined changes in the demand of different kinds of energy and the research of the link for a sustainable and economical possible supply of cogenerated energy should be done.

Examples of energy saving projects

The manufacturing industry e.g. durable goods includes the difficulty of its kind of industrial processing - discontinuously working system - by supplying with utilities. The steps in continuous processing industries like chemical, pharmaceutical or refinery may be mostly linked to less effort. The result of energy saving should also be seen in the effects on machinery equipment and on the interrelation of the different kinds of energy (electricity, gas, heating oil, heating water, cooling water, chill water, etc).
Changes in manufacturing processes in the preceding two decades from worker dominated ones to robotics included a change in energy demand resp. supply, too. The former processes needed more direct heating for the workforce and less electricity for machinery in comparison to present shopfloor. Presently, reduced heating (also in winter) of the shopfloor is needed on behalf of increased power demand for the machinery which turns to waste heat. The waste heat of the electric engine units in the shopfloor is keeping the temperature in the building very often so that the demand for heat in kind for e.g. heating water is reduced. In the building the temperature needed for comfortable manufacturing processes can be kept in many cases with the support of the waste heat, being ducted as vent to a heat exchanger for warming up the ducted fresh air from outside the building. This whole process is controlled electronically.
The planning of the size and power of the energy supply units (from as big as a cogeneration power plant to as small as an energy saving bulb) is a very important issue for meeting the standards of the return of investment.
A major effort can be the finding of the point of economically useful energy savings in existing equipment working as continuously working machinery within a manufacturing process, which is usually discontinuously. The steps are based on the results of a measuring of the technical process and in the - as exactly as possible - analysis of this process. Changing steps in this continuous process were done very cautiously and carefully in close cooperation with the production and the maintenance management. These results influenced successfully the development of new machinery in the construction of future low energy demanding equipment by the supply companies.

Feasibility studies content very often contain the knowledge for further projects in matching the given figure of return of investment. The profitability of energy saving is observed in the long run on a very high level with the peak result of reducing the demand for energy specifically by about the half. One important observation was made over the time: The single measures and steps for energy saving had to be researched and calculated each time for its special location and its specific purposes. No general validation for the different facilities could be made because of the differences which are sometimes relatively small but effected in the exact calculation a negative result. The general known techniques and technologies had to be fit into the specific manufacturing facilities with its own influences on the energy demand. None of the used techniques is a very special one; the specialty had been the fitting of the energy saving unit economically into the industrial resp. plant technology. The result of the adaptation should be the adjustment of the energy saving technology to the manufacturing equipment and not vice versa. A cogeneration plant in a specific design for a certain facility is not always valid for a very similar facility because the facility specific manufacturing processes are sometimes different in the detail. The cogeneration plant had to be designed for fitting into this new demanded profile. This difference can be decisive for being a economical success or being a economical failure.
All the experiences in the shopfloors, office building, recreation facilities showed the need for as exact as possible calculations and specific fittings always done with a lot of complex experience and knowledge of business standards as well as the processing with the influences of the changes of one of the parameters. This all together and the support by both electronic control units resulted in the above mentioned success.

Financial Tool

One of the most important financial tools is the method of internal rate of return (IRR). This kind of economical calculation shows the true annual rate of earnings on an investment. The results of this kind of calculation require predictions of income and expenses as well as the tax situation for the location of the particular company. The tax situation includes tax brackets, write-off possibilities, etc. All of these particular investment related expenses have to be related to the point of time when they are done or will be done. The same structure is valid for income resp. savings on not purchased energy.
These business standards force the engineering part of the project to find an economical solution for a technical problem. Finding the "perfect" solution not only means changes in the technical part, but also using the possibilities which could be found in the business standards. Important issues for a project in this field e.g. are the time schedules for expenses and for saved money as income and for the write-offs. This schedule e.g., might become very effective when the study shows that it will be difficult to meet the business standards.

Administrative measures

Effecting the energy supply contracts with the utility and power companies had to be checked and included in the single project's work. Calculation and checking for law purposes are time effected. The calculation had to be done very carefully, and in this step of any project the knowledge of the complexity of operational requirements and strategic planning for meeting the optimum economically for the company is an unconditional need. Several different simulations should be done to find the weak points, then choose the best one. The close to the reality and for the optimum of the company had to be controlled by the business management. The controlling department has to provide the business figures and the ranges for expected changes for these figures in the planned time period.

Cost savings are achieved sometimes by simple changes and adaptations in "running off" in the manufacturing processes, like making breaks at varied times rather than all breaks at a the same time.

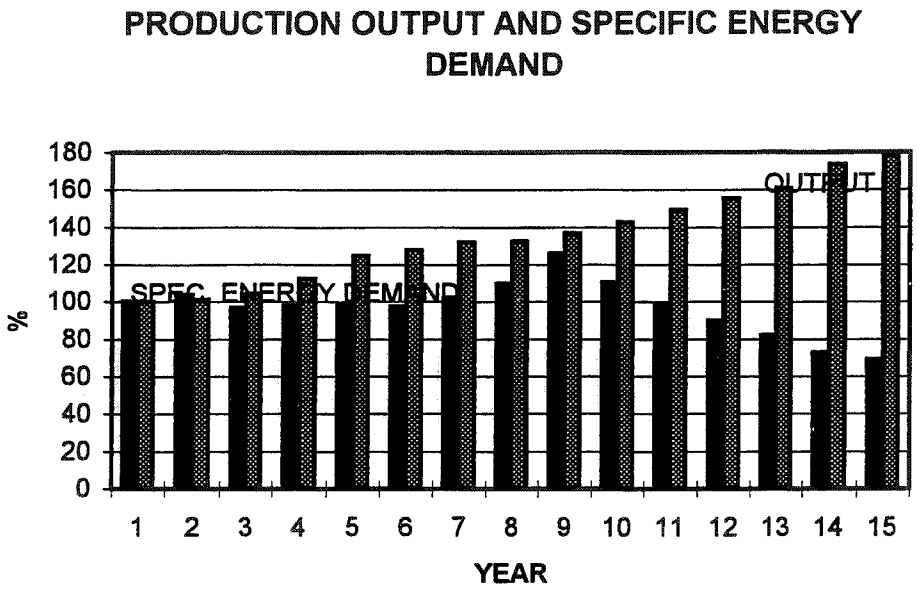

Fig. 2: Specific energy demand and output of the facility over a certain time period
The increase for a certain part of the watched period has the reason of expansion of plant, buildings and equipment, production is expanding later after construction is finished and show the reduction of the specific energy demand.

All of the realized projects of energy saving had been and are at present still economically very successful, and in comparision with the average use of energy supply technology, these investments are earning money and saving precious fuel energy. This kind of focus to reduce the use of fuel energy linked with the earning of interest may be a good guide for the overall view on the infrastructure of energy supply in a manufacturing company. The aim should be to raise energy efficiency, protect the environment, and use the economical figures as leading numbers. Earning money is one of the most desirable work.

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[1] Pester, W.: Flexibility as key factor for Germany's stand: A Manufacturer's CEO: "During the last 15 years energy consumption during production has been reduced by 50% per unit, even though the vehicles' structure has become much more expensive and complex." In: VDI Nachrichten, No. 38, 22 Sept. 1995, p. 6